nelson maths.

11

Essential Mathematics

Units **1** & **2**

Sue Thomson
Judy Binns



QLD

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LEARNING DISCOVERY

COLOURFUL RATIOS



RDVector/Adobe Stock Photos

A bag of confetti contains coloured pieces in the ratio red : blue : white : yellow = 2 : 5 : 3 : 2. If you grabbed a random sample of 20 pieces of confetti, you should expect to find 5 white pieces.

QLD

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*COMPLEX

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Preface

Nelson Maths 11-12 QLD is a new QCE mathematics series that is backed by research into the science of learning. The design and structure of the series has been informed by teacher advice and evidence-based pedagogy, with the focus on preparing QCE students for their exams and maximising their learning achievement.

- All theory, examples and practical applications are precisely mapped to the QCAA syllabus, including coverage of **problem-solving** and **complex** questions.
- To reduce the **cognitive load** for 21st century learners, explanations are clear and concise, using the technique of **chunking** text with accompanying diagrams and infographics.
- The cumulative structure of the 4 **Practice sets** is built on the learning and memory techniques of **spacing** and **retrieval,** as recommended by the new syllabus.

This book caters for students heading towards the workforce or further training after school, and teaches 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.

About the authors

Sue Thomson and **Judy Binns** have had long careers in creating mathematics texts for Queensland, NSW, Victoria and Western Australia, writing *Nelson QMaths Essential Mathematics 11–12*, *New Century Maths 11–12 Mathematics Standard 1*, *Nelson VICmaths Foundation Mathematics 11–12* and *Nelson Senior Maths 11–12 Mathematics Essentials* respectively.

Sue Thomson is an innovative teacher and educational leader. She was an examination writer, assessor, marker and curriculum writer, and a councillor for the Australian Association of Mathematics Teachers (AAMT). Sue is a prolific and successful author with an interest in language development, financial literacy and making mathematics accessible to all.

Judy Binns has taught and led mathematics 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 also co-authored *Nelson Maths 7–8*.

Contributing authors

Deborah Van Hoek wrote many of the *Nelson MindTap* worksheets.
Rashmi Bhagwati, Sue Thomson and **Judy Binns** wrote the topic tests.
John Drake, **Katie Jackson** and **Joanne Magner** created the video tutorials.

Syllabus reference grid

Topics and subtopics	*Nelson Maths 11* *Essential Mathematics QLD* chapter	
UNIT 1: NUMBER, DATA AND MONEY		
1 Number		
Ratios	5	Colourful ratios
Rates	4	Applying rates
Percentages	2	Giving 110%
	6	Applying percentages
Units of energy	9	Healthy figures
2 Representing data		
Classifying data	7	Show me the data
Data presentation and interpretation	7	Show me the data
3 Managing money		
Earning money	8	Earning money
	10	Paying tax
Budgeting	10	Paying tax
UNIT 2: DATA AND TRAVEL		
1 Data collection		
Census	14	Census and surveys
Surveys	14	Census and surveys
Simple survey procedure	14	Census and surveys
Sources of bias	15	That's biased
2 Graphs		
Reading and interpreting graphs	11	Show me the graph
Drawing graphs	11	Show me the graph
Using graphs	13	Practical graphs
3 Time and motion		
Time	12	It's about time
Distance	16	Going places
Speed	16	Going places

Note: The Fundamental topic, Calculations, is first covered in Chapter 1 *What's the score*?, then integrated in all other chapters. Chapter 3 is a special **Problem-solving** chapter.

About this book

At the beginning of each chapter

Each chapter begins on a double-page spread.



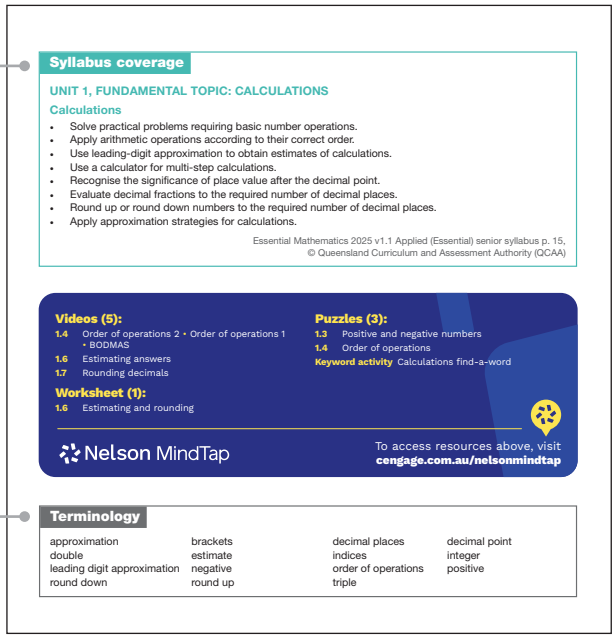
Chapter table of contents includes COMPLEX syllabus content marked by*.

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

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

Chapter problem to be solved.

Syllabus coverage and extracts are shown at the front of the chapter, along with a listing of **Nelson MindTap chapter resources**.



Terminology previews the keywords and phrases from within the chapter.

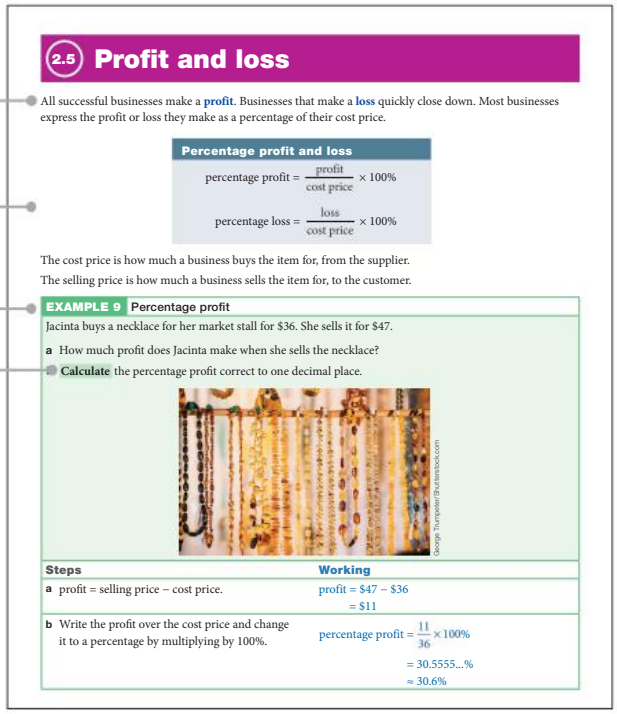
In each chapter

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.

Cognitive verbs are highlighted in light green. See QCAA's glossary of cognitive verbs for more verbs and details.



2.5 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 as a percentage of their cost price.

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 a 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 Percentage profit

Jacinta buys a necklace for her market stall for $36. She sells it for $47.

a How much profit does Jacinta make when she sells the necklace?

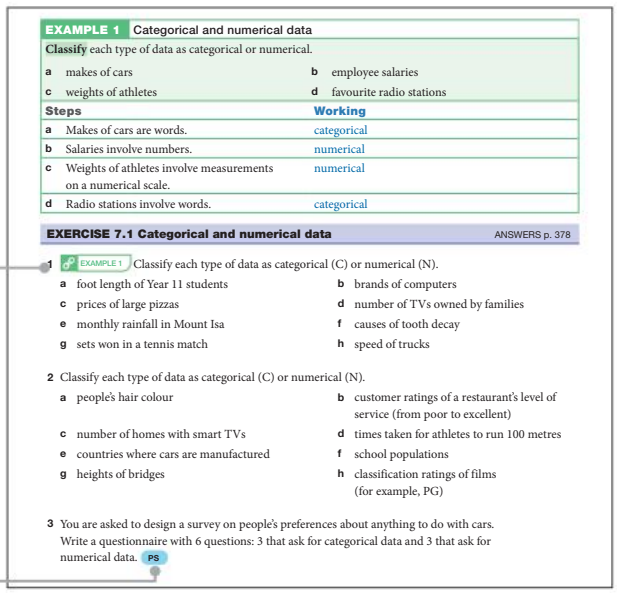
b **Calculate** the percentage profit correct to one decimal place.

George Trumpeter/Shutterstock.com

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%.	percentage profit = $\frac{11}{36} \times 100\%$ = 30.5555...% ≈ 30.6%

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

Problem-solving **PS** and complex **C** questions are clearly tagged and colour-coded.



EXAMPLE 1 Categorical and numerical data

Classify each type of data as categorical or numerical.

a makes of cars
b employee 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 7.1 Categorical and numerical data ANSWERS p. 378

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

a foot length 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

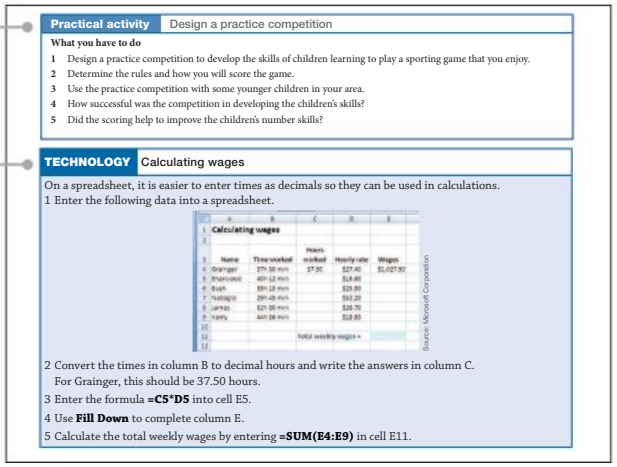
2 Classify each type of data as categorical (C) or numerical (N).

a people's hair colour
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 (for example, PG)

3 You are asked to design a survey on people's preferences about anything to do with cars. Write a questionnaire with 6 questions: 3 that ask for categorical data and 3 that ask for numerical data. **PS**

Investigations and practical activities explore the syllabus in more detail, providing ideas for modelling activities and assessment tasks.

Technology promotes ICT in the classroom, using spreadsheets and the internet.



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?

TECHNOLOGY Calculating wages

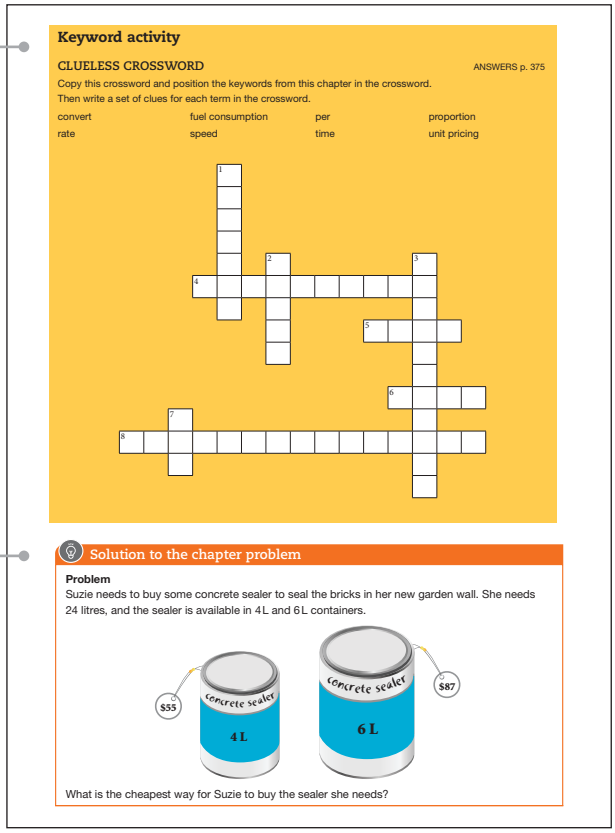
On a spreadsheet, it is easier to enter times as decimals so they can be used in calculations.
1 Enter the following data into a spreadsheet.

Source: Microsoft Corporation

2 Convert the times in column B to decimal hours and write the answers in column C. For Grainger, this should be 37.50 hours.
3 Enter the formula **=C5*D5** into cell E5.
4 Use **Fill Down** to complete column E.
5 Calculate the total weekly wages by entering **=SUM(E4:E9)** in cell E11.

At the end of each chapter

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



Keyword activity

CLUELESS CROSSWORD ANSWERS p. 375

Copy this crossword and position the keywords from this chapter in the crossword.
Then write a set of clues for each term in the crossword.

convert | fuel consumption | per | proportion
rate | speed | time | unit pricing

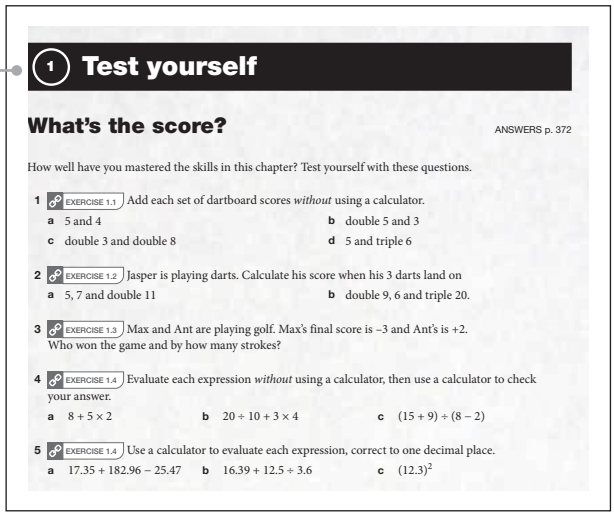
Solution to the chapter problem revisits the problem introduced at the start of the chapter and presents a solution using the 4 stages of problem-solving introduced in Chapter 3 *Solving problems:* WHAT?, SOLVE, CHECK and PRESENT.

Solution to the chapter problem

Problem
Suzie needs to buy some concrete sealer to seal the bricks in her new garden wall. She needs 24 litres, and the sealer is available in 4 L and 6 L containers.

What is the cheapest way for Suzie to buy the sealer she needs?

Test yourself contains revision questions linked to the relevant exercise set.



1 Test yourself

What's the score? ANSWERS p. 372

How well have you mastered the skills in this chapter? Test yourself with these questions.

1 EXERCISE 1.1 Add each set of dartboard scores *without* using a calculator.
a 5 and 4 **b** double 5 and 3
c double 3 and double 8 **d** 5 and triple 6

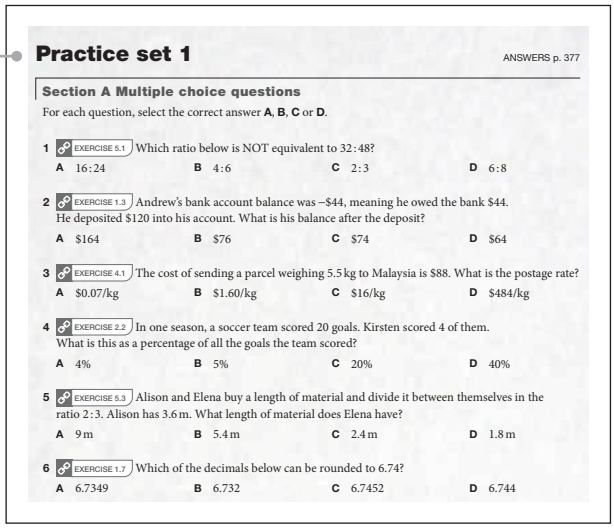
2 EXERCISE 1.2 Jasper is playing darts. Calculate his score when his 3 darts land on
a 5, 7 and double 11 **b** double 9, 6 and triple 20.

3 EXERCISE 1.3 Max and Ant are playing golf. Max's final score is −3 and Ant's is +2. Who won the game and by how many strokes?

4 EXERCISE 1.4 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 1.4 Use a calculator to evaluate each expression, correct to one decimal place.
a $17.35 + 182.96 - 25.47$ **b** $16.39 + 12.5 \div 3.6$ **c** $(12.3)^2$

Practice sets revise the skills and knowledge of previous chapters and include multiple choice and short answer questions.



Practice set 1 ANSWERS p. 377

Section A Multiple choice questions

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

1 EXERCISE 5.1 Which ratio below is NOT equivalent to 32:48?
A 16:24 **B** 4:6 **C** 2:3 **D** 6:8

2 EXERCISE 1.3 Andrew's bank account balance was −$44, meaning he owed the bank $44. He deposited $120 into his account. What is his balance after the deposit?
A $164 **B** $76 **C** $74 **D** $64

3 EXERCISE 4.1 The cost of sending a parcel weighing 5.5 kg to Malaysia is $88. What is the postage rate?
A $0.07/kg **B** $1.60/kg **C** $16/kg **D** $484/kg

4 EXERCISE 2.2 In one season, a soccer team scored 20 goals. Kirsten scored 4 of them. What is this as a percentage of all the goals the team scored?
A 4% **B** 5% **C** 20% **D** 40%

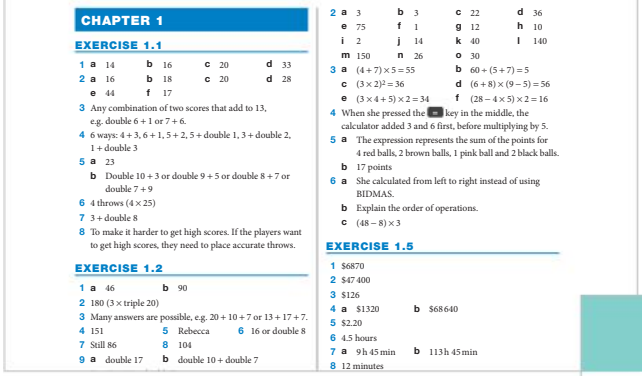
5 EXERCISE 5.3 Alison and Elena buy a length of material and divide it between themselves in the ratio 2:3. Alison has 3.6 m. What length of material does Elena have?
A 9 m **B** 5.4 m **C** 2.4 m **D** 1.8 m

6 EXERCISE 1.7 Which of the decimals below can be rounded to 6.74?
A 6.7349 **B** 6.732 **C** 6.7452 **D** 6.744

At the end of the book

Answers

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



CHAPTER 1

EXERCISE 1.1

1 a 14 b 16 c 20 d 33
2 a 16 b 18 c 20 d 28
e 44 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 1.2

1 a 46 b 90
2 180 (3 × triple 20)
3 Many answers are possible, e.g. 20 + 10 + 7 or 13 + 17 + 7.
4 151 5 Rebecca 6 16 or double 8
7 Still 86 8 104
9 a double 17 b double 10 + double 7

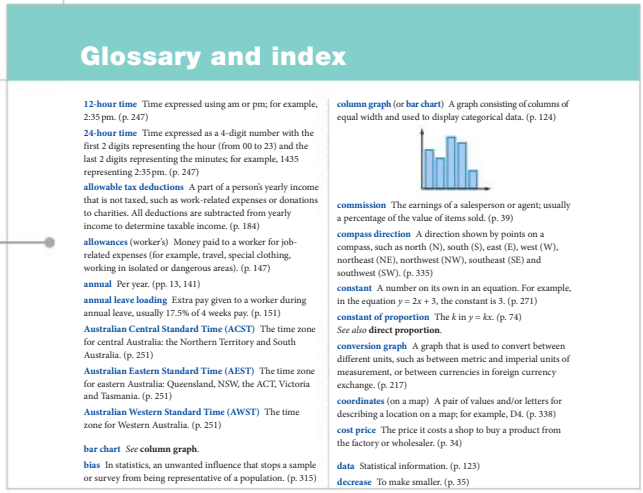
2 a 3 b 3 c 22 d 36
e 75 f 1 g 12 h 10
i 2 j 14 k 40 l 140
m 150 n 26 o 30
3 a (4 + 7) × 5 = 55 b 60 ÷ (5 + 7) = 5
c (3 × 2)² = 36 d (6 + 8) × (9 − 5) = 56
e (3 × 4 + 5) × 2 = 34 f (28 − 4 × 5) × 2 = 16
4 When she pressed the = key in the middle, the calculator added 3 and 6 first, before multiplying 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 17 points
6 a She calculated from left to right instead of using BIDMAS.
b Explain the order of operations.
c (48 − 8) × 3

EXERCISE 1.5

1 $6870
2 $47 400
3 $126
4 a $1320 b $68 640
5 $2.20
6 4.5 hours
7 a 9 h 45 min b 113 h 45 min
8 12 minutes

Glossary and index

A combined **Glossary and index**.



12-hour time Time expressed using am or pm; for example, 2:35 pm. (p. 247)

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 representing 2:35 pm. (p. 247)

allowable tax deductions 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. 184)

allowances (worker's) Money paid to a worker for job-related expenses (for example, travel, special clothing, working in isolated or dangerous areas). (p. 147)

annual Per year. (pp. 13, 141)

annual leave loading Extra pay given to a worker during annual leave, usually 17.5% of 4 weeks pay. (p. 151)

Australian Central Standard Time (ACST) The time zone for central Australia: the Northern Territory and South Australia. (p. 251)

Australian Eastern Standard Time (AEST) The time zone for eastern Australia: Queensland, NSW, the ACT, Victoria and Tasmania. (p. 251)

Australian Western Standard Time (AWST) The time zone for Western Australia. (p. 251)

bar chart *See* **column graph**.

bias In statistics, an unwanted influence that stops a sample or survey from being representative of a population. (p. 315)

column graph (or **bar chart**) A graph consisting of columns of equal width and used to display categorical data. (p. 124)

commission The earnings of a salesperson or agent; usually a percentage of the value of items sold. (p. 39)

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) and southwest (SW). (p. 335)

constant A number on its own in an equation. For example, in the equation $y = 2x + 3$, the constant is 3. (p. 271)

constant of proportion The k in $y = kx$. (p. 74)
See also **direct proportion**.

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. 217)

coordinates (on a map) A pair of values and/or letters for describing a location on a map; for example, D4. (p. 338)

cost price The price it costs a shop to buy a product from the factory or wholesaler. (p. 34)

data Statistical information. (p. 123)

decrease To make smaller. (p. 35)

Nelson MindTap

Nelson MindTap is an online learning space that provides students with interactive learning and assessment experiences. Margin links in the student book signpost multimedia student resources found on MindTap.*

Videos
Skillsheets
Worksheets

For students:

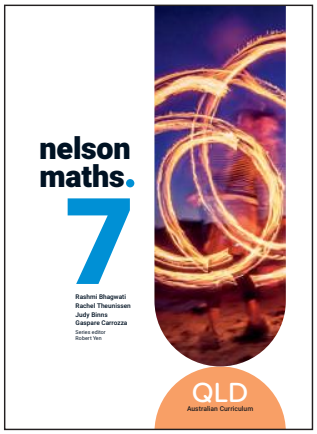
- **Engage** with the **online eBook** by adding notes, highlights and bookmarks, and using the **Search** and **Read Aloud** (in Australian voice) functions.
- **Watch videos** featuring expert teacher advice to unpack worked examples and deepen your understanding.
- **Revise** using **skillsheets** and **worksheets** to practise your skills and build your confidence.
- **Navigate** your own learning path, accessing the content and support as you need it.

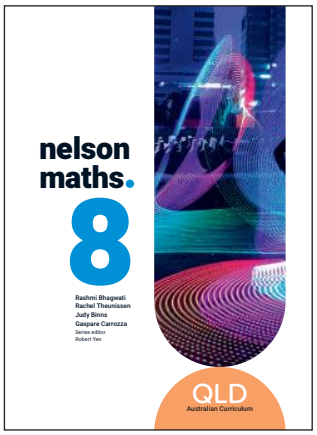
For teachers:

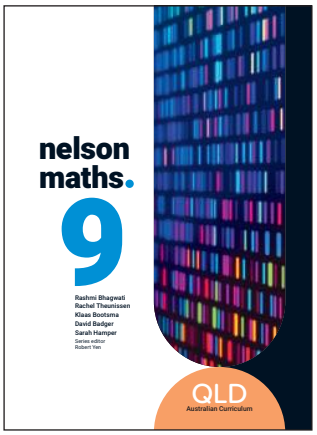
- **Access topic tests, teaching plans** and **worked solutions** to each exercise set.
- **Use course customisation** to tailor content and assign tasks to groups of students or the whole class.
- **Integrate** content directly within your school's LMS for ease of access.
- **Create** assessments using **Cognero testbanks**: interactive and self-marking.

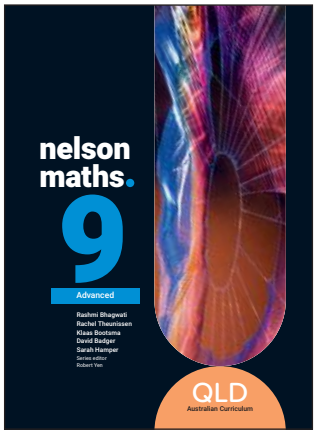
* Complimentary access to these resources is only available to schools that use this book as part of a class set, book hire or booklist. Not available for single purchases. Contact your Cengage Education Consultant for information about access and conditions.

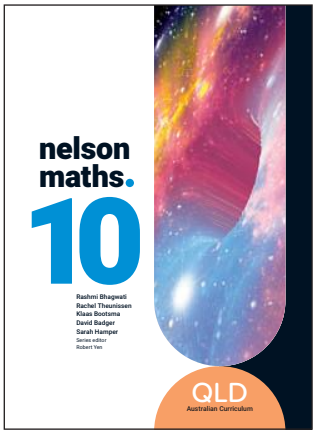
Nelson Maths 7–12 QLD series

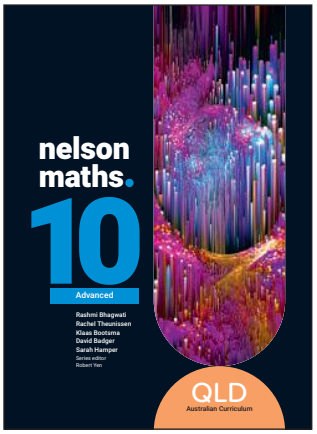


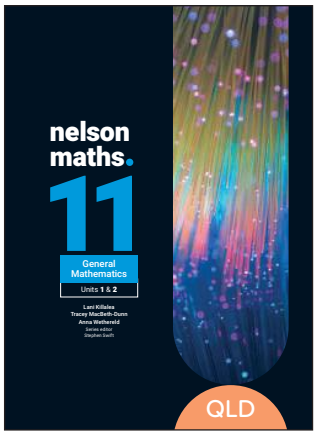


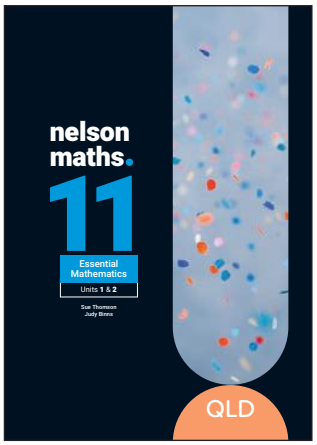


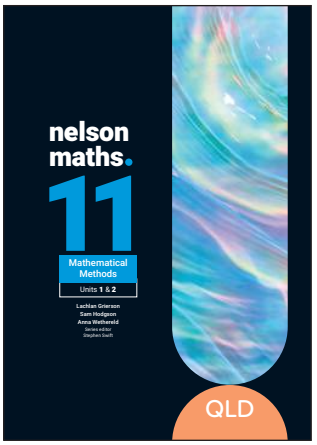


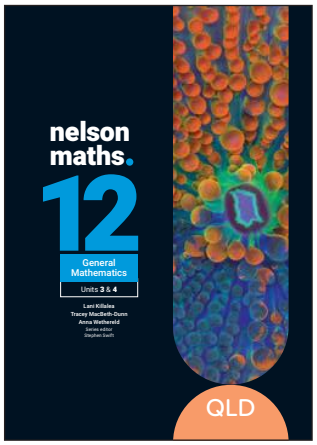


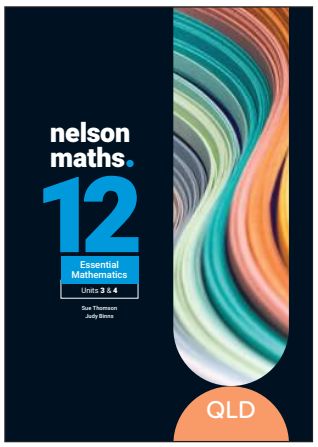


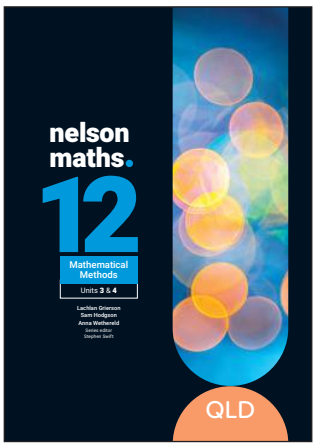












List of mathematical verbs

A glossary of 'doing words' commonly found in mathematics problems

Cognitive verbs are highlighted in light green. See QCAA's glossary of cognitive verbs for more details.

analyse: study and state in detail the relationship of parts of a situation

apply: use knowledge or a procedure in a given situation

calculate: find a numerical value

comment: express an opinion or judgement about a statement or calculation

communicate: transmit information to others

compare: state similarities and differences and their significance

consider: take into account; think carefully

construct: draw an accurate diagram or logically arrange items or ideas

convert: change from one form to another

classify: identify and sort into categories

deduce: use logic and reason to prove something

define: give the meaning of or identify in exact terms

demonstrate: show to be correct

describe: state the features of a situation, object, pattern, event, etc.

determine: find the answer or make a decision using evidence

discuss: give reasons based on evidence for and against a position or proposal

evaluate: find the value of or state the application, strengths and limitations of a solution

examine: investigate the details and assumptions of a situation

explain: state the meaning in logical detail

explore: examine or state the details and assumptions of a situation

identify: state the type, name or distinguishing feature of an item or situation

interpret: state a conclusion or trend from given information

investigate: establish facts, trends or conclusions from collected information

justify: give reasons or evidence for an answer or conclusion

modify: change to accommodate different information

predict: use given information or results to guess what will happen under different conditions

recall: remember (and state)

recognise: use knowledge to identify features of a situation

simplify: reduce the size of numbers in a fraction, or reduce the size of an algebraic expression

sketch: draw a diagram that shows the general shape and includes relevant features

solve: find the answer or explanation for a problem, particularly the values of variables in equations or inequalities

substitute: replace a variable by a number to calculate an answer

test: check that a statement or result is correct

verify: check a solution or result, usually referring to the given situation

write/state: give the answer, formula or result without showing any working or explanation (This usually means that the answer can be found mentally, or in one step.)



Chapter problem

Bani bought fish and chips for lunch for $16.35 and paid with a $50 note. The server gave him a $10 and a $5 note and a few coins for his change. Could the change be wrong?

9780170484589



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CHAPTER 1

NUMBER, DATA AND MONEY: CALCULATIONS

WHAT'S THE SCORE?

Syllabus coverage
Nelson MindTap chapter resources
Terminology
1.1 Target practice
1.2 Playing darts
1.3 Negative scores
1.4 Order of operations
1.5 How much do I pay?
1.6 Estimating costs
1.7 Rounding decimals
1.8 Practical multiples
1.9 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
- Estimate and check the reasonableness of answers
- Understand place value after the decimal point in decimals
- 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

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Syllabus coverage

UNIT 1, FUNDAMENTAL TOPIC: CALCULATIONS

Calculations

- Solve practical problems requiring basic number operations.
- Apply arithmetic operations according to their correct order.
- Use leading-digit approximation to obtain estimates of calculations.
- Use a calculator for multi-step calculations.
- Recognise the significance of place value after the decimal point.
- Evaluate decimal fractions to the required number of decimal places.
- Round up or round down numbers to the required number of decimal places.
- Apply approximation strategies for calculations.

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus p. 15,
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Videos (5):

1.4 Order of operations 2 • Order of operations 1 • BODMAS
1.6 Estimating answers
1.7 Rounding decimals

Worksheet (1):

1.6 Estimating and rounding

Puzzles (3):

1.3 Positive and negative numbers
1.4 Order of operations
Keyword activity Calculations find-a-word

Nelson MindTap

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

Terminology

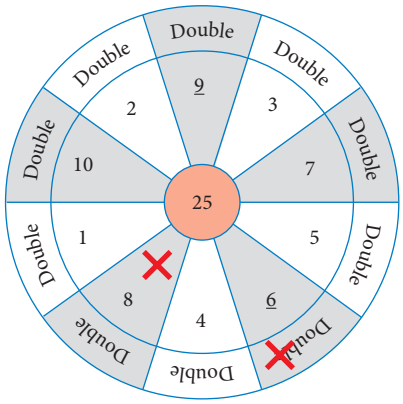
approximation	brackets	decimal places	decimal point
double	estimate	indices	integer
leading digit approximation	negative	order of operations	positive
round down	round up	triple	

1.1 Target practice

Alan coaches a junior football team. He designed a ball-throwing competition to help his players improve the accuracy of their passes. Each player throws 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 throws landed. One throw landed in **double 6** and the other in **8**.

Marc's score = $2 \times 6 + 8$
= $12 + 8$
= 20

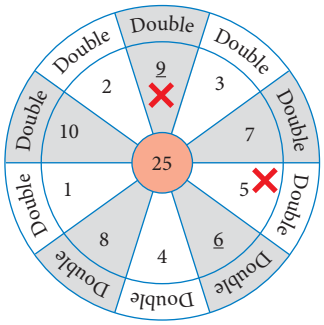


EXERCISE 1.1 Target practice

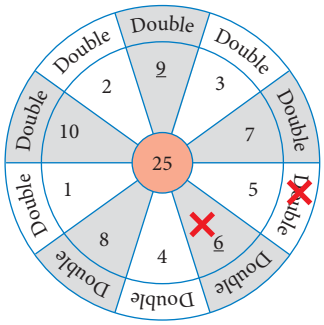
ANSWERS p. 371

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

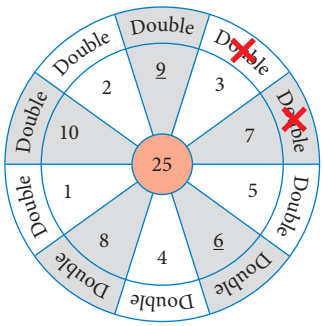
a



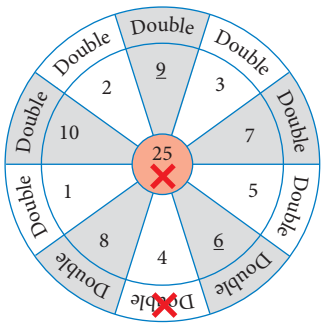
b



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 throws 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 throws? 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 throws 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 throw, 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

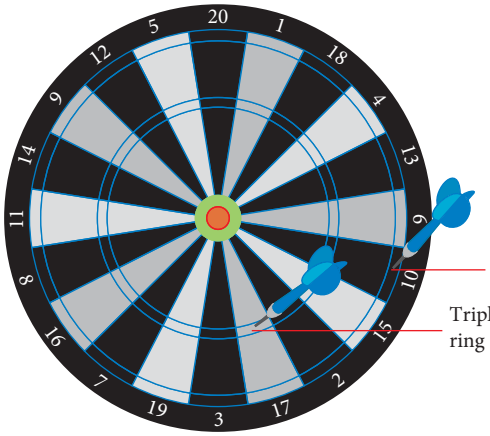
What you have to do

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?



BearFotos/Shutterstock.com

1.2 Playing darts



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

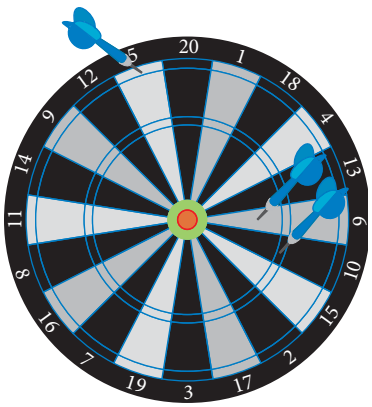
- Players score the number of points marked on the section in which the dart lands.
- If a dart lands in the **outside ring**, the player scores **double points**.
- If a dart lands in the **inside ring**, the player scores **triple points**.
- The **bullseye** is worth 50 points.
- The green ring around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

EXERCISE 1.2 Playing darts

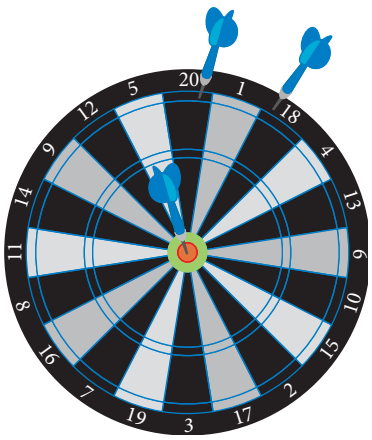
ANSWERS p. 371

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 darts 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 her turn?

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

6 Fiona 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 one 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. C

11 Renata and Samantha are playing 201. They write their progress scores on a board. C

Turn	Renata	Samantha
	~~201~~	~~201~~
1	~~162~~	~~176~~
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 Samantha could use to try to tie the game?

1.3 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.

Each hit of a 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 they took 2 fewer strokes than the course rating to complete their game. If an indoor cricketer's score is –2, it means that they lost 2 more runs than they 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.

Puzzle Positive and negative numbers

EXAMPLE 1 Negative scores

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.

Steps	Working
a In golf, negative scores are good scores. A negative score indicates how many strokes 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 1.3 Negative scores

ANSWERS p. 371

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?



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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

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

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 temperature on the ski fields today is –3°C. Tomorrow's forecast temperature says it will be 4°C colder than today. What 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. C

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. The table shows 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!

Kati Thanda (Lake Eyre) in South Australia is –16 metres above sea level. What does this mean?

What you have to do

- Investigate the location of Kati Thanda. 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 of a sign from a department store in the Netherlands, 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.



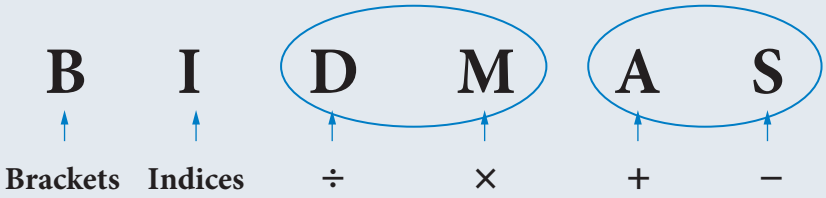
Photo courtesy of Sue Thomson

1.4 Order of operations

What is the answer to 200 ÷ 20 × 2? Is it 20 or 50?

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) 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.

EXAMPLE 2 Order of operations

Evaluate each mixed expression.

a $60 - 2 \times 5^2$

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

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

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 the answers in this example using a calculator.

Steps	Working
a The 5 is squared, so we do indices first.	$60 - 2 \times 5^2 = 60 - 2 \times 25$
Next comes multiply.	$= 60 - 50$
Subtraction is performed last.	$= 10$
b Do × before the + inside the brackets first.	$(12 + 5 \times 3) \div 9 + 4 = (12 + 15) \div 9 + 4$
	$= 27 \div 9 + 4$
Then do the ÷.	$= 3 + 4$
The + 4 is performed last.	$= 7$
c Do both sets of brackets first.	$11 + (5 + 11) \div (12 \div 3) = 11 + 16 \div 4$
Then do the ÷.	$= 11 + 4$
The + outside the brackets is performed last.	$= 15$

Puzzle
Order of operations

Videos
Order of operations 2
Order of operations 1
BODMAS

EXERCISE 1.4 Order of operations

ANSWERS p. 371

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. Check your answers using a calculator.

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** $5 \times (12 - 3 \times 2)$

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** $28 - 4 \times 5 \times 2 = 16$

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 incorrect.

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

Brad sank 4 red balls, 2 brown balls, 1 pink and 2 blacks. 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.

6 A parent talked to Mr Healy, his daughter's maths teacher, about the marking of his daughter's maths exam. He said that one of his daughter's answers was marked wrong, even though it was correct.

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

The daughter's answer was 120.

a Why was the daughter's answer incorrect?

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.

1.5 How much do I pay?

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

EXAMPLE 3 Converting a yearly amount to a monthly amount

Muspha's rent is $55 812 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 = $55 812 ÷ 12 = $4651
Write your answer.	Each month, Muspha pays $4651.

EXAMPLE 4 Debit account balance

Georgie bought 3 books online and paid with her debit card (EFTPOS). She paid $12.80 for postage and $9.95 for each book. Before Georgie bought the book, the balance of her debit card was $180.
Calculate the balance after her online purchase.

Steps	Working
Calculate the cost of the postage and the books. Remember that we do multiplication before addition.	cost = $12.80 + 3 × $9.95 = $42.65 The books and postage cost $42.65.
Subtract the amount that Georgie spent from the balance of her debit card.	$180 – $42.65 = $137.35
Write your answer.	After Georgie bought the books, the balance of her debit card was $137.35.

EXERCISE 1.5 How much do I pay?

ANSWERS p. 371

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

2 Gazi pays $3950 per month for rent. Calculate the annual rent that Gazi pays.

3 Li pays $18 per hour for parking. How much does he pay when he parks for 7 hours?

4 Aisling's business spends $2640 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 fortnights in a year.

5 EXAMPLE 4 Rohan ordered 2 burgers and some fries for his lunch. The burgers cost $11.80 each and the fries cost $4.20. Rohan paid with a $20 note and a $10 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 one of his golf games take 3 hours and 15 minutes.

a How many hours does Joel play golf for 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 dislikes 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 included 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 Mahla's garden party. They are supplying catering and bar service for 42 people. How much will Mahla have to pay?

The BBQ specialists
Catering
Steak and salad with bread rolls: $18.75 per person
Bar service
Fruit juices and soft drink: $6.50 per person

Investigation The Year 11 party

Group activity

Budget catering	
Price per person	
Finger food	$5.60
BBQ steak	$9.20
BBQ sausages	$2.10
BBQ seafood	$8.20
Salad	$4.35
Bread rolls	$0.90
Desserts	$3.95
Coffee/tea	$1.10
Cheese platters and biscuits	$2.60
Fruit platters	$2.40
Non-alcoholic drinks	$7.40

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 the budget.

1.6 Estimating costs

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

Video
Estimating answers

Worksheet
Estimating and rounding

EXAMPLE 5 Estimating costs

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



© 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.	Adding dollars and ignoring cents is an example of **leading digit approximation**.
Dog food: 5 × $3 = $15 Caesar salad: $6 Blueberries: $5 Teabags: $7 Strawberries: $5 Macadamia nuts: $14	estimated price = 15 + 6 + 5 + 7 + 5 + 14 = 52
	The items cost approximately $52.
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 1.6 Estimating costs

ANSWERS p. 371

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 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? Use a calculator to check your answer.



iStock.com/amixstudio

7 When Bryce bought 2 pizzas at $12.50 each and a salad for $7.20, he paid with a $50 note. Approximately how much change should he get?

8 EXAMPLE 5 Sebastian has only $60 remaining on his debit card until payday. 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 carton of soft drink 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 calculate 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 by how much your estimate is different from the true cost as a percentage:

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

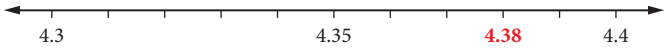
- Repeat the process for a different shopping docket. Does your percentage error become smaller with practice?

1.7 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 one 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.



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

Rounding decimals

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

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

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

Original decimal	Rounded to one 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 Rounding decimals

Round 18.3721 to one decimal place.

Steps	Working
Decide whether 18.3721 is closer to 18.3 or 18.4. The figure following the 1st decimal place is 7.	$18.3721 \approx 18.4$
Round the 3 up to 4 and leave all other digits off.	

EXERCISE 1.7 Rounding decimals

ANSWERS p. 371

1 EXAMPLE 6 Round each number correct to one 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.

Use the following information to answer questions **4** *and* **5**.

In surfing competitions, scores are rounded to one decimal place. This is how scores are calculated.

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

Step 2: The lowest and highest scores are removed.

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

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

4 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 one 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 one full tank of petrol? Express your answer in kilometres, correct to one decimal place.

8 Pauline 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 Pauline's 5 hanks.

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

9 Thanh bought 79.3 L of petrol at 198.9 c/L.

- **a** Explain why the value of 80×2 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** How different is your approximation from 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.



Timothy Large/Alamy Stock Photo

- **a** Jaye wanted to estimate the total cost. She calculated that the cost will be between $150 \times \$1$ and $150 \times \$2$.
  Will the cost be closer to $150 or $300? Give reasons for your answer.
- **b** Calculate the value of $151.65 \times \$1.35$ 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.

Practical activity Accuracy in measuring lengths

In this activity you are going to investigate how accurately each member of your group can measure lengths. Each group will need a tape measure that measures in metres, centimetres and millimetres.

What you have to do

1. Choose 3 suitable distances in your school environment; for example, the length of the school verandah, or the distance from your classroom doorway to the nearest tree.
2. Each member of the group measures the lengths as accurately as possible.
3. Compare your group's measurements. At what level of accuracy (for example, answers in metres correct to one decimal place) are the measurements the same?

1.8 Practical multiples

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

EXAMPLE 7 Practical multiples 1

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
'Multiples of 250' mean 'lots of 250', that is 1×250, 2×250, 3×250, 4×250, 5×250, etc. The first 5 multiples are 250, 500, 750, 1000, 1250. Anna can't order 600 pamphlets so she must choose the next multiple of 250.	Anna will have to order 750 pamphlets if she requires 600 pamphlets. To get the number of pamphlets she needs, Anna needs to round the quantity *up* to the next multiple.

EXAMPLE 8 Practical multiples 2

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

a Is it possible to buy a 1 m 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?



Flamingo Images/Shutterstock.com

Steps	Working
a Determine whether 1 m 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.

total length = 2 × 1300 mm
= 2600 mm

Divide by 300 mm to check if it is a multiple of 300.

2600 ÷ 300 = 8.666… (not a multiple of 300)

It isn't a multiple of 300, so round up to 9 and buy 9 × 300 mm.

length required = 9 × 300 mm
= 2700 mm

To have enough timber, Peter needs to round *up* the amount he is going to buy.

The best way is for Peter to cut 2 × 1300 mm from a 2700 mm length (100 mm left over).

EXERCISE 1.8 Practical multiples

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

a At the end of each month, Jess 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 Jess ordered?

b Miles requires 600 envelopes to post statements to customers. How many boxes of envelopes will he need?

c What are the first four multiples of 200?

d Joel needs 840 envelopes. How many boxes does he need to order?

2 EXAMPLE 8 Timber is available only in 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 m. Kelly calculated that for 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 that she needs cost?



Strakovskaya/Shutterstock.com

5 Dion 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 timberyard?

6 Coby is packing soft drink cans into boxes that hold 24 cans. He has 3715 cans to put into boxes. How many full boxes can he pack?

7 Practise your rounding skills by copying and completing this table.

	Number	Round up to the nearest whole number	Round down to the nearest whole number	Round to the nearest whole number
a	16.75			
b	103.2			
c	324.5			
d	72.49			

8 What number am I? Use the hints to identify me. C

- I only have 1 digit to the right of my decimal point.
- When you round me down, my value is 18.
- Rounded up, I'm 19.
- When I'm rounded to the nearest integer, my value is bigger by $\frac{2}{5}$.

1.9 After the point

While 1.5 metres means 1 metre and 50 centimetres, 1.5 hours doesn't mean 1 hour and 5 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 Digits after the decimal point

What does the .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 .45 represents 45 cents.
b For metres, the 2 digits after the decimal point represent centimetres.	In 16.45 m, the .45 represents 45 cm.

EXAMPLE 10 Coverting decimal hours to hours and minutes

Write 2.7 hours in hours and minutes.

Steps	Working
Change 2.7 hours to hours and minutes using 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 Coverting decimal months to months and days

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

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

EXERCISE 1.9 After the point

ANSWERS p. 372

1 EXAMPLE 9 What does the .24 represent in each amount?

a $7.24 **b** 7.24 m

2 What does the .90 represent in each measurement?

a $18.90 **b** 18.90 m

3 EXAMPLE 10 Use the °′″ or DMS key on your calculator to express each time 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 balls bowled by the same bowler. C

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', meaning 18 overs and 5 balls remaining. If the commentator was using mathematics correctly, how many overs and balls should be in 18.5 overs?

c Why do you think cricket commentators use decimal points in this non-standard way?

Puzzle
Calculations
find-a-word

Keyword activity

CALCULATIONS FIND-A-WORD

ANSWERS p. 372

Use each clue to find 11 keywords. Then copy the puzzle grid below or download it from Nelson MindTap 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

Bani bought fish and chips for lunch for $16.35 and paid with a $50 note. The server gave him a $10 and a $5 note and a few coins for his change. Could the change be wrong?

Solution

The fish and chips cost approximately $20. Bani's change from $50 should be about $50 – $20 = $30. He received in change a $10 and a $5 note plus a few coins, so around $20. Yes, he has probably been short-changed (by about $10).

1 Test yourself

What's the score?

ANSWERS p. 372

How well have you mastered the skills in this chapter? Test yourself with these questions.

1 EXERCISE 1.1 Add each set of dartboard scores *without* using a calculator.

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

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

2 EXERCISE 1.2 Jasper is playing darts. Calculate his score when his 3 darts land on

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

3 EXERCISE 1.3 Max and Ant are playing golf. Max's final score is –3 and Ant's is +2. Who won the game and by how many strokes?

4 EXERCISE 1.4 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 1.4 Use a calculator to evaluate each expression, correct to one decimal place.

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

6 EXERCISE 1.5 Jemima bought 8 balls of wool 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 1.6 Isma ordered lunch for her dance group. She ordered 3 chicken wraps and 6 small sushi. The chicken wraps cost $7.20 each and the sushi cost $4.20 each. She paid with a $50 note. How much change should Isma receive?

8 EXERCISE 1.7

a Round 15.32 to the nearest whole number.

b Round 16.75 correct to one decimal place.

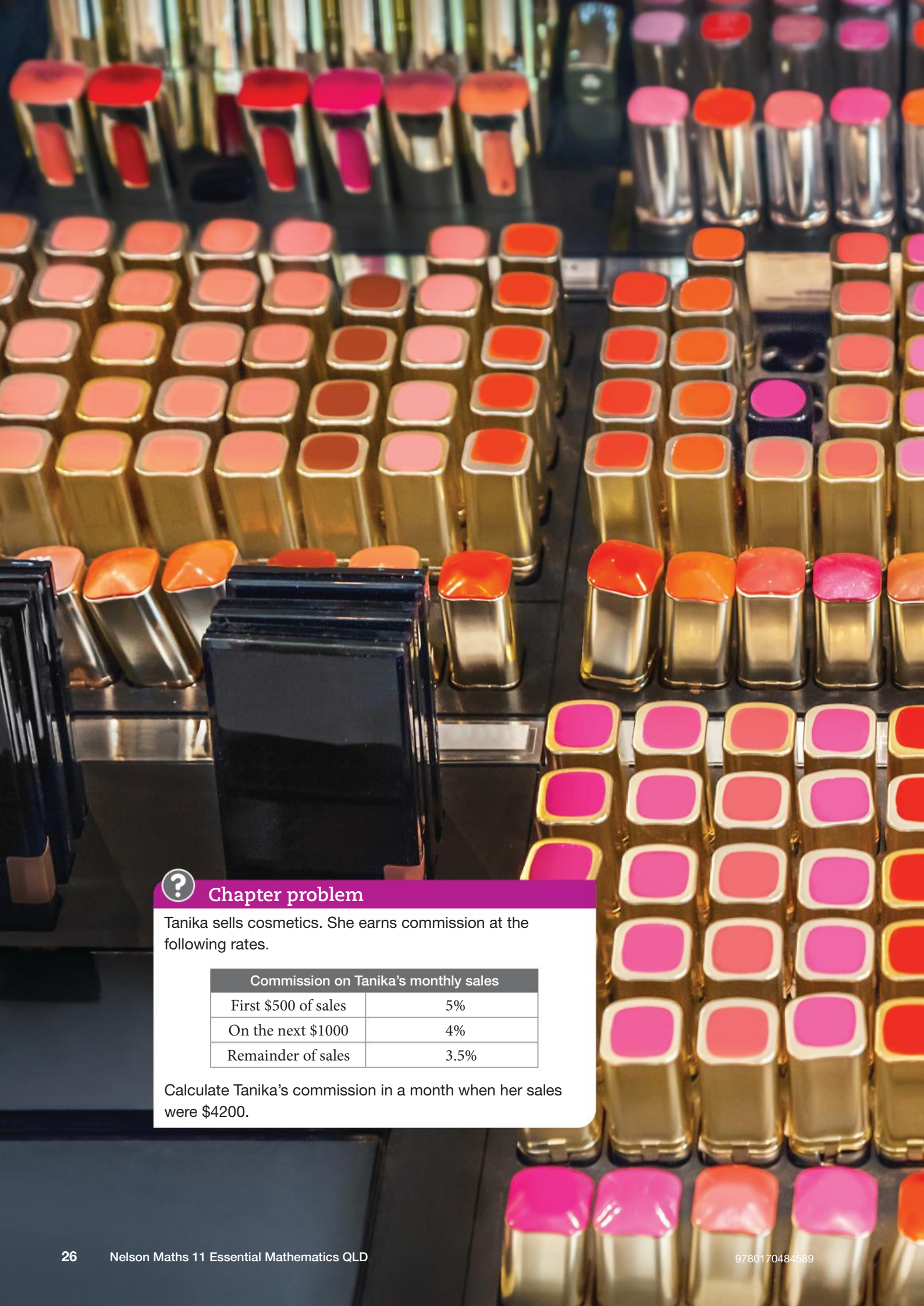
9 EXERCISE 1.7 Round each measurement correct to the nearest whole number.

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

10 EXERCISE 1.8 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 1.9 Approximately how many days are there in 4.7 months?

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Chapter problem

Tanika sells cosmetics. She earns commission at the following rates.

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

Calculate Tanika's commission in a month when her sales were $4200.

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CHAPTER 2

NUMBER, DATA AND MONEY: NUMBER

GIVING 110%

Syllabus coverage
Nelson MindTap chapter resources
Terminology
2.1 Finding a percentage of a quantity
2.2 What percentage of …?
2.3 Percentage increase
2.4 Percentage decrease
2.5 Profit and loss
2.6 Practising percentages
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Calculate a 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

How are we ever going to use this?

- Calculating discounts on items we want to buy
- Calculating statistics in sport
- Whenever we come across a percentage – which is often!

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Syllabus coverage

UNIT 1, TOPIC 1: NUMBER

Percentages

- Calculate a percentage of a given amount.
- Determine one amount expressed as a percentage of another for same units.
- Determine one amount expressed as a percentage of another for different units [complex].
- Apply percentage increases and decreases in real-world contexts, including mark-ups, discounts and GST [complex].

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, pp. 15–16
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Videos (4):

2.1 Fraction and percentage of a quantity
2.2 Expressing quantities as fractions and percentages
2.3, 2.4 Percentage increase and decrease
2.5 Profit and loss

Skillsheets (3):

2.1 Percentage calculations • Mental calculations • Simplifying fractions

Worksheets (7):

2.1 Fractions, decimals and percentages • Percentage shortcuts • Percentages without calculators • Changing units
2.5 Profit and loss
2.6 Percentage problems • Working with percentages

Puzzles (2):

2.4 Discounts code puzzle
2.6 Percentage power

Nelson MindTap

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

Terminology

commission, cost price, discount, goods and services tax (GST), interest, loss, mark-up, percentage, percentage decrease, percentage increase, profit, retainer, selling price

2.1 Finding a percentage of a quantity

Percentage of a quantity

$$\text{percentage of a quantity} = \frac{\text{percentage}}{100} \times \text{quantity}$$

OR

$$= \text{percentage} \div 100 \times \text{quantity}$$

EXAMPLE 1 Percentage of a quantity 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.	$23\% \text{ of } \$1650 = \frac{23}{100} \times \$1650$ $\text{OR} = 0.23 \times \$1650$ $= \$379.50$
b Write the percentage as a fraction or decimal, then multiply by the quantity.	$75\% \text{ of } 620\,\text{kg} = \frac{75}{100} \times 620$ $= 465\,\text{kg}$

Some calculators have a percentage key. Check with your teacher whether it is practical to use it.

EXAMPLE 2 Percentage of a quantity 2

Find 32% of 4 m. Give your answer in cm.

Sometimes it is necessary to change the units of the quantity before we calculate the percentage.

Steps	Working
Change 4 metres to centimetres.	$4\,\text{m} = 4 \times 100\,\text{cm}$ $= 400\,\text{cm}$
Write the percentage as a fraction or decimal and then multiply by the quantity.	$32\% \text{ of } 400 = 0.32 \times 400$ $= 128\,\text{cm}$

Video
Fraction and percentage of a quantity

Skillsheets
Percentage calculations
Mental calculations
Simplifying fractions

Worksheets
Fractions, decimals and percentages
Percentage shortcuts
Percentages without calculators

Worksheet
Changing units

EXERCISE 2.1 Finding a percentage of a quantity

ANSWERS p. 372

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 5.9% of $5300
k 12.5% of 96 L
l 17.75% of 640 hectares

2 EXAMPLE 2 Calculate each amount.

a 12% of 8 m, giving your answer in cm
b 35% of 10 days, giving your answer in hours
c 60% of 1 year, giving your answer in days
d 15% of 26 L, giving 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, giving your answer in metres
h 40% of 1.5 tonnes, giving your answer in kg

3 20% of the students at Nelson State High School study Chinese. There are 1290 students at the school. How many study Chinese?

4 Antony earns 5.5% p.a. interest on an investment account. He has $7500 in the account. How much interest will Antony earn in one 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 $97 500 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 stationery for her business, she must pay 10% GST. Calculate the GST payable on stationary 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?

Chapter problem

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

2.2 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 we can compare our performance in each subject. To do this, we must first write one amount as a fraction of another, then we change the fraction to a percentage by multiplying it by 100%.

Expressing an amount as a percentage

$$\text{percentage} = \frac{\text{amount}}{\text{whole amount}} \times 100\% \quad \text{OR} \quad \text{percentage} = \text{amount} \div \text{whole amount} \times 100\%$$

EXAMPLE 3 Expressing an amount as a percentage 1

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.



Video
Expressing quantities as fractions and percentages

When we compare 2 amounts by writing one as a percentage of the other, we need to make sure that they are expressed in the same units.

EXAMPLE 4 Expressing an amount as a percentage 2

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 2.2 What percentage of ...?

ANSWERS p. 372

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 of the 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 $1005 per week and pays $165 in tax. What percentage of his earnings does Joe pay in tax? Answer correct to one decimal place.

4 EXAMPLE 4 Express each measurement as a percentage. Remember to have both amounts in the same units! Answer correct to one 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 one 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 one decimal place.



iStock.com/J_Knaupe

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 one 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 George and Sue 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 one decimal place.

11 In a senior class of 23 students, 8 walk to school and 11 travel by bus. Calculate, correct to one decimal place, the percentage of students who

a walk to school.

b travel by bus.

12 Kyle had 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 one decimal place.

b In which exam did Kyle achieve the highest result?

Investigation How much sugar is in the food you eat?

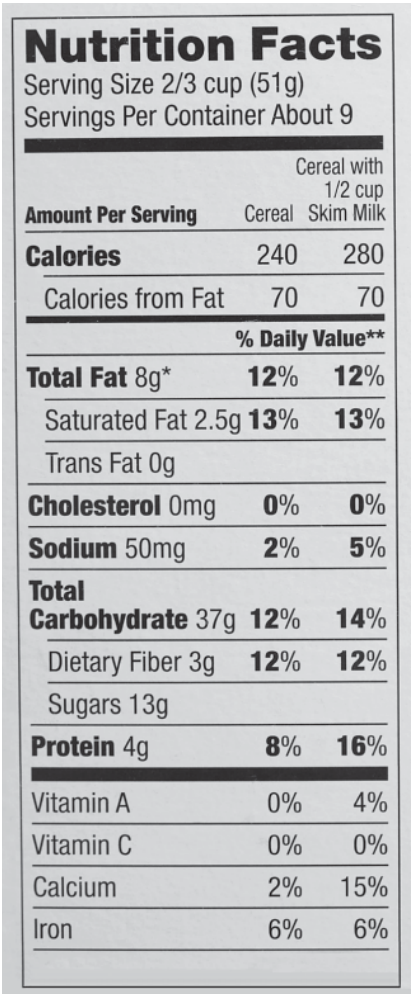
Sugar is one of the contributing factors to a poor diet. In this investigation you will examine the percentage of sugar in what you eat and drink.

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 variety of foods and drinks.
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 most sugar to least sugar.
4. Compare your findings with those of 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%

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2.3 Percentage increase

Video
Percentage increase and decrease

Percentage **increase** means to make a quantity bigger by a given percentage, for example, in pay increases or adding a **goods and services tax** (GST) to prices.

EXAMPLE 5 Percentage increase 1

Increase $500 by 12%.

There are 2 ways to do this. Choose the method you like!

Steps	Working
Find 12% of $500.	$0.12 \times 500 = \$60$
Add this amount to $500.	$\$500 + \$60 = \$560$
OR	
New amount is 100% plus 12%.	$100\% + 12\% = 112\%$
Find 112% of $500.	$1.12 \times 500 = \$560$

EXAMPLE 6 Percentage increase 2

All Government employees are to receive a 2.5% pay increase. Georgie is on a salary of $82 000 per year. What is her new salary after the increase?

Steps	Working
Find 2.5% of $82 000.	$0.025 \times 82\,000 = \$2050$
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.	$1.025 \times 82\,000 = \$84\,050$
Answer the question.	Georgie's new salary is $84 050.

EXERCISE 2.3 Percentage increase

ANSWERS p. 372

1 EXAMPLE 5 Increase

a 95 kg by 60% **b** $2500 by 6% **c** 150 m by 5% **d** 10 L by 33%

2 Increase a train fare of $7.50 by 20%.

3 Increase a price of $620 by 10%.

4 EXAMPLE 6 Nathan earns $32.75 per hour. His boss gives him a pay increase of 8%. What is his new hourly rate after the increase?

5 Saria runs a fashion business. She determines the selling price of each item of clothing by calculating a 95% **mark-up** on the **cost price**. Find the **selling price** of a jacket that costs Saria $120.



iStock.com/RyanJLane

6 Non-essential items in Australia attract a GST (goods and services tax) of 10%. Calculate the final price of a car costing $24 500 after GST is added.



iStock.com/Sjo

7 Kelvin and Mara buy a house for $640 000 and sell it 10 years later at a profit of 147%.

a Calculate the profit.

b What is the selling price of the house?

8 Binnsfield Council plans to increase the amount of parkland in the area by 20%. At present there are 20 hectares of parkland. How much parkland will there be under the new plan?



iStock.com/JudiParkinson

9 Marcus' weekly pay is $945. He is paid an 8% bonus for 2 weeks. How much will he be paid for these 2 weeks?

10 La Plage restaurant charges a 15% surcharge on public holidays. Find the total price for a meal costing $160 on Australia Day.

A **surcharge** is an extra charge or fee.

11 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 $370 per night if it is charged to a credit card.

12 Jayden buys TVs at a cost price of $295. He adds a mark-up of 75% of the cost price to get his selling price, then he adds 10% GST to calculate the final selling price. C

a Find the price of the TV after Jayden has added his 75% mark-up.

b Find the price of the TV after he adds GST. Round your answer to the nearest cent.

c Is it likely that Jason will charge his customers exactly that price? Why?

2.4 Percentage decrease

Video
Percentage increase and decrease

Puzzle
Discounts code puzzle

Percentage **decrease** means to make a quantity smaller by a given percentage, for example, in **discounts** and sale prices.

EXAMPLE 7 Percentage decrease

Decrease $340 by 7%.

Steps	Working
Find 7% of $340.	$0.07 \times 340 = \$23.80$
Subtract this amount from $340.	$\$340 - \$23.80 = \$316.20$
OR	
New amount is 100% minus 7%.	$100\% - 7\% = 93\%$
Find 93% of $340.	$0.93 \times 340 = \$316.20$

EXAMPLE 8 Discounted price

During an end-of-financial-year sale, computer games are discounted by 25%. Find the cost of a game regularly priced at $115.



René van den Berg/Alamy Stock Photo

Steps	Working
Find 25% of $115.	$0.25 \times 115 = \$28.75$
Subtract this amount from $115.	$\$115 - \$28.75 = \$86.25$
OR	
New amount is 100% minus 25%.	$100\% - 25\% = 75\%$
Find 75% of $115.	$0.75 \times 115 = \$86.25$
Answer the question.	The computer game will cost $86.25.

EXERCISE 2.4 Percentage decrease

ANSWERS p. 373

1 EXAMPLE 7 Decrease

a $150 by 57%

b 2000 L by 28%

c 110 kg by 4.5%

d 840 students by 15%

e 8 hours by 10%

f 4 weeks by 25%

2 Decrease a price of $330 by 25%.

3 Decrease a town's population of 32 780 by 5%.

4 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.



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5 One year, the Australian road toll was 1603 deaths. In the next year, the road toll decreased by 10.3%. Calculate the road toll for the second year. Round to the nearest whole number.

6 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 how much Amber is charged for her lessons per term.

b Calculate the total amount of fees paid for the 2 sisters.

7 The student population at Cengage Park College in 2023 was 879. This decreased by 7.5% the following year. How many students were at Cengage Park College in 2024? Round to the nearest whole number.

8 An electricity company offers a 2% discount when customers pay their account 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?

9 Keira works at the local supermarket. She is given a staff discount of 3.5% on all purchases. Find how much she pays for purchases totalling $178.25.



Robert Kneschke/Shutterstock.com

10 At the 'End-of-model' sale, Honest Ed's car yard offers a discount of 30% on all cars. Find the cost of a family car originally priced at $39 990.

11 For tax purposes, the value of a computer is depreciated at a rate of 20%. Samir buys a computer priced at $1290. What will be its depreciated value in his next tax return?

12 Thomson's Hardware is having a Christmas sale. All items in the store are discounted by 18%. C

a Lauren is a painter. She buys 10 of the 4-litre tins of paint regularly priced at $67 per tin.

i Calculate the cost of the paint at its regular price.

ii Calculate the cost of the paint after the 18% discount.

b 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.

2.5 Profit and loss

Video
Profit and loss

Worksheet
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 as a percentage of their cost price.

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 a 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 Percentage profit

Jacinta buys a necklace for her market stall 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 one decimal place.



George Trumpeter/Shutterstock.com

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 Percentage loss

During a sale, a bed is sold for $599. The bed cost the store $750.

a **Calculate** the loss for the store on the bed.

b **Calculate** the percentage loss, correct to one decimal place.



Robert Stainforth/Alamy Stock Photo

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%.	percentage loss = $\frac{151}{750} \times 100\,\%$ = 20.13333…% ≈ 20.1%

EXERCISE 2.5 Profit and loss

ANSWERS p. 373

1 EXAMPLE 9 Calculate, correct to one 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 one 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.

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.



George Trumpeter/Shutterstock.com

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 or 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 camping store 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% on the value of the shares. She later sells all 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 is too ripe.

- **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 one decimal place.



Alis Photo/Shutterstock.com

10 A shoe store 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 store makes when it sells the shoes during the sale. Answer correct to one decimal place.

2.6 Practising percentages

In this exercise, you will use all the skills you have learnt in this chapter to solve problems involving percentages.

Worksheets
Percentage problems
Working with percentages

Puzzle
Percentage power

EXERCISE 2.6 Practising percentages

ANSWERS p. 373

1 Nelson College's hockey team won 12 games out of 15. What percentage of games is this?

2 At one university, 55% of the students are female. The university population is 85 300. How many males attend the university?

3 A muesli bar is 35 g.

- **a** It contains 6.9 g of fat. What percentage is this? Answer to one 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 a house for $659 000. How much was his commission?

5 Zoe buys a used car for $14 000 and sells it 3 years later at a loss of 20%. Find its selling price.

6 Lachlan's pay rate of $18.45 per/hour is increased to $19.85 per/hour. Find the increase as a percentage of the original pay rate. Answer correct to one decimal place.



Jason Freeman/Alamy Stock Photo

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, according to the label. How many grams of sugar are in a 580 g jar?

9 Lee sells kitchenware by visiting homes. She is paid a **retainer** of $320 per week to cover her expenses, plus a commission of 15% on all sales. Lee's sales last week totalled $2896. Calculate her pay for that week.

10 Jacob is buying a house that was priced at $790 000 last year. House prices in the area have risen by 1.5% since then. What is the expected property value?

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 Computers R Us. She purchases a batch of laptop computers that cost her $395 each. She calculates their selling price by adding on 75% of the cost price. What is the selling price of each laptop computer?

13 Duraj's watch loses 3 minutes every 6 hours. C

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 So far this season, the Cowboys team has scored 584 points and had 355 points scored against them. Calculate their points percentage using the formula below. Answer correct to one decimal place.

$$\text{points percentage} = \frac{\text{points for}}{\text{points against}} \times 100$$

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 was $225 000.

16 A 500 g can of chicken and corn soup contains 110 g of corn. What percentage of the soup is corn?

17 Shanice buys her wedding dress for $1850. Several months after her wedding, she sells 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 a 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, in 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.

Keyword activity

PERCENTAGES TERMINOLOGY

Here are some keywords used in this chapter.

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

1 Some of these words are opposites. Find 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 **loss**.

Solution to the chapter problem

Problem

Tanika sells cosmetics. She earns commission at the following rates.

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

Calculate Tanika's commission in a month when her sales were $4200.

Solution

Commission on first $500 = 5% of $500
= $25

Commission on next $1000 = 4% of $1000
= $40

Remainder of sales = $4200 − $500 − $1000
= $2700

Commission on remainder = 3.5% of $2700
= $94.50

Total commission = $25 + $40 + $94.50
= $159.50

Tanika's commission is $159.50.

2 Test yourself

Giving 110%

ANSWERS p. 373

1 EXERCISE 2.1 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 hours, giving your answer in minutes

2 EXERCISE 2.1 In one 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 Maroun earns 3.5% p.a. interest on her investment of $27 000. How much interest does she earn in one year?

4 Ewan scores 80% on his driving theory test consisting of 20 questions. How many questions did he get right?

5 EXERCISE 2.2 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 2.2 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 Nelson Stadium has a capacity of 40 000 people. Recently, 37 200 people attended a finals game at the stadium. What was the attendance percentage of this game?

8 Angelo has 3 hours to complete an exam. He checks the time after completing 3 questions and he has used 1 hour and 5 minutes of the exam time. What percentage is this? Give your answer correct to one decimal place.

9 EXERCISE 2.3 Increase

a $350 by 5%

b 60 kg by 55%

c 15 000 people by 20%

10 EXERCISE 2.3 Michael receives a pay increase of 2.5%. Currently he earns $1442 per week. Calculate his new weekly wage.

11 Goods and services tax in Australia is 10%. Find the GST-inclusive price of a television advertised as '$2100 excluding GST'.

12 EXERCISE 2.4 Decrease

a $90 by 40%

b 75 m by 15%

c 8 weeks by 25%

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13 EXERCISE 2.4 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 2.4 The population of Nelsonville was 74 200 people. It dropped by 7%. Find the current population.

15 EXERCISE 2.5 Calculate the percentage profit or loss for each situation, correct to one 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 2.5 Jangmi buys souvenirs for her store at $17 each. She sells them for $29 each. Calculate her percentage profit, giving your answer correct to one decimal place.

17 EXERCISE 2.6 Emad 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.

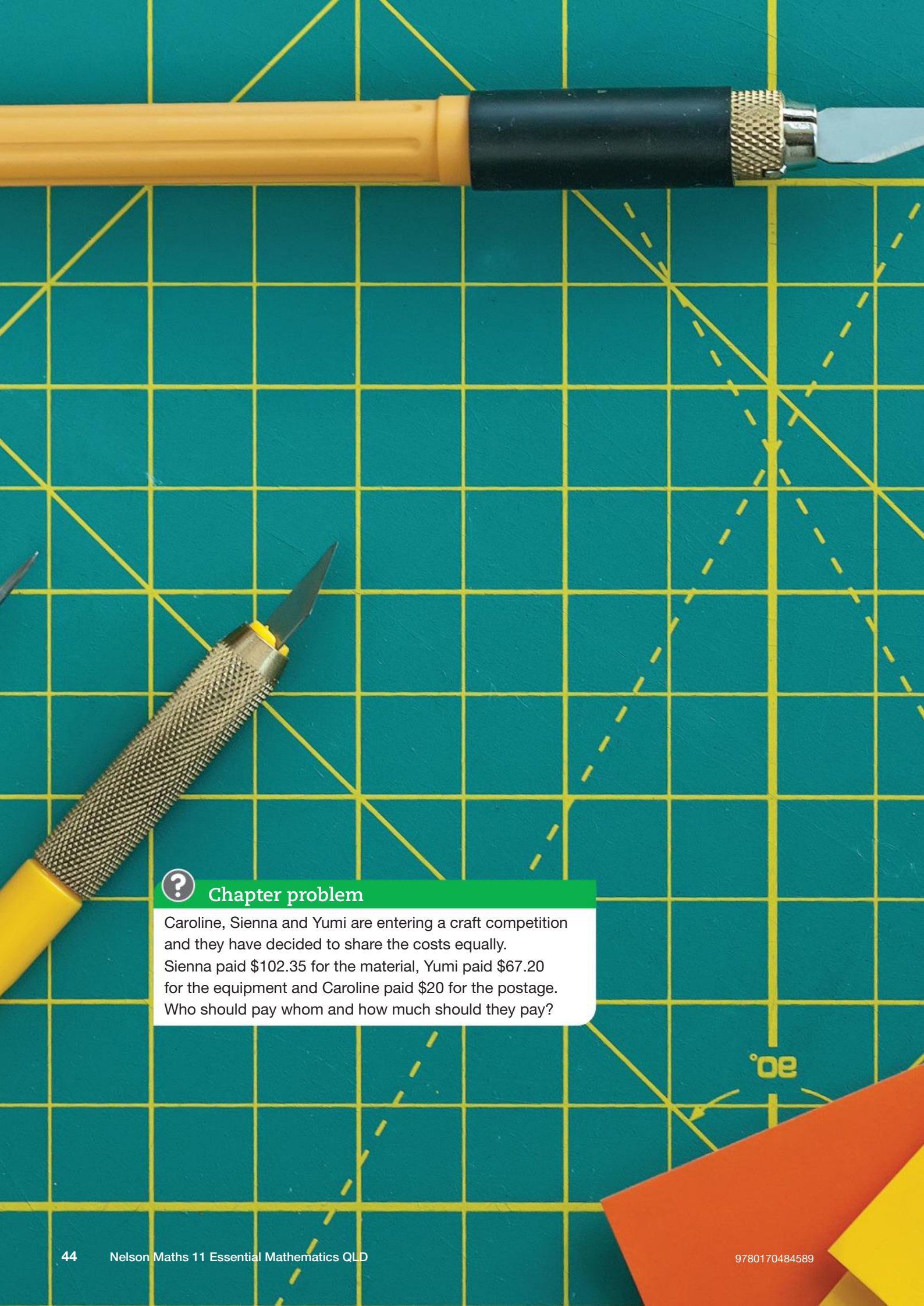
18 64% of workers at a fast food restaurant are males. How many female workers are there if 325 people work at the restaurant each week?

19 A muesli bar has a serving size of 40 g.

a It has 12.2 g of fat. What percentage is this? Answer correct to one decimal place.

b It is 5% protein. How many grams of protein are in the muesli bar?

20 Currently, the GST is 10%. Some politicians think it should be raised to 15%. A tradesman charges $320 excluding GST for a morning's work. Calculate how much more the tradesman would charge if the GST was raised to 15%.



Chapter problem

Caroline, Sienna and Yumi are entering a craft competition and they have decided to share the costs equally.
Sienna paid $102.35 for the material, Yumi paid $67.20 for the equipment and Caroline paid $20 for the postage.
Who should pay whom and how much should they pay?



CHAPTER 3

NUMBER, DATA AND MONEY: CALCULATIONS

SOLVING PROBLEMS

Syllabus coverage
Nelson MindTap chapter resources
Terminology
3.1 Does the answer look right?
3.2 What do we know?
3.3 Problem-solving strategies
3.4 Word clues
3.5 The 4 stages of problem-solving
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Interpret a problem and identify what it is
- Identify word clues in the problem that suggest which mathematical operation to use
- Solve the problem using a number of strategies
- Check the solution to the problem to see whether it looks right
- Present the solution to the problem

How are we ever going to use this?

