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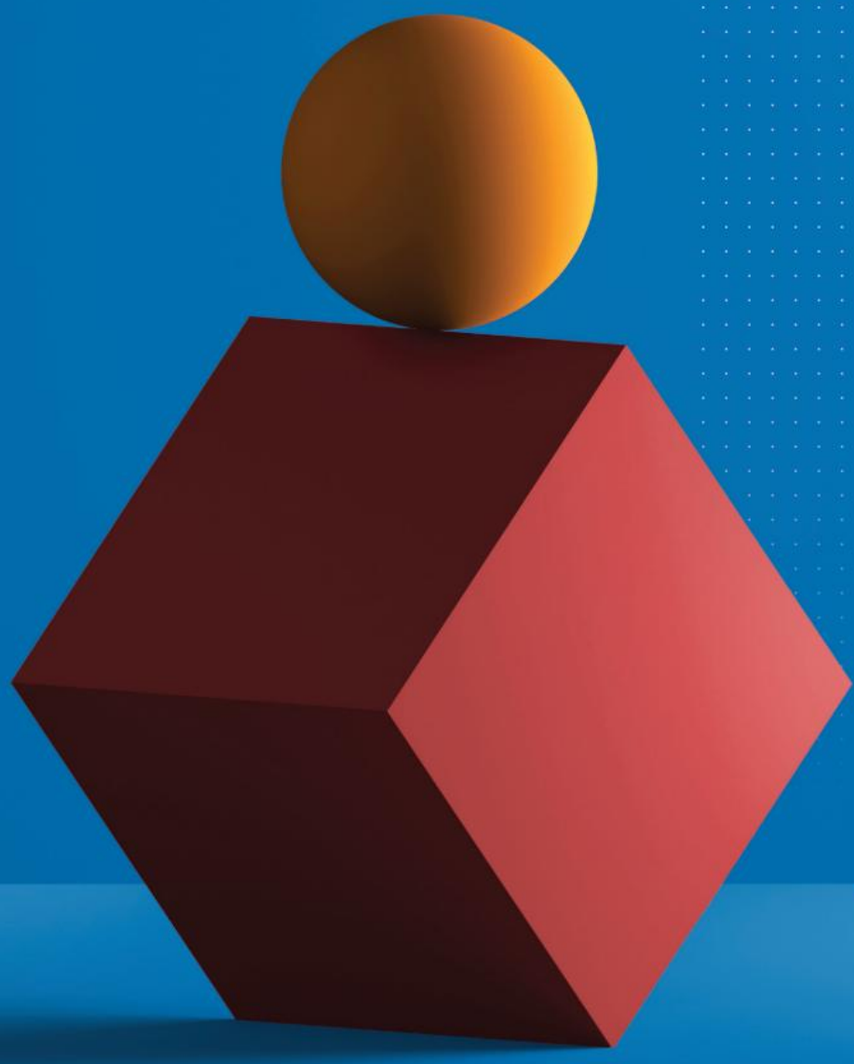
VICmaths

VCE UNITS 1 + 2



foundation mathematics

11

Sue Thomson
Judy Binns

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Sue Thomson
Judy Binns
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Preface

Nelson VICmaths Foundation Mathematics Units 1 and 2 has been written and updated for the 2022 Study Design. In this book, teachers will find familiar features that strongly contribute to effective mathematics teaching and learning: clear worked examples, graded exercises, investigations, technology integration, practical activities, language activities, and a combined glossary and index.

This book caters for students heading towards the workforce or further training after school, and is therefore focused on teaching useful mathematical skills and applications for life. The author team are experts in teaching and writing for senior practical mathematics courses, and have published for both state and Australian curriculums.

The authors and publishers have endeavoured to produce a practical text that captures the spirit of the course, providing relevant, current and interesting examples of mathematics being used in society and industry. The Years 11 and 12 student books cover the relevant Study Design with 15–16 short chapters written in plain English. There is an emphasis on numeracy, literacy and real-life applications, engaging students by using themes such as sport, careers, medicine, building and construction, travel, shopping and buying a car. We wish all teachers and students using this book every success in embracing the Foundation Mathematics course.

About the authors

Sue Thomson is an experienced teacher and educational leader. She was an examination writer, assessor, marker and curriculum writer. Sue is a prolific and successful author with an interest in language development, financial literacy and making mathematics accessible to all. She has written many successful series for NSW, Queensland and WA, including the *Hands-On Maths in Practice* and *Access to General Mathematics* series.

Judy Binns is an experienced teacher, leader and author who has taught in urban and rural schools. She has an interest in motivating students with learning difficulties, and wide experience in teaching senior practical mathematics courses. Judy co-wrote a successful mathematics series for Years 7–8 and with Sue Thomson has written for senior practical mathematics in NSW, Queensland and WA.

Contributing authors

John Drake, **Katie Jackson** and **Joanne Magner** created the video tutorials.

Study Design grid

Area of study	*Nelson VICmaths Foundation Mathematics 11* chapter	
UNIT 1		
1 Algebra, number and structure	2	What's the score?
	5	What's my share?
2 Data analysis, probability and statistics	3	Show me the graph
	7	It's better than average
3 Discrete mathematics: Financial and consumer mathematics	1	Earning money
	6	Managing money
4 Space and measurement	4	Metres, litres and grams
	8	Area, volume and time
UNIT 2		
1 Algebra, number and structure	9	Using algebra
	13	Equations and lines
2 Data analysis, probability and statistics	10	Displaying data
	15	Comparing data
3 Discrete mathematics: Financial and consumer mathematics	12	Spending and borrowing money
4 Space and measurement	11	Designs and plans
	14	Going places

About this book

In each chapter

Each chapter begins on a double-page spread.

Table of contents for the chapter.

What will we do in this chapter? list of outcomes.

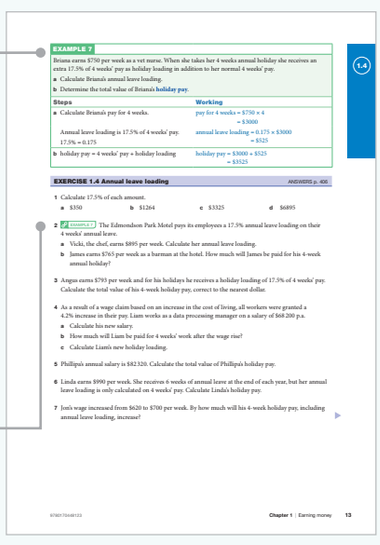
How are we ever going to use this? list of applications.

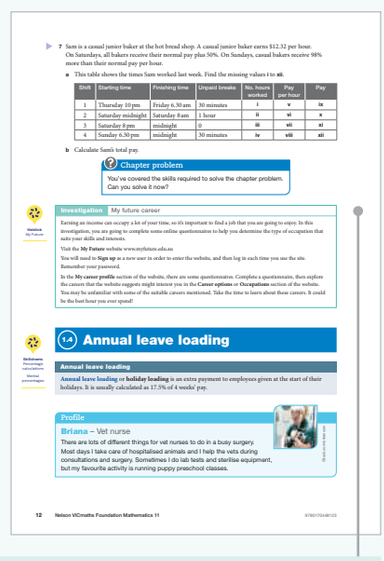
Chapter problem to be solved.

Study Design coverage and extracts are shown at the start of the chapter, along with a listing of **Nelson MindTap chapter resources**.

Important words and phrases are printed in blue and listed in the **Glossary and index** at the back of the book.

Important facts and formulas are highlighted in a shaded box.



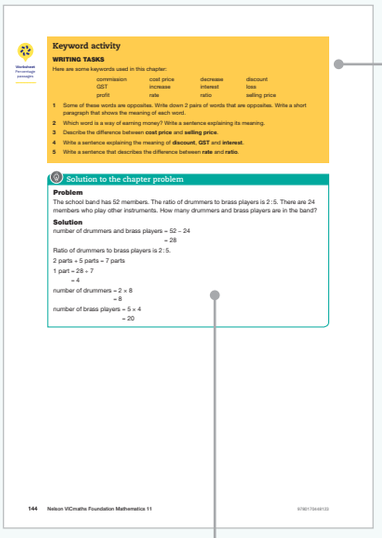


Worked examples are explained clearly step-by-step, with the mathematical working shown on the right-hand side.

Graded exercises are linked to the worked examples and include problems and realistic applications.

Investigations and **Practical activities** explore the syllabus in more detail, through group work, discovery and modelling activities. **Extended investigations** can be adapted into assessment tasks and projects.

At the end of each chapter



Keyword activity

WRITING TASKS

Here are some keywords used in this chapter:

commission	cost price	decrease	discount
GST	increase	interest	loss
profit	rate	ratio	selling price

1 Some of these words are opposites. Write down 2 pairs of words that are opposites. Write a short paragraph that shows the meaning of each word.
2 Which word is a way of earning money? Write a sentence explaining its meaning.
3 Describe the difference between **cost price** and **selling price**.
4 Write a sentence explaining the meaning of **discount**, **GST** and **interest**.
5 Write a sentence that describes the difference between **rate** and **ratio**.

Solution to the chapter problem

Problem
The school band has 52 members. The ratio of drummers to brass players is 2 : 5. There are 24 members who play other instruments. How many drummers and brass players are in the band?

Solution
number of drummers and brass players = 52 − 24
= 28

Ratio of drummers to brass players is 2 : 5.
2 parts + 5 parts = 7 parts
1 part = 28 ÷ 7
= 4
number of drummers = 2 × 8
= 8
number of brass players = 5 × 4
= 20

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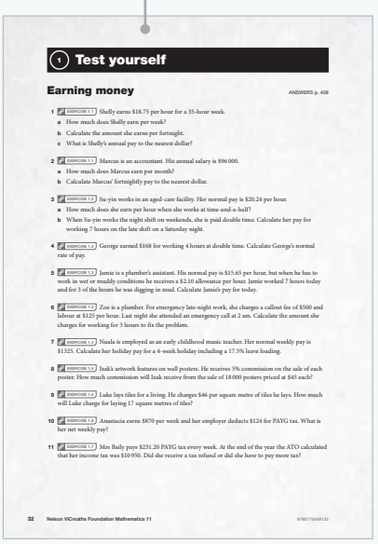
Keyword activity focuses on the mathematical language and terminology learned in the chapter.

Solution to the chapter problem revisits the problem introduced at the start of the chapter and presents a solution to the problem.

Test yourself contains revision linked to the relevant exercise set.



Test yourself

Earning money

ANSWERS p. 408

1 EXERCISE 1.1 Shelly earns $18.75 per hour for a 35-hour week.
a How much does Shelly earn per week?
b Calculate the amount she earns per fortnight.
c What is Shelly's annual pay to the nearest dollar?

2 EXERCISE 1.1 Marcus is an accountant. His annual salary is $96 000.
a How much does Marcus earn per month?
b Calculate Marcus' fortnightly pay to the nearest dollar.

3 EXERCISE 1.1 Su-yin works in an aged-care facility. Her normal pay is $20.24 per hour.
a How much does she earn per hour when she works at time-and-a-half?
b When Su-yin works the night shift on weekends, she is paid double time. Calculate her pay for working 7 hours on the late shift on a Saturday night.

4 EXERCISE 1.1 George earned $168 for working 4 hours at double time. Calculate George's normal rate of pay.

5 EXERCISE 1.1 Jamie is a plumber's assistant. His normal pay is $15.65 per hour, but when he has to work in wet or muddy conditions he receives a $2.10 allowance per hour. Jamie worked 7 hours today and for 3 of the hours he was digging in mud. Calculate Jamie's pay for today.

6 EXERCISE 1.1 Zoe is a plumber. For emergency late-night work, she charges a callout fee of $500 and labour at $125 per hour. Last night she attended an emergency call at 2 am. Calculate the amount she charges for working for 3 hours to fix the problem.

7 EXERCISE 1.1 Nuala is employed as an early childhood music teacher. Her normal weekly pay is $1325. Calculate her holiday pay for a 4-week holiday including a 17.5% leave loading.

8 EXERCISE 1.1 Izak's artwork features on wall posters. He receives 5% commission on the sale of each poster. How much commission will Izak receive from the sale of 18 000 posters priced at $45 each?

9 EXERCISE 1.1 Luke lays tiles for a living. He charges $46 per square metre of tiles he lays. How much will Luke charge for laying 17 square metres of tiles?

10 EXERCISE 1.1 Anastacia earns $870 per week and her employer deducts $124 for PAYG tax. What is her net weekly pay?

11 EXERCISE 1.1 Mrs Baily pays $231.20 PAYG tax every week. At the end of the year the ATO calculated that her income tax was $10 950. Did she receive a tax refund or did she have to pay more tax?

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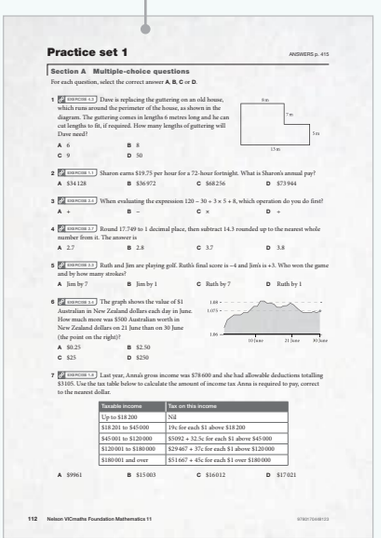
Practice sets revise the skills and knowledge of previous chapters.



Practice set 1

ANSWERS p. 415

Section A Multiple-choice questions

For each question, select the correct answer **A**, **B**, **C** or **D**.

1 EXERCISE 1.2 Dave is replacing the guttering on an old house, which runs around the perimeter of the house, as shown in the diagram. The guttering comes in lengths 6 metres long and he can cut lengths to fit, if required. How many lengths of guttering will Dave need?
A 6 B 8 C 9 D 50

2 EXERCISE 1.3 Sharon earns $19.75 per hour for a 72-hour fortnight. What is Sharon's annual pay?
A $34 128 B $36 972 C $68 256 D $73 944

3 EXERCISE 1.4 When evaluating the expression 120 − 30 ÷ 3 × 5 + 8, which operation do you do first?
A + B − C × D ÷

4 EXERCISE 1.7 Round 17.749 to 1 decimal place, then subtract 14.3 rounded up to the nearest whole number from it. The answer is
A 2.7 B 2.8 C 3.7 D 3.8

5 EXERCISE 1.8 Ruth and Jim are playing golf. Ruth's final score is −4 and Jim's is +3. Who won the game and by how many strokes?
A Jim by 7 B Jim by 1 C Ruth by 7 D Ruth by 1

6 EXERCISE 1.7 The graph shows the value of $1 Australian in New Zealand dollars each day in June. How much more was $500 Australian worth in New Zealand dollars on 21 June than on 30 June (the point on the right)?
A $0.25 B $2.50 C $25 D $250

7 EXERCISE 1.8 Last year, Anuja's gross income was $78 600 and she had allowable deductions totalling $3105. Use the tax table below to calculate the amount of income tax Anna is required to pay, correct to the nearest dollar.

Taxable income	Tax on this income
Up to $18 200	Nil
$18 201 to $45 000	19c for each $1 above $18 200
$45 001 to $120 000	$5092 + 32.5c for each $1 above $45 000
$120 001 to $180 000	$29 467 + 37c for each $1 above $120 000
$180 001 and over	$51 667 + 45c for each $1 over $180 000

A $9961 B $15 003 C $16 012 D $17 021

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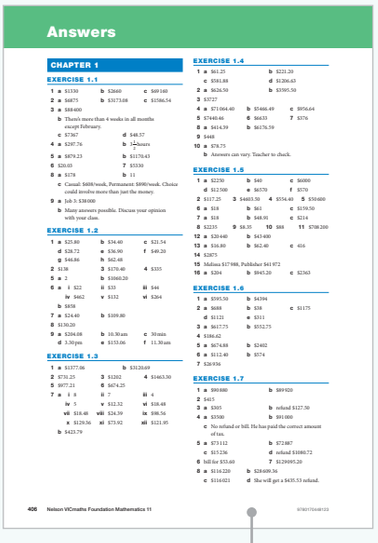
At the end of the book



Answers

CHAPTER 1

EXERCISE 1.1

1 a $1330 b $2660 c $69 160
2 a $6875 b $3373.08 c $1586.54
3 a $84 000
b There's more than 4 weeks in all months except February.
c $7367 d $48.57
4 a $287.76 b $\frac{1}{2}$ hours
5 a $879.23 b $1170.43
6 $20.05 7 $1530
8 a $178 b 11
c Casual: $688/week. Permanent: $890/week. Choice could involve more than just the money.
9 a Job 3: $38 000
b Many answers possible. Discuss your opinion with your class.

EXERCISE 1.2

1 a $25.80 b $34.40 c $21.54
d $28.72 e $36.90 f $49.20
g $46.86 h $82.48
2 $138 3 $170.40 4 $335
5 a 2 b $1060.20
6 a i $22 ii $33 iii $44
iv $462 v $132 vi $264
vii $858
7 a $24.40 b $109.80
8 $130.20
9 a $206.08 b 10.30 am c 30 min
d 1.30 pm e $153.06 f 11.30 am

EXERCISE 1.3

1 a $1377.06 b $3126.69
2 $731.25 3 $1202 4 $1463.30
5 $977.21 6 $674.25
7 a i 8 ii 7 iii 4
iv 5 v $12.32 vi $18.48
vii $18.48 viii $24.39 ix $98.56
x $129.56 xi $73.92 xii $121.95
b $423.79

EXERCISE 1.4

1 a $61.25 b $231.26
c $581.88 d $1206.63
2 a $626.50 b $3595.50
3 $3727
4 a $71 064.40 b $7486.49 c $956.64
5 $7448.46 6 $6633 7 $376
8 a $414.39 b $6176.59
9 $448
10 a $78.75
b Answers can vary. Teacher to check.

EXERCISE 1.5

1 a $2250 b $40 c $6000
d $12 500 e $6570 f $570
2 $117.25 3 $4883.50 4 $554.40 5 $50 600
6 a $18 b $61 c $170.50
7 a $18 b $48.91 c $214
8 $2235 9 $8.35 10 $88 11 $708 200
12 a $20 640 b $43 400
13 a $16.80 b $62.40 c 416
14 $2875
15 Mufasa: $17 988, Pedobear: $41 972
16 a $294 b $943.20 c $2363

EXERCISE 1.6

1 a $595.50 b $4704
2 a $688 b $38 c $1175
d $1121 e $311
3 a $617.75 b $552.75
4 $186.62
5 a $674.88 b $2402
6 a $112.40 b $574
7 $26 936

EXERCISE 1.7

1 a $90 800 b $89 920
2 $415
3 a $305 b refund $127.50
4 a $3500 b $81 000
c No refund or bill. He has paid the correct amount of tax.
5 a $73 112 b $72 887
c $15 236 d refund $1080.72
6 bill for $53.60 7 $129 095.20
8 a $116 220 b $28 600.36
c $116 021 d She will get a $435.53 refund.

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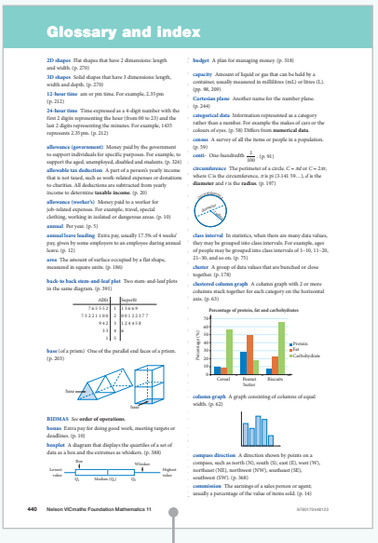

Glossary and index

2D shapes Flat shapes that have 2 dimensions: length and width. (p. 270)
3D shapes Solid shapes that have 3 dimensions: length, width and depth. (p. 270)
12-hour time am or pm time. For example, 2.35 pm (p. 212)
24-hour time Time expressed as a 4-digit number with the first 2 digits representing the hour (from 00 to 23) and the last 2 digits representing the minutes. For example, 1435 represents 2.35 pm. (p. 212)
allowance (government) Money paid by the government to support individuals for specific purposes. For example, to support the aged, unemployed, disabled and students. (p. 226)
allowable tax deduction A part of a person's yearly income that is not taxed, such as work-related expenses or donations to charities. All deductions are subtracted from yearly income to determine **taxable income**. (p. 20)
allowance (worker's) Money paid to a worker for job-related expenses. For example, travel, special clothing, working in isolated or dangerous areas. (p. 10)
annual Per year. (p. 5)
annual leave loading Extra pay, usually 17.5% of 4 weeks' pay, given by some employers to an employee during annual leave. (p. 12)
area The amount of surface occupied by a flat shape, measured in square units. (p. 186)
back-to-back stem-and-leaf plot Two stem-and-leaf plots in the same diagram. (p. 391)
base (of a prism) One of the parallel end faces of a prism. (p. 203)
BIDMAS *See* **order of operations**.
bonus Extra pay for doing good work, meeting targets or deadlines. (p. 10)
boxplot A diagram that displays the quartiles of a set of data as a box and the extremes as whiskers. (p. 388)
budget A plan for managing money. (p. 318)
capacity Amount of liquid or gas that can be held by a container, usually measured in millilitres (mL) or litres (L). (pp. 98, 299)
Cartesian plane Another name for the number plane. (p. 244)
categorical data Information represented as a category rather than a number. For example the makes of cars or the colours of eyes. (p. 58) Differs from **numerical data**.
census A survey of all the items or people in a population. (p. 59)
cent(i)- One-hundredth $\left(\frac{1}{100}\right)$. (p. 91)
circumference The perimeter of a circle. $C = \pi d$ or $C = 2\pi r$, where C is the circumference, π is $\frac{22}{7}$ or 3.14, d is the **diameter** and r is the **radius**. (p. 197)
class interval In statistics, when there are many data values, they may be grouped into class intervals. For example, ages of people may be grouped into class intervals of 1–10, 11–20, 21–30, and so on. (p. 75)
cluster A group of data values that are bunched or close together. (p. 178)
clustered column graph A column graph with 2 or more columns stuck together for each category on the horizontal axis. (p. 63)
column graph A graph consisting of columns of equal width. (p. 62)
compass direction A direction shown by points on a compass, such as north (N), south (S), east (E), west (W), northeast (NE), northwest (NW), southeast (SE), southwest (SW). (p. 368)
commission The earnings of a sales person or agent, usually a percentage of the value of items sold. (p. 14)

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Answers (with worked solutions provided on Nelson MindTap for teachers to allocate to students).

A combined **Glossary and index**.

Nelson MindTap

Nelson MindTap is an online learning space that provides students with tailored learning experiences. Access tools and content that make learning simpler yet smarter to help students achieve VCE maths mastery.

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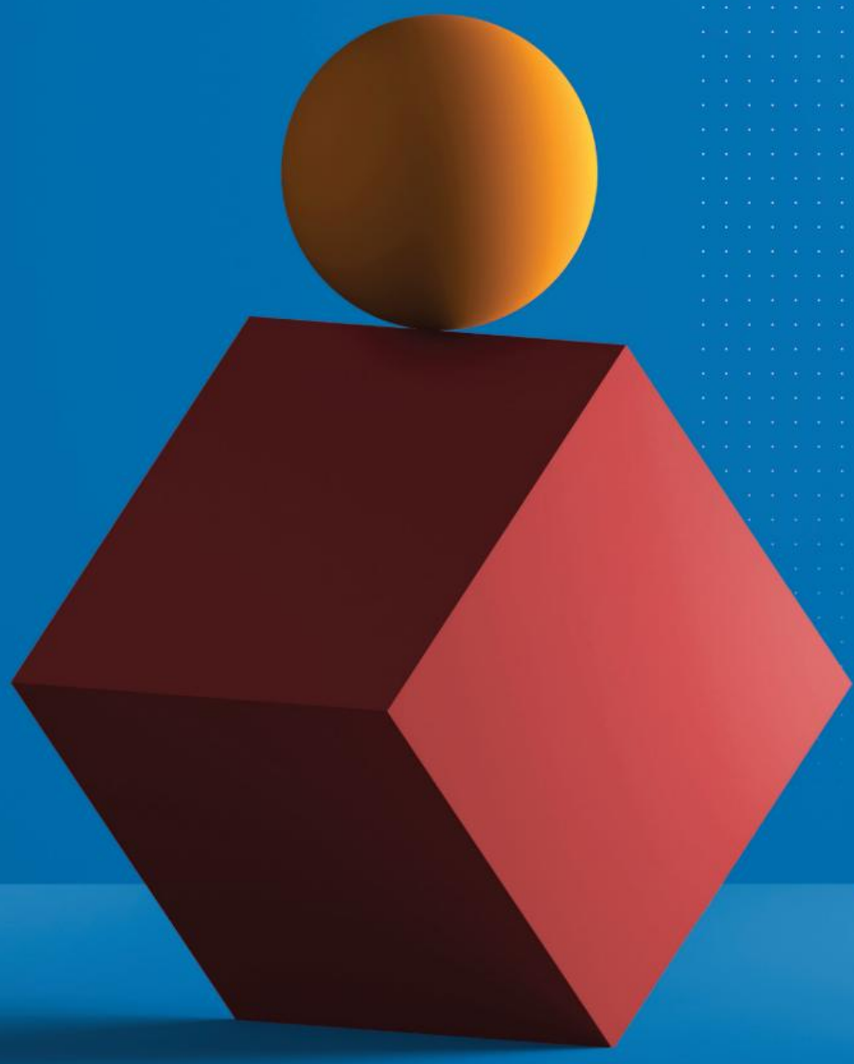

foundation mathematics

11

Sue Thomson
Judy Binns

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Preface

Nelson VICmaths Foundation Mathematics Units 1 and 2 has been written and updated for the 2022 Study Design. In this book, teachers will find familiar features that strongly contribute to effective mathematics teaching and learning: clear worked examples, graded exercises, investigations, technology integration, practical activities, language activities, and a combined glossary and index.

This book caters for students heading towards the workforce or further training after school, and is therefore focused on teaching useful mathematical skills and applications for life. The author team are experts in teaching and writing for senior practical mathematics courses, and have published for both state and Australian curriculums.

The authors and publishers have endeavoured to produce a practical text that captures the spirit of the course, providing relevant, current and interesting examples of mathematics being used in society and industry. The Years 11 and 12 student books cover the relevant Study Design with 15–16 short chapters written in plain English. There is an emphasis on numeracy, literacy and real-life applications, engaging students by using themes such as sport, careers, medicine, building and construction, travel, shopping and buying a car. We wish all teachers and students using this book every success in embracing the Foundation Mathematics course.

About the authors

Sue Thomson is an experienced teacher and educational leader. She was an examination writer, assessor, marker and curriculum writer. Sue is a prolific and successful author with an interest in language development, financial literacy and making mathematics accessible to all. She has written many successful series for NSW, Queensland and WA, including the *Hands-On Maths in Practice* and *Access to General Mathematics* series.

Judy Binns is an experienced teacher, leader and author who has taught in urban and rural schools. She has an interest in motivating students with learning difficulties, and wide experience in teaching senior practical mathematics courses. Judy co-wrote a successful mathematics series for Years 7–8 and with Sue Thomson has written for senior practical mathematics in NSW, Queensland and WA.

Contributing authors

John Drake, **Katie Jackson** and **Joanne Magner** created the video tutorials.

Study Design grid

Area of study	*Nelson VICmaths Foundation Mathematics 11* chapter	
UNIT 1		
1 Algebra, number and structure	2	What's the score?
	5	What's my share?
2 Data analysis, probability and statistics	3	Show me the graph
	7	It's better than average
3 Discrete mathematics: Financial and consumer mathematics	1	Earning money
	6	Managing money
4 Space and measurement	4	Metres, litres and grams
	8	Area, volume and time
UNIT 2		
1 Algebra, number and structure	9	Using algebra
	13	Equations and lines
2 Data analysis, probability and statistics	10	Displaying data
	15	Comparing data
3 Discrete mathematics: Financial and consumer mathematics	12	Spending and borrowing money
4 Space and measurement	11	Designs and plans
	14	Going places

About this book

In each chapter

Each chapter begins on a double-page spread.

Table of contents for the chapter.

What will we do in this chapter? list of outcomes.

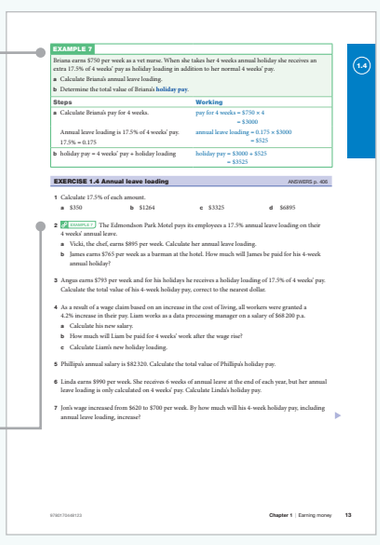
How are we ever going to use this? list of applications.

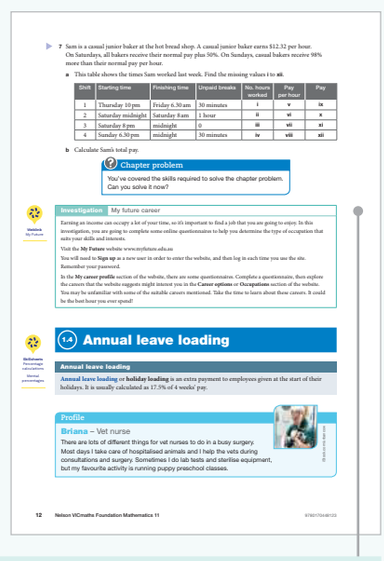
Chapter problem to be solved.

Study Design coverage and extracts are shown at the start of the chapter, along with a listing of **Nelson MindTap chapter resources**.

Important words and phrases are printed in blue and listed in the **Glossary and index** at the back of the book.

Important facts and formulas are highlighted in a shaded box.



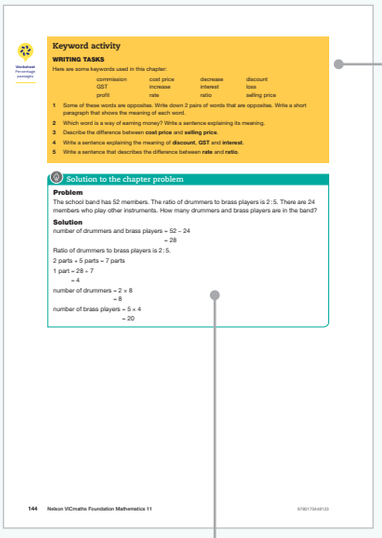


Worked examples are explained clearly step-by-step, with the mathematical working shown on the right-hand side.

Graded exercises are linked to the worked examples and include problems and realistic applications.

Investigations and **Practical activities** explore the syllabus in more detail, through group work, discovery and modelling activities. **Extended investigations** can be adapted into assessment tasks and projects.

At the end of each chapter



Keyword activity

WRITING TASKS

Here are some keywords used in this chapter:

commission	cost price	decrease	discount
GST	increase	interest	loss
profit	rate	ratio	selling price

1 Some of these words are opposites. Write down 2 pairs of words that are opposites. Write a short paragraph that shows the meaning of each word.
2 Which word is a way of earning money? Write a sentence explaining its meaning.
3 Describe the difference between **cost price** and **selling price**.
4 Write a sentence explaining the meaning of **discount**, **GST** and **interest**.
5 Write a sentence that describes the difference between **rate** and **ratio**.

Solution to the chapter problem

Problem
The school band has 52 members. The ratio of drummers to brass players is 2 : 5. There are 24 members who play other instruments. How many drummers and brass players are in the band?

Solution
number of drummers and brass players = 52 − 24
= 28

Ratio of drummers to brass players is 2 : 5.
2 parts + 5 parts = 7 parts
1 part = 28 ÷ 7
= 4
number of drummers = 2 × 8
= 8
number of brass players = 5 × 4
= 20

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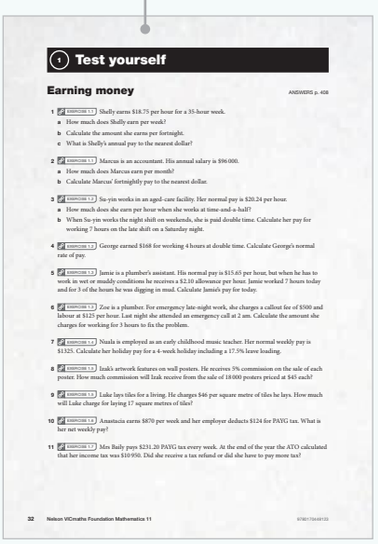
Keyword activity focuses on the mathematical language and terminology learned in the chapter.

Solution to the chapter problem revisits the problem introduced at the start of the chapter and presents a solution to the problem.

Test yourself contains revision linked to the relevant exercise set.



Test yourself

Earning money

ANSWERS p. 408

1 EXERCISE 1.1 Shelly earns $18.75 per hour for a 35-hour week.
a How much does Shelly earn per week?
b Calculate the amount she earns per fortnight.
c What is Shelly's annual pay to the nearest dollar?

2 EXERCISE 1.1 Marcus is an accountant. His annual salary is $96 000.
a How much does Marcus earn per month?
b Calculate Marcus' fortnightly pay to the nearest dollar.

3 EXERCISE 1.1 Su-yin works in an aged-care facility. Her normal pay is $20.24 per hour.
a How much does she earn per hour when she works at time-and-a-half?
b When Su-yin works the night shift on weekends, she is paid double time. Calculate her pay for working 7 hours on the late shift on a Saturday night.

4 EXERCISE 1.1 George earned $168 for working 4 hours at double time. Calculate George's normal rate of pay.

5 EXERCISE 1.1 Jamie is a plumber's assistant. His normal pay is $15.65 per hour, but when he has to work in wet or muddy conditions he receives a $2.10 allowance per hour. Jamie worked 7 hours today and for 3 of the hours he was digging in mud. Calculate Jamie's pay for today.

6 EXERCISE 1.1 Zoe is a plumber. For emergency late-night work, she charges a callout fee of $500 and labour at $125 per hour. Last night she attended an emergency call at 2 am. Calculate the amount she charges for working for 3 hours to fix the problem.

7 EXERCISE 1.1 Nuala is employed as an early childhood music teacher. Her normal weekly pay is $1325. Calculate her holiday pay for a 4-week holiday including a 17.5% leave loading.

8 EXERCISE 1.1 Izak's artwork features on wall posters. He receives 5% commission on the sale of each poster. How much commission will Izak receive from the sale of 18 000 posters priced at $45 each?

9 EXERCISE 1.1 Luke lays tiles for a living. He charges $46 per square metre of tiles he lays. How much will Luke charge for laying 17 square metres of tiles?

10 EXERCISE 1.1 Anastacia earns $870 per week and her employer deducts $124 for PAYG tax. What is her net weekly pay?

11 EXERCISE 1.1 Mrs Baily pays $231.20 PAYG tax every week. At the end of the year the ATO calculated that her income tax was $10 950. Did she receive a tax refund or did she have to pay more tax?

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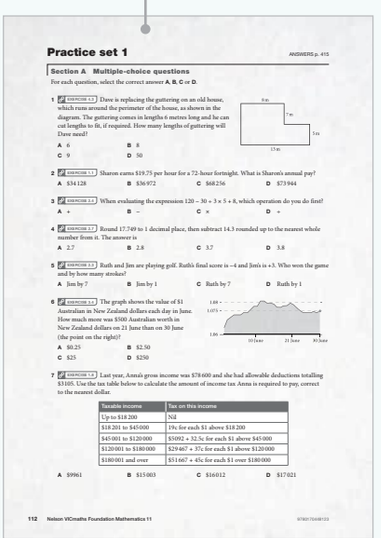
Practice sets revise the skills and knowledge of previous chapters.



Practice set 1

ANSWERS p. 415

Section A Multiple-choice questions

For each question, select the correct answer **A**, **B**, **C** or **D**.

1 EXERCISE 1.2 Dave is replacing the guttering on an old house, which runs around the perimeter of the house, as shown in the diagram. The guttering comes in lengths 6 metres long and he can cut lengths to fit, if required. How many lengths of guttering will Dave need?
A 6 B 8 C 9 D 50

2 EXERCISE 1.3 Sharon earns $19.75 per hour for a 72-hour fortnight. What is Sharon's annual pay?
A $34 128 B $36 972 C $68 256 D $73 944

3 EXERCISE 1.4 When evaluating the expression 120 − 30 ÷ 3 × 5 + 8, which operation do you do first?
A + B − C × D ÷

4 EXERCISE 1.7 Round 17.749 to 1 decimal place, then subtract 14.3 rounded up to the nearest whole number from it. The answer is
A 2.7 B 2.8 C 3.7 D 3.8

5 EXERCISE 1.8 Ruth and Jim are playing golf. Ruth's final score is −4 and Jim's is +3. Who won the game and by how many strokes?
A Jim by 7 B Jim by 1 C Ruth by 7 D Ruth by 1

6 EXERCISE 1.7 The graph shows the value of $1 Australian in New Zealand dollars each day in June. How much more was $500 Australian worth in New Zealand dollars on 21 June than on 30 June (the point on the right)?
A $0.25 B $2.50 C $25 D $250

7 EXERCISE 1.8 Last year, Anuja's gross income was $78 600 and she had allowable deductions totalling $3105. Use the tax table below to calculate the amount of income tax Anna is required to pay, correct to the nearest dollar.

Taxable income	Tax on this income
Up to $18 200	Nil
$18 201 to $45 000	19c for each $1 above $18 200
$45 001 to $120 000	$5092 + 32.5c for each $1 above $45 000
$120 001 to $180 000	$29 467 + 37c for each $1 above $120 000
$180 001 and over	$51 667 + 45c for each $1 over $180 000

A $9961 B $15 003 C $16 012 D $17 021

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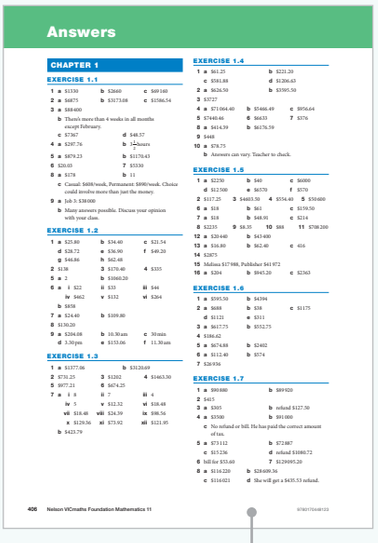
At the end of the book



Answers

CHAPTER 1

EXERCISE 1.1

1 a $1330 b $2660 c $69 160
2 a $6875 b $3373.08 c $1586.54
3 a $84 000
b There's more than 4 weeks in all months except February.
c $7367 d $48.57
4 a $287.76 b $\frac{1}{2}$ hours
5 a $879.23 b $1170.43
6 $20.05 7 $1530
8 a $178 b 11
c Casual: $688/week. Permanent: $890/week. Choice could involve more than just the money.
9 a Job 3: $38 000
b Many answers possible. Discuss your opinion with your class.

EXERCISE 1.2

1 a $25.80 b $34.40 c $21.54
d $28.72 e $36.90 f $49.20
g $46.86 h $82.48
2 $138 3 $170.40 4 $335
5 a 2 b $1060.20
6 a i $22 ii $33 iii $44
iv $462 v $132 vi $264
vii $858
7 a $24.40 b $109.80
8 $130.20
9 a $206.08 b 10.30 am c 30 min
d 1.30 pm e $153.06 f 11.30 am

EXERCISE 1.3

1 a $1377.06 b $3126.69
2 $731.25 3 $1202 4 $1463.30
5 $977.21 6 $674.25
7 a i 8 ii 7 iii 4
iv 5 v $12.32 vi $18.48
vii $18.48 viii $24.39 ix $98.56
x $129.56 xi $73.92 xii $121.95
b $423.79

EXERCISE 1.4

1 a $61.25 b $231.26
c $581.88 d $1206.63
2 a $626.50 b $3595.50
3 $3727
4 a $71 064.40 b $7486.49 c $956.64
5 $7448.46 6 $6633 7 $376
8 a $414.39 b $6176.59
9 $448
10 a $78.75
b Answers can vary. Teacher to check.

EXERCISE 1.5

1 a $2250 b $40 c $6000
d $12 500 e $6570 f $570
2 $117.25 3 $4883.50 4 $554.40 5 $50 600
6 a $18 b $61 c $170.50
7 a $18 b $48.91 c $214
8 $2235 9 $8.35 10 $88 11 $708 200
12 a $20 640 b $43 400
13 a $16.80 b $62.40 c 416
14 $2875
15 Mufasa: $17 988, Pedobear: $41 972
16 a $294 b $943.20 c $2363

EXERCISE 1.6

1 a $595.50 b $4704
2 a $688 b $38 c $1175
d $1121 e $311
3 a $617.75 b $552.75
4 $186.62
5 a $674.88 b $2402
6 a $112.40 b $574
7 $26 936

EXERCISE 1.7

1 a $90 800 b $89 920
2 $415
3 a $305 b refund $127.50
4 a $3500 b $81 000
c No refund or bill. He has paid the correct amount of tax.
5 a $73 112 b $72 887
c $15 236 d refund $1080.72
6 bill for $53.60 7 $129 095.20
8 a $116 220 b $28 600.36
c $116 021 d She will get a $435.53 refund.

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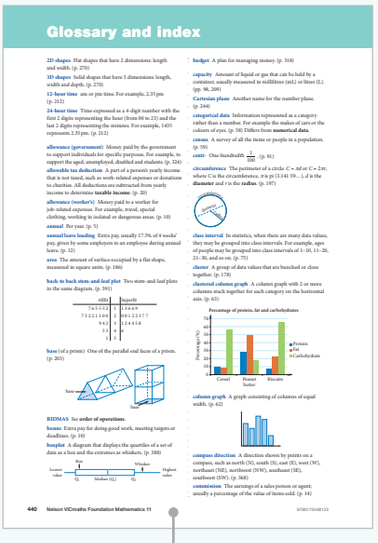

Glossary and index

2D shapes Flat shapes that have 2 dimensions: length and width. (p. 270)
3D shapes Solid shapes that have 3 dimensions: length, width and depth. (p. 270)
12-hour time am or pm time. For example, 2.35 pm (p. 212)
24-hour time Time expressed as a 4-digit number with the first 2 digits representing the hour (from 00 to 23) and the last 2 digits representing the minutes. For example, 1435 represents 2.35 pm. (p. 212)
allowance (government) Money paid by the government to support individuals for specific purposes. For example, to support the aged, unemployed, disabled and students. (p. 226)
allowable tax deduction A part of a person's yearly income that is not taxed, such as work-related expenses or donations to charities. All deductions are subtracted from yearly income to determine **taxable income**. (p. 20)
allowance (worker's) Money paid to a worker for job-related expenses. For example, travel, special clothing, working in isolated or dangerous areas. (p. 10)
annual Per year. (p. 5)
annual leave loading Extra pay, usually 17.5% of 4 weeks' pay, given by some employers to an employee during annual leave. (p. 12)
area The amount of surface occupied by a flat shape, measured in square units. (p. 186)
back-to-back stem-and-leaf plot Two stem-and-leaf plots in the same diagram. (p. 391)
base (of a prism) One of the parallel end faces of a prism. (p. 203)
BIDMAS *See* **order of operations**.
bonus Extra pay for doing good work, meeting targets or deadlines. (p. 10)
boxplot A diagram that displays the quartiles of a set of data as a box and the extremes as whiskers. (p. 388)
budget A plan for managing money. (p. 318)
capacity Amount of liquid or gas that can be held by a container, usually measured in millilitres (mL) or litres (L). (pp. 98, 299)
Cartesian plane Another name for the number plane. (p. 244)
categorical data Information represented as a category rather than a number. For example the makes of cars or the colours of eyes. (p. 58) Differs from **numerical data**.
census A survey of all the items or people in a population. (p. 59)
cent(i)- One-hundredth $\left(\frac{1}{100}\right)$. (p. 91)
circumference The perimeter of a circle. $C = \pi d$ or $C = 2\pi r$, where C is the circumference, π is $\frac{22}{7}$ or 3.14, d is the **diameter** and r is the **radius**. (p. 197)
class interval In statistics, when there are many data values, they may be grouped into class intervals. For example, ages of people may be grouped into class intervals of 1–10, 11–20, 21–30, and so on. (p. 75)
cluster A group of data values that are bunched or close together. (p. 178)
clustered column graph A column graph with 2 or more columns stuck together for each category on the horizontal axis. (p. 63)
column graph A graph consisting of columns of equal width. (p. 62)
compass direction A direction shown by points on a compass, such as north (N), south (S), east (E), west (W), northeast (NE), northwest (NW), southeast (SE), southwest (SW). (p. 368)
commission The earnings of a sales person or agent, usually a percentage of the value of items sold. (p. 14)

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Answers (with worked solutions provided on Nelson MindTap for teachers to allocate to students).

A combined **Glossary and index**.

Nelson MindTap

Nelson MindTap is an online learning space that provides students with tailored learning experiences. Access tools and content that make learning simpler yet smarter to help students achieve VCE maths mastery.

Nelson MindTap includes an eText with integrated interactives and online assessment.

Margin links in the student book signpost multimedia student resources found on MindTap.

Nelson MindTap for students:

- **Watch** video tutorials featuring expert teacher advice to unpack new concepts and develop your understanding.
- **Revise** using quizzes, worksheets and skillsheets to practise your skills and build your confidence.
- **Navigate** your own path, accessing the content, weblinks, analytics and support as you need it.

Nelson MindTap for teachers*:

- Tailor content to different learning needs – assign directly to the student, or the whole class.
- Monitor progress using assessment tools like Gradebook and Reports.
- Integrate content and assessment directly within your school's LMS for ease of access.
- Access topic tests, teaching plans and worked solutions to each exercise set.

*Complimentary access to these resources is only available to teachers who use this book as part of a class set, book hire or booklist. Contact your Cengage Education Consultant for information about access and conditions.

Videos

Worksheets

Skillsheets

Nelson VICmaths 11–12 series

Chapter problem

Alvin works at a large hardware store and his wage is $24.60 per hour. He also has a truck licence and sometimes he drives a 10-tonne vehicle to make pick-ups and deliveries.

When licensed employees are required to drive a heavy vehicle, they must be paid an extra 5% per hour.

In the week ending 20 April, Alvin worked in the store for 24 hours and drove the truck for 6 hours. His payslip is shown here:

Employee: A. Styles	Week ending 20 April	
24 hours store	24 × $24.60	$590.40
6 hours truck driving	6 × 0.05 × $24.60	$7.38
	Gross pay	**$597.78**

Alvin thinks his gross pay for the week ending 20 April is wrong. Is there an error?

CHAPTER 1

DISCRETE MATHEMATICS: FINANCIAL AND CONSUMER MATHEMATICS

EARNING MONEY

1.1 Wages and salaries
1.2 Working overtime
1.3 Bonuses and allowances
1.4 Annual leave loading
1.5 Commission, piecework and royalties
1.6 Gross pay and net pay
1.7 Taxable income and tax refunds
1.8 Income tax and Medicare levy
1.9 Superannuation
Extended investigation: Accessing superannuation early
Extended investigation: Extra superannuation payments
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Use rates to calculate wages, salaries, overtime and piecework
- Use percentages to calculate bonuses, allowances, annual leave loading, commissions and royalties
- Calculate net pay after making deductions from gross pay
- Calculate taxable income after making allowable deductions from income
- Calculate income tax and Medicare levy
- Calculate tax payable or refund after PAYG tax has been paid
- Calculate superannuation payments

How are we ever going to use this?

- Checking our pay is correct
- Calculating holiday pay
- Keeping accurate records and collecting receipts to calculate allowable deductions
- Preparing annual tax returns and calculating whether we will receive a tax refund
- Making superannuation and budgeting decisions based on income and taxation

Study Design coverage

UNIT 1, AREA OF STUDY 3: DISCRETE MATHEMATICS

Financial and consumer mathematics

- income calculations including rates of pay and payslips
- personal taxation and superannuation
- taxation as a community and contribution to government.

VCE Mathematics Study Design 2023–2027 p. 14, © VCAA 2022

Videos (2):
1.2 Overtime
1.8 Income tax

Skillsheets (2):
1.4, 1.5 Percentage calculations • Mental percentages

Worksheets (6):
1.1 Wages and salaries
1.5 Earning money
1.6 Pay day
1.8 Income tax tables • Income tax and Medicare levy
1.9 Investigation components

Puzzle (1):
1.9 Earning and taxation crossword

Spreadsheets (2):
1.1 Wages
1.4 Holiday pay

Weblinks (3):
1.1 Fair Work
1.3 My Future
1.9 MoneySmart

Nelson MindTap

To access resources above, visit **cengage.com.au/nelsonmindtap**

Worksheet
Wages and salaries

1.1 Wages and salaries

Wages and salaries

- A **wage** is an amount paid by an employer to an employee for each hour worked.
- A **salary** is a fixed amount per year that does not depend on the number of hours worked.

Profile

istock.com/monkey businessimages

Kristine – Childcare worker

When I was at school I earned money by babysitting. It was a job and it was fun. When I left school I decided to go into childcare. There are lots of jobs in childcare because most parents need to go to work. I did a Certificate III in Childcare at TAFE and now I have a job I love. The best part of my job is helping children to learn.

EXAMPLE 1

Kristine earns $23.21 per hour working in a long-day-care centre. She works a 38-hour week.

a How much does Kristine earn per fortnight?

b Calculate the amount Kristine earns per year.

Steps	Working
a Calculate Kristine's earnings for 1 week.	weekly earnings = 38 × $23.21 = $881.98
1 fortnight = 2 weeks	fortnightly earnings = 2 × $881.98 = $1763.96
b There are 52 weeks in a year.	yearly earnings = 52 × $881.98 = $45 862.96

EXAMPLE 2

Madeleine is a social worker. Her **annual** salary is $79 000. Calculate:

'Annual' means per year.

a her monthly pay

b her fortnightly pay.

Steps	Working
a There are 12 months in a year.	monthly pay = $79 000 ÷ 12 ≈ $6583.33
b There are 26 fortnights in a year.	fortnightly pay = $79 000 ÷ 26 ≈ $3038.46

Months, weeks, fortnights in 1 year

1 year = 12 months

1 year = 52 weeks

1 year = 26 fortnights

Watch out! 1 month is not 4 weeks and 1 year is not 48 weeks. This is a common mistake and it's WRONG.

Profile

Shutterstock.com/ Mihai Speteanu

Paul – An Australian volunteer abroad

I completed a building apprenticeship when I left school, but when I finished my trade I wasn't ready to settle down. I wanted to travel and see the world. I saw a news report about volunteers helping in developing countries and I decided to do my bit to help others. The aid agency paid my travel costs and provides my accommodation and the equipment I need. They also pay me a modest stipend. As a volunteer I'm making a difference in this community.

A *stipend* (pronounced 'sty-pend') is similar to a salary, but it is usually for a relatively small amount. People in religious orders and some volunteers receive a stipend.

EXERCISE 1.1 Wages and salaries

ANSWERS p. 406

1 EXAMPLE 1 Scott is a qualified ambulance paramedic. He is paid $35 per hour for a 38-hour week.

- **a** How much does Scott earn per week?
- **b** How much is Scott paid per fortnight?
- **c** Calculate Scott's annual pay.

2 EXAMPLE 2 Suzanne is a solicitor. She works part time and her salary is $82 500 p.a.

- **a** How much does Suzanne earn per month?
- **b** Calculate Suzanne's fortnightly pay.
- **c** How much does Suzanne earn per week?

p.a. = per annum = per year

3 Lance is paid a salary for being an office IT manager. Each week he earns $1700.

- **a** Calculate Lance's annual salary.
- **b** Explain why Lance's monthly pay is *not* $1700 × 4.
- **c** Divide Lance's annual salary by 12 to determine his monthly pay to the nearest dollar.
- **d** Lance's salary is based on 7 hours' work per day, 5 days per week and 52 weeks per year. Calculate the pay rate per hour, correct to the nearest cent, that is the basis of Lance's salary.

4 Zheng earns $18.61 per hour at the shopping mall food court.

- **a** Last week Zheng worked 16 hours. How much did he earn?
- **b** Today Zheng earned $65.14. How long did he work?

Getty Images/Jeff Greenberg

5 Ulla receives a stipend of $22 860 from the university to assist her with her postgraduate study and research.

- **a** How much does Ulla receive per fortnight from the stipend?
- **b** The stipend isn't enough to cover all of Ulla's living expenses. She also works as a waitress for 4 hours per night, 2 nights per week. She earns $18.20 per hour as a waitress. Calculate Ulla's total fortnightly **income**.

6 The minimum wage for a trainee pest inspector is $761.14 for a 38-hour week. What is the minimum pay per hour for a trainee pest inspector?

7 Carlos earns $410 per day as a relief teacher. The table shows the number of days he worked during May.

Dates	Number of days worked
30 April – 4 May	2
7 May – 11 May	1
14 May – 18 May	5
21 May – 25 May	3
28 May – 1 June	2

How much did Carlos earn over the 5 weeks?

8 Ashok is a casual office worker. He is paid $178 per day regardless of the number of hours he works. Usually he works about 12 days per month.

a How much did Ashok earn for working from 8 am to 1 pm on Monday?

b During February, Ashok earned $1958. How many days did he work in February?

c The office offers Ashok a permanent 38-hour a week job at $16 per hour. Do you think he should take the permanent job? Why or why not?

9 Pia is trying to decide which one of three jobs to take.

	Conditions	Pay
Job 1	38-hour week, 5 days per week, possibility of overtime	$19 / hour
Job 2	75 hours per fortnight, work 9 days per fortnight	$1450 per fortnight
Job 3	Salary, based on a 35-hour week	$38 800 p.a.

a Ignoring any overtime, which job pays the most per year?

b If you were Pia, which job would you take? Why?

Investigation Award wages

Search for **A-Z Modern Awards** at the Fair Work website www.fairwork.gov.au.

- Research the annual minimum wage for 3 jobs that interest you.
- Calculate the minimum weekly pay in each job.

Weblink
Fair Work

Technology Wages by spreadsheet

Download the **Wages** spreadsheet from Nelson MindTap.

Spreadsheet
Wages

1 Jessica doesn't work on Mondays or Tuesdays. Each day from Wednesday to Sunday she works from 7 am to 2.30 pm and she has an unpaid, 30-minute lunch break. Jessica's wage is $19.60 per hour. Enter the information about Jessica's job in the spreadsheet and determine her total weekly pay.

a One of the formulas used in the spreadsheet is =SUM(F11:F17). What is this formula calculating?

b What spreadsheet formula in cell F19 could be used to determine the total amount that Jessica is paid each week?

2 The following table shows the hours worked during the first week in February and the corresponding pay rates for the employees in a small office.

Employee	Pay rate per hour	Number of hours worked	Pay
Imran	$18.51	20	
Sofia	$17.25	35	
Cathy	$22.70	35	
Mike	$19.30	40	
Anita	$21.30	32	
		Total wages bill	

a The hours each employee works per week and their hourly rate of pay could change. Construct a spreadsheet that will allow you to calculate each employee's wage and the total office wage bill when the number of hours worked and the rates of pay could change.

b During the second week in February each employee received a $4 per hour wage increase. Imran worked 32 hours and the other employees worked for the same number of hours as in the previous week. Use the spreadsheet you constructed to determine the total wages bill for the second week in February.

Video
Overtime

1.2 Working overtime

Overtime is working beyond usual hours, such as at night and on weekends, and it's paid at a higher rate. Only people who work for a wage are paid overtime. It doesn't apply to salary earners, whose pay is fixed.

Overtime
Time-and-a-half is 1.5 times normal pay.
Double time is 2 times the normal pay.

Profile

iStock.com/PeopleImages

Alyssa – An aged care worker

I helped my mum look after my grandfather who has dementia when I couldn't get a job after I left school. When we took Pa for a 1-week holiday in a respite centre, the centre manager told me that I had the right attitude and I should consider working in the care service industry. I didn't need any special training because the employer provided on-the-job training and, with Australia's ageing population, there are lots of jobs to choose from. The best thing about my job is the variety. I deal with different clients and do different things every day.

EXAMPLE 3

Alyssa's normal rate of pay is $21.09 per hour. She is paid time-and-a-half on Saturdays and double time on Sundays.

a How much does Alyssa earn per hour on Saturdays?

b Calculate the amount that Alyssa will earn for working 4 hours on a Sunday.

Steps	Working
a When she works on a Saturday, Alyssa is paid 1.5 times her normal rate.	pay per hour on Saturdays = 1.5 × $21.09 = $31.64
b When Alyssa works on Sunday, she earns 2 × $21.09, or $42.18 per hour.	pay for 4 hours on Sunday = 4 × $42.18 = $168.72

EXAMPLE 4

Hasid earns $18 per hour working at a car wash centre.

a How much will he earn for working a 35-hour week?

b When Hasid works for more than 7 hours per day he is paid overtime. The first 3 hours of overtime are paid at time-and-a-half. Any additional overtime hours are paid at double time. How much will Hasid earn for working 12 hours in one day?

Steps	Working
a Calculate the pay for a normal hour working week.	pay for a 35-hour week = 35 × $18 = $630
b Hasid's 12-hour pay is broken into 7 hours normal + 3 hours at time-and-a-half + the remaining hours at double time. Hasid worked 12 hours = 7 hours normal + 3 hours at time-and-a-half + 2 hours at double time.	total pay = 7 × $18 + 3 × 1.5 × $18 + 2 × 2 × $18 = $279

EXERCISE 1.2 Working overtime

ANSWERS p. 406

1 EXAMPLE 3 Copy and complete this table.

Normal pay per hour	Pay per hour at time-and-a-half	Pay per hour at double time
$17.20	**a**	**b**
$14.36	**c**	**d**
$24.60	**e**	**f**
$31.24	**g**	**h**

2 Jenny's normal pay is $18.40 per hour. How much will she earn when she works 5 hours at time-and-a-half?

3 Mike's normal pay is $21.30 per hour. How much will he earn when he works for 4 hours on a Sunday at double time?

4 How much will Sancia earn when she works 3 hours at time-and-a-half and 4 hours at double time? Her normal pay is $26.80 per hour.

5 EXAMPLE 4 Tuan is a plumber's assistant. He works a 35-hour week at $22.80 per hour. His overtime is paid at time-and-a-half for the first 5 hours overtime in a week and double time for any hours after that. This week Tuan worked 42 hours.

a How many hours did Tuan work at double time?

b Calculate Tuan's pay for the week.

6 Mercia has a holiday job supervising children in a resort. She earns $22 per hour Monday to Friday, time-and-a-half on Saturday and double time on Sunday.

a The table shows the times Mercia worked during one week in January. Copy and complete the table.

Day	Hours worked	Pay rate per hour	Pay
Weekdays	21	**i**	**iv**
Saturday	4	**ii**	**v**
Sunday	6	**iii**	**vi**

b Calculate Mercia's pay for the week.

7 **a** Casey earned $146.40 when he worked at a hardware store for 3 hours at double time. What is Casey's normal pay per hour?

b How much will Casey earn when he works for 3 hours at time-and-a-half?

Shutterstock.com/Dmitry Kalinovsky

8 Elise earned $186 when she worked at a chemist on Sunday for 5 hours at double time. How much does Elise earn for a normal 7-hour day?

9 Callum works for a local council, maintaining the grass in parks and at sporting venues. He doesn't work any overtime on Monday to Friday. All the hours he works on Saturday are paid at time-and-a-half and Sunday work is at double time. For Callum's time and paysheet below, find the values of **a**, **b**, **c**, **d**, **e** and **f**.

Time and pay calculation sheet				
Callum O'Hare			Normal pay per hour $25.51	
Day	Start	Finish	Unpaid breaks	Pay
Monday	7 am	3.30 pm	30 minutes	**a**
Tuesday	**b**	5.30 pm	1 hour	$153.06
Wednesday	–	–		
Thursday	8 am	4 pm	**c**	$191.33
Friday	6.30 am	**d**	1 hour	$204.08
Saturday	7 am	11 am	Nil	**e**
Sunday	8 am	**f**	Nil	$178.57

1.3 Bonuses and allowances

Some jobs include **allowances** for doing unpleasant work, for working under difficult conditions or to cover expenses such as uniform and travel.

Some jobs pay **bonuses** (extra pay) for doing good work, achieving targets or meeting deadlines.

Profile

Shutterstock.com/paintings

Kaitlyn – Chef in the Australian Navy

I joined the navy because I didn't want a 9-to-5 job and I wanted to travel. I'm a fully qualified chef and the navy provided all my training and arranged my TAFE qualifications. I get good pay and conditions, as well as job security. I've got good friends in the navy and I've been around the world. I was surprised at the variety of jobs in the navy; jobs I'd never considered, like being a waiter or a chaplain. The navy even has permanent jobs for musicians in the navy bands!

EXAMPLE 5

Kaitlyn's basic salary in the navy is $48 989 and she receives an annual $13 448 service allowance, as well as an annual $419 uniform maintenance allowance. When she's at sea Kaitlyn receives an additional $10 661 annually.

a Calculate Kaitlyn's weekly pay when she is working on land.

b How much does Kaitlyn earn per fortnight when she's at sea?

Steps	Working
a annual salary on land = basic salary + service allowance + uniform allowance	salary = $48 989 + $13 448 + $419 = $62 856
Divide by 52 for weekly pay.	weekly pay on land = $62 856 ÷ 52 ≈ $1208.77

b annual pay at sea = annual salary on land + sea allowance	salary = $62 856 + $10 661 = $73 517
Divide by 26 for fortnightly pay.	fortnightly pay at sea = $73 517 ÷ 26 ≈ $2827.58

EXAMPLE 6

Sonia is paid $15.48 per hour as a security guard. Each week she receives an additional $61.05 for her guard dog and $6.75 for her torch. She receives $14.15 per shift travel allowance.

Sonia works a 4-hour shift, 6 nights per week. How much is she paid per week?

Steps	Working
Calculate Sonia's wages.	wages = 4 × 6 × $15.48 = $371.52
Calculate her travel allowance.	travel allowance = 6 × $14.15 = $84.90
total weekly pay = wages + allowances + dog + torch	total pay = $371.52 + $84.90 + $61.05 + $6.75 = $524.22

EXERCISE 1.3 Bonuses and allowances

ANSWERS p. 406

1 EXAMPLE 5 Tristan's base salary as an air force Mission Aircrew is $57 807 p.a. In addition, he receives the Australian Defence Force annual allowance of $13 118 and an annual $682 uniform allowance. He also receives $9531 p.a. when he is deployed overseas.

a Calculate Tristan's weekly pay when he is working in Australia.

b Determine Tristan's fortnightly pay when he is deployed overseas.

2 EXAMPLE 6 Zoran works for a pest control company. He is paid $17.93 per hour and he receives an extra $2.81 per day for handling poisons. Zoran works for 8 hours per day, 5 days per week. Calculate his weekly pay.

3 Ryan earns $921 per week as a mobile mechanic. In addition, he receives $29 per week for work-related mobile phone calls and $0.60 per kilometre for work-related travel. Calculate Ryan's pay for a week in which he drove 420 km in his truck for work.

4 Kate is the manager of a fast food chain. She is paid $38 per hour for a 35-hour week plus a $8.30 per week laundry allowance. She receives a $30 bonus for every accident-free week at the shop and another $95 bonus if the shop makes $100 000 or more in sales.

Last week, the shop was accident-free and the sales were $110 000. How much was Kate paid last week?

5 Zack drives a furniture removal truck. He is paid $19.12 per hour Monday to Friday, time-and-a-quarter on Saturday and double time on Sunday. He receives a flat fee of $12.59 per day for handling heavy furniture. Calculate Zack's pay for a week when he delivered furniture for 33 hours Monday to Friday, 6 hours on Saturday and 3 hours on Sunday.

6 Raina has a job driving disabled children to school. She is paid $17.50 per hour plus $3.65 per day for assisting children. In addition, she receives 85 cents for every work-related kilometre she drives in her car. Calculate Raina's pay for a week when she worked 4 hours a day from Monday to Friday and she used her car for 360 work-related kilometres.

7 Sam is a casual junior baker at the hot bread shop. A casual junior baker earns $12.32 per hour. On Saturdays, all bakers receive their normal pay plus 50%. On Sundays, casual bakers receive 98% more than their normal pay per hour.

a This table shows the times Sam worked last week. Find the missing values **i** to **xii**.

Shift	Starting time	Finishing time	Unpaid breaks	No. hours worked	Pay per hour	Pay
1	Thursday 10 pm	Friday 6.30 am	30 minutes	**i**	**v**	**ix**
2	Saturday midnight	Saturday 8 am	1 hour	**ii**	**vi**	**x**
3	Saturday 8 pm	midnight	0	**iii**	**vii**	**xi**
4	Sunday 6.30 pm	midnight	30 minutes	**iv**	**viii**	**xii**

b Calculate Sam's total pay.

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Weblink
My Future

Investigation My future career

Earning an income can occupy a lot of your time, so it's important to find a job that you are going to enjoy. In this investigation, you are going to complete some online questionnaires to help you determine the type of occupation that suits your skills and interests.

Visit the **My Future** website www.myfuture.edu.au

You will need to **Sign up** as a new user in order to enter the website, and then log in each time you use the site. Remember your password.

In the **My career profile** section of the website, there are some questionnaires. Complete a questionnaire, then explore the careers that the website suggests might interest you in the **Career options** or **Occupations** section of the website. You may be unfamiliar with some of the suitable careers mentioned. Take the time to learn about these careers. It could be the best hour you ever spend!

Skillsheets
Percentage calculations
Mental percentages

1.4 Annual leave loading

Annual leave loading

Annual leave loading or **holiday loading** is an extra payment to employees given at the start of their holidays. It is usually calculated as 17.5% of 4 weeks' pay.

Profile

iStock.com/urbancow

Briana – Vet nurse

There are lots of different things for vet nurses to do in a busy surgery. Most days I take care of hospitalised animals and I help the vets during consultations and surgery. Sometimes I do lab tests and sterilise equipment, but my favourite activity is running puppy preschool classes.

EXAMPLE 7

Briana earns $750 per week as a vet nurse. When she takes her 4 weeks annual holiday she receives an extra 17.5% of 4 weeks' pay as holiday loading in addition to her normal 4 weeks' pay.

a Calculate Briana's annual leave loading.

b Determine the total value of Briana's **holiday pay**.

Steps	Working
a Calculate Briana's pay for 4 weeks.	pay for 4 weeks = $750 × 4 = $3000
Annual leave loading is 17.5% of 4 weeks' pay. 17.5% = 0.175	annual leave loading = 0.175 × $3000 = $525
b holiday pay = 4 weeks' pay + holiday loading	holiday pay = $3000 + $525 = $3525

EXERCISE 1.4 Annual leave loading

ANSWERS p. 406

1 Calculate 17.5% of each amount.

a $350 **b** $1264 **c** $3325 **d** $6895

2 EXAMPLE 7 The Edmondson Park Motel pays its employees a 17.5% annual leave loading on their 4 weeks' annual leave.

a Vicki, the chef, earns $895 per week. Calculate her annual leave loading.

b James earns $765 per week as a barman at the hotel. How much will James be paid for his 4-week annual holiday?

3 Angus earns $793 per week and for his holidays he receives a holiday loading of 17.5% of 4 weeks' pay. Calculate the total value of his 4-week holiday pay, correct to the nearest dollar.

4 As a result of a wage claim based on an increase in the cost of living, all workers were granted a 4.2% increase in their pay. Liam works as a data processing manager on a salary of $68 200 p.a.

a Calculate his new salary.

b How much will Liam be paid for 4 weeks' work after the wage rise?

c Calculate Liam's new holiday loading.

5 Phillipa's annual salary is $82 320. Calculate the total value of Phillipa's holiday pay.

6 Linda earns $990 per week. She receives 6 weeks of annual leave at the end of each year, but her annual leave loading is only calculated on 4 weeks' pay. Calculate Linda's holiday pay.

7 Jon's wage increased from $620 to $700 per week. By how much will his 4-week holiday pay, including annual leave loading, increase?

8 PL Insurance had a very successful year. In addition to the normal 17.5% holiday loading, they decided to pay their employees a 'thank-you' bonus based on the number of years of service. They paid this bonus at the same time as the holiday loading.

Years of service	Bonus as a percentage of annual salary
1–5	0.4%
6–8	0.65%
Over 8	0.9%

Katrina is paid $2452 per fortnight and she has worked for the company for 7 years.

a How much is Katrina's 'bonus'?

b Calculate the total amount that Katrina was paid for her 4 weeks' holiday, including the bonus.

9 Nate earns $640 per week. At the end of the year, he receives 5 weeks of annual leave with a 17.5% loading on 4 weeks. How much more does Nate get paid for taking 5 weeks' holidays than for working 5 weeks?

Spreadsheet
Holiday pay

10 Download the **Holiday pay** spreadsheet from Nelson MindTap to answer this question.

a Yasmin earns $11.25 per hour for a 35-hour week. If the annual leave loading increases from 17.5% to 22.5% of 4 weeks' pay, by how much will Yasmin's 4-week holiday pay increase?

b What spreadsheet formula could be used to determine the value of:

i normal pay for 1 week?

ii normal pay for 4 weeks?

iii leave loading for 4 weeks?

Skillsheets
Percentage calculations

Mental percentages

Worksheet
Earning money

1.5 Commission, piecework and royalties

Some workers are not paid according to the number of hours they work.

Commission, piecework and royalties

Salespeople are often paid by **commission**, which is a percentage of the value of the items they've sold.

Piecework is a type of work where a worker is paid per item produced or processed.

A **royalty** is a payment to an author, singer or artist for each copy of their work sold. Usually a royalty is a percentage of the total sales amount.

Profile

Photo courtesy of Sue Thomson

Sarina – artist

It's great to be able to work doing something you love, but it hasn't always been easy. In the beginning, as an unknown artist, I had to work nights as a waitress because my art didn't pay very much. If I sold the same painting now as I did 10 years ago I'd get a lot more money for it. My current work involves projects where people ask me to paint something specific, and my agent negotiates a fee. I also earn royalties when my artwork is used on commercial items like placemats, drink coasters, plates, cups, serviettes, calendars and T-shirts.

You can view some of Sarina's work at www.sarina.net.

EXAMPLE 8

Sarina receives a 5% royalty on the wholesale price of serviettes featuring her art. Packets of serviettes wholesale for $3.20 each. Calculate Sarina's royalty for the sale of 8000 packets of serviettes.

Steps	Working
Find the value of the serviettes sold.	wholesale value = 8000 × $3.20 = $25 600
Calculate the royalty.	Sarina's royalty = 5% of $25 600 = $1280

EXAMPLE 9

Jordan sells cars at a dealership. He is paid a $170 weekly retainer plus 5% commission on his weekly sales over $50 000. Calculate his pay for a week when his sales totalled $80 000.

A **retainer** is the amount of money a salesperson is paid that does not depend on their sales.

Steps	Working
Find the value of the sales for which he is paid commission.	sales over $50 000 = $80 000 − $50 000 = $30 000
Calculate the commission.	commission = 5% of $30 000 = $1500
total earnings = retainer + commission	total earnings = $170 + $1500 = $1670

EXAMPLE 10

Danielle earns commission for selling cosmetics at the following rates:

Commission on monthly sales	
First $1000 of sales	5%
On the next $2000	4%
Remainder of sales	3.5%

These different rates are sometimes called a 'sliding scale'.

This month, Danielle's sales totalled $5200. Calculate her commission.

Steps	Working
Danielle's commission on $5200 sales can be broken down into $1000 + $2000 + $2200.	
Calculate 5% of the first $1000.	commission on $1000 = 0.05 × $1000 = $50
Calculate 4% of the next $2000.	commission on $2000 = 0.04 × $2000 = $80
Calculate 3.5% of the remaining $2200.	commission on $2200 = 0.035 × $2200 = $77
Calculate the total commission.	Danielle's total commission = $50 + $80 + $77 = $207

EXAMPLE 11

Jan made some embroidered hand towels to sell at a street stall. To create this, she bought:

- 10 plain hand towels at $8.25 each.
- 8 metres of embroidery ribbon at 95 cents per metre.
- 2 skeins of embroidery thread at $1.95.

It took her $2\frac{1}{2}$ hours to make the towels and she values her time at $15 per hour.

How much should Jan charge for her towels?

Steps	Working
Calculate the total cost of materials. Write 95 cents as $0.95.	cost of materials = 10 × $8.25 + 8 × $0.95 + 2 × $1.95 = $94
Calculate the cost of labour.	cost of labour = 2.5 × $15 = $37.50
Calculate the total cost.	total cost = $94 + $37.50 = $131.50
Divide by the number of towels.	price of one towel = $131.50 ÷ 10 = $13.15
Round up to a sensible price.	Jan should charge $13.50 or $14 per towel.

EXERCISE 1.5 Commission, piecework and royalties

ANSWERS p. 406

1 Calculate each percentage amount.

a 9% of $25 000 **b** 5% of $800 **c** 2% of $300 000

d $2\frac{1}{2}$% of $500 000 **e** $3\frac{3}{4}$% of $175 200 **f** 0.95% of $60 000

2 Marco earns 7% commission on all his sales. Find his commission on a sale of $1675.

3 EXAMPLE 8 Sarina receives a 3% royalty on the wholesale price of calendars featuring her art. How much royalty will she receive for 15 500 calendars with a wholesale price of $9.90?

4 EXAMPLE 9 Assam sells window shutters and is paid a retainer of $120 per week to cover his expenses, and a commission of 15% of all sales he makes. Assam's sales for the first week in April totalled $2896. Calculate his pay for that week.

5 In her job as a real estate agent Lily is paid a retainer of $600 per month plus a commission of 2% of her sales over $800 000. How much did Lily earn for a month when her sales totalled $3 300 000?

6 EXAMPLE 10 Tanika sells cosmetics. She earns commission at the following rates.

Commission on monthly sales	
First $500 of sales	5%
On the next $1000	4%
Remainder of sales	3.5%

Calculate Tanika's commission for each of the following monthly sales.

a $360 **b** $1400 **c** $4200

7 Emily earns monthly commissions when she sells perfumes, according to these rates.

Monthly sales	Commission
$800	5% of sales
$801 to $1200	$40 plus 4.5% of sales over $800
$1201 and over	$58 plus 4% of sales over $1200

Calculate Emily's commission in a month when her total sales were valued at:

a $360 **b** $998 **c** $5100

8 Trevor told Monique that she required 6 m^2 of tiles for the kitchen walls, 48 m^2 of slate for the lounge room floor and 7 m^2 of slate for the stairs. How much will Trevor charge to lay the tiles and slate?

Trevor's Tiling Service
Bathrooms, Kitchens

All Quality Work

* Tiles $32 per m^2
* Slate $36 per m^2
* 25% extra for stairs

9 EXAMPLE 11 Ivana makes crystal pendants that she sells at the markets. To make 20 pendants it costs her:

- $48 for the crystals
- $55 for the chains
- $10 for the clasps

Ivana values her time at $18 per hour and it takes her 3 hours to make 20 pendants. What price should she charge for each pendant?

10 Holly enjoys cooking the scones she sells at the local Devonshire Tea shop. She buys her ingredients in bulk and it costs her $12 to make 5 dozen scones in 2 hours. She values her labour at $16 per hour. How much should Holly charge for making 10 dozen scones?

1 dozen = 12

11 Basam is selling his house for $720 000. The real estate agent's commission is 2% on the first $200 000 and 1.5% on the balance of the sale price. How much will Basam receive from the sale of his house?

12 Dagma writes books that sell for $56 each. Each year she receives 10% royalty on the first 4000 copies and 12.5% royalty on the remaining sales of her books. Calculate the royalty Dagma receives in a year when:

a 3650 copies of her books are sold

b 7000 copies of her books are sold.

13 Milan puts letters in envelopes and attaches postage stamps for a marketing company. He is paid 24 cents per letter. Milan can process 70 letters per hour.

a How much does Milan earn per hour?

b How much will he earn for processing 260 letters?

c How many letters does Milan need to process in order to earn over $100?

14 Renuta is a self-employed antique furniture auctioneer. On every item she sells, she charges 15% commission on the first $2000 of the sale price and 12.5% of the amount over $2000. How much will Renuta charge for selling an antique dining room suite that sold for $22 600?

15 Melissa receives a copyright payment to compensate her when people photocopy pages of books she has written. The payment rates are shown in the table.

Type of copies	Payment rate
Page of text	$7.86
Artistic work	$30.96
Digital images	$87.89

The copyright statement showed that 7258 pages of text, 60 artistic works and 12 digital images were copied. Melissa receives 30% of the copyright payment. The remainder goes to the books' publisher. Calculate the amount that Melissa and her publisher will receive from the copyright payment, correct to the nearest dollar.

16 The table shows the rates of royalty Sarina receives when her art is used on plates. The wholesale price of the plates is $3.40.

Number of plates sold	Royalty rate
First 2000	4% of the wholesale price
From 2001 to 10 000	$272 plus 3% of the wholesale price for the number of plates sold in excess of 2000
10 001 or more	$1088 plus 2.5% of the whole price for the number of plates sold in excess of 10 000

Calculate Sarina's royalty for the sale of the following numbers of plates.

a 1500 **b** 8600 **c** 25 000

Worksheet
Pay day

1.6 Gross pay and net pay

Everyone who's had a job knows that the amount of money they've earned isn't what they end up getting. Most workers pay income tax under the **PAYG** (Pay As You Go) system, where their employer estimates and takes out the tax from their **gross pay** before they give them their **net pay**. Some people have other amounts deducted from their pay, such as health insurance payments, superannuation contributions or union fees. What's left of their pay after tax and other deductions is called their 'take-home pay'.

Gross pay and net pay

Gross pay is the total amount earned.

net pay = gross pay – tax

take-home pay = gross pay – tax – other deductions

EXAMPLE 12

Chris earns $155 per shift in his part-time job stacking supermarket shelves late at night. He works 3 shifts per week and each fortnight his employer deducts $45.60 for PAYG tax.

a What is Chris' fortnightly gross pay?

b Calculate Chris' fortnightly net pay.

Steps	Working
a Chris works 3 × 2 = 6 shifts per fortnight.	gross pay = 6 × $155 = $930
b net pay = gross pay – tax	net pay = $930 – $45.60 = $884.40

EXERCISE 1.6 Gross pay and net pay

ANSWERS p. 406

1 EXAMPLE 12 Dylan earns $680 per week for working part-time and his employer deducts $84.50 for PAYG tax.

a Calculate Dylan's net weekly pay.

b How much PAYG tax does Dylan pay per year?

2 Complete the missing values in the table.

Gross weekly income	Weekly tax	Net weekly income
$720	$32	**a**
$860	**b**	$822
c	$75	$1100
$1258	$137	**d**
$1450	**e**	$1139

3 Sarah earns $17.65 per hour for a 35-hour week. Each week she has $54 deducted from her pay for PAYG tax and $11 for health insurance.

a How much does Sarah earn per week?

b Calculate Sarah's weekly take-home pay.

4 Grant's annual tax bill is $9704. How much tax should he pay per week to cover his annual bill?

5 Aisha's gross salary is $80 000 and she calculated that her annual tax bill is $17 547. She is paid fortnightly.

a How much PAYG tax should Aisha pay each fortnight?

b Calculate her fortnightly net pay to the nearest dollar.

6 Juan's PAYG payment summary from his employer showed that he paid $5845 in PAYG tax last year. His gross annual salary was $35 700.

a How much PAYG tax was deducted from Jamie's pay per week?

b What was his net weekly pay to the nearest dollar.

7 Boun is a junior barrister in a city law firm. His gross fortnightly pay is $3692 and his net fortnightly pay is $2656. How much tax is deducted from Boun's pay each year?

1.7 Taxable income and tax refunds

Running a country is an expensive business. The Australian Government provides the community with public healthcare, social services, border security, education, highways and much more. **Income tax** is one of the taxes the government uses to pay for these things.

PAYG tax is deducted from your pay and is only an estimate of the income tax you need to pay. The actual amount of tax that you're supposed to pay is calculated at the end of the financial year (30 June) and is based on your total income over the previous 12 months.

After 30 June, you are required to complete a tax return to tell the Australian Tax Office (ATO) how much money you've earned and how much PAYG tax you've paid. The ATO then calculates the actual income tax payable and decides whether you've paid too much tax or not enough. If you've paid too much, you will receive a tax refund. If you haven't paid enough, you will be sent a bill to pay the tax debt.

If you donate some of your income to charities or spend it on work-related items and activities, then you do not have to pay tax on those amounts. These amounts are 'tax deductible' and are called **allowable tax deductions**. We deduct these amounts from our annual income and then income tax is calculated on the remaining amount, called our taxable income.

Taxable income

taxable income = total income – allowable deductions

EXAMPLE 13

Last financial year, Rowan's gross salary was $65 000 and he earned $420 in interest from his bank account. He had allowable tax deductions of his $290 union membership fees and an $80 donation to the RSPCA. How much is Rowan's taxable income?

Steps	Working
total income = gross salary + bank interest	total income = $65 000 + $420 = $65 420
Find total tax deductions.	deductions = $290 + $80 = $370
taxable income = total income – deductions	taxable income = $65 420 – $370 = $65 050

EXAMPLE 14

Last financial year, Rowan paid $302 each week in PAYG tax instalments. The tax office calculates that on an income of $65 050 his income tax should be $15 095. Will Rowan receive a tax refund or a tax debt? How much?

Steps	Working
Calculate the total PAYG tax paid. 52 weeks in one year.	PAYG tax paid = $302 × 52 = $15 704
Compare this to the amount Rowan has to pay ($15 095).	Rowan has paid too much tax ($15 704 > $15 095). The tax office will send him a refund.
Calculate the difference to find the refund.	tax refund = $15 704 – $15 095 = $609

EXERCISE 1.7 Taxable income and tax refunds

ANSWERS p. 406

1 EXAMPLE 13 Nabil's gross annual pay is $89 600 and he earns $1280 in bank interest. He has the following allowable deductions:

- trade tools $370
- mobile phone $413
- home office equipment $177

a Calculate Nabil's gross annual income.

b How much is Nabil's taxable income?

2 Last year, Sandy paid $11 865 in PAYG tax. The tax office informed Sandy that the tax on her taxable income is $11 450. How much will Sandy receive as a tax refund?

3 Madeleine's net pay is $1190 per week and her weekly gross pay is $1495.

a How much does Madeleine pay in PAYG tax each week?

b Madeleine's income tax payable is $15 732.50. Will she receive a tax refund or a tax bill? What amount is involved?

4 Every fortnight, Sunny earns $2729.15 in net pay after paying $770.85 in PAYG tax.

a Calculate his gross fortnightly pay.

b What is Sunny's annual gross pay?

c Sunny's income tax payable is $20 042. Will he receive a refund or a bill? Justify your answer.

5 EXAMPLE 14 Abdul earns $1406 per week working part time. During the year he paid $160 in union fees and $65 in work-related expenses.

a Calculate Abdul's gross annual income.

b What is his annual taxable income?

c Each week Abdul paid $293 in PAYG tax. How much tax did Abdul pay during the year?

d The tax office calculated that Abdul's income tax was $14 155.28. Will Abdul receive a refund or will he have to pay more tax? How much?

6 Mrs Durham pays $478.20 PAYG tax every week. At the end of the year, the Australian Taxation Office (ATO) calculated that the actual tax she was required to pay was $24 920. Did she receive a refund or did she have to pay more tax?

7 Peter's salary was $127 500 and he earned $1965.20 from his shares. His allowable taxation deductions were conference fees of $310 and a donation of $60 to the Salvation Army. How much was his taxable income?

8 Each week, Gianna earned $2235 and paid $550.18 in PAYG tax. Her work-related travelling expenses of $199 were tax deductible.

a Calculate Gianna's gross annual income.

b How much PAYG tax did she pay for the year?

c How much was her annual taxable income?

d The ATO calculated Gianna's tax to be $28 173.83. Did she receive a refund? Explain your answer.

Video
Income tax

Worksheets
Income tax tables

Income tax and Medicare levy

1.8 Income tax and Medicare levy

How does the Australian Tax Office calculate your income tax? It uses a sliding scale depending on the size of your taxable income. This table shows the tax rates for different income brackets.

Taxable income	Tax on this income
Up to $18 200	Nil
$18 201 to $45 000	19c for each $1 above $18 200
$45 001 to $120 000	$5092 + 32.5c for each $1 above $45 000
$120 001 to $180 000	$29 467 + 37c for each $1 above $120 000
$180 001 and over	$51 667 + 45c for each $1 over $180 000

EXAMPLE 15

Calculate the tax payable on each taxable income.

a $35 200

b $76 835

c $213 450

Steps	Working
a $35 200 is in the range $18 201 to $45 000. tax = 19c for each $1 over $18 200 (which means 19% or 0.19)	tax = 0.19 × ($35 200 − $18 200) = $3230
b $76 835 is in the range $45 001 to $120 000. tax = $5092 + 32.5c for each $1 above $45 000 (which means 32.5% or 0.325)	tax = $5092 + 0.325 × ($76 835 − $45 000) = $15 438.38
c $213 450 is in the range $180 001 and over. tax = $51 667 plus 45c for each $1 over $180 000 (which means 45% or 0.45)	tax = $51 667 + 0.45 × ($213 450 − $180 000) = $66 719.50

There is also a tax that goes towards funding Medicare, the public health system, called the **Medicare levy**. For most people, the Medicare levy is 2% of their taxable income. Higher income earners who do not have private health insurance are charged a higher Medicare levy.

Medicare levy on annual taxable income

		Higher income with no private health insurance		
	Basic	Tier 1	Tier 2	Tier 3
Singles	$23 226 – $90 000	$90 001 – $105 000	$105 001 – $140 000	$140 001 or more
Families	$36 705 – $180 000	$180 001 – $210 000	$210 001 – $280 000	$280 001 or more
Medicare levy	2%	3%	3.25%	3.5%

EXAMPLE 16

Liam's taxable income is $124 500 and he has private health insurance.

a Calculate his Medicare levy.

b How much more would his Medicare levy be if he didn't have health insurance?

Steps	Working
a Liam has health insurance, so his Medicare levy is 2% or 0.02.	Medicare levy = 0.02 × $124 500 = $2490
b Without health insurance Liam's Medicare levy would be 3.25% or 0.0325.	Medicare levy = 0.0325 × $124 500 = $4046.25
Calculate the difference.	difference = $4046.25 – $2490 = $1556.25

EXAMPLE 17

Declan works as a shop fitter. His gross income this year will be $63 240 and he will receive $210 interest from the bank. His allowable tax deductions will be $410 union fees, a $100 donation to the Red Cross and $2200 for the cost of tools and equipment he bought to use in his job. During the year he paid $12 540 in PAYG tax.

a Calculate:

- **i** Declan's total income
- **ii** his total deductions
- **iii** his taxable income
- **iv** the tax Declan should pay on his taxable income
- **v** his Medicare levy.

b Will Declan receive a refund from the tax office? If yes, how much? If no, how much more tax will he have to pay?

Steps	Working
a i total income = pay + bank interest	total income = $63 240 + $210 = $63 450
ii deductions are union fees, Red Cross donation and cost of tools and equipment.	total deductions = $410 + $100 + $2200 = $2710
iii taxable income = total income – allowable deductions	taxable income = $63 450 – $2710 = $60 740
iv The tax rate for Declan's income is $5092 + 32.5 c for each dollar above $45 000.	tax = $5092 + 0.325 × ($60 740 – $45 000) = $10 207.50
v Declan's Medicare levy is 2%.	Medicare levy = 0.02 × $60 740 = $1214.80
b Compare the amount Declan paid in PAYG tax to the sum of the tax and Medicare levy.	tax + Medicare levy = $10 207.50 + $1214.80 = $11 422.30
Declan paid $12 540 in PAYG tax, which is more than he needed to pay. He will get a tax refund.	Declan's tax refund = $12 540 – $11 422.30 = $1117.70

EXERCISE 1.8 Income tax and Medicare levy

ANSWERS p. 407

1 EXAMPLE 15 Use the income tax table on page 22 to calculate the tax payable on each taxable income. Round each answer to the nearest dollar.

a $23 780 **b** $97 342 **c** $166 400

d $221 400 **e** $15 450 **f** $72 345

2 EXAMPLE 16 Calculate the Medicare levy on each taxable income.

a $72 300

b $104 600 (single person without health insurance)

c $145 000 (single person with health insurance)

3 EXAMPLE 17 Terry works part time in a golf pro shop. His taxable income is $78 900.

a Calculate the amount of tax he is required to pay.

b What is his Medicare levy?

c His employer deducted $15 467 in PAYG tax. Will Terry receive a refund from the tax office?

4 Chantelle is a signwriter. Her weekly taxable income is $1659.

a How much is Chantelle's annual taxable income, rounded down to the nearest dollar?

b How much tax should she pay each year?

c What is her Medicare levy?

d How much tax should her employer deduct from her pay each week?

5 Dom's commission on book sales totalled $89 400 last year. The total value of his allowable deductions was $895. During the year, Dom paid a total of $19 900 in PAYG tax instalments. Will he receive a tax refund? Use calculations to justify your answer and remember to include his Medicare levy.

6 Kelly is a nursing supervisor. After she received a $1600 pay rise, her annual salary became $105 400. How much of her $1600 pay rise was she required to pay in extra tax? Kelly has private health insurance.

7 Last year, Eliza's gross weekly pay was $1720 and she received $523 in bank interest. Her allowable tax deductions totalled $1832.

a What was Eliza's taxable income?

b Calculate the amount of tax and Medicare levy she has to pay.

c Each week $473 was deducted from Eliza's pay under the PAYG system. How much was her tax refund?

8 Paul's taxable income is $64 000 and his friend Garth's taxable income is $128 000. Garth said to Paul, 'Because I earn twice as much as you, I pay twice as much tax as you do'. Is Garth right? Justify your answer.

9 Som earned $87 420 last year from his full-time job as a carpenter. He also earned an additional $29 842 from private jobs. His work-related deductions totalled $1350.

a How much did Som have to pay last year in tax and Medicare levy if he has private health insurance?

b Som's full-time job employer deducted a total of $19 720 in PAYG tax. How much extra will Sam have to pay the tax office, correct to the nearest dollar?

10 Because Jay is a low-income earner without health insurance, his Medicare levy was only $960. What was Jay's taxable income?

11 Taylor owns a townhouse. Her tenant pays $760 per week rent. Last year Taylor's expenses were:

Agent management fee = 7% of the rent collected

Postage and administration = $9 per month

Yearly insurance premium = $512

Council and water rates = $925

Maintenance levy = $370 per quarter

a Calculate the annual rent collected from Taylor's townhouse.

b All Taylor's expenses involved in owning the townhouse are allowable tax deductions. Calculate the total amount Taylor can claim as allowable deductions for the townhouse.

c Taylor's annual gross income from her job was $109 340 and she had no further deductions. Calculate her total taxable income.

d How much was Taylor's tax and Medicare levy assuming that she is single and has no private health insurance?

1.9 Superannuation

How do people have enough income to pay for essential items and enjoy life when they retire? Things like cars and holidays can be very expensive and the government's Age Pension isn't enough to pay for luxuries.

Superannuation is a compulsory savings scheme that occurs while we're working to pay for our retirement years. Our employers invest 12% of our pay into our superannuation fund and we can make additional payments into the account if we want to. These payments are called contributions and they can be an allowable tax deduction.

If you are reading this before July 2025, the employer's contribution rate will be a little lower than 12%. Check the ATO website for the current rate.

You can choose and keep track of your superannuation account. The fees charged and the type of investment selected for your account both make a big difference to the long-term value of your funds. Except in unusual circumstances, your superannuation money must remain in the account until you reach retirement age.

EXAMPLE 18

Lorna's annual pay is $56 000 and her employer invests 12% of her pay into her superannuation account. The employer makes the payments **quarterly**.

a How much does Lorna's employer pay into her account each quarter?

b Contributions to superannuation are taxed at 15%. How much of Lorna's quarterly superannuation payment remains in her account after tax?

Steps	Working
a Calculate 12% of $56 000 to determine the annual superannuation amount.	annual superannuation = 0.12 × $56 000 = $6720
For the quarterly amount, divide the annual amount by 4.	quarterly payment = $6720 ÷ 4 = $1680
b The contribution tax is 15%.	contribution tax = 0.15 × $1680 = $252
Subtract the tax.	amount remaining after tax = $1680 – $252 = $1428

EXERCISE 1.9 Superannuation

ANSWERS p. 407

1 Calculate each amount.

a 12% of $58 500 **b** 12% of $63 724 **c** 12% of $75 000

d 15% of $5680 **e** 15% of $8255 **f** 15% of $24 567

For Questions 2 to 5, use an employer contribution rate of 12%.

2 EXAMPLE 18 Kayla's annual pay is $98 400.

a How much does Kayla's employer contribute to her superannuation annually?

b Calculate the employer's quarterly contribution.

c Calculate the annual value of the 15% contribution tax withdrawn from Kayla's account.

d Calculate the annual net value of the superannuation paid into Kayla's account.

3 Rod's salary is $82 400.

a How much does his employer pay into Rod's superannuation account annually?

b Calculate the annual value of his superannuation contribution tax.

4 Cathy works part-time and she earns $825 per week.

a Calculate the annual superannuation payment her employer is required to make for her.

b What is the net annual value of Cathy's superannuation contribution?

5 Kate is a high-income earner. Her annual salary is $263K.

a How much contribution tax is charged on her employer's annual superannuation contribution?

b Calculate the net amount paid into Kate's superannuation annually.

c Kate received a 10% pay increase. Calculate her new annual employer superannuation contribution.

d When an annual superannuation contribution exceeds $27 500K, the entire contribution is taxed at 30%. Calculate the annual superannuation contribution tax for Kate's new salary.

e Calculate the net amount paid into Kate's superannuation account annually following her pay rise.

f How much less is Kate's net superannuation contribution following her pay rise?

Weblink
MoneySmart

For the rest of this exercise, use the online superannuation calculator on the **MoneySmart** website. You can find the calculator by selecting **Tools and resources**.

6 Predict the retirement value of Sanjeev's superannuation account by entering the following information into the superannuation calculator.

Age: 25

Income: $90 000

Retirement age: 67

Superannuation balance: $15 000

Employer contribution: 12%

No additional contributions

Fund fees: Default

Investment options: Default

7 Virat is Sanjeev's twin brother. His information is identical except that his salary is $100K. How much more is the value of Virat's projected retirement superannuation balance?

8 The final value of an account is affected by many factors, including:

- the age of the person when they started contributing
- the person's annual pay
- whether the person makes additional contributions
- the superannuation fund's fees and charges
- the types of investment the super fund takes
- variations in the stock market locally and globally

Keep all of Sanjeev's information the same as in question **6**. Scroll down to **Fund Fees** and select **other**. Leave investment at default.

a Reduce the fee from $74 to $50. What effect did this have?

b Increase the fee to $100. What effect did this have?

c What conclusion can you make about the effects of the fee?

Now reset the fund fees to default and select **other** for investment. Leave the investment returns and tax on earnings at 7.5% and 7% respectively.

d Reduce the investment fee from 0.85% to 0.5%. How does this affect the final value?

e Predict the effect of increasing the investment fee to 1%. How accurate was your prediction?

9 In most superannuation accounts the owner can choose the type of investment strategy. Scroll down to **Choosing a super fund** at the bottom of the page, then **Investment options**. Which option (from Growth, Balanced, Conservative, Cash):

a aims for high earnings but risks big losses in some years?

b aims to keep the value of the investment without any losses but the returns are low?

c aims for a small chance of losses but the returns are only moderate?

Investigations

You are required to complete some investigations in the Foundation Mathematics course.

This diagram shows the 3 components of an investigation. You can also download **Investigation components** from Nelson MindTap.

Worksheet
Investigation components

Components of an investigation

1. Formulation
- What is the investigation about?
- What do you know?
- What tools can you use?
- What extra information do you need?

→

2. Exploration
- Make calculations.
- Summarise results systematically, for example in a table, graph or spreadsheet.
- Consider your results:
  - Do they make sense?
  - Is there a pattern?
- Make a conjecture.
- Test your conjecture.

→

3. Communication
- Describe what you did.
- Summarise your results.
- Explain your conclusions.

There are many different ways to approach an investigation. You and your friends may take very different approaches and they can all be correct!

The extended investigations in this book can be adapted into assessment tasks and projects.

Extended investigation | Accessing superannuation early

During the COVID-19 pandemic, the Australian Government allowed people who were experiencing financial hardship to withdraw up to $10 000 prematurely from their superannuation account. How could withdrawing $10 000 in 2020 affect the amount a person has in their account when they retire?

1 Formulation

Each question or statement in the left column matches to a component of formulation in the right column.
Match each item from **a** to **g** with a component **A**, **B**, **C** or **D**.

Questions and statements	Components of formulation
a The maximum withdrawal is $10 000.	**A** What is the scenario about?
b We could use the superannuation calculator on the **MoneySmart** website.	**B** What do we know?
c How old is the person making the withdrawal?	**C** What tools can we use?
d We need to work out the long-term effects of making an early withdrawal from superannuation.	**D** What extra information do we need?
e What is the account balance of the person making the withdrawal?	
f Only people who are experiencing financial hardship can make the withdrawal.	
g What is the annual wage or salary of the person making the withdrawal?	

2 Exploration

a We need to make some assumptions. Here is one set of assumptions. Only the current ages (in years) are different so that we can see the effect of changing the age.

	Age now	Income	Retire age	Current balance
Ben	24	$62K	67	$20K
Allyssa	35	$62K	67	$20K
Kim	45	$62K	67	$20K

Construct a similar table, keeping everything the same except the current account balance. Keep this table to use in again in part **e**.

b Extend the table above and start exploring by completing the values in the last 3 columns.

	Age now	Income	Retire age	Current balance	Balance at retirement	Balance at retirement if $10 000 withdrawn	Reduction in balance
Ben	24	$62K	67	$20K			
Allyssa	35	$62K	67	$20K			
Kim	45	$62K	67	$20K			

c Look at the results. What is happening? Make a conjecture.

A **conjecture** is a theory or idea that you think might be true.

d Complete another table with a different value for the income, but leave the other columns the same.
Check your conjecture. Is it still true?

e Use the table you constructed in part **a**. Complete the 3 additional columns as in part **b**.
Is your conjecture still true?

f Think about the patterns you've observed. It could be interesting to consider the effect of withdrawing $10 000 as a percentage of what the balance of the account at retirement would have been without the withdrawal. Add an extra column to the right of the tables for the percentage.

$$\text{percentage reduction} = \frac{\text{actual reduction}}{\text{balance without the withdrawal}} \times 100\%$$

g Compare the percentages. What pattern can you see?

3 Communication

Prepare your report. Include:

- a description of what you did
- a summary of your results
- the conclusions you reached.

A sample solution can be found on page 407.

Extended investigation | Extra superannuation payments

You can make voluntary contributions to your superannuation account but the total amount contributed in any year must not be more than $27 500. This includes any employer contributions.

Miriam, aged 22, won $20 000 in a TV quiz show. She is considering putting as much of it as she can into her superannuation account. Her current annual pay is $60 000. How much of the $20 000 can she contribute to superannuation this year and how will it affect her retirement balance?

Hints

- How much will Miriam's employer contribute to her superannuation?
- Subtract the amount the employer pays from the maximum amount allowed ($27 500).
- Make an assumption about the current value of Miriam's account and add the extra contribution to it. Use the superannuation calculator on the **MoneySmart** website to investigate the value when Miriam is 67, with and without the additional contribution.

Puzzle
Earning and taxation crossword

Keyword activity

CHAPTER SUMMARY

ANSWERS p. 408

The keywords from this chapter are missing in the following chapter summary. Read through the chapter and locate the missing words.

allowance	annual	annual leave loading	bonus	deductions
double	financial	fixed	income	levy
overtime	Pay As You Go	percentage	refund	retirement
royalties	schools	social	superannuation	tax
wage	week			

There are many different ways to earn an income. Most people earn a $_1$ _____ per hour, but some people earn an $_2$ _____ amount called a salary. Only people who earn a wage get paid for extra hours for $_3$ _____, which can be paid at time-and-a-half or double time. When a worker is paid at double time they are paid for $_4$ _____ the hours they worked. People who work in difficult or dirty places can be paid an additional $_5$ _____ while some employers pay hardworking or successful employees a $_6$ _____.

People who are paid a commission receive a $_7$ _____ of the value of the items they sell, or in the case of artists, make. Sometimes they also receive a retainer, which is a $_8$ _____amount before they make any sales. Creative people, such as artists, musicians and authors, receive $_9$ _____ for their work.

Permanent workers are paid more during annual holidays. They receive an $_{10}$ _____ of 17.5% of 4 weeks' pay. Employers also contribute 12% of an employee's pay into their $_{11}$ _____ account to help provide money for their $_{12}$ _____.

The Government collects taxes to pay for public facilities and services for the community, such as hospitals, $_{13}$ _____, roads, public transport and $_{14}$ _____ services.

Income tax is charged on your taxable $_{15}$ _____, which is your total income minus your allowable $_{16}$ _____. Medicare $_{17}$ _____ is a tax that funds our public healthcare system. Each $_{18}$ _____, fortnight or month when employees receive their pay, the tax has already been taken out as part of the $_{19}$ _____ (PAYG) system.

At the end of the $_{20}$ _____ year individuals complete a taxation return to inform the Government about the income they have earned and the $_{21}$ _____ they have paid. If they have paid too much tax, the Government gives them a tax $_{22}$ _____, but if they haven't paid enough they will receive a tax bill for more.

Solution to the chapter problem

Problem

Alvin works at a large hardware store and his wage is $24.60 per hour. He also has a truck licence and sometimes he drives a 10-tonne vehicle to make pick-ups and deliveries.

When licensed employees are required to drive a heavy vehicle, they must be paid an extra 5% per hour.

In the week ending 20 April, Alvin worked in the store for 24 hours and drove the truck for 6 hours. His payslip is shown here:

Employee: A. Styles	Week ending 20 April	
24 hours store	24 × $24.60	$590.40
6 hours truck driving	6 × 0.05 × $24.60	$7.38
	Gross pay	**$597.78**

Alvin thinks his gross pay for the week ending 20 April is wrong. Is there an error?

Solution

The pay for the truck driving is wrong. It should be ($24.60 + 5% × $24.60) per hour, but the payslip shows only (5% × $24.60) per hour.

pay per hour for truck driving = $24.60 + 0.05 × $24.60
= $25.83

Alvin's total pay = 24 × $24.60 + 6 × $25.83
= $745.38

1 Test yourself

Earning money

ANSWERS p. 408

1 EXERCISE 1.1 Shelly earns $18.75 per hour for a 35-hour week.

a How much does Shelly earn per week?

b Calculate the amount she earns per fortnight.

c What is Shelly's annual pay to the nearest dollar?

2 EXERCISE 1.1 Marcus is an accountant. His annual salary is $96 000.

a How much does Marcus earn per month?

b Calculate Marcus' fortnightly pay to the nearest dollar.

3 EXERCISE 1.2 Su-yin works in an aged-care facility. Her normal pay is $20.24 per hour.

a How much does she earn per hour when she works at time-and-a-half?

b When Su-yin works the night shift on weekends, she is paid double time. Calculate her pay for working 7 hours on the late shift on a Saturday night.

4 EXERCISE 1.2 George earned $168 for working 4 hours at double time. Calculate George's normal rate of pay.

5 EXERCISE 1.3 Jamie is a plumber's assistant. His normal pay is $15.65 per hour, but when he has to work in wet or muddy conditions he receives a $2.10 allowance per hour. Jamie worked 7 hours today and for 3 of the hours he was digging in mud. Calculate Jamie's pay for today.

6 EXERCISE 1.3 Zoe is a plumber. For emergency late-night work, she charges a callout fee of $500 and labour at $125 per hour. Last night she attended an emergency call at 2 am. Calculate the amount she charges for working for 3 hours to fix the problem.

7 EXERCISE 1.4 Nuala is employed as an early childhood music teacher. Her normal weekly pay is $1325. Calculate her holiday pay for a 4-week holiday including a 17.5% leave loading.

8 EXERCISE 1.5 Izak's artwork features on wall posters. He receives 5% commission on the sale of each poster. How much commission will Izak receive from the sale of 18 000 posters priced at $45 each?

9 EXERCISE 1.5 Luke lays tiles for a living. He charges $46 per square metre of tiles he lays. How much will Luke charge for laying 17 square metres of tiles?

10 EXERCISE 1.6 Anastacia earns $870 per week and her employer deducts $124 for PAYG tax. What is her net weekly pay?

11 EXERCISE 1.7 Mrs Baily pays $231.20 PAYG tax every week. At the end of the year the ATO calculated that her income tax was $10 950. Did she receive a tax refund or did she have to pay more tax?

9780170448123

12 EXERCISE 1.8 Brett's total annual income is $88 240 and he has allowable deductions totalling $3530.

a Calculate his taxable income.

b Use the income tax table to calculate how much income tax Brett must pay.

Taxable income	Tax on this income
Up to $18 200	Nil
$18 201 to $45 000	19c for each $1 above $18 200
$45 001 to $120 000	$5092 + 32.5c for each $1 above $45 000
$120 001 to $180 000	$29 467 + 37c for each $1 above $120 000
$180 001 and over	$51 667 + 45c for each $1 over $180 000

13 EXERCISE 1.9 Bella earns $84 500 annually and her employer pays 12% of her annual pay into superannuation. What is the value of Bella's employer's annual superannuation contribution?

Chapter problem

Lyndel works at a café. When customers pay in cash, she always estimates the change before using the cash register. For this payment, she thinks there is something wrong with the register. It says that she has to give out more than $5000 in change. What could be wrong?

*** ORDER 140 ***

SALAD CAESER WITH CHICKEN* GF OPTION	$17.90
vietnamese chicken salad* GF OPTION	$18.50
Decorated gingerbread man*	$5.00
Turmeric Latte* 2 @ $5.00 ea	$10.00
TOTAL	$51.40
GST Subtotal	$51.40
GST Amount	$4.67
CASH	$5,150.00
Change	$5,098.60

CHAPTER 2

ALGEBRA, NUMBER AND STRUCTURE

WHAT'S THE SCORE?

2.1 Target practice
2.2 Playing darts
2.3 Negative scores
2.4 Order of operations
2.5 How much do I pay?
2.6 Estimating costs
2.7 Rounding decimals
2.8 Rounding up when buying materials
Extended investigation: Melanie's grand idea
2.9 After the point
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Calculate with numbers, including negative numbers and decimals
- Add, subtract, multiply and divide using order of operations, with and without a calculator
- Estimate and check the reasonableness of answers
- Understand place value after the decimal point
- Round numbers to decimal places
- Solve practical problems involving numbers

How are we ever going to use this?

- Keeping score in sporting events
- Shopping
- At work
- Budgeting: for yourself or for a party
- Home renovations

Study Design coverage

UNIT 1, AREA OF STUDY 1: ALGEBRA, NUMBER AND STRUCTURE

- applications of integers and decimals, their properties and related operations
- estimation, approximation and reasonableness of calculations and results.

VCE Mathematics Study Design 2023–2027 p. 13, © VCAA 2022

Video (1):
2.4 Order of operations

Worksheets (2):
2.3 Positive and negative numbers
2.6 Estimating and rounding

Puzzle (1):
2.4 Order of operations

Nelson MindTap

To access resources above, visit
cengage.com.au/nelsonmindtap

2.1 Target practice

Getty Images/E+

Alan coaches a junior football team. He designed a ball-passing competition to help his players improve the accuracy of their passes. Each player handballs a football at the target 2 times each turn. The first player to reach 100 points is the winner.

The 2 red crosses on the diagram show where Marc's first 2 handballs landed. One handball landed in **double 6** and the other in **8**.

$$\begin{aligned}\text{Marc's score} &= 2 \times 6 + 8 \\ &= 12 + 8 \\ &= 20\end{aligned}$$

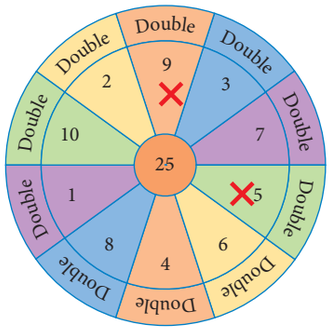
EXERCISE 2.1 Target practice

ANSWERS p. 409

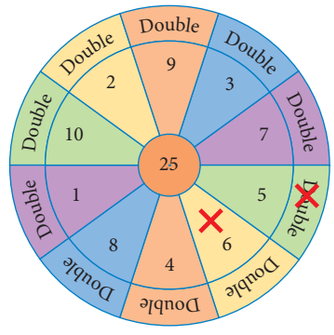
Refer to Alan's handball target to answer the following questions.

1 Without using a calculator, work out the scores for each turn.

a

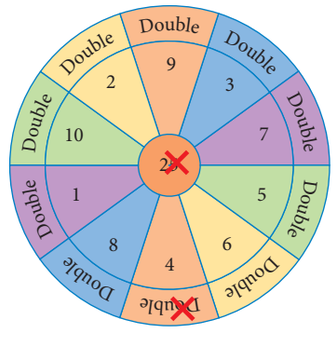


b



c

d



2 Add each set of scores as quickly as you can.

a 7 and 9 **b** double 5 and 8 **c** double 6 and double 4

d double 9 and double 5 **e** bullseye and double 10 **f** 3 and double 7

3 Jason's score from 2 handballs was 13. Suggest 5 different combinations of points that can make a score of 13.

4 How many different ways can you get a score of 7 from 2 handballs? List the ways.

5 To win the game, a player's score must add to exactly 100. David's score is 77.

a How many more points does David need to score to win?

b What strategy can David use to win on his next turn?

6 What is the smallest number of handballs required to make a total of exactly 100? How is it achieved?

7 Courtney's score is 81. She decided to aim for a 9 and a 10. With her first handball, Courtney missed the 9 and her ball landed on 3. How can she still make 100 on her second throw?

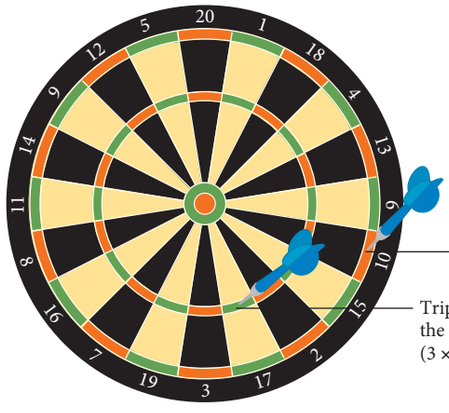
8 When Alan designed the positions of the numbers on the target, he didn't put any big numbers next to each other. He put small numbers on each side of the big numbers. Why do you think Alan arranged the numbers in this way?

Practical activity Design a practice competition

What you have to do

1. Design a practice competition to develop the skills of children learning to play a sporting game that you enjoy.
2. Determine the rules and how you will score the game.
3. Use the practice competition with some younger children in your area.
4. How successful was the competition in developing the children's skills?
5. Did the scoring help to improve the children's number skills?

2.2 Playing darts



There are 20 numbers on a dartboard and each player throws 3 darts on their turn.

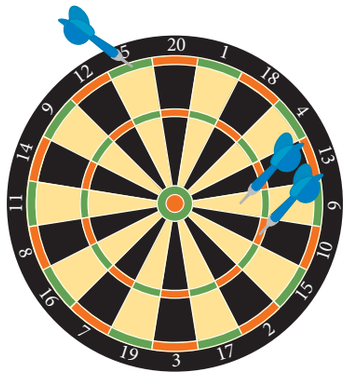
- Players score the number of points marked on the section in which the dart lands.
- If a dart lands in the **outside ring**, the player scores **double points**.
- If a dart lands in the **inside ring**, the player scores **triple points**.
- The **bullseye** is worth 50 points.
- The green ring around the bullseye is worth 25 points.

EXERCISE 2.2 Playing darts

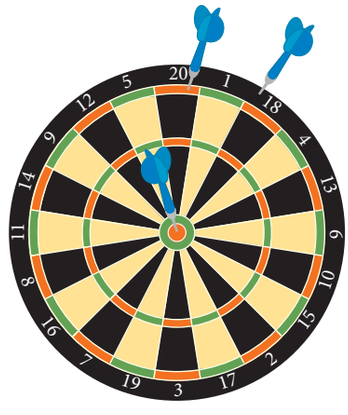
ANSWERS p. 409

1 Calculate the score for each player.

a



b



2 What is the highest score possible with 3 darts?

3 How can you score a total of 37 using 3 darts? Suggest 2 possible ways.

In the dart game '201', players start with 201 points and they keep subtracting the points they score with 3 darts. The winner is the first to reach 0, but they must finish with a double. If a player's score on one turn is more than their remaining points, *no* points are subtracted for that turn. Use the rules of the game to answer the rest of the questions in this exercise.

4 With her first set of 3 darts, Madeleine scored a 7, a double 5 and a triple 11.
How many points did Madeleine have left after this?

5 After the second round, Tim had 152 points left and Rebecca had 147. Who is winning the game: Tim or Rebecca?

6 Fliss had 126 points remaining before her turn. After her turn, she had 103 points. One of her darts landed on double 1 and another on 5. Where could her third dart have landed?

7 Divya's score was 86. She threw 2 double 20s and a triple 19. What was Divya's score after her turn?

8 Before he had his turn, Santo had 136 points remaining. His first dart landed on 20, his second landed on triple 4 and his third missed the board. How many points did Santo have left after his turn?

9 Andre needs to score 34 points, finishing with a double, to win a game of 201. How could he win using:
a 1 dart? **b** 2 darts? **c** 3 darts?

10 What is the largest number of points a player can have and still win on their next turn? Explain your answer.

11 Renata and Samantha are playing 201, writing their progress scores on a board.

Turn	Renata	Samantha
	~~201~~	~~201~~
1	~~162~~	~~175~~
2	~~102~~	~~143~~
3	~~63~~	~~85~~
4	~~39~~	~~55~~
5	~~24~~	29
6	0	

a In what number turn did Samantha score a total of 30 points?
b Who threw 20 three times in the same turn? In which turn did she do it?
c What was Samantha's biggest score in one turn?
d In which turn did Samantha throw a double 3, triple 2 and single 20?
e Renata finished when she threw a double 7. Explain how it was possible for her to finish with a double 7.
f Samantha can tie the game if she can score a total of 29, finishing with a double. Explain why Samantha will need more than one throw to score 29.
g What strategy do you suggest for Samantha to try to tie the game?

Worksheet
Positive and negative numbers

2.3 Negative scores

Integers are positive and negative whole numbers and zero.

Scores in golf and indoor cricket both make use of **negative numbers**. In golf, a negative number is a good score, but in indoor cricket it's a bad score.

In golf, each hit of the golf ball is called a **stroke**. The course rating is called 'par', meaning average score. If a golfer's score is –2, it means that she took 2 fewer strokes than the course rating to complete her game. If an indoor cricketer's score is –2, it means that he lost 2 more runs than he scored.

Golf has a language of its own.
- A 'birdie' is 1 stroke under par, or –1.
- An 'eagle' is 2 strokes under par, or –2.
- An 'albatross' is 3 strokes under par, or –3.
- A 'bogie' is 1 stroke over par, or +1.
- A 'double-bogie' is 2 strokes over par, or +2.

EXAMPLE 1

Jake and Megan played very well in a golf championship. Jake finished with a score of –2 and Megan's score was –3.

a What do scores of –2 and –3 mean?

b Did Jake or Megan play the better game? Explain your answer.

Shutterstock.com/ESB Professional

Steps	Working
a In golf, negative scores are good scores. Every 1 negative number means 1 better than the course rating.	–2 means 2 strokes better than the course rating, and –3 means 3 strokes better.
b In golf, –3 is a better score than –2.	Megan played the better game. Her score of –3 is lower than Jake's score of –2.

EXERCISE 2.3 Negative scores

ANSWERS p. 409

1 EXAMPLE 1 Angelo and Brett are playing golf. Angelo's score is +2 and Brett's score is –1. Who is winning the game?

Remember that a negative golf score tells you how many strokes below the course rating a player took to complete the course.

2 Last week, Darren's golf score was +3. Today, his score was 4 strokes better. What was Darren's score today?

3 This sign shows the leaderboard at the end of a golf tournament. Par, or the course rating, is 72 strokes.

Leader board

Alan Best	4
Heather Long	–1
John Wynn	–2

a How many strokes did John take to complete the course?

b How many more strokes did Alan take than Heather?

4 Shari is going snow skiing.

a What does a temperature of −10°C mean?

b Which temperature is the coldest: 5°C, −4°C or 0°C?

c The minimum temperature on the ski fields today was −3°C. Tomorrow's forecast minimum temperature will be 4°C colder than today. What minimum temperature is forecast for tomorrow?

d At lunchtime, the temperature was −7°C. The temperature went up 2°C between lunch and afternoon tea. What was the temperature at afternoon tea time?

5 In indoor cricket, batters score runs by hitting the ball into specially marked zones and by running between the batting and running creases. Every time a batter is given out, 5 runs are deducted from the score, but the batter continues with their innings.

a Jesinta scored 8 runs and was given out twice. What was her final score?

b Shane scored 46 runs but his final score was only 31. How many times was he given out?

c Grant and Mark are batting together. Here are their statistics.

Batter	Zone A 1 run hits	Zone B 2 run hits	Zone C 4 run hits	Zone D 6 run hits	Runs scored by running	Number of outs
Mark	4	8	2	1	12	3
Grant	2	4	6	3	21	2

Together, Mark and Grant scored $\frac{1}{4}$ of their team's runs. How many runs did the team score?

d The batting team is 8 runs in front and there are 4 balls remaining. How is it possible for the batting team to lose?

Investigation Negative environments!

Lake Eyre in South Australia is −16 metres above sea level.

What you have to do

- Investigate the location and features of Lake Eyre. What is the relevance of the negative sign in '−16 metres'?
- Find other locations around the world that have a negative height above sea level.
- In the photograph, one of the floors is labelled −1. What does this mean?
- What does a bank mean when it says 'The amount owing on this credit card is −$30'?
- Find examples of negative numbers in banking. You could investigate credit card statements, loan statements or internet banking sites.
- Explain how banks use negative numbers.

Photo courtesy of Sue Thomson

Puzzle
Order of operations

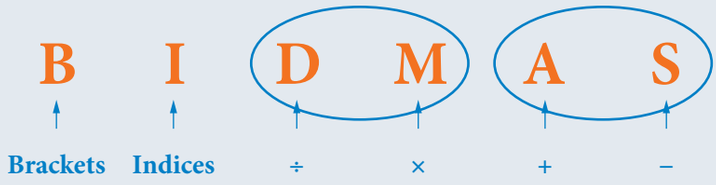
2.4 Order of operations

What is the answer to 200 ÷ 20 × 2?

Is it 20 or 5?

BIDMAS is an easy way to remember the **order of operations** in a **mixed calculation**.

Order of operations



To solve this problem, we have special rules for the order in which we do calculations.

- **B**rackets ( ) first
- **I**ndices (powers) and roots next
- Then any **D**ividing ÷ or **M**ultiplying ×, working from left to right
- Finally, any **A**dding + or **S**ubtracting −, working from left to right

So 200 ÷ 20 × 2 = 20, because we do × and ÷ at the same time and we work from left to right.

Video
Order of operations

EXAMPLE 2

Evaluate each mixed expression.

a $60 - 2 \times 5^2$

b $(12 + 5 \times 3) \div 9 + 4$

c $11 + (5 + 11) \div (12 \div 3)$

d $\sqrt{100 - 4 \times 9}$

Steps	Working
a The 5 is squared, so we do indices first. Next comes multiply. Subtraction comes last.	$60 - 2 \times 5^2 = 60 - 2 \times 25$ $= 60 - 50$ $= 10$
b Do × before the + inside the brackets first. Then do the ÷. The + 4 comes last.	$(12 + 5 \times 3) \div 9 + 4 = (12 + 15) \div 9 + 4$ $= 27 \div 9 + 4$ $= 3 + 4$ $= 7$
c Do both sets of brackets first. Then do the ÷. The + outside the brackets comes last.	$11 + (5 + 11) \div (12 \div 3) = 11 + 16 \div 4$ $= 11 + 4$ $= 15$
d Simplify what's under the **square root** first.	$\sqrt{100 - 4 \times 9} = \sqrt{100 - 36}$ $= \sqrt{64}$ $= 8$

Most calculators 'know' the order of operations. If you press the = key only at the end of the calculation, your calculator's answer will be correct. Check answers in this example using a calculator.

EXERCISE 2.4 Order of operations

ANSWERS p. 409

1 EXAMPLE 2 Is each statement true or false? Write the correct value for any false statements.

a $4 + 2 \times 3 = 18$ **b** $12 - 3 \times 4 = 0$ **c** $20 \div 2 + 2 = 12$

d $6 + 18 \div 3 = 12$ **e** $2 \times 4^2 = 64$ **f** $48 \div 4 \times 3 = 4$

g $20 - 5 + 8 = 7$ **h** $5 \times (20 - 3 \times 4) = 40$ **i** $2 \times 5^3 = 250$

2 Find the value of each expression.

a $18 - 3 \times 5$ **b** $24 \div (5 + 3)$ **c** $8 \times 3 - 10 \div 5$

d $(2 + 10) \times (12 - 9)$ **e** $3 \times (1 + 4)^2$ **f** $36 \div 12 \div 3$

g $30 \div 5 \times 2$ **h** $40 \times 2 \div 8$ **i** $4 \times (7 - 2) \div (3^2 + 1)$

j $4^2 + 5^2 - 3 \times 9$ **k** $10 + 5 \times 6$ **l** $300 - 20 \times 8$

m $120 \div 4 \times 5$ **n** $10 + 4^2$ **o** $5 \times (12 - 3 \times 2)$

p $\sqrt{19 + 6 \times 5}$ **q** $5^2 - \sqrt{11 + 5}$ **r** $\sqrt[3]{8 \times 5 - 13}$

3 Copy each statement and insert brackets to make the statement true.

a $4 + 7 \times 5 = 55$ **b** $60 \div 5 + 7 = 5$ **c** $3 \times 2^2 = 36$

d $6 + 8 \times 9 - 5 = 56$ **e** $3 \times 4 + 5 \times 2 = 34$ **f** $28 - 4 \times 5 \times 2 = 16$

g $\sqrt{7 + 5 \times 3 + 9} = 12$ **h** $\sqrt{12 \times 11 - 6 + 5} = 11$

4 When Siobhan used her calculator to evaluate $3 + 6 \times 5$, she got the wrong answer. She pressed the following calculator keys:

3 [+] 6 [=] [×] 5 [=]

Explain why the answer on Siobhan's calculator was wrong.

5 In the game of Snooker, the points scored are determined by the colours of the balls sunk in the correct order. This table shows the value of each colour.

Colour	Red	Yellow	Green	Brown	Blue	Pink	Black
Points	1	2	3	4	5	6	7

In snooker, Brad sank 4 red balls, 2 brown balls, 1 pink and 2 black balls. In the same game, he lost 15 points for foul shots.

a What does the expression $4 \times 1 + 2 \times 4 + 6 + 2 \times 7$ represent?

b Determine Brad's score for the game.

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6 Mr Healy, the school principal, has a parent complaining about the marking of his daughter's maths exam. He claims his daughter's answer was marked wrong.

This is the question: $48 - 8 \times 3$

The daughter's answer is 120.

a Why was the daughter's answer wrong?

b How could Mr Healy explain why the daughter's answer is wrong?

c Put brackets in $48 - 8 \times 3$ to make the daughter's answer correct.

2.5 How much do I pay?

We put numbers to work in every aspect of our lives: from earning and spending money, through organising schedules, preparing food, assisting with our leisure activities to scoring sporting events.

EXAMPLE 3

Muspha's rent is $42 768 annually.
How much is his rent per month?

Annually means 'per year'.

Steps	Working
There are 12 months in a year. Divide the annual amount by 12 to calculate the monthly amount.	monthly rent = $42 768 ÷ 12 = $3564
Write your answer.	Each month, Muspha pays $3564.

EXAMPLE 4

Gillian bought 3 books online and paid with her debit card. She paid $6.40 for postage and $7.95 for each book. Before Gillian bought the book, the balance of her debit card was $160. Calculate the balance after her online purchase.

Steps	Working
Calculate the cost of the postage and the books. Remember that we do × before +.	cost = $6.40 + 3 × $7.95 = $30.25 The books and postage cost $30.25.
Subtract the amount that Gillian spent from the balance of her debit card.	$160 – 30.25 = $129.75
Write your answer.	The balance of Gillian's debit card was $129.75.

EXERCISE 2.5 How much do I pay?

ANSWERS p. 409

1 EXAMPLE 3 Finn's annual business expenses total $82 440. Calculate his average monthly expenses.

2 Gazi pays $3250 per month for rent. Calculate the annual rent that Gazi pays.

3 Li pays $12 per hour for parking. How much does he pay when he parks for 7 hours?

4 Aisling's business spends $1840 per fortnight on electricity.

a How much does it spend per week on electricity?

b Calculate the amount the business spends annually on electricity.

Remember! A fortnight is 2 weeks long and there are 26 fornights in a year.

5 EXAMPLE 4 Rob ordered 2 burgers and some fries for his lunch. The burgers cost $4.80 each and the fries cost $3.20. Rob paid with a $20 note. How much change should he get?

6 Voula spends 45 minutes at the gym 6 days per week. How many hours does she spend at the gym each week?

7 Joel plays golf 3 times per week. On average his golf games take 3 hours and 15 minutes.

a How many hours does Joel play golf per week?

b During holidays, Joel plays golf every day. Calculate the number of hours he played golf on his 5-week holiday.

8 Reah hates TV advertisements. During a 1-hour period, she counted 12 of the 30-second advertisements and 24 of the 15-second advertisements. How many minutes of advertisements were shown in the 1-hour period?

9 The Rockets and the Rascals are opposing teams in a rugby league match. Tries are worth 4 points and goals 2 points. The Rockets scored 5 tries and 3 goals and the Rascals scored 6 tries and no goals. Which team won and by how many points?

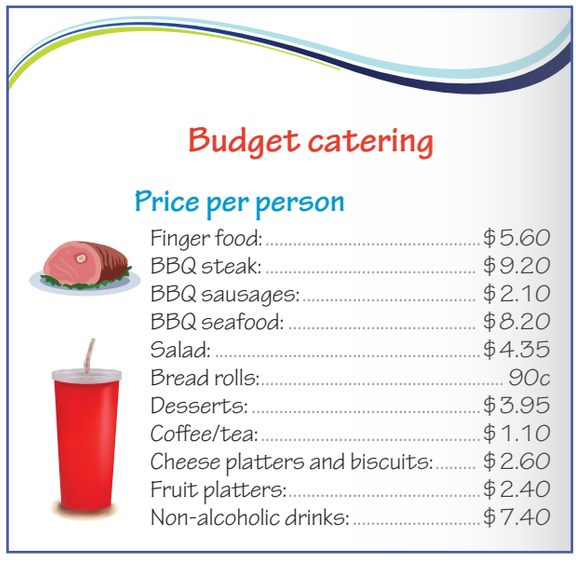
10 The Boomers and the Snakes are opposing teams in an AFL match. In AFL, teams score 6 points for a goal and 1 point for a behind. At three-quarter time, the Boomers had scored 18 goals and 2 behinds, while the Snakes had scored 17 goals and 8 behinds. Who is winning?

11 The BBQ Specialists are catering for Mala's garden party. They are supplying catering and bar service for 42 people. How much will Mala have to pay?

Practical activity The Year 11 party

Toby is responsible for organising the catering for the Year 11 end-of-year party. The organising committee has allocated $4000 to spend on the food and non-alcoholic drinks for the 180 people expected to attend.

Your group's task is to help Toby decide on an interesting menu for food and drink. Remember to stay within your budget.



Worksheet
Estimating and rounding

2.6 Estimating costs

It's difficult to mentally calculate the total cost of the items in your supermarket trolley, but careful shoppers can **estimate** using approximation techniques.

EXAMPLE 5

Patrick is purchasing the supermarket items shown below: 5 cans of dog food, Caesar salad, blueberries, teabags, strawberries and macadamia nuts. The price of each item is shown.

Shutterstock.com/Scout Kozakiewicz

Patrick has $54 in his wallet. Estimate whether he has enough to pay for his shopping.

Steps	Working
Mentally round each price *up* to the nearest dollar.	estimated price = 15 + 6 + 5 + 7 + 5 + 14
Dog food: 5 × $3 = $15	= 52
Caesar salad: $6	The items cost approximately $52.
Blueberries: $5	
Teabags: $7	
Strawberries: $5	
Macadamia nuts: $14	
When we estimated the costs, each estimate was more than the true cost.	The true cost of the items is less than $52.
Patrick has $54.	
Write the answer to the question.	Patrick has enough money to pay for his shopping.

EXERCISE 2.6 Estimating costs

ANSWERS p. 409

Answer all questions *without* using a calculator.

For questions **1** to **5**, select the correct answer **A**, **B**, **C** or **D**.

1 Which is the best estimate of the value of $9.99 × 8?

A $72 **B** $80 **C** $90 **D** $100

2 What is the best approximate value of $25.99 + $4.10 + $15.05 + $3.90?

A $45 **B** $49 **C** $55 **D** $60

3 Gavin ordered 19.5 m of materials at a cost of $29.90 per metre. Estimate the cost of the materials.

A $60 **B** $90 **C** $600 **D** $900

4 Seth is buying small chocolates that cost 49c each. Approximately how much will 50 cost?

A $9 **B** $25 **C** $99 **D** $2500

5 Davinia buys bags of nuts and bolts to use in her furniture business. The bags contain between 48 and 51 nuts and bolts. She has 11 bags in her supply cupboard. Approximately how many nuts and bolts does she have?

A 50 **B** 550 **C** 1100 **D** 2500

6 Christina cuts 18.9 m lengths of wool for the warp threads in her loom. She requires 82 lengths.

a Approximately how many metres of wool will she need for the 82 warp threads?

b The wool Christina uses comes in 400-metre long balls. How many balls of wool will Christina need?

c Use a calculator to check your answer to part **b**.

7 When Bryce bought 2 pizzas at $8.95 each and a large fries for $5.80, he paid with a $50 note. Approximately how much change should he get?

8 EXAMPLE 5 Sebastian has only $60 on his debit card. He has these items in his supermarket basket:

- 2 packets of sausages @ $5.99 per packet
- 1 packet of potatoes $4.99
- 1 carton of milk $3.95
- 1 carton of yoghurt $6.95
- 1 packet of breakfast cereal $5.95

a Estimate the cost of the items in Sebastian's supermarket basket.

b Will he have sufficient funds in his account to pay for his shopping?

c Does he have enough money to add a $9.80 bag of buns to his shopping?

9 Paige is knitting a scarf. It takes her 29 seconds to complete 1 row.

a Explain why we can use the calculation 80 ÷ 2 = 40 to estimate the number of minutes Paige takes to complete 80 rows of knitting.

b Paige needs to knit 50 more rows to finish the scarf. Approximately how long will it take her?

Chapter problem

You've now covered the skills required to solve the chapter problem. Can you solve it now?

Investigation My shopping docket

To complete this investigation, you will need samples of supermarket shopping dockets.

What you have to do

- Estimate the total cost of the items on a docket.
- Compare your estimate to the total on the docket. Was it more or less than the actual total?
- What is the difference between your estimate and the true cost?
- Use this formula to calculate how much your estimate is different from the true cost as a percentage.