- Can I afford to buy this?
- How much will it cost?
- What time will I have to get there?
- Is the change right?
- How much of each ingredient do I need?

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Syllabus coverage

PROBLEM-SOLVING

Problem-solving is required when a task or goal has limiting conditions placed upon it or an obstacle blocking the path to a solution (Marzano & Kendall 2007). It involves:

- knowledge of the relevant details
- using generalisations and principles to identify, define and interpret the problem
- mental computation and estimation
- critical, creative and lateral thinking
- creating or choosing a strategy
- making decisions
- testing, monitoring and evaluating solutions.

UNIT 1, FUNDAMENTAL TOPIC: CALCULATIONS

Calculations

- Ascertain the reasonableness of answers to arithmetic calculations.
- Check results of calculations for accuracy.

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, pp. 8, 15
© Queensland Curriculum and Assessment Authority (QCAA)

Worksheet (1):
3.5 A page of problems

Nelson MindTap

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

Terminology

assumption	check	diagram	identify
information	number line	present	solution
solve	strategies	symbols	timeline
work backwards			

3.1 Does the answer look right?

To be good problem solvers, we need to develop some special skills. We need to be able to:

- identify information in a problem
- change words into mathematical symbols
- identify and use appropriate ways to solve a problem
- spot an incorrect or silly answer
- write our **solution** in a way that others can understand.

In this chapter, we are going to learn the special skills required to solve a problem, one at a time, starting with spotting an incorrect or silly answer.

EXAMPLE 1 Spotting an incorrect answer

The answer to the following problem is not correct. What's wrong with the answer?

Problem: Gerry earns $720 per week. How much does he earn per fortnight?

Answer: Gerry earns $650 per fortnight.

Steps	Working
$650 is too small. Fortnights are longer than weeks.	The answer is incorrect because it should be *more* than $720, not less.

EXAMPLE 2 Checking an answer

When Amelia bought a cup of coffee, she paid with a $20 note and she received $12.80 change. Could the change be right?

Steps	Working
$20 – $12.80 is about $20 – $13 = $7	The change could be right.
A cup of coffee could cost about $7.	$7 is about the right price for a cup of coffee.

EXERCISE 3.1 Does the answer look right?

ANSWERS p. 373

Each answer given in questions **1** to **8** below is incorrect. Explain how you can tell the answer is incorrect without actually calculating it.

1 EXAMPLE 1 Sam earns $18 per hour working in a fast food shop. How much will she earn for a 3-hour shift? Answer: $21

2 The balance of Jake's debit card is $127. He bought a t-shirt for $15 and paid with his debit card. What is the balance of Jake's debit card after he bought the t-shirt? Answer: $142

3 Lara catches the bus to work. The bus trip takes 65 minutes and she starts work at 9 am. What is the latest time she can catch the bus to be at work on time? Answer: 8 am

4 Suresh spends 45 minutes at the gym 5 days per week. How many hours does he spend at the gym each week? Answer: 6 hours

5 A 500 g bag of macadamia nuts costs $17.50. At this rate, how much does 1 kg of macadamia nuts cost? Answer: $65

6 Lina's car uses 10 L of petrol to travel 100 km. How many litres of petrol will she use to drive 70 km? Answer: 7 km

7 Dimitri has $5000 in a bank savings account that pays 1% p.a. interest. How much interest will he earn for 3 years? Answer: $150 000

8 Convert 60 cm into mm. Answer: 6 mm

Each answer given in questions **9** to **14** below could be incorrect. Explain how you can tell whether the answers are correct or incorrect.

9 EXAMPLE 2 A TV streaming service charges customers an additional 1% if they pay their bill by credit card. Suyen's bill is $135. How much will she have to pay if she pays her bill by credit card? Answer: $133

10 An electricity supply company gives customers who pay their bill early a 6% discount. Will's electricity bill is $230. How much will he pay if he pays the bill early? Answer: $216

11 In a survey of 800 people, 550 said they drank tea or coffee with their breakfast. What percentage is this? Answer: 46%

12 Electricity prices are going up by 10%. At the moment, off-peak electricity costs 32c/kWh. How much will off-peak electricity cost after the increase? Answer: 35.2c/kWh

13 It costs Jessie $10 to make a bracelet and she sold it for $15. Calculate her percentage profit. Answer: 150%

14 Anthea is going to buy an apartment. In the last year, apartment prices have increased by 10%. Today the apartment costs $450 000. How much did it cost last year? Answer: $400 000

3.2 What do we know?

When we're solving a problem, we need to identify what it is we have to work out and what information we have available to do it. Sometimes, we don't have enough information and we have to find more information or make assumptions. Sometimes, we have *too much* information.

EXAMPLE 3 What information is given?

For the problem below, **identify**:

- what we have to work out
- what information is given to work out the answer.

Kirsty's problem

When Kirsty weighed herself, the scales showed 65 kg. She went on an unhealthy crash diet and lost 12% of her body weight. Calculate Kirsty's weight after her diet.

Steps	Working
The key information is bolded below:	Work out: weight after diet
When Kirsty weighed herself, the scales showed **65 kg**. She went on an unhealthy crash diet and **lost 12%** of her body weight. Calculate **Kirsty's weight after her diet**.	The information given is: • starting weight: 65 kg • lost weight: 12%

EXERCISE 3.2 What do we know?

ANSWERS p. 373

Keep a record of your responses in this exercise. You will need them for Exercises 3.4 and 3.5.

1 EXAMPLE 3 Think about the following problem.

Danica was on holidays in Fiji for 12 days and it rained on 25% of the days. How many fine days did Danica have in Fiji?

a What is the problem asking us to work out?

b What information is in the problem that can help us solve it?



iStock.com/zstockphotos

In questions **2** to **6**, identify what the problem is asking us to work out and what information we know. You do *not* have to solve the problem.

2 Mark wants to buy the 'perfect car'. The recommended price was $36 000, but when he went to buy it, Mark discovered that the dealer had increased all the prices in the car yard by 5%. What is the new price of Mark's 'perfect car'?

3 Before Charlotte attends a doctor's appointment, she wants to check that she has enough money in her EFTPOS account. How much will she have to pay if the consultation costs $72, and her doctor gives a 5% discount to patients who pay with EFTPOS?

4 Jonah increased the price of all items in his shop. He increased the price of jeans to $54 from $50. By what percentage did Jonah increase prices?

5 Grandma had heart surgery on 12 March. She has to go back to the doctor for a check-up in 8 days and then 6 weeks after the surgery. On what dates should Grandma make appointments to see her doctor?

6 Daniel's son William is unwell. The doctor told Daniel to give William 8 mL of medicine 3 times per day for 5 days. The bottle contains 120 mL and Daniel gave William the first dose at 2 pm. Will there be enough medicine for 5 days in one bottle?



Wavebreakmedia/Shutterstock.com

3.3 Problem-solving strategies

Good problem-solvers use a variety of strategies. Here are 8 useful strategies, but there are plenty more.

- Draw a picture, diagram or make a model
- Make a table or list
- Draw a timeline
- Construct a number line
- Guess, check and improve
- Work backwards
- Solve a simpler problem
- Break it into smaller pieces

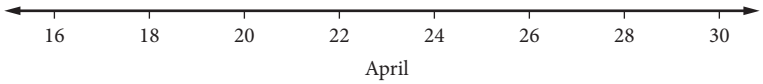
We will use different problem-solving techniques as we work through Exercise 3.3.

EXERCISE 3.3 Problem-solving strategies

ANSWERS p. 373

1 Jules has an appointment with the doctor on 26 April. Before the appointment, she needs to have 2 blood tests: one 8 days before and the other 2 days before the appointment. On what dates does Jules need the blood tests?

a Copy this timeline and mark the date of Jules' appointment on it.



b Count the correct number of days backwards from Jules' appointment date to find the dates she needs to have the blood tests. What are the dates?

c Which of the 8 problem-solving strategies did you use to solve this problem?

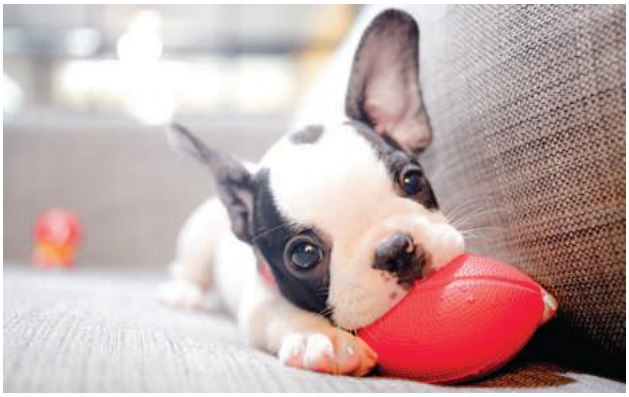
2 Year 1 students are going on an excursion. Adult tickets cost $25 and children's tickets cost $6. The school secretary ordered 20 tickets with a total cost of $196. How many adults are going on the excursion?

a Guess the number of adults. If 2 adults have tickets, how many children have tickets? Calculate the total cost of the tickets. Is it correct?

b Guess that there were 5 adults, calculate the number of children and the total cost of the tickets. Repeat until the total cost is $196.

c Which of the 8 problem-solving strategies did you use to solve this problem?

3 Caroline uses dog treats to train her new puppy to go to the toilet outside. On the first day, she gave the puppy 32 dog treats and on each following day, she gave the puppy half the number of treats of the previous day. The puppy was toilet-trained on day 5, so she stopped the treats. How many dog treats did Caroline give her puppy altogether?



MAXXSIPHOTO/Shutterstock.com

a How many treats did Caroline give the puppy on the second day?

b Copy and complete this table and calculate the total number of treats Caroline gave her puppy.

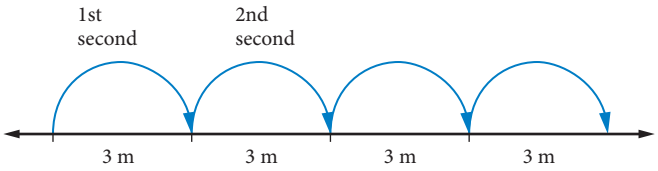
Day	1	2	3	4	5
Number of treats	32				

c Which of the 8 problem-solving strategies did you use to solve this problem?

4 Think about these 2 problems:

- A rocket travels 11.9 km every second. How far will it travel in 15.75 seconds?
- Jim walks 3 metres every second. How far does he walk in 4 seconds?

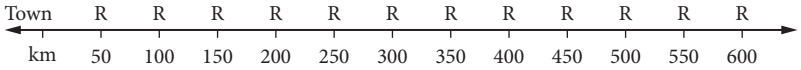
a Use this diagram to help you calculate how far Jim walks in 4 seconds. What mathematical operation using 3 and 4 gives the answer?



b Use the same operation with 11.9 km and 15.75 seconds to calculate how far the rocket will travel.

c Which of the 8 problem-solving strategies did you use to solve this problem?

5 Every 50 km along the highway there is a rest area. Every 80 km there is a food stop and every 100 km there's a petrol station. How far from town is there a rest area, food stop and petrol station at the same place?



a R on the number line above represents the locations of rest areas. Copy the number line and show the positions of food stops and petrol stations.

b Solve the problem.

c Which problem-solving strategy did you use to solve this problem?



Jaaske M/Shutterstock.com

6 Damien sells real estate. He receives 2% commission on the first $500 000 of the property he sells and 2.5% on any amount above $500 000. How much should Damien charge for his commission on a $960 000 sale?

a To solve this question, separate the sale into $500 000 and the amount over $500 000. How much of the sale is over $500 000?

b Calculate the 2 separate parts of the commission, then the total commission.

c What problem-solving strategy did you use to solve this problem?

3.4 Word clues

Sometimes, a problem contains words that can give us a clue or tip-off about the mathematical operations that we need to use to solve it. The table below shows lists of words that suggest when we have to add, subtract, multiply or divide.

Adding words (+)	Subtracting words (–)	Multiplying words (×)	Dividing words (÷)
total	more	lots of	share
sum	difference	product	how many times
increase	less	by	out of
combined	decrease	times	split
perimeter	deduct	groups of	parts
	change	per	at this rate
	how many left	at this rate	
	fewer	double (× 2)	
	reduce	triple (× 3)	
	remains	area	
	discount	volume	
words that end in 'er' like bigger, slower, taller		percentage of	

Be careful! Occasionally words can have more than one meaning. Always check that your answer makes sense!

EXAMPLE 4 Word clues 1

Let's revisit Kirsty's problem from Example 3:

'When Kirsty weighed herself, the scales showed 65 kg. She went on an unhealthy crash diet and lost 12% of her body weight. Calculate Kirsty's weight after her diet.'

What word clues can we find to help us decide whether to add, subtract, multiply or divide?

Working

In this problem, '**lost**' means '**reduced**'. '**Reduced**' is in the **subtract** column.

'**12% of**' is a '**percentage of**', which is in the **multiply** column.

To solve this problem, we will have to multiply and subtract.

EXAMPLE 5 Word clues 2

a **Identify** the word clues in the following problem:

Sarah has a small flock of sheep to grow wool to use in her craft work. During lambing, the number of animals increased from 12 to 15. How many lambs were born?

b **Describe** how you know that even though the word clue is in the 'addition' column, addition is NOT what we have to do to solve the problem.

Working

a The word clue is 'increased'.

b In this problem, the 'ed' at the end of 'increased' means the increase has happened already. We don't have to add, we have to undo an addition. We have to **subtract**.

EXERCISE 3.4 Word clues

ANSWERS p. 374

In each question, identify the word clues and write whether we have to add, subtract, multiply or divide to solve the problem. You do *not* have to solve the problem.

1 EXAMPLE 4 5 people equally share the $2 million first prize in Lotto. How much did each person win?

2 On Saturday, 6 friends are going to the movies. It's going to cost $26 per ticket. How much will the tickets cost altogether?

3 Nick earns $780 per week. Each week, his employer deducts $129 from Nick's earnings for tax. How much of Nick's wage is left after his employer deducts the tax?

4 Josie is a doctor in a medical centre. On average, she spends 15 minutes with each patient. If she decreases the average time she spends with each patient to 10 minutes, how many more patients can she see in an hour?

5 Newsagents sell 35 600 copies of 'Girlfriend' magazine per month. How many copies of the magazine do newsagents sell each year?

6 The speed limit on the highway is 70 km/h, but during school zone times the speed limit is reduced to 40 km/h. How much slower do cars have to travel during school zone times?

7 Mariah placed an online order for 3 boxes of envelopes, 5 boxes of papers and a box of pens. Calculate the total number of boxes Mariah ordered.

8 'At this rate' is in both the multiplying and dividing columns. Which meaning of the clue 'at this rate' do we need to solve the following problem?

Troy assembles components in a factory. He assembles 12 components in an hour. At this rate, how long will it take him to assemble 72 components?

9 The gym instructor arranged the people in a class into 4 groups each containing 6 people. How many people are in the class?

In questions **10** to **12**, identify the word clues that have a different meaning from those in the table on the previous page. What is the same about each of these questions?

10 EXAMPLE 5 A grandfather died and left some money to be shared equally among his 5 grandchildren. Each grandchild's share was $35 000. How much money did the grandfather leave his grandchildren in total?

11 Marco has been practising his golf putting. Now he can sink 6 out of 10 difficult putts, which is double the number he could sink before he started practising. How many difficult putts could he sink before he started practising?



Image Source Limited/Alamy Stock Photo

12 Vicki received a $10 student discount when she bought some travel books from the bookshop. She paid $65. How much would the books have cost without the student discount?

13 Go back to the questions in Exercise 3.2 and look at your answers. Identify any word clues in each question and record what the clue is telling you to do. Keep your answers to use later.

Worksheet
A page of problems

3.5 The 4 stages of problem-solving

We can break down the process of solving a problem into 4 stages.

The 4 stages of problem-solving

- Stage 1: **W**HAT is the problem? What do we know?
- Stage 2: **S**OLVE the problem
- Stage 3: **C**HECK the solution
- Stage 4: **P**RESENT the solution



To demonstrate, we will revisit Kirsty's problem from Example 3:

'When Kirsty weighed herself, the scales showed 65 kg. She went on an unhealthy crash diet and lost 12% of her body weight. Calculate Kirsty's weight after her diet.'

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	To find Kirsty's weight after her diet. We know her weight before the diet was 65 kg and that she lost 12% of her body weight.
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	There are 2 word clues in this problem: 12% of → multiply, 'lost' → subtract 12% × 65 = 7.8, therefore she lost 7.8 kg. 65 − 7.8 = 57.2 kg, so her new weight is 57.2 kg. *[If you can't work out the solution, go back to Stage 1.]*
STAGE 3: CHECK THE SOLUTION	
 CHECK	Does it make sense? Have you solved the problem? 57.2 kg is less than 65 kg, the answer seems correct and there's nothing else to work out. *[If your answer doesn't solve the problem, go back to Stages 1 and 2.]*
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	Write the conclusion: Kirsty weighed 57.2 kg after the diet.

EXERCISE 3.5 The 4 stages of problem-solving

ANSWERS p. 374

Use the 4 stages of problem-solving to solve the problem given in Part A below. Having your responses to Exercise 3.2 and question **13** of Exercise 3.4 will save you time and effort with the questions in Part B.

Part A

Saskia's horse weighs 500 kg and is feeding a foal. The horse's food is a mix of concentrate and paddock grass. Horses require 2% of their body weight in food each day. A mare (female horse) feeding a foal requires 70% of her food to be concentrate and the remainder paddock grass. How many kilograms of concentrate and of paddock grass should Saskia give her horse each day?



Pazargic Liviu/Shutterstock.com

Answer the following questions to help you learn what to do at each stage of solving a problem.

 WHAT?	**1** What do we have to work out and what do we know?
 SOLVE	**2** Are there any word clues that can help us know what to do? **3** What calculations do we need to do? **4** Complete the working out.
 CHECK	**5** Check that the answer makes sense and comment about it.
 PRESENT	**6** Complete the solution by writing the answer or conclusion.

Part B

For each question in Exercise 3.2, use the problem-solving stages to solve the problem.
Remember that you identified the word clues in question **13** of Exercise 3.4.

Keyword activity

PROBLEM-SOLVING STAGES

Descriptions of the stages are listed below but they are *not* in order. Copy the grid below them and write the descriptions of each stage in the appropriate place. Ask your teacher to check your grid.

- Checking your answer is very important. If it doesn't make sense, go back to stage 1 and start again.
- In this stage, write your conclusions and the solution to the problem.
- Decide which problem-solving strategy to use. Sometimes you'll use more than one strategy. Look at the language in the problem for clues for what to do and then solve the problem.
- In this stage, decide what the problem is asking you to find.
- Read the problem carefully and list all the information that is given.

 WHAT?	
 SOLVE	
 CHECK	
 PRESENT	

Solution to the chapter problem

Problem

Caroline, Sienna and Yumi are entering a craft competition and they have decided to share the costs equally. Sienna paid $102.35 for the material, Yumi paid $67.20 for the equipment and Caroline paid $20 for the postage. Who should pay whom and how much should they pay?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	To find the amount each person pays and whom they pay. Sienna paid $102.35, Yumi paid $67.20, Caroline paid $20 and they will share the cost equally.
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	Word clues: Share equally → divide What strategy? Break it into smaller parts. $102.35 + $67.20 + $20.00 = $189.55 $189.55 ÷ 3 ≈ $63.18 Sienna and Yumi each paid too much. They require refunds from Caroline. Sienna's refund = $102.35 – $63.18 = $39.17 Yumi's refund = $67.20 – $63.18 = $4.02
STAGE 3: CHECK THE SOLUTION	
 CHECK	Caroline will pay $20 + $39.17 + $4.02 = $63.19. That's right.
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	Caroline should pay Sienna $39.17 and Yumi $4.02.

3 Test yourself

Solving problems

ANSWERS p. 374

1 EXERCISE 3.1 *Without* working out the answer, decide whether the answers given are incorrect or could be correct. Justify your answers.

- **a** Phoebe is an electrician. She buys electrical cable in 100 m rolls that cost $52.10 each. She estimates that she will need 860 m of cable to wire a block of townhouses. How much will the cable cost? Answer: $156.30
- **b** The price of a pair of shoes without GST included is $64. Calculate the price including 10% GST. Answer: $58.20
- **c** When Skye pays her electricity bill early, she receives a 10% discount. Skye's electricity bill is $380. How much will she save if she pays the bill early? Answer: $342
- **d** Billy is going to buy a motorbike. He will pay a $450 deposit and 12 monthly repayments of $180. How much will Billy pay for the bike? Answer: $2610

2 EXERCISE 3.2 Read the following problem but *don't* work out the answer.

Shelly has a new roll of electrical cord 20 m long that she is going to use to wire up a new sound system in her unit. She needs 2 pieces of wire, one 8 m long and the other 3.6 m long. After Shelly is finished, how much wire will be left on the roll?

- **a** What is the question asking?
- **b** What information is included in the problem?

3 EXERCISE 3.2 For the following problem:

- **a** list the information provided
- **b** state what you have to work out.

'On the hour' means times 'with zero minutes' like 2 pm, 11 am, 5 pm, not times like 2:05 pm or 5:30 am.

Problem

You are catching a bus to a football match at the stadium. Buses leave every hour on the hour and it takes 1 hour 20 minutes to get there. It takes you 30 minutes to get to the bus from your home. The match starts at 3:45 pm. What is the latest time you can leave home?

4 EXERCISE 3.4 For each problem, identify the word clues. You *don't* have to solve the problem.

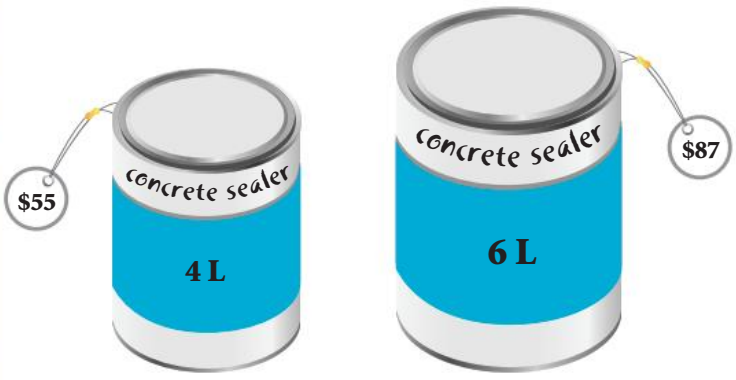
- **a** Ann and Mike are cleaning their neighbour's house. Ann worked for 3 hours and Mike worked for 1 hour. Their neighbour paid them $100 for the job. They want to share the money fairly. How much should they each receive?
- **b** The bus fare to the mall is $3.40 one way or $4.50 return. How much cheaper is it to buy a return ticket than 2 one-way tickets?
- **c** Coffee costs $4.20 per mug. Five friends each had a mug of coffee. Calculate the total cost.
- **d** When Harry buys car products, he receives a 15% discount because he is a member of a vintage car club. How much will Harry pay for car-cleaning products that normally cost $36?

5 EXERCISE 3.5 Use the 4 problem-solving stages to answer each question.

- **a** A bike track is 500 m long. How many times do you need to ride around the track to ride 6 km?
- **b** Parking at the beach costs 50c for 15 minutes. At 11:30 am, Max put $5 in the parking meter. At what time will his parking meter run out?

Chapter problem

Suzie needs to buy some concrete sealer to seal the bricks in her new garden wall. She needs 24 litres and the sealer is available in 4 L and 6 L containers.



What is the cheapest way for Suzie to buy the sealer?



Corma/Shutterstock.com

CHAPTER 4

NUMBER, DATA AND MONEY: NUMBER

APPLYING RATES

Syllabus coverage
Nelson MindTap chapter resources
Terminology
4.1 Rates
4.2 Converting rates
4.3 Unit pricing
4.4 Rate problems*
4.5 Fuel consumption*
4.6 Direct proportion*
Keyword activity
Solution to the chapter problem
Test yourself
*COMPLEX

What will we do in this chapter?

- Identify and simplify rates
- Convert rates from one pair of units to another, for example, m/s to km/h
- Solve practical problems using rates, including speed, fuel consumption and unit pricing

How are we ever going to use this?

- Comparing prices of different brands of groceries to select the cheapest
- Calculating how long a trip will take if driving at a certain speed
- Determining quantities required for a painting or tiling job
- Calculating the quantity of fuel a car will use on a trip
- When mixing ingredients where there is a relationship between the quantities such as recipes, concrete, fertilisers, pesticides or other concentrates

9780170484589

Syllabus coverage

UNIT 1, TOPIC 1: NUMBER

Rates

- Identify examples of rates in the real world, e.g. rate of pay, cost per kilogram, currency exchange rates, flow rate from a tap.
- Convert between units for rates.
- Complete calculations with rates, including solving problems involving direct proportion in terms of rates [complex].
- Use rates to make comparisons.
- Use rates to determine costs.

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, p. 15
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Videos (7):

4.2 Converting rates 1 • Converting rates 2
4.3 Unit pricing
4.4 Rate problems 1 • Rate problems 2
4.5 Fuel consumption
4.6 Direct proportion

Worksheets (5):

4.2 Converting rates • More rates
4.4 Rapid rates • Rate problems
4.5 How much petrol?

Puzzles (3):

4.3 Best buys puzzle
4.4 Rate problems • Rate skills

Nelson MindTap

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

Terminology

comparison
constant of proportion
convert
direct proportion
fuel consumption
per
rate
speed
unit pricing

4.1 Rates

Rates compare 2 different types of quantities.

The most common rate we use is **speed**, which compares distance travelled over time. If a car has a speed of 100 km/h, it means that the car travels 100 km for *each* hour it travels.

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'.

EXAMPLE 1 Writing rates

Write each situation as a rate.

a Andrea 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.	$\text{rate} = \frac{200 \text{ metres}}{25 \text{ seconds}}$
Divide the number of metres by the number of seconds.	$= 8 \text{ m/s}$
b The units will be dollars per litre.	$\text{rate} = \frac{\$35}{20 \text{ litres}}$
Divide the number of dollars by the number of litres	$= \$1.75/\text{L}$

EXERCISE 4.1 Rates

ANSWERS p. 374

1 EXAMPLE 1 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 kilograms

e 400 m in 55 seconds

f $65 earned in $2\frac{1}{2}$ hours

g 500 g in 2 litres

h 1800 revolutions in 3 minutes

2 Marcella uses 90 litres of composting manure on her flower bed, which has an area of 5 m^2. What is this as a rate in L/m^2?

3 Goran used sprinklers to water his garden for $2\frac{1}{2}$ hours. He used 3375 litres of water. What is the 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 80 g in 15 cm^3

d $22.40 to buy 7 chocolate bars

e 175 mm rain in 5 days

f 290 km driven using 20 L of petrol

g $40.32 for 1.8 m of curtain material

h 768 vibrations in 3 seconds

i 140 sheep on 3.5 hectares of land

j $37.80 for 18 L of petrol

5 Dakota used 8 L of stone sealer to seal 72 m^2 of slate. Calculate this rate in m^2/L.

6 John is preparing a budget for his 10-day holiday. He is budgeting $1200 for meals. Calculate John's meal budget in $/day.

7 Marcus runs a barbecue for his sports club's market day. He has purchased the food listed in the table. Calculate the cost rate, including units, for each item.

	Item	Cost
a	Sausages	$57.80 for 6.8 kg
b	Steak	$119.25 for 7.5 kg
c	Onions	$11.40 for 4 kg
d	Rolls	$156 for 240 rolls
e	Tomato sauce	$26.80 for 8 bottles



Monkeybusinessimages/Getty Images

8 Group work: In your group, brainstorm examples of rates mentioned in the media; for example, cricket run rate, interest rates, and the exchange rate between the Australian dollar and other currencies. How many can your group list?

Worksheets
Converting rates

More rates

4.2 Converting rates

Sometimes, it is useful to be able to convert rates from one set of units to another. Doing this helps us to compare rates for different circumstances.

Converting rates from one set of units to another

- Write the rate as a fraction, including its units.
- Convert the units on the numerator of the fraction to the new unit.
- Convert the units on the denominator of the fraction to the new unit.
- Simplify the rate.

Videos
Converting rates 1

Converting rates 2

EXAMPLE 2 Converting rates 1

Convert 90 km/h to metres per second (m/s).

Steps	Working
Convert 90 km into metres and 1 hour into seconds.	$90\text{ km} = 90 \times 1000 \text{ metres}$ $= 90\,000\text{ m}$ $1\text{ h} = 60 \text{ minutes}$ $= 60 \times 60 \text{ seconds}$ $= 3600\text{ s}$
Divide the number of metres by the number of seconds.	$90\text{ km/h} = \frac{90\text{ km}}{1\text{ h}}$ $= \frac{90\,000\text{ m}}{3600\text{ s}}$
Simplify the rate.	$= 25\text{ m/s}$

EXAMPLE 3 Converting rates 2

Convert 2.5 g/m^2 to kg/ha.

Steps	Working
Change 2.5 g to kg and 1 m^2 to hectares.	$2.5\text{ g} = (2.5 \div 1000)\text{ kg}$ $= 0.0025\text{ kg}$
There are 10 000 m^2 to 1 hectare.	$1\text{ m}^2 = 1 \div 10\,000$ $= 0.0001\text{ ha}$
Simplify the rate.	$2.5\text{ g/m}^2 = \frac{2.5\text{ g}}{1\text{ m}^2}$ $= \frac{0.0025\text{ kg}}{0.0001\text{ ha}}$ $= 25\text{ kg/ha}$

EXERCISE 4.2 Converting rates

ANSWERS p. 374

In this exercise, round your answers to one decimal place where needed.

1 EXAMPLE 2 Convert each speed into m/s.

a 20 km/h **b** 50 km/h **c** 80 km/h **d** 110 km/h

2 Alice is walking at a rate of 80 metres per minute. What is her speed in:

a km/h? **b** m/s?

3 EXAMPLE 3 Convert each speed to km/h.

a 12.5 m/s **b** 2400 m/min **c** 3500 m/h

4 Joshua fertilises his land at a rate of 4 g/m^2. Express this rate in kilograms per hectare (kg/ha).

5 A tap leaks at a rate of 30 mL per minute. What is this rate in litres per hour?

6 The steel mesh used in fencing weighs 1.2 kg/m.

a Convert this rate to g/mm.

b Convert this rate to tonnes per kilometre (t/km).

c What do you notice about the answers to parts **a** and **b**?

d What is the rate in g/cm?

7 Jesse pumps water from his dam to irrigate his market gardens. The pump delivers water at a rate of 3.5 kL/h. Express this rate as:

a L/h **b** L/min **c** L/s

8 A 5 L container of varnish costs $24.

a What is the cost in $/L?

b Express this as a cost in cents/mL.

9 Jamaica's Usain Bolt set the world record for the 100-metre sprint. He ran the distance in 9.58 seconds.

a Express this as a rate in m/s, correct to one decimal place.

b Convert this speed to km/h, correct to 2 decimal places.



AFP/Getty Images

10 Sophie is painting her house before putting it on the market. She uses 2 L of decking oil to paint her 38 m^2 wooden deck, and 350 mL of black paint to paint the outside surface of her garden pots, an area of 4.6 m^2. Which surface, the wooden deck or the garden pots, uses the larger rate of paint? PS

Puzzle
Best buys puzzle

4.3 Unit pricing

The government requires supermarkets to display the **unit price** for all items. The unit price makes comparing the prices of different-sized packaging easy.

EXAMPLE 4 Unit pricing 1

Jonathan is calculating the unit price for rolls of paper towels. There are 15 m rolls for $2.40 each and 20 m rolls at $3.60 per roll. He decided to use 1 metre as the comparison unit.

a **Calculate** the unit price for each roll.

b Which roll is better value for money?



Jeffrey Isaac Greenberg 11+/Alamy Stock Photo

Steps	Working
a For the 15 m roll, calculate the cost of 1 metre by dividing by 15. For the 20 m roll, calculate the cost of 1 metre by dividing by 20.	For the 15 m roll: unit price = $2.40 ÷ 15 = $0.16/m For the 20 m roll: unit price = $3.60 ÷ 20 = $0.18/m
b The better price is the item with the lower unit price.	The 15 m roll is better value.

EXAMPLE 5 Unit pricing 2

The same cooking oil is available in 2 sizes of bottle:
500 mL for $5.25 and 750 mL for $7.43.

> 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.

a **Calculate** the unit price for each bottle.

b Which size of bottle is the better value?

Steps	Working
a For each bottle, calculate the price for 100 mL.	Unit price of the 500 mL bottle:
500 mL is 5 × 100 mL. Divide the price of the 500 mL bottle by 5.	$5.25 ÷ 5 = $1.05 per 100 mL
750 mL is 7.5 × 100 mL. Divide the price of the 750 mL bottle by 7.5.	Unit price of the 750 mL bottle: $7.43 ÷ 7.5 = $0.99 per 100 mL
b The smaller unit price is the better value.	The 750 mL bottle is the better value.

Video
Unit pricing

EXERCISE 4.3 Unit pricing

ANSWERS p. 375

1 EXAMPLE 4 Calculate the price of 1 m of wallpaper for each size roll.

a 5 m for $18.00

b 10 m for $47.50

c 20 m for $83.00

2 The same seafood sauce is available in 50 mL bottles for $4.60 and 80 mL bottles for $7.12.

a For each size of bottle, calculate the price per 10 mL.

b Which size of bottle is the better value?

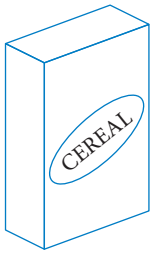
3 A box containing 1 dozen eggs costs $7.80 and a box containing 6 eggs is $3.84.

a Calculate the price per egg in each box.

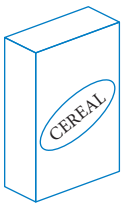
b Which size box is the better value?

c Damien is buying 18 eggs. What is the cheapest way for him to do it?

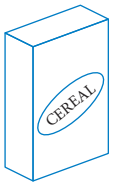
4 Supermarket signs show the packet price and the unit price for 3 packets of breakfast cereal. Which size packet is the best value for money? Justify your answer.



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

5 EXAMPLE 5 Rice is available in 3 different-sized packets: PS

- 1 kg for $4.38
- 2 kg for $10.00
- 5 kg for $22.49

a What would be a sensible unit to use for a price comparison?

b Determine which size packet is the best value.

6 The yellow spice saffron is the world's most expensive spice.



GracePhotos/Shutterstock.com

The price of 1 g of saffron is 3 times the price of 1 g of 24 carat gold.

Carmen is ordering some saffron online. The prices are shown below.



a Calculate the unit (1 g) price for each size.

b Carmen is going to order 7.5 g. What is the cheapest way for her to do it?

7 Boxes of the breakfast biscuit cereal QBix are on special because the 'use by' date is only 5 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 buys? PS

8 Hair shampoo is available in 2 sizes of bottle:

- 750 mL for $9.75
- 1 L for $12.20

Which size bottle is the better value? Justify your answer. PS

Chapter problem

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

4.4 Rate problems*

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 $\left(\text{e.g., } = \frac{\text{km}}{\text{h}}\right)$.
- To find the numerator of the fraction, multiply by the rate.
- To find the denominator of the fraction, divide by the rate.

EXAMPLE 6 Rate problem 1

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. We can express the units as $\frac{\$}{\text{day}}$. To find the number of dollars, which is the numerator 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.

EXAMPLE 7 Rate problem 2

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 the denominator, 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 4.4 Rate problems*

ANSWERS p. 375

1 EXAMPLE 6 Lizzie plants tomato seedlings in rows at a rate of 28 seedlings per row. How many seedlings are there in:

a 4 rows? **b** 7 rows? **c** 12 rows?

2 Jayden earns $19.70/h as a barista in a cafe. How much is he paid for working 20 hours?

3 EXAMPLE 7 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 for him to hike

a 15 km? **b** $7\frac{1}{2}$ km? **c** 24 km?

4 Mandarins cost $3.20/kg. How many kilograms of mandarins can Rithy buy for $20?

5 Penina 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?

Videos
Rate problems 1
Rate problems 2

Worksheets
Rapid rates
Rate problems

Puzzles
Rate problems
Rate skills

6 A plane flies at an average 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 one decimal place.

i Brisbane: 1670 km

ii Auckland, New Zealand: 2626 km

iii Perth: 3430 km

iv Los Angeles, USA: 12 773 km

We will solve more speed problems in Chapter 16, using a formula for speed.

7 The yields Maxine achieves from different vegetable crops are shown below.

Crop	Yield (vegetables/m^2)
Beetroot	40
Lettuce	18
Cabbage	8

a How many beetroots can Maxine expect to get from her 24 m^2 beetroot plot?

b How many lettuces will she grow in a 15 m^2 plot?

c What area does she need to grow 450 lettuces?

d What area does she need to grow 760 cabbages?

8 Aaron uses fertiliser on his farm at a rate of 24 kg/ha. How many kilograms of fertiliser does he require to cover 32 hectares?

9 A dripping tap leaks water at the rate of 25 mL/min. PS

a How much water will leak from the tap in 30 minutes?

b How much water will be lost in 1 hour?

Remember, there are 60 minutes in an 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 litre of water?

Remember, there are 1000 mL in 1 L.

f How many hours will it take for the tap to leak 60 L of water?

10 Vijay is saving to purchase a car. He can save $400 per week.

a How much can Vijay save in 20 weeks?

b The car he wants costs $14 000. How long will it take Vijay to save this amount?

c A newer car is available, but it costs $15 200. How much longer would it take Vijay to save for this car?

11 Chloe earns $27.50/h as a secretary. How many hours will she need to work to earn

a $495? **b** $962.50? **c** $660?

12 Elise wants to hang curtains on 12 windows in her house. Each window requires 1.8 metres of material, which costs $22.50 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?

13 Gustav uses a small aircraft to do crop dusting. His plane uses fuel at a rate of 28 litres per hour. In one 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 of crop dusting?
- **d** In a different week, Jacob had only 420 litres of fuel available. How many hours could he fly in that week?

4.5 Fuel consumption*

Video Fuel consumption

Worksheet How much petrol?

The **fuel consumption** of a vehicle is the amount of fuel the vehicle uses per distance travelled. It depends on many factors, including the size and efficiency of the engine, the mass of the vehicle and whether it is driven on city or country roads.

Fuel consumption is a rate expressed as the number of litres used per 100 km travelled (L/100 km). The lower the rate, the less fuel the vehicle uses.

Fuel consumption

$$\text{fuel consumption} = \frac{\text{fuel used in L}}{\text{distance travelled in km}} \times 100$$

For example, the fuel consumption for a typical small car is 5.8 L/100 km, and for the much larger V6 car it is 9.8 L/100 km.

There are 3 types of fuel consumption questions:

- What is the fuel consumption rate in L/100 km? Divide the fuel used by the distance travelled and multiply by 100.
- How much fuel will the car use? To find litres (L), multiply by the rate.
- How far can the car go? To find km travelled, divide by the rate.

EXAMPLE 8 Fuel consumption 1

The dashboard computer in Tadeja's car shows that over the last 5000 km travelled, the car used fuel at a rate of 6.9 L/100 km.

a How much fuel did Tadeja's car use in the last 5000 km?

b At an average price of $1.89/L, how much did the petrol to travel 5000 km cost?

Steps	Working
a Express 6.9 L/100 km as $\frac{6.9\text{ L}}{100\text{ km}}$.	$\text{fuel consumption} = \frac{6.9\text{ L}}{100\text{ km}} = 0.069\text{ L/km}$
To find litres, multiply by the rate.	$\text{fuel used} = 5000\text{ km} \times 0.069\text{ L/km}$ $= 345\text{ L}$
b Express $1.89/L as $\frac{\$1.89}{L}$.	$\text{cost} = 345\text{ L} \times \$1.89/\text{L}$ $= \$652.05$
To find cost ($), multiply by the rate.	

EXAMPLE 9 Fuel consumption 2

Jesse bought a secondhand car. This week, he travelled 425 km and used 32 L of fuel.
Calculate, correct to one decimal place, the car's fuel consumption in L/100 km.

Steps	Working
$\text{fuel consumption} = \frac{\text{fuel used in L}}{\text{distance travelled in km}} \times 100$	fuel consumption $= 32\text{ L} \div 425\text{ km} \times 100$ $= 7.5294...$ $\approx 7.5\text{ L/100 km}$



Art Konovalov/Shutterstock.com

EXAMPLE 10 Fuel consumption 3

Saskia's BMW has a fuel consumption rate of 7.1 L/100 km.
How far (to the nearest kilometre) can the car travel on 60 L of fuel?

Steps	Working
Express 7.1 L/100 km as $\frac{7.1\text{ L}}{100\text{ km}}$.	fuel consumption $= \frac{7.1\text{ L}}{100\text{ km}}$ $= 0.071\text{ L/km}$
To find km, divide the fuel used by the rate.	distance $= 60\text{ L} \div 0.071\text{ L/km}$ $= 845.0704...$ $\approx 845\text{ km}$

EXERCISE 4.5 Fuel consumption*

ANSWERS p. 375

1 EXAMPLE 8 The petrol consumption rate of Jack's car is 5.9 L/100 km.

a How many litres of petrol will the car use on an 850 km trip?

b How much will the fuel cost for the trip if petrol costs $1.90/L?

2 EXAMPLE 9 Lela's old Holden used 25 L of fuel to travel 180 km.
Calculate the car's fuel consumption in L/100 km, correct to one decimal place.

3 EXAMPLE 10 Jeff's VW Golf uses diesel fuel. It has a fuel consumption rate of 6.1 L/100 km.
How far can Jeff travel on 50 litres of diesel fuel?

4 Cyrus used 18 L of petrol to drive 190 km. Calculate his car's fuel consumption in L/100 km.

5 A motoring organisation tested the fuel consumption for several SUV vehicles by measuring the fuel consumed for the same 790 km journey. Calculate the fuel consumption of each vehicle, correct to one decimal place.

	Vehicle	Litres of fuel used
a	Kia SUV	80.1
b	BMW	69.9
c	Toyota Rav4	67.2
d	Subaru Outback	57.7
e	Range Rover	61.6

6 Carol's secondhand Toyota Camry uses 7.5 L/100 km. The petrol tank holds 60 litres of fuel. How far can Carol travel on one tank of petrol?

7 To save fuel, the motor in Samena's SUV turns itself off when the car stops in traffic. With this fuel-saving option turned on, the car uses 8.9 L/100 km, but with it turned off, it uses 10.0 L/100 km. Each week, Samena travels 650 km.

a How much less fuel per week does Samena use with the fuel-saving option turned on?

b At an average price of $1.86/L, how much does Samena save by turning on the fuel-saving option?

8 Arsenio's Lexus Sport uses premium fuel (98 petrol) with a fuel consumption of 11.1 litres per 100 km.

a How much petrol will his car use on a 425 km trip to the vineyards? Answer correct to the nearest litre.

b Calculate the cost of fuel for the journey at $2.36 per litre.

9 Josh lives on a large property. He uses a ride-on mower to cut the grass, but he's heard that ride-on mowers use much more fuel than a push mower and he's concerned about the effect on the environment. He decided to investigate. He divided his biggest paddock into 2 equivalent sections and mowed one with a ride-on and the other with a push mower. He summarised the results in a table. PS



Sopotnicki/Shutterstock.com

Method	Fuel usage rate	Time taken
Push mower	600 mL/h	3 hours
Ride-on mower	3.6 L/h	30 minutes

a Calculate the actual amount of fuel Josh used to mow each section.

b Which method of cutting the grass would you recommend Josh use? Why?

10 Tara's chainsaw uses fuel depending on the hardness of the wood she is cutting. When cutting large gum trees, it uses fuel at a rate of 310 mL in 45 minutes.

a Calculate this fuel usage in L/h. Answer correct to one decimal place.

b Tara estimates that it will take her 8 hours to cut up a large gum tree. How much fuel will Tara require?

c Tara only has 3 L of fuel. For how long will she be able to use the chainsaw?

Video
Direct proportion

4.6 Direct proportion*

Cans of soft drink are priced at $1.50 per can. This table shows the number of cans and the cost.

Number of cans, n	0	1	2	3	4	5	6	7	8
Total cost, C	0	$1.50	$3.00	$4.50	$6.00	$7.50	$9.00	$10.50	$12.00

As we buy more cans, the cost increases.

When we double the number of cans we buy, the cost doubles.

When we triple the number of cans we buy, the cost triples.

When we halve the number of cans, the cost halves.

This situation is an example of **direct proportion** (or **direct variation**).

When 2 variables are in direct proportion, one variable is a constant multiplier of the other variable.

Total cost of the cans = $1.50 × the number of cans

or $C = 1.50 \times n$

We say that the cost of the cans is directly proportional to the number of cans, or that it varies directly with the number of cans.

Direct proportion

Any relationship between 2 quantities x and y where there is a direct proportion between them can be written in the form

$$y = kx$$

where k is a number called the **constant of proportion**.

EXAMPLE 11 Direct proportion

A car travels at an average speed of 90 km/h. The distance it travels and the time it takes are related by direct proportion. This is shown in the table below.

Time (t hours)	0	1	2	3	4	5
Distance (d km)	0	90	180	270	360	450

a Write a proportion equation relating the car's distance (d) to the time (t).

b **Calculate** the constant of proportion.

c Complete the sentence: For every _____, the car travels _____ km.

d Use the equation to find the distance the car travels in 10 hours.

Steps	Working
a The variation equation is in the form $y = kx$.	In this case, $d = kt$.
b To find the value of k, substitute one of the pairs of values into the equation. Any pair of values except (0, 0) gives the same value for k. Choose the pair you like.	Choose $t = 3$, $d = 270$: $d = kt$ $270 = k \times 3$ $3k = 270$ $k = 90$
c Complete the sentence.	For every hour, the car travels 90 km.
d Substitute $t = 10$ into the equation. Direct proportion can be described in words, given as a table or shown on a straight-line graph.	$d = 90t$ When $t = 10$: $d = 90 \times 10$ $= 900$ The car travels 900 km in 10 hours.

EXERCISE 4.6 Direct proportion* ANSWERS p. 375

1 EXAMPLE 11 The cost of filling your petrol tank is directly proportional to the number of litres it takes. This is shown in the table below.

Petrol amount (L litres)	0	10	20	30	40	50
Cost ($\$C$)	0	18	36	54	72	90

a Write the direct proportion equation relating the cost ($\$C$) to the amount of petrol (L litres) bought.

b Calculate the constant of proportion.

c Write the equation for C in terms of L.

d Use the equation to calculate the cost of buying 75 L of petrol.

2 The weight of an object on the Moon (M kg) is $\frac{1}{6}$ the weight of the same object on Earth (E kg).

a Sami weighs 66 kg on Earth. How much does he weigh on the Moon?

b Write an equation relating weight on the Moon (M) to weight on Earth (E).

c Calculate the constant of proportion.

d Write the equation for M in terms of E.

e Using the equation, calculate the weight on the Moon of an astronaut who weighs 84 kg on Earth.

f Calculate the weight on Earth of a machine that weighs 44 kg on the Moon.

3 Archie is a store manager for Speedy Pizzas. He is paid according to the formula $W = 29.4h$, where W represents wage in dollars and h represents hours worked.

a How much is Archie paid to work 7 hours?

b What is the constant of proportion in the equation $W = 29.4h$?

c What does the constant of proportion mean in this context?

d How much is Archie paid for a week in which he works 37 hours?

e How many hours does Archie need to work to earn $500?

4 Ava uses the electricity she produces from her house's solar panels to charge her electric car. This table shows the distance (R km) she can travel from a charge lasting t hours.

Charge time (t hours)	1	2	3	4
Distance travelled (R km)	15	30	45	60

a Use a sentence to explain how you know that distance travelled, R, and time, t, are in direct proportion.

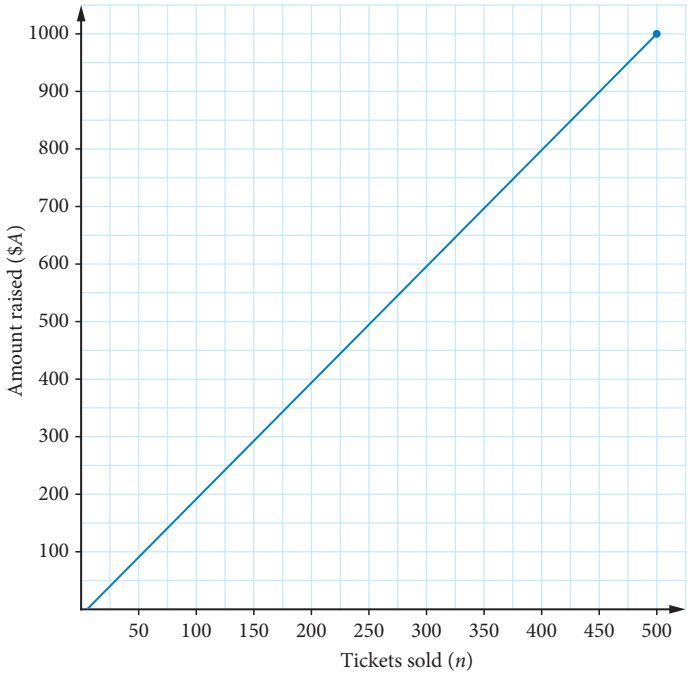
b In the formula $R = kt$, what is the value of k?

c What does this value represent?

d Ava's car can travel 567 km on a maximum charge. How long does it take Ava's car to charge from empty to full using her home solar panels?

e The car manufacturer recommends charging the car to at most 90% of the maximum. Ava's car currently has electricity for 275 km stored in the batteries. How long will it take to charge to the recommended maximum amount using her home solar panels? Answer in hours and minutes. PS

5 Chantelle is organising a raffle for a local mental health charity. Prizes have been donated by local businesses. This graph shows that the amount raised, $\$A$, varies directly with the number of raffle tickets sold, n.



a How much is raised if they sell 200 tickets?

b How many tickets have to be sold to raise \$900?

c How much does 1 ticket cost?

d Write an equation for A (amount raised) in terms of n (number of tickets sold).

e How much will they raise if they sell 1375 tickets?

f The charity needs office supplies valued at \$3200. How many tickets need to be sold to raise this amount?

6 A small car has a fuel consumption of 12.5 km/L. This means the car travels 12.5 km for every 1 L of fuel used.

a Write the direct proportion equation relating distance expected to travel (D) to the amount of fuel used (L).

b Calculate the constant of proportion.

c Write the equation for D in terms of L.

d Use the equation to calculate the distance travelled on 75 L of fuel.

e How many litres are expected to be used to travel 250 km?

f How realistic is this model? What other factors may affect how much fuel a car uses?

7 When we travel overseas, we need to change Australian dollars into local currency. International money conversion is an application of direct proportion.

Three friends travelled from Brisbane to Laos in southeast Asia. This table shows some of their money conversions.

Australian dollars, \$$A$	1	2	10	100			7.69
Laos kip, KP	13 000				20 000	50 000	100 000

a Copy and complete the table.

b Use the table of values to calculate the value of k in the proportion equation $P = kA$.

c Helen changed \$A250 (Australian dollars) into kip. How many kip did she receive?

d The largest Lao note is 100 000 kip. What is the maximum number of 100 000 kip notes Helen could have received for her \$A250?

e When the 3 friends had dinner at a street stall, the total bill was 90 000 kip. Calculate the average price of one meal in Australian dollars, correct to the nearest cent. PS

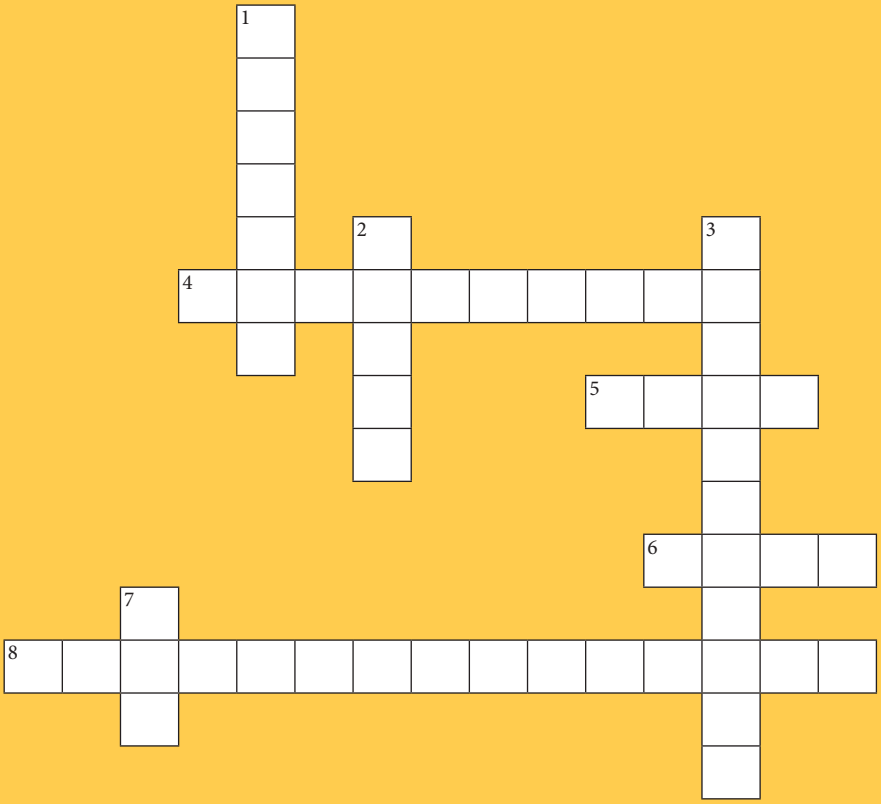
Keyword activity

CLUELESS CROSSWORD

ANSWERS p. 375

Copy this crossword and position the keywords from this chapter in the crossword.
Then write a set of clues for each term in the crossword.

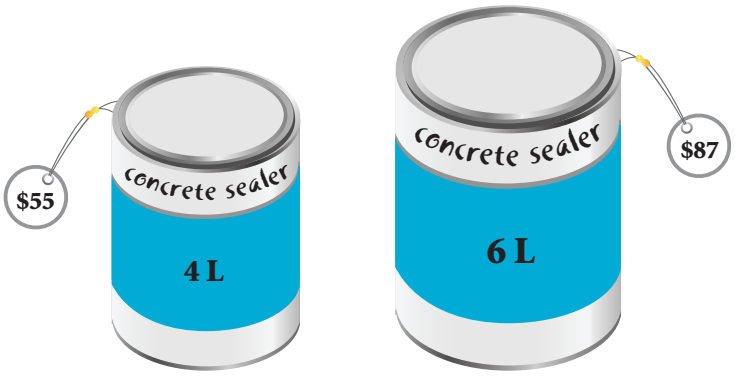
convert	fuel consumption	per	proportion
rate	speed	time	unit pricing



Solution to the chapter problem

Problem

Suzie needs to buy some concrete sealer to seal the bricks in her new garden wall. She needs 24 litres, and the sealer is available in 4 L and 6 L containers.



What is the cheapest way for Suzie to buy the sealer she needs?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	We have to work out the cheapest way to buy the sealer. Cost of one 4 L container is $55. Cost of one 6 L container is $87.
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	Calculate the cost per litre for each container. Cost per litre in the 4 L container = $55 ÷ 4 = $13.75 Cost per litre in the 6 L container = $87 ÷ 6 = $14.50 It is cheaper to buy the sealer in 4 L containers, so 6 × 4 L containers.
STAGE 3: CHECK THE SOLUTION	
 CHECK	Suzie needs 24 L. If she buys 4 L containers, she will need 6. If she buys 6 L containers, she will need 4. Total cost of the sealer in 4 L containers = 6 × $55 = $330 Total cost of the sealer in 6 L containers = 4 × $87 = $348
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	It is cheaper to buy 6 × 4 L containers of sealer.

4 Test yourself

Applying rates

ANSWERS p. 375

1 EXERCISE 4.1 An electrician charged $300 for $2\frac{1}{2}$ hours work. Calculate the rate in dollars per hour.

2 EXERCISE 4.2 Convert a speed of 75 km/h into m/s. Answer to one decimal place.

3 EXERCISE 4.2 Earth travels at approximately 30 km/s in its orbit around the Sun.
What is this speed in km/h?

4 EXERCISE 4.3 The same brand of olive oil is available in 3 sizes.

	Size	Cost
Small	375 mL	$6.80
Medium	750 mL	$13.00
Large	1 L	$18.00

a Calculate the cost per 100 mL in each size.

b Which size is the best value for money?

5 EXERCISE 4.4 Damir charges $\$95/m^2$ to lay marble tiles.
How much will he charge for laying $42\,m^2$ of marble tiles?

6 EXERCISE 4.4 A plumber charges a $60 callout fee, which includes the first 15 minutes.
For calls longer than 15 minutes, he charges an additional $35 per 15 minutes or part thereof.
How much will the plumber charge for a callout that takes 45 minutes?

7 EXERCISE 4.4 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?

8 EXERCISE 4.5 Kim is comparing the fuel consumption of 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 one decimal place.

b Which car is the more fuel-efficient?

9 EXERCISE 4.6 The monthly cost of renting retail space is directly proportional to the area of the floor space. A space of $60\,m^2$ rents for $2700 per month.

a What is the monthly cost to rent $120\,m^2$ of floor space?

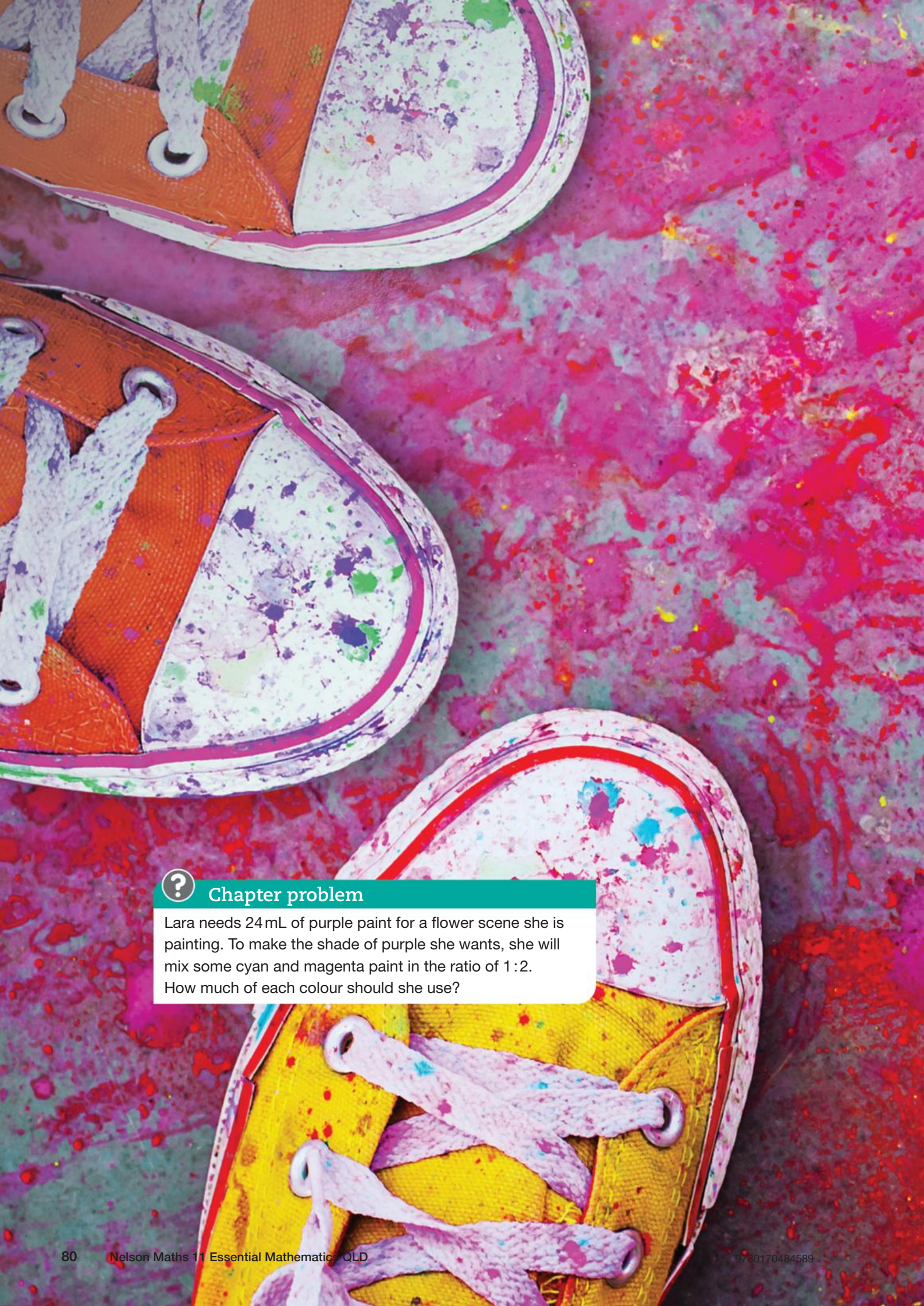
b Write an equation relating the total cost per month ($\$R$) to the area of the floor space ($S\,m^2$).

c Calculate the constant of proportion.

d Write an equation for R in terms of S.

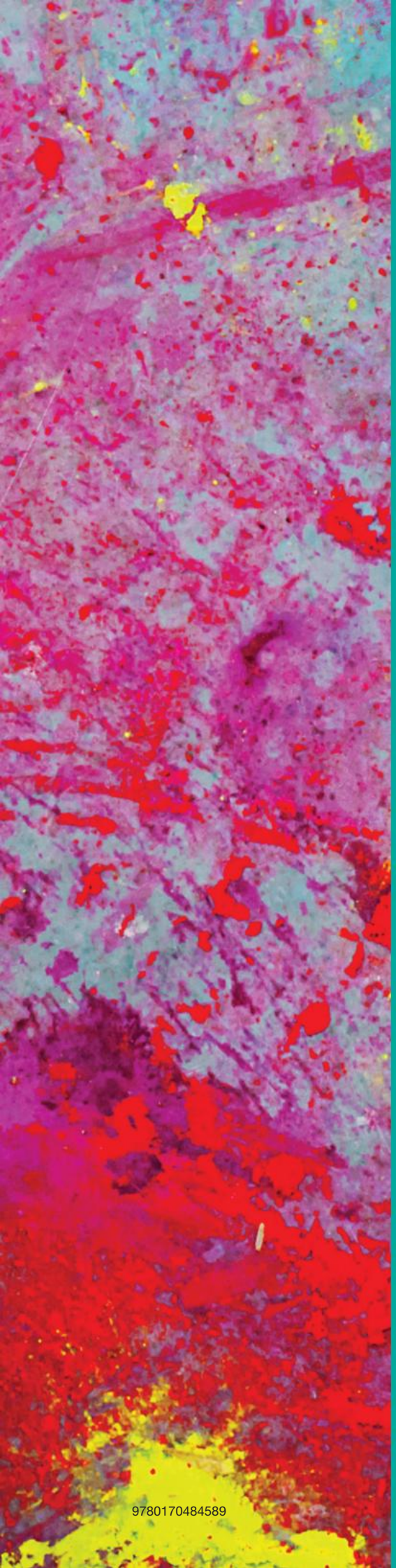
e Calculate the monthly cost of renting a retail space of $850\,m^2$.

f Jamilla pays $7875 per month in rent. How many square metres of retail space does she rent?



Chapter problem

Lara needs 24 mL of purple paint for a flower scene she is painting. To make the shade of purple she wants, she will mix some cyan and magenta paint in the ratio of 1 : 2.
How much of each colour should she use?



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CHAPTER 5

NUMBER, DATA AND MONEY: NUMBER

COLOURFUL RATIOS

Syllabus coverage
Nelson MindTap chapter resources
Terminology
5.1 Ratios
5.2 Mixing paint
5.3 Dividing a quantity in a given ratio*
5.4 Ratios of body parts
5.5 Scale drawings*
Keyword activity
Solution to the chapter problem
Test yourself

* COMPLEX

What will we do in this chapter?

- Understand the meaning of a ratio
- Write and simplify ratios
- Solve problems involving ratios and scales
- Divide an amount in a given ratio
- Use scale ratios in scale drawings

How are we ever going to use this?

- Mixing paint, hair colour and cake ingredients
- Mixing fertiliser, bleach, pesticide and other concentrates
- Interpreting scale drawings, models and plans

9780170484589

Syllabus coverage

UNIT 1, TOPIC 1: NUMBER

Ratios

- Demonstrate an understanding of the fundamental ideas and notation of ratio.
- Understand the relationship between fractions and ratio.
- Express a ratio in simplest form using whole numbers.
- Find the ratio of two quantities in its simplest form.
- Divide a quantity in a given ratio [complex].
- Use ratio to describe simple scales [complex].

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Videos (8):

5.1 Simplifying ratios 1 • Simplifying ratios 2
5.2 Ratio problems 1 • Ratio problems 2
5.3 Dividing a quantity in a given ratio 2 • Dividing a quantity in a given ratio 1
5.5 Scale drawings 1 • Scale drawings 2

Skillsheet (1):

5.1 Ratios

Worksheets (8):

5.1 Simplifying ratios
5.3 Ratios in other contexts • Ratio problems • Calculating quantities in ratios
5.5 Scaled vs actual size • Scales and scale diagrams • Scale drawings
Keyword activity Ratio word blanks

Puzzles (2):

5.1 Ratio match-up puzzle • Ratios code puzzle

Nelson MindTap

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

Terminology

order	ratio	scale	scale drawing	simplify

5.1 Ratios

A **ratio** shows the relative sizes of 2 or more quantities of the same type. Before we can write quantities as a ratio, they must be in the **same units**.

EXAMPLE 1 Writing ratios

Write these ratios.

a 15 cm to 37 cm **b** 59 seconds to 2 minutes

Steps	Working
a Both quantities have the same units, cm.	Ratio is 15 : 37.
b These quantities have different units, so convert 2 minutes to seconds.	2 minutes = 2 × 60 = 120 seconds
Now, both quantities are in seconds.	Ratio is 59 : 120.

Simplifying ratios

To **simplify** a ratio, divide each term in the ratio by the same amount.

EXAMPLE 2 Simplifying ratios

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 ÷ 2 : 6 ÷ 2
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.	= 5 : 3
b Divide both 21 and 7 by 7.	21 : 7 = 21 ÷ 7 : 7 ÷ 7
For 21 $a^{b/c}$ 7 =, the calculator will display 3, which we can write as 3 : 1.	= 3 : 1
c All 3 terms can be divided by 5.	10 : 15 : 20 = 10 ÷ 5 : 15 ÷ 5 : 20 ÷ 5
When there are more than 2 terms in the ratio, we can't use the calculator to simplify.	= 2 : 3 : 4
We should always check our answer to see if it can be simplified further.	

EXERCISE 5.1 Ratios

ANSWERS p. 376

1 EXAMPLE 1 Write these as ratios.

a 13 g to 25 g **b** $17 to $100 **c** 5 L to 12 L

d 150 km to 1 km **e** 31 seconds to 51 seconds to 101 seconds

2 Marianne surveyed the eye colour of the 25 members of her netball club and found that 12 had brown eyes, 8 had blue eyes, 4 had green eyes and one had hazel eyes. Write the ratio of players with:

a hazel eyes to green eyes **b** brown eyes to hazel eyes

c blue eyes to brown eyes **d** brown eyes : green eyes

e blue eyes : brown eyes : hazel eyes **f** green eyes to blue eyes to brown eyes.

Videos
Simplifying ratios 1
Simplifying ratios 2
Skillsheet
Ratios
Worksheet
Simplifying ratios
Puzzles
Ratio match-up puzzle
Ratios code puzzle

3 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?

4 Of the 75 people who attended a bush dance, 27 were men, 29 were women and the remainder were children. Find the following ratios.

a men to women

b children to men

c women to the total

d women to children

e men to women to children

5 Write these as ratios.

a 3 cents to $2.50

b 23 mm to 3 cm

c 37 minutes to 2 hours

d 10 years to 36 months

e 14 days to 5 weeks

f 0.3 km to 173 metres

6 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

Be sure to write the colours in the same order as the ratio is written.

7 EXAMPLE 2 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

8 Simplify each ratio using your calculator.

a 4.5:9

b 1.8:2.7

c $2\frac{1}{2}:7\frac{1}{2}$

d $14:3\frac{1}{2}$

e $\frac{1}{2}:\frac{3}{4}$

f 2.9:5.8

g 3.5:2.1

h 3.6:1.2

9 Karen uses a soil conditioning solution on her vegetable garden. The ingredients are listed on the label shown.

FERTILISER	
Ingredients	
Seaweed extract	135 mL
Organic acid	45 mL
Water	900 mL

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.

10 These tables show the average annual yield in kilograms from various fruit and nut trees.

Apple	144
Apricot	36
Pear	54

Nectarine	63
Fig	9
Walnut	27

What is the yield ratio of

a apple to pear?

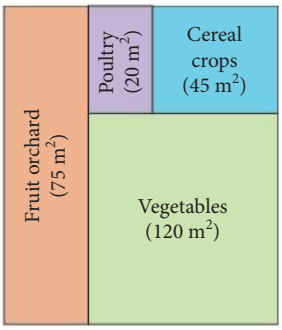
b nectarines to walnuts?

c apricot to apple?

d pear to fig?

e apples to nectarines to figs?

11 Sebastian runs a small gourmet business producing specialty fruits, vegetables and cereal products. He also has poultry 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 egg 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.

12 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?

5.2 Mixing paint

Videos
Ratio problems 1
Ratio problems 2

Laura 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 will be wrong and she wastes paint.

Laura 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.



EXAMPLE 3 Ratios of paint 1

Laura 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 4 Ratios of paint 2

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. 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
Write the brown amount first.	brown : white = 10 mL : 8000 mL
	= 10 : 8000
Simplify the ratio.	= 1 : 800

EXERCISE 5.2 Mixing paint

ANSWERS p. 376

1 EXAMPLE 3 Laura mixed 5 mL of red with 9 mL of green paint to make brown to create a painting of some trees.

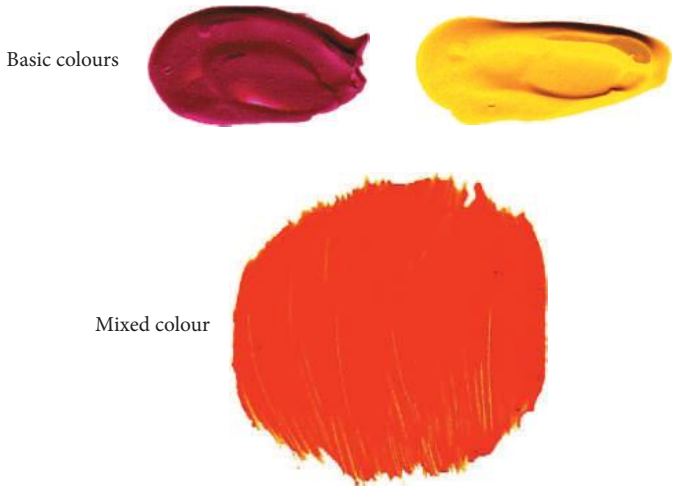
- **a** What is the ratio of green to red paint in the brown mixture?
- **b** What fraction of the brown paint is red?

2 Laura 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 Laura made 2 containers of orange paint by mixing red and yellow. She mixed 20 mL of red with 40 mL of 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?



4 EXAMPLE 4 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.



iStock.com/Highwaystarz-Photography

5 Laura wants 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 Laura makes colours lighter by mixing them with white; the more white, the lighter the colour. Here are 4 shades of blue Laura 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 Laura 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 Laura makes different shades of pink paint by mixing red and white, as shown in the below table. Calculate the amount of white paint Laura should add to 5 mL of red to produce each shade of pink.

	Colour sample	Ratio red : white
a		1 : 1
b		1 : 2
c		1 : 3
d		1 : 4

9 Compared to adults, children have larger 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 Sienna 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 Sienna 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 Sienna make PS

i the man's head? **ii** the son's height?

10 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 one pound coin.



KenDrysdale/Shutterstock.com

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.

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 millilitres 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).


CapturePB/Shutterstock.com

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. For what type of weed will she use this spray?

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 below. 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

5.3 Dividing a quantity in a given ratio*

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.

Videos
Dividing a quantity in a given ratio 2
Dividing a quantity in a given ratio 1

Worksheets
Ratios in other contexts
Ratio problems
Calculating quantities in ratios

EXAMPLE 5 Dividing a quantity in a ratio 1

Laura 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
5 parts red, 1 part white and 2 parts green makes 8 parts.	5 + 1 + 2 = 8 parts 8 parts make up 10 L.
Find the size of one part by dividing 10 L by 8.	1 part = 10 ÷ 8 = 1.25 L
For each colour, multiply by the appropriate number of parts.	amount of red = 5 × 1.25 (5 parts) = 6.25 L amount of white = 1.25 L (1 part) amount of green = 2 × 1.25 (2 parts) = 2.5 L
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 6 Dividing a quantity in a ratio 2

Tanika and Daniel 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.	Tanika's share = 2 × $27 000 = $54 000 Daniel's share = 3 × $27 000 = $81 000
Check that the parts add up to the whole.	$54 000 + $81 000 = $135 000 ✓ Correct!

EXERCISE 5.3 Dividing a quantity in a given ratio*

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1 EXAMPLE 5 Laura 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 Tranni 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. Tranni requires 12 mL of this colour. How much red, white and yellow paint should she mix together?



4 Moe needs 140 mL of a golden paint for the sand dunes in an outback scene. He will make the colour by mixing red, yellow and white in the ratio of 1 : 4 : 2. How much of each colour will he need? PS

5 At the end of each painting session, Dale cleans his equipment with commercial cleaner. He needs to dilute the concentrated cleaner with water in the ratio of 1 : 9. How much concentrate will he need to make 4 L of diluted cleaner? PS

6 EXAMPLE 6 Lexi sells her paintings in an art gallery. Lexi and her agent share the sale price in the ratio of 1 : 7. How much did Lexi 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 these ratios.

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 g piece of rose gold jewellery?

b A flute made of rose gold weighs 420 g. 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 two 225 mL mocktails?

b How much mineral water does Sam use to make 900 mL of the mocktail?

c How many millilitres of cranberry juice does this mixture require?



Wavebreakmedia/Shutterstock.com

Chapter problem

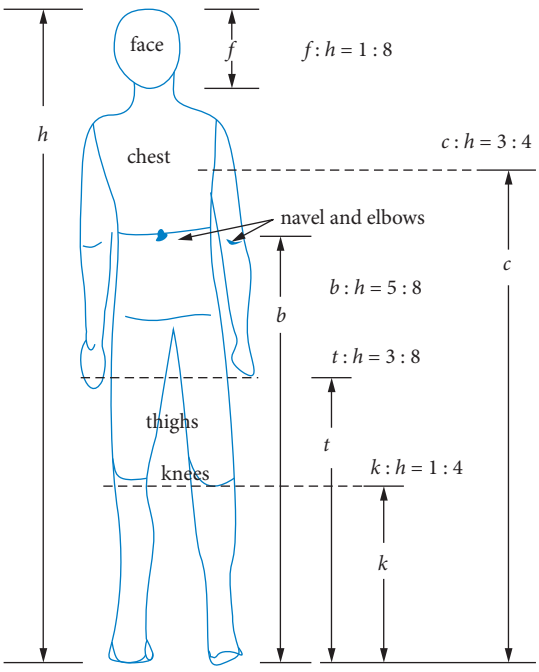
You've covered the skills required to solve the chapter problem. Can you solve it now?

5.4 Ratios of body parts

Artists use body part ratios to make sketches of people look realistic. The diagram shows some of the important ratios for sketching images of adults.