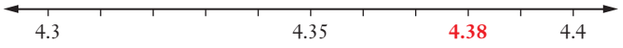
$$\text{percentage error} = \frac{\text{difference}}{\text{true value}} \times 100\%$$

- Repeat the process for a different shopping docket. Does your percentage error become smaller with practice?

2.7 Rounding decimals

Calculators often show a lot of **decimal places**. When Imran used his calculator to divide 5.7 by 1.3, it showed the answer as 4.384 615 385. Imran wants the answer with only 1 decimal place, so he has to **round** his answer.

Imran has to decide whether 4.384 615 385 is closer to 4.3 or 4.4. He will check using just the first 2 decimal places: 4.38. On the number line, he can see that 4.38 is closer to 4.4.



This is because the 8 in 4.38 is more than 5, which is the halfway mark. Imran will round to 4.4.

Remember that 4.30 is the same as 4.3 and 4.40 is the same as 4.4.

Rounding numbers

When the digit following the decimal place you want to round to is:

- **4 or smaller** – just **round down** and leave all the extra digits off.
- **5 or bigger** – **round up** and add 1 to the digit in the decimal place you want to round to, and leave all the extra digits off.

This table shows the results when some decimals are correctly rounded to 1 decimal place.

Original decimal	Rounded to 1 decimal place
6.802 956	6.8
6.830 5	6.8
6.849 99	6.8
6.853	6.9
6.893	6.9

EXAMPLE 6

Round 18.3721 to 1 decimal place.

Steps	Working
Decide whether 18.3721 is closer to 18.3 or to 18.4. The figure following the first decimal place is 7.	$18.3721 \approx 18.4$
Round the 3 up to 4.	

EXERCISE 2.7 Rounding decimals

ANSWERS p. 409

1 EXAMPLE 6 Round each number correct to 1 decimal place.

a 16.1256 **b** 29.7681 **c** 14.6472

d 13.2836 **e** 104.554 **f** 195.219

2 Write 124.727 56 correct to 2 decimal places.

3 Darryn correctly rounded a number to 16.3. Suggest 2 possible values the original number could have been.

4 In surfing competitions, the **scores** for each wave a **surfer** catches are rounded to 1 decimal place. This is how the scores are determined.

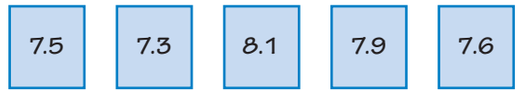
Step 1: Each of 5 judges awards a result from 0.0 to 10.0 for the wave a surfer catches.

Step 2: The lowest and highest scores are removed.

Step 3: The **average** of the 3 remaining scores is determined by adding the 3 scores together, then dividing by 3. The average is rounded to 1 decimal place.

Step 4: Each competitor's best 2 scores are added to obtain their final score for the competition.

Here are the scores that the judges gave Sally for her first wave. Use calculations to show that Sally's score for her first wave is 7.7.



5 Mia and Elissa are competing against each other in a surfing competition. This table shows the points judges awarded them on 4 waves.

Mia's scores			
Wave 1	Wave 2	Wave 3	Wave 4
4.7	7.2	8.5	7.4
5.1	7.1	8.5	7.8
4.9	7.5	8.4	7.6
5.0	7.3	8.2	7.9
4.9	7.5	8.6	7.5

Elissa's scores			
Wave 1	Wave 2	Wave 3	Wave 4
6.9	7.8	5.2	8.2
7.0	7.9	5.1	8.1
7.2	7.8	5.3	8.4
6.9	8.0	5.2	8.0
7.1	7.8	5.0	8.9

a Calculate the score awarded to each surfer for each wave.

b Calculate each surfer's final score for the competition.

c Who won the event?

6 Express the total of 2 m, 148 cm and 384 mm in metres, correct to 1 decimal place.

7 Ben's car travels 8.9 km on 1 L of petrol. The car's fuel tank holds 60.5 L of petrol. How far can the car travel on 1 full tank of petrol? Express your answer in kilometres, correct to 1 decimal place.

8 Lina buys knitting wool in hanks from a wool mill. She bought 5 hanks. Two of the hanks contained 1560 m each, and the other 3 hanks contained 1875 m each.

a Calculate the total length of wool in Lina's 5 hanks.

b How many kilometres of wool are in the 5 hanks? Express your answer correct to 1 decimal place.

9 Thanh bought 79.3 L of petrol at 155.8c/L.

a Explain why the value of 80 × 1.5 will give the approximate cost of the petrol in dollars.

b Approximately how much will the petrol cost?

c Use a calculator to determine the cost of the petrol, correct to the nearest 5 cents.

d As a percentage, how different is your approximation to the actual cost?

10 The gas company replaces the LPG (liquid petroleum gas) in the bottles at Jaye's house each month. Today's delivery docket showed a delivery of 151.65 L of LPG priced at $1.35 per litre.

a Jaye wanted to estimate the total cost. She calculated that the cost will be between $150 × 1 and $150 × 2. Will the cost be closer to $150 or $300? Give reasons for your answer.

b Calculate the value of 153.8 × $1.35 and express the answer correct to 2 decimal places.

c Jaye allows $2200 in her annual budget for gas. Is this too much or not enough? Justify your answer.

11 Simone paid $48.62 for 3 metres of fabric. Calculate the amount she paid per metre, correct to the nearest cent.

2.8 Rounding up when buying materials

Nuts and bolts can be sold in packets of 20 or 100, fertiliser in 40 kg bags and copy paper in reams of 500 sheets. Many manufacturers pack the items in multiple quantities for use by tradespeople and in most cases it's not possible to buy part of a packet.

EXAMPLE 7

Anna starts a dog-walking service and wants to have some advertising pamphlets printed. The printer handles advertising pamphlets only in multiples of 250. Anna wants 600 pamphlets. How many will she have to order?

Steps	Working
The multiples of 250 mean 'lots of 250', that is: 250, 500, 750, 1000, 1250 … Anna can't order 600 pamphlets as it isn't a multiple of 250.	Anna will have to order 750 pamphlets if she requires 600 pamphlets.

EXAMPLE 8

Timber is available only in lengths that are multiples of 300 mm.

a Is it possible to buy a 1-metre length of timber? Why or why not?

b Peter needs 2 lengths of timber, each 1300 mm long. What is the best way for him to buy the timber?

Steps	Working
a Determine whether 1 metre is a multiple of 300 mm by dividing it by 300 mm. If the answer is a whole number, then it is a multiple of 300 mm. First convert 1 m to mm.	1 m = 1000 mm 1 m ÷ 300 mm = 1000 mm ÷ 300 mm = 3.333… The answer is not a whole number, so 1 m is not a multiple of 300 mm. It is not possible to buy a 1 m length of timber.
b Find the total length. Divide by 300 mm to check if it is a multiple of 300. It isn't, so round up to 9 and buy 9 × 300 mm.	total length = 2 × 1300 mm = 2600 mm 2600 ÷ 300 = 8.666… (not a multiple of 300) length required = 9 × 300 mm = 2700 mm Cut 2 × 1300 mm from 2700 mm length (100 mm left over).

EXERCISE 2.8 Rounding up when buying materials

ANSWERS p. 410

1 EXAMPLE 7 Business envelopes are sold in boxes of 200.

- **a** At the end of each month, Xanthe posts accounts to all the company's customers. She ordered 8 boxes of envelopes for the letters. How many envelopes are contained in the boxes Jane ordered?
- **b** Mike requires 600 envelopes to post statements to customers. How many boxes of envelopes will he need?
- **c** What are the first 4 multiples of 200?
- **d** How are the multiples of 200 related to the number of envelopes in the boxes?
- **e** Tash needs 840 envelopes. How many boxes does she need to order?

2 EXAMPLE 8 Timber is available only in lengths that are multiples of 300 mm.

- **a** Explain why you can't buy a piece of timber 1400 mm long.
- **b** If you need a piece of timber 1400 mm long, what length do you need to buy?
- **c** Oliver needs 2 pieces of timber, each 1150 mm long. What length of timber should he buy?
- **d** A building plan requires a piece of timber 1.04 m long. What length of timber should be bought?

3 At the wholesaler, electrical wire is available only in multiples of 100 metres. Kelly calculated that to complete her next job she will need 3 × 74 m lengths of wire and 2 × 180 m lengths. How much wire does she need to buy for the job?

4 Rose likes to make patchwork quilts. At the shop, fabric is available only in lengths that are multiples of 20 cm. Rose requires 15 cm of a pink fabric and 22 cm of a white fabric. Both fabrics cost $22 per metre.

- **a** What length of each fabric does Rose need to buy?
- **b** How much will the fabric cost?

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5 Ashok is making a fence from treated pine. The wood is available in lengths that are multiples of 0.3 m from 2.1 m to 3 m. He needs 17 posts, each 1.35 m long, and 8 top rails, each 2.3 m long. What lengths of timber should he order from the timber yard?

Extended investigation — Melanie's grand idea

Melanie lives in a large, city apartment block. She's noticed that residents are placing recyclable bottles and cans in the rubbish. Melanie needs $460 to buy some new technology. She doesn't have sufficient money saved but she has an idea.

Melanie put a crate near the rubbish bins with a sign asking residents to put their recyclable bottles and cans in it. She's going to cash them in at the recycling centre to make the money she needs to buy the technology. Melanie will receive 10c for each recycled item.

- **a** How many bottles and cans will she need to recycle?
- **b** How long will it take her?

A sample solution can be found on p. 410.

2.9 After the point

While 1.5 metres means 1 metre and 50 centimetres, 1.5 hours doesn't mean 1 hour and 50 minutes, and 1.5 years doesn't mean 1 year and 5 months. Fortunately, scientific calculators have a 'degrees, minutes, seconds' key (° ' " or DMS) that converts 1.5 hours into 1 h 30 min, but in other situations we have to think for ourselves!

EXAMPLE 9

What does the 0.45 represent in the following 2 situations?

a $16.45 **b** 16.45 metres

Steps	Working
a For money, the 2 digits after the decimal point represent cents.	In $16.45, the 0.45 represents 45 cents.
b For metres, the 2 digits after the decimal point represent centimetres.	In 16.45 m, the 0.45 represents 45 cm.

EXAMPLE 10

Write 2.7 hours in hours and minutes.

Steps	Working
Change 2.7 hours to hours and minutes using the ° ' " or DMS key on your calculator by pressing 2.7 ° ' " = or 2.7 2nd F DMS.	2.7 hours = 2 h 42 min
OR first change the decimal part, 0.7 hours, into minutes by multiplying it by 60 minutes (1 hour).	0.7 hours = 0.7 × 60 = 42 minutes
Write the answer.	2.7 hours = 2 h 42 min

EXAMPLE 11

Express 1.6 months in months and days, assuming that an 'average month' is 30 days.

Steps	Working
Change 0.6 months into days.	0.6 month = 0.6 × 30
Multiply 0.6 by 30.	= 18 days
Write the answer.	1.6 months ≈ 1 month and 18 days

EXERCISE 2.9 After the point

ANSWERS p. 410

1 EXAMPLE 9 What does the 0.24 represent in each amount?

a $7.24 **b** 7.24 m

2 What does the 0.9 represent in each measurement?

a $18.9 **b** 18.9 m

3 EXAMPLE 10 Use the ° ' " or DMS key on your calculator to express the following times in hours and minutes.

a 2.5 h **b** 3.8 h **c** 1.4 h **d** 2.9 h

4 Follow these steps to convert 4.5 years into years and months.

a How many months are there in 1 year?

b Multiply the number of months in a year by 0.5.

c 4.5 years is 4 years and the number of months you calculated in part **b**.

5 Convert 2.25 years into years and months.

6 **a** How many months are equivalent to 0.75 years?

b Write 5.75 years in years and months.

7 EXAMPLE 11 Express each time in months and days. Assume that there are 30 days in a month and write your answers correct to the nearest day.

a 6.5 months **b** 8.9 months **c** 3.24 months **d** 5.3 months

8 A cricket match is measured in 'overs'. An over consists of 6 bowls of the cricket ball, or 6 balls.

a Express 18 balls in 'overs'.

b During a test match the commentator said 'There are 18.5 overs remaining until the end of play'. If the commentator was using mathematics correctly, how many overs and balls should be remaining?

c The commentator meant that there were 18 overs and 5 balls remaining. Why do you think cricket commentators use decimal points in this non-standard way?

Keyword activity

CALCULATIONS FIND-A-WORD

ANSWERS p. 410

Use each clue to find 11 keywords. Then copy the puzzle grid below and find the same 11 keywords in the grid.

1 Multiply by 2.

2 Multiply by 3.

3 The centre of a dartboard.

4 A positive or negative whole number.

5 The initials we use to remember the 'order of operations' rules.

6 Above zero.

7 Another word for powers, beginning with I.

8 For order of operations, we calculate what's inside these first.

9 Below zero.

10 A game played on a circular board numbered with points values.

11 Electronic Funds Transfer at Point Of Sale (initials).

X	P	O	S	I	T	I	V	E	Y	T
D	M	I	C	T	N	P	D	L	S	G
I	R	A	U	B	I	D	M	A	S	W
N	B	N	E	G	A	T	I	V	E	J
T	U	R	W	Z	C	F	R	C	J	A
E	L	O	A	K	T	S	X	N	E	I
G	L	D	M	C	L	R	H	C	Q	S
E	S	H	Y	W	K	G	I	V	O	B
R	E	S	A	J	R	E	F	P	O	Y
B	Y	E	H	D	A	R	T	S	L	R
K	E	L	P	O	X	F	N	S	R	E
D	O	U	B	L	E	M	F	O	Z	U

Solution to the chapter problem

Problem

Lyndel works at a café. When customers pay in cash, she always estimates the change before using the cash register. For this payment, she thinks there is something wrong with the register. It says that she has to give out more than $5000 in change. Lyndel doesn't think it makes sense. What could be wrong?

*** ORDER 140 ***

SALAD CAESER WITH CHICKEN* GF OPTION	$17.90
vietnamese chicken salad* GF OPTION	$18.50
Decorated gingerbread man*	$5.00
Turmeric Latte* 2 @ $5.00 ea	$10.00
TOTAL	$51.40
GST Subtotal	$51.40
GST Amount	$4.67
CASH	$5,150.00
Change	$5,098.60

Solution

The customer spent $51.40 and paid in cash. The customer may have paid $60 or $70. At the most, the customer would have paid $100, and the change should be approximately $100 – $50 = $50. Lyndel is right to think that there is something wrong.

The amount of cash paid shown on the docket is the problem. No customer would pay $5150 in cash at a café.

Lyndel left the decimal point out when she entered $51.50, and the change should be 10 cents. Fortunately, Lyndel estimated and checked when her estimate was very different to what the cash register said.

2 Test yourself

What's the score?

ANSWERS p. 410

1 EXERCISE 2.1 Add each set of dart board scores without using a calculator.

a a 5 and a 4 **b** double 5 and a 3

c double 3 and double 8 **d** a 5 and a triple 6

2 EXERCISE 2.2 Jasper is playing darts. Calculate his score when his 3 darts landed on

a 5, 7 and double 11 **b** double 9, 6 and triple 20.

3 EXERCISE 2.3 Mike and Tony are playing golf. Mike's final score is –3 and Tony's is +2. Who won the game and by how many strokes?

4 EXERCISE 2.4 Evaluate each expression without using a calculator, then use a calculator to check your answer.

a $8 + 5 \times 2$ **b** $20 \div 10 + 3 \times 4$ **c** $(15 + 9) \div (8 - 2)$

5 EXERCISE 2.4 Use a calculator to evaluate each expression, correct to 1 decimal place.

a $17.35 + 182.96 - 25.47$ **b** $16.39 + 12.5 \div 3.6$ **c** $(12.3)^2$

6 EXERCISE 2.5 Jemima bought 8 balls of wool each priced at $11.99.

a Estimate how much the wool will cost in total.

b The shop charged her $71.94. Is the bill right?

7 EXERCISE 2.6 Bella ordered lunch for her dance group. She ordered 4 chicken wraps and 6 small sushi. The chicken wraps cost $5.50 each and the sushi cost $2.90 each. She paid with a $50 note. How much change should Bella get?

8 EXERCISE 2.7

a Round 15.32 up to the nearest whole number.

b Round 16.75 correct to 1 decimal place.

9 EXERCISE 2.7 Round each measurement correct to the nearest whole number.

a 27.9 kg **b** 135.2 m **c** 4.5 mm

10 EXERCISE 2.8 The buttons that Mai wants to use on a jacket she's designing are sold in multiples of 3. Mai needs 13 buttons for the jacket. How many buttons will she have to buy?

11 EXERCISE 2.9 There are 16 stitches in a knitting pattern repeat. Dorothy calculated that she needs 6.5 pattern repeats.

a Explain why 6.5 pattern repeats doesn't mean 6 pattern repeats and 5 more stitches.

b How many stitches does Dorothy require for 6.5 pattern repeats?

12 EXERCISE 2.9 Approximately how many days are there in 4.7 months?

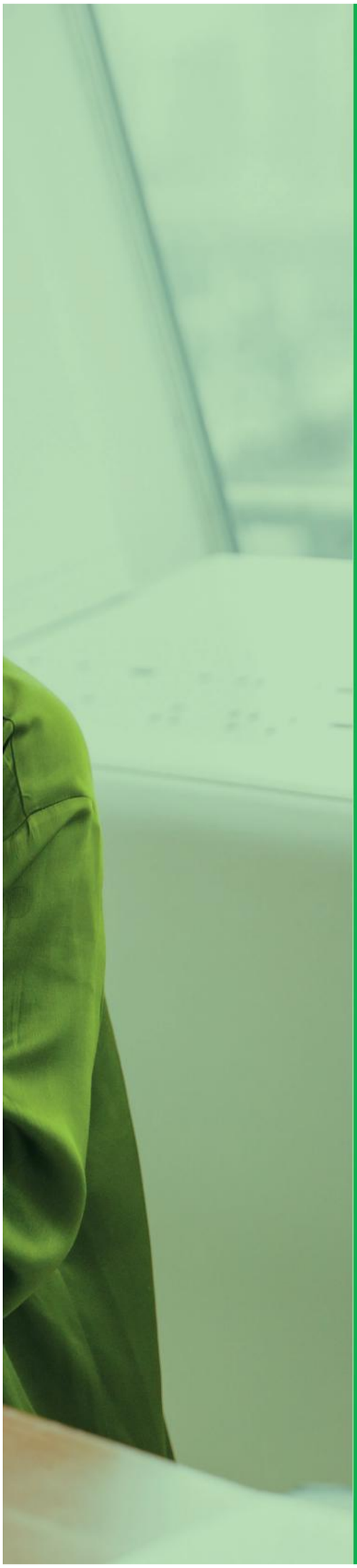
9780170448123

Chapter problem

As part of a research assignment, Madeline has collected data on the month of birth for the Year 11 students at her school. Her results are shown in this table.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7	4	6	3	9	5	9	2	6	3	4	2

Madeline wants to present this data graphically. What is the best graph for her to use? Justify your answer.



CHAPTER 3

DATA ANALYSIS, PROBABILITY AND STATISTICS

SHOW ME THE GRAPH

3.1 Categorical and numerical data
3.2 Census vs sample
3.3 Interpreting graphs
3.4 Everyday graphs
3.5 Choosing the best graph
3.6 Dot plots and stem-and-leaf plots
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Distinguish between categorical and numerical data
- Discuss the advantages and disadvantages of a census and a sample
- Interpret information presented in graphs
- Determine which type of graphs are more appropriate to represent a dataset

How are we ever going to use this?

- When we need to organise information we have collected
- When preparing a presentation of information for a group of people
- When interpreting and evaluating data presented in the media

Study Design coverage

UNIT 1, AREA OF STUDY 2: DATA ANALYSIS, PROBABILITY AND STATISTICS

- collection and representation of data in diagrammatic, tabular and graphical forms and the features, conventions and terminology used in these processes
- construction of charts, tables and graphs to represent data.

VCE Mathematics Study Design 2023–2027 p.13, © VCAA 2022

Videos (3):
3.1 Types of data
3.6 Dot plots • Stem-and-leaf plots

Worksheets (8):
3.2 Student survey form
3.3 Australian statistics • Census questions • Every picture tells a story • Currency conversion graph
3.4 Every picture tells a story • Reading graphs and tables
3.6 Stem-and-leaf plots 1

Weblink (1):
3.2 Australian Bureau of Statistics

Puzzles (2):
3.1 Statistical data match-up
3.6 Data find-a-word

Nelson MindTap

To access resources above, visit **cengage.com.au/nelsonmindtap**

Video
Types of data

Puzzle
Statistical data match-up

3.1 Categorical and numerical data

A collection of facts or information is called **data**. There are 2 main types of data.

Types of data

Categorical data is information that is grouped into **categories**, such as the colours of cars or the flavours of ice cream.

Numerical data is information that is counted or measured as **numbers**, such as the number of goals scored or a person's height.

EXAMPLE 1

Classify each type of data as categorical or numerical.

a makes of cars

b people's salaries

c weights of athletes

d favourite radio stations

Steps	Working
a Makes of cars are words.	categorical
b Salaries involve numbers.	numerical
c Weights of athletes involve measurements on a numerical scale.	numerical
d Radio stations involve words.	categorical

EXERCISE 3.1 Categorical and numerical data

ANSWERS p. 411

1 EXAMPLE 1 Classify each type of data as categorical (C) or numerical (N).

- **a** weights of Year 11 students
- **b** brands of computers
- **c** prices of large pizzas
- **d** number of TVs owned by families
- **e** monthly rainfall in Mount Isa
- **f** causes of tooth decay
- **g** sets won in a tennis match
- **h** speed of trucks

2 Classify each type of data as categorical (C) or numerical (N).

- **a** people's hair colours
- **b** customer ratings of a restaurant's level of service (from poor to excellent)
- **c** number of homes with smart TVs
- **d** times taken for athletes to run 100 metres
- **e** countries where cars are manufactured
- **f** school populations
- **g** heights of bridges
- **h** classification ratings of films (e.g. PG)

3 You are asked to conduct a survey on people's preferences about anything to do with cars.

Write a questionnaire with 6 questions: 3 questions whose answers are categorical and 3 questions whose answers are numerical.

3.2 Census vs sample

Worksheet
Student survey form

Statistics involves the collecting of information, which is then analysed and used to make decisions. To collect information, we usually survey a representative group of the target **population**. This process is called taking a **sample**.

To collect information about a whole population, *all* people or items must be surveyed. This is called taking a **census**. People who are members of small groups can be missed in a sample. We always use a census when we want to make sure that the views of small groups are included.

The Australian Bureau of Statistics conducts a national census every 5 years. This census is held in years ending in a 1 or a 6, such as 2021.

Sample	Census
• surveys a selected group of people or items	• surveys all people or items in the population
• gives approximate information about the population	• gives exact information about the population
• simple and inexpensive	• complex and expensive
• can be done quickly	• takes a lot of time to collect and process the information

EXAMPLE 2

a The United Football Club asked Andrew to evaluate the facilities and services it provides to its 14 100 members. Should he use a census or a sample to gather information?

b Andrew also wants to investigate the reputation of the club in the local community. From what target population should he sample for views?

Steps	Working
a A census would be expensive and it would take a long time to process the information.	A sample should be used in this situation.
b Target population means the people represented by the sample.	The target population would be the residents of the community where the club is located.

EXERCISE 3.2 Census vs sample

ANSWERS p. 411

1 Write a paragraph in your own words describing the advantages and disadvantages of using a census to collect information.

2 EXAMPLE 2 For each investigation, should a census or a sample be used? Give a reason for your answer.

a The most popular car colour in Australia
b The number of retired people living in Darwin
c The number of Australians who watch the AFL Grand Final
d The use of soap versus body wash
e Testing coffee for taste
f The population of Hobart
g The number of people using the emergency department at St Vincent's hospital on Saturday night
h Length of time a certain type of car battery lasts
i The political party supported by people in Western Australia
j The favourite TV show of your 10 best friends
k Cricketer Steve Smith's batting average
l Internet usage by Year 8 students at your school
m Hours of paid work per week completed by students in your school
n NelsonFlix wants to know how satisfied its customers are with its streaming service

3 What is the target population for each investigation?

a Girls are better than boys at Maths
b Voting intentions for the next State election
c The best song of the decade
d Student attitudes to school uniform at your school
e Favourite make of car in Victoria
f The amount of money people are prepared to spend on going to the gym each week
g The venue Year 12 should use for their formal
h Donations to charities from wealthy individuals
i The factors influencing the choice of supermarket
j The batting performance of the Australian cricket team
k NVM Bank wants to know if its customers find internet banking easy to use
l The time taken to deal with complaints to a phone company
m The local council wants to know what recreational equipment should be added to the town's parks

Investigation The Australian Census

The Australian census is conducted by the **Australian Bureau of Statistics**. Visit its website www.abs.gov.au and search for the answers to these questions.

1. When was the first national census conducted?
2. When was the last census?
3. List 5 questions that will give categorical data.
4. List 5 questions that will give numerical data.
5. Find 3 questions that have been asked in the past but were not asked in the most recent census.
6. Were there any questions in the most recent census that have not been asked before? If so, what were they?
7. Are all questions in the Census compulsory?
8. Give 3 examples of how census information is used.
9. What was different about the Census in 2021? What challenges did this present?
10. Who is NOT required to complete the Census?

Weblink
Australian Bureau of Statistics

3.3

3.3 Interpreting graphs

Statistical data can be represented in a variety of ways. The exercise below revises and extends your knowledge of different graphs.

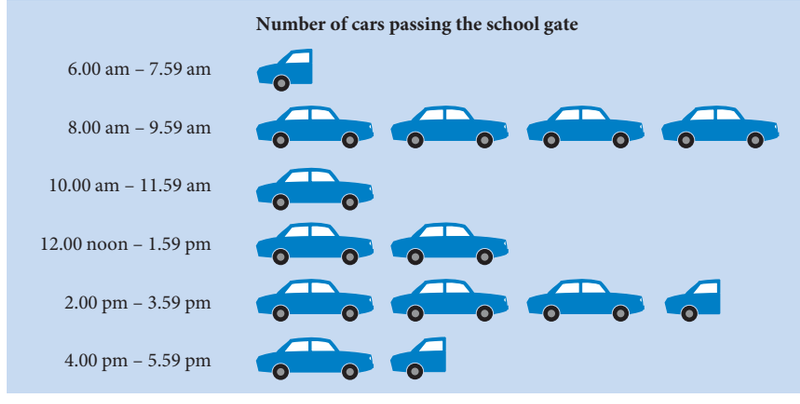
Worksheets
Australian statistics
Census questions
Every picture tells a story

EXERCISE 3.3 Interpreting graphs

ANSWERS p. 411

1 **Pictograms** or **picture graphs** use symbols to represent quantities. This pictogram shows the number of cars passing a local high school at different times of day.

Key: Each represents 10 cars.



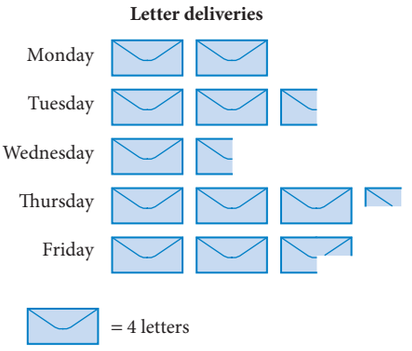
a What does represent?

b How many cars passed the school between 2 pm and 3.59 pm?

c What time of day had the least traffic?

d Write a paragraph describing the traffic flow and suggesting reasons for the differences.

2 This pictogram shows the number of letters delivered to an office each day last week.



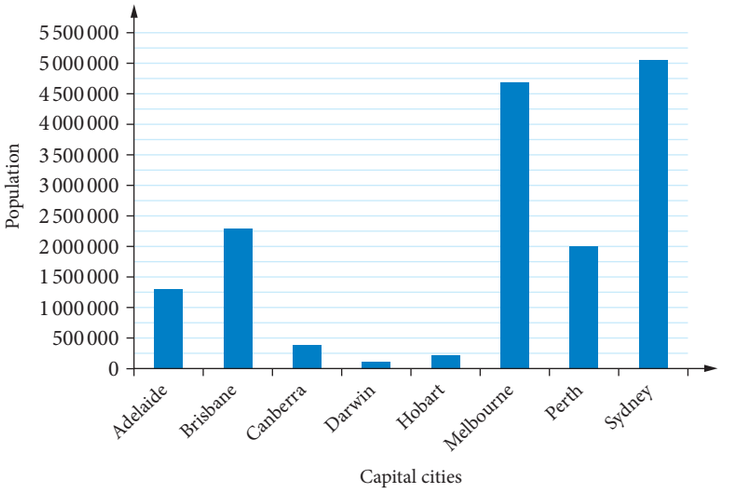
a How many letters were delivered on Thursday?

b On which day were 11 letters delivered?

c How many letters were delivered to the office last week?

d What is one disadvantage of this type of graph?

3 **Column graphs** are mostly used for data that is in categories. This column graph shows the populations of the 8 Australian capital cities.



a What does one interval on the vertical axis represent?

b Which city has the largest population? Estimate its population from the graph.

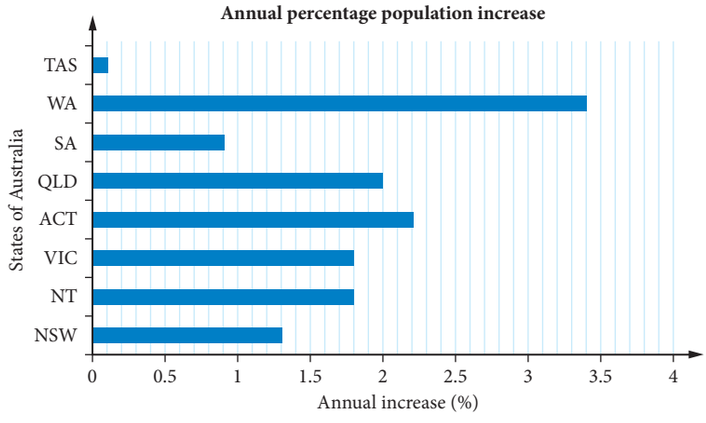
c Which city has the smallest population? Estimate its population from the graph.

d Explain why we can only *estimate* the population from the graph.

e Which city has an approximate population of 1.3 million?

f Use the internet to find the current populations of each city.

4 A column graph on its side is sometimes called a horizontal **bar graph**.



a By what percentage did Queensland's population increase in 2013?

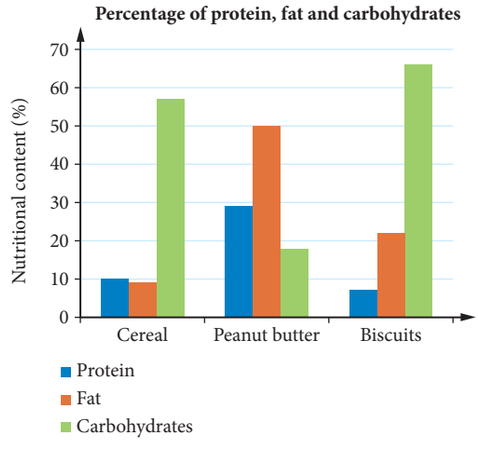
b In which state was the percentage population increase 1.3%?

c Which 2 states had the same percentage increase?

d Does this graph tell you anything about the actual population of each of the states? Explain your answer.

e The population of Tasmania last year was approximately 512 400. Calculate the actual increase in Tasmania's population.

5 We use a **clustered column graph** for categories we want to compare. This graph shows the nutritional information for different foods.



a Which food has the highest percentage of protein?

b Which food has the highest percentage of carbohydrates?

c Which food has the lowest percentage of fat?

d What is the difference in the percentage of fat in peanut butter and biscuits?

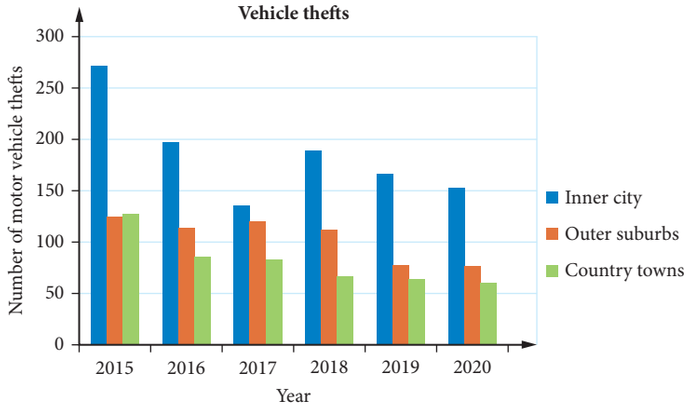
e If you were on a low carbohydrate diet, which food could you include in your diet?

f If you were on a low protein diet, which foods could be included in your diet?

g Jack had a 140 g serving of cereal for his breakfast. Approximately how many grams of protein did the serving of cereal contain?

h Lizzie has to limit her carbohydrate intake. What foods should she avoid?

6 This clustered column graph shows the number of motor vehicle thefts per year for 3 different areas.



a Describe the trend in motor vehicle thefts in the country towns.

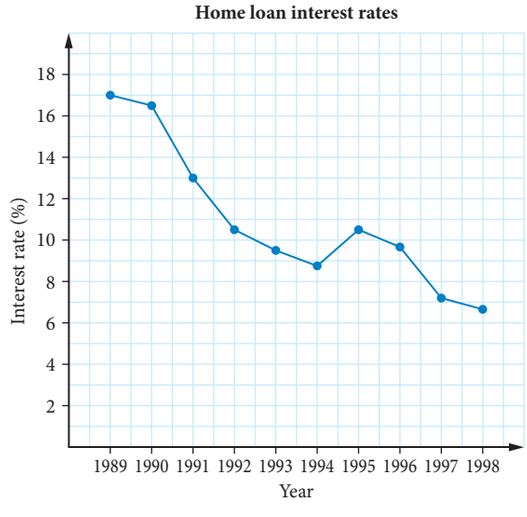
b In which year does the outer suburbs have the lowest number of thefts?

c In which year is the difference between the number of thefts in the inner city and the country towns the smallest? Estimate this difference.

d Write a brief paragraph describing the differences and similarities in the number of motor vehicle thefts in these 3 areas.

7 A **line graph** shows data that change over time. The table and graph below show the dramatic changes in home loan interest rates during the 1990s.

1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
17%	16.5%	13%	10.5%	9.5%	8.75%	10.5%	9.75%	7.2%	6.7%



a By how much did the interest rates drop between 1989 and 1998?

b Between which 2 years was the drop the greatest?

c Between which 2 years did interest rates increase?

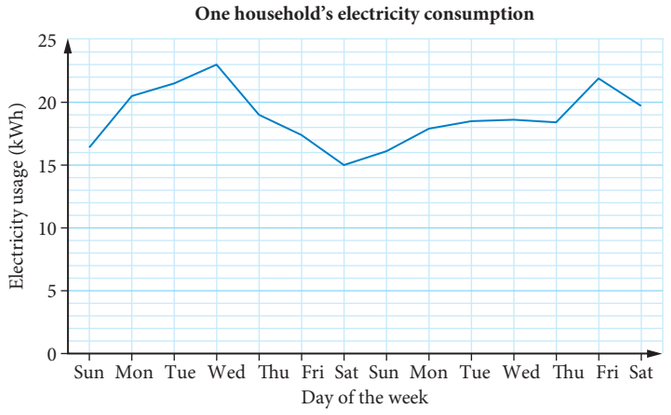
d Anand borrowed $120 000 in 1989 to buy a house. If a flat rate of interest was used, how much interest did he pay in 1 year?

e Catriona borrowed the same amount in 1997.

i Approximately how much interest did she pay in the first year?

ii How much more did Anand pay in the first year?

8 This graph shows the electricity consumption for a household over a fortnight.

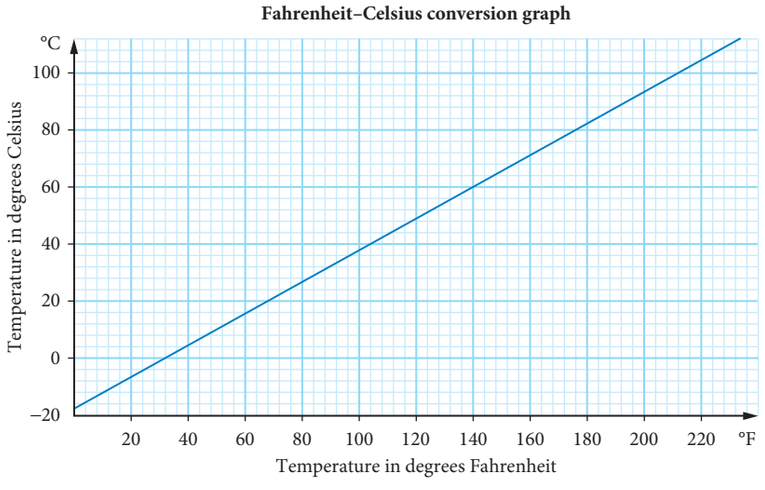


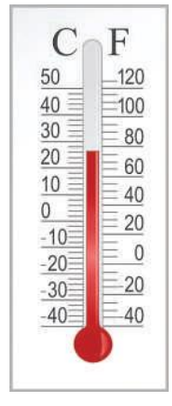
a What was the lowest daily rate of electricity usage?

b What was the highest daily rate of electricity usage?

c The usage was above 20 kWh for 4 days in the fortnight. Which 4 days were these?

9 A **conversion graph** is used to convert from one unit to another. This graph shows conversions between degrees Celsius and degrees Fahrenheit.





a Convert a temperature of 68°F to °C.

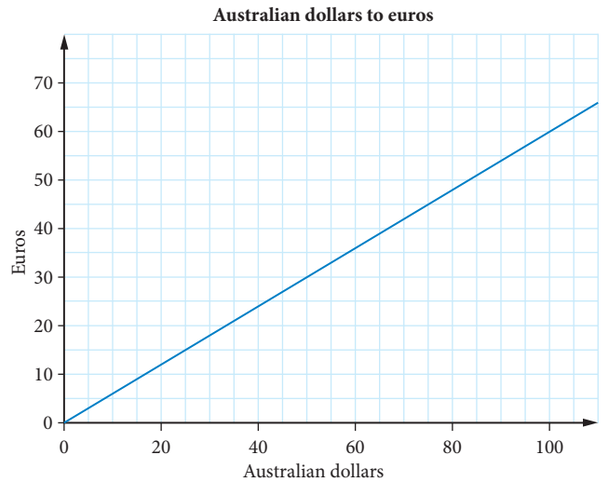
b Water boils at 100°C. What Fahrenheit temperature is this?

c Water freezes at 0°C. What Fahrenheit temperature is this?

d When Australian temperatures were measured in Fahrenheit, a day when the temperature reached 100°F was considered a very hot day. What is this temperature in degrees Celsius?

Worksheet
Currency conversion graph

10 This conversion graph can be used to convert Australian dollars (A$) to euros (€), the currency used in Europe.



a Convert A$15 to euros.

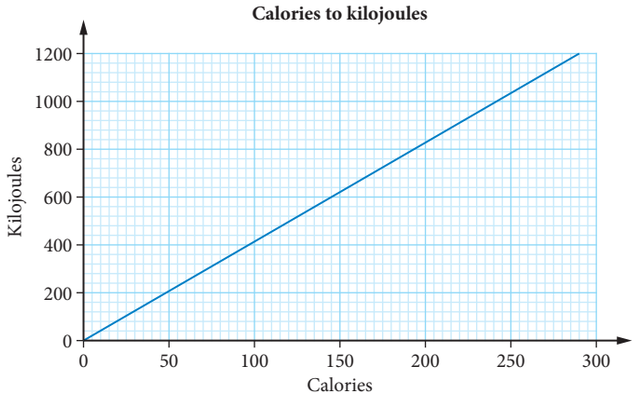
b Convert €50 to Australian dollars.

c A meal in Paris costs €35. What is this in Australian dollars?

d Gustav is visiting Australia. He has €25 on his debit card. Is this enough to pay for a $25 meal at the local club?

e Calculate how many euros you would get for A$220.

11 This conversion graph converts between calories and kilojoules, units of energy used in food nutrition.



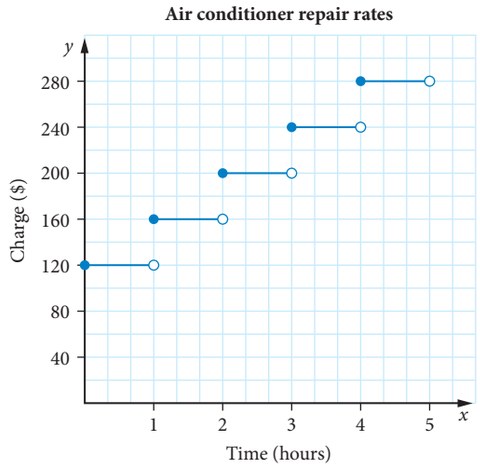
a Convert 100 calories to kilojoules.

b Nami's muesli bar contains 700 kJ of energy. How many calories is this?

c Jordan burned 500 calories working out at the gym. How many kilojoules is this?

d The average daily allowance for a healthy diet is 8700 kJ. How many calories is this?

12 A **step graph** is a line graph of 'broken' horizontal intervals that look like steps.
Prem repairs air conditioners. This step graph shows his charges according to the hours of work.



Remember: read the amount with the filled circle, not the open circle.

a How much does Prem charge for any time under an hour?

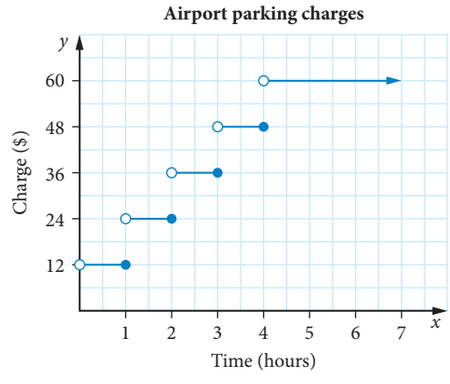
b How much does he charge for exactly 2 hours?

c How much would Prem charge for working at your house for 4.5 hours?

d How much does he charge for each additional hour he stays to make repairs?

e Why does he charge a lot more for the first hour than for additional hours?

13 This graph shows the charges for parking at an airport.



a How much does the airport charge for 2 hours of parking?

b Anh parked for 3 hours and 23 minutes. How much did his parking cost?

c When Madison went to the airport to pick up her mum, the plane was delayed. She had to park for 6 hours and 42 minutes. How much did this cost?

d According to this graph, what is the most you will have to pay for parking at the airport?

e What is the average charge per hour for parking at the airport for 6 hours?

14 This **pie graph** or **sector graph** shows the results of a survey of NSW people about their favourite sport to watch on TV.

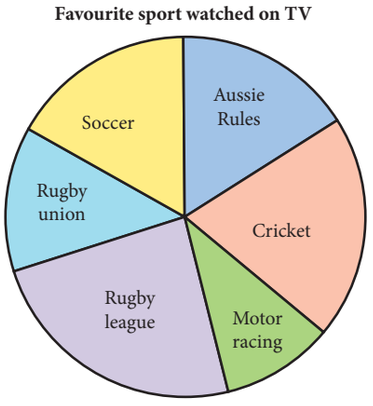
a What is the most popular sport?

b What is the least popular sport?

c Which 2 sports have sectors approximately the same size?

d Rugby league was the favourite sport of 24% of the 3500 people surveyed. How many people preferred to watch rugby league on TV the most?

e Do you think the results of a survey like this one would be different if the survey was taken in different states? Justify your answer.

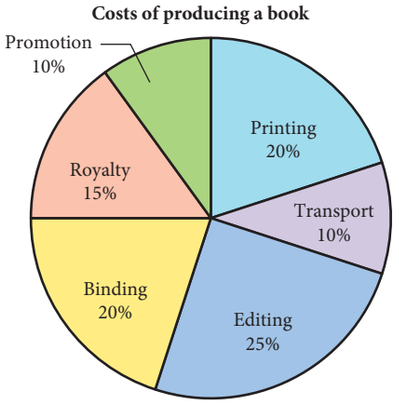


15 This graph shows the costs of producing a book as a percentage of the book price.

a Which is the highest cost in producing a book?

b List the costs in order from highest and lowest.

c Royalties to authors account for 15% of the cost of production. A new textbook costs $65. How much is the royalty payment?

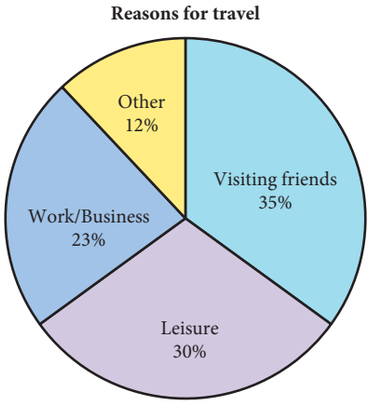


16 Air Nelson surveyed passengers on a flight from Perth to Melbourne about their reasons for travelling to Melbourne.

a What was the main reason people were travelling from Perth to Melbourne?

b Of the 176 passengers on this flight, how many were travelling for work/business?

c This survey was conducted on a Friday evening. Would you expect the same results if the survey was conducted on a Monday evening? Justify your answer.

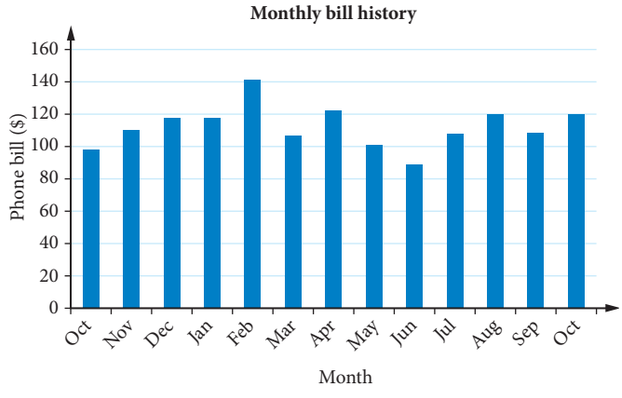


3.4 Everyday graphs

EXERCISE 3.4 Everyday graphs

ANSWERS p. 411

1 This type of graph commonly appears on a phone bill.



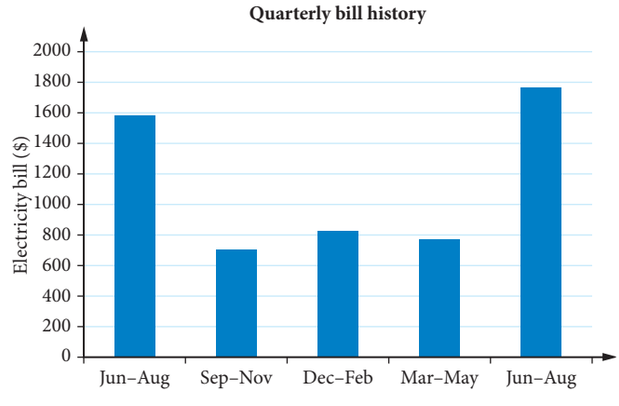
a How much is the most recent phone bill?

b How does this compare with the same time last year?

c What is the lowest amount paid for 1 month?

d Why would the telephone company include this graph on a phone bill?

2 This is a typical electricity bill graph.



a How many months does each bill cover?

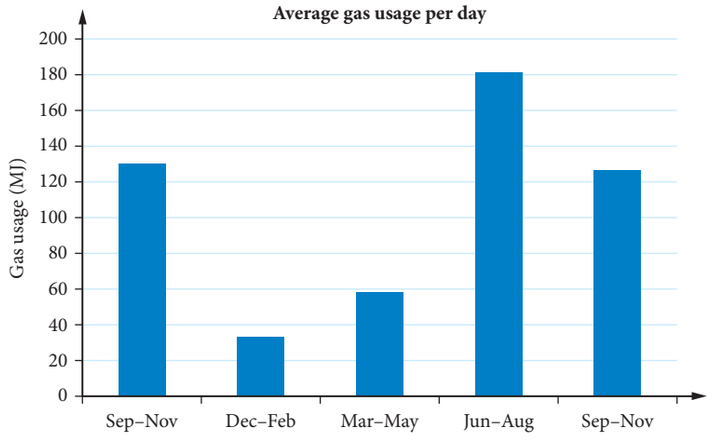
b What is the most recent amount paid?

c Give a reason why the amounts in June to August are much bigger than for the other months.

d Why is this type of graph useful to customers?

Worksheets
Every picture tells a story
Reading graphs and tables

3 Gas bills usually show 'Your average daily gas usage' measured in megajoules (MJ).



a How many months in total does this graph cover?

b What is the highest average daily gas usage?

c At what time of year is the most amount of gas used? Why might this occur at this time of year?

d Why is this type of graph useful to customers?

4 This table shows the interest rates offered by NVM Bank for term deposits over differing periods of time. With a term deposit, the money must stay in the account for the whole time and interest is paid at the end.

	Number of months												
Minimum deposit	1	2	3	4	5	6	7	8	9	10	11	12	24
$1000	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
$5000	2.05	2.05	2.55	2.30	2.30	2.75	2.30	2.30	2.30	2.30	2.30	2.75	3.15
$20 000	2.05	2.05	2.55	2.30	2.30	2.75	2.30	2.30	2.30	2.30	2.30	2.75	3.15
$50 000	2.05	2.05	2.55	2.30	2.30	2.75	2.30	2.30	2.30	2.30	2.30	2.75	3.15
$100 000	2.05	2.05	2.55	2.30	2.30	2.75	2.30	2.30	2.30	2.30	2.30	2.75	3.15

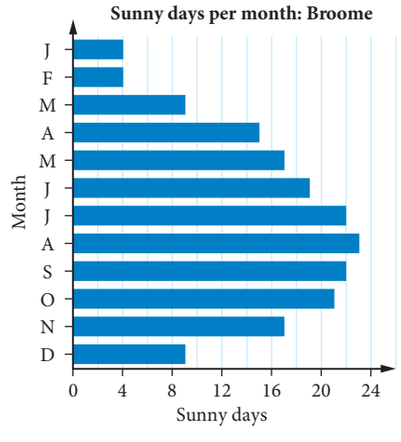
a What is the lowest interest rate offered?

b Regina has $5000 that she wants to spend on a holiday in 10 months. What is the best interest rate available to her?

c Stephen invests $20 000 for 12 months. How much interest does he earn?

d What are the disadvantages of putting your money in a term deposit for 24 months?

5 This graph shows the number of sunny days per month last year in Broome, Western Australia.



a Which month had the most sunny days?

b Which month had the least sunny days?

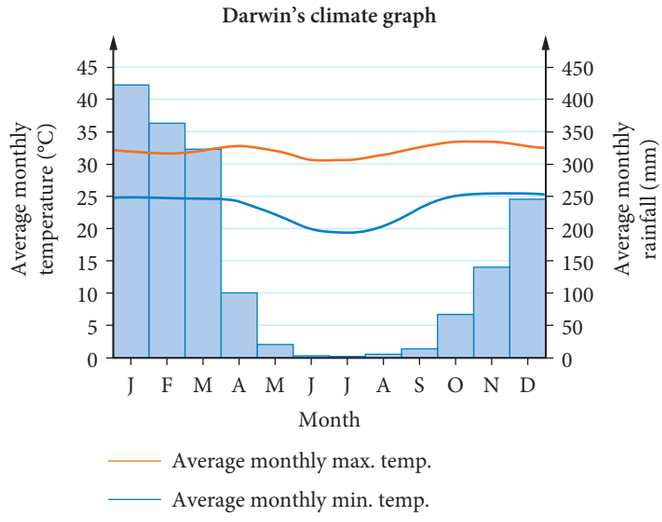
c List 3 pairs of months that had approximately the same number of sunny days.

d How many months of the year had 16 or more sunny days?

e Andrea is getting married in Broome. She would like a sunny day for her wedding. In which 3-month period should she plan her wedding to be most likely to get a sunny day?

f Give another reason why this graph might be useful.

6 A **climate graph** combines temperature and rainfall information. This climate graph is for Darwin.

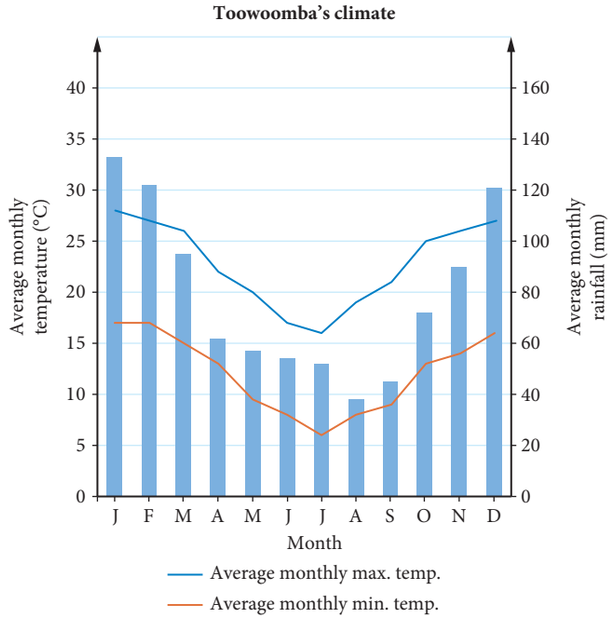


a What is the average maximum temperature in Darwin in December?

b Which 3 months have the coldest minimum temperatures?

c Describe Darwin's average monthly rainfall pattern.

7 This climate graph is for Toowoomba, Queensland.



a Which 4 months have the lowest rainfall?

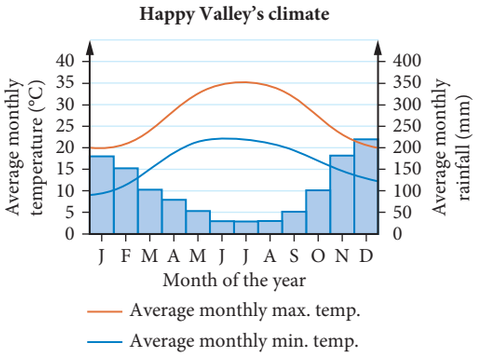
b What is the difference between the average maximum and minimum temperatures in Toowoomba in February?

c How much more rain falls during October than during July?

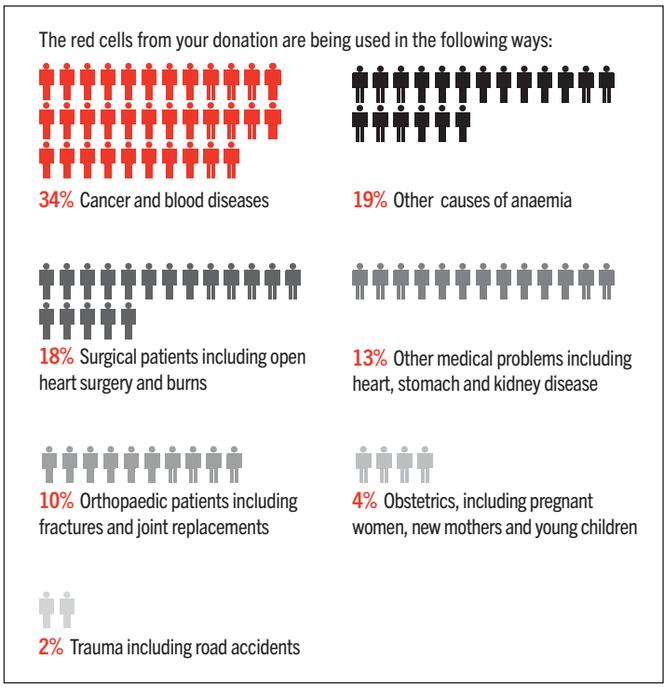
d Explain why it would be useful to have a graph like this for any place you might consider moving to.

8 Is Happy Valley in the northern hemisphere or the southern hemisphere?

Explain your answer.



9 This picture graph published by the Australian Red Cross Blood Service shows how the red cells from blood donations are being used.



a What does each person symbol stand for?

b Explain how this graph helps you understand how blood donations are used.

c Is there any information in this graph that surprises you? Explain your answer.

d Does this graph make you more likely to donate blood?

e If 27 000 litres of blood are collected in a week, how much of it goes to help patients with cancer and blood diseases?

Investigation Graphs in other subjects

Graphs are used to record and present data across all subject areas. For each of the subjects you study other than Mathematics:

- find examples of graphs used in the subject (find as many different types as possible).
- name the types of graphs used.

Which is the most common type of graph used across different subjects? Suggest a reason why this type of graph is used frequently.

Write a short paragraph on the uses of graphs in your areas of study. Explain the similarities and differences. Suggest reasons why different subjects use different types of graphs.

Present your findings as a PowerPoint presentation or display them as wall charts.

3.5 Choosing the best graph

We use different graphs for different types of data. In this exercise, you will learn some hints to help you choose the best graph for each type of data.

EXERCISE 3.5 Choosing the best graph

ANSWERS p. 412

1 Categorical data is often represented by a **column graph**. A group of Year 11 students were surveyed on the make of car owned by their families, with the results shown in the table. Draw a column graph for the data.

Make of car	Frequency
Holden	12
Ford	10
Mitsubishi	7
Subaru	5
Toyota	8
Other	3

2 The media often use a **pictogram** because it is an attractive graph. They are best used when the data is not too spread out and precise accuracy isn't required.

The Cairns Tourism Board wants to increase its tourist numbers in winter. It published the number of rainy days in June for a number of cities.

City	Rainy days in June
Cairns	10
Melbourne	18
Adelaide	24
Sydney	15
Hobart	17
Perth	16
Brisbane	15

Graph the data as a pictogram, using the symbol to represent 4 rainy days.

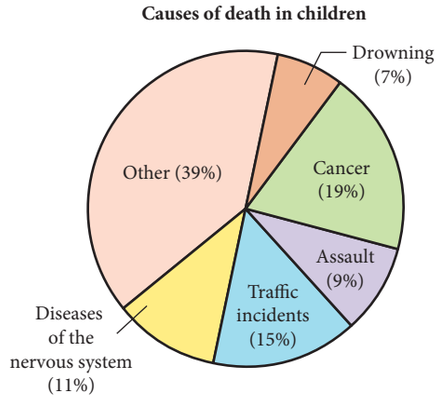
3 A pie graph is used to show each category as a fraction of the whole. This pie graph shows the causes of children's deaths over a year in Australia.

a What percentage of the deaths were caused by drowning?

b What was the most common cause of death?

c Drowning, assault and traffic incidents are considered preventable causes of death. What percentage of deaths are from something that could have been prevented?

d If there were 1769 child deaths in total, how many were preventable?



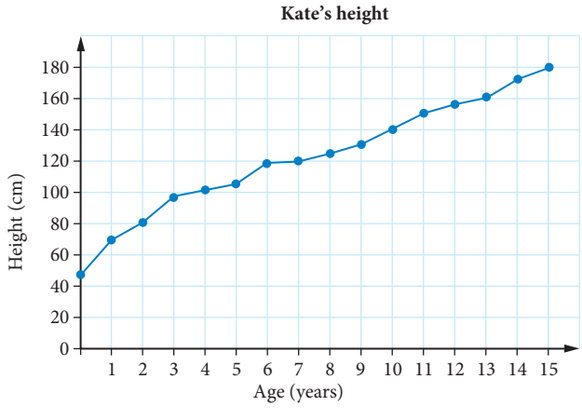
4 A survey of 1080 office workers in central Melbourne were asked how they travelled to work. This data is a summary of their responses.

a Copy and complete this table of results that calculates the angle for each sector in a pie graph. Round each answer to the nearest degree.

Method of transport	Frequency	Angle for sector graph
Train	220	$\frac{220}{1080} \times 360° =$
Tram	280	$\frac{280}{1080} \times 360° =$
Bus	130	$\frac{130}{1080} \times 360° =$
Car	230	$\frac{230}{1080} \times 360° =$
Ferry	80	$\frac{80}{1080} \times 360° =$
Cycle	140	$\frac{140}{1080} \times 360° =$
Total	1080	

b Draw a pie graph for this data.

5 This **line graph** charts Kate's height over her first 15 years. At birth, Kate was 48 cm long.



a What was Kate's height:

i on her first birthday? **ii** at age 10?

b At what age did Kate reach:

i 1 metre? **ii** 150 cm?

c Between which 2 birthdays did Kate grow the most?

d How long did it take Kate to double her height from birth?

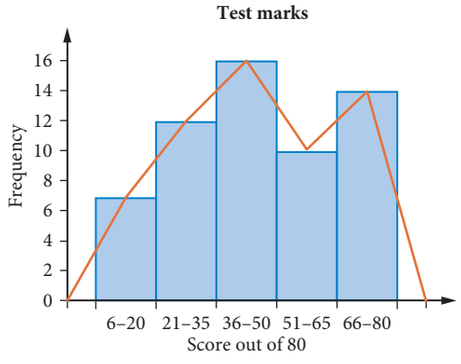
e What do you think the graph would look like from age 15 to 20 years?

6 This table shows the temperatures over 24 hours in Alice Springs in November.

Time	noon	3 pm	6 pm	9 pm	midnight	3 am	6 am	9 am	noon
Temperature	32°C	35°C	33°C	29°C	26°C	24°C	23°C	29°C	34°C

Draw a line graph for this data.

7 We use a **frequency histogram** or a **frequency polygon** to see the shape of the data. A group of students was given a maths test and the test marks out of 80 were grouped into **class intervals**, then graphed on this frequency histogram and polygon.



a Copy and complete the frequency table using the graph.

Test marks	Frequency
6–20	
21–35	
36–50	
51–65	
66–80	
Total	

b How many students sat the test?

c Which class interval of test marks was the most common?

d How many students scored less than 36 in this test?

8 The water level of a canal was measured over 43 days and recorded below.

Water level (cm)	Frequency
152	5
153	6
154	8
155	12
156	4
157	8
Total	43

Draw a frequency histogram for this data.

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Videos
Dot plots

Stem-and-leaf plots

Worksheet
Stem-and-leaf plots 1

3.6 Dot plots and stem-and-leaf plots

Dot plots are used for small sets of numerical data that are close together.

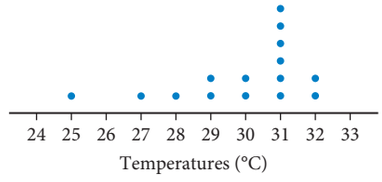
Stem-and-leaf plots are used for larger sets of numerical data and list the actual data values.

EXAMPLE 3

The daily maximum temperature (in °C) in Cairns in July was recorded for 15 days.

32, 30, 31, 32, 31, 30, 31, 31, 31, 31, 29, 25, 28, 27, 29

Construct a dot plot for this data.

Steps	Working
The temperatures go from 25°C to 32°C, so the line for the dot plot should go from 24 to 33. Add a dot above the line for each data value.	

EXAMPLE 4

Sarah works for law enforcement and recorded the number of malicious property damage reports in the inner-city each month over 3 years.

54, 41, 55, 49, 37, 38, 37, 48, 51, 44, 52, 44, 58, 70, 60, 46, 63, 54
45, 43, 46, 55, 55, 67, 49, 66, 90, 45, 66, 62, 51, 51, 53, 53, 38, 52

Draw an ordered stem-and-leaf plot for this data.

Steps	Working
The stem will be the tens digits. The smallest number is 37 and the largest number is 90, so the stem will go from 3 to 9.	Stem | Leaf 3 | 4 | 5 | 6 | 7 | 8 | 9 |
The leaf will be the units digit for each number in the data. This is called an unordered stem-and-leaf plot because the 'leaves' are not in order.	Stem | Leaf 3 | 7 8 7 8 4 | 1 9 8 4 4 6 5 3 6 9 5 5 | 4 5 1 2 8 4 5 5 1 1 3 3 2 6 | 0 3 7 6 6 2 7 | 0 8 | 9 | 0 Key: 3 | 7 = 37

Then we write the 'leaves' in order. This is called an ordered stem-and-leaf plot.

Stem	Leaf
3	7 7 8 8
4	1 3 4 4 5 5 6 6 8 9 9
5	1 1 1 2 2 3 3 4 4 5 5 5 8
6	0 2 3 6 6 7
7	0
8	
9	0

Key: 3|7 = 37

EXERCISE 3.6 Dot plots and stem-and-leaf plots

ANSWERS p. 412

1 EXAMPLE 3 Ahmed surveyed his maths class to find the number of hours each student spent on the internet each week. These are the results.

14, 15, 17, 18, 13, 16, 19, 19, 18, 14, 17, 15, 13, 13, 14, 19, 13, 14, 17, 18

a Draw a dot plot for Ahmed's data.

b How many students were in the class?

c How many students used the internet for 14 hours per week?

d How many students used the internet for more than 16 hours per week?

2 The number of motor vehicle thefts in an inner-city suburb was recorded each month for 1 year.

15, 9, 11, 16, 13, 11, 13, 12, 10, 15, 13, 9.

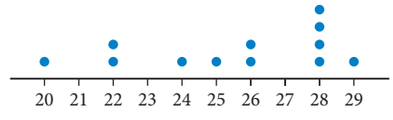
a Draw a dot plot for this data.

b In how many months were 13 motor vehicles stolen?

c What percentage of months had 13 motor vehicles stolen?

d In how many months were less than 12 motor vehicles stolen?

3 Lisa surveyed her friends on how much they spent on public transport last week. Their responses are shown on the dot plot, rounded to the nearest dollar.



Transport costs ($)

a How many friends did Lisa survey?

b What was the most common amount of money spent on public transport?

c How many of Lisa's friends spent less than $26 on public transport?

4 EXAMPLE 4 Mrs White, the school canteen manager, records the daily number of students served at the canteen over 3 weeks.

105, 76, 97, 88, 114, 86, 124, 101, 112, 98, 95, 105, 117, 81, 112

a Show this information in an ordered stem-and-leaf plot.

b On what percentage of days were more than 100 students served? Answer correct to the nearest whole percentage.

5 A security firm recorded the monthly number of shoplifting incidents over 3 years.

20, 20, 23, 11, 12, 33, 22, 30, 16, 17, 35, 48,
25, 27, 25, 34, 20, 23, 25, 17, 12, 14, 13, 13,
48, 42, 55, 33, 24, 39, 26, 41, 33, 31, 19, 55

a Show this data on a stem-and-leaf plot.

b How many months had the number of incidents in the 30s?

c What percentage of the total months was this? Answer correct to the nearest whole percentage.

6 A class of Year 11 students was surveyed on the number of hours of part-time work they did in a month. The results are shown on this stem-and-leaf plot.

Stem	Leaf
0	0 0 5 8 9
1	1 4 5 6 7
2	1 2 4 5 6 7 9
3	1 3 5
4	2

Key: 4 | 2 = 42 hours

a What was the most number of hours worked by anyone in this sample?

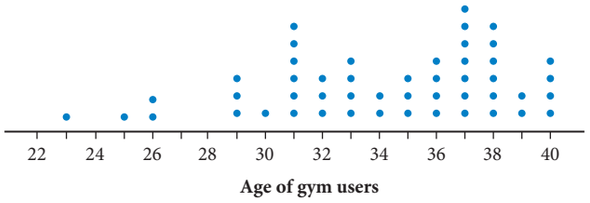
b How many students worked between 10 and 20 hours in the month?

c How many students worked more than 20 hours in the month?

d How many students were in this class?

e What percentage of students worked more than 20 hours in the month? Answer correct to the nearest whole percentage.

7 The ages of the people exercising at a gym one evening are shown in this dot plot.



Age of gym users

a What is the most common age of gym users?

b How old is the youngest gym user?

c How many people aged over 35 attended the gym on this evening?

d Copy and complete: Ages range from _____ to _____.

e How many people were at the gym that evening?

8 The points scores of all AFL teams in the first 4 rounds of the season are shown in this stem-and-leaf plot.

Stem	Leaf
6	4 4 6 6 6 8
7	0 0 2 2 3 3 7 8 8 9
8	0 2 3 4 4 6 9 9
9	3 4 4 4 5 7 7 8 8 9 9 9 9
10	0 3 4 8 9
11	0 1 1 2 3 4 8 9
12	0 7
13	4 4 5 5 7
14	2 3
15	0 0 2 3 4

Key: 15|0 = 150

a How many scores are there altogether?

b How many scores are below 100 points?

c What was the most frequent score?

d Copy and complete: The team scores range from _____ to _____.

e Which stem had the most scores?

9 Decide which graph – a histogram (H), a dot plot (D) or a stem-and-leaf plot (SL) – would be best to use for the given data. Justify your answer.

a Number of apples per tree

b Minimum temperature each day for a fortnight in February in Bendigo

c Salaries of the 40 employees of a small business

d Time taken to travel to school in minutes by students in Year 12

e Rainfall each day for the month of August in Sale

f Number of mobile phones per family in Railway St

g Ages of patients at a medical centre

h Sales of shirts at all branches of a fashion store in a week

i Number of students in each class at St Judy's Primary School

j Heights of all Year 11 students at Thomson Grammar School

Choosing the best graph

- Column and bar graphs are mostly used for categorical data.
- Clustered column graphs are used to compare categories.
- Pictograms display categories using graphics or symbols.
- Line graphs show data that change over time.
- Pie graphs are used to show each category as a fraction of the whole.
- Histograms and frequency polygons display numerical data that is in class intervals. They are used to show the shape of the distribution for large amounts of data, actual data values.
- **Dot plots** are used for small sets of numerical data that are close together.
- **Stem-and-leaf plots** are used for larger sets of numerical data and list the actual data values.

Puzzle
Data find-a-word

Keyword activity

CHAPTER SUMMARY

ANSWERS p. 413

1 Copy and complete each statement.

There are 2 types of data: _____ and _____.

When we take a _____, we ask some people to answer our questions.

All people in the population answer the questions in a _____.

2 Summarise in your own words the important features of each type of graph.

a climate graph
b column graph
c clustered column graph
d conversion graph
e dot plot
f line graph
g picture graph
h pie graph
i stem-and-leaf plot
j step graph

Solution to the chapter problem

Problem

As part of a research assignment, Madeline has collected data on the month of birth for the Year 11 students at her school. Her results are shown in this table.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7	4	6	3	9	5	9	2	6	3	4	2

Madeline wants to present this data graphically. What is the best graph for her to use? Justify your answer.

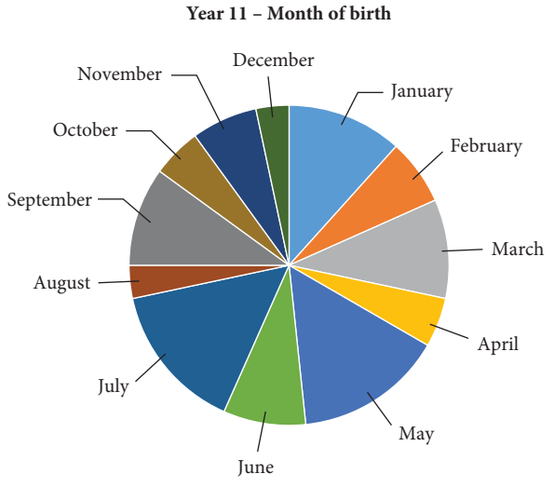
Solution

Madeline decides the best graph for this is a pie graph.

The reasons for choosing a pie graph are:

- the whole group of students (60 students) can be represented by the circle
- the number of students with birthdays in each month can be shown as the sectors in the circle
- the data can be shown as a fraction of the whole. For example, birthdays in January take up $\frac{7}{60}$ of the circle.
- it is easy to compare the number of birthdays in each month using this graph.

The graph is shown here.



3 Test yourself

Show me the graph

ANSWERS p. 413

1 EXERCISE 3.1 Classify each type of data as categorical (C) or numerical (N):

a brands of toothpaste
b hours of television watched per week
c number of employees in small businesses
d country of birth of students at a school
e heights of school students
f ratings given by customers for a restaurant

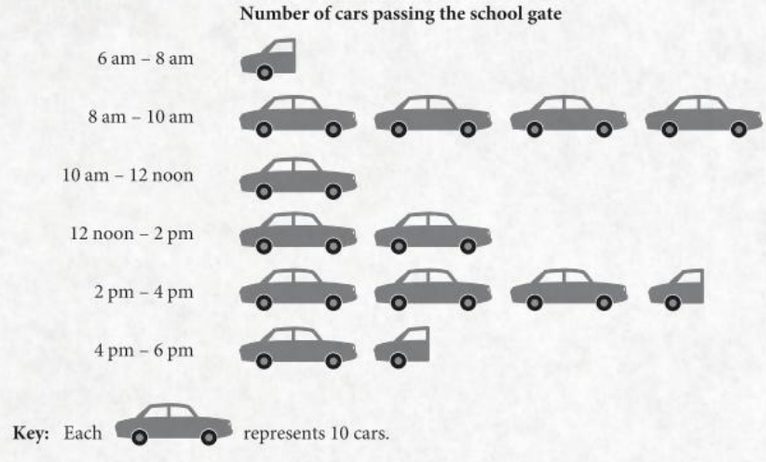
2 EXERCISE 3.2 Should you use a census or a sample to find the most popular television show in Victoria? Give a reason for your answer.

3 EXERCISE 3.2 For each investigation suggested below, determine:

i what the target population is
ii whether a census or a sample should be used

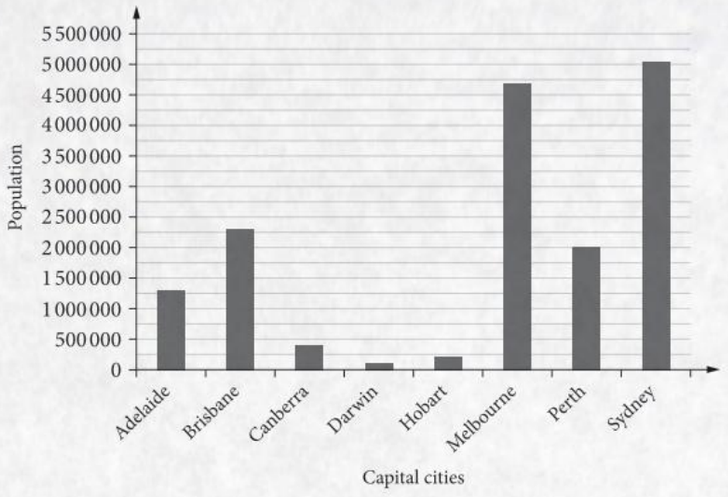
a number of children in each family in your street
b make of car in car fleets of Melbourne businesses
c voting intentions at the next Federal election
d in Victorian schools, whether boys complete more homework than girls

4 EXERCISE 3.3 This pictogram shows the number of cars passing a local high school at different times of day.



a How many cars passed the school gate between 8 am and 10 am?
b During which time period did 5 cars pass the school gate?

5 EXERCISE 3.3 This column graph shows the populations of the 8 Australian capital cities.

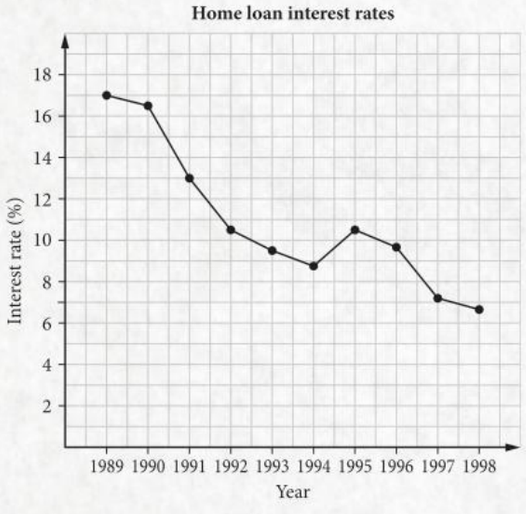


a Estimate the population of Perth from the graph.

b Estimate the difference between the populations of Perth and Melbourne.

6 EXERCISE 3.3 The table and graph below show the dramatic changes in home loan interest rates from 1989 to 1998.

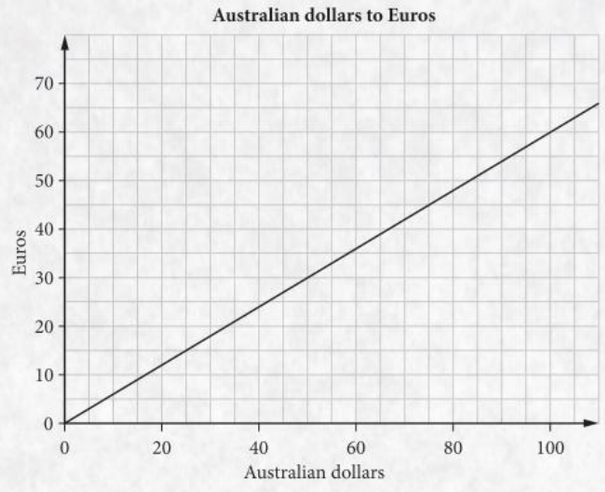
1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
17%	16.5%	13%	10.5%	9.5%	8.75%	10.5%	9.75%	7.2%	6.7%



a What was the home loan interest rate in 1991?

b By how much did the home loan interest rate rise from 1994 to 1995?

7 EXERCISE 3.3 This conversion graph can be used to convert Australian dollars to euros (€), the currency used in Europe.



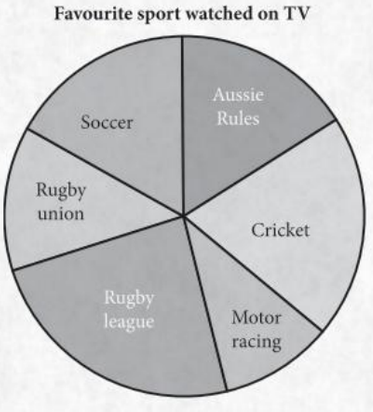
a Convert $60 to euros.

b Convert 60 euros to Australian dollars.

8 EXERCISE 3.3 This pie graph shows the results of a survey of NSW people about their favourite sport to watch on TV.

a Which sport has the smallest sector?

b Soccer was the favourite sport of 17% of those surveyed. 3500 people were surveyed. How many people preferred to watch soccer on TV?

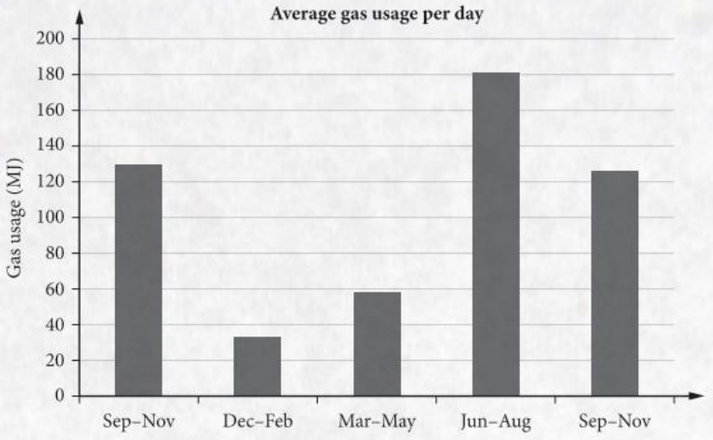


9 EXERCISE 3.4 This type of graph commonly appears on a phone bill.

a How much was the bill in August?

b What is the difference between the highest telephone bill and the lowest telephone bill over these 13 months?

10 EXERCISE 3.4 Gas bills usually show 'Your average daily gas usage' measured in megajoules (MJ).



a What is the lowest usage per day for gas shown on this graph?

b When did this occur?

c Suggest why the gas usage would be lowest at this time.

11 EXERCISE 3.4 This table shows the interest rates offered by NVM Bank for term deposits over differing periods of time. With a term deposit, the money must stay in the account for the whole time and interest is paid at the end.

	Number of months												
Minimum deposit	1	2	3	4	5	6	7	8	9	10	11	12	24
$1000	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
$5000	2.05	2.05	2.55	2.30	2.30	2.75	2.30	2.30	2.30	2.30	2.30	2.75	3.15
$20 000	2.05	2.05	2.55	2.30	2.30	2.75	2.30	2.30	2.30	2.30	2.30	2.75	3.15
$50 000	2.05	2.05	2.55	2.30	2.30	2.75	2.30	2.30	2.30	2.30	2.30	2.75	3.15
$100 000	2.05	2.05	2.55	2.30	2.30	2.75	2.30	2.30	2.30	2.30	2.30	2.75	3.15

a What is the highest interest rate offered?

b Annabel invests $50 000 for 6 months. How much interest does she earn?

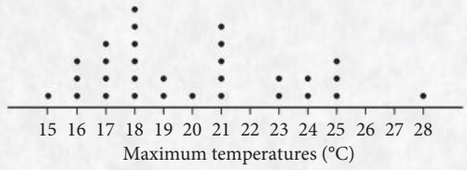
12 EXERCISE 3.5 Copy and complete this paragraph, choosing from this list:

categorical changes frequency histogram pictogram pie time

A column graph is often used for $_{a}$ _____ data. An attractive graph involving repeated images, symbols or icons often used in the media is a $_{b}$ _____. When we are showing parts of a whole, we use a $_{c}$ _____ graph. A line graph is used to show $_{d}$ _____ over $_{e}$ _____. A $_{f}$ _____ $_{g}$ _____ can be used with grouped data.

9780170448123

13 EXERCISE 3.6 The daily maximum temperatures (in °C) at Beechworth during April are shown in this dot plot:



a What was the most common daily temperature in April?

b What was the highest temperature in April?

c On how many days was the temperature below 20°C?

d Copy and complete: Temperatures in April ranged from _____ to _____.

14 EXERCISE 3.6 This stem-and-leaf plot shows the masses, in kilograms, of the players of a football team.

Stem	Leaf
7	1 5 6 8 9 9
8	0 0 0 2 2 2 3 4 4 5 8 8
9	0 0 0 0 2 2 4 5 6 8 8
10	4 5

Key: 7|1 = 71

a How many players are on the team?

b How many players weigh less than 90 kg?

c What mass occurs most often?

d What is the lowest mass?

e Copy and complete: The team weights range from _____ to _____.

Chapter problem

Charlie is making fruit punch for a birthday party. The recipe for 20 people uses 1.8 L of lemonade, 2.25 L of ginger ale, 4.5 L of orange juice, 2.25 L of pineapple juice plus fruit. How many 200 mL cups of punch will Charlie have for the birthday party?

CHAPTER 4

SPACE AND MEASUREMENT

METRES, LITRES AND GRAMS

4.1 Estimating length
4.2 Units of length
4.3 Perimeter
4.4 Measuring capacity, mass and time
4.5 Reading measurement scales
4.6 Reading medical scales
4.7 Measuring medicine
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Estimate and measure lengths
- Calculate perimeters
- Convert between metric units for length, capacity, mass and time
- Use and interpret non-metric units
- Read measurement scales
- Apply measurement to medical scales and medicine dosages

How are we ever going to use this?

- Estimating lengths when we don't have measuring equipment
- Converting different metric units
- Calculating the length of fencing we require
- Building and renovating

Study Design coverage

UNIT 1, AREA OF STUDY 4: SPACE AND MEASUREMENT

- standard metric units and measures, including common derived metric measures
- reading and interpretation of scales on digital and analogue instruments
- estimation and approximation strategies.

VCE Mathematics Study Design 2023–2027 p.14, © VCAA 2022

Skillsheet (1):
4.4 Units of time

Worksheets (3):
4.1 Your body as a ruler
4.4 Mass time trial • Converting time units

Puzzles (2):
4.2 Metric match-up
4.3 Perimeter code puzzle

Nelson MindTap

To access resources above, visit
cengage.com.au/nelsonmindtap

4.1 Estimating length

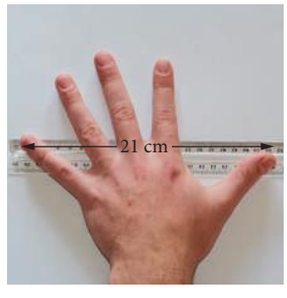
Most of us don't walk around with a tape measure or ruler in our pocket, but we often need to know how long an object is. There are a few tricks we can use to closely estimate a length. Our body parts can act as rulers for us; they're convenient and we always have them with us!

If you record on your smartphone the length of your little finger, the width of your palm, the length of your shoe and the length of your stride, you can use them to estimate lengths.

And you can use your phone's calculator to help too!

The photos below show some useful lengths. Your own measurements will be slightly different from these.

iStock.com/Hanis



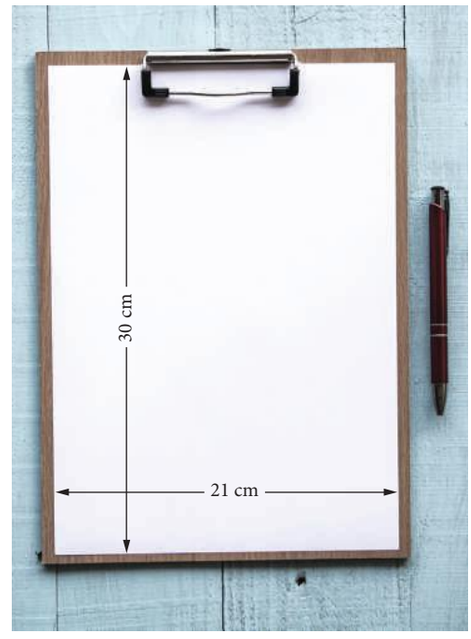
Scout Kozakiewicz

iStock.com/GoodLifeStudio

iStock.com/TayaCho

Reserve Bank of Australia

Reserve Bank of Australia



Shutterstock.com/Happy_studio

EXAMPLE 1

Melanie used her shoe to estimate the length of a table. She counted that it was 5 shoes long. Approximately how long is the table?

Steps	Working
According to the photo, a shoe is approximately 30 cm long, so multiply the number of shoes by 30.	$5 \times 30 = 150$ cm
Write your answer.	The table is approximately 150 cm long.

EXERCISE 4.1 Estimating length

ANSWERS p. 413

Use the photos on the previous page to help answer questions 1, 2 and 3.

1 EXAMPLE 1 Emma's verandah is 8 shoe lengths wide. Approximately how many centimetres wide is Emma's verandah?

2 Copy and complete this table.

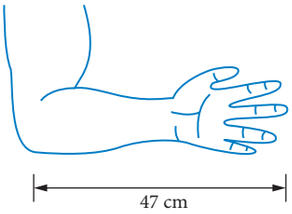
	Item	Length	Approximate length in cm
a	Children's story book	4 little fingers	
b	Length of a work bench	8 $50 notes	
c	Height of a cake	2 thumbs	
d	Height of a skateboard jump	3 widths of an A4 piece of paper	
e	Child's height	$3\frac{1}{2}$ hand spans	
f	The distance across the room	11 paces	

3 **a** This horse is 14 hand widths high. Calculate the height of the horse in cm.

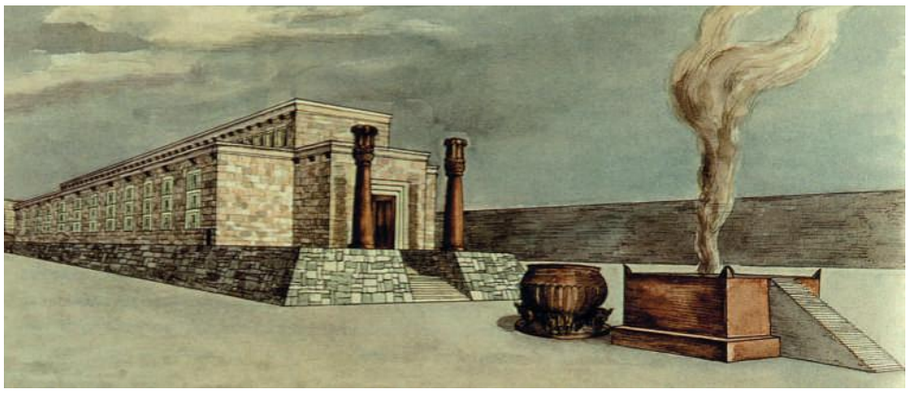
b Why do you think we measure a horse's height as it is shown in the photo and not as the distance of the top of its ears to the ground?

Shutterstock.com/lenkadan

4 A **cubit** is the distance from the top of our fingers to our elbow. Farrouk measured a piece of rope as 15 cubits long. Calculate the length of the rope in centimetres.



5 The Bible includes the measurements of King Solomon's Temple, which is thought to have been built around 1000 BCE. The temple's length was 60 cubits, its width 20 cubits, and its height 30 cubits.



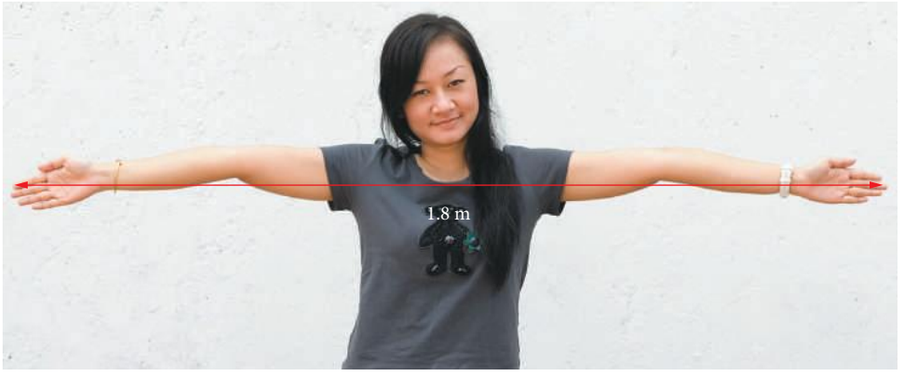
Alamy/www.BiblelandPictures.com

a Calculate the length, width and height of King Solomon's Temple in centimetres.

b Divide each measurement by 100 to convert them to metres.

6 A **fathom** is an old English measurement that we can use to help us approximate the length of fabric or fencing wire. It was also used in the imperial system to measure the depth of water (equal to 6 feet). A fathom is the distance from the finger tips on one hand to the finger tips on the other when the arms are stretched wide.

A fathom is 1.8 metres long. Alexis measured that she has 8 fathoms of fabric. How many metres of fabric does she have?



Shutterstock.com/Ampyang

The length of a 'fathom'.

Practical activity Your body as a ruler

To complete this investigation, each member of your group needs a ruler and a copy of the table below, which can be downloaded from Nelson MindTap.

Part 1

Measure each body part and record the length in the table.

Name:		
Body part	**Approximation use**	**Length**
Top section of thumb	Small lengths	
Little finger	Small lengths	
Hand span	Short lengths	
Foot (shoe)	Short distances on the ground	
Pace	Walking distances	
Fathom	Lengths of fabric or rope	

Part 2

Use your body measurements and a calculation to approximate each length.

1. The length of your classroom
2. The width of a page from this book
3. The length of your calculator
4. The length of a pen
5. The height of your desk above the floor
6. The width of a window in your classroom
7. The distance from your classroom door to the school canteen
8. The height of the classroom door above the floor

Part 3

Use a ruler or tape measure to check the accuracy of your approximations.

How good is your body as a ruler?

Worksheet
Your body as a ruler

4.2 Units of length

Puzzle
Metric match-up

Using body parts to estimate lengths can be convenient, but it's not very accurate because measurements vary from person to person. In the 1790s, the French Academy of Sciences developed a standardised measurement system called the **metric system**.

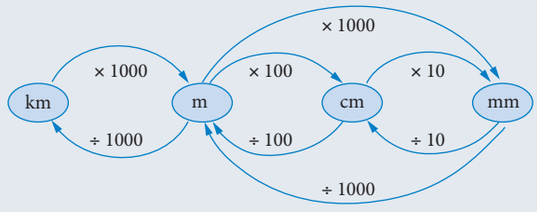
In the metric system, the **metre** is the basic unit for measuring length. Originally, 1 metre was defined to be one ten-millionth of the distance from the Equator to the North Pole at sea level.

Unit	Relationships	How we use it
kilometre (km)	1 km = 1000 m	Used to measure long distances, such as the distance between cities or countries
metre (m)	1 m = 100 cm 1 m = 1000 mm	Used to measure medium lengths, such as the length of a sporting field or the width of a room
centimetre (cm)	1 cm = 10 mm	Used to measure small lengths, such as the dimensions of a brick
millimetre (mm)		Used to measure very small lengths, such as the length of an insect or the size of your toenail

Metric units of length

To change from a small unit to a bigger unit, **divide** by the conversion factor.

To change from a big unit to a smaller unit, **multiply** by the conversion factor.



EXAMPLE 2

Convert:

a 30 m to cm **b** 780 m to km **c** 65 cm to mm

Steps	Working
a There are 100 cm in 1 metre. The conversion factor is 100. Changing from m to cm is changing to a smaller unit. We need to multiply by the conversion factor.	30 m = 30 × 100 cm = 3000 cm
b 1000 m in 1 km. Changing from m into km is changing into a bigger unit. Divide by the conversion factor.	780 m = 780 ÷ 1000 km = 0.78 km
c 10 mm in 1 cm. Changing from cm into mm is changing into a smaller unit. Multiply by the conversion factor.	65 cm = 65 × 10 mm = 650 mm

Non-metric units

Before Australia adopted the metric system in 1974, we used the Imperial system of measurement based on feet (for length), pounds (for mass) and gallons (for capacity). The USA still uses the imperial system today.

Sometimes, we use non-metric lengths. For example, distances at sea and in the air are often given in nautical miles. The depth of water can be stated in fathoms. Many people still use miles, yards, feet and inches to measure distances. The conversion factors are shown in the table below for interest. Note that they are unlike the metric system and *not* based on powers of 10.

Unit	Metric equivalent	How the unit is used
inch	2.54 cm	To measure small lengths.
foot	30.48 cm	To measure small lengths. 1 foot = 12 inches
yard	0.9144 m	To measure lengths where we would use metres today. 1 yard = 3 feet
fathom	1.8288 m	To measure the depth of water. 1 fathom = 6 feet
furlong	201.168 m	A length used in horse racing.
mile	1.609 km	To measure large distances where we would use kilometres today. 1 mile = 1760 yards
nautical mile	1.852 km	Measure long distance across water or in the air.

EXAMPLE 3

The distance from Adelaide to Perth by air is 1144 nautical miles.

What is this distance in kilometres, correct to the nearest km?

Steps	Working
1 nautical mile = 1.852 km	1144 nautical miles = 1144 × 1.852
Converting to km is changing to a smaller unit. Multiply by the conversion factor.	= 2118.688 km ≈ 2119 km
Write the answer.	The air distance from Adelaide to Perth is 2119 km.

EXAMPLE 4

The pattern for the shawl that Rhea plans to knit requires 856 yards of wool. She has 820 metres of wool. Is this enough?

Steps	Working
1 yard = 0.9144 m	820 m = 820 ÷ 0.9144
Converting 820 m into yards is changing to the bigger unit. We have to divide the number of metres by 0.9144.	= 896.7629 yards
Answer the question.	Rhea has 896 yards of wool and needs 856 yards. She has enough wool for the shawl.

EXERCISE 4.2 Units of length

ANSWERS p. 413

1 Write the metric unit that is most suitable for measuring:

a your height

b the length of your bedroom

c the distance from your home to Geelong

d the length of an ant

e the distance from Perth to Melbourne

f the thickness of a strand of hair.

2 EXAMPLE 2 In each part, state the conversion factor and whether you have to multiply or divide.

a km to m **b** mm to cm **c** cm to m **d** m to km

e m to cm **f** m to km **g** cm to mm

3 Copy and complete each conversion.

a 3 cm = _____ mm **b** 5 m = _____ cm **c** 400 m = _____ km

d 2 km = _____ m **e** 30 mm = _____ cm **f** 200 cm = _____ m

g 500 mm = _____ m **h** 250 m = _____ km **i** 60 cm = _____ m

j 60 cm = _____ mm **k** 4500 m = _____ km **l** 0.8 km = _____ m

m 8 mm = _____ cm **n** 90 m = _____ cm **o** 90 m = _____ km

p 6.5 m = _____ mm

4 Follow each step to convert 0.64 km into cm.

a Change 0.64 km into m.

b Change your answer to part **a** into cm.

5 Follow each step to convert 85 000 cm into km.

a Convert 85 000 cm into metres.

b Change your answer to part **a** into km.

6 Copy and complete each conversion.

a 0.45 km = _____ cm

b 4 800 000 mm = _____ km

c 1.3 km = _____ mm

d 41 750 cm = _____ km

7 Express 5970 m in kilometres, correct to the nearest km.

8 Change 75 640 mm to metres, correct to the nearest metre.

9 Every morning, Scott goes to the pool to train. This morning, Scott completed 78 laps at training. Each lap was 50 metres long.

a How many metres did Scott swim this morning?

b How many kilometres did Scott swim at training this morning?

c Scott's coach wants him to swim 4.5 km tomorrow. How many laps of the 50 m pool will Scott have to complete to swim 4.5 km?

10 In one layer of a coil there are 165 wire turns. Each wire turn is 12.95 cm long. Calculate the total length of the wire in metres. Express your answer correct to the nearest metre.

11 Melissa is making 75 cm long elastic bandages from a bulk roll of bandage 120 m long. How many bandages will she be able to make?

12 When Brent went canoeing, he paddled down a 3540-m rapid and a 2860-m rapid.

a Calculate the total length of the rapids in metres.

b Express the distance in kilometres.

13 A cricket pitch is 22.6 metres long. During a test match, Grant ran the length of the pitch 137 times.

a Calculate the length he ran in metres.

b Calculate the length he ran in kilometres, correct to 2 decimal places.

14 Ian has a lawn and garden maintenance business. He takes all of his green waste to be recycled at the tip. Last week, he drove to the tip 6 times and each return trip was 26.8 km. Ian claims 75c for each km he travels as a business expense. Calculate the amount he will claim for last week's trips to the tip.

Photo courtesy of Sue Thomson

15 Select the most likely measurement **A**, **B**, **C** or **D**.

a The height of a 10-storey building

A 4 m **B** 40 m **C** 400 m **D** 4000 m

b The distance from Melbourne to Sydney

A 100 km **B** 500 km **C** 1000 km **D** 5000 km

c The diameter of a doughnut

A 1.2 cm **B** 12 mm **C** 12 cm **D** 120 m

16 EXAMPLE 3 Copy and complete each conversion, correct to 1 decimal place.

a 80 nautical miles = _____ km **b** 15 inches = _____ cm

c 5 furlongs = _____ m **d** 2000 feet = _____ m

e 4 fathoms = _____ m **f** 7 miles = _____ km

Use the table on page 92.

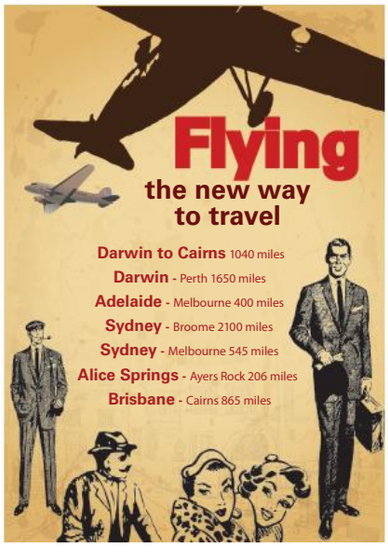
17 EXAMPLE 4 Convert 120 yards to metres, correct to 1 decimal place.

18 Which is the longer horse race: 8 furlongs or 1600 metres?

19 An old navigation chart shows that the water is 9 fathoms deep. How deep is the water in metres, correct to 1 decimal place?

20 This travel poster from the 1940s uses miles instead of kilometres.

Design a new poster that shows the distances in kilometres.



21 Rolls of carpet are traditionally 12 feet wide. What is the width of a roll of carpet in metres, correct to 2 decimal places?

22 Olympic swimming pools were once 55 yards long, now they are 50 m long. Are they now longer or shorter than the old pools and by how much?

23 How many furlongs in a mile?

Puzzle
Perimeter code puzzle

4.3 Perimeter

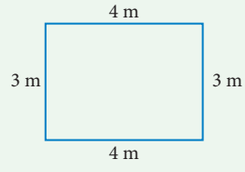
When we measure the distance around the outside of a shape, we are measuring its **perimeter**. Home renovators use perimeter calculations to work out the quantity of a variety of materials they need to order.

EXAMPLE 5

To decorate her baby's bedroom, Menhal is applying a wallpaper **frieze** around the top of its walls. The diagram below on the right shows the dimensions of the room.

The frieze is available in 5 m and 10 m rolls. How many rolls of frieze will Menhal need?

Alamy Stock Photo/Elizabeth Whiting & Associates



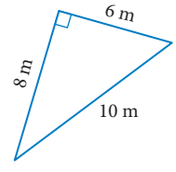
Steps	Working
Calculate the perimeter of the room by adding up the lengths of all sides.	perimeter = 3 + 4 + 3 + 4 = 14 m
Then compare the length that Menhal needs to the lengths of the rolls.	Menhal needs to buy 1 of the 10 m rolls and 1 of the 5 m rolls. (She will have 1 m left over.)

EXERCISE 4.3 Perimeter

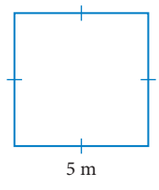
ANSWERS p. 414

1 EXAMPLE 5 Calculate the perimeter of each shape.

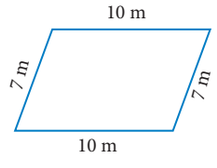
a



b



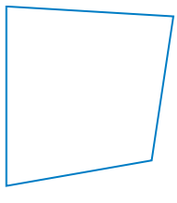
c



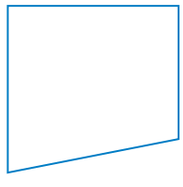
2 The sides of a **rectangle** are 4 m and 11 m long. Calculate the perimeter of the rectangle.

3 Measure the perimeter of each shape as accurately as you can.

a



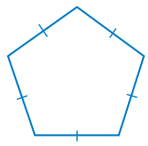
b



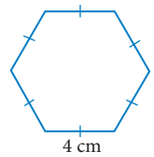
4 The perimeter of a rectangle is 36 m. What could the lengths of its sides be? Suggest 2 possible sets of sides.

5 All the sides in a **regular polygon** are the same size. The diagrams show 3 regular polygons. Write the name of each polygon and calculate its perimeter.

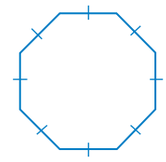
a



b



c



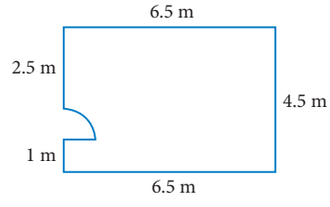
6 The perimeter of a 10-sided regular polygon is 60 m. How long are the sides of the polygon?

7 Kylie needs to replace the fence around her pool and BBQ area. In her **scale diagram**, 1 cm represents 2 m.

a What is the perimeter of Kylie's scale drawing?

b Kylie is going to put a fence around the perimeter with a 90 cm wide gate in it. How long will the fence be?

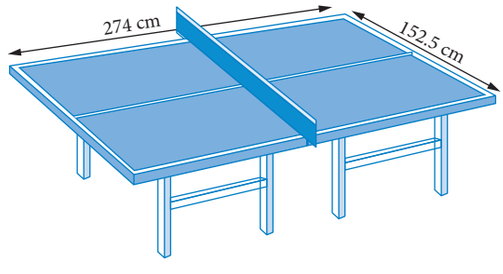
8 Alex is replacing the skirting boards in his home cinema room. The diagram below shows the lengths of the wooden boards that surround a room along the base of its walls.



a Calculate the length of the skirting boards that Alex will need.

b The skirting boards cost $9 per metre. How much will it cost Alex to buy the skirting boards?

9 The college table tennis tables need some restoration before the competition starts. A special tape is going to be placed on the lines around the outside of the table and down the middle.



a Calculate the length of tape required.

b How many metres of tape will be required for 5 tables?

c The tape comes in rolls of size 5 m, 10 m and 25 m. Which rolls should the college buy and how many?

Skillsheet
Units of time

Worksheets
Mass time trial

Converting time units

4.4 Measuring capacity, mass and time

Unit	Relationships
Capacity	
millilitre (mL)	
litre (L)	1 L = 1000 mL
kilolitre (kL)	1 kL = 1000 L
megalitre (ML)	1 ML = 1 000 000 L
Mass	
milligram (mg)	
gram (g)	1 g = 1000 mg
kilogram (kg)	1 kg = 1000 g
tonne (t)	1 t = 1000 kg
megatonne (Mt)	1 Mt = 1 000 000 t
Time	
second (s)	
minute (min)	1 min = 60 s
hour (h)	1 h = 60 min = 3600 s
day (day)	1 day = 24 h

EXAMPLE 6

Convert:

a 2500 g to kg

b 1.2 kL to mL

Steps	Working
a 1 kg = 1000 g We are converting to a larger unit (kg), so we divide by 1000.	2500 g = 2500 ÷ 1000 = 2.5 kg
b First convert kL to L, and then L to mL. 1 kL = 1000 L 1 L = 1000 mL We are converting to a smaller unit (mL), so we multiply.	1.2 kL = 1.2 × 1000 L = 1200 L = 1200 × 1000 mL = 1 200 000 mL

EXERCISE 4.4 Measuring capacity, mass and time

ANSWERS p. 414

1 What unit would be the most suitable to use if you were measuring:

a the time it takes to eat lunch?

b your best friend's mass?

c how long it takes for a plant seed to shoot?

d the amount of medicine in a teaspoon?

e the amount of water in a bucket?

f the time it takes to drive from Melbourne to Canberra?

g the mass of one egg?

h the amount of water in an Olympic-sized swimming pool?

i the mass of a truck?

j how long it takes to tie your shoe lace?

k the mass of a feather?

2 EXAMPLE 6 Convert each mass to grams.

a 1800 mg **b** 9.5 kg **c** 365 mg **d** 0.2 t

3 Convert each capacity to litres.

a 12.2 kL **b** 6340 mL **c** 550 mL **d** 0.98 kL

4 Copy and complete each conversion.

a 32 min = _____ s **b** 550 g = _____ kg

c 45 g = _____ mg **d** 15.2 L = _____ mL

e 0.8 h = _____ min **f** 96 h = _____ d

g 65 700 L = _____ kL **h** 16 h = _____ min

i 12 300 kg = _____ t **j** 3.2 t = _____ g

k 3 d = _____ min **l** 56 800 mg = _____ kg

5 Hamish delivers 6750 kg of grapes to the market in South Melbourne. How many tonnes is this?

6 A large egg weighs 60 g on average. The eggs are sold in cartons containing 12 eggs per carton.

a What is the weight of eggs in one carton?

b For delivery to the supermarket, the eggs are packaged in containers holding 24 cartons each. How many kilograms of eggs are there in a package?

c The vehicle transporting the eggs can carry 20 of these packages. What is the weight of eggs transported in kilograms and in tonnes?

7 Elizabeth has some pet rabbits, which she feeds with a special milk supplement. Each rabbit is given 125 mL of the supplement each day.

a How many litres of the supplement will she need per day to feed 12 rabbits?

b Elizabeth buys the supplement in 4.5 L containers. How many 125 mL feeds will it make?

8 It takes Yestin $3\frac{1}{2}$ minutes to sow each row of corn. Today he intends to plant out 48 rows.

How many hours will it take him?

9 Select the most likely measurement **A**, **B**, **C** or **D**.

a The capacity of a backyard swimming pool.

A 30 L **B** 300 L **C** 3000 L **D** 30 000 L

b The mass of an orange.

A 3 mg **B** 3 g **C** 300 g **D** 3000 g

c The capacity of a soft drink can.

A 3.8 mL **B** 38 mL **C** 380 mL **D** 3800 mL

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Investigation Estimating mass

To complete this investigation, your group will need a set of scales that measures small masses (for example, a set of kitchen scales) and scales that measure weights in kg (for example, a set of bathroom scales). You will also need a range of items to estimate their mass.

This table shows some common items and their approximate mass.

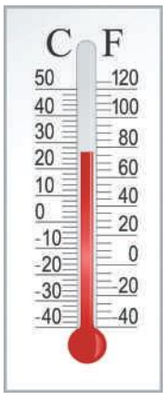
Mass	Items with this approximate mass
1 mg	grain of sand tiny insect like a sandfly
2 g	5c coin
100 g	iPhone without a case
1 kg	1 litre of water or milk 5 medium-sized oranges
50 kg	a thin woman or fashion model
100 kg	a tall, solid or muscular man

What you have to do

1. Choose an item, for example a debit card.
2. Select an item in the right column of the table that has a similar mass. For example, a debit card is similar in mass to a 5c coin.
3. Compare the two items and estimate the mass of the unknown item. A debit card is about twice as heavy as a 5c piece. It will be about twice as heavy as 2 g. It will be about 4 g.
4. Use the scales to check the accuracy of your estimate.

Investigation Celsius vs Fahrenheit

There are two different units for measuring temperature: degrees Celsius (°C) and degrees Fahrenheit (°F).



123RF Stock Photo/Wolfgang Grossman Wolfgang

1. Investigate the Celsius and Fahrenheit temperature scales. Which one belongs to the metric system?
2. Copy and complete this table to compare common temperatures.

Temperature	Celsius °C	Fahrenheit °F
Freezing point (temperature) of water		
Comfortable air-conditioning temperature		
Normal human body temperature		
The maximum temperature on a hot day		
Boiling point (temperature) of water		

3. Find a formula or online calculator to convert between the 2 temperature scales and use it to copy and complete each conversion.

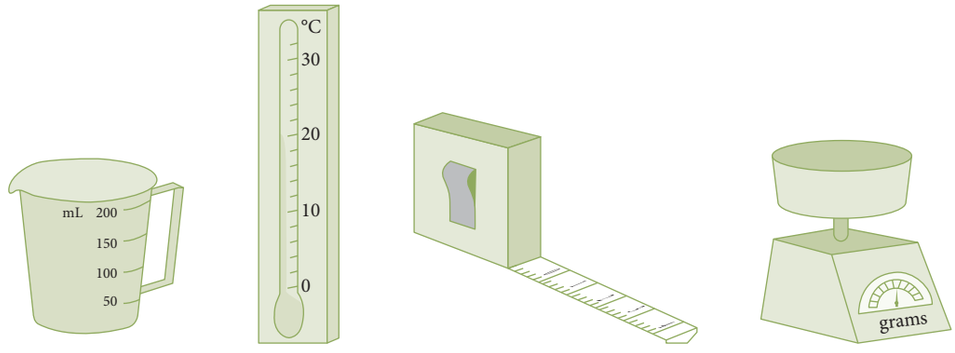
   50°C = _____ °F

   50°F = _____ °C

4. American ovens use °F and Australian ovens use °C. Design a conversion table that shows common cooking temperatures in both scales.

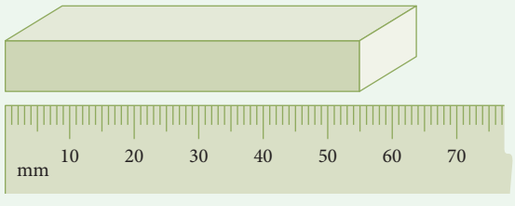
4.5 Reading measurement scales

Many measuring devices use markings called scales. Your ruler is a good example.



EXAMPLE 7

How long is the eraser?



Steps	Working
On the ruler's scale, there are 10 units between 0 and 10 mm, so each unit is 1 mm. The length of the eraser is halfway between 50 mm and 60 mm, or (50 + 5) mm.	The length of the eraser is 55 mm.

EXERCISE 4.5 Reading measurement scales

ANSWERS p. 414

1 Read the temperature, in degrees Celsius, from the scale on each thermometer.

a

b

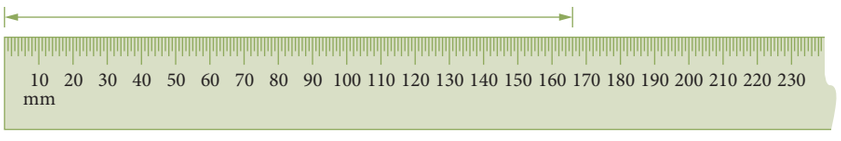
c

d

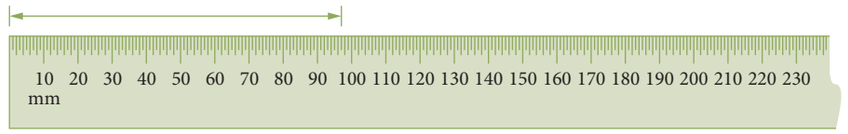
e

2 EXAMPLE 7 Read the scale on the ruler to find the length of each given line segment, to the nearest millimetre.

a



b



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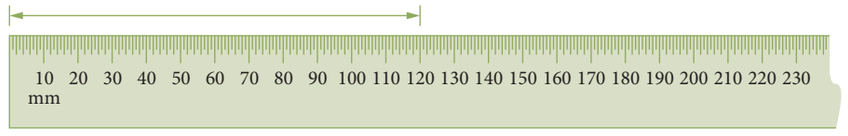

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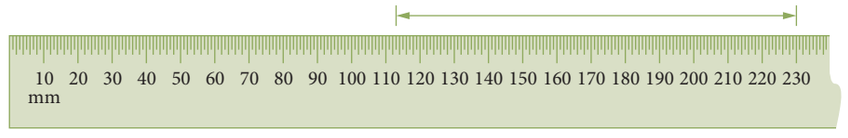

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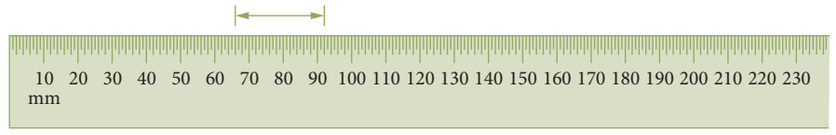

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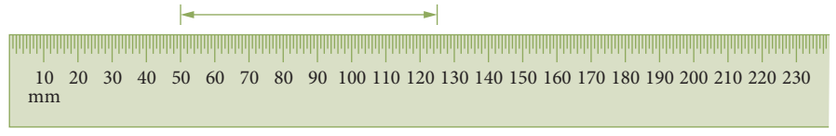

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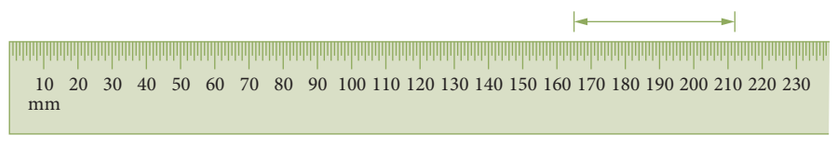

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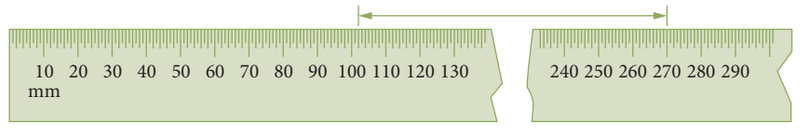
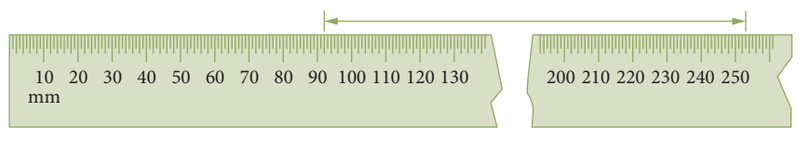


i



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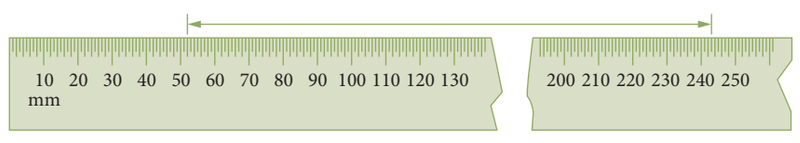
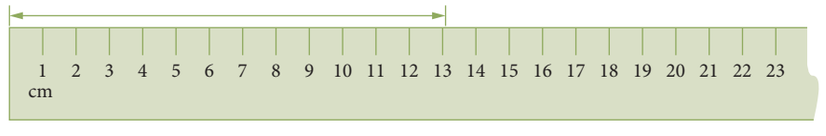


3 Read the scale on the ruler to find the length of each given line segment, to the nearest centimetre.

a



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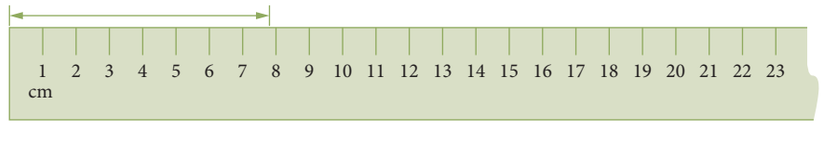

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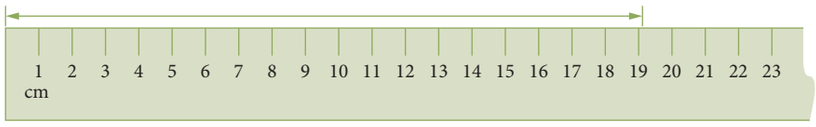

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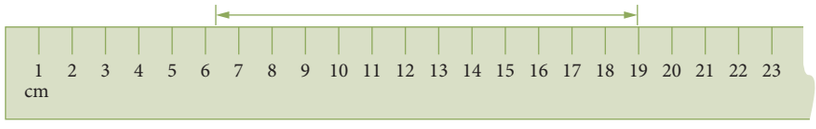

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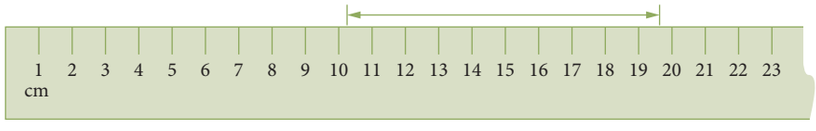

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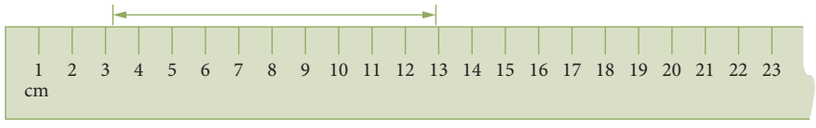

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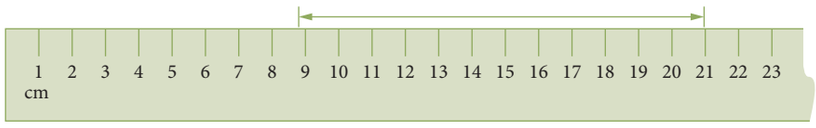

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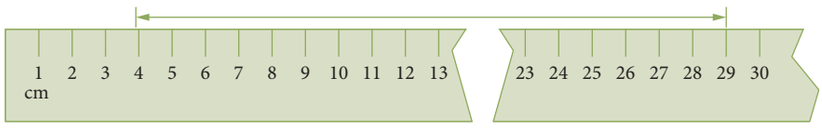

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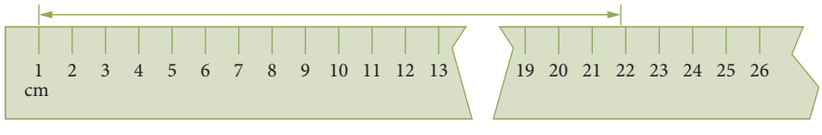

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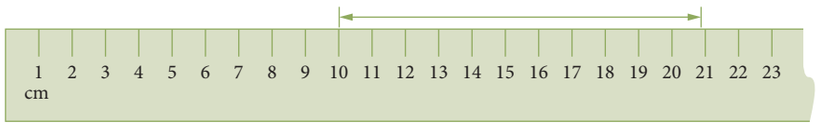
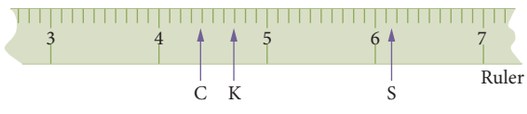
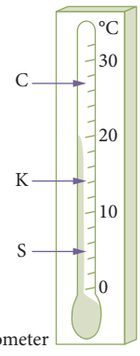


4 Write the values shown by C, K and S on each of these scales.

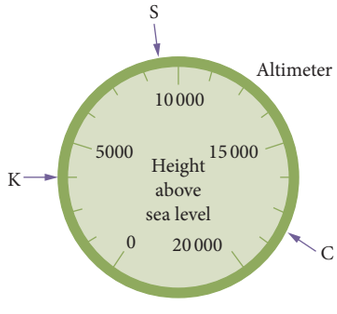
a



b

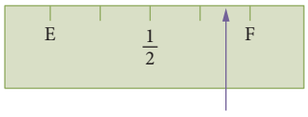


c

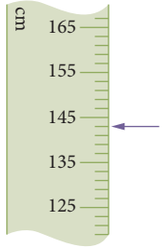


5 Write the value shown by the arrow marker each time.

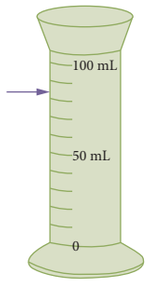
a



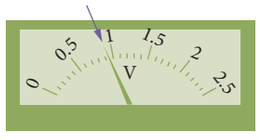
b



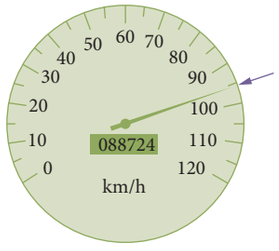
c



d



e



6 Find other mathematical uses of the word 'scale'.

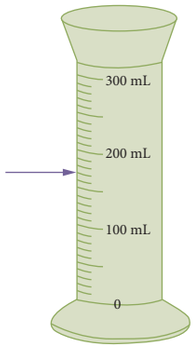
7 What value is shown by the arrow? Select the correct answer **A**, **B**, **C** or **D**.

A 17 mL

B 107 mL

C 152 mL

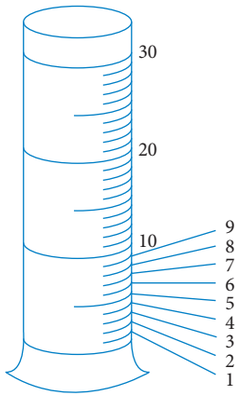
D 170 mL



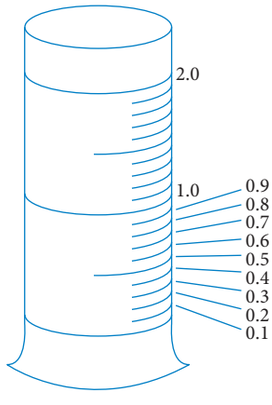
4.6 Reading medical scales

Medications are an important part of modern medicine. When we are measuring medications it is important to measure and interpret the quantities accurately. Making a mistake can affect someone's health and wellbeing.

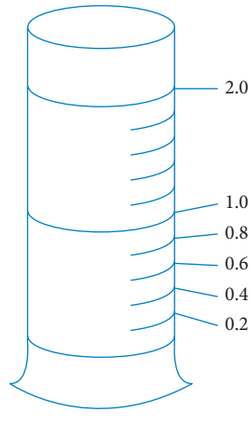
Scales always go up by a constant amount.



In this measuring cylinder, the scale goes up by 1.



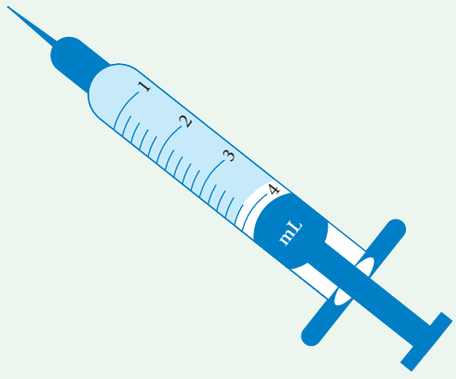
The scale on this cylinder goes up by 0.1.



The scale on this cylinder goes up by 0.2.

EXAMPLE 8

How much penicillin is in this syringe?



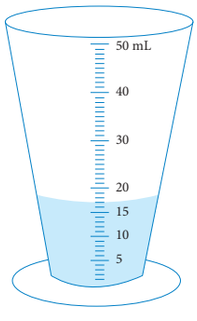
Steps	Working
The scale is going up by 0.2 mL.	
The amount is between 3 and 4, so it will be 3 point something.	$3 + 4 \times 0.2 = 3.8$
The amount is 4 units above 3.	There is 3.8 mL of penicillin in the syringe.

EXERCISE 4.6 Reading medical scales

ANSWERS p. 414

1 EXAMPLE 8 Read the volume of medicine shown in each container.

a



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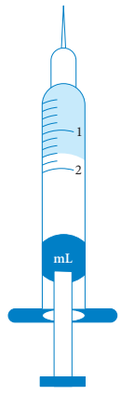
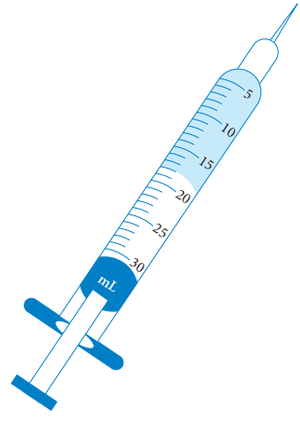
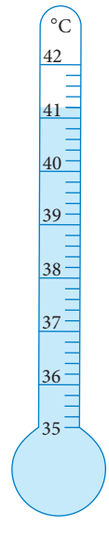


c

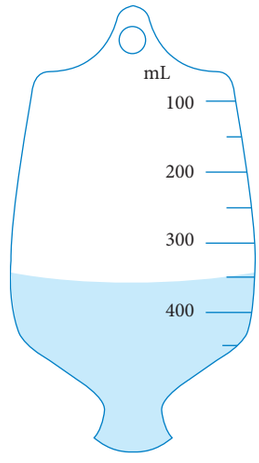


2 Nadine feels very hot. Her mother took her temperature with this thermometer. What is Nadine's temperature?



3 The scale on an IV drip bag tells you how much of the drip has already gone into the patient. When it was full, this bag held 500 mL.

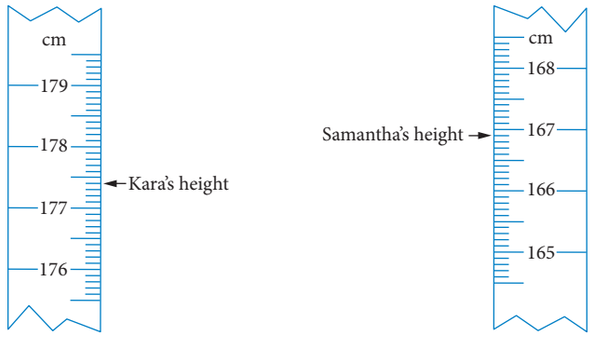
iStockphoto/araraadt



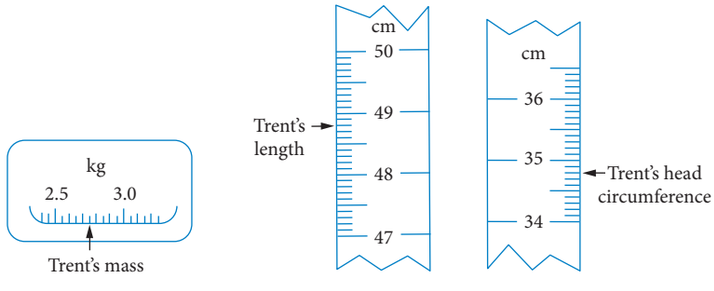
a How much of the drip has the patient received already?

b How much is left in the drip bag?

4 The doctor in the sports clinic measured Kara and Samantha's height. How tall is each girl?

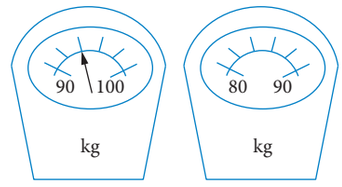


5 When Trent was born, the midwife measured his weight, length and head circumference. What was Trent's weight, length and head circumference?



9780170448123

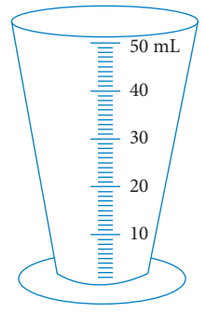
6 Paul's doctor asked him to stand on the scales on the left (90–100).



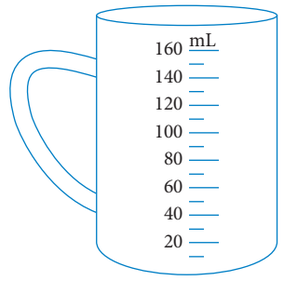
a How much does Paul weigh?

b Paul needs to lose 8 kg. His doctor told him to follow a special diet and to do regular exercise. Copy the scales on the right (80–90) and mark Paul's target weight on them.

7 Jody has a fever. Her doctor wants her to take 35 mL of paracetamol to help bring down her temperature. Copy the diagram of the medicine cup and show the volume of paracetamol Jody should take.



8 Anh is on a 'restricted fluids' diet. He is only allowed 1.2 L of liquid per day. The nurse gives Anh a drink every 2 hours. His first drink is at 0600 (6 am) each day and the last drink at 2000.



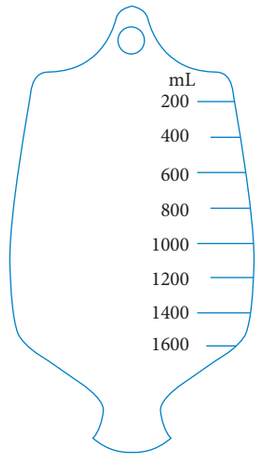
a How many drinks is Anh allowed per day?

b Express 1.2 L in mL.

c How many mL is in each of Anh's drinks?

d Copy the diagram of the drinking mug and mark the level of Anh's drink.

9 Kristy receives a dietary supplement each day. She receives 150 mL of supplement every 2 hours through a nasal tube.



a How many *litres* of supplement does she receive in 24 hours?

b Show the height of the supplement in the feed bag 14 hours after a new bag started.

4.7 Measuring medicine

A dose of medicine (liquid or tablet) is often quite small, usually measured in millilitres or milligrams.

EXAMPLE 9

A 500 g bottle in the hospital pharmacy contains 12 500 pills. Calculate the mass of one pill in mg.

Steps	Working
Divide 500 g by 12 500 to calculate the mass of 1 pill.	mass of 1 pill = 500 ÷ 12 500 g = 0.04 g
Convert the answer to milligrams by multiplying by 1000.	= 0.04 × 1000 mg = 40 mg

EXERCISE 4.7 Measuring medicine

ANSWERS p. 414

1 EXAMPLE 9 A pharmacist ordered a 120 g bottle that contains 2000 tablets.

a Calculate the mass of 1 tablet in g.

b What is the mass of each tablet in mg?

2 Copy and complete each conversion.

a 0.5 g = _____ mg

b 700 mL = _____ L

c 300 mg = _____ g

d 0.4 L = _____ mL

3 After Anthony had a heart attack, his doctor told him to take one 100 mg aspirin tablet every morning to help stop his blood from forming clots.

a How many grams of aspirin does Anthony take in a 30-day month?

b The packet contains 168 aspirin tablets. Calculate the mass of the tablets in grams.

4 The nurse on the mobile blood bank van gives everyone who donates blood a 150 mL glass of orange juice.

a How much orange juice will the nurse use to fill 12 glasses?

b How many glasses can the nurse fill from a 5-L cask of orange juice?

5 When Natasha had a severe infection her doctor prescribed a penicillin injection. The injection contained 0.0022 L of liquid. How many millilitres is this?

6 Vitamin C powder contains 90% ascorbic acid and 10% calcium.

a How many milligrams of calcium are in 40 mg of vitamin C powder?

b How many milligrams of ascorbic acid are in 60 mg of vitamin C powder?

c Calculate the number of milligrams of calcium in 2.4 g of vitamin C powder.

7 The total mass of a bottle of 500 tablets is 155 g. The bottle weighs 20 g.

a Calculate the mass of the tablets in grams.

b What is the mass of the tablets in milligrams?

c Calculate the mass of one tablet in milligrams.