Men and women's bodies have a different shape. Women's necks and waists are thinner, while their hips and thighs are wider. This table shows some of the ratios that are different in 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



EXAMPLE 7 Ratios of body parts

Kye is sketching an adult male. His sketch will be 20 cm tall. In his sketch, how big should he make each of the following features?

a the man's head length **b** the height of his chest **c** the width of his shoulders

Steps	Working
a $f:h = 1:8$ from the diagram. A person's head length is $\frac{1}{8}$ of their height. Height in sketch = 20 cm.	head length $= \frac{1}{8} \times 20$ $= 2.5$ cm
b $c:h = 3:4$ from the diagram. A person's chest height is $\frac{3}{4}$ of their height.	chest height $= \frac{3}{4} \times 20$ $= 15$ cm
c Shoulder width : head length = 7 : 3. His shoulder width is $\frac{7}{3}$ times the length of his head (2.5 cm from part **a**).	shoulder width $= \frac{7}{3} \times 2.5$ $= 5\frac{5}{6}$ cm

EXERCISE 5.4 Ratios of body parts

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1 EXAMPLE 7 Kye is going to make a sketch of a man 12 cm tall. Calculate the size of each body part on the sketch.

a length of head
b height of knees
c height of mid-thighs and fingertips
d height of navel and elbows
e height of chest
f width of shoulders
g width of hips

2 In the same sketch, Kye is going to draw a woman 10 cm tall. Calculate the size of each body part on the sketch.

a length of head
b height of knees
c height of mid-thighs and fingertips
d height of navel and elbows
e height of chest
f width of shoulders
g width of hips

3 Use the answers to questions **1** and **2** to sketch a drawing of the man and woman.

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 screen. 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 could have in your TV room?



Erik Reis/123 RF

5.5 Scale drawings*

A **scale drawing** is a reduced or enlarged diagram of a real object, whose lengths are in the same ratio as the actual lengths of the object. The **scale** on a scale drawing can be given as a statement (for example, 1 cm represents 5 m) or as a ratio (for example, 1 : 500).

The most common scale drawings are maps and house plans. By taking measurements on the scale drawing, we can calculate the size of objects in real life using the scale given on the diagram.

Calculating a real length

To calculate a real length on a scale drawing:

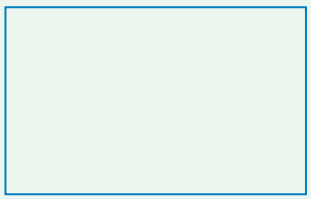
- measure the scaled length on the scale drawing
- multiply by the scale factor
- convert your answer to the required units if necessary.

EXAMPLE 8 Scale drawings 1

Barry, a farmer, used a scale of 1 cm : 100 m when he drew this scale drawing of one of his paddocks.

a What are the actual dimensions of Barry's paddock?

b Express the scale as a ratio.



Steps	Working
a Measure the scaled length.	scaled length = 4 cm
Multiply by 100 m.	actual length = 4 × 100 m = 400 m
Measure the scaled width and multiply by 100 cm.	scaled width = 2.5 cm
	actual width = 2.5 × 100 m = 250 m
b Change 100 m to centimetres, then simplify.	scale = 1 cm : 100 m = 1 cm : 100 × 100 cm = 1 cm : 10 000 cm = 1 : 10 000

EXAMPLE 9 Scale drawings 2

Olga, an architect, made a scale drawing of a house using a scale of 1 : 50.

a The actual length of the house is 20 m. What is the length of the house in the drawing?

b The width of the house in the drawing is 24 cm. What is the actual width of the house?

Steps	Working
a Convert 20 m to cm first.	actual length = 20 m = 2000 cm
Divide by 50 for the scaled length.	scaled length = 2000 cm ÷ 50 = 40 cm
b Multiply by 50 for the actual width.	scaled width = 24 cm
	actual width = 24 × 50 cm = 1200 cm = 12 m

Videos
Scale drawings 1
Scale drawings 2

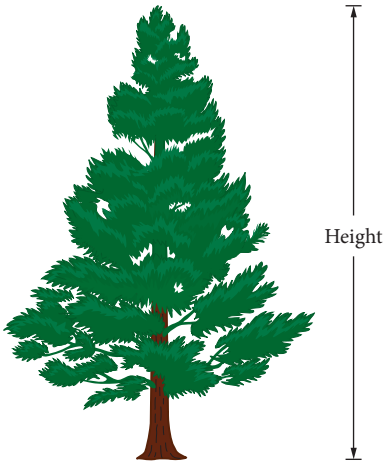
Worksheets
Scaled vs actual size
Scales and scale diagrams
Scale drawings

EXERCISE 5.5 Scale drawings*

ANSWERS p. 376

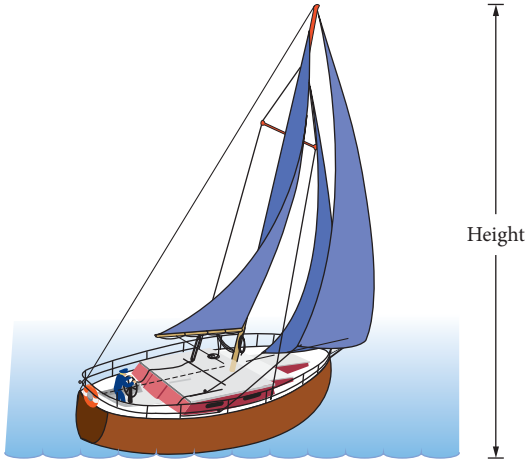
1 EXAMPLE 8 For each scale drawing, find the actual length shown by measurement and calculation, then express each scale as a ratio.

a



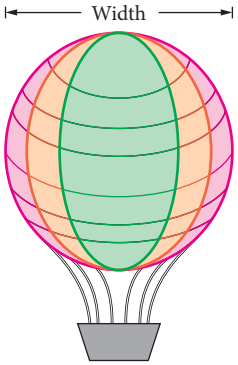
Scale:
1 cm represents 2 m

b



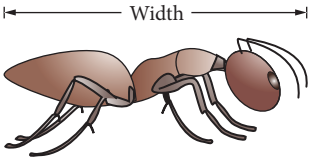
Scale: 1 cm represents 5 m

c



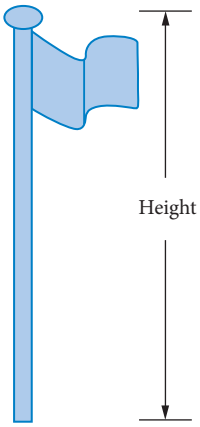
Scale: 1 cm represents 1.5 m

d



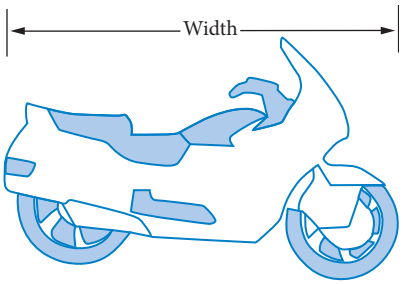
Scale: 1 cm represents 5 mm

e



Scale: 1 cm represents 3 m

f



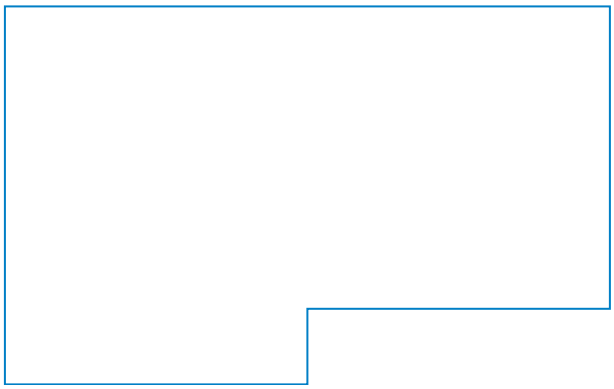
Scale: 1 cm represents 40 cm

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2 A street map uses a scale such that 1 cm represents 200 m. Lily walks from the Town Hall to the shopping centre, a distance that measures 5.5 cm on the map. How far does she walk?

3 Yifei has a model of his favourite yacht in his study. The model has been made on a scale such that 2 cm represents 1 m. The model is 50 cm long. How long is the yacht?

4 EXAMPLE 9 Nagala used a scale of 1 : 50 when she constructed a scale drawing of her courtyard.



Find the length and width of Nagala's courtyard in metres.

5 Measure the length of each scaled image below, then use the scale ratio to calculate its actual length.

a Fish 1 : 3



Andrew Burgess/Shutterstock.com

b House 1 : 300



Alexmisu/Shutterstock.com

c Pen 1 : 4



Anton Starikov/ Shutterstock.com

d Tennis racquet 1 : 16

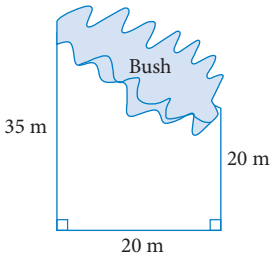


Wabeno/Shutterstock.com

6 Lena collects model cars. Her favourite model is made in the ratio 1 : 43 and measures 9.3 cm long. Calculate the actual length of the car to the nearest metre.

7 A map has a scale of 1 : 50 000. Dean has to travel a distance measured as 128 mm on the map. How far does Dean have to travel? Express your answer in kilometres.

8 Ryan is constructing a fence through the bush at the end of his block of land. He draws a scale drawing with the scale 2 cm : 5 m. C PS



a Write this scale as a simplified ratio.

b How long will the lengths marked 20 m and 35 m be on the scale diagram?

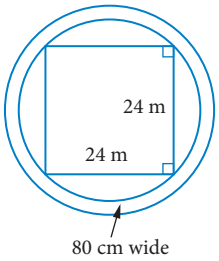
c Accurately construct a scale drawing of Ryan's land.

d Determine the length of the fence through the bush.

e Suggest another way you could calculate the length of the fence without using a scale diagram.

9 Nelson Springs Council plans to build an exercise area inside Thomson Park, which is a square of length 36 m. The exercise area containing outdoor gym equipment is also a square, of length 24 m, surrounded by a circular jogging track 80 cm wide, as shown in the diagram.

Use a scale drawing to calculate the diameter of the outer circle to determine whether the planned exercise area will fit inside the park. C PS



Worksheet
Ratio word blanks

Keyword activity

IN YOUR OWN WORDS

1. Explain in your own words what you have to do when a question tells you to **simplify**.
2. Describe the process involved in dividing a quantity in a ratio.
3. Explain the difference between a **ratio** and a **rate**.
4. Describe how to calculate the real-life length in a scale drawing.

Solution to the chapter problem

Problem

Lara needs 24 mL of purple paint for a flower scene she is painting. To make the shade of purple she wants, she will mix some cyan and magenta paint in the ratio of 1 : 2. How much of each colour should she use?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	To find paint quantities to mix. We know the ratio is 1 : 2 (cyan : magenta). Total amount of paint required is 24 mL.
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	There's a word clue: in a ratio → divide Lara needs 1 part cyan to 2 parts magenta. That's 3 parts. Each part will be 24 mL ÷ 3 = 8 mL. Lara will need 8 mL of cyan and 16 mL of magenta.
STAGE 3: CHECK THE SOLUTION	
 CHECK	8 mL + 16 mL = 24 mL and there's twice as much magenta. ✓ Correct!
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	Lara needs 8 mL cyan and 16 mL magenta.

5 Test yourself

Colourful ratios

ANSWERS p. 377

1 EXERCISE 5.1 Phoebe 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?

2 EXERCISE 5.1 Simplify each ratio.

a 10 : 25 **b** 8 : 4 **c** 50 : 20 **d** 300 : 500

3 EXERCISE 5.2 A recipe for making pizza dough mixes plain flour and water in the ratio 8 : 5. Jasmine uses 400 g of flour to make pizza. How much water does she add?

4 EXERCISE 5.2 Lara is mixing yellow and red paint in the ratio of 4 : 1. She is using 12 mL of yellow. How much red should she add?

5 EXERCISE 5.3

a Divide $80 between Manal and Eddie in the ratio of 4 : 1.

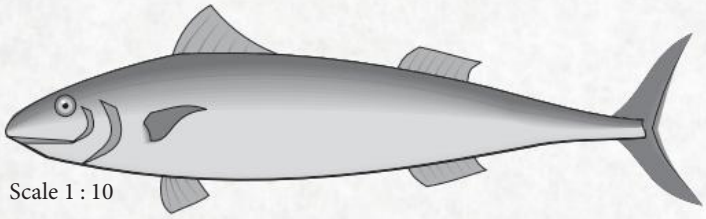
b Divide 72 km in the ratio of 1 : 2.

6 EXERCISE 5.3 Lara needs 24 mL of a shade of blue that is obtained by mixing blue, green and white in the ratio of 3 : 2 : 1. How much of each colour should she use?

7 EXERCISE 5.4 The ratio of the length of a man's head to his total height is 1 : 8. Lara is sketching a man and makes his head 6 mm long. How long should she make the rest of his body?

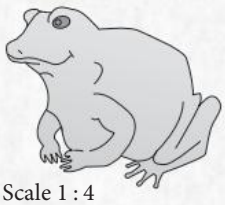
8 EXERCISE 5.5 Measure the length of each drawing and use the scale to find the actual length.

a



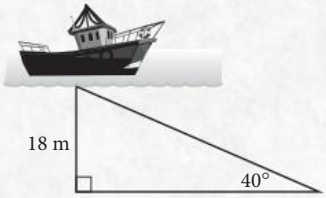
Scale 1 : 10

b



Scale 1 : 4

9 EXERCISE 5.5 Roman anchors his fishing boat at a part of the lake that is 18 m deep. The angle the anchor chain makes with the bottom of the lake is 40°. Use a scale diagram to determine the length of the anchor chain, correct to the nearest metre.



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Practice set 1

ANSWERS p. 377

Section A Multiple choice questions

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

1 EXERCISE 5.1 Which ratio below is NOT equivalent to 32 : 48?

A 16 : 24 **B** 4 : 6 **C** 2 : 3 **D** 6 : 8

2 EXERCISE 1.3 Andrew's bank account balance was −$44, meaning he owed the bank $44. He deposited $120 into his account. What is his balance after the deposit?

A $164 **B** $76 **C** $74 **D** $64

3 EXERCISE 4.1 The cost of sending a parcel weighing 5.5 kg to Malaysia is $88. What is the postage rate?

A $0.07/kg **B** $1.60/kg **C** $16/kg **D** $484/kg

4 EXERCISE 2.2 In one season, a soccer team scored 20 goals. Kirsten scored 4 of them. What is this as a percentage of all the goals the team scored?

A 4% **B** 5% **C** 20% **D** 40%

5 EXERCISE 5.3 Alison and Elena buy a length of material and divide it between themselves in the ratio 2 : 3. Alison has 3.6 m. What length of material does Elena have?

A 9 m **B** 5.4 m **C** 2.4 m **D** 1.8 m

6 EXERCISE 1.7 Which of the decimals below can be rounded to 6.74?

A 6.7349 **B** 6.732 **C** 6.7452 **D** 6.744

7 EXERCISE 2.3 A department store has a mark-up of 200% on clothing. The store buys a vest for $12. What will be its selling price after the mark-up?

A $24 **B** $36 **C** $212 **D** $224

8 EXERCISE 4.3 Tuna cat food is sold in 4 different packs. Which pack is the cheapest price per 100 g?

A 24 × 250 g cans for $39.99 **B** 12 × 300 g cans for $24.99

C 9 × 400 g cans for $25.99 **D** 6 × 1 kg cans for $38.50

Section B Short answer questions

1 EXERCISE 4.4 A tap drips water at a rate of 18 mL/h. How much water is wasted from these drips over a week?

2 EXERCISE 2.1 Find:

a 2% of 250 kg **b** 75% of $150 000

c 80% of 4 hours (in minutes) **d** 18% of 36 L (in mL)

3 EXERCISE 1.4 Evaluate each expression.

a $2 + (13 - 6) \times 11$ **b** $\dfrac{8-3}{100 \div 4}$

c $14 - 5 \times (-3)$ **d** $\dfrac{4^2}{16 \div (-2)}$

4 EXERCISE 2.2 What percentage is:

a 69 out of 75?

b 9 mm out of 300 mm?

c 300 g of 2 kg?

d 6 h of 1 day?

5 EXERCISE 1.7 Round each quantity to the nearest whole number.

a 85.4 m **b** 16.9 kg **c** $9.80

6 EXERCISES 5.2, 5.3 Nada likes to mix a paint colour called Spring Green. She mixes blue and yellow paint in the ratio 5 : 3. How much blue paint does Nada use to make a 4-litre can of Spring Green? Give your answer in millilitres.

7 EXERCISE 4.5 Junko's car uses diesel fuel and has a fuel consumption of 7.4 L/100 km.

a How far can Junko travel on 50 L of diesel fuel? Answer to the nearest 5 km.

b Diesel costs 209.9 c/L. How much does it cost Junko to put 50 L of diesel fuel into her car?

8 EXERCISE 2.4 At the end-of-financial-year sale, a car yard offers an 18% discount on all cars. Calculate the price of a car marked at $29 990, correct to the nearest dollar.

9 EXERCISE 5.4 For an adult male, the ratio of the length of his head to his height is 1 : 8. Police found an adult male skull in scrubland measuring 21.5 cm long. What was the approximate height of the man?

10 EXERCISE 2.5 Terry and Andrea purchased a block of land for $133 000. Six years later they sell it for $164 000. Calculate their percentage profit, correct to 2 decimal places.

11 EXERCISE 4.2 A large vat is being filled at the rate of 350 mL/min. Convert this to a rate in L/day.

12 EXERCISE 4.6 Lenka is making necklaces with beads, and she must thread 765 beads onto the yarn. She measured that a piece of yarn 5 cm long holds 45 beads.

a How many beads would be on 15 cm of yarn?

b Copy and complete this table of values.

Length of yarn (L cm)	0	5	10	15	20	25	30
Number of beads (B)	0	45					

c Write the direct proportion equation relating B to L.

d Find the constant of proportion.

e Write the equation for L in terms of B.

f How long will a thread holding 765 beads be?



Chapter problem

Gemma works in retail fashion. She buys clothing from wholesalers and manufacturers to sell in her company's shops. Company policy is to sell items at a price that is 150% higher than the cost price before adding GST.

Gemma orders a selection of shirts that cost $32 each. She believes she can sell them for $82.50 including GST. Does this price comply with company policy?



iStock.com/monkeybusinessimages

CHAPTER 6

NUMBER, DATA AND MONEY: NUMBER

APPLYING PERCENTAGES

Syllabus coverage
Nelson MindTap chapter resources
Terminology
6.1 Finding a percentage of a quantity
6.2 Comparing quantities using percentages
6.3 Goods and services tax (GST)*
6.4 Percentage after percentage*
6.5 Percentage problems
Keyword activity
Solution to the chapter problem
Test yourself
* COMPLEX

What will we do in this chapter?

- Calculate a percentage of an amount
- Calculate one amount as a percentage of another
- Calculate GST
- Apply repeated percentage increases and decreases to a given amount
- Solve problems involving percentages

How are we ever going to use this?

- Understanding how GST works and how to calculate it
- Making comparisons of content in food
- Calculating increases in the prices of items or discounts when shopping

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Syllabus coverage

UNIT 1, TOPIC 1: NUMBER

Percentages

- Calculate a percentage of a given amount.
- Determine one amount expressed as a percentage of another for same units.
- Determine one amount expressed as a percentage of another for different units [complex].
- Apply percentage increases and decreases in real-world contexts, including mark-ups, discounts and GST [complex].
- Determine the overall change in a quantity following repeated percentage changes [complex].

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, p. 15
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Videos (2):
6.3 GST • Discounts and GST

Worksheets (2):
6.5 Working with percentages • Percentage problems

Puzzle (1):
Keyword activity Percentages find-a-word

Nelson MindTap

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

Terminology

cost price	discount	GST	selling price

6.1 Finding a percentage of a quantity

Remember from Chapter 2:

Percentage of a quantity

$$\text{percentage of a quantity} = \frac{\text{percentage}}{100} \times \text{quantity}$$

OR

$$= \text{percentage} \div 100 \times \text{quantity}$$

EXAMPLE 1 Percentage of a quantity

Find:

'of' means multiply.

a 74% of \$63

b 40% of 2 km

Steps	Working
a Write the percentage as a decimal (or fraction) and then multiply by the quantity.	74% of \$63 = 0.74 × \$63 = \$46.62
b First convert 2 km to metres. Calculate the percentage.	2 km = 2 × 1000 = 2000 m 40% of 2 km = 0.4 × 2000 m = 800 m

EXERCISE 6.1 Finding a percentage of a quantity

ANSWERS p. 377

1 EXAMPLE 1 Find the percentage of each quantity.

a 12% of \$125

b 50% of 88 000 people

c 7.5% of 14 kg

d 27% of 3000 letters

e 62.5% of 1200 m^2

f 150% of 32 L

g 71% of 84 600

h 5% of 120 min

i 0.4% of \$5270

j $6\frac{1}{4}$% of 960 people

2 Larissa went to Hong Kong for 28 days for a holiday. It rained on 25% of the days.

a On how many days did it rain during Larissa's holiday?

b How many days were fine?

3 In July, 93 700 new cars were sold in Australia. Of these, 27% were sold in Queensland. How many new cars were sold in Queensland in July?

4 Josephine earns \$97.50 per week from her part-time job. She decides to save 30% of her income so she can go on a holiday at the end of Year 12.

a How much does she save each week? Round your answer to the nearest dollar.

b Josephine is given a 2.5% wage increase. How much extra does she earn each week? Round your answer to the nearest cent.

5 Brandon pays \$225 per week in rent for his share of a house. The landlord decides to increase the rent by 4%.

a How much extra rent will Brandon have to pay each week?

b What is the total amount of rent he will have to pay per week?

6 At Vanna's school, 85% of Year 11 students have a smartphone. There are 133 students in Year 11. How many have smartphones? Give your answer correct to the nearest whole number.

7 New vehicle registration duty is a tax paid to the state government when you purchase a new car. In Queensland, it is 3% of the purchase price of the car. Simone buys a new car for $29 990. How much new vehicle registration duty will she pay?

8 An aircraft can seat 350 passengers. The plane flies from Brisbane to Perth with 82% of the seats occupied. How many passengers were on the plane?



Matej Kastelic/Shutterstock.com

9 Australia has approximately 800 000 km of roads. Approximately 40.5% of Australian roads are sealed with bitumen or concrete. All other roads are gravel, sand or dirt.

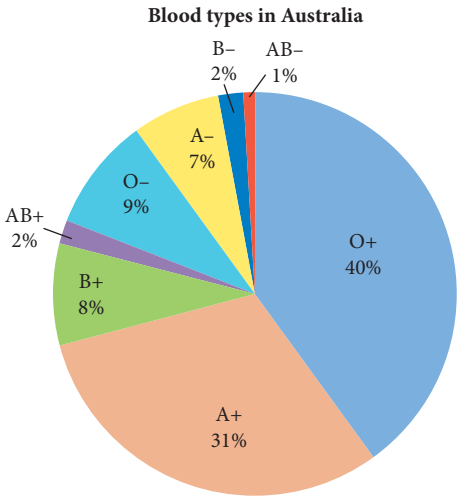
a How many kilometres of Australian roads are sealed?

b Of the roads that are not sealed, approximately 66% are improved surfaces. How many kilometres of improved surface roads are there?

10 **a** Approximately 5% of Australians suffer from arachnophobia, the fear of spiders. In a school of 1200 students, how many students would you expect to suffer from arachnophobia?

b Necrophobia is the fear of death. When Kara interviewed 700 people, she found 11% of them had a fear of death. How many of the people Kara interviewed suffer from necrophobia?

11 This pie graph shows the percentages of each blood type in the Australian population of 24 835 000. Calculate the number of people with each blood type.



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Investigation Blood types around the world

Is the percentage of people with the different blood types the same in all countries and continents?

What you have to do

Choose a country from each region below and research the percentages of people in the country that have each blood type.

- Europe
- Asia
- North America
- South America
- Africa
- Middle East

Copy and complete the table below to summarise your results. For each country, write in the percentages of each blood type. Add some extra countries of your choice if you like.

Country	A+	B+	AB+	O+	A–	B–	AB–	O–

Write a paragraph describing the similarities and differences in the percentages of blood types between different countries. How do other countries compare with Australia?

6.2 Comparing quantities using percentages

Expressing an amount as a percentage

$$\text{percentage} = \frac{\text{amount}}{\text{whole amount}} \times 100\%$$

OR

$$= \text{amount} \div \text{whole amount} \times 100\%$$

EXAMPLE 2 Expressing amounts as percentages 1

Express a test mark of 27 out of 45 as a percentage.

Steps	Working
Write the result as a fraction and multiply by 100%.	$\frac{27}{45} \times 100\% = 60\%$

Sometimes, we have to change the units so they are the same before we can find the percentage.

EXAMPLE 3 Expressing amounts as percentages 2

What percentage of 2 days is 12 hours?

If you are having trouble knowing which amount to write on the bottom of the fraction, look for the number following the word 'of'.

Steps	Working
Change 2 days into hours.	2 days = 2 × 24 hours = 48 hours
Write as a fraction and multiply by 100%.	$\frac{12}{48} \times 100 = 25\%$
Write your answer.	12 hours is 25% of 2 days.

EXERCISE 6.2 Comparing quantities using percentages

ANSWERS p. 377

1 EXAMPLE 2 Express each test mark as a percentage.

a 17 out of 20

b 51 out of 60

c 14 out of 35

d 105 out of 140

2 Eliza scored the following marks for her Year 11 exams.

English:	43 out of 80	Science:	26 out of 40
Mathematics:	69 out of 85	Business Studies:	59 out of 70
Design:	38 out of 65	Health:	34 out of 45

a Calculate each test mark as a percentage. Give your answers correct to 2 decimal places.

b Rank Eliza's achievement in subjects from highest to lowest.

3 Over the last 3 basketball matches, Tiago was successful with 18 shots out of 33 attempts, while Luke was successful with 23 shots out of 37 attempts.

Who was more successful? Justify your answer.



Image Source Limited/Alamy Stock Photo

4 Which food has the higher percentage of sugar in it?

- muesli bars with 11 g of sugar in a 35 g bar

OR

- jam with 9.8 g of sugar in a 20 g serving

5 Colombia has an area of 1 141 748 km^2, of which 100 210 km^2 is water.

Iran has an area of 1 648 195 km^2, of which 116 600 km^2 is water.

a Calculate the percentage of area covered by water for each country. Give your answer correct to 2 decimal places.

b Which country has a higher percentage of water?

c Why might the percentage of water be important?

6 EXAMPLE 3 For each pair of measurements, find the first quantity as a percentage of the second.

Remember to express both quantities in the same units first.

a 3 minutes, 1 hour

b 75 mm, 20 cm

c 400 g, 32 kg

d 18 hours, 3 days

7 Jo exercises at the local gym 3 times a week. The table shows how much time Jo spent swimming and her total exercise time for her 3 visits last week.

	Swimming	Total exercise time
Monday	20 minutes	1 hour 10 minutes
Wednesday	35 minutes	1 hours 40 minutes
Saturday	45 minutes	2 hours 30 minutes

a Calculate the percentage of exercise time spent swimming on each visit. Give your answers correct to one decimal place.

b On which day did Joanne spend the highest percentage of her time swimming?

c Calculate the percentage of exercise time spent swimming for the week.

8 Which of the following cocktails has the higher percentage of alcohol?

- 750 mL of alcohol in a jug of 3 L

OR

- 320 mL of alcohol in a bottle of 1.2 L

9 Two cricket players score at the following rates:

- Clarkson hit 82 runs off 68 balls
- Bailden hit 48 runs off 38 balls

a Calculate the strike rate for each player, correct to one decimal place.

$$\text{strike rate} = \frac{\text{runs}}{\text{balls}} \times 100\%$$

b Who is the better player, based on these figures?

10 Which state has the higher rate of stamp duty payable on new cars? PS

- Victoria, $1230 stamp duty on a car purchase of $41 000
- Western Australia, $522.50 stamp duty on a car purchase of $19 000



iStock.com/shaunl

Investigation — Stamp duty when buying a house

When you buy a house, you pay the state government a tax called **stamp duty**. In this investigation, you will find out the different rates for stamp duty in Australia.

What you have to do

- Search the internet for an online calculator for stamp duty for house purchases.
- Suppose you are buying a $580 000 house and you are not a first home buyer. Use the online calculator to find the amount of stamp duty paid for each state/territory in Australia. Write this information down.
- Calculate the percentage rate used in each state/territory.
- Which state/territory has the lowest stamp duty? Which has the highest?
- What is the difference between the lowest and the highest stamp duty?
- Why do you think the states and territories charge different amounts of stamp duty?

$$\text{rate} = \frac{\text{stamp duty}}{\text{home price}} \times 100\%$$

Videos
GST
Discounts and GST

6.3 Goods and services tax (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 4 Prices including GST

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 10% 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 5 Calculating GST

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 6.3 Goods and services tax (GST)*

ANSWERS p. 377

1 EXAMPLE 4 Without GST the price of a pair of shoes is $46.

a Calculate the amount of GST (at 10%) that must 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 the 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**

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4 EXAMPLE 5 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 L of petrol	$1.65	**g**	**h**
A haircut	$22	**i**	**j**

6 Businesses registered for GST can have the GST for items they purchase refunded. Safia's new business car cost $57 200 including GST. Calculate the value of her GST refund.

7 Tibor designed a spreadsheet to help him calculate GST-free prices quickly.

	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				

Source: Microsoft Corporation

What formulas could be used in cells C4 and C5?

8 Wang is registered to charge 10% GST on all services his business provides. At the end of every 3 months, Wang must 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 report that the Australian Government is going to increase the rate of GST. If the rate was to increase from 10% to 15%, what would be the new GST-inclusive price of a suit with a 10% GST-inclusive price of $286? PS

Investigation Which supermarket items do not have GST?

The prices of some supermarket items do not include GST. For example, a hot BBQ chicken has a GST but a cold packaged raw 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?

Chapter problem

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

6.4 Percentage after percentage*

In some situations, we may need to calculate one percentage after another; for example, buying something on sale with an additional discount for cash or for paying your bill on time. In this situation, we need to remember to do each percentage calculation separately.

EXAMPLE 6 Repeated percentage discounts 1

Jodie buys a new dress priced at $189 during a '20% off' sale.

a How much discount does she receive on the dress?

b What price does Jodie pay for the dress?

c At the checkout, the cashier says there is an additional 5% off the discounted price if she pays cash. How much would this additional discount be?

d What is the final price of the dress if Jodie pays cash?

e Is this equal to 25% off the original price? Justify your answer with a calculation.

Steps	Working
a Calculate 20% of $189.	discount = 0.2 × $189 = $37.80
b Discount price = original price – discount	discount price = $189 – $37.80 = $151.20
c Calculate 5% of $151.20.	discount = 0.05 × $151.20 = $7.56 The additional discount is $7.56.
d Final price = discount price – discount	final price = $151.20 – $7.56 = $143.64 The final price of the dress is $143.64.
e Calculate 25% of $189. Subtract this discount from the original price and compare with $143.64.	0.25 × $189 = 47.25 $189 – $47.25 = $141.75 No, $143.64 is not the same as a 25% discount. A 25% discount is larger.

We saw in Example 6 that we can't just add the percentages together and find a single percentage. However, we can find a single percentage that is equivalent to one percentage followed by another.

EXAMPLE 7 Repeated percentage discounts 2

The Paint Palace offers a 25% trade discount to builders and a further 5% discount if the account is paid within 10 days. Chris is a builder. He purchased $840 worth of paint and paid the account within 10 days.

a How much did he pay for the paint?

b What single discount is equivalent to a 25% discount followed by a 5% discount?



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Steps	Working
a First, calculate the trade discount.	trade discount = 25% × $840 = $210
Then calculate the discounted price.	trade price = $840 − $210 = $630
Then calculate the further discount.	further discount = 5% × $630 = $31.50
Calculate the final price.	final price = $630 − $31.50 = $598.50
b Find the total discount.	total discount = $210 + $31.50 = $241.50
The percentage discount is $\frac{\text{total discount}}{\text{original price}} \times 100\%$	percentage discount = $\frac{\$241.50}{\$840} \times 100$ = 28.75%

EXERCISE 6.4 Percentage after percentage*

ANSWERS p. 377

1 EXAMPLE 6 Brody buys a dinner suit costing $720 for his formal. The suit shop has a special formal price of 15% off and offers a further 5% off if Brody pays in cash.

- **a** How much discount does Brody receive for the special formal price?
- **b** What price does he pay for the suit?
- **c** Brody decides to pay cash for his suit. By how much more would his suit be discounted?
- **d** What is the final price of the suit?
- **e** Is this equal to 20% off the original price? Justify your answer with a calculation.

2 The advertised price for a Luxura car is $75 999. When Angelique visits the car dealership, she is offered an end-of-financial-year deal of 30% discount. If she finalises the deal within 2 days, she is offered an additional 5% discount.

- **a** What is the price of the Luxura car after the 30% discount?
- **b** What price would Angelique pay if she finalises the deal in two days?
- **c** Is this equal to 35% off the original price? Justify your answer with a calculation.

3 MindTap News surveyed 2000 people about phone usage while driving. 58% of people interviewed admitted to texting or talking on their phone while driving. Of these people, 30% believed it was safe to do so.

- **a** How many people admitted to using their phone while driving?
- **b** How many people thought it was safe to do?
- **c** What percentage of the original sample thought it was safe to use their phone while driving?

4 EXAMPLE 7 Mainline Electrical offers a 20% trade discount to electricians and a further 5% discount for bills paid by the end of the month. Tina is an electrician. She buys $345 worth of electrical parts and pays her bill before the end of the month.

- **a** How much did she pay for the electrical parts?
- **b** What single percentage discount is equivalent to a 20% discount followed by a 5% discount?

5 The Complete Discount Store is having an end-of-year sale, offering 25% off normal prices and a further 10% discount for cash.

- **a** Simon and Maddy plan to pay cash for a bed that normally sells for $2300. How much will they pay during the sale?
- **b** How much is their total saving?
- **c** What single percentage discount is equivalent to a 25% discount followed by a 10% discount?

6 On Mad Monday, Sam's Cameras offers 20% off everything in the store plus a further 5% discount on all PAINT brand cameras.

a Find Sam's Mad Monday price for a PAINT camera usually priced at $730.

b What single percentage would give the same discount to customers?

7 The Golden Camellia restaurant gives a 15% discount on all takeaway meals. They also give customers with a loyalty card a further 3% discount.

a Kate and Jon are loyalty card customers. They order takeaway food that would cost $42 in the restaurant. How much did they pay for the meal?

b What single percentage discount did they get? Give your answer correct to one decimal place.

8 Vision Discounts offers 20% off the cost price of TVs. However, it must then add 10% GST to the price.

a What is the discount price of a 55 cm TV that normally sells for $800?

b What is the final price when the GST is added?

9 TV Deals 4 U add the GST to the cost of the TV and then offer a 20% discount.

a The television in question **8** is also available at TV Deals 4 U. What is its price at TV Deals 4 U?

b Which deal is cheaper for the customer: discount followed by GST or GST followed by discount? Justify your answer.

10 The population of Nelson Waters increased by 7% in 2022 and by 3.5% in 2023. At the beginning of 2022, the population was 2516. What was the population at the end of 2023? PS

11 Judy and Keith deposit $10 000 in an investment account for 4 months at 5.5% p.a. interest. At the end of the 4 months, they reinvest the $10 000 plus the interest they received for a further 4 months at 4.5% p.a. interest. How much interest have they earned from these 2 investments? PS

To calculate the interest for 4 months, write it as a fraction of a year:

4 months $= \frac{4}{12}$ years.

12 When a casting company advertised for extras to be part of a crowd scene for a movie, 12 400 people applied to be involved. The company rejected 42% of the applicants because they were too young, and they rejected 65% of the remainder because they were too tall. How many of the applicants were neither too young nor too tall? PS



Worksheets
Working with percentages
Percentage problems

6.5 Percentage problems

In this chapter, we have used various techniques for different types of problems involving percentages. Deciding which technique to use is an important skill.

Percentages formulas

$$\text{percentage of a quantity} = \frac{\text{percentage}}{100} \times \text{quantity}$$

OR

$$= \text{percentage} \div 100 \times \text{quantity}$$

$$\text{finding a percentage} = \frac{\text{amount}}{\text{whole amount}} \times 100\%$$

OR

$$= \text{amount} \div \text{whole amount} \times 100\%$$

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For each problem in the following exercise, decide which strategy you will use before you start solving the problem. You might like to use the problem-solving stages for these problems.

EXERCISE 6.5 Percentage problems

ANSWERS p. 378

1 Cindy booked an overseas holiday costing $3650. The travel agent offered her a 17% discount if she paid 90 days in advance.

- **a** How much will Cindy save if she takes advantage of this offer?
- **b** Cindy decides to pay 90 days in advance. How much will the trip cost her?

2 Damien borrowed $16 000 from a finance company to buy a new car. He was charged 13% p.a. interest and agreed to pay the loan back over 5 years.

- **a** How much interest was Damien charged by the company?
- **b** How much did he repay in total?
- **c** Damien repaid the loan by making monthly payments. How much did he have to pay each month?

3 Gabrielle owns a fashion shop. When items come into the store, Gabrielle increases the wholesale price by 95%, and then adds another 10% for GST to determine the final selling price.

- **a** Gabrielle receives a dress costing $140. Calculate the price of the dress without GST.
- **b** Determine the price of the dress including GST.
- **c** What price do you think Gabrielle will put on the price tag? Give reasons for your answer.
- **d** The wholesale price of a suit is $125. What amount, including GST, will Gabrielle write on the price tag?

4 Thomson Valley Council will not approve house plans if the floor area is greater than 40% of the area of the land on which it is to be built. Jackie's block of land is 480 m^2. What is the floor area of the largest house the council will allow her to build on her block of land? PS

5 During the summer sales Felicity bought a towel that is normally priced at $48 for $35. What percentage discount did she receive? Answer to the nearest whole percentage. PS

6 Holly's new lounge cost $3000 and it is depreciating (decreasing in value) at a rate of 10% per year.

- **a** How much will the lounge be worth at the end of 1 year?
- **b** Find the value of Holly's lounge when it is 2 years old.
- **c** Is this the same as depreciating by 20% of the original price? Justify your answer with a calculation.



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7 Xander owns 700 shares in the company Telco. Each share has a market value of $9.50.

- **a** How much are Xander's shares worth?
- **b** Telco pays a dividend of 5% of the value of the shares. How much does Xander receive as his dividend?

8 Ken is charged $95 for a visit to the doctor. The Medicare rebate given to Ken is $37.60. What percentage of the doctor's charge is the Medicare rebate? Answer correct to one decimal place.

9 Forster Auto Superstore gives customers who pay cash a 5% discount, but it charges customers who pay with a credit card an additional 1.5%. The shop advertised a set of car mats for $60. PS

a What is the 'cash price' of the mats?

b How much will Joe, who pays with a credit card, be charged for the mats?

10 TVs R Us advertised a TV for $3999. It can be bought with a 10% deposit and weekly repayments of $38.75 over 2 years. PS

a Marco bought the TV this way. How much deposit does he pay?

b How much does Marco owe after paying the deposit?

c Calculate the amount Marco pays in the weekly repayments.

d How much does Marco pay altogether?

e How much more than the sale price did Marco pay?

f The extra calculated in part **e** is the interest Marco is charged. How much interest was Marco charged for *one* year?

g What rate of interest was Marco charged?

$$\text{Interest rate} = \frac{\text{interest charged for 1 year}}{\text{amount owing after deposit is paid}} \times 100\%$$

11 Yvonne owns Bucknall Mining shares valued at $15.20 each. The company pays a dividend of 53 cents per share. What percentage was this dividend of the value of the share? Give your answer correct to 2 decimal places.

Remember: units in each quantity must be the same!

Puzzle
Percentages find-a-word

Keyword activity

DEFINITIONS

deposit	depreciate	discount	dividend
good and services tax (GST)	interest	repayment	stamp duty

1 For each word in the list, write a definition or explanation of the word and then use it in a sentence showing its meaning.

2 Read over the exercises in the chapter and write down any words that you are not familiar with. Write a sentence explaining the meaning of each.

Solution to the chapter problem

Problem

Gemma works in retail fashion. She buys clothing from wholesalers and manufacturers to sell in her company's shops. Company policy is to sell items at a price that is 150% higher than the cost price before adding GST.

Gemma orders a selection of shirts that cost $32 each. She believes she can sell them for $82.50 including the GST. Does this price comply with company policy?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	We must work out whether Gemma has followed company rules when she calculated the price. Cost price: $32 Selling price including GST: $82.50
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	We must work out how much Gemma has added to the cost price before the GST is added. Calculate how much GST is included in the selling price: GST = $82.50 ÷ 11 = $7.50 price without GST = $82.50 – $7.50 = $75 Calculate the price paid before GST if the company policy is used: price = $32 + 150% of $32 = $32 + 1.5 × $32 = $80 This is $5 more than Gemma intends to charge. So, Gemma's price is not consistent with company policy.
STAGE 3: CHECK THE SOLUTION	
 CHECK	Under company policy, the price should be $80 plus GST: $80 + 10% of $80 = $88 This is more than $82.50, so the conclusion is reasonable.
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	A selling price of $82.50 including GST does NOT comply with company policy. Gemma would need to charge $88 for the shirt to comply with company policy.

6 Test yourself

Applying percentages

ANSWERS p. 378

1 EXERCISE 6.1

a Mark's pay is $2764.80 per fortnight. He is saving 15% of his pay to buy a new car. How much does he save each fortnight?

b There are 135 students in Year 12 at Nelson Waters High. Approximately 78% of Year 12 have paid for their formal tickets. How many students have paid for their tickets?

2 EXERCISE 6.2

a When the Jets netball team played on the weekend, Megan shot 23 goals out of 31 attempts and Jasmine shot 33 goals out of 48 attempts.

i Calculate the success rate for each shooter as a percentage. Give your answer correct to 2 decimal places.

ii Who was the better shooter on the weekend?

b The Brisbane Broncos played the North Queensland Cowboys in an NRL match. The Broncos completed 17 out of 22 tackle sets. The Cowboys completed 19 out of 24 tackle sets.

i Write each completion rate as a percentage. Give your answer correct to the nearest whole number.

ii Who achieved the better completion rate?

3 EXERCISE 6.3 Australian GST is 10%. 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		

4 EXERCISE 6.3 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.

5 EXERCISE 6.3 Businesses that charge GST can claim a GST refund on the price of business supplies. Last tax quarter Luca's business bought items totalling $3650. Calculate the GST included in this amount.

6 EXERCISE 6.4 Vamsee buys a new Volkswagen. The price is $39 900 with a 'model runout' sale discount of 22%. If he buys a display car already in the saleyard, he receives a further 5% discount.

a What is the price of the car after the sale discount?

b What price does Vamsee pay if he buys a display car?

7 EXERCISE 6.4 Franken Furniture is having a mid-year sale. All items in the store are 20% off normal prices. Customers who pay in cash are offered a further 10% discount.

a Joshua and James pay cash for a lounge suite that normally sells for $2599. How much will they pay?

b How much is their total saving?

c What single percentage discount is equivalent to a 20% discount followed by a 10% discount?

8 EXERCISE 6.5 Ella is charged $304.60 for X-rays of her foot. The Medicare rebate for Ella is $164.60. What percentage of the charge is the Medicare rebate? Answer correct to one decimal place.

9 EXERCISE 6.5 For tax purposes, equipment bought for a business is depreciated at 20% per year. Stefan buys a photocopier for $3070.

a Calculate the amount of the depreciation in the first year.

b What is the photocopier valued at after 1 year?

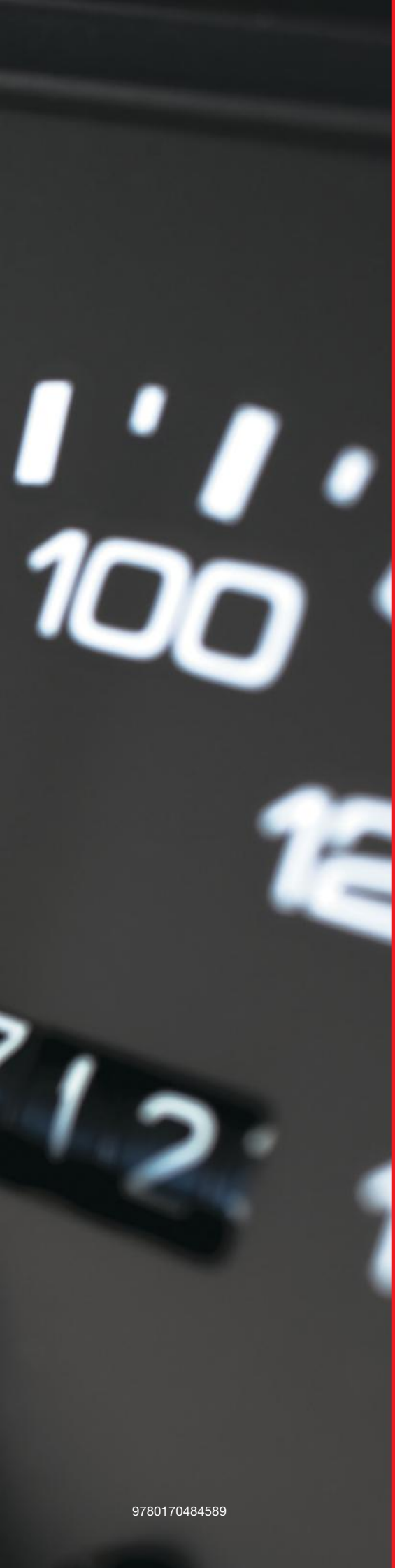
c Find the value of the photocopier at the end of the second year.



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 would be the best way to organise and present this data?



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CHAPTER 7

NUMBER, DATA AND MONEY: REPRESENTING DATA

SHOW ME THE DATA

Syllabus coverage
Nelson MindTap chapter resources
Terminology
7.1 Categorical and numerical data
7.2 Displaying categorical data
7.3 Displaying numerical data
7.4 Dot plots and stem plots
7.5 Which graph should I use?*
7.6 Outliers
Keyword activity
Solution to the chapter problem
Test yourself
* COMPLEX

What will we do in this chapter?

- Distinguish between categorical data and numerical data
- Graph categorical data and numerical data
- Graph and interpret histograms, dot plots and stem plots
- Choose the best display for a particular set of data
- Identify outliers in a set of data

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 evaluating data presented in the media

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Syllabus coverage

UNIT 1, TOPIC 2: REPRESENTING DATA

Classifying data

- Identify examples of categorical data.
- Identify examples of numerical data.

Data presentation and interpretation

- Display categorical data in tables and column graphs.
- Display numerical data as frequency distribution tables, dot plots, stem plots and histograms.
- Recognise and identify outliers from a dataset.
- Compare the suitability of different methods of data presentation in real-world contexts [complex].

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Worksheets (2):

7.3 Frequency tables
7.4 Stem-and-leaf plots 1

Puzzles (2):

7.1 Statistical data match-up
Keyword activity Data find-a-word

Nelson MindTap

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

Terminology

categorical data	column graph	data	dot plot
frequency	frequency histogram	frequency table	histogram
numerical data	outlier	stem plot	

7.1 Categorical and numerical data

A collection of facts or information is called **data**.

There are two main types of data:

Categorical data is information that is grouped into categories, such as the colour of cars or ice cream flavour.

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

EXAMPLE 1 Categorical and numerical data

Classify each type of data as categorical or numerical.

a makes of cars
b employee 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



Puzzle Statistical data match-up

EXERCISE 7.1 Categorical and numerical data

ANSWERS p. 378

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

a foot length 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 colour
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 (for example, PG)

3 You are asked to design a survey on people's preferences about anything to do with cars. Write a questionnaire with 6 questions: 3 that ask for categorical data and 3 that ask for numerical data. PS

7.2 Displaying categorical data

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 2 Frequency table for categorical data

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 3 columns. Complete the tally column by putting one tally mark for each response.

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** (also called a **bar chart**).

EXAMPLE 3 Column graph

Display the data from Example 2 in a column graph.

Day of the week	Frequency
Thursday	7
Friday	12
Saturday	8
Sunday	1

Steps

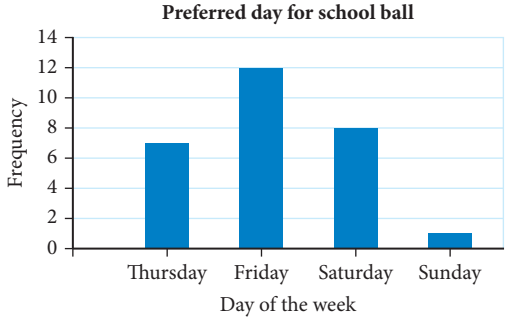
The horizontal axis will be the days of the week.

The vertical axis will be the frequency.

Columns will have spaces between them.

Give the graph a title.

Working



EXERCISE 7.2 Displaying categorical data

ANSWERS p. 378

1 EXAMPLE 2 Piyush recorded the methods students in his year use to travel to school. He recorded the data as W = walk, R = ride a bike, B = bus, C = car and T = train. This is his data.

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 Nelsonville to find out the age of each child. She recorded the data as B = babies up to 2 years, P = pre-schooler, I = early primary and O = children older than 8 years. This is Tiana's data.

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 Tiana's data in a frequency table.

b Which category contains the largest number of children?

c What percentage of children in the survey are babies?

3 Jasmine asked 30 students in Year 11 'What is your preferred brand of car?'

Her results are shown below and coded as follows: Hyundai = 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 3 Sam surveys a class of 30 students about the day of the week that each student's birthday falls on this year. The results are shown in the table below. Display this data in a column graph.



Hoxton/Alamy Stock Photo

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of students	6	3	4	6	3	5	3

5 Allison 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

7.3 Displaying numerical data

We can also summarise numerical data into a frequency table and present it in a graph.

EXAMPLE 4 Frequency table for numerical data

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.

Working

Number of children	Tally	Frequency
1	𝍸	4
2	𝍸	5
3	𝍸 |||	8
4	|||	3
5	||	2
6	|	1
7	||	2

We often graph numerical data using a **frequency histogram**. A **histogram** is like a column graph but there are no spaces between the columns. We show frequency on the vertical axis and the scores on the horizontal axis.



Goodluz/Shutterstock.com

EXAMPLE 5 Histogram

Draw a histogram for the data in Example 4.

Steps

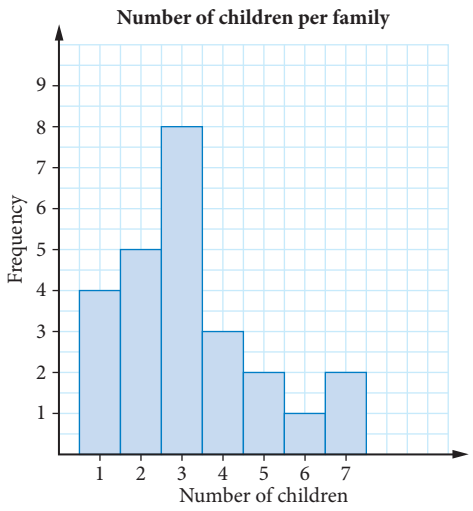
Place 'Number of children' on the horizontal axis.

Place 'Frequency' on the vertical axis.

Make sure that the columns are centred so that the values on the horizontal axis are directly below them.

Give the histogram a title.

Working



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EXERCISE 7.3 Displaying numerical data

ANSWERS p. 378

1 EXAMPLE 4 The number of hamburgers sold in a food court each day between 12 noon and 2 pm in August is listed below.



Sorbis/Shutterstock.com

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. The results were as follows:

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 A life insurance company recorded the ages of 40 clients.

84	76	39	45	38	74	66	81	49	57
59	42	31	43	71	80	40	37	73	87
77	49	53	62	62	74	84	90	31	47
52	62	79	33	31	52	46	43	55	38

a Copy and complete the grouped frequency table below for this data.

Age	Tally	Frequency
31–40		
41–50		
51–60		
61–70		
71–80		
81–90		
Total		

b Which age group has the most clients in it?

c How many clients were 50 years old or younger?

d What percentage of clients were over 70 years old?

4 EXAMPLE 5 Jordan surveyed 20 households in her street about how many mobile phones they owned. The results are shown in this frequency table.

Draw a frequency histogram to display Jordan's data.

Number of phones	Frequency
0	2
1	7
2	8
3	2
4	1

5 This frequency table shows the number of letters received by an office each day.

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?

Number of letters	Frequency
3	4
4	7
5	8
6	14
7	12
More than 7	10

6 Atiq counted the number of phone calls he made each day for 30 days.

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 most common number of phone calls made each day?

7 The P.E. department recorded the heights of Year 11 students, rounded to the nearest centimetre. PS

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

a Copy and complete this grouped frequency table.

Class	Tally	Frequency
150–154		
155–159		
160–164		
165–169		
170–174		
175–179		
180–184		
Total		

b How many students had their height recorded?

c Draw a histogram for this data.

d How many students were 170 cm or taller?

e Which class interval has the most students in it?

7.4 Dot plots and stem plots

Dot plots are used for small sets of numerical data that are close together.

Stem plots (also called **stem-and-leaf plots**) are used for larger sets of numerical data and list the actual data values.

Worksheet
Stem-and-leaf plots 1

EXAMPLE 6 Dot plot

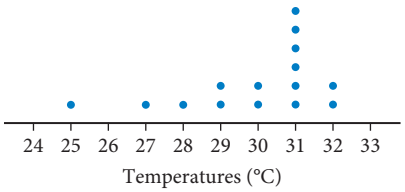
The daily maximum temperature (in °C) in Cairns in July was recorded for 15 days.

32 30 31 32 31 30 31 31 31 31 29 25 28 27 29

Construct a dot plot for this data.



Nic Cleave Photography/Alamy Stock Photo

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 7 Stem plot

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 plot for this data.

Steps	Working
The stem will be the 10s 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 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 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



iStock.com/Chameleonseye

EXERCISE 7.4 Dot plots and stem plots

ANSWERS p. 379

1 EXAMPLE 6 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 one 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 fewer than 12 motor vehicles stolen?

3 Lisa surveyed her group of friends about the amount of money they spent on fuel last week. The answers were rounded to the nearest dollar. This is the data she recorded.

$20 $28 $25 $26 $22 $26 $28 $28 $24 $22 $29 $28

a Draw a dot plot for this data.

b How many friends did Lisa survey?

c What was the most common amount of money spent on fuel?

d How many of Lisa's friends spent less than $26 on fuel?

4 EXAMPLE 7 Mrs White, the school canteen manager, recorded the daily number of students visiting 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 a stem 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 plot.

b For how many months was 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 each did last month.

42 16 35 27 9 0 33 21 14 11
26 29 31 22 8 24 5 0 15 25 17

a Complete a stem plot to show this information.

b What was the highest number of hours worked by anyone in this class?

c How many students worked between 10 and 20 hours in the month?

d How many students worked more than 20 hours in the month?

e How many students were in this class?

f What percentage of students worked more than 20 hours in the month? Answer correct to the nearest whole percentage.

7.5 Which graph should I use?*

In this chapter, we have looked at different ways of organising and presenting data.

Type of statistical display	Used for ...
Frequency table	Categorical data, or numerical data over a small range
Grouped frequency table	Numerical data spread out over a large range
Column graph (bar chart)	Categorical data
Frequency histogram	Numerical data; Shows the shape of the data; Can be graphed from frequency tables and grouped frequency tables
Dot plot	Small sets of numerical data that are close together
Stem plot	Larger sets of numerical data; Lists the actual data values

EXERCISE 7.5 Which graph should I use?* ANSWERS p. 380

1 For each set of data, decide whether you would use a frequency table or a grouped frequency table to organise it. Justify your answer.

- **a** favourite music artist of Year 11 students
- **b** weights of students on their first day of pre-school
- **c** quiz results out of 10 for a class of Maths students
- **d** number of students served each day at the school canteen during term
- **e** speeds of vehicles caught speeding by a speed camera
- **f** colour of hair of students in Year 12
- **g** star ratings of motels/hotels in your town
- **h** number of pairs of shoes owned by each relative in your extended family

2 Jacinta surveys 100 people in her office building about how they travel to work. What graph should she use to show her results? Justify your answer.

3 Liam asks each student in his Maths class how many children there are in their family (including themselves). What graph could he use to show his results? Justify your answer.

4 Anushka records the number of phone calls she makes each day for 2 months. What graph could she use to show this information? Justify your answer.

5 Fitness Now gym recorded the age of each person who joined the gym over one month. This data is reported to the chief executive of all the Fitness Now gyms. What graph could be used to show this information? Justify your answer.

6 Ziad works in a bank. The Board asks him to survey his fellow employees about whether they make donations to charities and, if so, how much they donate in a year. What 2 graphs could he use to present his findings? Justify your answer.

7 Which graph – histogram, dot plot or stem plot – would be best to display the given data? Justify your answer.

- **a** number of apples per tree in an apple orchard
- **b** minimum temperature each day for a fortnight in February in Bundaberg
- **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 Townsville
- **f** number of mobile phones per family in Cengage St
- **g** ages of patients in a doctor's practice
- **h** sales of shirts at all branches of a fashion store in one 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

Chapter problem

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

7.6 Outliers

Sometimes with numerical data we have a number that is an **outlier**, a value that is very different from the rest of the data. It can be either much larger or much smaller than the other scores. An outlier can make it difficult to graph the data. When we see a score that looks like an outlier, we should check that the score is reasonable because it could be a mistake.

EXAMPLE 8 Outlier

Lochie asked 8 friends about the amount of pocket money they received 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	Write the data in order.	18, 18, 20, 32, 32, 32, 40, 75
	Look for the score that is either much larger than or much smaller than the other scores.	The outlier here is $75 because it is much larger than the other data values.
b		It is reasonable, as it is quite possible for one student to receive much more pocket money than other students.

EXERCISE 7.6 Outliers

ANSWERS p. 380

1 EXAMPLE 8 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 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 kg) of patients in the hospital emergency room. The results are shown below.

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, in centimetres, of 25 Year 11 male students. The results are shown.

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 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 wrongly recorded height. Explain your answer.

6 The prices of 8 houses sold in Nelson Waters Rd over the last 2 years are:

$620 000	$700 500	$738 000	$625 000
$598 000	$696 500	$720 000	$1 800 000

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 Ten people work in a stationery superstore. Their annual salaries are:

$61 000	$57 000	$66 000	$51 000	$53 000
$62 000	$56 000	$63 000	$60 000	$245 000

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 the 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 scores 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 wrongly recorded foot length. Explain your answer.

9 Felicity 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 and $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.

Investigation Data in everyday life

In this investigation you will find real-world examples of data presented in different ways. Here are some of the keywords from this chapter:

categorical data	numerical data	histogram
dot plot	stem plot	outlier

What you have to do

1. Search the internet for each keyword/phrase. Look for definitions and images. You might like to search for Australian examples.
2. Find a real-world example of a graph for each keyword/phrase. It is preferable not to use an example from a maths site.
3. Save the definitions, images and graphs, and explain its context and purpose.
4. Create a PowerPoint presentation of what you have found that explains each keyword/phrase, and the context and purpose of each graph.

Keyword activity

DATA FIND-A-WORD

ANSWERS p. 380

categorical data	dot plot	frequency table	histogram
numerical data	outlier	stem plot	

Match each word above with one of the following definitions.

A A table summarising data

B A graph using dots to make columns

C Information that is grouped into categories, such as the colour of cars

D A data value that is very different from the rest of the data

E A graph that looks like a column graph but there are no spaces between the columns

F Information that is counted or measured, such as the number of goals scored

G Graph used for larger data sets that keeps all the detail of the data

Puzzle
Data
find-a-word

Solution to the chapter problem

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 would be the best way to organise and present this data?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	We need to determine: • what type of data we are collecting • how to organise and present this data.
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	The data is speed, which is a number, so the data is numerical. Numerical data is best organised into a frequency table. If the speeds are spread over a wide range, it may be necessary to use a grouped frequency table. Data is usually presented in a graph. For a few cars, we could use a dot plot, but as there will probably be a lot of cars, we should use a histogram or a stem 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.
STAGE 3: CHECK THE SOLUTION	
 CHECK	We have answered all parts of the problem.
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	The data is numerical. It should be organised into a frequency table and presented using a histogram or a stem plot.

7 Test yourself

Show me the data

ANSWERS p. 380

1 EXERCISE 7.1 Classify each type of data as categorical (C) or numerical (N):

a Brands of toothpaste

b Hours of TV 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 7.2 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:

BBPRB	GYYMG	BGRPY	MMYPP	RRGBG	PYRGM
YPGRP	BBBBM	GGRPY	GGBBB	YYPPR	MMBBG

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.

3 EXERCISE 7.3 The temperature at 11 am each day is recorded. The results are:

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 On how many days was the temperature below 20°C?

d Draw a histogram for this data.

4 EXERCISE 7.4 These are the results for Andre's Year 11 class for a 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 this data.

b How many students are in the class?

c How many students scored more than 14 out of 20 for the quiz?

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5 EXERCISE 7.4 Tech-to-go Gamestore recorded the age of each customer who came into the store 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 on a stem plot.

b How many customers came into the store 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 one decimal place.

6 EXERCISE 7.5 Decide which graph – column graph, histogram, dot plot or stem plot – would be best to display the given data. Justify your answer.

a Number of points each member of a basketball team scored in a match

b Maximum daily temperatures for the month of March in your town

c The make of car each family in your class drives

d The daily number of people visiting a house for sale over 1 month

7 EXERCISE 7.6 For each set of data, identify the outlier.

a 27 28 19 26 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

8 EXERCISE 7.6 Air Cengage flies from Brisbane to Sydney. The number of passengers 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 smallest to greatest.

b What are the outliers in this data?

c For each outlier you stated in part **b**, decide if it is reasonable or likely to be a mistake. Explain your answer.



Chapter problem

Hugo earns $19.04 per hour working a 37-hour week in a wholesale plant nursery. He is paid time-and-a-half for the first 5 hours of overtime per week and double time after that. If he is required to work any unscheduled overtime, he receives a $12.68 meal allowance per shift. Hugo also receives a $1.80 allowance per hour when he is required to work in wet areas.

In the week ending 29 May, he worked 43 hours, which included one unscheduled overtime shift and 6 hours of working in a wet area.

Pay slip

Hugo Mendozia

Week ending 29 May	
Normal pay	$704.48
Overtime	$171.36
Allowances	$23.48
Gross pay	$899.32

Hugo thinks his pay for the week ending 29 May is wrong. Is his gross pay correct?



ER_09/Shutterstock.com

CHAPTER 8

NUMBER, DATA AND MONEY: MANAGING MONEY

EARNING MONEY

Syllabus coverage
Nelson MindTap chapter resources
Terminology
8.1 Wages and salaries*
8.2 Working overtime
8.3 Bonuses and allowances
8.4 Annual leave loading
8.5 Commission, piecework and royalties
8.6 Superannuation
Keyword activity
Solution to the chapter problem
Test yourself
*COMPLEX

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 superannuation payments

How are we ever going to use this?

- Using rates to calculate wages, salaries, overtime and piecework
- Applying percentages to calculate bonuses, allowances, commissions, royalties and holiday pay
- Calculating superannuation payments and making superannuation decisions

9780170484589

Syllabus coverage

UNIT 1, TOPIC 3: MANAGING MONEY

Earning money

- Find earnings, including salary, wages, overtime, piecework and commission.
- Convert between annual, monthly, fortnightly, weekly and hourly rates of earning [complex].
- Understand the purpose of superannuation.
- Interpret entries on a selection of wage or salary pay slips and timesheets.

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, p. 16
© Queensland Curriculum and Assessment Authority (QCAA)

Video (4):
- **8.2** Overtime 1 • Overtime 2
- **8.4** Annual leave loading
- **8.5** Commission

Skillsheets (2)
- **8.4, 8.5** Percentage calculations • Mental percentages

Worksheets (3):
- **8.1** Time and money calculations • Wages and salaries
- **8.5** Earning money

Puzzles (2):
- **8.5** Commission and piecework
- **Keyword activity** Money crossword

Spreadsheets (3):
- **8.1** Wages
- **8.4** Holiday pay
- **8.6** How much will my superannuation be worth?

Weblinks (3):
- **8.1** Fair Work
- **8.3** My Future
- **8.5** Human Services

Nelson MindTap

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

Terminology

allowance	annual	annual leave loading	bonus
commission	double time	fortnightly	overtime
pay slip	per annum (p.a.)	piecework	royalty
salary	superannuation	time-and-a-half	wage

8.1 Wages and salaries*

Wages and salaries are different ways we can be paid for work we do for an employer.

- A **wage** is an amount paid for each hour worked.
- A **salary** is a fixed amount per year that does not depend upon the number of hours worked. Teachers and other professionals earn a salary.

Profile **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 learn.



iStock.com/goldenKB

Worksheets
Time and money calculations
Wages and salaries

EXAMPLE 1 Wages

Kristine earns $32.10 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 × $32.10 = $1219.80
1 fortnight = 2 weeks	fortnightly earnings = 2 × $1219.80 = $2439.60
b There are 52 weeks in a year.	yearly earnings = 52 × $1219.80 = $63 429.60

EXAMPLE 2 Salaries

Madeleine is a social worker. Her **annual** salary is $89 806. **Calculate**:

a her monthly pay

b her fortnightly pay.

'Annual' means per year.

Steps	Working
a There are 12 months in a year.	monthly pay = annual salary ÷ 12 = $89 806 ÷ 12 = $7483.83
b There are 26 fortnights in a year.	fortnightly pay = annual salary ÷ 26 = $89 806 ÷ 26 = $3454.08

Months, weeks, fortnights in 1 year

1 year = 12 months
1 year = 52 weeks
1 year = 26 fortnights

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

Profile **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.



Neil McAllister/Alamy Stock Photo

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

EXERCISE 8.1 Wages and salaries*

ANSWERS p. 381

1 EXAMPLE 1 Scott is a qualified ambulance paramedic. He is paid $69.08 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 $124 500 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 $2923.

- **a** Calculate Lance's annual salary.
- **b** Explain why Lance's monthly pay is *not* $2923 × 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 $19.61 per hour working at the Chinese take-away.

- **a** Last week Zheng worked 16 hours. How much did he earn?
- **b** Today Zheng earned $78.44. How long did he work?

5 Ulla receives a yearly stipend of $26 860 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 $26.20 per hour as a waitress. Calculate Ulla's total fortnightly income.

6 The minimum wage for a trainee pest inspector is $1057.69 for a 38-hour week. What is the minimum pay per hour for a trainee pest inspector?



Andrey_Popov/Shutterstock.com

7 Carlos earns $440 per day as a relief teacher. The table shows the number of days he worked over a 5-week period.

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

How much did Carlos earn over the 5 weeks as a relief teacher?

8 Alana works an average of 36 hours per week and receives an annual salary of $127 296. She is going to receive a 5% pay rise. How much will Alana earn per hour after the pay rise? C PS

9 Pia is trying to decide which one of 3 jobs to take. PS

	Conditions	Pay
Job 1	38-hour week, 5 days per week, possibility of overtime	$24/h
Job 2	75 hours per fortnight, work 9 days per fortnight	$1875 per fortnight
Job 3	Salary, based on a 35-hour week	$43 550 p.a.

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

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

Profile — Jonathan – 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 an after-hours, part-time job stacking shelves in a supermarket. Because the manager was impressed with my work ethic and reliability, the company offered me a management traineeship when I finished Year 12. Now I'm a supermarket manager with a range of responsibilities.



Juice Flair/Shutterstock.com

Weblink
Fair Work

Investigation — Award wages

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

- Research the annual minimum wage for 3 jobs that interest you.
- Calculate the minimum weekly pay in each job.
- Go to the **pay slips** section of the website. Write a summary of information employers must show on pay slips.

Spreadsheet
Wages

Investigation — Wages by spreadsheet

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

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 $17.60 per hour. Enter the information about Jessica's job in the spreadsheet and determine her total weekly pay.

2 **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?

3 This 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	$16.51	20	
Sofia	$25.25	35	
Cathy	$21.70	35	
Mike	$19.30	40	
Anita	$36.30	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.

8.2 Working overtime

Overtime is working beyond usual working hours, such as at night and on weekends, and it is paid at a higher rate. Only people who work for a wage are paid for 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 normal pay.

Profile 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 one-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.



Alexander Raths/Shutterstock.com

Videos
Overtime 1
Overtime 2

EXAMPLE 3 Overtime 1

Alyssa's normal rate of pay is $23.89 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 × $23.89 = $35.84
b When Alyssa works on Sunday, she earns 2 × $23.89, or $47.78 per hour.	pay for 4 hours on Sunday = 4 × $47.78 = $191.12

EXAMPLE 4 Overtime 2

Hasid earns $28 per hour.

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 working week by multiplying the hourly rate by 35.	pay for a 35-hour week = 35 × $28 = $980
b Hasid's 12-hour pay is broken into 7 hours at normal pay + 3 hours at time-and-a-half + 2 hours at double time.	total pay = 7 × $28 + 3 × 1.5 × $28 + 2 × 2 × $28 = $434 Hasid's pay for a 12-hour day is $434.

EXERCISE 8.2 Working overtime

ANSWERS p. 381

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**
$31.25	**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 Luis' normal pay is $21.30. 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 of 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? PS

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

8 Billie earned $186 when she worked on Sunday for 4 hours at double time. How much does she earn for a normal 7-hour day?

9 Callum works for the 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 paid 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	$102.04

8.3 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, meeting targets or meeting deadlines.

Profile **Caitlyn** – 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!



PJF Military Collection/Alamy Stock Photo

EXAMPLE 5 Allowances 1

Caitlyn's basic salary in the navy is $65 987 and she receives an annual $12 128 service allowance, as well as an annual $419 uniform maintenance allowance. When she's at sea, Caitlyn receives an additional $11 758 annually.

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

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

Steps	Working
a annual salary on land = basic salary + service allowance + uniform allowance	salary = $65 987 + $12 128 + $419 = $78 534
Divide by 52 for weekly pay.	weekly pay on land = $78 534 ÷ 52 ≈ $1510.27
b annual salary at sea = annual salary on land + sea allowance	salary = $78 534 + $11 758 = $90 292
Divide by 26 for fortnightly pay.	fortnightly pay at sea = $90 292 ÷ 26 ≈ $3472.77

EXAMPLE 6 Allowances 2

Sonia is paid $35.48 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 wage.	wages = 4 × 6 × $35.48 = $851.52
Calculate her travel allowance.	travel allowance = 6 × $14.15 = $84.90
Total weekly pay = wages + allowances + dog + torch	total weekly pay = $851.52 + $84.90 + $61.05 + $6.75 = $1004.22

EXERCISE 8.3 Bonuses and allowances

ANSWERS p. 381

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

a Calculate Sophie's weekly pay when she is working in Australia.

b Determine Sophie's fortnightly pay when she is deployed overseas.

2 EXAMPLE 6 Zoran is an apprentice in a pest control company. He is paid $16.93 per hour and he receives an extra 12.81 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 $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 Cassie has a part-time, casual job at Big Burgers, Gympie. This is her pay slip.

UHAJMO
Big Burgers
Pay ID 4720364

Cassie Toms
100 Bruce Highway,
Gympie, QLD 4570

Employee code: 26051
Pay date: 27 Oct 2024
Tenure: Casual
Hourly rate: $14.36

Pay period
20 Oct 2024 to 26 Oct 2024

		Amount	YTD
Ordinary pay	9h $14.36	A	$1378.56
CAS Saturday	7.5h $17.23	B	$1361.17
CAS Sunday	7.5h $17.23	C	$775.35
Crew coach allowance per hour	24 $0.30	D	$66.00
Laundry allowance per shift	4 $1.25	E	$47.50
Gross pay	F		
Deductions	0		
Net pay	G		
Banking Direct credit balance BSB 732 515, Account 657528			
Payment summary			
Gross		H	$3628.58
PAYG tax		0	$98.00
Direct credit		I	$3530.58

a What is the pay period for this pay slip?

b On what date was Cassie paid?

c Was Cassie paid in cash?

d How much does Cassie earn per hour, normal time?

e What allowance is Cassie paid per hour as a crew coach?

f How much is Cassie's laundry allowance and how often is she paid it?

g Complete the missing values on Cassie's pay slip. Some values are repeated.

h How many shifts has Cassie worked in the year to 26 October?
(Hint: Think about her laundry payment.) PS

i How many hours has Cassie worked in the year to 26 October?
(Hint: Think about her crew coach allowance.) PS

j What penalty rate does Cassie receive for working on the weekend?
(HINT: it's NOT time-and-a-half.) PS

6 Zack drives a furniture removal truck. He is paid $29.12 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 in which he delivered furniture for 33 hours Monday to Friday, 6 hours on Saturday and 3 hours on Sunday.

7 Raina has a job driving children with a disability to school. She is paid $26.20 per hour plus $30.65 per day for assisting children. In addition, she receives 65 cents for every work-related kilometre she drives in her car. Calculate Raina's pay for a week when she worked 4 hours each day from Monday to Friday and she used her car for 360 work-related kilometres. PS

8 Sam is a casual junior baker at a bread shop who earns $16.32 per hour. On Saturdays, all bakers receive time-and-a-half pay. On Sundays, all casual bakers receive 98% more than their normal pay per hour. PS

a The table shows the times Sam worked last week. Complete the missing values in the table.

Shift	Starting time	Finishing time	Unpaid breaks	Number of hours worked	Pay per hour	Pay
1	Thursday 10 pm	Friday 6:30 am	30 minutes	**A**	**E**	**I**
2	Saturday midnight	8 am	1 hour	**B**	**F**	**J**
3	Saturday 8 pm	midnight	0	**C**	**G**	**K**
4	Sunday 6:30 pm	midnight	30 minutes	**D**	**H**	**L**

b Calculate Sam's total pay.



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.

1. Visit the **My Future** website.
2. 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.
3. 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 insight** or **Occupations** sections of the website. You may be unfamiliar with some of the careers to which you may be suited. Take the time to learn about these careers. It could be the best hour you ever spend!



Chapter problem

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

8.4 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 **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 favorite activity is running puppy preschool classes.



Monkey Business Images/Shutterstock.com

Video Annual leave loading

Skillsheets Percentage calculations

Mental percentages

EXAMPLE 7 Annual leave loading

Briana earns $1053 per week as a vet nurse. When she takes her 4 weeks of annual holiday leave, she receives an extra 17.5% of 4 weeks' pay as a 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 before she must pay tax.

Steps	Working
a Briana receives 17.5% of 4 weeks' pay.	Briana's pay for 4 weeks = $1053 × 4 = $4212
17.5% = 0.175 →	Briana's holiday loading = 0.175 × $4212 = $737.10
b Holiday pay = 4 weeks' pay + holiday loading	Briana's holiday pay = $4212 + $737.10 = $4949.10

EXERCISE 8.4 Annual leave loading

ANSWERS p. 381

1 Calculate 17.5% of each amount.

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

2 EXAMPLE 7 The Edmondson Park Hotel pays its employees a 17.5% annual leave loading on their 4-week 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 $743 per week from his part-time job and for his holidays he receives a 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 wage is $72 320. She receives a loading of 17.5% of 4 weeks' pay with her holiday pay. Calculate the total value of Phillipa's holiday pay.

6 Linda earns $890 per week. She receives 6 weeks' annual leave at the end of each year, but her annual leave loading of 17.5% is only calculated on 4 weeks' pay. Calculate Linda's holiday pay.

7 Jon's wage increased from $720 to $800 per week. By how much will his 4-week holiday pay, including the 17.5% annual leave loading, increase?

8 NMQ 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 $2152 per fortnight, and she has worked for the company for 7 years.

a How much is Katrina's bonus?

b Calculate the total amount Katrina was paid, before tax, for her 4-week holiday pay, including the bonus.

9 Nate earns $840 per week. At the end of the year, he receives 5 weeks of holiday leave with a 17.5% loading on 4 weeks. How much more does Nate get paid for taking 5 weeks of holidays than for working 5 weeks? PS

10 Declan receives a 17.5% loading on his 4-week holiday pay. His 4-week holiday pay, including the loading, is $4634.20. How much does Declan normally earn per fortnight? C PS

Spreadsheet
Holiday pay

11 Use the **Holiday pay** spreadsheet from Nelson MindTap to answer the following questions.

a Yasmin earns $18.25 per hour for a 35-hour week. If the holiday 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?

8.5 Commission, piecework and royalties

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

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 for which 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 **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 such as placemats, drink coasters, plates, cups, serviettes, calendars and t-shirts.



Sue Thomson

EXAMPLE 8 Royalties

Sarina receives a 5% royalty on the wholesale price of serviettes featuring her art. Packets of serviettes sell for $3.20 wholesale 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 Commission 1

Jordan is a used car salesman. He is paid a $270 weekly retainer plus 5% commission on his weekly sales over $50 000. **Calculate** Jordan's pay for a week in which his sales totalled $80 000.

A retainer is the amount of money a salesperson is paid that does not depend on his 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 = $270 + $1500 = $1770

Video Commission

Skillsheets Percentage calculations

Mental percentages

Worksheet Earning money

Puzzle Commission and piecework

EXAMPLE 10 Commission 2

Danielle earns commission for selling cosmetics. She is paid 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'.



Alexxx1981/iStock/Getty Images

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

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

EXAMPLE 11 Piecework

Isla embroidered some hand towels to sell at a charity street stall. To create the towels, 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 Isla charge for each of her towels?

Steps	Working
Find the total cost of the materials.	cost of materials = 10 × $8.25 + 8 × $0.95 + 2 × $1.95 = $94 Remember to change the 95 cents into $0.95.
Find the cost of Isla's 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	cost per towel = $131.50 ÷ 10 = $13.15
Round up to a sensible price.	Isla should charge $13.50 or $14 per towel.

EXERCISE 8.5 Commission, piecework and royalties

ANSWERS p. 382

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. Andrew'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 $4 300 000?

6 EXAMPLE 10 Tanika sells books. 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 on sales, 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 floor and 7 m^2 of slate for the stairs. The table shows the amount Trevor charges for each of these tasks.

How much will Trevor charge to lay the tiles and slate?

Trevor's tiling service Bathrooms, kitchens
All quality work
*Tiles $52 per m^2
*Slate $66 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? PS

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 10 dozen scones?

1 dozen = 12

11 Basam is selling his house for $920 000. 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 a 10% royalty on the first 4000 copies and a 12.5% royalty on the remaining sales of her books. Calculate the royalties Dagma receives in a year in which:

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
Overhead transparency	$87.89

The copyright statement showed that 7258 pages of text, 60 artistic works and 12 overhead transparencies were copied. Melissa receives 30% of the copyright payment. The remainder goes to the publisher. Calculate the amount Melissa and her publisher will receive from the copyright payment. PS

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 wholesale price for the number of plates sold in excess of 10 000

Calculate Sarina's royalty for the sale of each number of plates.

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

Profile **Ben – 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 the 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.



Jacob Ammentorp Lund/iStock/Getty Images

Investigation Help from Centrelink

The Australian Government provides support for people in need. Visit the **Human Services** website and research the assistance available to people in situations similar to Ben.

Weblink Human Services

8.6 Superannuation

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



MJTH/Shutterstock.com

Superannuation is a scheme that occurs while we're earning an income to save 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.

EXAMPLE 12 Superannuation

Jake earns $26.80 per hour for a 35-hour week. His employer is required to pay 12% of his earnings into a superannuation account every 13 weeks. **Calculate** the amount of this superannuation payment.

Steps	Working
Calculate Jake's pay for 13 weeks.	Jake's weekly pay = $26.80 × 35 = $938 Jake's pay for 13 weeks = $938 × 13 = $12 194
Calculate 12% of 13 weeks' pay.	superannuation = 12% of $12 194 = $1463.28
Write the answer.	Jake's employer must pay $1463.28 into his superannuation account every 13 weeks.

On retirement, you will be able to access the money in your superannuation account, which can be paid to you as a lump sum or in regular instalments.

EXAMPLE 13 Superannuation pension payments

Katherine is retired and has $1.05 million in her pension account created from her superannuation. Because she is 81 years old, the Government requires that she withdraws 9% of the balance annually. **Calculate** the value of Katherine's monthly pension.

Steps	Working
Calculate Katherine's annual pension.	annual pension = 9% × $1 050 000 = $94 500
Divide by 12 for the monthly pension.	monthly pension = $94 500 ÷ 12 = $7875
Write the answer.	Katherine's monthly pension is $7875.

EXERCISE 8.6 Superannuation

ANSWERS p. 382

1 EXAMPLE 12 Zack earns $29.15 per hour for a 38-hour week and his employer pays 12% of his pay into superannuation every 13 weeks. How much will Zack's employer pay into his superannuation account every 13 weeks?

2 Ruby's annual salary is $98 500.

a Calculate the amount her employer must pay into her superannuation every 13 weeks. Use a superannuation guarantee rate of 12%.

b Until 30 June 2024, the employer superannuation rate was 11%. The superannuation guarantee rate from 1 July 2025 is 12%. How much more superannuation does an employer now have to pay annually for a salary of $98 500?

3 Employers aren't required to pay superannuation for employees aged under 18 years unless they work more than 30 hours per week. PS

a Shanti is 16 and works part-time at the local pizza shop. This is part of her pay slip for February.

Dates	Hours worked	Pay
February 1–7	8	$121.60
February 8–14	7	$106.40
February 15–21	9	$136.80
February 22–28	12	$182.40
Superannuation		$0.00
Totals	36	$547.20

Shanti is confused. She worked more than 30 hours. Why didn't she receive a superannuation payment?

b How much, at 12%, would her superannuation payment be, if Shanti was eligible for it?

4 People employed by the Australian Armed Forces receive a higher superannuation rate. The Armed Forces pay 16.4% in superannuation annually. Coby earns $143 000 p.a. as an air force pilot. How much more superannuation is paid into his account annually compared to the normal 12%?

5 Jake is 60 years old and has $784 000 in a superannuation account-based pension. He is required to withdraw at least 4% p.a. as a pension. How much will Jake receive if he decides to take the pension

a annually? **b** monthly? **c** weekly?

6 EXAMPLE 13 The minimum amount a person can take as a pension from a superannuation fund is determined by the person's age, as shown in the table.

a Matt is 71 years old and he has $556 000 in a superannuation account. He decided to only withdraw the minimum and to take a fortnightly pension. Calculate the amount of his fortnightly pension.

b Nanna has $967 500 in an account-based pension fund. She is about to have her 85th birthday. By how much will her minimum pension change when she turns 85? PS

c Suggest a reason why the minimum pension percentage increases with age.

Age in Years	Minimum percentage
Less than 65	4%
65 to 74	5%
75 to 79	6%
80 to 84	9%
85 to 89	10%
90 to 94	11%
95 or more	14%

7 Christine is 68 years old and she withdraws the minimum amount she can from her account-based pension. Each month her pension pays her $4230. How much does Christine have in her pension account? PS

Spreadsheet
How much will my superannuation be worth?

Investigation How much will my superannuation be worth?

Download the **How much will my superannuation be worth?** spreadsheet from Nelson MindTap.

Imagine that you've been working for 3 years and your employer has been contributing 12% of your wage into your superannuation account every 13 weeks. You've been saving hard and you've decided to go overseas to explore the world. Your superannuation account will continue to grow while you're away.

1 Enter a weekly pay rate of $800 into cell B7 and an interest rate of 5% (0.05) into cell B10.
Record how much your superannuation will be worth when you finish work in 3 years' time and how much it will be worth in a further 10, 20, 30 and 40 years.
2 In which 10-year time period is the change in value the greatest?
3 Change your weekly pay. What effect does this have?
4 Change the interest rate. How does this affect the future value of your account?
5 Why is it important to start a superannuation account when you're young?

We will learn more about savings, investments and superannuation in Year 12.



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Puzzle
Money crossword

Keyword activity

DEFINITIONS MATCH

ANSWERS p. 382

Match each word in the first column to its correct meaning in the second column.

	Word		Meaning
1	allowance	A	Yearly
2	annual leave loading	B	Pay based on the number of hours worked
3	bonus	C	Pay based on the number of items made or processed
4	double time	D	1.5 times the normal rate of pay
5	income	E	A payment to authors, artists or others who create items
6	overtime	F	Extra amount paid for holidays, usually 17.5% of 4 weeks' pay
7	per annum (p.a.)	G	Extra pay for doing good work
8	piecework	H	A fixed amount paid per year
9	retirement	I	Twice the normal rate of pay
10	royalty	J	Additional payment for work under difficult conditions or for doing unpleasant tasks
11	salary	K	Money that is received or gained, usually regularly
12	superannuation	L	Working more hours per day or week than normally
13	time-and-a-half	M	A regular payment scheme for providing an income in retirement
14	wage	N	The end of your formal working life

Solution to the chapter problem

Problem

Hugo earns $19.04 per hour for a 37-hour week in his job in a wholesale plant nursery. He is paid time-and-a-half for the first 5 hours of overtime per week and double time after that. If he is required to work any unscheduled overtime, he receives a $12.68 meal allowance per shift. Hugo also receives a $1.80 allowance per hour when he is required to work in wet areas.

In the week ending 29 May, he worked 43 hours, which included one unscheduled overtime shift and 6 hours of working in a wet area.

Hugo thinks his pay for the week ending 29 May is wrong. Is Hugo's gross pay correct?

Pay slip

Hugo Mendozia

Week ending 29 May	
Normal pay	$704.48
Overtime	$171.36
Allowances	$23.48
Gross pay	$899.32

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?



WHAT?

Determine Hugo's pay to decide whether there's a mistake in his pay slip.

We know he earns $19.04/h for 37 hours. He gets paid time-and-a-half for the first 5 hours of overtime, and double time for any hours after that.

Meal allowance $12.68 for unscheduled overtime shifts.

Wet allowance $1.80 per hour for 6 hours.

The pay slip shows $899.32.

STAGE 2: SOLVE THE PROBLEM



SOLVE

Word clues: 'gross' → total

43 hours = 37 + 5 + 1

Hugo worked 37 hours at normal pay, 5 hours overtime at time-and-a-half and 1 hour at double time.

Normal pay	37 × $19.04	$704.48
Time-and-a-half	5 × 1.5 × $19.04	$142.80
Double time	1 × 2 × $19.04	$38.08
Total overtime	$142.80 + $38.08	$180.88
Wet area allowance	6 × $1.80	$10.80
Meal allowance		$12.68
Total allowances	$10.80 + $12.68	$23.48
Gross pay	$704.48 + $180.88 + $23.48	$908.84

The calculations for Hugo's normal pay and allowances are correct but the overtime calculation is wrong.

Hugo has been underpaid by $180.88 – $171.36 = $9.52
(or $908.84 – $899.32 = $9.52)

STAGE 3: CHECK THE SOLUTION	
 CHECK	Except for overtime, all the answers match the pay slip. Check the overtime pay: $142.80 + $38.08 = $180.88 Calculations are correct and complete.
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	Hugo has been underpaid by $9.52.

8 Test yourself

Earning money

ANSWERS p. 382

1 EXERCISE 8.1 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?

2 EXERCISE 8.1 Marcus is a junior accountant. His annual salary is $96 000.

a How much does Marcus earn per month?

b Calculate Marcus' fortnightly pay.

3 EXERCISE 8.2 Amal works in an aged-care facility. Her normal pay is $24.35 per hour.

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

b When Amal 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 8.2 George earned $168 for working 4 hours at double time. Calculate George's normal rate of pay.

5 EXERCISE 8.3 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.

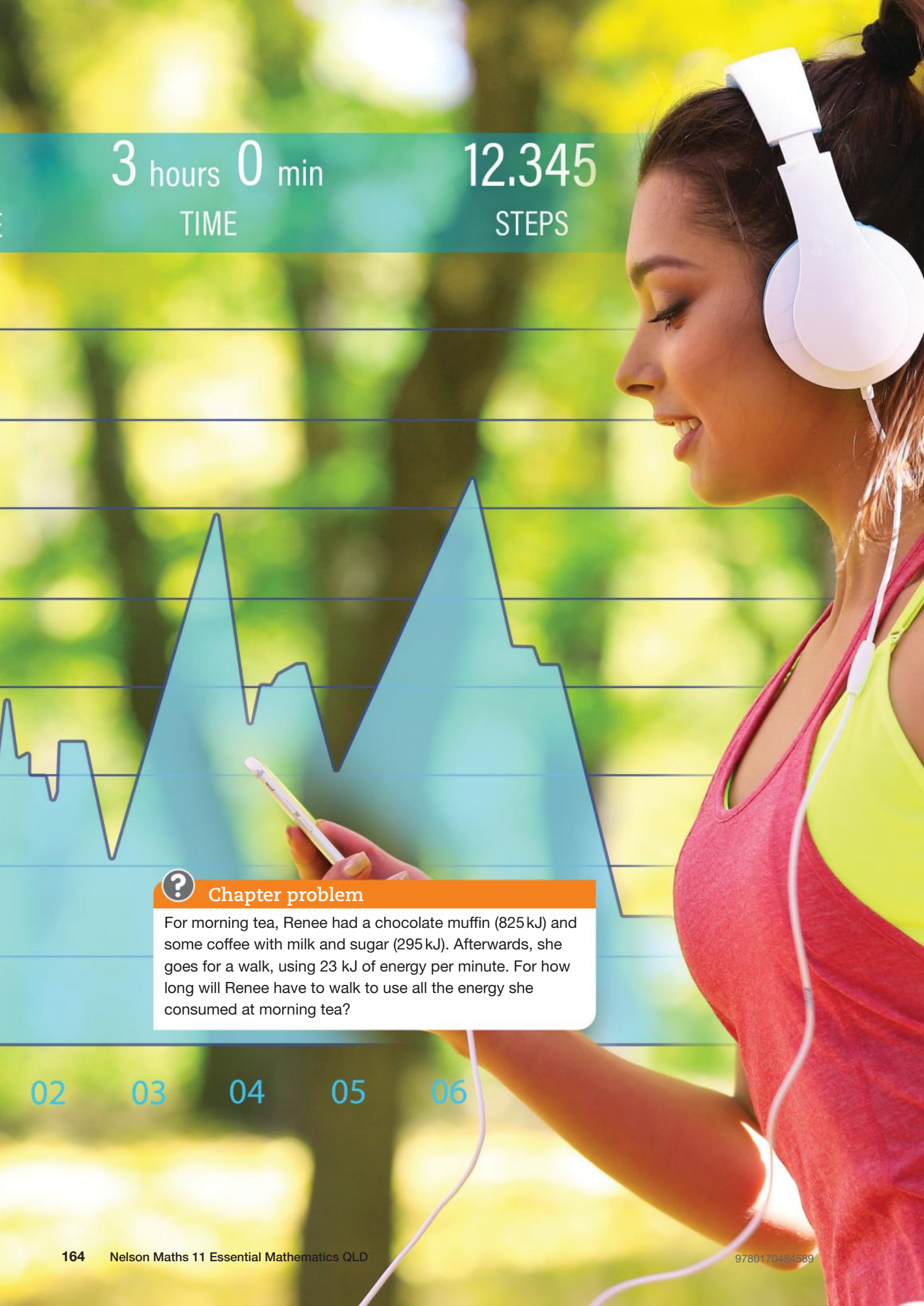
6 EXERCISE 8.3 Angelo is a plumber. For emergency late night callouts, he charges a callout fee of $500 and labour at $125 per hour. Last night he received an emergency call at 2 am. Calculate the amount he will charge for going to the emergency and working for 3 hours to fix the problem.

7 EXERCISE 8.4 Sabine is 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 8.5 Yoshi is an artist whose art features on fun park admission tickets. He receives 5% commission on the sale of each ticket. How much commission will Yoshi receive from the sale of 18 000 tickets priced at $45 each?

9 EXERCISE 8.5 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 8.6 The balance on Brittany's superannuation-based pension account is $829 000 and she has chosen to take 5% of the balance annually as a fortnightly pension. Calculate the value of her fortnightly pension payment.



Chapter problem

For morning tea, Renee had a chocolate muffin (825 kJ) and some coffee with milk and sugar (295 kJ). Afterwards, she goes for a walk, using 23 kJ of energy per minute. For how long will Renee have to walk to use all the energy she consumed at morning tea?

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CHAPTER 9

NUMBER, DATA AND MONEY: NUMBER

HEALTHY FIGURES

Syllabus coverage
Nelson MindTap chapter resources
Terminology
9.1 Burning energy
9.2 Energy in food
9.3 Energy in electricity
9.4 Renee's gym training
Keyword activity
Solution to the chapter problem
Test yourself

What will we do in this chapter?

- Convert units of energy, including between kilojoules (kJ) and calories (Cal)
- Apply units of energy and rates to solve a variety of problems involving food, exercise and electricity

How are we ever going to use this?

- Exercising adequately to maintain a healthy weight
- Consuming an appropriate level of food to meet our nutritional needs

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Syllabus coverage

UNIT 1, TOPIC 1: NUMBER

Units of energy

- Use units of energy to describe consumption of electricity, e.g. kilowatt hours.
- Use units of energy to describe the amount of energy for foods and in activities, including calories and kilojoules.
- Convert from one unit of energy to another including between calories and kilojoules.

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, p. 16
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Video (1):

9.3 Energy consumption

Worksheets (5):

9.2 Investigating fast food

9.3 Household energy costs • Power problems • Energy ratings

9.4 Heartbeat rates

Nelson MindTap

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

Terminology

calories	energy	heart rate	kilojoules (kJ)
kilowatt (kW)	kilowatt hour (kWh)	pulse	

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9.1 Burning energy

Kilojoules (kJ) are metric units of energy. If we use more energy than we eat, we lose body weight. However, if we eat more energy than we use, this energy is stored as fat.

This table shows the amount of energy our body needs each day, depending on our age group, sex and level of activity.

Age	Lifestyle	Men kJ/day	Women kJ/day
18–35	inactive	10 500	8 000
	active	12 500	9 000
	very active	14 800	10 500
36–70	inactive	10 000	8 000
	active	11 800	8 800
	very active	14 300	10 400
Pregnant women			10 100
Breast-feeding women			11 800

EXAMPLE 1 Daily energy needs

Kylie is 18 years old, works in an office and has an inactive lifestyle. Every day on her way to work, she has a cappuccino at the coffee shop. The cappuccino contains 940 kJ.

a How many kilojoules of energy does Kylie need each day?

b What percentage of her daily energy needs does Kylie have in her morning cappuccino?

Steps	Working
a Kylie is 18, a female, and has an inactive lifestyle. Her energy needs are shown in the top row and right column in the table.	8000 Kylie needs 8000 kJ per day.
b $\frac{\text{kJ in the cappuccino}}{\text{kJ per day}} \times 100\%$	$\frac{940}{8000} \times 100\% = 11.75\%$ Kylie's cappuccino contains 11.75% of her daily energy needs.

Calories (Cal) are an older unit of energy. Calories are bigger than kilojoules.

Calories and kilojoules

1 Cal = 4.2 kJ

EXAMPLE 2 Converting calories to kilojoules

A 500 mL chai tea latte with full cream milk contains 240 calories. How many kilojoules is this?

Steps	Working
Kilojoules are smaller than calories. To change to a smaller unit, multiply by the conversion factor.	240 Cal = 240 × 4.2 kJ = 1008 kJ

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EXERCISE 9.1 Burning energy

ANSWERS p. 382

1 EXAMPLE 1 Mark is a 20-year-old bricklayer and has a very active lifestyle.

a According to the table above, how many kilojoules does he require per day?

b Mark eats a hearty breakfast containing 3250 kJ to give him energy for the day's work. What percentage (to the nearest whole number) of his daily energy requirements does Mark have for breakfast?

2 Stella is 36 years old. During the week she is inactive, and on the weekend she is very active.

a How much energy does she need each day during the week?

b How much more energy does she require per day on the weekend than during the week?

3 Courtney, aged 18, is very thin and refuses to eat more than 6000 kJ per day. Every afternoon she works out at the gym for 2 hours. Courtney's mother is worried and knows that the type of gym workout Courtney does burns 2500 kJ/h.

a How much energy does Courtney use at the gym each day?

b How much energy does Courtney have left from her diet for the remaining 22 hours in the day?

4 EXAMPLE 2 Copy and complete each statement. Use the conversion 1 Cal = 4.2 kJ and answer to the nearest whole number.

a 500 Cal = ___ kJ **b** 360 kJ = ____ Cal **c** 68 Cal = ___ kJ

d 25 kJ = ____ Cal **e** 2460 kJ = ___ Cal **f** 10 800 kJ = ___ Cal

5 **a** The treadmill at the gym shows that Samantha has used 550 Cal. How many kilojoules is this?

b Samantha wants to use 2500 kJ on the machine. How many more calories does she have to burn?

6 This graph shows children's daily energy requirements.

a Do boys or girls need more energy per day?

b At what age do boys and girls need approximately the same amount of energy per day?

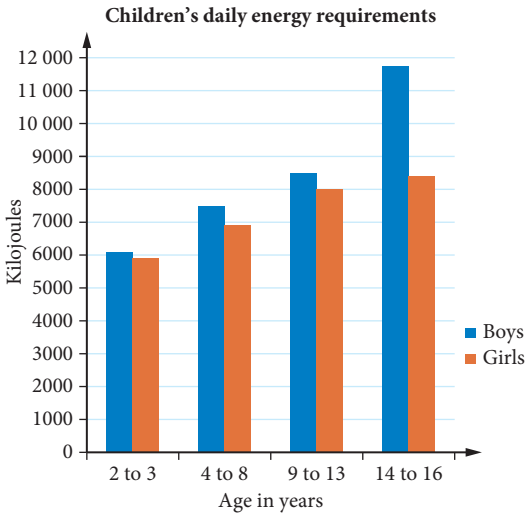
c How many more kJ/day do 16-year-old boys need than 16-year-old girls?

d At what age do boys require approximately 7500 kJ/day?

e Calculate the weekly energy requirements for a 12-year-old girl.

f Jon is an 8-year-old boy who usually eats 8600 kJ of food per day. Is he eating an appropriate amount?

g If Jon continues to eat 8600 kJ/day, will Jon's weight increase or decrease?



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7 This table shows the average length of time it takes an 18-year-old to burn up 1000 kJ for different activities.

Activity	Time required to use 1000 kJ
Sleeping	4 hours
Eating	3 hours
Working in class Studying Screen time	2 hours 30 minutes
Walking	1 hour
Bike riding	50 minutes
Swimming	30 minutes

a How much energy does Scott use swimming for 1 hour?

b How long will it take Jessica to use 500 kJ while she is sleeping?

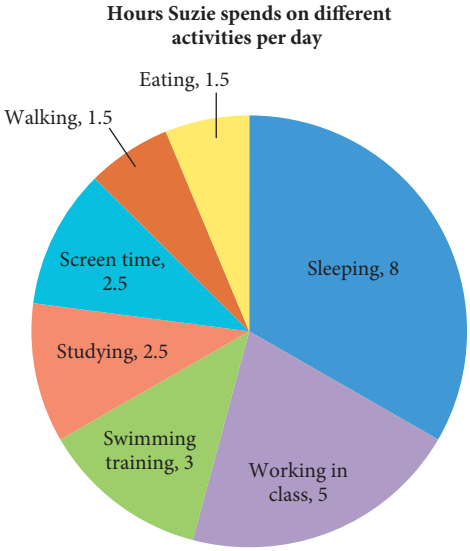
c Suzie, aged 18, leads a very active life. This pie chart shows the number of hours each day that she spends on different activities. PS

i According to the table on page 167, how much energy does Suzie need per day?

ii Use this pie chart and the table above to calculate the amount of energy Suzie uses per day.

iii If Suzie eats food that provides the energy requirement given in part **i**, is it enough for what she uses per day?

iv What recommendations would you give Suzie concerning her lifestyle?



8 The relationship between calories, Cal, and kilojoules, kJ, is an example of direct proportion. We can model the relationship with the direct proportion equation $k = mc$, with m representing the constant of proportionality.

> We usually use k for the constant of proportionality, but in this case k represents the number of kilojoules, so we will use m instead.

We know that 1 Cal = 4.2 kJ. That means that in the equation $k = mc$, when $c = 1$, $k = 4.2$.

a Find the value of m, the constant of proportionality, and write the equation $k = mc$ using this value.

b Use your equation to calculate the number of kilojoules in 2150 calories.

c How many calories are equivalent to 1000 kJ? Answer correct to the nearest calorie.

Worksheet
Investigating fast food

9.2 Energy in food

The food we eat supplies us with energy. This table shows the amount of energy stored in some normal-sized serves of food.

Food	kJ	Food	kJ	Food	kJ
Roast lamb, gravy	1064	Apple pie	1380	Apple	243
Potato bake	1175	One slice of buttered bread	520	Large tomato Small tomato	120 30
Mixed grill	2600	Yoghurt	315	Chocolate biscuit	493
Steak	3900	Muesli	1470	Can of soft drink	372
Bacon (2 slices)	640	Eggs (2)	735	Orange juice	206
Fish	340	Cheese (1 slice)	115	Milk (glass)	628
Grilled chicken breast	1264	Ham (2 slices)	224	Milk for cereal	400
Chips	1425	Mixed nuts (100 g)	2640	Coffee with milk and sugar	295
Ice cream	810	Broccoli	98	Banana	546
Sauce for steak	246	Aioli	265	Beef sausage	176

EXAMPLE 3 Energy in food 1

On a plane, Lucas was served a meal of grilled chicken breast with aioli, chips, broccoli and tomato.
How many kilojoules were in this meal?



Food Shop/Shutterstock.com

Steps	Working
Use the table to look up the kJ content of each food item.	chicken breast: 1264 aioli: 265 chips: 1425 broccoli: 98 half a large tomato: 60
Add them.	total kJ = 1264 + 265 + 1425 + 98 + 60 = 3112
Write your answer.	The meal contained 3112 kJ.

EXAMPLE 4 Energy in food 2

Marna had 200 g of mixed nuts. **Calculate** how long it will take her to use the energy from them when she is working out at the gym at the rate of 30 kJ/minute.

Steps	Working
200 g of nuts = 2 serves (from the table)	total energy = 2640 × 2 = 5280 kJ
Divide the number of kJ by the rate to find the time.	time = 5280 ÷ 30 = 176 minutes = 2 hours 56 minutes
Write your answer.	Marna will work out for 2 h 56 min to use the energy from the mixed nuts.

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EXAMPLE 5 Energy in exercise

Athletes running at 15 km/h use 75 kJ/h per kg of their body weight. Claire's body weight is 58 kg. How much energy does she use when she runs for 30 minutes at 15 km/h?

Steps	Working
Claire burns 75 kJ per hour per kg of her body weight. She weighs 58 kg, so each hour she burns 75 × 58.	energy burned per hour = 75 kJ × 58 = 4350 kJ
30 minutes is half of an hour. Divide by 2.	energy burned in 30 minutes = 4350 ÷ 2 = 2175 kJ
Write your answer.	Claire burns 2175 kJ when she runs for 30 minutes.

EXERCISE 9.2 Energy in food

ANSWERS p. 382

Use the table on page 170 to complete questions **1** and **2**.

1 EXAMPLE 3 Calculate the energy content of each meal.

a Dani's breakfast contains a serving of muesli with milk, an apple and a banana.



iStock.com/Serge_Bertasius

b Felix's breakfast comprises 2 slices of ham, 2 beef sausages, one egg and one slice of buttered bread.

c Milan ate a steak with sauce, a large tomato and a serving of chips for his lunch.



iStock.com/rakratchada

d Emma had some grilled fish with aioli and a large sliced tomato for her lunch.

2 George is 16 years old. The menu shows what he eats in a typical day.

Menu		
Breakfast	**Lunch**	**Dinner**
• 2 slices of bacon • 2 eggs • muesli with milk • 2 slices of toast with butter • glass of orange juice	• ham sandwich with 2 slices of ham • cheese sandwich • apple • 2 chocolate biscuits • yoghurt • can of soft drink	• mixed grill • chips • broccoli • potato bake • apple pie • ice cream • coffee, milk, sugar

a Calculate the total number of kilojoules George eats in a typical day.

b On average, a 16-year-old boy should eat 11 800 kJ per day. What effect will George's typical day's food have on his body weight? PS

3 Amanda requires a daily diet of 8800 kJ. Use the food items in the table on page 170 to plan a healthy day's menu for Amanda.

4 EXAMPLE 4 A large chocolate cake contains 27 600 kJ. Suyen cut the cake into 8 equal slices.

a How many kilojoules are in each slice of cake?

b How many minutes of gym work, at 30 kJ/minute, will it take to use the energy in one slice of the cake?

5 This table shows the energy an average person uses per minute for different activities. Calculate the amount of energy an average person uses when

a gardening for 30 minutes

b ironing for 45 minutes

c bricklaying for an hour

d circuit training for $1\frac{1}{4}$ hours

e sleeping for 8 hours

f walking for 50 minutes every day for a week.

Activity	kJ/minute
Sleeping	4
Cleaning	15
Ironing	17
Bricklaying	17
Playing tennis	31
Gardening	23
Circuit training	53
Walking	23

6 EXAMPLE 5 The more you weigh, the more kilojoules you will burn doing different activities. The table shows the amount of energy per kg of body weight that teens and adults use in one hour in various activities.

Activity	kJ used per hour per kg of weight
Sleeping	3.7
Driving a car	6.4
Schoolwork	6.8
Walking	18
Skiing (15 km/h)	43
Swimming (45-second laps)	29

a Lisa weighs 45 kg. How much energy does she use during a 1-hour maths lesson?

b Ali's body mass is 75 kg. How many more kilojoules than Lisa does he use in 8 hours sleep?

c Marko started walking every day to try to lose weight. He currently weighs 128 kg. How much energy does he use when he walks for 30 minutes?

d Filomena is a keen skier who weighs 63 kg. One Saturday she drove her car for 3 hours to the snowfields. Then she skied at an average speed of 15 km/h for 5 hours. How many kJ of energy did she use in the 8 hours?

e Every morning Scott spends an hour swimming 45-second laps of the pool as part of his training routine. During the hour, Scott uses approximately 2200 kJ. What is Scott's approximate body weight? PS

Chapter problem

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

Investigation My daily energy requirements

What you have to do

- Keep an activities/exercise diary for one week. Record the number of hours you spend on different activities each day. Classify the activities as sleeping, eating, schoolwork or study, low-level activities such as screen time, medium-level activities such as walking, and high-level activities such as swimming, running or going to the gym.
- Also keep a food diary to record the number of kilojoules you eat each day. Remember to include 'hidden' kilojoules such as those in tea/coffee, biscuits and other snacks.
- Use the results in your activities/exercise diary to calculate the kilojoules you need, on average per day. If you don't know the amount of kilojoules involved in any of your activities, use the internet to find out.
- Summarise what you have discovered: Do your kilojoules and energy expenditure balance? What changes might you need to make?

9.3 Energy in electricity

Video Energy consumption

Worksheets Household energy costs

Power problems

Units of electricity

- A **watt** (abbreviation **W**) is a unit of electrical **power**.
- 1 **kilowatt (kW)** = 1000 watts.
- Electrical energy is measured in **kilowatt hours (kWh)**, which is the amount of electricity used by a 1000 W load drawing power for one hour.

The running costs of different appliances can be calculated if you know the power rating or wattage of the appliance, your usage time and the electricity tariff (costs) for your area.



Ksander/Shutterstock.com

EXAMPLE 6 Energy in electricity

Lina has a 200 W TV that she uses for 6 hours per day. The domestic tariff for electricity is 34 cents per kilowatt-hour, written as 34c/kWh.

a How many kWh of electricity will Lina's TV use each day?

b How much will the electricity cost?

Steps	Working
a First change 200 W to kW by dividing by 1000.	200 W = 200 ÷ 1000 = 0.2 kW
Find the electricity usage by multiplying by the number of hours.	electricity usage = 0.2 kW × 6 h = 1.2 kWh
b Find the electricity cost by multiplying by the rate.	electricity cost = 1.2 kWh × 34c = 40.8c

EXERCISE 9.3 Energy in electricity

ANSWERS p. 382

1 EXAMPLE 6 Copy and complete this table to calculate the typical daily and monthly costs of some home appliances. Assume electricity costs are 34 cents per kWh and that there are 30 days in a month.

	Appliance	Power rating (W)	Hours used per day	kWh per day	Daily cost (cents)	Monthly cost ($)
a	fridge (600 L)	800	24			
b	clothes dryer	2400	1.5			
c	washing machine	900	0.5			
d	bathroom/fan/heater/light	1100	1			
e	normal light globe	100	6			
f	food processor	380	0.5			
g	electric kettle	1500	1			
h	hotplate (max setting)	1500	0.25			
i	dishwasher	1900	1			
j	toaster	650	0.5			
k	vacuum cleaner	950	0.25			
l	stereo system	40	5			
m	hair dryer	1400	0.5			
n	TV (medium to large)	550	6			
o	iron	950	0.75			

2 Which of the appliances from question **1** are in your household? How many are there of each appliance?

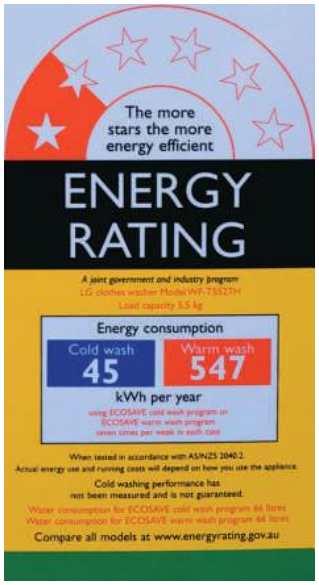
3 Use the information from question **1** to calculate the approximate cost of electricity for running these appliances in your household for one year.

4 How close is your calculation in question **3** to your household's electricity bill? Give reasons why your calculation might be different to your actual bill.

Worksheet
Energy ratings

Investigation The energy rating system

Some household appliances now display **energy rating labels** to help people choose energy-efficient appliances. These labels contain a star rating to show how efficient the appliance is – the more stars, the more efficient the energy use. The label also gives an estimate of the energy the appliance will use over a year.



Mark Boulton/Alamy Stock Photo

Use the internet to research the answers to these questions.

1 What information does the energy rating label on electrical appliances provide?
2 What does it mean for an appliance to have more stars than another?
3 Apart from the number of stars, what other important information is printed on the label?
4 There are 8 appliances that are required to carry energy rating labels. List them.
5 The 2 key features of the label are:
   a the star rating band: how many stars can this have and what does the coloured section indicate?
   b the energy consumption box: what does the number in this box indicate?
6 For all star-rated appliances other than air conditioners, the energy consumption figure is given in what units and for what period?
7 How is the information given for air conditioners?
8 Write down how the energy consumption figure can be used to calculate the annual electricity cost of the appliance.
9 Calculate the annual cost of running a refrigerator rated at 750 kWh/year if the electricity tariff is 34 cents/kWh.

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9.4 Renee's gym training

Heart rates

The heart is a large muscle that pumps blood around our body. If it stops beating for more than a few minutes, we may die. Our hearts beat faster during exercise. After exercise, the time it takes for our heart to return to its resting rate is a measure of our fitness.

Our **heart rate** or **pulse** is measured in beats per minute. The average rate is 72 beats/min.

We can use a simple formula to convert a pulse rate for any time period into a rate per minute.

Pulse

$$\text{pulse in beats per minute} = \frac{\text{number of beats}}{\text{time in seconds}} \times 60$$



Worksheet
Heartbeat rates

EXAMPLE 7 Heart rate

Darren takes his pulse during an exercise session and counts 52 beats in 20 seconds.
Calculate his pulse in beats per minute.

Steps	Working
$\text{pulse in beats per minute} = \frac{\text{number of beats}}{\text{time in seconds}} \times 60$	$\text{pulse} = \frac{52}{20} \times 60$ $= 156 \text{ beats/min}$

Some gyms can collect the energy people use on exercise machines and convert it to electricity. One person doesn't generate a lot of energy, but when the gym is full, the electricity generated can power the gym's TV and sound systems, which saves money.

EXAMPLE 8 Generating electricity

At the gym, each exercise bike rider generates 100 watts of electricity per hour. On average, an exercise bike is used for 6 hours per day, 364 days per year (closed Christmas Day) and the gym pays 54c per kilowatt for electricity.

How much in electricity costs does each bike save the gym annually?

Steps	Working
Calculate the electricity a bike generates each day by multiplying the rate by 6 hours.	$\text{electricity generated per day} = 100 \times 6$ $= 600 \text{ W}$
Multiply the daily amount by 364 to get the annual amount.	$\text{electricity generated per year} = 600 \times 364$ $= 218\,400 \text{ W}$
Divide by 1000 to change it into kilowatts.	$218\,400 \div 1000 = 218.4 \text{ kW}$
Calculate the electricity cost by multiplying by the cost rate. Write 54c as \$0.54.	$\text{cost} = 218.4 \times \$0.54$ $= \$117.94$
Write the answer.	On average, each exercise bike saves the gym \$117.94 in electricity costs per year.

EXERCISE 9.4 Renee's gym training

ANSWERS p. 382

1 Renee's 3-month gym membership costs $234 and gives her 13 weeks of unlimited use of the gym.

- **a** How much does Renee's membership cost per week?
- **b** Casual users of the gym are charged $11 per visit. Renee attends the gym 4 times per week. How much will her 3-month membership save her compared to the casual rate?
- **c** How many visits to the gym does a member need to make in 3 months to make membership worthwhile?

2 A gym is advertising special membership deals to attract new members.

- **a** Calculate the charge per week for each of the two plans.
- **b** If you were joining the gym, which plan would you choose? Why?



3 EXAMPLE 7 Convert each pulse rate to beats per minute.

- **a** 25 beats in 20 s
- **b** 16 beats in 15 s
- **c** 65 beats in 30 s

4 The gym manager has prepared a table to help visitors convert their pulse for 15 seconds to beats per minute. Complete the missing values in the table.

Heart beats in 15 seconds	Pulse in beats per minute
20	**a**
25	**b**
30	**c**
35	**d**
40	**e**
45	**f**
50	**g**

5 During her first aerobics class, Renee counted her pulse as 43 beats in 15 seconds.

- **a** What is Renee's pulse in beats per minute?
- **b** The best pulse rate during exercise is 60% of the maximum pulse rate. Renee is 16 years old. Use the table to calculate her best exercise pulse rate.
- **c** What advice would you give Renee if she exercises at an intensity that gives her a pulse of 43 beats in 15 seconds?

Maximum pulse rates in beats per minute	
15–19 years	180
20–29 years	170
30–39 years	160
40–49 years	150
50+ years	140

6 Renee's resting breathing rate (respiration rate) is 16 breaths per minute. When she runs on the treadmill, she likes to run at a pace that gives her a 75% increase in her respiration rate. What respiration rate does Renee aim for when she uses a treadmill? PS

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7 As a warm-up exercise, Renee rode an exercise bike at a speed of 20 km/h for 5 minutes.

a What fraction of one hour is 5 minutes?

b Use your answer to part **a** to calculate how many kilometres, correct to 2 decimal places, Renee rode on the bike during the 5 minutes.

8 In a circuit class, participants change fitness machines every 30 seconds. There are 28 different activities in the circuit. These are completed at workstations.

a How long will it take Renee to complete one circuit using each workstation once?

b In the circuit class, the workstations are used for 25 minutes.
How many workstations will Renee use per class?

9 EXAMPLE 8 When Renee is using the fitness machines, she generates 85 watts of electricity per hour. She uses the machines for 3 hours per week.

a How many watts of electricity does Renee generate on the machines per week?

b Calculate the amount of electricity Renee will generate during her 13-week membership.
Express your answer in kilowatts.

c Calculate the value of the electricity Renee generates in 13 weeks at 54 c/kilowatt.

10 The gym has 24 treadmills. On average, each treadmill is in use for 10 hours per day, 364 days per year. Members using a treadmill generate 110 watts of electricity per hour. PS

a Calculate the total number of kilowatts of electricity generated by members on the treadmills per day.

b How many kilowatts of electricity do members generate on the treadmill per year?

c At 54c/kW, calculate the total annual value of the electricity generated on the treadmills.

Keyword activity

DEFINITIONS MATCH

ANSWERS p. 383

Match the terms in the left column with their meaning on the right.

	Term		Meaning
1	calorie	a	A word used in rates that means 'for each'
2	kilowatt-hour	b	A unit for measuring electrical power, equal to 1000 watts
3	kilojoule	c	The rate measured in beats/minute
4	kilowatt	d	An old unit for measuring the energy in food
5	speed	e	A measurement involving 2 different types of units
6	per	f	The metric unit for measuring energy in food
7	pulse	g	A rate that compares distance travelled with the time taken to travel that distance
8	rate	h	A unit for measuring electrical energy

Solution to the chapter problem

Problem

For morning tea, Renee had a chocolate muffin (825 kJ) and some coffee with milk and sugar (295 kJ). Afterwards, Renee goes for a walk, using 23 kJ of energy per minute. For how long will Renee have to walk to use all the energy she consumed at morning tea?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	Calculate the time Renee has to walk to use the energy from morning tea. She had a muffin (825 kJ) and coffee (295 kJ).
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	Total energy Renee consumed = 825 + 295 = 1120 kJ Number of minutes walking = 1120 ÷ 23 = 48.7 minutes ≈ 50 minutes
STAGE 3: CHECK THE SOLUTION	
 CHECK	50 minutes is reasonable for burning over 1000 kJ of energy at 23 kJ/minute. The time is in a reasonable range.
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	Renee should walk for about 50 minutes to use up the energy she had at morning tea.

9 Test yourself

Healthy figures

ANSWERS p. 383

1 EXERCISE 9.1 Use the conversion 1 Cal = 4.2 kJ to complete each statement.

a 250 Cal = ____ kJ **b** 5754 kJ = ____ Cal

2 EXERCISE 9.1 When riding a bike, Alex takes 50 minutes to burn 1000 kJ.

a How many kJ does Alex use riding a bike for 25 minutes?

b How long does it take Alex to use 3500 kJ when bike riding?

3 EXERCISE 9.2 Renata is an active pregnant woman aged 24.

a Use the table on page 167 to determine how many more kilojoules Renata requires per day when she is pregnant than when she is not.

b Use the table on page 170 to suggest foods Renata could add to her diet to make up the kilojoules she requires while she is pregnant.

4 EXERCISE 9.2 Marc ate a mixed grill and apple pie with ice cream for his dinner. Use the table on page 170 to calculate the number of kilojoules in Marc's dinner.

5 EXERCISE 9.2 Adults running at 15 km/h use 75 kJ/h per kilogram of their body weight. Kristy's body weight is 64 kg. How many kilojoules does she use when she runs for 45 minutes at 15 km/h?



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6 EXERCISE 9.3 How much electricity is used (in kWh) when a 100 W light globe is on for 5 hours?

7 EXERCISE 9.3 Tamara takes about $1\frac{1}{2}$ hours per week to iron her clothes. If she uses a 200 W iron and the cost of electricity is 28 c/kWh, calculate the cost of using the iron each week.

8 EXERCISE 9.4 Lenny's heart beats 11 times in 10 seconds. Calculate his pulse in beats per minute.

9 EXERCISE 9.4 Diaz generates 96 watts of electrical energy per hour when he uses an exercise bike. Calculate the total value of the energy he generates using the bike for 45 minutes per day for 6 days. Use 55 c/kilowatt-hour as the value of the electricity.

10 EXERCISES 9.1, 9.2 Sandra is 65 years old and has a new dog that requires a 5 km walk every morning. When Sandra was 18 years old, she used 210 kJ/km while walking but, because she walks more slowly now, she only uses 85% of this energy. Sandra likes to have a muffin with her coffee. Each muffin contains an average of 980 kJ of energy. How many muffins can Sandra eat per week to balance the kilojoules she uses when she is walking the dog?



Chapter problem

Hamish is preparing his income tax return. The annual payment summary shown below is for his day job only. Hamish also earned $7640 and paid $1440 tax in his part-time job. He has $960 in allowable tax deductions and has private health insurance.

Will Hamish receive a tax refund?

PAYG payment summary		
Employee	Hamish Donald	
Employment period	1 July 2024–30 June 2025	
	Total income	$58 230
	Total tax withheld	$11 461



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CHAPTER 10

NUMBER, DATA AND MONEY: MANAGING MONEY

PAYING TAX

Syllabus coverage
Nelson MindTap chapter resources
Terminology
10.1 Gross and net pay
10.2 Taxable income and PAYG tax*
10.3 Income tax and Medicare levy*
10.4 The costs of living*
10.5 Personal budgeting*
Keyword activity
Solution to the chapter problem
Test yourself
*COMPLEX

What will we do in this chapter?

- Calculate net pay after making deductions from gross pay
- Calculate taxable income after making allowable tax deductions from income
- Calculate income tax and Medicare levy
- Calculate tax payable or refund owing after PAYG tax has been paid
- Prepare a household budget

How are we ever going to use this?

- Checking the amount of tax deducted from our pay
- Making sure we don't pay too much tax
- Keeping accurate records and collecting receipts to calculate allowable tax deductions
- Calculating whether we're entitled to a tax refund
- Using a budget to manage our income and spending

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Syllabus coverage

UNIT 1, TOPIC 3: MANAGING MONEY

Earning money

- Understand the purpose of taxation and the use of tax file numbers.
- Use tax tables to determine PAYG tax for periodic (weekly/fortnightly/monthly) earnings [complex].
- Interpret entries on a simple PAYG summary.
- Apply the concepts of taxable income, gross income, allowable deductions and levies in simple contexts [complex].
- Calculate a simple income tax return and net income using current income tax rates [complex].

Budgeting

- Investigate the costs involved in independent living [complex].
- Prepare a personal budget plan [complex].

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Video (1):
10.3 Income tax

Worksheets (5):
10.3 Income tax tables • Income tax and Medicare levy
10.5 Budgeting scenarios • Budget grid • My budget

Puzzle (1):
Keyword activity Taxation and budgeting crossword

Weblinks (2):
10.5 My Future • Australian Tax Office

Nelson MindTap

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

Terminology

allowable deductions	annual	budget	discretionary expenses
expense	fixed expenses	fortnightly	gross income
income tax	invoice	Medicare levy	net income
off-peak electricity	PAYG summary	PAYG tax	private health insurance
quarterly	taxable income	taxation	tax debt
tax rates	tax refund	tax return	tax tables

10.1 Gross 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) **tax** system, in which their employer estimates and takes out the tax from their **gross income** before they give them their **net income**. 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 income and net income

Gross income is the total amount earned.

net income = gross income – tax

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

EXAMPLE 1 Gross and net income

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 **Calculate** Chris' fortnightly gross income.

b **Calculate** Chris' fortnightly net income.

Steps	Working
a Chris works $3 \times 2 = 6$ shifts per fortnight.	gross income $= 6 \times \$155$ $= \$930$
b net income = gross income – tax	net income $= \$930 - \$45.60$ $= \$884.40$

EXERCISE 10.1 Gross and net pay

ANSWERS p. 383

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

a Calculate Dylan's net weekly income.

b How much PAYG tax does Dylan pay per year?

2 Copy the table and complete the missing values.

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

3 Hayley 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 Hayley earn per week?

b Calculate her 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 calculates 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 income, correct 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 Juan's pay per week?

b What was his net weekly income 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?

10.2 Taxable income and PAYG tax*

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. This information is supplied by your employer on a statement called a **PAYG payment summary**. 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**. You deduct these amounts from your annual income. Income tax is calculated on the remaining amount, called your **taxable income**.

Taxable income
taxable income = total income – allowable deductions

EXAMPLE 2 Taxable income after deductions

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 the total tax deductions.	deductions = $290 + $80 = $370
taxable income = total income – deductions	taxable income = $65 420 – $370 = $65 050

EXAMPLE 3 Tax refund or debt 1

Last financial year, Rowan paid $302 each week in PAYG tax instalments. The tax office calculates that on an income of $65 000, 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 must 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 determine the refund amount.	tax refund = $15 704 – $15 095 = $609

EXAMPLE 4 PAYG tax table

Jesinta earns a gross pay of $2290.33 per fortnight. Her deductions are for PAYG tax, $44.10 for health insurance and $55.82 for superannuation.

Fortnightly earnings ($)	PAYG tax withheld ($)
2270–2275	418
2276–2279	420
2280–2285	422
2286–2291	424
2292–2297	426
2298–2303	428

a Use the PAYG tax table to find Jesinta's PAYG tax per fortnight.

b Calculate her take-home pay.

Steps	Working
a In the table, $2290.33 falls in the $2286 – $2291 range.	fortnightly PAYG tax = $424
b take-home pay = gross income – tax – other deductions	take-home pay = $2290.33 – $424 – $44.10 – $55.82 = $1766.41

EXERCISE 10.2 Taxable income and PAYG tax*

ANSWERS p. 383

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

3 Madeleine's net pay is $1190 per week and her weekly gross income 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 income.
- **b** What is Sunny's annual gross income?
- **c** Sunny's income tax payable is $20 042. Will he receive a refund or a bill? Justify your answer.

5 EXAMPLE 3 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? What amount is involved?

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

8 Each week, Gianna earned $2235 and paid $550.18 in PAYG tax. Her work-related travel 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** Calculate her annual taxable income.
- **d** The ATO calculated Gianna's tax to be $28 173.83. Did she receive a refund? What amount was involved?

Use the table from Example 4 on the previous page to answer questions **9**, **10** and **11**.

9 EXAMPLE 4 Every fortnight, Santosh earns $2278 and pays $22.80 in union fees and $94.10 in superannuation.

- **a** Find how much PAYG tax he pays per fortnight.
- **b** Calculate Santosh's fortnightly take-home pay.

10 Holly earns a gross pay of $2295 per fortnight. Her deductions are PAYG tax, $64.35 for superannuation and $30 for life insurance. Find Holly's:

- **a** PAYG tax
- **b** take-home pay.

11 Enrique earns $1148 per week.

a If he is paid fortnightly, what is his fortnightly gross pay?

b Find the PAYG tax that is taken out of his gross pay.

c Enrique's deductions are $141.94 for his health fund and $51.33 for superannuation. Calculate Enrique's fortnightly take-home pay.

12 Ava works part-time as a house painter. In July, she received this PAYG payment summary from her employer.

PAYG payment summary – individual non-business

Payment summary for year ending 30 June 2025

Payee details

CONSTANCE
AVA
15 KINGSTON ST
COOROY QLD 4563

NOTICE TO PAYEE

If this payment summary shows an amount in the total tax withheld box you must lodge a tax return. If no tax was withheld you may still have to lodge a tax return.

For more information on whether you have to lodge, or about this payment and how it is taxed, you can:

- refer to *TaxPack*
- phone **13 28 61** between 8.00 am and 6.00 pm (EST), Monday to Friday, or
- visit **www.ato.gov.au**

Period during which payments were made — Day/Month/Year 01/07/2024 to Day/Month/Year 30/06/2025

Payee's tax file number 644422228

TOTAL TAX WITHHELD $ 1396

		Lump sum payments
Gross payments	$ 24, 390	A $
CDEP payments	$	B $
Other income	$	C $
Reportable fringe benefits amount FBT your April to 31 March	$	D $

ALLOWANCES:

Travel - $1040

Tool Allowance - $260

a What financial year does this PAYG summary cover?

b What was Ava's gross pay for the year?

c How much PAYG tax has she paid?

d What was the $260 allowance for?

e Assuming Ava works the same number of hours each fortnight, calculate her fortnightly net pay. PS

f Each week, Ava works a total of 20 hours. Calculate her hourly pay rate.

g Ava's income tax payable at the end of the financial year is $1663.90. Will she receive a tax refund? If yes, how much? If no, how much more tax will she have to pay?

Video
Income tax

Worksheets
Income tax tables

Income tax and Medicare levy

10.3 Income tax and Medicare levy*

How does the Australian Tax Office (ATO) 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

Individual income tax rates - Resident tax rates 2023–24, https://www.ato.gov.au/rates/individual-income-tax-rates/ © Australian Taxation Office for the Commonwealth

The ATO uses tax file numbers to keep track of wage and investment earnings. If you don't give your tax file number to your employer, your employer is required to tax you at the highest rate.

EXAMPLE 5 Income tax

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–$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–$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, Australia's 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		
	Base tier	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%

Medicare levy surcharge income thresholds and rates, http://www.ato.gov.au/individuals-and-families/medicare-and-private-health-insurance/medicare levy surcharge © Australian Taxation Office for the Commonwealth

EXAMPLE 6 Medicare levy

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 7 Tax refund or debt 2

Declan works as a shop fitter. His gross income this year will be $63 240 and he thinks 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 include union fees, costs of tools and donations to charity.	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 + 32.5c 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 10.3 Income tax and Medicare levy*

ANSWERS p. 383

1 EXAMPLE 5 Use the income tax table on page 188 to calculate the tax payable on each taxable income.

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

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

2 EXAMPLE 6 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 7 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? If yes, how much? If no, how much more tax will he have to pay?

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 How much is her Medicare levy?

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

5 Tim earns $480 per week in his part-time job.

a Calculate Tim's annual pay.

b If Tim has no allowable deductions, what is the tax payable on his annual income?

c Determine the weekly tax using your calculation in part **b**.

d Calculate the weekly take-home pay for a person who earns $480 per week.

e Because Tim hasn't given his employer a tax file number, he must pay 45c of every dollar he earns in tax. How much tax will Tim pay per week?

f Calculate Tim's take-home pay.

g How much less is Tim's take-home pay because he didn't supply a tax file number?

6 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. PS

7 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?

8 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?

9 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.

10 Sam 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 Sam have to pay last year in tax and Medicare levy?

b Sam'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?

11 Because Jay is a low-income earner without health insurance, his Medicare levy is only $960.
Calculate Jay's taxable income. PS

12 Taylor owns a townhouse for which 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 for Taylor's townhouse.

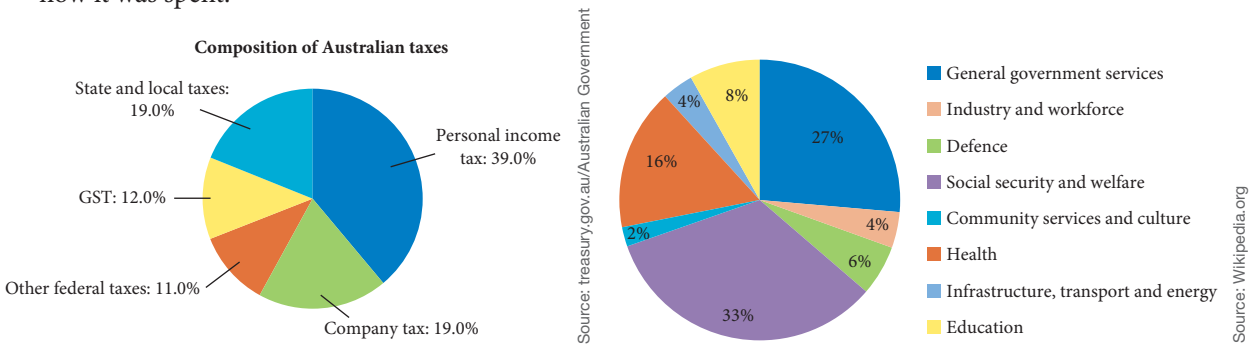
b All Taylor's expenses involved in owning the townhouse are allowable deductions.
Calculate the total amount Taylor can claim as allowable deductions for the townhouse.

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 has no private health insurance?

13 Anna didn't supply her tax file number (TFN) when she opened a term deposit at her bank.
She calculated that the investment would earn $4894 in interest, but she only received $2691.70.
How can this be explained? Use a calculation to support your answer. PS

14 The following 2 graphs show the source of the Australian Government's money in 2022–23 and how it was spent.



In 2022–23 the government raised a total of approximately $683 billion in tax.

a Approximately how much came from individual income tax? Answer to the nearest billion.

b How much more was raised in company tax than in GST? Answer to the nearest billion.

c In a balanced budget, the amount of money spent is the same as the amount raised (received).
How much, to the nearest billion, could the government spend on social security and welfare as part of a balanced budget?

d In a balanced budget, is the amount received from company tax sufficient to cover the cost of health services? Use calculations to justify your answer.

Chapter problem

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

Practical activity Completing a tax return

In Chapter 8, *Earning money*, you looked at your possible career in the 'My future career' investigation. Imagine you have just completed a financial year working in one of the careers recommended for you.

Part 1: Your financial details

1 Write down your 9-digit tax file number if you have one or make one up if you haven't.
2 Research the income you can expect to earn per year in your recommended career.
3 Calculate 20% of the value of your income and assume you have paid that amount in PAYG tax.
4 List any expenses you could incur that are work-related.
5 Decide whether you will have private medical insurance and research the annual insurance cost.
6 Record any bank interest or dividends from shares that you think you might receive.

Part 2: Completing the tax return form

1 Visit the **Australian Taxation Office** website, www.ato.gov.au, and download a tax return form for individuals.
2 Print the form, then open the **Individual tax return** instructions document. Printing this document is not required.
3 Enter the information from part 1 into the tax return form. If you don't know how to complete any section, ask your teacher for help or look at the relevant pages of the tax return instructions.
4 Determine your taxable income, the income tax you are required to pay, and your Medicare levy.
5 Determine the amount of your tax refund or any extra tax you have to pay.
6 You can use the tax calculators on the ATO website to check your calculations.

When you have a real job and tax file number, you can complete your tax return online.

Weblink
Australian Tax Office

10.4 The costs of living*

Moving out of home and living on your own is an expensive business. There's rent, council rates, electricity, gas, petrol, insurances, internet, phone and more. Wise consumers keep track of their bills and pay them promptly to avoid problems.

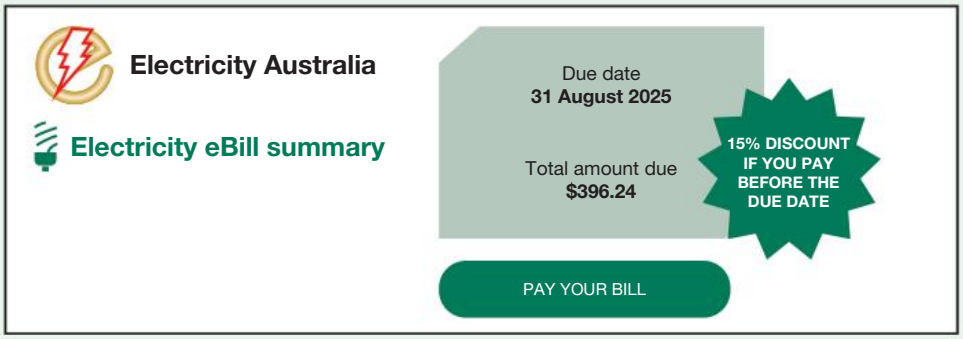
Sometimes, you can get a discount if you pay your bills early, but if you pay them late you can be charged penalty fees and interest. Setting up an automatic direct debit can avoid this problem.

Look for the following information on your bill or invoice.

- Date of invoice
- Account number
- Due date for payment
- Will the bill be paid by direct debit from your account? If so, does your account have sufficient funds to cover the payment?
- Do you need to pay the bill yourself? If so, is there a discount for an early payment or a penalty for a late payment?

EXAMPLE 8 Electricity bill

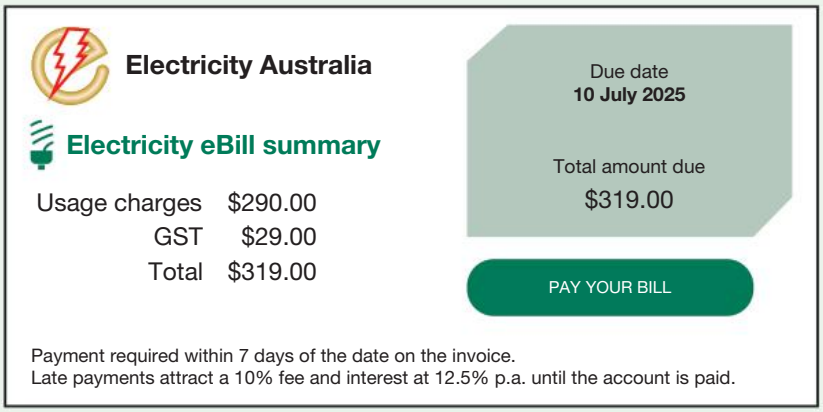
Ryan received this electricity bill:



Ryan pays the bill on 30 August. How much does he have to pay?

Steps	Working
Ryan pays before 31 August.	
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 9 Bill late fees



Jacki pays this bill late, on 28 July.

a How much will it cost?

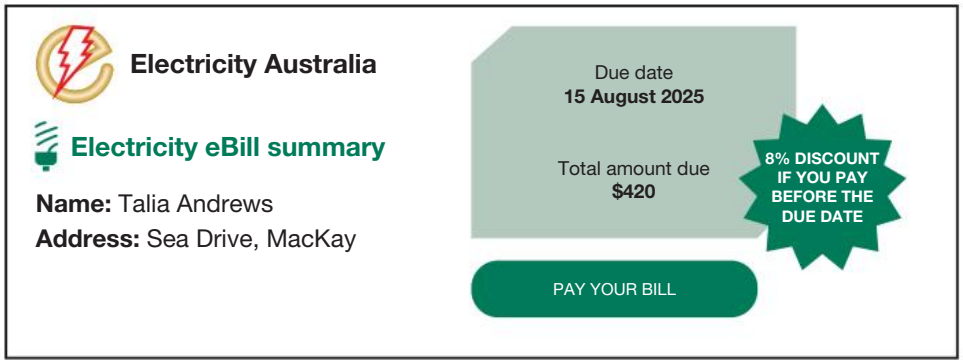
b How much extra will Jacki have to pay because she paid the bill late?

Steps	Working
a The late fee is 10% of the account, $319.00	late fee = 10% × $319 = $31.90
Add the late fee to the bill.	total bill = $319 + $31.90 = $350.90
Jacki pays the bill 18 days late (10 to 28 July). Calculate the interest at 12.5% for 18 days.	interest = $0.125 \times \$350.90 \times \frac{18}{365}$ = $2.16
Add the interest to the bill.	total bill = $350.90 + $2.16 = $353.06
b extra paid = total bill – original bill	extra paid = $353.06 – $319 = $34.06

EXERCISE 10.4 The costs of living*

ANSWERS p. 383

1 EXAMPLE 8

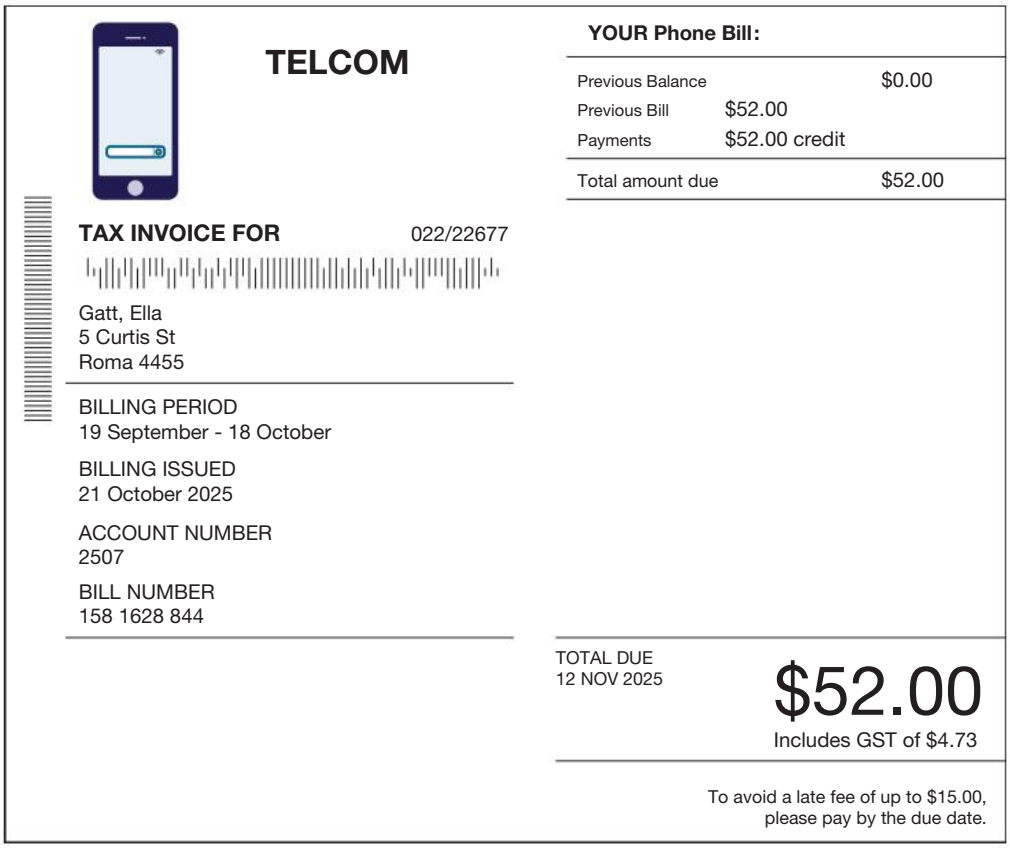


a When does Talia have to pay her electricity bill if she wants the discount?

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 the bill after the due date?

e Ella paid the bill on 15 November. How much did it cost her?

3 EXAMPLE 9 Walter received his quarterly water bill this morning.

Greater Middleton Council (GMC)

GMC

1.1658 019

Civic Centre,
215 Main Street, Middleton QLD 4727
Ph: (07) 4811 7392 **Fax:** (07) 4811 0000
Email: council@middleton.qld.gov.au

Opening Hours
8.30 am to 5.00 pm Monday to Friday

Mr Walter Bill,
17 Reservoir Rd,
Middleton QLD 4727

Consumption Notice

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

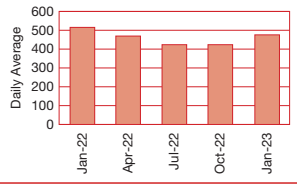
See reverse for details

PAYMENT SUMMARY

Arrears	$0.00
Total	
This account	$71.81
Amount due	**$71.81**

Deduct payments since 06/02/2023

Your average daily water use for this account is: 478



See reverse for details

The daily interest accrues on overdue charges at a rate of 11% per annum.

TOTAL DUE: $71.81

Remittance Advice

Greater Middleton Council (GMC)

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 QLD 4727

POST billpay Billpay Code: 9159 Ref: 30789999

*71 159 30789999

Pay in person at any Post Office phone 13 18 or go to postbillpay.com.au

☐ Please tick box if a receipt is required

Present this remittance advice at our office Civic Centre, 215 Main Street, Middleton QLD 4727

Post this remittance advice with your cheque

Credit card payments can be made at Civic Centre or via the Postbillpay service.

BPAY Biller Code: 9159 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

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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 over this period?

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 might 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 Southern Downs. This is their rates notice.

SOUTHERN DOWNS Regional Council
Private Bag 1000,
Besgrove Street, Warwick 4370

ABN 53 159 890 000
For general enquiries, call us or visit our wensite
sdrc.qld.gov.au
1300 555 600 (local call, fees apply)

Sean Smith and Jett Chi
2 Ashleigh Ave, Warwick QLD 4370

032
1017921
R2_18429

2025–26
Rate Instalment Notice

SOUTHERN DOWNS
regional council

Property details
2 Ashleigh Ave, Warwick QLD 4370

Property number
70643

Date of Issue
04/11/2025

Financial details

Due date
30/11/2025

2ND INSTALMENT
(including arrears where applicable)

$548.30
DUE 30/11/2025

Amount due
$548.30

Notes
If you are having difficulty paying your rates, please contact the Revenue Team to discuss your circumstances and payment plan options.

Phone: 07 555 1080
Email: manager@sdrc.qld.gov.au

The rating year is from 01/07/2025 to 30/06/2026. 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 or go to stbillpay.com.au

5009 70643

Property location: 2 Ashleigh Ave, Warwick QLD 4370
Name: S Smith and J Chi
Property number: 80648

Instalment payment amount: $548.30
Instalment payment due: 30/11/2025

For emailed notices
southdown.enotices.com.au
Ref no: ABC849E1AA

Council use only

SOUTHERN DOWNS
regional council

a How much are the quarterly rates?

b When do the rates 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?

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?

Remember: **quarterly** means 4 times per year or every 3 months.

Remember: **annual** means yearly.

5 The following bill shows the electricity charges for a quarter.

NMQ Energy

Account Number: 56007899
Date Due: Thursday 23 August 2023
Amount Due: $296.27

FOR ACCOUNT ENQUIRIES: PHONE 131 000
FOR 24HR EMERGENCY ASSISSTANCE: PHONE 131

MR B POWER
125 FARADAY DR
MEGAWATT 4571

ELECTRICITY ACCOUNT

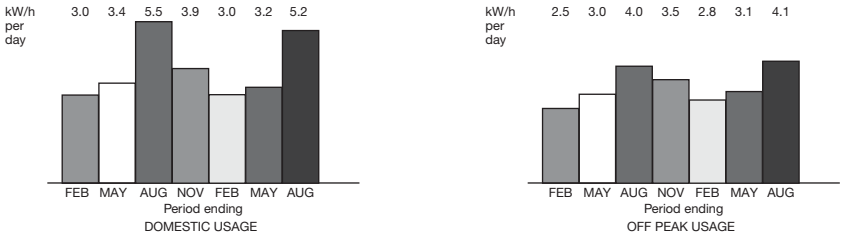
Issue Date: 03/08/2023

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 the 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** is cheaper and refers to electricity that is used during late night and early morning periods, when the demand is much lower.

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

Investigation | Your household bills

What bills does your household have to pay each year? List the bills and their approximate value. In your group discuss why each person's bills could be different and how you might be able to reduce the cost of some of the bills.

10.5 Personal budgeting*

Worksheets
Budgeting scenarios
Budget grid

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 your expected income and expenses and can help you to manage your money.

Income covers all the money you might earn.

Expenses covers all the ways you might spend that money. 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.



Wavebreakmedia/Shutterstock.com

A budget needs to balance your income and expenses so that you have enough money for everything you require and some left over to save for special items, such as a car or holiday.

EXAMPLE 10 Personal budget

Ashleigh works part-time while studying. She receives an allowance from her parents of $100 per week and she earns $120 from her job. She pays $80 per week in rent in a share house and spends $30 per week on food. She averages $10 per week for her phone and $20 per week on clothes. She divides the remainder equally between entertainment and savings.

a Create 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 increased expense?

Working

a List income and expenses and make sure total expenses equals total income.

total of fixed expenses = $80 + $30 + $10 + $20 = $140

remainder available for entertainment and savings = $220 − $140 = $80

divided equally = $80 ÷ 2 = $40

Income		Expenses	
Allowance	$100	Rent	$80
Earnings	$120	Food	$30
		Phone	$10
		Clothes	$20
		Entertainment	$40
		Savings	$40
Total income	**$220**	**Total expenses**	**$220**

b The $25 increase in rent means Ashleigh now has $25 less to spend on entertainment and savings. She has $80 − $25 = $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 10.5 Personal budgeting*

ANSWERS p. 385

1 Lily owns a car and has the following expenses each year:

- registration $349
- Compulsory Third Party (CTP) insurance $795
- comprehensive insurance $1110
- maintenance bills $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 EXAMPLE 10 Mitchell works in an office during the week and in the bar at the local club on weekends. His take-home pay is $820 per week from the office job and $285 from the club. He pays $380 per week in rent and spends an average of $90 per week on food. His phone costs him $25 per week and travel expenses are $70 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 car expenses. Create a new budget for Mitchell.

3 Ali is an apprentice mechanic. His take-home pay is $790 per week.
This table shows his weekly expenses.

Item	Amount
Board	$120
Phone	$21
Clothes	$65
Car	$112
Entertainment	$72
Other expenses	$88
Savings	
Total	**$790**

a How much does Ali save each week?

b Calculate his net annual income.

c How much is Ali able to save each year?

4 This table shows Lucia's monthly budget.

Income		Expenses	
Part-time job	$290	Clothes and make up	$140
Babysitting	$130	School needs	$32
		Entertainment	$50
		Phone	$35
		Fares	$23

a Calculate Lucia's monthly income and expenses.

b Calculate the amount she is able to save each year.

c Lucia 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 Sanjeev has taken a second job to save for a new car. His budget for a week is shown below.

Income		Expenses	
Main job	$850	Rent	$325
Second job		Travel	$56
		Food	$128
		Clothes	$70
		Entertainment	$75
		Bills	$157
		Savings	
Total	**$1108**	**Total**	**$1108**

a Calculate how much Sanjeev earns from his second job.

b Calculate how much he can save each week.

c If the car Sanjeev wants to buy costs $25 000, how long would it take him to save this money?

d Suggest ways Sanjeev could save more per week so that he can buy the car sooner. Create a new budget for Sanjeev.

Worksheet
My budget

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

- You have finished school.
- After school, you enrolled in a TAFE course for a year.
- You are now working and earn $27 040 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).

1 Download the **My budget** worksheet from Nelson MindTap, which contains the **Weekly tax tables, 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 insurance etc. or train, bike or walking	
Personal spending	Clothing	
	Hair, grooming, cosmetics etc.	
Food	Groceries, including pet food	
Utilities	Phone expenses	
	Electricity, gas, water	
Total regular expenses		$

Discretionary weekly expenses		$
Insurance	Home and/or contents	
Insurance	Car – comprehensive	
Insurance	Health	
Entertainment	Pay TV, 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: You in your preferred occupation

Now, 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 (e.g. 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 insurance of various types. Consider the advantages and disadvantages and whether you can afford them. 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 your preferred occupation and determine the gross wage for that occupation as follows.
   - Go to the **My Future** website.
   - Click on Occupations, then find your occupation.
   - Select Prospects, then Full-time weekly 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 found on the 'My budget' worksheet or downloaded from the **Australian Tax Office** website by searching for the table of 'Weekly withholding amounts'.
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.



Wear it out/Shutterstock.com

Weblinks
My Future

Australian Tax Office

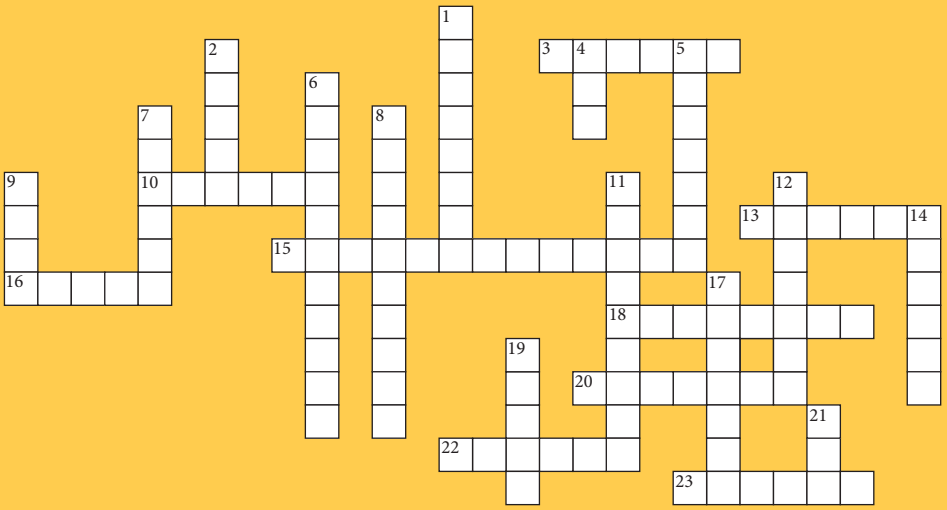
Puzzle
Taxation and budgeting crossword

Keyword activity

TAXATION AND BUDGETING CROSSWORD

ANSWERS p. 384

Copy or download this crossword and complete it using the clues given below.



Across

3 A tax on the money you earn

10 A plan to manage income and expenses

13 Yearly

15 Expenses that aren't essential

16 Total amount earned without deducting expenses

18 A method governments use to raise money

20 A type of health insurance; examples include Medibank Private and BUPA

22 Every 7 days

23 An amount paid when more tax than is necessary has been paid

Down

1 The Australian public healthcare system

2 Expenses that don't change

4 A type of income, income after tax and other payments are removed

5 Every 30 or 31 days

6 Every 2 weeks

7 Summary of income tax rates

8 Amounts that can be subtracted from gross income

9 Pay-as-you-go (abbreviation)

11 Every 3 months

12 An account or bill

14 A type of tax imposed for items like Medicare or natural disasters

17 A type of income equivalent to gross income less allowable deductions

19 Tax _____ show cents in the dollar to pay in tax

21 Tax file number (abbreviation)

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Solution to the chapter problem

Chapter problem

Hamish is preparing his income tax return. The annual payment summary shown below is for his day job only. Hamish also earned $7640 and paid $1440 tax in his part-time job. He has $960 in allowable tax deductions and has private health insurance.

Will Hamish receive a tax refund?

PAYG payment summary		
Employee	Hamish Donald	
Employment period	1 July 2024–30 June 2025	
	Total income	$58 230
	Total tax withheld	$11 461

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?



WHAT?

Has Hamish paid too much tax and is he entitled to a refund?

We know his income and tax paid from 2 jobs. We know his allowable deductions and that he has private health insurance.

STAGE 2: SOLVE THE PROBLEM



SOLVE

Calculate Hamish's income tax first.