8 Ordinary table salt contains 40% sodium.

a How much sodium is in 100 g of salt?

b Kim is allowed 2 g of salt in her diet per week. How many milligrams of sodium is she allowed per week?

9 How many 50 mg injections can a doctor make from a 1 g container of streptomycin?

10 Kate is 35 weeks pregnant and has a urinary tract infection. Her doctor prescribed her an antibiotic to clear up the infection before the baby is born. The appropriate dose is 20 mg per kg of body weight per day. Kate weighs 74 kg.

a How many grams of antibiotic does she require per day?

b Kate will take the medication every 3 hours. How many mg of antibiotics does she need in each dose?

11 Ceftriaxone is an antibiotic that treats pneumonia. The daily intravenous dose is 100 mg per kg of body weight, with a maximum dose of 4 g. How much antibiotic should a 65-kg pneumonia patient receive daily?

Keyword activity

CHAPTER SUMMARY

ANSWERS p. 414

4.7

Select the correct keyword from the list to copy and complete the chapter summary.

body	capacity	gram	kilometres
length	medicine	metric	perimeter
one thousandth	scales		

Throughout history people have used different ways to measure items. Early systems of measurement used parts of the [1]_____, which was quite confusing. In the 18th century, the French developed a measuring system called the [2]_____ system, in which the metre is the basic unit for measuring [3]_____. For longer distances we use [4]_____, which are equivalent to 1000 m. We can use millimetres, which are [5]_____ of a metre, to measure small lengths.

When we measure the distance around the outside of a shape, we are measuring its [6]_____.

We use millilitres and litres when we measure [7]_____. The base unit for measuring mass is the [8]_____. Time units are NOT based on powers of 10.

When taking measurements we need to be able to read [9]_____. This is particularly important for nurses when they measure and give out [10]_____ to patients. When we take measurements we have to be as accurate as we can.

Solution to the chapter problem

Problem

Charlie is making fruit punch for a birthday party. The recipe for 20 people uses 1.8 L of lemonade, 2.25 L of ginger ale, 4.5 L of orange juice, 2.25 L of pineapple juice plus fruit. How many 200 mL cups of punch will Charlie have for the birthday party?

Solution

total amount of liquid = 1.8 + 2.25 + 4.5 + 2.25
= 10.8 L
= 10.8 × 1000 mL (change to millilitres)
= 10 800 mL

number of cups = 10 800 ÷ 200
= 54 cups

Charlie will have approximately 54 cups of punch for the birthday party.

4 Test yourself

Metres, litres and grams

ANSWERS p. 414

1 EXERCISE 4.1 Using the information in 4.1 Estimating length, page 88, calculate the approximate measurements of these items:

a length of a desk that is 5 lengths of an A4 sheet of paper.

b the width of a room that is 9 paces.

c dimensions of your phone that is 1 little finger wide and 3 little fingers long.

2 EXERCISE 4.2 Copy and complete each conversion.

a 5 cm = _____ mm

b 3 m = _____ cm

c 3600 m = _____ km

d 4.2 m = _____ mm

e 770 cm = _____ m

f 8500 m = _____ km

3 EXERCISE 4.2 Puti needs 5 lengths of chain to complete a chain front fence. Each length will be 1.7 metres.

a How much chain does Puti need? Answer in metres.

b How much is this in centimetres?

4 EXERCISE 4.3 What is the perimeter of a rectangular garden, 11 metres by 4 metres?

5 EXERCISE 4.3 Stuart is installing new guttering around the perimeter of a rectangular shed. The dimensions of the shed are width 6.8 m by length 14.3 m.

a How much guttering does Stuart need?

b Guttering comes in 3-metre lengths. How many lengths of guttering Stuart will need?

6 EXERCISE 4.4 Copy and complete each conversion.

a 3.4 kL = _____ L

b 6200 g = _____ kg

c 480 seconds = _____ mins

d 7.5 t = _____ kg

e 8750 mL = _____ L

f 2 weeks = _____ hours

7 EXERCISE 4.4 Julia is a farmer who sends her fruit and vegetables to market in cartons. Each carton weighs 22.5 kg and she sends a truckload of 115 cartons each week. What is the mass of fruit and vegetables that Julia sends in tonnes? Round your answer to 1 decimal place.

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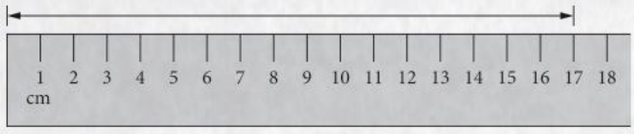
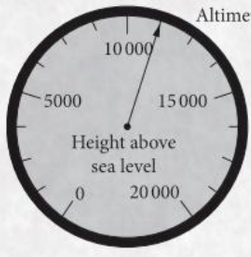
8 EXERCISE 4.5 Read each scale carefully and write down the measurement shown.

a



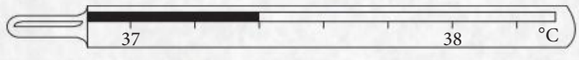
b



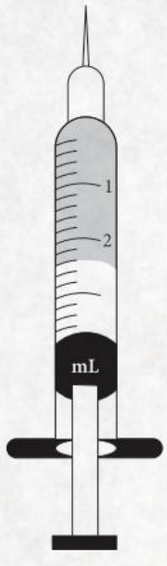
c

9 EXERCISE 4.6 Read each scale carefully and write down the measurement.

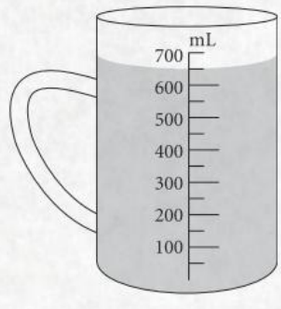
a



b



c



10 EXERCISE 4.7 The total mass of a bottle of 250 tablets is 105 grams. The bottle weighs 10 grams.

a Calculate the mass of the tablets in grams.

b What is the mass of the tablets in milligrams?

c Calculate the mass of one tablet in milligrams.

11 EXERCISE 4.7 How many 100 mg injections can a doctor make from a 1.5-gram container of the drug he is using?

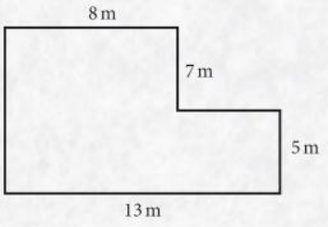
Practice set 1

ANSWERS p. 415

Section A Multiple-choice questions

For each question, select the correct answer **A**, **B**, **C** or **D**.

1 EXERCISE 4.3 Dave is replacing the guttering on an old house, which runs around the perimeter of the house, as shown in the diagram. The guttering comes in lengths 6 metres long and he can cut lengths to fit, if required. How many lengths of guttering will Dave need?



A 6 **B** 8
C 9 **D** 50

2 EXERCISE 1.1 Sharon earns $19.75 per hour for a 72-hour fortnight. What is Sharon's annual pay?

A $34 128 **B** $36 972 **C** $68 256 **D** $73 944

3 EXERCISE 2.4 When evaluating the expression $120 - 30 \div 3 \times 5 + 8$, which operation do you do first?

A + **B** − **C** × **D** ÷

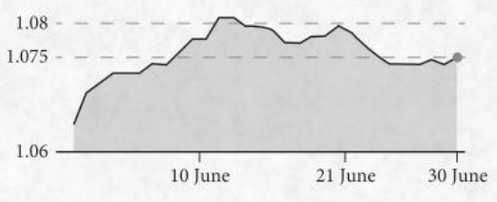
4 EXERCISE 2.7 Round 17.749 to 1 decimal place, then subtract 14.3 rounded up to the nearest whole number from it. The answer is

A 2.7 **B** 2.8 **C** 3.7 **D** 3.8

5 EXERCISE 2.3 Ruth and Jim are playing golf. Ruth's final score is −4 and Jim's is +3. Who won the game and by how many strokes?

A Jim by 7 **B** Jim by 1 **C** Ruth by 7 **D** Ruth by 1

6 EXERCISE 3.4 The graph shows the value of $1 Australian in New Zealand dollars each day in June. How much more was $500 Australian worth in New Zealand dollars on 21 June than on 30 June (the point on the right)?



A $0.25 **B** $2.50
C $25 **D** $250

7 EXERCISE 1.8 Last year, Anna's gross income was $78 600 and she had allowable deductions totalling $3105. Use the tax table below to calculate the amount of income tax Anna is required to pay, correct to the nearest dollar.

Taxable income	Tax on this income
Up to $18 200	Nil
$18 201 to $45 000	19c for each $1 above $18 200
$45 001 to $120 000	$5092 + 32.5c for each $1 above $45 000
$120 001 to $180 000	$29 467 + 37c for each $1 above $120 000
$180 001 and over	$51 667 + 45c for each $1 over $180 000

A $9961 **B** $15 003 **C** $16 012 **D** $17 021

9780170448123

8 EXERCISE 2.2 Dylan is playing darts. Calculate his score when his 3 darts landed on double 7, 11 and triple 19.

A 37 **B** 82 **C** 93 **D** 132

9 EXERCISE 1.1 Sunil earns $3672 per month. What is his weekly salary, correct to the nearest dollar?

A $847 **B** $918 **C** $1695 **D** $1836

10 EXERCISE 4.7 The total mass of a bottle of 500 tablets is 310 grams. The bottle weighs 10 grams. What is the mass of 1 tablet in milligrams?

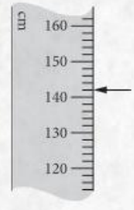
A 0.6 mg **B** 6 mg **C** 60 mg **D** 600 mg

Section B Short-answer questions

1 EXERCISE 4.5 What measurements are indicated by the arrows?

a

b



2 EXERCISE 2.4 Use a calculator to evaluate each expression, correct to 1 decimal place.

a $18.36 + 242.36 - 26.87$ **b** $26.51 + 19.5 \div 2.4$ **c** $(9.3)^2$

3 EXERCISE 1.1 Baily is a part-time solicitor. His annual salary is $102 000.

a How much does Baily earn per month?

b Calculate Baily's fortnightly pay to the nearest dollar.

4 EXERCISE 3.5 Match each description of a set of data (**a**, **b**, **c**) with the best type of graph to display the data (**A**, **B**, **C**).

a A company's share price each month for 2 years.

b The proportion of petrol, hybrid, hydrogen and electric cars registered in Victoria.

c The number of boys (2 to 10 years), girls (2 to 10 years), babies (less than 2 years) and teenagers (greater than 10 years) in a queue to see Santa Claus.

A Pie chart

B Column graph

C Line graph

5 EXERCISE 1.2 Liam works in a 24-hour childcare centre for children of essential workers. His normal pay is $21.20 per hour.

a How much does he earn per hour when he works at time-and-a-half?

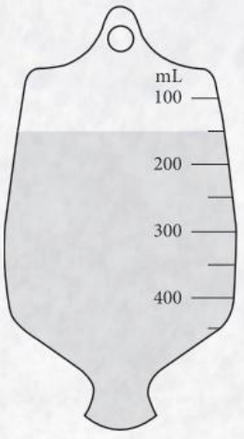
b When Liam works the night shift on weekends he is paid double time. Calculate his pay for working 7 hours on the late shift on a Saturday night.

6 EXERCISE 2.7 Round each measurement correct to the nearest whole number.

a 14.76 kg **b** 84.2 m **c** 3.5 mm **d** 12.49 cm

7 EXERCISE 1.2 Emma earned $276 for working 6 hours at double time. Calculate Emma's normal rate of pay.

8 EXERCISE 4.6 The scale on the drip bag tells you how much of the drip has already gone into the patient. The bag holds 500 mL when it is full.



a How much of the drip has the patient received already?

b What percentage of the full bag is remaining?

9 EXERCISE 1.2 Jack is an electrician. For emergency late night callouts, he charges a callout fee of $560 and labour at $135 per hour or part thereof. Last night, he received an emergency call at 2 am.. Calculate the amount he will charge for going to the emergency and working for 2 hours 30 minutes to fix the problem.

10 EXERCISE 4.2 Copy and complete each conversion.

a 4 cm = _____ mm

b 8 m = _____ cm

c 4500 m = _____ km

d 6.2 m = _____ mm

e 850 cm = _____ m

f 4900 m = _____ km

11 EXERCISE 3.2 Annabel wants to convince the local council that the residents in the area need more play equipment in the local parks. To support her campaign, she is investigating the number of children in each family in the area.

a Should she use a census or a sample?

b Who is the target population?

12 EXERCISE 1.4 Zoe is a teacher's aide. Her normal weekly pay is $1336. Calculate her holiday pay for a 4-week holiday including a 17.5% annual leave loading.

13 EXERCISE 1.5 Josh is a commercial artist. His art features on tourist souvenirs. He receives 5% commission on the sale of each souvenir. How much commission will Josh receive from the sale of 13 000 souvenirs with an average price of $26?

14 EXERCISE 2.5 Answer this question by estimating without using a calculator.

Hannah bought 6 metres of fabric priced at $13.99/m.

a Approximately how much will the fabric cost?

b The shop assistant charged her a total of $81.94. Is the bill right?

15 EXERCISE 1.5 Cody is a landscape gardener. He charges $38 per square metre to lay pavers. How much will Cody charge for laying 22 square metres of paving?

16 EXERCISE 1.6 Sienna earns $970 per week and her employer deducts $164 for PAYG tax. What is Sienna's net weekly pay?

17 EXERCISE 3.1 Classify each type of data as categorical (C) or numerical (N).

a Types of newspapers

b Hours of sport played per week

c Number of followers on Instagram

d The region of Victoria that students visited for holidays

e Shoe size of basketball players

f Ratings given by users of a tourism website

18 EXERCISE 1.9 Rhiannon earns $78 500 annually and her employer pays 12% of her annual pay into superannuation. What is the value of Rhiannon's employer's annual superannuation contribution?

19 EXERCISE 2.4 Evaluate each expression without using a calculator, then use a calculator to check your answer.

a $18 + 5 \times 4$ **b** $30 \div 10 + 3 \times 5$ **c** $(11 + 9) \div (7 - 2)$

20 EXERCISE 2.6 Emily ordered coffee for her friends. She ordered 5 cappuccinos and 2 flat whites and paid with a $50 note. Estimate how much change Emily should receive.

Long black	$4.90
Cappuccino	$5.20
Mocha	$5.90
Flat white	$5.10

21 EXERCISE 2.7

a Round 28.22 up to the nearest whole number.

b Round 103.82 down to the nearest integer.

22 EXERCISE 3.6 It's Abbey's birthday and she's celebrating. This unordered stem-and-leaf plot shows the age in years of everyone who gave her a gift for her birthday.

Stem	Leaf
0	9 8 8
1	4 3 4 0 4 2 1 3 2
2	
3	9

Key: 3|9 = 39

a How many people gave Abbey a gift for her birthday?

b Present this information as an *ordered* stem-and-leaf plot.

c Which age occurs most often?

d What is the lowest age?

e What age is the outlier? Who might this be?

23 EXERCISE 2.8 Goran needs a piece of wood 1670 mm long to complete a job. The wood is only available in lengths that are multiples of 300 mm. What length of wood will Goran need to buy?

24 EXERCISE 4.4 Copy and complete each conversion.

a 2.8 kL = _____ L **b** 6200 g = _____ kg

c 360 s = _____ min **d** 6.5 t = _____ kg

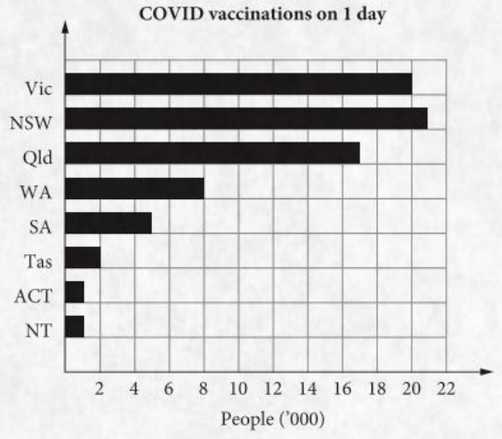
e 9250 mL = _____ L **f** 1 week = _____ hours

25 EXERCISE 2.9 Approximately how many months are there in 8.7 years?

26 EXERCISE 3.2 Should you use a census or a sample to find the most popular sports program on TV in Australia? Give a reason for your answer.

27 EXERCISE 4.4 Akshaya grows organic potatoes that she sends to market in 23 kg bags. Each truckload Akshaya sends to market contains 180 bags of potatoes. Calculate the mass of the potatoes in 1 truckload. Answer in tonnes, correct to 2 decimal places.

28 EXERCISE 3.3 This horizontal column graph shows the number of Australians in each state and territory who received a COVID-19 vaccination on 1 day in 2021, correct to the nearest thousand.



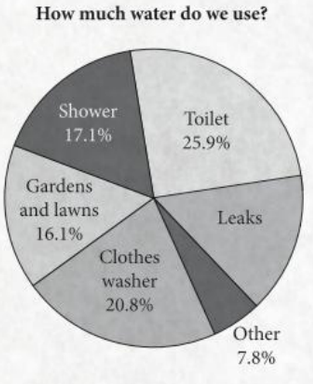
a How many Tasmanians had a COVID-19 vaccination that day?

b Which state had the most vaccinations that day?

c How many times more Victorians were vaccinated that day than people who live in Western Australia?

d The graph correctly shows that the number of vaccinations, correct to the nearest thousand, were the same in ACT and NT. However, the ACT had 624 more vaccinations than did NT. How is this possible?

29 EXERCISE 3.3 Tyler is writing an article about water usage in the local area. He constructed this graph to illustrate how his family uses water.



a Where does Tyler's family use the most water?

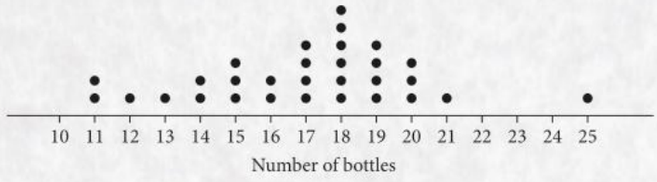
b The sector for leaks doesn't include a percentage. What percentage should be there?

c Tyler's family uses an average of 2400 L of water per day. Calculate the amount of water they use in the shower each day, correct to the nearest litre.

d If the family fixed their leaking taps, how much water could they save in 1 week? Answer to the nearest litre.

e The average Victorian person uses 340 L of water per day. There are 5 people living in Tyler's house. Is their water usage more or less than average?
Use a calculation to justify your answer.

30 EXERCISE 3.6 Emad collects bottles and cans for recycling from the residents in his apartment complex. This dot plot shows the number he collected each day in June.



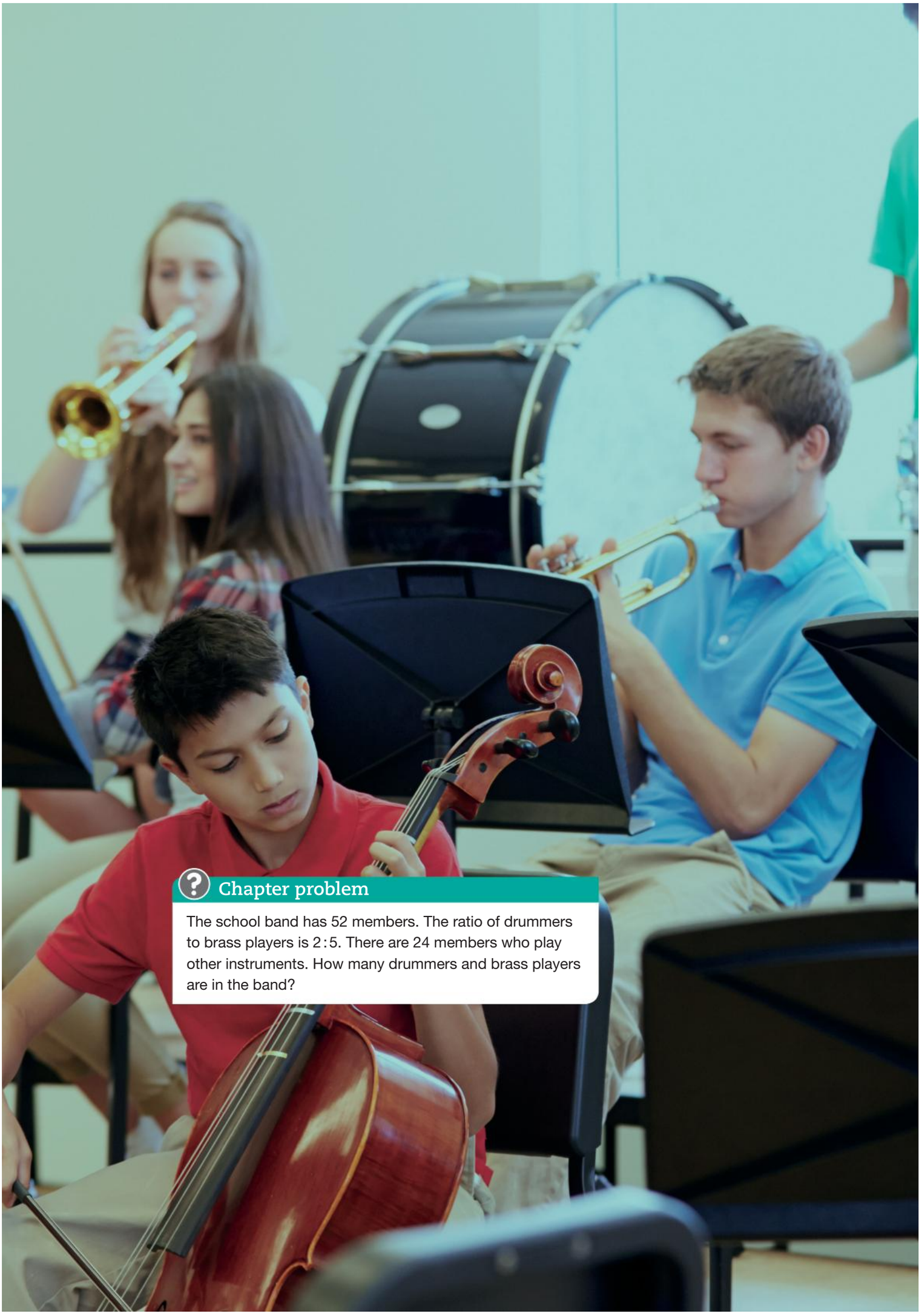
a What is the mode?

b What is the outlier?

c On how many days did Emad collect 15 bottles?

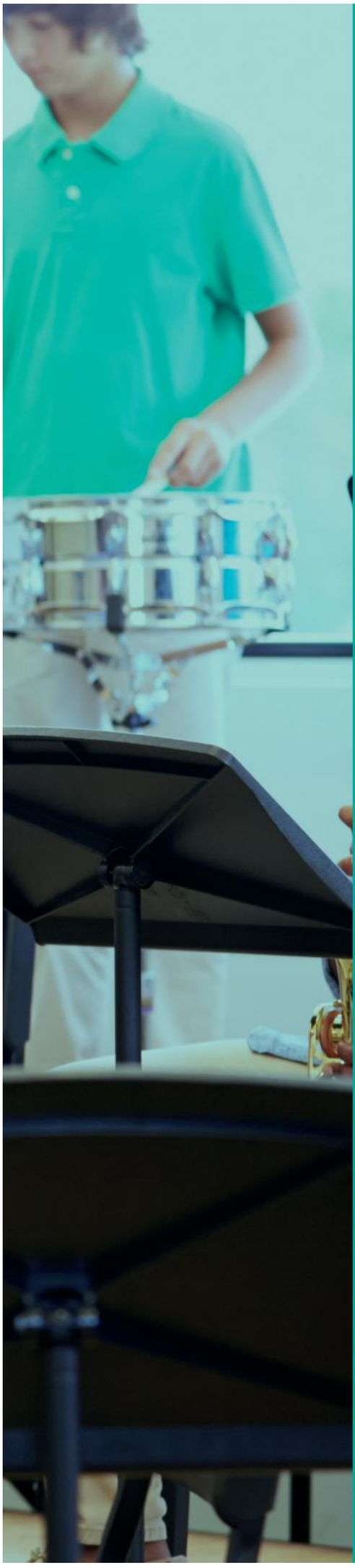
d Emad receives 10c for each bottle and can he recycles. How much did he earn for collecting the cans and bottles in June?

31 EXERCISE 1.7 Harley pays $251.30 PAYG tax every week. At the end of the year, the Taxation Office calculated that the actual tax he was required to pay was $11 350. Did he receive a tax refund or did he have to pay more tax?



Chapter problem

The school band has 52 members. The ratio of drummers to brass players is 2 : 5. There are 24 members who play other instruments. How many drummers and brass players are in the band?



CHAPTER 5

ALGEBRA, NUMBER AND STRUCTURE

WHAT'S MY SHARE?

5.1 Finding a percentage of a quantity
5.2 What percentage of …?
5.3 Percentage increase and decrease
5.4 Profit and loss
5.5 Practising percentages
5.6 Simplifying ratios
5.7 Ratio problems
5.8 Dividing a quantity in a given ratio
5.9 Rate problems
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Calculate a fraction and percentage of an amount
- Express one amount as a percentage of another
- Increase and decrease an amount by a percentage
- Solve problems involving cost price, selling price, profit, loss, discounts and GST
- Write and simplify ratios
- Solve problems involving ratios and scales
- Divide an amount in a given ratio
- Understand and apply rates to solve a variety of problems

How are we ever going to use this?

- Spending and investing money
- Calculating business costs including GST
- Mixing paint, hair colour and cake ingredients
- Mixing fertilisers, bleach, pesticides or other concentrates
- Measuring during cooking and gardening
- Calculating costs of items and speeds of vehicles

Study Design coverage

UNIT 1, AREA OF STUDY 1: ALGEBRA, NUMBER AND STRUCTURE

- application of fractions and decimals, their properties and related operations
- use of ratios, proportions, percentages and rates to solve problems
- estimation, approximation and reasonableness of calculations and results.

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Videos (7):

5.1 Fraction and percentage of a quantity
5.2 Converting fractions and decimals to percentages
5.3 Percentage increase and decrease
5.6 Simplifying ratios
5.7 Ratio problems
5.8 Dividing a quantity in a given ratio
5.9 Rate problems

Skillsheets (4):

5.1 Percentage calculations • Mental percentages • Simplifying fractions
5.6 Ratios

Worksheets (14):

5.1 Fractions, decimals and percentages • Percentage shortcuts • Percentages without calculators • Changing units
5.4 Profit and loss
5.5 Percentage problems • Working with percentages
5.6 Ratio match
5.8 Ratio calculations • Ratios in other contexts • Ratio problems • Calculating quantities in ratios
5.9 Rapid rates
Keyword activity Percentage passages

Puzzles (7):

5.3 Discounts code puzzle
5.5 Percentage power
5.6 Ratio match-up puzzle • Ratios code puzzle • Simplifying ratios
5.9 Rate problems • Rate skills

Nelson MindTap

To access resources above, visit **cengage.com.au/nelsonmindtap**

5.1 Finding a percentage of a quantity

Video
Fraction and percentage of a quantity

Skillsheets
Percentage calculations
Mental percentages
Simplifying fractions

Worksheets
Fractions, decimals and percentages
Percentage shortcuts
Percentages without calculators

Percentage of a quantity

$$\text{percentage of a quantity} = \frac{\text{percentage}}{100} \times \text{quantity}$$

$$\text{OR} \quad = \text{percentage} \div 100 \times \text{quantity}$$

EXAMPLE 1

Calculate:

a 23% of $1650
b 75% of 620 kg

'of' means multiply.

Steps	Working
a Write the percentage as a fraction or decimal and then multiply by the quantity.	$23\% \text{ of } \$1650 = \frac{23}{100} \times \$1650$ OR $0.23 \times \$1650$ $= \$379.50$
b Write the percentage as a fraction or decimal and then multiply by the quantity.	$75\% \text{ of } 620\,\text{kg} = \frac{75}{100} \times 620\,\text{kg}$ OR $0.75 \times 620\,\text{kg}$ $= 465\,\text{kg}$

Some calculators have a percentage key. Ask your teacher to show you how to use it to calculate percentages.

EXAMPLE 2

Find 32% of 4 metres. Give your answer in centimetres.

Steps	Working
Change 4 metres to centimetres.	4 m = 4 × 100 cm = 400 cm
	32% of 400 cm = 0.32 × 400 cm = 128 cm

Sometimes it is necessary to change the units of the quantity before we calculate the percentage.

EXERCISE 5.1 Finding a percentage of a quantity

ANSWERS p. 415

1 EXAMPLE 1 Find:

a 11% of $300
b 60% of 140 kg
c 42% of 600 cm
d 25% of $1230
e 90% of 240 marks
f 85% of 700 000 people
g 19.4% of 785 kg
h 2.5% of 200 m
i 35% of 840 students
j 9% of $5300
k 12.5% of 96 L
l 17.75% of 640 hectares

2 EXAMPLE 2 Calculate each amount.

a 12% of 8 metres, giving your answer in cm
b 35% of 10 days, giving your answer in hours
c 60% of 1 year, expressing your answer in days
d 15% of 26 L, writing your answer in mL
e 10% of $2.30, giving your answer in cents
f 87.5% of 16 weeks, giving your answer in days
g 22.5% of 6 km, expressing your answer in metres
h 40% of 1.5 tonnes, giving your answer in kg

Worksheet
Changing units

3 20% of the students at Nelson Secondary College study Chinese. There are 1290 students at the college. How many study Chinese?

4 Antony earns 5.5% interest on an investment account. He has $7500 in the account. How much interest will Antony earn in 1 year?

5 Employees at the GMC Steel Company are given a 2.5% pay increase.

a Dinesh is paid $32.40 per hour. How much extra will he be paid per hour after the increase?
b Sofija is paid $82 500 per year. How much extra will she be paid per year after the increase?

6 Xi's laptop can be used for 6 hours without recharging. Her laptop shows she has 62% of her time left. How much time does she have left before her laptop needs recharging?

7 Michael planted 850 seedlings in his market garden. 92% of the seedlings survive to full maturity. How many seedlings survive?

8 When Frankie orders stationary for her business, she must pay 10% GST. Calculate the GST payable on stationery purchases of $524.

9 In a poll of 1500 people, 85% of people agreed that Mathematics is the most useful subject to study at school. How many people is this?

10 At the Strolling Bones concert, 65% of seats need to be sold for the promoter to make a profit. The venue seats 18 000 people. How many seats need to be sold to make a profit?

11 Jason decides to go on a weight loss program. His starting weight is 187 kg. In the first 6 weeks, he loses 13% of his body weight. How many kilograms did Jason lose in the first 6 weeks?

12 Taylor is downloading the latest album of her favourite band. The file is 750 megabytes. So far she has downloaded 45% of the album. How many megabytes has Taylor downloaded so far?

Video
Converting fractions and decimals to percentages

5.2 What percentage of ...?

We often change amounts into percentages so that we can compare them. For example, we calculate our marks in tests as percentages so that we can compare our performance in each subject. To do this, we first write one amount as a fraction of another, then we change the fraction to a percentage by multiplying it by 100%.

Finding a percentage

$$\text{percentage} = \frac{\text{amount}}{\text{whole amount}} \times 100\% \quad \text{OR}$$

$$\text{percentage} = \text{amount} \div \text{whole amount} \times 100\%$$

EXAMPLE 3

18 out of the 25 students in the class have part-time jobs. What percentage of the class is this?

Steps	Working
Write as a fraction and multiply by 100%.	$\frac{18}{25} \times 100\% = 72\%$
Write your answer.	72% of the class have part-time jobs.

When we compare 2 quantities by writing one as a percentage of the other, we must make sure they are in the same units.

EXAMPLE 4

Express 36 minutes as a percentage of 2 hours.

Steps	Working
Both quantities should be in the same units, so change 2 hours to minutes.	2 hours = 2 × 60 minutes = 120 minutes
Write as a fraction and multiply by 100%.	$\frac{36}{120} \times 100\% = 30\%$
Write your answer.	36 minutes is 30% of 2 hours.

EXERCISE 5.2 What percentage of ...?

ANSWERS p. 415

1 EXAMPLE 3 Convert each test mark to a percentage.

a 32 out of 40 **b** 11 out of 20 **c** 60 out of 75 **d** 71 out of 80

2 In a driving test, Melanie answered 21 out of 24 questions correctly.

a What percentage is this?

b The pass mark on the driving test is 95%. Did Melanie pass the test?

3 Joe earns $1004 per week and pays $420 in tax. What percentage of his earnings does Joe pay in tax? Answer correct to 1 decimal place.

4 EXAMPLE 4 Express each measurement as a percentage. Remember to have both amounts in the same units! Answer correct to 1 decimal place.

a 5 minutes of 1 hour **b** 18 hours of 4 days **c** 75c of $6

d 75 mm of 20 cm **e** 520 kg of 1 tonne **f** 400 mL of 3.5 L

g 3 months of 1 year **h** 3 days of 1 fortnight **i** 50 days of 1 year

j 25 minutes of 3 hours **k** 36 hours of 1 week **l** 5 fortnights of 3 years

5 In a survey of 1500 people, 1125 of the respondents agreed that breakfast is the most important meal of the day. What percentage is this?

6 Brianne sells jeans in her boutique for $85. She increases the price by $15. What percentage increase is this? Answer correct to 1 decimal place.

7 Australia has an area of 7.7 million square kilometres. Of this, desert takes up 3.8 million square kilometres. What percentage of Australia is desert? Answer correct to 1 decimal place.

8 The cost of Ziad's new glasses is $295. His health fund pays him a benefit of $165. What percentage is Ziad's benefit of the cost of his glasses? Answer correct to 1 decimal place.

9 Vanessa buys 6 metres of rope to tie up her plants. She uses 315 cm in her backyard. What percentage of the rope has she used?

10 Georgie and Nathan are travelling to see their parents. The trip takes 7 hours. They take a break after 2 hours 40 minutes. What percentage of the trip have they completed when they take the break? Answer correct to 1 decimal place.

11 In a senior class of 23 students, 8 walk to school and 11 travel by bus. Calculate, correct to 1 decimal place, the percentage of students who:

a walk to school **b** travel by bus

12 Kyle scored the following results in his half-yearly exams.

English: 45 out of 75

Mathematics: 38 out of 70

Science: 80 out of 125

a Calculate Kyle's percentage in each subject. Answer correct to 1 decimal place.

b In which exam did Kyle achieve the highest result?

Investigation How much sugar is in the food you eat?

Sugar is one of the contributing factors to weight gain. In this investigation, you will examine the percentage of sugar in what you eat and drink.

Did you know that sugar has many different names? Some of them include:

- Sucrose – normal table sugar
- Corn sugar – made from cornstarch
- Fructose – sugar in honey, plants and some fruit
- Lactose – found in milk
- Mannitol – a sugar alcohol in many plants

What you need to do

1. Choose 10 items that you regularly eat or drink. You will need to choose items that have product information on the packaging. You should include a soft drink, cereal, pasta or rice, some tinned food and a variety of other foods.
2. For each item, find:
   - **a** the serving size
   - **b** the amount of sugar per serving
   - **c** the percentage of sugar in the product
3. Which product had the highest percentage of sugar? Which had the lowest? Write a list of the items from those with the most sugar to those with the least sugar.
4. Compare your findings with other students in your class.
5. Write a report on sugar levels in food. Include recommendations about how a person could reduce the amount of sugar in their diet.

Nutrition Facts
Serving Size 2/3 cup (51g)
Servings Per Container About 9

Amount Per Serving	Cereal	Cereal with 1/2 cup Skim Milk
Calories	240	280
Calories from Fat	70	70
	% Daily Value**	
Total Fat 8g*	**12%**	**12%**
Saturated Fat 2.5g	**13%**	**13%**
Trans Fat 0g		
Cholesterol 0mg	**0%**	**0%**
Sodium 50mg	**2%**	**5%**
Total Carbohydrate 37g	**12%**	**14%**
Dietary Fiber 3g	**12%**	**12%**
Sugars 13g		
Protein 4g	**8%**	**16%**
Vitamin A	0%	4%
Vitamin C	0%	0%
Calcium	2%	15%
Iron	6%	6%

iStock.com/CHRISsadowski

5.3 Percentage increase and decrease

Video
Percentage increase and decrease

Puzzle
Discounts code puzzle

Percentage increase means to make a quantity bigger by a given percentage. Examples include pay increases and adding GST to prices.

Percentage decrease means to make a quantity smaller by a given percentage. Examples include **discounts** and calculating sale prices.

EXAMPLE 5

Increase $200 by 7%.

Steps	Working
Find 7% of $200.	$0.07 \times \$200 = \$14$
Add this amount to $200.	$\$200 + \$14 = \$214$
OR	
New amount is 100% plus 7%.	$100\% + 7\% = 107\%$
Find 107% of $200.	$1.07 \times \$200 = \$214$

There are 2 ways to do this. Choose the method you like!

EXAMPLE 6

Decrease $150 by 12%.

Steps	Working
Find 12% of $150.	0.12 × $150 = $18
Subtract this amount from $150.	$150 – $18 = $132
OR	
New amount is 100% minus 12%.	100% – 12% = 88%
Find 88% of $150.	0.88 × $150 = $132

EXAMPLE 7

All government employees receive a 2.5% pay increase. Reggie is on a salary of $82 000 per year. What is her new salary?

Steps	Working
Find 2.5% of $82 000.	0.025 × $82 000 = $2050
Add this amount to $82 000.	$82 000 + $2050 = $84 050
OR	
New amount is 100% plus 2.5%.	100% + 2.5% = 102.5%
Find 102.5% of $82 000.	1.025 × $82 000 = $84 050
Answer the question.	Reggie's new salary is $84 050.

EXAMPLE 8

During an end-of-financial-year sale, computer games are discounted by 25%. Find the cost of a game regularly priced at $115.

Steps	Working
Find 25% of $115.	0.25 × $115 = $28.75
Subtract this amount from $115.	$115 – $28.75 = $86.25
OR	
New amount is 100% minus 25%	100% – 25% = 75%
Find 75% of $115.	0.75 × $115 = $86.25
Answer the question.	The computer game will cost $86.25.

EXERCISE 5.3 Percentage increase and decrease

ANSWERS p. 415

1 EXAMPLE 5

a Increase 95 kg by 60%
b Increase $2500 by 6%
c Increase 150 metres by 5%
d Increase 10 L by 33%

2 EXAMPLE 6

a Decrease $150 by 57%
b Decrease 2000 L by 28%
c Decrease 110 kg by 4.5%
d Decrease 840 students by 15%

3 Decrease a price of $330 by 25%.

4 Decrease a town's population of 32 780 by 5%.

5 Increase a train fare of $7.50 by 20%.

6 Increase a price of $620 by 10%.

7 EXAMPLE 7 Nathan earns $32.75 per hour. His boss gives him a pay rise of 8%. What is his new hourly rate?

8 Saria runs a fashion business. She determines the selling price of each item of clothing by increasing the cost price by 95%. Find the selling price of a jacket that costs Saria $120.

Alamy/Westend61/GmbH

9 EXAMPLE 8 In the January sales, all whitegoods are discounted by 15%. Jenna buys a new washing machine usually priced at $799. Calculate the amount Jenna pays for the washing machine during the sale.

10 During 2019, the Australian road toll was 1185 deaths. During 2020, the road toll decreased by 6.7%. Calculate the road toll for 2020. Round to the nearest whole number.

11 Keira and her sister, Amber, have singing lessons. Keira pays full fees of $450 per term, but Amber gets a 5% family discount.

a Calculate the value of the discount for Amber.

b Calculate the total amount of fees for the 2 sisters.

12 Non-essential items in Australia attract a GST (goods and services tax) of 10%. Find the price of a new car costing $28 900 after GST is added.

13 Ken and Amanda bought a house for $640 000 and sold it 10 years later at a profit of 147%. What is the selling price of the house?

14 Marcus' weekly pay is $945. He is paid an 8% bonus for 2 weeks. Calculate his pay for these 2 weeks.

15 La Plage restaurant charges a 15% surcharge on public holidays. Find the total charge for a meal costing $160 on Australia Day.

A surcharge is an extra amount added to the bill.

16 An electricity company offers a 2% discount when customers pay on time.

a Calculate the discount if a bill of $1978.70 is paid on time. Round your answer to the nearest cent.

b How much does the customer pay?

17 Katie works at the local supermarket. She is given a staff discount of 3.5% on all purchases. How much does she pay for purchases totalling $178.25?

18 The Luxury Hotel charges an additional 1.5% when the customer pays with a credit card. Find the total cost of 3 nights' accommodation at $585 per night if it is charged to a credit card. Round your answer to the nearest cent.

19 Jayden buys TVs at a cost price of $295. He adds 75% of the cost price to get his selling price, then he adds 10% GST to calculate the final selling price.

a Find the price of the TV after Jayden has added his 75% markup.

b Find the price of the TV after he adds GST. Round your answer to the nearest cent.

c Is it likely that Jayden will charge his customers exactly that price? Why?

20 Thomson's Hardware is having a Christmas sale. All items in the store are discounted by 18%.

Lauren is a painter. She buys 10 of the 4-litre tins of paint regularly priced at $67 per tin.

a Calculate the cost of the paint at its regular price.

b Calculate the cost of the paint after the 18% discount.

c Because she is a painter, Lauren is also entitled to a trade discount of 10% of the discounted price. Calculate the cost of the paint for Lauren.

5.4 Profit and loss

All successful businesses make a **profit.** Businesses that make a **loss** quickly close down. Most businesses express the profit or loss they make on a particular item as a percentage of their cost price.

Worksheet
Profit and loss

Percentage profit and loss

$$\text{percentage profit} = \frac{\text{profit}}{\text{cost price}} \times 100\%$$

$$\text{percentage loss} = \frac{\text{loss}}{\text{cost price}} \times 100\%$$

The **cost price** is how much the business buys the item for, from the supplier.

The **selling price** is how much a business sells the item for, to the customer.

EXAMPLE 9

Jacinta buys a necklace for her shop for $36. She sells it for $47.

a How much profit does Jacinta make when she sells the necklace?

b Calculate the percentage profit, correct to 1 decimal place.

Steps	Working
a profit = selling price – cost price	profit = $47 – $36 = $11
b Write the profit over the cost price and change it to a percentage by multiplying by 100%.	$\text{percentage profit} = \frac{11}{36} \times 100\%$ = 30.5555…% ≈ 30.6%

EXAMPLE 10

During a sale, single beds are sold for $599. Each bed costs the store $750.

a Calculate the loss for the store on the bed.

b Calculate the percentage loss, correct to 1 decimal place.

Steps	Working
a loss = cost price – selling price	loss = $750 – $599 = $151
b Write the loss over the cost price and change it to a percentage by multiplying by 100%.	$\text{percentage loss} = \frac{151}{750} \times 100\%$ = 20.1333…% ≈ 20.1%

EXERCISE 5.4 Profit and loss

ANSWERS p. 416

1 EXAMPLE 9 Calculate, correct to 1 decimal place, the percentage profit for each sale.

a cost price $35, selling price $45

b cost price $625, selling price $810

c cost price $149.75, selling price $274.25

d cost price $2.60, selling price $4.05

2 EXAMPLE 10 Calculate, correct to 1 decimal place, the percentage loss for each sale.

a cost price $516, selling price $420

b cost price $2175, selling price $1300

c cost price $12 500, selling price $11 000

d cost price $5.20, selling price $4.40

3 Carrie pays $40 for a small cupboard at a garage sale. She later sells it for $75 to a furniture dealer. Calculate her percentage profit.

4 Paolo pays $165 for a ticket to the football grand final. When his team doesn't make the grand final, he sells the ticket for $90. Calculate his percentage loss to 1 decimal place.

5 Natasha buys an old bicycle for $20. She spends $115 replacing some parts and painting it. She sells it for $150.

a Has she made a profit or a loss? How much is the profit or loss?

b Calculate the percentage profit or loss.

6 Keiran buys a used car for $2500 and spends $1750 replacing some parts. At the end of the year he sells it for $3750.

a Does he make a profit or a loss? How much is the profit or loss?

b Calculate the percentage profit/loss.

c Comment on whether you think Keiran would be happy with this outcome.

7 Matt needs to make 65% profit on the items in his shop to cover costs. What price does he charge for hiking boots that cost him $165?

8 Sophie buys 2000 shares valued at $23 400. She pays a stockbroker's fee of 2.5% of the value of the shares. She later sells the shares for $10.55 per share.

a Calculate the stockbroker's fee for Sophie's purchase.

b Calculate the total amount she paid for the shares.

c How much money does Sophie receive for her shares when she sells them?

d Has she made a profit or a loss on the shares?

e Calculate the percentage profit or loss on the shares. Answer correct to the nearest whole number.

9 Gianni buys 7 boxes of bananas for $45 each. Each box contains 10 kg of bananas. He sells 4 of the boxes at $5.10 per kg. He reduces the price to $4 per kg to clear the remaining boxes before the fruit goes bad.

a How much do the bananas cost Gianni?

b How much does he receive from selling the bananas?

c Does Gianni make a profit or a loss? Calculate the percentage profit or loss, correct to 1 decimal place.

10 A shoe shop bought pairs of shoes for $48 each and priced them at $90 per pair. During the end-of-season sale, the manager reduced the price by $20. Calculate the percentage profit the shop makes when it sells the shoes in the sale. Answer correct to 1 decimal place.

5.5 Practising percentages

In this exercise, you will use the skills you have learnt in this chapter to solve problems involving percentages.

EXERCISE 5.5 Practising percentages

ANSWERS p. 416

1 Nelson Secondary College's hockey team wins 12 games out of 15. What percentage is this?

2 55% of the students at one university are female. The university population is 85 300. How many *males* attend the university?

3 A muesli bar weighs 35 g.

a It contains 6.9 g of fat. What percentage is this? Answer correct to 1 decimal place.

b The muesli bar is 64% carbohydrate. How many grams is this?

4 Luka, a real-estate agent, earns 2.5% commission on a sale of $345 000. How much was his commission?

5 Zoe buys a used car for $14 000 and sells it at a loss of 20%. Find its selling price.

6 Lachlan's pay rate of $18.45/hour is increased to $19.85/hour. Find the increase as a percentage of the original pay rate. Answer correct to 1 decimal place.

7 Sarah earns $2346 per fortnight. Her rent is 30% of her income. How much rent does Sarah pay?

8 Alfredo's Spaghetti Sauce contains 11.9% sugar. How many grams of sugar are in a 580 g jar?

9 Mia sells kitchenware by visiting homes and is paid a retainer of $320 per week to cover her expenses, plus a commission of 15% of all sales. Mia's sales last week totalled $2896. Calculate her pay for that week.

10 Jacob is buying a unit that was priced at $345 000 last year. Property prices have risen by 1.5% since then. How much does the unit cost now?

11 When a new model is coming, car dealers offer discounts on the current model. Tony is interested in buying a car that has a price of $36 990. The car dealer offers him this car for $31 990. What percentage discount is this?

12 Kaitlyn runs *Computer R Us*. She purchases a batch of laptops that cost her $395 each. She calculates her selling price by adding on 75% of the cost price. What is the selling price of one of these laptops?

13 Daniel's watch loses 3 minutes every 6 hours.

a What percentage time loss is this?

b He sets his watch correctly at 8 am in the morning. He finishes work at 5 pm in the afternoon. What time will his watch show when he finishes work?

14 In one season, the Melbourne Demons scored a total of 2012 points and had 2041 points scored against them. Calculate their points percentage using the formula below. Answer correct to 1 decimal place.

$$\text{points percentage} = \frac{\text{points for}}{\text{points against}} \times 100\%$$

Worksheets
Percentage problems
Working with percentages

Puzzle
Percentage power

15 The Costello family donates 2% of their annual income to medical research into dementia. Calculate how much they donated in a year when the family income is $225 000.

16 A 500 g can of chicken and corn soup contains 110 g of corn. What percentage is this?

17 Shanice bought her wedding dress for $1850. Several months after her wedding, she sold the dress online for $1280. Calculate her percentage loss on the wedding dress.

18 The book Anthea wrote sells for $54 a copy. She earns a 10% royalty on the first 4000 copies sold and 12.5% royalty on the remaining sales. Calculate the royalty Anthea receives on the sales of 7000 copies of her book.

Investigation Uses of percentages

1 Look on the internet, newspapers, magazines and brochures for examples of different ways we use percentages in real life. Find photographs or draw situations where percentages are used. Present the information you have found as a 1-page display or as a PowerPoint presentation.

2 Select an example from what you have found in part **1**. Write a set of 10 questions for the example, using what you have learnt about where and how we use percentages in real life. Calculate the answers.

3 Swap the questions you have written with others in the class. Each person should answer at least 3 sets of questions. Ask the student who prepared the questions to mark your answers. If there are any disagreements, check with your teacher.

Video Simplifying ratios

Skillsheet Ratios

Worksheet Ratio match

Puzzles Ratio match-up puzzle

Ratios code puzzle

Simplifying ratios

5.6 Simplifying ratios

A **ratio** consists of 2 or more numbers that compare the parts or shares of things of the same type, in the same units. For example, if a cake recipe uses sugar to flour in a ratio of 1 to 2, written '1 : 2,' it means that for every 1 part of sugar we need 2 parts of flour.

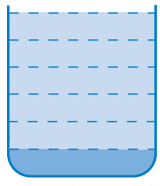
Ratios

A ratio compares quantities of the same type given in the same units.

We say 'a to b' and write $a : b$, where a and b are numbers.

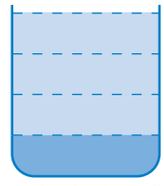
Each number in a ratio is called a **term** of the ratio.

Jerry mixes cordial and water in the ratio 1 : 5, meaning that for every 1 part of cordial there are 5 parts of water.



1 : 5 (read as '1 to 5')
1 part cordial to 5 parts water

Nina prefers a stronger flavour, so she uses a cordial to water ratio of 1 : 3.



1 : 3 (read as '1 to 3')
1 part cordial to 3 parts water

Ratios can be simplified in the same way that fractions are simplified.

5.6

Simplifying ratios

To **simplify** a ratio, divide each term in the ratio by the same amount.

EXAMPLE 11

Simplify each ratio.

a 10:6 **b** 21:7 **c** 10:15:20

Steps	Working
a Both 10 and 6 can be divided by 2.	$10:6 = 10 \div 2 : 6 \div 2$ $= 5:3$
We can also use the fraction key on our calculator: enter 10 $a^{b/c}$ 6 = and the calculator will display $\frac{5}{3}$, which we write as 5:3.	
b Divide both 21 and 7 by 7.	$21:7 = 21 \div 7 : 7 \div 7$ $= 3:1$
c All 3 terms can be divided by 5.	$10:15:20 = 10 \div 5 : 15 \div 5 : 20 \div 5$ $= 2:3:4$
When there are more than 2 terms in the ratio, we can't use the calculator to simply.	

If the terms of a ratio are fractions or decimals, then multiply them by the same number to make them whole numbers, then simplify if possible.

EXAMPLE 12

Simplify each ratio.

a 1.6:3.6 **b** $2\frac{1}{4} : 1\frac{2}{3}$

Steps	Working
a Multiply both terms by 10. Simplify if possible.	$1.6:3.6 = 1.6 \times 10 : 3.6 \times 10$ $= 16:36$ $= \frac{16}{4} : \frac{36}{4}$ $= 4:9$
b Multiply both terms by $4 \times 3 = 12$ to remove the fractions.	$2\frac{1}{4} : 1\frac{2}{3} = 2\frac{1}{4} \times 12 : 1\frac{2}{3} \times 12$ $= 27:20$

EXERCISE 5.6 Simplifying ratios

ANSWERS p. 416

1 EXAMPLE 11 Simplify each ratio.

a 8:6	**b** 9:12	**c** 15:10	**d** 20:10
e 21:14	**f** 27:9	**g** 18:12	**h** 150:25
i 120:24	**j** 56:49	**k** 28:52	**l** 200:50
m 8:12:4	**n** 6:3:18	**o** 15:25:50	**p** 90:60:120

2 EXAMPLE 12 Simplify each ratio.

a 1.8 : 3.6 **b** $1\frac{1}{4} : 1\frac{2}{3}$ **c** 4.2 : 3.6 **d** $2\frac{1}{2} : 1\frac{1}{2}$

e 3.5 : 5.5 **f** $4\frac{3}{10} : \frac{2}{5}$ **g** 6.75 : 3.25 **h** $\frac{5}{8} : 1\frac{1}{2}$

i 0.125 : 1.75 **j** $3\frac{1}{4} : 2\frac{3}{4}$ **k** 2.2 : 6

3 Karen uses a soil conditioning solution on her vegetable garden.

The ingredients are listed on this label.

Express in simplest form the ratio of:

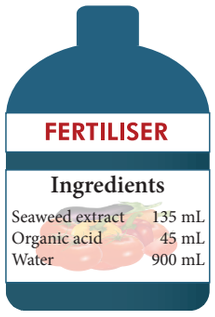
a seaweed extract to water

b organic acid to water

c seaweed extract to organic acid

d seaweed extract to total solution

e seaweed extract to organic acid to water.



4 The table shows the average annual yield in kilograms from various fruit and nut trees.

What is the yield ratio of:

a apple to pear?

b nectarines to walnuts?

c apricot to apple?

d pear to fig?

e apples to nectarines to figs?

Apple	144
Apricot	36
Pear	54
Nectarine	63
Fig	9
Walnut	24

5 Steven runs a small gourmet business producing specialty fruits, vegetables and cereal products. He also has poultry (such as chicken and ducks) producing a variety of eggs. The drawing shows the area of land he has dedicated to each activity. Find the ratio of the following production areas:

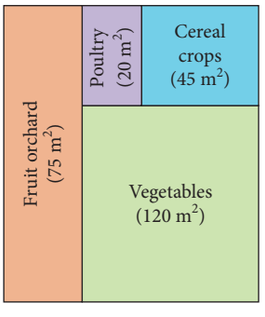
a fruit to vegetables

b eggs to total area

c vegetables to total crop area (the area excluding poultry)

d cereal crop to the total crop area

e vegetable to fruit to cereal crop area.



6 Robyn is cleaning the floor with a cleaning liquid she has mixed from a detergent concentrate and water. The instructions say to mix concentrate to water in the ratio 3 : 16 for light cleaning or 5 : 16 for heavy-duty cleaning. Robyn has mixed 22.5 mL of concentrate with 72 mL of water for this job.

Is she doing light or heavy-duty cleaning?

7 Kris buys avocados at the market for $2 each and sells them in his grocery store for $3 each.

a How much profit does Kris make on each avocado?

b What is the ratio of:

i selling price to cost price? **ii** selling price to profit?

iii cost price to profit? **iv** profit to selling price?

8 Of the 75 people who attended a bush dance, 27 were men, 29 were women and the remainder were children. Find the ratio of:

a men to women **b** children to men **c** women to the total

d women to children **e** men to women to children.

9 Write the simplified ratio for:

a 30 cents to $2.50 **b** 24 mm to 3 cm **c** 30 minutes to 2 hours

d 4 years to 18 months **e** 14 days to 5 weeks **f** 0.3 km to 175 metres.

10 The diagram shows a cluster of yellow, green, purple, grey, red and black balls. Write the colours that are in the ratio:

a 6 : 1 **b** 4 : 3 **c** 2 : 5

d 2 : 21 **e** 2 : 1 : 6 **f** 3 : 4 : 5

11 Eva is saving as much as she can from her wage in her weekend job. She is planning to travel when she finishes school. She receives $180 each week from her job. From her pay, she puts $15 into her clothes budget, spends $20 on fares to travel to work and she saves the remainder.

a What is the ratio of the money she spends on fares to what she puts into her clothes budget?

b What percentage of her pay does Eva put in her clothes budget, correct to 1 decimal place?

c What is the ratio of Eva's savings to her pay?

5.7 Ratio problems

Video
Ratio problems

Lara uses ratios to make the colours she needs for her paintings. She knows that the order of a ratio is very important. If she gets it wrong, the resulting colour is wrong and she wastes paint.

Lara mixed yellow and blue paint. When she used the ratio of 5 : 1, she mixed 5 parts yellow with 1 part blue. When she used the ratio of 1 : 5, she mixed 1 part yellow and 5 parts blue. The images here show that the resulting 2 colours were quite different.

Yellow

Blue

5 : 1

1 : 5

EXAMPLE 13

Lara mixed 12 mL of white paint with 8 mL of red paint to make dark pink paint.

a What is the ratio of red to white paint in the mixture?

b What fraction of the mixture was red paint?

Steps	Working
a The order is important. For red : white, we need to write the quantity of red first.	red : white = 8 : 12 = 2 : 3
b 12 + 8 = 20 mL of total paint and 8 mL came from red paint. That's 8 mL out of 20 mL.	Fraction of the paint that was red paint $= \frac{8}{20}$ $= \frac{2}{5}$

EXAMPLE 14

Zack is painting his lounge room. He wanted the colour to be white with a hint of brown. He mixed 10 mL of brown with 8 L of white paint to achieve the colour he wanted. What ratio of brown to white should he write on the lid of the paint tin so that he can make the same colour in the future?

Steps	Working
Change 8 L into mL so the units are the same.	8 L = 8000 mL We have to be careful with units. All quantities have to be in the same unit before we can write the quantities in a ratio.
Write the brown amount first.	brown : white = 10 mL : 8000 mL = 10 : 8000
Simplify the ratio.	= 1 : 800

EXAMPLE 15

Lara wants to make an orange-yellow paint by mixing yellow and orange in the ratio of 3 : 1.

How much yellow paint should she mix with 5 mL of orange paint?

Steps	Working
3 : 1 means 3 parts yellow to 1 part orange. Lara has 5 mL of orange.	1 part (orange) = 5 mL
We need 3 parts yellow.	3 parts (yellow) = 3 × 5 = 15 mL
Write your answer.	Lara should mix 15 mL of yellow paint with 5 mL of orange paint.

EXAMPLE 16

Grant makes food for his chickens by mixing grain and protein meal in the ratio 5 : 2. If he uses 30 kg of grain, how much protein meal should he use?

Steps	Working
5 : 2 means 5 parts grain to 2 parts protein meal. Grant has 30 kg of grain.	5 parts (grain) = 30 kg
First find one part by dividing by 5.	1 part = 30 kg ÷ 5 = 6 kg
Then find 2 parts of protein meal by multiplying by 2.	2 parts (protein meal) = 2 × 6 = 12 kg
Write your answer.	Grant should use 12 kg of protein meal.

EXERCISE 5.7 Ratio problems

ANSWERS p. 416

1 EXAMPLE 13 Lara mixed 5 mL of red with 9 mL of green paint to make brown to create a painting of some trees.

a What is the ratio of green to red paint in the brown mixture?

b What fraction of the brown paint is red?

2 Lara mixed 6 mL of green with 2 mL of blue paint to make a blue-green paint for the leaves.

a What is the ratio of green : blue paint in the blue-green mixture?

b Simplify your answer to part **a**.

c What fraction of the blue-green mixture came from the green paint?

3 Lara made 2 containers of orange paint by mixing red and yellow. She mixed 20 mL of red with 40 mL yellow in one mixture and 8 mL of yellow with 4 mL of red in the other.

She is confused. Both colours are the same! Why?

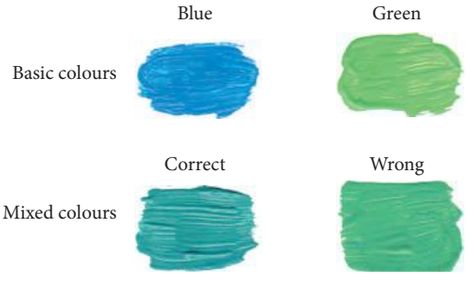
Basic colours Mixed colour

4 EXAMPLE 14 Zack mixed 5 mL of brown and 2 L of white paint to paint the woodwork in his lounge room.

a What is the ratio of brown to white paint in mL?

b Write your answer to part **a** in its simplest form.

5 Lara needs to make a particular shade of blue-green by mixing blue and green in the ratio of 4 : 1, but when she mixed the paint she got the wrong colour (see images). What could she have done wrong?



6 Lara makes colours lighter by mixing them with white; the more white, the lighter the colour.

Here are 4 shades of blue Lara made by mixing blue and white in the ratios of 3 : 1, 3 : 2, 1 : 1 and 1 : 2, but she forgot to label the diagrams. Match the ratios to the colour samples.

a

b

c

d

7 EXAMPLE 15 Lara makes this shade of purple by mixing red and blue paint in the ratio of 3 : 1. How much red paint does she need to add to 24 mL of blue to make this shade of purple?

8 Lara makes different shades of pink paint by mixing red and white in different ratios, as shown in the table.

	Colour sample	Ratio red : white
a		1 : 1
b		1 : 2
c		1 : 3
d		1 : 4

Calculate the amount of white paint Lara should add to 5 mL of red to produce each shade of pink.

9 Compared to adults, children have bigger heads in relation to their bodies. This table shows values for males of different ages.

Age	head length : height	Typical height in cm
1 year	1 : 4	60
3 years	1 : 5	81
5 years	1 : 6	105
Adult	1 : 8	180

a What fraction of a 1-year-old boy's height is the length of his head?

b Lara is painting a picture of 5-year-old Tyson. In the picture, Tyson is 12 cm tall. How long should she make his head in the picture?

c What is the ratio of an adult man's height to the height of a 1-year-old boy?

d Lara is sketching a picture of a man with his 1-year-old son. In the picture, the man is 20 cm tall. What length should Lara make

i the man's head? **ii** the son's height?

10 EXAMPLE 16 To make a fertiliser for his rose garden, Ahmed mixes manure and grass clippings in the ratio of 3 : 2.

a How many spades of grass does Ahmed need to mix with 15 spades of manure?

b When he uses 6 spades of grass, how much manure will he need to mix with it?

11 Nickel brass is a metal that contains copper, zinc and nickel mixed in the ratio 14 : 5 : 1. It is used to make many musical instruments, as well as the English pound coin.

Shutterstock.com/KenDrysdale

a A manufacturer used 70 g of copper to make a batch of nickel brass. How much zinc and nickel did he need?

b Vinh has 8 g of nickel. How much copper and zinc will he need to mix with it to make nickel brass?

c How much nickel brass can Vinh make?

12 When Padmina makes scones for the school fete, she mixes self-raising flour and milk in the ratio 3 : 1.

a How much milk does she add to 15 cups of flour?

b If she uses 6 cups of milk, how many cups of flour are required?

13 Abi makes a spray to kill weeds by mixing a concentrated solution of poison with water. She needs different mixtures for different types of weeds.

Weed	Ratio of poison to water
Flat-leaf weeds	1 : 10
General perennial weeds	3 : 20
Woody weeds	1 : 50

a Abi needs to kill some blackberries, which are woody weeds. How many mL of water should she mix with 40 mL of poison to make the spray?

b How many litres of water is this?

c Abi is going to clear a small area infested with perennial weeds to make a new garden. How much poison does she need to add to 1 L of water to make a spray to kill the weeds?

Convert 1 L to mL first.

d Abi has flat-leaved weeds coming up in her lawn. How much poison should she mix with 250 mL of water to make the spray for these weeds?

e Abi has made a spray using 45 mL of poison mixed with 300 mL of water. What type of weed will she use this for?

Practical activity Making colours

You need some red, yellow and blue paint (the **primary colours**), a surface for mixing paint and some paint brushes.

What you need to do

Find which primary colours need to be mixed to make each colour in the table. Copy and complete the table with the correct colours and ratios. Purple has already been done for you.

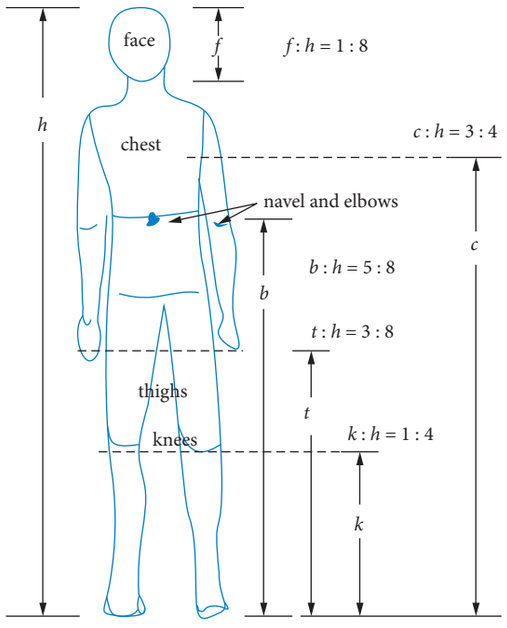
	Colour	Primary colour parts used	Ratio
		1 part red, 1 part blue	1 : 1
1			
2			
3			
4			

Investigation Ratios, body parts and supermodels

Artists use body part ratios to make sketches of people look realistic. The ratios of body parts are slightly different in males and females. In this investigation, you are going to compare the ratios that artists use in sketches to the ratios of body parts in everyday people and supermodels.

Men and women's bodies have different shapes. Women's necks and waists are thinner, while their hips and thighs are wider. This table shows the different ratios for adult males and females.

	Males	Females
Shoulder width : head length	7 : 3	2 : 1
Waist width : head length	15 : 7	1 : 1
Hips width : head length	2 : 1	3 : 2



What you need to do

- Find some photographs online or in magazines
- Use a ruler to measure the lengths f, h, c and t.
- Calculate the ratios $f : h$, $c : h$ and $t : h$.
- Describe how the ratios of body parts in supermodels are similar to and different from the ratios artists use to draw realistic people. What conclusions can you make?

5.8 Dividing a quantity in a given ratio

Video Dividing a quantity in a given ratio

Worksheets Ratio calculations

Ratios in other contexts

Ratio problems

Calculating quantities in ratios

Sometimes we want to divide or share quantities into unequal amounts. For example, the owners of businesses often share the profits and expenses according to the size of their share in the business.

EXAMPLE 17

Lara mixes red, white and green paint in the ratio of 5 : 1 : 2 to make a red shade for painting house bricks. She needs to make 10 L of paint for the bricks. How much of each colour should she mix?

Steps	Working	
Find the total number of parts.	5 + 1 + 2 = 8 parts	
Find the size of 1 part.	1 part = 10 L ÷ 8 = 1.25 L	
For each colour, multiply by the appropriate number of parts.	amount of red = 5 × 1.25 = 6.25 L	(5 parts)
	amount of white = 1.25 L	(1 part)
	amount of green = 2 × 1.25 = 2.5 L	(2 parts)

Check that your answer is correct by adding up the parts to see whether they make up the whole:
6.25 + 1.25 + 2.5 = 10 L

EXAMPLE 18

Jana and Damien own a small market garden, which made a profit this year of $135 000. They have agreed to share the profit in the ratio 2 : 3. How much does each person receive?

Steps	Working
Find the total number of parts.	total number of parts = 2 + 3 = 5
Find the size of one part.	1 part = $135 000 ÷ 5 = $27 000
For each share, multiply by the appropriate number of parts.	Jana's share = 2 × $27 000 = $54 000
	Damien's share = 3 × $27 000 = $81 000

Check that the parts add up to the whole: $54 000 + $81 000 = $135 000.

EXERCISE 5.8 Dividing a quantity in a given ratio

ANSWERS p. 416

1 EXAMPLE 17 Lara needs to mix blue and black in the ratio of 14 : 1 to make paint for a sky. She needs to make 60 mL. How much of each colour will she need?

2 Lara needs 24 mL of this shade of red to paint some waratahs in a bush scene. The colour is a 3 : 1 mix of red and yellow. How much of each colour will she need?

3 This shade of red will show the parts of the waratahs in the direct sunlight. It consists of red, yellow and white in the ratio of 4 : 1 : 1. Lara requires 12 mL of this colour. How much red, white and yellow paint should she mix together?

4 Lara needs 140 mL of a golden paint for the sand dunes in an outback scene. She will make the colour by mixing red, yellow and white in the ratio of 1 : 4 : 2. How much of each colour will she need?

5 At the end of each painting session, Lara cleans her equipment with commercial cleaner. She needs to mix the concentrated cleaner with water in the ratio of 1 : 9. How much concentrate will she need to make 4 L of diluted cleaner?

6 EXAMPLE 18 Lara sells her paintings in an art gallery. Her agent and she share the sale price in the ratio of 1 : 7. How much did Lara receive when one of her paintings sold for $4800?

7 Hamish needs to mix 180 kg of concrete. Concrete is made using cement, sand and gravel in the ratio 1 : 2 : 3. How much of each product will Hamish need?

8 Divide a prize of $2100 between Toby and Vinson in the ratio:

a 2 : 3 **b** 5 : 1

9 At Jemma's school there are 741 students. The ratio of boys to girls is 7 : 6. How many boys are there in the school?

10 Asher is making a bracelet using silver beads, porcelain balls and crystal eyedrops in the ratio of 4 : 3 : 2. She uses 45 pieces to make the bracelet. How many of each type will she require?

11 A flat white coffee contains black espresso coffee and steamed milk in the ratio 1 : 2. How much milk is there in a 240 mL mug of flat white coffee?

12 Rose gold is used in jewellery and high-quality flutes because of its attractive appearance. It is an alloy of gold, copper and silver blended in the ratio 15 : 4 : 1.

a How much silver is in a 40 gram piece of rose gold jewellery?

b A flute made of rose gold weighs 420 grams. How much gold and copper does it contain?

13 Sam makes mocktails using 3 parts grape juice, 2 parts cranberry juice and 4 parts sparkling mineral water.

a How many millilitres of grape juice will he need to make 2 of the 225 mL mocktails?

b How much mineral water does Sam use to make 900 mL of the mocktail?

c How many mL of cranberry juice does this mixture require?

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Investigation Ratios and TV screens

1 Measure the width and height of a variety of TV screens. Alternatively, find the measurements of TV screens on the internet.

2 Calculate the width : height ratio for each TV. Comment on any similarities and differences.

3 Experts recommend that the distance you sit from the TV and the length of the TV's diagonal should be in a ratio of 3 : 1 or bigger. What is the length of the diagonal of the largest TV you should have in your lounge room?

123RF.com/Erik Reis

Worksheet
Rapid rates

Puzzles
Rate problems

Rate skills

5.9 Rate problems

Rates compare 2 different types of quantities.

Unlike ratios, rates have units. We express these as the units of the first quantity **per** unit of the second quantity. 'Per' means 'for each one'.

The most common rate we use is speed, which compares distance travelled with time taken. If a car has a speed of 100 km/h, it means that the car travels 100 km for **each** hour it travels.

EXAMPLE 19

Write each situation as a rate.

a Andrew runs 200 m in 25 seconds.

b The fuel for Boris' cultivator costs $35 for 20 L.

Steps	Working
a The units for this rate will be metres per second or m/s. Divide the number of metres by the number of seconds.	$\text{rate} = \frac{200 \text{ metres}}{25 \text{ seconds}}$ $= 8 \text{ m/s}$
b The units will be dollars per litre. Divide the number of dollars by the number of litres.	$\text{rate} = \frac{\$35}{20 \text{ litres}}$ $= \$1.75/\text{L}$

Rate problems

To solve problems involving rates, we either **multiply** or **divide** by the rate.

- Identify the rate and express the units of the rate as a fraction (for example, $\frac{\text{km}}{\text{h}}$)
- To find the top quantity of the fraction, multiply by the rate (for example, km)
- To find the bottom quantity of the fraction, divide by the rate (for example, h)

EXAMPLE 20

Noah hires a small car for $42 per day. How much will the hire cost be if Noah keeps the car for 16 days?

Steps	Working
The rate is $42/day. Express the units as $\frac{\$}{\text{day}}$. To find the number of dollars, which is in the top of the fraction, multiply by the rate.	hire cost = 16 days × $42/day = $672
Check that the answer is realistic, then write the answer.	It will cost Noah $672 to hire the car for 16 days.

Video
Rate problems

EXAMPLE 21

Amy sends the fruit she grows on her farm to market in cartons that hold 12 kg of fruit per carton. How many cartons will she need to pack 180 kg of fruit?

Steps	Working
The rate is 12 kg/carton. The units are $\frac{\text{kg}}{\text{carton}}$. To find the number of cartons, which is in the bottom of the fraction, divide by the rate.	number of cartons = 180 kg ÷ 12 kg/carton = 15 cartons
Check and write the answer.	Amy will need 15 cartons.

EXERCISE 5.9 Rate problems

ANSWERS p. 416

1 EXAMPLE 19 Write each situation as a rate.

a 200 km travelled in 4 hours

b 75 words typed in 3 minutes

c 250 L used in 5 hours

d $87.50 for 5 kg

e 401.5 m in 55 seconds

f $65 earned in $2\frac{1}{2}$ hours

g 500 g in 2 L

h 1800 revolutions in 3 minutes

2 Marcella uses 90 litres of composting manure on her flower bed that has an area of $5\,m^2$.
What is this as a rate in L/m^2?

3 Goran used his sprinklers to water his garden for $2\frac{1}{2}$ hours. He used 3375 litres.
What is his rate of water use in L/h?

4 Write each situation as a rate.

a 320 L in 8 containers
b 10 litres consumed in $2\frac{1}{2}$ days
c 90 g in $15\,cm^3$
d $22.40 to hire 7 DVDs
e 175 mm rain in 5 days
f 290 km driven using 20 L of petrol
g $20.52 for 1.8 m of curtain material
h 768 vibrations in 3 seconds
i 140 sheep on 3.5 hectare of land
j $28.44 for 18 L of petrol

5 Marcus runs a barbecue for his sport club's market day. He has purchased the food that is shown in the table. Calculate the cost rate, including units, for each item.

	Item	Cost and amount
a	Sausages	$57.80 for 6.8 kg
b	Steak	$93.60 for 7.5 kg
c	Onions	$9.80 for 4 kg
d	Bread rolls	$132 for 240 rolls
e	Tomato sauce	$19.60 for 8 bottles

6 EXAMPLE 20 Lizzie plants tomato seedlings in rows at the rate of 28 seedlings per row.
How many seedlings are there in:

a 4 rows?
b 7 rows?
c 12 rows?

7 Jayden earns $24.80/h as a barista in a café. How much is he paid for working 10 hours?

8 EXAMPLE 21 Kane proudly claims that he can hike at an average rate of 5 km/h even in difficult conditions. At this rate, how long will it take him to walk:

a 15 km?
b $7\frac{1}{2}$ km?
c 24 km?

9 Mandarins cost $3.20/kg. How many kilograms of mandarins can Peter buy for $20?

10 Danielle is growing nectarine trees. She can expect a yield of 80 kg of fruit per tree.

a How many kilograms of nectarines can Danielle expect to produce if she plants 9 trees?
b How many trees would Danielle need to plant if she wanted to produce 1200 kg of nectarines?

11 A plane flies at a speed of 840 km/h.

a How far does the plane travel in $6\frac{1}{2}$ hours?
b Calculate how long it would take the plane to fly from Melbourne to each city, given their distances. Answer in hours, correct to 1 decimal place.

i Brisbane 1670 km
ii Auckland, New Zealand 2626 km
iii Perth 3430 km
iv Los Angeles, USA 12 773 km

12 The yields Olivia achieves from different vegetable crops are shown in the table on the right.

Crop	Yield (vegetables/m^2)
Beetroot	40
Lettuce	18
Cabbage	8

a How many beetroots can Olivia expect to get from her 24 m^2 beetroot plot?

b How many lettuces will she grow in a 15 m^2 garden?

c What area does she need to grow 450 lettuces?

d What area does she need to grow 760 cabbages?

13 Sunil is saving to purchase a car. He can save $400 per week.

a How much can Sunil save in 20 weeks?

b The car he wants costs $14 000. How long will it take Sunil to save this amount?

c A newer car is available, but it costs $15 200. How much longer would it take Sunil to save for this car?

14 Aaron uses fertiliser on his farm at the rate of 24 kg/hectare. How many kilograms of fertiliser does he require to cover 32 hectares?

15 A dripping tap leaks water at the rate of 25 mL/minute.

a How much water will leak from the tap in 30 minutes?

b How much water will be lost in 1 hour?

c Convert your answer to part **b** to litres.

d How many litres will be lost in 24 hours?

e How many minutes will it take for the tap to leak 1 L of water?

f How many hours will it take for the tap to leak 60 L of water?

Remember, there are 1000 mL in 1 L.

16 Chloe earns $24.50/h as a secretary. How many hours will she need to work to earn:

a $441? **b** $857.50? **c** $588?

17 Elise wants to hang curtains on 12 windows in her house. Each window requires 1.8 metres of material, which costs $12.50 per metre.

a How many metres of material will Elise need for all 12 windows?

b How much will it cost?

c Elise has budgeted only $225 for the material. How many metres of material can she buy if she sticks to this budget?

d How many windows can she curtain in this situation?

18 Jacob uses a small aircraft to do crop dusting on properties. His plane uses fuel at the rate of 28 litres per hour. In 1 week, Jacob flew his plane for 18 hours.

a How many litres of fuel did Jacob use that week?

b That week, aviation fuel cost $2.25/L. How much was his fuel bill for the week?

c Jacob charges $124/h when he is crop dusting. How much did he charge for the week crop dusting?

d In a different week, Jacob only had 420 L of fuel available. How many hours could he fly in that week?

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Worksheet
Percentage passages

Keyword activity

WRITING TASKS

Here are some keywords used in this chapter:

commission	cost price	decrease	discount
GST	increase	interest	loss
profit	rate	ratio	selling price

1 Some of these words are opposites. Write down 2 pairs of words that are opposites. Write a short paragraph that shows the meaning of each word.

2 Which word is a way of earning money? Write a sentence explaining its meaning.

3 Describe the difference between **cost price** and **selling price**.

4 Write a sentence explaining the meaning of **discount**, **GST** and **interest**.

5 Write a sentence that describes the difference between **rate** and **ratio**.

Solution to the chapter problem

Problem

The school band has 52 members. The ratio of drummers to brass players is 2 : 5. There are 24 members who play other instruments. How many drummers and brass players are in the band?

Solution

number of drummers and brass players = 52 – 24
= 28

Ratio of drummers to brass players is 2 : 5.

2 parts + 5 parts = 7 parts

1 part = 28 ÷ 7
= 4

number of drummers = 2 × 8
= 8

number of brass players = 5 × 4
= 20

9780170448123

5 Test yourself

What's my share?

ANSWERS p. 417

1 EXERCISE 5.1 Find:

a 8% of $400

b 75% of 280 mL

c 12.5% of 90 hectares

d 20% of 3 m, giving your answer in cm

e 72% of 5 kg, giving your answer in g

f $7\frac{1}{2}$% of 18 h, giving your answer in min

2 EXERCISE 5.1 In 1 year, 42% of all road deaths occurred on country roads. If the road toll for that year was 650, how many people died on country roads that year?

3 EXERCISE 5.1 Maroun earns 3.5% p.a. interest on her investment of $27 000. How much interest does she earn in 1 year?

4 EXERCISE 5.1 Ewan scored 80% on his driving theory test consisting of 20 questions. How many questions did he get right?

5 EXERCISE 5.2 Express as a percentage:

a test mark of 34 out of 40

b tax payment of $310 out of $1240

c 3 students out of 30

d 750 mL of 1 L

e $17.50 of $70

f 1500 m of 10 km

6 EXERCISE 5.2 Louise sells her home for $825 000. The real-estate agent is paid a commission of $28 875. What percentage of the sales price is this?

7 EXERCISE 5.2 Nelson Stadium holds 40 000 people. Recently, 37 200 people attended a finals game at the stadium. What percentage attendance was this? Give your answer correct to 1 decimal place.

8 EXERCISE 5.2 Angelo has 3 hours to complete an exam. He checks the time after completing one section and he has used 1 hour and 5 minutes of the exam time. What percentage is this? Give your answer correct to 1 decimal place.

9 EXERCISE 5.3 Increase:

a $350 by 5% **b** 60 kg by 55% **c** 15 000 people by 20%

10 EXERCISE 5.3 Michael receives a pay increase of 2.5%. Currently, he earns $1442 per week. Calculate his new weekly wage.

11 EXERCISE 5.3 Goods and services tax (GST) in Australia is 10%. Find the GST-inclusive price of a TV advertised as '$2100 excluding GST'.

12 EXERCISE 5.3 Decrease:

a $90 by 40% **b** 75 m by 15% **c** 8 weeks by 25%

13 EXERCISE 5.3 Max buys a shirt at a '40% off all weekend' sale. If the shirt is marked at $75, how much does Max pay for it?

14 EXERCISE 5.3 The population of Binnsville was 74 200 people. It has dropped by 7%. Find the current population.

15 EXERCISE 5.4 Calculate the percentage profit or loss for each situation, correct to 1 decimal place where necessary.

a cost price $85, selling price $102

b cost price $2500, selling price $3500

c cost price $19, selling price $14

d cost price $1400, selling price $1267

16 EXERCISE 5.4 Joanna buys souvenirs for her store at $17 each. She sells them for $29 each. Calculate her percentage profit, correct to 1 decimal place.

17 EXERCISE 5.4 Joshua buys shirts for $35 each and sells them for $105 each. In the January sales, he reduced the price by $30. Calculate his percentage profit on the sale price.

18 EXERCISE 5.5 64% of workers at a fast food restaurant are males. Each week 325 people work in the restaurant. How many female workers are there?

19 EXERCISE 5.5 A muesli bar has a serving size of 40 grams.

a It has 12.2 grams of fat. What percentage is this? Answer correct to 1 decimal place.

b It is 5% protein. How many grams of protein are in the muesli bar?

20 EXERCISE 5.5 Currently, the GST is 10%. Some politicians think it should be raised to 15%. A tradesman charges $320 ex GST for a morning's work. Calculate how much more you would pay if the GST was raised to 15%.

21 EXERCISE 5.6 Lara mixed 24 mL of white paint with 8 mL of blue paint.

a What ratio of blue to white paint did she use?

b What percentage of the mixture was white paint?

22 EXERCISE 5.6 Simplify each ratio.

a 10 : 25 **b** 8 : 4 **c** 50 : 20 **d** 300 : 500

23 EXERCISE 5.6 A recipe for making pizza dough suggests mixing plain flour and water in the ratio 8 : 5. Jasmine is going to use 400 grams of plain flour to make pizza. How much water does she need to add?

24 EXERCISE 5.7 Sandra is mixing yellow and red fabric dye in the ratio of 4 : 1 to dye some wool she has spun. She is using 12 mL of yellow. How much red should she add?

25 EXERCISE 5.8

a Divide $80 between Manal and Eddie in the ratio of 4 : 1.

b Divide 72 km in the ratio of 1 : 2.

26 EXERCISE 5.8 In a musical stage show, the ratio of male to female dancers is 1 : 6.
A total of 35 dancers are involved in the show. How many of the dancers are male?

27 EXERCISE 5.8 To make a sketch of an adult look in proportion, the ratio of the length of the head to the man's total height should be 1 : 8. Lara is sketching a man and she made his head 6 mm long.
How long should she make the rest of his body?

28 EXERCISE 5.9 Write each situation as a rate.

a 600 km travelled in 8 hours

b $126.50 for 5.5 kg

c $84 received for working 3 hours.

29 EXERCISE 5.9 T-shirts are on sale for $4 each. How many can Sonya buy for $36?

30 EXERCISE 5.9 Tom is fertilising his rose garden with chicken manure at a rate of 250 g per m^2.
His garden is 12 m^2. How much manure will he use?

31 EXERCISE 5.9 Olivia has been offered a new job. She has to choose her pay rate:
$36.50 per hour or a flat rate of $1400 per week.
In the job, Olivia will be working 40 hours per week. Which pay rate is the better deal?

32 EXERCISE 5.9 Kim is comparing the fuel consumption of her 2 cars.

Car	Distance travelled	Fuel used
White car	620 km	53 L
Red car	470 km	43 L

a Calculate the rate at which both cars used fuel in L/100 km. Answer to 1 decimal place.

b Which car is more fuel-efficient?

Chapter problem

Sally received this bill.

Professional Surveying

Survey, calculation and preparation of a detailed plan.

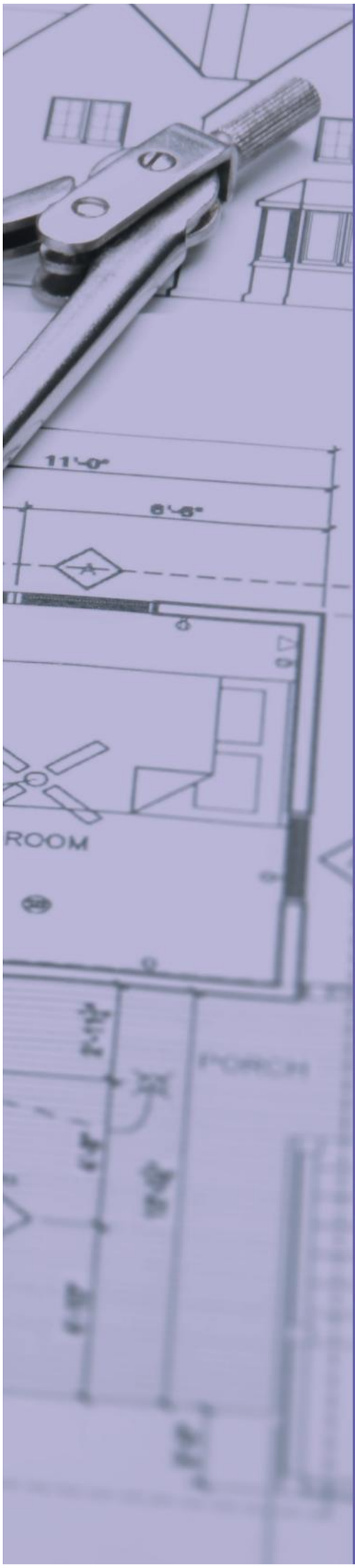
INVOICE
22.02.23

As quoted:
$1500.00 plus GST

FEES DUE

Payment due within 7 days of date on the invoice.
Charges will apply to late payments at 12.55% p.a.

Sally forgot about the bill and didn't pay it until 30 days after 22 February. How much did she have to pay, including GST and late charges?



CHAPTER 6

DISCRETE MATHEMATICS: FINANCIAL AND CONSUMER MATHEMATICS

MANAGING MONEY

6.1 Paying bills
6.2 Bank accounts
6.3 Credit accounts
6.4 Goods and services tax (GST)
6.5 Big numbers
Extended investigation: One trillion dollars in $1 coins
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Read and interpret bills
- Calculate GST
- Examine banking and borrowing fees
- Make calculations relevant to personal loans
- Interpret credit and debit card bills

How are we ever going to use this?

- Establishing a good credit history for yourself
- Spending and investing money
- Calculating business costs including GST
- Paying bills responsibly
- Using credit and debit cards responsibly
- Calculating the real cost of borrowing money

Study Design coverage

UNIT 1, AREA OF STUDY 3: DISCRETE MATHEMATICS
Financial and consumer mathematics

- personal financial services and information such as borrowing, bills and banking
- fees and interest
- cost structures and related information associated with financial transactions.

VCE Mathematics Study Design 2023–2027 p.14, © VCAA 2022

Videos (3):
6.2 Simple interest
6.4 GST • Discounts and GST

Worksheets (2):
6.5 Big numbers • Investigation components

Nelson MindTap

To access resources above, visit
cengage.com.au/nelsonmindtap

6.1 Paying bills

Sometimes, we can get a discount if we pay our bills early, but if we pay them late we can be charged penalty fees and interest. Setting up an automatic direct debit can avoid this problem.

Look for the following information on your bill or invoice.

- Date of invoice
- Account number
- Due date of payment
- Will the bill be paid by direct debit from your account? If so, does your account have enough funds to cover the payment?
- Do you need to pay the bill yourself? If so, is there a discount for early payment or a penalty for late payment?

TELCOM

YOUR Phone Bill:

Telephone 0400 XXX XXX	$52.00

BILLING ISSUED
21 October 2022

ACCOUNT NUMBER
2507

BILL NUMBER
158 1628 844

TAX INVOICE FOR 022/22677

Gatt, Ella
5 Curtis ST
Bendigo 3550

TOTAL DUE
12 NOV 2022

$52.00
Includes GST of $4.73

Your payment will be deducted via direct debit on 12 Nov 2022.

For help with your bill, visit telcom/yourbill

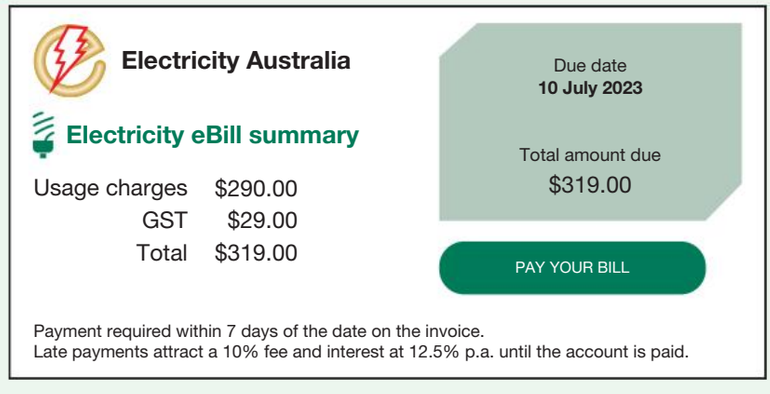
EXAMPLE 1

Ryan received this electricity bill:

Ryan pays the bill on 30 August. How much does he have to pay?

Steps	Working
Ryan pays before August 31.	
Calculate the 15% discount. Round to the nearest cent.	discount = 15% × $396.24 ≈ $59.44
Calculate the amount Ryan pays.	amount = $396.24 – $59.44 = $336.80
Write the answer.	Ryan has to pay $336.80.

EXAMPLE 2



Jacki pays this bill late on 28 July.

a How much will it cost?

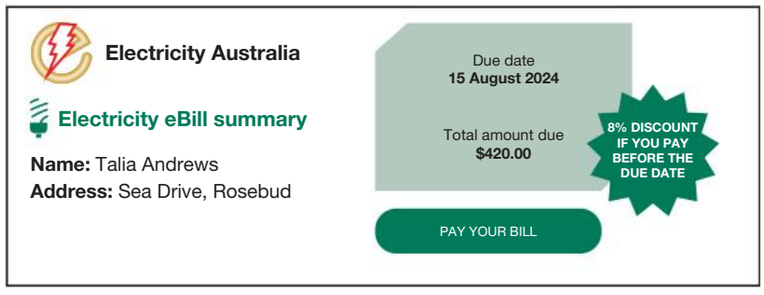
b How much extra will Jacki have to pay because she paid late?

Steps	Working
a The late fee is 10% of the account, $319.00.	late fee = 10% × $319 = $31.90
Add this to the bill.	total bill = $319 + $31.90 = $350.90
Jacki pays the bill 18 days late (10–28 July). Calculate the interest at 12.5% p.a. for 18 days.	interest = $0.125 \times \$350.90 \times \frac{18}{365}$ ≈ $2.16
Add this to the bill.	total bill = $350.90 + $2.16 = $353.06
b extra paid = total bill – original	extra paid = $353.06 – $319 = $34.06

EXERCISE 6.1 Paying bills

ANSWERS p. 417

1 EXAMPLE 1

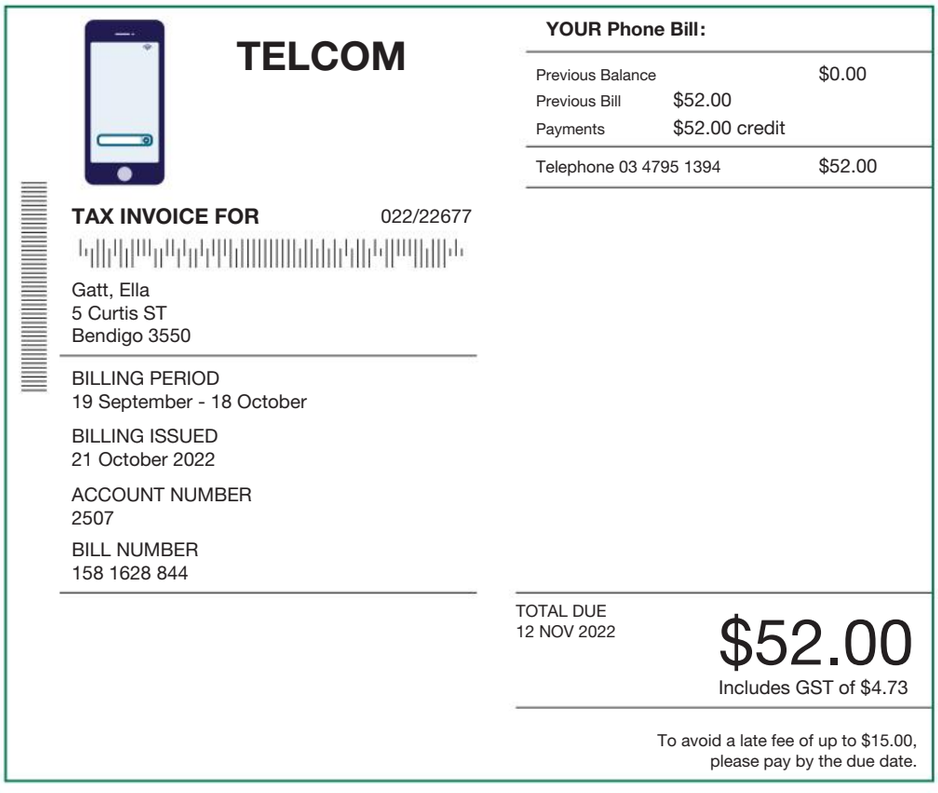


a When does Talia have to pay her electricity bill if she wants the discount?

b Calculate the value of Talia's discount.

c Talia is going to pay the bill on 10 August. How much will she have to pay?

2 This is Ella's phone bill.



a Where does Ella live?

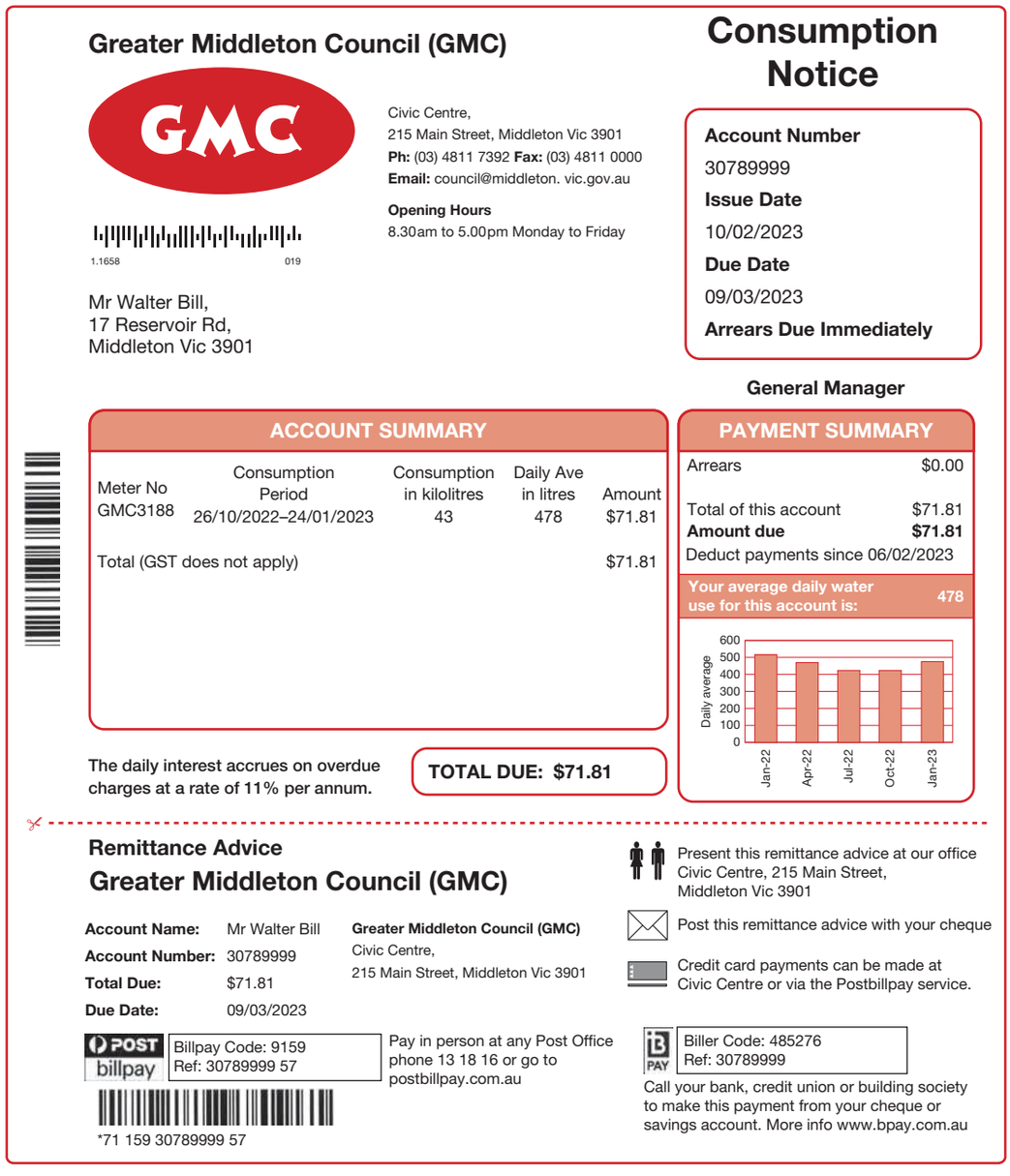
b On what date was her bill issued?

c When does she need to pay the bill?

d What penalty will she get if she pays after the due date?

e Ella paid the bill on 15 November. How much did it cost her?

3 Walter received his quarterly water bill this morning.



Greater Middleton Council (GMC)

Consumption Notice

GMC

Civic Centre,
215 Main Street, Middleton Vic 3901
Ph: (03) 4811 7392 **Fax:** (03) 4811 0000
Email: council@middleton. vic.gov.au

Opening Hours
8.30am to 5.00pm Monday to Friday

1.1658 019

Mr Walter Bill,
17 Reservoir Rd,
Middleton Vic 3901

Account Number
30789999
Issue Date
10/02/2023
Due Date
09/03/2023
Arrears Due Immediately

General Manager

ACCOUNT SUMMARY

Meter No	Consumption Period	Consumption in kilolitres	Daily Ave in litres	Amount
GMC3188	26/10/2022–24/01/2023	43	478	$71.81
Total (GST does not apply)				$71.81

PAYMENT SUMMARY

Arrears	$0.00
Total of this account	$71.81
Amount due	**$71.81**
Deduct payments since 06/02/2023	

Your average daily water use for this account is: 478

The daily interest accrues on overdue charges at a rate of 11% per annum.

TOTAL DUE: $71.81

Remittance Advice

Greater Middleton Council (GMC)

Account Name: Mr Walter Bill
Account Number: 30789999
Total Due: $71.81
Due Date: 09/03/2023

Greater Middleton Council (GMC)
Civic Centre,
215 Main Street, Middleton Vic 3901

Present this remittance advice at our office Civic Centre, 215 Main Street, Middleton Vic 3901

Post this remittance advice with your cheque

Credit card payments can be made at Civic Centre or via the Postbillpay service.

POST billpay
Billpay Code: 9159
Ref: 30789999 57
*71 159 30789999 57

Pay in person at any Post Office phone 13 18 16 or go to postbillpay.com.au

BPAY
Biller Code: 485276
Ref: 30789999

Call your bank, credit union or building society to make this payment from your cheque or savings account. More info www.bpay.com.au

a What is the date of this notice?

b When does this bill need to be paid?

c What is the total amount payable on this bill?

d Did Walter pay his previous bill? (Hint: Check if there is any money in arrears [owing])

e What was the consumption period for this bill?

f How many days are in the consumption period?

g What was the total consumption of water over this period in kilolitres?

h What was the average daily consumption of water in litres?

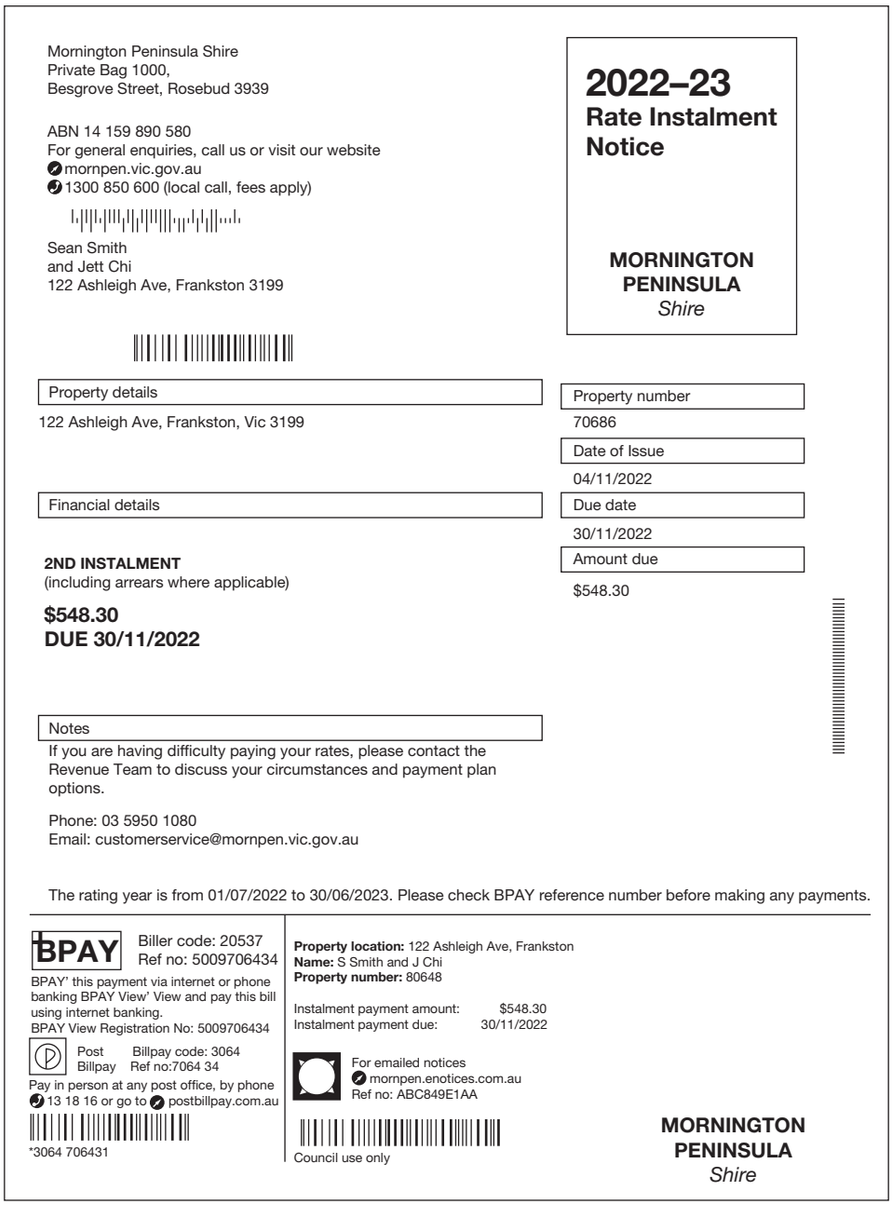
i The bar chart shows the average daily water usage for the property for this billing quarter as well as for the 4 previous quarters. Briefly describe the pattern of consumption. Which quarters have the highest usage and which have the lowest usage?

j Give one reason why consumption in the January quarter may be higher than for the other periods.

k List the options available to pay this account.

l What penalty applies for overdue payments?

4 Sean and Jett own a property together in the Mornington Peninsula Shire. This is their rate notice.



Mornington Peninsula Shire
Private Bag 1000,
Besgrove Street, Rosebud 3939

ABN 14 159 890 580
For general enquiries, call us or visit our website
mornpen.vic.gov.au
1300 850 600 (local call, fees apply)

Sean Smith
and Jett Chi
122 Ashleigh Ave, Frankston 3199

2022–23
Rate Instalment Notice

MORNINGTON PENINSULA
Shire

Property details
122 Ashleigh Ave, Frankston, Vic 3199

Property number
70686

Date of Issue
04/11/2022

Financial details

Due date
30/11/2022

Amount due
$548.30

2ND INSTALMENT
(including arrears where applicable)

$548.30
DUE 30/11/2022

Notes
If you are having difficulty paying your rates, please contact the Revenue Team to discuss your circumstances and payment plan options.

Phone: 03 5950 1080
Email: customerservice@mornpen.vic.gov.au

The rating year is from 01/07/2022 to 30/06/2023. Please check BPAY reference number before making any payments.

BPAY Biller code: 20537
Ref no: 5009706434

BPAY' this payment via internet or phone banking BPAY View' View and pay this bill using internet banking.
BPAY View Registration No: 5009706434

Post Billpay Billpay code: 3064
Ref no:7064 34

Pay in person at any post office, by phone 13 18 16 or go to postbillpay.com.au

*3064 706431

Property location: 122 Ashleigh Ave, Frankston
Name: S Smith and J Chi
Property number: 80648

Instalment payment amount: $548.30
Instalment payment due: 30/11/2022

For emailed notices
mornpen.enotices.com.au
Ref no: ABC849E1AA

Council use only

MORNINGTON PENINSULA
Shire

a How much are the quarterly rates?

b When do they have to be paid?

c Calculate the annual rates.

d How much should Sean and Jett budget for each week to cover their council rates?

Remember: quarterly means 4 times a year or every 3 months.

Remember: annual means yearly.

e What should Sean and Jett do if they can't pay the bill?

f Jett is going to pay the bill by BPay. What is the biller code and reference number he should use?

5 EXAMPLE 2 The following bill shows the electricity changes for a quarter.

NVM Energy

Account Number: 56007899
Date Due: Thursday 23 August 2023
Amount Due: $296.27

MR B POWER
125 FARADAY DR
MEGAWATT 3571

FOR ACCOUNT ENQUIRIES: PHONE 131 002
FOR 24HR EMERGENCY ASSISSTANCE: PHONE 131

ELECTRICITY ACCOUNT

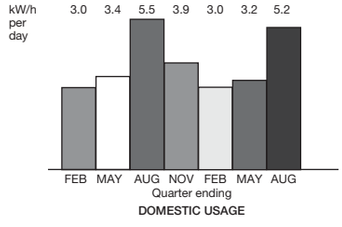
Issue Date: 03/08/2023

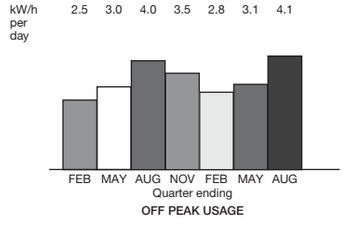
Summary of Your Account

Description		Amount
Balance of last account		$350.83
Less payments and rounding		$350.83 CR
Subtotal		$0.00
Account Summary – 05/05/23 to 03/08/23		
Electricity charges (see next page for details)*	$269.34	
Plus GST payable	$26.93	
Total amount of this account (including GST)		$296.27
Total Amount Due (including GST)		**$296.27**

*GST applies to this item

Your Electricity Usage





a How much was the previous bill?

b Was this amount paid?

c What are the electricity charges (excluding GST) for the current quarter?

d What is the GST on this amount?

e What is the total cost of electricity including GST?

f What percentage of the total cost is the GST? Answer correct to 2 decimal places.

Electricity usage is measured in **kilowatt-hours (kWh). Domestic electricity** refers to electricity that is used during the day. **Off-peak electricity** refers to electricity that is used during late night and early morning, when the demand is much lower. Off-peak electricity is charged at a cheaper rate.

g According to the graph, did domestic usage increase or decrease between May and August? By how much?

h For the quarter ending in August 2023, use the graph to find (in kWh) the average daily consumption of:

i domestic electricity

ii off-peak electricity.

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Investigation Your household bills

What bills does your family, or the people where you live, have to pay each year? List the bills and their approximate value. Discuss how you might be able to help reduce the cost of some of these bills.

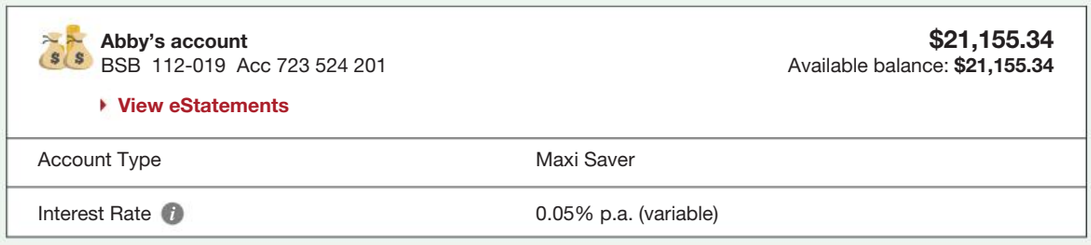
Video
Simple interest

6.2 Bank accounts

Banks make their profit by borrowing from investors at low interest rates and lending to borrowers at a higher rate. Banks have different costs and charges as well as paying and charging different interest rates. Careful consumers evaluate the fine print on their accounts to make sure they have the best possible deals.

EXAMPLE 3

How much interest will Abby earn on this account in April?



Steps	Working
interest = Prn where P = principal, r = interest rate per period as a decimal, n = number of periods	$n = \frac{30}{365}$ years
interest rate = 0.05% = 0.0005 per year, so n must also be measured in years. April has 30 days, out of 365 days in a year.	April interest $= \$21\,155.34 \times 0.0005 \times \frac{30}{365}$ $= \$0.869\,39\ldots$ $\approx \$0.87$

EXERCISE 6.2 Bank accounts

ANSWERS p. 417

1 EXAMPLE 3 Darcy has $8560 in his saver account. The bank only pays him 0.05% p.a. interest.

- **a** Calculate the interest this account will earn in 1 year.
- **b** How much interest will his account earn in March?

2 The same bank charges 22.5% p.a. interest on unpaid credit card balances.

- **a** How much interest does the bank charge when $8560 is owing for the 31 days in March?
- **b** How much more interest does the bank charge for $8560 owing on a credit card for March than it pays for the same amount in a savings account?

3 Pisa charges 20.25% p.a. interest for cash advances. Calculate the annual charge for a $560 cash advance on a Pisa credit card.

4 Dragons Bank charges a $5 monthly service fee on its FireSaver account. This fee is waived if the owner deposits $2000 into the account during the month. Calculate the annual fee on a FireSaver account if the customer isn't able to deposit $2000 monthly.

5 Rachel saves her birthday and Christmas money together with the money she earns from recycling bottles in an investment account. She has $6240 in the account. The account pays her 0.05% p.a. interest. However, she's seen a better account with The Greater Bank. This account for investors under 18 years old offers 2.5% p.a. provided they make a deposit each month and make no withdrawals. How much more interest will Rachel earn in a year on $6240 in the account with The Greater Bank compared to her current bank?

6 Ebony's bank believes that she uses EFTPOS too much. They imposed a 55c fee for every EFTPOS transaction she makes in excess of 25 per month. Calculate the EFTPOS fees the bank charges Ebony when she makes 96 EFTPOS transactions in a month.

7 When customers use their debit or credit cards to buy items online in overseas currency, Eastpac charges a foreign currency fee of 2.9% of the value of the item.

a Calculate Eastpac's foreign currency fee for books valued at $114 purchased in UK pounds.

b SouthBank doesn't have a foreign currency fee for its credit or debit cards. Finn bought a $651 computer program online from the USA. How much in foreign currency fees did he save by using his SouthBank debit card instead of an Eastpac card?

8 Banks charge businesses every time they accept a customer's payment by credit and debit cards. This table shows some of the charges.

Card	Assessment fee	Description
Pisa	0.14%	Applies to credit card transactions
Pisa	0.13%	Applies to debit and prepaid card transactions
Fastercard	0.1375%	Applies to all Fastercard sale transactions

This table shows a department store's financial records for last week. Calculate the bank charge for each type of transaction and then the total.

	Type of transaction	Total value
a	Pisa credit card transactions	$246 300
b	Pisa debit card transactions	$58 790
c	Pisa card prepaid transactions	$3 965
d	Fastercard transactions	$277 858
e	Total bank charges	

9 Eva's bank charges her 2.95% p.a. on the $895 000 she owes on her home loan, but the loan has a linked offset account. An **offset account** is a savings account that reduces the amount of interest you have to pay on your loan. The loan interest is calculated on the loan balance less the amount you have saved in your offset account, so it's a good idea to have as much money in your offset account as possible. The less interest you have to pay, the quicker you'll be able to repay your loan.

a Calculate the interest Eva is charged on the loan for June without the offset account.

b Eva's grandmother deposited $600 000 of her savings in Eva's offset account to reduce Eva's loan interest. How much will Grandma's deposit save Eva in August?

c Calculate the annual value of Grandma's generous deposit.

Investigation Banks in your local area

What types of accounts are available in your local banks? What are the fees and charges involved? What interest rates are charged on loans and paid on investments? Which bank has the most expensive fees? Which bank gives customers the best deal? Prepare a report.

6.3 Credit accounts

When we buy items on credit, we buy the items and pay for them later or by instalments. Buying on credit is convenient but it can be very dangerous if not monitored wisely. Usually banks charge very high interest on overdue credit card payments and stores that offer 'buy now, pay later' deals have large penalties for late payments.

EXAMPLE 4

Charles is excited! He's just got his driver's licence and saw the car of his dreams for sale. The car is advertised at $18 600 cash or terms of $4000 deposit and monthly repayments of $649 for 3 years. How much more will Charles pay for the car if he buys on terms?

Shutterstock.com/Tantsinua

Steps	Working
Charles will pay the $4000 deposit and $649 every month for 3 years. That's 3 × 12 = 36 repayments.	total on terms = $4000 + $649 × 36 = $27 364
The extra is the difference between the cash price and the price on terms.	extra = $27 364 − $18 600 = $8764
Write the conclusion.	Charles will pay an extra $8764 if he buys the car on terms.

EXERCISE 6.3 Credit accounts

ANSWERS p. 417

1 EXAMPLE 4 Erin is buying a $3650 e-bike. She can buy the bike on terms of $850 deposit and monthly repayments of $152.45 for 2 years.

Shutterstock.com/stockphoto-graf

a Calculate the total value of the monthly repayments Erin will make.

b How much will Erin pay for the bike if she buys it on terms?

c How much more is the bike on terms?

2 How much does this computer cost 'on terms'?

BRAND NEW COMPUTERS!

Cash price $2950 or terms $350 deposit and monthly payments of $249 for 1 year.

Shutterstock.com/Nick NA

3 Calculate the price of each item.

	Item	Deposit	Regular payments
a	Large screen TV	$320	Weekly payments of $24 for 1 year
b	Jet ski	$1500	Fortnightly payments of $325 for 2 years
c	Motor bike	$2300	Monthly payments $298 for 3 years
d	Football gear	$25	Weekly payments of $12 for 6 months

4 When interest rates were low, Seth borrowed $650 000 to buy a small house in the country. His repayments are $3264 each month for 25 years.

a Calculate the total amount Seth will repay.

b If interest rates increase from 3.5% p.a. to 5% p.a. his monthly repayments will increase to $3810 for 25 years. How much more will he have to repay at 5% p.a. interest compared to 3.5% p.a. over the life of the loan?

5 Cooper borrowed $375 000 to buy a home unit. Interest rates on housing loans were only 4% p.a. His fortnightly repayments are $1053 for 20 years.

a How many fortnights are there in 1 year?

b How much more than the $375 000 Cooper borrowed will he repay?

6 Annabelle is thinking about buying this furniture for her new unit. The furniture costs $6530, but the fine print says that if the full amount isn't repaid before the end of 2 years, the customer will be charged 28% interest then monthly interest at 22% p.a. until the amount is repaid.

a Calculate the initial charge at 28% if the $6530 account isn't paid before the end of 2 years.

b Calculate the total amount a customer has to pay if they buy the furniture but don't pay for it until the end of 26 months after purchase.

Shutterstock.com/Ksana Durand

7 Alana has a credit card that she uses to pay her phone and internet bill. This month Alana's bill is $112. If she pays this bill with her credit card, how much will she have to pay?

PHONE AND INTERNET BILL

Credit card charges: $1.00 plus 1.67% of the bill amount.

6.4 Goods and services tax (GST)

Videos
GST
Discounts and GST

Most countries have some form of **goods and services tax (GST)** or value-added tax (VAT). In Australia, 10% GST is added to the original price of all non-essential goods and services. Price tags show the price of an item with the GST already included, but in some countries, price tags show the original price only, with the GST added on when the customer pays.

EXAMPLE 5

In Australia, 10% GST is added to the value of an item to determine the final price. The price of a Persian carpet was $3250 before GST. Calculate the final price of the carpet.

Steps	Working
Calculate 10% GST and add this amount to the price.	cost of the carpet without GST = $3250 GST = 10% × $3250 = $325 cost including GST = $3250 + $325 = $3575
OR To increase a price by 10%, multiply it by 1.10 = 1.1	cost including GST = $3250 × 1.1 = $3575

The final price of an item is 110% of the original price, so an easy way to calculate the 10% GST included in an Australian price is to divide the price by 11.

EXAMPLE 6

How much GST is included in the price of a shirt that is on sale for $62?

Steps	Working
GST = final price ÷ 11	GST = $62 ÷ 11 = $5.64

EXERCISE 6.4 Goods and services tax (GST)

ANSWERS p. 418

1 EXAMPLE 5 Without GST the price of a pair of shoes is $46.

a Calculate the amount of GST (at 10%) that has to be added to the price of the shoes.

b What is the GST-inclusive price of the shoes?

2 When Jake issues invoices to customers he is required to add 10% GST to the invoice. How much GST will Jake have to add to an invoice for $3800?

3 Rhondell calculates the price of items and completes price tags in a fashion store. Complete Rhondell's prices table.

Item	Price before GST	GST	GST inclusive price
Jeans	$75	**a**	**b**
Jumper	**c**	$8.50	$93.50
Coat	$230	**d**	$253
Scarf	$15	**e**	**f**

4 EXAMPLE 6 A 10% GST is included in an invoice for $290.40.

a How much GST is included in the $290.40 invoice?

b What is the value of the invoice without GST?

5 Determine the missing values in the table.

Item	Price including GST	GST included In the price	Price without GST
Basket of flowers	$55	**a**	**b**
Bottle of perfume	$169.40	**c**	**d**
Restaurant meal	$105.60	**e**	**f**
1 litre of petrol	$1.65	**g**	**h**
A haircut	$22	**i**	**j**

6 Businesses registered for GST can get the GST included in items they purchase refunded. Sally's new business car cost $57 200 including GST. Calculate the value of her GST refund.

7 Tom designed a spreadsheet to help him calculate GST-free prices quickly.

What formulas could he have used in cells C4 and C5?

	A	B	C	D
1	GST Calculator			
2				
3	GST inclusive price		$78.00	
4		GST	$7.09	
5	Price without GST		$70.91	
6				

8 Wang is registered to charge 10% GST on all services his business provides. At the end of every 3 months, Wang has to send the GST he has collected to the Australian Tax Office. The total value of Wang's invoices is $82 350, including GST. How much GST does Wang have to send the tax office?

9 Every so often the media falsely reports that the Australian Government is going to increase the rate of the GST. If the rate were to be increased from 10% to 15%, calculate the new GST inclusive price of a suit priced at $286 that includes GST at 10%.

Investigation Which supermarket items do not have a GST?

The prices of some supermarket items do not include GST. For example, a hot BBQ chicken has a GST but a cold, cooked chicken does not. Why?

1. Collect a supermarket docket that includes a lot of items.
2. How much GST is included in the final sale amount?
3. Classify the items on the docket into 2 lists: items that are GST-free and items including GST.
4. What do all the items that include GST have in common?

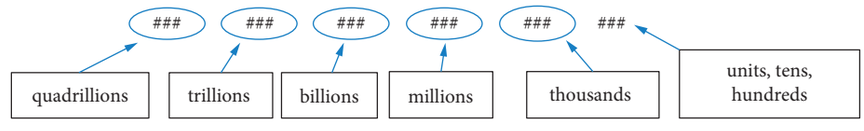
6.5 Big numbers

Worksheet
Big numbers

During the COVID-19 pandemic, governments around the world spent large amounts of money stimulating their economy. News bulletins quoted amounts like $17 trillion or $2.6 billion. How big are these numbers?

When writing big numbers, we group and name digits in 3s.

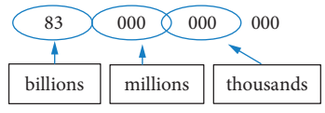
1000	1 thousand
1 000 000	1 million
1 000 000 000	1 billion
1 000 000 000 000	1 trillion
1 000 000 000 000 000	1 quadrillion



Within each block we use units, tens and hundreds.

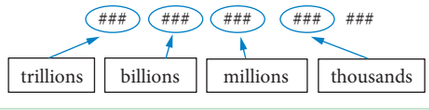
EXAMPLE 7

What is the name of the number 83 000 000 000?

Steps	Working
Starting at the right-hand side, make groups of 3 digits. Label each group.	
There is 83 in the billion's group.	The number is 83 billion.

EXAMPLE 8

Write the number 'four trillion, two hundred and five billion' in digits.

Steps	Working
Draw a diagram with the groupings of digits in 3s.	

Write the 4 and 205 in the appropriate places: trillions and millions respectively.	
Put 0s in all the remaining places to the right.	4 205 000 000 000

EXAMPLE 9

Write 6.2 billion in figures.

Steps	Working
Draw a diagram with the groupings of digits in threes, up to and including billions.	
Put the 6 in the billions group and the 2 in the millions group.	
Fill the remaining boxes with 0s.	6 200 000 000

EXERCISE 6.5 Big numbers

ANSWERS p. 418

1 EXAMPLE 7 Match each number in the first column with its digital form in the second column.

a	473 thousand	**A**	3 000 000
b	300 million 470 thousand	**B**	47 000 000
c	47 million	**C**	3 470 000 000
d	30 trillion	**D**	473 000
e	3 trillion 470 billion	**E**	47 300 000
f	7 million 43 thousand	**F**	3 470 000 000 000
g	3 million	**G**	300 470 000
h	30 quadrillion	**H**	30 000 000 000 000
i	473 million 300 thousand 300	**I**	47 300 000 000
j	3 billion 470 million	**J**	7 043 000
k	47 billion 300 million	**K**	473 300 300
l	47 million 300 thousand	**L**	30 000 000 000 000 000

2 EXAMPLE 8 Write each number in figures.

a five hundred million

b six billion, seven hundred and eighty thousand

c seventy-five trillion, two hundred million

d forty-two billion, nine hundred thousand

e sixty-four million

f fifty-three trillion, four hundred million

3 EXAMPLE 9 By the year 2030, the world's population is predicted to be 8.5 billion people. Write this number using digits.

4 A Google search displayed 316 000 000 sites in less than 1 second. Write this number in words.

5 During the COVID-19 pandemic, more than 2.4 million people in the UK caught the virus and then recovered. Write this number in digits.

6 In March 2020, the Australian Government announced an economic stimulus package to help people and businesses through the COVID-19 pandemic. The value of the announced package was $17 600 000 000. Write this number in words.

7 How many 20c coins would you need to make $1 billion? Write your answer in words and figures.

8 NASA's Mars Perseverance rover cost $US2.9 billion. $US1 is equivalent to $1.3 Australian. Calculate the cost of NASA's Perseverance rover in Australian dollars. Express your answer in words and figures.

To convert American dollars to Australian dollars, multiply the number of American dollars by 1.3.

9 During the COVID-19 pandemic, Australians returning from overseas were required to spend at least 14 days in hotel quarantine. Those staying in NSW hotels cost NSW taxpayers $50 million per month. Calculate the annual NSW COVID hotel quarantine bill. Express your answer in words and figures.

10 In 2019, the annual Australian cost for intensive care unit (ICU) beds in public hospitals was $2.2 billion. The average cost per patient per day for an ICU bed was $5000.

a Calculate the ICU cost for a patient to spend 14 days in an ICU bed.

b How many bed-days are required to reach an annual cost of $2.2 billion?

Investigation Googol, not Google

A googol is 1 followed by 100 zeros.

What are the names of other numbers bigger than a quadrillion?

Design a poster to display the information you find.

Extended investigation One trillion dollars in $2 coins

In 2021, the Federal Australian Government's debt was $1 trillion. Imagine that you could have $1 trillion in $2 coins and that you could place them next to each other in a line starting in the centre of Melbourne. How far would the line stretch?

- To Albury?
- To Canberra?
- To the top of Queensland?
- To the Equator?
- To the North Pole and back to Melbourne?
- Several times around the Equator?
- To the Moon?
- To the Sun?
- Or further than the Sun?

Follow the guided steps to determine your solution.

1 Formulation

a Describe what the investigation is about.

b What do you know?

c What tools can you use?

d What extra information do you need?

Find the diameter of an Australian $2 coin.

We'll also need some distances, for example, the distance to the moon.

Worksheet
Investigation components

2 Exploration

a Calculate the number of $2 coins required to make $1 trillion.

b Multiply your answer to **2a** by the diameter of a $2 coin.

c Divide your answer to **2b** by 1000 to change the millimetres to metres.

d Divide by 1000 again to change the metres into kilometres.

e Write this length in words.

f Think about your results. Do they make sense? If not, repeat the calculations.

g Research some appropriate lengths for comparison.

3 Communication

a Describe what you did.

b Summarise your results.

c Explain your conclusion.

Keyword activity

FIND-A-WORD

ANSWERS p. 418

Use the clues to write a list of the key words in this chapter, then locate the key words in the find-a-word puzzle.

1 Three different types of cards that can be used for shopping.

2 A type of bill that arrives every 3 months.

3 Another word for year.

4 A word to describe a bill that hasn't been paid on time.

5 2 weeks

6 One followed by six zeros.

7 This word has several meanings, including 'putting money into a bank account' or 'an initial amount paid with more to be paid later'.

8 Money paid on an investment or charged on a loan.

9 A regular amount to pay off a loan.

10 An amount subtracted from the usual price.

11 A punishment for not doing the right thing, for example paying a bill late.

12 A bill with a description of the goods or service provided.

13 An Australian 10% tax on goods and services.

14 A one followed by nine zeros.

15 How often a loan is repaid if there are 52 repayments per year.

E	F	T	P	O	S	M	I	L	L	I	O	N
D	F	B	I	L	L	I	O	N	T	X	T	H
B	C	T	S	I	N	V	O	I	C	E	F	P
D	R	O	E	X	O	Q	S	N	Q	Y	O	K
I	E	V	S	D	O	U	O	B	W	I	R	N
S	D	E	R	E	P	A	Y	M	E	N	T	B
C	I	R	T	P	A	R	E	H	E	Y	N	M
O	T	D	G	O	H	T	U	E	K	N	I	V
U	Y	U	S	S	G	E	N	I	L	Q	G	C
N	U	E	T	I	T	R	R	E	Y	W	H	X
T	I	O	P	T	L	L	D	E	B	I	T	Z
P	E	N	A	L	T	Y	A	N	N	U	A	L
I	N	T	E	R	E	S	T	K	J	G	F	D

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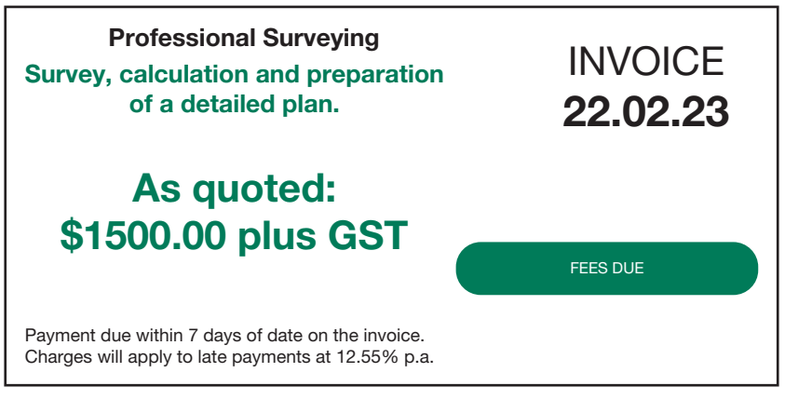
Solution to the chapter problem

Problem

Sally received this bill.



Professional Surveying

Survey, calculation and preparation of a detailed plan.

INVOICE

22.02.23

As quoted:
$1500.00 plus GST

FEES DUE

Payment due within 7 days of date on the invoice.
Charges will apply to late payments at 12.55% p.a.

Sally forgot about the bill and didn't pay it until 30 days after 22 February.

How much did she have to pay, including GST and late charges?

Solution

GST = 10% of $1500
= $150

total price including GST = $1500 + $150
= $1650

Payment was due 7 days after the invoice date 22 February, so Sally paid the bill 30 – 7 = 23 days late.

$$\text{late penalty} = \$1650 \times 0.1255 \times \frac{23}{365}$$
$$\approx \$13.05$$

Total Sally has to pay = $1650 + $13.05
= $1663.05

6 Test yourself

Managing money

ANSWERS p. 418

1 EXERCISE 6.1 Kye installed solar electricity at his house to help the environment and to reduce his electricity bills. This is his latest electricity bill.

Green Energy

Kye Healy
97 Redbourne Ave
MOUNT ELIZA VIC 3930

Account number
340142

Invoice No
11019865

Issue date
10 November 2022

Your Electricity Account
Current Plan: Smile Power

ACCOUNT SUMMARY

Opening Balance 11/08/2022	$896.21
Payment Received (thank you) 03/09/2022	–$896.21
Balance before this period's charges	**0.00**
Electricity charges (please see over for details) (GST included on the invoice $66.61)	$732.66
Total charges this period (GST incl)	**$732.66**
Less Solar Rebate	-$47.89
Total Amount Due	**$684.77**

Amount due:
$684.77
Due date: 02 December 2022

a On what date was Kye's bill issued?

b By what date does he have to pay the bill?

c How much does he have to pay?

d What was Kye's solar rebate?

e How much less is his bill this quarter compared to his last bill?

f A quarter is 13 weeks. Approximately how much should Kye budget for electricity each week?

2 EXERCISE 6.2 Brianna has $24 625 in an account that pays 0.055% p.a. interest. Calculate the interest Brianna's account will earn in September.

3 EXERCISE 6.2 Sam's bank charges him $5 per month in account keeping fees, but the bank waives the $5 fee if he deposits $2000 into the account during the month. Calculate the annual account keeping fees if Sam is able to deposit $2000 in 3 separate months.

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4 EXERCISE 6.3 Erin bought a motor scooter to travel to her fashion design course. The cash price of the scooter was $2400. She paid $680 deposit and agreed to repay $165 monthly for 1 year.

a Calculate the total amount Erin will pay for the scooter.

b How much more than the cash price will Erin pay because she bought it on credit?

5 EXERCISE 6.3 Taylah borrowed $540 000 to buy an apartment. Her fortnightly repayments will be $1319 for the next 25 years.

a Calculate the total amount Taylah will repay in the next 25 years.

b How much more than the $540 000 she borrowed will Taylah repay?

6 EXERCISE 6.4 Copy and complete this table for Australian prices.

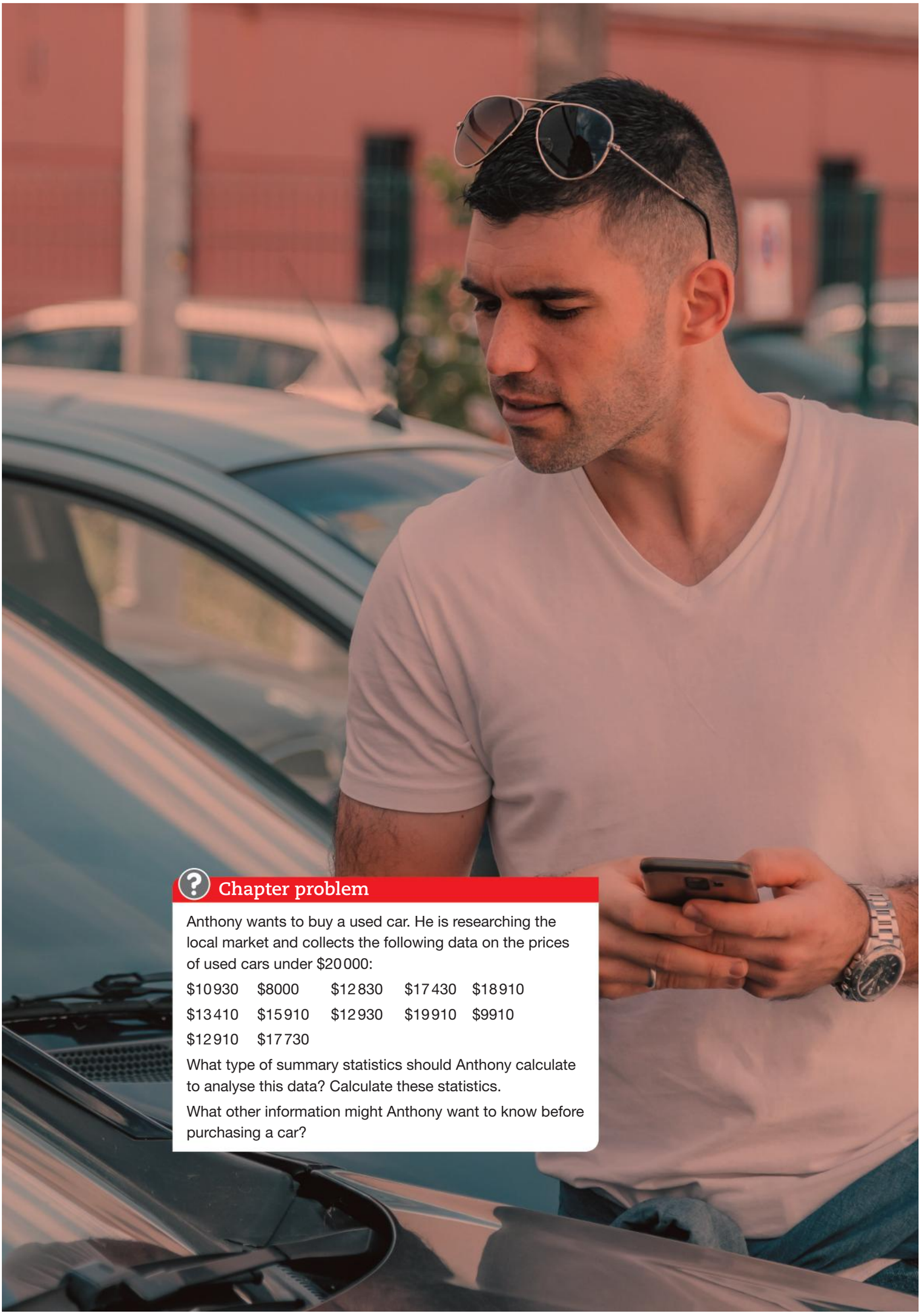
	Price without GST	GST	Price including GST
a	$75	$7.50	
b	$136		$149.60
c	$210		
d	$15 400		

7 EXERCISE 6.4 When Owen bought a book online from the United States, the price quoted in Australian dollars was $42 + GST. Calculate the total price in Australian dollars.

8 EXERCISE 6.4 Businesses that charge GST can claim a GST refund on the price of business supplies. Last tax quarter Luca's business bought items that cost $3650. Calculate the GST included in this amount.

9 EXERCISE 6.5 By the year 2100, the world population is expected to exceed 11 200 000 000. Write this number in words.

10 EXERCISE 6.5 By February 2021, over 111.1 million people in the world had caught COVID-19. Write this number in figures.



Chapter problem

Anthony wants to buy a used car. He is researching the local market and collects the following data on the prices of used cars under $20 000:

$10 930 $8000 $12 830 $17 430 $18 910
$13 410 $15 910 $12 930 $19 910 $9910
$12 910 $17 730

What type of summary statistics should Anthony calculate to analyse this data? Calculate these statistics.

What other information might Anthony want to know before purchasing a car?

CHAPTER 7

DATA ANALYSIS, PROBABILITY AND STATISTICS

IT'S BETTER THAN AVERAGE

7.1 What's the average?
7.2 What's the outlier?
7.3 What's the spread?
7.4 Describing clusters, gaps and spread
Keyword activity
Solution to chapter problem
Test yourself

What will we do in this chapter?

- Calculate measures of central tendency for a set of data: the mean, the median and the mode
- Choose the best measure of central tendency to use in different situations
- Calculate measures of spread for a set of data: the range, quartiles and interquartile range
- Describe the spread of a graphed set of data

How are we ever going to use this?

- To calculate summary statistics to allow comparisons of data
- When reading media reports or advertising claims involving statistics
- When we evaluate the results of surveys

Study Design coverage

UNIT 1, AREA OF STUDY 2: DATA ANALYSIS, PROBABILITY AND STATISTICS

- interpretation of data to summarise and communicate findings and possible conclusions.

VCE Mathematics Study Design 2023–2027 p.13, © VCAA 2022

Videos (3):

7.1 The mean, mode, median and range • The mode, median and mean

7.3 Interquartile range

Worksheets (3):

7.1 Mean, median, mode 1 • Mean, median, mode 2

7.3 Interquartile range

Nelson MindTap

To access resources above, visit **cengage.com.au/nelsonmindtap**

7.1 What's the average?

Videos
The mean, mode, median and range

The mode, median and mean

Worksheets
Mean, median, mode 1

Mean, median, mode 2

Sets of data are often too big to understand just by looking at them. We need to analyse them and one way to do this is to find a typical or central value to represent all of the data.

There are three types of **average** or **measures of central tendency.**

Measures of central tendency

- The **mode** is the most common or frequent data value(s).
- The **median** is the middle value (or the average of the 2 middle values) when the data values are placed in order from smallest to largest.
- The **mean** is calculated by adding all the data values and dividing by the number of values. This is what many people call the 'average'.

	Features	When is it best to use?
Mean	• Depends on all the values in the data set. • Is affected by extreme data values (outliers).	• When the data set does NOT have many extreme values. • Not suitable for categorical data.
Median	• Can be one of the values. • Is not affected by extreme values.	• When the data set has extreme values. • Not suitable for categorical data.
Mode	• May be more than one mode, or no mode at all. • Is not affected by extreme values.	• Always used for categorical data. • When the most common data value or category is needed.

EXAMPLE 1

The following data shows the daily maximum temperature (in °C) for 15 days in Ceduna, South Australia, in November.

22, 25, 24, 35, 22, 25, 24, 20, 23, 29, 33, 32, 30, 25, 21

a For this set of data, find:

i the mode **ii** the median **iii** the mean

b Which measure best represents the data?

Steps	Working
a i 25 occurs 3 times, which is more than the number of times any other temperature occurs.	Mode is 25°C.
ii Place the values in order.	20, 21, 22, 22, 23, 24, 24, 25, 25, 25, 29, 30, 32, 33, 35
There are 15 values, so the middle one will be the 8th value.	Median is 25°C.
iii Add all the values and divide by 15.	$\frac{390}{15} = 26$
	Mean is 26°C.
b There aren't any outliers in this data set, so the mean best represents the data.	

EXAMPLE 2

Find the mode for each set of data.

a 3, 3, 4, 5, 5, 6, 7, 9, 10

b 1, 2, 3, 5, 7, 10

Sometimes there is more than one mode and sometimes there is no mode at all!

Steps	Working
a Both 3 and 5 occur twice.	The modes are 3 and 5.
b All values occur only once.	There is no mode for this data.

EXAMPLE 3

Find the median for this set of data:

68, 81, 64, 57, 95, 62

Steps	Working
Arrange the values in order.	
There are 2 middle values.	57, 62, 64, 68, 81, 95
Find the average of the 2 middle values by adding them up and dividing by 2.	$\frac{64+68}{2} = 66$
	The median is 66.

When you have an even number of values in the data, there are 2 middle values. To find the median, you average the 2 middle values.

EXERCISE 7.1 What's the average?

ANSWERS p. 418

1 EXAMPLE 1 The scores in a class test were:

8, 9, 7, 7, 10, 5, 9, 10, 9, 8, 9, 6, 7

a What is the mode for this data? **b** What is the median? **c** What is the mean?

To find the median, remember to place the values in order.

2 EXAMPLE 2 What is the mode for each set of data?

a 6, 9, 2, 1, 2, 9, 2

b 67, 43, 89, 45, 54, 86, 45, 76, 54

c 12, 3, 6, 5, 8, 2, 7, 1

d blue, green, yellow, green, blue, red, green, yellow, red, green, red, blue

e heart, spade, spade, diamond, spade, club, heart, heart, diamond, spade

3 EXAMPLE 3 Find the median for each set of data.

a 12, 17, 14, 15, 16, 16, 18

b 36, 40, 38, 37, 40, 30

c 64.1, 100, 99.2, 71.4, 91.5, 60.8, 72.9

d 74, 50, 0, 27, 14, 99, 51, 66

4 Last week, a security company recorded the number of minutes it took one of their security guards, Leon, to respond to each alarm call. The results were:

6, 2, 13, 7, 26, 10, 13, 9

a How many alarm calls did Leon respond to last week?

b What is the mode of this data?

c What is Leon's median response time?

d Calculate his mean response time.

e Which of the 3 measures of central tendency most accurately describes the typical response time? Justify your answer.

5 This table shows the number of people who breached their bail conditions in a city over 1 year.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
19	17	14	12	13	14	12	14	10	11	14	16

a For this set of data, find:

i the median **ii** the mode **iii** the mean (correct to 1 decimal place).

b In which months were the number of people breaching bail conditions the highest? Suggest a reason for this.

6 This is the data for the same offence of breaching bail conditions in a country region over 1 year.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7	9	7	6	3	4	5	3	2	1	1	4

For this set of data, find:

a the median **b** the mode

c the mean (correct to 1 decimal place)

7 **a** What are the differences in the statistics for questions **5** and **6**? Suggest a reason for these differences.

b What are the similarities in the statistics for questions **5** and **6**? Suggest a reason for these similarities.

8 Skye and her dad are having an argument about the number of phone calls Skye makes each night. The data are shown in this table.

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Number of phone calls	9	3	6	2	13	1	1

a Find the mode, the median and the mean for this data.

b Which of these measures of central tendency could Dad use to demonstrate that Skye makes too many phone calls? Explain your answer.

c Which of these measures could Skye use to show that she doesn't make many calls? Explain your answer.

d Which of the 3 measures gives the best indication of the typical number of calls Skye receives each night? Justify your answer.

9 Andrea asked 50 students how many text messages they sent within the last 2 hours.

Number of text messages (Score)	Frequency	Score × frequency
0	8	$0 \times 8 = 0$
1	4	$1 \times 4 = 4$
2	10	
3	10	
4	15	
5	3	
Total	50	

a What is the mode for this data?

b Copy and complete the above table.

c Use the formula:

$$\text{mean} = \frac{\text{total of (score} \times \text{frequency)}}{\text{total of frequency}}$$

to calculate the mean for this data.

You can also use your calculator or a spreadsheet to calculate the mean from a table.

10 Centrelink officers want to encourage jobseekers to keep applying for jobs. They recorded the number of jobs each person applied for before they received their first job interview.

a How many people were surveyed?

b What is the mode for this data?

c Copy the table, add a 'score × frequency' column, then complete it.

d Calculate the mean for this data.

Score	Frequency
1	2
2	5
3	10
4	6
5	11
6	13
7	3

Investigation What is average?

Using the internet, search the word 'average'. Scroll through the results to complete the following questions. You will be looking for articles, blogs and other media uses of the word average. Do not use mathematical definitions or maths-help websites.

1. Find one way the word average has been used in an article. Save it.
2. Find a different usage of the word average. Explain the differences and save your work.
3. Look for further different uses of the word average and compare them to the first ones you found.
4. Make a presentation of your examples and findings and share it with your class. Make sure you look at 'Images for average'. Pick out your favourites and include them in your presentation.

7.2 What's the outlier?

Sometimes with numerical data we have a number that is an **outlier,** a data value that is very different from the rest of the data. It can be either much bigger or much smaller than the other values. An outlier can make it difficult to graph the data. When we see a value that looks like an outlier, we should check to make sure the value is reasonable because it could be a mistake or a wrongly recorded value.

EXAMPLE 4

Lochie asked 8 friends about the amount of pocket money they receive each week. The results were:

$20, $32, $32, $40, $18, $32, $18, $75

a Identify the outlier in this data.

b Is this outlier reasonable or likely to be a mistake?

Steps	Working
a 1 Write the data in order.	18, 18, 20, 32, 32, 32, 40, 75
2 Choose the extreme value.	The outlier here is $75 because it is much bigger than the other values.
b Look at what the data values represent to decide whether the extreme value is possible.	It is reasonable, as it is quite possible for one student to receive much more pocket money than other students.

EXERCISE 7.2 What's the outlier?

ANSWERS p. 419

1 EXAMPLE 4 For each set of data, identify the outlier.

a 12, 15, 28, 19, 15, 14, 16

b 7, 5, 6 8, 7, 1, 8, 6, 9

c 32, 35, 12, 40, 36, 29, 38, 30

d 94, 49, 35, 38, 31, 44

2 A set of data can have more than one outlier. What are the outliers in this data set?

6, 8, 0, 6, 8, 16, 8, 7, 2, 8, 9, 9, 8

3 The results of a mathematics test (out of 100) for a Year 10 class are shown.

55, 52, 50, 45, 55, 45, 60, 50, 60, 58, 75, 45, 49, 59, 58, 59, 56, 49, 31, 52

a Sort these results in order from highest to lowest.

b What are the outliers in this data?

4 The nurse recorded the masses (in kilograms) of a group of patients in a hospital emergency room.

68, 59, 63, 80, 68, 54, 48, 49, 64, 47, 48, 59, 68, 30

a Place these results in order from highest to lowest.

b What are the outliers in this data set?

5 Katrina measured the heights of 25 Year 11 male students in centimetres.

175, 176, 185, 176, 25, 184, 197, 161, 186, 169, 171, 170, 182,
165, 179, 180, 167, 169, 198, 167, 170, 180, 182, 173, 230

a Draw a stem-and-leaf plot of this data.

b What are the outliers for this data?

c For each outlier, decide if it is reasonable or likely to be a height that was recorded incorrectly. Explain your answer.

6 The prices of 8 houses sold in Nelson Waters Road over the last 2 years are:

$620 000, $700 500, $738 000, $625 000, $1 800 000, $598 000, $696 500, $720 000

a What is the outlier for this data?

b Is this outlier reasonable or is it likely to be a mistake? Explain your answer.

7 A small stationary business has 10 employees. Their annual salaries are:

$81 000, $77 000, $86 000, $71 000, $73 000, $82 000, $76 000, $83 000, $80 000, $247 000

a What is the outlier for this data?

b Is this outlier reasonable or is it likely to be a mistake? Explain your answer.

8 For the same sample of Year 11 males used in question **5**, Katrina recorded the length of their right foot in centimetres.

35, 27, 28, 28, 25, 28, 30, 27, 27, 25, 28, 26, 29, 10, 26, 30, 15, 27, 33, 25, 25, 20, 33, 11, 40

a How many of these values are in the 20s?

b What are the outliers in this data?

c For each outlier, decide if it is reasonable or likely to be a foot length that was recorded incorrectly. Explain your answer.

9 Francine is a florist. In the first 8 years of her business, her annual profits were:

$35 000, $66 000, $69 000, $72 000, $75 000, $71 000, $68 000, $76 000

a What is the outlier for this data?

b Is this outlier reasonable or is it likely to be a mistake? Explain your answer.

Worksheet
Interquartile range

7.3 What's the spread?

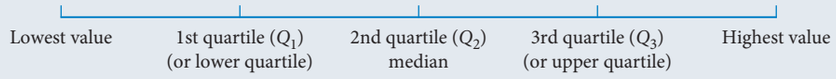
Sometimes is it useful to see how the data is spread out.

The **range** and the **interquartile range** are both **measures of spread**.

Measures of spread

range = highest value – lowest value

Quartiles divide the data into 4 equal groups. 25% of the data is in each quartile.



interquartile range = 3rd quartile (Q_3) – 1st quartile (Q_1)

50% of the data lies within the interquartile range.

Video
Interquartile range

EXAMPLE 5

The ages of 23 people at a café are shown here.

33, 23, 28, 36, 27, 15, 32, 18, 13, 13, 38, 38
27, 7, 34, 27, 12, 26, 33, 21, 24, 39, 20

Find:

a each quartile **b** the range **c** the interquartile range

Steps	Working
a Place the ages in ascending order and find the median, which is also the 2nd quartile. There are 23 data values, so the middle value is the 12th value.	7, 12, 13, 13, 15, 18, 20, 21, 23, 24, 26, 27, 27, 27, 28, 32, 33, 33, 34, 36, 38, 38, 39 $Q_2 = 27$
The median splits the data set in half. Find the middle of each half of the values. These are the 1st and 3rd quartiles. There are 11 values in each half, so the 1st quartile is the 6th value and the 3rd quartile is the 6th value in the second half.	7, 12, 13, 13, 15, 18, 20, 21, 23, 24, 26 27, 27, 28, 32, 33, 33, 34, 36, 38, 38, 39 $Q_1 = 18$, $Q_3 = 33$ The quartiles are 18, 27 and 33.
b range = highest value – lowest value	range = 39 – 7 = 32
c interquartile range = 3rd quartile (Q_3) – 1st quartile (Q_1)	interquartile range = 33 – 18 = 15

EXERCISE 7.3 What's the spread?

ANSWERS p. 419

Keep your answers to this exercise because you will need them again in Exercise 15.1.

1 EXAMPLE 5 The number of fish cooked each day at lunchtime in a fish and chip shop during August were:

17, 27, 28, 18, 18, 17, 19, 19, 25, 27, 17, 19, 20, 19, 21, 26,
28, 18, 19, 20, 17, 19, 23, 24, 20, 18, 17, 20, 19, 27, 28

For this data, find:

a the range **b** each quartile **c** the interquartile range

2 The daily maximum temperatures (in °C) for 15 days in Cairns in July were:

32, 30, 31, 32, 31, 30, 31, 31, 31, 31, 29, 25, 28, 27, 29

For this data, find:

a the range **b** each quartile **c** the interquartile range.

3 The heights of 25 Year 11 students in centimetres are:

151, 167, 181, 172, 179, 155, 159, 162, 169, 174, 178, 180, 158,
166, 171, 168, 157, 160, 175, 172, 150, 169, 163, 170, 176

Find:

a the range **b** each quartile **c** the interquartile range.

4 A Year 11 class was surveyed to find the number of hours each student spent on homework each week. These are the results:

4, 5, 7, 8, 3, 6, 9, 9, 8, 4
7, 5, 3, 3, 4, 9, 3, 4, 7, 8

If there is an even number of values in each half after sorting, then the quartile is the average of the 2 middle values.

Find:

a the range **b** each quartile **c** the interquartile range.

5 The monthly number of thefts from retail stores in two regions over 2 years were:

Inner city: 13, 13, 13, 12, 16, 25, 23, 20, 33, 25, 27, 25,
55, 20, 27, 33, 28, 26, 38, 24, 33, 55, 42, 48

Coastal: 62, 60, 52, 62, 52, 63, 60, 65, 74, 61, 36, 66
36, 69, 70, 47, 39, 64, 69, 55, 40, 60, 58, 52

a For each set of data, find:

i the range **ii** each quartile **iii** the interquartile range.

b Comment on the differences between these 2 sets of data.

6 When Bianca was observing some cases in the traffic court, she recorded the BAC (blood alcohol content) of each person on trial. Her results are listed below.

0.15, 0.09, 0.04, 0.18, 0.00, 0.07, 0.09, 0.00, 0.02, 0.05, 0.12, 0.20

a Arrange the data in ascending order.

b Determine the mean, mode, median and range.

c When you arrange the data into quartiles, how many values will be in each quarter?

d Calculate the value of the lower quartile (Q_1) and upper quartile (Q_3).

e Calculate the interquartile range.

f What fraction of people on trial had alcohol in their bloodstream at the time of their traffic offence?

Chapter problem

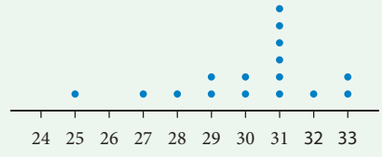
You've covered the skills required to solve the chapter problem. Can you solve it now?

7.4 Describing clusters, gaps and spread

When we display data on a dot plot, stem-and-leaf plot or histogram, we can make judgements about the spread of the data values. Values can be spread out or clustered around one place or there might be gaps. **Clusters** are where values are bunched or grouped together.

EXAMPLE 6

The daily temperatures in Mildura in January were recorded and displayed in the dot plot below. Comment on the spread of the data shown in this dot plot.

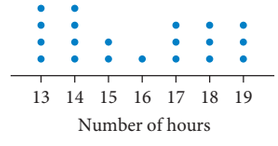


Steps	Working
Look for clusters.	These values are clustered around 31°C.
Look for gaps.	There are gaps at the bottom end of the data.
The temperatures range from 25 to 33.	These temperatures are quite spread out.
Write a description.	The temperatures are quite spread out, but they are clustered around 31°C. There are gaps towards the bottom end of the data.

EXERCISE 7.4 Describing clusters, gaps and spread

ANSWERS p. 419

1 EXAMPLE 6 Ahmed surveyed his class on the number of hours each student spent on the internet each week. Comment on the spread of the values shown in this dot plot.

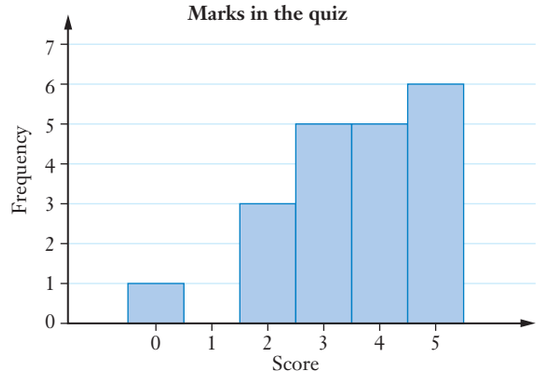


2 This stem-and-leaf plot displays the number of burglaries per month over the last few years in a regional city. Describe the spread of values shown in this data.

Stem	Leaf
3	7 7 8 8
4	1 3 4 4 5 5 6 6 8 9 9
5	1 1 1 2 2 3 3 4 4 5 5 5 8
6	0 2 3 6 6 7
7	0
8	
9	0

Key: 5|2 = 52

3 Ms Thomson gave her class a short quiz. This frequency histogram shows the results.

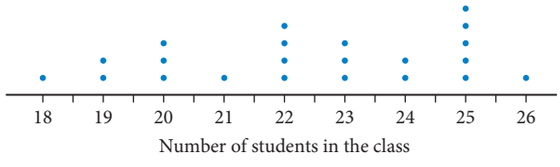


Comment on the spread of the data.

4 Copy and complete the descriptions of each set of data using words from this list.

spread out	tightly packed	clustered
gaps	more dense	less dense

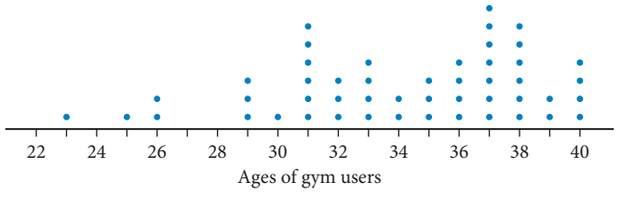
a This dot plot shows the number of students in each class at St Judy's Primary School.



Class sizes are _____ between 22 and 25.

The class sizes are _____ ____ from 18 to 26.

b The ages of people exercising at a gym one evening are shown in the dot plot below.



These ages show ____ between 26 and 29. They are ____ _____ between 36 and 38 but ____ _____ between 23 and 26.

c This stem-and-leaf plot shows the heights of students in a fitness class in centimetres.

These heights are _____ _____ in the 150s and 160s. They are _____ ____ from 137 to 177.

Stem	Leaf
13	7
14	0 1 3 5
15	3 4 5 7 7 7 8 9
16	2 2 3 6 6 8
17	0 1 5 5 7

Key: 15|4 = 154

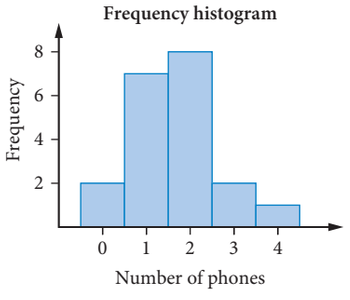
d This stem-and-leaf plot shows the number of people who visited the information desk at Nelson Mall daily over a 3-week period.

These are evenly _____ ___ across the 80s, 90s, 100s and 110s. The data does not show any _____.

Stem	Leaf
7	6
8	1 6 8
9	5 7 8
10	1 5 5
11	2 2 4 7
12	4

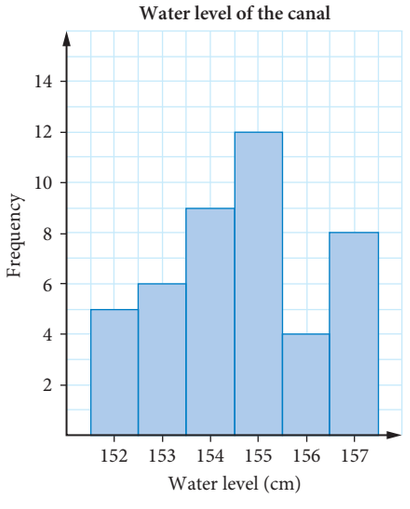
Key: 10|5 = 105

e Households were surveyed about how many phones they owned. The results are shown in this histogram.



The values are _____ at 1 and 2. The responses are not _____ ____ but t_____ _____.

f This histogram shows the water level of a canal recorded over 44 days.



The water level is _____ _____ from 152 to 157. There are no _____.

9780170448123

Keyword activity

CHAPTER SUMMARY

ANSWERS p. 419

average	clustered	interquartile range	median
mode	number	outlier	odd
order	quartiles	range	

Copy and complete each sentence using a word from the list. When you have completed this, you will have a summary of the chapter.

1 The _____ is the most frequent data value.

2 Another word for the mean is the _____.

3 The mean is the sum of the data values divided by the _____ of values.

4 The _____ is the middle value when the data is arranged in order.

5 There's only one middle value when there is an _____ number of data values.

6 To find the median, you must first place the data values in _____.

7 A value that is much higher or much lower than the other data values is called an _____ .

8 Data values that are all very close together are said to be _____.

9 _____ divide the data into 4 equal parts.

10 The difference between the highest value and the lowest value is the _____.

11 The difference between the 3rd quartile and the 1st quartile is the _____ _____.

Solution to the chapter problem

Problem

Anthony wants to buy a used car. He is researching the local market and collects the following data on the prices of used cars under $20 000:

$10 930, $8000, $12 830, $17 430, $18 910, $13 410
$15 910, $12 930, $19 910, $9910, $12 910, $17 730

What type of summary statistics should Anthony calculate to analyse this data? Calculate these statistics.

What other information might Anthony want to know before purchasing a car?

Solution

Anthony will want to know the average or typical price of a used car.

Mode: There is no mode as all the prices are different. Even if there were two prices the same, the mode is unlikely to reflect a typical price.

Mean: total of prices = $170 810
number of cars = 12
mean = 170 810 ÷ 12
≈ $14 234 (rounded to the nearest dollar)

Median: place values in order

$8000, $9910, $10 930, $12 830, $12 910, $12 930
$13 410, $15 910, $17 430, $17 730, $18 910, $19 910

The middle two values are $12 930 and $13 410.

$$\text{median} = \frac{\$12\,930 + \$13\,410}{2}$$
$$= \$13\,170$$

In this case, the median and the mean are similar, so either is a good estimate of the average price.

Anthony may also find it useful to calculate the range of prices.

range = $19 910 – $8000
= $11 910

When purchasing a car, Anthony also needs to consider:

- the year of manufacture
- the number of kilometres the car has already travelled
- manual or automatic gearbox
- any extras that come with the car
- the length of registration left
- having the car checked over by a mechanic

7 Test yourself

It's better than average

ANSWERS p. 419

1 EXERCISE 7.1 For each set of data, find:

i the mode **ii** the median **iii** the mean.

a Computer frauds per year: 808, 1126, 1003, 913, 300

b Students' pocket money ($): 32, 29, 41, 34, 29, 40, 40, 37, 39, 40, 33

c Minimum daily temperatures at Echuca (°C): 7, 8, 7, 12, 12, 17, 7, 11, 10, 3, 4, 6

d Monthly rainfall at Swan Hill (mm): 9, 24, 14, 100, 19, 19, 22, 5, 23, 2, 20, 5

2 EXERCISE 7.1 The following percentage values are the room occupancy rates for Mornington Peninsula hotels per quarter (3 months) in recent times.

57, 62, 61, 56, 58, 65, 60, 59, 56, 66, 64, 59, 58, 70, 69, 62, 61, 73, 68

a Find the median for this data.

b What is the mode for this data?

c Calculate the mean for this data, correct to 1 decimal place.

d Which measure of central tendency most accurately reflects the data? Justify your answer.

3 EXERCISE 7.2 For each set of data, identify the outlier.

a 27, 28, 19, 26, 27, 25, 28, 27

b 0, 3, 2, 3, 1, 7, 1, 0, 0, 2, 3

c 43.1 43.3, 43.1, 43.2, 43.9, 43.0, 43.1, 43.0

d 95, 101, 98, 76, 97, 105, 103, 99

4 EXERCISE 7.2 NelsonJet flies from Melbourne to Canberra. The number of seats filled on the 7 am flight for 10 days was recorded.

56, 100, 98, 104, 125, 101, 89, 93, 100, 99

a Write these values in order from lowest to highest.

b What are the outliers in this data?

c For each outlier, decide if it is reasonable or if it is likely to be a mistake? Explain your answer.

5 EXERCISE 7.3 For each set of data in question **1**, find:

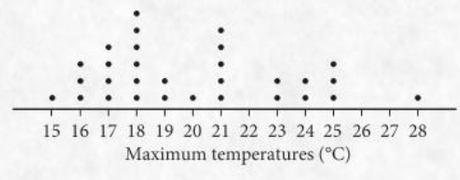
i the range **ii** the 1st and 3rd quartiles **iii** the interquartile range.

6 EXERCISE 7.3 Using your answers to question **5**, for which data set is:

a the range the better measure of spread?

b the interquartile range the better measure of spread?

7 EXERCISE 7.4 Describe the spread of data in this dot plot using words from this list: spread out, tightly packed, clustered, gaps, more dense, less dense



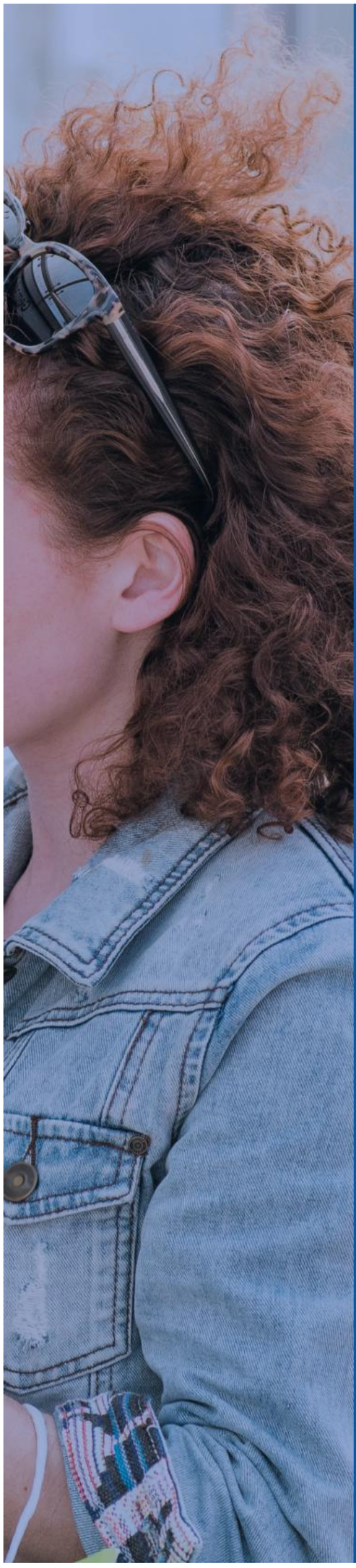
Chapter problem

Phoebe has a flute exam at 2 pm but she wants to be at the examination centre by 1.30 pm. She has to:

- walk to the station
- catch a train, then
- catch a bus to the examination centre.

It takes Phoebe 10 minutes to walk to the station. The trains leave every half hour after 9.05 am and the trip takes 20 minutes. Buses leave the train station every 15 minutes on the quarter hour and the bus trip takes 25 minutes.

At what time should Phoebe leave home?



CHAPTER 8

SPACE AND MEASUREMENT

AREA, VOLUME AND TIME

8.1 Measuring area
8.2 Areas of quadrilaterals, circles and sectors
8.3 Surface areas of prisms and cylinders
8.4 Measuring volume
8.5 Volumes of prisms and cylinders
8.6 Volume and capacity
8.7 24-hour time
8.8 Time calculations
8.9 Timetables
Extended investigation: Planning a trip
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Use metric units of area
- Calculate the area of shapes and the surface area of prisms
- Use metric units of volume and capacity and convert between them
- Use formulas to calculate the volume and capacity of prisms
- Write the time of day in 12- and 24-hour time
- Calculate time differences
- Solve problems involving timetables and schedules

How are we ever going to use this?

- When we are doing craft and need to work out what materials are required
- When we are covering furniture, cushions or making quilts
- To determine the capacity and mass of storage containers
- Many trades require knowledge of area, surface area, volume and capacity
- Looking up timetables and making plans for travel
- Checking television programs or performance times
- Any time you need to calculate anything to do with time

Study Design coverage

UNIT 1, AREA OF STUDY 4: SPACE AND MEASUREMENT

- standard metric units and measures, including common derived metric measures
- estimation and approximation strategies
- time and duration including time and date specifications, conventions, schedules and timetables.

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Videos (6):

8.2 Area of a circle • Perimeter and area of a sector • Areas of trapeziums, circles and sectors
8.3 Surface area of a prism
8.6 Volume and capacity
8.8 Time differences

Skillsheet (1):

8.4 What is volume?

Worksheets (14):

8.1 Converting units for length and area • Australian areas
8.2 Area ID • A page of circles
8.3 Nets of solids • A page of prisms and cylinders
8.4 Converting volume units
8.6 Mass, volume and capacity time trial
8.7 12-hour and 24-hour time • 24-hour time on an analogue clock
8.8 Time calculations
8.9 Time travel • TV times • Public transport trips

Puzzles (5):

8.2 Area of quadrilaterals and triangles • Area code puzzle • Area group clues
8.3 Surface area
8.8 Time calculations

Nelson MindTap

To access resources above, visit **cengage.com.au/nelsonmindtap**

8.1 Measuring area

Worksheets Converting units for length and area

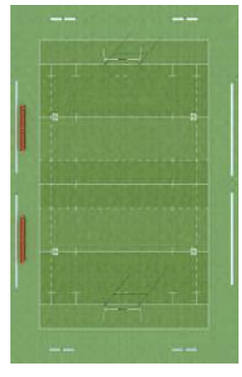
Australian areas

The **area** of a shape is the amount of surface enclosed by the shape. It is measured in square units, which are based on the length units.

Area unit	The size of a square of length:	Approximately the size of:
square millimetre (mm^2)	1 mm (Actual size: ▪)	
square centimetre (cm^2)	1 cm (Actual size: ■)	a fingernail
square metre (m^2)	1 m	the floor of a large shower recess
hectare (ha)	100 m	the area bounded by an athletics track, or less than half the area of an Australian football oval
square kilometre (km^2)	1 km	a theme park

iStock.com/firebrandphotography

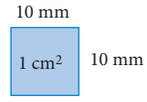
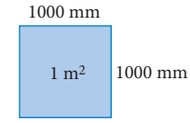
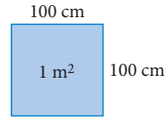
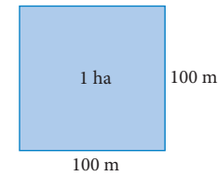
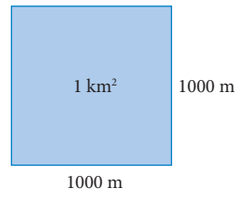
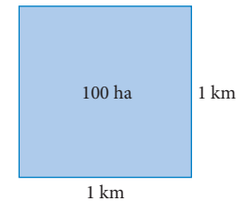
Shutterstock.com/Foamfoto



Alamy Stock Photo/Archideaphoto

Converting area units

8.1

$1\text{ cm} = 10\text{ mm}$ $1\text{ cm}^2 = 10 \times 10\text{ mm}^2$ $= 100\text{ mm}^2$	
$1\text{ m} = 1000\text{ mm}$ $1\text{ mm}^2 = 1000 \times 1000\text{ mm}$ $= 1\,000\,000\text{ mm}^2$	
$1\text{ m} = 100\text{ cm}$ $1\text{ m}^2 = 100 \times 100\text{ cm}^2$ $= 10\,000\text{ cm}^2$	
$1\text{ ha} = 100 \times 100\text{ m}$ $= 10\,000\text{ m}^2$	
$1\text{ km} = 1000\text{ m}$ $1\text{ km}^2 = 1000 \times 1000\text{ m}$ $= 1\,000\,000\text{ mm}^2$	
$1\text{ km}^2 = 100\text{ ha}$	

When converting area units, we have to convert the length unit twice because each shape has two **dimensions**. One conversion is for the length and the other for the width. We *square* the simple linear conversion factor to get the area conversion factor.

For example: to change from m to cm, multiply by 100
but to change from m^2 to cm^2 multiply by $100^2 = 10\,000$

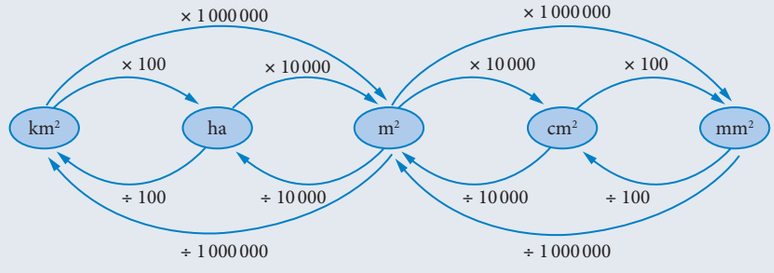
Metric units of area

$$1\text{ cm}^2 = 10^2\text{ mm}^2 = 100\text{ mm}^2$$
$$1\text{ m}^2 = 100^2\text{ cm}^2 = 10\,000\text{ cm}^2$$
$$1\text{ m}^2 = 1000^2\text{ mm}^2 = 1\,000\,000\text{ mm}^2$$
$$1\text{ ha} = 100^2\text{ m}^2 = 10\,000\text{ m}^2$$
$$1\text{ km}^2 = 1000^2\text{ m}^2 = 1\,000\,000\text{ m}^2$$

To change from a small unit to a bigger unit, **divide** by the conversion factor.

To change from a big unit to a smaller unit, **multiply** by the conversion factor.

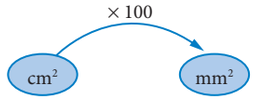
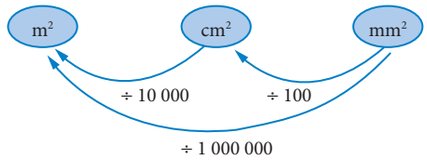
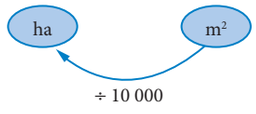
This diagram shows how to convert between units of area.



EXAMPLE 1

Convert:

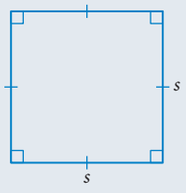
a $3\,cm^2$ to mm^2 **b** $4000\,mm^2$ to m^2 **c** $81\,000\,m^2$ to ha

Steps	Working
a cm^2 to mm^2, large to small unit: × 100 	$3\,cm^2 = 3 \times 100\,mm^2$ $= 300\,mm^2$
b mm^2 to m^2, small to large unit: ÷ 1 000 000 	$4000\,mm^2 = 4000 \div 1\,000\,000\,m^2$ $= 0.004\,m^2$
c m^2 to ha, small to large unit: ÷ 10 000 	$81\,000\,m^2 = 81\,000 \div 10\,000\,ha$ $= 8.1\,ha$

Area of a square

area = side × side

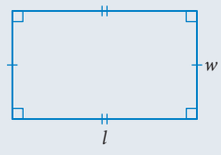
$A = s^2$



Area of a rectangle

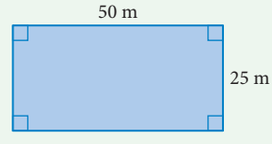
area = length × width

$A = l \times w$

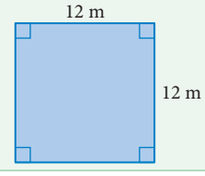


EXAMPLE 2

a The floor of an Olympic swimming pool is 50 m long and 25 m wide. Calculate the area of the floor.



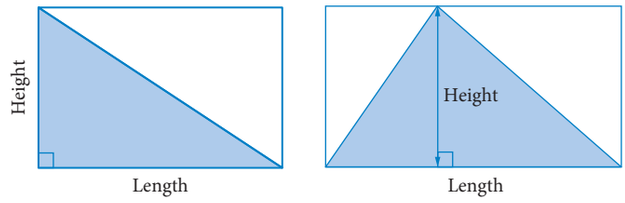
b Gymnastic floor competitions are held in a square with sides 12 m long. What is the area of a square with sides of 12 m?



Steps	Working
a Multiply the length by the width. The units in the question are metres, so the answer for area is in square metres (m^2).	area = $l \times w$ $= 50 \times 25$ $= 1250\,m^2$
b The length and the width are both 12 m. To calculate the area, multiply 12 by 12.	area = $l \times w$ $= 12 \times 12$ $= 144\,m^2$

Area of a triangle

8.1



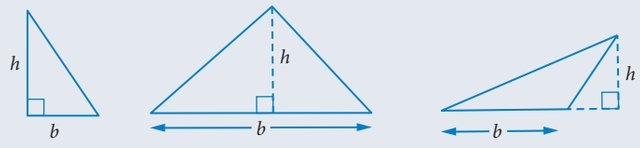
The above diagrams show that the area of a triangle is half the area of the rectangle that encloses it.

For a triangle, the length is called the **base** and the height is called the **perpendicular height** because it is at a right angle (90°) to the base.

Area of a triangle

$$\text{area} = \frac{1}{2} \times \text{base} \times \text{perpendicular height}$$

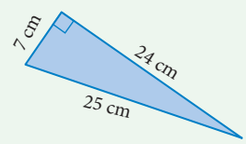
$$A = \frac{1}{2}bh$$



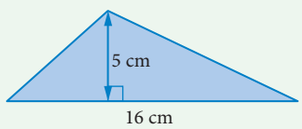
EXAMPLE 3

Calculate the area of each triangle.

a



b



Steps	Working
a The area of a triangle is $A = \frac{1}{2}bh$. The base and the height must be at 90° to each other.	$\text{area} = \frac{1}{2} \times 24 \times 7$ $= 84\,\text{cm}^2$
base = 24 cm, height = 7 cm ← The 25 cm length is not used in this calculation.	
b base = 16 cm, height = 5 cm	$\text{area} = \frac{1}{2} \times 16 \times 5$ $= 40\,\text{cm}^2$

EXERCISE 8.1 Measuring area

ANSWERS p. 420

1 Select the best unit (km^2, ha, m^2, cm^2 or mm^2) for measuring each area.

a a farm
b the floor of a classroom
c a shirt
d a football field
e a sheet of paper
f your eardrum
g Australia
h a butterfly
i Phillip Island

2 EXAMPLE 1 Copy and complete each conversion.

a $7.9\,cm^2 =$ _____ mm^2

b $1\,500\,000\,mm^2 =$ _____ m^2

c $690\,mm^2 =$ _____ cm^2

d $76\,000\,000\,m^2 =$ _____ km^2

e $865\,000\,cm^2 =$ _____ m^2

f $12\,ha =$ _____ m^2

g $0.32\,km^2 =$ _____ m^2

h $4.5\,m^2 =$ _____ cm^2

i $0.75\,m^2 =$ _____ mm^2

j $19\,000\,m^2 =$ _____ ha

3 Arrange these areas from smallest to largest: $6.5\,m^2$, $25\,050\,000\,mm^2$ and $114\,000\,cm^2$.

To compare sizes, the measurements need to be in the *same units*.

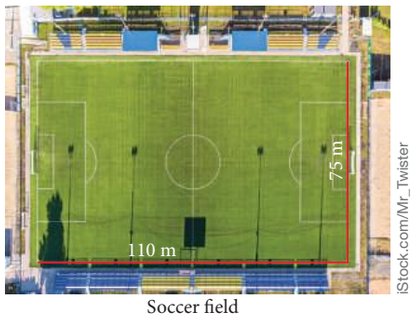
4 Arrange these areas from largest to smallest: $990\,mm^2$, $54\,cm^2$ and $0.000\,032\,m^2$.

5 The centre of Adelaide is approximately a square bounded by streets called North, South, East and West Terraces. Its area is about $3\,521\,000\,m^2$. Express the area of this square in:

a hectares

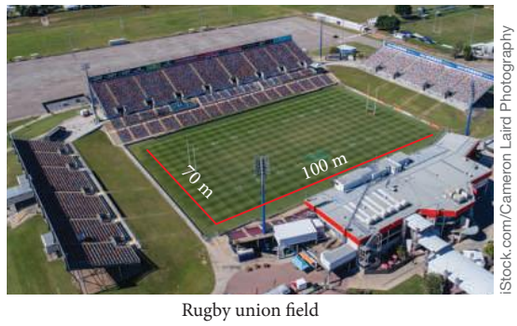
b square kilometres

6 EXAMPLE 2 Which field below has an area closer to 1 ha? Justify your answer.



iStock.com/Mr_Twister

Soccer field



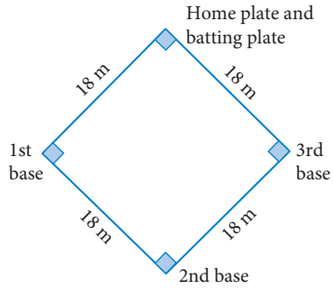
iStock.com/Cameron Laird Photography

Rugby union field

7 The infield of a junior softball ground is in the shape of a square with sides 18 metres long.

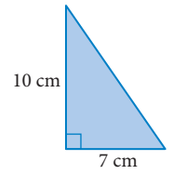
a What is the area of the infield?

b A batter can score a home run if she hits the ball a long way and then runs through all the bases and back to the home plate. Kate hit a home run. How far did she run?

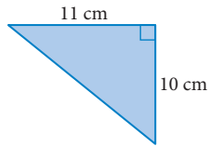


8 EXAMPLE 3 Calculate the area of each triangle.

a



b



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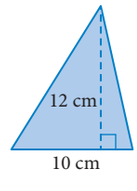
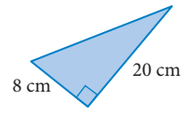


d



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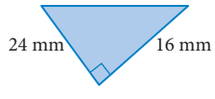

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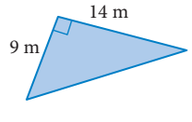
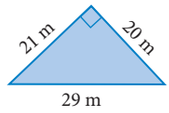


9780170448123

9 **a** Which 2 sides of the triangle on the right do you use in the formula $A = \frac{1}{2}bh$ to calculate the area of the triangle?



b What is the area of the triangle?

10 Nabil's driveway is in the shape of a rectangle, 15 m long with area 45 m^2. How wide is the driveway?

11 A large bushfire is burning out of control. Overnight it destroyed 2400 ha of bush.

a Convert 2400 ha to m^2.

b Convert your answer from part **a** to km^2.

c The burnt bush is in the shape of a rectangle. What could be the dimensions of the burnt area?

12 Ross is going to tile his verandah. The square tiles are 30 cm long.

a Calculate the area of one tile in cm^2.

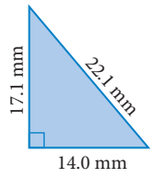
b How many tiles cover 1 m^2?

c Ross' verandah is a rectangle 3 m wide by 8.4 m long. How many tiles will he need to cover the verandah?

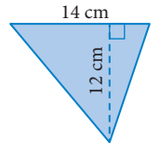
d To allow for cutting and breakage, Ross is going to order 5% more than the minimum number of tiles he requires. How many tiles should he order?

13 Calculate the area of each triangle.

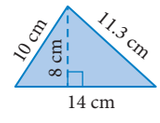
a



b



c



Make sure that you use the two dimensions that are at right angles to each other.

14 The area of a rectangle is 36 cm^2.

a What could the dimensions of the rectangle be? Give 2 possible sets of values.

b Calculate the perimeter of the rectangle for your suggested values in part **a**.

c What is the smallest the perimeter could be?

15 **a** Estimate the area of the stamp.

b Use a ruler to measure the stamp and then calculate the stamp's area. How close was your approximation?

16 Draw 2 possible right-angled triangles that each has an area of 24 cm^2, showing values for the base and height of the triangle.

Practical activity Estimating area

It takes practice to become good at estimating. Complete these practical estimation activities to develop your group's estimation skills.

To complete these activities, each group will need:

- 4 metre rulers or measuring tapes
- paper, pencils and scissors

Make a copy of this table:

Estimating area					
Names	Group members' estimates				Real measurement
Footprints in a square metre					
Handprints in a square metre					
Area of a car number plate in square centimetres					

Activity 1: Footprints in a square metre

Imagine you are going to cover a square metre with your footprints. How many footprints will fit inside 1 m^2 without any overlaps? Record your group's estimates on the record sheet.

How good was your estimate?

- Make a template of your foot. Put a piece of paper under your foot and trace around the outside. Use scissors to cut out the template. Make several templates.
- Place 4-metre rulers on the floor to outline 1 m^2.
- Systematically place your foot template in the 1 m^2 and count the number required to cover the square.

Activity 2: Handprints in a square metre

Now imagine that you are going to cover a square metre with your handprints without any overlaps. How many handprints will you need? Use a similar method to that for checking footprints in a square metre to check the accuracy of your group's handprint estimates.

Activity 3: The area of a car number plate

Estimate the area covered by a standard car number plate.

To check your estimate, measure the length and the height of an appropriate number plate, then use the formula area = $l \times w$ to calculate the area.

Alamy Stock Photo/James Davis Photography

Activity 4: Laying grass

Keira is planning to use rolls of grass to cover her backyard that is 15.4 m wide by 12 m long. Each roll of grass is 50 cm wide and 2 m long.

a Draw a diagram to represent Keira's backyard.

b Calculate the area of Keira's backyard and the area covered by one roll of grass.

c How many rolls of grass will Keira need to buy to cover her backyard?

We can only buy whole rolls of grass.

d On the diagram you drew in part **a**, decide whether it will be better to lay the grass in rows or columns or both.
Find the best way.

e Describe the size and shape of the pieces of grass that will be left over after Keira has finished covering her backyard.

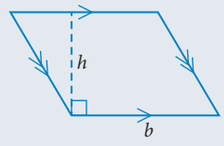
8.2 Areas of quadrilaterals, circles and sectors

Areas of quadrilaterals, circles and sectors

Area of a parallelogram

area = base × perpendicular height

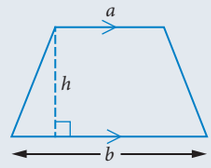
$A = bh$



Area of a trapezium

area = $\frac{1}{2}$ × sum of parallel sides × perpendicular height

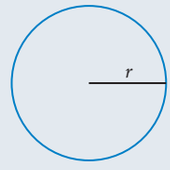
$A = \frac{1}{2}(a + b)h$



Area of a circle

area = $\pi \times (\text{radius})^2$

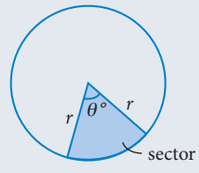
$A = \pi r^2$



Area of a sector

area = $\frac{\text{sector angle}}{360} \times \pi \times (\text{radius})^2$

$A = \frac{\theta}{360} \times \pi r^2$



Videos
Area of a circle
Perimeter and area of a sector

Worksheets
Area ID
A page of circles

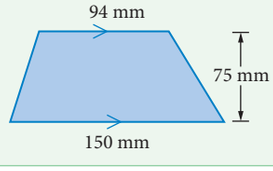
Puzzles
Areas of quadrilaterals and triangles
Area code puzzle
Area group clues

The sector area is a fraction of the area of the circle, and $\frac{\theta}{360}$ is the fraction because there are 360° in a circle.

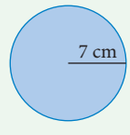
EXAMPLE 4

Find the area of each shape, correct to 2 decimal places where necessary.

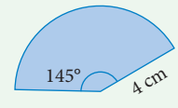
a



b



c



Steps	Working
a For a trapezium, $A = \frac{1}{2}(a + b)h$. $a = 94\,\text{mm}$, $b = 150\,\text{mm}$, $h = 75\,\text{mm}$	area $= \frac{1}{2} \times (94 + 150) \times 75$ $= 9150\,\text{mm}^2$
b For a circle, $A = \pi r^2$. $r = 7\,\text{cm}$	area $= \pi \times 7^2$ $= 153.9380\ldots$ $\approx 153.94\,\text{cm}^2$
c For a sector, $A = \frac{\theta}{360} \times \pi r^2$. $\theta = 145°$, $r = 4\,\text{cm}$	area $= \frac{145}{360} \times \pi \times 4^2$ $= 20.2458\ldots$ $\approx 20.25\,\text{cm}^2$

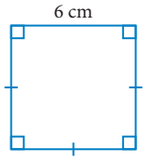
Video
Areas of trapeziums, circles and sectors

EXERCISE 8.2 Areas of quadrilaterals, circles and sectors

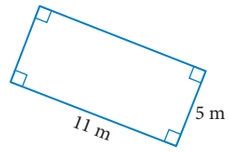
ANSWERS p. 420

1 EXAMPLE 4 Calculate the area of each quadrilateral.

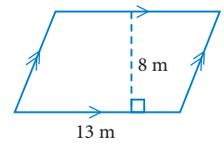
a



b



c



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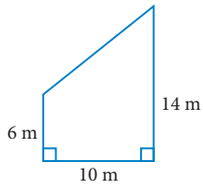

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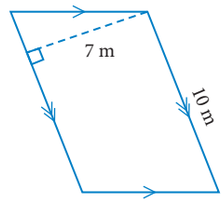

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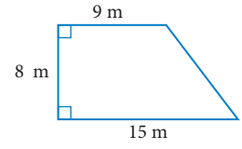
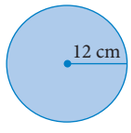
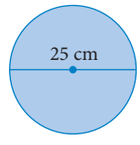


2 Find the area of each circle or sector, correct to 2 decimal places.

a



b



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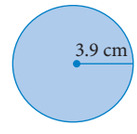
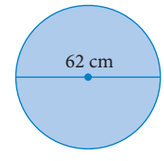


d



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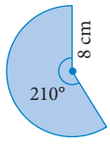
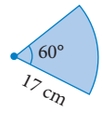


f



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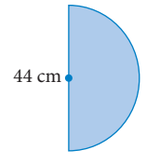

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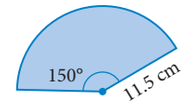
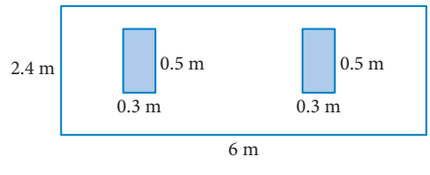


3 Mark is a bricklayer. He uses 65 bricks to build 1 m^2 of wall.

a How many square metres of wall can Mark build with 715 bricks?

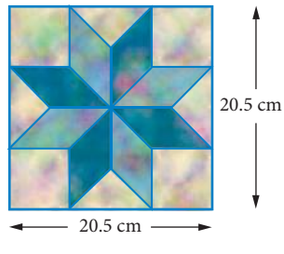
b Mark is going to build this brick fence, leaving two holes as requested by the customer.

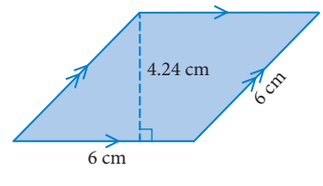
How many square metres of brickwork are in the fence?



c How many bricks will Mark need to build the fence?

4 Rachel uses parallelograms to make a star pattern on a quilt. The star pattern is shown on the left, and one of the parallelograms is shown on the right.





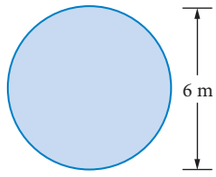
a Calculate the area of a parallelogram.

b What is the area covered by the star?

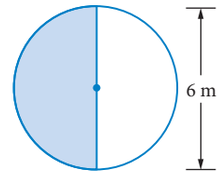
c How much of the area of the square is **not** covered by the star?

5 Calculate the area of each shaded region, correct to 1 decimal place.

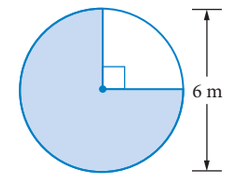
a



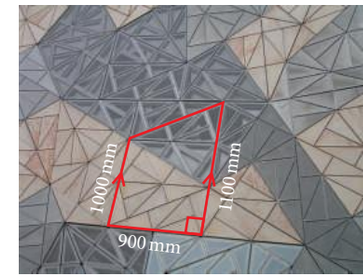
b



c



6 Find the area of the trapezoidal shape on the exterior of the Federation Square building in central Melbourne.



7 A large pizza is 30 cm in diameter.

a What is the area of the pizza, correct to 2 decimal places?

b The pizza is cut into 8 equal pieces. What is the area of each piece?

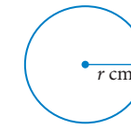
c Lakshmi eats 3 slices and Anya eats 5 slices. How many more square centimetres of pizza does Anya eat?

Shutterstock.com/Tobik

8 During World War II in the 1940s, army barracks were built with a semicircular end with diameter 7 m. Find the area of tin used for one end of the building, correct to 2 decimal places.

Shutterstock.com/Paul Briden

9 This circle has an area of 36 cm^2. Find its radius, r cm, correct to 2 decimal places.



Video
Surface area of a prism

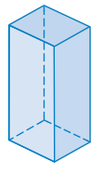
Worksheets
Nets of solids

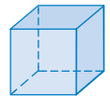
A page of prisms and cylinders

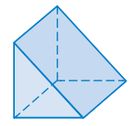
Puzzle
Surface area

8.3 Surface areas of prisms and cylinders

A **prism** is a solid object that has identical ends and flat side faces. A prism has straight edges and the shape of the ends gives the name of the prism. All other faces are rectangles. Some examples are shown below.


rectangular prism


cube


triangular prism

Surface area

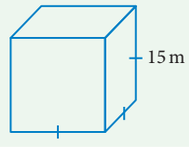
total surface area = sum of the area of all faces

When we want to make boxes for packaging, we need to know the total area of all the faces of the box. This is called **surface area** because it is the sum of the areas of all the surfaces of the box. The easiest way to calculate the surface area of an object is to draw its **net**. We calculate the area of each shape on the net individually and then add them together to find the total surface area.

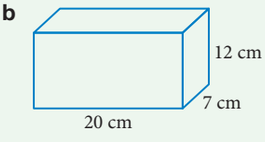
EXAMPLE 5

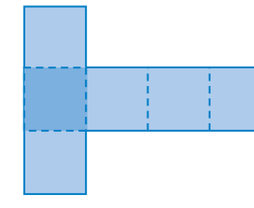
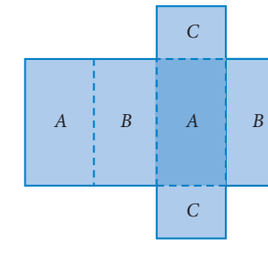
Find the surface area of each prism.

a



b

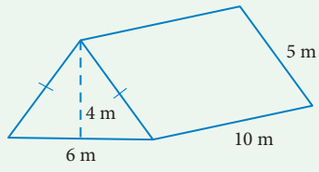


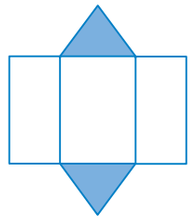
Steps	Working
a A cube has 6 identical faces, all squares.	
This is the net of a cube.	
The surface area is 6 times the area of each square.	total surface area $= 6 \times 15^2$ $= 1350\,\text{cm}^2$
b This is the net of a rectangular prism.	
Notice that the rectangles are in matching pairs.	
The ends (C) are the same rectangles.	area of ends $= 2 \times (7 \times 12)$ $= 168\,\text{cm}^2$
The top and bottom faces (A) are the same size.	area of top/bottom $= 2 \times (20 \times 7)$ $= 280\,\text{cm}^2$
The front and back faces (B) are the same size.	area of front/back $= 2 \times (20 \times 12)$ $= 480\,\text{cm}^2$
Add the areas together.	total surface area $= 168 + 280 + 480$ $= 928\,\text{cm}^2$

9780170448123

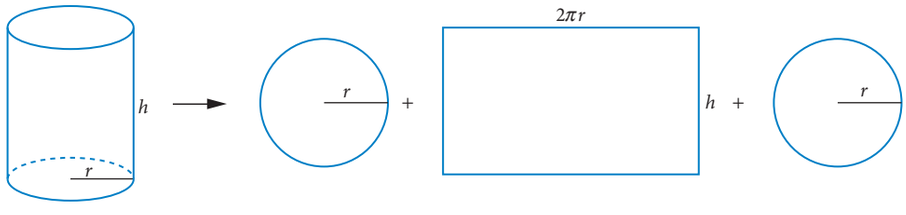
EXAMPLE 6

Find the surface area of this triangular prism.



Steps	Working
This is the net of a rectangular prism. There are 3 rectangles and 2 identical triangles.	
Find the area of the base rectangle.	area of base $= 6 \times 10$ $= 60\,\text{m}^2$
Find the area of the 2 side rectangles.	area of side faces $= 2 \times (5 \times 10)$ $= 100\,\text{m}^2$
Find the area of the 2 triangles.	area of 2 triangles $= 2 \times \left(\frac{1}{2} \times 6 \times 4\right)$ $= 24\,\text{m}^2$
Add the areas together.	total surface area $= 60 + 100 + 24$ $= 184\,\text{m}^2$

A flatten **cylinder**, has a net of two circles and a rectangle.



Note: The length of the rectangle is the **circumference** of the circle ($2\pi r$).

surface area of a cylinder = area of two circles + area of rectangle

$= 2 \times \pi r^2 + 2\pi r \times h$

$= 2\pi r^2 + 2\pi rh$

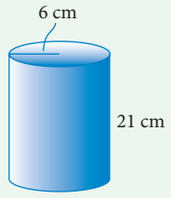
Surface area of a cylinder

surface area = area of 2 circles + area of rectangle

$SA = 2\pi r^2 + 2\pi rh$

EXAMPLE 7

Find the surface area of this cylinder, correct to 2 decimal places.



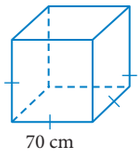
Steps	Working
$r = 6$ cm, $h = 21$ cm	$SA = 2\pi r^2 + 2\pi rh$ $= 2 \times \pi \times 6^2 + 2 \times \pi \times 6 \times 21$ $= 1017.8760\ldots$ $\approx 1017.88\ \text{cm}^2$

EXERCISE 8.3 Surface areas of prisms and cylinders

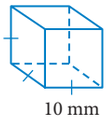
ANSWERS p. 420

1 EXAMPLE 5 Find the surface area of each cube.

a



b



2 Charlotte has a plastic storage cube that is 35 cm long with no top. Calculate its external surface area. (Ignore the holes for the handles.)

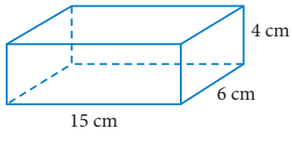
Alamy Stock Photo/Stephanie Jackson

3 This metal cube sculpture has a side length of 450 cm. The surface is to be covered with a weather-resistant finish. How many square metres need to be covered?

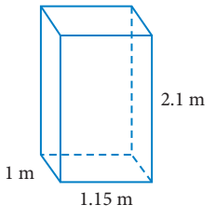
Shutterstock.com/Holly Vegter

4 Find the surface area of each prism.

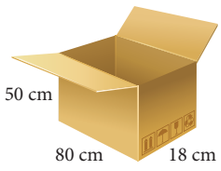
a



b



5 James' new TV was packed in this box. Find the surface area of the box.

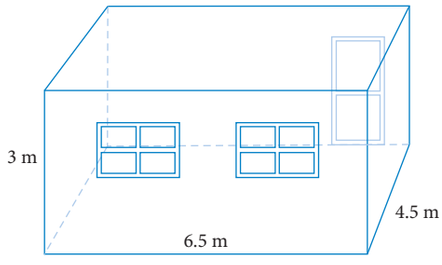


6 Aexa and Jai built a new living room.

a Calculate the area of the walls and ceiling to be painted. Subtract 6 m^2 for the windows and door.

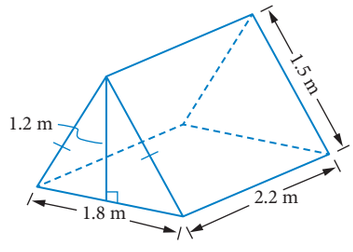
b If paint costs \$23 for a 4-litre can that covers 10 m^2, calculate how much it would cost to paint the room with 2 coats.

c Calculate the area of the floor to be covered with wood parquet.



d If wood parquet costs \$15.70 per square metre, how much would it cost to cover the floor? Answer to the nearest \$10.

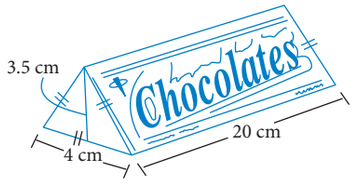
7 EXAMPLE 6 Tom's company makes camping equipment, including this tent. What amount of material is required to make the tent (including the floor)?



8 The diagram shows a chocolate box in the shape of a prism. The ends of the box are equilateral triangles.

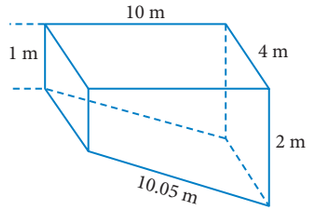
a Calculate the surface area of the box.

b The manufacturer allows an extra 10% of the surface area for tabs and wastage. How much cardboard is required for one box?



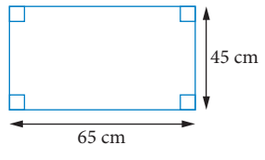
9 Harish and Rachna have a backyard pool shaped as shown. All of its surfaces need to be repainted. There are tiles around the top edge to a depth of 40 cm. Calculate the area to be painted.

Remember to convert 40 cm to m.



10 A metal tray is made by taking a rectangular piece of metal and cutting squares from the corners. The edges are then bent upwards and welded at the corners to form the tray.

a Squares of side length 10 cm are cut out of each corner. What are the dimensions of the tray that can be formed?

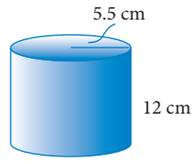


b The bottom of the tray is to be lined with material. What area of material is required?

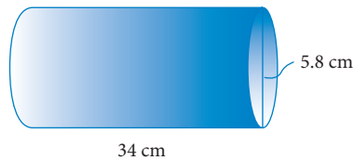
c Each of the four upright sides (inside and outside) and the underside of the bottom of the tray are to be enamelled. What area is to be enamelled?

11 EXAMPLE 7 Find the surface area of each cylinder, correct to 2 decimal places.

a



b

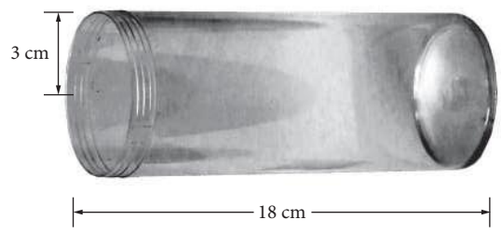


12 A can of pineapple rings has height 11 cm and radius 5 cm. A label will be wrapped around the curved surface.

Calculate the area of the label, correct to 2 decimal places.

Shutterstock.com/Moving Moment

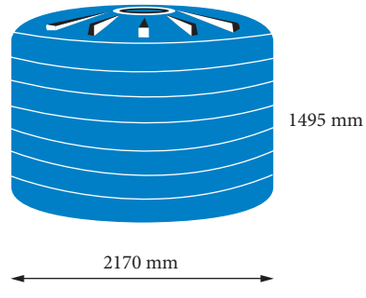
13 Calculate, correct to 1 decimal place, the area of recycled plastic used to make this food container. Note that it has an open end.



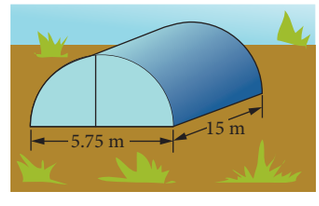
Shutterstock.com/small smiles

14 How much plastic would be needed to make this water tank?

Answer correct to the nearest square metre.



15 A hydroponics shed is made in the shape of half of a cylinder. Find the area of sheet metal needed for the shed, correct to the nearest square metre. Do not include the floor.



16 Elise bought a tube for sending posters through the mail. It is a cardboard cylinder with plastic plugs at each end. The tube is 1.1 m long and has a radius of 2.5 cm.

a Calculate the amount of cardboard used in creating the tube, correct to the nearest square centimetre.

b Calculate the total area of the plastic ends, correct to 1 decimal place.

Shutterstock.com/Damon Allen Davison

17 The ceilings in Mason's house are 2.88 m high compared to the standard 2.4 m. If his ceiling was the usual height, he would need 36 L of paint to paint the interior of his lounge and hall.

a Use a calculation to show that Mason's walls are 1.2 times as high as 2.4 m high walls.

b Write a sentence to explain why the expression 36×1.2 represents the quantity of paint Mason will need to paint his walls.

c How many litres of paint will Mason need to paint the walls in his lounge and hall?

d How much more paint will Mason need to paint the walls in his lounge and hall because he has high ceilings?

8.4 Measuring volume

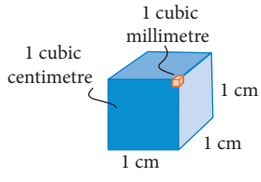
The **volume** of a solid is the amount of space occupied by the solid. Volume is measured in cubic units.

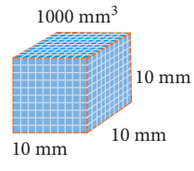
Volume unit	The size of a cube of length:	Approximately the size of:
cubic millimetre (mm^3)	1 mm	a grain of raw sugar or rock salt
cubic centimetre (cm^3)	1 cm	a tooth or a pain relief tablet
cubic metre (m^3)	1 m	2 washing machines

Skillsheet What is volume?

Worksheet Converting volume units

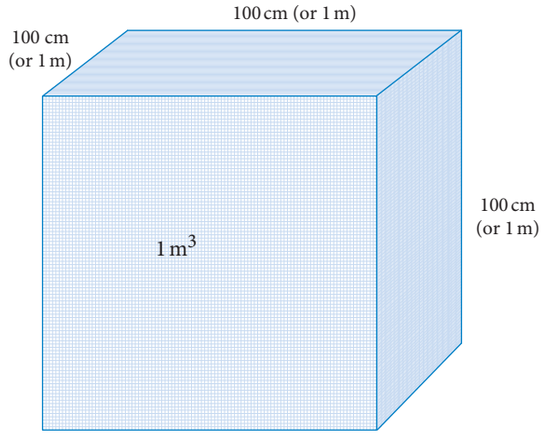
These diagrams compare a cubic millimetre with a cubic centimetre.





$1\ cm^3 = 10\ mm \times 10\ mm \times 10\ mm$
$= 1000\ mm^3$

This diagram compares a cubic centimetre with a cubic metre.



$1\ m^3 = 100\ cm \times 100\ cm \times 100\ cm$
$= 1\,000\,000\ cm^3$

When converting area units, we have to convert the length unit twice. When converting volume units, we have to convert the length unit 3 times. We *cube* the simple linear conversion factor to get the volume conversion factor.

For example, to change from m to cm, multiply by 100,
but to change from m^3 to cm^3 multiply by $100^3 = 1\,000\,000$.

Metric units of volume

$1\text{ cm}^3 = 1000\text{ mm}^3$

$1\text{ m}^3 = 1\,000\,000\text{ cm}^3$

To change from a small unit to a bigger unit, **divide** by the conversion factor.

To change from a big unit to a smaller unit, **multiply** by the conversion factor.

EXAMPLE 8

Convert:

a 36 cm^3 to mm^3 **b** $84\,000\,000\text{ cm}^3$ to m^3

Steps	Working
a cm^3 to mm^3, large to small unit: $\times 10^3 = 1000$	$36\text{ cm}^3 = 36 \times 1000\text{ mm}^3$ $= 36\,000\text{ mm}^3$
b cm^3 to m^3, small to large unit: $100^3 = 1\,000\,000$	$84\,000\,000\text{ cm}^3 = 84\,000\,000 \div 1\,000\,000\text{ m}^3$ $= 84\text{ m}^3$

EXERCISE 8.4 Measuring volume

ANSWERS p. 420

1 What units would you use (m^3, cm^3 or mm^3) to measure the volume of each object?

a bedroom **b** backpack **c** mobile phone
d matchbox **e** concert hall **f** swimming pool
g calculator **h** car **i** driver's licence
j glass of water **k** USB drive **l** box of laundry powder

2 Match the correct volume (**A** to **G**) with each item (**a** to **g**) listed.

a bottle of nail polish **A** 200 m^3
b box of tissues **B** 3980 m^3
c glass of fruit juice **C** 1250 cm^3
d bottle of soft drink **D** 5000 cm^3
e classroom **E** $20\,000\text{ mm}^3$
f school hall **F** 250 cm^3
g box of cereal **G** 2200 cm^3

Hint: You may find it helpful to put the items in descending order of volume and then choose the measurements.

3 EXAMPLE 8 Copy and complete each conversion.

a $5000\text{ cm}^3 = _____\text{ mm}^3$ **b** $1.6\text{ m}^3 = _____\text{ cm}^3$
c $6000\text{ cm}^3 = _____\text{ m}^3$ **d** $4000\text{ mm}^3 = _____\text{ cm}^3$
e $160\,000\text{ cm}^3 = _____\text{ m}^3$ **f** $250\text{ mm}^3 = _____\text{ cm}^3$
g $0.18\text{ m}^3 = _____\text{ cm}^3$ **h** $0.12\text{ cm}^3 = _____\text{ mm}^3$
i $4\text{ m}^3 = _____\text{ mm}^3$ **j** $9\,600\,000\text{ mm}^3 = _____\text{ m}^3$

4 Arrange in ascending order: 42 cm^3, 4210 mm^3, 0.0042 m^3.

5 Arrange in descending order: $65\,000\text{ cm}^3$, 0.6 m^3, $7\,000\,000\text{ mm}^3$.

6 The volume of Marty's chest of drawers is 306 000 cm^3. What is this in cubic metres?

7 Ruchi's lunchbox has a volume of 2520 cm^3. What is the volume of her lunchbox in cubic millimetres?

8 Hans ordered 1 m^3 of pine bark to mulch his vegetable garden. After he finished putting the mulch on his garden, he had 20% of the original amount left. How many cubic centimetres of mulch were left over?

8.5 Volumes of prisms and cylinders

Volume of a prism or other solid with identical ends

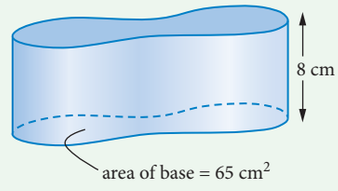
$$V = A \times h$$

where A is the area of the end or **base**, and h is the height.

EXAMPLE 9

The area of the base of this solid is 65 cm^2. What is the volume of the solid?

This is not a prism because its ends are not shapes with straight sides, but it does have identical ends.

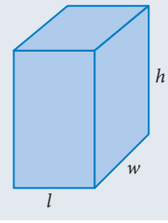


Steps	Working
Both ends of the solid are identical, so we can use the formula $V = A \times h$.	$V = 65 \times 8$
$A = 65\ cm^2$, $h = 8$ cm	$= 520\ cm^3$

Volume of a rectangular prism

$$V = lwh$$

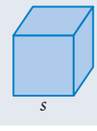
where l = length, w = width, h = height.



Volume of a cube

$$V = s^3$$

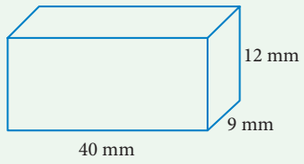
where s = side length.



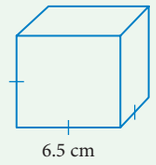
EXAMPLE 10

Find the volume of each prism.

a



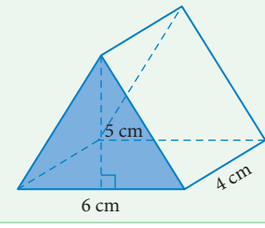
b



Steps	Working
a Use the formula $V = lwh$.	$V = 40 \times 9 \times 12$ $= 4320\,\text{mm}^3$
b This is a cube, a special type of rectangular prism. $V = s^3$	$V = 6.5 \times 6.5 \times 6.5$ $= 6.5^3$ $= 274.625\,\text{cm}^3$

EXAMPLE 11

Find the volume of this triangular prism.



Steps	Working
Use the formula $V = A \times h$. $h = 4\,\text{cm}$ (height of prism) For a triangular prism, $A = \frac{1}{2}bh$. $b = 6\,\text{cm}$, $h = 5\,\text{cm}$	$V = \left(\frac{1}{2} \times 6 \times 5\right) \times 4$ $= 60\,\text{cm}^3$

We can also use the formula $V = Ah$ to find the volume of a cylinder, because a cylinder has identical ends. For a cylinder, the base is a circle, with area $A = \pi r^2$.

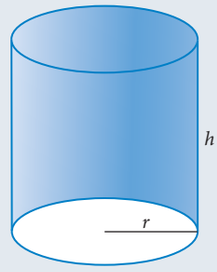
$V = Ah$
$= \pi r^2 \times h$
$= \pi r^2 h$

A cylinder is not a prism because it has a curved surface, but its volume can still be found using $V = Ah$.

Volume of a cylinder

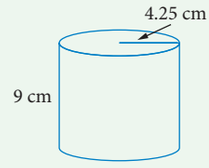
$$V = \pi r^2 h$$

where r = radius of base, h = height of cylinder.



EXAMPLE 12

Find the volume of this cylinder, correct to 2 decimal places.



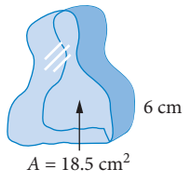
Steps	Working
$V = \pi r^2 h$	$V = \pi \times 4.25^2 \times 9$
$r = 4.25$ cm, $h = 9$ cm	$= 510.7051$
	$\approx 510.71 \text{ cm}^3$

EXERCISE 8.5 Volumes of prisms and cylinders

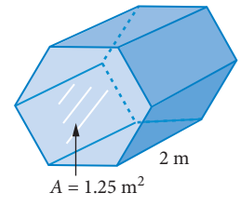
ANSWERS p. 421

1 EXAMPLE 9 Find the volume of each solid.

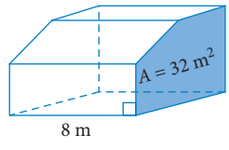
a



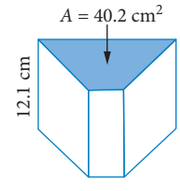
b



c

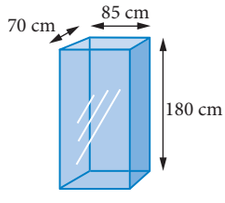


d



2 EXAMPLE 10 Find the volume of each prism.

a



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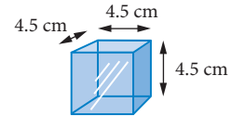

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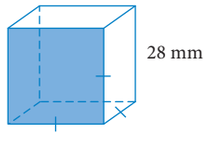

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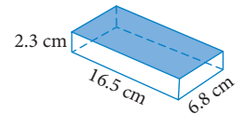
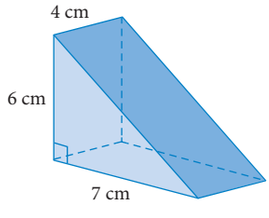
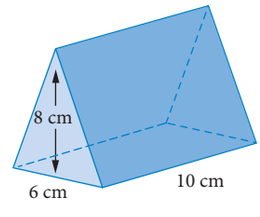


3 EXAMPLE 11 Find the volume of each triangular prism.

a



b



4 Concrete blocks are used to build houses.

a If each concrete block measures 45 cm by 17 cm by 21 cm, calculate the volume of one block.

b A wall is made from 80 concrete blocks. Calculate the volume of the wall.

5 These storage cubes have a side length of 35 cm.

a Calculate the volume of one cube.

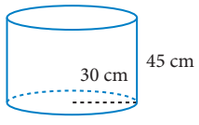
b Inga has a stack of 11 cubes in her bedroom to store books. What volume of books can she store?

c Inga's books have an average volume of 1425 cm^3 each. Approximately how many books can she store?

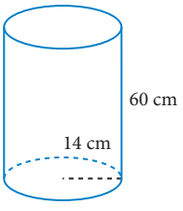
Shutterstock.com/Leszek Glasner

6 EXAMPLE 12 Calculate, correct to 1 decimal place, the volume of each cylinder.

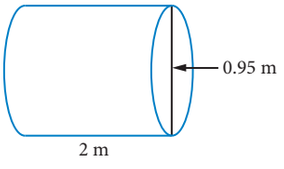
a



b



c



7 Calculate the volume of each food item (correct to 1 decimal place for parts **g** and **h**).

a

GS1 Smart Media

b

GS1 Smart Media

c

GS1 Smart Media

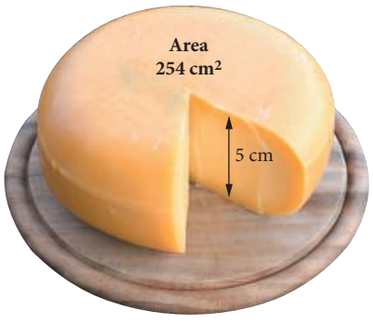
d

GS1 Smart Media

e

Alamy Stock Photo/Martin Lee

f



Dreamstime.com/Emprize

g

Shutterstock.com/sockagphoto

h

Shutterstock.com/Carlos Yudica

8 Michael is laying pavers for a new rectangular outdoor area, 4.2 m by 2.7 m. Each paver is 300 mm by 300 mm and 50 mm thick.

a How many pavers will he need?

b Calculate the volume of one paver.

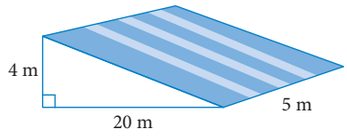
c Calculate the volume for the total number of pavers required for this job in cubic millimetres.

Remember to have all your measurements in the same units!

d Pavers come in boxes of 10. How many boxes will Michael need to purchase?

e Each box costs $56.70. How much will the pavers cost?

9 This concrete ramp was built at Hawk's Garden beach to give easy access to the beach. Calculate the volume of concrete required for this ramp.



10 Nazneen plans to install air-conditioning inside her house. The air conditioner is available in 4 sizes.

Air conditioner size	Volume of air in house
Small	210 m^3
Medium	350 m^3
Large	500 m^3
Extra large	720 m^3

Nazneen's house is in the shape of a rectangular prism, with the dimensions shown on the photograph.

Photo courtesy of Sue Thomson

What size air conditioner will Nazneen need?

11 Gianni makes cylinder-shaped cardboard yogurt tubs. He is experimenting with a new size of tub. Which of these options provides the larger volume? Justify your answer with calculations.

A a tub of radius 3.95 cm and height 11.8 cm

B a tub of diameter 6.1 cm and height 14 cm

12 **a** The volume of this 1 L carton of milk is 1000 cm^3. The height of the carton is 20.4 cm. What is the area of the base, correct to the nearest cm^2?

b The base is a square. How long are the sides of the square?

Newspix/Jessica Lee

13 Jo uses a cylindrical tank to store water on her property. What is the volume of Jo's tank? Answer correct to 2 decimal places.

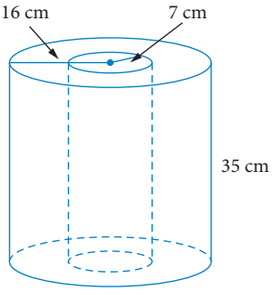
Shutterstock.com/kezza

14 A hollow cylinder is shown.

a Find the volume of a cylinder with radius 16 cm, correct to 2 decimal places.

b Find the volume of the 'hole' with radius 7 cm, correct to 2 decimal places.

c Calculate the volume of the hollow cylinder by subtracting your answer to part **b** from your answer to part **a**.



Investigation Volume of a car

Complete these practical estimation activities to develop your group's estimation skills.

To complete these activities, each group will need metre rulers or measuring tapes

Estimating volume					
Names	Group members' estimates				Real measurement
Volume of a car boot					
Volume of a car					

Activity 1: The volume of a car boot

Car boots (luggage compartments) come in different sizes. Before your group starts this activity, select an appropriate car.

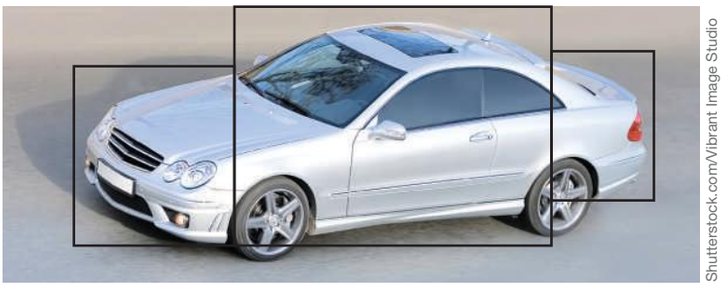
Record the group's estimates for the volume, then measure the width, depth and height of the car boot in metres. Use this formula to calculate the volume in cubic metres (m^3).

volume = area of the base × height

Shutterstock.com/kilukilu

Activity 2: The volume of a car

The volume of most cars can be modelled by using two or three rectangular prisms.


Shutterstock.com/Vibrant Image Studio

Record the estimates, then measure the width, depth and height of the sections of the car in metres. Then calculate the volume of each section in cubic metres. Then add the sections to determine the total volume.

Investigation | Designing a smaller can

Changing the dimensions of a package is one method that manufacturers use to disguise price rises. Keeping the price the same but reducing the size of the contents is equivalent to increasing the price.

The formula $V = \pi r^2 h$, where r = the radius of the base and h = the height, can be used to calculate the volume of this can of dog food.

This can has a base radius of 5 cm and a height of 10 cm and it contains 785 cm^3.

Design a can that looks almost the same size, but contains about 20% less volume.

DIlibrary/Mars Petcare Australia

Hints

- How much is 20% less than 785 cm^3?
- Reduce the radius or the height, or both, by a small amount and calculate the volume.

Is it in the range you want? If not, try some other values for the radius and height.

8.6 Volume and capacity

Volume measures the amount of space taken up by a container and its contents.

Capacity measures the amount of liquid or gas a container will hold.

Capacity unit	Approximately the size of:
millilitre (mL)	a large drop of water
litre (L)	a tall carton of milk
kilolitre (kL)	a small rainwater tank
megalitre (ML)	half an Olympic-sized swimming pool

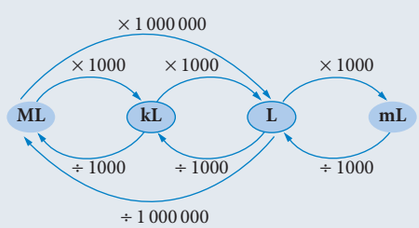
Worksheet
Mass, volume and capacity time trial

Metric units of capacity

1 L = 1000 mL

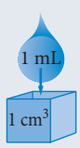
1 kL = 1000 L

1 ML = 1000 kL = 1 000 000 L

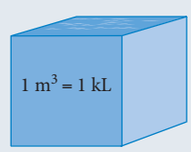


Converting volume and capacity units

1 cm^3 holds 1 mL.



1 m^3 holds 1000 L or 1 kL.



Video
Volume and capacity

EXAMPLE 13

Convert:

a $5\,cm^3$ to mL **b** 1850 mL to litres

Steps	Working
a $1\,cm^3$ holds 1 mL. The number of cm^3 and mL are always the same.	$5\,cm^3 = 5\,mL$
b mL to L: small to large unit: ÷ 1000	$1850\,mL = 1850 \div 1000\,L$ $= 1.85\,L$

Video
Volume and capacity

EXAMPLE 14

The volume of a large fishpond is $3.4\,m^3$. How many litres of water does it hold?

Shutterstock.com/Ron Zmiri

Steps	Working
$1\,m^3$ holds 1000 L.	$3.4 \times 1000 = 3400\,L$
Multiply the number of m^3 by 1000.	
Write your answer.	The fishpond holds 3400 L of water.

EXERCISE 8.6 Volume and capacity

ANSWERS p. 421

1 State what unit of capacity you would use to measure the size of a:

a glass of milk **b** dam **c** car's petrol tank
d bottle of medicine **e** office water cooler **f** swimming pool.

2 Match the correct capacity (**A** to **J**) with the items (**a** to **j**) listed.

a car petrol tank	**A** 200 mL
b a cup of flour	**B** 23 kL
c bathtub	**C** 5 mL
d bucket of water	**D** 70 L
e can of drink	**E** 1250 mL
f glass of water	**F** 1.875 ML
g Olympic swimming pool	**G** 250 mL
h bottle of lemonade	**H** 9 L
i teaspoon	**I** 375 mL
j water storage tank	**J** 180 L

Hint: You may find it helpful to put the items in descending order of capacity and then choose the measurements.

3 EXAMPLE 13 Convert each measurement to mL.

a $8\,cm^3$ **b** $1500\,cm^3$ **c** $425\,cm^3$

4 Convert each measurement to litres.

a 2000 mL **b** 3500 mL **c** 250 mL

5 EXAMPLE 14 The volume of a large container is 5000 cm^3.

a How many millilitres does the container hold?

b How many litres will a container with a volume of 5000 cm^3 hold?

6 How many litres can a 2 m^3 container hold?

7 How many litres of water does a water truck with a volume of 4 m^3 hold?

8 Liam is pouring 1500 cm^3 of liquid chlorine into the swimming pool. Express this quantity in litres.

9 What is the volume of a carton that holds 1 L of milk?

10 What is the volume in cubic centimetres of a 1.25 L soft drink bottle?

11 Each can in a box of 24 cans of soft drink holds 375 mL. How many litres of soft drink are contained in the box?

12 This inflatable children's pool contains water 20 cm deep. How many litres of water are in the pool?

Make sure you convert 20 cm to metres before you start the calculations!

123RF Stock Photo/smikeymikey1

13 A tap leaks 10 mL of water every 50 seconds. How much water will the tap lose in:

a 1 second? **b** 1 minute? **c** 3 hours? **d** 1 day?

14 Zina lives in Alice Springs and her swimming pool is 5.8 m long and 3.2 m wide. The hot, dry winds in Central Australia causes 11 cm of water in the pool to evaporate.

a What solid shape could be used to represent the volume of water that evaporated from Zina's pool?

b How many cubic metres of water evaporated from the pool?

c How many litres of water are required to top up Zina's pool?

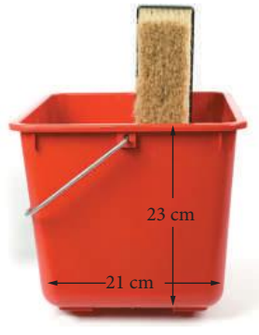
d The pump on Zina's water tank delivers 105 L per minute. For how long will she need to pump water from the tank into her pool to replace the evaporated water? Express your answer correct to the nearest minute.

15 This bucket has a square base with side lengths of 21 cm.

a The height of the bucket is 23 cm. Calculate the volume of the bucket in cm^3.

b How many whole litres of water can the bucket hold?

c One litre of water weighs 1 kg. Approximately how much will the bucket weigh when it is half-full of water?



Shutterstock.com/Spinetta

16 The size of a refrigerator is its capacity in litres. Calculate the size of a refrigerator that is 85 cm wide, 170 cm tall and 55 cm deep. Express the capacity correct to the nearest litre.

17 Claire wants to fertilise the plants in her fish tank. The tank is 120 cm long, 55 cm high and 45 cm deep.

a How many litres of water does the tank hold?

b Claire needs to add 5 mL of liquid fertiliser for every 38 litres of water. How much liquid fertiliser should she add? Express the quantity correct to the nearest mL.

Worksheets
12-hour and 24-hour time

24-hour time on an analogue clock

8.7 24-hour time

There are 2 ways to show the time of day:

- **12-hour time:** the conventional way using am and pm and the hours 1 to 12.
- **24-hour time:** a more formal way that uses 4 digits, the hours 00 to 23 and no am/pm.

There are 2 main types of clocks we use to tell the time:

- Analog clock with a clock face that shows the numbers 1 to 12.
- Digital clock that shows either 12-hour or 24-hour time.

Dreamstime.com/Monticello

Analog clock

Dreamstime.com/Olga Popova

Digital clock

This table shows the relationship between 12-hour and 24-hour time.

24-hour time	12-hour time
0000	12 am (midnight)
0100	1 am
0200	2 am
0300	3 am
0400	4 am
0500	5 am
0600	6 am
0700	7 am
0800	8 am
0900	9 am
1000	10 am
1100	11 am

24-hour time	12-hour time
1200	12 pm (midday)
1300	1 pm
1400	2 pm
1500	3 pm
1600	4 pm
1700	5 pm
1800	6 pm
1900	7 pm
2000	8 pm
2100	9 pm
2200	10 pm
2300	11 pm

EXAMPLE 15

Express 8.25 am in 24-hour time.

Steps	Working
8.25 am is in the morning.	8.25 am = 0825
Put a zero at the front.	

EXAMPLE 16

Write 1615 as 12-hour time.

Steps	Working
1615 is bigger than 12.00 so it's in the afternoon. Take 12 away from 16 and write as an am/pm time.	1615 = 4.15 pm

EXERCISE 8.7 24-hour time

ANSWERS p. 421

1 EXAMPLE 15 Write as 24-hour time.

a 11.44 am **b** 6.35 pm **c** 2.51 am **d** 9.54 pm

2 EXAMPLE 16 Write as 12-hour time.

a 0845 **b** 1320 **c** 2331 **d** 1045

3 Write the time shown on each clock in 12-hour time.

a

b

c

4 Write the time shown on each clock in 12-hour time. All times are in the morning.

a

b

c

5 Write the time shown on each clock in 12-hour time. All times are in the afternoon or evening.

a

b

c

6 Show each time on an analog clock face.

a 8.15 am **b** 10.40 pm **c** 3.35 pm

7 Copy and complete this table.

12-hour time	5 am	a	2.10 pm	5.18 pm	b	c	d
24-hour time	e	0715	f	g	1730	2150	1120

8 Sue wants to program her DVR to record a television program when she's out. The program starts at 8.30 pm and lasts for an hour and a half. Her DVR works in 24-hour time.

a At what time will Sue need to set her DVR to start recording the program?

b What time should she set for her finish time? Allow an extra 5 minutes for the recording.

9 The army, navy and air force all use 24-hour time, and sometimes 24-hour time is called 'military time'. Sean rings his wife from the army camp at 1730. What time is this in 12-hour time?

10 Andrew was on police duty one Saturday night from 2200 to 0600 on Sunday morning. He receives a report of a fight at 2245 and again at 0220.

a How long was Andrew on duty?

b How long was it between the 2 incident reports?

c A patient is taken from the second fight to hospital and arrives 45 minutes after the incident was reported. What time does the patient arrive at hospital?

Worksheet
Time calculations

Puzzle
Time calculations

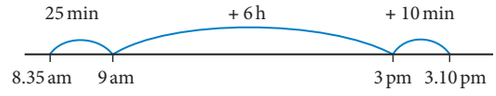
Video
Time differences

8.8 Time calculations

How long do I have before the party starts? How long is my stopover in Hong Kong? How long have I worked here? We can answer all these questions by doing a time calculation.

EXAMPLE 17

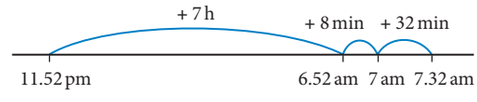
What is the difference in time between 8.35 am and 3.10 pm?

Steps	Working
Use a timeline and count to the next full hour.	
From 8.35 am to 9.00 am.	25 minutes
From 9.00 am to 3.00 pm.	6 hours
From 3.00 pm to 3.10 pm.	10 minutes
Add together.	Total time difference = 6 h + 25 min + 10 min = 6 h 35 min

Video
Time differences

EXAMPLE 18

What is the time 7 hours and 40 minutes after 11.52 pm?

Steps	Working
Use a timeline and add the hours first:	
11.52 pm + 7 hours	6.52 am
Count to the next full hour and add the number of minutes.	8 minutes to 7 am
To make up 40 minutes, add another 32 minutes: 7 am + 32 min.	7.32 am

EXAMPLE 19

In March 2022, Kane's car was 5 years and 9 months old. When was Kane's car made?

Steps	Working
Subtract 5 years from March 2022.	2022 – 5 = 2017 March 2017
Count back to the start of 2017 and subtract 3 months.	3 months to start of 2017.
To make up 9 months, subtract another 6 months: start of 2017 – 6 months.	June 2016

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EXERCISE 8.8 Time calculations

ANSWERS p. 421

1 EXAMPLE 17 Calculate the time difference between each pair of times.

a 7.27 am and 1.12 pm
b 4.09 am and 9.53 am
c 3.42 pm and 6.02 pm
d 11.15 pm and 3.08 am

2 What is the time difference between each pair of 24-hour times?

a 0800 and 1100
b 0500 and 1500
c 0940 and 1455
d 1340 and 2150

3 Vamsee's flight lands in Hong Kong at 0950. His next flight leaves Hong Kong at 1920. How long does Vamsee have in the Hong Kong airport?

4 At Thomson Secondary College, the school day begins at 8.45 am and ends at 3.10 pm. How long is the school day?

5 EXAMPLE 19 What time will it be:

a 5 hours after 3.00 pm?
b 28 minutes after 7.15 pm?
c 3 hours 32 minutes after 9.45 am?
d 9 hours 10 minutes after 5.14 pm?

6 What time was it:

a 4 hours before 6.15 pm?
b 45 minutes before 3.20 am?
c 2 hours 10 minutes before 1.35 pm?
d 3 hours 35 minutes before 11.25 am?

7 Ewan has to take his tablets $1\frac{1}{2}$ hours after he finishes lunch. He finished his lunch at 1.45 pm. What time should Ewan take his medicine?

8 Ramona wants to go for a jog for 50 minutes, but be back in time to watch *Zombie Vampire Athletes* on TV starting at 8.35 pm. What is the latest time that she can leave for her jog?

9 EXAMPLE 19 Jamie bought a computer in December 2019. How old is it:

a in August 2023?
b in January 2024?
c today?

10 A box of chocolates bought in November 2022 has a 'Use by' date of March 2024. How long, in months, will the chocolates last?

11 In February 2018, Stephanie was $3\frac{1}{2}$ years old. When was Stephanie born?

12 Ask your teacher when they started teaching at your school. Work out how long they have been at your school in years, months and days.

13 How old are you today in years, months and days?

Chapter problem

You've now covered all the skills you need to solve the chapter problem. Can you solve it now?

Worksheets
Time travel
TV times
Public transport trips

8.9 Timetables

Thousands of Australians rely on train, tram, bus and ferry **timetables** every day.

EXAMPLE 20

A section of a train timetable is shown here.

Armadale/Thornlie to Perth

Source: Transperth

	AM	AM	AM	AM	AM	AM	AM	AM
Armadale	7.16		7.46		8.16		8.31	
Sherwood	7.18		7.48		8.18		8.33	
Challis	7.20		7.50		8.20		8.35	
Kelmscott	7.22		7.52		8.22		8.37	
Seaforth	7.25		7.55		8.25		8.40	
Gosnells	7.27		7.57		8.27		8.42	
Maddington	7.30		8.00		8.30		8.45	
Kenwick	7.32		8.02		8.32		8.47	
Beckenham	7.34		8.04		8.34		8.49	
Thornlie		7.35		8.05		8.35		8.50
Cannington	7.36	7.39	8.06	8.09	8.36	8.39	8.51	8.54
Queens Park		7.40		8.10		8.40		8.55
Welshpool		7.42		8.12		8.42		8.57
Oats Street	7.39	7.44	8.09	8.14	8.39	8.44	8.54	8.59
Carlisle		7.45		8.15		8.45		9.00
Victoria Park		7.48		8.18		8.48		9.03
Burswood		7.50		8.20		8.50		9.05
Belmont Park				8.22		8.52		9.07
Claisebrook	7.47	7.54	8.17	8.24	8.47	8.54	9.02	9.09
McIver	7.49	7.56	8.19	8.26	8.49	8.56	9.04	9.11
Perth	7.50	7.58	8.20	8.28	8.50	8.58	9.05	9.13

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Perth to Armadale/Thornlie

	PM	PM	PM	PM	PM	PM	PM	PM
Perth	4.37	4.45	4.52	5.00	5.07	5.15	5.22	5.30
McIver	4.38	4.46	4.53	5.01	5.08	5.16	5.23	5.31
Claisebrook	4.40	4.48	4.55	5.03	5.10	5.18	5.25	5.33
Belmont Park	4.42		4.57		5.12		5.27	
Burswood	4.44		4.59		5.14		5.29	
Victoria Park	4.46		5.01		5.16		5.31	
Carlisle	4.48		5.03		5.18		5.33	
Oats Street	4.49	4.54	5.04	5.09	5.19	5.24	5.34	5.39
Welshpool	4.51		5.06		5.21		5.36	
Queens Park	4.53		5.08		5.23		5.38	
Cannington	4.55	4.58	5.10	5.13	5.25	5.28	5.40	5.43
Beckenham		4.59		5.14		5.29		5.44
Kenwick		5.01		5.16		5.31		5.46
Maddington		5.03		5.18		5.33		5.48
Gosnells		5.07		5.22		5.37		5.52
Seaforth		5.09		5.24		5.39		5.54
Kelmscott		5.12		5.27		5.42		5.57
Challis		5.14		5.29		5.44		5.59
Sherwood		5.16		5.31		5.46		6.01
Armadale		5.19		5.34		5.49		6.04
Thornlie	5.00		5.15		5.30		5.45	

Louise catches the 7.52 am train from Kelmscott to get to work at Burswood.

What time does she arrive at Burswood station?

Steps	Working
The 7.52 am train from Kelmscott does not stop at Burswood. She will need to change trains at Oats Street or Cannington. She can then catch a train to Burswood.	The train to Burswood arrives at the station at 8.20 am.

EXERCISE 8.9 Timetables

ANSWERS p. 421

Use the timetable on the previous pages to answer each question.

1 EXAMPLE 20 What time does the 7.16 am train from Armadale arrive at Perth?

2 What time does the 5.03 pm train from Carlisle arrive at Thornlie?

3 Ravi lives at Queens Park and works in Perth. He starts work at 8.45 am. It takes him 10 minutes to walk to work from the station. What is the latest train he can catch at Queens Park to get to work on time?

4 Ravi finishes work at 4.30 pm. It takes him 10 minutes to walk to the station.

- **a** What time can he catch the train home?
- **b** What time does he get to Queens Park?
- **c** On three days each week Ravi catches up with friends after work for half an hour. On these days, what time does he catch the train home?

5 Ania catches the 5 pm train from Perth. What time will she arrive at Gosnells?

6 Katarina is going to catch the train at Maddington to meet her friend Vimala at Belmont Park. They have agreed to meet for shopping and coffee at 9.15 am. What time does Katarina need to catch the train?

7 It takes 1 hour and 10 minutes to travel by bus from Thornlie to Perth.

- **a** How much longer does it take by bus than by train?
- **b** Suggest reasons why the bus might take longer.

8 Use the internet to find a local or Melbourne train timetable.

- **a** Write 5 questions, similar to those in questions **1** to **7**, for the timetable you have found.
- **b** Swap questions with a friend and answer their questions.

*Use this bus timetable for Adelaide to Alice Springs and return to answer questions **9** to **13**.*

ALICE SPRINGS – ADELAIDE				
TOWN	CODE		GX850 DAILY EST	PICK-UP AND SET-DOWN POINT
ALICE SPRINGS	ASP	Dep	10.30A	Greyhound Terminal, Shop 2/76 Todd St
Erldunda	ERL		12.35P	Desert Oaks Resort, Cnr Stuart & Lassester Hwy
Kulgera	KUL	Arr	1.25P	Kulgera Roadhouse Hotel, Stuart Hwy
		Dep	2.00P	
SOUTH AUSTRALIA				
Indulkna Turnoff	IDK		3.20P	Roadside mailbox at turn off
Marla	MBR		4.00P	Traveller's Rest, Stuart Hwy
Cadney Park	CDY		4.55P	Mobil Roadhouse
Coober Pedy	CPD	Arr	6.30P	Terminal, 52–56 Hutchison St
		Dep	7.25P	
Bilgunnia Turnoff	BGN		8.55P	Turn Off
Glendambo	GBO	Arr	10.10P	Mobil Roadhouse
		Dep	10.30P	
Pimba	PIM	Arr	11.45P	Pimba Roadhouse
		Dep	12.01A	
Port Augusta	PUG		1.50A	Post Office, 50 Commerical Road
Port Augusta Meal Break	PUB	Arr	2.00A	Gull Service Station, Lot 8 Highway
		Dep	2.45A	
Port Pirie	PIR	Arr	3.40A	BP Service Station
Port Wakefield	PWF	Dep	5.00A	BP Service Station, 26 Snowtown Rd.
Bolivar	BLV		5.45A	BP Service Station
Cavan	CAV		6.00A	Bus Stop 26, Port Wakefield Road
ADELAIDE	ADL	Arr	6.25A	Greyhound Terminal, 85 Franklin St

ADELAIDE – ALICE SPRINGS				
TOWN	CODE		GX580 DAILY EST	PICK-UP AND SET-DOWN POINT
ADELAIDE	ADL	Dep	6.00P	Greyhound Terminal, 85 Franklin St
Cavan	CAV		6.20P	Bus Stop 26, Port Wakefield Road
Bolivar	BLV		6.30P	Caltex Service Station
Port Wakefield	PWF		7.25P	BP Service Station, 26 Snowtown Rd.
Port Pirie	PIR		8.40P	BP Service Station
Port Augusta Meal Break	PUB	Arr	9.45P	Gull Service Station, Lot 8 Highway
		Dep	10.30P	
Port Augusta	PUG		10.50P	Post Office, 50 Commerical Rd
Pimba	PIM	Arr	12.45A	Shell Roadhouse
		Dep	1.00A	
Glendambo	GBO	Arr	2.15A	Shell Roadhouse
		Dep	2.30A	
Bulgunnia Turnoff Coober Pedy	CPD	BGN Arr	3.35A 5.15A	Turn Off Terminal, 52–56 Hutchison St
		Dep	5.50A	
Cadney Park	CDY	Arr	7.30A	Mobil Roadhouse
Marla	MBR		8.20A	Traveller's Rest, Stuart Hwy
			9.05A	
Indulkna Turn Off	IDK		9.35A	Roadside mailbox at turn off
NORTHERN TERRITORY				
Kulgera	KUL		11.00A	Kulgera Roadhouse Hotel, Stuart Hwy
Erldunda	ERL	Arr	11.45A	Desert Oaks Resort, Cnr Stuart & Lassester Hwy
		Dep	12.20P	
ALICE SPRINGS	ASP	Arr	2.30P	Greyhound Terminal, Shop 2/76Todd St

Source: Greyhound Australia.

9 How long does the trip from Adelaide to Alice Springs take?

10 How many times during the trip does the bus stop for more than 20 minutes? Where are these stops?

11 Harry joins the bus at Port Augusta to travel to Coober Pedy.

a How long is his bus trip?

b When Harry returns from Coober Pedy he will travel all the way to Adelaide. How long will it take?

12 Ariana and Axel are long-distance friends. Ariana lives in Adelaide and Axel lives in Alice Springs. They are planning to meet 'in the middle' to spend the weekend together.

a Where is the closest stop to 'the middle'?

b Taking into account the time of day and when each person would arrive, where would be the best place to meet along this route? Justify your answer.

13 The train from Adelaide to Alice Springs leaves Adelaide at 12.20 pm Sunday and arrives in Alice Springs at 1.45 pm Monday.

a How long does it take to travel by train from Adelaide to Alice Springs?

b How does this time compare to the bus trip?

c Would you prefer to travel by bus or train from Adelaide to Alice Springs? Justify your answer.

*This timetable is for CityCat ferries operating on the Brisbane River. Use it to answer questions **14** to **16**.*

Departs Terminal:	am	am	am	am	am	am	am	am	pm
Northshore Hamilton	…..	…..	…..	…..	…..	…..	…..	…..	…..
Apollo Wharf	10.25	10.37	10.50	11.02	11.15	11.27	11.40	11.52	12.05
Bretts Wharf	10.28	10.40	10.53	11.05	11.18	11.30	11.43	11.55	12.08
Bulimba	10.34	10.46	10.59	11.11	11.24	11.36	11.49	12.01	12.14
Teneriffe	10.37	10.49	11.02	11.14	11.27	11.39	11.52	12.04	12.17
Hawthorne	10.41	10.53	11.06	11.18	11.31	11.43	11.56	12.08	12.21
New Farm Park	10.46	10.58	11.11	11.23	11.36	11.48	12.01	12.13	12.26
Mowbray Park	10.50	11.02	11.15	11.27	11.40	11.52	12.05	12.17	12.30
Sydney Street	10.53	11.05	11.18	11.30	11.43	11.55	12.08	12.20	12.33
Riverside	11.01	11.13	11.26	11.38	11.51	12.03	12.16	12.28	12.41
QUT Gardens Point	11.09	11.21	11.34	11.46	11.59	12.11	12.24	12.36	12.49
South Bank 2	11.12	11.24	11.37	11.49	12.02	12.14	12.27	12.39	12.52
North Quay	11.16	11.28	11.41	11.53	12.06	12.18	12.31	12.43	12.56
Regatta	11.24	11.36	11.49	12.01	12.14	12.26	12.39	12.51	1.04
Guyatt Park	11.28	11.40	11.53	12.05	12.18	12.30	12.43	12.55	1.08
West End	11.31	11.43	11.56	12.08	12.21	12.33	12.46	12.58	1.11
University of Queensland	11.35	11.47	12.00	12.12	12.25	12.37	12.50	1.02	1.15

Translink © State of Queensland (https://jp.translink.com.au/plan-your-journey/timetables/ferry/t/citycat)

14 How long does the ferry take to travel from Bretts Wharf to South Bank 2?

15 **a** Phillip needs to be at work in a restaurant at Riverside by 11.30 am. What is the latest time he can catch the ferry at Teneriffe?

b After work, he travels out to the University of Queensland to meet up with friends. How long does the ferry trip take?

c At the end of the evening, he returns home. How long will this trip take if he chooses to go by ferry? Assume the reverse journey will take the same length of time as the forward journey.

d To travel from the University of Queensland to Teneriffe by bus takes approximately 55 minutes. Why might people choose to travel by bus rather than ferry?

16 Why is one part of the timetable white and one part grey?

17 The CityBus stops at places of interest in Brisbane.

GPO terminal	9.00	9.45	10.30	11.15	12.00	12.45	1.30	2.15	3.00	3.45	4.30	5.15
City Hall	9.05	9.50	10.35	11.20	12.05	12.50	1.35	2.20	3.05	3.50	4.35	5.20
Treasury Casino Hotel	9.10	9.55	10.40	11.25	12.10	12.55	1.40	2.25	3.10	3.55	4.40	5.25
Riverside Centre	9.15	10.00	10.45	11.30	12.15	1.00	1.45	2.30	3.15	4.00	4.45	5.30
Old Windmill	9.20	10.05	10.50	11.35	12.20	1.05	1.50	2.35	3.20	4.05	4.50	5.35
Transit Centre	9.28	10.13	10.58	11.43	12.28	1.13	1.58	2.43	3.28	4.13	4.58	5.43
Suncorp Stadium	9.32	10.17	11.02	11.47	12.32	1.17	2.02	2.47	3.32	4.17	5.02	5.47
Regatta Hotel	9.45	10.30	11.15	12.00	12.45	1.30	2.15	3.00	3.45	4.30	5.15	6.00
Park Rd	9.48	10.33	11.18	12.03	12.48	1.33	2.18	3.03	3.48	4.33	5.18	6.03
Cultural Centre	9.54	10.39	11.24	12.09	12.54	1.39	2.24	3.09	3.54	4.39	5.24	6.09
Southbank	10.00	10.45	11.30	12.15	1.00	1.45	2.30	3.15	4.00	4.45	5.30	6.15
Maritime Museum	10.04	10.49	11.34	12.19	1.04	1.49	2.34	3.19	4.04	4.49	5.34	6.19
City lookout	10.10	10.55	11.40	12.25	1.10	1.55	2.40	3.25	4.10	4.55	5.40	6.25
Chinatown	10.20	11.05	11.50	12.35	1.20	2.05	2.50	3.35	4.20	5.05	5.50	6.35
ANZAC Square	10.24	11.09	11.54	12.39	1.24	2.09	2.54	3.39	4.24	5.09	5.54	6.39
GPO terminal	10.30	11.15	12.00	12.45	1.30	2.15	3.00	3.45	4.30	5.15	6.00	6.40

a How many buses are needed to meet the CityBus timetable? Explain how you arrived at your answer.

b Vo, Binh and Vicki arrived at City Hall at 11.42 am. They caught the Explorer Bus to Southbank. What is the earliest time they could expect to arrive at Southbank? Explain your answer.

c Manuel and Sofia are dropped off by car at the Riverside Centre at 10.25 am. They arrange to meet their hosts at the City lookout at 4.30 pm. They want to spend at least an hour at Suncorp Stadium, ride on the Ferris Wheel at Southbank and do some souvenir shopping at the Maritime Museum. Plan a list of times for them to catch the Explorer Bus to do these things and meet their hosts on time.

d The company is considering introducing an early morning bus starting at the GPO terminal at 8.15 am. Write out the timetable for this bus.

Extended investigation Planning a trip

You are a travel agent. An 18-year-old client has asked you to prepare an itinerary for visiting one of the state capitals in Australia and make a day trip to an island off the coast. You are going to plan a 5-day, 4 night trip.

1. Choose a capital city for your client to visit.
2. Choose a hotel in the CBD of the capital city for your client. You need to organise transfers, that is, travel from the airport to the accommodation and return. Find out the best way to travel from the airport to the hotel, how long it will take and what it will cost.
3. Your client is going to visit an island near the capital city you have chosen (Rottnest, Kangaroo, or Stradbroke, for example). Find out how to get there from the hotel (train, bus and/or ferry), how long it will take and what it will cost.
4. Choose another tourist attraction in the city to recommend to your client and find out how to get there from the hotel.
5. Find out if there any special public transport deals (such as a tourist travel card) available in the capital city you have chosen that could save your client money when they are visiting the city.
6. Prepare a detailed itinerary including dates, locations, times and the cost of all activities. Remember to include opening and closing times for attractions.

Keyword activity

CHAPTER SUMMARY

Write a three-paragraph summary of this chapter. Use ALL the words listed for each paragraph. Your paragraphs must make sense and show clearly the meanings of the words.

First paragraph: summarise the sections on area and surface area.
Use the following words:

area, hectare, prism, square millimetre, square centimetre, square metre, surface area

Second paragraph: summarise the sections on volume and capacity.
Use the following words:

capacity, cubic centimetre, cubic metre, cylinder, liquid, millilitre, kilolitre, volume

Third paragraph: summarise the sections on time.
Use the following words:

12-hour time, 24-hour time, am, pm, timetable

Solution to the chapter problem

Problem

Phoebe has a flute exam at 2 pm but she wants to be at the exam centre by 1.30 pm. She has to:

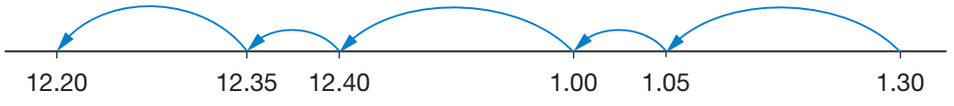
- walk to the station
- catch a train, then
- catch a bus to the examination centre.

It takes Phoebe 10 minutes to walk to the station. The trains leave every half hour after 9.05 am and the trip takes 20 minutes. Buses leave the train station every 15 minutes on the quarter hour and the bus trip takes 25 minutes.

What time should Phoebe leave home?

Solution

Using a timeline diagram will help to work this out.



We work backwards from examination centre to home. Phoebe needs to be at the examination centre by at least 1.30 pm.	1.30 pm
Phoebe must catch the bus by at least 1.05 pm (25 minute bus trip).	1.30 pm – 25 min = 1.05 pm
Buses leave at 12 noon, 12.15 pm, 12.30 pm, 12.45 pm, 1 pm and 1.15 pm. So, Phoebe must catch the bus at 1 pm.	Phoebe catches the 1 pm bus
Phoebe must catch the train by 12.40 pm (20 minute train trip).	1 pm – 20 min = 12.40 pm
Trains leave at 11.05 am, 11.35 am, 12.05 am, and 12.35 am. So Phoebe must catch the train at 12.35 am	Phoebe catches the 12.35 pm train.
Phoebe must leave home at the latest at 12.25 pm (10 min walk).	Phoebe should probably leave home at 12.20 pm.

Depending on the reliability of the bus and train, she may choose to leave earlier to be sure to get to the examination centre on time.

8 Test yourself

Area, volume and time

ANSWERS p. 422

1 EXERCISE 8.1 Copy and complete each statement.

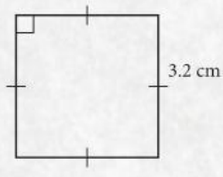
a $5\,\text{cm}^2 = _____\ \text{mm}^2$

b $75\,000\,\text{m}^2 = _____\ \text{ha}$

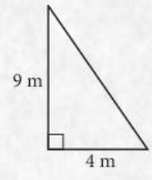
c $500\,\text{cm}^2 = _____\ \text{m}^2$

2 EXERCISE 8.1 Calculate the area of each shape.

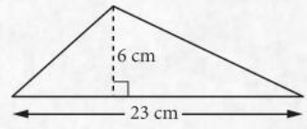
a



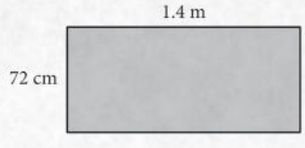
b



c

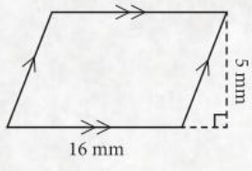


3 EXERCISE 8.1 Calculate the area of this rectangle in square metres.

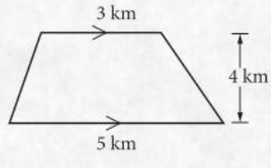


4 EXERCISE 8.2 Calculate the area of each shape. Round your answer to 2 decimal places for part **c**.

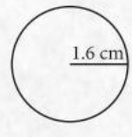
a



b

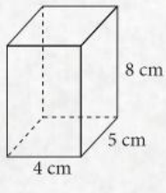


c

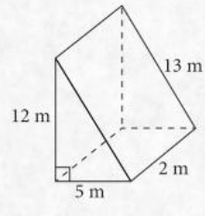


5 EXERCISE 8.3 Calculate the surface area of each prism.

a



b



6 EXERCISE 8.4 What unit of volume would you use to measure the volume of:

a a basketball?

b this maths book?

c a sports field changeroom?

7 EXERCISE 8.4 Copy and complete each conversion.

a $6\,\text{cm}^3 = _____\ \text{mm}^3$

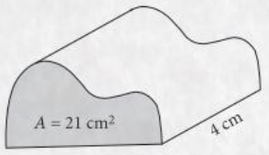
b $5\,\text{m}^3 = _____\ \text{cm}^3$

c $2400\,\text{mm}^3 = _____\ \text{cm}^3$

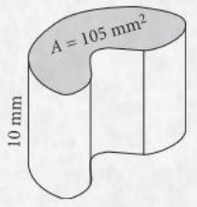
d $0.4\,\text{m}^3 = _____\ \text{cm}^3$

8 EXERCISE 8.5 Calculate the volume of each solid.

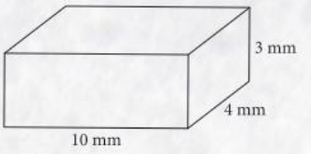
a



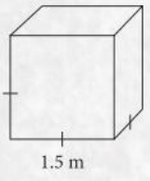
b



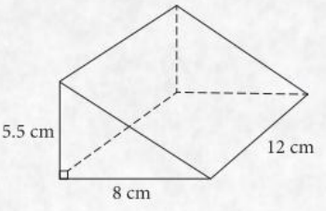
c



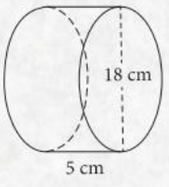
d



e



9 EXERCISE 8.5 Calculate the volume of this cylinder, correct to the nearest cm^3.



10 EXERCISE 8.6 Convert 2600 mL to litres.

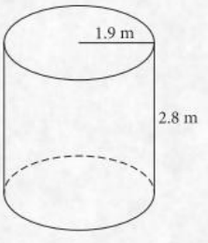
11 EXERCISE 8.6 How many 120 mL baby bottles can be filled from a 2 L container of milk?

12 EXERCISE 8.6 A container holds 3 L. What is the volume of the container in cm^3?

13 EXERCISE 8.6

a Calculate the volume of the water tank, correct to the nearest m^3.

b What is the capacity of the tank in litres?



14 EXERCISE 8.7 Express in 24-hour time:

a 4.17 am **b** 3.25 pm **c** 10 am

15 EXERCISE 8.7 Write in 12-hour time:

a 0615 **b** 1640 **c** 2300

16 EXERCISE 8.7 A bus leaves Melbourne at 0845 and arrives in Sydney at 2120. How long is the bus trip?

17 EXERCISE 8.7 Janine works as a paramedic. Her shift starts at 2300 and ends at 0600. She has 4 callouts during her shift, at 2325, 0048, 0215 and 0450.

a How long is her shift?

b How long was it between the last 2 callouts?

c The callout at 0048 required transport to hospital, which took 25 minutes. What time did Janine arrive at the hospital?

18 EXERCISE 8.8 Calculate the time difference between 11.15 am and 3.40 pm.

19 EXERCISE 8.8 What time was it 3 hours and 5 minutes before 2.30 pm?

20 EXERCISE 8.8 Lalaja has a stopover at New Delhi airport from 1015 to 1505. How long will she be at the airport?

21 EXERCISE 8.8 Kasun wants to watch a film screening on TV for 2 hours 40 minutes. It starts at 8 pm. What time should it finish?

22 EXERCISE 8.8 In January 2017, Maya had been paying off her car monthly for 22 months. In what month and year did she start paying off the car?

23 EXERCISE 8.9 Use the train timetable from page 216 to answer these questions.

- **a** Anthony catches the 8.25 am train from Seaforth to Perth. What time does he arrive in the city?
- **b** The Kane family are travelling from Gosnells to Victoria Park to catch up with friends. They have planned to meet at 9 am. What train should they catch from Gosnells?
- **c** The Kane family want to be home in Gosnells by 5.30 pm. What train should they catch from Victoria Park?

24 EXERCISE 8.9 Use the bus timetable from page 218 to answer these questions.

- **a** Carmel is travelling from Alice Springs to Coober Pedy. How long will her trip take?
- **b** Mick joins the bus at Port Augusta to travel to Marla. What time will he arrive in Marla?
- **c** On the trip from Alice Springs to Adelaide the bus has long stops in Kulgera, Coober Pedy and Port Augusta. Give a possible reason for these longer stops.

25 EXERCISE 8.9 Use the ferry timetable from page 220 to answer these questions.

- **a** How long does the ferry take to travel from New Farm Park to the University of Queensland?
- **b** Nigel lives near Apollo Wharf and starts work near Riverside at 12 noon. What is the latest time he can catch the ferry and not be late?

Practice set 2

ANSWERS p. 422

Section A Multiple-choice questions

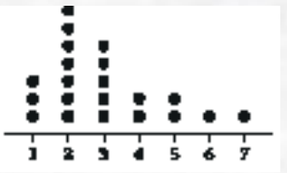
For each question, select the correct answer **A**, **B**, **C** or **D**.

1 EXERCISE 8.8 Benji's flight arrived at the Tel Aviv airport at 0950 and his connecting flight leaves at 1305. How long will he have to wait between the flights?

A 3 hours 15 minutes **B** 3 hours 55 minutes

C 4 hours 45 minutes **D** 4 hours 55 minutes

2 EXERCISE 7.4 Which phrase describes the spread of the data in this graph?



A evenly spread

B gaps at 6 and 7

C clustered from 1 to 3

D clustered from 4 to 7

3 EXERCISE 5.7 Jo is mixing pink and blue dye in the ratio of 3 : 2 to dye some wool she has spun. She uses 30 mL of blue. How much pink should she add?

A 12 mL **B** 18 mL **C** 20 mL **D** 45 mL

4 EXERCISE 5.9 Steve's company has 4 business cars. He is comparing the fuel consumption of the cars in L/100 km. Which car has the best fuel consumption?

	Distance travelled	Fuel used
Black car	510 km	51 L
Blue car	320 km	40 L
White car	620 km	53 L
Red car	470 km	43 L

A Black car **B** Blue car **C** White car **D** Red car

5 EXERCISE 6.2 Jack's bank charges him $5 per month in account-keeping fees, but the bank waives (removes) the $5 fee if he deposits $2000 into the account during the month. Calculate the account-keeping fees for 1 year if Jack was able to deposit $2000 in 4 separate months of that year.

A $20 **B** $40 **C** $60 **D** $80

6 EXERCISE 6.4 Last tax quarter, Jim's business bought items totalling $57 530 including GST. Calculate the value of the items *without* GST.

A $5230 **B** $5753 **C** $51 777 **D** $52 300

7 EXERCISE 7.1 For 11 days Mrs Jones recorded the number of children absent from her class.

7, 8, 7, 12, 11, 12, 7, 7, 8, 4, 6

Determine the median number of absentees.

A 7 **B** 8 **C** 11 **D** 12

8 EXERCISE 6.3 Jacob borrowed $530 000 to buy an apartment. His fortnightly repayments will be $1320 for the next 25 years. How much will Jacob repay in fees and interest?

A $262 000 **B** $328 000 **C** $792 000 **D** $858 000

9 EXERCISE 7.1 The number of concert tickets customers bought online in 5 minutes is shown.

5, 3, 1, 3, 5, 1, 3, 1, 4, 4, 1

What is the mode?

A 1 **B** 3 **C** 4 **D** 5

10 EXERCISE 6.5 What is the number 4 trillion and 2 million in figures?

A 4 000 200 000 **B** 4 002 000 000

C 4 000 000 200 000 **D** 4 000 002 000 000

Section B Short-answer questions

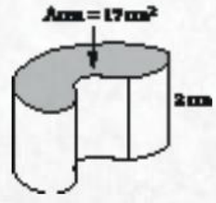
1 EXERCISE 5.1 Ellie is organising a retreat for 35 people. Because of pandemic lockdown restrictions, she has to change the date. She emailed the participants and 31 replied that the new date was fine, but 4 people can't make the new date. What percentage of the participants can't make the new date? Answer to 1 decimal place.

2 EXERCISE 8.6 A container holds 4 L. What is the volume of the container in cm^3?

3 EXERCISE 8.6 Convert 5400 mL to L.

4 EXERCISE 5.2 Express 520 mL as a percentage of 2 L.

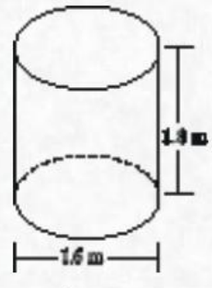
5 EXERCISE 8.5 Calculate the volume of the solid.



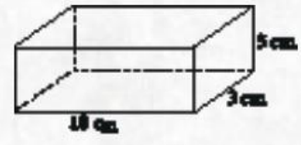
6 EXERCISE 5.2 When Marianne sold her home for $925 000 she paid the real estate agent a commission of $18 500. What percentage of the sales price was this?

7 EXERCISE 8.6 This water storage tank is in the shape of a cylinder.

Calculate the capacity of the tank, correct to the nearest litre.

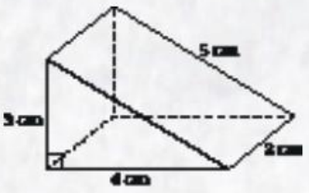


8 EXERCISE 8.3 Calculate the surface area of this rectangular prism.



9 EXERCISE 5.3 Decrease 300 m by 43%.

10 EXERCISE 8.3 Calculate the surface area of this triangular prism.



11 EXERCISE 8.8 Grant wants to record a European soccer match on TV that will go for 2 hours 40 minutes. He sets the recorder to start at 0245. What time should he set it to finish?

12 EXERCISE 5.3 Andre is buying some gym pants. Normally the pants cost $40 but the shop is having a '20% off' sale. How much do the pants cost in the sale?

13 EXERCISE 5.4 Jamiela buys necklaces for her store at $18 each. She sells them for $27 each. Calculate her percentage profit.

14 EXERCISES 7.1, 7.2 A large company held its meetings online. The data show the numbers of people at 12 different online meetings.

9, 19, 24, 51, 19, 19, 21, 5, 2, 12, 19, 5

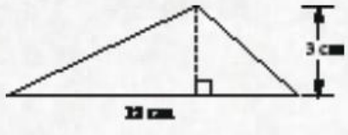
For this data, determine:

a the mode **b** the median **c** the mean, to 1 decimal place
d the range **e** the outlier.

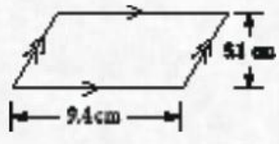
15 EXERCISE 5.5 65% of the shifts in a large restaurant are filled by casual employees. Each week there are 260 shifts in the restaurant. How many shifts are filled by casual employees?

16 EXERCISES 8.1, 8.2 Calculate the area of each figure (correct to 1 decimal place for parts **b** and **d**).

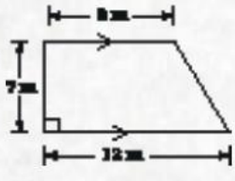
a



b



c



d

17 EXERCISE 8.1 Copy and complete each conversion.

a $12\,cm^2 =$ _____ mm^2 **b** $4000\,m^2 =$ _____ ha **c** $600\,cm^2 =$ _____ m^2

18 EXERCISE 5.6 Simplify the ratio 15 : 25.

19 EXERCISE 6.3 Alexis bought an electric bike to ride to her business course. The cash price of the bike was $4400. She paid $1280 deposit and agreed to repay $340 monthly for 1 year.

a Calculate the total amount Alexis will pay for the electric bike.

b How much more than the cash price will Alexis pay because she bought it on credit?