Hamish's taxable income = $65 870 – $960 = $64 910

According to the income tax table on page 186, the income tax payable on taxable incomes between $45 001 and $120 000 is:

$5092 plus 32.5c for each $1 above $45 000.

Income tax = $5092 + 0.325 × ($64 910 – $45 000)
= $11 562.75

Medicare levy: 2% of $64 910 = $1298.20

PAYG tax already paid = $11 461 + $1440
= $12 901

Total Hamish must pay the tax office = income tax + Medicare levy
= $11 562.75 + $1298.20
= $12 860.95

Hamish has paid just enough to cover his tax and Medicare levy.
He will receive a small refund.

Hamish's refund = $12 901 – $12 860 = $41

STAGE 3: CHECK THE SOLUTION



CHECK

Hamish has 2 jobs and he hasn't paid a lot of tax in either job. It is reasonable that he could have to pay more, but he might not need to. Check the calculations.

STAGE 4: PRESENT THE SOLUTION



PRESENT

Hamish will receive a $41 tax refund.

10 Test yourself

Paying tax

ANSWERS p. 384

1 EXERCISE 10.1 Anastacia earns $870.65 per week and her employer deducts $124.03 for PAYG tax. What is her net weekly pay?

2 EXERCISE 10.2 Charlotte 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?

3 EXERCISE 10.3 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 on page 188 to calculate how much income tax Brett must pay.

4 EXERCISE 10.4 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
14 Redbourne Ave
COOROY QLD 4563

Account number
349742

Invoice No
11015698

Issue date
10 November 2025

Your Electricity Account
Current Plan: Smile Power

ACCOUNT SUMMARY

Opening Balance 11/08/2025	$ 896.21
Payment Received (thank you) 03/09/2025	–$ 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 2025

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 does he have to pay this quarter compared to his last bill?

f A quarter is 13 weeks. Approximately how much should Kye budget for electricity each week?

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5 EXERCISE 10.5 This table shows Liam's fortnightly budget.

Income (after tax)		Expenses	
Day job	$974	Rent	$334
Weekend job	**i**	Food	$116
		Clothes	$90
		Health insurance	$42
		Transport	$86
		Entertainment	**ii**
		Savings	$250
Total	**$1260**	**Total**	**iii**

a Complete the 3 missing entries **i**, **ii** and **iii** in the budget.

b Liam wants to buy a $20 000 car. He has saved $8300 already. How much longer will it take to save the money for the car?

c Liam works 4 hours on his weekend job. How much is he paid per hour for this job?

d Liam's weekend employer has offered him an extra hour of work. Describe how this extra hour of work could affect his budget.

Practice set 2

ANSWERS p. 384

Section A Multiple choice questions

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

1 EXERCISE 9.4 During exercise, Robbie had an average pulse of 140 beats/minute. How many times did her heart beat during her 40-minute exercise session?

A 3.5 **B** 210 **C** 5600 **D** 8400

2 EXERCISE 8.5 Regina sells cars and is paid a weekly retainer of $320 plus 3.5% of the value of the cars she sells. Calculate her income for a week in which she sells cars worth $87 000.

A $331.20 **C** $3045 **B** $1120 **D** $3365

3 EXERCISE 7.1 Which of the following is NOT numerical data?

A The star ratings from ★ to ★★★★★ given by the audience of a movie

B The average temperature for each month

C Rainfall data for Rockhampton measured in millimetres

D The number of pairs of shoes each student owns

4 EXERCISE 6.1 Calculate $12\frac{1}{2}$% of 6 metres.

A 0.75 mm **B** 7.5 mm **C** 75 mm **D** 750 mm

5 EXERCISE 10.1 Petra earns an annual gross salary of $63 500. She paid $12 185 in PAYG tax in the last year and pays $17.60 per week for other deductions. Calculate Petra's net weekly pay.

A $969.23 **B** $986.83 **C** $1938.45 **D** $1973.65

6 EXERCISE 9.1 Using the information in the table in Exercise 9.1 Question 7 on page 169, which of the following activities will use 3500 kJ?

A Sleeping for 12 hours and 30 minutes

B Studying for 7 hours and 30 minutes

C Bike riding for 2 hours and 55 minutes

D Swimming for 1 hour and 35 minutes

7 EXERCISE 10.2 Aaron earns $1538.50 per week. He claims deductions of $715 for travel expenses and $218 for membership of a professional association. He also gives an allowable deduction of $50 a month to charity. Calculate his taxable income for one year.

A $80 002 **B** $79 069 **C** $79 019 **D** $78 469

8 EXERCISE 8.2 Tai works 12 hours at a normal pay rate of $22.80 per hour and 3 hours overtime at time-and-a-half. Which calculation can be used to find his pay?

A 22.80×15 **B** $22.80 \times 15 \times 1.5$

C $22.80 \times 12 + 22.80 \times 3 \times 1.5$ **D** $22.80 \times 12 + 22.80 \times 15 \times 1.5$

Section B Short answer questions

1 EXERCISE 9.4 Malek is exercising and he takes his pulse. He counts 39 beats in 15 seconds. Calculate his pulse in beats per minute.

2 EXERCISE 7.6 Identify the outlier(s) in this data set showing the number of goals scored in each match by a junior soccer team.

2	1	0	0	7	2	3	2	4
3	2	9	1	2	1	2	4	3

3 EXERCISE 10.3 Rajesh has a taxable income of $91 300. Calculate the 2% Medicare levy payable.

4 EXERCISE 8.1

a Michaela is paid an annual salary of $109 000. How much is this each fortnight?

b Tyson is paid $33.50 per hour. How much is he paid for a 35-hour week?

5 EXERCISE 7.4 Sam rolled a die 20 times and recorded the uppermost number. These are the results:
5, 2, 3, 4, 2, 2, 6, 2, 6, 3, 5, 1, 4, 1, 2, 5, 6, 2, 4, 1

a Draw a dot plot for this data.

b How many times did Sam roll a number greater than 3?

c In what percentage of rolls did Sam roll a 1 or a 2?

6 EXERCISES 6.3, 6.4 Franken's Furniture buys a lounge suite from a supplier for $2300. The store adds a 60% mark-up to obtain the selling price. Then 10% of the selling price must be added for GST.

a Calculate the selling price of the lounge suite before GST is added.

b Calculate the price including GST.

c In a stocktake sale in June, the lounge suite is discounted by 30%.
Find its discounted selling price.

7 EXERCISE 8.4 Anilha earns $970 per week. Each year, she is paid 17.5% annual leave loading on 4 weeks' pay. Calculate:

a her pay for 4 weeks

b the annual leave loading she will be paid

c the total amount she earns for her 4-week holiday.

8 EXERCISE 9.3 The Cunnington family own a 550 W TV that they use for an average of 7 hours per day. The domestic tariff for electricity is 34c per kilowatt-hour.

a How many kWh of electricity does the TV use each day?

b How much does the TV cost in electricity each day?

9 EXERCISE 7.3 In order to improve customer service, the NMQ Bank recorded the waiting times, in minutes, per customer at one of its biggest branches. The results are shown below.

14	11	12	7	6	13	12	21	11	6	13	11	7	3	8	11	10	8	9	7	9
11	10	5	14	12	12	10	13	14	9	15	9	12	7	22	8	9	12	7	6	9

a Copy and complete this frequency table for the data.

Waiting time	Tally	Frequency
1–5		
6–10		
11–15		
16–20		
21–25		

b How many customers were waiting from 11 to 15 minutes?

c What percentage of customers waited for over 20 minutes?
Answer correct to one decimal place.

d Draw a frequency histogram for this data.

10 EXERCISE 10.4 Kane and Anne have kept details of their household expenses for the last year.

Electricity	$3874
Insurance	$1297
Council and water rates	$2613
Internet/phones	$1200

a Calculate the total annual cost of Kane and Anne's household bills.

b In the coming year they expect increases to all expenses. Increase the total for Kane and Anne's annual household bills by 10% to allow for future price rises.
Round up to the nearest dollar.

c Both Kane and Anne are paid monthly. Use your answer to part **b** to calculate the amount they should budget each month to cover household expenses.
Round up to the nearest dollar.

d What other items might Kane and Anne have to budget for?

11 EXERCISES 9.1, 9.2 Niko has lunch consisting of 2 slices of ham, 1 slice of cheese and 1 slice of buttered bread, followed by a banana.

a Use the table on page 170 to calculate how many kilojoules are in Niko's meal.

b Niko goes swimming in the afternoon. Use the table in Exercise 9.1 Question 7, on page 169, to determine how long she must swim to use the kilojoules from her lunch.

12 EXERCISE 10.3 Annabel's taxable income for the last financial year is $77 210. She has $334.32 deducted each week in PAYG tax.

a Calculate how much tax Annabel has paid in one year.

b Use this table to calculate how much tax is payable on her taxable income.

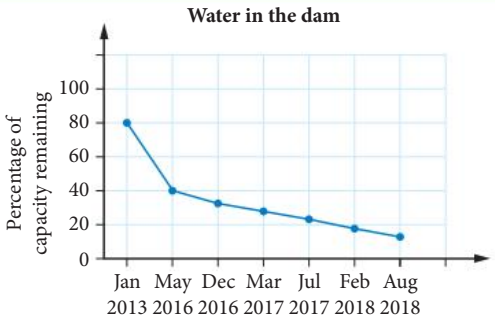
Taxable income	Tax on this income
0–$18 200	Nil
$18 201–$37 000	19 c for each $1 over $18 200
$37 001–$87 000	$3572 plus 32.5 c for each $1 over $37 000
$87 001–$180 000	$19 822 plus 37 c for each $1 over $87 000
$180 001 and over	$54 232 plus 45 c for each $1 over $180 000

Individual income tax rates - Resident tax rates 2023–24, https://www.ato.gov.au/rates/individual-income-tax-rates/ © Australian Taxation Office for the Commonwealth

c Does Annabel receive a refund or does she owe money to the tax office? Calculate the amount she receives or owes.

Chapter problem

During a drought, the water authority produced a graph to show the decreasing supply of water in a dam due to the water usage of local residents. Is the decrease in water supply as bad as the graph shows? If the graph gives a false impression, identify what has been done to create this impression.



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CHAPTER 11

DATA AND TRAVEL: GRAPHS

SHOW ME THE GRAPH

Syllabus coverage
Nelson MindTap chapter resources
Terminology
11.1 Interpreting graphs
11.2 Two-way tables
11.3 Everyday graphs
11.4 Choosing the best graph
11.5 Graphs and spreadsheets*
11.6 Line graphs*
11.7 Misleading graphs
Keyword activity
Solution to the chapter problem
Test yourself
* COMPLEX

What will we do in this chapter?

- Interpret information presented in a variety of graphs and two-way tables: picture graphs, column graphs, line graphs, conversion graphs, step graphs and pie graphs
- Determine which type of graph is best suited to display a particular set of data
- Use spreadsheets to graph data
- Identify misleading graphs appearing in the media and in advertising

How are we ever going to use this?

- When reading a graph that is presented in a newspaper, magazine or website
- When drawing a graph to illustrate data to others
- When noticing a graph is being misleading in a report or advertisement

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Syllabus coverage

UNIT 2, TOPIC 2: GRAPHS

Reading and interpreting graphs

- Interpret information presented in graphs, e.g. step graphs, column graphs, pie graphs, picture graphs, line graphs.
- Interpret information presented in two-way tables.
- Discuss and interpret tables and graphs, including misleading graphs found in the media and in factual texts [complex].

Drawing graphs

- Determine which type of graph is best used to display a dataset.
- Use spreadsheeting software to tabulate and graph data [complex].
- Draw a line graph to represent any data that demonstrates a continuous change [complex].

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, p. 19
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Videos (2):
11.2 Two-way tables 3 • Two-way tables 1

Worksheets (4):
11.1 Every picture tells a story • Currency conversion graph
11.2 Reading graphs and tables
11.3 Every picture tells a story
11.7 Misleading graphs

Spreadsheet (1):
11.5, 11.7 Statistical graphs

Nelson MindTap

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

Terminology

climate graph
clustered column graph
column graph
conversion graph
line graph
picture graph
pie graph
step graph
two-way table

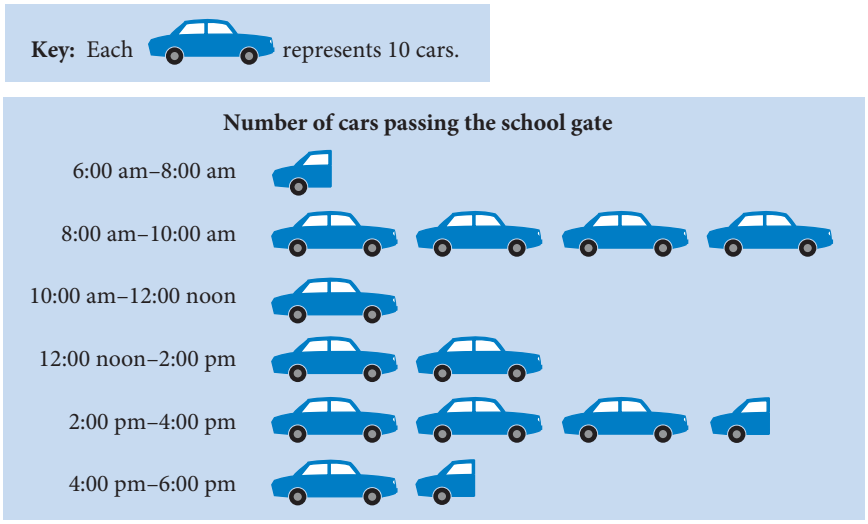
11.1 Interpreting graphs

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

EXERCISE 11.1 Interpreting graphs

ANSWERS p. 385

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



a What does represent?

b How many cars passed the school between 2 pm and 4 pm?

c What time of day had the least traffic?

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

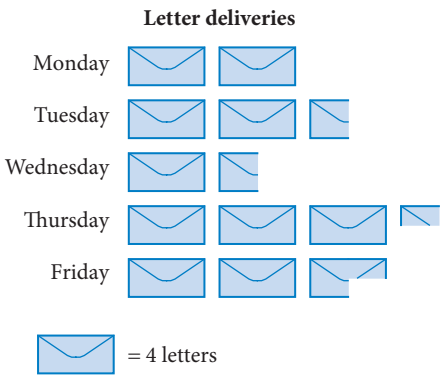
2 This picture graph shows the number of letters delivered to an office each day last week.

a How many letters were delivered on Thursday?

b On which day were 11 letters delivered?

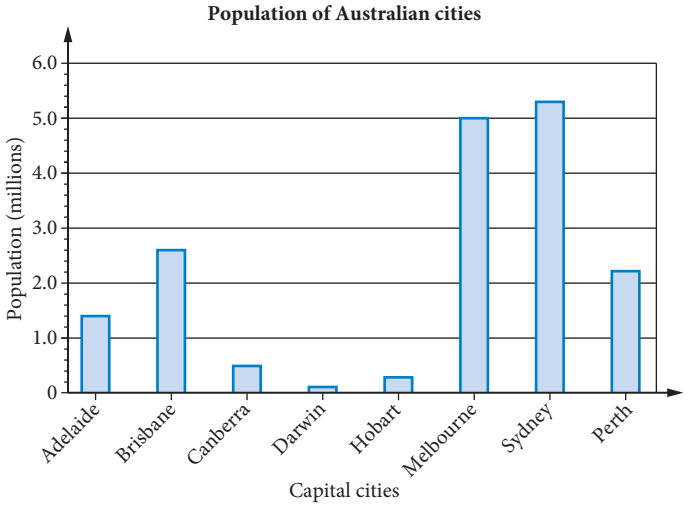
c How many letters were delivered to the office last week?

d What is one disadvantage of this type of graph?



Worksheet
Every picture tells a story

3 **Column graphs** (or **bar charts**) are mostly used for data that is in categories. This column graph shows the populations of the 8 Australian state and territory capitals.



a What does one interval on the vertical axis represent?

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

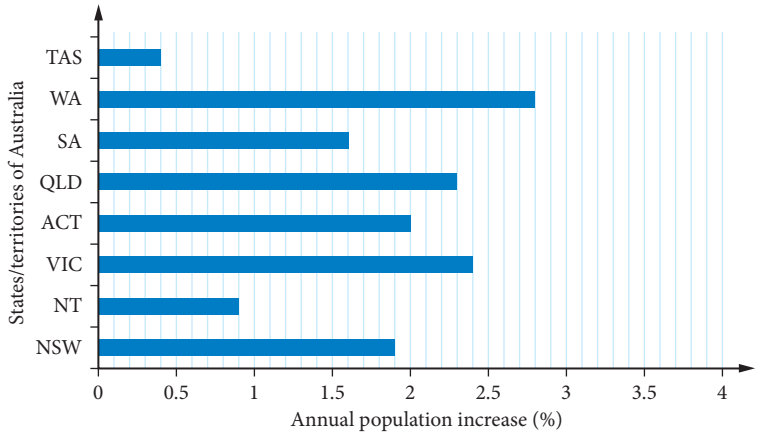
c Which city has the smallest population? Estimate its population from the graph.

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

e Which city has an approximate population of 1.4 million?

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

4 This column graph shows the annual percentage population increase for each state/territory.



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

a By what percentage did Queensland's population increase?

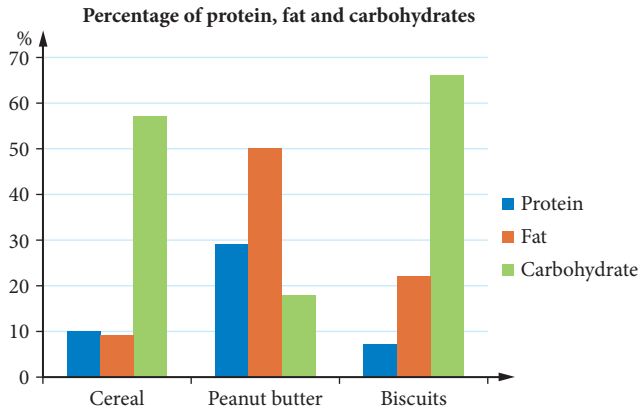
b In which state was the population increase 1.6%?

c Which 2 states had less than a 1% 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 570 000. By how much did it increase this year?

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



a Which food has the highest percentage of protein?

b Which food has the highest percentage of carbohydrate?

c Which food has the lowest percentage of fat?

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

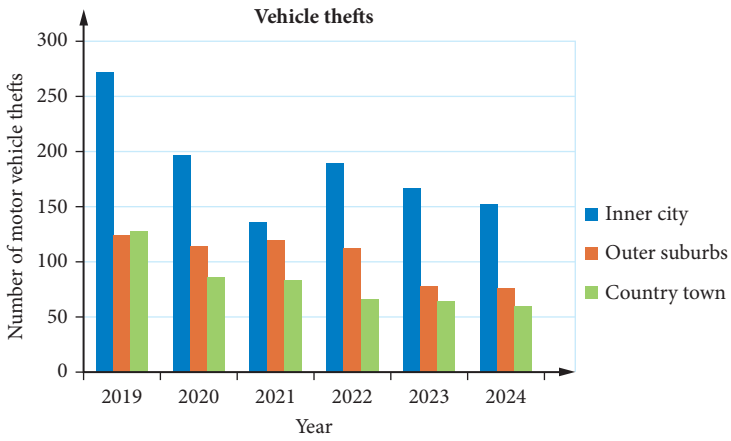
e If you were on a low carbohydrate diet, which food could you include in your diet?

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. Which of these foods should she avoid?

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



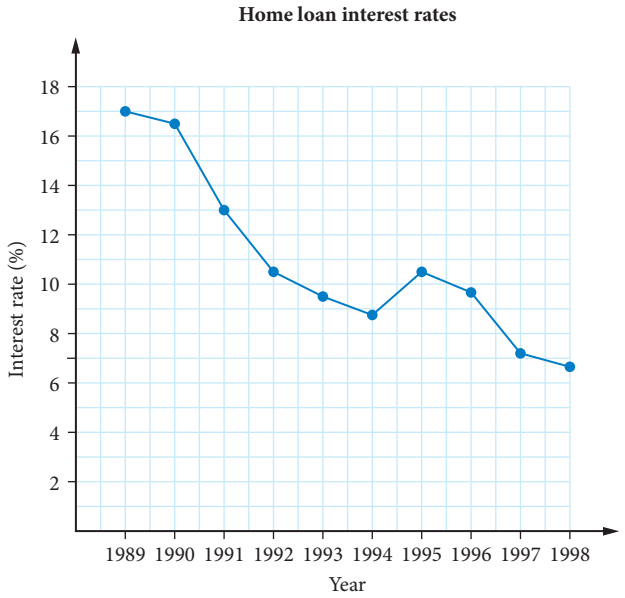
a Describe the trend in motor vehicle thefts in the country town.

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

c In which year was the difference between the number of thefts in the inner city and the country town 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 changes over time. The graph shows the dramatic changes in home loan interest rates during the 1990s.



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?

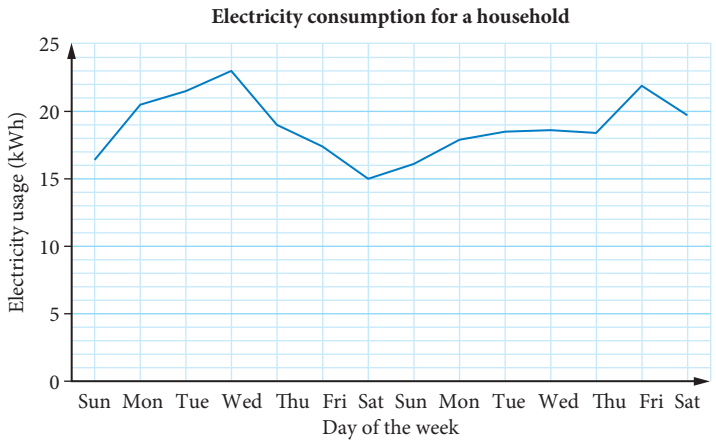
d Anand borrowed $120 000 in 1989 to buy a house. If a flat rate of interest was used, how much interest did he pay in one year?

e Catriona borrowed the same amount in 1997.

i Approximately how much interest did she pay in one year?

ii How much more did Anand pay in one year?

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

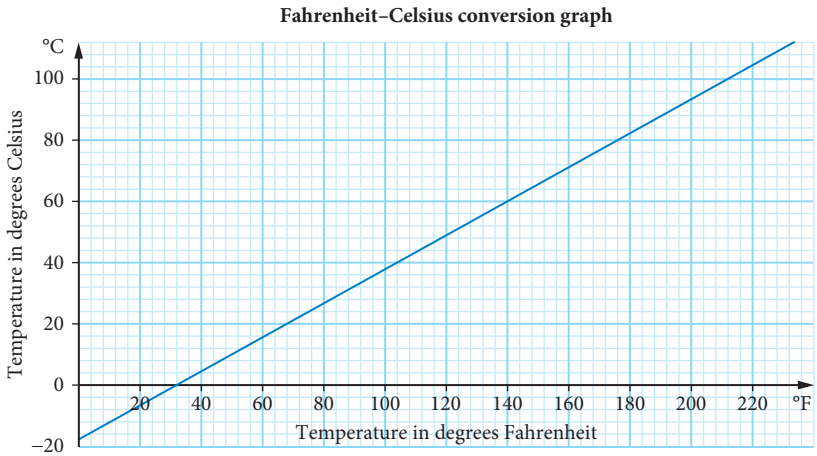


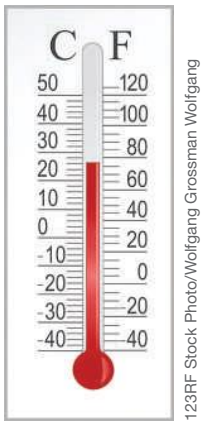
a What was the lowest daily rate of electricity usage?

b What was the highest daily rate of electricity usage?

c The usage is 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. It is a special type of line graph that is a smooth line constantly increasing rather than going up and down.





123RF Stock Photo/Wolfgang Grossman Wolfgang

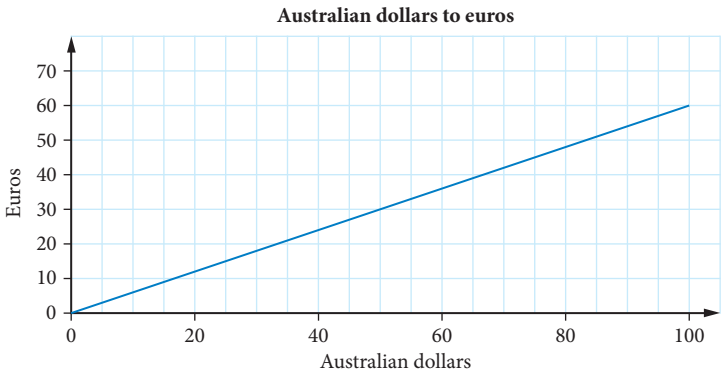
a Convert a temperature of 68°F to °C.

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, or a century, was considered a very hot day. What is this temperature in degrees Celsius?

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



Worksheet
Currency conversion graph

a Convert $15 to euros.

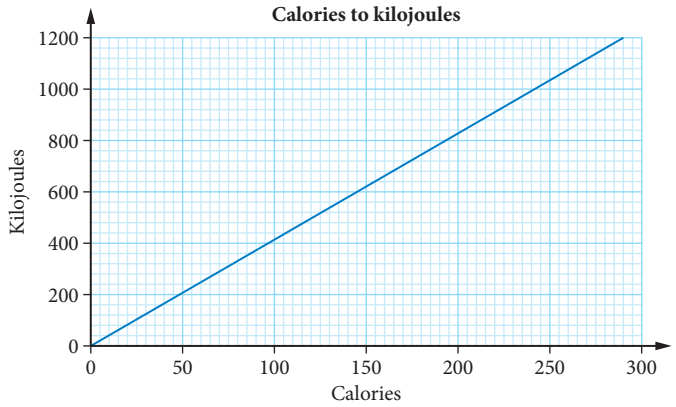
b Convert €30 to Australian dollars.

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

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

e Calculate how many euros you would get for $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.

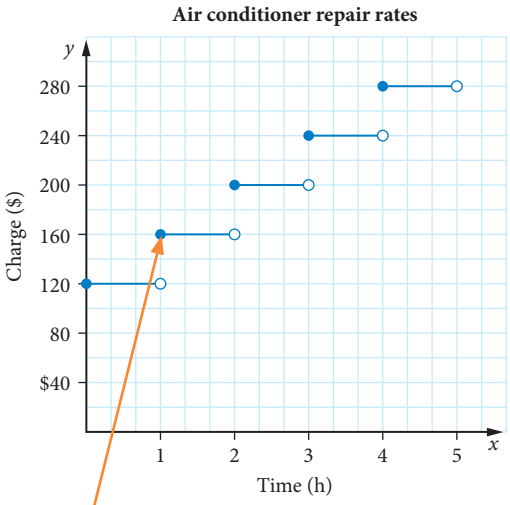
a How much does Prem charge for any time under an hour?

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?



Remember: read the amount with the filled circle, not the open circle.

13 This graph shows the charges for parking at an airport.

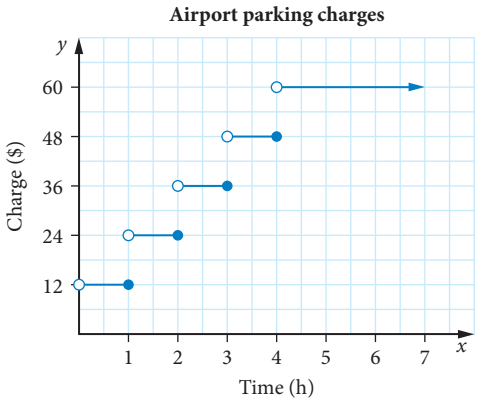
a How much does the airport charge for 2 hours of parking?

b Anh parked for 3 hours and 23 minutes. How much did his parking cost?

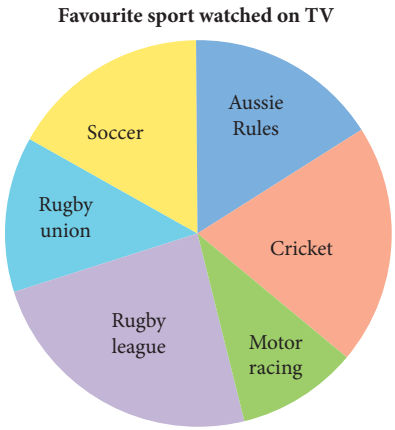
c When Madison went to the airport to pick up her mum, the plane was delayed. She had to park for 6 hours and 42 minutes. How much did this cost?

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?

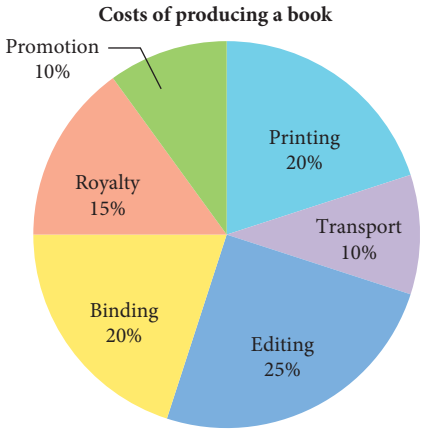


14 This **pie graph** (or **sector graph**) shows the results of a survey about people's favourite sport to watch on TV.



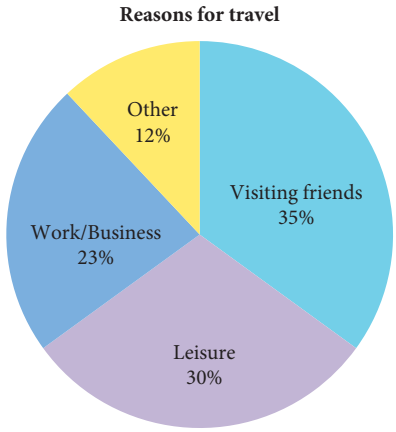
- **a** What is the most popular sport?
- **b** What is the least popular sport?
- **c** Which 2 sports have sectors approximately the same size?
- **d** Rugby league was the favourite sport of 24% of the 3500 people surveyed. How many people preferred to watch rugby league on TV the most?
- **e** Do you think the results of a survey like this would be different if the survey was taken in different places? Justify your answer. PS

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 to 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 Cengage surveyed passengers on a flight from Brisbane to Sydney on their reasons for travelling to Sydney.



- **a** What was the main reason people were travelling from Brisbane to Sydney?
- **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.

11.2 Two-way tables

Videos
Two-way tables 3
Two-way tables 1

Worksheet
Reading graphs and tables

Two-way tables show 2 characteristics of any set of data.

EXAMPLE 1 Two-way tables

This two-way table shows the results of a survey on right/left-handedness and right/left-footedness.

	Right-footed	Left-footed	Total
Right-handed	50	10	60
Left-handed	12	8	20
Total	62	18	80

If you're not sure what number to put on the bottom of the fraction, look at the quantity following 'of' in the expression 'what percentage of …'.

a What percentage of people in this survey are right-handed?

b What percentage of the right-handed people in this survey are left-footed? Answer correct to one decimal place.

Steps	Working
a There are 80 people in the survey and 60 people are right-handed.	$\text{percentage} = \frac{60}{80} \times 100$ $= 75\%$
b 60 people are right-handed and of those, 10 are left-footed.	$\text{percentage} = \frac{10}{60} \times 100$ $= 16.666\ldots\%$ $\approx 16.7\%$

EXERCISE 11.2 Two-way tables

ANSWERS p. 385

1 EXAMPLE 1 Jarrod manages a shop that sells muffins and scones. He surveyed locals on whether they preferred muffins or scones. The results are summarised in this table.

	Prefer muffins	Prefer scones	Total
People aged over 30	24	36	60
People aged 30 and younger	48	12	60
Total	72	48	120

a How many people did Jarrod survey?

b Which age group prefers scones to muffins?

c Overall, which item do Jarrod's customers prefer?

d How many of the people who prefer scones are over 30 years old?

e What percentage of people aged 30 or younger prefer muffins?

2 This table shows the smoking habits of the adult population of Nelson Waters.

	Men	Women	Total
Smoker	3500	2400	**i**
Non-smoker	7500	8600	**ii**
Total	**iii**	**iv**	**v**

a Copy the table and complete the missing values for **i** to **v.**

b What is the adult population of Nelson Waters?

c What fraction of the adults smoke?

d What percentage of the adults are non-smokers? Answer to 2 decimal places.

e What percentage of the adult women who live in Nelson Waters are smokers? Answer to one decimal place.

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3 Simone runs a café. She recorded data about who buys hamburgers and chicken wraps.

	Hamburgers	Chicken wraps	Total
Male	77	43	i
Female	31	64	ii
Total	iii	107	iv

a Calculate the missing totals.

b How many customers were surveyed?

c How many females bought chicken wraps?

d What percentage of customers bought hamburgers? Answer to 2 decimal places.

e What percentage of males bought chicken wraps? Answer to one decimal place.

f Simone is expecting a busload of male footballers to visit the café. Should she prepare more hamburgers or chicken wraps? Justify your answer.

4 Nick found this table in a news article for the local gym. The data was obtained by surveying people from the local area about whether they exercised regularly.

	Men	Women	Total
Regular exercise	75	i	158
No regular exercise	iii	77	ii
Total	iv	v	345

a Copy the table and complete the missing values for **i** to **v**.

b What percentage of the people interviewed were women who exercised regularly? Answer correct to 2 decimal places.

c What percentage of the men interviewed have no regular exercise? Answer correct to 2 decimal places.

d If the gym was aiming to encourage people who don't exercise to join the gym, should they aim the advertisement at men or women? Justify your answer.

5 Alannah surveyed a group of people for their opinion on changing the Australian flag.

	Aged under 35	Aged 35 and over	Total
Change the flag	2570	1060	i
Keep the flag	6350	2780	ii
Total	iii	iv	v

a Copy the table and complete the missing values for **i** to **v**.

b What percentage of those surveyed wanted to keep the flag? Answer correct to 2 decimal places.

c What percentage of those under 35 wanted to change the flag? Answer correct to 2 decimal places.

d Based on this survey, should the government change the Australian flag? Justify your answer.

6 Police are testing a new lie detector machine. The results are shown in this table.

	Machine judged as true	Machine judged as a lie	Total
True statements	65	15	i
False statements	ii	30	40
Total	iii	iv	v

a Copy the table and complete the missing values for **i** to **v**.

b On how many statements did the police test the machine?

c For how many statements did the machine correctly determine whether the statement was true or false?

d What percentage is this? Answer correct to one decimal place.

e What percentage of *true* statements were incorrectly identified by the machine? Answer correct to one decimal place.

Worksheet
Every picture tells a story

11.3 Everyday graphs

EXERCISE 11.3 Everyday graphs

ANSWERS p. 385

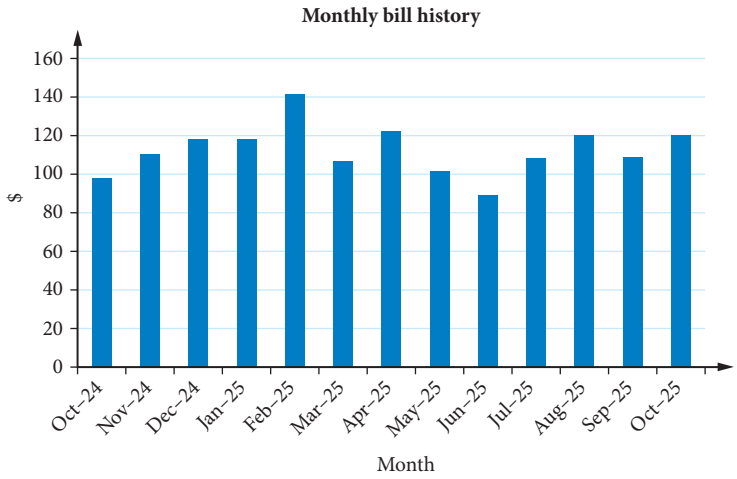
1 This type of graph often appears on a phone bill.

a How much is the most recent bill?

b How does this compare with the same time last year?

c What is the lowest amount paid for one month?

d Why would the telephone company include this graph on a telephone bill?



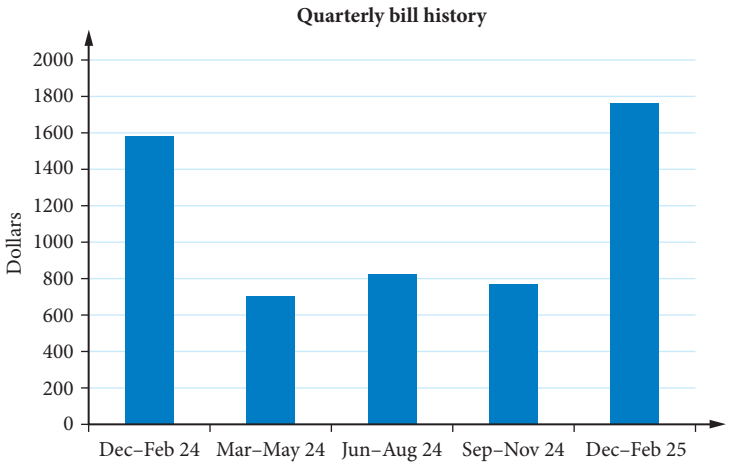
2 This is an electricity bill graph.

a How many months does each bill cover?

b What is the most recent amount paid?

c Give a reason why the amounts for December to February are much bigger than for the other periods.

d Why is this type of graph useful to customers?



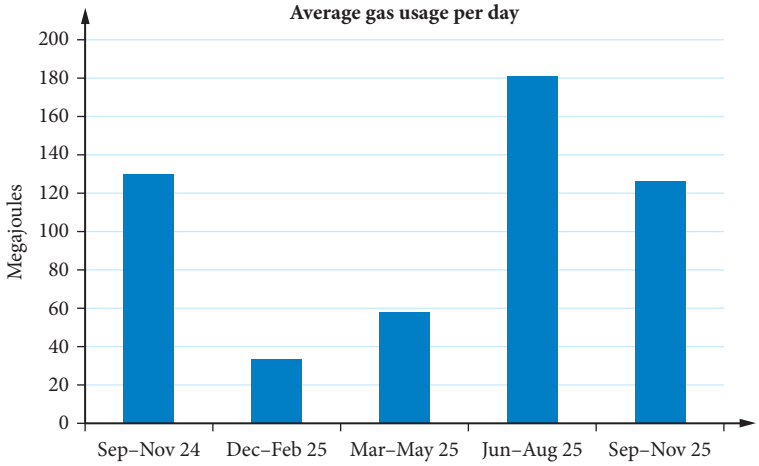
3 Gas bills usually show 'Your average daily gas usage' measured in megajoules (MJ).

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?



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4 This table shows the interest rates offered by Nelson Mutual 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 usually paid at the end.

Minimum deposit	Number of months												
	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

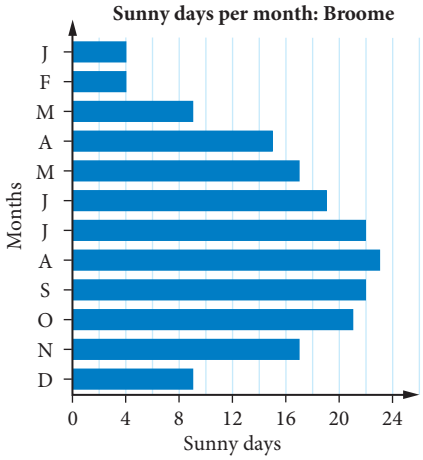
a What is the lowest interest rate offered?

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 fewest sunny days?

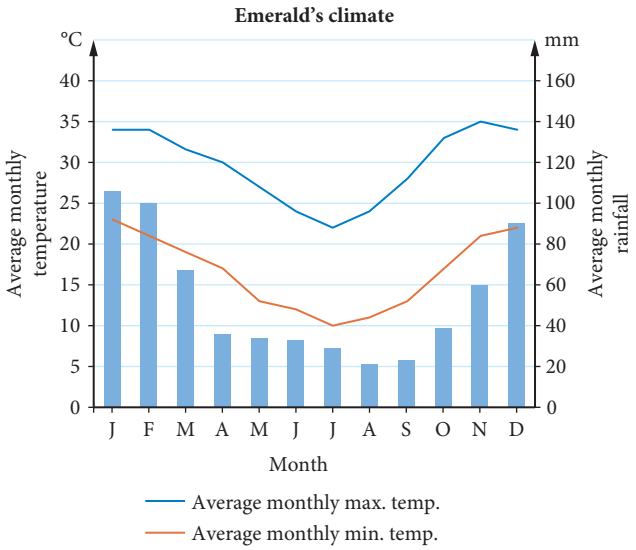
c List 3 pairs of months that had approximately the same number of sunny days.

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 Emerald, west of Rockhampton.



a What is the average maximum temperature in Emerald in December?

b Which 3 months have the coldest minimum temperatures?

c Describe Emerald's average monthly rainfall pattern.

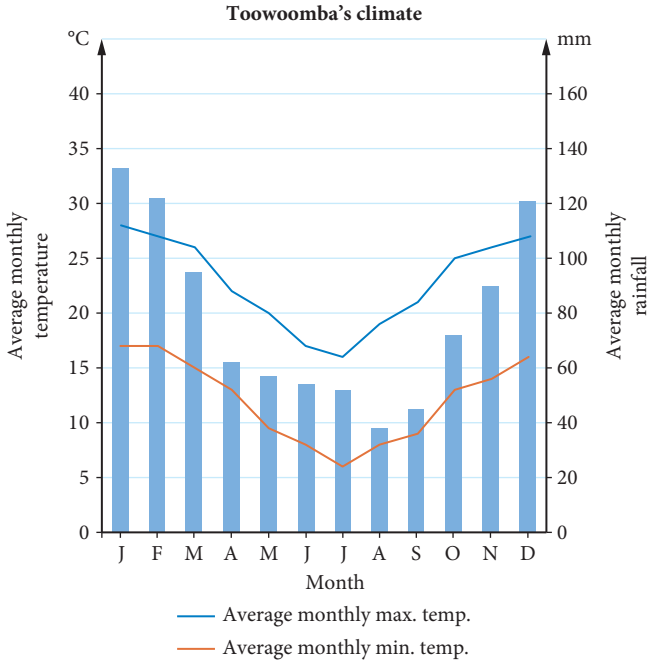
7 This is the climate graph for Toowoomba.

a Which 4 months have the lowest rainfall?

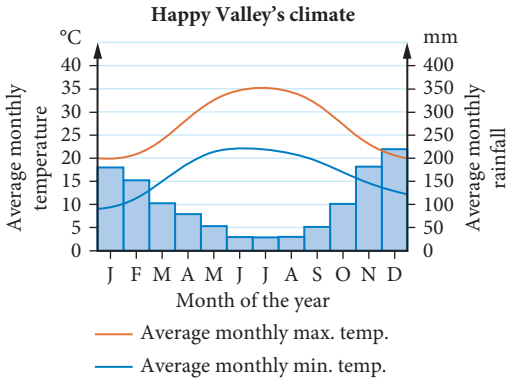
b What is the difference between the average maximum and minimum temperatures in Toowoomba in February?

c How much more rain falls in Toowoomba 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 Given the data in this graph, is Happy Valley in the northern hemisphere or the southern hemisphere? Explain your answer. PS



9 This picture graph published by the Australian Red Cross Blood Service shows how the red cells from blood donations are being used.

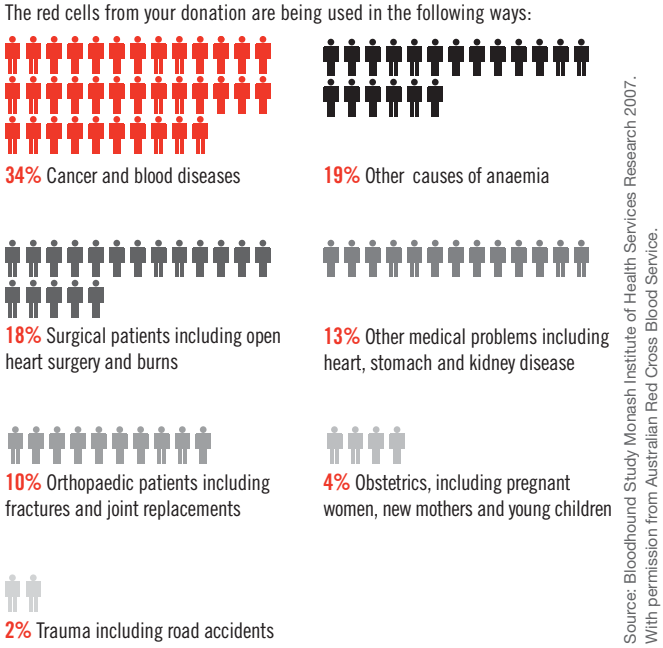
a What does each person symbol stand for?

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?



Source: Bloodhound Study Monash Institute of Health Services Research 2007. With permission from Australian Red Cross Blood Service.

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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.

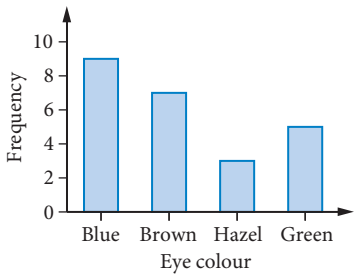
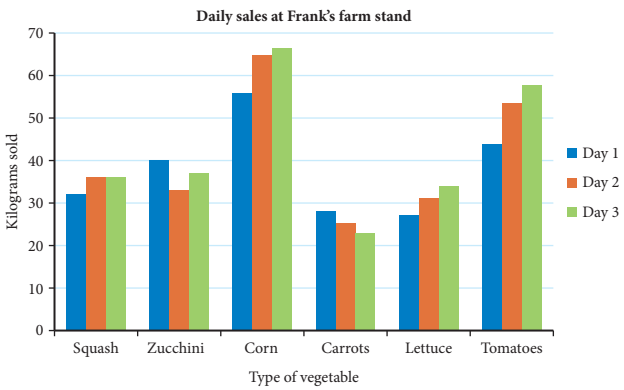
Which is the most common type of graph used across different subjects? Suggest a reason why this type of graph is used frequently.

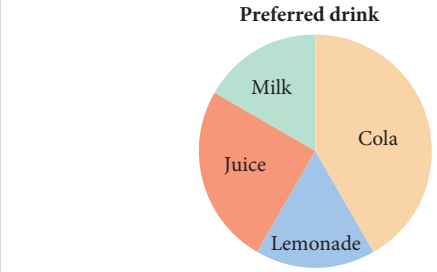
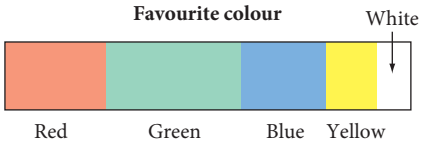
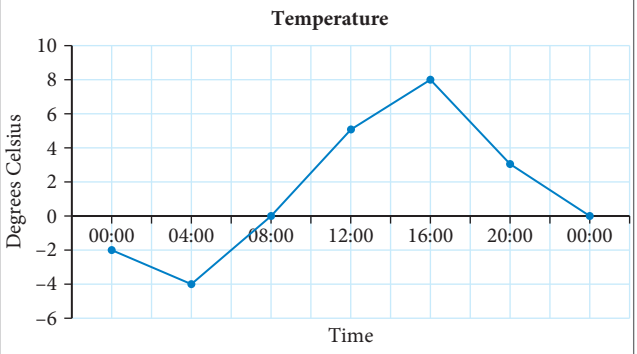
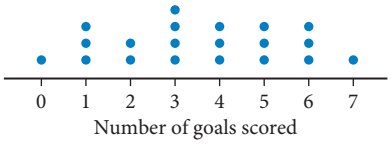
Write a short paragraph on the uses of graphs in your areas of study. Explain the similarities and differences. Suggest reasons why different subjects use different types of graphs.

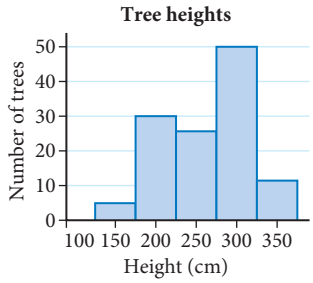
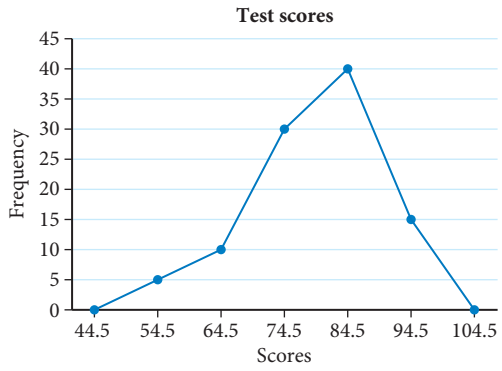
Present your findings as a PowerPoint presentation or display them as wall charts.

11.4 Choosing the best graph

The best type of statistical graph that should be used to represent a data set depends on the type of data being analysed. On these 3 pages are some examples of the most appropriate graphs to use depending on the type of data you are working with.

Type of graph	Appropriate for	Description
Picture graph Mode of transport / Number of students Bus: ☺☺☺☺☺☺☺ Car: ☺☺☺☺ Walking: ☺☺☺☺☺☺ Bicycle: ☺☺☺ Key: ☺ represents 4 students	• Simple data that doesn't require a lot of detail • Categorical data	• Uses pictures or symbols to represent frequencies • Has a key to show what one picture represents • Not precise
Column graph (or bar chart) 	• Categorical data	• Uses columns to show frequency, gaps between columns • Frequency shown on the vertical axis
Clustered column graph 	• Comparisons to be made between 2 or more data sets • Categorical data	• A key must be included to identify what the different colour bars represent

Type of graph	Appropriate for	Description
Pie graph (or sector graph) 	• Showing parts of a whole • Categorical data • Discrete numerical data	• Shows parts of a whole in circle form • Uses sectors of a circle to show sizes of parts
Divided bar graph 	• Showing parts of a whole • Categorical data • Discrete numerical data	• Shows parts of a whole in rectangular form • Uses sections of a rectangle to show sizes of parts
Line graph 	• Changes in a quantity over time • Numerical data	• Time on the horizontal axis, quantity on the vertical axis
Dot plot 	• Small data sets with low range and frequencies • Discrete numerical data	• A simplified column graph
Stem plot **Stem** | **Leaf** 0 | 1 1 2 2 3 4 4 4 4 5 8 1 | 0 0 0 1 1 3 7 9 2 | 5 5 7 7 8 8 9 9 3 | 0 1 1 1 2 2 2 4 5 4 | 0 4 8 9 5 | 1 6 7 7 8 6 | 3 6 Key: 6|3 = 63 years old	• Data sets with low frequencies • Discrete numerical data	• Lists every value in the data set

Type of graph	Appropriate for	Description
Frequency histogram 	• Large data sets with high frequencies • Numerical data	• No gaps between columns • A space at the beginning and end of the graph • Frequency is shown on the vertical axis
Frequency polygon 	• Large data sets with high frequencies • Numerical data	• Frequency is shown on the vertical axis • Graph starts and finishes on the horizontal axis

EXERCISE 11.4 Choosing the best graph

ANSWERS p. 386

1 Draw a column graph for the following data, which shows the make of car owned by the families of a group of Year 11 students.

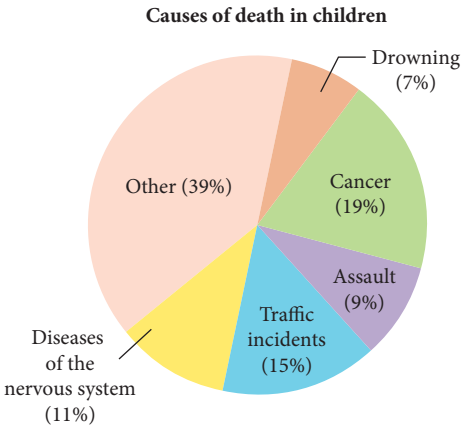
Make of car	Frequency
Toyota	12
Hyundai	10
Holden	7
Mazda	5
Ford	8
Other	3

2 The media often use a picture graph 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 number of tourists in winter. It published the number of rainy days in June for a number of cities. Graph the data as a picture graph, using the symbol 🌧 to represent 4 rainy days.

City	Rainy days in June
Cairns	10
Melbourne	18
Adelaide	24
Sydney	15
Hobart	17
Perth	16
Brisbane	15

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 one 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 In a survey, 1080 workers in central Melbourne were asked how they travelled to work.

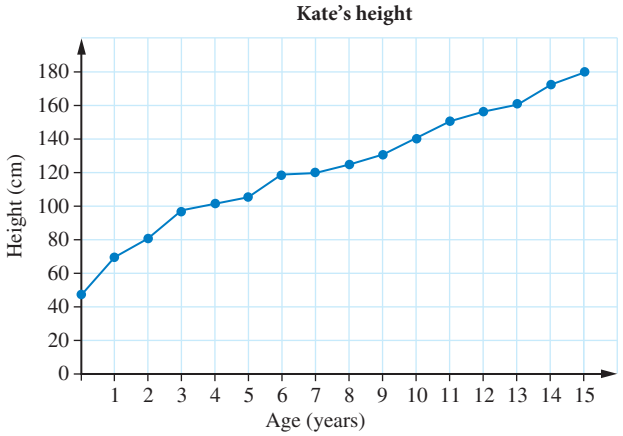
Method of transport	Frequency
Train	220
Tram	280
Bus	130
Car	230
Walk	80
Cycle	140

a Copy and complete the table below and calculate the angle for each sector in a pie graph. Round each answer to the nearest degree.

Method of transport	Angle for sector graph
Train	$\frac{220}{1080} \times 360° =$
Tram	$\frac{280}{1080} \times 360° =$
Bus	$\frac{130}{1080} \times 360° =$
Car	$\frac{230}{1080} \times 360° =$
Walk	$\frac{80}{1080} \times 360° =$
Cycle	$\frac{140}{1080} \times 360° =$

b Draw a pie graph for this data.

5 A line graph shows changes over time. 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 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 plot for this data.

Stem	Leaf
3	
4	
5	
6	
7	
8	
9	

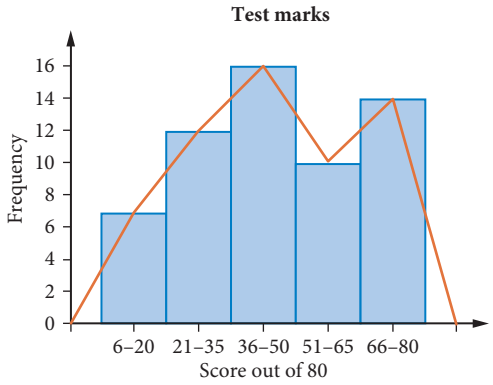
Remember: a stem plot has the tens digit as the stem and the units digit as the leaves.

8 The water level of a canal was measured over 43 days.

Draw a frequency histogram for this data.

Water level (cm)	Frequency
152	5
153	6
154	8
155	12
156	4
157	8
Total	43

9 We can use a frequency histogram or a frequency polygon to graph numerical data from a frequency table. 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 What was the most common class interval of test marks?

d How many students scored less than 36 in this test?

10 What is the best graph to use for each data set? Justify your answer.

a length of a baby each month for the first 12 months

b science test marks for all Year 8 students

c minimum temperature each day for a fortnight in Southport

d how students in your class travel to school

e favourite sport watched on TV

f heights of all students in your class

g costs of manufacturing a car as a percentage of the car's price

h number of households that own dogs in different streets

i number of bedrooms per home in Mary Street

11 A survey was conducted about the colour of people's cars. The results are shown in the table.

Colour	Red	Blue	White	Green	Silver	Black
Frequency	42	16	53	5	45	32

a What type of graph would you use to represent the results of this survey?

b Why is this an appropriate graph to use?

c Draw the graph you chose in part **a**.

d Is there a different type of graph that can be used to represent the same data set? Explain.

12 The table below shows the sale of fruit (in kilograms) from a fruit shop over two days.

Fruit	Monday	Tuesday
Apples	10	15
Bananas	32.5	22.5
Mangos	17.5	25
Oranges	27.5	35
Strawberries	15	20

a What display would you use to represent the results of this survey?

b Why is this an appropriate display to use?

11.5 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. You should save this spreadsheet to your own computer.



Spreadsheet
Statistical graphs

EXERCISE 11.5 Graphs and spreadsheets*

1 Column graph

Draw a column graph that shows the numbers of people immigrating to Australia by their region of origin in 1988–9.

- Select all of 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'.
- Ensure 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. PS

4 Pie graphs

The same data will be used to draw pie graphs 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 pie graph for the 2008–9 data. The steps are much the same as before, except the initial selections of cells are 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 graph 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 pie graph 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.

11.6 Line graphs*

Line graphs are usually used to graph data that changes over time. They can also be used to compare 2 or more sets of data.

EXERCISE 11.6 Line graphs*

ANSWERS p. 387

1 Simon was born weighing 4.3 kg. This line graph shows his weight over his first 12 months.

a What did Simon weigh at

i 2 months? **ii** 7 months?

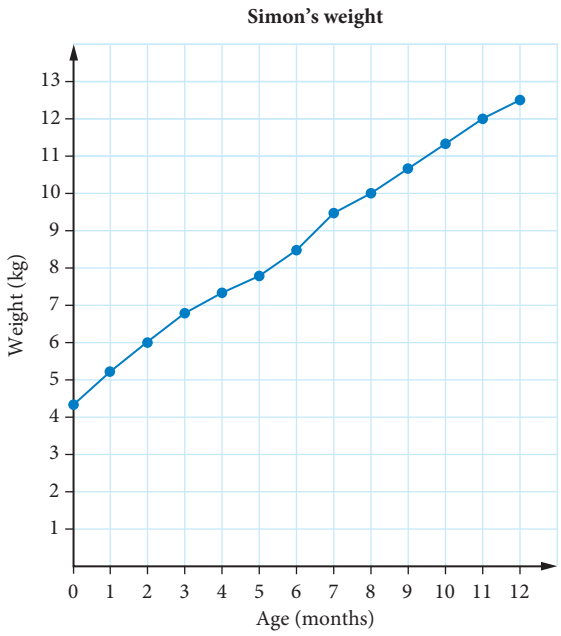
b When did Simon weigh

i 10 kg? **ii** 12 kg?

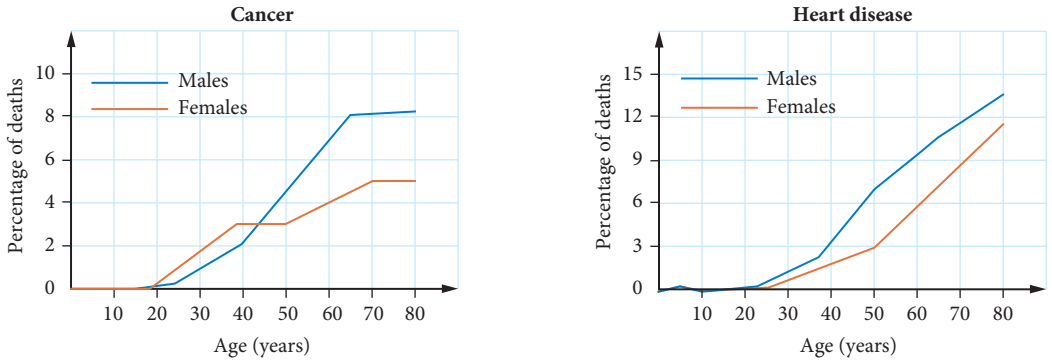
c Between which 2 months did Simon gain the most weight?

d Approximately how long did it take Simon to double his birth weight?

e Suggest what this graph might look like over the next 12 months. Give reasons for your suggestion.



2 These graphs show the percentages of deaths from cancer and heart disease at different ages.



a For males aged 70, what percentage of deaths are due to cancer?

b Between what 2 ages do 3% of women die of cancer?

c For males aged 50, what percentage of deaths are caused by heart disease?

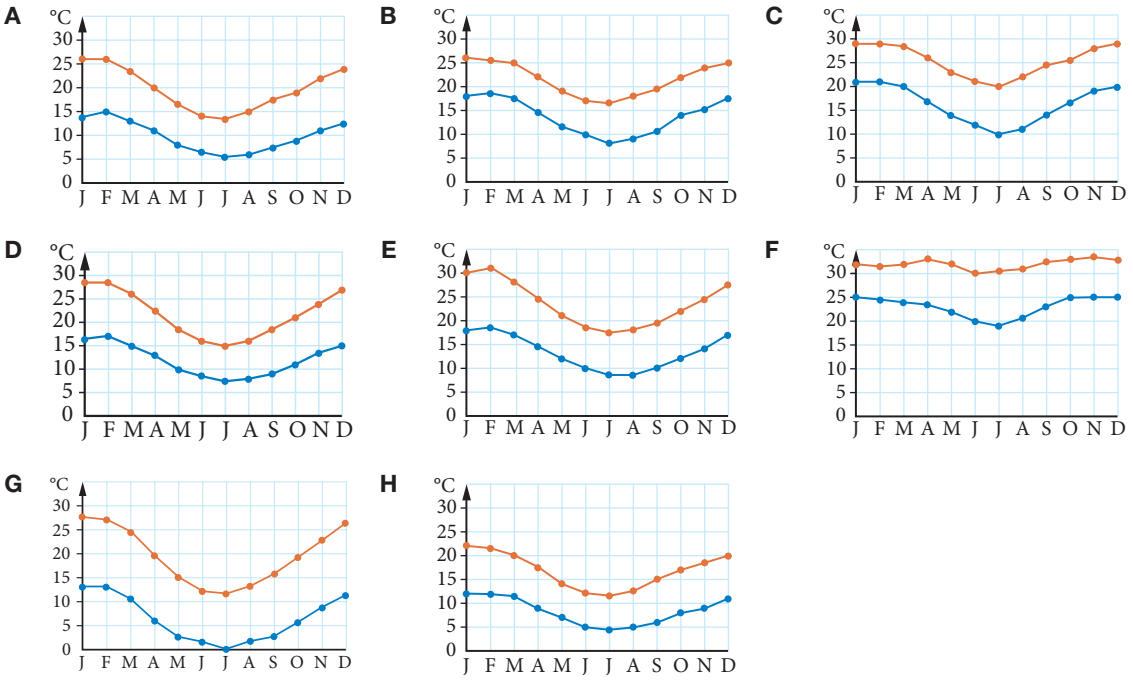
d Generally, according to both graphs, what happens as people get older?

e Is the statement 'More men die of heart disease than women' true or false? Suggest a reason why.

f At what age does the rate of cancer-related death in men increase?

g Between what ages do more women die of cancer than men? Discuss why.

3 The 8 graphs below illustrate the average maximum (orange) and minimum (blue) monthly temperatures of the Australian state and territory capitals (Adelaide, Brisbane, Canberra, Darwin, Hobart, Melbourne, Perth and Sydney) over a 12-month period, but they are presented in jumbled order. PS



a From your knowledge of geography and climate, decide which graph belongs to which city.

b For graph G, list the maximum temperature of each month.

c Graph D has 2 months with exactly the same minimum temperature. Which months are they?

d Which graphs have exactly one month with a minimum of 10°C? For each graph, state which month it is.

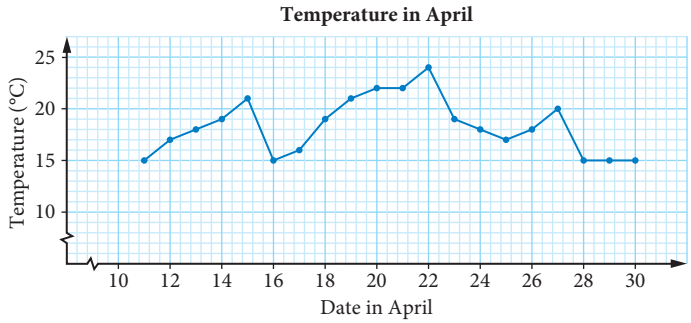
e Which graph has all the maximum temperatures approximately the same?

f Which graph has the greatest difference between the highest maximum temperature and the lowest minimum temperature for one month? What is this difference?

g Find the highest maximum temperature and state which graph shows it and in which month it occurs.

h Find the lowest minimum temperature and state which graph shows it and in which month it occurs.

4 This line graph shows the midday temperature for the last 20 days of April.



a On what date was the highest temperature, and what was that temperature?

b What was the lowest temperature?

c What was the range (the difference between the highest temperature and the lowest temperature)?

d What is the scale shown on the vertical axis?

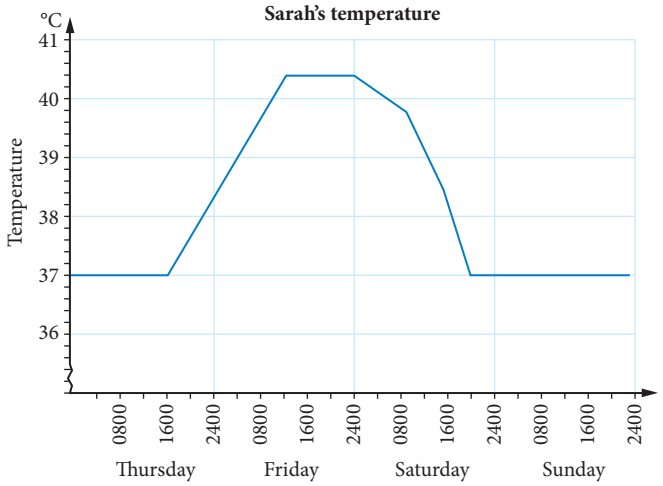
e What was the temperature on 17 April?

f On what days was the temperature 22°C?

g Which day experienced the biggest drop in temperature?

h On how many days was it colder than the day before?

5 Sarah is in hospital recovering from having her tonsils removed. The graph shows her temperature while she is in hospital.



a What does each unit represent on:

i the time scale? **ii** the temperature scale?

b What was Sarah's temperature at 0800 Friday?

c When did Sarah's temperature first reach 38.3°C?

d What was Sarah's maximum temperature?

e How long was her temperature at this maximum value?

f Increases in temperature can indicate an infection. Sarah's doctor prescribed some antibiotics. When did her temperature return to the normal of 37°C?

6 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
Temperature (°C)	42	42	41	40	40	41	39	40	38	39	37	37	37

Draw a line graph showing this information.

7 Jacob and Evan have decided to both diet and exercise in order to lose weight. The table records their weight loss over a 10-month period. PS

a Copy and complete this table.

		Month										
		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

b On one graph, draw two line graphs showing Jacob and Evan's weight loss over 10 months. Make each line graph a different colour.

c On another graph, draw two line graphs of Jacob and Evan's actual weight over 10 months. Make each line graph a different colour.

d By looking at both the sets of graphs you have drawn, who do you think was more 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 one decimal place.

11.7 Misleading graphs

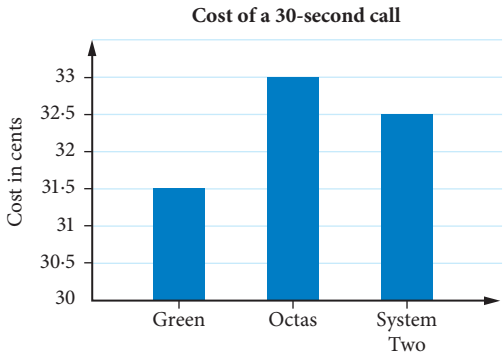
Worksheet
Misleading graphs

Sometimes graphs are deliberately drawn to give a false impression, like the one shown.

This can be done by:

- not having a scale on the vertical axis
- showing only part of the scale or an irregular scale
- not showing zero on the vertical scale or only showing a small part of the vertical axis
- using pictures or three-dimensional figures on the graph to exaggerate the differences.

This graph shows the cost of a 30-second call on 3 different mobile phone plans. If you view the graph quickly, it appears that the calls are much cheaper on the Green plan than on the other two plans, but a closer look will show that there really isn't a big difference in cost between the three plans. Although the information on the graph is correct, it gives a **misleading** impression.



Only showing a small part of the vertical axis on a graph is the most common way to create a misleading impression. As you work through the questions in the next exercise, you will learn about other ways that are used to create misleading impressions.

EXERCISE 11.7 Misleading graphs

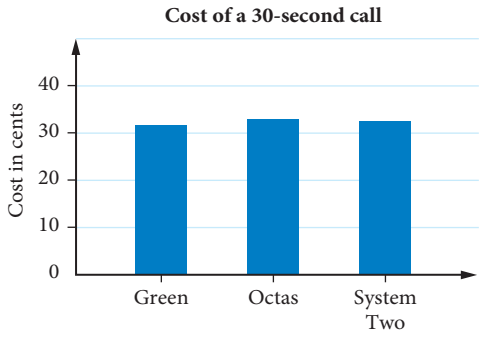
ANSWERS p. 388

1 Use the misleading graph on the previous page to answer the following questions.

a How much does a 30-second mobile phone call cost on each of the 3 plans?

b How much cheaper is a call on the Green plan than on the System Two plan?

c This graph shows the same information as the misleading graph.

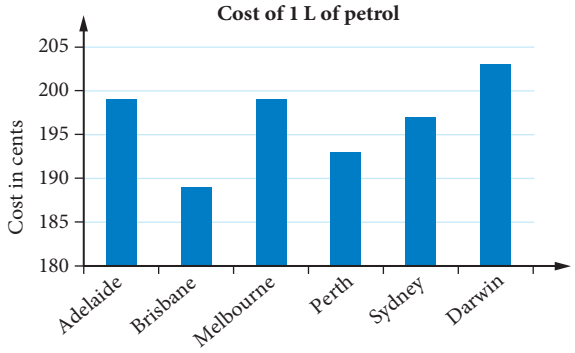


In which graph does the cost of a call on the Green plan look much cheaper than the cost on the other plans?

d Write a sentence to describe how the scales on the vertical axes are different on the 2 graphs.

e Which company do you think produced the misleading graph? Give a reason for your answer.

2 Darius drew a column graph to show the average cost of a litre of petrol in 6 capital cities.



a In which city is the price of petrol the cheapest?

b Which city has the highest petrol price?

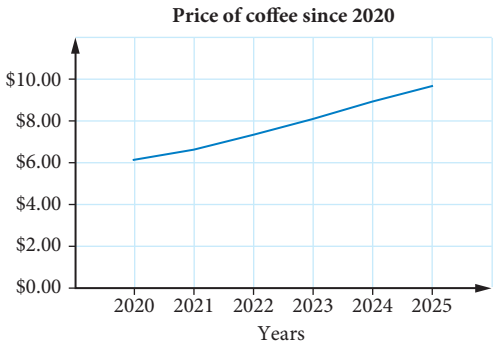
c Use the graph to estimate the price of petrol in Brisbane.

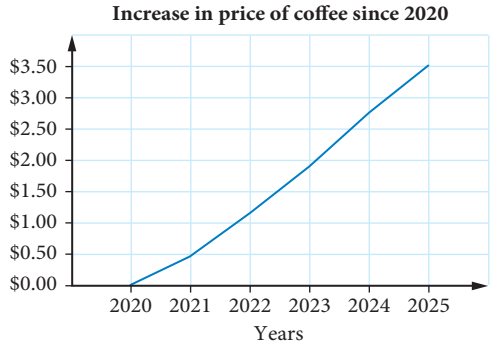
d Approximately how many cents cheaper is the price of petrol in Brisbane than in Darwin?

e Darius included this graph in an advertisement for motoring holidays in Brisbane. He claimed that the graph shows that petrol prices are much lower in Brisbane than they are in other capital cities. Explain what Darius did to the graph to make the price of petrol look a lot cheaper in Brisbane.

3 This table shows the price of a brand of coffee from 2020 to 2025, with the data graphed in 2 different ways.

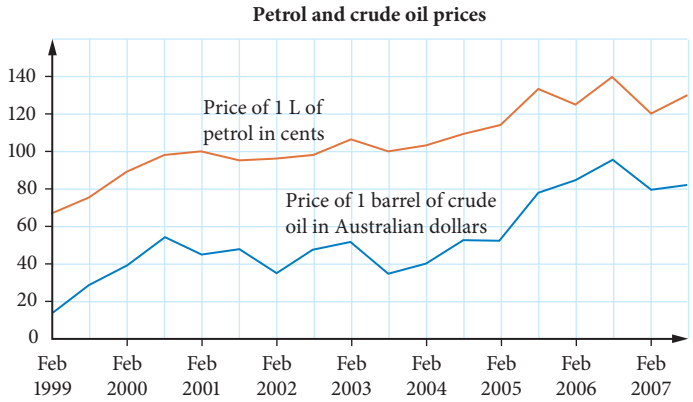
	Year					
	2020	2021	2022	2023	2024	2025
Price of coffee	$6.15	$6.60	$7.30	$8.05	$8.90	$9.65
Increase since 2010	$0	$0.45	$1.15	$1.90	$2.75	$3.50





The 2 graphs illustrate how graphs can make **increases** look small or big. Imagine that you want to draw a graph to show how the population in your area has increased. Describe how you could make the increase look small and how you could make it look big.

4 Scott thinks that oil companies are ripping people off. He decided to investigate the price of petrol and the cost of crude oil. Scott displayed his information on a graph. PS



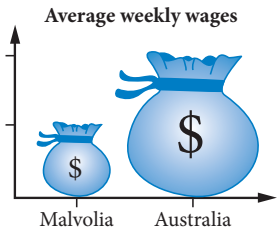
a What was the price of 1 L of petrol in February 2007?

b How much did a barrel of crude oil cost in February 2007?

c Profit = selling price – cost price. The graph shows the barrel cost at 56 and the petrol cost at 104 in February 2003, giving the impression that the profit is 104 – 56 = 48. Explain why this impression is completely false.

d What relationship does the graph show between the price of petrol and the price of crude oil?

5 This graph compares the average weekly wages in Malvolia ($700) and Australia ($1400).



- **a** What misleading impression does this graph give?
- **b** Explain 2 things that are wrong about this graph.
- **c** What should be drawn on the graph instead of pictures?
- **d** Redraw this graph correctly.

Spreadsheet
Statistical graphs

6 This question uses data from the spreadsheet from Exercise 11.5. It uses the results of a survey of households about their favourite commercial television network. The data are in cells A37 to B41.

- **a** Select cells A38 to B41 and make a basic column chart from the data.
- **b** Select **Layout**, then **Axes**, **Primary Vertical Axis**, **More Primary Vertical Axis**, **Options**.
- **c** In the dialogue box for **Minimum**, select **Fixed** and enter 3700 next to it. Close the dialogue box.
- **d** Give the graph the obvious title it deserves 'Nine blitzes the other networks' and put it in the Misleading sheet.
- **e** Do the same again but in the vertical axis dialogue box make the minimum zero. Close the box.
- **f** This is the same data but the impression is very different. Give this graph a title that explains the situation seen.
- **g** Move it to the Misleading sheet directly beneath the first graph.

Chapter problem

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

Keyword activity

GRAPHS SUMMARY

In your own words, summarise the important features of each type of graph.

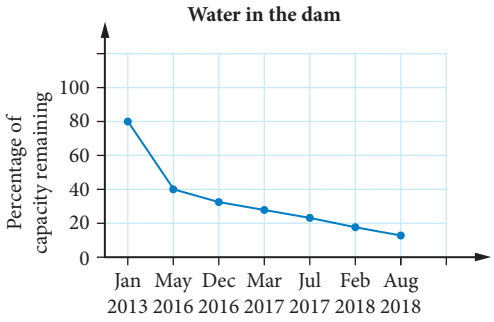
1	Column graph	**4**	Conversion graph	**7**	Picture graph
2	Climate graph	**5**	Histogram	**8**	Pie graph
3	Clustered column graph	**6**	Line graph	**9**	Stem plot

9780170484589

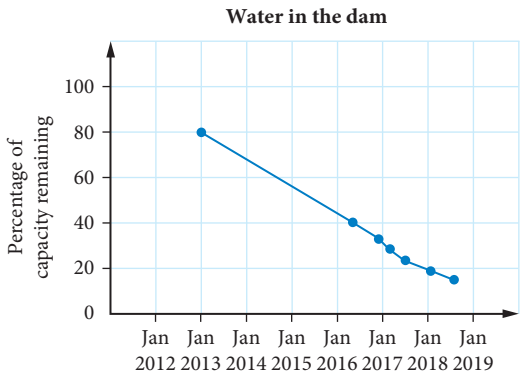
Solution to the chapter problem

Problem

During a drought, the water authority produced a graph to show the decreasing supply of water in a dam due to the water usage of local residents. Is the decrease in water supply as bad as the graph shows? If the graph gives a false impression, identify what has been done to create this impression.



Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	We need to decide if the graph is misleading and, if so, why?
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	This graph is misleading because the scale on the horizontal axis isn't consistent. The horizontal scale jumps from 2013 to 2016 and then various months from 2016 and 2018. The big drop in dam levels between January 2013 and May 2016, compared with the small drop between February and August in 2018, gives the impression that water was being wasted from 2013 to 2016.
STAGE 3: CHECK THE SOLUTION	
 CHECK	We have answered both parts of the question.
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	The graph below shows the same information in a non-misleading way. 

11 Test yourself

Show me the graph

ANSWERS p. 388

Use the graphs in Exercise 11.1 on pages 213–219 to answer questions **1** to **5**.

1 EXERCISE 11.1 Use the picture graph in question **1** on page 213.

- **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?

2 EXERCISE 11.1 Use the column graph in question **3** on page 214.

- **a** Estimate the population of Brisbane from the graph.
- **b** Estimate the difference between the populations of Brisbane and Melbourne.

3 EXERCISE 11.1 Use the line graph in question **7** on page 216.

- **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?

4 EXERCISE 11.1 Use the conversion graph in question **10** on page 217.

- **a** Convert $60 to euros.
- **b** Convert 60 euros to Australian dollars.

5 EXERCISE 11.1 Use the pie graph in question **14** on page 219.

- **a** Which sport has the smallest sector?
- **b** Football was the favourite sport of 17% of those surveyed. 3500 people were surveyed. How many people preferred to watch football on TV?

6 EXERCISE 11.2 The government gathered information about people's internet access by undertaking a survey. This table shows the results of that survey.

	High-speed internet	Limited high-speed internet	Total
City	105	38	**i**
Country	89	42	**ii**
Total	**iii**	**iv**	**v**

- **a** Copy the table and complete the missing values **i** to **v.**
- **b** How many country people were surveyed?
- **c** What percentage of city people have high-speed internet?
- **d** What percentage of the whole sample have limited high-speed internet?

Use the graphs in Exercise 11.3 on pages 222–223 to answer questions **7** to **9**.

7 EXERCISE 11.3 Use the telephone bill graph in question **1** on page 222.

- **a** How much was the bill in August 2025?
- **b** What is the difference between the highest telephone bill and the lowest telephone bill over this 13 months?

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8 EXERCISE 11.3 Use the gas bill in question **3** on page 222.

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.

9 EXERCISE 11.3 Use the table of interest rates in question **4** on page 223.

a What is the highest interest rate offered?

b Annabel invests $50 000 for 6 months. How much interest does she earn?

10 EXERCISE 11.4 Copy and complete this paragraph:

A column graph is often used for _____ data. When we are showing parts of a whole, we use a _____ graph. A line graph is used to show _____ over _____.
An advantage of a stem plot is _____.
To see the shape of a data set, we use a _____.

11 EXERCISE 11.6 This table gives the daily minimum temperature over a fortnight in Innisfail.

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Temperature (°C)	20	19	21	21	20	19	18	20	17	16	19	17	16	14

Draw a line graph showing this information.

12 EXERCISE 11.7 Redraw the misleading graph in Exercise 11.7, question **2** on page 236 so that it isn't misleading.



Chapter problem

Daniel needs to be at work by 8:30 am. To get to work, he catches a bus to the station and then a train. The bus stop is 10 minutes from home and the bus trip takes 15 minutes. Buses leave every 15 minutes from 6:00 am. The train trip takes 10 minutes and trains leave every 20 minutes from 6:05 am. Daniel's workplace is a 5-minute walk from the station. At what time does Daniel need to leave home to get to work on time?

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CHAPTER 12

DATA AND TRAVEL: TIME AND MOTION

IT'S ABOUT TIME

Syllabus coverage
Nelson MindTap chapter resources
Terminology
12.1 Units of time
12.2 0600 hours
12.3 How long will it take?
12.4 Times across Australia
12.5 Timetables
12.6 Nature's timetables*
Keyword activity
Solution to the chapter problem
Test yourself
* COMPLEX

What will we do in this chapter?

- Convert between units of time: second, minute, hour, day, week, fortnight, month, year
- Write the time of day in 12- and 24-hour time and convert between the two formats
- Calculate time differences
- Solve problems involving Australian time zones
- Solve problems involving transport timetables and schedules, including planning trips

How are we ever going to use this?

- When looking up timetables and making plans for travel
- When checking TV programs or performance times
- Any time you need to calculate anything to do with time

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Syllabus coverage

UNIT 2, TOPIC 3: TIME AND MOTION

Time

- Represent time using 12-hour and 24-hour clocks.
- Calculate time intervals, including time between, time ahead, time behind.
- Interpret timetables for buses, trains and/or ferries.
- Use several timetables and/or electronic technologies to plan the most time-efficient routes [complex].
- Interpret complex timetables, e.g. tide charts, sunrise charts and moon phases [complex].
- Compare the time taken to travel a specific distance with various modes of transport.

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, p. 20
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Videos (3):

12.2 24-hour time

12.3 Time differences 1 • Time differences 2

Worksheets (7):

12.1 Converting time units

12.2 12-hour and 24-hour time • 24-hour time on an analogue clock

12.3 Time calculations

12.5 Time travel • TV times • Public transport trips

Puzzles (3):

12.1 Converting time units

12.2 12- and 24-hour time

12.3 Time calculations

Nelson MindTap

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

Terminology

12-hour time	24-hour time	moon phases	sunrise
sunset	tide chart	time zone	timetable

12.1 Units of time

Unit	Relationships
second (s)	
minute (min)	1 min = 60 s
hour (h)	1 h = 60 min = 3600 s
day	1 day = 24 h
week	1 week = 7 days
fortnight	1 fortnight = 2 weeks = 14 days
month	1 month = 30 or 31 days February has 28 days (or 29 days on leap years)
year	1 year = 12 months 1 year = 52 weeks 1 year = 365 days (or 366 days on leap years)

EXAMPLE 1 Converting units of time

Convert

a 23 minutes into seconds

b 91 days into weeks.

Steps	Working
a 1 min = 60 s, so multiply by 60.	23 min = 23 × 60 s = 1380 s
b 1 week = 7 days, so divide by 7.	91 days = 91 ÷ 7 = 13 weeks



Worksheet
Converting time units

Puzzle
Converting time units

Scientific calculators have a degrees–minutes–seconds key °’” or DMS.

As we saw in Chapter 1, *What's the score?*, this key is useful for calculations involving hours, minutes and seconds.

EXAMPLE 2 Converting minutes to hours and minutes

Convert 275 minutes into hours and minutes.

Steps	Working
1 min = 60 s so divide by 60. Press the °’” or 2nd F DMS to change from decimal form to hours and minutes.	275 min = 275 ÷ 60 = 4.583 333… min = 4 h 35 min [4°35′0″ on the calculator display]

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EXERCISE 12.1 Units of time

ANSWERS p. 388

1 EXAMPLE 1 Copy and complete each conversion.

a 6 hours = _____ minutes

b $2\frac{1}{2}$ years = _____ weeks

c 480 seconds = _____ minutes

d 120 months = _____ years

e 96 hours = _____ days

f 3 fortnights = _____ days

g 5 years = _____ months

h 24 weeks = _____ fortnights

i 18 weeks =_____ days

j 78 months = _____ years

2 Saranya runs a marathon in $3\frac{1}{4}$ hours. What is this time in minutes?

3 Eddie is sentenced to spend 105 days in jail. How many weeks is this?

4 Letitia is paid $3040 per fortnight. How much is this per week?

5 Yusuf takes out a loan to be paid back in monthly instalments over 15 years. How many monthly repayments is this?

6 Evan is paid $5585 per month.

a How much is Evan paid per year?

b How much is Evan paid per week?

A general month does NOT have 4 weeks: a common mistake!

7 EXAMPLE 2 Use the degrees–minutes–seconds key on your calculator to copy and complete each conversion.

a 212 minutes = _____ hours _____ minutes

b 561 seconds = _____ minutes _____ seconds

c 330 seconds = _____ minutes _____ seconds

d 135 minutes = _____ hours _____ minutes

e 409 minutes = _____ hours _____ minutes

f 767 seconds = _____ minutes _____ seconds

8 In a training session, Zak takes 35 seconds to swim each 50 m lap.

a How many seconds does Zak take to complete 40 laps?

b Express your answer to part **a** in minutes and seconds.

c Zak started swimming laps at 5 am. At what time will he finish the 40 laps?

9 Pooja is training for a marathon. She runs every day. On weekdays, she runs for $1\frac{1}{2}$ hours in the morning and $2\frac{1}{4}$ hours in the evening. On weekends, she runs 4 hours each day. For how long does Pooja run each week? Give your answer in hours and minutes. PS

10 Nelson Anglican College has a 20-minute break in the morning and a 45-minute lunch break. What is the total time for breaks in a fortnight? Give your answer in hours and minutes. PS

How many school days in a fortnight?

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11 In a charity marathon run, 7 people ran an equal amount of time in a 24-hour relay. Jodean was one of the runners. To work out how long she ran for, she did the following calculation:

$$24 \div 7$$

The calculator answer shows as 3.4285 …

a Explain why the answer is *not* 3 hours 42 minutes.

b Calculate the correct answer.

TECHNOLOGY Calculating wages

On a spreadsheet, it is easier to enter times as decimals so they can be used in calculations.

1 Enter the following data into a spreadsheet.

	A	B	C	D	E
1	Calculating wages				
2					
3	Name	Time worked	Hours worked	Hourly rate	Wages
4	Grainger	37h 30 min	37.50	$27.40	$1,027.50
5	Sharwood	40h 12 min		$19.60	
6	Bush	39h 15 min		$25.90	
7	Nabaglo	29h 45 min		$32.20	
8	James	32h 30 min		$28.70	
9	Kerry	44h 36 min		$18.50	
10					
11			Total weekly wages =		
12					

Source: Microsoft Corporation

2 Convert the times in column B to decimal hours and write the answers in column C. For Grainger, this should be 37.50 hours.

3 Enter the formula **=C5*D5** into cell E5.

4 Use **Fill Down** to complete column E.

5 Calculate the total weekly wages by entering **=SUM(E4:E9)** in cell E11.

12.2 0600 hours

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:

- analogue clock with a clock face and often the numbers 1 to 12 on it
- digital clocks that can show either 12-hour or 24-hour time.



Monticello/Dreamstime.com

Analogue clock



Olga Popova/Dreamstime.com

Digital clock

Video
24-hour time

Worksheets
12-hour and 24-hour time

24-hour time on an analogue clock

Puzzle
12- and 24-hour time

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 3 24-hour time

Write 8:25 am in 24-hour time.

Steps	Working
8:25 am is in the morning. Leave out the ':' and put a zero at the front.	8:25 am = 0825

EXAMPLE 4 12-hour time

Write 1615 as 12-hour time.

Steps	Working
1615 is bigger than 1200 so it's in the afternoon (pm). For the hour, take 12 away from 16. 16 − 12 = 4	1615 = 4:15 pm

EXERCISE 12.2 0600 hours

ANSWERS p. 389

1 EXAMPLE 3 Write as 24-hour time.

a 11:44 am **b** 6:35 pm **c** 2:51 am **d** 9:54 pm

2 EXAMPLE 4 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 analogue 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 24-hour time is used in the army, navy and air force, so it is sometimes called 'military time'. Sean rings his wife from the army camp at 1730. What 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. PS

a How long was Andrew on duty?

b How long was it between the 2 incident reports?

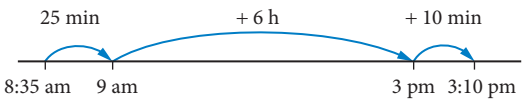
c A person from the second fight is taken to hospital and arrives 45 minutes after the incident was reported. At what time does the person arrive at the hospital?

12.3 How long will it take?

How long do I have before my favourite TV program 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 5 Time differences

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

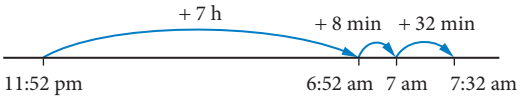
Videos
Time differences 1
Time differences 2

Worksheet
Time calculations

Puzzle
Time calculations

EXAMPLE 6 Forward in time

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 7 Backwards in time

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

EXERCISE 12.3 How long will it take?

ANSWERS p. 389

1 EXAMPLE 5 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 to wait for his next flight?

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 6 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?

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7 Ewan has to take his tablets $1\frac{1}{2}$ hours after he finishes lunch. He finished his lunch at 1:45 pm. At 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 7 Jamie bought a computer in December 2019. How old was it

a in August 2023? **b** in January 2024? **c** today?

10 A box of chocolates bought in November 2024 has a 'Use by' date of March 2026. How long, in months, will the chocolates last?



Stephen VanHorn/Shutterstock.com

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. PS

13 How old are you today in years, months and days? PS

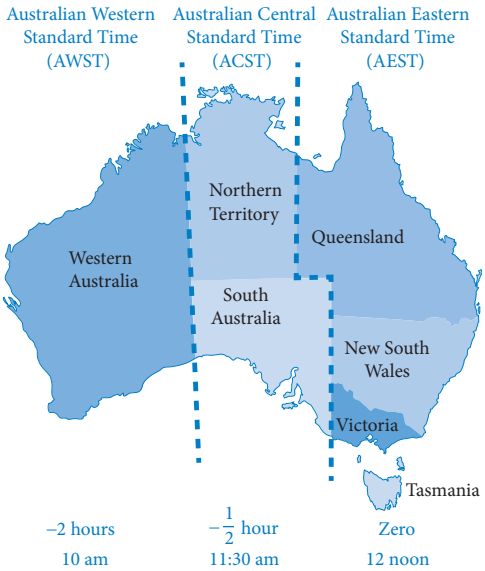
Chapter problem

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

12.4 Times across Australia

Australia has 3 **time zones**:

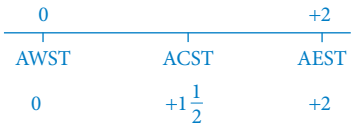
- **Australian Eastern Standard Time (AEST)**, covering Queensland, New South Wales, the ACT, Victoria and Tasmania
- **Australian Central Standard Time (ACST)**, covering South Australia and the Northern Territory and $\frac{1}{2}$ hour behind AEST
- **Australian Western Standard Time (AWST)**, covering Western Australia and 2 hours behind AEST



Golden Vector/Shutterstock.com

EXAMPLE 8 Australian time zones

Show the Australian time zones on a timeline with Western Australia as 0 hours.

Steps	Working
If Western Australia is 0, then Eastern Australia is +2 hours and Central Australia is $+1\frac{1}{2}$ hours.	

East vs west for time differences

- When moving east, add on the time difference.
- When moving west, subtract the time difference.

EXAMPLE 9 Australian local times

a It is 9 am in Perth. What time is it in Adelaide?

b It is 2 pm in Brisbane. What time is it in Adelaide?

Steps	Working
a Moving east from Perth to Adelaide: add the time difference.	9 am + $1\frac{1}{2}$ hours = 10:30 am
b Moving west from Brisbane to Adelaide: subtract the time difference.	2 pm − $\frac{1}{2}$ hour = 1:30 pm

EXERCISE 12.4 Times across Australia

ANSWERS p. 389

1 EXAMPLE 8 Show the time zones on a timeline with the Northern Territory as 0 hours.

2 State whether each location is ahead of, behind or has the same time as Adelaide.

a Brisbane **b** Melbourne **c** Darwin **d** Canberra
e Geraldton (WA) **f** Mt Isa (Qld) **g** Ballarat (Vic.) **h** Ceduna (SA)
i Hobart **j** Broome (WA)

3 EXAMPLE 9 It is 10:30 am in Adelaide. What time is it in:

a Cairns? **b** Fremantle (WA)? **c** Alice Springs (NT)?
d Launceston (Tas)? **e** Bendigo (Vic.)? **f** Broome (WA)?

4 What is the time in each city when it is 11 pm in Brisbane?

a Melbourne **b** Adelaide **c** Perth
d Darwin **e** Hobart **f** Canberra

5 The AFL Grand Final started in Melbourne at 2:15 pm and was shown live in Adelaide. At what time did the game start on Adelaide TV?

6 **a** Mick's flight from Brisbane to Perth will take $5\frac{1}{2}$ hours. He leaves Brisbane at 2 pm. At what time does he land in Perth? Give your answer as Perth local time.

b When Mick flies home, he leaves Perth at 11:30 am. At what time does he land in Brisbane? Give your answer as Brisbane local time. PS

7 When Valentina was holidaying at Margaret River in WA, she phoned her parents in Cairns. She rang at 6:30 pm Western Standard Time. What time was it in Cairns?

8 Simone, in Toowoomba, uses the internet to talk with her cousins in Fremantle, WA. At what time should Simone log on to catch her cousins at 8:00 pm Fremantle time?

9 **a** Use the internet to find out when daylight saving begins and ends in NSW and Victoria.

b Why do some states have daylight saving?

c How does daylight saving affect the different time zones?

d When it is 12:30 pm in Western Australia (not on daylight saving), what time is it in NSW on Eastern Daylight Saving Time?

10 Broken Hill in NSW operates on Central Standard Time rather than Eastern Standard Time like the rest of NSW. Suggest a reason why Broken Hill might have chosen to do this. (Hint: look at a map.)

11 At 2:30 pm, Khan is in Australia watching the cricket live on TV, which is being played at the Melbourne Cricket Ground, but the clock at the ground says 5:30 pm (Eastern Daylight Saving Time). Where might Khan be watching from? PS

12 Isabella and Lara like to talk on Facetime. On New Year's Eve, Lara called at 10 pm local time and it was 7:30 pm in Isabella's location. Where in Australia could the girls be located? PS

12.5 Timetables

Thousands of Australians rely on rail, bus and ferry **timetables** every day.

Worksheets
Time travel
TV times
Public transport trips

EXAMPLE 10 Train timetable

A section of a train timetable is shown here.

Armadale/Thornlie to Perth								
Armadale	7:16 AM		7:46 AM		8:16 AM		8:31 AM	
Sherwood	7:18 AM		7:48 AM		8:18 AM		8:33 AM	
Challis S	7:20 AM		7:50 AM		8:20 AM		8:35 AM	
Kelmscott	7:22 AM		7:52 AM		8:22 AM		8:37 AM	
Seaforth	7:25 AM		7:55 AM		8:25 AM		8:40 AM	
Gosnells	7:27 AM		7:57 AM		8:27 AM		8:42 AM	
Maddington	7:30 AM		8:00 AM		8:30 AM		8:45 AM	
Kenwick	7:32 AM		8:02 AM		8:32 AM		8:47 AM	
Beckenham	7:34 AM		8:04 AM		8:34 AM		8:49 AM	
Thornlie		7:35 AM		8:05 AM		8:35 AM		8:50 AM
Cannington	7:36 AM	7:39 AM	8:06 AM	8:09 AM	8:36 AM	8:39 AM	8:51 AM	8:54 AM
Queens Park		7:40 AM		8:10 AM		8:40 AM		8:55 AM
Welshpool		7:42 AM		8:12 AM		8:42 AM		8:57 AM
Oats Street	7:39 AM	7:44 AM	8:09 AM	8:14 AM	8:39 AM	8:44 AM	8:54 AM	8:59 AM
Carlisle		7:45 AM		8:15 AM		8:45 AM		9:00 AM
Victoria Park		7:48 AM		8:18 AM		8:48 AM		9:03 AM
Burswood		7:50 AM		8:20 AM		8:50 AM		9:05 AM
Belmont Park				8:22 AM		8:52 AM		9:07 AM
Claisebrook	7:47 AM	7:54 AM	8:17 AM	8:24 AM	8:47 AM	8:54 AM	9:02 AM	9:09 AM
McIver	7:49 AM	7:56 AM	8:19 AM	8:26 AM	8:49 AM	8:56 AM	9:04 AM	9:11 AM
Perth	7:50 AM	7:58 AM	8:20 AM	8:28 AM	8:50 AM	8:58 AM	9:05 AM	9:13 AM

Perth to Armadale/Thornlie								
Perth	4:37 PM	4:45 PM	4:52 PM	5:00 PM	5:07 PM	5:15 PM	5:22 PM	5:30 PM
McIver	4:38 PM	4:46 PM	4:53 PM	5:01 PM	5:08 PM	5:16 PM	5:23 PM	5:31 PM
Claisebrook	4:40 PM	4:48 PM	4:55 PM	5:03 PM	5:10 PM	5:18 PM	5:25 PM	5:33 PM
Belmont Park	4:42 PM		4:57 PM		5:12 PM		5:27 PM	
Burswood	4:44 PM		4:59 PM		5:14 PM		5:29 PM	
Victoria Park	4:46 PM		5:01 PM		5:16 PM		5:31 PM	
Carlisle	4:48 PM		5:03 PM		5:18 PM		5:33 PM	
Oats Street	4:49 PM	4:54 PM	5:04 PM	5:09 PM	5:19 PM	5:24 PM	5:34 PM	5:39 PM
Welshpool	4:51 PM		5:06 PM		5:21 PM		5:36 PM	
Queens Park	4:53 PM		5:08 PM		5:23 PM		5:38 PM	
Cannington	4:55 PM	4:58 PM	5:10 PM	5:13 PM	5:25 PM	5:28 PM	5:40 PM	5:43 PM
Beckenham		4:59 PM		5:14 PM		5:29 PM		5:44 PM
Kenwick		5:01 PM		5:16 PM		5:31 PM		5:46 PM
Maddington		5:03 PM		5:18 PM		5:33 PM		5:48 PM
Gosnells		5:07 PM		5:22 PM		5:37 PM		5:52 PM
Seaforth		5:09 PM		5:24 PM		5:39 PM		5:54 PM
Kelmscott		5:12 PM		5:27 PM		5:42 PM		5:57 PM
Challis		5:14 PM		5:29 PM		5:44 PM		5:59 PM
Sherwood		5:16 PM		5:31 PM		5:46 PM		6:01 PM
Armadale		5:19 PM		5:34 PM		5:49 PM		6:04 PM
Thornlie	5:00 PM		5:15 PM		5:30 PM		5:45 PM	

Source: Transperth

Louise catches the 7:52 am train from Kelmscott to get to work at Burswood. At 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. She can then catch a train to Burswood.	The train to Burswood arrives at the station at 8:20 am.

EXERCISE 12.5 Timetables

ANSWERS p. 389

Use the train timetable in Example 10 to answer each question.

1 EXAMPLE 10 At what time does the 7:16 am train from Armadale arrive at Perth?

2 At what time does the 5:03 pm train from Carlisle arrive at Thornlie?

3 Ravi lives in Queens Park and works in Perth. He starts work at 8:45 am. 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** At what time can he catch the train home?
- **b** At what time does he get to Queens Park?
- **c** Three days a week Ravi catches up with friends after work for half an hour. On these days, at what time does he catch the train home?

5 Frances catches the 5 pm train from Perth. At 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. At 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 Brisbane train timetable. Save it or print a copy. PS

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.

This is the bus timetable for Adelaide to Alice Springs and return. Use it 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				
Indulkana Turnoff	IDK		3:20P	Roadside mailbox at turnoff
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	Turnoff
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 Commercial 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 Road
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 Commercial Rd
Pimba	PIM	Arr	12:45A	Shell Roadhouse
		Dep	1:00A	
Glendambo	GBO	Arr	2:15A	Shell Roadhouse
		Dep	2:30A	
Bulgunnia Turnoff		BGN	3:35A	Turnoff
Coober Pedy	CPD	Arr	5:15A	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	
Indulkana Turnoff	IDK		9:35A	Roadside mailbox at turnoff
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 2/76 Todd St

Source: Greyhound Australia, with permission.

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 departs from Coober Pedy, he will travel all the way to Adelaide. How long will it take?

12 Ariana and Axel are friends. Ariana lives in Adelaide and Axel lives in Alice Springs. They are planning to meet 'in the middle' to spend the weekend together. PS

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

Source: 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?



Tupungato/Dreamstime.com

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 grey and one part unshaded?

17 The City Explorer Bus stops at places of interest in the city and operates in Brisbane, Sydney and Melbourne. This is the timetable for the explorer bus 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

Source: http://theaustralianexplorer.com.au/

a How many buses are needed to meet the Explorer Bus 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. PS

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. PS

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.

18 **a** Choose a town approximately 10 to 20 km from your home.

b Use Google Maps or a similar app to find the time it takes to travel there by different means; for example, by car, bike, walking, public transport.

c If you were travelling to this town, which travel option would you chose? Why? PS

d Repeat this for another place you would like to visit.

Investigation Planning a trip

You are visiting one of the state capitals in Australia outside of Queensland. You are going to plan a trip from the airport to the CBD and on to an island off the coast.

1 Choose which capital you are going to visit.
2 You need to travel from the airport to the CBD for your accommodation. Choose a hotel in the capital city to stay at. Find out the best way to travel from the airport to the hotel, how long it will take and what it will cost.
3 You are going to visit one of the islands near the city you have chosen (Rottnest near Perth, Kangaroo near Adelaide or Phillip near Melbourne, for example). Find out how to get there from your hotel (train, bus and/or ferry), how long it will take and what it will cost.
4 Choose another tourist attraction in the capital city and find out how to get there from your hotel.
5 Find out if there are any special public transport deals available in the capital city you have chosen that could save you money when you are visiting the city.

12.6 Nature's timetables*

Tide charts tell us when high and low tide are along our coastline. There are sunrise and sunset charts, and there are also charts for the phases of the moon.

EXAMPLE 11 Tide charts

This chart shows information about tides (time and height in metres, m) and sunrise/sunset times for Cairns over a fortnight in October.

Date	High tides				Low tides				Sunrise/sunset	
October	am	m	pm	m	am	m	pm	m	am	pm
Sun 13	4:59	2.02	5:36	2.76	10:50	0.85	11:54	0.77	5:49	6:16
Mon 14	5:53	2.24	6:22	2.85	11:43	0.72			5:49	6:16
Tue 15	6:40	2.45	7:04	2.88	12:30	0.60	12:30	0.63	5:48	6:16
Wed 16	7:24	2.60	7:40	2.84	1:05	0.48	1:12	0.60	5:47	6:17
Thu 17	8:03	2.70	8:11	2.73	1:39	0.41	1:51	0.64	5:46	6:17
Fri 18	8:39	2.74	8:38	2.58	2:13	0.39	2:30	0.74	5:46	6:17
Sat 19	9:13	2.71	9:04	2.40	2:46	0.43	3:08	0.89	5:45	6:17
Sun 20	9:48	2.63	9:31	2.19	3:18	0.53	3:46	1.08	5:45	6:18
Mon 21	10:25	2.50	9:57	1.96	3:50	0.68	4:26	1.29	5:44	6:18
Tue 22	11:05	2.33	10:12	1.75	4:21	0.87	5:10	1.49	5:43	6:18
Wed 23	11:55	2.17			4:49	1.06			5:43	6:19
Thu 24	2:48	2.09			5:19	1.24			5:42	6:19
Fri 25	4:15	1.44	3:57	2.17	1:28	1.35	6:08	1.41	5:42	6:19
Sat 26	4:42				12:12	1.28	11:56	1.18	5:41	6:20

The following time adjustments may be made for other places near Cairns.

Flinders Island: 22 min after Cairns
Morris Island: 14 min after Cairns
Cruiser Pass: 7 min before Cairns
Euston Reef: 27 min before Cairns
Cape Flattery: 10 min before Cairns
Cape Grenville: 51 min after Cairns
Michaelmas Cay: 11 min before Cairns
Swallows Landing: 2 min after Cairns

Find the time of the second high tide on 17 October in

a Cairns **b** Morris Island **c** Euston Reef.



Marc Anderson/Alamy Stock Photo

Steps	Working
a Find Oct 17 in the main table, and then the second high tide.	8:11 pm
b High tide at Morris Island is 14 min after Cairns.	8:11 pm + 14 min = 8:25 pm
c High tide at Euston Reef is 27 min before Cairns.	8:11 pm − 27 min = 7:44 pm

EXERCISE 12.6 Nature's timetables*

ANSWERS p. 389

Use the tide chart on the previous page to answer questions **1** to **9**.

1 EXAMPLE 11 Find the time of the morning low tide on 21 October in

a Cairns **b** Cruiser Pass **c** Swallows Landing.

2 Find the time of the first high tide on 25 October in

a Cairns **b** Flinders Island **c** Cape Flattery.

3 **a** Calculate how many hours and minutes are between the 2 low tides on 22 October.

b What is the height difference in metres between these low tides?

4 **a** What are the times for sunrise and sunset on 15 October?

b How many hours of daylight are there on this day?

5 Most days have 4 tides. Which days have fewer than 4 tides?

6 **a** Which day has the earliest sunrise?

b What is happening to the time of sunrise over these 14 days?

7 Jacob likes to fish on the 'rising tide', when the tide is changing from low to high.

a Approximately when could he go fishing at Cairns on 19 October?

b The next day he decides to fish at Cape Grenville. Approximately when could he go?

8 At Michaelmas Cay, boats cannot be launched within one hour of low tide because the water is too shallow. Kylie wants to launch her boat on the afternoon of 16 October. After what time can she launch the boat?

9 **a** How many hours of daylight are there on 26 October?

b What is happening to the hours of daylight over these 14 days?

10 There are tables listing when the 4 phases of the moon over a monthly cycle occur. This is part of the table for Sydney in 2024. PS

New moon		1st quarter		Full moon		3rd quarter	
11 Jan	10:57 pm	18 Jan	2:52 pm	26 Jan	4:54 am	3 Feb	10:18 am
10 Feb	9:59 am	17 Feb	2:00 am	24 Feb	11:30 pm	4 Mar	2:23 am
10 Mar	8:00 pm	17 Mar	3:10 pm	25 Mar	6:00 pm	2 Apr	2:14 pm
9 Apr	4:20 am	16 Apr	5:13 am	24 Apr	9:48 am	1 May	9:27 pm
8 May	1:21 pm	15 May	9:48 pm	23 May	11:53 pm	31 May	3:12 am
6 Jun	10:37 pm	14 Jun	3:18 pm	22 Jun	11:07 pm	29 Jun	7:53 am
6 Jul	8:57 am	14 Jul	8:48 am	21 Jul	8:17 pm	28 Jul	12:51 pm
4 Aug	9:13 pm	13 Aug	1:18 am	20 Aug	4:25 pm	26 Aug	7:25 pm

Source: www.timeanddate.com

a How many new moons were there in Sydney in the first 6 months of 2024?

b How many days were there between the new moon and the full moon in June? Is this the same for every month of the year?

c How many days were there between the 1st and 3rd quarters in March/April? Is this the same for every month of the year?

d Jamie wants to propose to his girlfriend under a full moon. The ring he has chosen will be ready on 31 July. When is the first full moon on which he can propose?

e Tamara decides to try some night fishing. She wants to do this in summer when the moon is between the full moon and the 3rd quarter. When would she be able to do this?

11 a Choose a city in Queensland and find a table of moon phases for this city.

b Choose a city in the Northern Hemisphere and find a table of moon phases for this city. Are there any differences between the 2 hemispheres? PS

Investigation My next trip

You are planning to experience a uniquely Australian attraction for your next holiday. Choose one of the following:

- see the fairy penguins at Phillip Island at dusk
- see the sun rise over Uluru.

Plan your trip to the attraction you chose.

Create a presentation or a display book that shows all times, methods of transport, itinerary and costs.

Share your plans with the rest of the class.

Investigation Travelling to K'gari Island

1 Investigate online the options for travelling to K'gari Island from where you live. These may be by car, bus, train and/or plane. Google may help.

- Write down all the options and how long each one takes.
- Give a reason why you might choose each of the different options. Consider factors such as travel time to get there, cost, activities you might do on the way, reasons for travelling.

K'gari Island was previously known as Fraser Island and officially reverted to its traditional Indigenous name in 2023.

2 Choose 2 places that you could visit, one in Queensland, one in another part of Australia, and repeat question **1**.

Keyword activity

TIME TERMS

ANSWERS p. 390

Describe each term below in a sentence and match it with one of the photos.

12-hour time 24-hour time time zone timetable

A



Claudio Divizia/Shutterstock.com

B



Matteo Fes/Shutterstock.com

C



Iraidka/Shutterstock.com

D



Golden Vector/Shutterstock.com

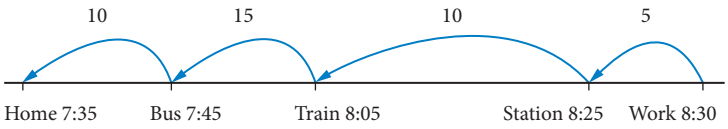
9780170484589

Solution to the chapter problem

Problem

Daniel needs to be at work by 8:30 am. To get to work, he catches a bus to the station and then a train. The bus stop is 10 minutes from home and the bus trip takes 15 minutes. Buses leave every 15 minutes from 6:00 am. The train trip takes 10 minutes and trains leave every 20 minutes from 6:05 am. Daniel's workplace is a 5-minute walk from the station. At what time does Daniel need to leave home to get to work on time?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	To work out at what time Daniel needs to leave home to arrive at work at 8:30 am. There is a lot of information given about bus, train and walking times.
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	We need to work backwards from 8:30 am.  Daniel needs to be at the station at least 5 minutes before 8:30 am, that is, at 8:25 am (5 minutes to walk). Daniel must catch the train by 8:15 am (10-minute train trip). Trains leave at 6:05 am and then every 20 minutes, so we need to calculate train departure times: 6:05, 6:25, 6:45, 7:05, 7:25, 7:45, 8:05 and 8:25. Daniel must catch the train at 8:05 am. Daniel must catch the bus by 7:50 am (15-minute bus trip). Buses leave at 6:00 am and then every 15 minutes, so the bus departure times are 6:00, 6:15, 6:30, 6:45, 7:00, 7:15, 7:30, 7:45 and 8:00. Daniel must catch the bus at 7:45 am. Daniel must leave home no later than 7:35 am (10-minute walk to bus stop).
STAGE 3: CHECK THE SOLUTION	
 CHECK	Daniel leaves home at 7:35 am, catches the bus at 7:45 am, arrives at the train station at 8:00 am, catches the train at 8:05 am, arrives at 8:15 am, walks to work and arrives at 8:20 am, which is before 8:30 am, so this solution works. Depending on the reliability of the bus and train, he may choose to leave earlier to be sure to get to work on time.
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	Daniel needs to leave home at or before 7:35 am.

12 Test yourself

It's about time

ANSWERS p. 390

1 EXERCISE 12.1 Copy and complete each conversion.

a 720 seconds = _____ minutes

b 7 weeks = _____ days

c 4 years = _____ months

d 192 hours = _____ days

2 EXERCISE 12.1

a Arima runs 8 km in 31 minutes and 17 seconds. What time is this in seconds?

b The Franken Furniture Super Sale runs for 96 hours. How many days is this?

3 EXERCISE 12.2

a Express in 24-hour time.

i 4:17 am **ii** 3:25 pm **iii** 10 am

b Write in 12-hour time.

i 0615 **ii** 1640 **iii** 2300

4 EXERCISE 12.2

a A bus leaves Brisbane at 0945 and arrives at Rockhampton at 2120. How long is the bus trip?

b Harika 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.

i How long is her shift?

ii How long was it between the last 2 callouts?

iii The callout at 0048 required transport to hospital, which took 25 minutes. At what time did Harika arrive at the hospital?

5 EXERCISE 12.3

a Calculate the time difference between 11:15 am and 3:40 pm.

b What time was it 3 hours and 5 minutes before 2:30 pm?

6 EXERCISE 12.3

a Lalaja has a stopover at New Delhi airport from 1015 to 1505. How long is she in New Delhi?

b Khalil wants to record a film screening on TV for 2 hours 40 minutes. He sets the recorder to start at 8 pm. At what time should he set it to finish?

c 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?

7 EXERCISE 12.4 Use the map of Australian time zones on page 251 to answer these questions.

a Name one city in Australia that is behind the time where you live.

b If it is 11:30 am in Perth, WA, what time is it in Brisbane?

c If it is 3:15 pm in Innisfail, Qld, what time is it in Adelaide, SA?

9780170484589

8 EXERCISE 12.5 Use the train timetable from Example 10 on pages 253–254 to answer these questions.

a Anthony catches the 8:25 am train from Seaforth to Perth. At what time does he arrive in the city?

b The Kane family is 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 by 5:30 pm. What train should they catch from Victoria Park?

9 EXERCISE 12.5 Use the bus timetable from Exercise 12.5 on pages 255–256, 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. At 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 breaks.

10 EXERCISE 12.5 Use the ferry timetable from Exercise 12.5 on page 257 to answer these questions.

a How long does the ferry take to travel from New Farm Park to the University of Queensland?

b Nate 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?

11 EXERCISE 12.6 Use the tide chart from Example 11 on page 259 to answer these questions.

a At what time is the morning low tide at Michaelmas Cay on 19 October?

b How many hours of daylight are there on 24 October?

c What is the difference in hours and minutes between the 2 high tides on October 16?

d What is the height difference in metres between these high tides?

12 EXERCISE 12.6 Use the moon phases table on page 261 to answer these questions.

a How many days are there from the 1st quarter moon in May to the full moon in May?

b How many days are there from the new moon in July to the new moon in August?



Chapter problem

Paul owns a factory that makes sails. It costs $9000 per month to cover rent, electricity and wages in the factory. Each sail costs $250 to make and sells for $850.

a How many sails does Paul need to make and sell per month to break even?

b What profit or loss will he make in a month if he makes and sells 20 sails?



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CHAPTER 13

DATA AND TRAVEL: GRAPHS

PRACTICAL GRAPHS

Syllabus coverage
Nelson MindTap chapter resources
Terminology
13.1 Straight-line graphs
13.2 Using straight-line graphs
13.3 Intersecting graphs*
13.4 Curved graphs
13.5 Practical graphs*
Keyword activity
Solution to the chapter problem
Test yourself
*COMPLEX

What will we do in this chapter?

- Graph straight lines and find the gradient and *y*-intercept
- Use straight-line graphs in practical situations and interpret the meaning of the gradient and *y*-intercept
- Solve problems involving 2 intersecting lines and identify break-even points for a business to make a profit
- Graph curves and use curves in practical situations
- Draw a graph of a practical situation that doesn't follow a formula, such as the noise level of a classroom over a lesson period

How are we ever going to use this?

- When we want to represent relationships graphically
- When we model real-life situations with algebra and a graph

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Syllabus coverage

UNIT 2, TOPIC 2: GRAPHS

Using graphs

- Use graphs in practical situations.
- Interpret graphs in practical situations [complex].
- Draw graphs from given data to represent practical situations [complex].
- Interpret the point of intersection and other important features (*x*- and *y*-intercepts) of given graphs of two linear functions drawn from practical contexts [complex].

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, p. 19
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Videos (5):

13.1 Graphing linear functions • Gradient and *y*-intercept of a line
13.2 Linear modelling
13.4 Quadratic functions
13.5 Graphing practical situations

Skillsheet (1):

13.1 Graphing linear equations

Worksheets (5):

13.1 Graphing linear functions • A page of number planes • Drawing gradients • Gradient and *y*-intercept
13.3 Intersection of lines

Puzzles (2):

13.1 Graph gradients • Gradient goat

Nelson MindTap

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

Terminology

break-even point	formula	gradient	horizontal intercept
initial	intersection	loss	number plane
profit	straight line	table of values	vertical intercept
x-axis	*x*-intercept	*y*-axis	*y*-intercept

13.1 Straight-line graphs

We can graph algebraic equations on a number plane. Some equations have graphs that are straight lines.

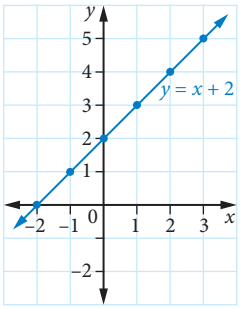
Graphing an equation on the number plane

- 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.

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 1 Graphing a line on the number plane

Graph the equation $y = x + 2$.

Steps	Working
Draw a table and choose some x values.	x: −2, −1, 0, 1, 2, 3 y:
Calculate the y values by substituting the x values in the equation.	$y = -2 + 2 = 0$ $\quad y = 1 + 2 = 3$ $y = -1 + 2 = 1$ $\quad y = 2 + 2 = 4$ $y = 0 + 2 = 2$ $\quad y = 3 + 2 = 5$
Complete the table.	x: −2, −1, 0, 1, 2, 3 y: 0, 1, 2, 3, 4, 5
Write the points from this table.	(−2, 0), (−1, 1), (0, 2), (1, 3), (2, 4), (3, 5)
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, y-intercept and x-intercept

The **gradient** of a line measures how steeply the line goes up or down.
The ***y*-intercept** of a line is the value where the line crosses the y-axis.
The ***x*-intercept** of a line is the value where the line crosses the x-axis.

Video Graphing linear functions
Skillsheet Graphing linear equations
Worksheets Graphing linear functions
A page of number planes
Video Gradient and y-intercept of a line

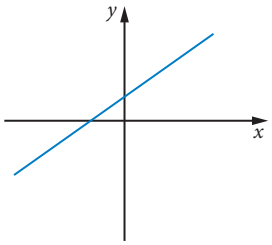
Worksheet
Drawing gradients

Puzzle
Graph gradients

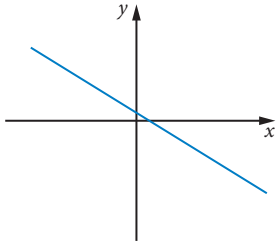
A *positive* gradient means the line goes up from left to right.

A *negative* gradient means the line goes down from left to right.

Positive gradient



Negative gradient



EXAMPLE 2 Gradient and *x*- and *y*-intercepts of a line

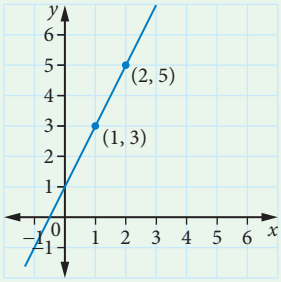
This line has the equation $y = 2x + 1$.

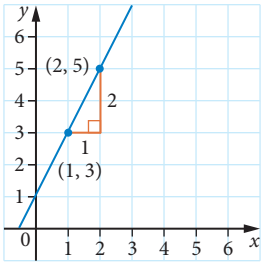
a What is the gradient of the line?

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?

d What is the value of the *x*-intercept?



Steps	Working
a Draw a right-angled triangle off 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 value where the line crosses the *y*-axis. Read the value off the graph or calculate it by substituting $x = 0$ into the equation.	Read the graph: The *y*-intercept is 1. Alternatively, when $x = 0$ $y = 2 \times 0 + 1$ $y = 1$
c The equation of the line is $y = 2x + 1$.	The gradient 2 is the number in front of the x (coefficient of x) in the equation. The *y*-intercept 1 is the number on its own (the constant) in the equation.
d The *x*-intercept is the value where the line crosses the *x*-axis. Read the value off the graph or calculate it by substituting $y = 0$ into the equation.	Read the graph: The *x*-intercept is $-\frac{1}{2}$. Alternatively, when $y = 0$ $0 = 2x + 1$ $2x = -1$ $x = -\frac{1}{2}$

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EXAMPLE 3 Gradient and y-intercept of a line

Find the gradient and y-intercept of the line with equation:

a $y = 4x - 1$ **b** $y = -2x$ **c** $y = 8 - 3x$

Steps	Working
a The gradient is the number in front of the x.	$y = 4x - 1$
The y-intercept is the **constant** or the number on its own.	gradient $= 4$
	y-intercept $= -1$
b $-2x$ is the same as $-2x + 0$.	$y = -2x + 0$
	gradient $= -2$
	y-intercept $= 0$
c $8 - 3x$ can be rewritten as $-3x + 8$.	$y = -3x + 8$
	gradient $= -3$
	y-intercept $= 8$

Worksheet
Gradient and y-intercept

Puzzle
Gradient goat

EXERCISE 13.1 Straight-line graphs

ANSWERS p. 390

1 EXAMPLE 1 Draw the graph of each equation.

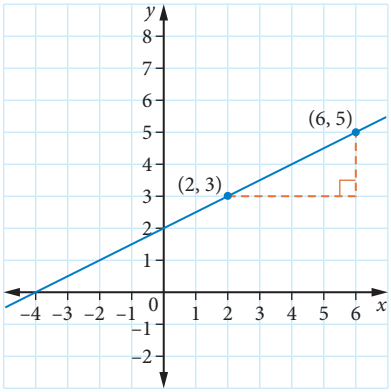
a $y = x - 4$ **b** $y = 2x$ **c** $y = x + 3$

d $y = \frac{x}{2}$ **e** $y = -3x$ **f** $y = 2x - 4$

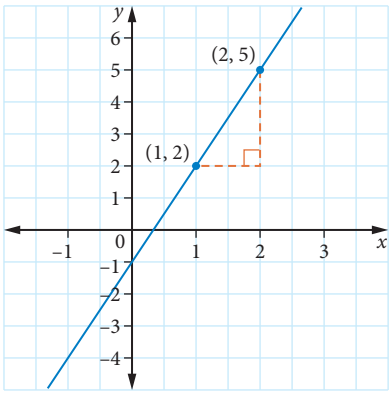
g $y = -x + 2$ **h** $y = 3x$ **i** $y = \frac{x}{4}$

2 EXAMPLE 2 For each line, find its gradient and y-intercept.

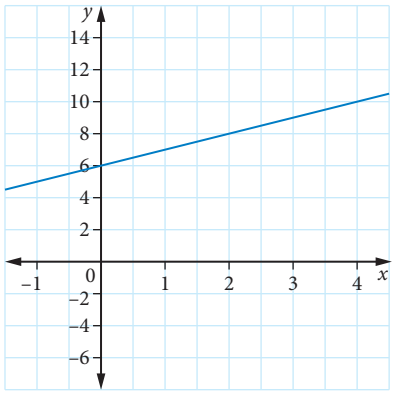
a



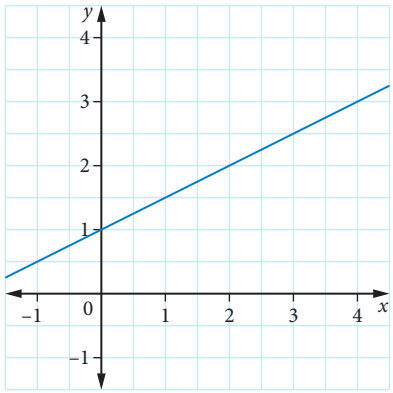
b



c



d



3 EXAMPLE 3 For each equation, state the

	i gradient	ii y-intercept	iii x-intercept
a	$y = 7 - x$	**b** $y = 4x$	**c** $y = 3x + 2$
d	$y = -2x + 3$	**e** $y = \frac{x}{4} - 2$	**f** $y = -\frac{x}{3} - 4$

Remember: $\frac{x}{4} = \frac{1}{4}x$

4 For each graph you drew in question **1**, state whether the gradient is positive or negative and write the gradient from the equation.

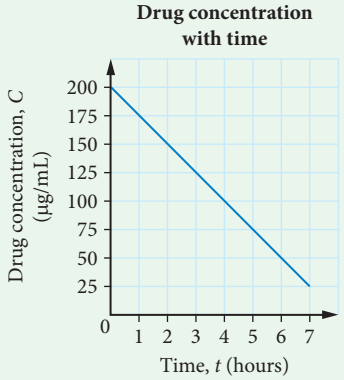
Video
Linear modelling

13.2 Using straight-line graphs

Often, straight-line graphs can be used to model real-world situations.

EXAMPLE 4 Applying straight-line graphs 1

The concentration of a particular drug in a person's body decreases as time passes. This is represented by the graph shown, which has equation $C = -25t + 200$. Note that the variables x and y have been replaced by t and C respectively.



a What is the gradient of the line?

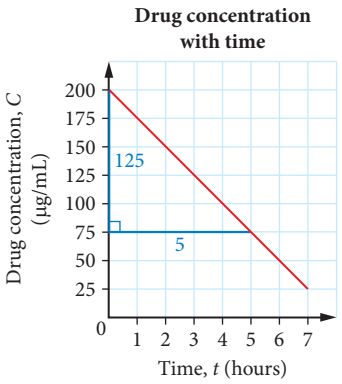
b What does the gradient represent?

c Find the **vertical intercept** of the line.

d What does the vertical intercept represent?

e When will there be no drug remaining in the body?

µg means micrograms or one-millionth of a gram.

Steps	Working
a Draw a triangle on the line to calculate the gradient. The line goes down 125 units for every 5 units across. The gradient will be negative because the line goes down rather than up. OR Read the gradient from the equation of the line. It is the number in front of t.	 gradient $= -\frac{125}{5}$ $= -25$
b	The gradient represents the decrease in drug concentration per hour. Drug concentration goes down 25 µg/mL every hour.

c The vertical intercept is the general name for the y-intercept. It is the value where the line crosses the vertical axis and is the constant in $C = -25t + 200$.	The vertical intercept is 200.
d The vertical intercept is the drug concentration when $t = 0$.	The vertical intercept represents the initial concentration of the drug: 200 μg/mL
e There is no drug remaining when $C = 0$. We can either extend the line to see where it crosses the horizontal axis, or substitute $C = 0$ into the equation and solve the equation. This is the x-intercept or horizontal intercept.	When $C = 0$, $0 = -25t + 200$ $25t = 200$ $\frac{25t}{25} = \frac{200}{25}$ $t = 8$ There will be no drug in the body after 8 hours.

EXAMPLE 5 Applying straight-line graphs 2

Carly has a window cleaning business. Each day it costs her an average of $75 for fuel and car maintenance and $8 per job.

a Let C = Carly's daily costs in dollars and n = the number of jobs she does per day.

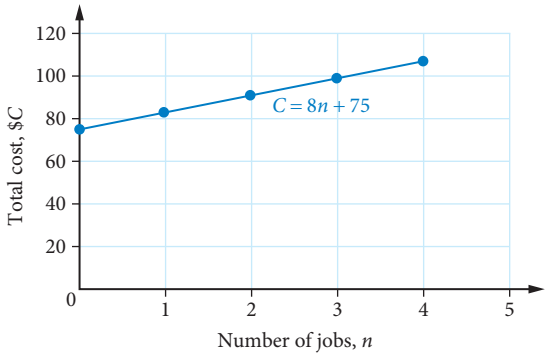
Write an equation for Carly's daily costs.

b Construct a graph to illustrate Carly's daily costs.

c What is the gradient and vertical intercept of the graph and what do these values represent?



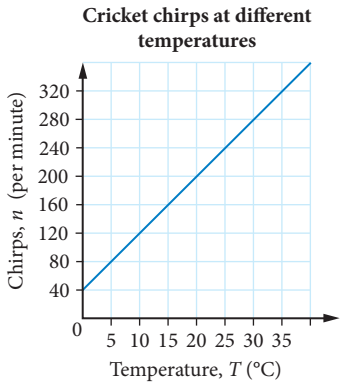
Veresovich/iStock Editorial/Getty Images

Steps	Working
a Carly's daily costs = $75 car costs + $8 per job	$C = 75 + 8 \times n$ $C = 8n + 75$
b Complete a table of values for $C = 8n + 75$. Use the table of values to graph a line on the number plane.	n: 0, 1, 2, 3, 4 C: 75, 83, 91, 99, 107 
c	For $C = 8n + 75$, the gradient is 8 and the vertical intercept is 75. The gradient represents Carly's costs per job ($8). The vertical intercept represents Carly's fixed daily costs ($75); the cost without doing any jobs.

EXERCISE 13.2 Using straight-line graphs

ANSWERS p. 391

1 EXAMPLE 4 The number of times a cricket chirps per minute is related to the temperature. The relationship is represented by the equation $n = 8T + 40$, where T is the temperature in °C and n is the number of chirps. This is shown on the graph.



a What is the graph's vertical intercept?

b What does the vertical intercept represent in this situation?

c Calculate the gradient of the line.

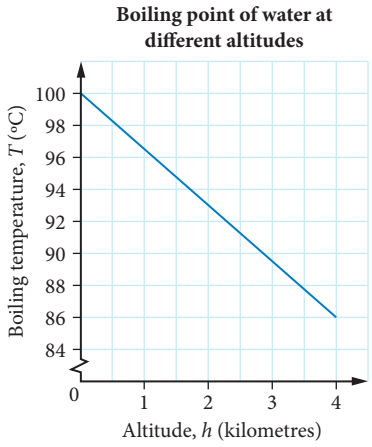
d In this context, what does the gradient represent?

e How many times per minute does a cricket chirp when it is 32°C?

f At what temperature do crickets chirp 160 times per minute?

g Using the formula, calculate how many times per minute a cricket chirps at 100°C. Is this realistic?

2 At sea level, water boils at 100°C. At different altitudes, the boiling temperature changes.



'Altitude' is another word for 'height'.

This graph shows the relationship between altitude (h km) and the temperature (T°C) at which water boils. The equation of the line is $T = -3.5h + 100$.

a Water boils at 100°C at sea level. What altitude is sea level?

b Calculate the gradient of the line.

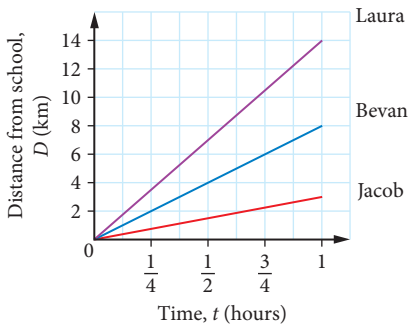
c What physical quantity does the gradient represent?

d Use the graph to determine the boiling point of water at an altitude of 2.8 km.

e Calculate the boiling point of water at the top of Mt Everest 8849 m above sea level. Answer to the nearest whole degree. C

f Calculate the horizontal intercept of the line. How does this value compare with the height of Mt Everest? C

3 After school, 3 students went home by walking, jogging or riding a bike. Each of them travelled at a constant speed and took one hour to reach home. The graph shows the distance they travelled.



a Calculate the gradient of each line.

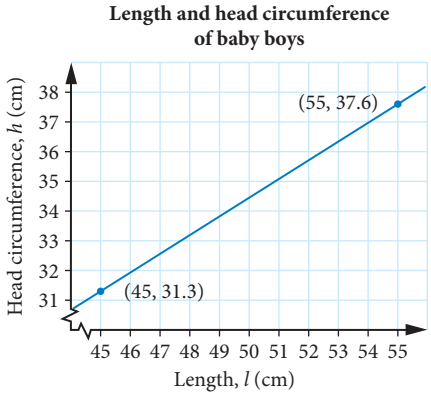
b In this context, what does the gradient represent?

c Which student travelled at the slowest speed? Give a reason for your answer.

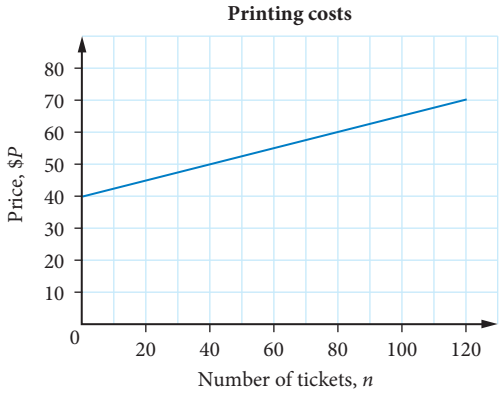
d Match Laura, Bevan and Jacob to their method of travelling home: walking, jogging or riding a bike.

4 This graph shows the length and head circumference of average newborn baby boys.

Newborn baby Jason is 51 cm long and his head circumference is 35.1 cm. Do you think Jason's mother should be worried about him? Give a reason for your answer.



5 Anastasia operates a printing business. When she quotes a price for printing tickets, she charges an initial fee to cover the cost of design and an additional fee of $0.25 per ticket printed. The price she charges for printing tickets is shown on the graph.



a How much is Anastasia's initial charge for the design?

b What is the gradient of the line?

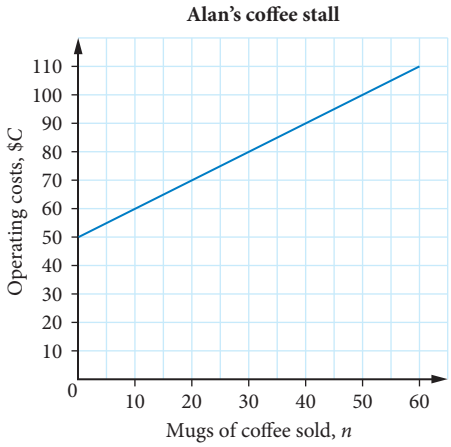
c What physical quantity does the gradient represent?

d How much does she charge to design and print 500 tickets?

e When Anastasia designs and prints elaborate wedding invitations, she charges an initial fee of $110 and 50c per invitation. Write a formula to determine the price, in D dollars, for designing and printing n elaborate wedding invitations. PS

f Use the formula to determine the number of wedding invitations Mel ordered if they cost $202.50.

6 Alan runs a coffee stall at sporting events. The graph shows how much it costs Alan to set up the stall and make mugs of coffee. PS



a How much does it cost Alan to set up the stall?

b How much does it cost Alan to make each mug of coffee?

c If n is the number of mugs sold and C are Alan's costs in dollars, what is the equation of the line on the graph?

7 EXAMPLE 5 Belinda's hobby is jumping out of planes! This table of values shows her height above the ground t seconds after she opened her parachute.

Time t seconds	0	60	90	120
Height, h metres	600	300	150	0

a How high above the ground was Belinda when she opened her parachute?

b How many metres is Belinda falling every second?

c Explain why the equation $h = 600 - 5t$ represents this situation.

d Graph this equation.

e What is the value of the t-intercept? What does this value represent?



Germanskydiver/Shutterstock.com

8 Gabrielle is investing $2000 at a simple interest rate of 3.5% p.a. This table shows the interest earned for different number of years.

Number of years (n)	0	1	2	3	4	5
Interest earned (I)	0	$70	$140	$210	$280	$350

a Graph this function.

b Find the gradient of the line and explain what this value represents.

c Find the horizontal intercept and explain what this value represents.

d Calculate the interest earned if $2000 is invested at 3.5% p.a. for 7 years.

e Gabrielle withdraws her money after 2 years. How much money in total does she receive?

9 The cost of petrol is shown in this table.

Petrol amount (L litres)	0	10	20	30	40	50
Cost ($C)	0	24	48	72	96	120

a Graph the relationship between number of litres of petrol and cost.

b What is the gradient of the graph?

c Calculate the cost of buying 75 litres of petrol.

10 Amy has old dressmaking patterns that show material measurements in yards, an imperial measure, which she needs to convert to metres. PS

a Use this table of values to construct a conversion graph between yards and metres.

Yards	0	1	3	5	10
Metres	0	0.9	2.7	4.5	9.1

b Use your graph to estimate the number of metres of material Amy needs when the pattern states $2\frac{3}{4}$ yards.

c Amy has 4.2 m of material left for making a dress. The pattern says she needs 4 yards of material. Does Amy have enough material to make the dress? Justify your answer.



UfaBizPhoto/Shutterstock.com

11 After a day playing golf, Mr Cook had snacks and drinks in the clubhouse. He had his last alcoholic drink at 7 pm and he used the club's breathalyser machine to test his blood alcohol concentration (BAC). He recorded the first few results in a table. C

Time	7 pm	8 pm	9 pm
Number of hours after 7 pm, h	0	1	2
BAC, A	0.09	0.078	0.066

a Construct a line graph with h on the horizontal axis and A on the vertical axis. The scale on the vertical axis needs to go from 0 to 0.1, so use intervals of 0.01.

b What is the value of the vertical intercept?

c What does the vertical intercept represent?

d Calculate the gradient of the line.

e What does the gradient represent in this context?

f What is the equation of the line?

g Use the equation to find the horizontal intercept.

h What does the horizontal intercept represent?

i Mr Cook can't drive until his BAC decreases to 0.05, the legal limit for driving. At what time can he drive the car?

Worksheet
Intersection of lines

13.3 Intersecting graphs*

We can graph 2 lines on the same number plane to help us solve problems.

EXAMPLE 6 Finding the break-even point

Cherie sells scones for $3 each. It costs her $240 for the necessary equipment and $1 to make each scone.

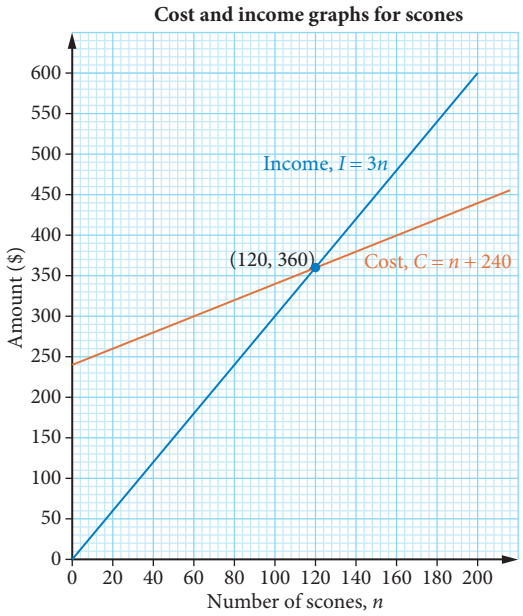
a Find an equation for C, the cost in dollars for making n scones.

b Find an equation for I, the income in dollars from selling n scones.

c Graph both equations on the same axes for values of n from 0 to 200.

d How many scones does Cherie need to sell to break even?

e How much profit will Cherie make if she sells 390 scones?

Steps	Working
a The cost is $240 plus $1 for each scone Cherie makes.	cost $= \$240 + n \times \$1$ $C = 240 + n$ $C = n + 240$
b Income is $3 for each scone.	income $= n \times \$3$ $I = 3n$
c Graph both lines together.	
d 'Break even' means that costs and income are the same. This is the point where the lines intersect, at (120, 360), where 120 represents the number of scones.	Cherie needs to sell 120 scones to break even.
e The profit is how much the income is more than the cost: substitute $n = 390$ into both the Income and Cost equations.	Income: $I = 3n$ $= 3 \times 390$ $= \$1170$ For 390 scones, the income will be $1170. Cost: $C = n + 240$ $= 390 + 240$ $= \$630$ For making 390 scones, the cost will be $630.

profit = income − cost	profit = \$1170 − \$630 = \$540 Cherie will make a \$540 profit when she makes and sells 390 scones.

Break-even point

In the above example, when $n = 120$, $C = 360$ and $I = 360$. The cost and income are the same. This means that when Cherie makes 120 scones, it costs her \$360 and she receives \$360 from the sales. From the graphs, we can see that if she sells more than 120 scones, she will make a profit because her income is greater than her costs, but if she sells fewer than 120 scones, she will make a loss because her income is less than her costs. The value of 120 is called the **break-even point**.

If we graph the equations of a business' costs and income, then the break-even point is the point where the 2 lines intersect. Below the break-even point, the costs are greater than the income and the business makes a loss. Above the break-even point, the income is greater than the costs and the business makes a profit.

EXERCISE 13.3 Intersecting graphs*

ANSWERS p. 392

1 EXAMPLE 6 Khalid bakes and sells muffins. The equipment used to bake the muffins costs \$200 and each muffin he makes costs \$1. Khalid sells the muffins for \$2 each.



Natalia Doroshenko/Shutterstock.com

Let n = the number of muffins,
\$$C$ = the total cost to make n muffins and
\$$I$ = the income from selling n muffins.

a Explain why $C = n + 200$ and $I = 2n$.

b Graph $C = n + 200$ and $I = 2n$ on the same axes using n from 0 to 400.

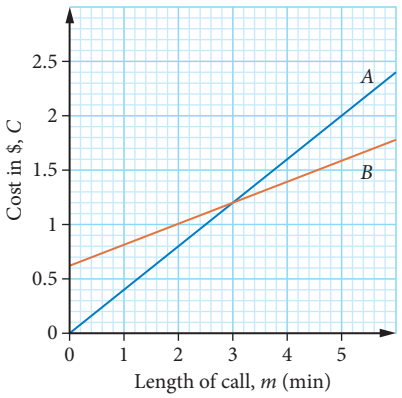
c What are the coordinates of the point where the 2 lines intersect?

d What does this point represent?

e Will Khalid make a profit if he sells 120 muffins? Explain your answer.

f How much profit will Khalid make if he sells 230 muffins?

2 Chloe is deciding between 2 mobile phone plans. Plan A offers her no connection fee and charges of 40c per minute for each call. Calls under plan B cost 20c per minute with a 60c connection fee. The graphs show the costs of phone calls under each plan for calls of up to 6 minutes.

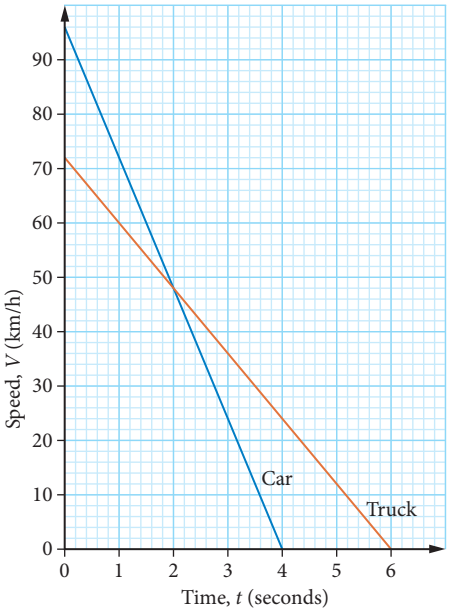


a Which plan (A or B) has the equation $C = 0.6 + 0.2m$? Explain the reason for your choice.

b For what length of phone call is the cost the same under both plans?

c Which plan is cheaper for longer calls?

3 A truck and a car were travelling on the freeway. When an accident occurred ahead of them, both vehicles had to stop quickly. The graphs show the speed at which each vehicle was travelling at t seconds after they applied their brakes.



a How fast were the car and the truck going in km/h before the accident?

b How many seconds after applying their brakes were the vehicles travelling at the same speed?

c How much longer than the car did it take for the truck to stop?

d Write a linear equation for V, the speed in km/h, for the speed of each vehicle t seconds after applying its brakes.

e Explain why the gradients of both lines are negative.

f What does the V-intercept represent on both lines?

g What does the t-intercept represent on both lines?

h Suggest a reason why the truck took longer to stop than the car, even though the car was travelling faster initially.

4 Allana sells flowers at the market for $10 per bunch.

a Copy and complete this table.

Bunches of flowers sold	0	10	20	30	40	50	60
Income received ($)							

b This graph shows Allana's *costs* when she sells n bunches of flowers. Copy the graph and use your answers to part **a** to graph Allana's income on the same axes.



c Explain how you know that Allana will break even when she sells 32 bunches of flowers.

d How many bunches of flowers will Allana need to sell to make a profit?



Ground Picture/Shutterstock.com

5 Each week, a toy factory's fixed costs total $1500. Its costs increase by $15 for every toy it produces. Each item produced sells for $35.

Let n = the number of items the factory produces each week, $\$C$ = the total costs to produce n items, and $\$I$ = the income the factory receives from selling n items. PS

a Does the expression $35n$ represent the income from selling n items or the cost to produce n items?

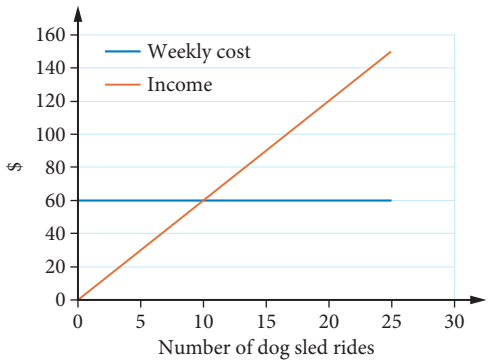
b What does the expression $15n + 1500$ represent?

c Graph both equations $I = 35n$ and $C = 15n + 1500$ on the same axes, using n from 0 to 200.

d How many toys does the factory need to produce each week to break even?

e How much profit will the company make if it sells 100 toys in a week?

6 Jon earns money taking tourists on dog sled rides in the snow. Jon has displayed his expenses and income on a graph.



Number of dog sled rides	0	5	10	15	20	25
Weekly cost	60	60	60	60	60	60
Income	0	30	60	90	120	150

a How much are Jon's weekly costs?

b How many dog sled rides does Jon require each week to break even?

c How much does Jon charge for a dog sled ride?

d Suggest a reason why Jon's cost line is horizontal.

7 To advertise the school musical, the drama class is making and selling promotional t-shirts. The set-up cost to make the t-shirts is $160 and each shirt will cost $10 to make. The class will sell the t-shirts for $20 each. PS

a Find an equation for C, the cost in dollars for making n t-shirts.

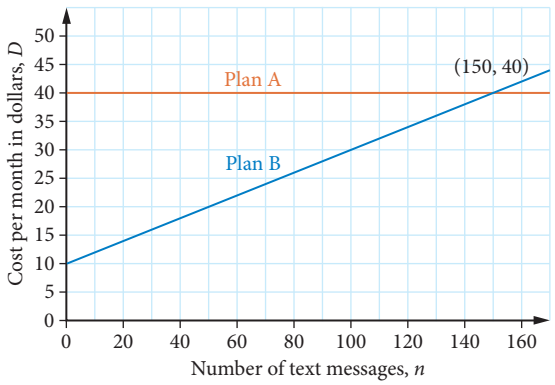
b Find an equation for I, the income in dollars from selling n t-shirts.

c Graph both equations on the same axes, for values of n from 0 to 50.

d How many t-shirts need to be sold to break even?

e The class estimates it will sell 90 t-shirts. How much profit can they expect to make?

8 Grant is hard of hearing and uses his mobile phone for text messages only. This graph shows the monthly cost, $\$D$ dollars for n text messages on 2 phone plans. Plan A is a fixed price per month with unlimited texts, while Plan B has a monthly charge and a cost per text. PS



a What is the monthly cost for Plan A?

b What is the vertical intercept of the graph of Plan B?

c What does the vertical intercept in Plan B represent?

d How much does each message cost to send on Plan B?

e What is the equation of the line representing Plan B?

f For what number of calls per month is Plan A the same cost as Plan B?

g Grant sends an average of 5 or 6 texts per day. Which plan would you recommend he chooses? Use calculations to justify your recommendation.

Chapter problem

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

Investigation — Costing the Year 12 formal

In this investigation you will model the costs and income for running the Year 12 formal.

1 You will need to collect the following information for where you live:

Costs	Hire of venue	
	Decorations	
	Band/DJ	
	Other costs	
	Total costs	

These are the fixed costs for the formal.

The committee decides to charge $120 per person to cover the fixed costs.

2 On the same number plane:

- draw a graph for $I = 120n$ for n from 0 to 200.
- draw a graph for $F =$ _____ for the fixed costs. This will be a horizontal line.

3 **a** Where do the 2 lines intersect? How many people need to attend the formal to cover the fixed costs?

b How many people do you expect to attend the formal? Will you cover the fixed costs if you charge $120 per person?

c Depending on what you have found, adjust the amount you need to charge per person to cover the fixed costs. This could be more or less than $120. Draw the income graph for this new amount.

d How many people now need to attend the formal to cover the fixed costs?

4 Find out from the venue how much they charge per person for catering and calculate what you need to charge for your formal tickets.



Sirtravelalot/Shutterstock.com

13.4 Curved graphs

Not all practical situations give straight-line graphs. Now we will look at some situations that when graphed give us curves rather than straight lines.

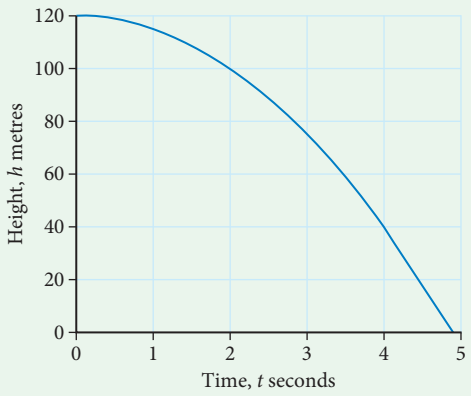
EXAMPLE 7 Curved graphs 1

A rock fell from the top of a cliff onto a road. The graph shows the height of the rock above the road t seconds after it fell.

a How high was the rock above the road after 2 seconds?

b How far did the rock fall during those first 2 seconds?

c Approximately after how many seconds did the rock hit the road?



Steps	Working
a Read from the graph.	The rock was 100 m above the road after 2 seconds.
b The rock was 120 m high before it fell and 100 m high after 2 seconds.	During the first 2 seconds it fell: 120 m − 100 m = 20 m
c Read from the graph.	The rock hit the road at about 4.9 s.

EXAMPLE 8 Curved graphs 2

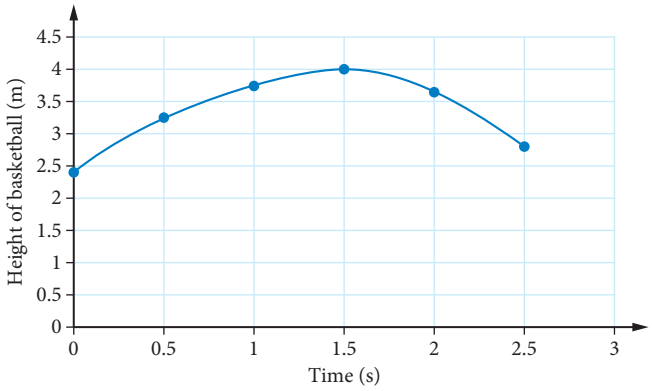
Isaiah plays basketball. When he takes a shot, the ball follows a curve. This table gives the height, h metres, of the ball t seconds after it leaves his hands.

Time, t (seconds)	0	0.5	1	1.5	2	2.5
Height, h (metres)	2.4	3.3	3.7	4.0	3.6	2.8

Graph this data and join the points with a smooth curve.



Mihailomilovanovic/E+/Getty Images

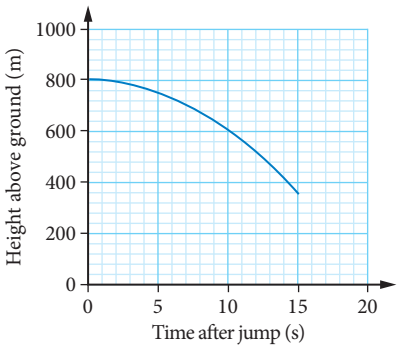
Steps	Working
Draw a set of axes with Time on the horizontal axis and Height on the vertical axis. Plot the points. Join them with a smooth curve.	

Video
Quadratic functions

EXERCISE 13.4 Curved graphs

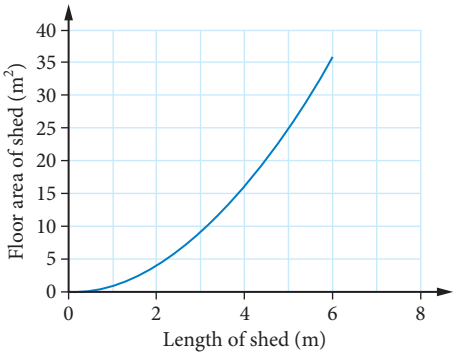
ANSWERS p. 393

1 EXAMPLE 7 When Jose jumps out of a plane, he freefalls for 15 seconds. The graph shows his height during the freefall.



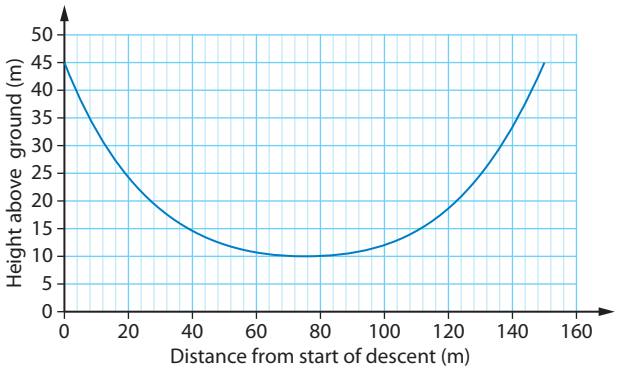
- **a** At what height did Jose jump out?
- **b** How high was Jose above the ground 10 seconds after he jumped?
- **c** How far did Jose fall in the first 10 seconds?
- **d** Approximately how high above the ground was Jose when he pulled his parachute chord?

2 Adriana is planning to make a square chicken shed on her farm. The graph shows the relationship between the length and area of the shed.