20 EXERCISE 5.8 Divide $180 in the ratio of 4 : 1.

21 EXERCISE 5.9 Write as a rate:

a 800 km travelled in 4 h

b $44.80 for 3.5 kg

22 EXERCISE 8.4 Copy and complete each conversion.

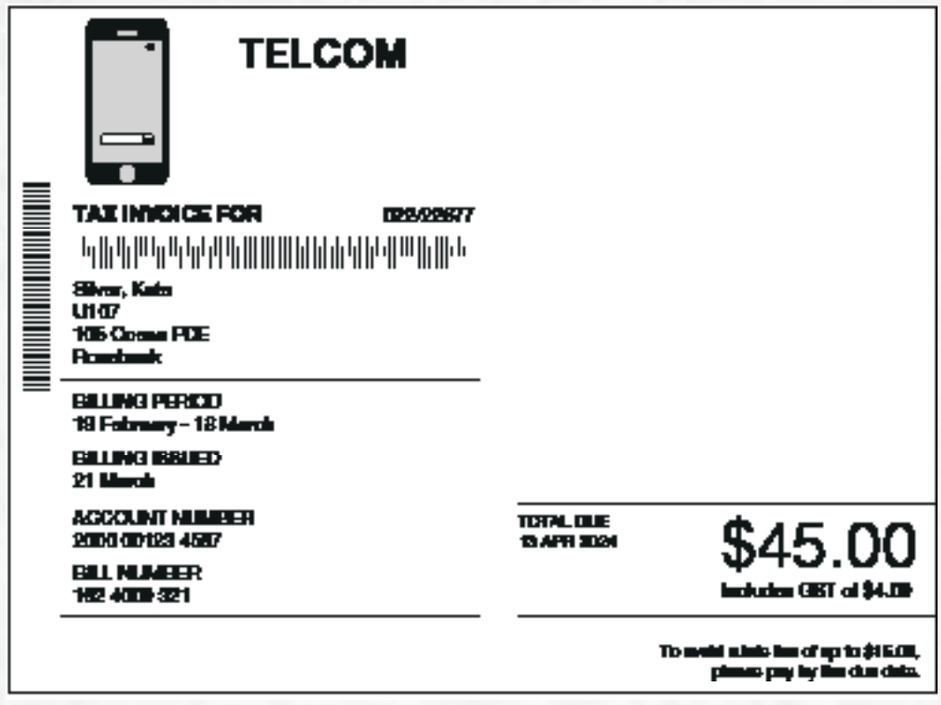
a $7\text{ cm}^3 =$ _____ mm^3

b $24\text{ m}^3 =$ _____ cm^3

c $240\text{ mm}^3 =$ _____ cm^3

d $0.2\text{ m}^3 =$ _____ cm^3

23 EXERCISE 6.1 This is Kate's home phone bill.


TELCOM

TAX INVOICE FOR

Silver, Kate
U1 07
105 Ocean PDE
Peachbeach

BILLING PERIOD
19 February – 18 March

BILLING ISSUED
21 March

ACCOUNT NUMBER

BILL NUMBER

TOTAL DUE
15 APR 2024

$45.00

Includes GST of $4.09

To avoid a late fee of up to $15.00, please pay by the due date.

a On what date was Kate's bill issued?

b By what date does she have to pay the bill?

c How much does she have to pay?

d What fee could Kate get if she pays the bill late?

e How much did Kate pay per day for her phone?

f How much should Kate budget for her home phone each week? Answer correct to the nearest dollar.

24 EXERCISE 6.5 By July 2021, 187 million people had been infected with COVID-19 worldwide. Write this number in figures.

25 EXERCISE 7.3 Over 11 days, Charlie counted the number of coins he had in his pocket when he arrived home from work. He arranged his results in ascending order:

4, 5, 6, 6, 8, 9, 11, 13, 16, 18, 20

Calculate:

a the range

b the median

c the upper and lower quartiles

d the interquartile range.

Practice set 2

ANSWERS p. 422

Section A Multiple-choice questions

For each question, select the correct answer **A**, **B**, **C** or **D**.

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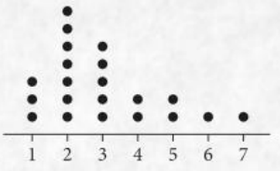
A 3 hours 15 minutes **B** 3 hours 55 minutes

C 4 hours 45 minutes **D** 4 hours 55 minutes

2 EXERCISE 7.4 Which phrase describes the spread of the data in this graph?



A evenly spread

B gaps at 6 and 7

C clustered from 1 to 3

D clustered from 4 to 7

3 EXERCISE 5.7 Jo is mixing pink and blue dye in the ratio of 3 : 2 to dye some wool she has spun. She uses 30 mL of blue. How much pink should she add?

A 12 mL **B** 18 mL **C** 20 mL **D** 45 mL

4 EXERCISE 5.9 Steve's company has 4 business cars. He is comparing the fuel consumption of the cars in L/100 km. Which car has the best fuel consumption?

	Distance travelled	Fuel used
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Red car	470 km	43 L

A Black car **B** Blue car **C** White car **D** Red car

5 EXERCISE 6.2 Jack's bank charges him $5 per month in account-keeping fees, but the bank waives (removes) the $5 fee if he deposits $2000 into the account during the month. Calculate the account-keeping fees for 1 year if Jack was able to deposit $2000 in 4 separate months of that year.

A $20 **B** $40 **C** $60 **D** $80

6 EXERCISE 6.4 Last tax quarter, Jim's business bought items totalling $57 530 including GST. Calculate the value of the items *without* GST.

A $5230 **B** $5753 **C** $51 777 **D** $52 300

7 EXERCISE 7.1 For 11 days Mrs Jones recorded the number of children absent from her class.

7, 8, 7, 12, 11, 12, 7, 7, 8, 4, 6

Determine the median number of absentees.

A 7 **B** 8 **C** 11 **D** 12

8 EXERCISE 6.3 Jacob borrowed $530 000 to buy an apartment. His fortnightly repayments will be $1320 for the next 25 years. How much will Jacob repay in fees and interest?

A $262 000 **B** $328 000 **C** $792 000 **D** $858 000

9 EXERCISE 7.1 The number of concert tickets customers bought online in 5 minutes is shown.

5, 3, 1, 3, 5, 1, 3, 1, 4, 4, 1

What is the mode?

A 1 **B** 3 **C** 4 **D** 5

10 EXERCISE 6.5 What is the number 4 trillion and 2 million in figures?

A 4 000 200 000 **B** 4 002 000 000

C 4 000 000 200 000 **D** 4 000 002 000 000

Section B Short-answer questions

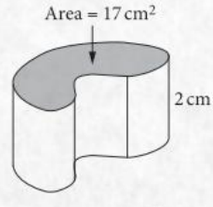
1 EXERCISE 5.1 Ellie is organising a retreat for 35 people. Because of pandemic lockdown restrictions, she has to change the date. She emailed the participants and 31 replied that the new date was fine, but 4 people can't make the new date. What percentage of the participants can't make the new date? Answer to 1 decimal place.

2 EXERCISE 8.6 A container holds 4 L. What is the volume of the container in cm^3?

3 EXERCISE 8.6 Convert 5400 mL to L.

4 EXERCISE 5.2 Express 520 mL as a percentage of 2 L.

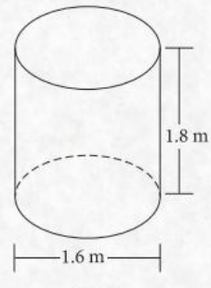
5 EXERCISE 8.5 Calculate the volume of the solid.



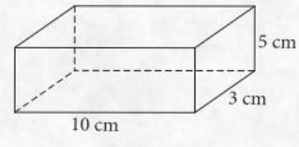
6 EXERCISE 5.2 When Marianne sold her home for $925 000 she paid the real estate agent a commission of $18 500. What percentage of the sales price was this?

7 EXERCISE 8.6 This water storage tank is in the shape of a cylinder.

Calculate the capacity of the tank, correct to the nearest litre.

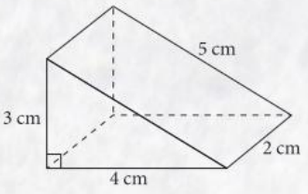


8 EXERCISE 8.3 Calculate the surface area of this rectangular prism.



9 EXERCISE 5.3 Decrease 300 m by 43%.

10 EXERCISE 8.3 Calculate the surface area of this triangular prism.



11 EXERCISE 8.8 Grant wants to record a European soccer match on TV that will go for 2 hours 40 minutes. He sets the recorder to start at 0245. What time should he set it to finish?

12 EXERCISE 5.3 Andre is buying some gym pants. Normally the pants cost $40 but the shop is having a '20% off' sale. How much do the pants cost in the sale?

13 EXERCISE 5.4 Jamiela buys necklaces for her store at $18 each. She sells them for $27 each. Calculate her percentage profit.

14 EXERCISES 7.1, 7.2 A large company held its meetings online. The data show the numbers of people at 12 different online meetings.

9, 19, 24, 51, 19, 19, 21, 5, 2, 12, 19, 5

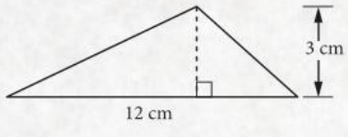
For this data, determine:

a the mode **b** the median **c** the mean, to 1 decimal place
d the range **e** the outlier.

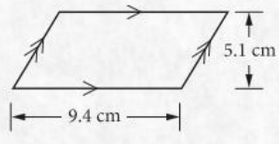
15 EXERCISE 5.5 65% of the shifts in a large restaurant are filled by casual employees. Each week there are 260 shifts in the restaurant. How many shifts are filled by casual employees?

16 EXERCISES 8.1, 8.2 Calculate the area of each figure (correct to 1 decimal place for parts **b** and **d**).

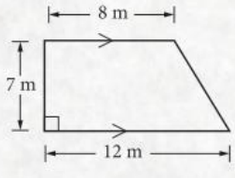
a



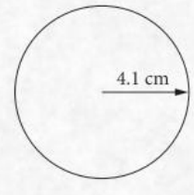
b



c



d



17 EXERCISE 8.1 Copy and complete each conversion.

a $12\,cm^2 =$ _____ mm^2 **b** $4000\,m^2 =$ _____ ha **c** $600\,cm^2 =$ _____ m^2

18 EXERCISE 5.6 Simplify the ratio 15 : 25.

19 EXERCISE 6.3 Alexis bought an electric bike to ride to her business course. The cash price of the bike was $4400. She paid $1280 deposit and agreed to repay $340 monthly for 1 year.

a Calculate the total amount Alexis will pay for the electric bike.

b How much more than the cash price will Alexis pay because she bought it on credit?

9780170448123

20 EXERCISE 5.8 Divide $180 in the ratio of 4 : 1.

21 EXERCISE 5.9 Write as a rate:

a 800 km travelled in 4 h

b $44.80 for 3.5 kg

22 EXERCISE 8.4 Copy and complete each conversion.

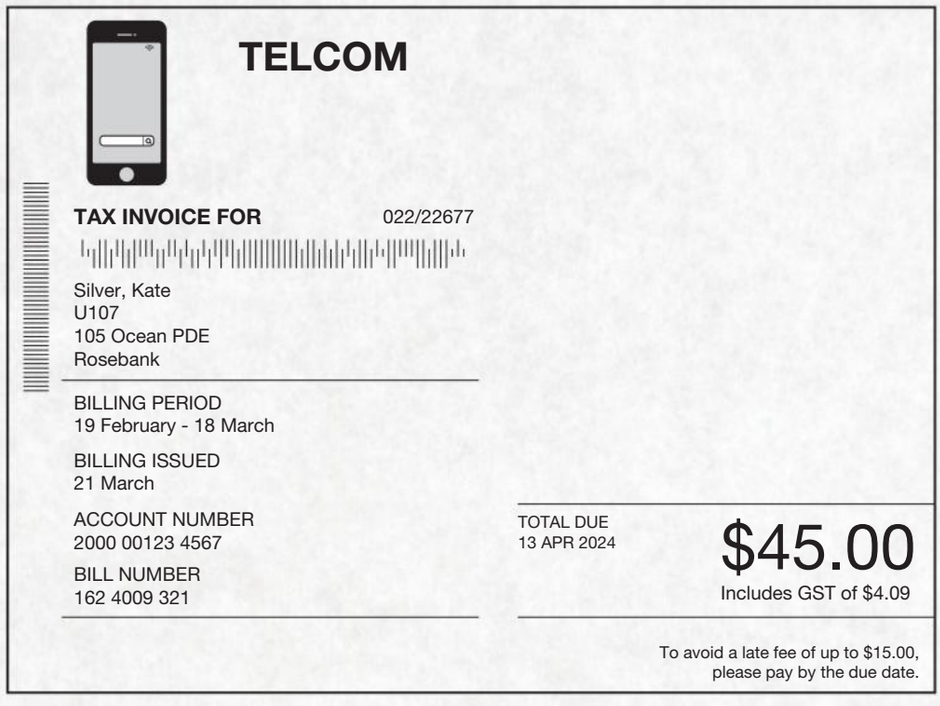
a $7\text{ cm}^3 =$ _____ mm^3

b $24\text{ m}^3 =$ _____ cm^3

c $240\text{ mm}^3 =$ _____ cm^3

d $0.2\text{ m}^3 =$ _____ cm^3

23 EXERCISE 6.1 This is Kate's home phone bill.



TELCOM

TAX INVOICE FOR 022/22677

Silver, Kate
U107
105 Ocean PDE
Rosebank

BILLING PERIOD
19 February - 18 March

BILLING ISSUED
21 March

ACCOUNT NUMBER
2000 00123 4567

BILL NUMBER
162 4009 321

TOTAL DUE
13 APR 2024

$45.00
Includes GST of $4.09

To avoid a late fee of up to $15.00, please pay by the due date.

a On what date was Kate's bill issued?

b By what date does she have to pay the bill?

c How much does she have to pay?

d What fee could Kate get if she pays the bill late?

e How much did Kate pay per day for her phone?

f How much should Kate budget for her home phone each week? Answer correct to the nearest dollar.

24 EXERCISE 6.5 By July 2021, 187 million people had been infected with COVID-19 worldwide. Write this number in figures.

25 EXERCISE 7.3 Over 11 days, Charlie counted the number of coins he had in his pocket when he arrived home from work. He arranged his results in ascending order:

4, 5, 6, 6, 8, 9, 11, 13, 16, 18, 20

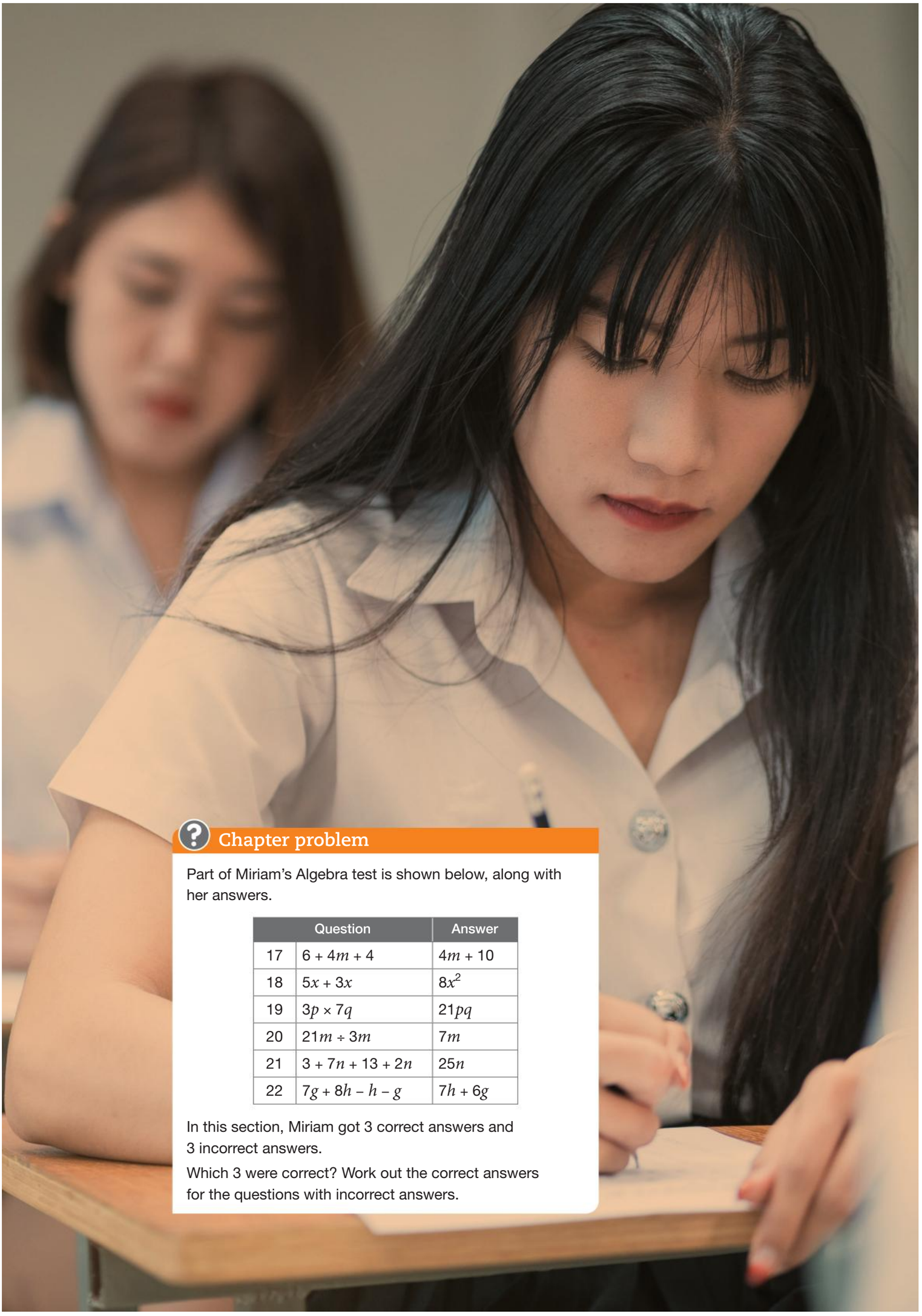
Calculate:

a the range

b the median

c the upper and lower quartiles

d the interquartile range.



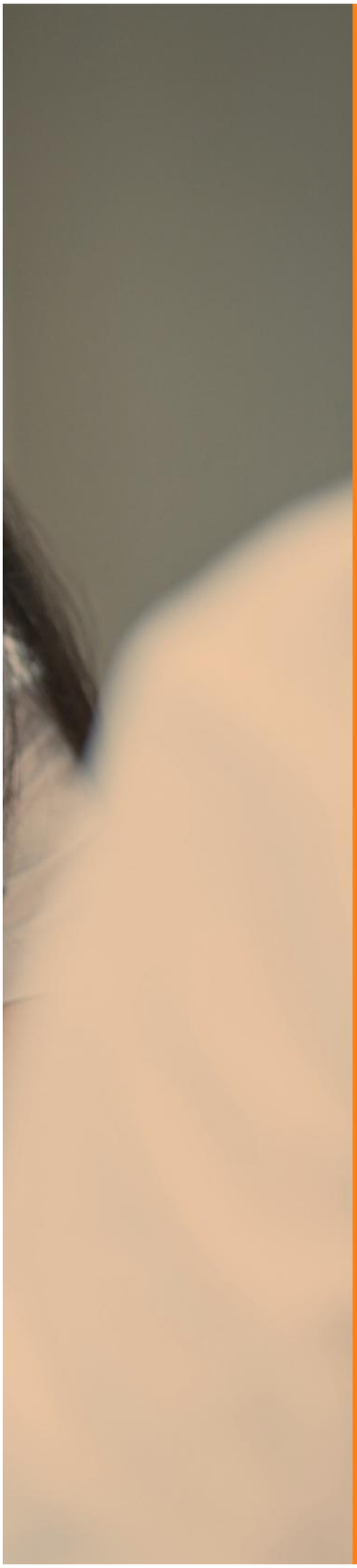
Chapter problem

Part of Miriam's Algebra test is shown below, along with her answers.

	Question	Answer
17	$6 + 4m + 4$	$4m + 10$
18	$5x + 3x$	$8x^2$
19	$3p \times 7q$	$21pq$
20	$21m \div 3m$	$7m$
21	$3 + 7n + 13 + 2n$	$25n$
22	$7g + 8h - h - g$	$7h + 6g$

In this section, Miriam got 3 correct answers and 3 incorrect answers.

Which 3 were correct? Work out the correct answers for the questions with incorrect answers.



CHAPTER 9

ALGEBRA, NUMBER AND STRUCTURE

USING ALGEBRA

9.1 Words to algebra
9.2 Adding and subtracting terms
9.3 Multiplying and dividing terms
9.4 Expanding algebraic expressions
9.5 Substitution
9.6 Solving equations
9.7 The number plane
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Convert a worded description to an algebraic expression
- Add, subtract, multiply and divide algebraic terms
- Expand brackets in algebraic expressions
- Substitute into algebraic expressions
- Solve equations

How are we ever going to use this?

- Algebra and equations are used in many trades and workplaces
- Many TAFE courses require students to be competent in using algebra
- To help when using formulas and solving equations

Study Design coverage

UNIT 2, AREA OF STUDY 1: ALGEBRA, NUMBER AND STRUCTURE

- construction, use and interpretation of formulas and symbolic expressions to describe relationships between variables and to model and represent generalisations and patterns
- manipulation of symbolic expressions
- estimation, approximation and reasonableness of calculations and results.

VCE Mathematics Study Design 2023–2027 p. 20, © VCAA 2022

Videos (7):
- **9.1** From words to algebraic expressions
- **9.2** Adding and subtracting terms
- **9.3** Multiplying terms • Dividing terms
- **9.4** Expanding expressions
- **9.5** Substitution
- **9.6** Two-step equations

Skillsheets (4):
- **9.2, 9.3, 9.4** Algebra using diagrams
- **9.6** Solving equations by balancing • Solving equations by backtracking • Solving equations using diagrams

Worksheets (8):
- **9.1** Writing algebraic expressions
- **9.2** Collecting like terms
- **9.3** Simplifying algebraic expressions
- **9.4** Expanding algebra
- **9.6** Equations code puzzle • Working with formulas • Algebra review
- **9.7** Number plane grid paper

Weblink (1):
- **9.2** Wolfram Alpha

Puzzles (3):
- **9.1** Generalised arithmetic
- **9.5** Substitution code puzzle
- **9.6** Equations match

Nelson MindTap

To access resources above, visit **cengage.com.au/nelsonmindtap**

9.1 Words to algebra

Video From words to algebraic expressions

Worksheet Writing algebraic expressions

Puzzle Generalised arithmetic

When we are given information in words, we often need to write it as an algebraic expression or a formula so that we can solve a problem.

EXAMPLE 1

Write an algebraic expression for each statement. Use N to represent any number.

a 4 times the number

b the number divided by 6

c 3 times the number plus 17

d 12 less than the number

Steps	Working
a Multiply the number by 4.	$4 \times N = 4N$
b We usually write division as a fraction in algebra.	$\frac{N}{6}$
c First multiply by 3. Then add 17.	$3 \times N = 3N$ $3N + 17$
d 'Less than' means subtraction.	$N - 12$

EXAMPLE 2

Write an algebraic expression for each statement.

a Think of a number, y, multiply it by 3 and subtract 7.

b Think of a number, m, divide it by 2 and then add 4.

Steps	Working
a First we multiply the number, y, by 3.	$3 \times y = 3y$
Then we subtract 7 from that answer.	$3y - 7$
b Write the division as a fraction.	$\frac{m}{2}$
Then add 4 to that answer.	$\frac{m}{2} + 4$

EXAMPLE 3

Carla has a window-cleaning business. It costs her $8 per cleaning job for equipment and then $75 per day to run her van.

Write an algebraic expression for C, Carla's daily costs in dollars, when she completes n jobs that day.

Steps	Working
Carla's daily costs are $8 per each job she completes + $75 fixed costs.	$C = 8 \times n + 75$ $C = 8n + 75$

EXERCISE 9.1 Words to algebra

ANSWERS p. 422

1 EXAMPLE 1 Match each worded statement from column A with the correct algebraic expression from column B, if x stands for 'a number'.

	Column A
a	The sum of a number and 8.
b	Divide a number by 6.
c	11 less than a number.
d	The product of a number and 7.
e	Increase 20 by a number.
f	Multiply a number by 3.
g	The difference between a number and 6.
h	Divide 20 by a number.
i	Decrease a number by 2.
j	20 decreased by a number.
k	13 more than a number.
l	A number multiplied by itself.
m	Subtract 7 from a number.
n	Double a number.
o	Deduct a number from 30.
p	30 less than a number.
q	5 lots of a number.

	Column B
A	$2x$
B	$x - 11$
C	$5x$
D	$x - 6$
E	$x + 13$
F	$\frac{20}{x}$
G	$20 - x$
H	$20 + x$
I	$3x$
J	$30 - x$
K	$x - 30$
L	$x + 8$
M	$\frac{x}{6}$
N	$x - 2$
O	$x - 7$
P	$7x$
Q	x^2

2 Write an algebraic expression for each statement. Use n to represent any number.

a 5 times the number
b the number plus 6
c the number divided by 10
d double the number
e half of the number
f 20 less than the number
g the number multiplied by itself
h 20 minus the number
i 6 divided by the number
j 8 less than the number
k the product of the number and (−4)
l the square of the number

3 EXAMPLE 2 Write an algebraic expression for each statement.

a Think of a number (y), multiply it by 3 and add 8.
b Think of a number (p), divide it by 3 and then subtract 6.
c Think of a number (m), multiply it by 4 and then add 27.
d Think of a number (k), multiply it by 5 and then divide it by 2.
e Think of a number (x), divide it by 6 and add 13.
f Think of a number (B), halve it and then subtract 2.
g Think of a number (R), divide it by 9 and then add 10.
h Think of a number (n), multiply it by 7 and then multiply it by 3.

4 Write an algebraic expression for each statement.

a The cost of m books at $10 each.
b The selling price of jeans with a marked price of k dollars after a discount of $15.
c The number of metres in w km.
d The cost of a taxi trip is $4.10 plus $2.30 per kilometre for y kilometres travelled.
e The perimeter of a rectangle with length x cm and width y cm.

5 a EXAMPLE 3 Anastasia operates a printing business. When she quotes a price for printing leaflets, she charges an initial fee of $40 to cover the cost of design and an additional fee of $1 per leaflet for n leaflets.

Write an algebraic expression for P, the price Anastasia charges in dollars, when she prints n leaflets.

Shutterstock.com/Diego Cervo

b When Anastasia designs and prints elaborate wedding invitations, she charges an initial fee of $110 and $2 per invitation. Write an expression to calculate the price, D, for designing and printing n wedding invitations.

6 Hawkes Landscaping Company supplies garden soil. The charge is $70 plus $30 per tonne to deliver k tonnes of soil. Write an algebraic expression for calculating the cost, C dollars, of having a load of k tonnes of soil delivered.

7 Kerri makes hot chips as part of her job in a fast-food shop. Each day, the fresh oil costs $48 and each container of chips costs her $1.25 to make.

a Write an algebraic expression for the total cost, $C, of producing n containers of chips.

b Kerri sells the containers of chips for $2.50 each. Explain why the formula $C = 2.5n$ represents the number of dollars Kerri receives from selling n containers of chips.

8 Alan runs a coffee stall at sporting events. It costs him $70 to set up the stall and each mug of coffee costs him $1.50 to make. If n is the number of mugs sold and C are Alan's costs in dollars, what is the algebraic expression for Alan's costs?

9.2 Adding and subtracting terms

Like terms contain exactly the same variables, for example, $4g$ and $\frac{1}{2}g$, $-2pq$ and $5pq$, x^2 and $-6x^2$. Terms containing different variables are *not* like terms.

Adding and subtracting like terms

Only **like terms** can be added or subtracted.

EXAMPLE 4

Simplify each expression.

a $8m + m$ **b** $3k^2 + 5k^2 + 2k^3$ **c** $3x + 7xy - x + 2xy$

Steps	Working
a $8m$ and m are like terms. We can add $8m$ and m. Remember m is the same as $1m$.	$8m + m = 9m$
b The only like terms are the 2 terms involving k^2. We have to keep the term in k^3 separate.	$3k^2 + 5k^2 + 2k^3 = 8k^2 + 2k^3$
c $3x$ and $-x$ are like terms, and $7xy$ and $2xy$ are like terms. Positive and negative signs are owned by the term *following* the sign. When we rearrange the order of terms we must keep the sign with the term that owns it.	$3x + 7xy - x + 2xy = 3x - x + 7xy + 2xy$ $= 2x + 9xy$

Video: Adding and subtracting terms

Worksheet: Collecting like terms

Skillsheet: Algebra using diagrams

EXERCISE 9.2 Adding and subtracting terms

ANSWERS p. 422

1 EXAMPLE 4 Simplify each expression.

a $5y + y$ **b** $8a^2 + 6a^2$

c $7h - h$ **d** $3ab + 11ab - 2ab$

e $4d^2 + 2d^2 - d^2$ **f** $3x^2 + 6x + 2x^2$

g $5b^2 + 2b^2 + b^3$ **h** $10f - 9f + f^2$

You can check your answers using the **Wolfram Alpha** website: www.wolframalpha.com

Weblink: Wolfram Alpha

2 Simplify each expression.

a $12 + x - 4x - 2$	**b** $3z - 6 + z + 11$	**c** $3a - b + a$
d $15ab + 2a + ab + b$	**e** $x^2 + x^3 + 4x^2 - 2x^3$	**f** $8k - 2 + 3k - k$
g $6xy - 3x + 2xy - x$	**h** $10m + mn + 3mn - 2m$	**i** $7a - ab - 3a + 2ab$
j $3xy + 5x - 2xy + x$	**k** $6a - 2a + 11 - a$	**l** $6p + 5pq - p + pq$

3 Simplify each expression.

a $3p + 2 + 8p$	**b** $3 + x + 2$	**c** $8w - 2 + w$	**d** $4k^2 + 6k^2 - k^2$
e $8t + t^2 + t$	**f** $25 - t - 2t$	**g** $7pq + 2pq + 2$	**h** $b^2 + 3b^2 + b^3$
i $10k - k$	**j** $5f + f^2 + 4f^2$	**k** $x + 9x$	**l** $8g + 3k - 9g + k$

Videos
Multiplying terms
Dividing terms

Worksheet
Simplifying algebraic expressions

Skillsheet
Algebra using diagrams

9.3 Multiplying and dividing terms

There is no 'like term rule' for multiplying or dividing algebraic terms. All algebraic terms can be multiplied together or divided.

Multiplying and dividing terms

When we are multiplying or dividing terms, we multiply or divide the numbers and variables separately.

EXAMPLE 5

Simplify each expression.

a $6a \times 2b$ **b** $12a \div 2b$ **c** $3a \times 6c \div 12h$ **d** $4n^2 \times 5n$ **e** $6a^3 \div 9a$

Steps	Working
a Multiply the numbers, then multiply the variables.	$6a \times 2b = (6 \times 2) \times (a \times b)$ $= 12ab$
b Writing a division as a fraction is a useful method for finding the correct answer. It's the term AFTER the division sign that goes on the bottom of the fraction.	$12a \div 2b = \frac{12a}{2b}$ $= \frac{12}{2} \times \frac{a}{b}$ $= 6 \times \frac{a}{b}$ $= \frac{6a}{b}$
c Write the expression as a fraction. Sometimes it's easier to simplify the numerical fraction using the fraction key on a calculator.	$3a \times 6c \div 12h = \frac{3a \times 6c}{12h}$ $= \frac{18ac}{12h}$ $= \frac{18}{12} \times \frac{ac}{h}$ $= \frac{3}{2} \times \frac{ac}{h}$ $= \frac{3ac}{2h}$

d When multiplying terms with powers that have the same base, add their powers.

n is the same as n^1. If there is no power written, the power is 1.

$$\begin{aligned} 4n^2 \times 5n &= (4 \times 5) \times (n^2 \times n^1) \\ &= 20 \times n^{2+1} \\ &= 20n^3 \end{aligned}$$

e When dividing terms with powers that have the same base, subtract their powers.

$$\begin{aligned} 6a^3 \div 9a &= \frac{6a^3}{9a^1} \\ &= \frac{6}{9} \times a^{3-1} \\ &= \frac{2a^2}{3} \end{aligned}$$

EXERCISE 9.3 Multiplying and dividing terms

ANSWERS p. 423

1 EXAMPLE 5 Simplify each expression.

a $5x \times 3y$ **b** $4x \times 10y$ **c** $4h \times 3$ **d** $8k \times 2$

e $5t \times 3s$ **f** $8 \times 3d$ **g** $15g \div 3b$ **h** $12x \div 4y$

i $10h \div 5y$ **j** $6y \div 12g$ **k** $9t \div 6w$ **l** $24p \div 12t$

2 Simplify each expression.

a $8a \times 3b \div 4c$ **b** $2a \times 4b \div 5y$ **c** $4p \times 8q \div 16a$

d $4x \times 10 \div 2a$ **e** $5m^6 \times 2m$ **f** $2a^3 \times 4a$

g $4m^2 \times 3m^4$ **h** $18p^8 \div 12p^3$ **i** $12x^9 \div 4x^4$

j $16t^5 \div 12t^2$ **k** $100b^{12} \div 20b^{10}$ **l** $36y^8 \div 18y$

3 Simplify each expression.

a $3m^2 \times 5m$ **b** $\frac{1}{2}m \times 6m$ **c** $\frac{1}{5}p \times 20p$

d $\frac{9l^3}{3l^2}$ **e** $34z^2 \div 18z$ **f** $3a \times 4b \times 5c$

g $4 \times 3d$ **h** $6h \times 2 \times 5m$ **i** $\frac{8a}{4}$

j $36p^4 \div 24p$ **k** $\frac{1}{8}h \times 16h$ **l** $\frac{4y}{9 \times 2y}$

m $\frac{1}{5}w \times 30w^2$ **n** $18p^5 \times \frac{1}{2}p$ **o** $\frac{15g^8}{5g^2}$

p $42h^{10} \div 12h^2$ **q** $\frac{12ab}{6a}$ **r** $\frac{4}{8a}$

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Video
Expanding expressions

Skillsheet
Algebra using diagrams

Worksheet
Expanding algebra

9.4 Expanding algebraic expressions

When **expanding** an algebraic expression, we multiply out the brackets.

EXAMPLE 6

Expand each expression.

a $5(2a + 3b - 1)$ **b** $12b + 8(2 + b)$

Steps	Working
a Multiply 5 by every term inside the brackets.	$5(2a + 3b - 1) = (5 \times 2a) + (5 \times 3b) - (5 \times 1)$ $= 10a + 15b - 5$
b Multiply 8 by every term inside the brackets, then add the $12b$.	$12b + 8(2 + b) = 12b + 8 \times 2 + 8 \times b$ $= 12b + 16 + 8b$ $= 20b + 16$

- If terms are added, then the order of the terms doesn't matter: $20b + 16$ is the same as $16 + 20b$.
- If terms are subtracted, then the order does matter: $20b - 16$ is NOT the same as $16 - 20b$.

EXAMPLE 7

Expand $-(x - 4)$.

Steps	Working
The negative sign in the front of the brackets really means $-1(x - 4)$.	$-(x - 4) = -1 \times x - 1 \times (-4)$ $= -x - (-4)$ $= -x + 4$

When the number in the front of the brackets is negative, we have to be very careful with the positive and negative signs. The negative in the front affects *every* sign inside the brackets.

EXAMPLE 8

Expand and simplify $5(2x - 3) - 2(x + 4)$.

Steps	Working
Multiply 5 by everything in the first bracket and multiply -2 by everything in the second bracket.	$5(2x - 3) - 2(x + 4) = 5 \times 2x - 5 \times 3 - 2 \times x - 2 \times 4$ $= 10x - 15 - 2x - 8$
Collect like terms and simplify.	$= 10x - 2x - 15 - 8$ $= 8x - 23$

EXERCISE 9.4 Expanding algebraic expressions

ANSWERS p. 423

1 EXAMPLE 6 Expand each expression.

a $2(x + 5)$ **b** $3(2a - 5)$ **c** $4(2x + 3y + 2)$

d $a(2a + 3b - 4)$ **e** $4a(2 - 3b)$ **f** $3b(b^2 + b + 7)$

2 Expand and simplify each expression.

a $2b + 3(2 + b)$ **b** $x + 2(4 + x)$ **c** $3d + 4(5 + d)$

d $2(3x + 7) + 10$ **e** $5(4p + q) + 6q$ **f** $8(3w + 4) - 20w$

3 EXAMPLE 7 Expand each expression.

a $-(2x + 5)$ **b** $-(3a - 1)$ **c** $-(4 + 5b)$

d $-(1 - x)$ **e** $-(4p - 3q + 10)$ **f** $-(x - y + z)$

4 EXAMPLE 8 Expand and simplify each expression.

a $-3(2x + 5)$ **b** $4(-2x + 3)$ **c** $2x(a + 5)$

d $5a + 2(a + 7)$ **e** $-(9 - x)$ **f** $-x(x - 3)$

g $2(3d + 5) + 6$ **h** $y(y - 2) + 4y$ **i** $-(2 - k) + k + 2$

5 Expand and simplify each expression.

a $3(2x + 1) - 4(x + 1)$ **b** $3(2x - 8) + 2(x + 1)$ **c** $3(2x + y) + 2(x - 2y)$

d $4(5x - 3) - 3(x + 2)$ **e** $4(2x - 7) - (x + 6)$ **f** $-4(2x - y) + 2(5x + 2y)$

Investigation The answer is ...

1 For each 'answer' below, make up algebraic expressions that have that answer.

- Use addition, subtraction, multiplication and division.
- Start with a single operation.
- Then use 2 or more operations in each question.
- Try to make up an expression using brackets.

a The answer is $12x$.

b The answer is $4m^2$.

c The answer is $6ab$.

d The answer is $5xy$.

e The answer is $21a^2b$.

f The answer is $\frac{4x}{5}$.

2 Choose your own answer and make up algebraic expressions that simplify to give that answer.

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Video
Substitution

Puzzle
Substitution code puzzle

9.5 Substitution

Substitution is the mathematical term for replacing a **variable** (or **pronumeral**) with a number, and **evaluate** is the term for finding the value of an algebraic expression.

EXAMPLE 9

Evaluate each expression when $x = 7$.

a $8x + 2$ **b** $5(2x - 4)$ **c** $\frac{3x-1}{4}$ **d** $3x^2$

Steps	Working
a Replace x with 7 and simplify.	$8x + 2 = 8 \times 7 + 2$ $= 56 + 2$ $= 58$
b Replace x with 7 and simplify. Do the brackets first.	$5(2x - 4) = 5 \times (2 \times 7 - 4)$ $= 5 \times (14 - 4)$ $= 5 \times 10$ $= 50$
c Replace x with 7 and simplify. Remember to calculate the value of the **numerator** first, then divide by the **denominator**.	$\frac{3x-1}{4} = \frac{3 \times 7 - 1}{4}$ $= \frac{20-1}{4}$ $= \frac{20}{4}$ $= 5$
d Replace x with 7 and simplify. Calculate the square first.	$3x^2 = 3 \times 7^2$ $= 3 \times 49$ $= 147$

EXERCISE 9.5 Substitution

ANSWERS p. 423

1 EXAMPLE 9 Calculate the value of $\frac{3x}{5}$ when:

a $x = 10$ **b** $x = 30$ **c** $x = 6$

d $x = 0.4$ **e** $x = 0.65$ **f** $x = 12.6$

2 Evaluate $5(2x - 4)$ when:

a $x = 7$ **b** $x = 16$ **c** $x = 3.5$

d $x = 12.75$ **e** $x = 25.5$ **f** $x = 2\frac{1}{2}$

3 Calculate the value of $\frac{4a}{3}$ when $a = 12$.

4 Determine the value of $6(2p + 3)$ when $p = 3$.

5 Evaluate $\frac{3x-1}{4}$ when:

a $x = 2$ **b** $x = 8$ **c** $x = 1.5$ **d** $x = 2\frac{1}{3}$

6 Calculate the value of $3x^2$ when:

a $x = 5$ **b** $x = 10$ **c** $x = 1.5$ **d** $x = 3\frac{1}{2}$

7 Evaluate $\frac{2(3+n)}{5}$ if:

a $n = 12$ **b** $n = 17$ **c** $n = 1.8$ **d** $n = 2\frac{1}{2}$

8 Copy and complete this table. The first column has been completed as an example.

a	8	6	14	4.5	9	6.25	$3\frac{1}{2}$
b	3	5	12	3	7.5	0	2
$a + b$	11						
$a - b$	5						
$2a + 3b$	25						
$5(a + 4b)$	100						
$\frac{2(3a - 5b)}{5}$	8.4						
$a^2 + b$	67						

9 Use the values in the table to evaluate each expression.

Variable	t	y	k	p	z	w
Value	4	0	3.5	16	$1\frac{1}{2}$	10

a $k + w$ **b** $p - t$ **c** $3y + p$

d $\frac{wp}{t}$ **e** $\sqrt{p}$ **f** $\frac{2k+3z}{w}$

10 In your group write a list of 5 algebraic expressions that have a value of 12 when $p = 6$ and $q = 3$.

9.6 Solving equations

Video
Two-step equations

Skillsheets
Solving equations by balancing

Solving equations by backtracking

Solving equations using diagrams

Worksheets
Equations code puzzle

Working with formulas

Algebra review

Puzzle
Equations match

An **equation** is a statement involving a variable, numbers, and an '=' symbol, such as $4k + 11 = 31$.

We **solve** equations to find the value for the variable that makes the equation true.

That value is called the **solution** to the equation.

For example, in the equation $4k + 11 = 31$, the solution is $k = 5$.

An equation is like a see-saw, balanced about the equal symbol. Provided we do the same thing to *both* sides, the equation will stay balanced.

We can check whether we've found the right solution by substituting the answer back into the original equation to see whether both sides have the same value.

EXAMPLE 10

Solve each equation.

a $m + 4 = 12$ **b** $k - 3 = 5$ **c** $4x = 44$ **d** $\frac{t}{8} = 6$

Steps	Working
a Write the equation.	$m + 4 = 12$
Subtract 4 from both sides.	$m + 4 - 4 = 12 - 4$
Write the solution.	$m = 8$
Check the solution: $8 + 4 = 12$ Correct ✓	
b Write the equation.	$k - 3 = 5$
Add 3 to both sides.	$k - 3 + 3 = 5 + 3$
Check the solution: $8 - 3 = 5$ Correct ✓	$k = 8$
c Write the equation.	$4x = 44$
Divide both sides by 4.	$\frac{4x}{4} = \frac{44}{4}$
Check the solution: $4 \times 11 = 44$ Correct ✓	$x = 11$
d Write the equation.	$\frac{t}{8} = 6$
Multiply both sides by 8.	$\frac{t}{8} \times 8 = 6 \times 8$
Check the solution: $\frac{48}{8} = 6$ Correct ✓	$t = 48$

Some equations require more than one operation to solve. These equations require more than one operation to solve. Provided we do the same thing to both sides, these equation will stay balanced.

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EXAMPLE 11

Solve each equation.

a $3x - 1 = 17$ **b** $\frac{k}{5} + 4 = 7$

Steps	Working
a Write the equation.	$3x - 1 = 17$
Add 1 to both sides.	$3x - 1 + 1 = 17 + 1$
	$3x = 18$
Divide both sides by 3.	$\frac{3x}{3} = \frac{18}{3}$
Check: $3 \times 6 - 1 = 17$ ✓	$x = 6$
b Write the equation.	$\frac{k}{5} + 4 = 7$
Subtract 4 from both sides.	$\frac{k}{5} + 4 - 4 = 7 - 4$
	$\frac{k}{5} = 3$
Multiply both sides by 5.	$\frac{k}{5} \times 5 = 3 \times 5$
Check: $\frac{15}{5} + 4 = 3 + 4 = 7$ ✓	$k = 15$

EXERCISE 9.6 Solving equations

ANSWERS p. 423

1 EXAMPLE 10 Solve each equation, showing all working. Remember to put the = signs under each other!

a $x + 5 = 12$ **b** $y + 13 = 36$ **c** $m + 9 = 21$

d $k + 27 = 54$ **e** $t + 11 = 40$ **f** $w - 7 = 4$

g $a - 5 = 2$ **h** $j - 23 = 51$ **i** $q - 12 = 17$

j $f - 42 = 68$ **k** $6x = 24$ **l** $4g = 16$

m $12d = 108$ **n** $9c = 81$ **o** $23p = 115$

p $\frac{s}{3} = 5$ **q** $\frac{m}{2} = 6$ **r** $\frac{d}{10} = 12$

s $\frac{w}{2} = 29$ **t** $\frac{a}{15} = 4$

2 Which of the following is the solution to $3x = -12$? Select the correct answer **A**, **B**, **C** or **D**.

A -9 **B** -36 **C** -4 **D** -15

3 EXAMPLE 11 Show all the steps you use to solve each equation.

a $2m + 7 = 19$ **b** $3x - 5 = 13$ **c** $5k + 12 = 52$

d $6w - 17 = 19$ **e** $4h + 21 = 9$ **f** $8d - 5 = -27$

g $-2x + 18 = 4$ **h** $-3a - 9 = -6$ **i** $14c + 2 = 37$

j $12p - 10 = 86$ **k** $9y + 11 = 101$ **l** $2r - 15 = 16$

4 Solve each equation.

a $\frac{m}{2} + 4 = 13$ **b** $\frac{c}{5} + 9 = 12$ **c** $\frac{d}{7} + 2 = 8$

d $\frac{k}{3} + 15 = 6$ **e** $\frac{h}{2} + 7 = 17$ **f** $\frac{x}{4} + 2 = -4$

g $\frac{n}{5} - 9 = 4$ **h** $\frac{t}{3} - 6 = -2$ **i** $\frac{a}{8} - 2 = -6$

j $\frac{x}{6} - 16 = -13$ **k** $\frac{v}{15} - 2 = 4$ **l** $\frac{b}{3} - 4 = 3$

5 Make up 4 equations of different types that have the solution $x = 2$.

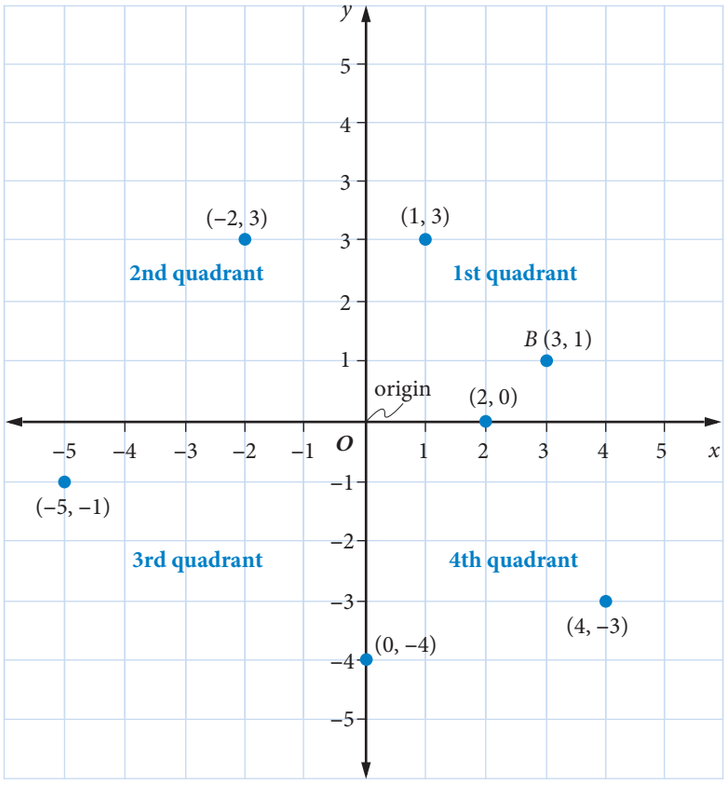
Worksheet
Number plane grid paper

9.7 The number plane

The **Cartesian plane,** another name for **number plane,** is a grid made from a horizontal number line called the ***x*-axis**, and a vertical number line called the ***y*-axis** as shown below. The centre of the number plane is called the **origin.**

We find points on the number plane by using a pair of numbers called **coordinates**, where the first number goes across from the origin and the second number goes up/down. For example, the point (3, 1) is 3 across and 1 up from the origin, labelled point *B* on the diagram. The origin has coordinates (0, 0).

The number plane is divided into 4 regions called **quadrants**.



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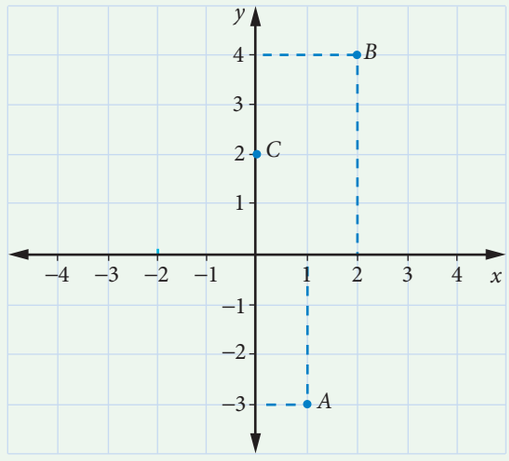
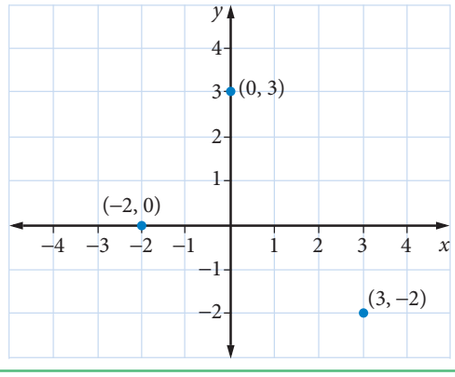
EXAMPLE 12

a What are the coordinates of points A, B and C on this graph?



b Plot the points $(3, -2)$, $(0, 3)$ and $(-2, 0)$ on a graph.

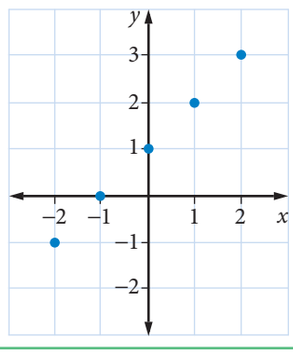
Steps	Working
a Find the across number, then the up-and-down number.	Point A has coordinates $(1, -3)$. B is at $(2, 4)$ and C is at $(0, 2)$.
b To plot $(3, -2)$, find 3 on the x-axis, then go down 2. To plot $(0, 3)$, find 0 on the x-axis, then go up 3. The point $(0, 3)$ is on the y-axis. To plot $(-2, 0)$, find -2 on the x-axis, then stay on the x-axis. The point $(-2, 0)$ is on the x-axis.	

A set of points can be written in a table of values. The coordinates of each point are shown in a table column.

EXAMPLE 13

Plot the points shown in this table of values.

x	−2	−1	0	1	2
y	−1	0	1	2	3

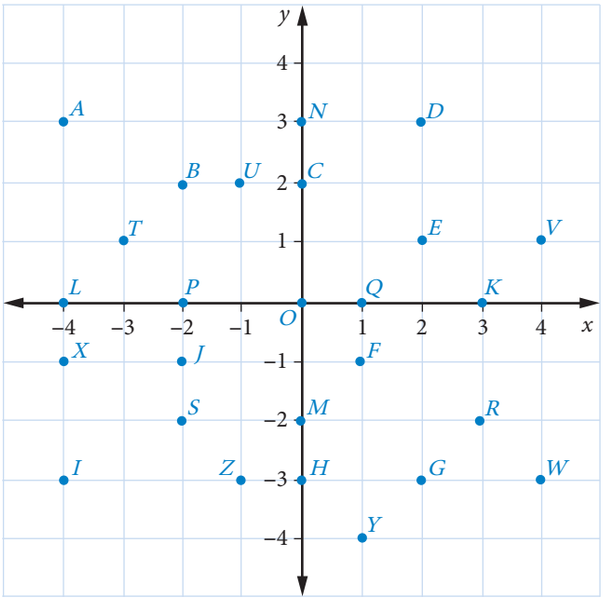
Steps	Working
From the table, the first point is $(-2, -1)$. The other points are $(-1, 0)$, $(0, 1)$, $(1, 2)$ and $(2, 3)$. Remember: first number across, second number up/down. Memorise this: x is 'across' because x is 'a cross'.	

Worksheet
Number plane grid paper

EXERCISE 9.7 The number plane

ANSWERS p. 423

1 EXAMPLE 12 Write the coordinates of each of the points A to Z.



2 **a** Draw a Cartesian plane with both axes (lines) extending from −6 to 6.

b Plot these points on the number plane.

A $(3, 1)$	**B** $(-4, 3)$	**C** $(-3, 4)$	**D** $(-2, -2)$
E $(0, -2)$	**F** $(1, -5)$	**G** $(4, -4)$	**H** $(-3, 0)$
I $(-6, 0)$	**J** $(-1, -6)$	**K** $(-3, -4)$	**L** $(0, 5)$
M $(6, 2)$	**N** $(-3, 5)$	**P** $(5, -5)$	**Q** $(-1, 6)$

3 List all of the points from Question **2** that are:

a in the 1st quadrant

b in the 2nd quadrant

c in the 3rd quadrant

d in the 4th quadrant

e on the border of 2 quadrants.

4 In which quadrant would you find each point?

a $(3, -5)$ **b** $(-2, -4)$ **c** $(-8, 1)$

5 Copy this table and complete it by placing a + or a − sign in the blank spaces.

Points in:	x-coordinate	y-coordinate
1st quadrant	+	
2nd quadrant	−	
3rd quadrant		
4th quadrant		

6 EXAMPLE 13 Plot the points given in this table on a number plane.

x	0	1	2	3	4
y	−2	−1	0	1	2

You need to decide what numbers to use on the x- and y-axes. Look at the table you are given. Check what numbers you need on each axis.

7 For each table, plot the points on a number plane.

a

x	−6	−3	0	3	6
y	−2	−1	0	1	2

b

x	−5	−2	1	3	4
y	3	0	−3	−5	−6

c

x	4	2	0	−1	−2
y	0	2	4	5	6

d

x	−1	0	1	2	3
y	−2	0	2	4	6

Investigation Changing points of view

In this investigation, we will see what happens when we change coordinates in different ways.

1 Draw a number plane with an x-axis from −15 to 15 and a y-axis from −20 to 20. Use 0.5 cm = 1 unit.

2 Plot these points and join them in the given order:

(3, 2) (11, 14) (9, 13) (10, 19) (5, 10) (6, 11) (3, 2)

3 You have drawn a lightning bolt in the first quadrant.

4 What happens to the lightning bolt if you multiply all the x values by −1? Rewrite the points with these new coordinates. Plot these points and join them as before. Describe in words what has happened to the lightning bolt.

5 Now investigate what happens if you multiply all the y values by −1. Rewrite the points, plot them and join them as before. Describe in words what has happened to the lightning bolt.

6 How would you place the lightning bolt in the other quadrant? Show that what you have said will actually work.

Keyword activity

CHAPTER SUMMARY

ANSWERS p. 424

Use this word list to determine which word goes in the blanks below.

divide	evaluating	expressions	like
multiply	numerical	origin	points
quadrants	quantities	same	value
variable	x-axis	y-axis	

In algebra, we use variables in place of unknown $_1$_____ and we call what we write 'algebraic expressions'. We can only add or subtract $_2$_____ terms, but we can multiply and $_3$_____ any algebraic $_4$_____. When we expand an algebraic expression, we $_5$_____ out the brackets.

Substitution is when we replace a variable with a $_6$_____ value and $_7$_____ is what we call finding the value of an algebraic expression.

When we solve an equation, we are finding the value of a $_8$_____. The solution of an equation is the value of the variable that gives both sides of the equation the same $_9$_____. When we solve equations we do the $_{10}$____ thing to both sides of the equation.

A number plane has 2 axes – the $_{11}$_____ goes across, and the $_{12}$_____ goes up and down. The point where the 2 axes intersect is called the $_{13}$_____. The axes divide the number plane into 4 $_{14}$_____. We can graph $_{15}$_____ on a number plane using coordinates.

Solution to the chapter problem

Problem

Part of Miriam's Algebra test is shown below, along with her answers.

Question		Answer
17	$6 + 4m + 4$	$4m + 10$
18	$5x + 3x$	$8x^2$
19	$3p \times 7q$	$21pq$
20	$21m \div 3m$	$7m$
21	$3 + 7n + 13 + 2n$	$25n$
22	$7g + 8h - h - g$	$7h + 6g$

In this section, Miriam got 3 correct answers and 3 incorrect answers.

Which 3 were correct? Work out the correct answers for the questions with incorrect answers.

Solution

Question		Miriam's answer		Correct answer
17	$6 + 4m + 4$	$4m + 10$	✓	
18	$5x + 3x$	$8x^2$	✗	$8x$
19	$3p \times 7q$	$21pq$	✓	
20	$21m \div 3m$	$7m$	✗	7
21	$3 + 7n + 13 + 2n$	$25n$	✗	$9n + 16$
22	$7g + 8h - h - g$	$7h + 6g$	✓	

Questions **17**, **19** and **22** were correct.

Questions **18**, **20** and **21** were incorrect.

18 $5x + 3x = 8x$ Adding like terms.

20 $21m \div 3m = \dfrac{21m}{3m}$

$= \dfrac{21}{3} \times \dfrac{m}{m}$

$= 7 \times 1$

$= 7$

21 $3 + 7n + 13 + 2n = 3 + 13 + 7n + 2n$ Adding like terms.

$= 9n + 16$

9 Test yourself

Using algebra

ANSWERS p. 424

1 EXERCISE 9.1 Write an algebraic expression for each of the following:

a 8 more than k **b** 6 times p minus 3 **c** p divided by q

2 EXERCISE 9.1 Write an algebraic expression for each of the following:

a decrease \$100 by \$$y$ **b** think of a number w, multiply it by 4 and add 5

3 EXERCISE 9.1 Bohdana needs to have some advertisements printed. The printer quotes a cost of \$55 plus \$0.08 per copy. Write an expression for the cost, C, of printing n copies.

4 EXERCISE 9.2 Simplify each expression.

a $5p + 3 + 8p$ **b** $3 + 4x + 12$ **c** $w - 12 + w$

d $3b^2 + 6b^2 - b^2$ **e** $t + t^2 + 3t$ **f** $5 - t - t$

g $78ab + 2ab + 2$ **h** $p^2 + 7p^2 + 2p^3$ **i** $20m - m$

5 EXERCISE 9.3 Simplify each expression.

a $12p \times 3q \div 9$ **b** $12a \times 2b \div 8y$ **c** $8p \times 4q \div 16t$

d $4y \times 6 \div 2y$ **e** $20 \div 4a \times p$ **f** $6y \div 2y \times 3$

g $6g^4 \times g$ **h** $a^3 \times 2a^3$ **i** $v \times 3v^5$

j $24k \div 2k \times 6$ **k** $24x^8 \div 6x^4$ **l** $20b^5 \div 12b^2$

6 EXERCISE 9.4 Expand and simplify each expression.

a $5a + 3(a + 2)$ **b** $-(8 - y)$

c $-x(x - 5)$ **d** $5(3p + 5) + 2$

7 EXERCISE 9.5 Evaluate each expression when $k = 15$.

a $2k$ **b** $3(k + 7)$ **c** $\frac{2k}{5}$ **d** $\sqrt{k + 1}$

8 EXERCISE 9.5 Calculate the value of the expression $2y + x$ when $x = 10.2$ and $y = 5.8$.

9 EXERCISE 9.6 Solve each equation.

a $k + 6 = 13$ **b** $x - 3 = 8$ **c** $10f = 120$ **d** $\frac{m}{4} = 7$

10 EXERCISE 9.6 Solve each equation.

a $4p + 3 = 23$ **b** $8k - 10 = 42$ **c** $\frac{h}{7} + 5 = 16$ **d** $\frac{a}{5} - 8 = 4$

11 EXERCISE 9.7 Plot each point on a number plane.

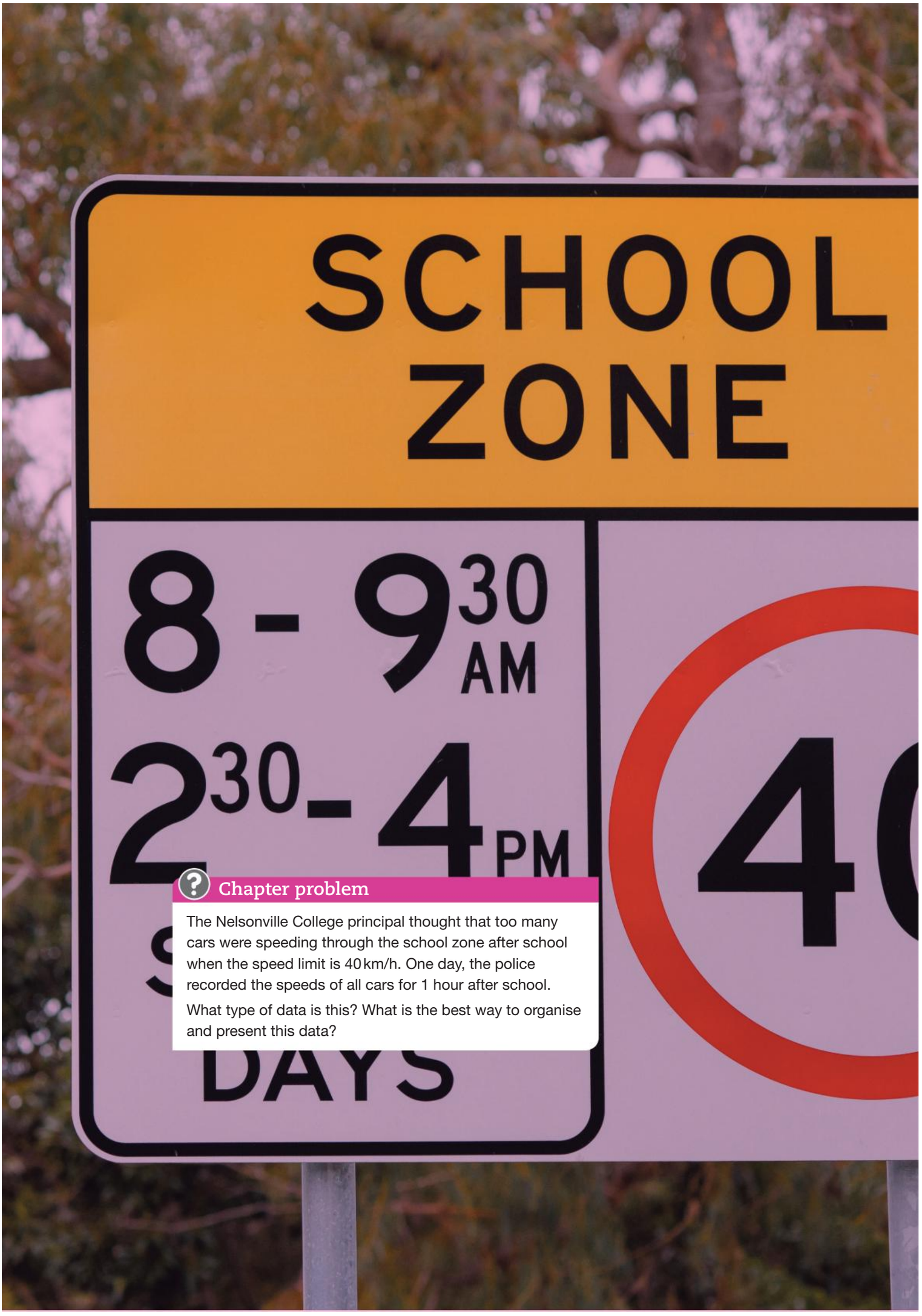
a $P(1, -4)$ **b** $Q(-3, -1)$ **c** $R(-1, 2)$ **d** $S(1, 3)$

e $T(0, 4)$ **f** $U(2.5, -2)$ **g** $W(-2, 0)$ **h** $Y(-3, 1.5)$

12 EXERCISE 9.7 Which points from question **11** are:

a on the y-axis? **b** in the 2nd quadrant?

c on the x-axis? **d** in the 4th quadrant?



Chapter problem

The Nelsonville College principal thought that too many cars were speeding through the school zone after school when the speed limit is 40 km/h. One day, the police recorded the speeds of all cars for 1 hour after school.

What type of data is this? What is the best way to organise and present this data?

CHAPTER 10

DATA ANALYSIS, PROBABILITY AND STATISTICS

DISPLAYING DATA

10.1 Displaying categorical data
10.2 Displaying numerical data
10.3 Constructing graphs
10.4 Graphs and spreadsheets
10.5 Analysing frequency tables
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Organise data into frequency tables, including data grouped into class intervals
- Graph categorical and numerical data
- Display data in pie graphs, line graphs, dot plots and stem-and-leaf plots
- Find the mean, median, mode and range for data presented in a frequency table, including grouped data

How are we ever going to use this?

- When we need to organise information we have collected
- When we want to present statistical information in an interesting way
- When interpreting different 'averages' and deciding which is the most appropriate

Study Design coverage

UNIT 2, AREA OF STUDY 2: DATA ANALYSIS, PROBABILITY AND STATISTICS

- creation of a range of charts, tables and graphs to represent and compare data
- measures of central tendency and simple measures of spread (such as range and interquartile range) to summarise and interpret data and compare sets of related data
- interpretation, summary and comparison of related data sets to report findings and draw possible conclusions.

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Videos (2):
10.5 Analysing frequency tables • Statistics from a frequency table

Worksheets (3):
10.2 Frequency tables
10.5 Statistical match-up • The mean and fx tables

Spreadsheet (1):
10.4 Statistical graphs

Weblink (1):
10.4 Bureau of Meteorology

Nelson MindTap

To access resources above, visit
cengage.com.au/nelsonmindtap

10.1 Displaying categorical data

Categorical data is information that is grouped into categories. When we collect categorical data, we can organise it into a **frequency table**. This makes it easier to see what the information is telling us.

EXAMPLE 1

Heidi asked a group of her fellow students which night of the week they would prefer to have the school ball. She recorded the responses as T (Thursday), F (Friday), Sa (Saturday) and Su (Sunday). This is her data:

F, F, T, Sa, F, Sa, F, Sa, Sa, F, Sa, T, Sa, F, F, T, T, Su, F, Sa, T, Sa, F, F, F, F, T, T

Arrange this data in a frequency table.

Steps

A frequency table has three columns. Complete the tally column by putting one tally mark for each response.

Put a line across each group of 4 to mark groups of 5.

Count the tally marks to complete the frequency column.

Working

Day of the week	Tally	Frequency
Thursday	𝍸 ||	
Friday	𝍸 𝍸 ||	
Saturday	𝍸 |||	
Sunday	|	

Day of the week	Tally	Frequency
Thursday	𝍸 ||	7
Friday	𝍸 𝍸 ||	12
Saturday	𝍸 |||	8
Sunday	|	1
Total		**28**

We can display categorical data in a column graph.

EXAMPLE 2

Display the data from Example **1** in a column graph.

Day of the week	Frequency
Thursday	7
Friday	12
Saturday	8
Sunday	1

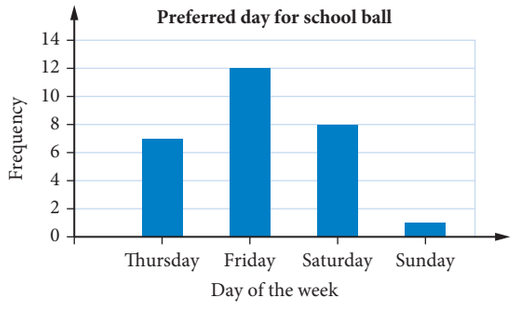
Steps

The horizontal axis will be the days of the week.

The vertical axis will be the frequency.

Columns will have spaces between them.

Working



EXERCISE 10.1 Displaying categorical data

ANSWERS p. 424

1 EXAMPLE 1 Piyush recorded how students in his year travelled to school. He recorded the data as W = walk, R = ride a bike, B = bus, C = car and T = train.

B, B, C, T, W, R, W, W, T, C, T, T, C, B, R, W, W, R, R, R,
W, W, C, R, B, B, W, T, W, R, W, W, B, R, B, R, W, W, T, C,
R, R, W, W, T, C, W, R, W, W, C, B, W, W, R, R, R, W, B, R,
W, R, R, W, C, T, R, W, W, B, R, R, C, B, T, W, R, R, B, C

a Arrange this data in a frequency table.

b What is the most common way for students to travel to school?

c What is the least common travel method?

2 Tiana surveyed a selection of homes in Nelson Bay to find out the ages of each child. She recorded the data as B = babies up to 2 years, P = pre-schooler, I = early primary and O for children over 8 years.

B, B, O, I, O, O, B, P, P, P, O, B, I, I, O, O, I, I, I, P, O, B,
B, O, I,P, O, O, P, I, P, P, O, B, I, I, O, P, O, O, B, I, P, B, I

a Arrange Tina's data in a frequency table.

b Which category of children contains the largest number of children?

c What percentage of children in the survey are babies?

Remember: percentage = amount ÷ whole amount × 100%

3 Jasmine asked 30 students in Year 11 'What is your preferred brand of car?'

Her results are shown below and coded as follows: Holden = H, Ford = F, Toyota = T, Mitsubishi = M, Subaru = S, Other = O

H, H, T, F, F, F, M, T, O, S, T, H, H, H, F, S, M, T, T, H, F, F, H, H, O, S, T, M, H, F

a Arrange Jasmine's data in a frequency table.

b What is the most popular brand of car amongst these students?

c What percentage of students preferred Mitsubishi?

4 EXAMPLE 2 Tristan surveys a class of 30 students about the day of the week that each student's birthday falls on this year. Display this data in a column graph.

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of students	6	3	4	6	3	5	3

5 Alli counted the colours of the jelly beans in a large jar.

Colour	Red	Black	Purple	Pink	Orange	White
Frequency	110	50	20	40	60	80

Display this data as a column graph.

You can use a spreadsheet to construct the graph if you want to.

Worksheet
Frequency tables

10.2 Displaying numerical data

Numerical data is information that is counted or measured. We can summarise numerical data using a frequency table and present it in a graph.

We often graph numerical data using a **histogram**. A histogram is like a column graph but for numerical data only and there are no spaces between the columns. We show **frequency** on the vertical axis and we show the data values on the horizontal axis.

EXAMPLE 3

Kyle asked 25 students in his class: 'How many children are there in your family?'

The answers are recorded below:

1, 6, 7, 4, 3, 3, 2, 2, 5, 3, 3, 3, 3, 1, 7, 3, 2, 3, 2, 5, 4, 4, 1, 1, 2

Arrange Kyle's information in a frequency table and draw a histogram for the data.

Steps

Complete a frequency table.

Check that the total of the frequency column is the same as the number of families asked the question.

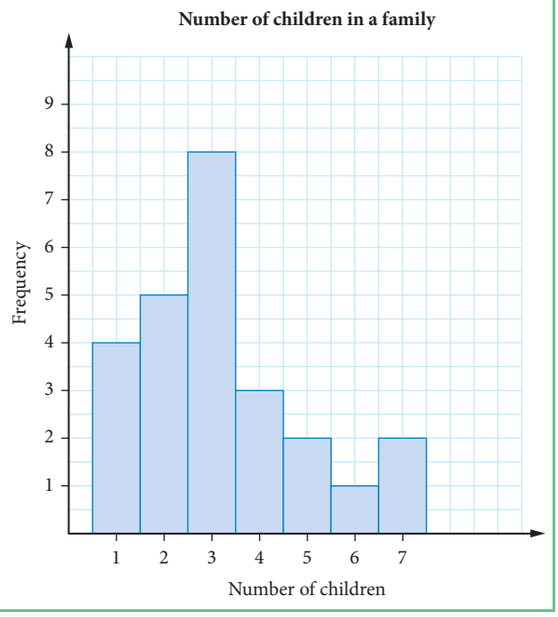
Working

Number of children	Tally	Frequency
1	𝍸	4
2	𝍸	5
3	𝍸 |||	8
4	|||	3
5	||	2
6	|	1
7	||	2
Total		**25**

Place 'Number of children' on the horizontal axis and 'Frequency' on the vertical axis.

Make sure that the columns are centred so that the values on the horizontal axis are directly below them.

Add a title to the graph.



10.2

EXERCISE 10.2 Displaying numerical data

ANSWERS p. 425

1 The number of hamburgers sold each day in a food court between 12 noon and 2 pm in August is listed below.

17, 27, 28, 18, 18, 17, 19, 19, 25, 27, 17, 19, 20, 19, 21, 26,
28, 18, 19, 20, 17, 19, 23, 24, 20, 18, 17, 20, 19, 27, 28

a Arrange this information in a frequency table.

b On how many days did the shop sell fewer than 20 hamburgers?

c On what percentage of days did it sell more than 25 hamburgers? Round your answer to the nearest whole number.

2 Sajjid asked a group of Year 11 students how many siblings (brothers and sisters) they had.

4, 0, 2, 3, 2, 4, 3, 4, 3, 0, 0, 1, 2, 3, 2, 2, 1, 4, 3, 1, 1, 1, 2, 0, 1, 2, 1, 0, 1, 3, 2, 3, 4, 1, 1, 3, 3

a Complete a frequency table for Sajjid's data.

b How many students were asked this question?

c How many students had no siblings?

d How many students had fewer than 3 siblings?

e What percentage of students had 1 sibling? Round your answer to the nearest whole number.

3 EXAMPLE 3 The scores for students' speeches (out of 10) in an English class are as shown.

7, 7, 8, 9, 7, 5, 4, 8, 9, 9, 8, 10, 8, 7, 5, 5, 4, 1, 8, 8, 9, 7, 7, 4, 8, 3, 1

a Complete a frequency table for this data.

b How many students are in this class?

c How many students scored 5 or less for their speech?

d What percentage of students scored 8 or more for their speech? Round your answer to the nearest whole number.

e Draw a histogram for this data.

4 Amber surveyed 20 households in her street about how many phones they owned.

Number of phones	Frequency
0	2
1	7
2	8
3	2
4	1

Draw a histogram to display Amber's data.

5 This frequency table records the number of letters received by an office each day.

Number of letters	Frequency
3	4
4	7
5	8
6	14
7	12
More than 7	10

a Draw a histogram for this data.

b On how many days did the office receive fewer than 5 letters?

c Which number of letters had the highest frequency?

6 Atiq counted the number of phone calls he made each day for 30 days. The results are shown:

5, 3, 6, 2, 4, 3, 3, 5, 4, 7, 5, 1, 6, 3, 2, 3, 5, 6, 1, 6, 2, 4, 3, 1, 5, 4, 2, 7, 3, 2

a Complete a frequency table for this data.

b Draw a histogram for this data.

c On how many days did Atiq make 5 calls?

d What was the mode?

7 A sample of hospital patients were surveyed on the number of hours they slept the previous night.

6, 7, 9, 8, 10, 11, 9, 10, 8, 9, 7, 6, 11, 9, 8, 8, 8, 10, 10, 9, 7, 8, 9, 10

a Complete a frequency table for this data.

b How many patients were surveyed?

c Draw a histogram for this data.

d How many patients slept for more than 8 hours?

e What was the mode number of hours that patients slept?

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Investigation Collecting and presenting data

Prepare a questionnaire, survey at least 20 students and present your data in frequency tables and with graphs.

Part A: Collecting data

You are going to ask other students to answer some questions.

- Write 3 questions where the answers give categorical data.
- Write 3 questions where the answers give numerical data.

When writing the questions think about how you will get the answers in a form that is easy to put into frequency tables, for example, use tickboxes or give a choice of several answers.

Check the questionnaire with your teacher before you ask people to answer it.

Have your questionnaire answered by at least 20 students.

Part B: Presenting data

For each question, tabulate the data in a frequency table and draw a graph for the data.

Part C: Analysing data

Write a paragraph about what you have found.

10.3 Constructing graphs

Data can be presented in many different types of graphs as we saw in Chapter 3, *Show me the graph*.

In this exercise, you will draw some of these graphs.

EXERCISE 10.3 Constructing graphs

ANSWERS p. 426

1 **a** Draw a dot plot to represent the number of goals that Daniel kicked in each soccer game he played last year.

4, 5, 1, 2, 3, 0, 3, 8, 4, 6, 5, 4, 1, 1, 4, 4, 2, 5, 3, 1, 1, 0

b Are there any outliers in this data? If so, what are they?

c Where is the data clustered?

d How many games did Daniel play?

2 This data shows the monthly number of burglaries over 3 years in an inner-city region.

54, 41, 55, 49, 37, 38, 37, 48, 51, 44, 52, 44, 58, 70, 60, 46, 63, 54, 45, 43, 46, 55, 55, 67, 49, 66, 90, 45, 66, 62, 51, 51, 53, 53, 38, 52

Copy and complete the stem-and-leaf plot for this data.

Stem	Leaf
3	
4	
5	
6	
7	
8	
9	

Remember: A stem-and-leaf plot for this data will have the 10s digit as the stem and the units digit as the leaves.

3 The number of accidents that occurred on the Western Freeway each day for 2 weeks was recorded:

1, 0, 0, 2, 0, 3, 5, 1, 0, 1, 0, 2, 3, 0

a Draw a dot plot for this data.

b What is the most common number of daily accidents?

c If the traffic patterns remain the same for the following weeks, how many accidents would you expect in a week?

d What is the outlier? Why?

4 Angelina was admitted to hospital at 10 pm with a high temperature. This table shows her temperature each hour for the next 12 hours.

Time	10 pm	11	12 am	1	2	3	4	5	6	7	8	9	10 am
Temperature (°C)	42	42	41	40	40	41	39	40	38	39	37	37	37

a Draw a line graph showing this information.

b What was Angelina's highest temperature?

c What is the range for this data?

5 A survey recorded the number of shoppers visiting Westvale Plaza daily over a 15-day period.

105, 76, 97, 88, 114, 86, 124, 101, 112, 98, 95, 105, 117, 81, 112

a Show this information in an ordered stem-and-leaf plot.

b Calculate the median and the interquartile range.

c Calculate the mean, correct to the nearest whole number.

6 In Exercise 10.1, question **4** on page 254, we drew a column graph for some categorical data that Tristan collected on the day of the week that each student's birthday fell on this year. We can also graph this data on a pie graph.

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of students	6	3	4	6	3	5	3

a Copy and complete this table that calculates the angle for each sector in a pie graph.

Day of the week	Angle for sector graph
Monday	$\frac{6}{30} \times 360° =$
Tuesday	$\frac{\quad}{30} \times 360° =$
Wednesday	$\frac{\quad}{30} \times 360° =$
Thursday	$\frac{\quad}{\quad} \times 360° =$
Friday	$\frac{\quad}{\quad} \times 360° =$
Saturday	$\frac{\quad}{\quad} \times 360° =$
Sunday	$\frac{\quad}{\quad} \times 360° =$

b Draw a pie graph for this data.

10.4 Graphs and spreadsheets

In this exercise, you will use a spreadsheet to produce some graphs. Download the **Statistical graphs** spreadsheet with the data for this exercise from Nelson MindTap. Save this spreadsheet to your computer.

Spreadsheet
Statistical graphs

EXERCISE 10.4 Graphs and spreadsheets

ANSWERS p. 426

1 Column graph

To draw a column graph that shows the numbers of people immigrating to Australia by their region of origin in 1988–9:

- Select all the cells from A3 to B8.
- Select the **Insert** tab at the top.
- Under **Charts,** select **Column** and then the first of the 2D column types.
- Click on the chart title, highlight the text '1988–9' and change it to 'Immigration by region of origin'.
- Ensuring the chart is selected (**Chart Tools** appears at the top of the sheet), select the **Layout** tab, then axis titles, go to **Primary Vertical Axis Title** and select **Rotated Title**. This will insert vertical script on the vertical axis. Highlight this script and change it to 'thousands'.
- With the chart selected, choose the **Design** tab and pick **Move Chart**. In the dialogue box, select the Object in option and immigration as the sheet and then **OK**. Move the whole chart to the top left of this sheet (click and hold the mouse on the chart border, move to the desired location and unclick).

2 Clustered column graph

Several years of information can be provided in the one graph by using clustered columns. For example, data for both years 1998–9 and 2008–9 can be shown.

- Return to the data sheet.
- Select all cells from B3 to C8.
- Select the **Insert** tab, and under **Charts** choose **Column** and select the first one of the 2D column types.
- Go to the **Layout** tab, click **Chart Title** and select **Above Chart**. Change the title text to the same as for the previous chart.
- Give the vertical axis the label 'thousands' as for the previous chart.
- Move the chart to the immigration sheet as you did for the last one and place it just below the previous column chart.

3 Find the latest data for immigration by region of origin and add a third column to the data provided. Draw a clustered column graph for all 3 years. Place the graph on the immigration sheet.

4 Pie graphs

The same data will be used to draw sector charts of the immigration statistics to show the contribution from the various regions.

- Return to the data sheet and select cells A2 to B8.
- Select the **Insert** tab, and under **Charts,** choose **Pie** and select the first 2D pie type.
- Check out the different possible **Chart Layouts** (top of screen). Try them out and choose the chart that you think shows the most information in the way that looks best.
- Move the chart to the immigration sheet as you have done previously and place it just to the right of the first simple column chart.

Now create another sector chart for the 2008–9 data. The steps are much the same as before, except the initial selections of cells is a little more complicated.

- Return to the data sheet. Select cells A3 to A8. Then press and hold the **Ctrl** button while you select C3 to C8 with the mouse.
- Insert the pie chart as before.
- This time the title needs to be changed. Click the cursor in front of 2008–9 in the title and add 'Immigration to Australia by Region of Origin' in front of it.
- When you are happy with its format, place it below the first sector chart on the immigration sheet.

5 Line graphs

Use the data for temperatures during a spring day in Launceston in cells A24 to J25 of the data sheet.

- Select cells A24 to J25.
- Choose **Insert**, **Line** and select the first of the 2D chart types.
- Go to the **Layout** tab, go to **Chart Title** and select **Above Chart**. Replace the words Chart Title with 'Temperatures in Launceston'.
- Place the graph in the **Lines** worksheet.

6 Use the vehicle and home theft figures in cells A10 to F13 of the data sheet. Both will be plotted on the same graph. Draw a line graph for this data. Place the graph in the **Lines** worksheet.

7 Use the data on Bazza's gym from the data sheet (A17 to M20). Draw a line graph for this data. Place the graph in the **Lines** worksheet.

Investigation More graphs on spreadsheets

10.4

Other types of graphs can be created using a spreadsheet. For this investigation, you will continue to use the **Statistical graphs** spreadsheet you used in the previous exercise. You should have this spreadsheet saved to your own computer.

Scatter graphs

Part A

We can use a scatter chart to get an idea about whether or not two variables are related. In this example, data collected on the heights and foot lengths of 20 individuals will be used to see if there might be some relationship between foot size and height. This data is displayed in the data sheet in cells A27 to U29.

- Select cells A28 to U29 in the data sheet.
- Choose **Insert**, **Scatter** and select the first option.
- In **Chart Layouts**, select the first option (rightmost).
- Change the title to 'Foot length versus height', replace 'Axis Title' on the bottom axis with 'foot length (cm)' and 'Axis Title' on the vertical axis with 'height (cm)'.
- Click on the legend and delete it.
- Place the chart in the scatter sheet. Enlarge it in this sheet by pulling down the bottom right-hand corner.

Part B

The data in Part A was obtained from **Census at School Australia**, a program that no longer exists. Search for **Census at School** in another country (for example, New Zealand or USA) and go to their website.

- Search for data that involves two variables that might be linked. For example, arm span and height, height of belly button and foot size, or reaction times. Save this data in the spreadsheet to your own computer.
- Draw a scatter graph for your data. Complete appropriate titles and axis labels, and save it.

Radar charts

Radar charts are like a circular version of a line graph and are used for data that is recorded over time. You will be plotting the maximum average monthly temperatures for Darwin and for where you live.

You need to go to the **Bureau of Meteorology** website to collect the data for each place. The data for Darwin will go in cells B33 to M33. The data for your own town will go in cells B34 to M34 on the spreadsheet with all the other data.

To collect data:

- Search for and go to the **Bureau of Meteorology** home page.
- Select **Climate Information.**
- Go down to and click on **Weather and climate data – (Climate Data Online)**.
- Then, for Darwin, select as follows.
  - Data about: Temperature
  - Type of data: **Monthly** then choose **Mean maximum temperature**
  - Under 'Select a weather station' write 'Darwin' and click **Find**.
  - Click **Darwin, NT** in the next window and **Darwin Airport** in the next.
  - Go down and click **Get Data** (this will open a new window).
  - Scroll down to **Summary Statistics** for all years and take monthly temperatures shown as 'Mean'. Enter these into cells B29 to M29.
- For your town, close the current window, scroll up and repeat the process for where you live.

Once the data is entered, draw the graph as follows.

- Select cells A32 to M34 in the data sheet.
- Choose **Insert, Other Charts** and then the first of the radar charts.
- Choose the first of the **Chart Layouts** and change 'Chart Title' to 'Average Maximum Temperature'.
- Place the chart in the radar sheet and expand it.

Take some time to experiment with all the different types of graphs in the spreadsheet! You can change colours, fonts, grids and all sorts of things.

Weblink
Bureau of Meteorology

Videos
Analysing frequency tables

Statistics from a frequency table

Worksheets
Statistical match-up

The mean and fx tables

10.5 Analysing frequency tables

For data presented in a frequency table, we can find the median, the mode, the mean and the range.

EXAMPLE 4

This frequency table shows the number of letters in each word in a paragraph of text.

For this set of data, find:

a the median

b the mode

c the mean, correct to 1 decimal place

d the range

Number of letters	Frequency
2	2
3	14
4	20
5	7
6	2

Steps	Working
a To find the median, add a cumulative frequency column to the table. This column is a progressive total of the frequency.	

Number of letters	Frequency	Cumulative frequency	
2	2	2	
3	14	16	2 + 14
4	20	36	16 + 20
5	7	43	
6	2	45	

There are 45 data values, so the median is the $(45 + 1) \div 2 = 23$rd value.

Reading down the cumulative frequency column, the 23rd value is between the 16th (the last of the 3s) and the 36th (the last of the 4s) values.

So the 23rd score is 4.

The median is 4.

b The mode is the value with the highest frequency. 4 has the highest frequency of 20.

The mode is 4.

c To find the mean, we add a 'frequency × score' column to the table. This is a shortcut to adding the 45 scores.

Number of letters	Frequency	Frequency x score	
2	2	4	2 × 2
3	14	42	3 × 14
4	20	80	
5	7	35	
6	2	12	
Total	**45**	**173**	

$$\text{mean} = \frac{173}{45}$$
$$= 3.844\,44\ldots$$
$$\approx 3.8$$

d range = highest value – lowest value

In the first column, the highest value is 6 and the lowest value is 2.

$$\text{range} = 6 - 2$$
$$= 4$$

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EXERCISE 10.5 Analysing frequency tables

ANSWERS p. 427

1 EXAMPLE 4 Here are the scores of students on a quick quiz out of 10.

Score	Frequency
5	4
6	3
7	8
8	4
Total	**19**

a Copy this table and add columns for cumulative frequency and frequency × score.

b Use the table to find:

- **i** the median
- **ii** the mode
- **iii** the mean (correct to 1 decimal place)
- **iv** the range.

2 Andrea surveyed 50 students on how many text messages they sent within the last hour.

Number of texts	Frequency
0	8
1	4
2	10
3	10
4	15
5	3
Total	**50**

a Copy this table and add columns for cumulative frequency and frequency × score.

b Use the table to find:

- **i** the median
- **ii** the mode
- **iii** the mean (correct to 1 decimal place)
- **iv** the range.

3 Centrelink officers recorded how many jobs each person applied for before they received their first job interview.

Score	Frequency
1	2
2	5
3	10
4	6
5	11
6	13
7	3

a Find the mode, the median, the mean and the range for this data.

b Which measure (mean, median or mode) would you use to encourage people to keep trying to get a job? Explain your answer.

4 This frequency table shows the heights in metres of a sample of junior school students.

Height (m)	Frequency
1.42	4
1.44	5
1.46	8
1.48	11
1.5	6
1.52	3

a How many students are in this sample?

b Find the mode, the median, the mean and the range for this data.

5 Thirty people were asked how often they went to a cinema in the previous month. The results are below:
4, 5, 3, 1, 3, 7, 1, 1, 4, 0, 0, 4, 3, 2, 4, 2, 4, 7, 6, 6, 1, 3, 5, 5, 1, 3, 6, 7, 0, 3

a Construct a frequency table and use it to find the range, the mode, the median and the mean.

b Write a comment on what this data shows.

Keyword activity

WORD MATCH

ANSWERS p. 427

Match each word below with one of the definitions **A** to **J**.

categorical data	histogram	line graph
frequency x score column	pie graph	stem-and-leaf plot
numerical data	dot plot	frequency table
cumulative frequency column	line graph	

A A table summarising data

B A graph using dots in columns

C Information that is grouped into categories such as the colour of cars

D A graph that usually shows changes over time

E A column added to a frequency table to help us calculate the mean

F Looks like a column graph but there are no spaces between the columns

G Information that is counted or measured such as the number of goals scored

H Graph used for larger data sets that keeps all the detail of the data

I A column added to a frequency table to help us calculate the median

J A graph that is a circle

Solution to the chapter problem

Problem

The Nelsonville College principal thought that too many cars were speeding through the school zone at the end of the day when the speed limit is 40 km/h. One day the police set up in the school zone and recorded the speeds of all cars for a period of 1 hour after school.

What type of data is this? What is the best way to organise and present this data?

Solution

This data is numerical data.

We can organise it into a frequency table. If the speeds are spread over a wide range, it may be necessary to use a grouped frequency table.

It would also be helpful to graph this data. If there were only a few cars, we could use a dot plot. If there were a lot of cars, we could use a histogram or a stem- and -leaf plot.

As the principal is interested in the number of cars doing more than 40 km/h, it would be useful to calculate this number.

10 Test yourself

Displaying data

ANSWERS p. 427

1 EXERCISE 10.1 Marisa surveyed Year 11 students about their favourite colour from the following list:

Blue (B) Green (G) Red (R) Purple (P) Yellow (Y) Magenta (M)

These are their results:

B, B, P, R, B, G, Y, Y, M, G, B, G, R, P, Y, M, M, Y, P, P, R, R, G, B, G, P, Y, R, G, M,
Y, P, G, R, P, B, B, B, B, M, G, G, R, P, Y, G, G, B, B, B, Y, Y, P, P, R, M, M, B, B, G

a Arrange this data in a frequency table.

b What is the most popular colour?

c What percentage of students chose green?

d Display this data in a column graph.

2 EXERCISE 10.2 The temperature in Ballarat at 11 am each day were recorded:

15°C, 22°C, 17°C, 21°C, 18°C, 20°C, 19°C, 21°C, 20°C, 19°C, 22°C,
21°C, 21°C, 19°C, 15°C, 21°C, 22°C, 18°C, 21°C, 20°C, 22°C

a Complete a frequency table for this data.

b For how many days was the temperature recorded?

c How many days had temperatures below 20°C?

d Draw a histogram for this data.

3 EXERCISE 10.3 These are the results for Andre's Year 11 class for a quick Maths quiz out of 20.

10, 14, 13, 17, 16, 11, 14, 14, 12, 14, 13, 16, 15, 12, 16, 13, 12, 15, 10, 14, 13, 16, 14

a Draw a dot plot for Andre's data.

b How many students are in the class?

c How many students scored more than 14 out of 20 for the test?

4 EXERCISE 10.3 The ages of customers in *Tech-to-go Gamestore* are recorded one morning.

25, 55, 36, 29, 28, 50, 47, 39, 52, 41, 33, 50, 29, 28, 56, 33, 26, 35, 35, 48, 32

a Show this information in an ordered stem-and-leaf plot.

b How many customers came in to the shop that morning?

c What age was the oldest customer that morning?

d What percentage of customers were under the age of 35? Answer correct to 1 decimal place.

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5 EXERCISE 10.4 Carmelina recorded the number of drinks bought by people visiting her shop during 1 hour. The results are shown in this frequency table.

Number of drinks	Frequency
0	7
1	5
2	13
3	4
4	1
5	2
6	1
Total	**33**

Use a spreadsheet to graph this data on a column graph.

6 EXERCISE 10.5

a Copy the above frequency table and add columns for cumulative frequency and frequency × score.

b For this data, find:

i the median

ii the mode

iii the mean (correct to 1 decimal place)

iv the range.

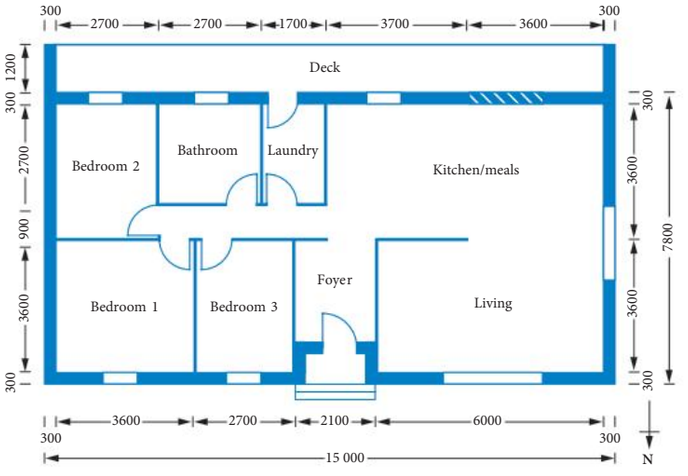
Chapter problem

Frankie and Charlie are building a house according to this plan. They need to order tiles for the bathroom and laundry and interior doors.

How many square metres of tile will they need?

Answer to the nearest square metre.

How many interior doors will they need to order for all rooms?



CHAPTER 11

SPACE AND MEASUREMENT

DESIGNS AND PLANS

11.1 2D shapes
11.2 3D solids
11.3 Designing a logo
11.4 Sketching solids
11.5 Scale diagrams
11.6 House plans and elevations
11.7 Reading house plans
11.8 Drawing scale diagrams
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Draw and recognise properties of common 2D and 3D shapes
- Create geometric designs
- Interpret 2D representations of 3D objects
- Interpret scale diagrams including commonly used symbols and abbreviations
- Find actual measurements from scale diagrams, such as lengths, perimeters and areas
- Create scale diagrams

How are we ever going to use this?

- Whenever we use shapes or solids in designs
- To know how to make models of 3D objects
- Building, renovating or buying a home
- Working in a building or painting trade

Study Design coverage

UNIT 2, AREA OF STUDY 4: SPACE AND MEASUREMENT

- description, representation and properties of simple and composite shapes and objects
- two-dimensional plans, models and diagrams of objects.

VCE Mathematics Study Design 2023–2027 p. 21, © VCAA 2022

Videos (2):
11.5 Scale drawings • Map scales

Worksheets (11):
11.1 2D shapes
11.2 Sorting solids • 3D solids
11.3 Enlarging a logo
11.4 Sketching solids • Isometric dot paper
11.5 Scaled vs actual size • Scales and scale diagrams • Scale drawings
11.7 Interpreting an office plan
11.8 Problems involving scale drawings
Test yourself Isometric dot paper

Weblink (1):
11.6 SketchUp

Puzzle (1):
11.1 Polygon puzzle

Nelson MindTap

To access resources above, visit **cengage.com.au/nelsonmindtap**

Worksheet
2D shapes

Puzzle
Polygon puzzle

11.1 2D shapes

2D shapes are flat and have two **dimensions**: length and width.

3D shapes are solids and have three dimensions: length, width and depth.

EXERCISE 11.1 2D shapes

ANSWERS p. 428

This exercise can be printed from Nelson MindTap as the worksheet **2D shapes**.

1 Triangles

Use the word list to complete the following paragraphs. You can use words more than once.

You may like to cut out some triangles and use them to help you fill in the blanks.

Alamy/Mediablitzimages

Alamy/DIZ München GmbH

Shutterstock.com/Arnab Maity

Word list: angle, angles, equilateral, scalene, sides, two.

We name triangles according to the lengths of their _____. A triangle with 3 sides the same length is called an _____ triangle. This triangle also has 3 _____ equal. Each _____ is equal to 60°. An isosceles triangle has _____ sides and _____ angles equal. A _____ triangle has no sides the same length.

Shutterstock.com/Mirek Hejnicki

Shutterstock.com/Alexander Chaikin

Shutterstock.com/jurij

The surface of this side of the pyramid is an equilateral triangle.

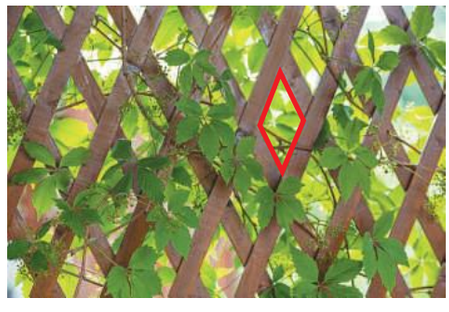
Word list: acute , obtuse, right.

We can also name triangles according to the types of angles in them. A triangle with 3 angles less than 90° is called an _____-angled triangle. A triangle with one angle between 90° and 180° is called an _____-angled triangle. A right-angled triangle has one _____ angle.

2 The parallelogram and rhombus

Use the word list to complete the following paragraphs. You can use words more than once. You may like to cut out a parallelogram and a rhombus and use them to help you fill in the blanks.

Shutterstock.com/Christian Mueller


Shutterstock.com/Pavel L Photo and Video

Word list: bisect, equal, four, opposite, parallel, 90°, rectangle, square.

Each of these shapes has _____ sides. A parallelogram has both pairs of _____ sides equal. Each pair of opposite sides is also _____. The opposite pairs of angles are _____. The diagonals of a parallelogram cut each other in half. We say they _____ each other.

A rhombus has all of the features of a parallelogram. In addition, all 4 sides of the rhombus are _____. This means the diagonals bisect each other at an angle of _____.

A parallelogram looks like a _____ pushed over and the rhombus looks like a _____ pushed over.

3 The rectangle and square

Use the word list to complete the following paragraphs. You can use words more than once.

You may like to cut out a rectangle and a square and use them to help you fill in the blanks.

Shutterstock.com/Buro Pavel

Shutterstock.com/fad82

Word list: diagonals, equal, parallelogram, rectangle, 90°

A rectangle has all the features of a _____. However in a rectangle all the angles are _____ and the diagonals are _____ lengths.

A square has all the features of a _____. In addition, the sides are all _____. The angles are all _____. The _____ are the same length.

4 The trapezium and kite

Use the word list to complete the following paragraphs. You can use words more than once.

Shutterstock.com/Rtimages

Shutterstock.com/Hurst Photo

Word list: diagonals, equal, parallel, quadrilateral, 90°.

Any shape with four sides is called a _____. The trapezium is a **quadrilateral** with one pair of opposite sides _____. A kite is a bit different. The 'top' pair of sides is _____ and the 'bottom' pair of sides is also _____. The angles at the 'sides' are _____. The _____ intersect at an angle of _____.

5 Polygons

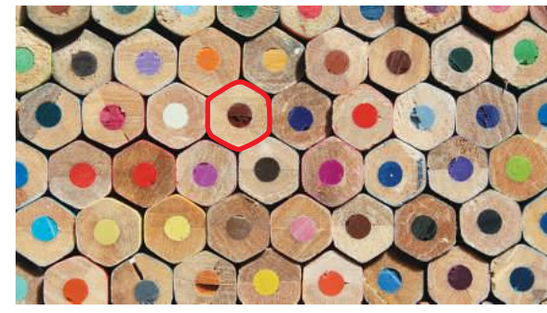
Use the word list to complete the following paragraphs. You can use words more than once.

Shutterstock.com/Tony Magdaraog

Shutterstock.com/irin-k

Shutterstock.com/koosen

AAP Image/www.spaceimaging.com


Shutterstock.com/Luma creative

Word list: decagon, hexagon, number, octagon, pentagon, quadrilaterals, regular.

A **polygon** is a shape with straight sides. We use the _____ of sides they have to name each polygon. We have already looked at triangles and _____ in detail. The table lists the names of the polygons with more than 4 sides.

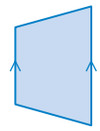
When all the sides of a polygon are equal, it is called a _____ polygon. The equilateral triangle and the square are _____ polygons.

Name	Number of sides
	5
	6
Heptagon	7
	8
Nonagon	9
	10
Undecagon	11
Dodecagon	12

A **rhombus** has 4 equal sides but not 4 equal angles, so it is **not** a **regular polygon**.

6 Name each shape.

a



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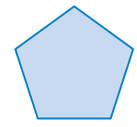

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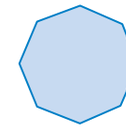

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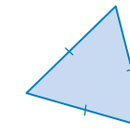

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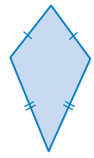

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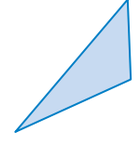

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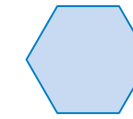

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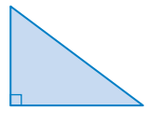

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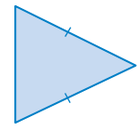

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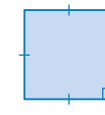

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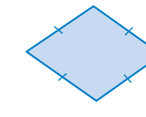


7 Is each statement TRUE or FALSE?

- **a** An isosceles triangle must be acute-angled.
- **b** A square is a regular quadrilateral.
- **c** An obtuse-angled triangle must also have acute angles.
- **d** A rhombus is a special parallelogram.
- **e** An acute-angled triangle cannot be isosceles.
- **f** A rectangle is a special trapezium.
- **g** An equilateral triangle must be acute-angled.
- **h** A trapezium must have 2 equal sides.

Investigation Road signs

Road signs in Australia are based on a number of geometrical shapes. Use the internet to research the following questions. **Google Images** may be helpful.

1 A regular octagon is used for only one sign. What sign is it? Draw or copy an example.

2 What signs use an equilateral triangle? Draw or copy an example.

3 Many signs are rectangular. Name some of the signs that use rectangles and draw or copy some examples.

4 Warning signs are usually black on yellow. Why are those colours used? What shape are they? Draw or copy an example.

5 Some signs have this shape. What sort of shape is it? Draw or copy an example.

Present your findings using a video or presentation software.

Worksheets
Sorting solids
3D solids

11.2 3D solids

We live in a three-dimensional world surrounded by 3D solids: buildings, cars, supermarket packages.

EXERCISE 11.2 3D solids

ANSWERS p. 428

This exercise can be downloaded and printed as the worksheet **3D solids**.

Use the word list to complete each paragraph.

1 Polyhedrons

iStock.com/vuduchild

Alamy Photo Stock/Dorling Kindersley/Steve Gorton

Word list

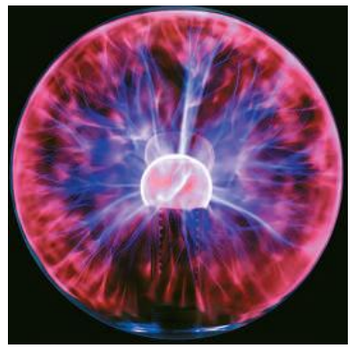
edge	flat	hexahedron	pentahedron
prism	pyramid	rectangular	vertex

Solids can have flat faces and curved faces. Solids that only have _____ faces are called **polyhedrons**. Some of the common polyhedrons are the _____ prism, the triangular _____ and the square _____. Polyhedrons have similar names to polygons. We call a solid with 5 faces a _____. A solid with 6 faces is called a _____. When the faces of a polyhedron, meet they form an _____. When 3 or more edges meet, they form a _____.

2 Solids with curved surfaces

iStock.com/enviromantic

Alamy Stock Photo/David Moore


Shutterstock.com/WhiteRabbit83

Word list

circle	cone	curved
flat	rectangle	sphere

Some solids are not polyhedrons because they have _____ faces. A solid that has only one curved face is the _____. The cylinder has 2 _____ faces and one _____ face. When we flatten the curved face, it is a _____. A _____ has one flat face and one curved face. When we flatten the curved section, it is a sector of a _____.

3 Copy and complete this table.

Solid	Number of faces	Shapes of faces	Number of identical faces
cube			
cylinder			
square pyramid			
triangular prism			
rectangular prism			
cone			
triangular pyramid			

4 Prisms and pyramids

Prisms and pyramids are special types of polyhedrons.

Dreamstime.com/Paop

iStock.com/falun

Shutterstock.com/Tobias Arhelger

Word list

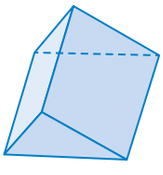
bottom	cross-section	end
pointed	rectangle	shape
size	square	triangle

A **prism** has the same _____ from one end to the other. Both ends are the same _____. Prisms take their names from the shape at each _____. A rectangular prism has a _____ at each end and a triangular prism has a _____ at each end.

A **pyramid** has a _____ top, called the apex. The shape at the _____ of the pyramid gives the pyramid its name. A square pyramid has a _____ at the bottom. A pyramid's _____ is NOT the same from the bottom to the top. Each cross-section is the same shape, but not the same _____.

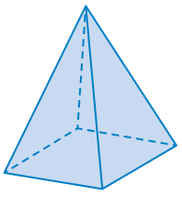
5 Name each solid.

a



b

c



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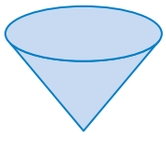

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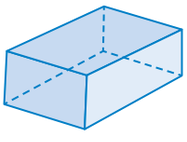

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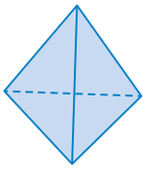

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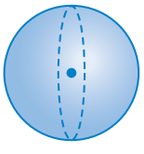

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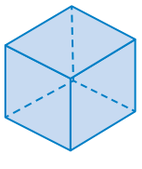


6 Name the solid shape shown in each picture.

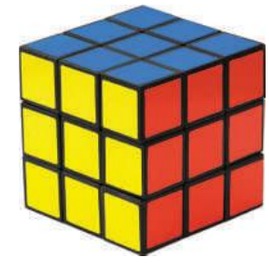
a

Alamy Stock Photo/Martin Lee

b

Shutterstock.com/M. Unal Ozmen

c



Shutterstock.com/PeterVrabel

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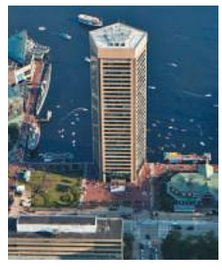
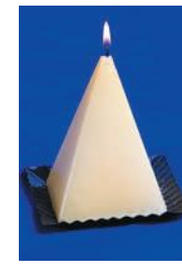


Getty Images/Greg Pease

e

Shutterstock.com/Sujin Saensing

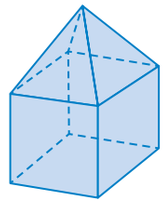
f



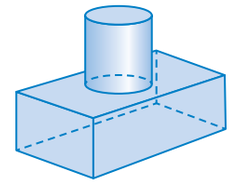
Shutterstock.com/PaterG

7 Each **composite** solid below is made up of 2 basic solids. Name the 2 solids that have been combined.

a



b



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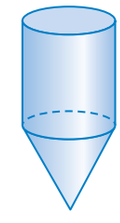

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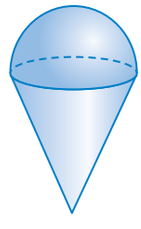

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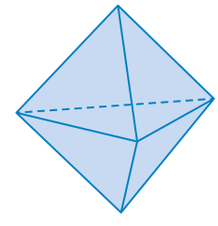

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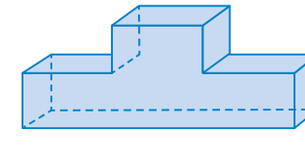


8 Is each statement TRUE or FALSE?

a A triangular prism has a triangle for its cross-section.

b A cylinder is a polyhedron.

c A rectangular prism is a hexahedron.

d A cone has 2 faces.

e A cube and a square pyramid each has 6 faces.

f A pyramid has the same cross-section from bottom to top.

Investigation Stacking and packaging

1. Look around your classroom. Why are bricks the shape of rectangular prisms? Why are most classrooms in the shape of a rectangular prism? What shape are most books? Why do you think this is?
2. Imagine you are in a supermarket. What solids are used for packaging? Why do you think manufacturers use different shapes? How are items stacked on the shelves? What part does packaging play in this?
3. Research the solid shape bees use to make a beehive and why they use it.
4. Find other 3D structures in your environment. What solid shapes have been used? Why might this be so? If you can't think of any, use the internet to find some examples of different structures.

Shutterstock.com/StudioSmart

Worksheet
Enlarging a logo

11.3 Designing a logo

Geometric designs are all around us. You can see logos in the design of packaging and marketing of products that you buy. Logos often use simple 2D and 3D shapes to create recognisable images that represent a business or organisation.

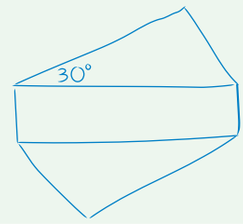
Alamy/Peter Lane

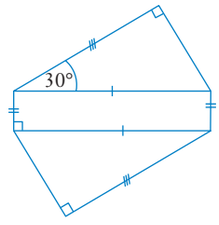
Alamy/Mark Richardson

Alamy/Kevin Foy

EXAMPLE 1

Chloe works for a design company. When she produces a design for a logo, she does a rough sketch first. Draw this design accurately.



Steps	Working
This logo is made up of a rectangle and two identical right-angled triangles. Draw the rectangle first.	
Draw 2 triangles with a 30° angle and a right angle.	

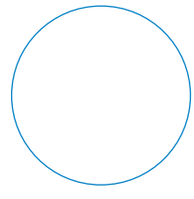
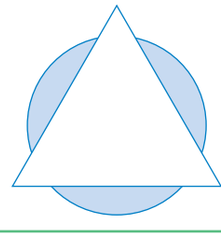
EXAMPLE 2

Sometimes, Chloe writes down a description of the design and other people are responsible for drawing it. This can be done by hand or by using drawing software.

Chloe described the design for a new logo as follows:
'The logo is a circle overlaid by an equilateral triangle. The vertices of the triangle are outside the circle and the segments of the circle outside the triangle are shaded'.

'Overlaid' means the triangle is 'on top' of the circle.

Draw this logo.

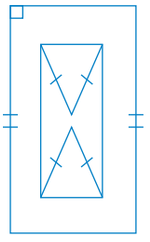
Steps	Working
Draw the circle first.	
Add the equilateral triangle and shade the segments of the circle outside the triangle.	

EXERCISE 11.3 Designing a logo

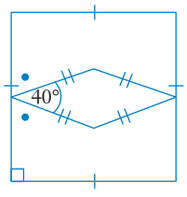
ANSWERS p. 428

1 EXAMPLE 1 Draw each design accurately, using a ruler and protractor or using technology.

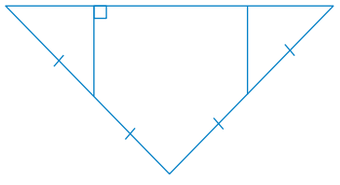
a In the large rectangle, the length is twice the width.
In the small rectangle, the width is half the width of the large rectangle.



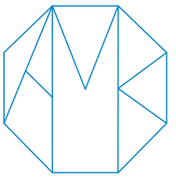
b



c



d

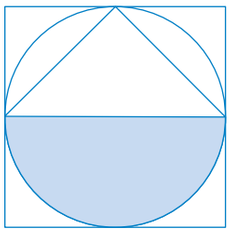


All sides of the octagon are equal

2 Design your own logo. Make a rough sketch first, then an accurate sketch.

Write your own initials somewhere in the logo.

3



Use the word list to complete the description of this bank logo.

Word list: circle, circumference, diameter, four, isosceles, semicircle, square, vertex.

The perimeter of the logo is a square. Inside the _____ there is a large circle whose _____ touches each of the _____ sides of the square. The lower _____ is shaded blue. There is an _____ triangle in the top semicircle. Two vertices of the triangle are on either ends of the _____ and the third _____ is on the circumference of the _____.

4 EXAMPLE 2 Read each description of a logo, then draw the logo.

a The vertices of an equilateral triangle are on the circumference of a circle. The segments between the triangle and the circle are shaded.

b The 4 vertices of a square are on the circumference of a circle. Both diagonals of the square have been drawn. Two of the 4 identical triangles have been shaded.

c A regular hexagon has 2 equilateral triangles inside it. One vertex of each triangle is at the centre of the hexagon and the triangles are opposite each other. One triangle has the letter R in it and the other has the letter M in it.

d A rectangle contains the letters B and B, back-to-back.

5 Choose three logos of well-known companies or products. What shapes are they based on? Write a description of them. Share your descriptions with your friends and see if they can guess what logos you have chosen.

11.4 Sketching solids

Solid shapes can be difficult to draw when you are completing design work. This exercise will give you some ideas to help you sketch common solids more easily and to give the solid the correct perspective.

EXERCISE 11.4 Sketching solids

ANSWERS p. 428

1 Copy each diagram on isometric dot paper. You can download and print the worksheet **Isometric dot paper** from Nelson MindTap.

a

b

c

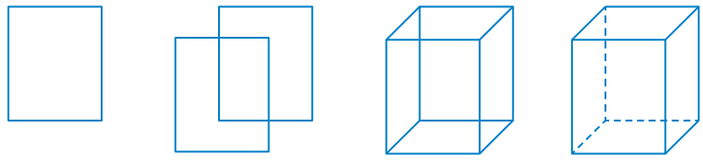
d

e

f

This solid might look like it has errors, but it is drawn correctly.

2 Sketch a rectangular prism using these diagrams and instructions.



a Draw a rectangle that will be the front face of the prism.

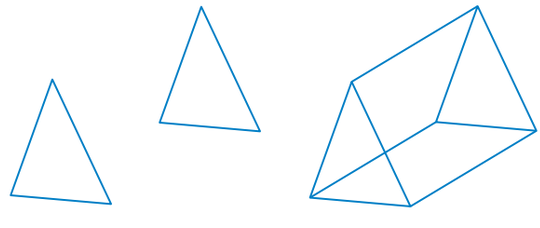
b Draw another rectangle the same size, but position it slightly above and to the right of the first rectangle.

c Join the matching vertices (corners).

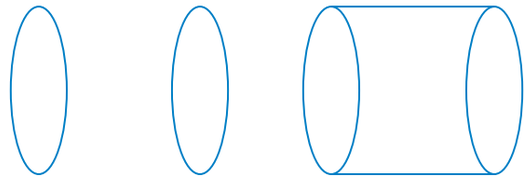
d Make the outside edges of the prism darker and use lighter or dotted lines for the inside edges.

3 Draw each solid using the method shown in question **2**.

a triangular prism



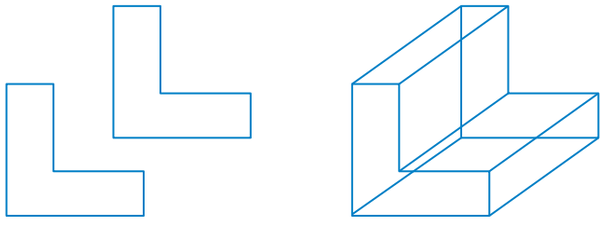
b cylinder



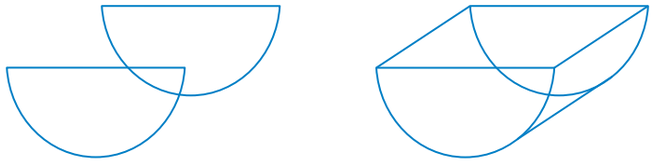
Worksheets
Sketching solids

Isometric dot paper

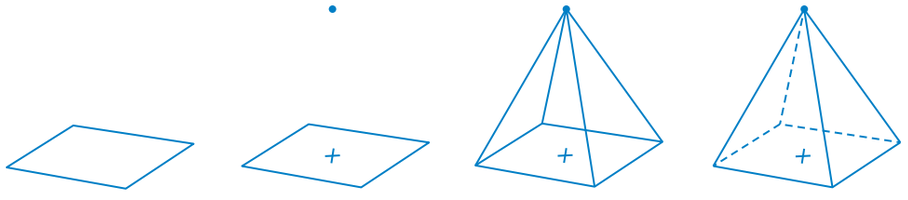
c an L-shaped prism



d half-cylinder



4 Sketch a rectangular pyramid using these diagrams and instructions.



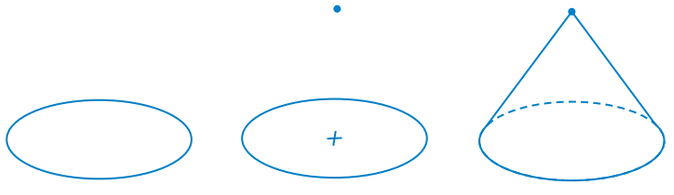
a Draw a parallelogram for the rectangular base.

b Determine the centre of the parallelogram (where the diagonals cross) and place a dot above this position: this dot will be the top of the pyramid.

c Join the 4 vertices of the parallelogram to the dot.

d Make the outside edges of the pyramid darker and the inside edges lighter or dotted.

5 Sketch a cone using these diagrams and instructions.



a Draw an oval for the circular base.

b Draw a dot above the centre of the oval.

c Join the dot to the oval.

11.5 Scale diagrams

A **scale diagram** is a reduced or enlarged image of a real object. The most common scale diagrams are maps and house plans. By taking measurements on the scale diagram, we can calculate the size of objects in real life using the **scale** on the diagram.

Scale diagrams

To calculate a real length on a scale diagram:

- measure the scaled length on the scale diagram
- multiply by the scale factor
- convert your answer to the required units if necessary

Scales on a diagram are most commonly given as a statement, such as '1 cm represents 5 m', or as a ratio, such as '1 : 500'.

Videos
Scale drawings
Map scales

Worksheets
Scaled vs actual size
Scales and scale diagrams
Scale drawings

EXAMPLE 3

Keiran is using a map with the scale: 1 cm represents 2 km.

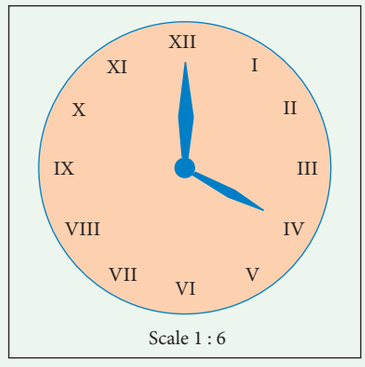
a How far would he have to walk if the distance on the map is 6 cm?

b Keiran is planning a 25 km hike with friends. How far is this on the map?

Steps	Working
a Multiply the scaled distance by the scale factor. Scaled distance is 6 cm.	real distance = 6 × 2 km = 12 km Keiran would have to walk 12 km.
b To calculate a scaled (map) distance, DIVIDE the actual distance (25 km) by the scale.	scaled distance = 25 ÷ 2 = 12.5 cm 25 km is 12.5 cm on the map.

EXAMPLE 4

This diagram of a square clock is drawn to a scale of 1 : 6. Measure its length and calculate its actual length.



Scale 1 : 6

Steps	Working
Measure the scaled length on the diagram.	scaled length = 5 cm
Multiply by the scale.	actual length = 5 × 6 cm = 30 cm

EXERCISE 11.5 Scale diagrams

ANSWERS p. 428

1 EXAMPLE 3 On a map with the scale '1 cm represents 100 km', the Nile River in Egypt is 67 cm long. How long is the Nile River in real life?

2 A street map uses a scale of '1 cm represents 200 m'.

Remember: 1 km = 1000 m
Check your units!

a Find the actual distance, in kilometres, represented by each scaled distance.

i 7 cm **ii** 9.5 cm **iii** 12.4 cm

b Find the scaled distance, in centimetres, used to represent each actual distance.

i 7 km **ii** 1500 m **iii** 3.3 km

3 Lord Howe Island is 10.8 km long. A map of the island has a scale of '1 cm represents 0.5 km'. Calculate the length of the island on the map.

4 A map has a scale of 1 : 50 000. What distance is represented by 64 mm on the map?

5 The town of Hughenden is 216 km north of Winton. On a map with a scale of 1 : 2 600 000, what is the scaled distance between the two towns? Answer to the nearest millimetre.

6 The Dunn family are visiting Victoria and they decide to stay in Anglesea for a few days. They have a map of Anglesea with a scale of 1 : 20 000.

a The children decide to walk to the mouth of the river. On the map, the distance from their caravan park to the mouth of the river is 2.2 cm. How far is the walk from the caravan park to the mouth of the river?

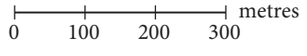
b Dad likes to do a 4 km run each day when he is on holiday. How far is this distance on the map?

c The family drove from the caravan park to Point Roadknight and then to the Golf Club for dinner. After dinner they drove back to the caravan park. This distance is 50.3 cm on the map. How far did they drive? Round your answer to the nearest 100 m.

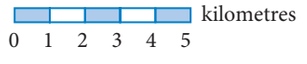
d Mum and Dad decided to walk to the end of the beach and back while the children played in the sand. Their GPS showed they had walked 2.7 km in total. How long is the beach on the map?

7 For each map scale below, what length does 1 cm represent? Write each map scale as a ratio.

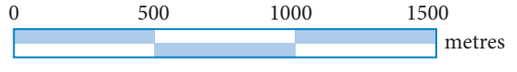
a



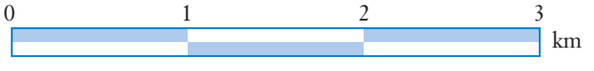
b



c

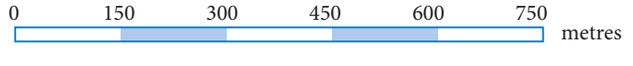


d



e

f



9780170448123

8 Measure the length of each scale diagram, then use the scale to calculate its actual length.

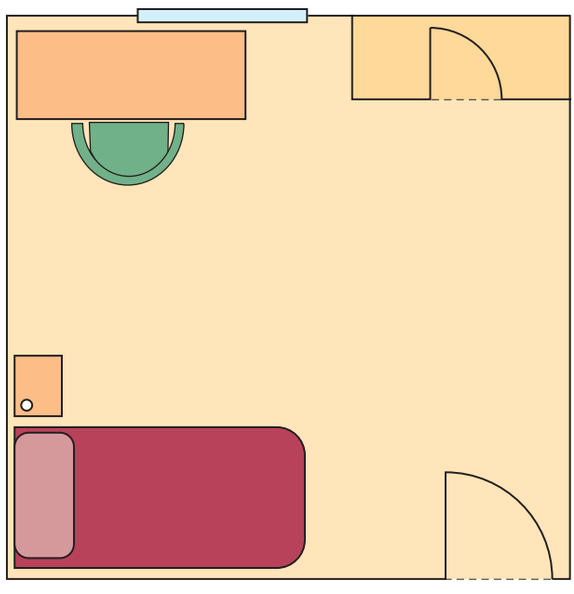
a Scale: 1 cm represents 0.7 m

Shutterstock.com/tamaguramo

b Scale: 1 : 24

Shutterstock.com/AlexMaster

9 EXAMPLE 4 This is a scale plan of a bedroom.



Scale 1 : 50

By measurement and calculation, find the actual:

a length of the bedroom

b width of the doorway (of the bedroom)

c length of the bed

d length of the window

e length of the table

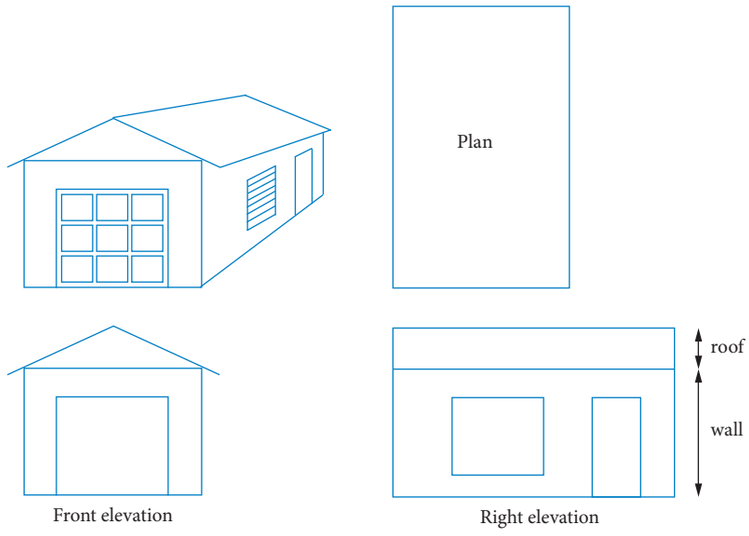
f width of the bed.

11.6 House plans and elevations

A draftsperson drawing a design for a new building includes different views of the building, such as:

- a **plan**: a diagram of the floor
- the **elevation views:** views of the front, back, left side and right side of the building.

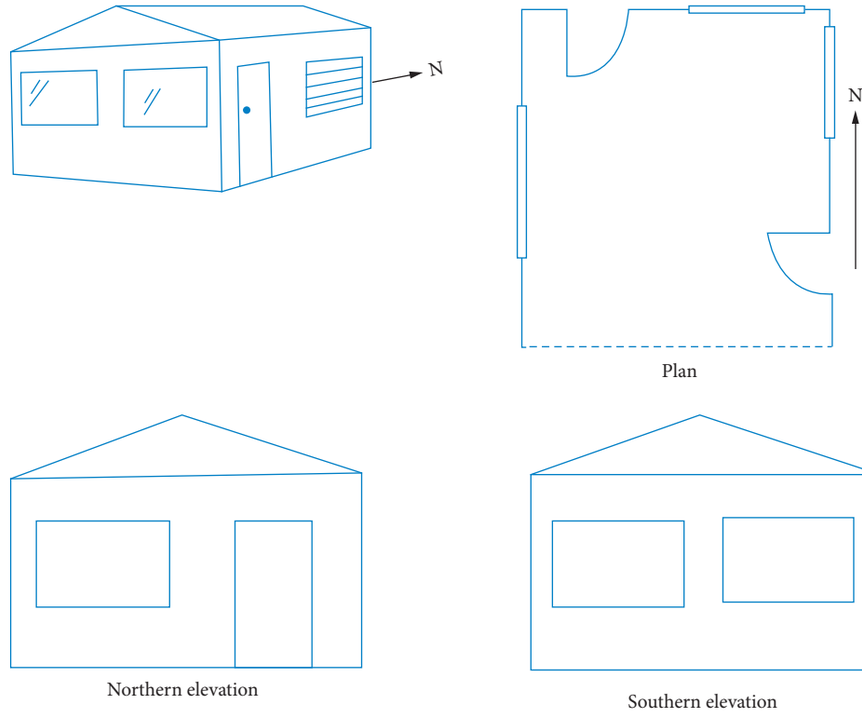
These diagrams show a garage with the front and right-side elevation and the view from above (plan):



EXERCISE 11.6 House plans and elevations

ANSWERS p. 428

1 The plan and two elevations for Erik's work shed are shown below.



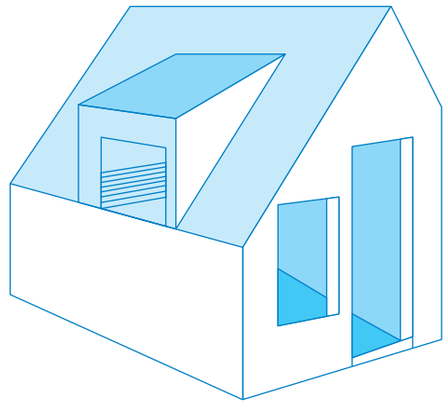
a The plan is incomplete where the dotted line is shown. Copy and complete the plan.

b Draw the eastern and western elevations.

The southern elevation is the view from the southern side.

2 For the house shown, sketch the front and side elevations.

You do not need to draw the elevations to scale, but use a ruler and be as accurate as you can.

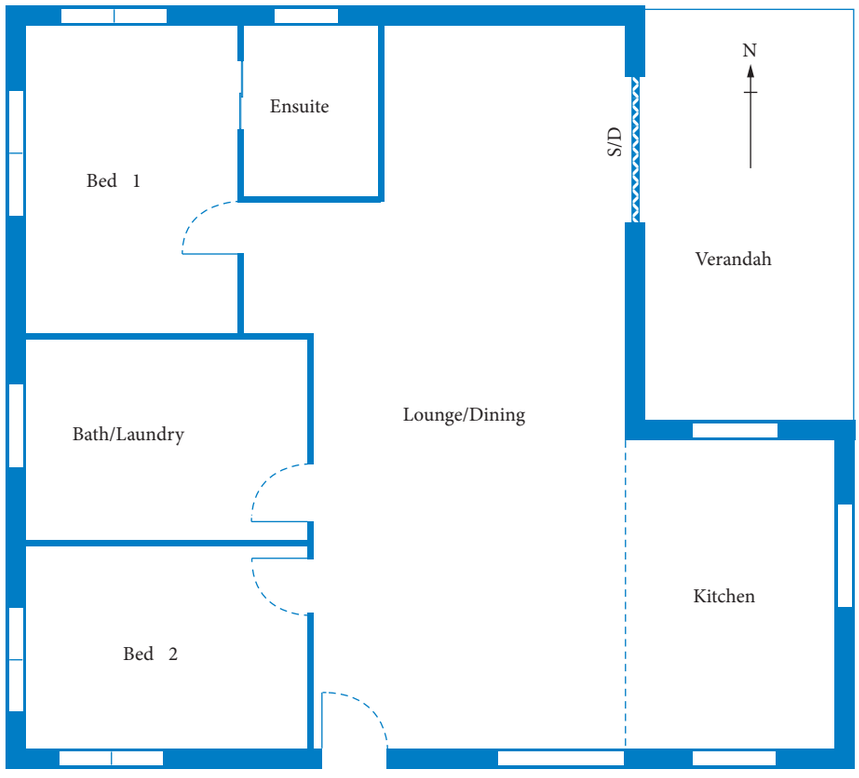


3 For the house shown, sketch the front and possible side elevations.

You do not need to draw them to scale, but use a ruler and be as accurate as you can.

Shutterstock.com/Ewelina Wachala

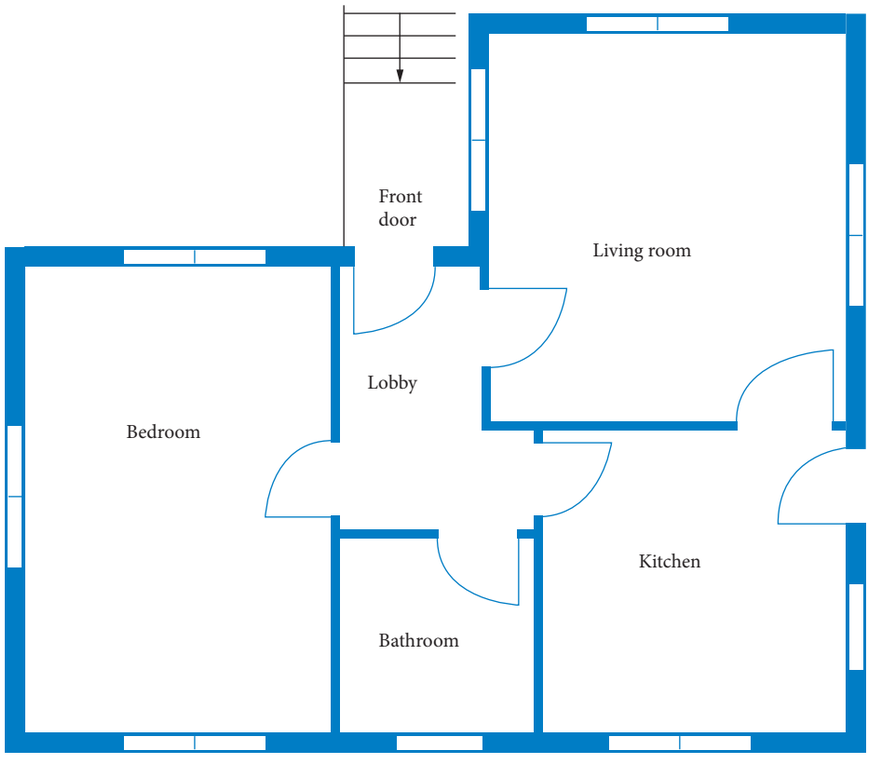
4 This is the plan of Grigor and Silvana's holiday house.



Sketch the northern and western elevations.

5 This is the plan for a one-bedroom apartment whose front door faces north.

Draw elevation views of each side of the apartment. Remember to write the direction of each elevation.



Weblink
SketchUp

Investigation Design your own building

In this investigation, you are going to use 3D modelling software to design a building. You can use SketchUp or any other software. A free version of SketchUp, called **SketchUp Make,** can be downloaded from www.sketchup.com. You can find tutorials on the internet to learn how to use SketchUp.

Part A

- Design a simple building. It can be a small house, a cubby or a shed. Design a floor plan, the elevations and the 3D version.
- Place the building on a block of land with a driveway leading to the building. Include an L-shaped swimming pool or a cylindrical water tank on the block.
- Add plants and trees to the block.

Part B (optional)

Design a more complex building such as a house or a set of units.

Save both designs.

iStock.com/Jeremy Poland

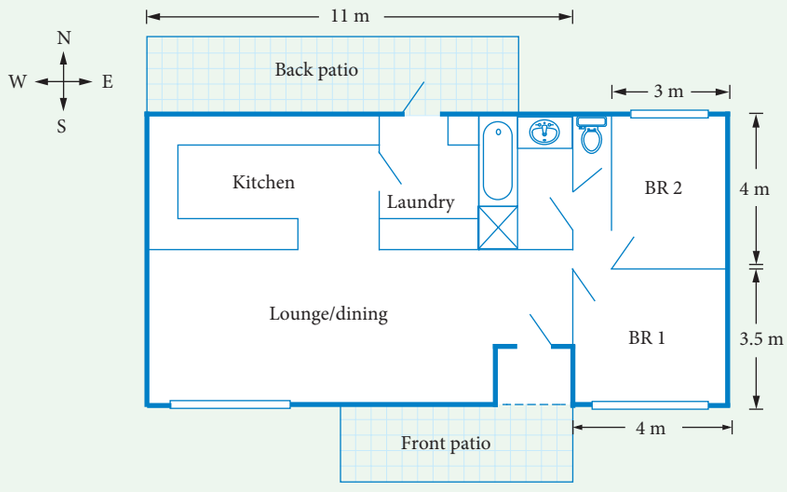
11.7 Reading house plans

Before any house or building can be constructed, a plan must be drawn up to show the builders the layout of the rooms. House plans use many different symbols and abbreviations. They are either drawn to scale or have measurements written on them. Often, measurements are shown in millimetres to avoid the use of decimal points, which can lead to errors in printing and reading.

Worksheet
Interpreting an office plan

EXAMPLE 5

This is the floor plan for Grant's house.



a What are the dimensions of bedroom 1?

b What is the area of bedroom 1?

c What is the length across the front of the house?

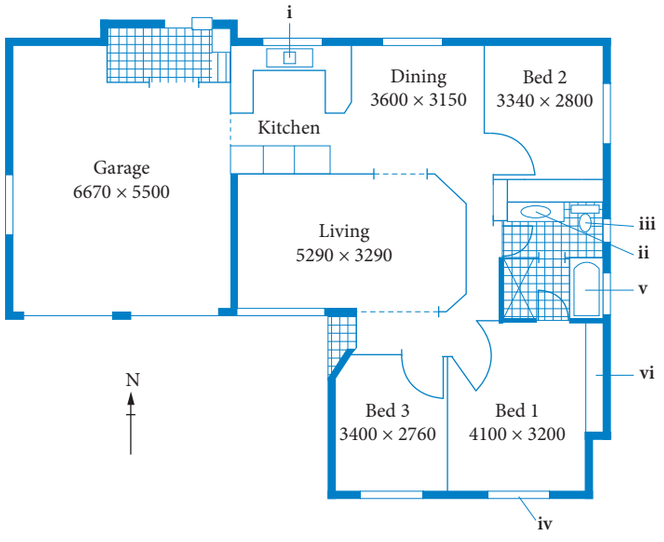
d What is the width of the house, excluding the patios?

Steps	Working
a Find bedroom 1 on the plan. The dimensions are the length and the width.	The dimensions of bedroom 1 are 4 m by 3.5 m.
b area = lw	area = 4×3.5 $= 14\,\text{m}^2$
c Find the full length from the plan.	length = $11 + 4$ $= 15\,\text{m}$
d Find the full width from the plan.	width = $4 + 3.5$ $= 7.5\,\text{m}$

EXERCISE 11.7 Reading house plans

ANSWERS p. 429

1 This is the plan for Menhal's new house.



a What does each symbol used on the plan represent?

i **ii** **iii**

iv **v** **vi**

b Three areas on the plan are shaded with this pattern. What does this mean?

c How many bedrooms does the house have?

d Which bedrooms have built-in wardrobes?

e What are the dimensions of bedroom 1?

f Where is the laundry?

g Where is the back door?

h How many bathrooms does the house have?

i How many toilets are there?

j How many doors lead into the bathroom?

k Which room has dimensions 5.29 m by 3.29 m?

l What are the dimensions of the garage?

m If Menhal looks out of the window of each room mentioned below, in which direction is she facing?

i living room **ii** dining room **iii** bedroom 1

iv bedroom 2 **v** garage

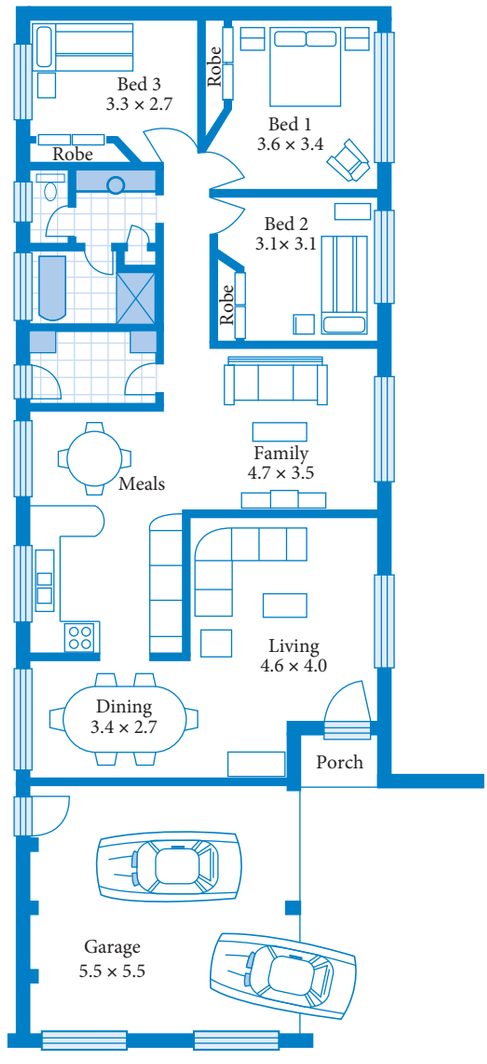
n Which direction do the garage doors face?

o From which room can you see people arriving at the front door?

p If Menhal stands in the front hallway, list the four rooms she can see into.

q If Menhal is working in the kitchen, list the three rooms she can see into.

2 a How many bedrooms does this house have?



b How many of the bedrooms have built-in wardrobes?

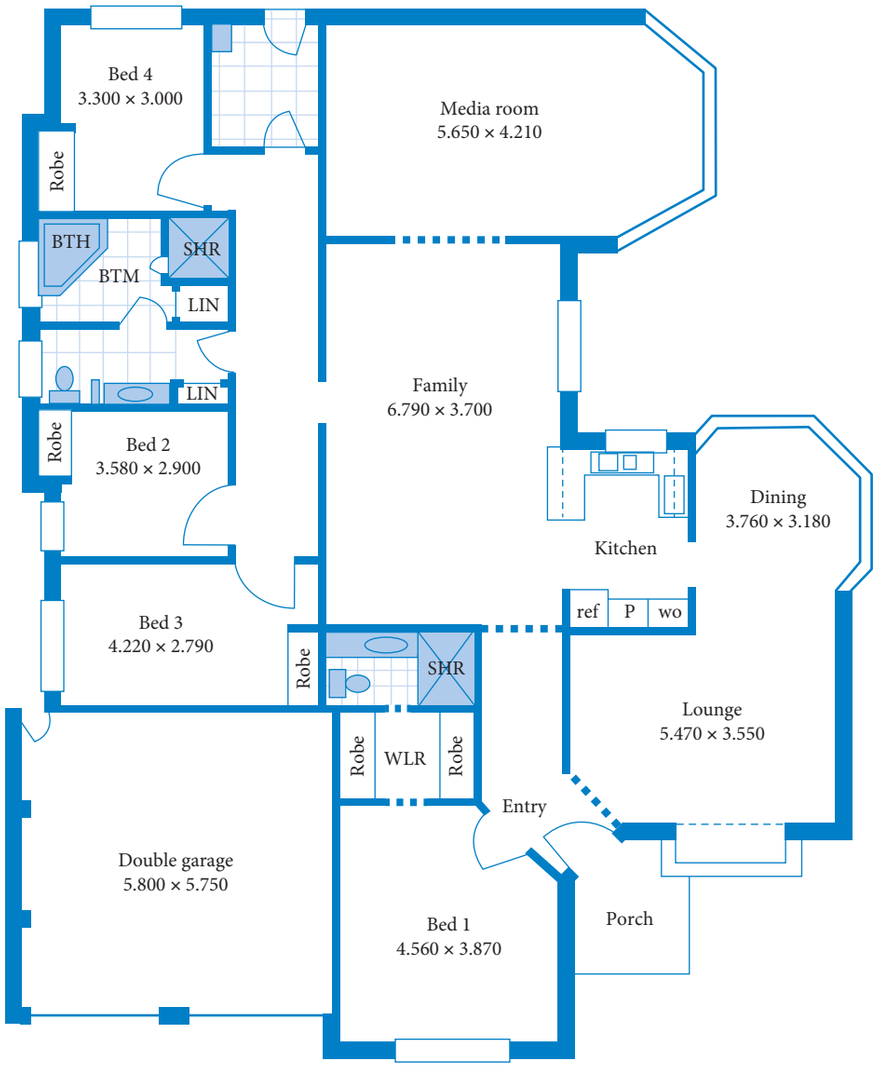
c Is there an ensuite bathroom?

d What are the dimensions of the family room?

e Which bedroom has the largest floor area?

f The floor area of the house is 128 square metres. Calculate the cost of building this house at a rate of $672 per square metre.

3 EXAMPLE 5 All measurements on this plan are in metres.



a What are the dimensions of the family room? Express your answer in mm.

b How many toilets are there?

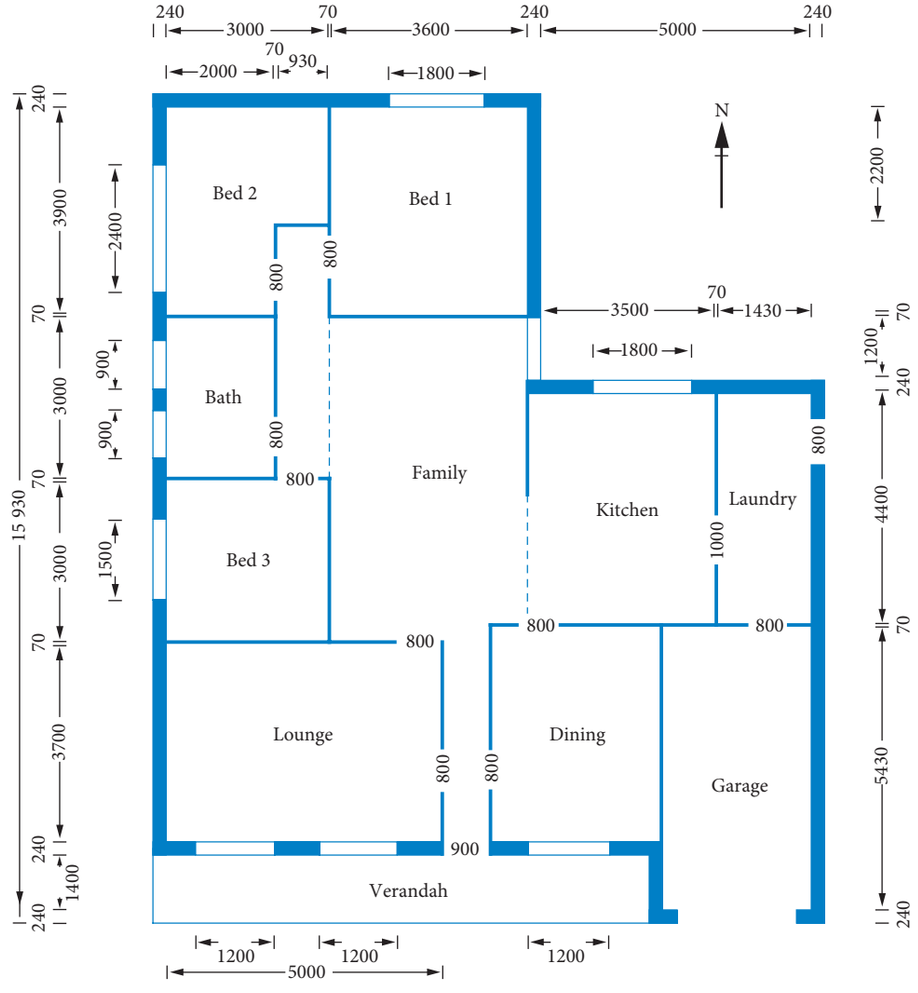
c Where are the two linen cupboards?

d What does 'SHR' stand for?

e Which bedroom has the smallest floor area?

f Which is bigger in area: the family room or the media room? By how many square metres?

4 Judy and Keith are buying a house with this floor plan.



a What is the thickness of the external walls of this house in mm?

b What is the thickness of the internal walls?

c What is the width of the house at the front, in metres?

d What is the length of the left side of the house?

e What are the dimensions of the lounge room?

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Worksheet
Problems involving scale drawings

11.8 Drawing scale diagrams

To make a scale diagram, start by drawing a rough sketch with the required measurements. Then choose a scale and draw the diagram accurately.

Lengths on scale diagrams

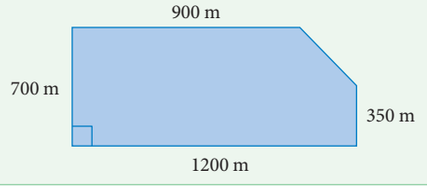
To calculate a scaled length, divide the actual length by the scale.

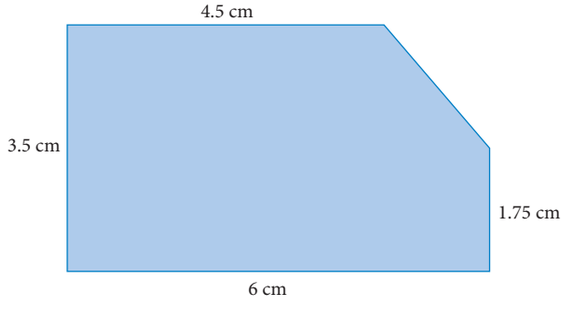
EXAMPLE 6

This is a sketch of Farmer Freda's field.

a Construct a scale diagram of the field.

b What is the length of the unknown side of the field?



Steps	Working
a Choose a suitable scale: we want it to fit easily on the page.	Use the scale: 1 cm represents 200 m.
Calculate the scaled length for each measurement by dividing by the scale.	900 ÷ 200 = 4.5 cm 700 ÷ 200 = 3.5 cm 1200 ÷ 200 = 6 cm 350 ÷ 200 = 1.75 cm
Use these measurements to draw your scale diagram.	
b Measure the unknown length on the scale diagram and multiply by the scale.	measured length = 2.3 cm 2.3 × 200 = 460 m The unknown side is 460 m.

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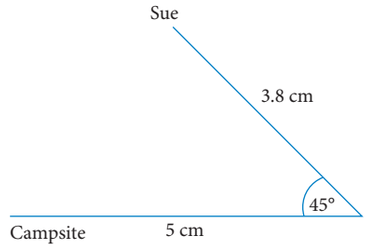
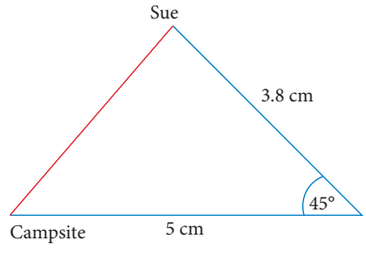
EXAMPLE 7

Sue is going on a bushwalk from her camping site. She walks 2.5 km due east and then 1.9 km due northwest.

a Make a scale diagram of Sue's walk.

b Use the diagram to determine how far Sue is from her campsite.

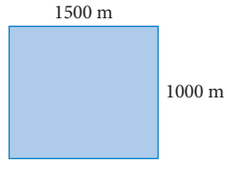
Steps	Working
a Choose a suitable scale.	Use the scale: 1 cm represents 0.5 km.
Find the scaled measurements by dividing by the scale.	2.5 ÷ 0.5 = 5 cm 1.9 ÷ 0.5 = 3.8 cm
Use a ruler and a protractor to construct the scale diagram.	
Northwest is at an angle of 45° (halfway) between west and north.	
b Join the starting point to the finishing point and measure this line.	
	The line is 3.5 cm long.
Find the actual distance by multiplying by the scale.	actual distance = 3.5 × 0.5 = 1.75 km
	Sue is 1.75 km from her campsite.

EXERCISE 11.8 Drawing scale diagrams

ANSWERS p. 429

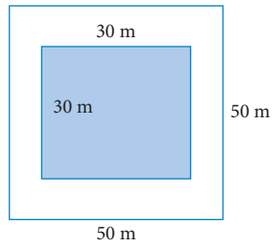
You need a ruler and a protractor to complete this exercise.

1 EXAMPLE 6 Make a scale diagram of this field.

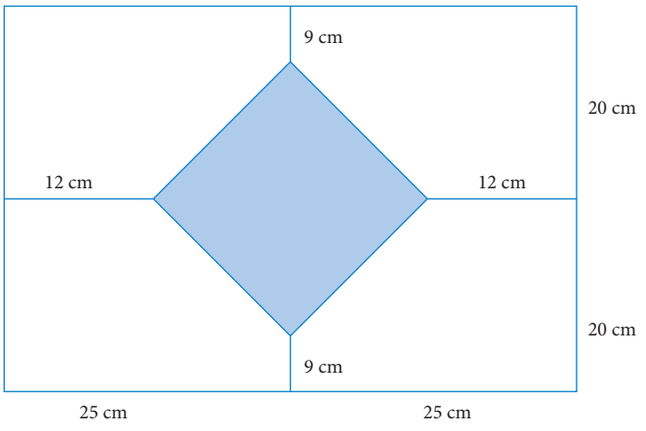


2 Antje drew a diagram of a courtyard.

Make a scale diagram of the courtyard.



3 Samantha designed this cutting plate. Make a scale diagram of her cutting plate.

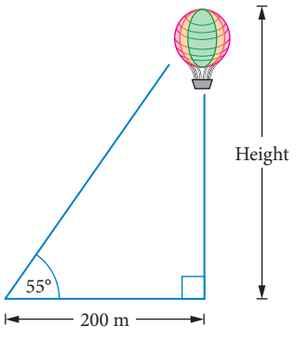


4 EXAMPLE 7 Hamish and Jacob are setting off on a hike. They walk 5 km due west of their starting point and then turn to walk 7 km south. They stop for lunch and then walk another 6 km northeast before stopping for afternoon tea.

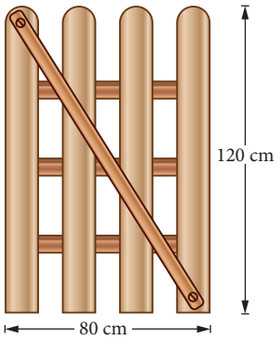
a Make a scale diagram of Hamish and Jacob's walk.

b How far are they from their starting point?

5 Construct a scale diagram to calculate the actual height of the hot air balloon above the ground.



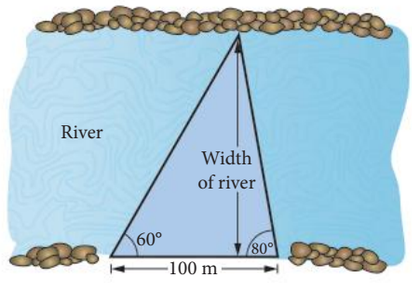
6 An old wooden gate 80 cm wide by 120 cm high needs a diagonal brace for support.



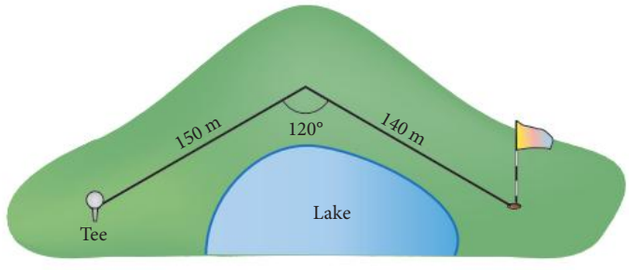
a Construct a scale diagram of the gate and find the actual length of the brace.

b Use Pythagoras' theorem to check the answer you obtained from the scale diagram. Answer correct to 1 decimal place.

7 Jodie wants to swim across the river. Draw this diagram to scale and calculate the width of the river.



8 A golf course has a large lake as an obstacle. Most golfers follow the dog leg around the lake. How far is it straight across the lake, from the tee to the hole? Use a scale diagram to answer this question.



Investigation Make your own scale diagram

Part A: Rectangle

1 Choose something that is a large rectangle, for example, a paved area, a quadrangle, a brick wall, a whiteboard or the classroom floor.

2 Measure the length and width of the rectangle.

3 Make a scale diagram of your rectangle. Be sure to include the scale you used.

Part B: Enlarged area

1 Measure the length and width of the school reception area or foyer.

2 There are plans to enlarge the length and width of this area by 50%. What will be the new dimensions of this area?

3 Draw a scale diagram of the enlarged area. Add the position of furniture and any other items in the school entrance area. Show the scale you used.

Keyword activity

WORD MATCH

ANSWERS p. 429

Match each word in the left column to its correct meaning in the right column.

	WORDS		DEFINITIONS
1	dimensions	**A**	A solid with all flat faces
2	elevation	**B**	Describes an object that has length, width and height
3	house plan	**C**	Represents real objects that are too big to draw with the actual measurements
4	polyhedron	**D**	A 4-sided shape
5	prism	**E**	The relationship between a real object and its scale diagram
6	pyramid	**F**	Icons that illustrate features on a house plan
7	quadrilateral	**G**	A 3-sided shape
8	scale	**H**	The view of a building from the side
9	scale diagram	**I**	Describes an object that has length and width only
10	symbols	**J**	A solid that comes to a point
11	3-dimensional	**K**	The length and width of a room on a plan
12	triangle	**L**	A solid whose cross-section is the same from end to end
13	2-dimensional	**M**	A diagram showing the arrangement and measurement of rooms in a house

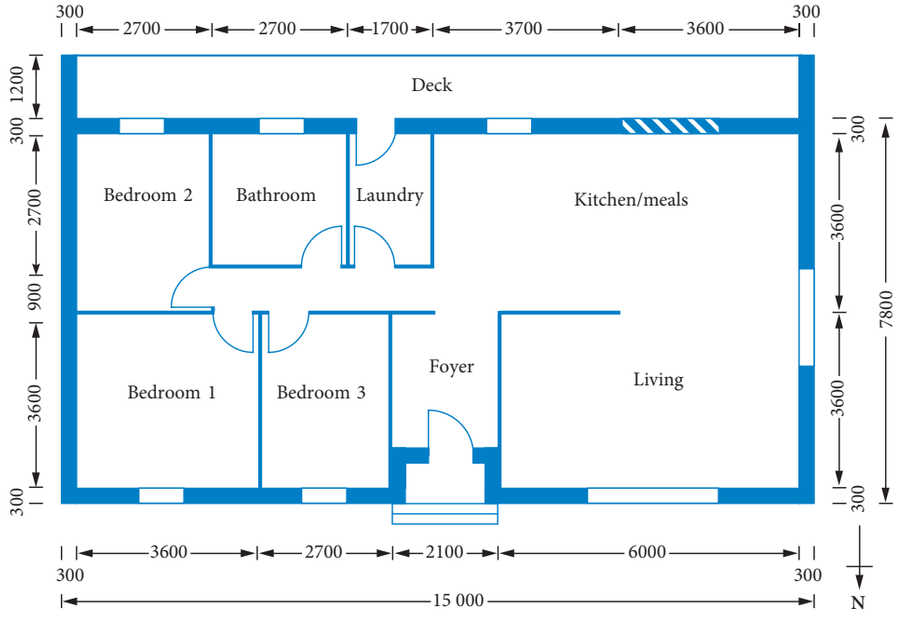
Solution to the chapter problem

Problem

Frankie and Charlie are building a house according to this plan. They need to order tiles for the bathroom and laundry and interior doors.

How many square metres of tile will they need? Answer to the nearest square metre.

How many interior doors will they need to order for all rooms?



Solution

Change the measurements into metres and calculate the areas.

area of bathroom = 2700 mm × 2700 mm
= 2.7 m × 2.7 m
= 7.29 m^2

area of laundry = 1700 mm × 2700 mm
= 1.7 m × 2.7 m
= 4.59 m^2

total area = 7.29 + 4.59
= 11.88 m^2
= 12 m^2 (to the nearest square metre)

Count the interior doors. Do NOT include the front door and the back door.

There are 5 interior doors.

11 Test yourself

Designs and plans

ANSWERS p. 429

1 EXERCISE 11.1 Draw a neat sketch of each 2D shape.

a A triangle that is right-angled and isosceles

b A hexagon

c A quadrilateral with four right angles

d A triangle that is scalene and obtuse-angled

e A quadrilateral whose diagonals cross at right angles

f An octagon

2 EXERCISE 11.1 What polygon am I? There may be more than one answer.

a I have 3 sides and all of my angles are equal.

b I am a quadrilateral with both pairs of opposite sides parallel.

c I have 5 sides.

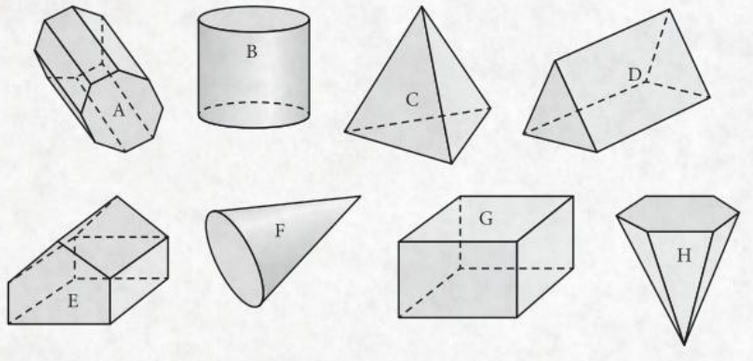
d I have 4 sides and my diagonals bisect one another.

e I am a quadrilateral with one pair of parallel sides.

f I have 3 sides. My angles are 60°, 80° and 40°.

3 EXERCISE 11.2 Which of these solids are:

a prisms? **b** pyramids? **c** solids with curved faces?



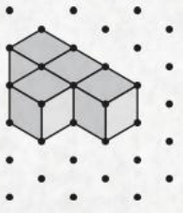
4 EXERCISE 11.3 Draw the logo described as follows.

The logo is a square. One diagonal is drawn. From one end of the diagonal, lines are drawn to the midpoint of the opposite two sides. Add your initials in 2 of the triangles formed.

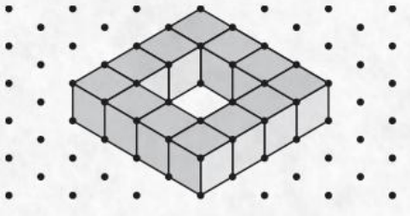
5 EXERCISE 11.4 Copy each diagram on isometric dot paper.

Worksheet
Isometric dot paper

a



b



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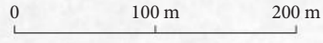
6 EXERCISE 11.4 Draw each solid using the method shown in Exercise **11.4**.

a rectangular prism **b** cylinder

7 EXERCISE 11.5 Measure the marked height of the house in the photograph and work out the actual height of the house. Scale: 1 cm represents 2.5 m.

Shutterstock.com/karamysh

8 EXERCISE 11.5 On a map of central Melbourne, the scale is 

a Write this scale as a simplified ratio.

b Find the actual distance between the following places given the scaled distance.

i Parliament House to the Royal Exhibition Building (4.8 cm)

ii Flinders St Station to the Melbourne Cricket Ground (11.3 cm)

c Find the scaled distance between the following places given the actual distance.

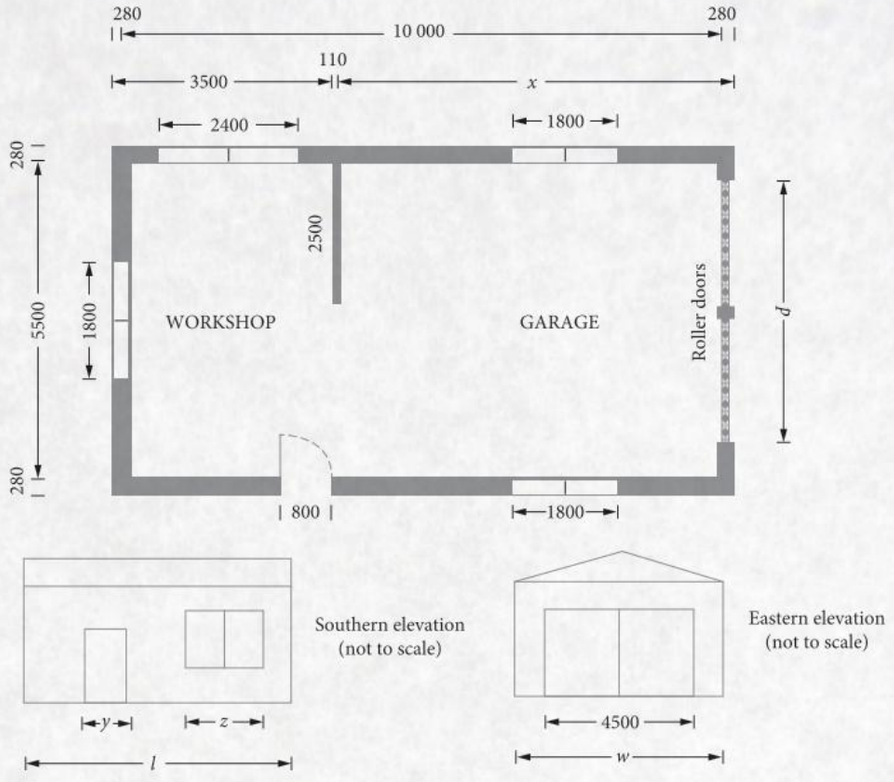
i National Gallery of Victoria to the Shrine of Remembrance (830 m)

ii Flagstaff Gardens to the Queen Victoria Market (305 m)

d The length of the Central Melbourne 'square' on the map measures 36.5 cm.

How long is this square?

9 EXERCISE 11.6 This is the plan for a workshop and garage. Measurements are in millimetres.



a Draw elevation views of the northern and western sides of the building. You do not need to draw them to scale, but use a ruler and be as accurate as you can.

b What is the length of x on the plan?

c Find the length of y, z, l, w and d.

d What is the width of the external walls of the building?

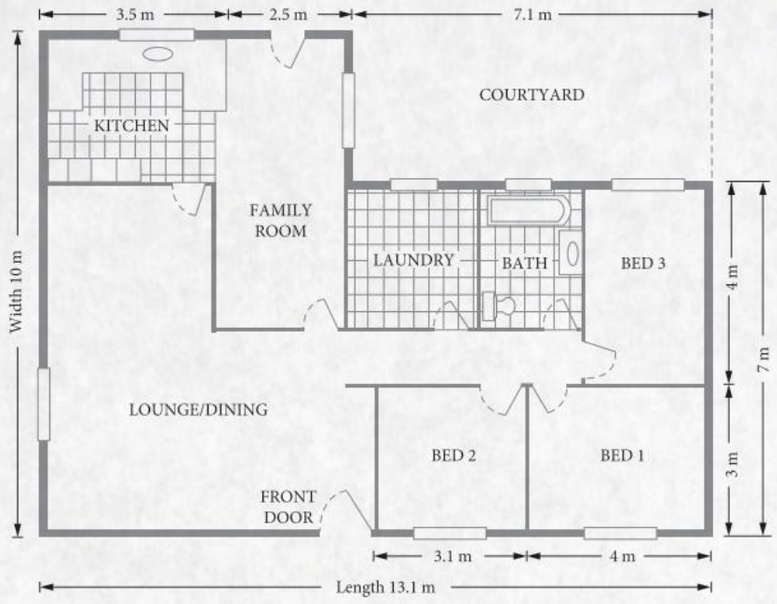
e What is the width of the wall between the workshop and the garage?

f Find the internal width of the building.

g What are the dimensions of the workshop?

h What are the dimensions of the garage?

10 EXERCISE 11.7 This is the plan for the house that Sam and Nic are buying.



a How many doors are shown on this plan?

b What are the dimensions of the house?

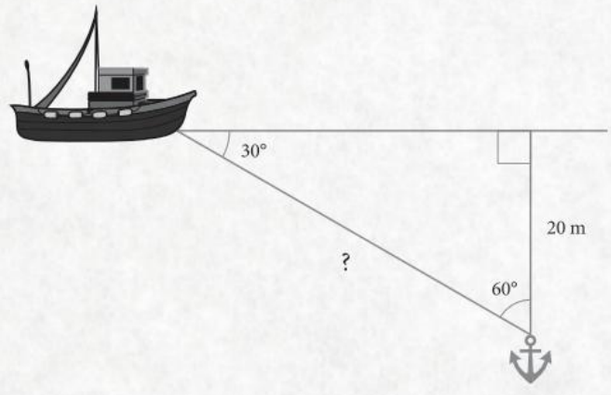
c Calculate the width of the kitchen.

d **i** Find the floor area of the house.

ii An estimate for the cost to build a house is \$1065/m^2. Estimate the cost of building this house to the nearest dollar.

e What rooms have tiled floors?

11 EXERCISE 11.8 Neil and Ted are keen scuba divers. When they moor their boat, the angle between the anchor rope and the top of the water is 30°. Construct a scale diagram to calculate the required length of anchor rope if the water is 20 m deep.



Chapter problem

Kai buys petrol a few times every week. He's noticed that the price varies quite a bit. At some service stations the price can be more than 30c/L more expensive than at others. How can he determine whether the price for petrol in his area is reasonable?

CHAPTER 12

DISCRETE MATHEMATICS: FINANCIAL AND CONSUMER MATHEMATICS

SPENDING AND BORROWING MONEY

12.1 Unit pricing
12.2 Comparing prices
Extended investigation: Comparing home contents insurance
Extended investigation: Local petrol prices
12.3 Buying a car
12.4 Budgeting
Extended investigation: My budget
12.5 Government allowances and pensions
12.6 Loans and interest rates
12.7 The cost of living
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Determine the cheapest way to buy items
- Use websites and calculations to compare prices with different providers
- Construct personal budgets
- Investigate government financial support
- Make interest calculations for loans

How are we ever going to use this?

- Manage our money effectively
- Avoid paying too much
- Knowing what financial support is available from the government if we need it
- Apply plans for a secure financial future

Study Design coverage

UNIT 2, AREA OF STUDY 3: DISCRETE MATHEMATICS

Financial and consumer mathematics

- products and services such as comparison of health products, informed spending choices, decision making according to criteria
- managing money: earning and spending, life-stage financial planning, servicing of current and future commitments such as HECS-HELP debt, child-care support and other benefits
- local, community and national financial and economic data and trends over time (national/community/local) such as CPI, interest rates, wages and house prices.

VCE Mathematics Study Design 2023–2027 p. 21, © VCAA 2022

Video (1):
12.1 Unit pricing

Worksheets (3):
12.4 Budget scenarios • Budget grid • My budget

Weblinks (8):
12.2 RACV fuel prices
12.3 VicRoads
12.4 My Future • Australian Tax Office
12.5 Services Australia • Centrelink
12.6 MoneySmart
12.7 Inflation calculator

Puzzle (1):
12.1 Best buys puzzle

Nelson MindTap

To access resources above, visit
cengage.com.au/nelsonmindtap

Puzzle
Best buys puzzle

12.1 Unit pricing

Profile

Shutterstock.com/Odua Images

Jonah – Supermarket manager

When I was growing up, there was never much money in my family. If I wanted money, I had to work for it and I had lots of part-time jobs.
When I was in Year 9, I got a part-time job stacking shelves in a supermarket after hours. Because the manager was impressed with my work ethic and reliability, the company offered me a management trainee position when I finished Year 12. Now I'm a supermarket manager and 'unit pricing' is one of my responsibilities.

The government requires supermarkets to display the unit price for all items.

The unit price makes comparing the prices of different-sized packaging easy.

The **unit price** is the price for a fixed quantity such as a 1 kilogram or 1 metre. We calculate the unit cost so we can compare the prices of goods that are sold in different quantities.

EXAMPLE 1

Jonah is calculating the unit price per metre for rolls of paper towels. He has 15 m rolls for $1.65 each and 20 m rolls at $2.40 per roll.

a Calculate the unit price per metre for each roll.

b Which roll is the better value for money?

Steps	Working
a For the 15 m roll, calculate the cost of 1 metre by dividing by 15.	For the 15 m roll: unit price = $1.65 ÷ 15 = $0.11/m
For the 20 m roll, calculate the cost of 1 metre by dividing by 20.	For the 20 m roll: unit price = $2.40 ÷ 20 = $0.12/m
b The better price is the lower unit price.	The 15 m roll is the better value.

Shutterstock.com/Odua Images

EXAMPLE 2

The same brand of cooking oil is available in 2 sizes of bottle:
500 mL for $4.75 and 750 mL for $6.45.

a Calculate the unit price for each bottle, using 100 mL as the unit.

b Which size of bottle gives the better value?

A 'unit' varies depending on the items being compared. It can be any convenient unit, for example, 100 g, 1 L, 100 mL or 1 m.

Video
Unit pricing

Steps	Working
a Calculate the price for 100 mL for each bottle.	
For the 500 mL bottle, divide by 5 to get 100 mL.	For the 500 mL bottle: unit price = $4.75 ÷ 5 = $0.95 / 100 mL
For the 750 mL bottle, divide by 7.5 to get 100 mL.	For the 750 mL bottle: unit price = $6.45 ÷ 7.5 = $0.86 / 100 mL
b The smaller unit price is the better value.	The 750 mL bottle is the better value.

EXERCISE 12.1 Unit pricing

ANSWERS p. 429

1 EXAMPLE 1 Calculate the price of 1 metre of wallpaper on each size roll.

a 5 m for $11.50 **b** 10 m for $22.00 **c** 20 m for $45.00

2 The same seafood sauce is available in 50 mL bottles for $3.60 or 80 mL bottles for $5.60.

a For each size of bottle, calculate the price per 10 mL.

b Which size bottle is the better value?

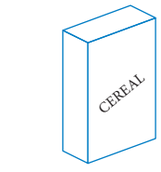
3 A box containing 1 dozen eggs costs $4.80 and a box containing 6 eggs is $2.10.

a Calculate the price per egg in each box.

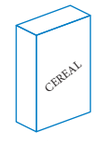
b Which size box is the better value?

c Damien is buying 18 eggs. What is the cheapest way for him to do it?

4 In supermarkets, the selling price and unit price of each item is shown on the shelves.



450 g for $4.49
Unit price $1.00 per 100 g



350 g for $3.00
Unit price $0.86 per 100 g

330 g for $4.25
Unit price $1.29 per 100 g

Which size packet is the best value for money? Justify your answer.

5 Rice is available in 3 sizes:

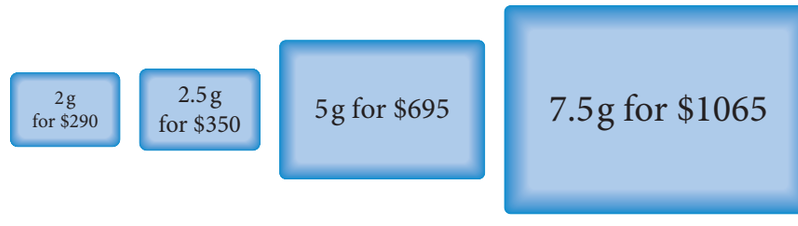
1 kg for $3.50 2 kg $8.00 5 kg for $17.99

a What would be a sensible unit to use for a price comparison?

b Determine which size is the best value.

6 EXAMPLE 2 The yellow spice, saffron, is the world's most expensive spice. The price of 1 gram of saffron is 3 times the price of 1 gram of 24 carat gold.

Carmen is ordering some saffron online and there are 4 available sizes:



a Calculate the unit (1 gram) price for each size.

b Carmen is going to order 7.5 grams. What is the cheapest way for her to do it?

7 Breakfast biscuit cereal VicBix are on special because the 'Best before' date is only 2 weeks away. A box containing 24 biscuits is priced at $4.56 and a box containing 48 biscuits is $8.64.

Mae likes to have one biscuit for breakfast on most days. Which size box do you recommend she buy?

8 Shampoo is available in 2 sizes of bottle:

- 750 mL for $8.95
- 1 L for $11.50

Which size bottle is the better value? Justify your answer.

12.2 Comparing prices

Today's market contains a wide variety of choices of brands, with companies supplying similar products from car and health insurance, through electricity, gas and petrol, to financial products such as investment and loan accounts. Wise consumers check the deals available before they decide.

Profile

Shutterstock.com/Rawpixel.com

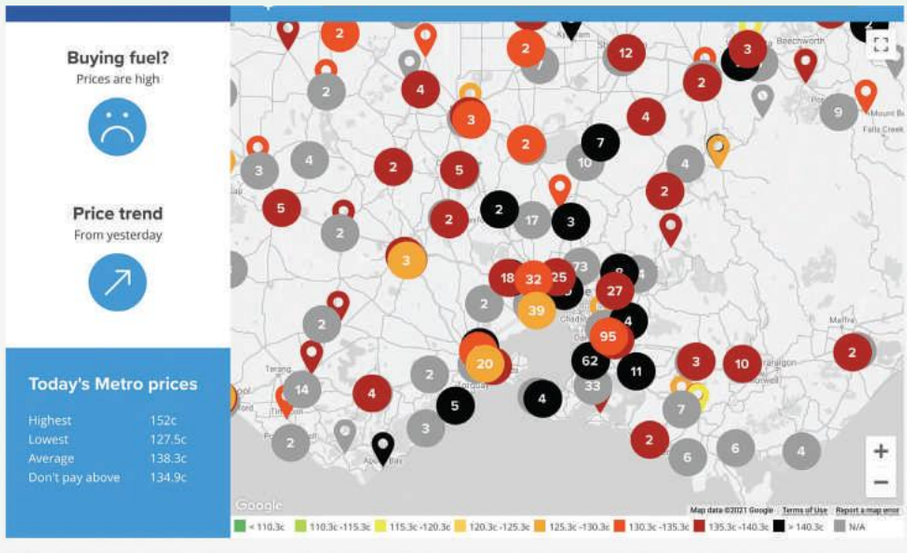
Mackenzie – Beautician and hairdresser

Just before the pandemic hit, I finished my apprenticeship in beauty and hair. The salon where I was working closed so I decided to set up a mobile service to visit clients at their homes. Petrol is a major cost in my business and it's essential for me to keep track of petrol prices. I've noticed a price variation of up to 30c/litre in the areas where my clients live.

EXAMPLE 3

On average, Mackenzie buys 85 L of petrol each week for her business.

The RACV website has a page that shows today's petrol prices in different areas. Here is a screenshot for Victoria one day.



Source: www.racv.com.au/on-the-road/driving-maintenance/fuel-prices.html

a Are today's prices higher or lower than yesterday's?

b What is the range in petrol prices today?

c Calculate the maximum and minimum amount Mackenzie can expect to pay for 85 L of petrol.

d Mackenzie works in the Torquay area. How difficult should it be for her to buy the cheapest fuel?

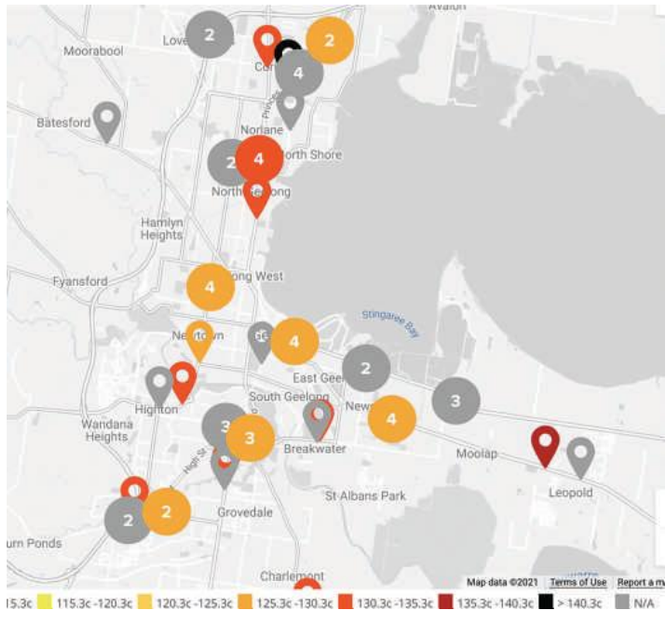
Steps	Working
a Look at the Price trend on the left-hand side. Arrow is pointing up.	Prices are higher than yesterday.
b This information is in Today's Metro prices. range = highest – lowest price	Lowest price is 127.5 c/L. Maximum price is 152 c/L. range = 152 – 127.5 c/L = 24.5 c/L

c Mackenzie is buying 85 L of petrol. Write the prices in dollars then multiply the prices by 85 L.

minimum amount = 85 × $1.275
= $108.38

maximum amount = 85 × $1.52
= $129.20

d Look at the colours of the circles near Torquay. There are 20 sites near Torquay offering petrol in the price range 125.3c to 130.3c. Clicking on the orange circle brings up the addresses of petrol stations in the Torquay area.



Source: www.racv.com.au/on-the-road/driving-maintenance/fuel-prices.html

There are several petrol stations with relatively low prices in the Torquay area. It should be easy for Mackenzie to buy petrol at the lowest price.

EXERCISE 12.2 Comparing prices

ANSWERS p. 429

You need to use the internet to complete this exercise.

Today's Metro prices	
Highest	155.9 c
Lowest	127.5 c
Average	140.0 c
Don't pay above	135.9 c

1 EXAMPLE 3 Owen's petrol tank is empty and he needs to buy 46 L of petrol. He sees this screen when he checks the RACV website:

a Calculate the range in petrol prices today.

b What is the minimum amount he can expect to pay for the tank of fuel?

c What is the maximum amount he can expect to pay?

d What is the range in the total amount Owen will have to pay for the tank of petrol?

2 Dylan bought 52 L of fuel and it cost him $75.40.

a How much did he pay per litre?

b Use the information in Today's Metro prices from question **1** to decide whether he paid a reasonable amount for the fuel.

3 Booko is a website for comparing the cost and availability of books, e-books and DVDs. The following table shows the prices and delivery details for the book *Millionaire Teacher* on the Booko website.

Retailer	Price	Delivery	Availability	Total
AbeBooks	$27.38	$0.90	10 available (United Kingdom)	$28.28
Book Depository	$30.18	$0.00	Available - dispatched from the UK in 3 business days	$30.18
Fishpond	$31.86	$0.00	Delivery Time 10 days.	$31.86
Amazon.com.au	$28.50	$3.90	In stock.	$32.40
Blackwell's	$32.71	$0.00	Usually dispatched within 48 hours	$32.71
Oz Game Shop	$33.99	$1.99	In stock	$35.98
Booktopia	$28.50	$7.95	In Stock. Ships from Australia today or next business day	$36.45
Angus & Robertson	$28.95	$7.95	Sent in 1-2 working days.	$36.90
Mighty Ape AU	$30.99	$5.99	Unknown	$36.98
Zookal	$29.38	$7.95	In stock	$37.33
Better World Books	$37.62	$0.00	79 in stock	$37.62

Jacqui wants to buy the book *Millionaire Teacher* and used the Booko website to compare prices and availability.

Shutterstock.com/fizkes

a What is the book's cheapest price?

b What is the most expensive delivery fee?

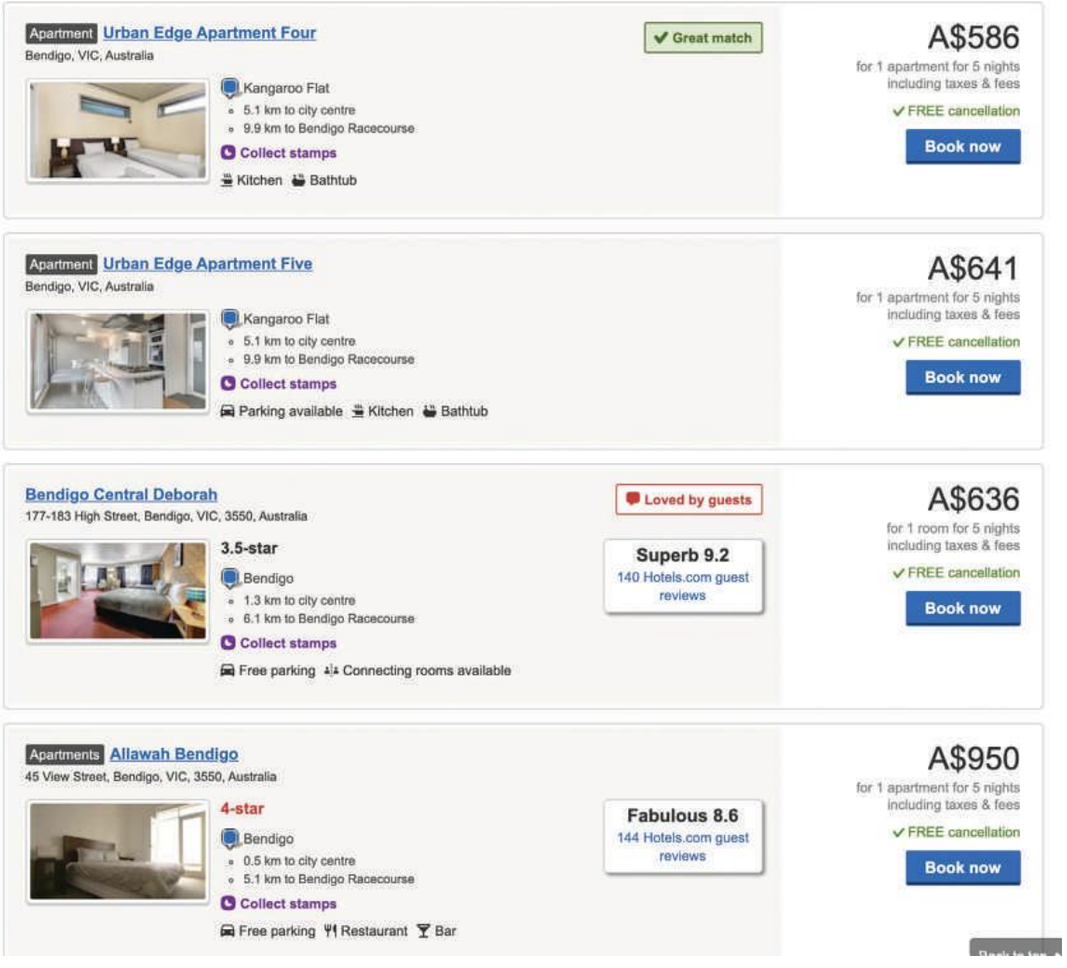
c Calculate the cost of the book, including delivery from *Zookal*.

d How many copies of the book are available at *Better World Books?*

e What is the cheapest way to buy the book?

f Jacqui wants to buy a copy of the book *The Grey Nomad's Ultimate Guide to Australia* for her mother for Mother's Day. Use the Booko website to find how much it will cost and the best place to buy it.

4 Gemma is going to Bendigo for 5 nights. She used a hotel website to find some possible hotels.



a Calculate the rate per night at the Bendigo Central Deborah hotel.

b How far is the Allawah Bendigo from the Bendigo Racecourse?

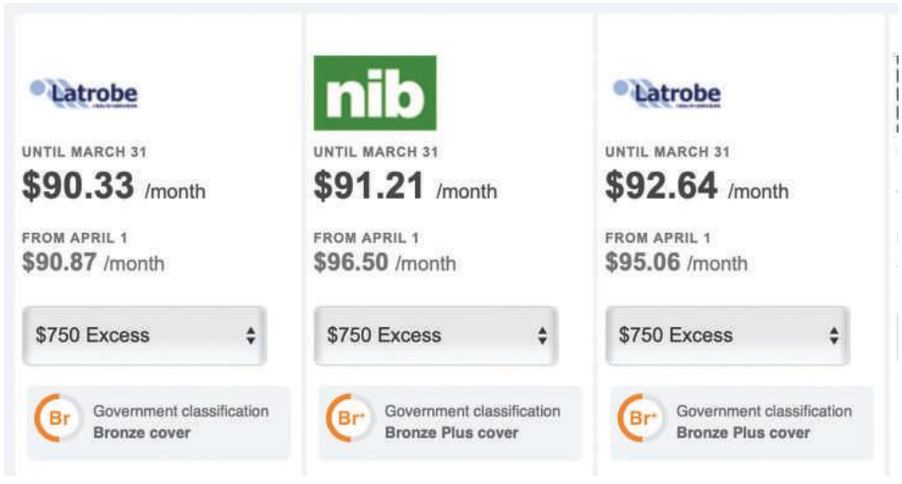
c Which location has a bathtub and parking available?

d At a speed of 3.9 km/h, how long will it take to walk from the Urban Edge apartments to the city centre?

e Gemma wants to book accommodation that is within walking distance of the city centre but isn't too expensive. Which of the 4 hotels would suit her best?

f Use a hotel website to find another suitable hotel for Gemma for 5 nights.

5 Grace is shopping around to make sure she has the best deal for health insurance. This screenshot shows the 3 cheapest options offered on a comparison website.



Source: i-select website

a How much is the excess on these policies?

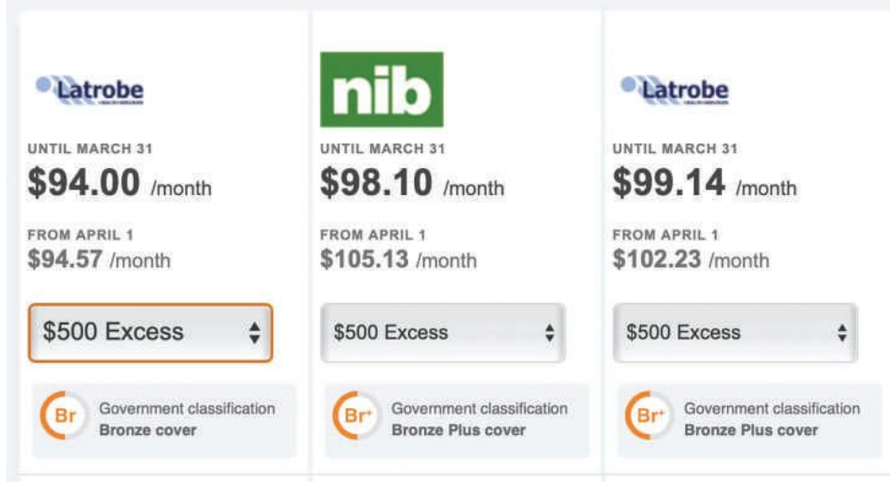
b How is the cover for the 2 Latrobe policies different?

c How much per month will the NIB policy price increase on 1 April?

d How much more will the annual cost of the more expensive Latrobe policy be than the other Latrobe policy after 1 April?

An **excess** is the amount you have to pay first towards your medical bills before the insurance company pays anything. For example, if your excess is $400 and the bill is $750, you have to pay $400 and the insurance company pays the remaining $350.

e Grace changed the excess from $750 to $500 for each policy and the insurance premiums (prices) changed.



Describe the effect that decreasing the excess has on the monthly premiums.

f Grace is looking at the small print for each policy. The ambulance policy is different. The cheaper Latrobe policy only covers 2 ambulance trips annually, but the NIB has unlimited cover plus air ambulance. Grace lives in the country and she does a lot of country driving as part of her work. Which ambulance policy do you think she needs? Justify your answer.

g Grace decided that the NIB policy with a $750 excess is the most suitable for her needs. Use a calculation to show that her weekly budget after 1 April should include $22.27 for her health insurance.

6 Jonathan is considering changing his electricity provider and he has obtained the following information.

Item	Current provider	New provider	Quantity last bill
Supply charge	\$0.95 per day	\$0.91	92 days
Electricity consumption	\$0.33 per kWh	\$0.31	645 kWh
Solar buyback	\$0.105	\$0.20	1 815 kWh

a Copy and complete the table below to allow you to compare the total bill for each provider. Remember, solar buyback is a refund not a charge! The first cell has been completed as an example.

Item	Current provider	New provider
Supply charge	\$0.95 × 92 = \$87.40	**i**
Electricity consumption	**ii**	**iii**
Solar buy back	**iv**	**v**
Total bill	**vi**	**vii**

A **supply charge** is a daily amount for having electricity available at the property.

b If you were Jonathan, would you change to the new provider? Why or why not?

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Extended investigation — Comparing home contents insurance

Moving out of home is a big step and requires careful planning. Finding somewhere to live is the first step but there are other important considerations, such as contents insurance.

Contents insurance covers the cost of the items inside your house if they are damaged by an unforeseen event, such as a fire, or stolen in a burglary.

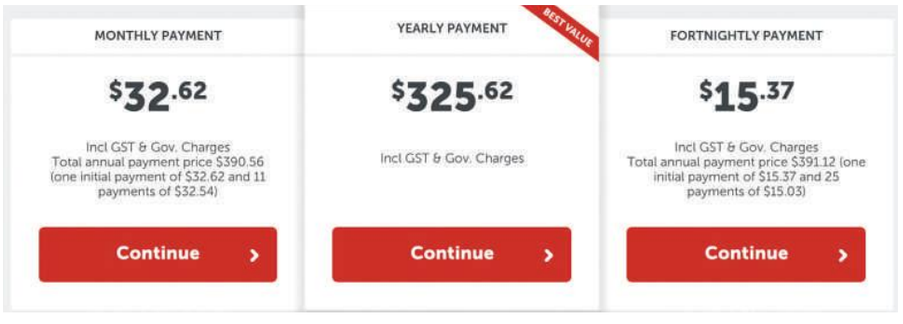
Before you can get a quote for contents insurance you need to know the value of your contents. Fortunately, there are plenty of websites that will do this for you.

- Search for a home contents insurance comparison website.
- Choose a location, enter the address, then ask the website to calculate the value of the house contents. Make sure you write this amount down.
- Now go back and change the type of property. What affect does this have on the cost of insurance?
- Go back to the original property type and change the occupancy from owner to tenant. Describe the effect.
- Change the number and type of occupants. What type of occupants have the highest- valued contents?
- Use the website to determine the value of the contents you could have when you first leave home and live in a rented property. Record this value, you'll need it in the following section.

Write a short summary of what you've discovered.

Visit an insurance website that offers home contents insurance to **get a quick quote online**.

- You'll need an address for your rented property. You may need to make an educated guess at some of the information you'll be asked to provide. Get a quote displayed on the screen. It will look something like this:



- Calculate the annual cost of making monthly and fortnightly payments. How much cheaper is it to pay yearly?
- Try changing the excess. What happens to the insurance cost as you increase the excess? Is the opposite true for decreasing the excess?
- If you're planning to leave home, how much should you budget for contents insurance each week?

Extended investigation Local petrol prices

- Locate approximately 6 petrol stations in your local area from the RACV website. Choose 2 in each of the categories: Highest (black), Lowest (orange) and Average (Red).
- Record the RACV cost of fuel each day and the real-life cost at each location each day for 2 weeks. A record sheet like the one below will be useful.

Date	RACV ↗ or ↘	Site 1	Site 2	RACV Price	Site 3	Site 4	RACV Price	Site 5	Site 6	RACV Price

Evaluate your results.

- Was the site always correct about whether the prices were higher or lower than the previous day? If not, on what percentage of days was the direction correct?
- Was the real price of fuel at each location always in the range the website indicated? On what percentage of the days was it correctly indicated?
- Did you notice any patterns in the price changes? Explain.

12.3 Buying a car

Profile

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Isabella – Student

When I was quite young, I decided that I wanted to get a driving licence and buy a car as soon as I could. I got Mum to open a bank account for me and I started saving all my birthday and Christmas money. As soon as I was old enough, I got a part-time job at a fast food restaurant and saved as much as I could from my pay. I also collected bottles and cans and cashed them in at the recycling centre. Now I'm 18 years old, have my Ps and I've just bought my car. It feels great to have achieved my goal.

EXAMPLE 4

Harrison is insuring his new car and has been quoted an annual premium of $1226.50 for comprehensive insurance. He is given a multi-policy discount of 20% as he has a home and contents insurance policy with the same company. How much does he pay for his insurance?

Steps	Working
Calculate the discount and subtract it from the price.	discount = 20% × $1226.50 = $245.30 price paid = $1226.50 – $245.30 = $981.20
OR use 100% – 20% = 80%.	price paid = 80% × $1226.50 = $981.20

EXERCISE 12.3 Buying a car

ANSWERS p. 430

You need internet access for this exercise.

1 Isabella bought her first car for $17 500, which included all on-road costs. She paid $5000 deposit and agreed to pay the balance by direct deposit when she picked up the car. How much will Isabella need to transfer by direct deposit when she picks up the car?

Weblink
VicRoads

2 Usually when a person buys a second-hand car, they have to pay for the registration to be transferred to the new owner's name. Use the **VicRoads** website, vicroads.vic.gov.au, and the section **Buy and transfer a registered vehicle** to determine the total transfer amount for cars with the following value. Enter **No** for all questions except the value of the car.

a $17 500 **b** $34 000 **c** $60 000

3 Each year, cars must be registered before they are allowed to go on public roads. Owners can choose to register their car for 3, 6 or 12 months. The registrations costs for a car located in postcode 3639 are shown below.

3 months $181.50	
Registration Fee	$75.60
TAC charge (inc GST of $8.55)	$94.00
Insurance duty	$9.40
Service Fee	$2.50
Total	**$181.50**

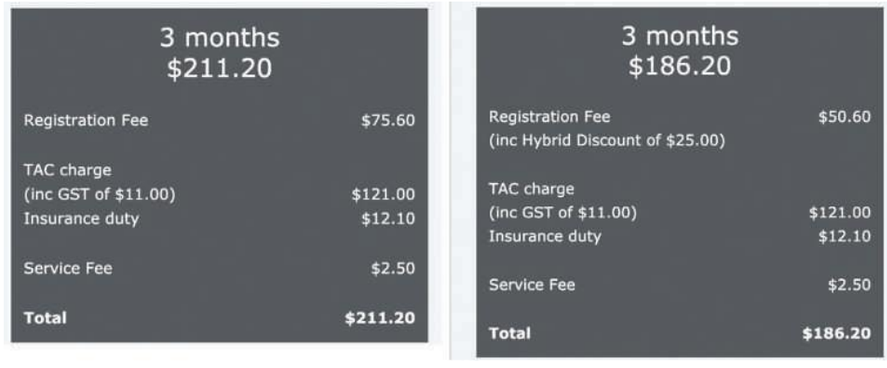
6 months $360.50	
Registration Fee	$151.20
TAC charge (inc GST of $17.09)	$188.00
Insurance duty	$18.80
Service Fee	$2.50
Total	**$360.50**

12 months $716.00	
Registration Fee	$302.40
TAC charge (inc GST of $34.18)	$376.00
Insurance duty	$37.60
Total	**$716.00**

a How much does it cost to register a car in postcode area 3639 (Picola) for 12 months?

b In postcode 3639, how much more does it cost per year to pay in 3-monthly instalments than 6-month instalments?

4 These 2 cars are both registered in postcode 3125 (Burwood) but one is cheaper than the other.



3 months $211.20	
Registration Fee	$75.60
TAC charge (inc GST of $11.00)	$121.00
Insurance duty	$12.10
Service Fee	$2.50
Total	**$211.20**

3 months $186.20	
Registration Fee (inc Hybrid Discount of $25.00)	$50.60
TAC charge (inc GST of $11.00)	$121.00
Insurance duty	$12.10
Service Fee	$2.50
Total	**$186.20**

a Why is the second car cheaper than the first?

b Calculate the percentage discount the cheaper registration receives.

5 The annual registration cost depends on the postcode where the car is garaged and the type of fuel it uses.

Postcode	Petrol motor	Electric or hybrid motor
3003		
3006		
3057		
3775		
3777		
3939		
3440		
3756		
3442		

a Use the **VicRoads** website to complete this table.

b How much cheaper is it to register an electric or hybrid car than a petrol car?

c What percentage discount does an electric and hybrid car get for its registration? Answer for the 3 different price categories, correct to the nearest whole percentage.

d The price of car registration varies depending on the risk of the area where the car is garaged. What areas of Victoria have the most expensive and the cheapest registration costs?

Remember:
Percentage discount
$= \frac{\text{discount}}{\text{full amount}} \times 100$

6 EXAMPLE 4 Mandy's comprehensive car insurance annual premium is $1392. She receives a 10% no-claim discount off this premium. How much does she pay for her insurance?

7 Josh has third-party property insurance on his car as the car is old and only worth $3000. When it is time to renew, the premium is $240.50. Josh is given a 30% no-claim bonus because he has had no claims over the last 5 years. How much will Josh pay?

8 Rachna's renewal premium for her comprehensive car insurance is $1782.50. She is given a multi-policy discount of 10% and a no-claim discount of 40%.

- **a** Calculate Rachna's premium after the multi-policy discount.
- **b** The no-claim discount is calculated on the amount after the multi-policy discount has been deducted. Calculate Rachna's premium after this second discount has been applied.
- **c** Is this equal to a 50% discount? Explain your answer.

9 Owing a car is an expensive business. This table shows Isabella's annual costs.

Item	Amount
Registration	$779.80
Insurance	$785.60
Services (total)	$320
Tyres	$760
Petrol / fortnight	$65

- **a** How much does it cost Isabella annually to run and maintain her car?
- **b** How much should Isabella save per month to cover her car expenses?

Worksheets
Budgeting scenarios
Budgeting grid

12.4 Budgeting

Profile

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Jake – Shopfitter

When I finished my apprenticeship and got my first real job, I felt really rich. I'd never had much money and I started to spend. I moved into a rented apartment, bought new furniture and a new ute on terms. For the first few weeks everything was fine, but then I started running out of money to pay for essentials. Then the electricity bill came and I didn't have the money to pay, so I used my credit card. When I couldn't pay my credit card bill, the penalties and interest charges got out of control. I didn't know what to do, so I contacted the government's National Debt Helpline on 1800 007 007. The counsellor helped me sort out my financial mess.

Have you ever wondered what happens to your money? It's a good idea to have a plan so that you don't waste it. A **budget** lists what you expect to be your income and expenses and can help you to manage your money.

Income covers all the money you might earn.

Expenses cover all the ways you might spend that money, and there are 2 types of expenses:

- **Fixed expenses** are costs that are essential and must be paid. Some are the same amount each time, such as rent. Others aren't always the same, such as food.
- **Discretionary expenses** are amounts that you often spend but which aren't essential, such as entertainment or magazines.

A budget needs to balance your income and expenses so that you have enough money for everything you require and maybe have some left over to save for special items, such as a car or holiday.

EXAMPLE 5

Ashleigh works part-time while studying. She receives an allowance from her parents of $100 per week and each week she earns $120 from her job. She pays $80 per week in rent and spends $30 per week on food. She averages $10 per week for her mobile phone and $20 per week on clothes. She divides the remainder equally between entertainment and savings.

a Draw up a budget for Ashleigh for a week.

b Ashleigh's rent is increased by $25 per week. How would she need to adjust her budget for this?

Working

a

Income		Expenses	
Allowance	$100	Rent	$80
Earnings	$120	Food	$30
		Mobile phone	$10
		Clothes	$20
		Entertainment	$40
		Savings	$40
Total income	$220	**Total expenses**	$220

total of fixed expenses = $80 + $30 + $10 + $20 = $140

remainder available for entertainment and savings = $220 – $140 = $80

divided equally = $80 ÷ 2 = $40

b The $25 increase in rent means Ashleigh now has $25 less to spend on entertainment and savings.

$80 – $25 = $55

She has $55 to divide between entertainment and savings. She could still divide this amount equally between the two ($27.50 each) or she could spend less on entertainment to continue to save $40 per week.

EXERCISE 12.4 Budgeting

ANSWERS p. 430

1 EXAMPLE 5 Lily owns a car and has the following expenses each year:

- registration $849
- compulsory third party (CTP) insurance $795
- comprehensive insurance $1110
- maintenance bills of $790.

She spends $53 per week on petrol.

a How much does Lily spend on her car each year?

b How much should she set aside in her weekly budget to cover her car expenses?

2 Mitchell works in an office during the week and behind the bar at a local club on weekends. He earns a net pay of $620 per week from the office job and $215 from his shifts at the club. He pays $280 per week in rent and spends an average of $60 per week on food. His smartphone costs him $20 per week and travel expenses are $60 per week. The remainder of his income has to be divided between entertainment, clothes and savings.

a Create a budget for Mitchell for one week.

b Mitchell is considering buying a car. He would no longer have public transport expenses, but he would need to allow $100 per week to pay off a loan and $75 for expenses. Draw up a new budget for Mitchell.

3 Sanjay is an apprentice mechanic. His take-home pay is $790 per fortnight. This table shows his fortnightly expenses.

a How much does Sanjay save each fortnight?

b Calculate his net annual income.

c How much is Sanjay able to save each year?

Item	Amount
Board	$120
Mobile phone	$21
Clothes	$65
Car	$112
Entertainment	$72
Other expenses	$88
Savings	
Total	**$790**

4 This table shows Katrina's monthly budget. The income is after tax has been deducted.

Income		Expenses	
Part-time job	$290	Clothes	$140
Baby sitting	$130	School needs	$32
		Entertainment	$50
		Mobile phone	$55
		Fares	$23

a Calculate Katrina's monthly income and expenses.

b Calculate the amount she is able to save each year.

c Katrina would like to increase her savings so that she can go on an end-of-year holiday. Suggest 3 ways she could do this.

5 Goran has taken a second job to save up for a new car. His budget for a week is shown below.

Income		Expenses	
Main job	$750	Rent	$225
2nd job		Travel	$56
		Food	$117
		Clothes	$55
		Entertainment	$75
		Bills	$157
		Savings	
Total	**$908**	**Total**	**$908**

a Calculate the amount Goran earns from his second job.

b Calculate how much he can save each week.

c If the car costs $25 000, how long would it take Goran to save this money?

d Suggest ways Goran could save more per week so that he can buy his car sooner. Create a new budget for him.

6 Sarah is starting to use the 50-30-20 budgeting method that a lot of her friends are using successfully:

- 50% for fixed essential expenses like rent, food and utilities like electricity
- 30% for enjoyment and relaxation, for example going out, eating at a café, going to the movies
- 20% for savings

Sarah's take-home pay is $1800 per fortnight.

a Calculate Sarah's fortnightly budget for each category; fixed essentials, enjoyment and relaxation, and savings.

b Last fortnight Sarah only spent $632 on items in the essentials category. What should she do with the remaining money? Why?

c Sarah is saving for a deposit on her own home. Currently she has $36 700 saved and she needs $45 000. How long will it take her to save this amount? Ignore any interest on the savings.

7 Hunter is divorced. The court ordered Hunter to pay his ex-wife child support of $19 200 annually to support their son. Hunter's annual taxable income is $98 700 with a tax liability of $22 642.

Child support calculations can be very involved. We'll explore this topic in Year 12.

a What is Hunter's after-tax weekly pay?

b How much does Hunter pay each week in child support?

c Hunter uses the 50-30-20 budgeting system. Explain why child support fits into the 50% category.

d How much of Hunter's weekly essentials budget remains after he pays child support?

e Hunter's weekly rent is $260 and he budgets $25 weekly to cover utilities. How much of his essentials budget remains for food?

f How could Hunter adjust his weekly budget to allow more for food?

8 The Australian Government provides financial support loans for Australians to study and obtain workforce skills. If you receive one of these loans, you are required to repay it when your income is high enough. This table shows the repayment rates for annual incomes up to $96 396. People with higher incomes pay a higher rate.

Repayment income (RI)	Repayment rate
Below $46 620	Nil
$46 620–$53 826	1.0%
$53 827–$57 055	2.0%
$57 056–$60 479	2.5%
$60 480–$64 108	3.0%
$64 109–$67 954	3.5%
$67 955–$72 031	4.0%
$72 032–$76 354	4.5%
$76 355–$80 935	5.0%
$80 936–$85 792	5.5%
$85 793–$90 939	6.0%
$90 940–$96 396	6.5%

Shutterstock.com/wavebreaker

Student loans are called HELP (Higher Education Loan Program). Previously they were known as HECS (Higher Education Contribution Scheme). The scheme is jointly administered by the Department of Education, Skills and Employment and the Australian Tax Office.

At the end of his university course, Harrison had a $42 500 HELP loan to repay.

a At what income does Harrison have to start repaying the loan?

b Harrison is required to repay 5% of the loan each year. Within what range is Harrison's annual repayment income?

c Calculate the amount he has to repay each year.

d At this rate, how many years will it take him to repay the loan?

9 The maximum HELP loan for high-cost degrees such as medicine and dentistry is $150 000.

Emily is a young doctor, working in a Victorian public hospital earning $81 000 p.a. She has a maximum HELP loan.

a Calculate Emily's annual HELP repayment.

b Assuming Emily's salary stays the same, how long will it take her to repay her HELP loan?

c Emily is required to pay $16 467 income tax on her salary. How much of her income will remain after she pays her tax and HELP repayment?

d Emily keeps her spending within a tight budget. She allocates 50% of her after tax and HELP income for essentials such as rent, food and utilities, 20% for entertainment and 30% for savings. How much does Emily budget for in each of the 3 categories per month?

Extended Investigation My budget

In this investigation you are going to prepare 2 budgets – one for a typical school leaver and one for yourself based on your own choice of job when you leave school.

Part A: Typical school leaver

Income:

- You have finished school.
- After school you enrolled in a TAFE course for a year.
- You are now working and earn $36 040 p.a.
- You don't have a partner or children, but you need to move out of home.
- Your new home will be 4 km from where you work (fast 50-minute walk).

Worksheet
My budget

1 Download the **My budget** worksheet, which contains the **Budget Guidelines** and the **Lifestyle Costs** provided for this activity.

2 Copy and complete this budget form based on the information, or use the worksheet.

Weekly income		$
Gross weekly income	Equals yearly wage ÷ 52	
Deduct tax (weekly)	from table (tax-free threshold, no leave loading)	
Net weekly income		

Regular weekly expenses		$
Housing	Mortgage, rent or share	
Transport	Car running costs, registration, CTP, etc. or train, bike or walking	
Personal spending	Clothing	
	Hair, grooming, cosmetics, etc.	
Food	Groceries, include pet food	
Utilities	Phone connection + landline calls, mobile	
	Electricity, gas	
Total regular expenses		

Discretionary weekly expenses		$
Insurance	Home and/or contents	
Insurance	Car – comprehensive	
Insurance	Health	
Entertainment	Streaming service, books, magazines, music, movies, etc.	
Recreation	Sport, holidays	
Technology	Internet, laptop	
Total discretionary expenses		

	$
Net weekly income	
Total weekly expenses (regular + discretionary)	
BALANCE	

Part B: Your preferred occupation

Now you will repeat the activity in Part **A** but create a budget based on your chosen occupation.

- The aim of a good budget is not simply to maximise savings.
- It is more to do with providing cost amounts that reflect the sort of lifestyle you want and ensuring these are within the income you have at your disposal.
- Your budget costing needs to cover the costs of the essentials of living (for example, regular expenses such as food, shelter).
- For discretionary expenses, weekly amounts should allow you to afford the extra activities you wish to pursue, whether it is entertainment, holidays, fashion or a more expensive car.
- You also need to consider carefully, within your budget, the pros and cons of taking out insurances of various types and explain the decisions you make.
- Consider carefully the advantages and disadvantages of taking out different types of insurance, whether you can afford them and explain the decisions you make.
- Assume you are single and have bought or are renting your new home, located 4 km from where you work (fast 50-minute walk).

1. Write down your preferred occupation and determine the gross wage for that occupation as follows:
   - go to the **My Future** website
   - click on **the facts → occupations,** then find your occupation
   - select **earnings**, then **View text version of earnings**
   - write the **Weekly Income** into your budget.
2. Find the tax to be deducted from gross pay, using ATO *weekly* tax tables. These can be downloaded from the **Australian Tax Office** website under **Business:** www.ato.gov.au/businesses. Use the column for tax-free threshold with no leave loading.
3. Regular income and Weekly expenses (regular) *must* have an amount in the last column.
4. Weekly expenses (discretionary) can be left blank as a means of saving money, but you must explain and justify your decision.
5. For this exercise, you are *not* to make up your own figures; you *must* use the prices listed in the **Budget guidelines** and **Lifestyle costs.**
6. Some of the prices/costs are per week, others are per fortnight, per month, or per year. You must convert *all* amounts to a weekly cost.

For *every cost category* (both regular and discretionary), you will need to show:

- a short explanation of what choice you have made and why
- the calculations/working you have done to arrive at the amount you have used.

Weblinks
My Future

Australian Tax Office

12.5 Government allowances and pensions

The Australian Government provides support through Centrelink to assist Australians in need.

Profile

iStock.com/bowdenimages

Boris – Student

I have to look after my mum because there's just the two of us and she's got bipolar disorder. When she takes her medication she's OK, but I still need to do the shopping, cook our food and do all our housework. It's really hard when I've got assignments and assessments, especially if Mum's unwell. I can't get a job because I have no spare time. Centrelink gives me a carer's pension and a carer's allowance. Mum receives sickness benefits and rent assistance.

Weblink
Services Australia

If you or someone you know is caring for someone, visit **Services Australia**, www.servicesaustralia.gov.au, to access help for carers.

EXAMPLE 6

To receive the age pension, you must be aged 66 or over and pass an income and assets test. Assume that the maximum fortnightly age pension for a single person is $952.70, but for each dollar the person earns over $178 (per fortnight), the pension reduces by 50 cents.

Paul is single, aged 70 and his fortnightly earnings are $326. How much will he receive for his age pension?

Steps	Working
Calculate how much over $178 Paul earns per fortnight.	amount over $178 = $326 – 178 = $148
Multiply by 50c to calculate the pension reduction.	pension reduction = $148 × 0.50 = $74
Calculate Paul's pension.	Paul's pension = $952.70 – $74 = $878.70

EXERCISE 12.5 Government allowances and pensions

ANSWERS p. 430

1 Cameron receives $303.20 per fortnight in youth allowance. He pays his mother $36 per week for board and his fortnightly public transport costs to travel to TAFE are $40. How much of Cameron's youth allowance is left each fortnight after he pays his board and transport expenses?

2 The maximum fortnightly age pension is $952.70 for singles and $718.10 per person for couples. How much less does a couple receive per fortnight than two single people sharing accommodation?

3 Senior healthcare cardholders and people who receive pensions are entitled to a government phone allowance. Every 3 months, they receive $44.60 towards the cost of having a phone. Calculate the annual value of the phone allowance.

4 Jin receives a disability pension and he lives in a public housing, rent-subsidised unit. Jin has to pay 15% of his pension in rent. His pension is $868.30 per fortnight. How much rent does Jin pay per year?

5 Greta receives a disability pension because she is too sick to work. Her fortnightly pension is $952.70.

a Calculate Greta's annual pension.

b Greta lives in a supported environment. Each fortnight she pays 85% of her pension for her accommodation, food, laundry and electricity. How much of her fortnightly pension is left?

c Greta's pension includes $5.80 per fortnight for medications and she pays $3 per prescription medicine. Greta takes a lot of medication, but after she has paid for 58 prescriptions per year, all further prescriptions are provided free. How much more than her fortnightly medication allowance does Greta have to pay for her medications each year?

6 EXAMPLE 6 The age pension for a single person is $952.70, but for every dollar the person earns over $178 per fortnight, the pension reduces by 50 cents.

a Abby is a single age pensioner who earns $290 per fortnight. Calculate the value of her age pension.

b Nanna thinks Centrelink is overpaying her for the age pension. For the last 8 weeks she has been receiving a pension of $520 per fortnight and she also receives a fortnightly income of $1070 from her investments. She knows that Centrelink will make her repay any overpayments she receives. How much will Nanna have to repay Centrelink?

7 All of the residents in a block of units are aged pensioners. 17 of them are single and 26 are coupled. Use the information in questions **2** and **3** to calculate the total maximum annual age pension they receive and the total phone allowance.

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8 Bill and Rose are a couple and they are both aged 20 years. Bill's annual taxable income is $28 400, but Rose is unable to work and she receives a disability support pension of $287 per fortnight. Recently, Rose received a letter from Centrelink informing her that for the last year she had been overpaid. The details included in the letter are:

Pension received:	$7462
Entitled:	$6450
Overpaid amount:	$1012

The maximum fortnightly disability pension for a member of a couple aged under 20 years is $594.10 and this amount reduces by 40c for each dollar of the couple's fortnightly taxable income over $316.

Are the details included in the letter correct? Justify your answer.

9 Jenny is a single, aged pensioner who owns her own home. She is allowed to have assets up to $268 000 and retain a full pension of $868.30 per fortnight. For every $1000 over $268 000 that Jenny has in assets her fortnightly pension reduces by $2.73. At present Joan's assets are valued at $198 000 and she is about to inherit $75 000. What effect will inheriting $75 000 have on her pension?

Investigation Financial support through Centrelink

The Australian Government provides financial support and assistance to Australian citizens through social security. The staff at Centrelink are trained to assist Australians when they are in need.

In this activity you are going to find out about your social security entitlements.

Weblink
Centrelink

1 Go to the **Centrelink** website at www.humanservices.gov.au

2 Click on **Individuals**, then select the appropriate option to research the answers to the following questions.

3 **a** What is the maximum fortnightly youth allowance Centrelink will pay a person who is under 18 years of age and living at home?

b What are 'approved activities'?

c Do you have to be involved in approved activities to receive a youth allowance?

d What other assistance can someone receiving a youth allowance receive?

e Is there an income or an asset test for youth allowance?

4 **a** If you are single with no dependent children, what is the maximum amount of rent assistance you can receive from Centrelink per week?

b If you are single and share a residence, but have no independent children, can you get rent assistance if your fortnightly rent is $190? If so, how much?

5 **a** Who can receive an ABSTUDY payment?

b Jake is 18 and is going to leave home to study at university. He is qualified to receive an ABSTUDY payment. How much will his fortnightly ABSTUDY payment be?

c Can Jake get any money from Centrelink in advance of his ABSTUDY payments? Explain your answer.

6 Melinda's grandmother died in her sleep while Melinda was living with her. Use the **Centrelink** website to find out what Melinda should do first.

12.6 Loans and interest rates

Profile

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Matt – First-time property investor

I'd been working for several years and saving for the deposit for an apartment. I can't afford to move out of home, but when interest rates were low I was able to buy an apartment and rent it out before property prices began to rise. The weekly amount I'm saving plus the rent is sufficient to cover my repayments and costs. I plan to be able to afford to move into my apartment at some time in the future.

The **Reserve Bank of Australia** determines **interest rates**. Changing interest rates affects payments to investors, interest charges on loans and, indirectly, the changes affect property and share prices.

When we borrow money, there are two types of interest we can be charged: **flat rate** (or **simple**) **interest** and **reducible interest**. The loan **repayments** include the amount we borrow plus the interest charged.

Flat rate interest

When we borrow money at flat rate interest, we pay the same amount of interest every time. The interest is calculated on the original amount we borrowed regardless of the actual amount we owe.

Usually finance companies charge flat rate interest when they are financing items like cars, bikes or boats.

Reducible interest

12.6

When we borrow large amounts of money, for example, to buy a home, usually we pay reducible interest. This means that the interest is only charged on the amount we still owe at the time. The interest reduces as we repay the loan and owe less.

Bank loans usually charge reducible interest.

EXAMPLE 7

Tim plans to borrow $50 000 over 4 years to buy a new 4WD car. The finance company is charging 9.5% p.a. flat rate interest.

a How much interest will Tim have to pay each year?

b Calculate the total amount Tim will repay the finance company.

c Tim plans to repay the money in monthly instalments. How much will his monthly payments be?

Steps	Working
a annual interest = amount borrowed × rate of interest	interest = $50 000 × 9.5% = $4750
b Add the amount he borrowed to the interest for 4 years.	total to repay = $50 000 + 4 × $4750 = $69 000
c number of repayments = 4 × 12 months Divide the total amount to be repaid by the number of repayments.	monthly repayment = $69 000 ÷ 48 ≈ $1437.50

Tim should think very carefully before he agrees to this loan. The loan is going to cost him a lot of money. Does he need such an expensive car?

EXERCISE 12.6 Loans and interest rates

ANSWERS p. 431

1 EXAMPLE 7 Chloe wants to borrow $3000 to buy some furniture. The finance company is charging 8% p.a. flat rate interest.

a Chloe will borrow the money for one year. How much interest will Chloe pay?

b Calculate the total amount Chloe will have to repay the finance company.

c Calculate the value of Chloe's monthly repayments.

2 Olivia is borrowing $8500 for 2 years to buy a small car. The finance company is charging 8.5% p.a. flat rate interest.

a Calculate the total amount of interest Olivia will pay.

b How much will Olivia have to repay the finance company?

c She is going to make weekly repayments. How many weeks are in 2 years?

d Calculate the value of Olivia's weekly repayments.

3 David's monthly car repayments are $800 for 2 years.

a Calculate the total amount David will repay the finance company.

b David borrowed $16 000. How much interest is he paying annually?

c Calculate the annual rate of interest the finance company is charging.

$$\text{Interest rate} = \frac{\text{interest per year}}{\text{original amount borrowed}} \times 100\%$$

4 Ryan is talking to a finance company about borrowing $12 500 for 3 years. Initially the company quoted him 7.9% p.a. interest, but before he signed the contract the Reserve Bank increased interest rates by 0.5%. As a result, the finance company changed its interest rate to 8.4%. How much more interest will Ryan have to pay on the 3-year loan?

5 Grandma has $200 000 in a 12-month term deposit earning 1.5% p.a. flat rate interest.

a How much interest will the term deposit earn?

b The Reserve Bank reduced interest rates and Grandma could only get 0.65% p.a. when she renewed her 12-month term deposit. How much interest will she earn for a 12-month deposit at this lower rate?

c How much less interest will the term deposit earn at the lower rate?

There's always two sides to interest rate changes.

When interest rates go up, investors get more for their savings while borrowers have to pay more interest.

When rates go down, investors get less but borrowers have reduced repayments.

6 Kye is considering borrowing $250 000 to buy a home to live in. At 2.45% p.a. reducible interest his repayments will be $1125 every month for 25 years.

a Calculate the total Kye will repay during this 25-year loan.

b How much interest will he be paying?

c Kye is concerned about the effect of future interest rate rises on his repayments. He used the mortgage calculator on the **MoneySmart** website to determine this information. Copy and complete the table using the **MoneySmart** website.

Weblink
MoneySmart

Interest rate	Monthly repayments	Total to repay	Total interest
2.9%	$1183		
3.5%	$1262		
4%	$1330		

d Kye also thought about the length of the loan. Help him to complete the missing columns for the same $250 000 loan over 15 years.

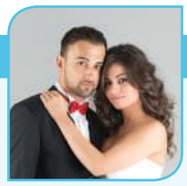
Interest rate	Monthly repayment	Total to repay	Total interest
2.45%	$1671		
2.9%	$1724		
3.5%	$1797		
4%	$1859		

e What observation can you make about the amount of interest paid and the length of the loan?

f Kye isn't sure that he can afford the $1671 per month required to repay the loan in 15 years. Use the mortgage calculator on the **MoneySmart** website to calculate the value of his monthly repayments at 2.45% reducible interest if he takes the loan over 20 years and the amount of interest he'll pay.

12.7 The cost of living

Profile



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Imran and Aisha – Newlyweds

We've been trying to save the deposit to buy our own home but it isn't easy. Real estate prices seem to be going up much faster than we can save and our weekly expenses just keep going up and up, making it even harder.

The cost of living is a common news topic, particularly at election time. While the abbreviation **CPI** stands for 'Consumer Price Index', it can also be read as 'Consumer Price Inflation'. **Inflation** measures how much prices increase each year.

The Reserve Bank of Australia controls parts of the economy to try to keep it working efficiently. Adjusting interest rates and inflation are 2 of its major strategies. However, as we'll see in Year 12, Australia's financial situation is affected by what is happening overseas.

EXERCISE 12.7 The cost of living

ANSWERS p. 431

Weblink Inflation calculator

1 This is the **Reserve Bank of Australia's inflation calculator** at www.rba.gov.au.

Inflation Calculator

This tool calculates the change in cost of purchasing a representative 'basket of goods and services' over a period of time. For example, it may show that items costing $10 in 1970 cost $26.93 in 1980 and $58.71 in 1990.

Calendar Year | Financial Year | Quarterly

A basket of goods and services valued at $ 50 in calendar year 1970 ,

would in calendar year 2021 cost $ 610.87

Reset | Calculate

Total change in cost is **1121.7 per cent**, over **51 years**, at an average annual inflation rate of **5.0 per cent**.

Source https://www.rba.gov.au/calculator/annualDecimal.html

Use the inflation calculator to determine the cost in 2021 of purchasing the following basket of items.

	Value of basket	Year
a	$50	1975
b	$120	1970
c	$200	2001
d	$75	2015

2 Imagine that your family spent $80 for an event to celebrate your birth. How much would this event have cost in 2021?

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3 Use the inflation calculator to determine the percentage increase in the Australian CPI from 1968 to 2021 and the average annual rate of increase during this time.

4 This graph shows long-term data for Australian inflation. Use the graph to answer the following questions.

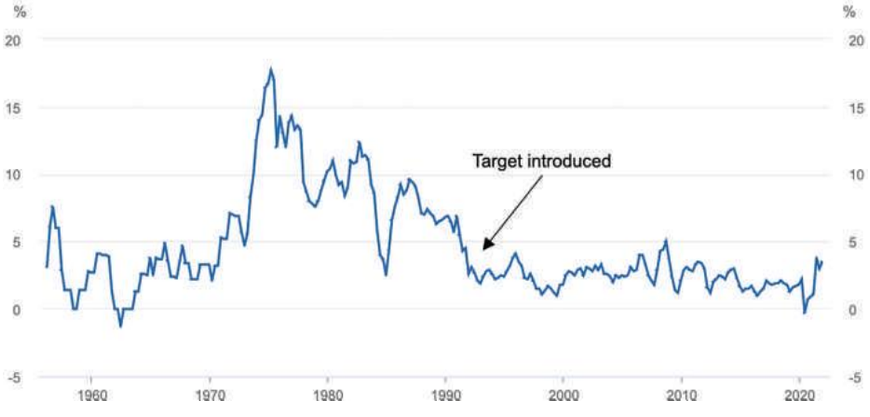
Measures of consumer price inflation

Last updated: 25 January 2022

Graph of the Year-ended percentage change

Help Export

Excludes interest charges prior to September quarter 1998 and adjusted for the tax changes of 1999–2000



a What was the highest CPI and in what year did it occur?

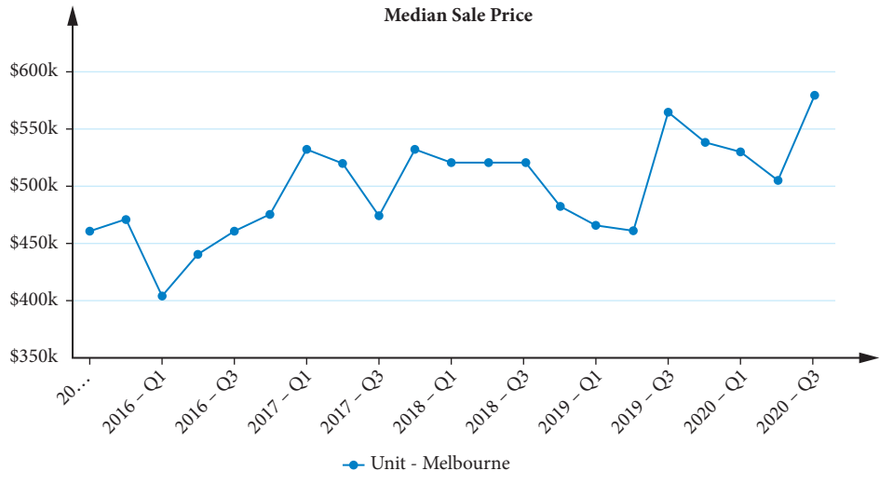
b When was the CPI negative?

c In 1987, there was a huge global share market crash and the value of Australian shares fell by 40%. What happened to the CPI at that time?

d What effect did the COVID-19 pandemic have on our CPI in 2020?

e In the 1990s, the Reserve Bank made changes in its policy to aim to keep inflation between 2 and 3% annually. It was said to have introduced an 'inflation target'. Have the changes been successful? Justify your answer.

5 This graph shows the median price of units in Melbourne from 2016 to 2020.



Source https://www.smartline.com.au/mortgage-news/australian-property-market/melbourne-december-2020/

a Q1 stands for the first quarter of the year and Q3 for the third quarter.
Which months of the year are in Q3?

b Why do you think the person constructing the graph chose to use median sale price, rather than average or mean sale price?

c How has the median price of units changed from 2016 to 2020?

d Use the graph to predict the median price of a Melbourne unit in 2022. How reliable is this prediction?

e Imran and Aisha need 20% of the sale price of the unit they buy for a deposit. Based on median prices, how has the value of the deposit they required changed from the first quarter of 2016 to the third quarter in 2020?

Shutterstock.com/gmstockstudio

6 The Reserve Bank of Australia's (RBA) interest rate affects home loan interest rates.

a In the 1960s, the RBA protected the Australian economy with trade tariffs and by controlling the exchange rate between the Australian dollar and overseas currencies. Describe local interest rates during this time.

b During the 1970s, there was high inflation and high unemployment. What happened to interest rates at that time?

c In 1984, the Australian government changed the way the Australian dollar was valued. Previously, the RBA fixed the exchange rate. Now the rate is determined by international supply and demand. What happened to interest rates following this change?

d In 1990, Australia was in recession. Describe interest rates during the recession.

e The Global Financial Crisis (GFC) in 2008–2009 had devastating financial effects around the world. What did the Reserve Bank do to Australian interest rates during that time?

f Use the graph to predict the RBA interest rate when Imran and Aisha have saved the deposit to buy a unit. How reliable is this prediction?

As a result of the stimulus packages introduced by the Australian Government at the beginning of the GFC and the market intervention by the RBA, Australia was the only major economy in the world to avoid a recession at the time.

Weblink
Inflation calculator

Investigation How prices have changed

Your task is to obtain appropriate data, then construct a graph showing how Australian prices have changed during your lifetime. Use the RBA's inflation calculator to find how prices have changed since you were born until this year.

You might find it useful to construct a table like this:

Year	2005	2007	2009	2011	2013	2015	2017	2019	2021
Value of item	$100								

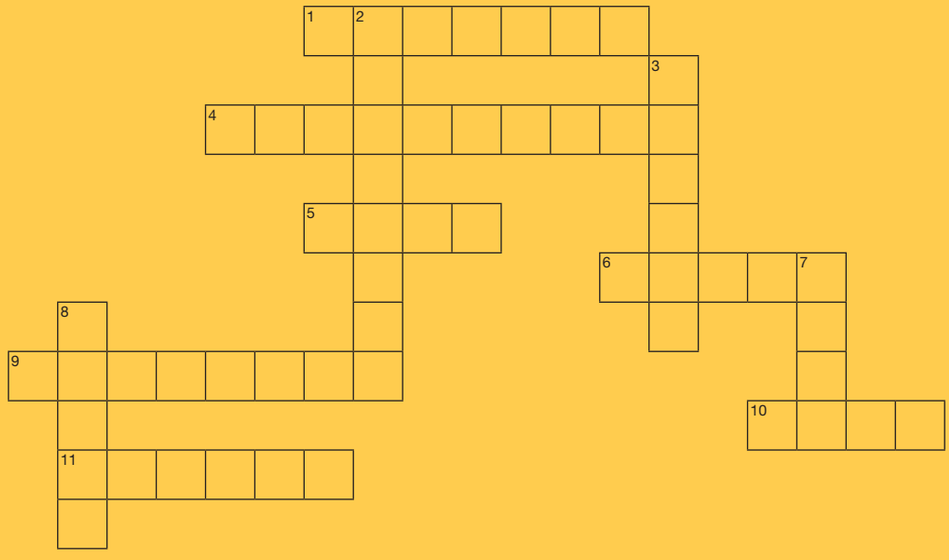
Keyword activity

CHAPTER SUMMARY

ANSWERS p. 431

Copy this crossword, then list the keywords that are needed to complete the chapter summary.

Use the keywords to complete the crossword.



Shopping is an expensive business, but wise shoppers check prices carefully before they buy. They use $_4$_____ websites to compare deals. The price of petrol can be very different in nearby suburbs and the RACV $_1$_____ can help us locate the cheapest local fuel.

In the supermarket we can compare prices by reading the $_5$_____ price. The unit is selected to suit the size of the containers.

Managing our money is easier when we prepare a budget. The 50-30-20 budget is a popular and easy way to budget. Just spend 50% of income on $_2$_____, limit entertainment and fun costs to 30% and $_7$_____ 20%.

If we stick to a sensible budget, our money will look after itself, but if we experience financial difficulties, Centrelink is there to help. The Government provides $_9$_____ and allowances for those in need. However, we need to be careful. If we claim more than we are entitled to in a pension or allowance, we have to $_8$_____ it. There are income and $_{11}$_____ tests for pensions to make sure that only those who really need the money receive it from Centrelink.

The Government also provides support to Australians enrolled in higher education through the $_{10}$_____ (Higher Education Loan Program). These loans also have to be repaid when a student graduates and obtains a job with an $_3$_____ income over $47 000. We need to be very careful borrowing money. Finance companies can charge high $_6$_____ of interest and we can end up repaying a lot more than we borrowed.

Solution to the chapter problem

Problem

Kai buys petrol a few times every week. He's noticed that the price varies quite a bit. At some service stations the price can be more than 30c/L more expensive than at others. How can he determine whether the price for petrol in his area is reasonable?

Solution

Kai should check the RACV website. The site lists the minimum and maximum prices for petrol. The site also shows the location of service stations and their current price.

12 Test yourself

Spending and borrowing money

ANSWERS p. 431

1 EXERCISE 12.1 Cooking oil is available in 3 sizes. Which size is the best buy?

500 mL for $3.60

800 mL for $5.68

1.2 L for $8.76

2 EXERCISE 12.2 Justine is comparing health insurance options. She is considering buying a Bronze cover policy.

a Why does the same policy cost 3 different amounts?

b Calculate the annual cost of the most expensive of the 3 options from 1 April.

c Calculate the extra annual cost of having a $250 compared to $750 excess from 1 April.

3 EXERCISE 12.3 The annual registration cost for a Victorian car is $834.80, but owners of cars registered in regional centres only have to pay $716. What percentage discount do regional car owners receive? Answer correct to the nearest percentage.

4 EXERCISE 12.3 The full price of Sienna's car insurance is $1436, but she receives a 25% no-claim bonus. Calculate the amount Sienna needs to pay for her insurance.

5 EXERCISE 12.4 Michelle uses the 50-30-20 method of budgeting. Her weekly take-home pay is $846.

a How much does she budget each week for essentials, entertainment and saving?

b This week Michelle only spent $298 on essentials. She is thinking of having a big night out with the remaining essentials money. Is this a good idea? Why or why not?

c How long will it take Michelle to save $1000 for the deposit for a holiday?

6 EXERCISE 12.5 The Age pension payment for a single person is $952.70, but for every dollar the person earns over $178 per fortnight, the pension reduces by 50 cents. Bill is an aged pensioner whose only non-pension income is the interest on his investments. As a result of record low interest rates, his annual income has fallen from $46 000 to $18 000.

a Calculate the fortnightly amount Bill earned in interest prior and after the low interest rates.

b Calculate his fortnightly pension before and after the low interest rates.

c How has Bill's fortnightly income changed from pre- to post- low interest rates?

9780170448123

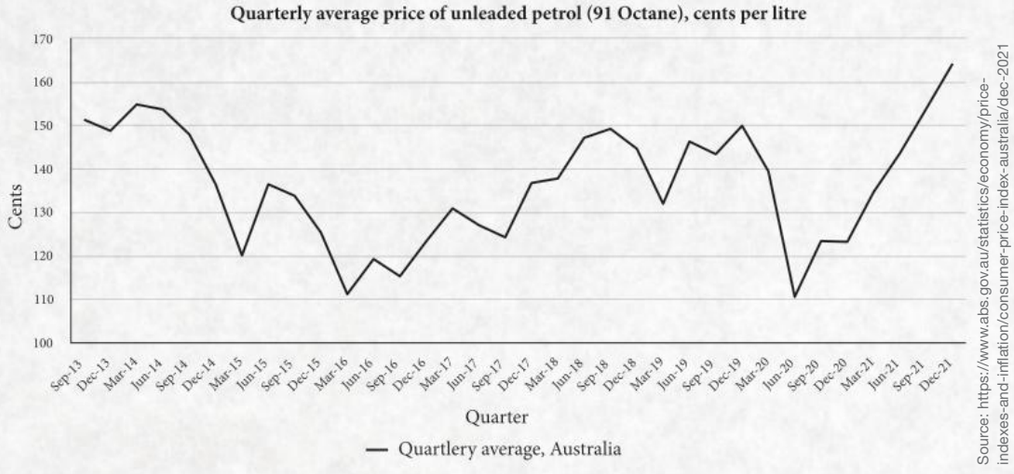
7 EXERCISE 12.6 Oliver is investigating borrowing $21 300 from different finance companies at flat rate interest. The table shows the deals he has been offered.

Interest rate	Length of loan	Interest he will pay	Total to be repaid	Monthly repayments
8% p.a.	2 years			
9% p.a.	3 years			
10% p.a.	18 months			

a Copy and complete the missing values.

b Which has the greater effect on the total interest Oliver will pay: the interest rate or the length of the loan?

8 EXERCISE 12.7 This graph shows the quarterly average price of unleaded petrol in Australia from September 2013 to December 2021.



Source: https://www.abs.gov.au/statistics/economy/price-indexes-and-inflation/consumer-price-index-australia/dec-2021

a What was the lowest price of 1 L of unleaded petrol and when was it this price?

b Describe what happened to the price of petrol for the year following September 2017.

c Widespread lockdowns at the beginning of the COVID-19 pandemic in Australia (start of 2020) had a significant effect on the price of petrol. Describe the effect and suggest a reason for it.

d In March 2022, the price of petrol soared as a result of the Russian invasion of Ukraine, with the price of 1 L reaching $2.20. How much more did 1 L of petrol cost in March 2022 than the average price in March 2015? Answer correct to the nearest 10c.

e Calculate the percentage increase in the price of 1 L of petrol from March 2015 to March 2022, using $2.20 as the March 2022 price. Answer to the nearest percent.

Practice set 3

ANSWERS p. 431

Section A Multiple-choice questions

For each question, select the correct answer **A**, **B**, **C** or **D**.

1 EXERCISE 9.3 Simplify $20p^{12} \div 4p^3$.

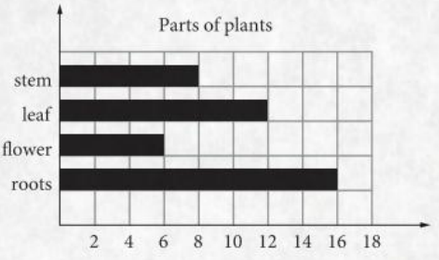
A $5p^4$ **B** $5p^9$ **C** $16p^4$ **D** $16p^9$

2 EXERCISE 11.1 What type of quadrilateral has one pair of sides parallel?

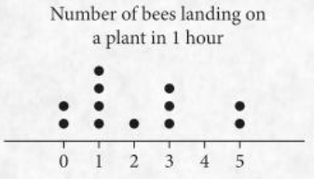
A kite **B** rectangle **C** rhombus **D** trapezium

3 EXERCISE 10.3 Which of these is a stem-and-leaf plot?

A



B



C

Score, x	Tally	Frequency, f	$f \times x$
4	|||	3	12
5	𝍸 |	6	30
6	||||	4	24
7	||	2	14
	Total	**15**	**80**

D Number of seeds in 20 seed pods

Stem	Leaf
0	7 8 8 9
1	0 0 2 4 8 9 9
2	1 2 3 3 7 8
3	0 1 2

4 EXERCISE 9.5 Calculate the value of the expression $4y - 3x$ when $x = 4.2$ and $y = 3.8$.

A 2.6 **B** 5.4 **C** 27.8 **D** 28.2

5 EXERCISE 12.3 The annual premium of Sally's car insurance is $1245, but she receives a 60% no-claim discount. Calculate the amount Sally pays for her insurance.

A $498 **B** $747 **C** $1743 **D** $1992

6 EXERCISE 12.1 Gluten-free bread-making flour is available in 4 sizes. Which size is the best value per kg?

A 250 g for $1.63 **B** 500 g for $3.20 **C** 1 kg for $6.70 **D** 5 kg for $32.25

7 EXERCISE 9.6 To solve the equation $\frac{p}{6} = 12$, what do you need to do to both sides?

A add 6 **B** subtract 6 **C** multiply by 6 **D** divide by 6

9780170448123

8 EXERCISE 10.5 This frequency table shows the number of children playing on a swing in a public playground at 11 am for 23 weekdays.

Score, x	Tally	Frequency f	Cumulative frequency	fx
1	𝍸 ||	7	7	7
2	𝍸 |||	8	15	16
3	|||	4	19	12
4	|||	3	22	12
5	|	1	23	5
	Total	**23**		**52**

For this data, which statement is *incorrect?*

A The mode is 2.

B The median is 3.

C The mean is 2.26, correct to 2 decimal places.

D There are twice as many scores of 2 than there are scores of 3.

9 EXERCISE 12.5 The maximum fortnightly Age pension payment for a single person is $952.70, but for every dollar the person earns over $178 per fortnight, the pension reduces by 50 cents. Will is an aged pensioner. His annual income falls from $36 000 to $16 000. How does his pension payment change?

A goes up $385

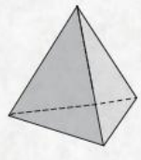
B goes down $385

C goes up $734

D goes down $734

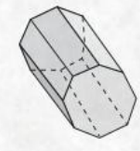
10 EXERCISE 11.2 Which one of these solids is a prism?

A

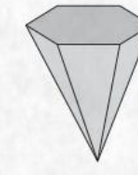


B

C



D



Section B Short-answer questions

1 EXERCISE 9.2 Simplify each expression.

a $7d + 9 + 2d$ **b** $13 + 2x + 4$ **c** $w^2 - 10 + w^2$ **d** $8 - b - b$

2 EXERCISE 11.1 Draw a neat sketch of each 2D shape.

a A triangle that is obtuse and isosceles.

b A pentagon.

c A quadrilateral that has exactly 2 right angles.

3 EXERCISE 9.3 Simplify each algebraic expression.

a $10p \times 4q \div 8$ **b** $4t \times 8 \div 2t$ **c** $3k^4 \times k$

d $25f \div 5f \times 2$ **e** $9a \times 4b \div 12t$ **f** $45h^8 \div 9h^2$

4 EXERCISE 11.5 The scale in this diagram is 1 cm represents 6 m.
Measure and calculate the actual height of the tower.

5 EXERCISE 9.4 Expand and simplify each expression.

a $6m + 4(m + 2)$

b $-(9 - z)$

c $-a(a - 2)$

d $3(2p + 10) + 12$

6 EXERCISE 10.1 Santi asked 25 students in Year 11 'What is your favourite category of animals at the zoo?'

Her results are shown below and coded as follows:

Cats = C, Primates = P, Elephants = E, Reptiles = R, Other = O

C, P, C, E, R, P, O, E, C, R, P, E, P, O, C, P, P, E, C, R, P, O, R, R, C

a Arrange Santi's data in a frequency table.

b What is the most popular category of zoo animals in this group of students?

c What percentage of students stated that their favourite category was reptiles?

7 EXERCISE 9.5 Evaluate each expression if $k = 24$.

a $2k$

b $3(k - 17)$

c $\frac{2k}{3}$

d $\sqrt{k + 1}$

8 EXERCISE 9.6 Solve each equation.

a $t + 11 = 13$

b $j - 3 = 11$

c $10g = 130$

d $\frac{r}{3} = 10$

e $5q + 3 = 33$

f $6y - 11 = 7$

9 EXERCISE 10.2 Dimetria recorded the temperature in Bendigo at 11 am each day.

16°C, 22°C, 15°C, 21°C, 19°C, 20°C, 20°C, 21°C, 20°C, 17°C,
23°C, 23°C, 21°C, 20°C, 14°C, 21°C, 23°C, 19°C, 22°C, 20°C, 22°C

a Complete a frequency table for this data.

b For how many days did Dimetria record the temperature?

c How many days had temperatures below 20°C?

d Draw a histogram for this data.

10 EXERCISE 11.1 What polygon am I? Match each description with its name in **A** to **F**.

A trapezium **B** octagon **C** rectangle
D obtuse-angled triangle **E** right-angled, isosceles triangle **F** square

a I have 3 sides. One of my angles is 90° and the other two are equal.
b I am a quadrilateral. All my angles are 90°.
c I have 8 sides.
d I have 4 equal sides and my angles are 90°.
e I am a quadrilateral. Only one pair of my sides is parallel.
f I have 3 sides. My angles are 110°, 30° and 40°.

11 EXERCISE 9.1 Write an algebraic expression for each description.

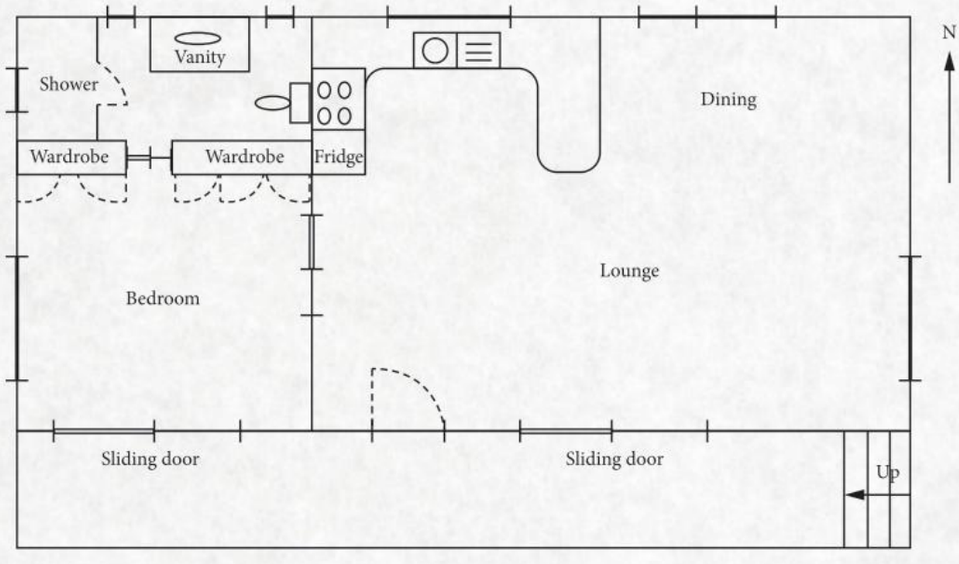
a 3 lots of k, increased by 10
b Think of a number (m), divide it by 7 and decrease the answer by 4

12 EXERCISE 10.3 These numbers represent the number of pets that live in the houses in Tan's street.

1, 4, 0, 2, 0, 1, 1, 4, 2, 0, 3, 1, 5, 1, 1, 4, 2, 3, 0, 1, 3, 2, 0

a Draw a dot plot to illustrate this data.
b How many houses are there in Tan's street?
c How many of the houses have more than 2 pets living in them?
d How many pets live in Tan's street?

13 EXERCISE 11.6 This is the plan of a granny flat. Sketch the northern and eastern elevations.



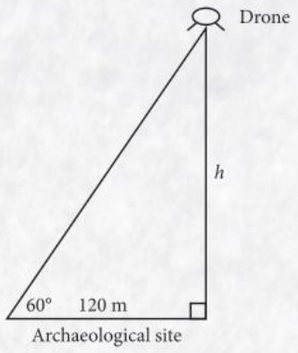
14 EXERCISE 10.3 Shay recorded the ages of each customer who came to her hairdressing salon on Friday.

75, 55, 56, 69, 78, 70, 57, 79, 72, 61, 83, 60, 59, 58, 66, 63, 76, 85, 65, 88, 72

a Show this information in an ordered stem-and-leaf plot.
b How many customers came in to the shop that day?
c How old was the oldest customer?
d What percentage of customers were under the age of 65? Answer correct to 1 decimal place.

15 EXERCISE 11.8 An archaeologist uses a drone to photograph a recently discovered site.

Construct a scale drawing to calculate the height of the drone above the archaeological site. Answer correct to the nearest metre.



16 EXERCISE 10.5 Kellie recorded the number of coffees bought by people visiting her shop during 1 hour. The results are shown in the table.

Number of coffees	Frequency
0	2
1	6
2	14
3	7
4	1
5	2
6	1
Total	**33**

a Copy this table and add columns for cumulative frequency and frequency × score.

b For this data, find:

i the median

ii the mode

iii the mean (correct to 1 decimal place)

iv the range.

17 EXERCISE 12.2 Hunter is comparing pet insurance options for his dog.

OMD Insurance	Guard Dog Insurance	Unreal Insurance
Accident and illness cover	Accident and illness cover	Accident and illness cover
$33.05 fortnightly	$29.93 fortnightly	$30.49 fortnightly
We will pay up to 70%	We will pay up to 60%	We will pay up to 65%

a Calculate the annual cost of OMD insurance.

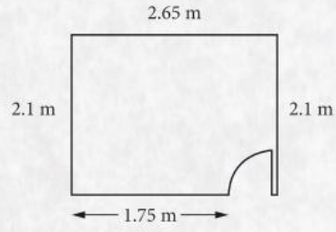
b Hunter's dog ate a sock, which had to be surgically removed. The incident cost him $2734. If Hunter has the policy with Guard Dog insurance, how much of the $2734 will the insurance company pay?

18 EXERCISE 12.4 Chelsea uses the 50–30–20 method of budgeting. Her weekly take-home pay is $1024.

a How much does she budget each week for each category: essentials, entertainment and saving?

b How long will it take Chelsea to save $2000 for the deposit for a car? Answer to the nearest month.

19 EXERCISE 11.7 Jeff and Melissa are renovating their bathroom. They are going to put a frieze of decorative tiles around the walls. The diagram shows the dimensions of the room.



a What total length of tiles is required?

b Each decorative tile is a 15 cm square. How many tiles will Jeff and Melissa need?

c Tiles come in boxes of 15. How many boxes will they need to buy?

20 EXERCISE 12.6 Carrie's monthly car repayments are $760 for 2 years for a flat rate loan.

a Calculate the total amount she will repay in the loan.

b Carrie borrowed $15 000. How much interest is she paying annually for the flat rate loan?

c Calculate the annual flat rate of interest charged.

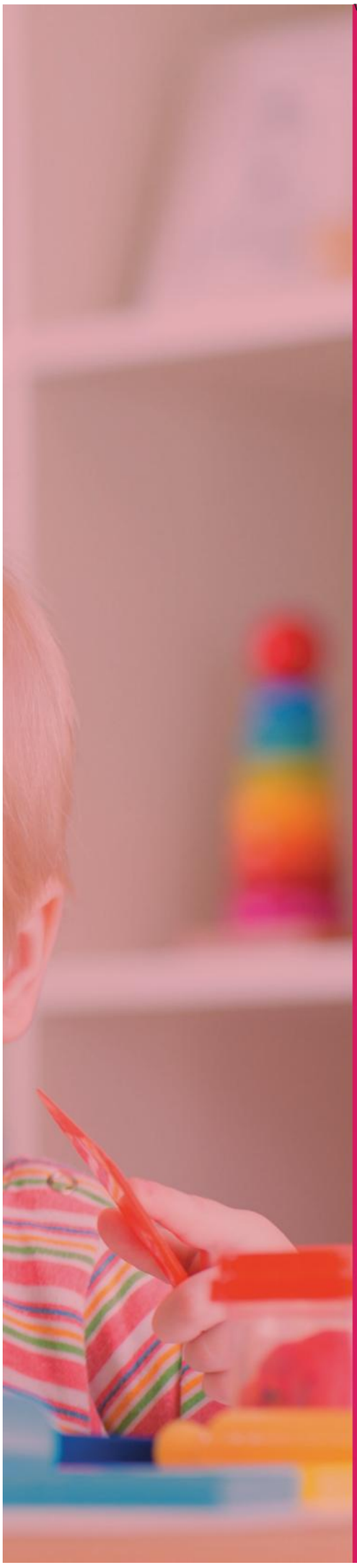
21 EXERCISE 9.1 Simon and Maddy are organising the catering for an outdoor wedding. The caterer charges $400 plus $55 per person attending the wedding. Write an expression for the total cost of catering for n wedding guests.

Chapter problem

Young children learn words at an amazing rate. When a child is aged between 1 and 5 years, we can predict the typical number of words they will understand using the formula $N = 60m + 100$, where m represents the age of the child in months and N is the number of words.

Anastacia, a childcare worker, is worried about Liam, a 20-month-old boy at her daycare centre who doesn't appear to understand many words. He has been tested and understands about 900 words.

Should Anastacia be concerned? Use calculations to support your answer.



CHAPTER 13

ALGEBRA, NUMBER AND STRUCTURE

EQUATIONS AND LINES

13.1 Formulas
13.2 Applying formulas
13.3 Solving equations
13.4 Tables of values
13.5 Graphing linear equations
13.6 Writing equations
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Substitute values into algebraic expressions and formulas
- Apply formulas to practical situations
- Complete tables of values to graph lines
- Solve equations
- Consider whether an answer is reasonable
- Write equations

How are we ever going to use this?

- Formulas, equations and graphs are used in many trades and workplaces
- Formulas are used in health and fitness, for example, to calculate BMI (body mass index).

Study Design coverage

UNIT 2, AREA OF STUDY 1: ALGEBRA, NUMBER AND STRUCTURE

- construction, use and interpretation of formulas and symbolic expressions to describe relationships between variables and to model and represent generalisations and patterns
- solution of equations
- estimation, approximation and reasonableness of calculations and results.

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Videos (4):
13.2 Formulas
13.3 Two-step equations • Equations with brackets
13.5 Graphing linear functions

Skillsheets (4):
13.3 Solving equations by balancing • Solving equations by backtracking • Solving equations using diagrams
13.5 Graphing linear equations

Worksheets (9):
13.3 Equations code puzzle • Working with formulas • Algebra review
13.4 Formula frolics • Tables of values
13.5 Graphing points and lines • Graphing linear functions • A page of number planes • Drawing gradients

Puzzles (3):
13.1 Substitution code
13.5 Graph gradients
13.6 Writing and solving equations

Nelson MindTap

To access resources above, visit **cengage.com.au/nelsonmindtap**

Puzzle
Substitution code

13.1 Formulas

Andy uses algebraic expressions every day in his electrical business. Regularly, he has to calculate the value of expressions like $\frac{E}{R}$, $\sqrt{PR}$ and I^2R by substituting values for each variable.

EXAMPLE 1

Evaluate I^2R when $I = 5$ and $R = 20$.

Steps	Working
Substitute $I = 5$ and $R = 20$ into the expression and calculate the answer.	$I^2R = 5^2 \times 20$ $= 500$

A **formula** is an algebraic rule that describes a mathematical relationship between variables. For example, Andy uses the formula $P = I^2R$ to measure the power in an electrical circuit.

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EXAMPLE 2

Andy uses the formula $S = V(1- r)^n$ to calculate the current value of his car. Calculate the value of S if $n = 5$, $r = 0.3$ and $V = 36\,000$.

Steps	Working
Replace the variables in the formula with their values and then calculate the final amount.	$S = 36\,000 \times (1 - 0.3)^5$ $= 36\,000 \times 0.7^5$ $= 6050.52$ The current value of Andy's car is \$6050.52.

EXERCISE 13.1 Formulas

ANSWERS p. 432

1 EXAMPLE 1 Find the value of I^2R when

a $R = 30$ and $I = 10$ **b** $I = 7$ and $R = 28$ **c** $R = 40$ and $I = 12$

2 EXAMPLE 2 Substitute the values $n = 3$, $r = 0.25$ and $V = 3000$ into the formula $S = V(1- r)^n$ and evaluate S, correct to the nearest whole number.

3 The formula for the perimeter of a rectangle is $P = 2l + 2w$. Calculate P when $l = 12$ and $w = 9.5$.

4 The area of a triangle is given by $A = \frac{bh}{2}$. Find A when $b = 12$ and $h = 7$.

5 Use the formula for changing temperatures in degrees Fahrenheit to degrees Celsius $C = \frac{5}{9}(F - 32)$ to calculate the value of C when $F = 104$.

6 Calculate the value of V in the formula for the volume of a sphere $V = \frac{4}{3}\pi r^3$ when $r = 5.2$. Express your answer correct to 2 decimal places.

7 Evaluate S in the formula $S = \frac{D}{T}$ when $D = 240$ and $T = 8$.

8 Use the formula $S = V - Dn$ to evaluate S when $V = 20\,000$, $D = 4000$ and $n = 3$.

9 In the formula $A = P(1 + r)^n$, determine the value of A when $P = 3500$, $n = 20$ and $r = 0.025$. Express your answer correct to 2 decimal places.

10 When $N = 15$, $H = 4$ and $M = 2$, calculate the value of B in the formula $B = \frac{10N - 7.5H}{5.5M}$. Answer correct to 2 decimal places.

11 In the formula $h^2 = a^2 + b^2$, what is the value of h when $a = 24$ and $b = 7$?

12 Use the formula $v^2 = u^2 + 2as$ to determine the value of v when $a = 6$, $s = 3.2$ and $u = 8$. Express your answer correct to 2 decimal places.

13.2 Applying formulas

Many people use formulas in the workplace. Concrete contractors use formulas to determine the amount of concrete required for paths. Electricians use formulas to calculate voltage changes. Nurses use formulas to calculate solution quantities for injections and medications.

Video
Formulas

EXAMPLE 3

Fried's formula can be used to determine the infant dose of an adult's medicine.

$$D = \frac{MA}{150}$$

where D = the infant dose in mL
A = the adult dose in mL
M = the child's age in months.

The adult dose of a cough medicine is 30 mL. What dose of cough medicine can be given to a 12-month-old child?

Steps	Working
We need to calculate the size of the child's dose, which is D.	$D = ?$
The adult dose is 30 mL.	$A = 30$
M is the child's age in months.	$M = 12$
Substitute the values into the formula.	$D = \frac{MA}{150}$ $= \frac{12 \times 30}{150}$ $= 2.4$
Write the answer.	The child's dose is 2.4 mL.

EXAMPLE 4

A civil engineer uses the formula $V = 0.25A(d_1 + d_2 + d_3 + d_4)$ to estimate the amount of cut and fill required to excavate a rectangular area. V is the volume of dirt and rock, A is the area of the site and d_1, d_2, d_3 and d_4 represent the depth of the excavation at the 4 corners.

A rectangular excavation site is 55 m long by 130 m wide and the depth of the excavation at each corner is 1.4 m, 0.7 m, 1.5 m and 2.8 m. Use the formula to estimate the amount of cut and fill required for the excavation.

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Steps	Working
Calculate A, the area of the rectangular site. length = 55 m, width = 130 m	$A = 55 \times 130$ $= 7150\ \text{m}^2$
Substitute the values of A, d_1, d_2, d_3 and d_4 into the formula, then calculate the answer.	$d_1 = 1.4$, $d_2 = 0.7$, $d_3 = 1.5$, $d_4 = 2.8$ $V = 0.25A(d_1 + d_2 + d_3 + d_4)$ $= 0.25 \times 7150 \times (1.4 + 0.7 + 1.5 + 2.8)$ $= 11440$
Write the answer.	$11\,440\ \text{m}^3$ is the amount of cut and fill required.

EXERCISE 13.2 Applying formulas

ANSWERS p. 432

1 EXAMPLE 3 The adult dose of a pain relief drug is 24 mL. Use Fried's formula $D = \frac{MA}{150}$ from Example **3** to calculate the dose of the drug that can be given to an 18-month-old child. Answer correct to the nearest mL.

2 The formula $V = \frac{4}{3}\pi r^3$ gives the relationship between the radius and volume of a sphere. Calculate the volume of a sphere with a radius of 6 cm. Express your answer correct to 1 decimal place.

3 The formula $C = \frac{5}{9}(F - 32)$ is used to covert temperatures in degrees Fahrenheit (°F) to temperatures in degrees Celsius (°C). A cake recipe requires an oven set to 350°F. Marna's oven measures the temperature in°C. At what temperature should Marna set her oven to bake the cake? Answer correct to the nearest whole degree.

4 The formula $D = S \times T$ relates distance, speed and time. D = the distance travelled, S = the speed and T = the time. A truck is travelling at an average speed of 95 km/h on the motorway.

a Calculate the distance the truck will travel in 3 hours.

b Express 45 minutes as a fraction of an hour, then calculate how far the truck will travel in 45 minutes.

5 Cockroaches can run at a speed of 80 cm/s. Sarah saw a cockroach, but she lost sight of it when she sneezed. Use the formula $D = S \times T$ to calculate the distance the cockroach ran while Sarah's eyes were shut for 3.5 seconds.

6 Young and Clark both have rules for approximating a child's dose of medicine for an adult.

Young's rule: $\text{dosage} = \frac{\text{age of the child in years} \times \text{adult dose}}{\text{age of the child in years} + 12}$

Clark's rule: $\text{dosage} = \frac{\text{weight of the child in kilogram} \times \text{adult dose}}{70}$

Bella is 5 years old and she weighs 15 kg. The adult dose of the cough medicine that Bella's mother wants to give her is 35 mL.

a Calculate the dose Bella can have based on each rule, correct to 1 decimal place.

b Most 5-year-old girls weigh approximately 18 kg. Should Bella's mother use Young's or Clark's formula to calculate the dose to give her? Justify your answer.

7 The formula $FV = PV(1 + r)^n$ shows the relationship between the future value FV of an investment, the present value PV of an investment, the annual rate of interest r as a decimal, and the length of the investment n in years. This morning Zhi invested $5400 at 6% p.a. for 7 years.

a Express 6% p.a. as a decimal.

b Calculate the future value of Zhi's investment.

8 Rani likes to weave her own scarves. Before she starts a project she uses the formula $M = 3.87WL$ to calculate the length of wool she will need to put on the loom.

M = the number of metres of wool she will need, W = the width of the weaving in cm, L = the length of the warp in metres.

a Rani wants to weave a scarf 54 cm wide and 2.4 m long. How many metres of wool will she need to put on the loom? Round your answer to the nearest metre.

b Rani has a cone of suitable wool. The wool on the cone weighs 500 g and the label says that 50 g of the wool is 260 m long. Is there sufficient wool on the cone for the warp? Justify your answer.

9 The formula $P = N(1 - R)^t$ can be used to predict future population numbers of endangered animals. P = the predicted future population, N = the current number of animals, R = the annual rate of decrease in numbers as a decimal, t = the time in years.

At the beginning of 2017, only 80 000 giraffes were living in the wild in Africa and this amount is decreasing at a rate of 3.7% annually due to habitat destruction and hunting.

a Write 3.7% as a decimal.

b Calculate the number of giraffes that we can expect to be living in the wild in 10 years' time.

c By what percentage will the population of giraffes living in the wild decrease in this 10 years?

10 The efficiency of a pumping station is given by the formula $E = PM$, where P is the efficiency of the pump, M is the percentage efficiency of the motor and E, P and M are expressed as decimals. Determine the percentage efficiency of the pumping station when the pump is at 85% efficiency and the motor is at 60% efficiency.

Make sure you express the percentages as decimals. Remember: 85% = 0.85

11 EXAMPLE 4 Use the excavation formula $V = 0.25A(d_1 + d_2 + d_3 + d_4)$ from Example 4 to determine the volume of soil and rock that must be removed from a square of land 60 m by 60 m. The depth of soil at the corners of the land is 0.3 m, 1.1 m, 1.4 m and 1.8 m.

12 When a car's skid marks are in a straight line, the formula $V = 16\sqrt{FS}$ can be used to estimate the car's speed before the brakes were applied. V is the speed of the car in km/h, F is the road surface coefficient of friction and S is the length of the skid marks in metres.

Accident investigators measured the length of a skid mark to be 31 metres. The road's coefficient of friction is 0.85. Calculate the speed of the car that left the skid marks. Answer correct to the nearest km/h.

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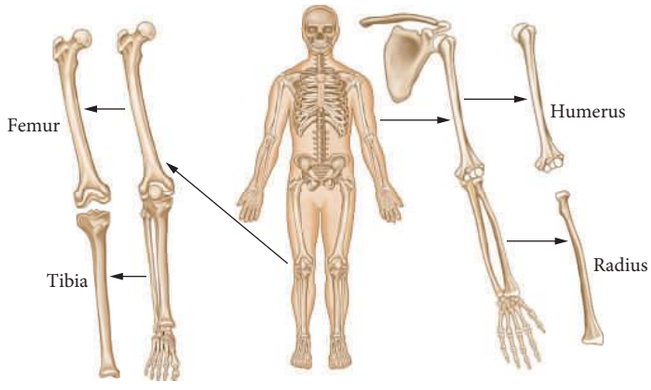
Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Investigation Your height can be found in your bones!

Forensic scientists use science and mathematics to help them determine all kinds of information. For example, the length of one of the four human 'long bones' and the sex of the person is all they require to be able to calculate the height of the person. They use formulas that allow them to determine height from the length of a skeleton's femur, tibia, humerus and radial bones.



	Females	Males
Humerus	$h = \frac{3144H + 64977}{1000}$	$h = \frac{2970H + 73570}{1000}$
Radius	$h = \frac{3876R + 73502}{1000}$	$h = \frac{3650R + 80405}{1000}$
Tibia	$h = \frac{2533T + 72572}{1000}$	$h = \frac{2392T + 81688}{1000}$
Femur	$h = \frac{2317F + 61412}{1000}$	$h = \frac{2238F + 69089}{1000}$

where

h = the person's height

H = the length of the humerus (upper arm bone)

R = the length of the radius (lower arm bone)

T = the length of the tibia (lower leg bone)

F = the length of the femur (upper leg bone)

All measurements are in centimetres.

1 The bones of 2 people, a male and a female, were found in a shallow grave. The female's humerus was 33.5 cm long and the male's tibia was 41 cm. What was the height of each person when they were alive?