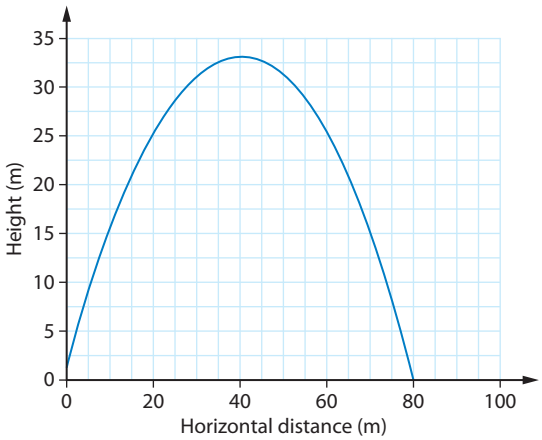
Use the graph to estimate the length of the chicken shed with an area of $30\,m^2$.

3 This graph represents part of a roller coaster track at a theme park.



- **a** At what height does this section of the ride start?
- **b** How high above the ground is the ride when it has travelled 50 m horizontally?
- **c** How far has the ride travelled horizontally when it reaches the height found in part **b** again?

4 Naresh hit a cricket ball out of the oval. The graph shows the path of the ball.



- **a** Estimate the maximum height of the ball.
- **b** Approximately how far from Naresh did the ball land?
- **c** While falling, the ball just cleared the top of the scoreboard, which is 12 m high. How far is the scoreboard (horizontally) from Naresh?

5 EXAMPLE 8 This table shows the heights of high and low in Cairns on 3 consecutive days.

Day	Wednesday				Thursday				Friday			
Time	1:00 am	7:30 am	1:15 pm	7:45 pm	1:45 am	8:00 am	2:00 pm	8:15 pm	2:15 am	8:45 am	2:30 pm	8:45 pm
Height of tide (m)	0.5	2.6	0.6	2.8	0.4	2.7	0.6	2.7	0.4	2.8	0.8	2.6

a Graph this data with Time on the horizontal axis and Height on the vertical axis. Join the points with a smooth curve.

b Use your graph to estimate the height of the tide at 11 am Thursday.

c Joe needs a tide height of 1 m to go fishing. Use your graph to estimate when he can go fishing on Friday afternoon.

6 For a Science project, Ellie measures the temperature of a cup of coffee at different times after she makes it. Her data is given in the table below.

Time (min)	0	4	8	12	16
Temperature (°C)	80	52	47	43	40

a When you graph this table, should Time or Temperature be on the horizontal axis?

b Graph this table and join the points with a smooth curve.

c Use your graph to estimate the temperature of the coffee after 2 minutes.

d Ellie likes to drink her coffee at approximately 53°C. After she makes her coffee, how long should she wait to drink it?

7 These tables show the hours and minutes of daylight in 2 cities on the 21st day of the month over one year. For example, 6:52 means 6 hours 52 minutes of daylight. PS

Anchorage, Alaska												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6:52	9:39	12:20	15:18	17:59	19:22	18:00	15:16	12:21	9:31	6:47	5:27

Perth, Australia											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
14:39	13:25	12:07	10:43	9:37	9:09	9:36	10:42	12:05	13:27	14:40	15:11

a On the same set of axes, graph the data for each city and join the points with a smooth curve. Use a different colour for each city.

b What are the similarities between the 2 graphs?

c What are the differences between the 2 graphs?

d In which months do the graphs cross?

e Why is the maximum hours of daylight in Anchorage in June greater than the maximum hours of daylight in Perth in December?

8 Toby is organising a bus trip to see a concert. The cost of the bus is $840 and the maximum number of people it carries is 40.

a Copy and complete this table to show the cost per person for different numbers of people.

Cost per person = 840 ÷ number of people

Number of people	1	5	10	20	30	40
Cost per person ($)	840	168				

b Graph this data, joining the points with a smooth curve.

c From your graph estimate the cost per person if 28 people attend.

d Calculate the cost using the formula. How close was your estimate from the graph?

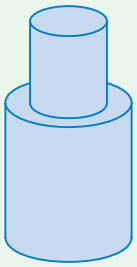
Video
Graphing practical situations

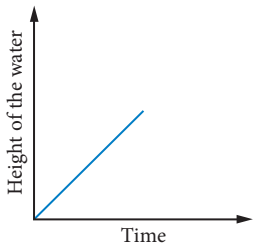
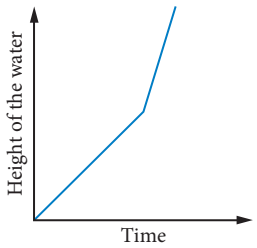
13.5 Practical graphs*

Some situations give graphs that don't follow an equation. However, we can draw a graph from a description of what is happening, or we can work out the story of what is happening when we see the graph.

EXAMPLE 9 Practical graphs

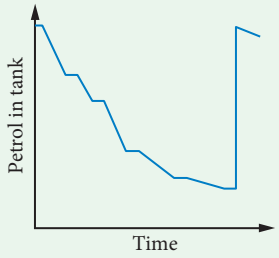
Sarah is pouring water into this container at a constant rate.
Draw a graph showing the height of the water in the container over time.



Steps	Working
At first, the height of the water will increase at a steady rate.	
When the water reaches the narrower section of the container, the height will go up more quickly, at a constant faster rate.	

EXAMPLE 10 Interpreting practical graphs

This graph shows the amount of petrol in the tank of Natasha's car over a week, starting on Monday. Describe what the graph is showing.



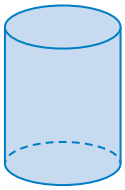
Steps	Working
The amount of petrol goes down over a number of days. It then increases quickly before decreasing a small amount.	Natasha starts the week with a full petrol tank. As she drives over the week, the amount of petrol in the tank goes down.
Other descriptions are possible.	When the graph is horizontal (flat), Natasha isn't using the car.
	Towards the end of the week, Natasha fills the tank and drives again.

EXERCISE 13.5 Practical graphs*

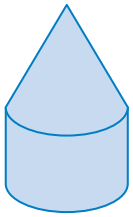
ANSWERS p. 393

1 EXAMPLE 9 Water is poured into each container at a steady rate. Match the container to the graph of the height of the water in the container.

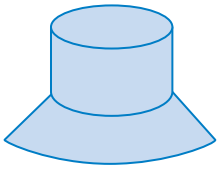
a



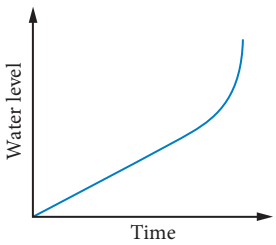
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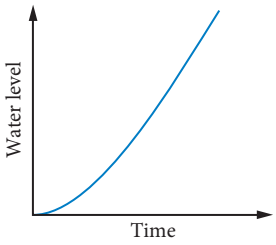
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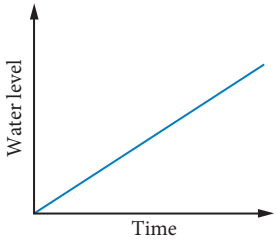
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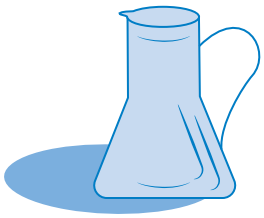
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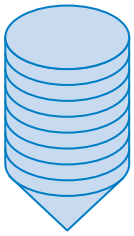
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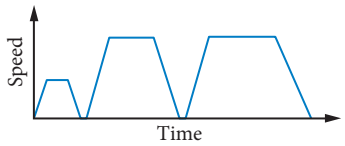
2 Filomena poured orange juice into this jug before her party. Draw a graph showing the height of the orange juice in the jug over time if she pours the orange juice at a constant rate.



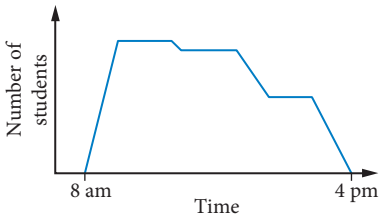
3 A grain silo at a train siding is emptied at a constant rate into a goods train to be transported to the city. Draw a graph showing the height of the grain in the silo over time.



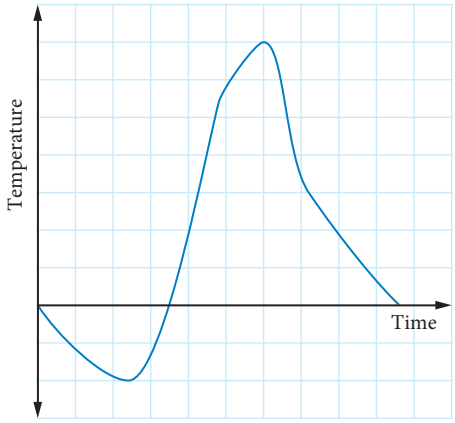
4 EXAMPLE 10 This graph shows the speed of a train as it travels from Oxford Park to Ferny Grove. Write a description of what happens during its journey.



5 This graph shows the number of students at Nelson Valley High over one day. Write a description of how the number of students changes over the day. PS



6 This graph shows the temperature in Canberra over one day in July from midnight. Write a story to describe the change in temperature based on this graph.

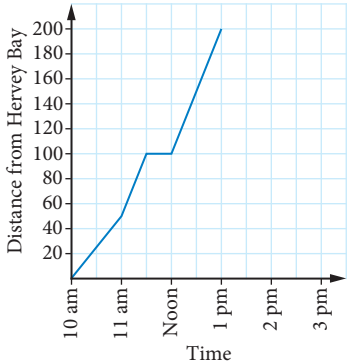


7 Draw a graph similar to that in question **6** to show the change in temperature in your town or city over one day. PS

8 This incomplete graph shows Hong's trip from Hervey Bay to Maroochydore and back. PS

a Describe the section of the journey shown on the graph.

b Hong stays in Maroochydore for 2 hours and then returns to Hervey Bay without stopping, arriving at 5 pm. Copy the graph, extending the Time axis to 5 pm, and complete the graph to show the return section of Hong's trip.



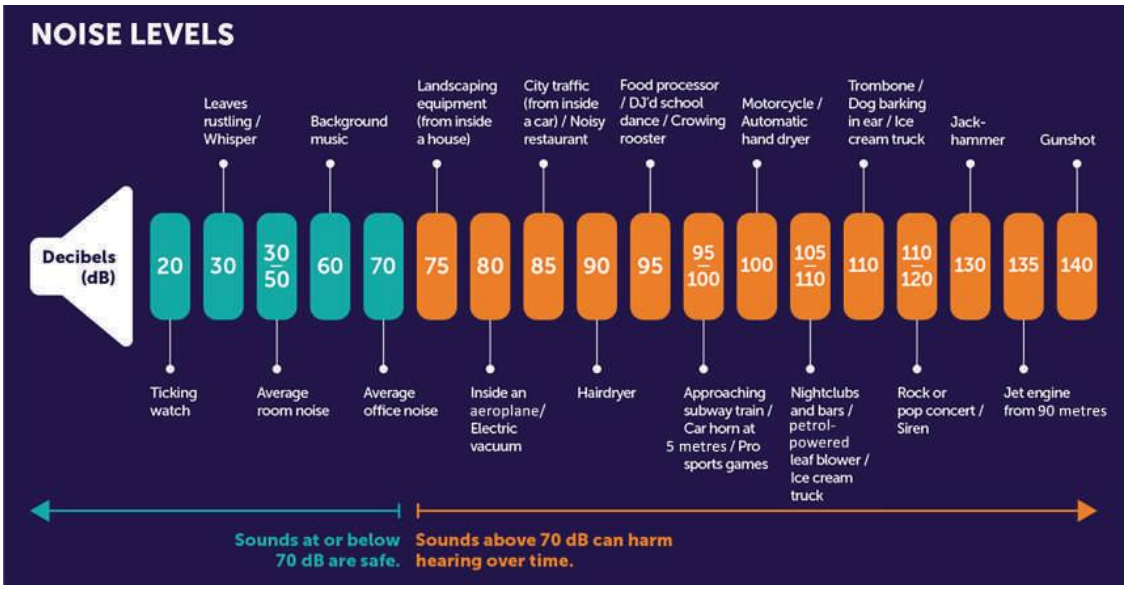
9 A lift is going up an 8-storey building. On ground level, 5 people enter the lift. 2 people get off on Level 2. One person gets off at Level 5. Two people get off on Level 8 where 3 other people get on the lift. They travel back to the ground level. PS

Construct a graph to represent the height of the lift. Use Time on the horizontal axis and Building level on the vertical axis.

Extended investigation | Noise levels in your environment

Equipment: You will need a sound meter to complete this activity. Free sound meter apps are available for mobile phones.

Sound is measured in decibels, dB. Usually, a normal human ear can hear sounds from 0 to 130 decibels, depending on the frequency and pitch of the sound. This diagram shows typical noise levels.



trgrowth/Shutterstock.com

Part 1

Measure the decibel levels for at least 6 common noises in your everyday life. Some possible ideas could include:

- school bell
- school assembly
- school bus
- canteen lines
- library
- classroom while everyone is quietly working
- classroom while the class is packing up.

Part 2

Locate an example of a noise in your everyday environment with each decibel level.

- 25 decibels
- 65 decibels
- 120 decibels

Part 3

How does the noise you are exposed to change during the day?

- Record the noise level around you every hour from when you wake in the morning to going to sleep at night. Present the information in a table.
- Construct a graph from your data showing the noise in your environment.
- Over time, noise levels above 70 dB can damage your hearing. Use your graph to identify times in your day when you are exposed to noise that could damage your hearing.
- People with neurodiversity (autism) often have heightened sensitivity to noise above 60 dB. Identify times of the day when a person with hearing-sensitive neurodiversity would experience difficulties during your day. Suggest some ways you could adapt your school to make it more 'neurodiversity friendly'.

Part 4

Prepare a report on your findings. Include your data, graph, and noise reduction suggestions in the report.

Keyword activity

CHAPTER SUMMARY

ANSWERS p. 394

Copy and complete the summary of this chapter using the words listed below.

linear	break-even	costs	curved
expenses	gradient	income	intersecting
loss	model	point	profit
straight	*y*-intercept		

In this chapter, we learnt about [1]_____ equations that give us [2]_____ lines when we graph them. The [3]_____ of the line tells us how steep the line is. The [4] _____ tells us where the line crosses the *y*-axis.

We used straight-line graphs to [5]_____ real-life contexts.

For two [6]_____ lines, we examined the [7]_____ where these lines crossed. We applied this idea to practical problems such as business, travelling and comparing mobile phone plans.

In business, we drew a graph for the money coming in, called [8]_____, and the money being spent, called [9]_____ or [10]_____. The point of intersection of these two lines is called the [11]_____ point. At this point, the business owner does not make a [12]_____ or a [13]_____.

We also learnt about practical situations that don't have a straight-line graph. Instead, many graphs are [14]_____.

Solution to the chapter problem

Problem

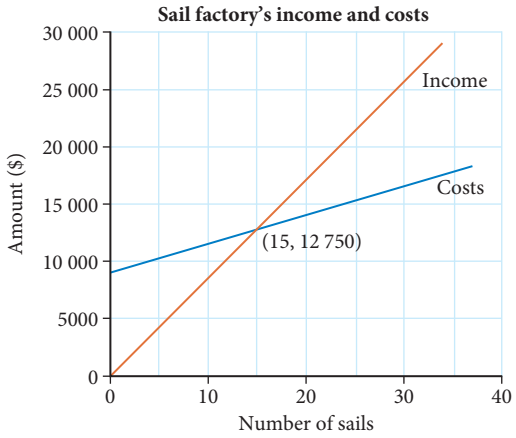
Paul owns a factory that makes sails. It costs Paul $9000 per month to cover rent, electricity and wages. Each sail costs $250 to make and sells for $850.

a How many sails does Paul need to make and sell per month to break even?

b What profit or loss will he make in a month when he makes and sells 20 sails?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	**a** We need to find the break-even point. To do this, we draw the graphs for cost and income. **b** We need to calculate the profit or loss if 20 sails are sold. We know the monthly business costs, the variable costs and the sail selling price.
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	Let n = the number of sails, C = the cost to produce n sails per month, and I = the income from selling n sails. **a** The linear functions are: $C = 250n + 9000$ $I = 850n$



The lines intersect at (15, 12 750), which means that the break-even point is $n = 15$.

Paul needs to make 15 sales per month to break even.

b When $n = 20$:

$\text{cost} = \$250 \times 20 + \$9000$

$= \$14\,000$

$\text{income} = \$850 \times 20$

$= \$17\,000$

Income is greater than cost, so a profit will be made.

$\text{profit} = \$17\,000 - \$14\,000$

$= \$3000$

The factory will make a profit of $3000 when it makes and sells 20 sails in a month.

STAGE 3: CHECK THE SOLUTION



CHECK

Income is above costs on the graph when $n = 20$, so the solution seems correct.

We have answered both parts of the question.

STAGE 4: PRESENT THE SOLUTION



PRESENT

a Paul needs to sell 15 sails per month to break even.

b The factory will make a profit of $3000 when it makes and sells 20 sails in a month.

13 Test yourself

Practical graphs

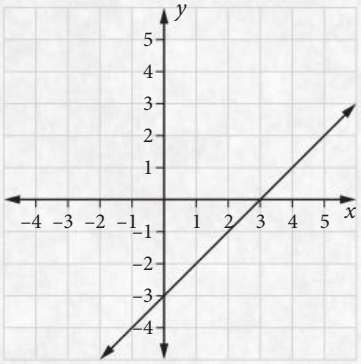
ANSWERS p. 394

1 EXERCISE 13.1 Draw the graph of each equation.

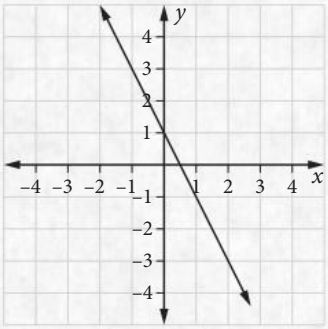
a $y = 2x - 2$ **b** $y = -x + 3$

2 EXERCISE 13.1 For each graph below, find the gradient, y-intercept and x-intercept.

a



b



3 EXERCISE 13.1 For the graph of each equation, find the gradient, y-intercept and x-intercept.

a $y = 4x - 3$ **b** $y = -x + 2$ **c** $y = \frac{x}{3}$

4 EXERCISE 13.2 Goran packs glass items in boxes. He has to assemble the box before he can pack it. The graph shows the time, T minutes, it takes him to assemble one box and pack n glass items in it.

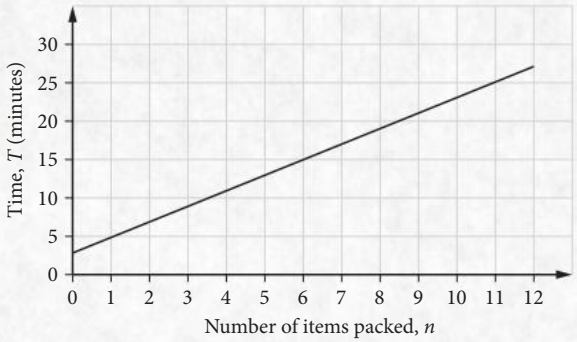
a How long does it take Goran to assemble a box before he starts to pack it?

b Calculate the gradient of the line.

c What physical amount does the gradient represent?

d Use the graph to find how many items can be packed in 15 minutes.

e Calculate the time it takes Goran to assemble a box and pack 15 items in it.



5 EXERCISE 13.2 Adrian's Awesome Appetisers charges $10 per person plus an $80 fixed charge. This table shows Adrian's charges.

Number of people, n	0	50	100	150	200	250
Charge, $C	80	580	1080	1580	2080	2580

a Construct a graph showing Adrian's charges for n people.

b Use the graph to find the cost for 170 people.

c Adrian charged Artificial Industries $830 for catering for a Christmas party. How many people were catered for?

d Find the vertical intercept of the line and explain what this value represents.

e Find the gradient and explain what this value represents.

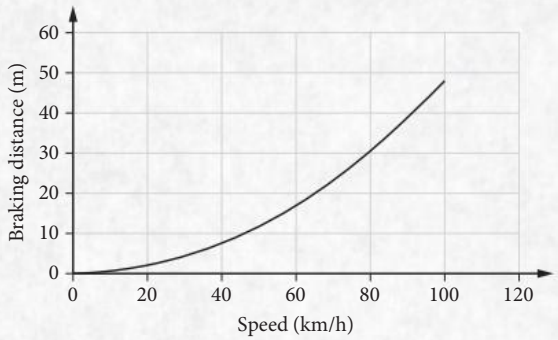
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6 EXERCISE 13.3 The Year 12 fundraising committee plans to sell school souvenir USB drives. The manufacturer quoted an 'initial charge of $126 plus $5 per unit' and the committee thinks that it will sell the units for $12 each.

- **a** Find an equation for $C, the cost of making n USB drives.
- **b** Find an equation for $I, the income from selling n USB drives.
- **c** Graph both equations on the same axes for values of n from 0 to 20.
- **d** How many USB drives does the committee need to sell to break even?
- **e** There are 140 students in Year 12. If half of them buy a USB drive each, how much profit can the committee expect to make?

7 EXERCISE 13.4 This graph shows the braking distance for a car at different speeds.

- **a** What is the braking distance at 100 km/h?
- **b** At what speed is the car travelling if the braking distance is 30 m?
- **c** Bridie is travelling at 60 km/h. She sees an accident ahead. She travels 25 m before she applies the brakes. What is her total stopping distance?



8 EXERCISE 13.4 Susie planted a new shrub in her garden. She measured its height each week.

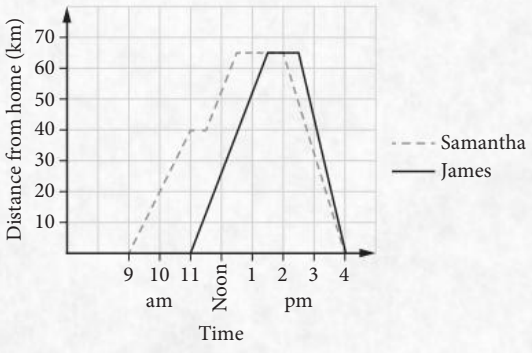
Week	1	2	3	4	5	6
Height (cm)	3	7	10.5	13.5	16	18

Draw a graph of this data and join the points with a smooth curve.

9 EXERCISE 13.5 Draw a graph that represents this story.

The noise level in a classroom varies over the one hour of a lesson. The students are quite noisy as they enter the classroom. They then become silent to listen to the teacher explain what is going to happen in the lesson. Some students ask questions before the class is divided into groups to work together for the rest of the lesson. Group work is very noisy. Five minutes before the end of the lesson, the teacher asks for silence so that she can finish the lesson.

10 EXERCISE 13.5 This shows the journeys of 2 cyclists on a Sunday bike ride. Describe the journeys of each cyclist.



11 EXERCISES 13.4, 13.5 Tomorrow's weather forecast is for a very hot day. This table shows the forecast temperatures at different times of the day. C

Time	Midnight	2 am	4 am	6 am	8 am	10 am	Noon	2 pm	4 pm	7 pm	9 pm
Temperature° (C)	23	25	27	28	31	37	39	34	28	26	20

- **a** Construct a graph to display the forecast temperatures.
- **b** Carlie likes to exercise outdoors for one hour, provided the temperature is lower than 30°C. Use your graph to identify appropriate times for her to schedule her exercise tomorrow.

Practice set 3

ANSWERS p. 395

Section A Multiple choice questions

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

1 EXERCISE 12.3 What is the time difference between 10:42 am and 2:13 pm?

A 3 h 31 min **B** 4 h 55 min **C** 8 h 29 min **D** 12 h 55 min

2 EXERCISE 13.1 Which statement is correct about the line with equation $y = 2x + 4$?

A gradient = 2, x-intercept = 4 **B** gradient = 4, y-intercept = 2

C gradient = 2, y-intercept = 4 **D** gradient = 4, x-intercept = –2

3 EXERCISE 11.4 What type of graph is best for displaying the mass of a baby changing over time?

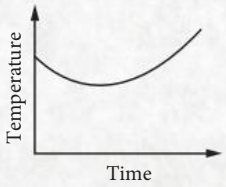
A line **B** column **C** pie **D** picture

4 EXERCISE 12.4 Ursula lives in Brisbane and rings her friend in Perth at 1:15 pm Brisbane time. What time is it in Perth?

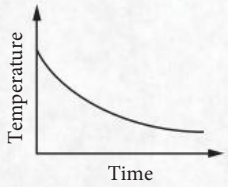
A 11:15 am **B** 12:45 pm **C** 1:45 pm **D** 3:15 pm

5 EXERCISE 13.5 A cup of tea sits on the kitchen bench cooling. At first it loses heat quickly, but as time passes, it loses heat more slowly until it reaches room temperature. Which graph best illustrates this?

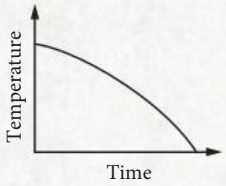
A



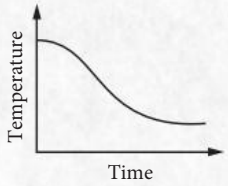
B



C



D



6 EXERCISE 11.2 A group of people were surveyed about whether they exercised regularly. This incomplete table shows the results of the survey.

Age group	Regular exercise	No regular exercise	Total
Under 40	60		110
40 and over		25	
Total	125	75	

How many people were surveyed altogether?

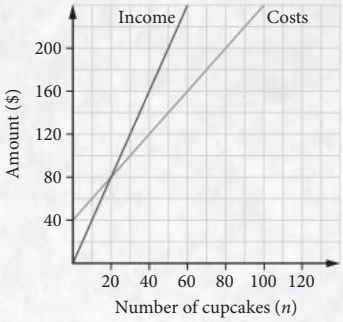
A 90 **B** 110 **C** 125 **D** 200

7 EXERCISES 12.2, 12.3 Ruane wants to watch the latest episode of her favourite TV series, *Family*. However, she needs to go to the supermarket before she watches it, which will take her 75 minutes. What is the latest time she can leave home and be back to watch the show at 8:30 pm? Give your answer in 24-hour time.

A 1715 **B** 1915 **C** 1955 **D** 2145

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8 EXERCISE 13.3 This graph shows the income and expenditure for Catriona's Cupcakes.



What happens if Catriona sells 40 cupcakes?

A She makes a profit.

B She breaks even.

C She makes a loss.

D You can't tell from the graph.

Section B Short answer questions

1 EXERCISE 12.1 Copy and complete each statement.

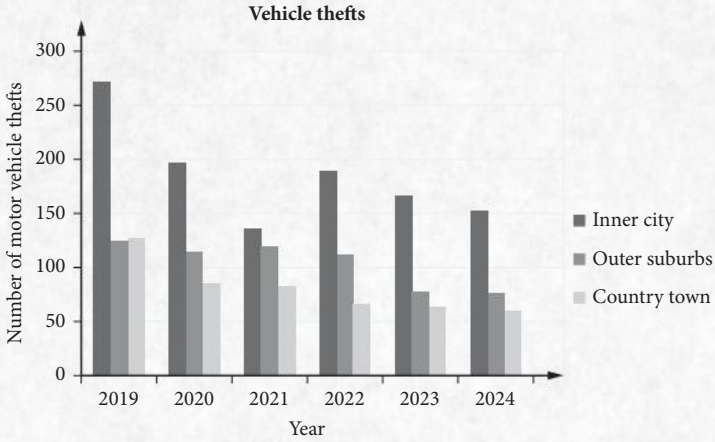
a 4 weeks = _____ days

b 84 months = _____ years

c 108 hours = _____ days

d 22 weeks = _____ fortnights

2 EXERCISE 11.1 This graph shows the number of motor vehicle thefts per year in different areas.



a Which year had the highest number of vehicle thefts in the outer suburbs?

b In which area have motor vehicle thefts declined the most?

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

3 EXERCISE 13.4 A catapult is a medieval weapon for hurling large stones. This table gives the height, h metres, of the stone d metres horizontally from the catapult as it travels through the air.

Horizontal distance from the catapult (d metres)	0	1	2	3	4	5
Height (h metres)	5	6.5	7	6.5	5	2.5

a Draw the graph of this data and join the points with a smooth curve.

b What is the greatest height reached by the stone?

4 EXERCISES 12.2, 12.3 Vincent wants to record a movie on TV that starts at 21:30 and runs for $2\frac{1}{2}$ hours.

a Convert 2130 to 12-hour time.

b Allow an extra 15 minutes for the recording, in case the movie starts and finishes late. What time should he set for his finish time? Answer in 12-hour time.

5 EXERCISE 11.7 State 2 ways a person can draw a misleading graph comparing the price of *Shine* shampoo in 3 different supermarket chains.

6 EXERCISE 13.2 Year 11 is running a sausage sizzle at the athletics carnival to raise money for charity. It will cost them $32 for the gas bottle for the barbecue, and each sausage in bread will cost $0.90 to make. This table shows the costs for making up to 200 sausages in bread.

Number of sausages in bread, n	0	10	20	30	40	50	100	150	200
Cost, $C	32	41	50	59	68	77	122	199	212

a Graph this table of values.

b Use the graph to estimate the cost of making 170 sausages in bread.

c Find the vertical intercept and explain what this value represents.

d Find the gradient and explain what this value represents.

e Year 11 sold 75 sausages in bread for $2 each at the carnival.
Did they make a profit or a loss? Justify your answer.

7 EXERCISE 12.5 Use the train timetable from Chapter 12 Example 10 on pages 253–254 to answer these questions.

a Chantelle catches the 7:57 am train from Gosnells to go to work near Oats Street.
At what time does she arrive at Oats Street?

b Scott lives in Sherwood. He goes to Cannington to work. He is allowed to arrive any time between 7 am and 9 am. At what times could he catch the train?

c Denise catches the 5:07 pm train from Perth. At what time can she expect to arrive at Seaforth?

8 EXERCISE 11.2

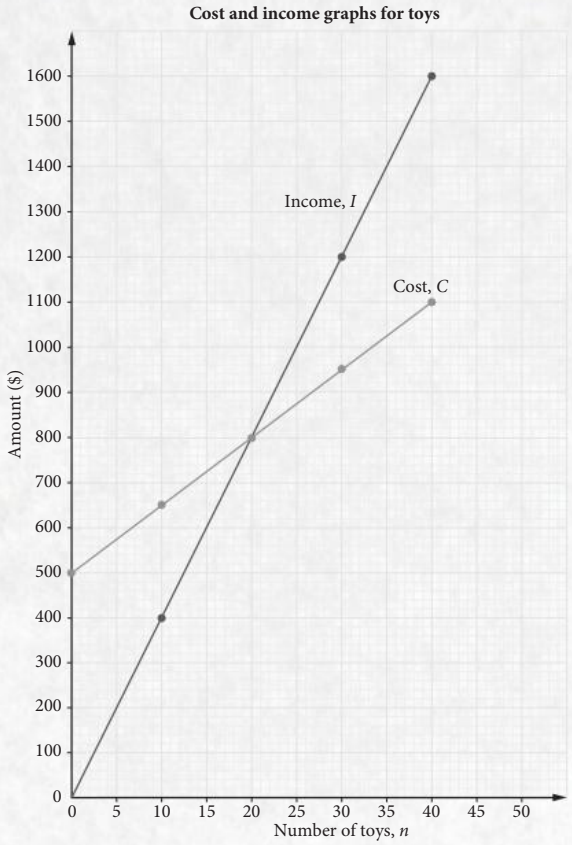
a Copy and complete this table from Section A, Question **5** on page 294.

Age group	Regular exercise	No regular exercise	Total
Under 40	60		110
40 and over		25	
Total	125	75	

b What percentage of the people surveyed do not exercise regularly?

c Of those who exercise regularly, what percentage were aged 40 and over?

9 EXERCISE 13.3 Karl makes and sells wooden toys for his online business. This graph and table of values illustrate his cost ($C) and income ($I) from making and selling the toys.



Number of toys (n)	0	10	20	30	40
Cost (C)	500	650	800	950	1100
Income (I)	0	400	800	1200	1600

a How many wooden toys would need to be sold to break even?

b What profit will the business make if it sells 40 wooden toys?

c Find the equation of C in terms of n. C

10 EXERCISE 12.4

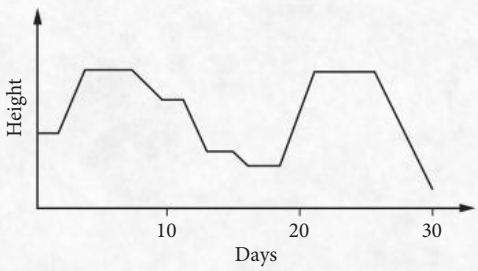
a A football match starts in Brisbane at 4 pm. What time is this in

i Adelaide? **ii** Perth?

b An AFL match starts in Darwin at 11:30 am What time is this in

i Cairns? **ii** Fremantle, WA?

11 EXERCISE 13.5 This graph shows the height of water in a water tank over one month. Write a description of what the graph is showing.



12 EXERCISE 11.6 Draw a line graph for this data about the temperature at a school over one school day.

Time	9 am	10 am	11 am	12 noon	1 pm	2 pm	3 pm	4 pm
Temperature	8°C	11°C	13°C	16°C	18°C	17°C	16°C	13°C



Chapter problem

Andrew is a market researcher. The United Club has asked him to evaluate the facilities and services it provides for members. Should he survey all 14 100 members or take a sample? If he chooses to use a sample, how should he select it to ensure that he has a good representative range of views?

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CHAPTER 14

DATA AND TRAVEL: DATA COLLECTION

CENSUS AND SURVEYS

Syllabus coverage
Nelson MindTap chapter resources
Terminology
14.1 The statistical investigation process
14.2 Census vs sample
14.3 The Australian Census
14.4 Year 11 census
14.5 Types of samples*
14.6 Choosing a sample
Keyword activity
Solution to the chapter problem
Test yourself
*COMPLEX

What will we do in this chapter?

- Follow the process of statistical inquiry
- Learn the difference between a census and a sample
- Examine the various types of samples and how to choose them

How are we ever going to use this?

- When we read and interpret statistical information in the media
- When we undertake a survey
- When we evaluate the results of surveys

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Syllabus coverage

UNIT 2, TOPIC 1: DATA COLLECTION

Census

- Investigate the procedure for conducting a census.
- Investigate the advantages and disadvantages of conducting a census [complex].

Surveys

- Understand the purpose of sampling to provide an estimate of population values when a census is not used.
- Investigate the different kinds of samples [complex].
- Investigate the advantages and disadvantages of these kinds of samples [complex].

Simple survey procedure

- Identify the target population to be surveyed.

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, p. 18
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Worksheets (3):

14.2 Student survey form
14.3 Australian statistics • Census questions

Puzzle (1):

Keyword activity Census and surveys find-a-word

Weblinks (5):

14.1 Australian Bureau of Statistics • United Nations • World Health Organization
14.3 Australian Bureau of Statistics
14.5 Roy Morgan • YouGov

Nelson MindTap

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

Terminology

census	random sample	sample	self-selected sample
stratified sample	systematic sample	target population	

14.1 The statistical investigation process

Statistics involves collecting information, which is then analysed and used to make decisions.
To collect information, we usually survey a representative group. 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.

Information is collected by organisations to help them make informed decisions. This process is called statistical investigation and it involves the following steps:

- **Posing questions** – deciding what information is needed and in what form
- **Collecting data** – choosing between using a **census** or a **sample**, deciding how we will collect information and then collecting the information
- **Organising data** – organising the collected information for better analysis, such as by using a frequency table, with either grouped or ungrouped data
- **Summarising and displaying data** – presenting the information in a way that makes it easy to follow and understand, such as with graphs or tables
- **Analysing data** – calculating summary statistics such as mean, median and mode, then looking for patterns and relationships in the data
- **Writing a report** – presenting the results of the investigation in a clear way, with the conclusions supported by the statistics

EXERCISE 14.1 The statistical investigation process

ANSWERS p. 395

1 In your own words, summarise the steps in the process of statistical investigation.

2 Classify each activity below as one of these steps:

- posing questions (PQ)
- collecting data (CD)
- organising data (OD)
- displaying data (DD)
- analysing data and drawing conclusions (AD)
- writing a report (WR)

a Liong asks fellow students in Year 11 how they travel to school.

b Tatiana draws a frequency histogram of her data.

c Anna finds the mean house price for her suburb.

d Managing Director Theo decides he needs to know customers' favourite car colour.

e Kieran makes recommendations in his final report.

f Emilia puts her information on favourite holiday destinations into a frequency table.

g Lee concludes that coffee is her friends' favourite daytime drink.

h Simon visits the residents of Lawson Street to collect their Census forms.

i Madeline decides to research the drinking habits of 18-year-olds.

j Will displays data about pocket money received by Year 11 students in a sector graph.

k Phoebe writes a report on her data about popular sports.

l Kim goes through a pile of surveys and records the responses to a specific question.



Richard G. Bingham II/Alamy Stock Photo

3 Choose a topic to research and describe how you would implement each of the 6 steps of a statistical investigation. PS

4 Some organisations collect information on a large scale. Visit the websites of each organisation listed and write at least 5 things they collect information about.

a Australian Bureau of Statistics (ABS)

b United Nations (UN)

c World Health Organization (WHO)

Weblinks
Australian Bureau of Statistics
United Nations
World Health Organization

5 The privacy of collected information is important. Visit the ABS website and click on the **Census** tab. Scroll down and click on **About the Census/Keeping your information safe**. Describe in your own words how the ABS ensures the privacy of the information we provide to the Census.

14.2 Census vs sample

When is it appropriate to use a sample or a census? This table outlines the differences between a sample and a census.

Worksheet
Student survey form

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
Is simple and inexpensive	Is complex and expensive
Can be done quickly	Takes a lot of time to collect and process the information

EXAMPLE 1 Census vs sample

The United 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?

Steps	Working
A census would be expensive and it would take a long time to process the information.	A sample should be used in this situation.

EXAMPLE 2 Choosing a population

From what population should Andrew take a sample to investigate the reputation of the United Club in the local community?

Steps	Working
Population means the people Andrew should be asking.	The target population would be the residents of the community where the United Club is located.

EXERCISE 14.2 Census vs sample

ANSWERS p. 395

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

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 on the Sunshine Coast
- **c** The number of Australians who watch the NRL Grand Final
- **d** The use of soap versus body wash
- **e** Testing coffee for taste
- **f** The population of Winton
- **g** The number of people using the emergency department at Redcliffe Hospital on Saturday night
- **h** The length of time a certain type of car battery lasts
- **i** The political party supported by people in Queensland
- **j** The favourite TV show of your 10 best friends
- **k** Cricketer Steve Smith's batting average
- **l** Internet usage by Year 11 students at your school
- **m** Hours of paid work per week completed by senior students in your school
- **n** Customer satisfaction with Nelson TV's streaming service

3 EXAMPLE 2 What is the target population for each investigation?

- **a** Whether girls are better than boys at Maths
- **b** Voting intentions for the next State election
- **c** The best song of the last decade
- **d** Student attitudes to school uniform at your school
- **e** Favourite make of car in Queensland
- **f** The amount of money people are prepared to spend on going to the gym each week
- **g** The venue Year 12 students should use for the formal
- **h** The size of donations to charities from wealthy individuals
- **i** The factors influencing the choice of supermarket
- **j** The batting performance of the Australian cricket team
- **k** NMQ 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** What recreational equipment the local council should add to the town's parks



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Weblink
Australian Bureau of Statistics

Worksheets
Australian statistics

Census questions

14.3 The Australian Census

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 2026.

Search for "Census form" or visit the ABS website to help you answer these questions.

EXERCISE 14.3 The Australian Census

ANSWERS p. 396

1 When was the first national census conducted?

2 When was the most recent census?

3 List 5 questions that were asked in the last census.

4 Find 3 questions that have been asked in the past but were not asked in the most recent census.

5 Were there any questions in the most recent census that have not been asked before? If so, what were they?

6 Are all questions in the Census compulsory?

7 Give 3 examples of how the Census information is used.

8 What was different about the Census in 2021? What challenges did this present?

9 Who is *not* required to complete the Census?

10 Why is the Census only conducted every 5 years?

11 In the past there were 10 years or more between the taking of the Census. Suggest a reason for why this has changed to every 5 years.

12 Who uses the Census information after it is collected?

14.4 Year 11 census

In this exercise you are going to conduct a census of all Year 11 students at your school. You may choose to work in small groups (3 or 4 students) or individually.

Remember the steps in conducting a statistical investigation:

- **Posing questions** – deciding what information is needed
- **Collecting data** – conducting a census of Year 11
- **Organising data** – organising the collected information using a frequency table
- **Displaying data** – presenting the information with graphs or tables
- **Analysing data** – calculating summary statistics such as mean, median and mode, and looking for patterns and relationships in the data
- **Writing a report** – presenting the results with the conclusions supported by the data

EXERCISE 14.4 Year 11 census

ANSWERS p. 396

1 Decide what questions you will ask. Choose 3 or 4 from the suggestions below or make up your own questions.

Possible questions:

- Are you male/female/non-binary?
- What is your date of birth and your age?
- Where do you live?
- Where did you live 5 years ago?
- In which country were you born?
- In which country was your mother born?
- In which country was your father born?
- Is a language other than English spoken in your home?
- Do you have a regular part-time job?
- How much do you earn per week from your job (if you have one)?
- In what occupation did you work in the last week?
- How do you travel to school each day?
- How far away from school do you live?
- How many bedrooms are there in the place you live in?
- How many siblings do you have?

For each question you will need to decide if you are going to give options for answers.

2 Collect the data from all Year 11 students. You will need to decide:

- how you are going to present your questions – hard copy or digital?
- how you will ensure you get responses from all students
- how you will ensure that responses are private.

3 Organise your data – decide as a group how best to do this:

- Frequency tables
- Grouped frequency tables
- Summaries of comments or categorical data

4 Create graphs and/or tables to present your results. These can be created digitally.

5 Analyse the data you have gathered and the graphs and/or tables you created to see what information and conclusions you can draw from it.

6 Put together a presentation for your class on what you have found.

14.5 Types of samples*

If we decide to use a sample for a survey, there are 4 types of samples we can use.

In a **random sample**, every member of the population has an equal chance of being included in the sample. For example, when a computer selects a customer of a phone company at random to be surveyed about the company's performance, every customer of that company has an equal chance of being selected.

In a **stratified sample**, different categories in a population are represented according to the proportion they make up of the population and then members of each category are selected randomly.

For example, a school's population may be made up of 72% junior students and 28% senior students. A stratified sample of school students must also be made up of 72% junior students and 28% senior students.

In a **systematic sample**, selections are made on a regular basis. For example, testing every 500th battery produced in a factory to check that the machines producing the batteries are working properly.

In a **self-selected sample**, whoever wishes to participate answers the questions asked. For example, when a current affairs TV program asks people to vote online about who should be Australia's next prime minister, anyone can participate.

EXAMPLE 3 Types of samples

Age group	Number of members
Less than 30 years	2100
30 to 39 years	2700
40 to 49 years	5100
50 years and over	4200

The United Football Club has 14 100 members. This table gives a breakdown of members by age group.

Andrew is considering 4 different of ways of choosing a sample for his market research. Which type of sample is each one?

a Every 100th member on the alphabetical membership list

b Names selected randomly by the computer

c Putting up a sign at the entrance of the club asking members to volunteer

d 21 members who are less than 30 years old, 27 members who are 30 to 39 years old, 51 members who are 40 to 49 years old and 42 members aged 50 years or more.

Steps	Working
a Selections are made on a regular basis, in this case every 100th member.	systematic sample
b Every member of the population has an equal chance of being included and the computer chooses randomly.	random sample
c Any member who volunteers can participate.	self-selected sample
d A predetermined number of members are chosen based on the number of members in each age group.	stratified sample

EXERCISE 14.5 Types of samples* ANSWERS p. 396

1 EXAMPLE 3 Which type of sampling is described in each case?

- **a** Selecting every 105th name from a customer database
- **b** The names of all Year 11 students are placed in a hat and 2 are drawn out to represent the school at a council function
- **c** A television program asks viewers to respond to a Yes/No question
- **d** Selecting an appropriate number of students from each year at your local high school
- **e** Subscribers are sent an email asking for their opinion of the play they have just seen
- **f** Names of employees at a bank are drawn out of a barrel
- **g** The audience at a concert finds prize tickets under every 40th seat in each row
- **h** A company sends out an email to customers asking for their opinions
- **i** Employees are sorted from tallest to shortest and every 5th employee completes a questionnaire
- **j** 20 females and 28 males were surveyed out of a group of athletes with 100 females and 140 males
- **k** An airport customs officer searching every 10th airline passenger
- **l** A medical researcher advertises for people to participate in a health survey
- **m** 5 cards are selected from a pack of cards without looking
- **n** An import–export business employs 125 women and 250 men. 17 women and 34 men are surveyed about their work hours
- **o** A computer selects every 1000th name from the electoral (voters) roll
- **p** A bank surveys 5% of its customers in each age group

2 Children from 400 families attend the local primary school. The P&C has raised money for new play equipment for the playground and wants to interview parents about their ideas. The committee would like to survey 40 families. Suggest how they might select the 40 families using a PS

- **a** random sample
- **b** stratified sample
- **c** systematic sample
- **d** self-selected sample.

3 For the survey above, which method of sampling is the best to use? Explain your answer.

4 What are the possible disadvantages of using a

- **a** self-selected sample?
- **b** random sample?
- **c** systematic sample?
- **d** stratified sample?

Chapter problem

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

Weblinks
Roy Morgan
YouGov

Investigation Sample sizes in polls

In this investigation, we will look at the sizes of samples used by polling organisations.

1. Visit the **Roy Morgan** research website.
2. Click on the **Findings** tab and select one of the polls in Australia that interests you.
3. Write down what the poll is about and the size of the sample.
4. Use the internet to find the population of Australia.
5. What percentage is the sample of Australia's population?
6. Visit the **YouGov Australia** website.
7. Select a recent national or state poll and write down the sample size they used.
8. Find the population of Australia or the state for the poll you have chosen.
9. What percentage is the sample of the population?
10. Write 2 or 3 sentences describing what you have found.
11. How well do you think the samples reflect the opinions of the population?

Remember:
percentage sampled = $\frac{\text{sample}}{\text{population}} \times 100$

14.6 Choosing a sample

When we have decided what type of sample to use, we need to know how to choose the sample.

EXAMPLE 4 Stratified sample

Selina decided to use a stratified sample to survey members at her local gym. There are 970 gym members, of whom 590 are female and 380 are male. She plans to survey 10% of the members.

a How many members will Selina survey?

b How many female members should she survey?

c How many male members should she survey?



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Steps	Working
a Calculate 10% of the membership.	10% of 970 = 97 Selina should survey 97 members.
b Female members make up 590 out of 970 members. Write this as a fraction and find this fraction of the 97 members to be surveyed.	$\frac{590}{970} \times 97 = 59$ Selina should survey 59 female members.
c Male members make up 380 out of 970 members. OR, subtract the answer to part **b** from the answer to part **a**.	$\frac{380}{970} \times 97 = 38$ 97 members − 59 females = 38 males Selina should survey 38 male members.

EXERCISE 14.6 Choosing a sample

ANSWERS p. 396

1 Maria wishes to survey the members of the fan club she belongs to. Suggest any method she could use to find a random sample of members to survey.

2 Mr Carrozza, the school principal, wants to survey a sample of students' parents at Nelson Valley College. Suggest how he could find a systematic sample of parents.

3 In a self-selected sample, people volunteer to complete a survey. Suppose you need to collect data on usage of the school canteen. Suggest 3 places in your school where you might make questionnaires available for those who wanted to fill them in.

4 EXAMPLE 4 Amanda is going to use a stratified sample to survey the parents of her local netball club. There are 540 children playing netball, made up of 380 primary school students and 160 high school students. Amanda is going to survey 15% of parents.

- **a** How many parents should complete the survey?
- **b** How many parents of primary students should complete the survey?
- **c** How many parents of high school students should complete the survey?

5 Kieran is going to survey Year 8 students about their opinions of the school. There are 96 boys and 69 girls in Year 8. He aims to survey 20% of students.

- **a** How many students should complete the survey?
- **b** How many boys should complete the survey?

6 Jamiela is going to ask a sample of her Facebook friends about their favourite sport. She has 376 single friends and 416 friends in a relationship. She is going to survey 12.5% of her friends.

- **a** How many friends will she survey?
- **b** How many single friends will be in the survey?
- **c** How many friends in a relationship will be in the survey?

7 Global Communications employs 750 people made up of 479 males and 271 females. The company intends to survey 75 employees about their working conditions.

- **a** How many males should be surveyed?
- **b** How many females should be surveyed?

8 Darren is researching political views in Queensland. He stands on Roma Street in central Brisbane and interviews every 10th person who walks past. PS

- **a** Is this a representative sample of the population of Queensland? Why or why not?
- **b** If not, describe how Darren could achieve a representative sample.

Puzzle
Census and surveys find-a-word

Keyword activity

WORD MATCH

ANSWERS p. 396

Match each word with its definition.

1	census	**A**	A representative group in a survey
2	population	**B**	Every member of the population has an equal chance of being selected
3	privacy	**C**	Different categories in a population are represented according to the size of each category
4	questionnaire	**D**	Your right not to share personal information
5	random sample	**E**	The process of collecting information to enable people to make informed decisions
6	sample	**F**	One of the most common ways to collect information
7	self-selected sample	**G**	Sample where selections are made on a regular basis, such as every 100th item
8	stratified sample	**H**	The group of people from whom a sample is chosen
9	statistical investigation sample	**I**	Whoever wishes to participate answers the questions asked
10	systematic sample	**J**	All people or items are surveyed

Solution to the chapter problem

Problem

Andrew is a market researcher. He has been asked to evaluate the facilities and services being provided to the community by the United Club. Should he survey all 14100 members or take a sample? If he chooses to use a sample, how should he select it to ensure that he gets a good representative range of views?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	We need to decide who Andrew will survey and what type of sample he could use.
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	It would be too expensive to survey all 14100 members and it would take too long to analyse the results. A sample is the better option. To ensure a representative sample, Andrew should take a stratified sample of the different age groups. If he is using a sample size of 10%, then he should survey 10% of each age group.
STAGE 3: CHECK THE SOLUTION	
 CHECK	This solution makes sense and we have answered both parts of the question.
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	Andrew should take a stratified sample of the members of the club, surveying 10% of members in each age group.

14 Test yourself

Census and surveys

ANSWERS p. 396

1 EXERCISE 14.1 List the steps in a statistical investigation in your own words.

2 EXERCISE 14.2 Should you use a census or a sample to find the most popular streaming platform in Queensland? Give a reason for your answer.

3 EXERCISE 14.2 For each investigation listed below:

- **i** what is the target population?
- **ii** should a census or sample be used?

a Number of children in each family in your street

b Make of car in car fleets of Queensland companies

c Voting intentions at the next federal election

d Whether boys complete more homework than girls in Queensland schools

4 EXERCISE 14.3 Who conducts the Australian Census? How often is it conducted?

5 EXERCISE 14.4 Simone is collecting information from Year 11 students. Some questions could be answered using a sample and some questions would require a census. Give one example of a question where Simone could use a

a sample

b census

6 EXERCISE 14.5 Cengage Engineering has 430 employees. The CEO wishes to survey the employees about working conditions at the company. He would like to survey 86 employees. Suggest how the firm contracted to do the research might select the 86 employees using these samples:

a random sample

b stratified sample

c systematic sample

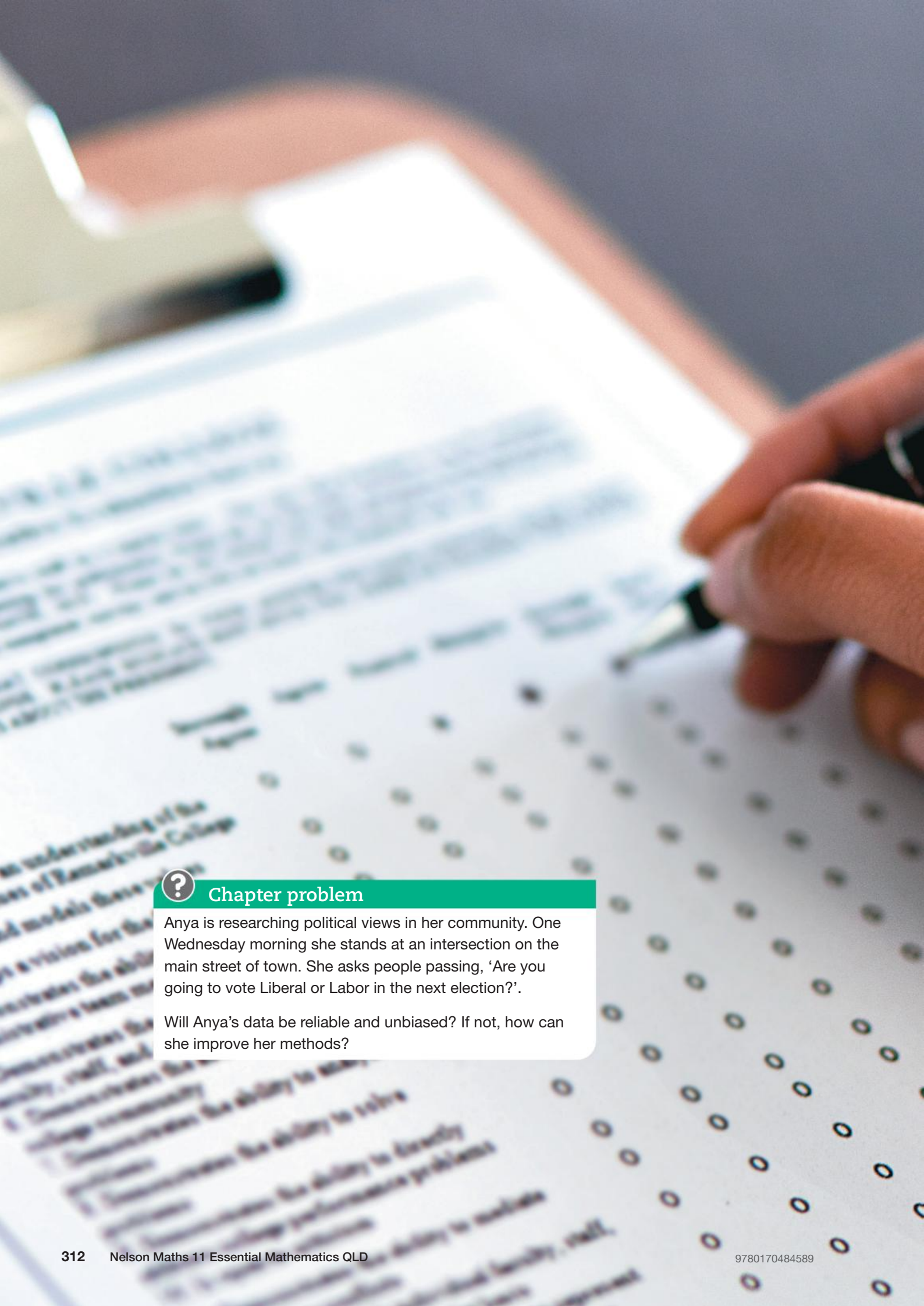
d self-selected sample

7 EXERCISE 14.6 Lindsay is going to use a stratified sample to survey the parents of all students in her dance classes. There are 375 children in the dance classes: 295 girls and 80 boys. Lindsay is going to survey 20% of parents.

a How many parents should complete the survey?

b How many parents of girls should complete the survey?

c How many parents of boys should complete the survey?



Chapter problem

Anya is researching political views in her community. One Wednesday morning she stands at an intersection on the main street of town. She asks people passing, 'Are you going to vote Liberal or Labor in the next election?'.

Will Anya's data be reliable and unbiased? If not, how can she improve her methods?

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CHAPTER 15

DATA AND TRAVEL: DATA COLLECTION

THAT'S BIASED

Syllabus coverage
Nelson MindTap chapter resources
Terminology
15.1 Questionnaires*
15.2 Bias in questionnaires*
15.3 Bias in sampling*
15.4 Errors in surveys
Keyword activity
Solution to the chapter problem
Test yourself
* COMPLEX

What will we do in this chapter?

- Design a questionnaire correctly and consider target populations
- Detect bias in our questionnaires, samples and statistical data
- Minimise bias in the statistical process

How are we ever going to use this?

- When creating questionnaires to collect data
- When we evaluate the results of surveys
- When we read or consider information reported in the media

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Syllabus coverage

UNIT 2, TOPIC 1: DATA COLLECTION

Simple survey procedure

- Investigate questionnaire design principles, including simple language, unambiguous questions, consideration of number of choices, issues of privacy and ethics, and freedom from bias [complex].

Sources of bias

- Describe the faults in the process of collecting data.
- Describe sources of error in surveys, including sampling error and measurement error.
- Investigate the possible misrepresentation of the results of a survey due to misunderstanding the procedure or the reliability of generalising the survey findings to the entire population [complex].
- Investigate errors and misrepresentation in surveys, including examples of media misrepresentations of surveys [complex].

Essential Mathematics 2025 v1.1 Applied (Essential) senior syllabus, p. 18
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Worksheets (2):
15.1 Student survey form • Census questions

Puzzles (2):
Keyword activity Questionnaires word match • Statistical scramble

Nelson MindTap

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

Terminology

bias	population	questionnaire	sampling	survey

15.1 Questionnaires*

Using questionnaires is one of the most common ways to collect information. A good questionnaire:

- uses simple language
- has clear and precise questions
- considers the number of choices offered as answers
- meets privacy requirements: unauthorised people cannot access your information
- is free from bias.

Bias is an unwanted influence in sampling or questionnaires that favours a particular section of the population unfairly. Bias produces unreliable results because the sample or questionnaire answers are not truly representative of the population.

EXERCISE 15.1 Questionnaires*

ANSWERS p. 396

Worksheets
Student survey form
Census questions

Andrew has designed the first draft of a questionnaire to survey club members about the entertainment that the United Club provides, including trips away. Andrew's draft is given below. Read the questionnaire and answer the questions that follow.

United Club **Help us help you!**

Please answer this short questionnaire to help the United Club better serve you.

1 How old are you?

- ☐ Less than 30 years
- ☐ Between 31 and 40 years
- ☐ Between 41 and 50 years
- ☐ Over 50 years

2 What is your gender?

- ☐ Male
- ☐ Female
- ☐ Non-binary/other
- ☐ Prefer not to answer

3 Which of the Club's entertainments do you attend?

4 How often do you attend the following Club activities?

Concerts _____ Films _____ Dance nights _____ Trips away _____

5 Do you think the entertainment offered is reasonably priced?

6 Should the club offer more types of entertainment and, if so, what should it offer?

7 Are there any other comments you would like to make about the Club's entertainment program?

Thank you for taking the time to complete this questionnaire. Please hand it in at the bar.

1 **Closed questions** give a number of options for the answer. How many questions in the questionnaire are closed?

2 **Open-ended questions** provide no options and require the person to write their own answer. How many questions in the questionnaire are open-ended?

3 The first question about age has a problem in the options given. What error has Andrew made? Rewrite the options to this question to fix this error.

4 When Andrew asks 'Which of the Club's entertainments do you attend?' it is not clear exactly what he means. Club members could be unsure which of the Club's activities is classified as entertainment. Rewrite the question to make it clear.

5 When Andrew asks, 'How often do you attend the following Club activities?', he will get a range of answers. Analysing the data will be easier if Andrew provides some options. Suggest a series of tick boxes that Andrew could provide for people to record their answers.

6 Would all Club members agree on what 'reasonably priced' means? Suggest how Andrew could change this question to make it clearly understood.

7 Write another question about the cost of entertainment for this questionnaire.

8 There is a risk that answers won't remain private if the questionnaires are handed in at the bar. Suggest a more secure way to collect the questionnaire forms.

9 Do you think Andrew has missed anything in his questionnaire? (Hint: how would people who don't attend the entertainment activities express their views?) Write 3 additional questions Andrew could use. **PS**



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15.2 Bias in questionnaires*

The way a question is worded in a questionnaire can introduce bias. The wording of the questions can lead people towards a particular view. This can unfairly influence the way people answer the questions.

EXAMPLE 1 Bias in questions

Andrew has written some questions to ask members about the club bistro.

a How often do you eat at our fabulous bistro?

b Rate your last meal: Excellent Yummy Quite nice

In what way are these questions biased? Rewrite them so they are not biased.

Working

a Using the word 'Fabulous' encourages the person answering the question to give a positive answer.
It would be better to ask: 'How often do you eat at the bistro?'

b This question doesn't give any negative options. The question could be:
Rate your last meal: Poor Average Good

EXERCISE 15.2 Bias in questionnaires*

ANSWERS p. 396

1 EXAMPLE 1 For each questionnaire question below,

i state how it is biased

ii rewrite it so that it is not biased.

a Do you prefer to holiday in fascinating Sydney or in wet Melbourne?

b Do you agree that we should increase the tax on those disgusting cigarettes?

c Rate the last movie you saw: OK Good Engaging

d Do you prefer exciting rugby league or boring old rugby union?

e Do you think the club is open long enough or should we be able to rage on into the early morning?

f Rate your health fund: Useless Not very good Reasonable

g Are there enough events for young people in this quiet town?

h Isn't this just the greatest music video you've ever seen?

i Are you one of those lame people who walk to school?

j Rate our gym: Best ever Very good OK

2 You have decided to survey your fellow students about the sports offered at your school. Make up 3 examples of biased questions. Then give 3 unbiased versions of these questions. PS

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15.3 Bias in sampling*

To be fair and reliable, a sample being surveyed should represent the population accurately. Bias can happen if a sample is not selected properly.

EXAMPLE 2 Bias in sampling

Andrew is considering how to find a fair sample of United Club members to complete his survey by:

a asking 100 people as they come through the door on a Friday night

b asking 100 people playing bingo on a Wednesday morning

In what way are these samples biased? How could you ensure that an accurate sample is found?



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Steps	Working
a The people at the club on a Friday night are more likely to be younger people.	All age groups would not be represented fairly.
b The people at the club on a Wednesday morning are more likely to be retired or not working.	Working members would be under-represented in the survey. For a more accurate sample, Andrew could find a list of all United Club members and choose every, say, 10th member (other answers are possible).

EXERCISE 15.3 Bias in sampling* ANSWERS p. 396

1 EXAMPLE 2 For each sample given below, state how

- **i** the sample is biased
- **ii** you could ensure that an accurate sample is found.

a Asking people in the crowd at an AFL match for their favourite sport

b Calling every 6th phone number in a customer database to ask about mobile phone usage

c Surveying people about their preferred supermarket in a shopping centre with only one supermarket

d Asking people in Brisbane their view on drought support by the Government

e Asking teachers what music should be played at the Year 12 formal

f Surveying the Maths staff on what books should be bought for the school library

g Finding out what people think of a new design for a football club jersey by asking people who walk past the office door

h Surveying taxi drivers on who they will vote for in the next election

i Emailing a survey to club members to complete

j Asking McDonalds customers to name their favourite coffee shop

2 Ms Benedict's Year 11 class is completing a statistical investigation project as part of their assessment. The students need to decide who they will ask to answer their questions. For each investigation, suggest PS

- **i** what kind of group should be surveyed to get useful results
- **ii** what kind of group is likely to give less useful or biased results.

a New tourist attractions that could be built in Mackay

b Children's favourite holiday destinations

c Most popular teacher in Nelson Valley State High

d Most popular sport in Australia

e Changes to the school uniform

f Exercise equipment to be installed in outdoor areas

g Types of stores to include in a new shopping centre

h Entertainment provided in a chain of retirement homes

Chapter problem

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

Investigation — Travelling to school

Conduct a survey of how the students at your school commute to school.

1 Before you start, you will need to make some decisions.
- How large a sample will you use?
- How will you select your sample?
- What questions will you ask?
- What are the possible categories of travel that students at your school might use? List them.
- What will you do if there is a category you haven't thought of?
- What will you do if someone uses more than one method of transport?

2 **Collect** the information.

3 **Organise** the data.

4 **Summarise and display** the data using tables and/or graphs.

5 **Analysis** the data. Use the data to answer the following questions:
- What is the most common method of travel?
- What is the least common method?
- What effect does the location of your school have on the method of travel?

6 **Present** your results in a report, either written or as PowerPoint slides.

15.4 Errors in surveys

There are different ways in which error can be part of the data collection process. Errors can result from:

- the surveyor not asking the question correctly
- the respondent interpreting the question incorrectly
- the respondent answering the questionnaire incorrectly
- the surveyor recording the answers incorrectly.

When collecting data, the aim is to avoid or minimise these errors.

Information that is collected can also be interpreted carelessly to favour a particular point of view.

EXAMPLE 3 Errors in surveys

Alex stood at the school gate one morning and asked 10 students if they liked the school uniform. 5 students said something negative about the uniform. Alex submitted a report to the school principal, claiming that half of the students hate the uniform. Describe 3 things that are wrong with this conclusion.

Working

1 Alex only asked 10 students and it is not a random selection. The sample is unlikely to be representative of the whole school.

2 The question is vague and it's not clear what students don't like. It may not be the whole uniform that students don't like, but some particular item.

3 Alex exaggerates the answers when he says 'hate'. We don't know how strongly students feel about the uniform.

EXERCISE 15.4 Errors in surveys

ANSWERS p. 396

1 Each situation listed below can affect the way a questionnaire is answered. Explain how it could affect the usefulness of the survey results.

- **a** The questionnaire is very long.
- **b** The presentation of the questionnaire is messy and hard to follow.
- **c** The choice of categories in some questions doesn't cover all the options.
- **d** The time allowed to answer the questionnaire is limited.

2 There are different ways to collect data. For each method listed, describe one possible error to avoid if using that method.

- **a** Sending a questionnaire by post
- **b** Asking people to complete a diary each day recording their behaviour
- **c** Calling up households and asking questions over the phone
- **d** Having an interviewer ask a person the questions and completing the questionnaire
- **e** Direct observation; for example, how many vehicles travel through an intersection at a given time of day

3 EXAMPLE 3 Jane asks 5 Year 12 students if they like the food served at the school canteen and 3 students say they don't like it. Jane writes an article for the school newspaper with the headline '60% of students hate canteen food'. Explain 3 things that are wrong with this headline.

4 The Hightop Hotel emails its customers to complete a survey about its service. It receives 25 replies, each of which makes some positive comments about the hotel. An advertisement is published saying 'Customers 100% happy with our hotel'. Explain what is wrong with this claim.

5 A newspaper headline reads 'Government program for disadvantaged students a disaster'. In the article, it is revealed that 35 students out of 1000 students receiving government support have dropped out of school. Explain why this headline is misleading.

6 Using the information you collected in the Investigation 'Travelling to school', write a presentation that is deliberately misleading. Perhaps you might like to write about additional student parking, motorbike parking, later school starting times or some other issue, but make sure you distort the true facts!

7 The following is a biased article from *The Nelsonville Gazette.* PS

New dog park gains support

A new dog park next to Regent St Park came a step closer this week following the meeting of interested residents on Tuesday morning. Following the advertisement in *The Gazette*, 30 interested folks met with the mayor and voiced their support for the project.

When put to the vote, 27 supported constructing the park while only 2 objected and 1 resident abstained from voting, giving a whopping 90% in favour. Based on this overwhelming percentage from a sample of locals, Council believes there is widespread support for the project throughout the community.

a Identify one correct fact from the article.

b Give 2 reasons the council's claim that 90% of residents support the dog park could be invalid.

c Describe a way that the council could get more reliable information.

d Write a paragraph outlining whether you believe the claim that the community supports the new dog park is justified.

8 Use the internet or library to find some newspaper or magazine articles that are based on statistics. Read them carefully to check if they have presented the information properly. Write a report on 3 articles you find, highlighting their use of statistics, either correctly or incorrectly. PS

Investigation — Statistics in the media

We live in a world of 24-hour news, through TV, news websites, Facebook, X and blogs. To detect bias, we need to consider where the news comes from and what samples were used. Is the information supplied by a journalist, the police, a company executive, a government official or an opinionated blogger? Are the statistics based on a small sample, a large sample, an unrepresentative sample, or a phone/online poll? Each may have a particular bias that may influence how the story is reported.

Find 3 examples of news items or surveys reported in a newspaper or online and investigate the following questions.

1. Where did it come from? What could influence how the story was reported?
2. Who wrote the story?
3. Does it show any bias?
4. Can it be supported by other news providers?
5. What type of sampling was used? Was it representative?
6. How many people were questioned?
7. When was the survey conducted?



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Keyword activity

BIAS IN STATISTICS

1 Explain what is meant by the word *bias* in the statistical context.

2 What are the qualities of a good questionnaire that doesn't have bias?

3 Write a paragraph explaining how samples can be biased and how to avoid this.

4 List 5 errors than can occur in a survey that could lead to unreliable results.

Solution to the chapter problem

Problem

Anya is researching political views in her community. One Wednesday morning she stands at an intersection on the main street of town. She asks people passing, 'Are you going to vote Liberal or Labor in the next election?'

Will Anya's data be reliable and unbiased? If not, how can she improve her methods?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	We need to establish whether Anya's data is reliable and whether there are any improvements she can make to her data collection.
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	**The sample:** On a Wednesday morning she will miss people who are working or shopping. She will mainly be asking older people who have retired, people who work unusual hours, or unemployed people. Her sample is *not* representative of her community. **The question:** There are alternatives to voting Liberal or Labor – other political parties or independent candidates. Her question doesn't cover all the options. Also, she has not specified which election – local council, state or federal. **Improvements:** She should choose her sample from the electoral roll of the community. The question could be asked with a tick box option for answering or it could be an open-ended question. It should specify which level of government it is referring to. For example, 'Who do you intend to vote for in the next federal election?'
STAGE 3: CHECK THE SOLUTION	
 CHECK	We have answered all parts of the question. We have used what we know about collecting reliable data.
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	Anya's sample is not representative of her community. She should choose a sample from the electoral roll. Anya needs to change her question. She must specify which level of government she is talking about. She can either give a tick box option covering all possible answers or she can make it an open-ended question.

15 Test yourself

That's biased

ANSWERS p. 396

1 EXERCISE 15.1 Anthony wrote 'How often do you drink?' as part of a questionnaire he was giving to Year 12 students about their alcohol consumption.

a What problem/s might people have in answering this question?

b Rewrite the question, providing some tick box options.

2 EXERCISE 15.2 Tranh is surveying students about the quality of food sold at the school canteen.

a Write an example of a biased question he could use if he wanted to show how great the food is.

b Rewrite the question you wrote in part **a** so that it is *not* biased.

3 EXERCISE 15.3 Jenni asks a sample of people in her town, 'Which coffee shop makes the best coffee?'

a Give an example of a sample that would be biased.

b State how could you ensure that an accurate sample is found.

4 EXERCISE 15.4 Kendall interviewed her Year 11 class about changing the time that school starts. 11 of the 20 students surveyed said they wouldn't mind if school started a bit earlier. Kendall presents a report to the student council with the title, 'Students support starting school half an hour earlier'. Describe 3 things that are wrong with this claim.



Chapter problem

Nina and Mitch are planning a 9 km bushwalk. They plan to walk at a speed of 2.5 km/h over the steep and bushy land. They will leave the car park at 10 am and for safety they will log their walk with the park ranger. At what time should Nina and Mitch tell the park ranger to expect them back at the car park?



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CHAPTER 16

DATA AND TRAVEL: TIME AND MOTION

GOING PLACES

Syllabus coverage
Nelson MindTap chapter resources
Terminology
16.1 Distance, speed and time
16.2 Compass directions*
16.3 Street maps
16.4 Scales on maps
16.5 Distances between places
16.6 Regional maps
16.7 GPS navigation*
16.8 Family road trip*
Keyword activity
Solution to the chapter problem
Test yourself
*COMPLEX

What will we do in this chapter?

- Solve problems involving speed, distance and time
- Interpret distance–time graphs
- Identify the 8 points (directions) on a compass
- Read grid references and information on street maps.
- Interpret and use scale on maps
- Find the shortest distance between two places
- Plan trips involving distances, speeds, times and costs
- Use a GPS to assist with navigation

How are we ever going to use this?

- Planning holidays and journeys
- Travelling in unfamiliar locations
- Finding an alternate route to avoid traffic problems

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Syllabus coverage

UNIT 2, TOPIC 3: TIME AND MOTION

Distance

- Use scales to find distances.
- Investigate distance through trial and error or systematic methods [complex].
- Apply directions to distances calculated on maps including the eight compass points: N, NE, E, SE, S, SW, W, NW [complex].

Speed

- Identify the appropriate units for different activities.
- Calculate speed, distance and time where s is speed, d is distance and t is time, using the formulas
  - $s = \frac{d}{t}$
  - $d = s \times t$
  - $t = \frac{d}{s}$
- Calculate the time and costs for a journey from distances estimated from maps, given a travelling speed [complex].
- Interpret distance-versus-time graphs, including reference to the steepness of the slope (or average speed) [complex].

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Videos (4):

16.1 Speed, distance and time • Distance-time graphs

16.4 Map scales 1 • Map scales 2

16.4 Map scales • Map of Adelaide

16.8 Travel trivia

Worksheets (9):

16.1 Distance, speed and time • Speed problems • Racing rates • Speed stories • Speed formula practice • Speed units

Puzzle (1):

Keyword activity: Travel crossword

Nelson MindTap

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

Terminology

compass points
coordinates
distance
distance-time graph
global positioning system (GPS)
scale
speed

16.1 Distance, speed and time

The question, 'How long will it take to get there?' can be answered easily with a little mathematics. The values for the distance covered, the speed and the time taken are related. When we know 2 of the values, we can calculate the third value.

The speed formula

distance covered = speed × time

OR $d = s \times t$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

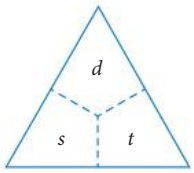
OR $s = \frac{d}{t}$

The units for 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 m/s, the distance is in metres and the time is in seconds.

Video Speed, distance and time

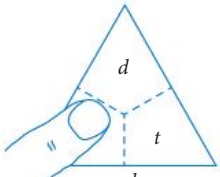
Worksheets Distance, speed and time
Speed problems
Racing rates
Speed stories
Speed formula practice

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.



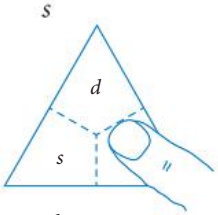
To calculate the **speed**, cover up s, which leaves $\frac{d}{t}$.

This means that $s = \frac{d}{t}$, or $s = d \div t$.



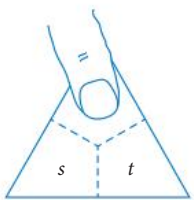
$s = \frac{d}{t}$

To calculate the **time**, cover up t, which leaves $\frac{d}{s}$.



$t = \frac{d}{s}$ or $t = d \div s$

To calculate the **distance**, cover up d, which leaves $s \times t$.



$d = s \times t$

EXAMPLE 1 Distance, speed and time

A racing greyhound runs at a speed of 18 m/s.

a **Calculate** 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 up d. $d = s \times t$, where $s = 18$ m/s and $t = 4$ s.	$d = s \times t$ $= 18 \times 4$ $= 72$ m
Write your answer.	The greyhound will run 72 metres in 4 seconds.
b To find the time, cover up t. $t = \frac{d}{s}$, where $d = 1200$ m and $s = 18$ m/s.	$t = \frac{d}{s}$ $= \frac{1200}{18}$ $= 66.666\ldots$ ≈ 66.7 s
Write your answer.	The greyhound will complete the race in 66.7 seconds.

EXAMPLE 2 Speed, distance and time

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 as well. Divide 20 min by 60 to change it to hours.	$t = \frac{20}{60} = \frac{1}{3}$ h
$d = s \times t$, where $s = 48$ km/h.	$d = s \times t$ $= 48 \times \frac{1}{3}$ $= 16$ km
Write your answer.	The kangaroo will bound 16 km in 20 minutes.

Remember:
1 hour = 60 minutes

EXAMPLE 3 Converting from km/h to m/s

Calvin is driving through a school zone at a speed of 40 km/h.
Convert 40 km/h to a speed in m/s, correct to one decimal place.