2 Several bones of an unidentified male skeleton were found in a forest. The humerus was 40 cm, the radius was 31 cm and the tibia was 47.5 cm.

a Calculate the height of the unidentified, based on each bone.

b What height do you think should be recorded?

c Can you suggest a reason why the bones don't give exactly the same height?

3 Measure your height and calculate the length of each of your 4 long bones.

13.3 Solving equations

Videos
Two-step equations

Equations with brackets

Skillsheets
Solving equations by balancing

Solving equations by backtracking

Solving equations using diagrams

Worksheets
Equations code puzzle

Working with formulas

Algebra review

As we learned in Chapter 9, *Using algebra*, we **solve** equations to find the value for the variable that makes the equation true. That value is called the **solution** to the equation. If we substitute the solution into the equation, then both sides of the equation will give the same value.

EXAMPLE 5

Show that $a = 5$ is the correct solution to the equation $3a + 2 = a + 12$.

Steps	Working
A solution is correct if we get the same value on both sides of the equation when we substitute the solution.	
Substitute $a = 5$ into the left-hand side (LHS) of the equation.	When $a = 5$, LHS $= 3 \times 5 + 2$ $= 17$
Substitute $a = 5$ into the right-hand side (RHS) of the equation.	When $a = 5$, RHS $= 5 + 12$ $= 17$
Compare the values of the LHS and RHS.	LHS = RHS $a = 5$ is the correct solution to the equation.

An equation is like a see-saw, balanced about the '=' symbol. As long as we do the same thing to *both* sides, the equation will stay balanced.

When we solve an equation, we want to finish with a statement like $x =$ ____.

EXAMPLE 6

Solve the equation $4x - 11 = 203$.

Steps	Working
	$4x - 11 = 203$
Add 11 to both sides of the equation.	$4x - 11 + 11 = 203 + 11$ $4x = 214$
Divide both sides by 4 to find x.	$\frac{4x}{4} = \frac{214}{4}$ $x = 53.5$

To solve an equation with brackets, expand the expression with brackets, then simplify and solve.

EXAMPLE 7

Solve the equation $15 + 2(4a - 3) = 81$.

Steps	Working
Expand the brackets and simplify.	$15 + 2(4a - 3) = 81$ $15 + 8a - 6 = 81$ $8a + 9 = 81$
Subtract 9 from both sides.	$8a + 9 - 9 = 81 - 9$ $8a = 72$
Divide both sides by 8.	$\frac{8a}{8} = \frac{72}{8}$ $a = 9$

If you substitute $a = 9$ back into the equation, both sides have the same value (81).

To solve an equation with fractions, multiply both sides of the equation by the denominator of the fraction. This will result in an equation with whole numbers only. Remember to simplify your equation first so that the fraction is isolated on the left-hand side of the equation.

EXAMPLE 8

Solve the equation $\frac{p}{15} - 20 = 165$.

Steps	Working
	$\frac{p}{15} - 20 = 165$
Add 20 to both sides.	$\frac{p}{15} - 20 + 20 = 165 + 20$ $\frac{p}{15} = 185$
Multiply both sides by 15.	$\frac{p}{15} \times 15 = 185 \times 15$ $p = 2775$

To solve an equation with a variable on the bottom of the fraction, multiply both sides of the equation by the variable. The denominator of the fraction will then cancel.

EXAMPLE 9

Solve the equation $12 = \frac{48}{t}$.

Steps	Working
	$12 = \frac{48}{t}$
Multiply both sides by t.	$12 \times t = \frac{48}{t} \times t$ $12t = 48$
Divide both sides by 12.	$\frac{12t}{12} = \frac{48}{12}$ $t = 4$

EXERCISE 13.3 Solving equations

ANSWERS p. 433

1 EXAMPLE 5 Is $a = 12$ the correct solution to the equation $5a - 30 = 2a + 6$? Use calculations to justify your answer.

2 $x = 7$ is the correct solution to some of the following equations. Which equations are they?

A $2x + 9 = 30 - x$ **B** $3x - 8 = 2x$ **C** $2(3x + 1) = 5x + 9$

3 EXAMPLE 6 Solve each equation.

a $8a - 4 = 420$ **b** $3x + 12 = 27$ **c** $2p - 18 = 48$

d $2d - \frac{1}{2} = 7\frac{1}{2}$ **e** $3m - 5 = 22$ **f** $5y - 1.6 = 8.4$

4 EXAMPLE 7 Solve each equation.

a $16 + 4(2x - 3) = 36$ **b** $18 + 2(3a - 1) = 34$ **c** $24 - 2(3 - 2a) = 44$

5 EXAMPLE 8 Solve each equation.

a $\frac{y}{10} - 5 = 3$ **b** $\frac{g}{3} - 1 = 11$ **c** $\frac{2t}{5} + 4 = 13$

6 EXAMPLE 9 Solve each equation.

a $4 = \frac{120}{x}$ **b** $15 = \frac{60}{k}$ **c** $\frac{12}{a} = 4$

d $64 = 16h$ **e** $\frac{15}{d} = 2$ **f** $8g + 7 = 27$

g $2p + 1\frac{1}{2} = 11$ **h** $\frac{4p}{3} = 10$ **i** $4t - 23 = 27$

j $\frac{2y}{7} = 5$ **k** $\frac{30}{x} = 10$ **l** $4k - \frac{3}{4} = 5\frac{1}{4}$

m $\frac{x}{2} + \frac{3}{4} = 5\frac{1}{2}$ **n** $\frac{10a}{3} = 8$ **o** $\frac{6p}{11} = 2$

p $\frac{10x}{3} = \frac{2}{5}$ **q** $2b - \frac{7}{10} = \frac{3}{5}$ **r** $\frac{8p}{3} = \frac{5}{4}$

s $\frac{-3d}{2} = 7$ **t** $\frac{k}{3} - 2 = -2\frac{1}{5}$

Investigation Workplace formulas

Who uses formulas in the workplace? How are they used?

Your challenge is to research formulas used by people in their workplace.

Locate 8 different formulas, describe who uses them and complete an example.

Share your findings with your class.

Try researching the formulas used by forensic scientists, pilots, electricians, builders, architects, banks and salespeople.

13.4 Tables of values

We can complete a table of values when we are given an equation (formula) relating x and y values.

EXAMPLE 10

Complete each table of values given the equation.

a $y = 4x + 3$

x	−2	−1	0	1	2	3
y						

b $y = 10 - 2x$

x	−2	−1	0	1	2	3
y						

Steps	Working
a Substitute $x = -2$ into the equation and write the answer in the table under $x = -2$.	$y = 4 \times (-2) + 3$ $= -8 + 3$ $= -5$
	x −2 −1 0 1 2 3 y −5
Repeat with the other 5 values of x in the table.	When $x = -1$, $y = 4 \times (-1) + 3 = -1$. When $x = 0$, $y = 4 \times (0) + 3 = 3$. When $x = 1$, $y = 4 \times (1) + 3 = 7$. When $x = 2$, $y = 4 \times (2) + 3 = 11$. When $x = 3$, $y = 4 \times (3) + 3 = 15$.
	x −2 −1 0 1 2 3 y −5 −1 3 7 11 15
b Substitute $x = -2$ into the equation and write the answer in the table under $x = -2$.	$y = 10 - 2 \times (-2)$ $= 10 - (-4)$ $= 10 + 4$ $= 14$
Repeat with the other 5 values of x in the table.	When $x = -1$, $y = 10 - 2 \times (-1) = 12$. When $x = 0$, $y = 10 - 2 \times 0 = 10$. When $x = 1$, $y = 10 - 2 \times 1 = 8$. When $x = 2$, $y = 10 - 2 \times 2 = 6$. When $x = 3$, $y = 10 - 2 \times 3 = 4$.
	x −2 −1 0 1 2 3 y 14 12 10 8 6 4

Worksheets
Formula frolics
Tables of values

EXERCISE 13.4 Tables of values

ANSWERS p. 433

1 EXAMPLE 10 Copy and complete each table of values for the given equation.

a $y = 2x + 3$

x	−5	−2	3	6	11
y					

b $y = 3x - 5$

x	4	2	5	7	−3
y					

c $y = \frac{1}{2}x$

x	−4	−2	3	6	9
y					

d $y = 20 - 2x$

x	−2	−1	4	7	10
y					

2 Copy and complete the table for the relationship $y = 12 - x$.

x	1	2	5	9	10
y					

3 Match each equation to its correct table of values.

a $y = 3x$ **b** $y = 3 + x$ **c** $y = x^2$

d $x \times y = 12$ **e** $y = 6 - x$ **f** $y = \frac{1}{2}x + 1$

A

x	1	2	3	4	6
y	1	4	9	16	36

B

x	1	2	−3	4	6
y	4	5	0	7	9

C

x	1	2	3	−4	6
y	12	6	4	−3	2

D

x	0	2	8	−4	6
y	1	2	5	−1	4

E

x	1	2	3	4	6
y	5	4	3	2	0

F

x	1	−2	3	4	−6
y	3	−6	9	12	−18

4 Find an equation for each table of values.

a

x	1	2	3	4	5
y	2	3	4	5	6

b

x	1	2	3	4	5
y	0.1	0.2	0.3	0.4	0.5

c

x	1	2	3	4	5
y	4	8	12	16	20

d

x	1	2	3	4	5
y	1	4	9	16	25

e

x	1	2	3	4	5
y	9	8	7	6	5

f

x	1	2	3	4	6
y	24	12	8	6	4

g

x	1	2	3	4	6
y	6	5	4	3	1

h

x	1	2	3	4	6
y	2	4	6	8	12

5 Construct your own table of values for the equation $x - y = 1$.

13.5 Graphing linear equations

We can graph algebraic equations on a number plane. Some equations have graphs that are straight lines. The equation of a straight line is called a **linear equation**.

Graphing linear equations

- Complete a table of values for the equation.
- Plot the points from the table of values on a number plane.
- Rule a straight line through the points.
- Label the line with its equation.

Linear means 'of a line.'

We can choose any numbers we want for x, but we need to make sure the points will fit on our graph and be easy to calculate. It is easiest to choose whole numbers close to 0.

EXAMPLE 11

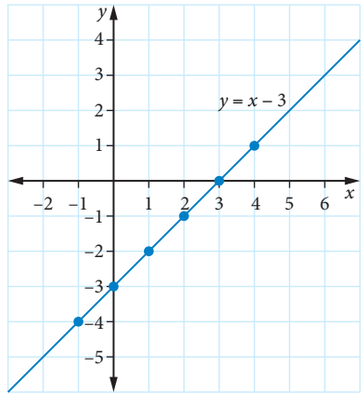
Graph the linear equation $y = x - 3$.

Steps	Working
Draw a table and choose some x values.	$x = -1$, $y = -1 - 3 = -4$
Calculate the y values to complete the table.	$x = 0$, $y = 0 - 3 = -3$
	$x = 1$, $y = 1 - 3 = -2$
	$x = 2$, $y = 2 - 3 = -1$
	$x = 3$, $y = 3 - 3 = 0$
	$x = 4$, $y = 4 - 3 = 1$

Do you notice a pattern with the y values?

x	−1	0	1	2	3	4
y	−4	−3	−2	−1	0	1

Draw a set of axes and plot the points. Rule a straight line through the points, place arrows at each end and label the line with its equation.



Gradient and y-intercept of a line

The **gradient** of a line measures how steeply the line goes up or down.

The ***y*-intercept** of a line is the y value of the point where the line crosses the y-axis.

13.5

Video Graphing linear functions

Skillsheet Graphing linear equations

Worksheets Graphing points and lines

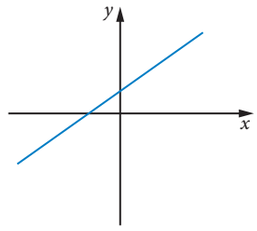
Graphing linear functions

A page of number planes

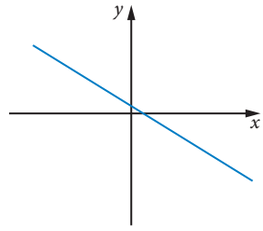
A **positive gradient** means the line goes up from left to right.

A **negative gradient** means the line goes down from left to right.

Positive gradient (increasing)



Negative gradient (decreasing)



Worksheet
Drawing gradients

Puzzle
Graph gradients

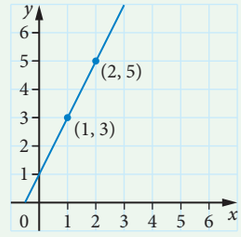
EXAMPLE 12

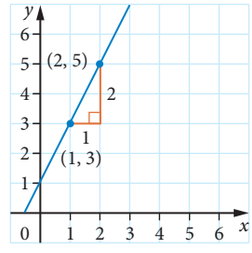
This line has the equation $y = 2x + 1$.

a What is the gradient of the line?

b What is the value of the y-intercept?

c How do your answers to parts **a** and **b** relate to the equation of the line?



Steps	Working
a Draw a right-angled triangle using the 2 points, using the line as the hypotenuse. The line goes up 2 units for every 1 unit across to the right.	 gradient $= \frac{2}{1} = 2$ The gradient is 2.
b The y-intercept is the y value of the point where the line crosses the y-axis.	The y-intercept is 1.
c The equation of the line is $y = 2x + 1$.	The gradient, 2, is the number in front of the x in the equation. The y-intercept, 1, is the number on its own in the equation.

EXAMPLE 13

Find the gradient and y-intercept of the line with equation:

a $y = 2x + 4$ **b** $y = -3x$ **c** $y = 7 - x$

Steps	Working
a The gradient is the number in front of the x. The y-intercept is the **constant** or the number on its own.	$y = 2x + 4$ gradient = 2 y-intercept = 4
b When there is no constant in the equation, the y-intercept is 0.	$y = -3x$ gradient = -3 y-intercept = 0
c Remember: $-x = -1x$ $y = 7 - x$ can be rewritten as $y = -x + 7$.	$y = 7 - x$ $y = -x + 7$ gradient = -1 y-intercept = 7

9780170448123

EXERCISE 13.5 Graphing linear equations

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13.5

1 EXAMPLE 11 Graph each linear equation.

a $y = x - 4$ **b** $y = 2x$ **c** $y = x + 3$

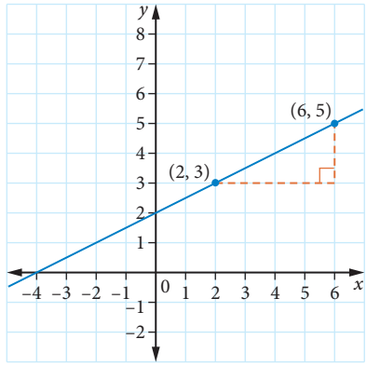
d $y = \frac{x}{2}$ **e** $y = -3x$ **f** $y = 2x - 4$

g $y = -x + 2$ **h** $y = 3x$ **i** $y = \frac{x}{4}$

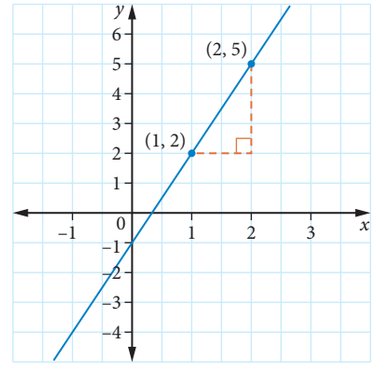
Remember: $\frac{x}{2} = \frac{1}{2}x$

2 EXAMPLE 12 For each line, find its gradient and y-intercept.

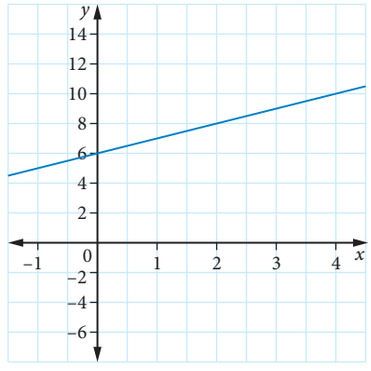
a



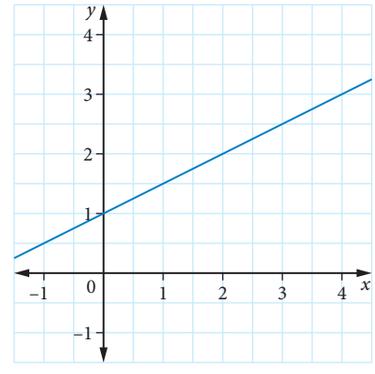
b



c



d



3 EXAMPLE 13 For each linear equation, state:

i the gradient **ii** the y-intercept.

a $y = 3x + 2$ **b** $y = -2x + 3$ **c** $y = 7 - x$

d $y = 4x$ **e** $y = \frac{x}{4} - 2$ **f** $y = -\frac{x}{3} - 4$

4 For each graph you drew in question **1**, state whether the gradient is positive or negative and write the gradient from the equation.

Puzzle
Writing and solving equations

13.6 Writing equations

Many mathematical problems are expressed in words. We can solve these problems by translating them into algebraic equations.

Writing equations to solve problems

- Choose a variable such as x.
- Translate the problem into an equation.
- Solve the equation.
- Write a sentence that answers the problem.

EXAMPLE 14

Wayne is thinking of a number. He doubled it and added 5. The answer is 69.
What is Wayne's number?

Steps	Working
Let the number be x.	
Double x is $x \times 2 = 2x$.	
Then add 5 means + 5.	$2x + 5 = 69$
Solve the equation.	$2x + 5 - 5 = 69 - 5$ $2x = 64$ $\frac{2x}{2} = \frac{64}{2}$ $x = 32$
Check the solution by substituting into the problem.	$2 \times 32 + 5 = 69$ ✓
Write the solution.	Wayne's number is 32.

EXAMPLE 15

Tom is 8 years older than Susi and the sum of their ages is 22. How old are they both?

Steps	Working
Let Susi's age be n.	Susi's age is n.
Tom is 8 years older. Add 8.	Tom's age is $n + 8$.
Susi's age + Tom's age = 22	$n + n + 8 = 22$ $2n + 8 = 22$
Solve the equation.	$2n = 14$ $n = 7$
Interpret the value of n and check it is correct.	Susi is 7 and Tom is $7 + 8 = 15$
$7 + 15 = 22$ ✓	
Write the answer.	Susi is 7 years old and Tom is 15.

EXERCISE 13.6 Writing equations

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1 EXAMPLE 14 Answer each question by writing an equation and then solving it to find the value of the unknown number.

a Five tickets for a film cost $55. How much does each ticket cost? (Let t represent the price of a ticket.)

b Ten oranges cost $4.80. How much does each orange cost? (Let x represent the cost of one orange.)

c A number is doubled and the result is 110. What is the number? (Let n represent the unknown number.)

d A number has 4 subtracted from it and the result is 6. Find the number. (Let y represent the unknown number.)

2 For each word problem, select the correct equation **A**, **B**, **C** or **D**. Then solve the equation to solve the problem.

a Jarrad has collected 1794 beetles. This is 6 times as many beetles as Lisa has. How many beetles does Lisa have? Let N = the number of beetles Lisa has.

A $1794 - N = 6$ **B** $6N = 1794$ **C** $N = 6 \times 1794$ **D** $N + 6 = 1794$

b Kurt mixed 590 mL of white paint with some blue paint. He mixed 1.73 L of paint altogether. How much blue paint did he use? Let N = the amount of blue paint.

A $N + 590 = 1730$ **B** $N - 590 = 1730$ **C** $\frac{N}{590} = 1730$ **D** $590N = 1730$

c 14 packets of chocolate biscuits are inside every large box. The supermarket sold 546 packets of biscuits. How many large boxes were sold? Let the number of large boxes be N.

A $14N = 546$ **B** $546 - N = 14$ **C** $N + 14 = 546$ **D** $\frac{N}{14} = 546$

d When N is subtracted from 100, the answer is 47. What is N?

A $N - 100 = 47$ **B** $100 + 47 = N$ **C** $N - 47 = 100$ **D** $100 - N = 47$

3 EXAMPLE 15 Translate each problem into an equation, then work out the solution of the equation to solve the problem.

> Remember: Sometimes drawing a diagram can help you to understand the information.

a Student Council is holding a school disco to raise $300. Each ticket is $5 and the costs for the evening are $130. How many tickets must be sold to make the required profit? (Let n stand for the number of tickets sold.)

b Mr Abdul says, 'I will not tell you my age, but I will tell you this: If you add 15 to my age and multiply the answer by 7, you'll get 294.' How old is Mr Abdul? (Let a stand for his age.)

c The perimeter of a rectangle is 100 cm and its width is 17 cm. What is the length? (Let l represent the length of the rectangle.)

d I am thinking of a number. If I take away 13, multiply by 6 and add 5, the answer is 95. What is the number? (Let y represent the number.)

e The area of a rhombus is calculated by multiplying the lengths of the diagonals and dividing by 2. One rhombus has an area of 44 cm^2 and one diagonal is 11 cm. What is the length of the other diagonal? (Let d represent the length of the diagonal.)

f Grace is a salesperson who earns $200 per week plus one-fifth of the value of her sales for that week. Last week her pay was $750. What was the value of her sales? (Let x stand for the value of her sales.)

Keyword activity

CHAPTER SUMMARY

ANSWERS p. 434

The letters in the keywords for this chapter have been scrambled. Unscramble these key words so that they fit in the following paragraph to create a summary of this chapter.

1	PREEXSSSNIO	**5**	TOAMUN	**9**	INGRUCTSTCON	**13**	ATETRANSL
2	STUEQAION	**6**	IDESS	**10**	AUEVLS	**14**	SWANER
3	EVOLS	**7**	TTTSSUUBIE	**11**	STIONP		
4	BDAAELNC	**8**	CRORETC	**12**	LNIE		

Many workplaces use formulas and algebraic $_1$_____ to assist with calculations. In this chapter we solved $_2$_____ and used formulas. To $_3$_____an equation, we have to do the same thing to both sides to keep the equation $_4$_____. For example, we can add the same $_5$_____to both sides or divide both $_6$_____ by the same quantity. An easy way to check whether a solution is correct is to $_7$_____ the value into both sides. If the LHS and RHS are equal, the value substituted is the $_8$_____ solution.

We can graph equations on a number plane. The first step is $_9$_____ a table of $_{10}$_____. Step 2 is plotting the $_{11}$_____ in the table on the number plane. Then we place a $_{12}$_____ through the points.

Sometimes problems are expressed in words. We have to $_{13}$_____ the problem into an equation and solve it to $_{14}$_____ the problem.

Solution to the chapter problem

Problem

Young children learn words at an amazing rate. When a child is aged between 1 and 5, we can predict the typical number of words they will understand using the formula $N = 60m + 100$, where m represents the age of the child in months and N is the number of words.

Anastacia, a childcare worker, is worried about Liam, a 20-month-old boy at her daycare centre who doesn't appear to understand many words. He has been tested and understands about 900 words.

Should Anastacia be concerned? Use calculations to support your answer.

Solution

Liam is 20 months old.

Substituting $m = 20$ into the formula $N = 60m + 100$:

$N = 60 \times 20 + 100$

$= 1300$

A typical 20-month old child understands 1300 words.

Liam only understands about 900 words, so Anastacia should be concerned.

13 Test yourself

Equations and lines

ANSWERS p. 434

1 EXERCISE 13.1

a Calculate the value of V in the formula $V = \frac{4}{3}\pi r^3$ when $r = 3.5$.
Express your answer correct to 1 decimal place.

b Evaluate S in the formula $S = \frac{D}{T}$ when $D = 450$ and $T = 18$.

c Use the formula $v^2 = u^2 + 2as$ to determine the value of v when $a = 4$, $s = 2.2$ and $u = 11$.
Express your answer correct to 1 decimal place.

2 EXERCISE 13.2 The formula $D = S \times T$ relates distance, speed and time. D = the distance travelled, S = the speed and T = the time. A motorcycle is travelling at an average speed of 115 km/h on the motorway.

a Calculate the distance the motorcycle will travel in 4 hours.

b Express 15 minutes as a fraction of an hour, then calculate how far will the bike travel in 15 minutes.

3 EXERCISE 13.2 The total distance it takes a car to stop at different speeds on a dry asphalt road can be calculated by using the formula $D = \frac{5Vt}{18}(5t + 2.27)$

where D = the total distance travelled in stopping, in metres
V = the car's velocity or speed in km/h
t = the driver's reaction time in seconds

Maya's reaction time is 0.9 seconds. Calculate the distance it takes Maya's car to stop when she is driving at 80 km/h.

4 EXERCISE 13.3 Is $d = 5$ the correct solution to the equation $12 - d = 2d - 3$? Use calculations to justify your answer.

5 EXERCISE 13.3 Solve each equation.

a $5x - 11 = 209$ **b** $\frac{p}{2} - 1 = 10$ **c** $\frac{24}{x} = 5.5$

6 EXERCISE 13.4 Copy and complete this table of values for the equation $y = 12 - 2x$.

x	0	1	3	4	5	6
y						

7 EXERCISE 13.5

a Construct a table of values to graph the linear equation $x + y = 9$.

b Graph the linear function $x + y = 9$.

c What is the gradient and y-intercept of the line $x + y = 9$?

8 EXERCISE 13.6 I am thinking of a number. If I divide the number by 8, then add 5, I get 9.
What is the number? Use an equation to find it.

9 EXERCISE 13.6 Joe is 15 years older than Renee. The sum of their ages is 67. How old are they both?

Chapter problem

Tommy is going deep-sea fishing. He plans to travel to a reef 30 km from a boat ramp at an average speed of 18 km/h. He'll leave the ramp at 5 am and spend 3 hours fishing before returning to the boat ramp.

At what time should Tommy expect to be back at the boat ramp?

CHAPTER 14

SPACE AND MEASUREMENT

GOING PLACES

14.1 Distance, speed and time
14.2 Compass directions
14.3 Street maps
14.4 Regional maps
14.5 GPS navigation
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Solve problems involving speed, distance and time
- Recognise and use compass directions
- Read grid references and information on street maps
- Interpret and use scale on maps
- Navigate using a GPS device

How are we ever going to use this?

- Planning holidays and journeys
- Travelling in unfamiliar locations
- Finding an alternate route to avoid traffic problems

Study Design coverage

UNIT 2, AREA OF STUDY 4: SPACE AND MEASUREMENT

- location, maps, directories and digital maps including birds-eye and street views
- routes and itineraries, including location and direction, speeds, distances and estimated travel times, for example daily work route and diversions, and itinerary for travel.

VCE Mathematics Study Design 2023–2027 p. 21, © VCAA 2022

Video (1):
14.1 Speed, distance and time

Worksheets (6):
14.1 Distance, speed and time • Speed problems • Racing rates • Speed stories • Speed formula practice
14.2 16 points of the compass

Weblink (1):
14.5 VicRoads

Nelson MindTap

To access resources above, visit **cengage.com.au/nelsonmindtap**

14.1 Distance, speed and time

Video Speed, distance and time

Worksheets Distance, speed and time
Speed problems
Racing rates
Speed stories
Speed formula practice

The question 'How long will it take to get there?' can be easily answered with a little mathematics. The values for the distance covered, the speed and the time taken are related. If we know two of the values, we can calculate the third value.

The speed formula

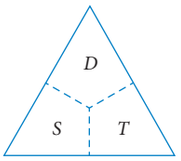
distance covered = speed × time

or $D = S \times T$

The units for the speed tell us the units for distance and time.

For example, when the speed is in km/h, the distance is in kilometres and the time is in hours. When the speed is in m/s, the distance is in metres and the time is in seconds.

Some students find it easier to use the 'distance, speed and time triangle' to solve problems involving speed. Place the letters D for distance, S for speed and T for time in alphabetical order in the triangle.

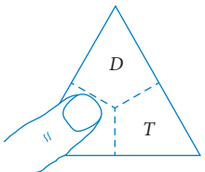


To calculate the **speed**, cover up S, which leaves $\frac{D}{T}$.

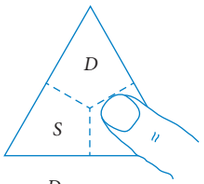
This means that $S = \frac{D}{T}$, or $S = D \div T$.

To calculate the **time**, cover up T, which leaves $\frac{D}{S}$.

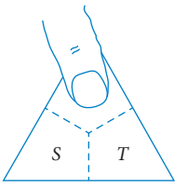
To calculate the **distance**, cover up D, which leaves $S \times T$.



$S = \frac{D}{T}$



$T = \frac{D}{S}$ or $T = D \div S$



$D = S \times T$

EXAMPLE 1

A racing greyhound runs at a speed of 18 m/s.

a How far will it run in 4 seconds?

b How long will it take the greyhound to complete a 1200 m race? Answer correct to the nearest 0.1 s.

Steps	Working
a Use the triangle. To find the distance, cover the D.	$D = S \times T$
$D = S \times T$	$= 18 \times 4$
where $S = 18$ m/s and $T = 4$ s.	$= 72$ m
Write your answer.	The greyhound will run 72 metres in 4 seconds.
b To find the time, cover the T.	$T = \frac{D}{S}$
$T = \frac{D}{S}$	$= \frac{1200}{18}$
where $D = 1200$ m and $S = 18$ m/s.	$= 66.666\ldots$
	≈ 66.7 seconds
Write your answer.	The greyhound will complete the race in 66.7 seconds.

EXAMPLE 2

A kangaroo bounds at a speed of 48 km/h. How far will a kangaroo bound in 20 minutes?

Steps	Working
The speed is in km/h so we need the time in hours. Divide 20 min by 60 to change to hours.	$T = \frac{20}{60} = \frac{1}{3}$ h
$D = S \times T$	$D = S \times T$
where $S = 48$ km/h	$= 48 \times \frac{1}{3}$
	$= 16$ km
Write your answer.	The kangaroo will bound 16 km in 20 minutes.

Remember:
1 hour = 60 minutes

EXAMPLE 3

Caitlin is driving through a school zone at a speed on 40 km/h. Convert 40 km/h to a speed in m/s, correct to 1 decimal place.

Steps	Working
To convert 40 km/h to m/s, change 40 km to m and 1 hour to seconds.	40 km = 40 × 1000 m
	= 40 000 m
	1 h = 60 × 60 seconds
	= 3600 s
$S = \frac{D}{T}$	$S = 40\,000$ m ÷ 3600 s
	$= 11.1111\ldots$
	≈ 11.1 m/s
Write your answer.	40 km/h is equivalent to 11.1 m/s.

Remember:
1 km = 1000 m

Remember:
1 hour = 60 minutes
1 minute = 60 seconds

EXERCISE 14.1 Distance, speed and time

ANSWERS p. 435

1 **a** Use the formula $T = \frac{D}{S}$ to find the value of T when $D = 80$ and $S = 16$.

b In the formula $D = S \times T$, what is the value of D when $S = 80$ and $T = 3$?

2 EXAMPLE 1

a Corrina is driving at a speed of 60 km/h. How far will she drive in 3 hours?

b How long will it take her to drive 240 km?

3 Anton has an appointment 160 km away. He must be there in 2 hours. At what speed must he travel to arrive in time?

4 Go-karts can race at a speed of 110 km/h. At this speed, how many kilometres can a go-kart travel in a $2\frac{1}{2}$-hour race?

5 EXAMPLE 2 Wasim is driving through heavy traffic at a speed of 32 km/h. How far will he travel in 15 minutes?

6 An ambulance is racing to the scene of a serious freeway accident at a speed of 100 km/h. The accident is 15 km from the ambulance station.

a How long will the ambulance take to reach the accident? Express your answer as a decimal of an hour.

b Multiply your answer to part **a** by 60 to change the time to minutes.

7 A tactical response team is travelling at 80 km/h to reach a siege 10 km away. How long will it take the team to arrive at the scene? Express your answer in minutes.

8 A whitewater rafting team completed 3 sets of rapids and 1.6 km of calm water in 30 minutes. The lengths of the sets of rapids are 150 m, 80 m and 170 m.

a Calculate the distance that the rafting team covered in 30 minutes. Express your answer in kilometres.

b Explain why you can't use $T = 30$ in the equation $S = \frac{D}{T}$ to calculate the speed of the raft in km/h.

c Calculate the raft's average speed in km/h.

Shutterstock.com/Ammit Jack

9 Cheetahs are the fastest animals on land, and can run at a speed of 31 m/s in short bursts.

a How far can a cheetah run in 9 seconds?

b How long does it take a cheetah to run 140 m? Answer in seconds, correct to 1 decimal place.

10 A peregrine falcon's top speed is 90 m/s.

a How far can the falcon fly in 1 minute?

b How long will it take the falcon to fly 1 kilometre?

11 This table shows distances between several eastern Australian cities in kilometres.

	Albury	Brisbane	Canberra	Goulburn	Sydney	Tamworth
Albury	–	1610	190	380	600	1040
Brisbane	1610	–	1300	1225	1020	575
Canberra	190	1300	–	95	300	750
Goulburn	380	1225	95	–	205	660
Sydney	600	1020	300	205	–	460
Tamworth	1040	575	750	660	460	–

a How far is it from Canberra to Tamworth?

b How long will it take to drive from Canberra to Tamworth at an average speed of 75 km/h?

c Gina took 5 hours to drive from Goulburn to Albury. What was her average speed?

d Max and Santosh left Albury at 6 am on Monday to drive to Brisbane. They shared the driving and completed the trip at an average speed of 70 km/h. At what time did they arrive in Brisbane?

12 EXAMPLE 3 Convert each speed to m/s.

a 60 km/h **b** 90 km/h

13 The minimum speed a rocket needs to escape the Earth's gravity is 11.2 km/s. What is this speed in km/h?

14 **a** Use a stopwatch to time how long it takes you to walk across your classroom.

b An international space station travels at a speed of approximately 28 000 km/h. How far does the space station travel in the time it takes you to walk across your classroom?

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Investigation Speed units

Use the internet to investigate a variety of speeds shown in the table below.

Decide on the appropriate units to express the speed: m/s, km/h, m/h or more than one. Develop a rule for answering the question: 'What unit should I use?'

Copy and complete this table.

Activity	Typical or record speed
Slow speeds Moving snail Adult walking Adult swimming Athlete running	
Medium speeds Cruise ship Car Downhill cross-country skiing Olympic speed skating	

Activity	Typical or record speed
Fast speeds Queensland tilt train Japanese high-speed train International airline jet	
Very fast speeds Bullet fired from a gun Fighter jet International space station Sound Light	

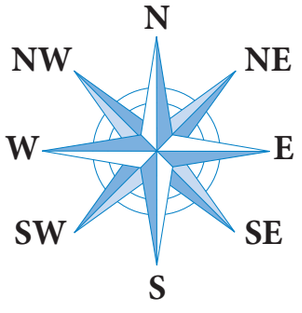
Group discussion questions

1. In what situations do we use the following speed units: m/h, m/s, km/s, km/h?
2. Why might we decide to measure the same speed using different speed units?

Worksheet
16 points of the compass

14.2 Compass directions

The four major directions are **north** (N), **east** (E), **south** (S) and **west** (W). The directions halfway between these are **northeast** (NE), **southeast** (SE), **southwest** (SW) and **northwest** (NW). We use these 8 **compass directions** to describe wind direction, the position of the sun and shadows, and the path of a plane or ship.



EXAMPLE 4

a According to this map, what compass direction is it from Coober Pedy to Port Augusta?

b In what direction is Coober Pedy from Port Augusta?

Steps	Working
a Position the centre of a compass rose on the place the direction is *from*. In this case, the bearing is from Coober Pedy.	
The direction to Port Augusta is between east and south.	The direction from Coober Pedy to Port Augusta is southeast.
b Now the bearing is from Port Augusta. Position the compass rose on Port Augusta.	
The direction to Coober Pedy is between north and west.	Coober Pedy is northwest of Port Augusta.

EXERCISE 14.2 Compass directions

ANSWERS p. 435

1 EXAMPLE 4 Write the compass direction:

a from Hobart to Roseberry

b from Launceston to Bothwell

c to Roseberry from Queenstown

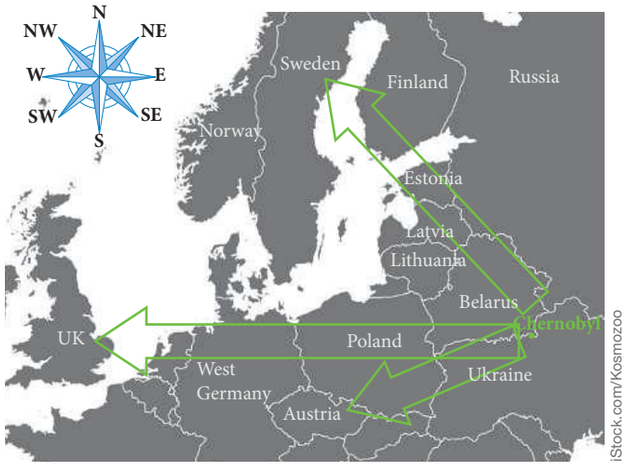
d to Launceston from George Town

iStock.com/pop_jop

2 After an explosion and fire at the Chernobyl nuclear power station in 1986, winds carried the radiation cloud over a vast area.

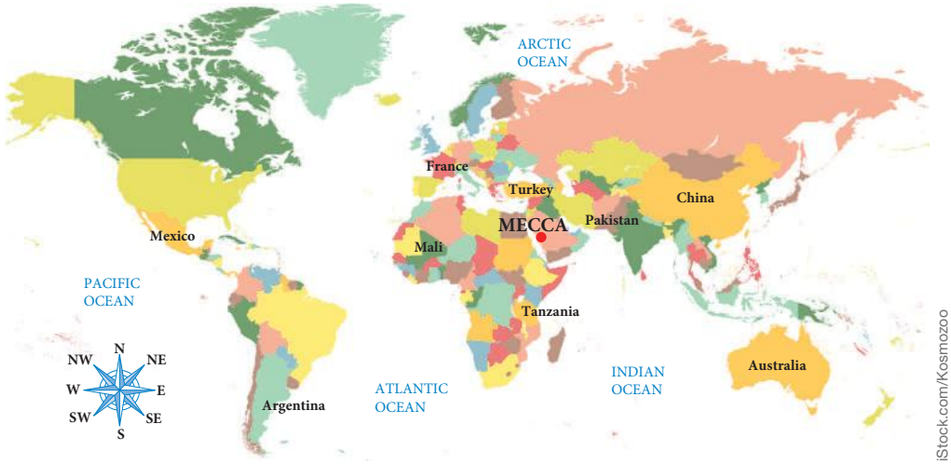
a What compass direction, NW, NE, SE or SW, is it from Chernobyl to Austria?

b Easterly winds are winds that come from an easterly direction. What countries experienced radiation clouds as a result of easterly winds?



iStock.com/Kosmozoo

3 When Muslim people pray, they always face in the direction of Mecca's Great Mosque, Islam's holiest place, in Saudi Arabia. What is the approximate compass direction from each place to Mecca?



iStock.com/Kosmozoo

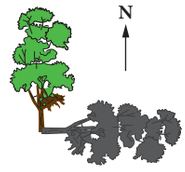
a Australia **b** China **c** Turkey

d Pakistan **e** Mali **f** Argentina

g France **h** Tanzania **i** Mexico

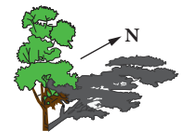
4 Late in the afternoon, the sun is in the west. Which of the diagrams **A**, **B**, **C** or **D** shows the correct position of the tree's shadow?

A

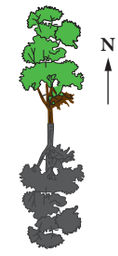


B

C



D

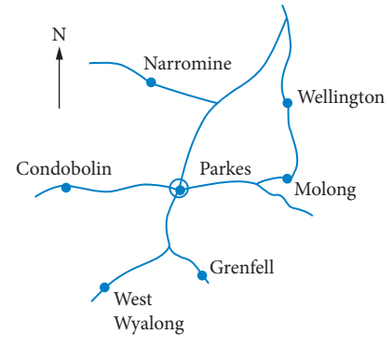


5 A westerly wind ('from the west') brought smoke from a bushfire to Parkes.

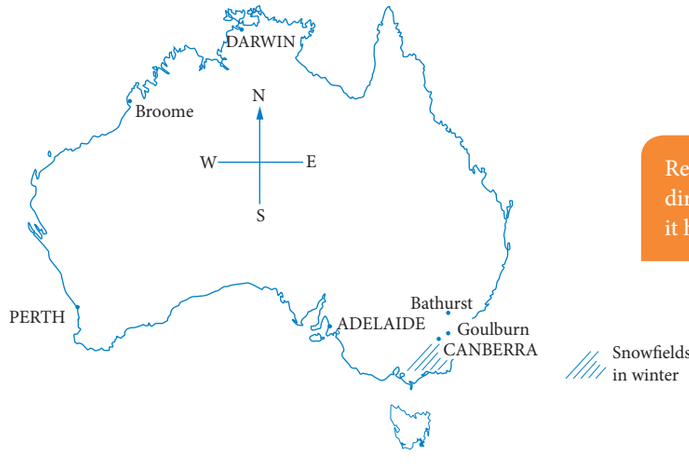
a Near which town on the map could the bushfire be?

b If the wind keeps blowing in the same direction, which other town will receive smoke from the fire?

c The wind changed direction and smoke went in the direction of SE. Which town experienced smoke?



6 Winds from over the ocean carry moisture and are likely to bring rain, while winds from over a land mass are likely to be dry. The temperature of the land the winds blow over determines whether the winds will be hot or cold. In winter, winds from over snow fields will be cold, while summer winds from Central Australia are likely to be dry and hot.



Remember: A wind's direction is the direction it has come *from*.

Are the following winds likely to be hot, cold, bring rain or fine weather?

a westerly winds in Perth

b westerly winds in Bathurst in summer

c northeasterly wind in Goulburn

d southerly winds in Canberra in winter

e southerly winds in Darwin in summer

f southerly winds in Adelaide

g northwesterly winds in Broome

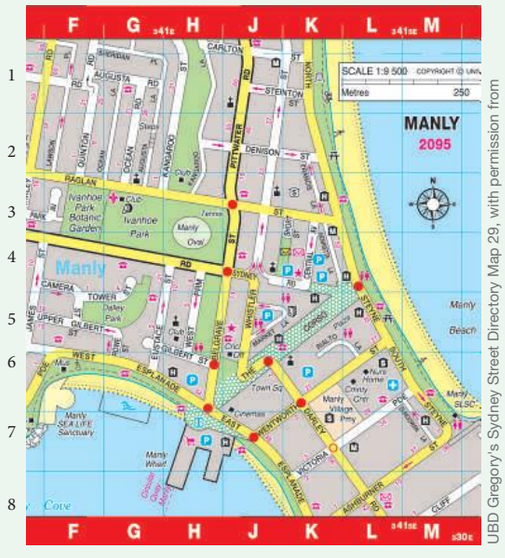
h southeasterly winds in Broome in summer

14.3 Street maps

Street maps usually have a grid coordinate system to help us locate places. Usually we read the coordinates by starting with the horizontal (across) letters, then we read the vertical (up and down) numbers.

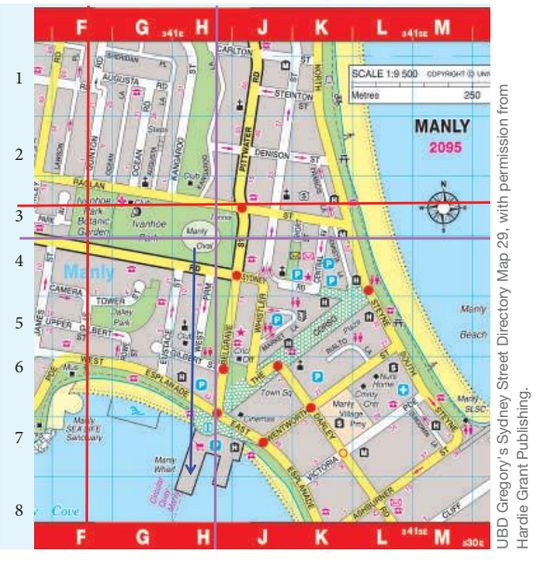
EXAMPLE 5

a On this map, what is the name of the park at F3?



b What are the position coordinates of Manly Oval?

c What direction is it from Manly Oval to Manly Wharf?

Steps	Working
a Find the position where column F meets row 3 (red lines).	
The red lines at F and 3 cross at Ivanhoe Park.	Ivanhoe Park is located at F3.
b Manly Oval is in column H and rows 3 or 4 (purple lines).	Manly Oval is at H3 or H4.
c The compass rose on the map shows that north (N) is straight up. An imaginary line (blue arrow) from Manly Oval to Manly Wharf points south.	Manly Wharf is south of Manly Oval.

F G H J K L M
1
2
3
4
5
6
7
8
SCALE 1:9 500
Metres 250
MANLY
2095
Manly
Manly Beach
Manly Cove
Ivanhoe Park Botanic Garden
Ivanhoe Park
Manly Oval
Manly Wharf
Manly SEA LIFE Sanctuary
Town Sq
Manly Village Prec
Manly SLSC
CARLTON
STEINTON ST
DENISON ST
PITTWATER RD
RAGLAN ST
SYDNEY RD
WHISTLER
BELGRAVE
CORSO
WENTWORTH
ESPLANADE
VICTORIA
AMBROSE
CLIFF
UPPER GILBERT ST
WEST ESPLANADE
CAMERA TOWER
Oxley Park
UBD Gregory's Sydney Street Directory Map 29, with permission from Hardie Grant Publishing.

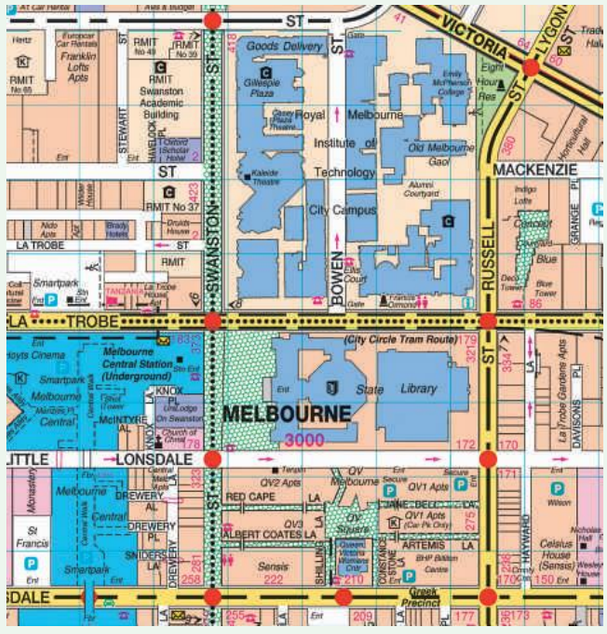
Distances on a street map

14.3

Street maps have a **scale**, which is shown on the map as a diagram or ratio. The scale on the Manly map is 1 cm represents 95 m, also shown as the ratio 1 : 9500 or as a diagram.

EXAMPLE 6

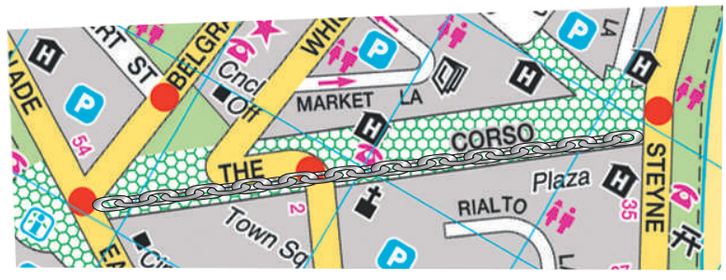
On this street map of the Melbourne CBD, each grid square length represents a distance of 62.5 metres. Use this scale to calculate the length of the RMIT campus along Swanston St.



UBD Gregory's Melbourne Street Directory Map 2, with permission from Hardie Grant Publishing.

Steps	Working
The length of the campus along Swanston St covers 4 grid squares. Multiply by 62.5 m.	boundary length = 62.5 × 4 = 250 m
Write your answer.	The Swanston St boundary is 250 metres long.

If we need to calculate a distance that isn't along the side of a grid square we can place a piece of string or chain along the distance, then compare the distance to the sides of the grid. In this picture, the length of the chain is roughly 3 grid squares.



UBD Gregory's Melbourne Street Directory Map 2, with permission from Hardie Grant Publishing.

EXERCISE 14.3 Street maps

ANSWERS p. 435

Use map 427 on the following page for this exercise.

1 **a** EXAMPLE 5 What is the name of the school located at E11?

b What does the small black square at D3 represent?

c Which Surf Life Saving Club is located at B1?

d There is a red light traffic camera at the intersection of the Frankston Freeway and Frankston-Dandenong Rd at F12. What symbol does the map use to show a red light camera?

e There are speed humps along Wangarra Rd (L18 to N19) to slow traffic. Name 2 other roads towards the top of the map that also have speed humps.

2 Write the position coordinates of each place.

a Belvedere Park Primary School

b Seaford Golf Driving Range

c Long Island Retirement Village

3 EXAMPLE 6 Name the compass direction:

a from Kananook Railway Station (F9) to the caravan park in C9

b from John Paul Secondary College (G15) to Long Island Country Club Clubhouse (G11)

c from VicRoads (H7) to the Indoor Cricket centre in H7

d to the tennis courts (B13) from the Arts Centre (B20)

4 Jeeva drove along the Nepean Highway from the tennis courts at B13 to his home in Brodie St (C3). In what direction did Jeeva drive?

5 Every day, Madison drives along the Frankston-Dandenong Rd from Ballarto Rd (P5) to Klauer St (K8) to get to her work. In what direction does she drive to work?

6 On the map, 1 kilometre covers 4 grid squares. Calculate the length of 1 grid square in metres.

7 Approximately how far is it along the Frankston Freeway from the overhead bridge at H2 to the interchange in G8? Answer correct to the nearest 100 metres.

8 Approximately how long is Skye Rd between the traffic lights in F13 and the roundabout in N15?

9 Each afternoon, Omar jogs along the beach from his home in Beach St at A17 to the Seaford Pier at B1 and back home.

a How far does Omar jog each afternoon? Answer to the nearest kilometre.

b Omar's afternoon jog takes 2 hours. Calculate his average jogging speed.

10 Calculate each distance 'as the crow flies'.

'As the crow flies' means 'in a straight line'.

a From Frankston Station (C19) to Kananook Station (F9)

b From Kananook caravan park (C6) to the post office in Seaford Business Centre (H5)

c From the swings in Skate Park (M9) to the closest public telephone

Map section reproduced with permission of UBD-Gregory's. Copyright Universal Publishers Pty Ltd DD 05/15

11 How far is it along the roads between each location?

a Corner of Boonong Ave and Fortescue Av (D11) to the roundabout on Govan St (E7)

b The traffic lights at the intersection of Nepean Highway and Seaford Rd (C4) to the telephone exchange at N5

12 Samantha rode her bike from John Paul College to Monterey College. She left from the roundabout in H16 and rode to the south western corner of Monterey College at K12. She rode along McMahons Rd, Syke Rd, then along Nats bike track.

a Approximately how far did Samantha ride?

b She rode at an average speed of 3 m/s. Approximately how long did the trip take?

13 Biljana lives near the roundabout on Buna Ave (C10). She left home and walked north along Kananook Ave. She turned into the first street on the right, then left into the third street on the left. She crossed the road and walked to the end of the park to practise her favourite sport. What is her favourite sport?

14 Dieter is visiting his grandmother in the retirement village at G17. Describe the route he could take to walk to his home in Oakhurst Ct (K15)

Investigation Directions to your home

Imagine your friends are going to visit your home for the first time. They will be arriving at the closest train station, bus stop or airport and then require directions to your place.

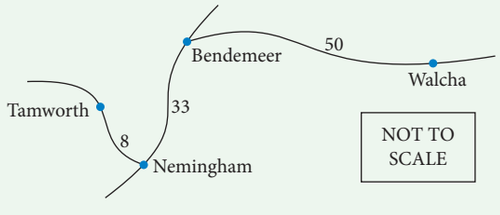
What you need to do

- Use either a street map or Google Maps to write instructions for your friends to walk, ride a bike, or catch a taxi to your place.
- Include distance and direction indications like left and right as well as compass directions to make following your instructions easy.

14.4 Regional maps

EXAMPLE 7

Josie is travelling from Tamworth to Walcha. The sketch below shows the distances between Tamworth and Walcha in kilometres. How far is it by road?



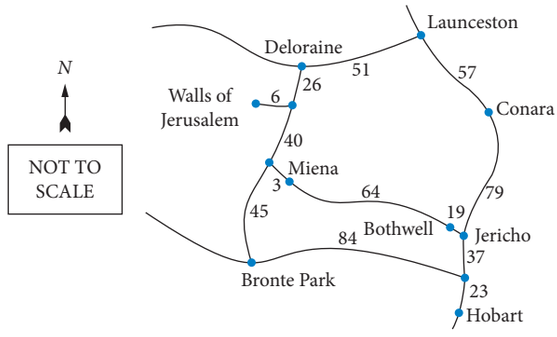
Steps	Working
It is 8 km from Tamworth to Nemingham, then 33 km to Bendemeer and 50 km to Walcha.	total distance = 8 + 33 + 50 = 91 km
Write your answer.	It is 91 km by road from Tamworth to Walcha.

9780170448123

EXERCISE 14.4 Regional maps

ANSWERS p. 435

Use this map from Tasmania to answer questions **1** to **4**. Distances are in kilometres.



1 EXAMPLE 7 Tyson drove from Launceston to Bothwell, via Jericho. How far did he drive?

2 How far is it from Launceston, via Deloraine, to Miena?

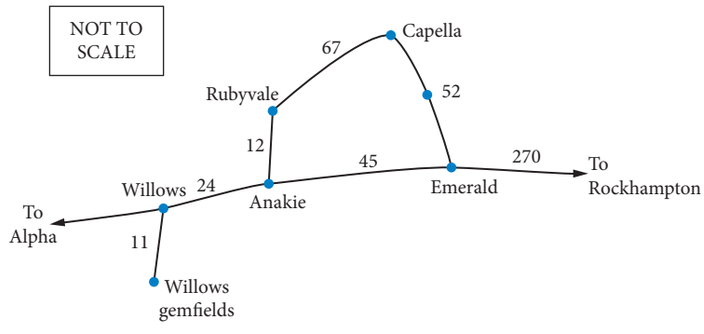
3 Luana drove from her hotel in Miena to see the Walls of Jerusalem. Then she drove back to her hotel for lunch. What distance did she travel on the round trip?

4 When Luana left Miena the next day to travel to Hobart, the odometer on her car showed 3521. She drove southeast and then south.

a What was the reading on her odometer when she reached Hobart?

b The trip took 2 hours and 15 minutes. Calculate her average speed from Miena to Hobart, correct to the nearest km/h.

5 Jerry left Emerald in Queensland to go sapphire mining in the nearby gemfields.



a How far is it from Emerald to the Willows gemfields?

b How long will it take Jerry to drive from Emerald to the Willows gemfields at an average speed of 75 km/h?

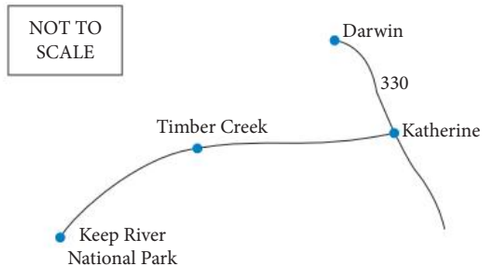
c Sapphire mining is very hard work in the sun. Jerry didn't take sufficient water with him and the closest shop that sells water is in Anakie. At 1.10 pm, he left the gemfields to get water. If Jerry averages 70 km/h, what time should he arrive at the shop?

d Jerry found a big star sapphire in the gemfields and was very excited! He drove to Rubyvale in 20 minutes to have it valued. He was booked by a speed camera for travelling 120 km/h in a 100 km/h zone.

i Calculate Jerry's average speed from the gemfields to Rubyvale.

ii So how can the speed detected by the speed camera be explained?

6 Linda drove from Darwin to Katherine in the Northern Territory and then on to see the spectacular red sandstone cliffs in Keep River National Park.

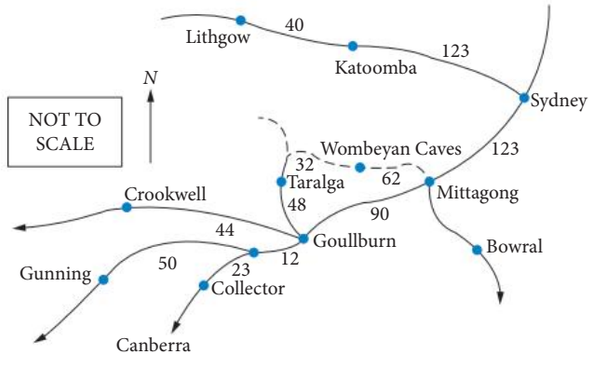


When she left Darwin the car's odometer reading was 73475 and when she reached Keep River National Park, it was 74261.

a How far is it from Katherine to the Keep River National Park?

b Linda drove at an average speed of 60 km/h. How long did the drive take her?

7 Claire and Jimmy drove southwest from Sydney for 123 km and stopped for lunch.



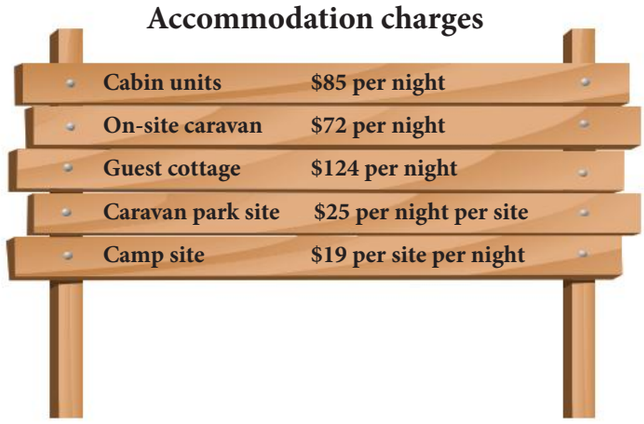
a Where did they stop for lunch?

b Wombeyan Caves was their next stop. They thought the dirt road directly to the caves looked too rough, so they went via Goulburn. How far did they travel?

c Their average speed after lunch was 90 km/h. How long did it take them?

d Their friends Jorja and Gilbert met them at the caves. They drove the 'short', dirt road route from Mittagong to the caves. It took them 1 hour 40 minutes. What was their average speed?

8 At Wombeyan Caves, Claire and Jimmy camped in their tent while Jorja and Gilbert stayed in an on-site caravan.



Calculate the total accommodation costs for the 4 friends to stay for 2 nights.

9 a Claire and Jimmy went on an afternoon tour of the Junction Cave. What time did the tour start?

Cave tours times

Fig Tree (Self guided)	9 am to 5 pm
Wollondilly Junction	1.45 pm and 11 am and 2.30 pm
Mulwaree	11.30 am
Kooringa	3.15 pm

Cave inspection fees

	Adult	Child	Family
Self guided (Fig Tree cave)	$15	$7	$35
Guided tour	$18	$9	$40
Two-cave package	$22	$12	$50

b How much did the tour cost?

c Jorja and Gilbert toured both the Wollondilly Caves and the Fig Tree Caves. How much did they save altogether by buying the two-cave package instead of separate tickets?

10 The next day the 4 friends left the caves and had breakfast in Goulburn. They left Goulburn at 10.15 am and drove at an average speed of 85 km/h to Gunning. What time did they arrive in Gunning?

14.5 GPS navigation

The **global positioning system (GPS)** developed from space-age technology has revolutionised our lives. 24 satellites orbiting the Earth can give us our location and assist with maps and navigation. Using our mobile phones or car GPS systems we can determine easily the best route to our destinations. Live traffic information and locating such things as petrol stations and restaurants along the way makes travelling easy.

EXAMPLE 8

Bailey wants to travel from Frankston Station to Koornalla Crescent in Mt Eliza by bus. He used a GPS mapping app to get directions by public transport.

a What number bus should he catch?

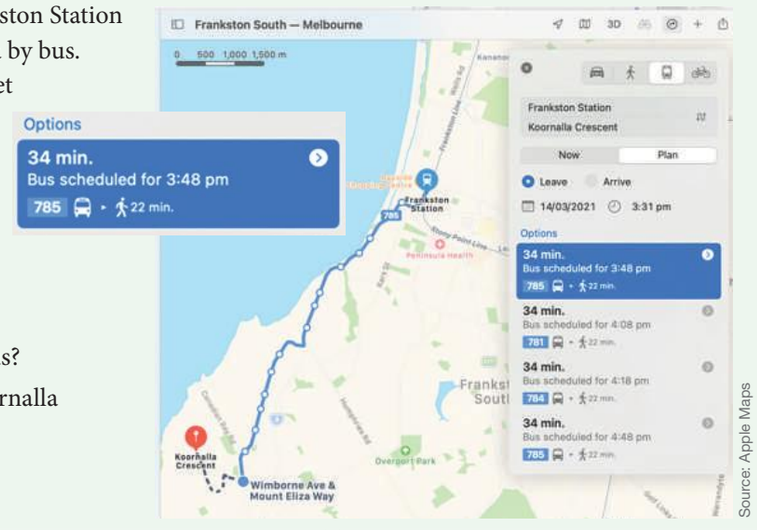
b What time does the bus leave the station?

c How long will the ride take?

d Where should he get off the bus?

e How long will the walk to Koornalla Cres take?

f At what time will Bailey reach Koornalla Cres?



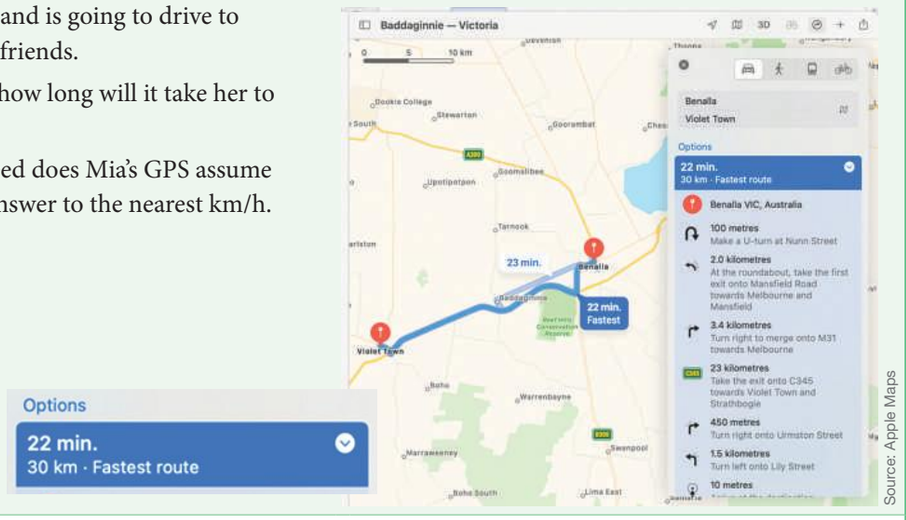
Steps	Working
a The first available bus is shown in the large blue box.	He should catch the 785 bus.
b Read the scheduled time in the blue box.	The bus leaves at 3.48 pm.
c Read the trip time at the top of the blue box.	The bus trip is 34 minutes.
d Use the map to read where Bailey should get off the bus.	He should get off the bus at the corner of Wimborne Ave and Mt Eliza Way.
e Read the walking time at the bottom of the blue box.	22 minutes
f Bus leaves at 3.48 + 34 min on the bus + 22 min walking.	Bailey will arrive at 4.44 pm.

EXAMPLE 9

Mia lives in Benalla and is going to drive to Violet Town to visit friends.

a How far is it and how long will it take her to get there?

b What average speed does Mia's GPS assume she will travel? Answer to the nearest km/h.



Steps	Working
a Read the information in the blue box.	The trip is 30 km and it will take 22 minutes.
b Time needs to be converted to hours if we want the speed in km/h. $\text{speed} = \frac{\text{distance}}{\text{time}}$ distance = 30 km	$\text{time} = 22 \text{ min} = \frac{22}{60} \text{ hours}$ $\text{speed} = 30 \div \frac{22}{60}$ $= 81.8181\ldots$ $\approx 82 \text{ km/h}$

EXERCISE 14.5 GPS navigation

ANSWERS p. 435

You need a GPS mapping app or website for this exercise.

GPS mapping apps include Google Maps, Where Is and Apple Maps.

1 EXAMPLE 8 Georgia is going to walk from Geelong Railway Station to Mercer Place.

- **a** How far is it from Geelong Station to Mercer Place?
- **b** How long will it take Georgia to complete the walk?
- **c** Name 2 food places she will walk past.
- **d** How much further is the trip by car than walking?
- **e** Georgia could catch a bus. What is the bus number and how long will she need to walk?

2 Peter is at Macleod Railway Station and he needs to get to Greensborough Primary School.

- **a** How far is it by car?
- **b** How long does the drive take on the shortest route?
- **c** Peter doesn't have a car. How can he make the trip by public transport?
- **d** Approximately how long would it take to walk? How far is it?
- **e** Use the street or satellite view to describe the features around the school.

3 Sam and Zac both live in Hampton Park. Sam lives at 5 Ridge Ct, and Zac lives at 67 Leopold Cres.

- **a** How far is it by car from Sam's house to Zac's house?
- **b** How long does the car trip take?
- **c** How long will it take to walk to Zac's house?
- **d** How much shorter is the walking than the car route?
- **e** Why is the car trip longer?

4 EXAMPLE 9 Zoe is very excited. She's just got an after-school job at the Parkdale Yacht Club.

- **a** How far is it by car from her home at 16 MacGregor St, Parkdale to the yacht club?
- **b** How long does the car trip take?
- **c** How long should it take to walk from the club to Zoe's home?
- **d** Calculate the average speed the app uses to calculate travel times.
- **e** The car speed limit is 60 km/h. Why does the app use such a low speed?
- **f** Write instructions for Zoe to follow when she walks home from the club.

5 Sarah needs to travel from her home at 40 Arthurs Seat Rd, Red Hill to pick up an important parcel from 296 Dundas St, Rye.

- **a** Use a street view of 296 Dundas St, Rye to determine if there is parking nearby.
- **b** How long will it take Sarah to drive to Rye?
- **c** How far is it?
- **d** What average speed did the app use to calculate the travel time?
- **e** Sarah arranged to pick up the parcel at 3.45 pm. What is the latest time she can leave home and arrive on time?
- **f** Sarah plans to have coffee somewhere before she heads home. Suggest a café she could visit and describe how she could get there after she picks up the parcel.

6 Jack is going to London for a holiday. He'll be leaving from Swan Hill and travelling to Melbourne airport. His London flight leaves at 6 pm.

- **a** How far is it from Swan Hill to Tullamarine Airport using the fastest route with tolls?
- **b** How long will it take to get there?
- **c** Name two freeways listed as part of the route.
- **d** Jack needs to be at the airport no later than 2 hours before the flight. When is the latest he can leave Swan Hill?
- **e** What time do you recommend he leave Swan Hill?
- **f** The car uses 7 L of fuel per 100 km. How much fuel will the car use on the trip to the airport?

7 Abby's family is having a road trip along the Great Ocean Road. Last night, they stayed at Bells Beach Cottages. Abby loves ice cream and she wants to visit the Great Ocean Road Chocolaterie and Ice Creamery.

- **a** What is the address of this tourist spot?
- **b** Is there any parking nearby?
- **c** Is the shop in town or outside town?
- **d** Travelling from Bells Beach, is the shop on the right or the left-hand side?
- **e** How far is it from Bells Beach Cottages?
- **f** Will it take long to get there?
- **g** Locate a satellite view of the site in 2 different apps. Is there any difference? How can any difference be explained?

Practical activity How accurate is your GPS?

Some people complain that the suggested time a GPS app says a trip will take isn't reliable. In this practical activity you are going to check the timing suggested by your device.

Plan trips on a bus and by car, recording the time your device suggests the trip will take.

- Complete the trip on a local bus and record the time the trip took.
- Complete the car trip and record the time taken.

Evaluate your results. How well did your experimental results match your GPS?

Planning a trip

Some people are required to drive long distances in their job. In this activity, you are going to plan a driving trip for a travelling salesperson from Geelong to Mildura. The trip will start at 7.30 am.

To complete this activity you will need access to the internet.

What you have to do

1. Use **Google Maps** to determine the best route to follow from Geelong to Mildura.
2. How long is the trip in kilometres?
3. List several towns on the route and the distances between the towns.
4. How long does the website suggest it will take to complete the drive?
5. Safety experts suggest drivers take a break every 2 hours. At an average speed of 80 km/h, how far will the salesperson travel in 2 hours?
6. How many rest stops should be planned to include during the trip?
7. Print a map for the trip and locate some possible rest stop sites.
8. Visit the **VicRoads** website and search for **Rest areas**. Locate some recommended rest stops near the locations you determined in step **3**.
9. List some things that the salesperson should be aware of as they drive this route.

Weblink
VicRoads

Solution to the chapter problem

Problem

Tommy is going deep-sea fishing. He plans to travel to a reef 30 km from a boat ramp at an average speed of 18 km/h. He'll leave the ramp at 5 am and spend 3 hours fishing before returning to the boat ramp.

At what time should Tommy expect to be back at the boat ramp?

Solution

travel time to the reef = distance ÷ speed
= 30 ÷ 18
= 1.666… hours
= 1 h 40 min

total time = travel out and back + fishing time
= 2 × 1 h 40 min + 3 h
= 6 hours 20 min

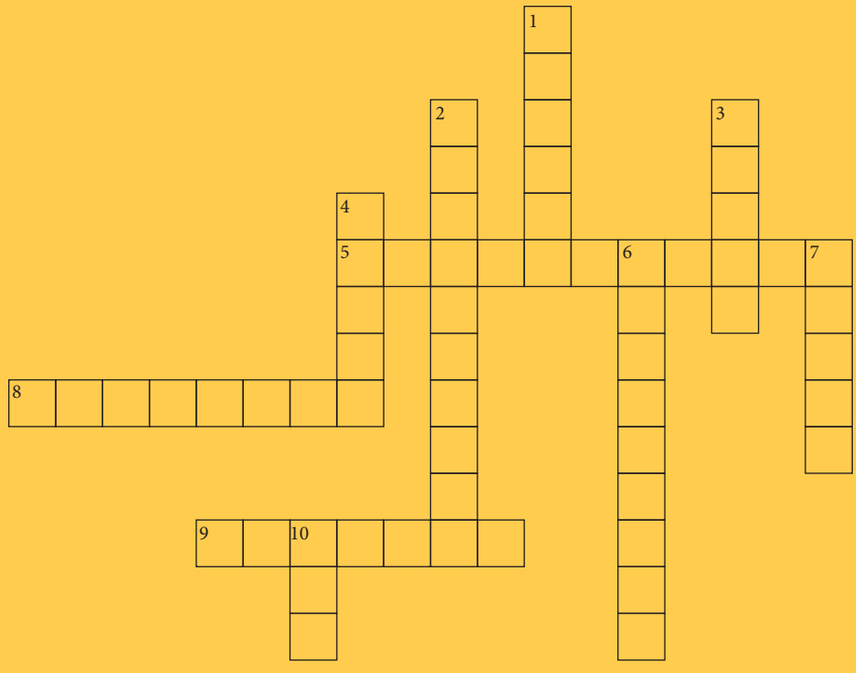
Time back at the boat ramp = 5 am + 6 hours 20 min
= 11.20 am

Keyword activity

GOING PLACES CROSSWORD

ANSWERS p. 436

Copy this crossword, then use the clues to complete it.



Across

5 The letter-number combination that gives the position of a street or object on a street map.

8 What D stands for in the formula $D = S \times T$

9 A type of direction, for example, north, south, east and west.

Down

1 What 's' stands for in the speed unit m/s.

2 Speed is often measured in _____ per hour.

3 On a map, the direction pointing down the page.

4 A ratio that allows us to calculate real distances from a map.

6 The opposite direction to southeast.

7 Distance ÷ time

10 A scale diagram of a city or region.

14 Test yourself

Going places

ANSWERS p. 436

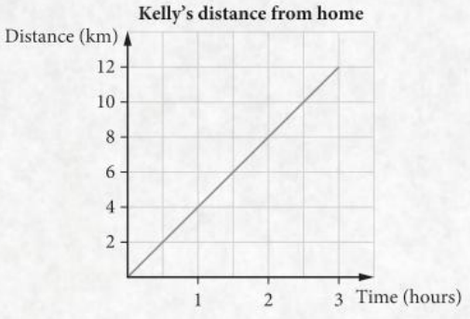
1 EXERCISE 14.1 How long will it take Bianca to ride 24 km at an average speed of 8 km/h?

2 EXERCISE 14.1 Kane is driving at an average speed of 60 km/h. How far will he drive in 15 minutes?

3 EXERCISE 14.1 Ava travelled 900 m in 45 seconds. Calculate her average speed in m/s.

4 EXERCISE 14.1 Convert a speed of 90 km/h to a speed in m/s.

5 EXERCISE 14.1 The graph shows the distance that Kelly was from home. What was Kelly's average speed?



6 EXERCISES 14.2, 14.3 Use map 427 on page 375 to answer the following questions.

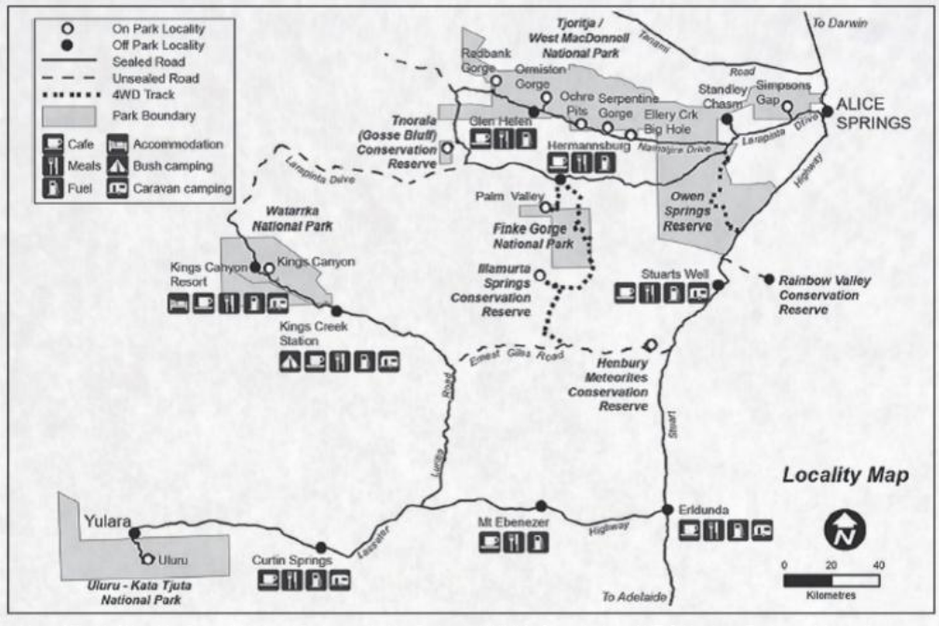
a What feature is at K4?

b Approximately how far is it from the Seaford Pier B1 to the tennis courts B13?

c In what compass direction does the Frankston-Dandenong Road run?

9780170448123

7 EXERCISES 14.2, 14.4 The map shows the central region of the Northern Territory that contains Uluru.



Map of Tjoritja/West MacDonnell National Park supplied by Parks and Wildlife Commission of NT © Northern Territory of Australia. The Northern Territory of Australia does not warrant that the product or any part of it is correct or complete and will not be liable for any loss, damage or injury suffered by any person as a result of its inaccuracy or incompleteness.

a What type of vehicle can travel to Finke Gorge National Park?

b Jess wants to drive from Alice Springs to Kings Canyon, but she doesn't want to travel on any unsealed roads. Describe a route she could take.

c Describe a route Jess could take to drive from Kings Canyon to Yulara.

d Damian is having coffee at Mt Ebenezer on the way to visit Uluru.
Approximately how far is it from Mt Ebenezer to Yulara?

e Damian plans to spend the night in a caravan park on the way to Yulara.
Where do you suggest he should stay?

f What compass direction is the trip from Mt Ebenezer to Yulara?

g Tegan is driving from Stuarts Well to Alice Springs. In what compass direction is she heading?

8 EXERCISES 14.2, 14.5 Hamish is meeting friends in Bacchus Marsh McDonalds at 4 pm today. Currently, he's at his grandparents' house at Baxter Crescent, Baxter.

a Hamish doesn't like toll roads. Use a GPS to find how far is it from his grandparents' house to McDonalds Bacchus Marsh, avoiding toll roads.

b How long will it take him to drive from Baxter to Bacchus Marsh?

c What average speed did the GPS use to calculate the travel time?

Chapter problem

Ziad and Adrian are arguing about which local football team is better. The number of goals scored by their favourite teams in each match over the previous season are listed here:

Eagles: 20, 10, 40, 12, 17, 20, 22, 20, 34, 19, 36, 18, 24, 12, 38, 34, 24, 36, 32, 22, 6, 7, 38, 18

Cougars: 14, 18, 24, 39, 14, 4, 4, 14, 10, 13, 28, 22, 16, 18, 18, 12, 18, 28, 21, 6, 10, 18, 36, 12

a What is the best graph to use to show this data? Construct this graph.

b Which is the better team based on this data? Justify your answer.

c What additional data might you need to know to decide which is the better team?

CHAPTER 15

DATA ANALYSIS, PROBABILITY AND STATISTICS

COMPARING DATA

15.1 Boxplots
15.2 Back-to-back stem-and-leaf plots
15.3 Parallel boxplots
15.4 Comparing data
Keyword activity
Solution to the chapter problem
Chapter review

What will we do in this chapter?

- Calculate a five-number summary and create a boxplot for the data
- Compare two sets of data using back-to-back stem plots and parallel boxplots
- Compare data using a variety of information

How are we ever going to use this?

- To calculate summary statistics to allow comparisons of data
- When comparing products for sale
- When examining performances in a variety of sports
- To determine whether data has been analysed correctly in the media

Study Design coverage

UNIT 2, AREA OF STUDY 2: DATA ANALYSIS, PROBABILITY AND STATISTICS

- creation of a range of charts, tables and graphs to represent and compare data
- measures of central tendency and simple measures of spread (such as range and interquartile range) to summarise and interpret data and compare sets of related data
- interpretation, summary and comparison of related data sets to report findings and draw possible conclusions.

VCE Mathematics Study Design 2023–2027 p. 20, © VCAA 2022

Videos (2):
15.1 Box-and-whisker plots
15.3 Double boxplots

Worksheets (2):
15.1 Box-and-whisker plots
15.2 Stem-and-leaf plots 2

Weblink (1):
15.3 Bureau of Meteorology

Nelson MindTap

To access resources above, visit
cengage.com.au/nelsonmindtap

Video
Box-and-whisker plots

Worksheet
Box-and-whisker plots

15.1 Boxplots

In Chapter 7, *It's better than average,* we learned how to find the quartiles for a set of data.

Q_1 is the lower or first quartile.

Q_2 is the median.

Q_3 is the upper or third quartile.

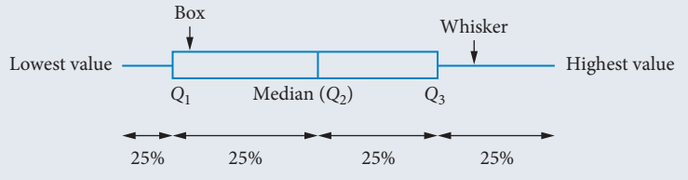
The 3 quartiles and the lowest and highest data values together make a **five-number summary** for the data set, which can then be graphed on a **boxplot,** also called a **box-and-whisker plot**.

Five-number summary and boxplot

The **five-number summary** for a set of data consists of:

- the lowest value
- the first or lower quartile, Q_1
- the second quartile, the median, Q_2
- the third or upper quartile, Q_3
- the highest value

A **boxplot** is a graphical representation of a five-number summary.



Range and IQR

The **range** is the difference between the highest and lowest values.

The **interquartile range** is the difference between the third and first quartiles.

$$\text{IQR} = Q_3 - Q_1$$

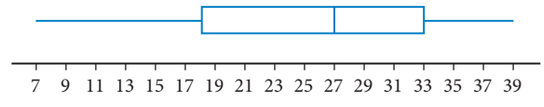
EXAMPLE 1

The ages of 23 people at a café are shown below.

33, 23, 28, 36, 27, 15, 32, 18, 13, 13, 38, 38, 27, 7, 34, 27, 12, 26, 33, 21, 24, 39, 20

a Find the five-number summary for this data.

b Draw a boxplot for this data.

Steps	Working
a Place the ages in ascending order and find the quartiles.	7, 12, 13, 13, 15, (18), 20, 21, 23, 24, 26
	(27), 27, 27, 28, 32, 33, (33), 34, 36, 38, 38, 39
There are 23 values so the median, the middle value, is the 12th value.	$Q_1 = 18$, $Q_2 = 27$, $Q_3 = 33$
There are 11 values below the median, so the first quartile is the 6th value.	
There are 11 values above the median, so the third quartile is the 18th value.	
For the five-number summary, include the lowest value (7) and the highest value (39).	The five-number summary is: 7, 18, 27, 33, 39
b Draw the boxplot with the box between 18 and 33 with a middle bar at 27, and the whiskers extending to 7 and 39.	

EXERCISE 15.1 Boxplots

ANSWERS p. 436

Use your answers to Exercise **7.3** on page 176 for this exercise.

1 EXAMPLE 1 Use your answers to question **1** about the sale of fish in a fish and chip shop to:

- **a** write a five-number summary for the data
- **b** draw a boxplot for the data.

2 Use your answers to question **2** about maximum temperatures in Cairns to:

- **a** write a five-number summary for the data
- **b** draw a boxplot for the data.

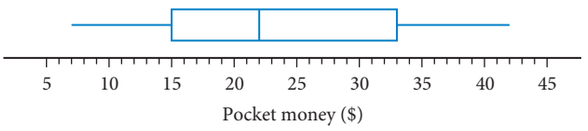
3 Use your answers to question **3** about student heights to draw a boxplot for the data.

4 The monthly number of home burglaries in Emu Springs were recorded over 27 months.

21, 25, 17, 23, 16, 21, 41, 22, 25, 20, 22, 11, 20, 12, 13, 12, 6, 12, 10, 19, 30, 22, 21, 14, 34, 33, 24

- **a** What is the five-number summary for this data?
- **b** Draw the boxplot for this data.

5 This boxplot represents the amount of pocket money in dollars received by a sample of 60 children.



a Find the median.

b Find the range.

c How many children received between:

i $33 and $42?

ii $15 and $42?

d Find the interquartile range.

6 This stem-and-leaf plot shows the number of students served at the school canteen over a 3-week period.

Stem	Leaf
7	6
8	1 6 8
9	5 7 8
10	1 5 5
11	2 2 4 7
12	4

Key: 7|6 = 76

a Find the five-number summary for this data.

b Draw the boxplot for this data.

7 This back-to-back stem-and-leaf plot shows the heights, in centimetres, of boys and girls in a Year 11 class.

Boys	Stem	Girls
4 4 4 3	16	0 1 3 4 4
9 8	16	5 7
4 2 1 1	17	0 1 2 2 4
6 9 9	17	5 7
2 1 0	18	

Key: 3|16| = 163

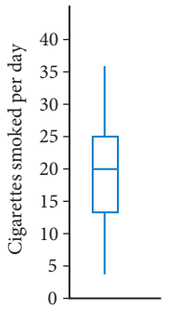
|16|0 = 160

a Find the five-number summary for each set of data.

b Draw the boxplot for each set of data.

c Summarise the differences between the heights of boys and girls.

8 This boxplot shows the number of cigarettes smoked per day by a sample of 60 smokers who are trying to quit.



a What is the median number of cigarettes smoked per day?

b What is the interquartile range?

c What is the lowest number?

d How many people smoked between 20 and 25 cigarettes per day?

e How many people smoked fewer than 20 cigarettes per day?

9 a Use your answers to question **5** in Exercise **7.3** on page 177 about retail thefts to write a five-number summary for each set of data

b Draw a boxplot for each set of data.

c In which region do you think it would be safer to open a shop? Justify your answer.

15.2 Back-to-back stem-and-leaf plots

We can use **back-to-back stem-and-leaf plots** to compare 2 data sets.

EXAMPLE 2

Madeline compares the ages of people attending 2 local gyms.

Allfit: 17, 22, 51, 12, 27, 43, 39, 20, 21, 15, 15, 45, 15, 20, 32, 21, 23, 16, 34, 22

Superfit: 19, 20, 32, 56, 27, 16, 11, 32, 38, 21, 13, 22, 32, 35, 23, 31, 20, 19, 22, 35

a Draw a back-to-back stem-and-leaf plot for this data.

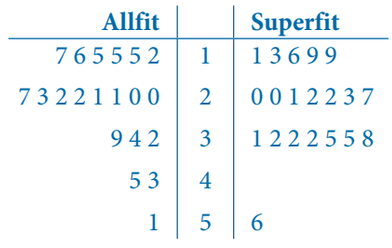
b Find the median age for each gym.

c Find the range for each gym.

d Are there any outliers in either gym? If so, state the outliers.

e State one similarity between the 2 sets of data.

f State one difference between the 2 sets of data.

Steps	Working
a The stem is in the middle.	 Key: 2|1| = 12 |1|6 = 16
b Each gym has 20 values, so the middle values are the 10th and 11th values.	Allfit: middle values are 21 and 22. median for Allfit $= \frac{21 + 22}{2}$ $= 21.5$ Superfit: middle values are 22 and 23. median for Superfit $= \frac{22 + 23}{2}$ $= 22.5$
c range = highest value – lowest value	range for Allfit = 51 – 12 = 39 range for Superfit = 46 – 11 = 35
d An outlier is an extreme value.	56 is an outlier for Superfit.
e Look for similar things about the data.	The medians for both sets of data are quite close.
f Look for different things about the data.	Allfit's ages are more spread out than Superfit's. Superfit's ages are spread evenly across the 10s, 20s and 30s; the Allfit ages are clustered in the 10s and 20s.

Worksheet
Stem-and-leaf plots 2

EXERCISE 15.2 Back-to-back stem-and-leaf plots

ANSWERS p. 436

1 EXAMPLE 2 The results of two Year 10 classes in their final mathematics exam are listed.

10A: 84, 71, 79, 82, 78, 89, 71, 95, 93, 81, 85, 65, 70, 95, 91, 89, 89, 75, 62, 71, 69, 88, 94, 81, 85, 76, 80, 67, 60

10B: 88, 60, 66, 74, 42, 59, 61, 68, 54, 65, 56, 46, 65, 71, 57, 72, 40, 65, 41, 38, 35, 39, 51, 47, 39, 42, 39, 42

a Draw a back-to-back stem-and-leaf plot for this data.

b How many students are in 10A?

c Find the median for each class.

d Find the range for each class.

e Are there any outliers in either class? If so, state the outliers.

f If one class is the top class and one class is the middle class, which class is which?

2 The school principal Mr Farley is concerned about absences in Year 11 and Year 12. The following shows the daily number of absentees over a 4-week period.

Year 12: 20, 22, 12, 8, 19, 13, 14, 23, 7, 22, 18, 20, 13, 19, 21, 15, 24, 10, 26, 24

Year 11: 30, 15, 30, 23, 39, 20, 31, 42, 22, 41, 30, 25, 23, 30, 22, 30, 29, 15, 15, 44

a Draw a back-to-back stem-and-leaf plot for this data.

b Find the median for each year group.

c Find the range for each year group.

d Are there any outliers in either year group? If so, state the outliers.

e State one similarity between the 2 sets of data.

f State one difference between the 2 sets of data.

g Mr Farley believes there is more absenteeism in Year 11 than in Year 12. What other information do we need to evaluate this statement?

3 For a PE assignment, Kayne compares the heights of males and females in Year 11. The following data he collected are in centimetres.

Males: 178, 183, 167, 184, 181, 170, 190, 181, 181, 200, 183, 160, 165, 172, 178, 178, 168, 191, 181, 190, 180, 184, 180, 175, 170

Females: 178, 166, 166, 150, 168, 166, 163, 162, 167, 159, 157, 185, 176, 164, 165, 164, 160, 185, 176, 177, 171, 152, 173, 173

a Draw a back-to-back stem-and-leaf plot for this data. Use stems of 15, 16, 17 …

b How many males were measured?

c How many females were measured?

d Find the five-number summary for the males and for the females.

e Are there any outliers in each group? If so, state the outliers.

f State one difference between the 2 sets of data.

g Write 2–3 sentences that Kayne could use as a conclusion for his assignment.

4 The following are the daily maximum temperatures for Townsville, Qld and Kiama, NSW in the month of February.

Townsville: 32.1, 32.3, 33.1, 33.4, 31.8, 31.0, 33.7, 34.3, 32.7, 32.7, 31.0, 33.4, 33.6, 34.2, 32.3, 32.5, 31.9, 32.1, 32.8, 31.7, 29.3, 31.9, 31.2, 31.7, 31.2, 32.2, 29.5, 31.0

Kiama: 33.0, 27.9, 32.6, 27.6, 36.3, 29.6, 21.0, 23.0, 22.5, 25.0, 26.4, 22.1, 20.7, 22.3, 24.9, 25.6, 25.5, 24.5, 27.0, 32.5, 21.8, 20.3, 22.5, 24.7, 25.6, 25.9, 26.7, 25.4

a Draw a back-to-back stem-and-leaf plot for this data. Use stems 20, 21, 22 … up to 36.

b How many days are there in February?

c Find the median for each city.

d Find the range for each city.

e Are there any outliers in the data for either city? If so, state the outliers.

f State one difference between the 2 sets of data.

g Write 2–3 sentences comparing the temperatures in the 2 towns.

h Which town would you prefer to live in based on this data? Justify your answer.

15.3 Parallel boxplots

In statistics, there are many opportunities to compare 2 sets of data. We can use **parallel boxplots** to compare sets of data by drawing 2 or more boxplots using a common scale. Other types of graphs can also be used to make comparisons.

Video
Double boxplots

EXAMPLE 3

The five-number summaries below describe the number of rainy days per month over 2 years for Sydney and Melbourne.

Sydney: 9, 11, 13, 14, 15

Melbourne: 7, 10, 14, 16, 19

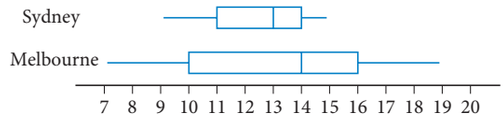
a Draw parallel boxplots for these summaries.

b Find the median for each city.

c What is the interquartile range for each city?

d Which city has more rainy days per month?

e If Corrina prefers a more consistent pattern of rainy days, which city would you recommend for her to live in? Justify your answer.

Steps	Working
a Use one scale for both boxplots.	
b The median is the middle value in the five-number summary and the middle bar in the boxplot.	median for Sydney = 13 median for Melbourne = 14
c interquartile range = $Q_3 - Q_1$ In a five-number summary, Q_1 is the 2nd value and Q_3 is the 4th value, or the ends of the boxes in the boxplots.	interquartile range for Sydney = 14 – 11 = 3 interquartile range for Melbourne = 16 – 10 = 6
d Compare the medians and boxes of the boxplots.	Melbourne has more rainy days per month. Its median is higher and half its data values are above 14, compared to one-quarter of scores for Sydney.
e Consistent means the data is less spread out.	Sydney has the more consistent pattern of rainy days because its range and interquartile range are smaller than Melbourne's. This is shown by the shorter boxplot.

EXERCISE 15.3 Parallel boxplots

ANSWERS p. 437

1 EXAMPLE 3 The following five-number summaries are for the half-yearly exam in Rigby's class and Alex's class.

Rigby's class: 48, 64, 75, 87, 96

Alex's class: 47, 57, 69, 80, 97

a Draw parallel boxplots for these summaries.

b What is the median for:

i Rigby's class?

ii Alex's class?

c What is the range for:

i Rigby's class?

ii Alex's class?

d Both Rigby and Alex scored 85 in the half-yearly exam. Who performed better in relation to their own class? Justify your answer.

e Which class generally performed better in the half-yearly exam? Justify your answer.

f Can we calculate the mean from the given information? Explain.

2 These are the waiting times, in minutes, for calls to customer service in 2 phone companies.

Chatphone: 10, 7, 6, 8, 7, 5, 6, 9, 7, 3, 8, 8, 9, 7, 9, 7, 9, 8

Oztel: 10, 5, 9, 9, 9, 10, 11, 9, 8, 7, 9, 7, 7, 6, 9, 8, 11, 11

a Find the five-number summary for each set of data.

b Construct parallel boxplots for this data.

c Find the median for each company.

d Find the mode for each company.

e Find the interquartile range for each company.

f Chatphone claims that its waiting times are generally lower than those of Oztel. Is this correct? Justify your answer.

g Is there sufficient information to decide which company you would choose to have your mobile phone with? What other information would you need, if any?

3 The Mayor of Middleton claims that his town is safer for drivers than the nearby town of Blakewell. To test this, James measured the speed (in km/h) of a sample of 20 cars in each town.

Middleton: 60, 65, 70, 68, 62, 75, 80, 83, 82, 69, 73, 75, 85, 72, 67, 88, 90, 85, 72, 63

Blakewell: 76, 64, 58, 82, 72, 70, 68, 75, 63, 67, 74, 70, 79, 80, 73, 75, 71, 68, 72, 73

a Find the five-number summary for each town's data.

b Construct parallel boxplots for this data.

c Find the median for each town.

d Find the mode(s) for each town.

e Find the mean for each town.

f Find the interquartile range for each town.

g Is the Mayor of Middleton correct? Justify your answer.

4 The following data lists the prices for houses sold in a Melbourne suburb over one month. All amounts are in dollars.

890 000, 580 000, 895 000, 550 000, 680 000, 690 000, 530 000, 790 000
650 000, 480 000, 980 000, 850 000, 495 000, 690 000, 570 000

a Find the five-number summary for this data.

b Find the range and interquartile range for this data.

c This data lists the prices for houses sold in a Victorian country town over one month. All amounts are in dollars.

460 000, 390 000, 369 000, 349 000, 545 000, 465 000, 385 000, 395 000
249 000, 445 000, 350 000, 849 000, 280 000, 369 000, 460 000

Find the five-number summary for this data.

d Find the range and interquartile range for this data.

e Is there an outlier in this data? How does it affect your answers in part **d**?

f Construct a parallel boxplot showing both sets of data.

g Write a paragraph comparing the house prices in the Melbourne suburb with the house prices in the Victorian country town.

5 This back-to-back stem-and-leaf plot shows the number of points scored in each match by 2 basketball teams during last season.

Langley Lynx		Blakely Bears
6 6 5 4 3	4	4 9
8 8 3 0	5	2 3 3 6 8
8 8 6 6 3 1 1	6	5 6 8 9
7 4 3 0	7	0 0 1 3 6
6 6 5	8	2 5 7 7 9 9
2 2	9	0 3 4

Key: 3 |4| = 43
|4|4 = 44

a How many games were played in this season?

b Find the range for each team.

c Find the median for each team.

d Find the five-number summary for each team.

e Draw a parallel boxplot for the data.

f Comment on the similarities and differences of the points scored by the 2 teams.

g Which is the better-scoring team?

Chapter problem

You've covered the skills required to solve the chapter problem. Can you solve it now?

Weblink
Bureau of Meteorology

Investigation Where would you like to live?

In this investigation, you are going to compare the climate data for two places in Australia you might like to live in.

- Choose two towns or cities where you would like to live. At least one must be in another state.
- Go to the **Bureau of Meteorology** website, www.bom.gov.au, and find the following climate data for each place over 2 years: monthly mean maximum temperature, monthly mean minimum temperature and monthly rainfall.
- For each place you have chosen:
  - **i** find the five-number summary for each set of data
  - **ii** calculate the mean and mode for each set of data.
- Compare the data using either a parallel boxplot or a back-to-back stem-and-leaf plot. Complete one graph for:
  - **1** monthly mean maximum temperatures
  - **2** monthly mean minimum temperatures
  - **3** monthly rainfall.

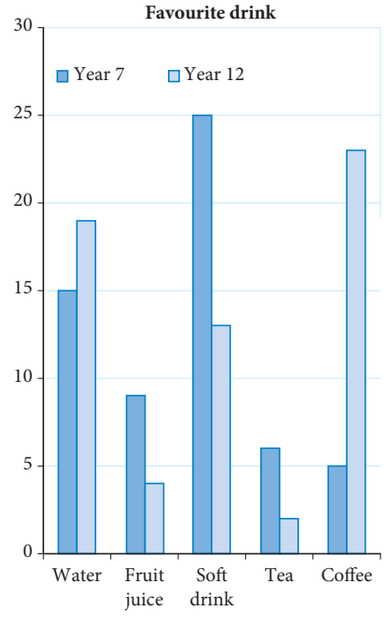
  Use at least one of each type of graph.
- Write a paragraph explaining which place you would prefer to live in based on the data and your own preferences.

15.4 Comparing data

EXERCISE 15.4 Comparing data

ANSWERS p. 438

1 Jess surveyed a selection of Year 7 and Year 12 students at her school about their favourite drinks, and graphed the results on this **clustered column graph**.



a How many Year 7 students did Jess survey?

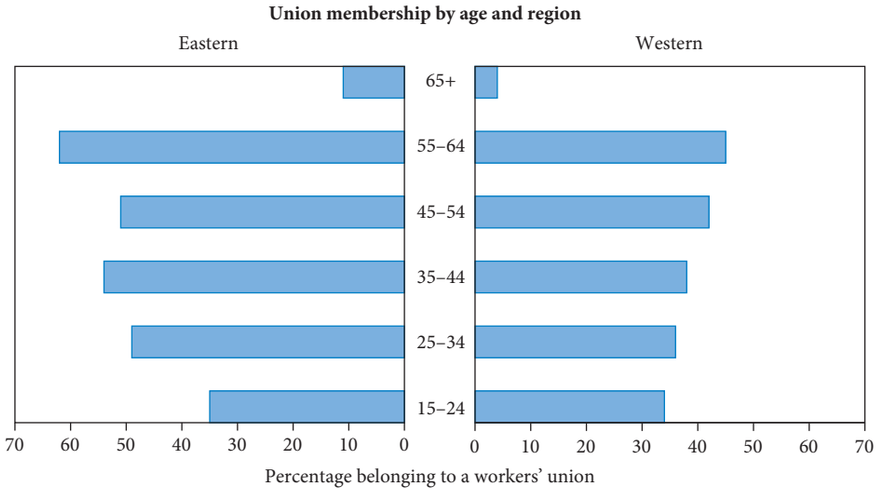
b How many Year 12 students did Jess survey?

c What was the most popular drink in Year 7?

d What was the most popular drink in Year 12?

e Why do you think the most popular drink is different in Year 7 and Year 12?

2 The workers across different age groups in 2 regions were surveyed to find out how many belonged to a workers' union. The results are displayed in a back-to-back column graph, also called a **population pyramid**.



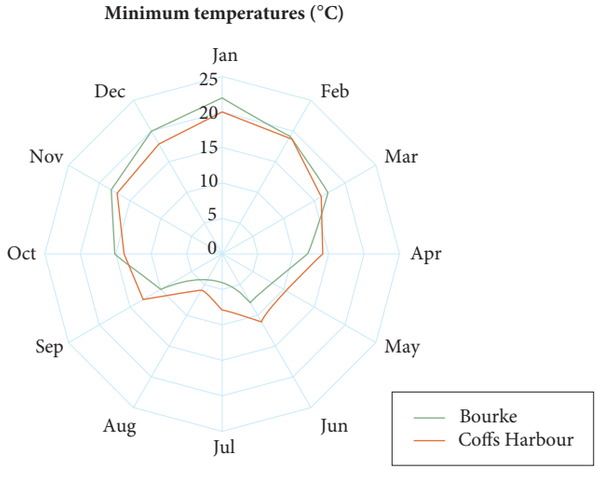
a What percentage of 45- to 54-year-olds in the eastern region belonged to a union?

b Which age group had about the same percentage of union members across both regions?

c Compare the shapes of both distributions.

d Comment on the statement 'People in the eastern region are more likely to join a union'. Justify your answer.

3 The monthly average minimum temperatures (in °C) for Bourke and Coffs Harbour in NSW are displayed on this radar chart.



a What was the average minimum temperature in Coffs Harbour in January?

b In which month did both cities have the same average minimum temperature?

c In which months did Bourke have the lower average minimum temperature?

d Estimate the range of monthly minimum temperatures in Coffs Harbour.

e Which town would you choose to live in, if you don't like hot summers and cold winters? Justify your answer.

4 Jacob and Evan have decided to diet and exercise in order to lose weight. This table records their weight loss over a 10-week period.

	Week	Start	1	2	3	4	5	6	7	8	9	10
Jacob	Weight loss (kg)		4	7	5.5	12		5	6.5	8.5	3	
	Weight (kg)	183					152					125
Evan	Weight loss (kg)		2.5	4.5	1.1		6.4	3	4.6	5	5	
	Weight (kg)	137				125						99

a Copy and complete the above table.

b On one graph, draw 2 line graphs showing Jacob's and Evan's weight loss over 10 weeks. Make each line graph a different colour.

c On one graph, draw 2 line graphs of Jacob's and Evan's actual weight over 10 weeks. Make each line graph a different colour.

d By looking at both the sets of graphs you have drawn, who do you think was the most successful at losing weight? Justify your choice.

e What is the total weight loss for

i Jacob?

ii Evan?

f Calculate the total weight loss as a percentage of the starting weight for both Jacob and Evan. Give your answer correct to 1 decimal place.

Shutterstock.com/Dragon Images

Keyword activity

Definitions

1 What is a **five-number summary**?

2 Describe in your own words a **back-to-back stem-and-leaf plot**. Draw a rough sketch of what one looks like.

3 Describe in your own words a **parallel boxplot**. Draw a rough sketch of what one looks like.

4 What other graphs can be used to compare data?

Solution to the chapter problem

Problem

Ziad and Adrian are arguing about which local football team is better. The number of goals scored by their favourite teams in each match over the previous season are listed here:

Eagles: 20, 10, 40, 12, 17, 20, 22, 20, 34, 19, 36, 18, 24, 12, 38, 34, 24, 36, 32, 22, 6, 7, 38, 18

Cougars: 14, 18, 24, 39, 14, 4, 4, 14, 10, 13, 28, 22, 16, 18, 18, 12, 18, 28, 21, 6, 10, 18, 36, 12

a What is the best graph to use to show this data? Construct this graph.

b Which is the better team based on this data? Justify your answer.

c What additional data might you need to know to decide which is the better team?

Solution

a For this list of values (number of goals), the best graph is a stem-and-leaf plot.

Eagles		Cougars
7 6	0	4 4 6
9 8 8 7 2 2 0	1	0 0 2 2 3 4 4 4 6 8 8 8 8
4 4 2 2 0 0 0	2	1 2 4 8 8
8 8 6 6 4 4 2	3	6 9
0	4	

Key: | 3 | 6 = 36
8 | 3 | = 38

b From the shape of the data for each team, it looks like the Eagles scored more goals than the Cougars. Compare their medians and clusters.

The median for the Eagles is 21.

The median for the Cougars is 17.

The values for the Cougars are clustered in the 10s.

The values for the Eagles are spread evenly across the 10s, 20s and 30s.

Based on this data, the better team is the Eagles.

c You would need to know how many matches each team won. It would also help to know how many points were scored *against* each team.

15 Test yourself

Comparing data

ANSWERS p. 439

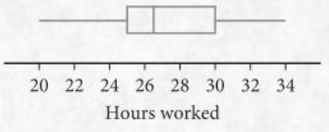
1 EXERCISE 15.1 The following are the Mathematics test results for Manuel's class.

6, 4, 2, 10, 16, 12, 14, 12 , 6, 11, 9, 10, 12, 13, 18, 4, 10, 14

a What is the five-number summary for this data?

b Draw a boxplot for this data.

2 EXERCISE 15.1 This boxplot summarises the number of hours worked in 1 week by each employee of Café Coffee.



a What is the median for this data?

b Find the range.

c How many employees worked between 30 and 34 hours, if there are 36 employees altogether?

3 EXERCISE 15.2 The scores of two cricket teams in one season of a local competition are listed below:

The Bulls: 83, 125, 89, 113, 109, 90, 127, 159, 98, 140, 114, 137

The Tigers: 130, 144, 104, 72, 139, 133, 109, 97, 138, 147, 126, 139

a Draw a back-to-back ordered stem-and-leaf plot for this data.

b How many matches did the Bulls play in one season?

c Find the median for each team.

d Are there any outliers in either set of data? If so, state the outliers.

e Which team is the better team? Justify your answer.

4 EXERCISE 15.3 These are the five-number summaries for the quiz results of two Year 11 classes.

11 Blue: 0, 4, 7, 9, 10

11 Magenta: 1, 5, 7, 8, 10

a Draw a parallel boxplot for these five-number summaries.

b What is the median for each class?

c What is the interquartile range for each class?

d Shane in 11 Blue and Adele in 11 Magenta both scored 9 in the quiz. Who performed better in relation to their own class? Justify your answer.

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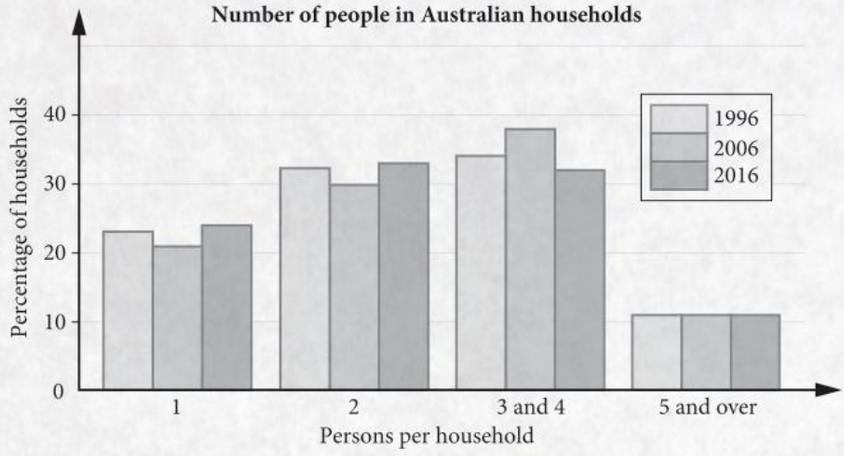
5 EXERCISE 15.4 This **clustered column graph** compares the number of people living in Australian households in 1996, 2006 and 2016.



a What percentage of households had more than 2 persons in 1996?

b In which year were 30% of households made up of 2 people?

c Generally, which category of persons per household was the:

i most common? **ii** least common?

d Which category had the greatest difference between 2006 and 2016?

e 'There was a higher percentage of one-person households in 2006 than in 1996.' True or false?

f Describe the changes in the data from 1996 to 2016.

Practice set 4

ANSWERS p. 439

Section A Multiple-choice questions

For each question, select the correct answer **A**, **B**, **C** or **D**.

1 EXERCISE 13.1 Calculate the value of C in the formula $C = 4\pi r^2$ when $r = 2.5$, correct to 1 decimal place.

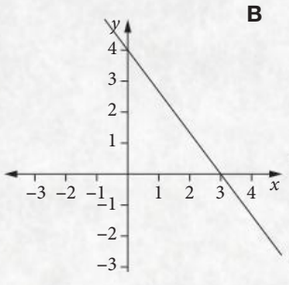
A 31.4 **B** 62.8 **C** 78.5 **D** 987.0

2 EXERCISE 14.2 The map for a hiking trail has the northeast direction pointing up. What direction is pointing down?

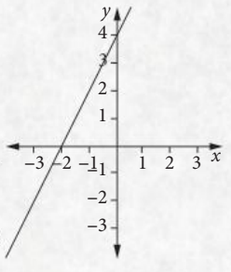
A southwest **B** northwest **C** southeast **D** west

3 EXERCISE 13.5 Which line has a negative gradient?

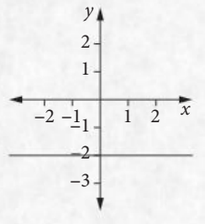
A



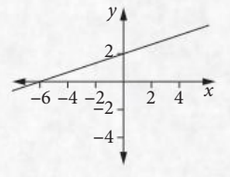
B



C



D

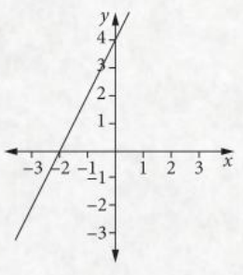


4 EXERCISE 13.6 I am thinking of a number, p. When I divide the number by 3 and subtract 7, I get 4. Which equation represents this information?

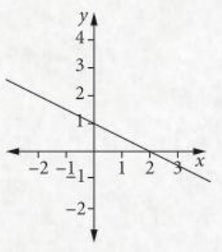
A $7 - \frac{p}{3} = 4$ **B** $\frac{p}{3} - 7 = 4$ **C** $\frac{p}{3} - 4 = 7$ **D** $\frac{p - 7}{3} = 4$

5 EXERCISE 13.5 Which line has a y-intercept of 2?

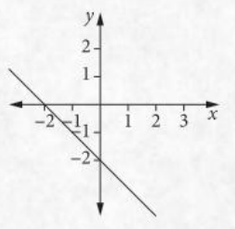
A



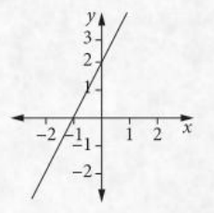
B



C

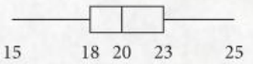


D

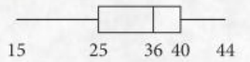


6 EXERCISE 15.1 Which boxplot has an interquartile range of 10?

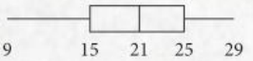
A



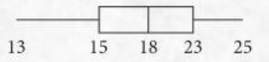
B



C



D



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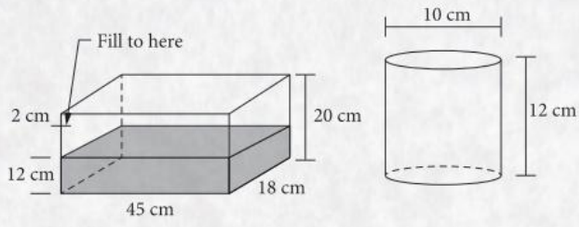
7 EXERCISE 8.5 Tom is using a cylindrical can to top up the water in his fish tank.



Approximately, how many full cylinders will he need to fill the tank to 2 cm below the top?

A 1

B 5

C 7

D 17

8 EXERCISE 14.1 On Tuesday, Skye left home at 4.21 am to drive to work and she arrived back home after work at 5.10 pm. How long was she away from home?

A 1 h 7 min

B 1 h 11 min

C 11 h 7 min

D 12 h 49 min

9 EXERCISE 13.4

What is the correct equation for this table of values?

x	−2	0	2	4
y	2	1	0	−1

A $y = \frac{1}{2}x + 1$

B $y = 1 - \frac{1}{2}x$

C $y = 2x - 1$

D $y = 1 - 2x$

10 EXERCISE 14.1 Which distance and time set of data does NOT give an average speed of 20 km/h?

A 2 km in 6 min

B 10 km in 30 min

C 15 km in 45 min

D 24 km in 70 min

Section B Short-answer questions

1 EXERCISE 14.3 Use map 427 from page 375 to answer the following questions.

a What feature is at J8?

b Approximately how far is it along Fortesque Ave from Boonong Ave (D11) to Seaford Rd?

2 EXERCISE 14.3 Use the street map of Manly on page 372 to find:

a the feature at J6

b the coordinates of Manly Wharf.

3 EXERCISE 13.1 Use the formula $v^2 = u^2 + 2as$ to determine the value of v if $a = 5$, $s = 24$, $u = 9$ and v is positive. Express your answer correct to 1 decimal place.

4 EXERCISE 13.3 Is $k = 5$ the correct solution to the equation $10 - k = 2k - 5$? Use calculations to justify your answer.

5 EXERCISE 13.3 Solve each equation.

a $4x - 19 = 105$ **b** $\frac{m}{5} - 1 = 8$ **c** $\frac{10}{x} = 2.5$

6 EXERCISE 13.6 I am thinking of a number. If I divide the number by 2, then add 12, I get 70. Use an equation to find the number.

7 EXERCISE 13.5

a Copy and complete this table of values for the equation $y = 2x + 5$.

x	0	1	2	4	−1	−2
y						

b Graph the line $y = 2x + 5$ on a number plane.

c What is the y-intercept of the line $y = 2x + 5$?

d Find the gradient of the line $y = 2x + 5$.

8 EXERCISE 13.6 Joe is 16 years older than Renee. The sum of their ages is 104. How old are they both? Use an equation to solve this problem.

9 EXERCISE 15.1 Ali recorded the daily maximum temperature, in °C, for the 11 days he was on holidays.

22, 25, 21, 31, 29, 25, 26, 20, 34, 32, 30

a For this data, find the five-number summary.

b Construct a box-and-whisker plot for this data.

10 EXERCISE 14.1 Chris is going to walk to the top of Mount Ngungun, a distance of 1400 metres.

a The walk is quite challenging and Chris will only be able to walk at an average speed of 24 m/min. How many minutes will the walk to the top take? Round up to the nearest minute.

b Chris plans to start climbing at 9 am and walk to the top, spend 40 minutes at the top and then return back down. At approximately what time will he be back?

11 EXERCISE 14.5 You need to use an appropriate GPS mapping app or website to answer this question.

Mr Plumber is the coach of the soccer team at Newcomb Secondary College. He is driving the team to play in a knockout match at North Geelong Secondary College.

- **a** How far is it from Newcomb Secondary College to North Geelong Secondary College?
- **b** How long will the drive take?
- **c** What average speed did the GPS use to calculate the travel time?
- **d** The match starts at 1 pm and Mr Plumber wants to be there at least 45 min before the game. At what time should the team leave the college?

12 EXERCISES 15.2, 15.3 Year 11 students completed 2 tests for their assessment, both marked out of 50.

Test 1:	**Test 2:**
48 19 17 45 39 27 40 41 30 23	39 30 20 47 35 35 27 36 34 44
38 32 30 27 31 34 36 20 25 22	11 11 47 31 28 32 3 38 7 28
40 41 30 46 27 34 31 23 8 38	29 21 32 46 19 50 31 49 17 23

- **a** Draw a back-to-back stem-and-leaf plot for this data.
- **b** Find the range for each test.
- **c** Are there any outliers in either test? If so, state the outliers.
- **d** Find the five-number summary of each set.
- **e** Draw a parallel boxplot to display the data.

13 EXERCISE 14.2 Use the map from Question 5 on page 371 to determine what compass direction West Wyalong is from Parkes.

Answers

CHAPTER 1

EXERCISE 1.1

1 **a** $1330 **b** $2660 **c** $69 160

2 **a** $6875 **b** $3173.08 **c** $1586.54

3 **a** $88 400

b There's more than 4 weeks in all months except February.

c $7367 **d** $48.57

4 **a** $297.76 **b** $3\frac{1}{2}$ hours

5 **a** $879.23 **b** $1170.43

6 $20.03 **7** $5330

8 **a** $178 **b** 11

c Casual: $608/week, Permanent: $890/week. Choice could involve more than just the money.

9 **a** Job 3: $38 000

b Many answers possible. Discuss your opinion with your class.

EXERCISE 1.2

1 **a** $25.80 **b** $34.40 **c** $21.54

d $28.72 **e** $36.90 **f** $49.20

g $46.86 **h** $62.48

2 $138 **3** $170.40 **4** $335

5 **a** 2 **b** $1060.20

6 **a** **i** $22 **ii** $33 **iii** $44

iv $462 **v** $132 **vi** $264

b $858

7 **a** $24.40 **b** $109.80

8 $130.20

9 **a** $204.08 **b** 10.30 am **c** 30 min

d 3.30 pm **e** $153.06 **f** 11.30 am

EXERCISE 1.3

1 **a** $1377.06 **b** $3120.69

2 $731.25 **3** $1202 **4** $1463.30

5 $977.21 **6** $674.25

7 **a** **i** 8 **ii** 7 **iii** 4

iv 5 **v** $12.32 **vi** $18.48

vii $18.48 **viii** $24.39 **ix** $98.56

x $129.36 **xi** $73.92 **xii** $121.95

b $423.79

EXERCISE 1.4

1 **a** $61.25 **b** $221.20

c $581.88 **d** $1206.63

2 **a** $626.50 **b** $3595.50

3 $3727

4 **a** $71 064.40 **b** $5466.49 **c** $956.64

5 $7440.46 **6** $6633 **7** $376

8 **a** $414.39 **b** $6176.59

9 $448

10 **a** $78.75

b Answers can vary. Teacher to check.

EXERCISE 1.5

1 **a** $2250 **b** $40 **c** $6000

d $12 500 **e** $6570 **f** $570

2 $117.25 **3** $4603.50 **4** $554.40 **5** $50 600

6 **a** $18 **b** $61 **c** $159.50

7 **a** $18 **b** $48.91 **c** $214

8 $2235 **9** $8.35 **10** $88 **11** $708 200

12 **a** $20 440 **b** $43 400

13 **a** $16.80 **b** $62.40 **c** 416

14 $2875

15 Melissa $17 988, Publisher $41 972

16 **a** $204 **b** $945.20 **c** $2363

EXERCISE 1.6

1 **a** $595.50 **b** $4394

2 **a** $688 **b** $38 **c** $1175

d $1121 **e** $311

3 **a** $617.75 **b** $552.75

4 $186.62

5 **a** $674.88 **b** $2402

6 **a** $112.40 **b** $574

7 $26 936

EXERCISE 1.7

1 **a** $90 880 **b** $89 920

2 $415

3 **a** $305 **b** refund $127.50

4 **a** $3500 **b** $91 000

c No refund or bill. He has paid the correct amount of tax.

5 **a** $73 112 **b** $72 887

c $15 236 **d** refund $1080.72

6 bill for $53.60 **7** $129 095.20

8 **a** $116 220 **b** $28 609.36

c $116 021 **d** She will get a $435.53 refund.

EXERCISE 1.8

1 a $1060 **b** $22 103 **c** $46 635
d $70 297 **e** nil **f** $13 979

2 a $1446 **b** $3138 **c** $2900

3 a $16 109 **b** $1578
c No. He will get a bill for $2220 extra.

4 a $86 268 **b** $18 504.10
c $1725.36 **d** $389.03

5 No. He will get a bill for $1101.23 extra.

6 $520

7 a $88 131
b tax = $19 109.58, Medicare levy = $1762.62
c $3723.80

8 Incorrect. Paul's tax is $11 267, Garth's tax is $32 427. Garth's tax is almost 3 times that of Paul.

9 a tax = $28 138, Medicare levy = $2318
b $10 736.64

10 $48 000

11 a $39 520
b $5791.40
c $143 068.60
d tax = $38 002.38, Medicare levy = $5007.40

EXERCISE 1.9

1 a $7020 **b** $7646.88 **c** $9000
d $852 **e** $1238.25 **f** $3685.05

2 a $11 808 **b** $2952
c $1771.20 **d** $10 036.80

3 a $9888 **b** $1483.20

4 a $5148 **b** $4375.80

5 a $4734 **b** $26 826 **c** $34 716
d $10 414.80 **e** $24 301.20 **f** $2524.80

The answers to the remaining questions were correct at the time of printing but could change if the assumptions on the MoneySmart calculator change.

6 $646 312 **7** $69 649

8 a The future value increases by $1385.
b The future value decreases by $1501.
c Fees can make several thousands of dollars difference.
d The future value increases by $51 560.
e It will decrease the future value.

9 a growth
b cash
C conservative

EXTENDED INVESTIGATION: ACCESSING SUPERANNUATION EARLY

Note: The values in the following tables were correct at the time of printing. However, if the MoneySmart website changes any assumptions, for example the interest rate, the values will be different, but the trends will be the same.

1 a B **b** C **c** D **d** A **e** D **f** B **g** D

2 a, b

	Age now	Income	Retire age	Current balance	Balance at retirement	Balance at retirement if $10 000 withdrawn	Reduction in balance	%
Ben	24	$62K	67	$20K	$476 038	$451 463	$24 575	5.2
Allyssa	35	$62K	67	$20K	$319 701	$300 107	$19 594	6.1
Kim	45	$62K	67	$20K	$205 254	$189 307	$15 947	7.8

c The younger the person is when they withdraw the $10 000, the greater the reduction in their final, retirement balance. The reductions range from approximately $16K to $24.5K.

d

	Age now	Income	Retire age	Current balance	Balance at retirement	Balance at retirement if $10 000 withdrawn	Reduction in balance	%
Ben	24	$82K	67	$20K	$619 303	$594 728	$24 575	4.0
Allyssa	35	$82K	67	$20K	$413 848	$394 254	$19 230	4.6
Kim	45	$82K	67	$20K	$263 443	$247 496	$15 947	6.1

e Many answers possible. The following is an example. Teacher to check.

	Age now	Income	Retire age	Current balance	Balance at retirement	Balance at retirement if $10 000 withdrawn	Reduction in balance	%
Ben	24	$62K	67	$50K	$549 763	$525 188	$24 575	4.5
Allyssa	35	$62K	67	$50K	$378 483	$358 889	$19 594	5.2
Kim	45	$62K	67	$50K	$253 096	$ 237 149	$15 947	6.3

f Percentages shown in tables above.

g The older the person is, the greater the percentage effect in their final balance.

3 Many reports possible. The following is only an example.

Introduction

During the COVID-19 pandemic, the Australian Government allowed people suffering financial hardship to withdraw up to $10 000 from their superannuation account. The aim of my investigation is to determine the possible effect such a withdrawal will have on the retirement value of the account.

Methodology

I decided to use the superannuation calculator on the Australian Government's MoneySmart website. The calculator requires information about the account owners' current age, income, age at which the person intends to retire and the current account balance. I decided to use the default setting whenever it was offered and restrict my investigation to a 67-year retirement age.

I completed calculations for 3 imaginary people with ages 24 years, 35 years and 45 years and I varied only one of income ($62K or $82K) and account balance ($20K and $50K) each time.

My first step was determining the retirement account balance without making the $10K withdrawal. Then I redid the calculation assuming there had been a $10K withdrawal. Initially, I was surprised that there was a bigger difference for the youngest person, but that the oldest person had a smaller balance. I decided to consider the percentage effect and included a final column in my summary tables.

Summary of results

Case 1: Income $62K and current account balance $20K

	Age now	Income	Retire age	Current balance	Balance at retirement	Balance at retirement if $10 000 withdrawn	Reduction in balance	%
Ben	24	$62K	67	$20K	$476 038	$451 463	$24 575	5.2
Allyssa	35	$62K	67	$20K	$319 701	$300 107	$19 594	6.1
Kim	45	$62K	67	$20K	$205 254	$189 307	$15 947	7.8

Case 2: Income $82K and current account balance $20K

	Age now	Income	Retire age	Current balance	Balance at retirement	Balance at retirement if $10 000 withdrawn	Reduction in balance	%
Ben	24	$82K	67	$20K	$619 303	$594 728	$24 575	4.0
Allyssa	35	$82K	67	$20K	$413 848	$394 254	$19 230	4.6
Kim	45	$82K	67	$20K	$263 443	$247 496	$15 947	6.1

Case 3: Income $62K and current account balance $50K

	Age now	Income	Retire age	Current balance	Balance at retirement	Balance at retirement if $10 000 withdrawn	Reduction in balance	%
Ben	24	$62K	67	$50K	$549 763	$525 188	$24 575	4.5
Allyssa	35	$62K	67	$50K	$378 483	$358 889	$19 594	5.2
Kim	45	$62K	67	$50K	$253 096	$ 237 149	$15 947	6.3

My observations and conclusion

In all 3 cases, the 3 figures in the 'Reduction in balance' column are close to identical. Probably the small differences only resulted from rounding in the calculations. This indicates that the key issue is the age of the person making the withdrawal. The younger the person, the greater the actual retirement balance reduction but the smaller the percentage effect the withdrawal makes.

In the current economic climate, withdrawing $10K at age 24 results in a $25K reduction in the final balance. Anyone considering making this withdrawal should weigh up their current need against their future requirements. They should remember that if interest rates increase, the $25K reduction will also increase.

KEYWORD ACTIVITY

1 wage **2** annual **3** overtime
4 double **5** allowance **6** bonus
7 percentage **8** fixed **9** royalties
10 annual leave loading **11** superannuation
12 retirement **13** schools **14** social
15 income **16** deductions **17** levy
18 week **19** Pay As You Go **20** financial
21 tax **22** refund

TEST YOURSELF

1 **a** $656.25 **b** $1312.50 **c** $34 125
2 **a** $8000 **b** $3692
3 **a** $30.36 **b** $283.36
4 $21/h **5** $115.85 **6** $875
7 $6227.50 **8** $40 500 **9** $782
10 $746 **11** refund of $1072.40
12 **a** $84 710 **b** $17 997.75
13 $10 140

CHAPTER 2

EXERCISE 2.1

1 **a** 14 **b** 16 **c** 20 **d** 33

2 **a** 16 **b** 18 **c** 20 **d** 28
e 45 **f** 17

3 Any combination of two scores that add to 13, e.g. double 6 + 1 or 7 + 6.

4 6 ways: 4 + 3, 6 + 1, 5 + 2, 5 + double 1, 3 + double 2, 1 + double 3

5 **a** 23
b double 10 + 3 or double 9 + 5 or double 8 + 7 or double 7 + 9

6 4 throws (4 × 25)

7 3 + double 8

8 To make it harder to get high scores. If the players want to get high scores, they need to place accurate throws.

EXERCISE 2.2

1 **a** 46 **b** 90

2 180 (3 × triple 20)

3 Many answers are possible, for example, 20 + 10 + 7 or 10 + 10 + 17

4 151 **5** Rebecca **6** 16 or double 8

7 still 86 **8** 104

9 **a** double 17 **b** double 10 + double 7
c 10 + 10 + double 7

10 180, could throw 3 triple 20s at the next round

11 **a** 4 **b** Renata on turn 2
c 58 on turn 3 **d** 2
e 2 throws for combined 10, then double 7
f 29 is an odd number (no number on the board doubles to make 29)
g Teacher to check

EXERCISE 2.3

1 Brett

2 –1

3 **a** 70 strokes **b** 5 strokes

4 **a** The temperature is 10°C below zero.
b –4°C **c** –7°C **d** –5°C

5 **a** –2 **b** 3 times **c** 376 runs
d Many answers are possible, for example, batter gets out twice and scores 0 on the other 2 balls.

EXERCISE 2.4

1 **a** false, 4 + 2 × 3 = 10 **b** true
c true **d** true
e false, $2 \times 4^2 = 2 \times 16 = 32$
f false, 48 ÷ 4 × 3 = 12 × 3 = 36
g false, 20 – 5 + 8 = 23 **h** true **i** true

2 **a** 3 **b** 3 **c** 22 **d** 36
e 75 **f** 1 **g** 12 **h** 10
i 2 **j** 14 **k** 40 **l** 140
m 150 **n** 26 **o** 30 **p** 7
q 21 **r** 3

3 **a** (4 + 7) × 5 = 55 **b** 60 ÷ (5 + 7) = 5
c $(3 \times 2)^2 = 36$ **d** (6 + 8) × (9 – 5) = 56
e (3 × 4 + 5) × 2 = 34 **f** (28 – 4 × 5) × 2 = 16
g $\sqrt{(7 + 5) \times (3 + 9)}$ **h** $\sqrt{12 \times 11 - (6 + 5)}$

4 When she pressed the = key in the middle, the calculator added 3 and 6 first, before multiplying by 5.

5 **a** The expression represents the sum of the points for 4 red balls, 2 brown balls, 1 pink ball and 2 black balls.
b 32 points

6 **a** She calculated from left to right instead of using BIDMAS.
b Explain the order of operations.
c (48 – 8) × 3

EXERCISE 2.5

1 $6870 **2** $39 000 **3** $84

4 **a** $920 **b** $47 840

5 $7.20 **6** 4.5

7 **a** 9 h 45 min **b** 113 h 45 min

8 12 min **9** Rockets by 2

10 Neither team is in front. The score is 110 each.

11 $1060.50

EXERCISE 2.6

1 B **2** B **3** C

4 B **5** B

6 **a** 1600 m **b** 4

7 $26

8 **a** $34 **b** Yes **c** Yes

9 **a** Paige knits approximately 2 rows per minute.
b approximately 25 minutes

EXERCISE 2.7

1 **a** 16.1 **b** 29.8 **c** 14.6
d 13.3 **e** 104.6 **f** 195.2

2 124.73

3 Many answers are possible, such as 16.27 or 16.32

4 Teacher to check

5 **a** Mia: wave 1, 4.9; wave 2, 7.3; wave 3, 8.5; wave 4, 7.6
Elissa: wave 1, 7.0; wave 2, 7.8; wave 3, 5.2; wave 4, 8.2
b Mia: 7.6 + 8.5 = 16.1; Elissa: 7.8 + 8.2 = 16.0
c Mia

6 3.9 m **7** 538.5 km

8 **a** 8745 m **b** 8.7 km

9 **a** 79.3 is close to 80 and 155.8c is close to $1.50
b $120 **c** $123.55
d about 3% lower than the actual cost

ANSWERS

10 **a** Closer to $150 because $1.35 is closer to $1 than $2.

b $207.63

c If she uses the same amount of LPG each month, her budget allowance isn't enough.

11 $16.21

EXERCISE 2.8

1 **a** 1600 envelopes **b** 3 boxes

c 200, 400, 600, 800

d The total numbers of envelopes are multiples of 200.

e 5 boxes

2 **a** 1400 mm is not a multiple of 300 mm.

b 1500 mm **c** 2400 mm **d** 1.2 m

3 600 m

4 **a** 20 cm of pink, 40 cm of white

b pink $4.40, white $8.80, total cost $13.20

5 Posts: 8 of 2.7 m and 1 of 2.1 m. Top rails: 8 of 2.4 m.

EXERCISE 2.9

1 **a** 24 cents **b** 24 cm

2 **a** 90c **b** 90 cm

3 **a** 2 h 30 min **b** 3 h 48 min

c 1 h 24 min **d** 2 h 54 min

4 **a** 12 **b** 6 **c** 4 years 6 months

5 2 years 3 months

6 **a** 9 **b** 5 years 9 months

7 **a** 6 months 15 days **b** 8 months 27 days

c 3 months 7 days **d** 5 months 9 days

8 **a** 3 **b** 18 overs and 3 balls

c Teacher to discuss

EXTENDED INVESTIGATION: MELANIE'S GRAND IDEA

Formulation

Melanie is going to recycle bottles and cans to make money. I know that each item recycled earns her 10c and that she needs to make $460.

I can use a calculator to determine the number of bottles and cans, but I will need to either make an assumption about the numbers of items she can recycle per week or carry out a survey to determine the information.

Exploration

Each item recycled gives Melanie 10c.

10 items give = 10 × 10c
= 100c or $1

Melanie needs 10 items per $1.

To earn $460 she will need 460 × 10 = 4600 items.

How long will it take?

Assumed number of items recycled per week	Calculation for number of weeks required	Time to make $460
100	4600 ÷ 100	46 weeks
250	4600 ÷ 250	18.4 weeks
400	4600 ÷ 400	11.5 weeks

My conjecture (observation) is that she will need 4600 items to recycle and that the more she can recycle per week, the quicker she will save the $460 she needs to buy the technology she wants.

Communication

In this investigation, I calculated that Melanie needs to recycle 10 items to make $1. Because I don't know how many items Melanie can recycle per week, I constructed a table and made calculations for different quantities. I summarised my results in this table.

Assumed number of items recycled per week	Calculation for number of weeks required	Time to make $460
100	4600 ÷ 100	46 weeks
250	4600 ÷ 250	18.4 weeks
400	4600 ÷ 400	11.5 weeks

My conclusion is that Melanie will need to recycle 4600 items to raise $460 and that the more items she can recycle per week, the quicker she will make the money she requires. She could need up to 46 weeks if she can only recycle 100 items per week.

KEYWORD ACTIVITY

1 double **2** triple **3** bullseye

4 integer **5** BIDMAS **6** positive

7 indices **8** brackets **9** negative

10 darts **11** EFTPOS

TEST YOURSELF

1 **a** 9 **b** 13 **c** 22 **d** 23

2 **a** 34 **b** 84

3 Mike won by 5 strokes.

4 **a** 18 **b** 14 **c** 4

5 **a** 174.8 **b** 19.9 **c** 151.3

6 **a** $96 **b** No, it's too small.

7 $10.60

8 **a** 16 **b** 16.8

9 **a** 28 kg **b** 135 m **c** 5 mm

10 15

11 **a** 0.5 means 'half', not 5 **b** 104

12 Any whole number in the range 141 to 144.

9780170448123

CHAPTER 3

EXERCISE 3.1

1 **a** N **b** C **c** N **d** N
e N **f** C **g** N **h** N

2 **a** C **b** C **c** N **d** N
e C **f** N **g** N **h** C

3 Teacher to check

EXERCISE 3.2

1 Teacher to check

2 **a** sample **b** census **c** sample
d sample **e** sample **f** census
g census **h** sample **i** sample
j census **k** census **l** sample
m census **n** sample

3 **a** students in schools
b people of voting age in the state
c listeners of a radio station, or readers of a magazine, or musicians
d students at my school
e people of Victoria
f the general population
g Year 12 students
h rich people
i people who shop at supermarkets
j the Australian cricket team
k customers of the bank
l customers of the communications company
m the population of the town and surrounding areas

EXERCISE 3.3

1 **a** 5 cars **b** 35
c 6 am–7.59 am **d** Teacher to check

2 **a** 13 **b** Friday
c 48 **d** Teacher to check

3 **a** 500 000 people or half a million
b Sydney, 5 100 000
c Darwin, 100 000
d The scale means we can only estimate to the nearest 100 000, but the actual population is more exact than that.
e Adelaide **f** Teacher to check

4 **a** 2% **b** NSW
c Victoria and Northern Territory
d No, it only tells you the percentage increase, not the actual numbers.
e 512

5 **a** peanut butter **b** biscuits
c cereal **d** 28%
e peanut butter **f** biscuits
g 14 g **h** cereal and biscuits

6 **a** Motor vehicle thefts in the country town are decreasing over these 6 years.
b 2020 **c** 2017, 55
d Teacher to check

7 **a** 10.5% **b** 1990 and 1991
c 1994 and 1995 **d** $20 400
e **i** $8640 **ii** $11 760

8 **a** 15 kWh **b** 23 kWh
c Monday, Tuesday, Wednesday in the first week, Friday in the second week.

9 **a** 20°C **b** 212°F **c** 32°F **d** 38°C

10 **a** €9 **b** $83 **c** $58
d Yes, as €25 ≈ $42. **e** €132

11 **a** 420 kJ **b** 170 cal
c 2100 kJ **d** about 2100 cal

12 **a** $120 **b** $200 **c** $280 **d** $40
e To cover his business costs, e.g. tools.

13 **a** $24 **b** $48 **c** $60
d $60 **e** $12

14 **a** rugby league **b** motor racing
c Aussie rules and soccer **d** 840
e Teacher to check

15 **a** editing
b editing, printing, binding, royalty, transport and promotion
c $9.75

16 **a** visiting friends
b 40 people
c No, on Monday evening there would be more people travelling for work and fewer people travelling for leisure or visiting friends.

EXERCISE 3.4

1 **a** $120 **b** about $23 more
c about $90 **d** Teacher to check

2 **a** 3 **b** about $1750
c These are for winter, when extra electricity is used for heating and cooking.
d Teacher to check

3 **a** 15 months
b approximately 181 MJ
c June to August; heating in winter, other answers possible.
d Teacher to check

4 **a** 2.05% **b** 2.30% **c** $550
d Money is locked in for the 24 months, you cannot withdraw any of it.

5 **a** August
b January and February
c January and February, March and December, May and November, or July and September

d 7

e July, August, September

f Teacher to check

6 a 33°C **b** June, July, August

c A lot of rain from November to March, little rain from April to October.

7 a June, July, August, September

b about 10°C **c** about 22 mm

d Teacher to check

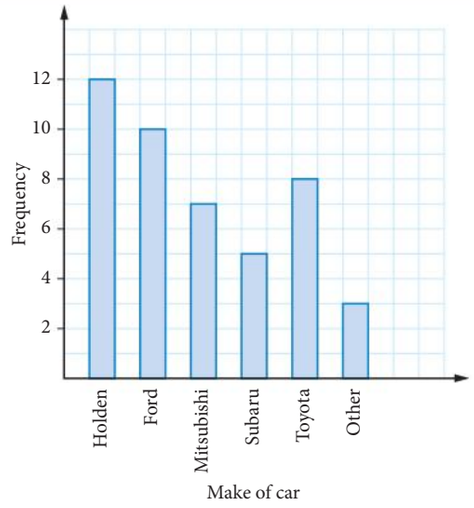
8 Northern hemisphere, because the warmest temperatures are in the middle of the year.

9 a 1% of donations **b–d** Teacher to check

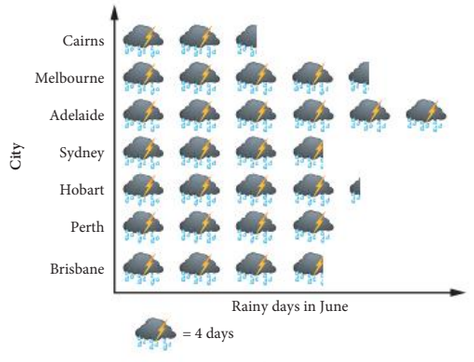
e 9180 L

EXERCISE 3.5

1



2

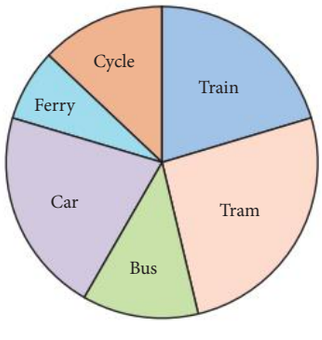


3 a 7% **b** other

c 31% **d** 548

4 a 73°, 93°, 43°, 77°, 27°, 47°

b



5 a **i** 70 cm **ii** 140 cm

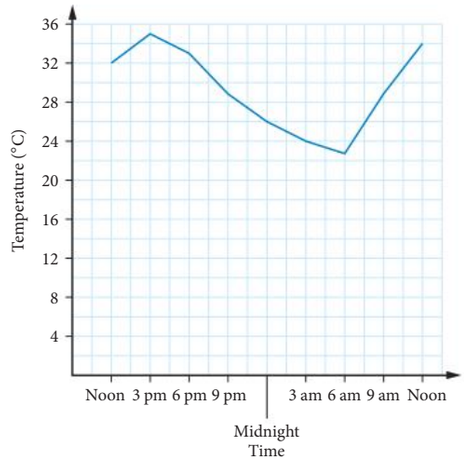
b **i** 3 years **ii** 11 years

c 0 and 1 year

d about 2 years 10 months

e fairly flat

6

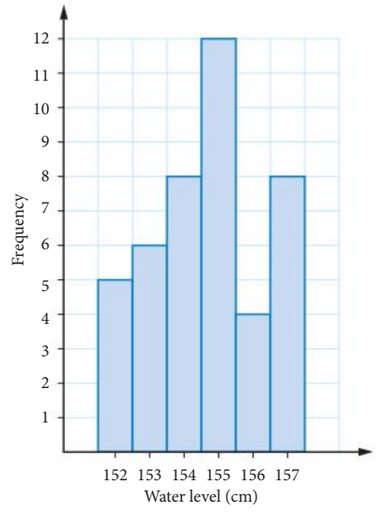


7 a

Test marks	Frequency
6–20	7
21–35	12
36–50	16
51–65	10
66–80	14
Total	59

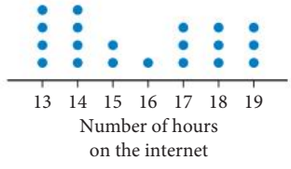
b 59 **c** 36–50 **d** 19

8



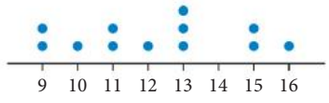
EXERCISE 3.6

1 a



b 20 **c** 4 **d** 9

2 a



b 3 **c** 25% **d** 5

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3 **a** 12 **b** $28 **c** 5

4 **a**

Stem	Leaf
7	6
8	1 6 8
9	5 7 8
10	1 5 5
11	2 2 4 7
12	4

Key: 7|6 = 76

b 53%

5 **a**

Stem	Leaf
1	1 2 2 3 3 4 6 7 7 9
2	0 0 0 2 3 3 4 5 5 5 6 7
3	0 1 3 3 3 4 5 9
4	1 2 8 8
5	5 5

Key: 5|5 = 55

b 8 **c** 22%

6 **a** 42 hours **b** 5 **c** 11

d 21 **e** 52%

7 **a** 37 **b** 23 **c** 23

d Ages range from 23 to 40. **e** 49

8 **a** 64 **b** 37 **c** 99

d 64 to 154 **e** 9, or the 90s

9 **a** stem-and-leaf plot **b** dot plot

c histogram **d** stem-and-leaf plot

e dot plot **f** dot plot

g histogram or stem-and-leaf plot

h histogram

i dot plot **j** histogram

KEYWORD ACTIVITY

1 categorical, numerical, sample, census.

2 Teacher to check

TEST YOURSELF

1 **a** C **b** N **c** N

d C **e** N **f** C

2 Possible reasons – census would be too expensive and take too long, a sample is quick with immediate feedback.

3 **a** **i** families in the street **ii** census

b **i** businesses operating in Melbourne **ii** sample

c **i** voting population of Australia **ii** sample

d **i** school students in Victoria **ii** sample

4 **a** 40 **b** 6 am to 8 am

5 **a** 2 000 000 **b** 2 700 000

6 **a** 13% **b** approximately 1.6%

7 **a** 36 euros **b** $100

8 **a** motor racing **b** 595

9 **a** $120 **b** approximately $52

10 **a** approximately 32 MJ **b** December to February

c This is summer and gas would not be needed for heating/cooking/hot water.

11 **a** 3.15% **b** $1375

12 **a** categorical **b** pictogram **c** pie

d changes **e** time **f** frequency

g histogram

13 **a** 18°C **b** 28°C **c** 16 days

d Temperatures in April ranged from 15°C to 28°C.

14 **a** 31 **b** 18 **c** 90 kg

d 71 kg **e** 71 kg, 105 kg

CHAPTER 4

EXERCISE 4.1

1 240 cm

2 **a** 20 cm **b** 120 cm **c** 6 cm

d 63 cm **e** 73.5 cm **f** 550 cm

3 **a** 140 cm **b** Teacher to discuss

4 705 cm

5 **a** length = 2820 cm, width = 940 cm, height = 1410 cm

b length = 28.2 m, width = 9.4 m, height = 14.1 m

6 14.4 m

EXERCISE 4.2

1 **a** cm **b** m **c** km

d mm **e** km **f** mm

2 **a** 1000, × **b** 10, ÷ **c** 100, ÷ **d** 1000, ÷

e 100, × **f** 1000, ÷ **g** 10, ×

3 **a** 30 **b** 500 **c** 0.4 **d** 2000

e 3 **f** 2 **g** 0.5 **h** 0.25

i 0.6 **j** 600 **k** 4.5 **l** 800

m 0.8 **n** 9000 **o** 0.09 **p** 6500

4 **a** 640 **b** 64 000

5 **a** 850 **b** 0.85

6 **a** 45 000 **b** 4.8

c 1 300 000 **d** 0.4175

7 6 **8** 76

9 **a** 3900 **b** 3.9 **c** 90

10 21 **11** 160

12 **a** 6400 m **b** 6.4 km

13 **a** 3096 m **b** 3.10 km

14 $120.60

15 **a** B **b** C **c** C

16 **a** 148.2 **b** 38.1 **c** 1005.8

d 609.6 **e** 7.3 **f** 11.3

17 109.7 **18** 8 furlongs **19** 16.5

20 1673 km, 2655 km, 644 km, 3379 km, 877 km, 331 km, 1392 km

21 3.66

22 Modern pools are 29.2 cm shorter than old pools.

23 8

ANSWERS

EXERCISE 4.3

1 **a** 24 m **b** 20 m **c** 34 m

2 30 m

3 **a** 14.9 cm **b** 17 cm

4 Any 2 lengths that add to 18 m, such as 12 m by 6 m, or 9 cm by 9 cm.

5 **a** regular pentagon, 25 m

b regular hexagon, 24 cm

c regular octagon, 24 cm

6 6 m

7 **a** 16.8 cm **b** 15.9 m

8 **a** 21 m **b** $189

9 **a** 11.27 m **b** 56.35 m

c Two 25 m rolls and one 10-metre roll.

EXERCISE 4.4

1 **a** minutes **b** kilograms **c** days

d millilitres **e** litres **f** hours

g grams **h** kilolitres **i** tonnes

j seconds **k** milligrams

2 **a** 1.8 g **b** 9500 g **c** 0.365 g

d 200 000 g

3 **a** 12 200 L **b** 6.34 L **c** 0.55 L

d 980 L

4 **a** 1920 **b** 0.55 **c** 45 000

d 15 200 **e** 48 **f** 4

g 65.7 **h** 960 **i** 12.3

j 3 200 000 **k** 4320 **l** 0.0568

5 6.75

6 **a** 720 g **b** 17.28 kg **c** 345.6 kg, 0.3456 t

7 **a** 1.5 L **b** 36

8 2.8 h or 2 h 48 min

9 **a** D **b** C **c** C

EXERCISE 4.5

1 **a** 40°C **b** 75°C **c** 37.6°C

d 37.4°C **e** 37.75°C

2 **a** 166 mm **b** 97 mm **c** 120 mm

d 117 mm **e** 26 mm **f** 75 mm

g 47 mm **h** 168 mm **i** 161 mm

j 191 mm

3 **a** 13 cm **b** 8 cm **c** 19 cm

d 13 cm **e** 9 cm **f** 10 cm

g 12 cm **h** 25 cm **i** 21 cm

j 11 cm

4 **a** C is 4.4, K is 4.7, S is 6.15

b C is 27°C, K is 14.2°C, S is 5°C

c C is 18 125, K is 3750, S is 9375

5 **a** $\frac{7}{8}$ **b** 143 cm **c** 85 mL

d 0.95 V **e** 96 km/h

6 Teacher to check **7** D

EXERCISE 4.6

1 **a** 17 mL **b** 1.6 mL **c** 18 mL

2 41.2°C

3 **a** 350 mL **b** 150 mL

4 Kara 177.4 cm, Samantha 166.9 cm

5 **a** 2.75 kg **b** 48.8 cm **c** 34.8 cm

6 **a** 94 kg **b** Teacher to check

7 Teacher to check

8 **a** 8 **b** 1200

c 150 mL **d** Teacher to check

9 **a** 1.8 L **b** Teacher to check

EXERCISE 4.7

1 **a** 0.06 g **b** 60 mg

2 **a** 500 **b** 0.7 **c** 0.3 **d** 400

3 **a** 3 **b** 16.8 g

4 **a** 1.8 L **b** 33

5 2.2 mL

6 **a** 4 **b** 54 **c** 240

7 **a** 135 g **b** 135 000 mg **c** 270 mg

8 **a** 40 g **b** 800 mg

9 20

10 **a** 1.48 g **b** 185 mg

11 The rate gives 6500 g per day, which is greater than the maximum dose of 4 g daily. The patient should receive 4 g per day.

KEYWORD ACTIVITY

1 body **2** metric

3 length **4** kilometres

5 one thousandth **6** perimeter

7 capacity **8** gram

9 scales **10** medicine

TEST YOURSELF

1 **a** 150 cm **b** 450 cm **c** 5 cm by 15 cm

2 **a** 50 **b** 300 **c** 3.6 **d** 4200

e 7.7 **f** 8.5

3 **a** 8.5 m **b** 850 cm

4 30 m

5 **a** 42.2 m **b** 15 lengths (14 won't be enough)

6 **a** 3400 **b** 6.2 **c** 8 **d** 7500

e 8.75 **f** 336

7 2.6 tonnes

8 **a** 17 cm **b** 11 250 m **c** 45 km/h

9 **a** 37.4°C **b** 2.4 mL **c** 650 mL

10 **a** 95 g **b** 95 000 mg **c** 380 mg

11 15 injections

PRACTICE SET 1

Section A

1 C **2** B **3** D **4** A
5 C **6** B **7** B **8** B
9 A **10** D

Section B

1 a $\frac{3}{8}$ **b** 142 cm
2 a 233.9 **b** 34.6 **c** 86.5
3 a $8500 **b** $3923
4 a C **b** A **c** B
5 a $31.80 **b** $296.80
6 a 15 kg **b** 84 m **c** 4 m **d** 12 cm
7 $23/h
8 a 150 mL **b** 70%
9 $965
10 a 40 **b** 800 **c** 4.5
d 6200 **e** 8.5 **f** 4.9
11 a census **b** families in the area
12 $6279.20 **13** $16 900
14 a $84 **b** No, it's about $2 too low.
15 $836 **16** $806
17 a C **b** N **c** N
d C **e** C **f** C
18 $9420
19 a 38 **b** 18 **c** 4
20 $13.80
21 a 29 **b** 103
22 a 13
b

Stem	Leaf
0	8 8 9
1	0 1 2 2 3 3 4 4 4
2	
3	9

c 14 **d** 8
e 39, possibly her parent
23 1800 mm
24 a 2800 **b** 6.2 **c** 6
d 6500 **e** 9.25 **f** 168
25 104
26 Sample. A census would be too expensive and take too long.
27 4.14 t
28 a 2000 **b** NSW **c** 2.5
d ACT numbers rounded down, NT rounded up. They could have been 1434 and 810.
29 a toilet **b** 12.3% **c** 410 L **d** 2066 L
e 2400 ÷ 5 = 480 L; they use more than the average.
30 a 18 **b** 25 **c** 3 **d** $51.00
31 refund $1717.60

CHAPTER 5

EXERCISE 5.1

1 a $33 **b** 84 kg
c 252cm **d** $307.50
e 216 marks **f** 595 000 people
g 152.29 kg **h** 5 m
i 294 students **j** $477
k 12 L **l** 113.6 ha
2 a 96 cm **b** 84 hours **c** 219 days
d 3900 mL **e** 23c **f** 98 days
g 1350 m **h** 600 kg
3 258 students **4** $412.50
5 a $0.81 **b** $2062.50
6 3 hours 43 minutes (3.72 hours)
7 782 seedlings **8** $52.40
9 1275 people **10** 11 700 seats
11 24.31 kg **12** 337.5 MB

EXERCISE 5.2

1 a 80% **b** 55% **c** 80% **d** 88.75%
2 a 87.5% **b** no
3 41.8%
4 a 8.3% **b** 18.8% **c** 12.5% **d** 37.5%
e 52% **f** 11.4% **g** 25% **h** 21.4%
i 13.7% **j** 13.9% **k** 21.4% **l** 6.4%
5 75% **6** 17.6% **7** 49.4%
8 55.9% **9** 52.5% **10** 38.1%
11 a 34.8% **b** 47.8%
12 a English 60%. Mathematics 54.3%, Science 64%
b Science

EXERCISE 5.3

1 a 152 kg **b** $2650 **c** 157.5 m **d** 13.3 L
2 a $64.50 **b** 1440 L **c** 105.05 kg **d** 714
3 $247.50 **4** 31 141 **5** $9 **6** $682
7 $35.37 **8** $234 **9** $679.15 **10** 1106
11 a $22.50 **b** $877.50
12 $31 790 **13** $1 580 800
14 $2041.20 **15** $184
16 a $39.57 **b** $1939.13
17 $172.01 **18** $1781.33
19 a $516.25 **b** $567.88
c Probably he would round to the nearest dollar.
20 a $670 **b** $549.40 **c** $494.46

ANSWERS

EXERCISE 5.4

1 **a** 28.6% **b** 29.6% **c** 83.1% **d** 55.8%

2 **a** 18.6% **b** 40.2% **c** 12% **d** 15.4%

3 87.5% **4** 45.5%

5 **a** profit, $15 **b** 11.1%

6 **a** loss, $500

b 20% If you add in the cost of the parts, then it is a 11.8% loss

c Keiran might be happy as he used the car for a year.

7 $272.25

8 **a** $585 **b** $23 985 **c** $21 100

d loss

e 10% (not including the stockbroker's fee)

9 **a** $315 **b** $324 **c** profit **d** 2.9%

10 45.8%

EXERCISE 5.5

1 80% **2** 38 385

3 **a** 19.7% **b** 22.4 g

4 $8625 **5** $11 200 **6** 7.6%

7 $703.80 **8** 69.02 g **9** $754.40

10 $350 175 **11** 13.5% **12** $691.25

13 **a** 0.83% **b** 4.55.30

14 164.5% **15** $4500 **16** 22%

17 30.8% **18** $41 850

EXERCISE 5.6

1 **a** 4:3 **b** 3:4 **c** 3:2 **d** 2:1

e 3:2 **f** 3:1 **g** 3:2 **h** 6:1

i 5:1 **j** 8:7 **k** 7:13 **l** 4:1

m 2:3:1 **n** 2:1:6 **o** 3:5:10 **p** 3:2:4

2 **a** 1:2 **b** 3:4 **c** 7:6 **d** 5:3

e 7:11 **f** 43:4 **g** 27:13 **h** 5:12

i 1:14 **j** 13:11 **k** 11:30

3 **a** 3:20 **b** 1:20 **c** 3:1 **d** 1:8

e 3:1:20

4 **a** 8:3 **b** 21:8 **c** 1:4 **d** 6:1

e 16:7:1

5 **a** 5:8 **b** 1:13 **c** 1:20 **d** 9:52

e 8:5:3

6 heavy-duty cleaning

7 **a** $1

b **i** 3:2 **ii** 3:1 **iii** 2:1 **iv** 1:3

8 **a** 27:29 **b** 19:27 **c** 29:75 **d** 29:19

e 27:29:19

9 **a** 3:25 **b** 4:5 **c** 1:4 **d** 8:3

e 2:5 **f** 12:7

10 **a** black:red **b** purple:yellow

c green:grey **d** green:all

e green:red:black **f** yellow:purple:grey

11 **a** 4:3 **b** 8.3% **c** 29:36

EXERCISE 5.7

1 **a** 9:5 **b** $\frac{5}{14}$

2 **a** 6:2 **b** 3:1 **c** $\frac{3}{4}$

3 They are both a red : yellow = 1:2.

4 **a** 5:2000 **b** 1:400

5 Ratio is in the wrong order.

6 **a** 3:2 **b** 1:2 **c** 3:1 **d** 1:1

7 72 mL

8 **a** 5 mL **b** 10 mL **c** 15 mL **d** 20 mL

9 **a** $\frac{1}{4}$ **b** 2 cm **c** 3:1

d **i** $2\frac{1}{2}$ cm **ii** $6\frac{2}{3}$ cm

10 **a** 10 **b** 9

11 **a** 25 g zinc, 5 g nickel

b 40 g zinc, 112 g copper

c 160 g

12 **a** 5 cups **b** 18 cups

13 **a** 2000 mL **b** 2 L

c 150 mL **d** 25 mL

e general perennial weeds

EXERCISE 5.8

1 56 mL blue, 4 mL black

2 18 mL red, 6 mL yellow

3 8 mL red, 2 mL yellow, 2 mL white

4 20 mL red, 80 mL yellow, 40 mL white

5 400 mL **6** $4200

7 30 kg cement, 60 kg sand, 90 kg gravel

8 **a** $840:$1260 **b** $1750:$350

9 399

10 20 silver beads, 15 porcelain balls, 10 crystal eyedrops

11 160 mL

12 **a** 2 g **b** 315 g gold, 84 g copper

13 **a** 150 mL **b** 400 mL **c** 200 mL

EXERCISE 5.9

1 **a** 50 km/h **b** 25 words/min

c 50 L/h **d** $17.50/kg

e 7.3 m/s **f** $26 /h

g 250 g/L **h** 600 rev/min

2 18 L/m^2 **3** 1350 L/h

4 **a** 40 L / container **b** 4 L/day

c 6 g/cm^3 **d** $3.20/DVD

e 35 mm/day **f** 14.5 km/L

g $11.40/m **h** 256 vibrations/s

i 40 sheep/ha **j** $1.58/L

5 **a** $8.50/kg **b** $12.48/kg **c** $2.45/kg

d 55c/roll **e** $2.45/bottle

6 **a** 112 **b** 196 **c** 336

9780170448123

7 $248

8 **a** 3 h **b** $1\frac{1}{2}$ h **c** 4 h 48 min

9 6.25 kg

10 **a** 720 kg **b** 15

11 **a** 5460 kg

b **i** approx. 2 hours **ii** 3 h 8 min

iii 4 h 5 min **iv** 15 h 12 min

12 **a** 960 **b** 270 **c** 25 m^2 **d** 95 m^2

13 **a** $8000 **b** 35 weeks **c** 3 extra weeks

14 768 kg

15 **a** 750 mL **b** 1500 mL **c** 1.5 L

d 36 L **e** 40 min **f** 40 hours

16 **a** 18 **b** 35 **c** 24

17 **a** 21.6 m **b** $270 **c** 18 m

d 10 windows

18 **a** 504 L **b** $1134 **c** $2232

d 15 hours

KEYWORD ACTIVITY

Teacher to check

TEST YOURSELF

1 **a** $32 **b** 210 mL **c** 11.25 ha

d 60 cm **e** 3600 g **f** 81 min

2 273 people **3** $945 **4** 16 questions

5 **a** 85% **b** 25% **c** 10%

d 75% **e** 25% **f** 15%

6 3.5% **7** 93% **8** 36.1%

9 **a** $367.50 **b** 93 kg **c** 18 000 people

10 $1478.05 **11** $2310

12 **a** $54 **b** 63.75 m **c** 6 weeks

13 $45 **14** 69 006 people

15 **a** 20% profit **b** 40% profit

c 26.3% loss **d** 9.5% loss

16 70.6% **17** 114.3% **18** 117 females

19 **a** 30.5% **b** 2 g

20 $16

21 **a** 1 : 3 **b** 75%

22 **a** 2 : 5 **b** 2 : 1 **c** 5 : 2 **d** 3 : 5

23 250 g water **24** 3 mL

25 **a** $64 : $16 **b** 24 km : 48 km

26 5 male dancers **27** 42 mm

28 **a** 75 km/h **b** $23/kg **c** $28/h

29 9 **30** 3 kg

31 Choose $36.50/h. It pays $60 more per week.

32 **a** white car 8.5L/100 km, red car 9.1 L/100 km

b white car

CHAPTER 6

EXERCISE 6.1

1 **a** On or before August 15.

b $33.60 **c** $386.40

2 **a** 5 Curtis St, Bendigo **b** 21 October 2022

c 12 November **d** $15

e $67

3 **a** 10 Feb 2023 **b** 9 Mar 2023

c $71.81 **d** yes (no arrears)

e 26 Oct 2022 to 24 Jan 2023

f 91 days **g** 43 kL **h** 478 L

i Water consumption is highest in summer and then decreases during the year. Highest bill in January, lowest bill in October.

j Watering gardens, topping up swimming pools, playing water games

k In person, by post, by credit card (over the phone), using BPAY, at the post office

l 11% p.a. interest accrued daily

4 **a** $548.30 **b** 30 November

c $2193.20 **d** $42.18

e Contact the revenue team on 03 5950 1080.

f Biller code 20537, Reference number 5009706434

5 **a** $350.83 **b** yes

c $269.34 **d** $26.93

e $296.27 **f** 9.09%

g increased, 2 kWh/day

h **i** 5.2 kWh **ii** 4.1 kWh

EXERCISE 6.2

1 **a** $4.28 **b** 36c

2 **a** $163.58 **b** $63.22

3 $113.40 **4** $60 **5** $152.88

6 $39.05

7 **a** $3.31 **b** $18.88

8 **a** $344.82 **b** $76.43 **c** $5.15

d $382.05 **e** $808.45

9 **a** $2170.07 **b** $1454.80 **c** $17 700

EXERCISE 6.3

1 **a** $3658.80 **b** $4508.80 **c** $858.80

2 $3338

3 **a** $1568 **b** $18 400

c $13 028 **d** $337

4 **a** $979 200 **b** $163 800

5 **a** 26 **b** $172 560

6 **a** $1828.40 **b** $8597.83

7 $114.87

ANSWERS

EXERCISE 6.4

1 **a** $4.60 **b** $50.60

2 $380

3 **a** $7.50 **b** $82.50 **c** $85 **d** $23
e $1.50 **f** $16.50

4 **a** $26.40 **b** $264

5 **a** $5 **b** $50 **c** $15.40 **d** $154
e $9.60 **f** $96 **g** $0.15 **h** $1.50
i $2 **j** $20

6 $5200

7 C4 = C3/11 C5 = C4*10 **OR** = C3–C4 OR = C3/11*10

8 $7486.36 **9** $299

EXERCISE 6.5

1 **a** D **b** G **c** B **d** H
e F **f** J **g** A **h** L
i K **j** C **k** I **l** E

2 **a** 500 000 000 **b** 6 000 780 000
c 75 000 200 000 000 **d** 42 000 900 000
e 64 000 000 **f** 53 000 400 000 000

3 8 500 000 000

4 Three hundred and sixteen million **5** 2 400 000

6 seventeen point 6 billion dollars OR seventeen billion six hundred million dollars

7 5 billion, 5 000 000 000

8 $3.77 billion, $3 770 000 000

9 $600 million, $600 000 000

10 **a** $70 000 **b** 440 000

EXTENDED INVESTIGATION (SOME KEY ANSWERS ONLY)

1 **d** The diameter of an Australian $2 coin is 20.5 mm.

2 **a** 500 000 000 000 coins (500 billion coins)

b 1 025 000 000 000 mm (1 trillion 25 thousand billion mm)

c 102 500 000 000 m (102 billion 500 million m)

d 10 250 000 km (10.25 million km)

g The distance to the moon is less than 400 00 km. The line of coins will go much further than that. The distance from the Earth to the Sun is approximately 150 million km. That's too far.

The Equator is approximately 40 000 km long. 10 250 000 ÷ 40 000 = 256.25.

The line of $2 coins would go around the Equator approximately 256 times.

KEYWORD ACTIVITY

1 EFTPOS, credit, debit

2 quarterly **3** annual **4** overdue

5 fortnight **6** million **7** deposit

8 interest **9** repayment **10** discount

11 penalty **12** invoice **13** GST

14 billion **15** weekly

E	F	T	P	O	S	M	I	L	L	I	O	N
		B	I	L	L	I	O	N				
	C			I	N	V	O	I	C	E	F	
D	R	O				Q					O	
I	E	V		D		U			W		R	
S	D	E	R	E	P	A	Y	M	E	N	T	
C	I	R		P		R			E		N	
O	T	D	G	O		T			K		I	
U		U	S	S		E			L		G	
N		E	T	I		R			Y		H	
T				T		L	D	E	B	I	T	
P	E	N	A	L	T	Y	A	N	N	U	A	L
I	N	T	E	R	E	S	T					

TEST YOURSELF

1 **a** 10 Nov 2022 **b** 2 Dec 2022
c $684.77 **d** $47.89
e $211.44 **f** approx. $50 to $60

2 $1.13 **3** $45

4 **a** $2660 **b** $260

5 **a** $857 350 **b** $317 350

6 **a** $82.50 **b** $13.60
c $21, $231 **d** $1540, $16 940

7 $46.20 **8** $331.82 **9** 11.2 billion

10 111 100 000

CHAPTER 7

EXERCISE 7.1

1 **a** 9 **b** 8 **c** 8

2 **a** 2 **b** 45, 54 **c** no mode
d green **e** spade

3 **a** 16 **b** 37.5 **c** 72.9 **d** 50.5

4 **a** 8 **b** 13 **c** 10.5 **d** 10.76
e Teacher to check

5 **a** **i** 14 **ii** 14
iii 13.8, January, February, December
b Teacher to check

6 **a** 4 **b** 1, 3, 4, 7 **c** 4.3

7 Teacher to check

8 **a** mode = 1, median = 3, mean = 5
b mean, it is the highest **c** mode, it is the smallest
d Teacher to check

9 **a** 4

b

Number of texts (score)	Frequency	Score × frequency
0	8	0
1	4	4
2	10	20
3	10	30
4	15	60
5	3	15
Total	**50**	**129**

9780170448123

c 2.58

10 a 50 **b** 6

c

Score	Frequency	Score × frequency
1	2	2
2	5	10
3	10	30
4	6	24
5	11	55
6	13	78
7	3	21
Total	**50**	**220**

d 4.4

EXERCISE 7.2

1 a 28 **b** 1 **c** 12 **d** 94

2 0, 2, 16

3 a 31, 45, 45, 45, 49, 49, 50, 50, 52, 52, 55
55, 56, 58, 58, 59, 59, 60, 60, 75

b 31, 75

4 a 30, 47, 48, 48, 49, 54, 59, 59, 63, 64, 68, 68, 68, 80

b 30, 80

5 a

Stem	Leaf
2	5
16	1 5 7 7 9 9
17	0 0 1 3 5 6 6 9
18	0 0 2 2 4 5 6
19	7 8
23	0

b 25, 230

c 25 cm – definitely a wrongly recorded measurement, no Year 11 student would be this short.
230 cm – probably a wrongly recorded measurement, a Year 11 student is unlikely to be this tall.

6 a $1 800 000

b Reasonable – this could be paid for a particularly large/luxurious house

7 a $247 000

b Reasonable – this could be the salary of the CEO or overall business manager

8 a 16

b 10 cm, 11 cm, 15 cm, 40 cm

c All are likely to be wrongly recorded measurements – too small (10, 11, 15) or too large (40) for a foot measurement

9 a $35 000

b Reasonable – often a business only makes a small profit in the first year

EXERCISE 7.3

1 a range = 11 **b** $Q_1 = 18$, $Q_2 = 19$, $Q_3 = 25$

c 7

2 a range = 7 **b** $Q_1 = 29$, $Q_2 = 31$, $Q_3 = 31$

c 2

3 a range = 31 **b** $Q_1 = 159.5$, $Q_2 = 169$, $Q_3 = 174.5$

c 15

4 a range = 6 **b** $Q_1 = 4$, $Q_2 = 5.5$, $Q_3 = 8$

c 4

5 a Inner city

i 43 **ii** $Q_1 = 20$, $Q_2 = 25.5$, $Q_3 = 33$

iii 13

Coastal

i 38 **ii** $Q_1 = 52$, $Q_2 = 60$, $Q_3 = 64.5$

iii 12.5

b Coastal is much higher, but the interquartile ranges are much the same.

6 a 0.00, 0.00, 0.02, 0.04, 0.05, 0.07,
0.09, 0.09, 0.12, 0.15, 0.18, 0.20

b mean = 0.08, modes = 0.00 and 0.09, median = 0.08, range = 0.20

c 3 **d** $Q_1 = 0.03$, $Q_3 = 0.135$

e 0.105 **f** $\frac{5}{6}$

EXERCISE 7.4

1 The number of hours is evenly spread over a small range.

2 The values are clustered in the 40s and 50s and tightly packed. There is a gap and extreme outlier at the end of the values.

3 The test results are tightly packed with a gap at the lower end of the scores.

4 Other answers possible.

a clustered, spread out

b gaps, more dense, less dense

c more dense, spread out

d spread out, gaps

e clustered, spread out, tightly packed

f tightly packed, gaps

KEYWORD ACTIVITY

1 mode **2** average **3** number
4 median **5** odd **6** order
7 outlier **8** clustered **9** quartiles
10 range **11** interquartile range

TEST YOURSELF

1 a **i** no mode **ii** 913 **iii** 830

b **i** $40 **ii** $37 **iii** $35.82

c **i** 7°C **ii** 7.5°C **iii** 8.67°C (2 d.p.)

d **i** 5 mm, 19 mm **ii** 19 mm

iii 21.83 mm (2 d.p.)

2 a 61 **b** 56, 58, 59, 61, 62 **c** 62.3

d The mean, because it involves every data value and there are no outliers.

3 a 19 **b** 7 **c** 43.9 **d** 76

ANSWERS

4 **a** 56, 89, 93, 98, 99, 100, 100, 101, 104, 125

b 56 and 125

c Both answers are reasonable: 56 could be on the weekend (Sunday morning) and 125 could be at the start of a parliamentary sitting week

5 **a** **i** 826 **ii** 554, 1064.5 **iii** 510.5

b **i** $12 **ii** $32, $40 **iii** $8

c **i** 14°C **ii** 6.5°C, 11.5°C **iii** 5°C

d **i** 98 mm **ii** 7 mm, 22.5 mm **iii** 15.5 mm

6 **a** computer fraud, student pocket money (no outliers)

b rainfall, temperatures (outliers)

7 The data are quite spread out. The values are clustered between 15 and 21, and between 23 and 25. It is most tightly packed at 16 to 18.

CHAPTER 8

EXERCISE 8.1

1 **a** hectares **b** square metres

c square centimetres **d** square metres

e square centimetres **f** square millimetres

g square kilometres **h** square millimetres

i square kilometres

2 **a** 790 **b** 1.5 **c** 6.9 **d** 76

e 86.5 **f** 120 000 **g** 320 000 **h** 45 000

i 750 000 **j** 1.9

3 6.5 m^2, 114 000 cm^2, 25 050 000 mm^2

4 54 cm^2, 990 mm^2, 0.000 032 m^2

5 **a** 352.1 hectares **b** 3.521 km^2

6 A soccer field as it is 1750 m^2 smaller than 1 ha.

A rugby field is 3000 m^2 smaller than 1 ha.

7 **a** 324 m^2 **b** 72 m

8 **a** 35 cm^2 **b** 55 cm^2 **c** 60 cm^2

d 80 cm^2 **e** 192 mm^2 **f** 63 m^2

9 **a** 21 m and 20 m **b** 210 m^2

10 3 m

11 **a** 24 000 000 **b** 24

c Many answers possible, such as 6 km by 4 km.

12 **a** 900 cm^2 **b** 12 **c** 280

d 294

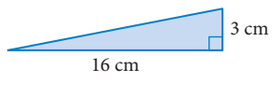
13 **a** 119.7 mm^2 **b** 84 cm^2 **c** 56 cm^2

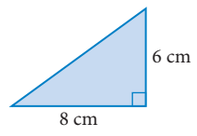
14 **a** Any pair of numbers that multiply to give 36, for example 4 × 9, 3 × 12, 6 × 6.

b Teacher to check **c** 24 cm

15 **a** Teacher to check **b** 5 × 3 = 15 cm^2

16 Many answers are possible, such as





EXERCISE 8.2

1 **a** 36 cm^2 **b** 55 m^2 **c** 104 m^2

d 100 m^2 **e** 70 m^2 **f** 96 m^2

2 **a** 452.39 cm^2 **b** 490.87 cm^2 **c** 47.78 mm^2

d 3019.07 cm^2 **e** 117.29 cm^2 **f** 151.32 cm^2

g 760.27 cm^2 **h** 173.11 cm^2

3 **a** 11 m^2 **b** 14.1 m^2 **c** 917 bricks

4 **a** 25.44 cm^2 **b** 203.52 cm^2 **c** 216.73 cm^2

5 **a** 28.3 m^2 **b** 14.1 m^2 **c** 21.2 m^2

6 945 000 mm^2

7 **a** 706.86 cm^2 **b** 88.36 cm^2 **c** 176.71 cm^2

8 19.24 m^2 **9** 3.39 cm

EXERCISE 8.3

1 **a** 29 400 cm^2 **b** 600 mm^2

2 6125 cm^2 **3** 121.5 m^2

4 **a** 348 cm^2 **b** 11.33 m^2

5 12 680 cm^2

6 **a** 89.25 m^2 **b** $414

c 29.25 m^2 **d** $460

7 12.72 m^2

8 **a** 254 cm^2 **b** 279.4 cm^2

9 71 m^2

10 **a** 45 cm by 25 cm by 10 cm

b 1125 cm^2 **c** 3925 cm^2

11 **a** 604.76 cm^2 **b** 672.36 cm^2

12 345.58 cm^2 **13** 367.6 cm^2

14 18 m^2 **15** 161 m^2

16 **a** 1728 cm^2 **b** 39.27 cm^2

17 **a** 2.88 ÷ 2.4 = 1.2 **b** Teacher to check

c 43.2 ≈ 44 L **d** 8 L

EXERCISE 8.4

1 **a** m^3 **b** cm^3 **c** cm^3 **d** mm^3

e m^3 **f** m^3 **g** cm^3 **h** m^3

i mm^3 **j** cm^3 **k** mm^3 **l** cm^3

2 **a** E **b** G **c** F **d** C

e A **f** B **g** D

3 **a** 5 000 000 **b** 1 600 000 **c** 0.006

d 4 **e** 0.16 **f** 0.25

g 180 000 **h** 120 **i** 4 000 000 000

j 0.0096

4 4210 mm^3, 42 cm^3, 0.0042 m^3

5 0.6 m^3, 65 000 cm^3, 7 000 000 mm^3

6 0.306 m^3

7 2 520 000 mm^3

8 200 000 cm^3

9780170448123

EXERCISE 8.5

1 **a** 111 cm^3 **b** 2.5 m^3
c 256 m^3 **d** 486.42 cm^3

2 **a** 1 071 000 cm^3 **b** 91.125 cm^3
c 21 952 mm^3 **d** 258.06 cm^3

3 **a** 84 cm^3 **b** 240 cm^3

4 **a** 16 065 cm^3 **b** 1 285 200 cm^3

5 **a** 42 875 cm^3 **b** 471 625 cm^3
c approximately 330 books

6 **a** 127 234.5 mm^3 **b** 36 945.1 cm^3
c 1.4 m^3

7 **a** 648 cm^3 **b** 3420 cm^3 **c** 1068.375 cm^3
d 1026 cm^3 **e** 794.75 cm^3 **f** 1270 cm^3
g 367.6 cm^3 **h** 346.4 cm^3

8 **a** 126 pavers **b** 4 500 000 mm^3
c 567 000 000 mm^3 **d** 13 **e** $737.10

9 200 m^3

10 Volume is 420 m^3, so Nazneen requires a large air-conditioner.

11 A is 454 cm^3, B is 409 cm^3; A has a larger volume.

12 **a** 49 cm^2 **b** 7 cm

13 41.56 m^3

14 **a** 28 148.67 cm^3 **b** 5387.83 cm^3 **c** 22 760.84 cm^3

EXERCISE 8.6

1 **a** mL **b** kL **c** L **d** mL
e L **f** kL

2 **a** D **b** G **c** J **d** H
e I **f** A **g** F **h** E
i C **j** B

3 **a** 8 mL **b** 1500 mL **c** 425 mL

4 **a** 2 L **b** 3.5 L **c** 0.25 L

5 **a** 5000 mL **b** 5

6 2000 **7** 4000 **8** 1.5 L

9 1000 cm^3 **10** 1250 cm^3 **11** 9 L

12 504 L

13 **a** 0.2 mL **b** 12 mL
c 2160 mL **d** 17.28 L

14 **a** rectangular prism **b** 2.042 m^3
c 2042 L **d** 19 minutes

15 **a** 10 143 cm^3 **b** 10 L **c** 5 kg

16 795 L

17 **a** 297 L **b** 39 mL

EXERCISE 8.7

1 **a** 1144 **b** 1835 **c** 0251 **d** 2154

2 **a** 8.45 am **b** 1.20 pm **c** 11.31 pm **d** 10.45 am

3 **a** 11.23 am **b** 5.54 pm **c** 1.16 pm

4 **a** 5.20 am **b** 10.05 am **c** 2.45 am

5 **a** 3.15 pm **b** 8.31 pm **c** 11.55 pm

6 **a**

b

c

7 **a** 7.15 am **b** 5.30 pm **c** 9.50 pm **d** 11.20 am
e 0500 **f** 1410 **g** 1718

8 **a** 2030 **b** 2205

9 5.30 pm

10 **a** 8 hours **b** 3 hours 35 minutes **c** 0305

EXERCISE 8.8

1 **a** 5 h 45 min **b** 5 h 44 min
c 2 h 20 min **d** 3 h 53 min

2 **a** 3 h **b** 10 h
c 5 h 15 min **d** 8 h 10 min

3 9 h 30 min

4 6 h 25 min

5 **a** 8.00 pm **b** 7.43 pm
c 1.17 pm **d** 2.24 am

6 **a** 2.15 pm **b** 2.35 am
c 11.25 am **d** 7.50 am

7 3.15 pm **8** 7.45 pm

9 **a** 3 years 8 months **b** 4 years 1 month
c Teacher to check

10 1 year 4 months **11** August 2014

12–13 Teacher to check

EXERCISE 8.9

1 7.50 am **2** 5.15 pm **3** 8.10 am

4 **a** 4.52 pm **b** 5.08 pm **c** 5.22 pm

5 5.22 pm **6** 8.45 am

7 **a** 47 min longer **b** Teacher to check

8 Teacher to check

9 20 h 30 min

10 4, 9.45 pm at Port Augusta, 5.15 am (next day) at Bulgunnia Turnoff, 8.20 am at Marla, 11.45 am at Erldunda

11 **a** 6 h 45 min **b** 11 h

12 **a** approximately Bulgunnia Turnoff
b Teacher to check

13 **a** 25 h 25 min **b** longer
c Teacher to check

14 44 min

15 **a** 11.02 am **b** 34 min
c 58 min **d** Teacher to check

ANSWERS

16 grey is am times, white is pm times

17 **a** 2 buses, Bus 1 can do the 10.30 am departure and so on.

b 1 pm, first bus after 11.42 am is 12.05 pm

c, d Teacher to check

KEYWORD ACTIVITY

Teacher to check

TEST YOURSELF

1 **a** 500 mm^2 **b** 7.5 ha **c** 0.05 m^2

2 **a** 10.24 cm^2 **b** 18 m^2 **c** 69 cm^2

3 1.008 m^2

4 **a** 80 mm^2 **b** 16 km^2 **c** 8.04 cm^2

5 **a** 184 cm^2 **b** 120 m^2

6 **a** cm^3 **b** cm^3 **c** m^3

7 **a** 6000 **b** 5 000 000 **c** 2.4

d 400 000

8 **a** 84 cm^3 **b** 1050 mm^3 **c** 120 mm^3

d 3.375 m^3 **e** 264 cm^3

9 1272 cm^3 **10** 2.6 L **11** 16 bottles

12 3000 cm^3

13 **a** 32 m^3 **b** 32 000 L

14 **a** 0417 **b** 1525 **c** 1000

15 **a** 6.15 am **b** 4.40 pm **c** 11 pm

16 12 h 35 min

17 **a** 7 h **b** 2 h 35 min **c** 0113

18 4 h 25 min **19** 11.25 am

20 4 h 50 min **21** 10.40 pm **22** March 2015

23 **a** 8.50 am **b** 8.27 am **c** 5.01 pm

24 **a** 8 h **b** 8.20 am

c Meal or toilet breaks

25 **a** 49 min **b** 11.15 am

PRACTICE SET 2

Section A

1 A **2** C **3** D **4** C

5 B **6** D **7** A **8** B

9 A **10** D

Section B

1 11.4% **2** 4000 cm^3 **3** 5.4 L

4 26% **5** 34 cm^3 **6** 2%

7 3619 L **8** 190 cm^2 **9** 171 m

10 36 cm^2 **11** 0525 **12** $32

13 50%

14 **a** 19 **b** 19 **c** 17.1

d 49 **e** 51

15 169

16 **a** 18 cm^2 **b** 47.9 cm^2 **c** 70 m^2 **d** 52.8 cm^2

17 **a** 1200 **b** 0.4 **c** 0.06

18 3 : 5

19 **a** $5360 **b** $960

20 $144 : $36

21 **a** 200 km/h **b** $12.80/kg

22 **a** 7000 **b** 24 000 000

c 0.24 **d** 200 000

23 **a** 21 March **b** 13 April

c $45 **d** $15

e from $1.55 to $1.60 **f** $10

24 187 000 000

25 **a** 16 **b** 9 **c** 16, 6 **d** 10

CHAPTER 9

EXERCISE 9.1

1 **a** L **b** M **c** B **d** P

e H **f** I **g** D **h** F

i N **j** G **k** E **l** Q

m O **n** A **o** J **p** K

q C

2 **a** $5n$ **b** $n + 6$ **c** $\frac{n}{10}$ **d** $2n$

e $\frac{n}{2}$ **f** $n - 20$ **g** n^2 **h** $20 - n$

i $\frac{6}{n}$ **j** $n - 8$ **k** $-4n$ **l** n^2

3 **a** $3y + 8$ **b** $\frac{p}{3} - 6$ **c** $4m + 27$

d $\frac{5k}{2}$ **e** $\frac{x}{6} + 13$ **f** $\frac{B}{2} - 2$

g $\frac{R}{9} + 10$ **h** $21n$

4 **a** $10m$ **b** $k - 15$ **c** $1000w$

d $4.1 + 2.3y$ **e** $2x + 2y$

5 **a** $P = 40 + n$ OR $P = n + 40$ **b** $D = 110 + 2n$

6 $C = 70 + 30k$

7 **a** $C = 48 + 1.25n$ **b** Teacher to check

8 $C = 70 + 1.5n$

EXERCISE 9.2

1 **a** $6y$ **b** $14a^2$ **c** $6h$

d $12ab$ **e** $5d^2$ **f** $5x^2 + 6x$

g $7b^2 + b^3$ **h** $f + f^2$

2 **a** $10 - 3x$ **b** $4z + 5$ **c** $4a - b$

d $16ab + 2a + b$ **e** $5x^2 - x^3$ **f** $10k - 2$

g $8xy - 4x$ **h** $8m + 4mn$ **i** $4 + ab$

j $xy + 6x$ **k** $3a + 11$ **l** $5p + 6pq$

3 **a** $11p + 2$ **b** $5 + x$ **c** $9w - 2$

d $9k^2$ **e** $9t + t^2$ **f** $25 - 3t$

g $9pq + 2$ **h** $4b^2 + b^3$ **i** $9k$

j $5f + 5f^2$ **k** $10x$ **l** $4k - g$

EXERCISE 9.3

1 **a** $15xy$ **b** $40xy$ **c** $12h$ **d** $16k$
e $15ts$ **f** $24d$ **g** $\frac{5g}{b}$ **h** $\frac{3x}{y}$
i $\frac{2h}{y}$ **j** $\frac{y}{2g}$ **k** $\frac{3t}{2w}$ **l** $\frac{2p}{t}$

2 **a** $\frac{6ab}{c}$ **b** $\frac{8ab}{5y}$ **c** $\frac{2pq}{a}$ **d** $\frac{20x}{a}$
e $10m^7$ **f** $8a^4$ **g** $12m^6$ **h** $\frac{3p^5}{2}$
i $3x^5$ **j** $\frac{4t^3}{3}$ **k** $5b^2$ **l** $2y^7$

3 **a** $15m^3$ **b** $3m^2$ **c** $4p^2$ **d** $3l$
e $\frac{17z}{9}$ **f** $60abc$ **g** $12d$ **h** $60hm$
i $2a$ **j** $\frac{3p^3}{2}$ **k** $2h^2$ **l** $\frac{2}{9}$
m $6w^3$ **n** $9p^6$ **o** $3g^6$ **p** $\frac{7h^8}{2}$
q $2b$ **r** $\frac{1}{2a}$

EXERCISE 9.4

1 **a** $2x + 10$ **b** $6a - 15$
c $8x + 12y + 8$ **d** $2a^2 + 3ab - 4a$
e $8a - 12ab$ **f** $3b^3 + 3b^2 + 21b$

2 **a** $6 + 5b$ **b** $8 + 3x$ **c** $7d + 20$
d $6x + 24$ **e** $20p + 11q$ **f** $4w + 32$

3 **a** $-2x - 5$ **b** $-3a + 1$ **c** $-4 - 5b$
d $-1 + x$ **e** $-4p + 3q - 10$ **f** $-x + y - z$

4 **a** $-6x - 15$ **b** $-8x + 12$ **c** $2ax + 10x$
d $7a + 14$ **e** $-9 + x$ **f** $-x^2 + 3x$
g $6d + 16$ **h** $y^2 + 2y$ **i** $2k$

5 **a** $2x - 1$ **b** $8x - 22$ **c** $8x - y$
d $17x - 18$ **e** $7x - 34$ **f** $2x + 8y$

EXERCISE 9.5

1 **a** 6 **b** 18 **c** 3.6 **d** 0.24
e 0.39 **f** 7.56

2 **a** 50 **b** 140 **c** 15 **d** 107.5
e 235 **f** 5

3 16 **4** 54

5 **a** 1.25 **b** 5.75 **c** 0.875 **d** 1.5

6 **a** 75 **b** 300 **c** 6.75 **d** 36.75

7 **a** 6 **b** 8 **c** 1.92 **d** 2.2

8

a	8	6	14	4.5	9	6.25	$3\frac{1}{2}$
b	3	5	12	3	7.5	0	2
$a + b$	11	11	26	7.5	16.5	6.25	5.5
$a - b$	5	1	2	1.5	1.5	6.25	1.5
$2a + 3b$	25	27	64	18	40.5	12.5	13
$5(a + 4b)$	100	130	310	82.5	195	31.25	57.5
$\frac{2(3a - b)}{5}$	8.4	5.2	12	4.2	7.8	7.5	3.4
$a^2 + b$	67	41	208	23.25	88.5	39.0625	14.25

9 **a** 13.5 **b** 12 **c** 16
d 40 **e** 4 **f** 1.15

10 Teacher to check

EXERCISE 9.6

1 **a** $x = 7$ **b** $y = 23$ **c** $m = 12$ **d** $k = 27$
e $t = 29$ **f** $w = 11$ **g** $a = 7$ **h** $j = 74$
i $q = 29$ **j** $f = 110$ **k** $x = 4$ **l** $g = 4$
m $d = 9$ **n** $c = 9$ **o** $p = 5$ **p** $s = 15$
q $m = 12$ **r** $d = 120$ **s** $w = 58$ **t** $a = 60$

2 C

3 **a** $m = 6$ **b** $x = 6$ **c** $k = 8$
d $w = 6$ **e** $h = -3$ **f** $d = -2.75$
g $x = 7$ **h** $a = -1$ **i** $c = 2.5$
j $p = 8$ **k** $y = 10$ **l** $x = 15.5$

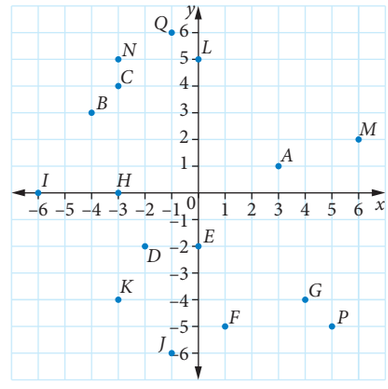
4 **a** $m = 18$ **b** $c = 15$ **c** $d = 42$
d $k = -27$ **e** $h = 20$ **f** $x = -24$
g $n = 65$ **h** $t = 12$ **i** $a = -32$
j $x = 18$ **k** $v = 90$ **l** $b = 21$

5 Teacher to check

EXERCISE 9.7

1 $A(-4, 3)$, $B(-2, 2)$, $C(0, 2)$, $D(2, 3)$, $E(2, 1)$, $F(1, -1)$, $G(2, -3)$, $H(0, -3)$, $I(-4, -3)$, $J(-2, -1)$, $K(3, 0)$, $L(-4, 0)$, $M(0, -2)$, $N(0, 3)$, $O(0, 0)$, $P(-2, 0)$, $Q(1, 0)$, $R(3, -2)$, $S(-2, -2)$, $T(-3, 1)$, $U(-1, 2)$, $V(4, 1)$, $W(4, -3)$, $X(-4, -1)$, $Y(1, -4)$, $Z(-1, -3)$

2



3 **a** A, M **b** B, C, N, Q **c** D, K, J
d F, G, P **e** E, I, H, L

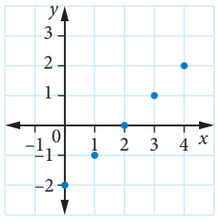
4 **a** 4th **b** 3rd **c** 2nd

ANSWERS

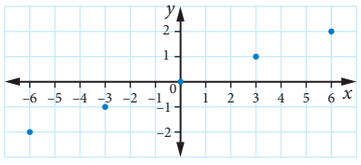
5

Points in:	x-coordinate	y-coordinate
1st quadrant	+	+
2nd quadrant	−	+
3rd quadrant	−	−
4th quadrant	+	−

6



7 a



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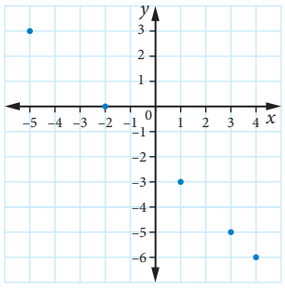

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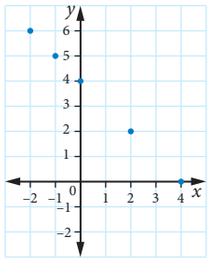
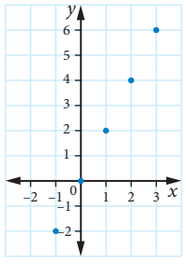


d



KEYWORD ACTIVITY

1 quantities	**2** like	**3** divide
4 expressions	**5** multiply	**6** numerical
7 evaluate	**8** variable	**9** value
10 same	**11** x-axis	**12** y-axis
13 origin	**14** quadrants	**15** points

TEST YOURSELF

1 a $k + 8$ **b** $6p - 3$ **c** $p \div q$ or $\frac{p}{q}$

2 a $100 - y$ **b** $4w + 5$

3 $C = 0.08n + 55$

4 a $13p + 3$ **b** $4x + 15$ **c** $2w - 12$

d $8b^2$ **e** $4t + t^2$ **f** $5 - 2t$

g $80ab + 2$ **h** $8p^2 + 2p^3$ **i** $19m$

5 a $4pq$ **b** $\frac{3ab}{y}$ **c** $\frac{2pq}{t}$ **d** 12

e $\frac{5p}{a}$ **f** 9 **g** $6g^5$ **h** $2a^6$

i $3v^6$ **j** 72 **k** $4x^4$ **l** $\frac{5b^3}{3}$

6 a $8a + 6$ **b** $-8 + y$ **c** $-x^2 + 5x$ **d** $15p + 27$

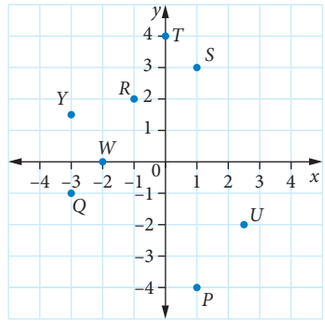
7 a 30 **b** 66 **c** 6 **d** 4

8 21.8

9 a $k = 7$ **b** $x = 11$ **c** $f = 12$ **d** $m = 28$

10 a $p = 5$ **b** $k = 6.5$ **c** $h = 77$ **d** $a = 60$

11



12 a T **b** R, Y **c** W **d** P, U

CHAPTER 10

EXERCISE 10.1

1 a

Method of travel	Tally	Frequency
W	𝍸 𝍸 𝍸 𝍸 |	26
R	𝍸 𝍸 𝍸 𝍸 |||	23
B	𝍸 𝍸 ||	12
C	𝍸 𝍸	10
T	𝍸 ||||	9
Total		**80**

b walk **c** train

2 a

Age	Tally	Frequency
B	𝍸 ||||	9
P	𝍸 𝍸	10
I	𝍸 𝍸 ||	12
O	𝍸 𝍸 ||||	14
Total		**45**

b Children older than 8 years.

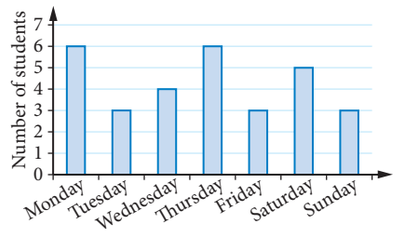
c 20%

3 a

Make of car	Tally	Frequency
H	𝍸 ||||	9
F	𝍸 ||	7
T	𝍸 |	6
M	|||	3
S	|||	3
O	||	2
Total		**30**

b Holden **c** 10%

4



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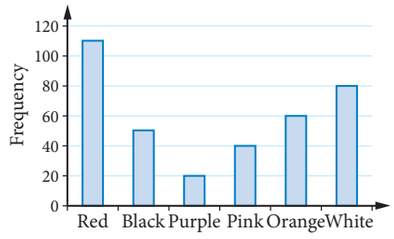


EXERCISE 10.2

1 a

Number of hamburgers	Tally	Frequency
17	𝍸	5
18	𝍸	4
19	𝍸 ||	7
20	𝍸	4
21	|	1
22		0
23	|	1
24	|	1
25	|	1
26	|	1
27	|||	3
28	|||	3
Total		**31**

b 16 **c** 23%

2 a

Number of siblings	Tally	Frequency
0	𝍸	5
1	𝍸 𝍸	10
2	𝍸 |||	8
3	𝍸 𝍸	9
4	𝍸	5
Total		**37**

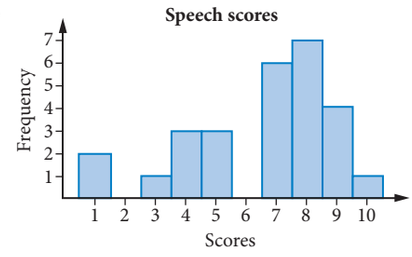
b 37 **c** 5 **d** 23 **e** 27%

3 a

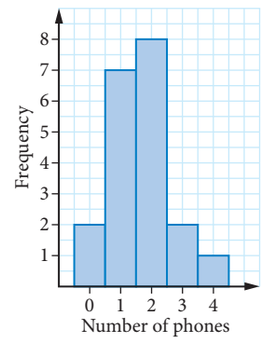
Speech score	Tally	Frequency
1	||	2
2		0
3	|	1
4	𝍸	3
5	𝍸	3
6		0
7	𝍸 |	6
8	𝍸 ||	7
9	𝍸	4
10	|	1
Total		**27**

b 27 **c** 9 **d** 44

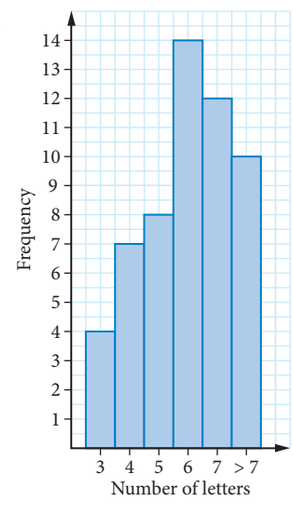
e



4



5 a

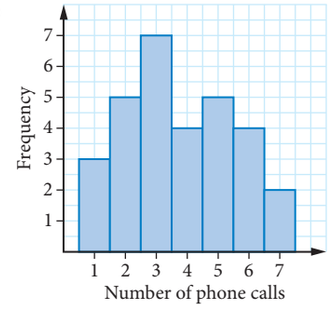


b 11 days **c** 6 letters

6 a

Number of phone calls	Tally	Frequency
1	|||	3
2	𝍸	5
3	𝍸 ||	7
4	𝍸	4
5	𝍸	5
6	𝍸	4
7	||	2
Total		**30**

b



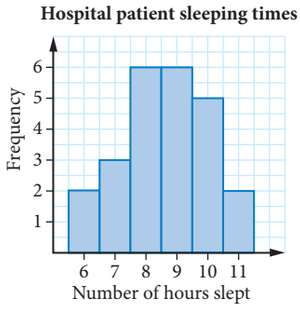
c 5 days **d** 3 phone calls

7 a

Number of hours slept	Tally	Frequency
6				2
7					3
8	𝍸	6
9	𝍸	6
10	𝍸	5
11				2
Total		**24**

b 24

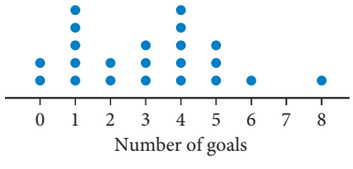
c



d 13 **e** 8, 9

EXERCISE 10.3

1 a



b yes, 8

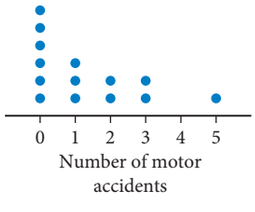
c clustered from 1 to 5

d 22

2

Stem	Leaf
3	7 7 8 8
4	1 3 4 4 5 5 6 6 8 9 9
5	1 1 2 2 3 3 4 4 5 5 5 8
6	0 1 2 3 6 6 7
7	0
8	
9	0

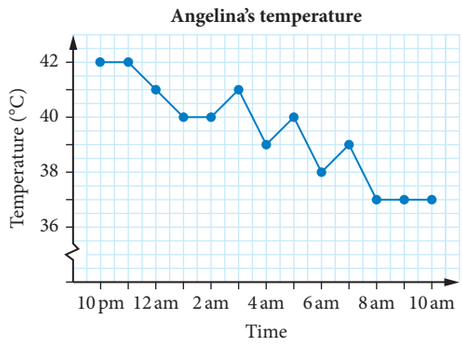
3 a



b 0 **c** 9

d 5, has a gap to the nearest score

4 a



b 42°C **c** 5°C

5 a

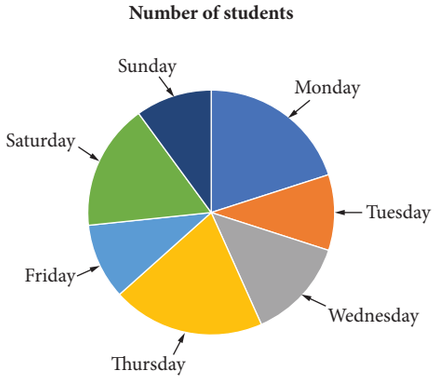
Stem	Leaf
7	6
8	1 6 8
9	5 7 8
10	1 5 5
11	2 2 4 7
12	4

b median = 101, IQR = 24 **c** 101

6 a

Day of the week	Angle for sector graph
Monday	$\frac{6}{30} \times 360 = 72^\circ$
Tuesday	$\frac{3}{30} \times 360 = 36^\circ$
Wednesday	$\frac{4}{30} \times 360 = 48^\circ$
Thursday	$\frac{6}{30} \times 360 = 72^\circ$
Friday	$\frac{3}{30} \times 360 = 36^\circ$
Saturday	$\frac{5}{30} \times 360 = 60^\circ$
Sunday	$\frac{3}{30} \times 360 = 36^\circ$

b



EXERCISE 10.4

Teacher to check all spreadsheets

EXERCISE 10.5

1 a

Mark x	Frequency f	Cumulative frequency	fx
5	4	4	20
6	3	7	18
7	8	15	56
8	4	19	32
Total:	**19**		**126**

b **i** 7 **ii** 7 **iii** 6.6 **iv** 3

2 a

Number of text messages, x	Frequency, f	Cumulative frequency	fx
0	8	8	0
1	4	12	4
2	10	22	20
3	10	32	30
4	15	47	60
5	3	50	15
Total:	**50**		**129**

b **i** 3 **ii** 4 **iii** 2.58 **iv** 5

3 a mode = 6, median = 5, mean = 4.4, range = 6

b Mean, as it is the lowest.

4 a 37

b mode = 1.48, median = 1.48, mean ≈ 1.47, range = 0.1

5 a

Cinema visits	Frequency
0	3
1	5
2	2
3	6
4	5
5	3
6	3
7	3

range = 7, mode = 3, median = 3, mean = 3.4

b Teacher to check

KEYWORD ACTIVITY

A frequency table
B dot plot
C categorical data
D line graph
E fx column
F histogram
G numerical data
H stem-and-leaf plot
I cumulative frequency column
J pie graph

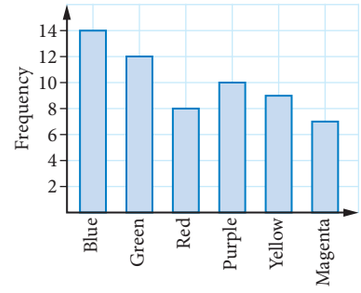
TEST YOURSELF

1 a

Colour	Tally	Frequency
Blue	𝍸 𝍸 ||||	14
Green	𝍸 𝍸 ||	12
Red	𝍸 |||	8
Purple	𝍸 𝍸	10
Yellow	𝍸 ||||	9
Magenta	𝍸 ||	7
Total		**60**

b blue **c** 20%

d

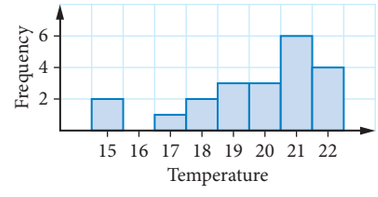


2 a

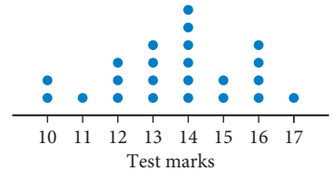
Temperature	Tally	Frequency
15	||	2
16		0
17	|	1
18	||	2
19	|||	3
20	|||	3
21	𝍸 |	6
22	||||	4
Total		**21**

b 21 days **c** 8 days

d



3 a



b 23 **c** 7

4 a

Stem	Leaf
2	5 6 8 8 9 9
3	2 3 3 5 5 6 9
4	1 7 8
5	0 0 2 5 6

b 21 **c** 56 **d** 42.9%

5 Teacher to check spreadsheet

6 a

Number of drinks	Frequency	Cumulative frequency	Frequency × score
0	7	7	0
1	5	12	5
2	13	25	26
3	4	29	12
4	1	30	4
5	2	32	10
6	1	33	6
Total	**33**		**63**

b **i** 2 **ii** 2 **iii** 1.9 **iv** 6

ANSWERS

CHAPTER 11

EXERCISE 11.1

1 sides, equilateral, angles, angle, two, two, scalene, acute, obtuse, right

2 four, opposite, parallel, equal, bisect, equal, 90°, rectangle, square

3 parallelogram, 90°, equal, rectangle, equal, 90°, diagonals

4 quadrilateral, parallel, equal, equal, equal, diagonals, 90°

5 number, triangles, quadrilaterals,
Table: pentagon, hexagon, octagon, decagon, regular, regular

6 **a** trapezium **b** pentagon
c octagon **d** equilateral triangle
e kite **f** scalene triangle
g parallelogram **h** hexagon
i right-angled triangle **j** isosceles triangle
k square **l** rhombus

7 **a** F **b** T **c** T **d** T
e F **f** F **g** T **h** F

EXERCISE 11.2

1 flat, rectangular, prism (or pyramid), pyramid (or prism), pentahedron, hexahedron, edge, vertex

2 curved, sphere, flat, curved, rectangle, cone, circle

3

Solid	Number of faces	Shapes of faces	Number of identical faces
cube	6	squares	6
cylinder	3	two circles and a cylinder	2
square pyramid	5	square and 4 triangles	4
triangular prism	5	two triangles and three rectangles	2
rectangular prism	6	rectangles	3 pairs of 2
cone	2	circle and a sector	0
triangular pyramid	4	triangles	0

4 cross-section, shape, end, rectangle, triangle, pointed, bottom, square, cross-section, size

5 **a** triangular prism **b** cylinder
c square pyramid **d** cone
e rectangular prism **f** triangular pyramid
g sphere **h** cube

6 **a** triangular prism **b** cone, sphere
c cube **d** pentagonal prism
e sphere
f square or rectangular pyramid

7 **a** cube, square pyramid
b rectangular prism, cylinder
c cylinder, cone
d cone, hemisphere
e two triangular pyramids
f two rectangular prisms

8 **a** T **b** F **c** T
d T **e** F **f** F

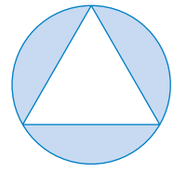
EXERCISE 11.3

1, 2 Teacher to check

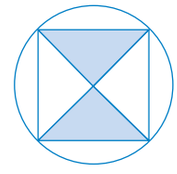
3 square, circumference, four, semicircle, isosceles, diameter, vertex, circle.

4 Other answers possible.

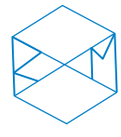
a



b



c



d

5 Teacher to check

EXERCISE 11.4

Teacher to check

EXERCISE 11.5

1 6700 km

2 **a** **i** 1.4 km **ii** 1.9 km **iii** 2.48 km
b **i** 35 cm **ii** 7.5 cm **iii** 16.5 cm

3 21.6 cm **4** 3200 m or 3.2 km **5** 83 mm

6 **a** 440 m **b** 20 cm
c 10 100 m or 10.1 km **d** 13.5 cm

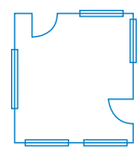
7 **a** 100 m, 1 : 10 000 **b** 2 km, 1 : 200 000
c 250 m, 1 : 25 000 **d** 400 m, 1 : 40 000
e 500 m, 1 : 50 000 **f** 100 m, 1 : 10 000

8 **a** 4.2 m **b** 96 cm

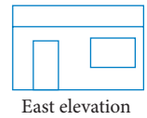
9 **a** 4 m **b** 75 cm **c** 2.05 m
d 1.2 m **e** 1.6 m **f** 1 m

EXERCISE 11.6

1 **a**



b



East elevation

West elevation

2–5 Teacher to check

EXERCISE 11.7

1 a **i** kitchen sink **ii** vanity (or wash basin)
iii toilet **iv** window
v bath **vi** built-in wardrobe
b They are all tiled. **c** 3
d 1 and 2 **e** 4100 mm × 3200 mm
f in the back of the garage
g in the laundry **h** 1
i 1 **j** 2
k living room **l** 6670 mm × 5500 mm
m **i** south **ii** north **iii** south
iv east **v** west
n south **o** living room
p living room, dining room, bedroom 1, bedroom 3
q dining room, bedroom 2, living room

2 a 3 **b** 3
c no **d** 4.7 m × 3.5 m
e bedroom 1 **f** $86 016

3 a 6790 mm × 3700 mm **b** 2
c inside the bathroom, next to the doors
d shower **e** bedroom 4
f family room = 25.123 m^2, media room = 23.787 m^2
Family room is larger by 1.337 m^2.

4 a 240 mm **b** 70 mm **c** 12.39 m
d 15.93 m **e** 3.7 m × 5.0 m

EXERCISE 11.8

1–3 Teacher to check

4 a Teacher to check **b** 2.9 km

5 286 m

6 a Teacher to check **b** 144.2 cm

7 133 m **8** 251 m

KEYWORD ACTIVITY

1 K **2** H **3** M **4** A
5 L **6** J **7** D **8** E
9 C **10** F **11** B **12** G
13 I

TEST YOURSELF

1 Teacher to check

2 a equilateral triangle
b parallelogram, rectangle, square, rhombus
c pentagon
d parallelogram, rectangle, square, rhombus
e trapezium
f scalene triangle, acute-angled triangle

3 a A, D, E, G **b** C, H **c** B, F

4

5, 6 Teacher to check

7 10.5 m

8 a 1 : 5000
b **i** 240 m **ii** 565 m
c **i** 16.6 cm **ii** 6.1 cm
d 1825 m

9 a Teacher to check
b x = 6950 mm
c y = 800 mm, z = 1800 mm, l = 10 560 mm, w = 6060 mm, d = 4500 mm
d 280 mm **e** 110 mm
f 5500 mm **g** 322 mm by 5500 mm
h 6670 mm by 5500 mm

10 a 9 **b** length 13.1 m, width 10 m
c 3 m
d **i** 109.7 m^2 **ii** $116 831 approximately
e bathroom, laundry, kitchen

11 Teacher to check diagram, 40 m

CHAPTER 12

EXERCISE 12.1

1 a $2.30 **b** $2.20 **c** $2.25

2 a 50 mL: 72 c/10 mL; 80 mL: 70 c/10 mL
b 80 mL

3 a 40c and 35c
b box containing 6 eggs
c 3 boxes containing 6 eggs

4 350 g, as it's the cheapest per 100 g

5 a 1 kg **b** 1 kg for $3.50

6 a $145, $140, $139, $142
b one 2.5 g packet and one 5 g packet

7 Teacher to discuss

8 The 1 L bottle is the better value. The 750 mL bottle is the equivalent of $11.93 per L.

EXERCISE 12.2

1 a 28.4 c/L **b** $58.65
c $71.71 **d** $13.06

2 a $1.45 **b** He paid too much.

3 a $27.38 **b** $7.95
c $37.33 **d** 79
e from AbeBooks in the UK
f Teacher to check

4 a $127.20 **b** 5.1 km
c Urban Edge Apartment 5 **d** 1 h and 19 min

e Bendigo Central Deborah

f Teacher to check

5 a $750

b The cheaper one is for Bronze cover, while the more expensive is for Bronze Plus cover.

c $5.29 **d** $50.28

e Premiums increase when the excess decreases.

f She should take the policy with air ambulance cover. Road accidents on country roads usually involve high speeds resulting in serious injuries that can require urgent treatment in a large city hospital.

g $96.50 × 12 ÷ 52 = $22.27

6 a **i** $83.72 **ii** $212.85

iii $199.95 **iv** $190.58

v $363 **vi** Bill $109.67

vii credit or refund $79.33

b Change immediately!

EXERCISE 12.3

1 $12 500

2 a $781.20 **b** $1470.00 **c** $2562.00

3 a $716 **b** $5

4 a The one on the right gets a hybrid discount.

b 13.4%

5 a

Postcode	Petrol motor	Electric or hybrid motor
3003	$834.80	$734.80
3006	$834.80	$734.80
3057	$834.80	$734.80
3775	$779.80	$679.80
3777	$779.80	$679.80
3939	$779.80	$679.80
3440	$716.00	$616.00
3756	$716.00	$616.00
3442	$716.00	$616.00

b $100/year **c** 12%, 13%, 14%

d Inner Melbourne rates are the most expensive and regional rates the cheapest.

6 $1252.80 **7** $168.35

8 a $1604.25 **b** $962.55

c No, a 50% discount would give a final price. of $891.25

9 a $4335.40 **b** $361.30

EXERCISE 12.4

1 a $6300 **b** $121.15

2 a

Income		Expenses	
Office job	$620	Rent	$280
Club	$215	Food	$60
		Phone	$20
		Travel	$60
		Entertainment, clothes and savings	$415
Total	**$835**	**Total**	**$835**

b

Income		Expenses	
Office job	$620	Rent	$280
Club	$215	Food	$60
		Phone	$20
		Car loan	$100
		Car expenses	$75
		Entertainment, clothes and savings	$300
Total	**$835**	**Total**	**$835**

3 a $312 **b** $20 540 **c** $8112

4 a income $420, expenses $300

b $1440

c Teacher to check: do more work, spend less on clothes and entertainment.

5 a $158

b $223

c approx. 113 weeks

d Reduce entertainment and/or get more hours of work.

Income		Expenses	
Main job	$750	Rent	$225
2nd job	$158	Travel	$56
		Food	$117
		Clothes	$55
		Entertainment	$50
		Bills	$157
		Savings	$248
Total	**$908**	**Total**	**$908**

6 a essentials $900, relaxation $540, savings $360

b Save it because she'll need it for bills later.

c just over 23 fortnights

7 a $1462.65 **b** $369.23

c It's an amount he must pay and it's neither savings nor entertainment.

d $362.09 **e** $77.09

f Reduce his entertainment or savings budget. He should make cheap meals at home rather than eating out.

8 a $46 620 **b** $76 355–$80 935

c $2125 **d** 20 years

9 a $8250 **b** 18.2 years

c $56 283

d essentials $2345.13
entertainment $938.05
savings $1407.08

EXERCISE 12.5

1 $191.20 **2** $469.20 **3** $178.40

4 $3386.37

5 a $24 770.20 **b** $142.91 **c** $23.20

6 a $896.70

b Her pension should be $506.70.
She will have to repay 4 × $13.30 = $53.20.

7 $906 529, $7671.20

8 The letter stating that she has been overpaid is correct, but the amounts quoted are wrong.

Her pension should be $283.58 per fortnight.

amount received = $7462

amount entitled to = $7373.08

overpayment = $88.92

9 Her fortnightly pension will decrease by $13.65.

EXERCISE 12.6

1 **a** $240 **b** $3240 **c** $270

2 **a** $1445 **b** $9945 **c** 104

d $95.63

3 **a** $19 200 **b** $1600 **c** 10%

4 $187.50

5 **a** $3000 **b** $1300 **c** $1700

6 **a** $337 500 **b** $87 500

c

Interest rate	Monthly repayments	Total to repay	Total interest
2.9%	$1183	$354 900	$104 900
3.5%	$1262	$378 600	$128 600
4%	$1330	$399 000	$149 000

d

Interest rate	Monthly repayment	Total to repay	Total interest
2.45%	$1671	$300 780	$50 780
2.9%	$1724	$310 320	$60 320
3.5%	$1797	$323 460	$73 460
4%	$1859	$334 620	$84 620

e The shorter the loan, the less interest.

f $1319 per month, interest = $66 560

EXERCISE 12.7

1 **a** $374.37 **b** $1466.09

c $320.07 **d** $83.18

2 Answers will vary but should be approximately $110 to $120.

3 1205.2%, average 5.0%

4 **a** 17 to 18%, approximately 1975

b 1963, 2020

c It fell from approximately 13% to 2.5%.

d It fell to below 0, then rebounded to approximately 4% reasonably quickly.

e Reasonably successful. The high levels seen in 1970 to 1990 haven't occurred since.

5 **a** July, August, September

b The median is not affected by extreme or outlying values.

c In the short term they have gone up and down, but the general tendency is for the price to go up.

d $600K, an unreliable prediction because it is beyond the data.

e Increased from $80 000 to $116 000, which is an increase of $36 000.

6 **a** Relatively stable at 5% p.a.

b Interest rates increased from 6% to 10%.

c They went up and down but in general increased from 13 to 17%.

d Interest rates fell.

e Reduced from 9% to under 6%.

f 5%, unreliable because it is beyond the data.

KEYWORD ACTIVITY

1 website **2** expenses **3** annual

4 comparison **5** unit **6** rates

7 save **8** repay **9** pensions

10 HELP **11** assets

TEST YOURSELF 12

1 The prices per 100 mL are 72c, 71c and 73c. The 800 mL bottle is the best buy.

2 **a** The excess is different.

b $1214.64

c $124.20

3 14%

4 $1077

5 **a** essentials $423, entertainment $253.80, savings $169.20

b Not a good idea. She will need the money for bills in the future.

c 6 weeks

6 **a** $1769.23 prior, $692.31 post

b $157.09 prior, $695.55 post

c It has fallen from $1926.32 to $1387.86, which is a $538.46 reduction.

7 **a**

Interest rate	Length of loan	Interest he will pay	Total to be repaid	Monthly repayments
8% p.a.	2 years	$3408	$24 708	$1029.50
9% p.a.	3 years	$5751	$27 051	$751.42
10% p.a.	18 months	$3195	$24 495	$1360.83

b The length of the loan.

8 **a** $1.10 June 2020

b It increased from $1.25 to $1.46.

c Prices fell from $1.50/L to $1.10/L. There was a reduced demand for petrol because people couldn't go anywhere and people were working from home.

d $1.00

e 83%

PRACTICE SET 3

Section A

1 B **2** D **3** D **4** A

5 A **6** B **7** C **8** B

9 A **10** C

Section B

1 **a** $9d + 9$ **b** $17 + 2x$

c $2w^2 - 10$ **d** $8 - 2b$

2 Teacher to check

3 **a** $5pq$ **b** 16 **c** $3k^5$

d 10 **e** $\frac{3ab}{t}$ **f** $5h^6$

4 30 m

5 **a** $10m + 8$ **b** $-9 + z$

c $-a^2 + 2a$ **d** $6p + 42$

6 **a**

	Tally	Frequency
Cats	𝍸 |	6
Primates	𝍸 ||	7
Elephants	||||	4
Reptiles	𝍸	5
Other	|||	3
Total		25

b primates **c** 20%

7 **a** 48 **b** 21 **c** 16 **d** 5

8 **a** $t = 2$ **b** $j = 14$ **c** $g = 13$

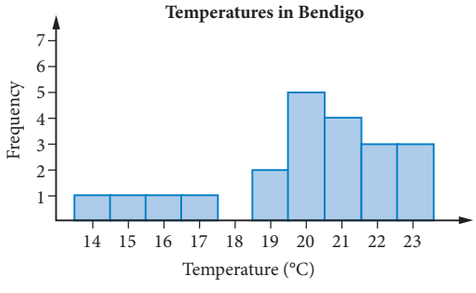
d $r = 30$ **e** $q = 6$ **f** $y = 3$

9 **a**

Score	Tally	Frequency
14	|	1
15	|	1
16	|	1
17	|	1
18		0
19	||	2
20	𝍸	5
21	||||	4
22	|||	3
23	|||	3

b 21 **c** 6

d

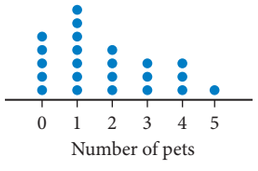


10 **a** E **b** C **c** B

d F **e** A **f** D

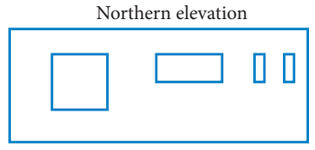
11 **a** $3k + 10$ **b** $\frac{m}{7} - 4$

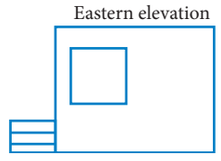
12 **a**



b 23 **c** 7 **d** 41

13





14 **a**

Stem	Leaf
5	5 6 7 8 9
6	0 1 3 5 6 9
7	0 2 2 5 6 8 9
8	3 5 8

b 21 **c** 88 years **d** 38.1%

15 208 m

16 **a**

Number of coffees	Frequency	Cumulative frequency	fx
0	2	2	0
1	6	8	6
2	14	22	28
3	7	29	21
4	1	30	4
5	2	32	10
6	1	33	6
Total	**33**		**75**

b **i** 2 **ii** 2 **iii** 2.3 **iv** 6

17 **a** \$859.30 **b** \$1640.40

18 **a** \$512 essentials, \$307.20 entertaining, \$204.80 savings

b 3 months

19 **a** 8.6 m **b** 58 tiles **c** 4 boxes

20 **a** \$18 240 **b** \$1620 **c** 10.8%

21 $55n + 400$

CHAPTER 13

EXERCISE 13.1

1 **a** 3000 **b** 1372 **c** 5760

2 1266 **3** 43 **4** 42

5 40 **6** 588.98 **7** 30

8 8000 **9** 5735.16 **10** 10.91

11 25 **12** 10.12

EXERCISE 13.2

1 3 mL **2** 904.8 cm^3 **3** 177°C

4 **a** 285 km **b** 71.25 km

5 280 cm or 2.8 m

9780170448123

6 a Young's rule: 10.3 mL
Clark's rule: 7.5 mL

b Clark's rule because it's based on weight and Isabella is underweight for her age.

7 a 0.06 **b** $8119.60

8 a 502 m

b Ruth has plenty of wool. The cone contains 2600 m of wool.

9 a 0.037 **b** 54 872 **c** 31.4%

The male formula has a larger denominator, which makes the overall value smaller.

10 51% **11** 4140 m^3 **12** 82 km/h

EXERCISE 13.3

1 Yes, both sides equal 30.

2 A, C

3 a $a = 53$ **b** $x = 5$ **c** $p = 33$

d $d = 4$ **e** $m = 9$ **f** $y = 2$

4 a $x = 4$ **b** $a = 3$ **c** $a = 6.5$

5 a $y = 80$ **b** $g = 36$ **c** $t = 22.5$

6 a $x = 30$ **b** $k = 4$ **c** $a = 3$

d $h = 4$ **e** $d = 7.5$ **f** $g = 2.5$

g $p = 4.75$ **h** $p = 7.5$ **i** $t = 12.5$

j $y = 17.5$ **k** $x = 3$ **l** $k = 1.5$

m $x = 9.5$ **n** $a = 2.4$ **o** $p = 3\frac{2}{3}$

p $x = 0.12$ **q** $b = 0.65$ **r** $p = \frac{15}{32}$

s $d = -4\frac{2}{3}$ **t** $k = -\frac{3}{5}$

EXERCISE 13.4

1 a

x	−5	−2	3	6	11
y	−7	−1	9	15	25

b

x	4	2	5	7	−3
y	7	1	10	16	−14

c

x	−4	−2	3	6	9
y	−2	−1	1.5	3	4.5

d

x	−2	−1	4	7	10
y	24	22	12	6	0

2

x	1	2	5	9	10
y	11	10	7	3	2

3 a F **b** B **c** A

d C **e** E **f** D

4 Other answers possible.

a $y = x + 1$ **b** $y = x \div 10$

c $y = 4x$ **d** $y = x^2$

e $x + y = 10$ **f** $x \times y = 24$

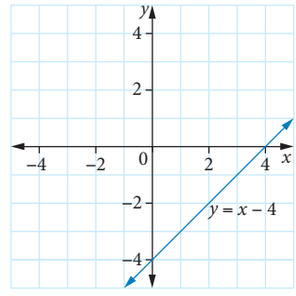
g $x + y = 7$ **h** $y = 2x$

5 Other answers possible.

x	5	6	7	8	9
y	4	5	6	7	8

EXERCISE 13.5

1 a



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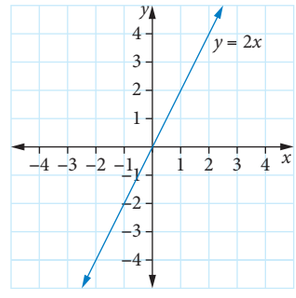

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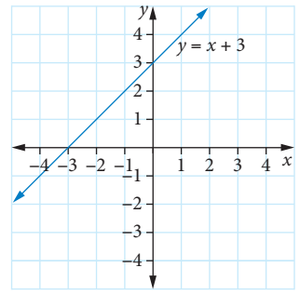

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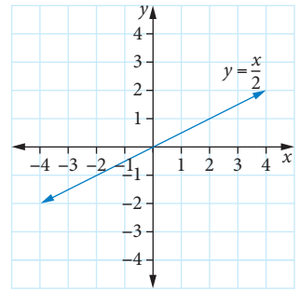

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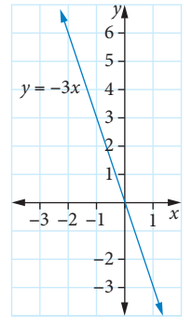
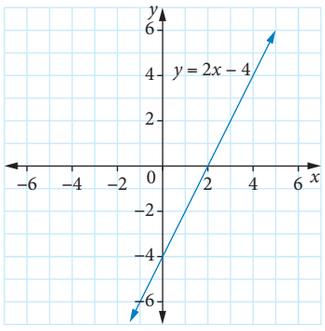
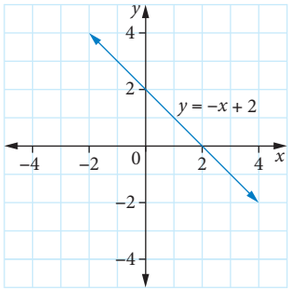


f



g



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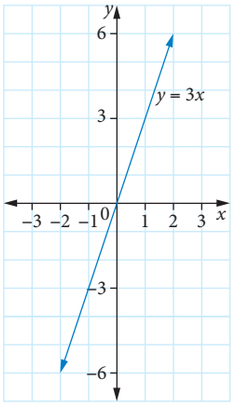
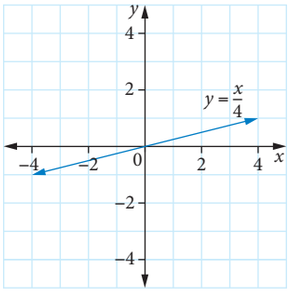


i



2

	Gradient	y-intercept
a	$\frac{1}{2}$	2
b	3	−1
c	1	6
d	$\frac{1}{2}$	1

3 **a** **i** 3 **ii** 2

b **i** −2 **ii** 3

c **i** −1 **ii** 7

d **i** 4 **ii** 0

e **i** $\frac{1}{4}$ **ii** −2

f **i** $\frac{-1}{3}$ **ii** −4

4 **a** positive, 1 **b** positive, 2

c positive, 1 **d** positive, $\frac{1}{2}$

e negative, −3 **f** positive, 2

g negative, −1 **h** positive, 3

I positive, $\frac{1}{4}$

EXERCISE 13.6

1 **a** $5t = 55$, $t = 11$ **b** $10x = 4.8$, $x = 48c$

c $2n = 110$, $n = 55$ **d** $y - 4 = 6$, $y = 10$

2 **a** B, $N = 299$ beetles **b** A, 1140 mL

c A, 39 boxes **d** D, $N = 53$

3 **a** $5n - 130 = 300$, $n = 86$

b $(a + 15) \times 7 = 294$, $a = 27$

c $2l + 2 \times 17 = 100$, $l = 33$ cm

d $(y - 13) \times 6 + 5 = 95$, $y = 28$

e $11d \div 2 = 44$, $d = 8$ cm

f $200 + x \div 5 = 750$, $x = \$2750$

KEYWORD ACTIVITY

1	expressions	**2**	equations	**3**	solve
4	balanced	**5**	amount	**6**	sides
7	substitute	**8**	correct	**9**	constructing
10	values	**11**	points	**12**	line
13	translate	**14**	answer		

TEST YOURSELF

1 **a** 179.6 **b** 25 **c** 11.8

2 **a** 460 km **b** 28.75 km

3 135.4 m

4 Yes, both sides have a value of 7.

5 **a** $x = 44$ **b** $p = 22$

c $x = 4.36$ to 2 decimal places

6

x	0	1	3	4	5	6
y	12	10	6	4	2	0

7 **a** Other answers possible.

x	0	2	4	6	8	9
y	9	7	5	3	1	0

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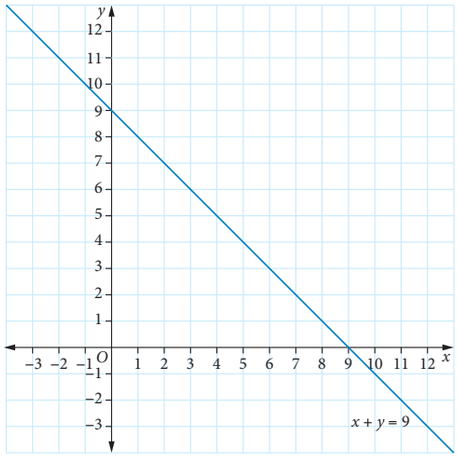
b



c gradient = −1, y-intercept = 9

8 $\frac{x}{8} + 5 = 9$, $x = 32$

9 $2R + 15 = 67$, $R = 26$. Renee is 26 and Joe is 41.

CHAPTER 14

EXERCISE 14.1

1 a $T = 5$ **b** $D = 240$

2 a 180 km **b** 4 h

3 80 km/h **4** 275 km **5** 8 km

6 a 0.15 **b** 9 min

7 7.5 min

8 a 2000 m = 2 km **b** 30 is minutes not hours

c 4 km/h

9 a 279 m **b** 4.5 s

10 a 5400 m **b** $11\frac{1}{9}$ s

11 a 750 km **b** 10 h

c 76 km/h **d** 5 am Tuesday

12 a 16.7 m/s **b** 25 m/s

13 40 320 km/h

14 Teacher to check. The distance will be in the order of 100 km.

EXERCISE 14.2

1 a NW **b** S **c** N or NW

d SE

2 a SW **b** Poland, West Germany, UK

3 a NW **b** SW **c** S

d W **e** E **f** NE

g SE **h** N **i** E

4 A

5 a Condobolin **b** Molong **c** Grenfell

6 a rain **b** hot, dry **c** rain **d** cold

e hot, dry **f** rain **g** rain **h** hot, dry

EXERCISE 14.3

1 a Kanook Primary School

b tennis court

c Seaford

d white star inside a red circle

e Several answers possible, e.g., East Rd, Austin Rd, Mitchell St, Barry St

2 a K4 **b** J7 **c** C11, C12, D11 or D12

3 a west **b** north **c** south **d** north

4 north **5** south-west **6** 250 m

7 1400 m **8** 1750 m

9 a 8 km **b** 4 km/h

10 a 2500 m **b** 1300 m **c** 625 m

11 a 1250 m **b** 2750 m

12 a 1375 m **b** Between 7 and 8 minutes

13 Basketball **14** Teacher to check

EXERCISE 14.4

1 155 km **2** 120 km **3** 98 km

4 a 3664 **b** 64 km/h

5 a 80 km **b** 1 h 4 min **c** 1.40 pm

d **i** 141 km/h

ii His average speed was 141 km/h, but at some times he was travelling faster and other times slower.

6 a 456 km **b** 13 h 6 min

7 a Mittagong **b** 170 km

c 1 h 53 min **d** 37 km/h

8 $182

9 a 2.30 pm **b** $18 each **c** $11 each

10 11.06 am

EXERCISE 14.5

Answers may vary.

1 a 600 m **b** 9 min

c Wood Oven Pizza, Texas Hamburgers, House of Salimar

d 200 m **e** bus 20, 2 min

2 a 4.3 km **b** 9 min

c Train to Greensborough station (7 min), then walk for 13 min or 6 min walk to the bus stop, catch bus 513 for 15 min, then walk for 3 min

d 56 min, 4.4 km

e There's grass and trees surrounding the school, near a major intersection and a shopping centre across the road.

3 a 1.7 km **b** 4 min **c** 11 min **d** 800 m

e Cars can't turn right onto Horizon Blvd, so have to go the long way.

4 a 2.1 km **b** 5 min **c** 23 min

d car 25.2km/h, walking 4.6 km/h

e The car will have to stop for traffic.

f Walk southeast down Beach Rd, turn left into Foam St until the end, turn left on Parkers Rd and keep going until you reach the roundabout. Parkers Rd then veers right. Keep going on Parkers Rd as it passes the church and after it crosses the Nepean Highway it becomes Imes St with the cricket oval on the right. At the end of Imes St, turn left into Chandler St, then right on MacGregor St. No. 16 is about halfway down the block on the right.

5 **a** yes **b** 21 min **c** 23.68 km
d 68 km/h **e** 3.24 pm
f Hunter Cafe, head south on Dundas St for 700 m (2 min); other answers possible

6 **a** 329 km **b** 3h 38 min
c Murray Valley Freeway, Calder Freeway
d 12.22 pm
e Leave earlier in case of delays. Consider leaving by 11.30 am.
f 23.03 L

7 **a** 1200 Great Ocean Rd, Bellbrae
b car park **c** outside town
d right-hand side **e** 5.2 km
f 5 min
g Teacher to check. Photos taken at different times.

KEYWORD ACTIVITY

Across

5 coordinates **8** distance **9** compass

Down

1 second **2** kilometres **3** south
4 scale **6** northwest **7** speed
10 map

TEST YOURSELF

1 3 hours **2** 15 km **3** 20 m/s
4 25 m/s **5** 4 km/h

6 **a** Belvedere Park Primary School
b approximately 2.75 km
c northeast or southwest

7 **a** 4WD (4-wheel-drive) vehicle
b Alice Springs – Eridunda – Mt Ebenezer – Kings Creek Station – Kings Canyon
c Head south on Luntja Rd, turn right at Lasseter Highway.
d 200 km **e** Curtin Springs
f west **g** northeast

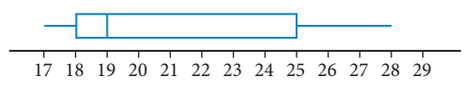
8 **a** 1 h 33 min **b** 107 km **c** 69 km/h

CHAPTER 15

EXERCISE 15.1

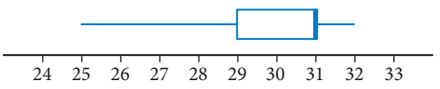
1 **a** 17, 18, 19, 25, 28

b



2 **a** 25, 29, 31, 31, 32

b



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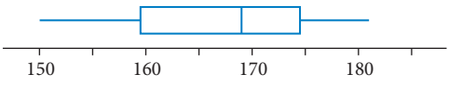
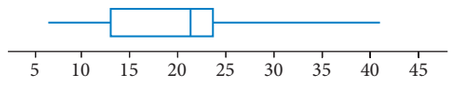


4 **a** 6, 13, 21, 24, 41

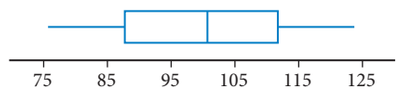
b



5 **a** 22 **b** 35
c **i** 15 **ii** 45
d 18

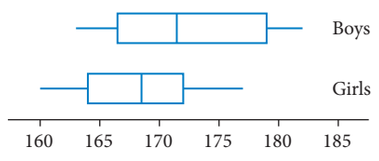
6 **a** 76, 88, 101, 112, 124

b



7 **a** Boys: 163, 166.5, 171.5, 179, 182
Girls: 160, 164, 168.5, 172, 177

b

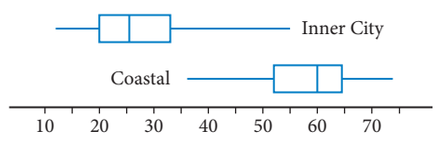


c Girls tend to be shorter than boys. The heights of the boys are more spread out.

8 **a** 20 **b** 11 **c** 4
d 15 **e** 30

9 **a** Inner city: 12, 20, 25.5, 33, 55
Coastal: 36, 52, 60, 64.5, 74

b



c Inner city, lower risk of theft.

EXERCISE 15.2

1 **a**

Class A		Class B
	3	5 8 9 9
	4	0 1 2 2 2 6 7
	5	1 4 6 7 9
9 7 5 2 0	6	0 1 5 5 5 6 8
9 8 6 5 1 1 1 0	7	1 2 4
9 9 9 8 5 5 4 2 1 1 0	8	8
5 5 4 3 1	9	

Key: 0|6 = 60
3|5 = 35

b 29 **c** A: 81, B: 56.5
d A: 35, B: 53 **e** an outlier in B (88)
f A – top, B – middle

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2 a

Year 11		Year 12
	0	7 8
5 5 5	1	0 2 3 3 4 5 8 9 9
9 5 3 3 2 2 0	2	0 0 1 2 2 3 4 4 6
9 1 0 0 0 0 0	3	
4 2 1	4	

Key: 5|1 = 15
1|0 = 10

b 11: 29.5, 12: 19

c 11: 29, 12: 19

d no outliers

e clustered in the 20s

f medians are very different

g number of students in each year level

3 a

Male		Female
	15	0 2 7 9
8 7 5 0	16	0 2 3 4 4 5 6 6 6 7 8
8 8 8 5 2 0 0	17	1 3 3 6 6 7 8
4 4 3 3 1 1 1 1 0 0	18	5 5
1 0 0	19	
0	20	

Key: 0|16 = 160
15|0 = 150

b 25

c 24

d Males: 160, 171, 180, 183.5, 200
Females: 150, 162.5, 166, 174.5, 185

e 200 is an outlier in the male group.

f Male median is higher than the female median.

g Teacher to check

4 a

Townsville		Kiama
	20	3 7
	21	0 8
	22	1 3 5 5
	23	0
	24	5 7 9
	25	0 4 5 6 6 9
	26	4 7
	27	0 6 9
	28	
5 3	29	6
	30	
9 9 8 7 7 2 2 0 0 0	31	
8 7 7 5 3 3 2 1 1	32	5 6
7 6 4 4 1	33	0
3 2	34	
	35	
	36	3

Key: 0|29 = 290
20|3 = 203

b 28

c Townsville: 32.15°, Kiama: 25.45°

d Townsville: 5°, Kiama: 16°

e Townsville: 29.3°, 29.5°
Kiama: 36.3°, 33.0°, 32.6°, 32.5°

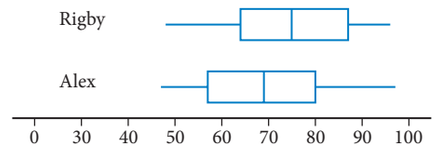
f Townsville temperatures are close together, Kiama temperatures are widely spread out.

g Teacher to check

h Teacher to check

EXERCISE 15.3

1 a



b **i** 75 **ii** 69

c **i** 48 **ii** 50

d Alex: his mark is 16% above the median, while Rigby's is only 10% above the median.

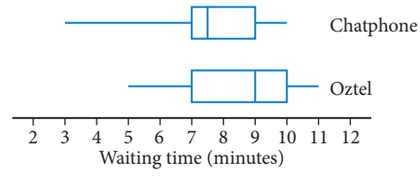
e Rigby's class: more than 50% of the scores are above the median for Alex's class.

f No, we don't have any data values or the numbers of students in each class.

2 a Chatphone: 3, 7, 7.5, 9 10

Oztel: 5, 7, 9, 10, 11

b



c Chatphone: 7.5, Oztel: 9

d Chatphone: 7, Oztel: 9

e Chatphone: 2, Oztel: 3

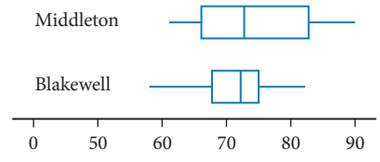
f Yes, Chatphone's median is 1.5 minutes less than Oztel and 75% of Chatphone's calls wait less than 50% of Oztel calls.

g Teacher to check

3 a Middleton: 60, 67.5, 72.5, 82.5, 90

Blakewell: 58, 68, 72, 75, 82

b



c Middleton: 72.5 km/h, Blakewell: 72 km/h

d Middleton: 72, 75, 85, Blakewell: 68, 70, 72, 73, 75

e Middleton: 74.2 km/h, Blakewell: 71.5 km/h

f Middleton: 15 km/h, Blakewell: 7 km/h

g No, the mean in Blakewell is lower and 25% of the sample in Middleton were faster than the entire Blakewell sample.

4 **a** 480 000, 550 000, 680 000, 850 000, 980 000

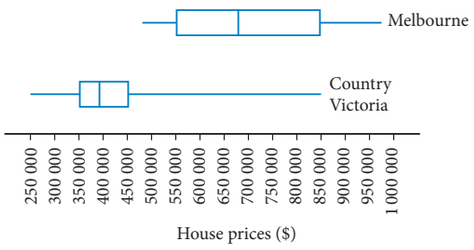
b range = 500 000, IQR = 300 000

c 249 000, 350 000, 390 000, 460 000, 849 000

d range = 600 000, IQR = 110 000

e Outlier is $849 000, it makes the range very large.

f



g Teacher to check

5 **a** 25

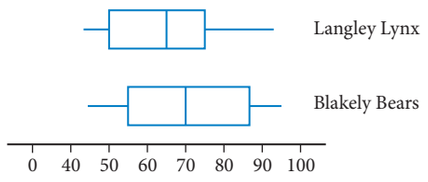
b Langley Lynx: 49, Blakely Bears: 50

c Langley Lynx: 66, Blakely Bears: 70

d Langley Lynx: 43, 51.5, 66, 75.5, 92

Blakely Bears: 44, 57, 70, 87, 94

e



f Teacher to check **g** Blakely Bears

EXERCISE 15.4

1 **a** 60 **b** 61

c soft drink **d** coffee

e Teacher to check

2 **a** 52%

b 15–24

c Higher percentage of union membership as age group becomes higher

d Teacher to check

3 **a** 20°C

b February

c April, May, June, July, August, September

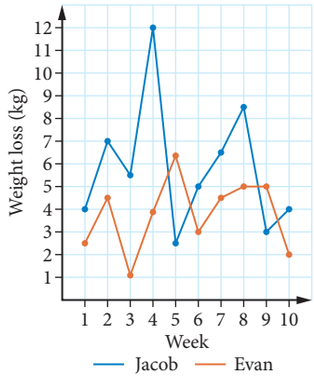
d 14

e Teacher to check

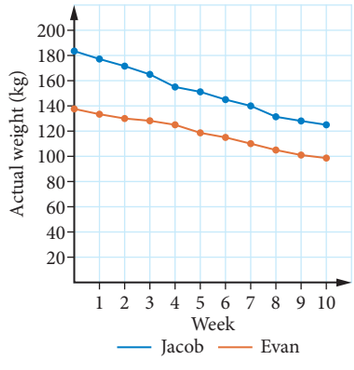
4 **a**

	Week	Start	1	2	3	4	5	6	7	8	9	10
Jacob	Weight loss (kg)		4	7	5.5	12	2.5	5	6.5	8.5	3	4
	Actual weight (kg)	183	179	172	166.5	154.5	152	147	140.5	132	129	125
Evan	Weight loss (kg)		2.5	4.5	1.1	3.9	6.4	3	4.6	5	5	2
	Actual weight (kg)	137	134.5	130	128.9	125	118.6	115.6	111	106	101	99

b



c



d Teacher to check

e **i** 58 kg **ii** 38 kg

f Jacob 31.7%, Evan 27.7%

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KEYWORD ACTIVITY

Teacher to check

TEST YOURSELF

1 a min. = 2

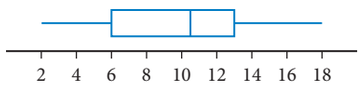
1st quartile = 6

median = 10.5

3rd quartile = 13

max. = 18

b



2 a median = 26.5

b 14

c 9 employees

3 a

Bulls		Tigers
	7	2
9 3	8	
8 0	9	7
9	10	4 9
4 3	11	
7 5	12	6
7	13	0 3 8 9 9
0	14	4 7
9	15	

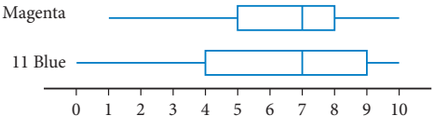
b 12

c Bulls: 113.5 Tigers: 131.5

d Bulls: 159 Tigers: 72

e Tigers: higher median and scores clustered in the 130s.

4 a



b Median is 7 for both classes.

c 11 Blue: 5, 11 Magenta: 3

d Adele: she is above the 3rd quartile (75%) of her class, while Shane is *at* the 3rd quartile of his class.

5 a 45%

b 2006

c **i** 3 and 4 **ii** 5 and over

d 3 and 4

e false

f Teacher to check

PRACTICE SET 4

Section A

1 C **2** A **3** A **4** B

5 D **6** C **7** B **8** D

9 B **10** D

Section B

1 a Nepean Special School **b** $1\frac{1}{2}$ km

2 a Town Square **b** H7

3 17.9

4 yes, $10 - 5 = 2 \times 5 - 5 = 5$

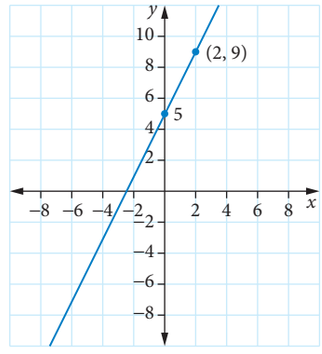
5 a 31 **b** 45 **c** 4

6 116

7 a

x	0	1	2	4	−1	−2
y	5	7	9	13	3	1

b

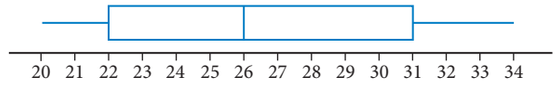


c 5 **d** 2

8 Renee 44, Joe 60

9 a 20, 22, 26, 31, 34

b



10 a 59 min **b** 11.38 am

11 a 11.2 km **b** 16 min

c 42 km/h **d** 11.59 am

12 a

Test 1	Stem	Test 2
8	0	3 7
9 7	1	1 1 7 9
7 7 7 5 3 3 2 0	2	0 1 3 7 8 8 9
9 8 8 6 4 4 2 1 1 0 0 0	3	0 0 1 1 2 2 4 5 5 6 8 9
8 6 5 1 1 0 0	4	4 6 7 7 9
	5	0

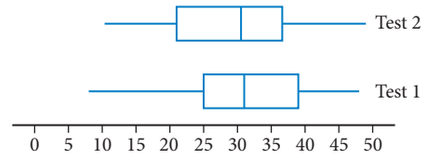
b Test 1: 40, Test 2: 47

c Test 1: 8, Test 2: none

d Test 1: 8, 25, 31, 39, 48

Test 2: 3, 21, 31, 38, 50

e



13 southwest

ANSWERS

Glossary and index

2D shapes Flat shapes that have 2 dimensions: length and width. (p. 270)

3D shapes Solid shapes that have 3 dimensions: length, width and depth. (p. 270)

12-hour time am or pm time. For example, 2.35 pm (p. 212)

24-hour time Time expressed as a 4-digit number with the first 2 digits representing the hour (from 00 to 23) and the last 2 digits representing the minutes. For example, 1435 represents 2.35 pm. (p. 212)

allowance (government) Money paid by the government to support individuals for specific purposes. For example, to support the aged, unemployed, disabled and students. (p. 324)

allowable tax deduction A part of a person's yearly income that is not taxed, such as work-related expenses or donations to charities. All deductions are subtracted from yearly income to determine **taxable income**. (p. 20)

allowance (worker's) Money paid to a worker for job-related expenses. For example, travel, special clothing, working in isolated or dangerous areas. (p. 10)

annual Per year. (p. 5)

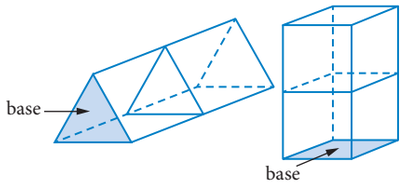
annual leave loading Extra pay, usually 17.5% of 4 weeks' pay, given by some employers to an employee during annual leave. (p. 12)

area The amount of surface occupied by a flat shape, measured in square units. (p. 186)

back-to back stem-and-leaf plot Two stem-and-leaf plots in the same diagram. (p. 391)

Allfit		Superfit
7 6 5 5 5 2	1	1 3 6 6 9
7 3 2 2 1 1 0 0	2	0 0 1 2 2 3 7 7
9 4 2	3	1 2 4 4 5 8
3 3	4	6
1	5	

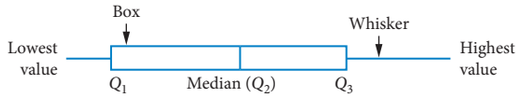
base (of a prism) One of the parallel end faces of a prism. (p. 203)



BIDMAS *See* **order of operations**.

bonus Extra pay for doing good work, meeting targets or deadlines. (p. 10)

boxplot A diagram that displays the quartiles of a set of data as a box and the extremes as whiskers. (p. 388)



budget A plan for managing money. (p. 318)

capacity Amount of liquid or gas that can be held by a container, usually measured in millilitres (mL) or litres (L). (pp. 98, 209)

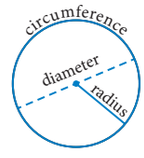
Cartesian plane Another name for the number plane. (p. 244)

categorical data Information represented as a category rather than a number. For example the makes of cars or the colours of eyes. (p. 58) Differs from **numerical data**.

census A survey of all the items or people in a population. (p. 59)

centi- One-hundredth $\frac{1}{100}$. (p. 91)

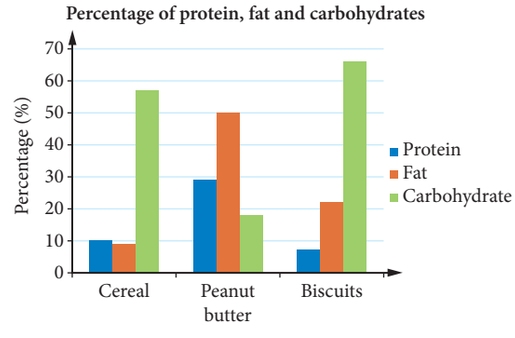
circumference The perimeter of a circle. $C = \pi d$ or $C = 2\pi r$, where C is the circumference, π is pi (3.141 59…), d is the **diameter** and r is the **radius**. (p. 197)



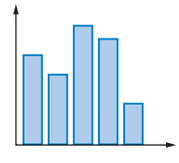
class interval In statistics, when there are many data values, they may be grouped into class intervals. For example, ages of people may be grouped into class intervals of 1–10, 11–20, 21–30, and so on. (p. 75)

cluster A group of data values that are bunched or close together. (p. 178)

clustered column graph A column graph with 2 or more columns stuck together for each category on the horizontal axis. (p. 63)



column graph A graph consisting of columns of equal width. (p. 62)



compass direction A direction shown by points on a compass, such as north (N), south (S), east (E), west (W), northeast (NE), northwest (NW), southeast (SE), southwest (SW). (p. 368)

commission The earnings of a sales person or agent; usually a percentage of the value of items sold. (p. 14)

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composite Made of more than one thing. For example, a composite shape is made up of 2 or more simpler shapes. (p. 277)

conversion graph A graph that is used to convert between different units, such as between metric and imperial units of measurement, or between currencies in foreign currency exchange. (p. 65)

coordinates A pair of values and/or letters for describing a location on a map. For example, D4. (p. 244)

cost price The price it costs a shop to buy a product from the factory or wholesaler. (p. 127)

CPI Consumer Price Index, a measure of the prices of goods and services in Australia. (p. 329)

cubic metre (m^3) A unit of volume equal to the volume of a cube of length 1 m (the size of 2 washing machines). $1\,m^3 = 1\,000\,000\,cm^3$. (p. 201)

cumulative frequency A running total of frequencies. (p. 262)

cylinder The shape of a can, a solid that has a circular base and cross-section. (p. 197)

data Raw statistical information. (p. 58)

decrease To make smaller. (p. 124)

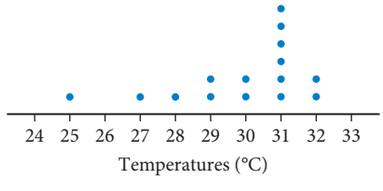
diameter The length of the interval passing through the centre of a circle and joining 2 points on the **circumference** of the circle. The diameter is double the **radius**. (p. 195) See **circumference** for diagram. (p. 195)

dimensions The length, width or height of an object. (pp. 187, 270)

discount Money deducted from the usual marked price. (p. 124)

dot plot A graph that uses dots to show frequencies of data values. (p. 76)

See also **stem-and-leaf plot**.



double time A rate of overtime pay that is 2 times the normal hourly rate. (p. 8)

elevation view On a plan, the view of a building from the sides, front and back. (p. 286)

equation A statement involving a variable, numbers and an '=' symbol to show that quantities are equal. For example, $4k + 11 = 31$. (p. 242)

estimate To make an educated guess for a numerical answer. (p. 46)

evaluate To find the value of a numerical or algebraic expression. (p. 240)

excess In an insurance claim, this is the amount you pay towards the expense/bill and the insurance company pays the rest. (p. 313)

expense The cost of spending. (p. 318)

five-number summary These 5 values for a set of data: the lowest value, the lower quartile, Q_1, the median, Q_2, the upper quartile, Q_3, and the highest value. These are used to construct a **box-and-whisker plot**. (p. 388)

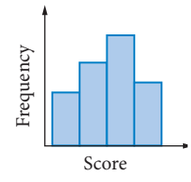
flat rate interest *See* **simple interest**.

formula A rule written as an algebraic equation, using variables. For example, the formula for the area of a triangle is $A = \frac{1}{2}bh$. (p. 344)

fortnightly Every 2 weeks. (p. 5)

frequency The number of times a value or group of values occurs in a data set. (p. 254)

frequency histogram A column graph in which the height of each column represents the frequency of a single value or group of values. There is no space between the columns. (p. 75)



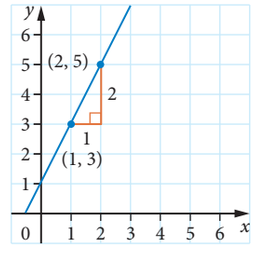
frequency polygon A line graph formed by joining the midpoints of the tops of the columns of a frequency histogram. (pp. 75, 254)

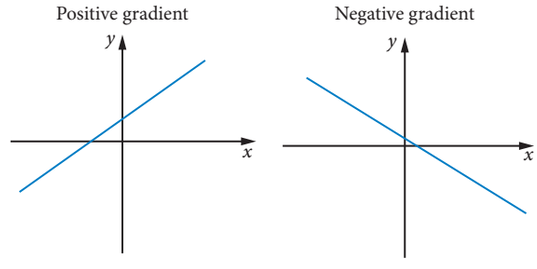
frequency table A table that lists the frequency of each item in a data set. (p. 252)

global positioning system (GPS) A system of identifying your position on the Earth on your phone or computer using satellite technology and the internet. (p. 379)

goods and services tax (GST) A tax on goods and services, usually 10% in Australia. (p. 159)

gradient The steepness of a line. For the line below, gradient $= \frac{2}{1} = 2$. (p. 355)





gross pay Your pay before the tax is taken out. (p. 18) *See also* **net pay**.

hectare A large unit for measuring area, equal to 10 000 square metres. (p. 186)

histogram *See* **frequency histogram**.

holiday loading *See* **annual leave loading**.

holiday pay Total pay for holidays, including usual pay plus annual leave loading. (p. 13)

income Money that is earned or gained (usually regularly). (pp. 6, 318)

income tax A personal tax that is calculated on the amount of income a person earns over the financial year. (p. 20)

increase To make bigger. (p. 124)

inflation The rate at which the overall costs of goods and services are increasing. (p. 329)

integer A positive or negative whole number or zero. For example, –3, 7, 0. (p. 40)

interest Money earned on an investment, or money paid to a financial institution for borrowing. (p. 326)

interest rate The percentage of the investment or loan on which interest is calculated. (p. 326)

interquartile range (IQR) The difference between the upper quartile and lower quartile of a data set ($Q_3 - Q_1$). It is a measure of the spread of the data. (p. 176)

kilo- 1 thousand. (p. 91)

kilogram 1000 grams. (p. 98)

kilometre 1000 metres. (p. 91)

like terms Terms in an algebraic expression that have exactly the same variable(s), such as $8ab$ and $-2ab$. (p. 235)

line graph A graph made of lines, often used to represent data that changes over time (p. 64)

linear equation An equation whose graph is a straight line. (p. 355)

litre A measure of liquid. 1 L = 1000 mL. The size of a tall carton of milk. (p. 98)

loss The amount of money lost by a shop on an item when it sells for less than it cost; the opposite of **profit**; loss = cost price – selling price. (p. 127)

mass A measure of size or weight in units such as grams, kilograms or tonnes. (p. 98)

mean The average of a set of numerical data, calculated by adding all the values and dividing by the number of values. (p. 170)

measure of central tendency A statistical value, such as the **mean**, **median** or **mode**, that describes the centre or average of a set of data. (p. 170)

measure of spread A statistical value, such as the **range** or **interquartile range**, that describes the spread of a set of data. (p. 176)

median The middle value of a set of numerical data, or the average of the 2 middle values when values are arranged in ascending order. (p. 170)

Medicare levy A tax to cover the costs of the public health system, calculated as a percentage (usually 2%) of a person's income. (p. 22)

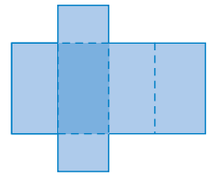
mega- One million. (p. 98)

metric system A measurement system based on powers of 10. (p. 91)

milli- One-thousandth, $\left(\frac{1}{1000}\right)$. (p. 91)

mode The most common value(s) in a set of data. (p. 170)

net (of a solid) The faces of a solid shape laid out flat. For example, this is the net of a rectangular prism. (p. 196)



net pay Your pay after the tax has been taken out. (p. 18) *See also* **gross pay**.

number plane *See* **Cartesian plane**.

numerical data Data that involves numbers, such as heights or the number of cars owned. (p. 58)

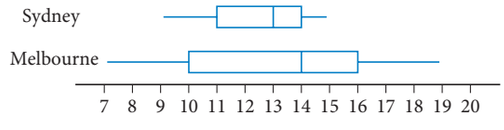
order of operations The order in which you calculate an expression with 2 or more operations: brackets, indices (powers), multiply and divide from left to right, add and subtract from left to right. This can be remembered using the initials BIDMAS. (p. 42)

origin The centre of a number plane, the point with coordinates (0, 0). (p. 244)

outlier An extreme (high or low) value in a data set that is very different from the other values. It affects the mean, but not the mode or median. (p. 174)

overtime Working beyond normal hours, paid at a higher rate. (p. 8)

parallel boxplot Two boxplots shown on the same scale. (p. 393)

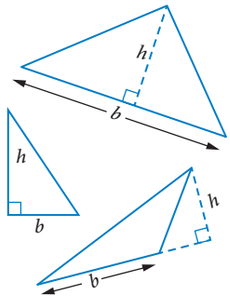


PAYG tax 'Pay As You Go' tax; income tax deducted from our pay in instalments each payday by our employer. (p. 18)

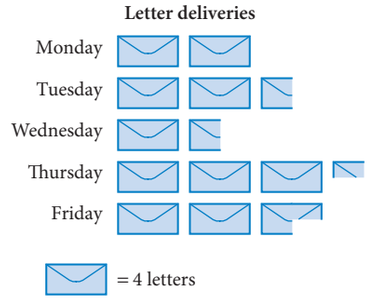
per annum (p.a.) Per year. (p. 6)

perimeter The distance around the outside of a shape. (p. 96)

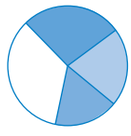
perpendicular height The height of a shape that is at right angles (90°) to the base. For example, h is the perpendicular height of each triangle. (p. 189)



pictogram (or **picture graph**) A type of graph where pictures are used to indicate quantities. (p. 61)



pie graph (or **sector graph**) A graph using a circle divided into parts called sectors. (p. 68)



piecework A type of work in which a worker is paid per item produced or processed, such as dressmaking or craftwork. (p. 14)

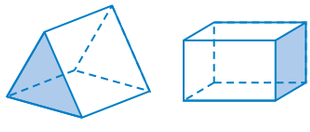
plan Diagram of the floor of a house or building, floor plan. (pp. 286, 383)

polygon Any flat shape with straight sides, such as a rectangle or octagon. (p. 273)

polyhedron A solid with all flat faces. (p. 274)

population In statistics, all of the items under investigation. (p. 59)

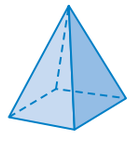
prism A solid shape with flat sides that has the same shape at both ends. A triangular prism and square prism are shown below. (pp. 196, 276)



profit The amount of money gained or made by a shop on an item; profit = selling price – cost price. (p. 127)

pronumeral *See* **variable**.

pyramid A solid shape that has a polygon as its base, with side faces that are triangles that meet at a point called the apex. This is a diagram of a square pyramid. (p. 276)



quadrant A quarter of the number plane, bordered by the x- and y-axes. (p. 244)

quadrilateral A 4-sided shape. (p. 272)

quarterly Four times per year, or every 3 months (quarter of a year). (p. 25)

quartiles Values that divide a set of data into 4 equal parts when the data are arranged in ascending order. The 1st quartile (Q_1) is the lower quartile, the 2nd quartile (Q_2) is the median and the 3rd quartile (Q_3) is the upper quartile. (p. 176)
See also **interquartile range**.

radius (plural: radii) The length of the interval joining the centre of a circle to the circumference. The radius is half of the **diameter**. (p. 193)
See **circumference** for diagram.

range For a set of data, range = highest value – lowest value. (p. 176)

rate A comparison of 2 quantities with different units. For example, km/h. (p. 140)

ratio A comparison of two quantities with the same units. For example, 2 : 3. (p. 130)

reducible interest Interest that is charged on the amount still owing on the loan, the type of interest charged on a reducing balance loan. (p. 326)

regular polygon A polygon with all sides (and all angles) the same size. For example, a regular pentagon has 5 equal sides. (p. 97)

repayment (or **instalment**) Amount paid regularly to pay off a loan. (p. 326)

Reserve Bank The Australian Central Bank. (p. 326)

retainer A fixed amount of money paid to a salesperson that does not depend on sales, paid before commission is added. (p. 15)

royalty A payment to an author, singer or artist for each copy of their work sold, usually a percentage of the total sales amount. (p. 14)

salary Fixed earnings quoted as a yearly amount, but paid weekly, fortnightly or monthly. (p. 4)
See also **wage**.

sample A group of items selected from a population to study or survey. (p. 59)

scale (on a map or diagram) The ratio of scaled length to actual length. For example, a scale of 1 : 500 means that lengths represented on the map or diagram are actually 500 times larger in real life. (pp. 283, 373)

scale diagram A diagram of an object, usually smaller, whose lengths are in the same ratio as the actual lengths of the object. (pp. 97, 283)

sector graph *See* **pie graph**.

selling price The price a shop sells a product for. (p. 127)

simple interest (or **flat rate interest**) Interest earned or charged only on the original amount of money (principal) invested or borrowed, different from compound interest. (p. 326)

solution The value of an equation that makes the equation true. For example, the solution to the equation $4k + 11 = 31$ is $k = 5$. (p. 242)

speed A rate that compares distance travelled with time taken. Speed is often measured in kilometres per hour (km/h) or metres per second (m/s). (p. 364)

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

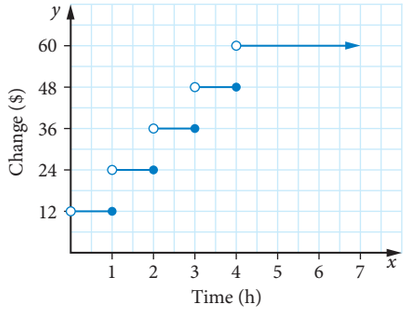
square metre (m^2) A unit of area equal to the area of a square of length 1 m (the size of a large shower floor). $1\,m^2 = 10\,000\,cm^2$. (p. 186)

square root (of a number) The positive value which, if squared, gives the number. For example, $\sqrt{25} = 5$ because $5^2 = 5 \times 5 = 25$. (p. 42)

stem-and-leaf plot A 'number graph' that lists all the data values, in groups. This stem-and-leaf plot shows 12 test values, from 42 to 82. (p. 76)
See also **dot plot**.

Stem	Leaf
4	2 5
5	0 2 8
6	6 7
7	3 5 7 7
8	2

step graph A graph that has horizontal line segments. For example, parking station charges. (p. 67)



substitute To replace a variable in an expression or formula with a number. (p. 240)

superannuation A compulsory saving scheme for workers to provide funds for their retirement years. (p. 25)

surface area The total area of all the faces of a solid shape. (p. 196)

three-dimensional (3D) Having length, width and height, describing a solid or object. (p. 270)

time-and-a-half A rate of overtime pay that is 1.5 times the normal hourly rate. (p. 8)

timetable A table displaying a schedule of events. For example, the times trains arrive. (p. 216)

tonne A unit of mass equal to 1000 kilograms. (p. 98)

triangular prism A solid shape with a constant, triangular cross-section. (p. 196)
See also **prism.**

two-dimensional (2D) Having length and width, describing a flat shape or figure. (p. 270)

unit price In supermarket pricing, the price of one unit per fixed quantity, weight or volume. For example, the price of an item per 100 g or 1 L. (p. 306)

variable (or **pronumeral**) A letter or symbol such as x that stands in place of a number. (p. 240)

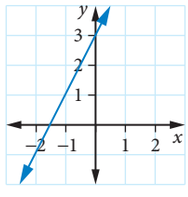
volume The amount of space occupied by a solid, measured in cubic units. (p. 201)

wage An amount paid for work as a rate in dollars per hour. (p. 4)

***x*-axis** The axis or number line going across (horizontally) on a number plane. (p. 244)

***y*-axis** The axis or number line going up and down (vertically) on a number plane. (p. 244)

***y*-intercept** The y value of the point at which a graph cuts the y-axis on the number plane. For example, the vertical intercept of this graph is 3. (p. 355)



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