Steps	Working
To convert 40 km/h to m/s, change 40 km to metres and 1 hour to seconds.	40 km $= 40 \times 1000$ m $= 40\,000$ m 1 h $= 60 \times 60$ seconds $= 3600$ s
$s = \frac{d}{t}$	$s = \frac{40\,000 \text{ m}}{3600 \text{ s}}$ $= 11.1111\ldots$ ≈ 11.1 m/s
Write your answer.	40 km/h is equivalent to 11.1 m/s.

Remember:
1 km = 1000 m
1 hour = 60 minutes
1 minute = 60 seconds

A **distance–time graph** is a line graph that describes a journey, by comparing distance with time (on the vertical and horizontal axes, respectively). The slope or steepness of the graph indicates speed.

16.1

EXAMPLE 4 Distance–time graph

This graph shows Monique's cycling trip.

a At what time did Monique leave home?

b When was Monique's first stop? How far from home was she?

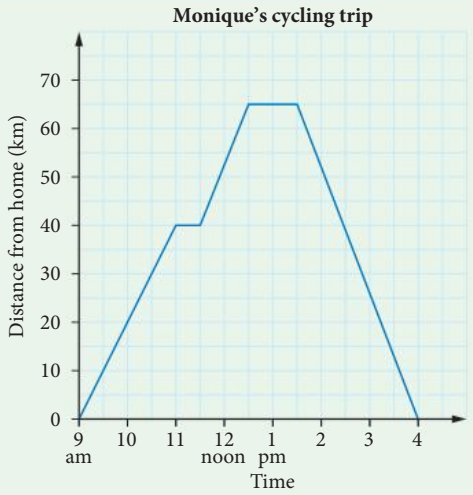
c **Calculate** her average speed over the first 2 hours.

d What time was it when Monique began her journey home?

e How far did she travel in total?

f Find her average speed during the trip home.

g For how long did Monique stop altogether during the trip?



Steps	Working
a Monique left home at the start of the graph, when the distance was 0.	Monique left home at 9 am.
b Monique first stopped where the graph is flat. The distance from home does not change, which means Monique has stopped.	Monique first stopped at 11 am, 40 km from home.
c distance = 40 km, time = 2 h $s = \frac{d}{t}$	average speed $= \frac{40\text{ km}}{2\text{ h}}$ $= 20$ km/h
d Monique started her return journey where the graph points downward.	Monique started returning home at 1:30 pm.
e Monique travelled 65 km to return home.	total distance $= 2 \times 65$ km $= 130$ km
f distance = 65 km, time = $2\frac{1}{2}$ h $s = \frac{d}{t}$	average speed $= \frac{65\text{ km}}{2\frac{1}{2}\text{ h}}$ $= 26$ km/h
g Look at the places where the graph is flat.	first stop: $\frac{1}{2}$ hour, second stop: 1 hour total stopping time $= \frac{1}{2} + 1 = 1\frac{1}{2}$ hours

Video
Distance–time graphs

Distance–time graph

On a distance–time graph:

- a horizontal (flat) section on the graph indicates a stop
- the steeper the line, the greater the speed (more distance covered in less time)
- a section going down towards the right indicates a change in direction; in this case, that the traveller is heading in the direction they started from (home).

EXERCISE 16.1 Distance, speed and time

ANSWERS p. 397

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 average 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 hostage situation 10 km away.
How long will it take the team to arrive at the scene? Express your answer in minutes. PS

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 were 150 m, 80 m and 170 m.

a Calculate the distance 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.

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 one 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 the distances between Brisbane, Canberra and some NSW 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 Glen took 5 hours to drive from Goulburn to Albury. What was his average speed?

d Max and Sanjay left Brisbane at 6 am on Monday to drive to Albury. They shared the driving and completed the trip at an average speed of 70 km/h. At what time did they arrive in Albury?

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 Earth's gravity is 11.2 km/s.
What is this speed in km/h?

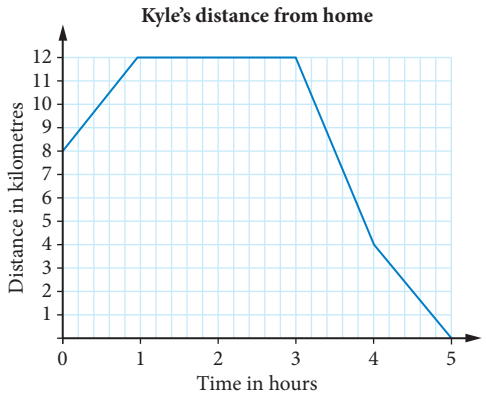
14 **a** Use a stopwatch to time how long it takes you to walk across your classroom.

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? PS



3DSculptor/iStock/Getty Images

15 EXAMPLE 4 Kyle and Ashley went to the cinema.
The distance–time graph shows the distance they were from Kyle's house after the movie finished.



a How far is the cinema from Kyle's house?

b After the movie finished, Kyle and Ashley rode their bikes to Ashley's house.
How far is Ashley's house from the cinema?

c How long did it take them to ride from the cinema to Ashley's house?

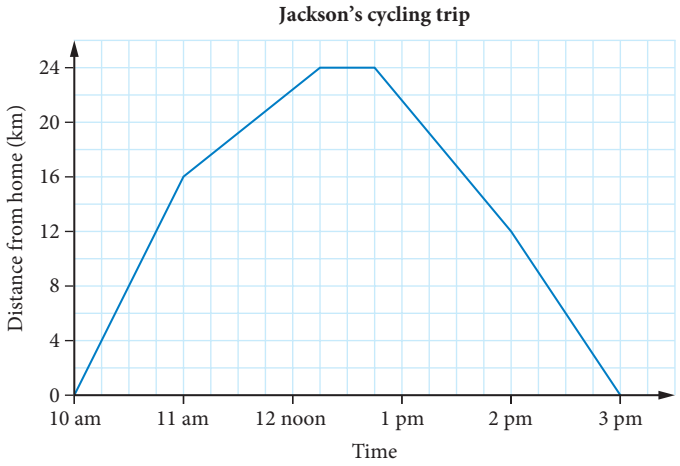
d What was their average speed riding to Ashley's house?

e How long did Kyle stay at Ashley's house?

f Calculate Kyle's average speed riding home.

g Part of the trip home is downhill and part of it is uphill. Did he ride the uphill section during the first or second hour of his ride home? Justify your answer. C

16 This graph shows Jackson's cycling trip.



a At what time did Jackson's cycling speed

i increase?

ii decrease?

b When did he start to return home?

c How far did Jackson travel altogether on this day?

d How long did he spend 'on the road'?

e Calculate Jackson's average speed for: C

i the first hour

ii 11:00 am to 12:15 pm

iii 12:45 pm to 2:00 pm

iv the entire day

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17 Brian travels from Bligh to Macquarie, while Sam travels from Macquarie to Bligh.



a How far is it between the two towns?

b Who is travelling faster? How can you tell?

c How far is Brian from Macquarie at 11 am?

d How far is Sam from Macquarie at 11 am?

e At what time do Brian and Sam pass each other? How far are they from Macquarie when they pass?

f Is Sam travelling faster before 9 am or after 9:15 am? How does the graph show this? C

g Calculate Brian's average speed before he stops.

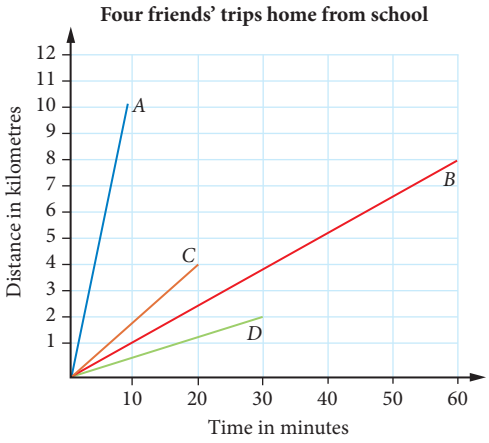
h For how long did Sam stop in total on the trip? Select the correct answer **A**, **B**, **C** or **D**.

A 60 minutes **B** 75 minutes **C** 5 minutes **D** 90 minutes

18 Use the clues to determine which person matches with each graph. Copy and complete the table to record your answers. C

Clues

- Shelby walks home at a speed of 4 km/h.
- Wayne rides his bike at an average speed of 12 km/h.
- Peta travels on the slow bus. With all the stops, the bus averages only 8 km/h.
- Luke drives home at an average speed of 60 km/h.



Graph	Person	Distance from school
A		
B		
C		
D		

19 Construct a graph, similar to the graph in question **18**, which shows the trips home from school made by you and 3 other people in your class. PS C

Chapter problem

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

Investigation The great trail bike race PS

Renaldo and Megan were racing against each other in a trail bike competition.

Renaldo completed the first half of the course at an average speed of 5.5 m/s and the second half at an average speed of 4.5 m/s.

Megan rode at an average speed of 5.0 m/s for the whole race.

1 Which rider completed the race in the faster time? Justify your answer.

2 A common misconception is that Renaldo's average speed is $(5.5 + 4.5) \div 2 = 5.0$ m/s, which is the same speed as Megan, so they should finish the race at the same time. Write a paragraph explaining why this thinking is incorrect. C



Westend61 GmbH/Alamy Stock Photo

Trying a few different values for the length of the race, such as 4000 m or 1000 m, could help you solve the problem.

Worksheet
Speed units

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, km/s, m/h or more than one.
Develop a rule for answering the question: 'What units should I use?'

Copy and complete this table or print a copy from Nelson MindTap.

Activity	Typical or record speed
Slow speeds	
Moving snail	
Adult walking	
Athlete running	
Medium speeds	
Cruise ship	
Car	
Downhill cross-country skiing	
Olympic speed-skating	
Fast speeds	
Queensland tilt train	
Japanese high-speed train	
International airline jet	
Very fast speeds	
Bullet fired from an assault weapon	
Fighter jet	
International Space Station	
Sound	
Light	

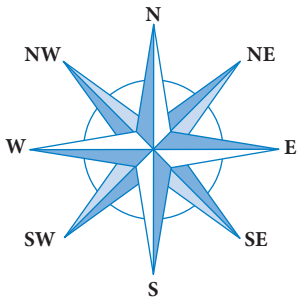
Group discussion questions

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?

16.2 Compass directions*

The 4 major **compass 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, position of the Sun and shadows, and the path of a plane or ship.



EXAMPLE 5 Compass directions



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a According to this map, **determine** what compass direction it is 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.

iStock.com/pop_jop

b Now the bearing is from Port Augusta. Position the compass rose on Port Augusta.



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The direction to Coober Pedy is between north and west. Coober Pedy is northwest of Port Augusta.

EXERCISE 16.2 Compass directions*

ANSWERS p. 397

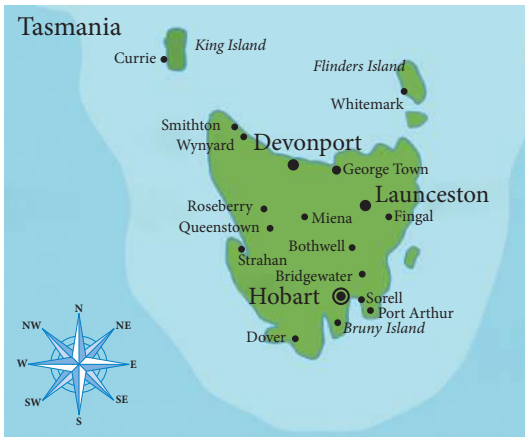
1 EXAMPLE 5 Write the compass direction:

a from Hobart to Roseberry

b from Launceston to Bothwell

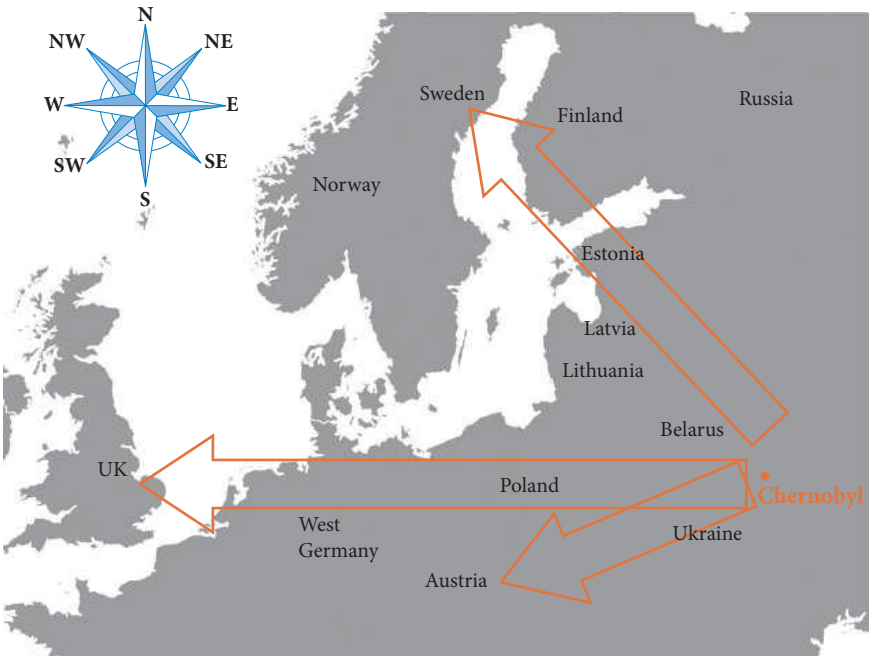
c to Roseberry from Queenstown

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.



iStock.com/Kosmozoo

a What compass direction is it from Chernobyl to Austria: NW, NE, SE or SW?

b Easterly winds are winds that come from an easterly direction. What countries experienced radiation clouds as a result of easterly winds?

3 When Muslim people pray, they always face in the direction of the central shrine in Mecca's Great Mosque, Islam's holiest place, in Saudi Arabia.

What is the approximate compass direction (N, S, E, W, NE, SE, SW or NW) from each of the following places to Mecca?



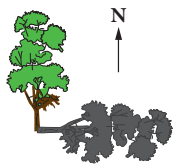
a Australia **b** China **c** Turkey

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? PS

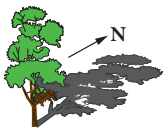
A



B



C



D

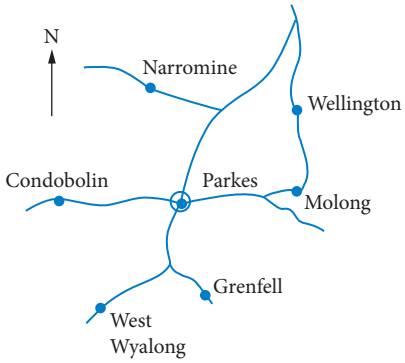


5 A westerly wind ('from the west') brought smoke from a bushfire to Parkes.

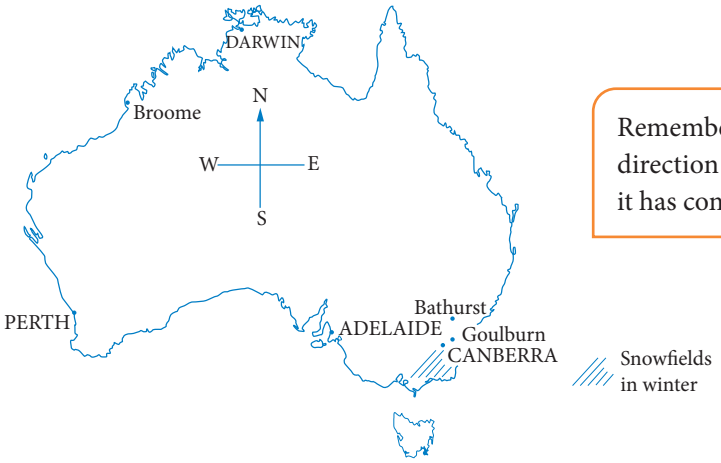
a Near which town on the map could the bushfire be located?

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 snowfields 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

16.3 Street maps

Even though we don't use street maps very often today, the skills involved in reading them are important. There are times when we can't use GPS, such as when the internet signal is weak or we are out of range.

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.

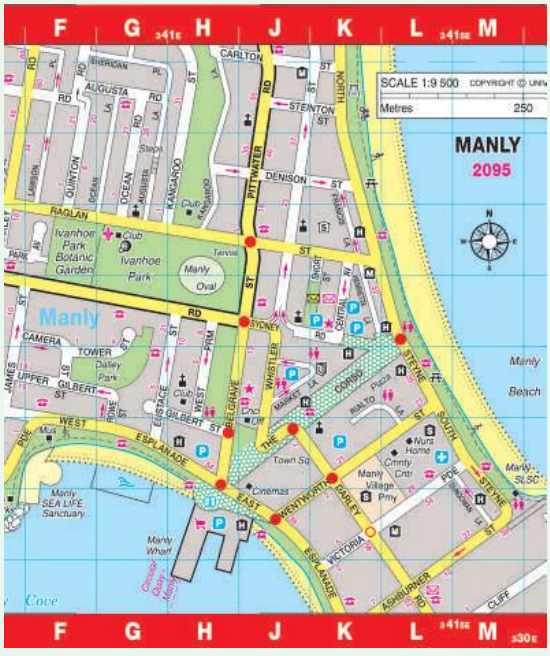
EXAMPLE 6 Street map

This is a street map of Manly in Sydney.

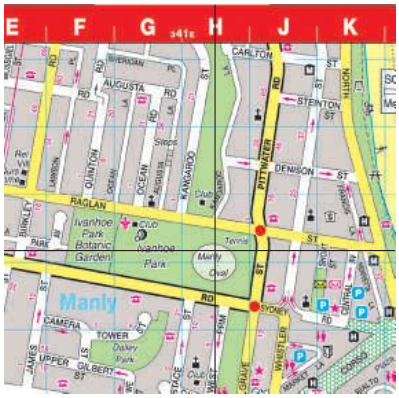
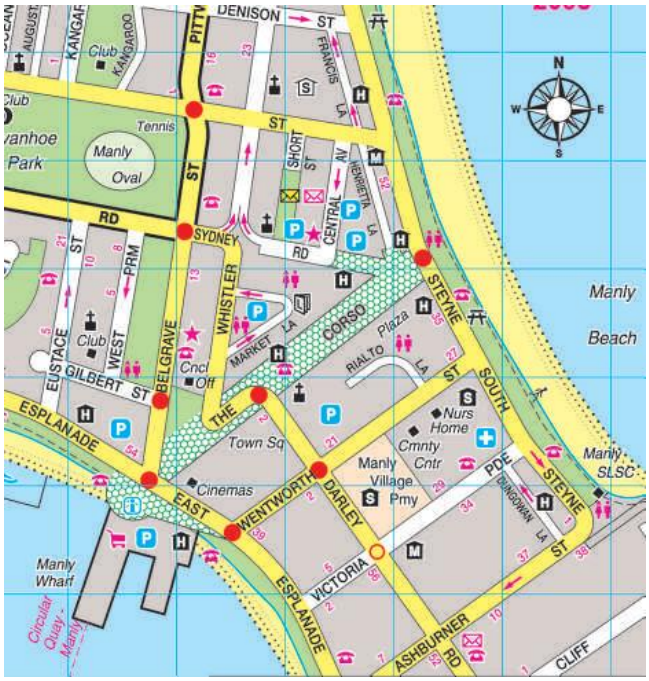
a On this map, what is the name of the park at F3?

b What are the position coordinates of Manly Oval?

c What direction is it from Manly Oval to Manly Wharf?

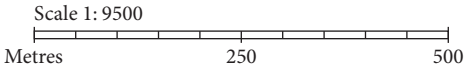


UBD Gregory's Sydney Street Directory Map 29, with permission from Hardie Grant Publishing.

Steps	Working
a Find the position where column F meets row 3.	 UBD Gregory's Sydney Street Directory Map 29, with permission from Hardie Grant Publishing.
The 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.	 UBD Gregory's Sydney Street Directory Map 29, with permission from Hardie Grant Publishing.
	Manly Oval is at H3 or H4.
c This symbol  shows the compass directions on the map. On this map, North (N) is straight up. An imaginary line from Manly Oval to Manly Wharf points south.	 UBD Gregory's Sydney Street Directory Map 29, with permission from Hardie Grant Publishing.
	Manly Wharf is south of Manly Oval.

Distances on a street map

Street maps have a scale, which is shown on the map as a diagram or ratio. The scale on the Manly map on page 338 is 1 cm represents 95 m, also shown as the ratio 1 : 9500 and as the diagram below.



EXAMPLE 7 Distance on a street map

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 Royal Melbourne Institute of Technology (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 m long.

If we need to calculate a distance that isn't along the side of a grid square, we can place a chain or piece of string along the distance, then compare the distance to the sides of the grid. In the part of the map of Manly below from Example 6, the length of the chain is roughly 3 grid squares.

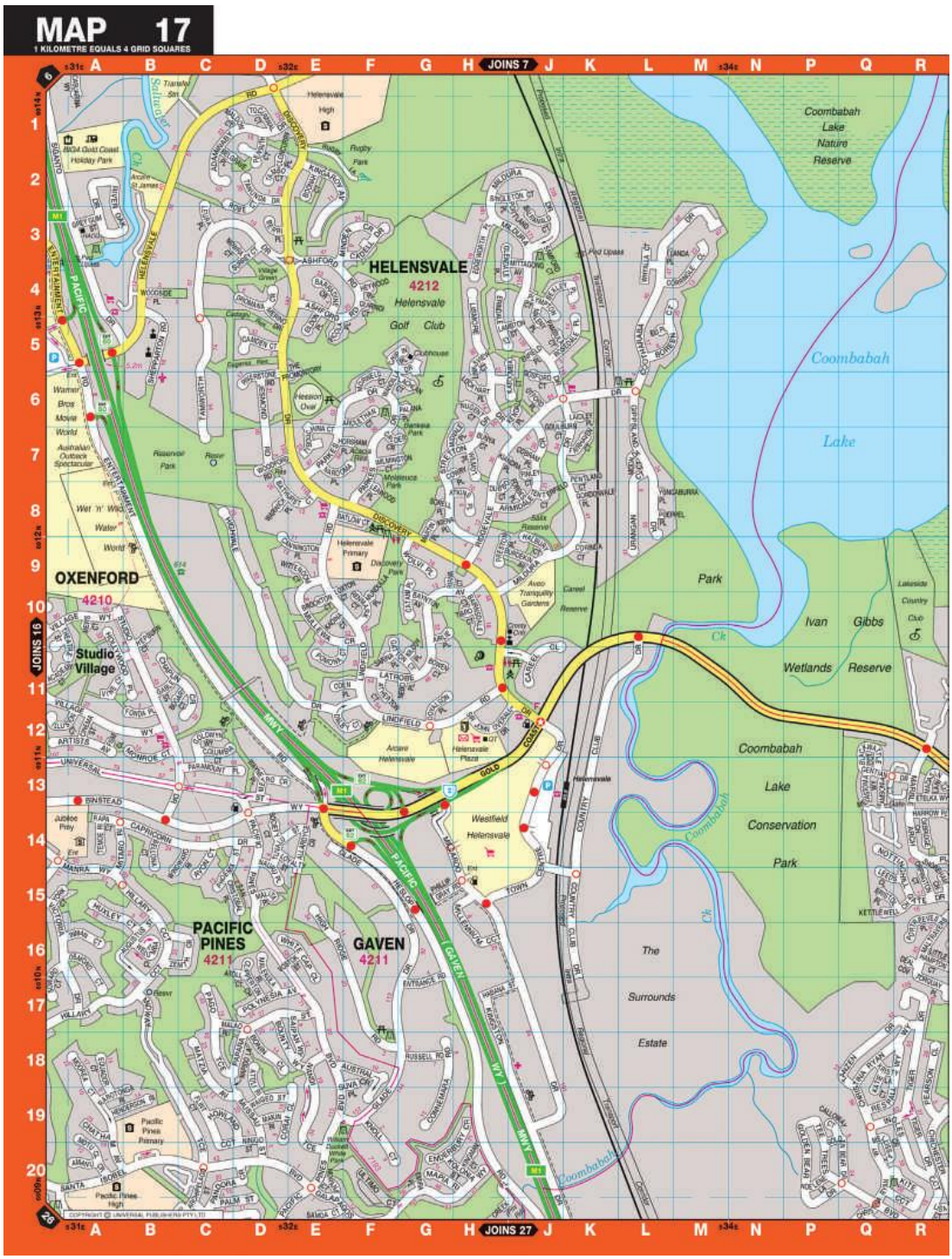


UBD Gregory's Sydney Street Directory Map 29, with permission from Hardie Grant Publishing.

EXERCISE 16.3 Street maps

ANSWERS p. 397

Use this map to answer questions **1** to **8**.



UBD Gregory's Gold Coast Street Directory Map 17, with permission from Hardie Grant Publishing.

1 EXAMPLE 6

a What is the name of the school at F9?

b What do the small black shapes at B5 represent?

c Which shopping centre is located at H12 and H13?

d There is an ambulance station on the side of Kingston Drive at J18.
What symbol does the map use to show an ambulance station?

2 Write the position coordinates of each place.

- **a** Westfield Helensvale
- **b** Warner Bros Movie World
- **c** Aveo Tranquility Gardens

3 Name the compass direction from:

- **a** Westfield Helensvale to Jubilee Primary School (A14)
- **b** Jubilee Primary School to Warner Bros Movie World
- **c** Helensvale Primary School to Arcare Helensvale (F12, F13)
- **d** Arcare Helensvale to Helensvale Plaza

4 EXAMPLE 7 On the map, 1 grid square length represents a length of 250 m. Use the grid squares and find:

- **a** the distance between the traffic lights on Discovery Drive, near the community centre (J10), and the traffic lights at the intersection of Discovery Drive and Lindfield Rd (H11)
- **b** the direct distance from the roundabout at Helensvale High School (E1) to Helensvale Railway Station (K13)
- **c** the length of the Pacific Motorway from the on-ramp in A5 to the off-ramp in E13
- **d** the length of the bike track from the Philip Grey roundabout at (H15) to the traffic lights at Warner Bros Movie World (A6).

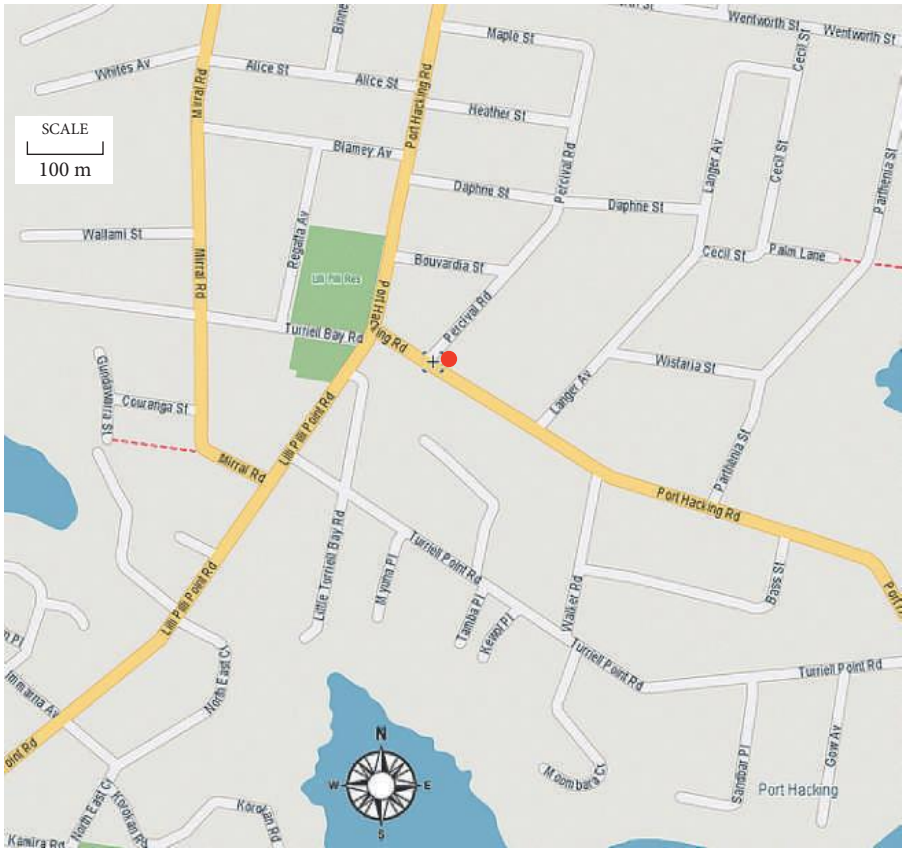
5 Sisters Kelly and Sian got off the train at Helensvale station and began the walk home. They walked north along Town Centre Drive and crossed over the Gold Coast Highway. They then turned into the second street on the left, then the first on the right. Where do the sisters live?

6 Anna lives on the corner of Ashford Rd and Quirindi Ct (F4). Write instructions for her friend to walk from Hession Oval (E6) to Anna's house.

7 Dinesh is trying to drive west along the Gold Coast Highway to join the Pacific Motorway and head north towards Brisbane. At present he is at K11. There is a traffic jam ahead following a serious road accident. Describe an alternate route Dinesh could take to avoid the traffic. PS

8 An ambulance has been called to attend an accident on the Gold Coast Highway in front of the Westfield Shopping Centre. Describe a route for the ambulance to follow from the ambulance station in J18 to the accident in H13.

Use this map to answer questions **9** and **10**.



Source: http://www.streetdirectory.com.au/

9 Katarina lives on the corner of Port Hacking Rd and Percival Rd (position of the red dot). She walks southeast along Port Hacking Rd and turns left onto Parthenia St. She then walks in a northeasterly direction to Zhi's house on the corner of Wisteria St and Parthenia St.

- **a** What compass direction is it from Katarina's house to Zhi's house?
- **b** Place a chain or piece of string on the map along Katarina's route and use the scale on the map to calculate the approximate distance she walks.

10 The next day, Katarina walks northwest from her home to the corner of Mirral Rd and Blamey Ave.

- **a** Describe the shortest route she could take.
- **b** Approximately what is the distance of this route?
- **c** At an average speed of 4 km/h, approximately how many minutes will the walk take her? C

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, ferry terminal 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 such as left and right, as well as compass directions, to make following your instructions easy.

Videos
Map scales 1
Map scales 2

Worksheets
Map scales
Map of Adelaide

16.4 Scales on maps

In Chapter 5, *Colourful ratios*, we learned about scales and scale drawings. We can use a map's scale to calculate distances on a map.

EXAMPLE 8 Scale on a map

The scale on a bushwalking map is 1 : 5000. On the map, a short walking trail is 4.5 cm long. How long, in metres, is the trail in real life?

Steps	Working
1 : 5000 means that 1 unit on the map represents 5000 units in real life. Multiply 4.5 cm on the map by 5000 to find the real length.	real length = 4.5×5000 $= 22\,500$ cm
Convert to metres.	$= 22\,500 \div 100$ m $= 225$ m
Write your answer.	The trail is 225 m long.

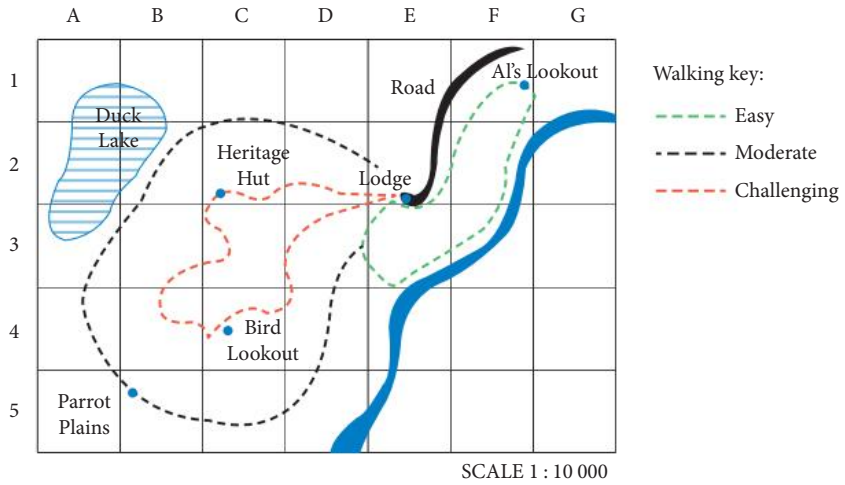
EXERCISE 16.4 Scales on maps

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1 EXAMPLE 8 A map's scale is 1 : 20 000. Calculate the real lengths, in metres, of each feature.

- **a** Lake: 1.5 cm wide
- **b** Walking track: 5.8 cm long
- **c** Creek: 9.5 cm long

2 The map shows the walking trails that start at the lodge.

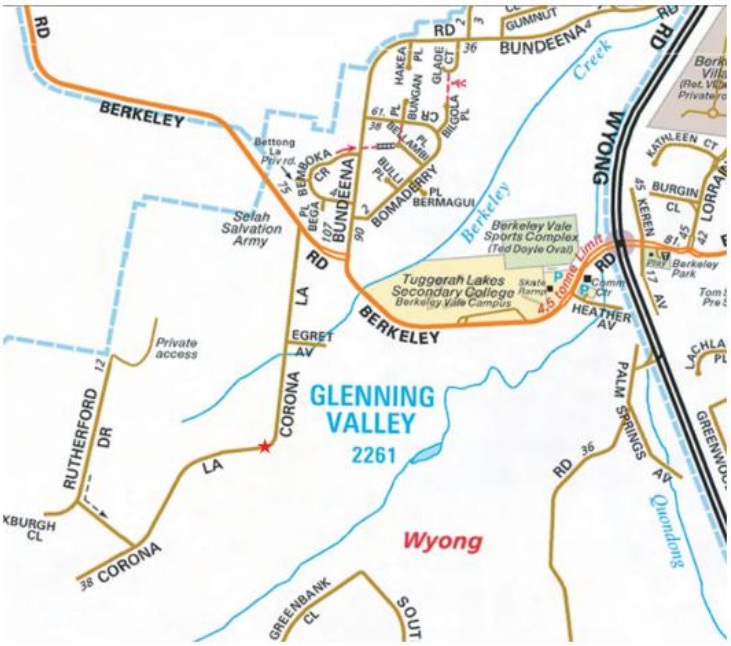


- **a** What is the scale?
- **b** What length in real life is represented by 10 cm on the map?
- **c** How long is the creek?
- **d** Calculate the length of the moderate walking track.
- **e** Jude started walking along the moderate walking track at 11 am. She is walking at a speed of 3 km/h. When will Jude finish walking the track?

Remember! You can use a chain or a piece of string to help you measure lengths on a map.

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3 Zack lives in Corona Lane. The star on the map shows the position of his house.

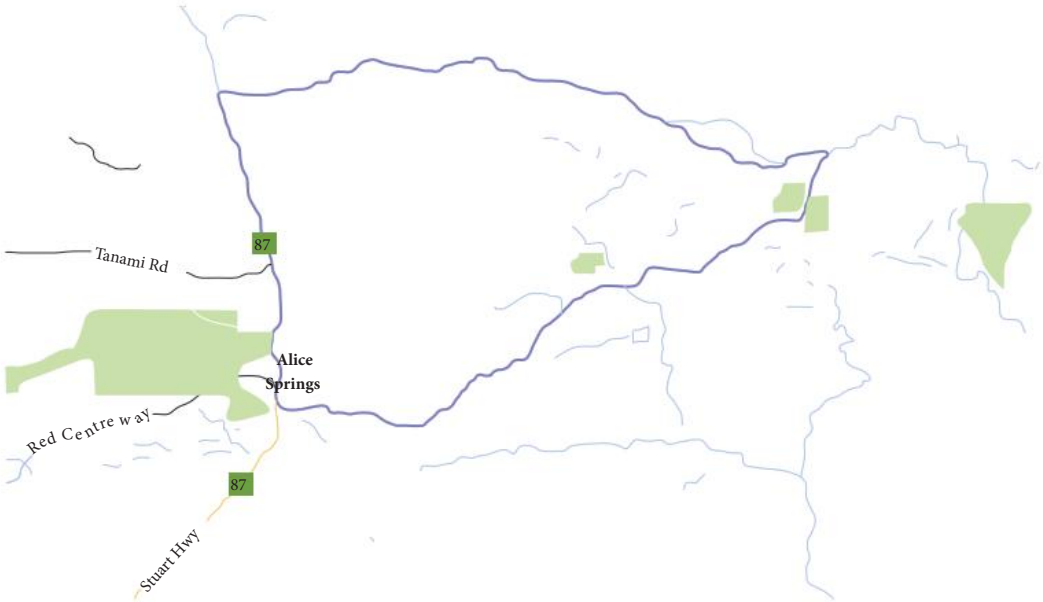


Map proudly reproduced with permission from Sydway Street Directory

a Use the scale 1 : 14 000 to calculate the distance Zack walks along roads to Tuggerah Lakes Secondary College each day.

b Zack walks to school at a speed of 1 m/s. How long does it take him to walk to school?

4 This map shows the road around East MacDonnell National Park in Central Australia. The scale is 1 : 909 000.

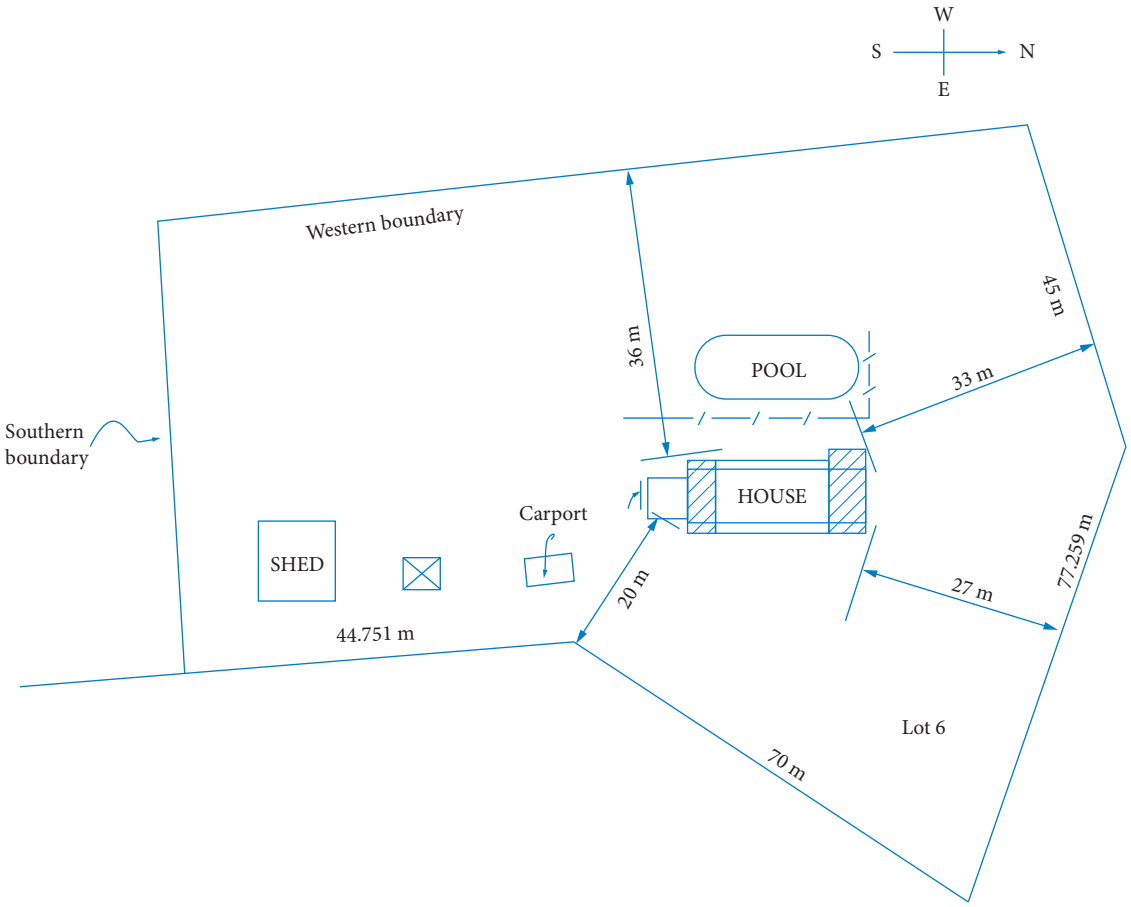


a Use the scale to calculate the length of the road (the circuit outlined in dark blue).

b The suggested time to drive one circuit of this road is $5\frac{1}{2}$ hours. At average speed do drivers need to travel to complete the circuit in $5\frac{1}{2}$ hours? Express your answer correct to the nearest km/h.

c What do you think the surface of the road is like? Give a reason for your answer.

5 **Cadastral maps** show the boundaries of properties. This part of a cadastral map shows the dimensions of a block of land and the buildings on the land.



a Approximately how close to the house is the nearest boundary?

b The scale is 1 : 1000. Calculate the length of the southern and western boundaries.

c The owners are going to replace the fence on the southern and western boundaries. Fencing costs $28/m for materials and labour. Calculate the cost of replacing the fence.

6 The city of Gympie in south-east Queensland is prone to flooding. The map shows the areas affected when the height of the Mary River is 18 m and 23.5 m (the 1-in-50 year flood level) at the Kidd Bridge (not shown but south of the map). The scale is 1 : 2300.



a Which properties in Mary St flood when the Mary River reaches 18 m?

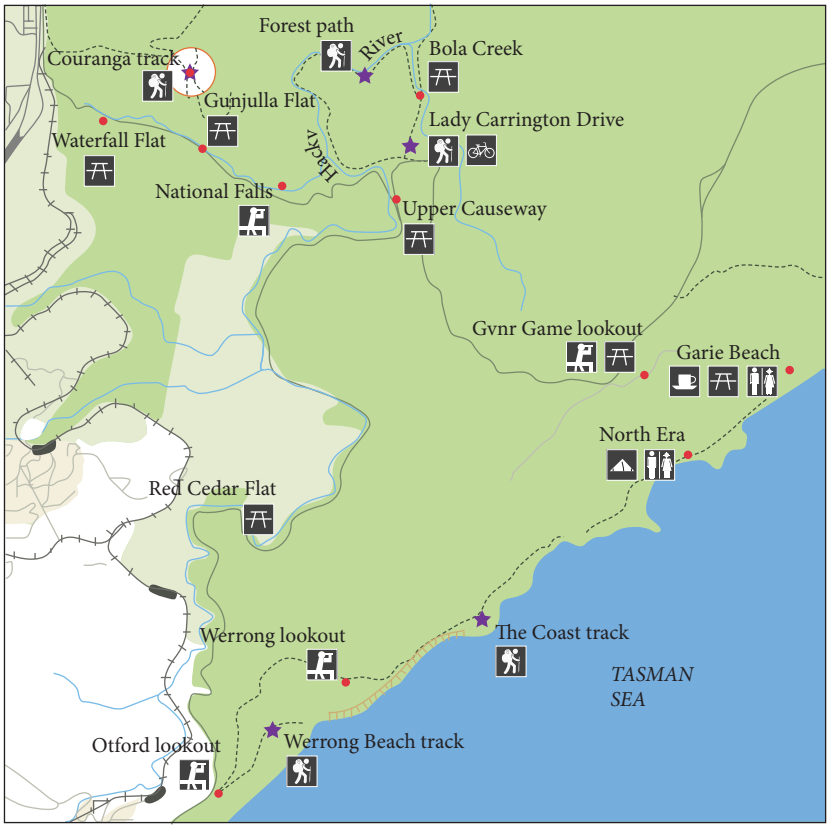
b Calculate correct to the nearest metre the length of Reef St that is under water when the Mary River is at 18 m.

c Calculate the length of Mary St that is under water during a 1-in-50-year flood.

d Estimate the depth of the Mary River when the shop at 187 Mary St floods.

e Rhys is considering buying the hotel at 135 Mary St. What recommendation could you give him with regard to flooding?

7 Jose, Isaac and Chase were hiking along the coastal track in the Royal National Park south of Sydney. They left their bikes at Otford lookout and set out for Garie Beach.



a The map scale is 1 : 87 600. How long is the walk from the Otford lookout to Garie Beach?

b The boys hike at an average speed of 4 km/h. How long should the hike take them?

c When they had been hiking for 2 hours, Chase lost his footing, fell and broke his leg. Isaac phoned emergency services for help. Approximately where on the track should he tell the rescue helicopter they are?

Investigation | A cadastral map of your school

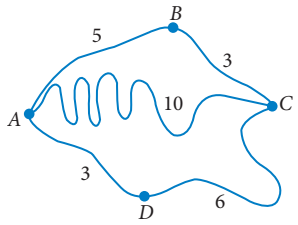
A cadastral map shows information about the boundaries of individual and surrounding blocks of land. In this investigation, you are going to make a cadastral map of your school and surrounding properties. Make the map suitable for display in the school's front office foyer.

On the map you should include a compass rose, a scale, the lengths of all boundaries and the position of buildings.

Start your investigation by downloading a map and a picture of the terrain from Google Earth.

16.5 Distances between places

We can use roughly drawn diagrams called **mud maps** to represent roads. Here is an example of a map of some roads linking towns *A*, *B*, *C* and *D*, with all the measurements written in kilometres.



Map

EXAMPLE 9 Mud maps

a For the mud map above, **describe** 3 different ways to travel from town *A* to town *C* and the length of each route.

b Which route is the shortest?

Steps	Working
a We could travel directly from *A* to *C*, which is 10 km. We could also go via *B* or *D*. We can calculate the distances via *B* or *D* by adding the distances on the roads.	There are 3 routes: $AC = 10$ km $ABC = 5 + 3 = 8$ km $ADC = 3 + 6 = 9$ km
b Compare the 3 distances and determine the shortest route.	$ABC = 8$ km The shortest route from *A* to *C* is via *B*.

EXERCISE 16.5 Distances between places

ANSWERS p. 397

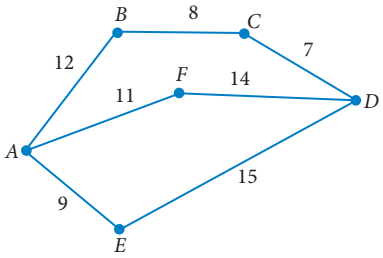
In this exercise, all measurements are in kilometres.

1 EXAMPLE 9

a Describe 3 different routes from *A* to *D*.

b Calculate the length of each route from *A* to *D*.

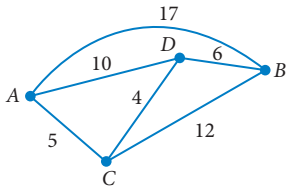
c Which route from *A* to *D* is the shortest?



2 a Describe 3 possible ways to travel from *A* to *B* and the distance involved with each route.

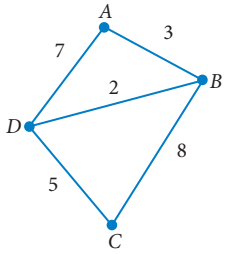
b How long is the route from *A* to *B* via *C* and *D*?

c What is the shortest distance from *A* to *B*?

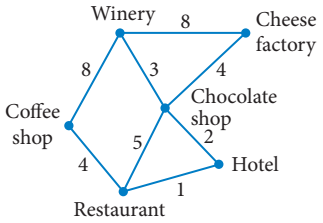


3 a List 4 ways you could travel from *A* to *C*.

b Which one of the 4 ways from *A* to *C* is the longest?



4 Jack is visiting a wine region of the Darling Downs. He sketched a mud map of the places he wants to visit. The numbers are the distances in kilometres.



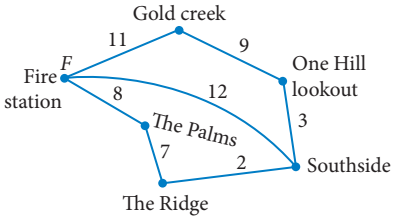
a Jack is at the chocolate shop. What is the shortest way to the restaurant?

b What is the shortest distance from the restaurant to the winery?

c Calculate the shortest distance from the winery to the cheese factory.

5 The local fire station has a mud map of the area to help get fire trucks to locations efficiently.

There are fires at The Ridge and One Hill lookout. Describe the shortest routes for the fire trucks to get to the fires. **PS**





John Eveson/Alamy Stock Photo

6 Use the map of Manly on page 338 to find the shortest way by road from the corner of Victoria Parade and East Esplanade to Manly Oval in Raglan Street. Check your answer using Google Maps.

Investigation | Shortest distance from home

You will need a street map of your local area to complete this investigation.

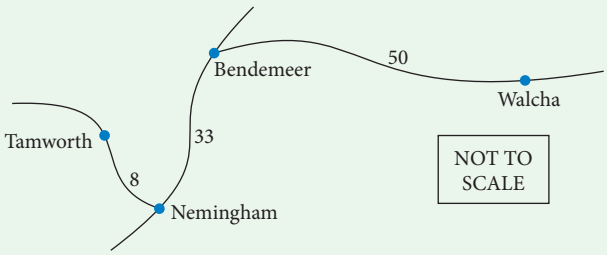
Locate your home and a useful location on the map, for example, hospital, bank, library, police station or pool.

Determine the shortest way to get from your home to the location you selected travelling on roads.
Check your route using Google Maps.

16.6 Regional maps

EXAMPLE 10 Regional maps

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?

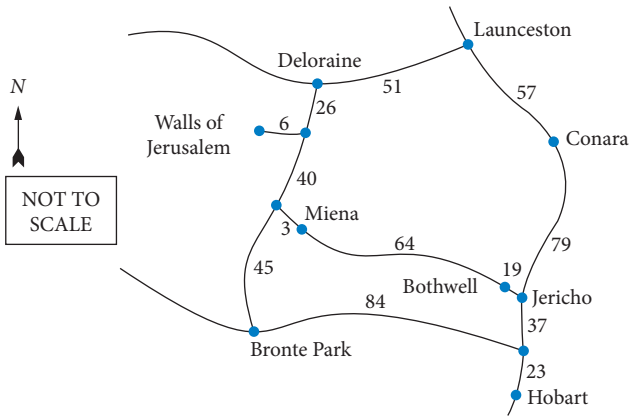


Steps	Working
It is 8 km from Tamworth to Nemingham, then 33 km to Bendemeer and 50 km to Walcha.	total distance = 8 + 33 + 50 = 91 km
Write your answer.	It is 91 km by road from Tamworth to Walcha.

EXERCISE 16.6 Regional maps

ANSWERS p. 398

Use this map from Tasmania to answer questions **1** to **4**. Distances are in kilometres.



1 EXAMPLE 10 Terry drove from Launceston to Bothwell via Jericho. How far did he drive?

2 How far is it from Launceston, via Deloraine, to Miena?

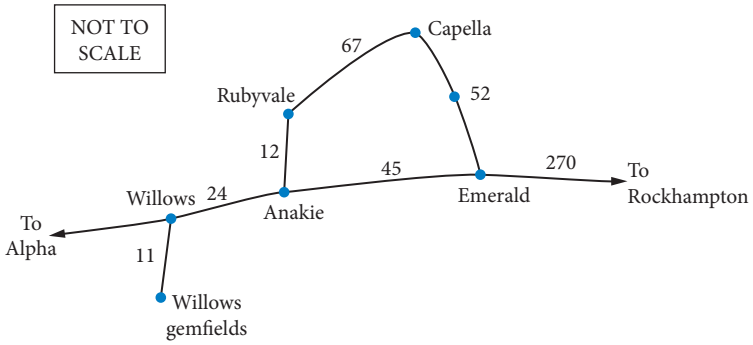
3 Luana drove from her hotel in Miena to see the Walls of Jerusalem. Then she drove back to her hotel for lunch. What distance did she travel on the round trip?

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 Mick left Emerald 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 Mick to drive from Emerald to the Willows gemfields at an average speed of 75 km/h?

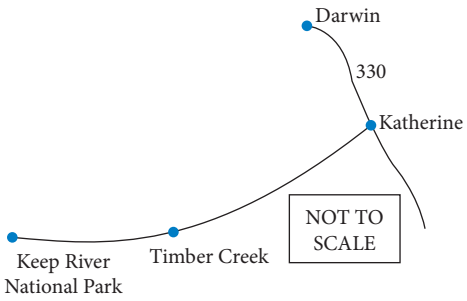
c Sapphire mining is very hard work in the sun. Mike didn't take sufficient water with him and the closest shop that sells water is in Anakie. At 1:10 pm, he left the gemfields to get water. If he averages 70 km/h, what time should he arrive at the shop?

d Mike 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. PS

i Calculate Mike's average speed from the gemfields to Rubyvale.

ii 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 7 3 4 7 5, and when she reached Keep River National Park, it was 7 4 2 6 1.

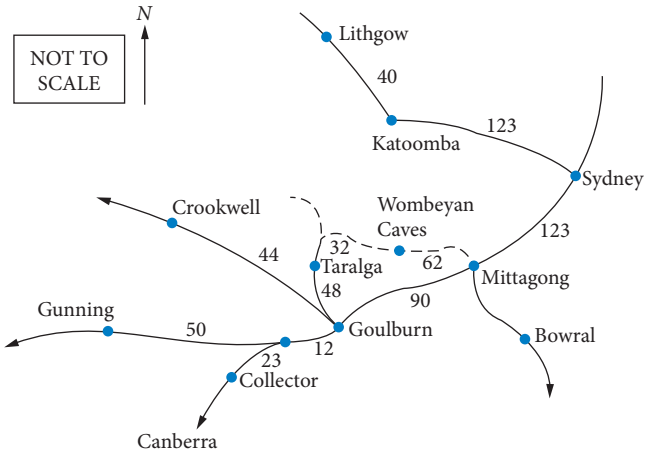
a How far is it from Katherine to Keep River National Park?

b Linda drove at an average speed of 60 km/h. How long did the drive take her?



Blickwinkel/Alamy Stock Photo

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 and 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. Use the accommodation charges shown below to calculate the total accommodation costs for the 4 friends to stay for 2 nights.

Accommodation charges	
Cabin units	$85 per night
On-site caravan	$72 per night
Guest cottage	$124 per night
Caravan park site	$25 per night per site
Camp site	$19 per site per night

9 a Claire and Jimmy went on an afternoon tour of Junction cave. At what time did the tour start?

Cave tours times	
Fig Tree (Self-guided)	9 am to 5 pm
Wollondilly	1:45 pm
Junction	11 am and 2:30 pm
Mulwaree	11:30 am
Kooringa	3:15 pm

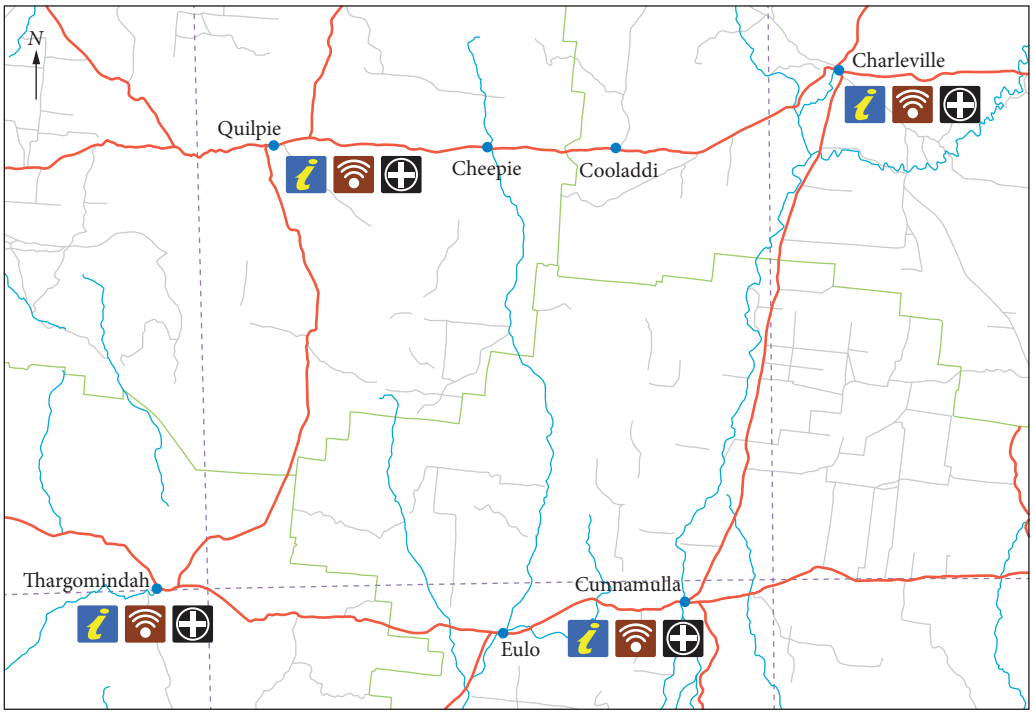
Cave inspection fees			
	Adult	Child	Family
Self guided (Fig Tree)	$15	$7	$35
Guided tour	$18	$9	$40
Two-cave package	$22	$12	$50

b How much did the tour cost?

c Jorja and Gilbert toured both Wollondilly and 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?

Investigation Declan's thermal adventure



Scale 1 : 2 540 000

Declan is in Charleville for a camping holiday and plans to visit some thermal pools in the region. He drives an SUV that uses 15 L of unleaded petrol to travel 100 km. In this region, he will travel at an average speed of 60 km/h. In particular, he wants to visit the thermal pools in Eulo, 67 km west of Cunnamulla, and Quilpie. He has 5 days to complete the trip and return to Charleville.

Your task is to organise Declan's trip and prepare an itinerary that includes:

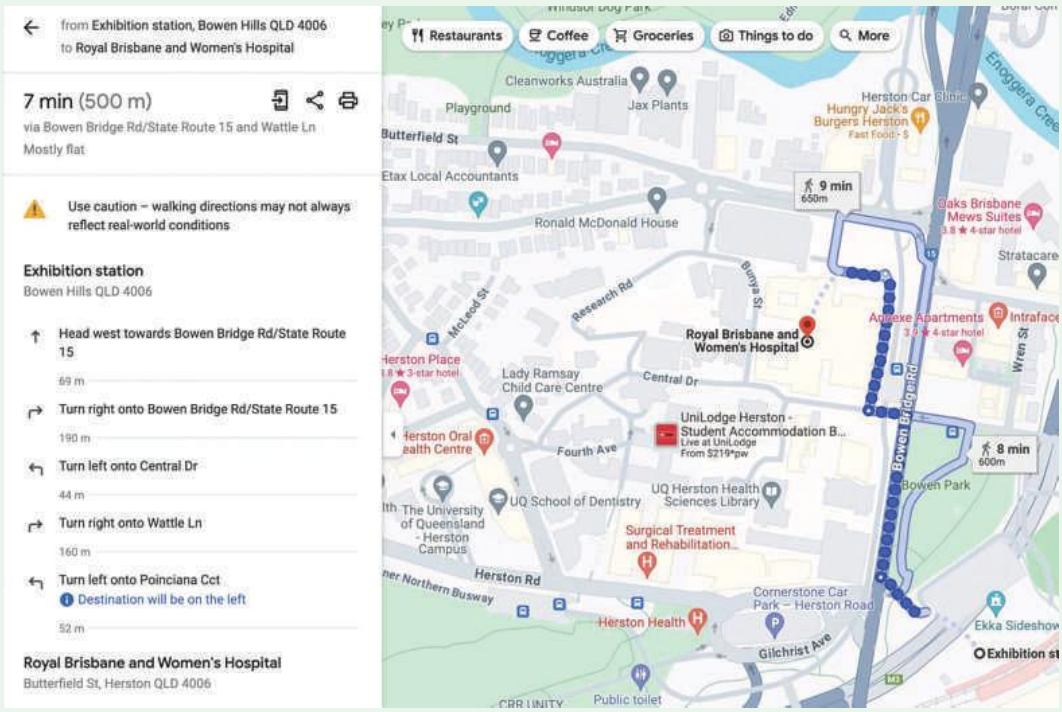
- a map displaying the route he will drive, showing relevant distances
- estimated travel times
- estimated fuel costs
- recommendations for overnight camping sites.

16.7 GPS navigation*

The **global positioning system (GPS)** developed from space-age technology has revolutionised our lives. Twenty-four satellites orbiting Earth can give our location and assist with maps and navigation. Using our mobile phones or car GPS systems, we can easily determine the best route to our destination. Live traffic information and locating such things as petrol stations and restaurants along the way makes travelling easier.

EXAMPLE 11 Using a GPS app

Kirralee has an appointment at the Royal Brisbane and Women's Hospital at 11 am. She is going to catch the train to Exhibition Station, walk to the hospital and have coffee on the way. Kirralee uses Google Maps to find walking directions from the station to the hospital.



Source: Google Maps

a How far is it from the station to the hospital?

b How long will the walk take?

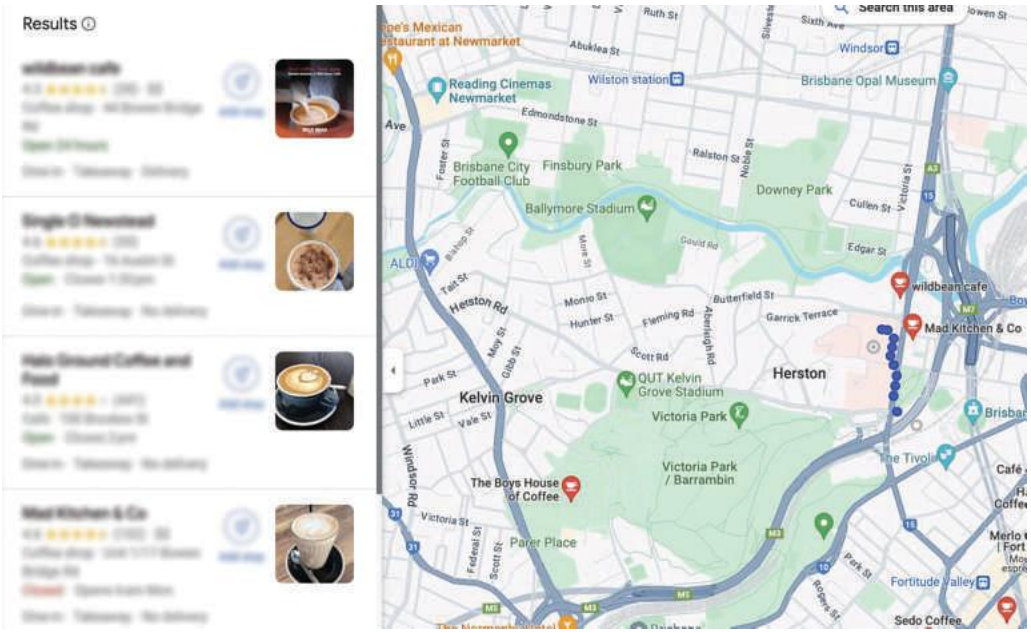
c **Describe** the route of the walk from the station to the hospital.

d Find a convenient café near the station or hospital.

e The train trip from Kirralee's home to Exhibition Station takes 37 minutes and the train arrives on the hour and every 10 minutes after that. She needs to be at the appointment 10 minutes before the scheduled time and she wants to allow 25 minutes for coffee.
At what time should Kirralee catch the train?

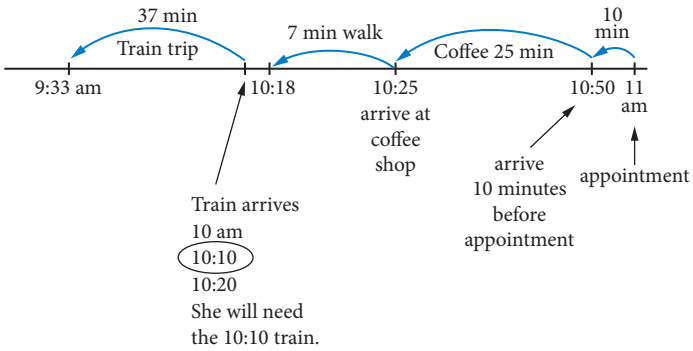
Steps	Working
a Read the distance shown at the top left.	The distance is 500 m.
b Read the trip time at the top left.	The walk will take 7 minutes.
c Read the directions on the left.	Head west towards Bowen Bridge Rd. Turn right onto Bowen Bridge Rd. Turn left onto Central Drive. Turn right onto Wattle Lane. Turn left onto Poinciana Circuit.

d Click on the 'Coffee' tab at the top of the screen.



Either Mad Kitchen & Co or Wildbean Café would be suitable cafes near the hospital.

e Use a timeline.



Kirralee needs to catch the 9:33 am train.

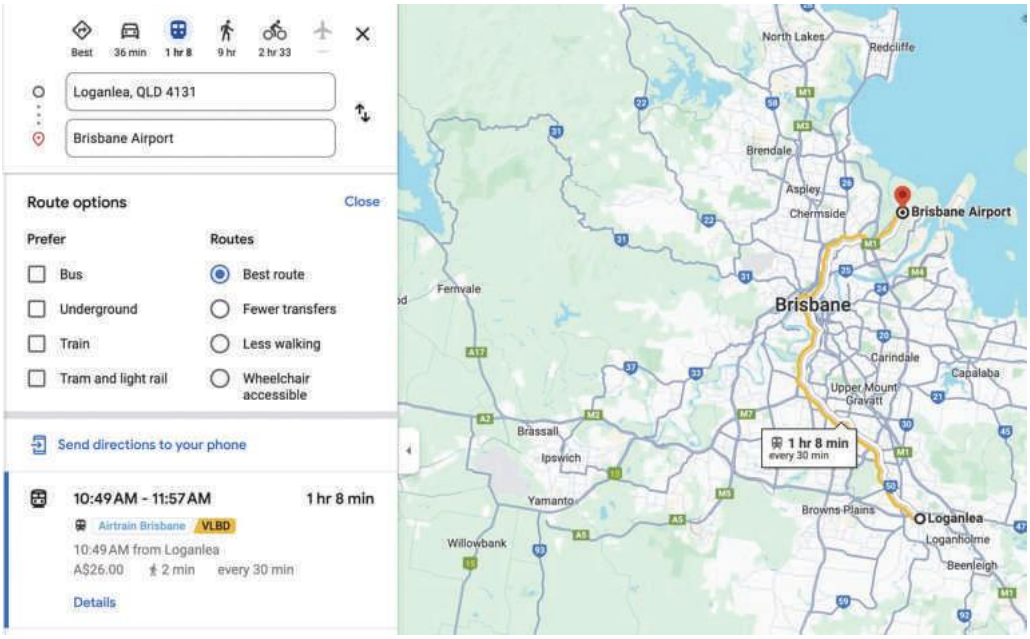
EXERCISE 16.7 GPS navigation*

ANSWERS p. 398

You need a GPS mapping app or website for this exercise.

GPS mapping apps include Google Maps, Where Is and Apple Maps.

1 EXAMPLE 11 Elliot needs to go from Loganlea to Brisbane Airport. Use the Google Maps information to answer the following questions.



Source: Google Maps

a How long will the trip take by car?

b Elliot plans to take the train. How much does the train trip cost?

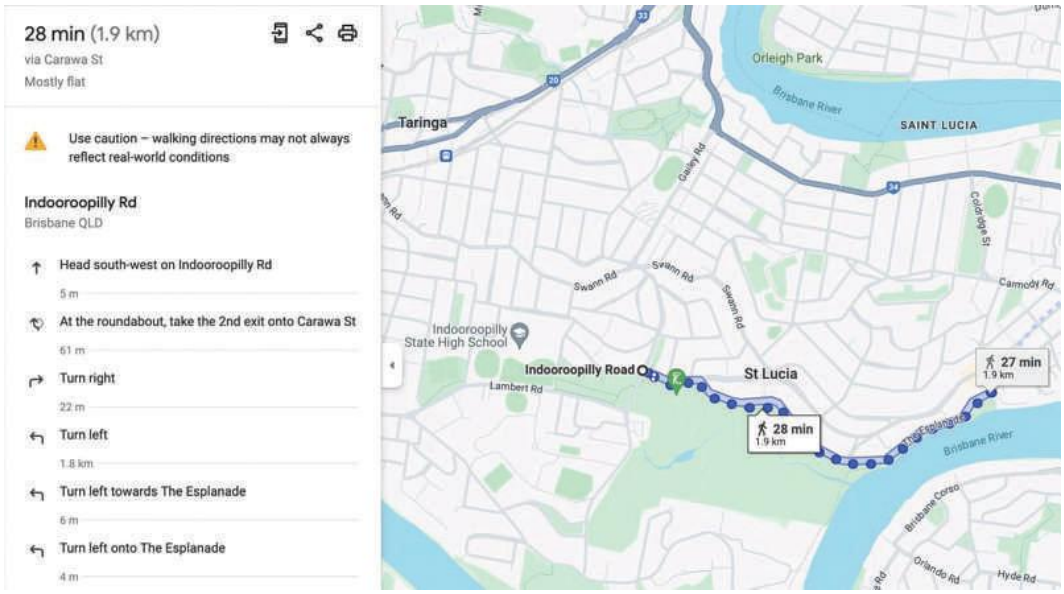
c How long does the train trip take?

d How often does the train leave Loganlea Station?

e If he misses the 10:49 am train, what time is the next train from Loganlea?

f How long will it take Elliot to walk from the airport train station to the international terminal?

2 Sophorn is walking from her house on Indooroopilly Rd to the university on Brisbane River.



a How far is Sophorn's walk to the university?

b How long will the walk take?

c Sophorn needs to attend a lecture that's due to start at 10 am.
What is the latest time she can start walking and be there on time?

d In what compass direction is the start of the walk?

e When she gets to The Esplanade, should Sophorn turn left or right?

f Will Sophorn have to walk up hills on the way?

Use a GPS app or website for the remaining questions.

3 Sam and Zac both live in Camp Hill: Sam at 40 Pampling St and Zac at 23 Pryde St.

a How far is it from Sam's house to Zac's house by car?

b How long does the car trip take?

c How long does it take to walk?

d Use a calculation to show that the app uses a speed of about 4 km/h to calculate the walking time.

4 Lara has arranged to meet friends for coffee at Kirra Beach at 2 pm.

a Write directions for Lara to walk from her accommodation at Eden Tower, Ward St, Coolangatta, to Kirra Beach.

b Is it an easy walk?

c How far is it?

d How long will the walk take?

e What is the latest time Lara can leave Eden Tower to walk to the beach and arrive by 2 pm?

f Suggest a café near Kirra Beach.

5 Nora is taking the bus to go to her great-grandmother's funeral at Our Lady of Perpetual Succour Church, 5 Moorindil St, Tewantin. C

a Nora lives at 21 Lake View Drive, Tewantin. How far is the church from her home?

b How long will it take to get there by public transport?

c Write instructions for her to follow to travel to the church.

d The funeral is at 2 pm. Nora plans to leave home at 1:45 pm. Is this enough time? Justify your answer.

6 Jarrod lives at 62 Macauley Rd, Emerald and drives his daughter Denise to Rockhampton Girls Grammar School in Denham St, Rockhampton.

- **a** How far is it from Emerald to the school?
- **b** How long will the drive take?
- **c** What is the average speed of this trip? Answer to the nearest 10 km/h.
- **d** After he delivers his daughter to school, Jarrod wants to recharge his electric car. Where can he charge the car?
- **e** When is the charging station open?

7 Sarah needs to travel from her home at 40 Arthurs Seat Rd, Red Hill in Victoria 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? Answer to the nearest km/h.
- **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.

8 Jack is going to Japan for a holiday. He'll be leaving from Hughenden and travelling to Cairns International Airport to catch his flight, which departs at 6 pm. C

- **a** How far is it from Hughenden to Cairns Airport?
- **b** How long will it take to get there by car?
- **c** Along what highway will Jack be travelling?
- **d** Jack needs to be at the airport 2 hours before the flight. When is the latest he can leave Hughenden?
- **e** What time do you recommend he leave Hughenden? Justify your answer.
- **f** Jack's car has a fuel consumption of 7 L per 100 km. How much fuel will the car use on the trip to the airport? Answer to the nearest litre.

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 GPS.

Plan trips that can be completed by bus or car. Record the time your app suggests the trips will take.

- Complete the trip by bus, recording the time it took.
- Complete the trip by car 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 Mackay to Longreach. The trip will start at 7:30 am.

To complete this activity, you need access to the internet.

What you have to do

1. Use **Google Maps** to determine the best route from Mackay to Longreach.
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 90 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. List some things that the salesperson should be aware of as they drive this route.

Worksheet
Travel trivia

16.8 Family road trip*

The Wynter family of 2 adults and 3 children is travelling from Brisbane to South Australia for a holiday. They plan to stay in motels, caravan parks and the occasional luxury hotel.

EXERCISE 16.8 Family road trip*

ANSWERS p. 398

1 Buses travel from Brisbane to Adelaide every day. Adelaide's local time is 30 minutes behind Brisbane and the times in the bus timetable are local times.

Location	Arrival time	Departure time
Brisbane (Roma St)		8:00 am
Goondiwindi	12:15 pm	1:00 pm
Dubbo	6:40 pm	7:00 pm
Wilcannia	1:00 am	1:15 am
Cockburn	3:47 am	
Time change		
Burra	7:33 am	8:13 am
Adelaide		

a The family plan to arrive at Roma St bus terminal 30 minutes before the bus is due to leave. What time did they plan to be at Roma St?

b The bus stopped at Goondiwindi for the passengers to have lunch. How long was the lunch stop?

c How long does the bus take to travel from Dubbo to Wilcannia?

d Calculate the average speed of the bus between Dubbo and Wilcannia, a trip of 557 km. Answer correct to the nearest km/h.

e Cockburn is on the NSW/SA border and the bus doesn't stop in Cockburn. What is the South Australian local time as the bus travels through Cockburn?

f The bus stops in Burra for the passengers to have breakfast. The family ordered breakfast and it arrived at 7:55 am. How long do they have to finish it?

g The trip from Burra to Adelaide takes 2 hours and 7 minutes. At what time does the bus arrive in Adelaide?

h How long does it take to travel from Brisbane to Adelaide on the bus?

i The adult bus fare is $210 each way and children pay 70% of the adult fare. How much did it cost the Wynter family of 2 adults and 3 children to travel from Brisbane to Adelaide on the bus?

j The cheapest budget airline tickets from Brisbane to Adelaide are $170 each and the flight takes approximately 8 hours, including a stopover. How much more does it cost the family to travel by bus to Adelaide compared to flying? Suggest some reasons why the family might have decided to go by bus. PS

2 From Adelaide, the family visits Kangaroo Island in South Australia. They stay here for 2 days and enjoy watching its friendly wildlife.

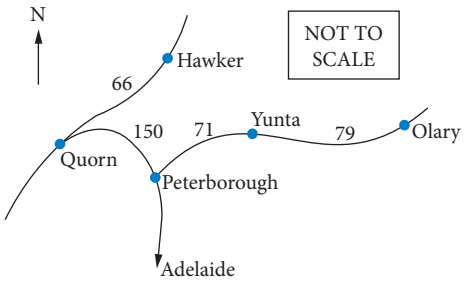
Kangaroo Island Tours 2 days/night $170 per person	or	Organise the trip yourself Return bus trip from Adelaide $180 family ticket Ferry trip $40 each way/person Kangaroo Island motel (price per night) $130 $30 per child

How much does the family save by using Kangaroo Island Tours instead of organising the trip themselves?

3 The Wynter family return to Adelaide and hire an SUV to travel north to Peterborough, and then Quorn.

a What compass direction is it from Peterborough to Quorn?

b They leave Peterborough at 11 am and arrive at Quorn at 1 pm. Calculate their average speed.



4 The Wynters stay at the Quorn Caravan Park.

	Tariff/night	
Cabin (acc. up to 6)	$75	$10
On-site van (acc. up to 4)	$55	$5

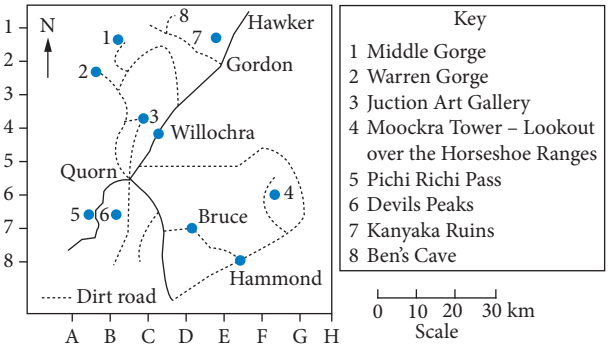
a How much does it cost the family to stay in the cabin for 2 nights?

b How much more would it cost them to use the on-site vans for 2 nights?

c Why would it cost more for the Wynters to stay in the on-site vans rather than the cabin?

d Is it always more expensive to stay in vans than in cabins? Explain your answer.

5 The region around Quorn is shown on this map.



a What scenic attraction is at F6?

b What is the name of the town at D7?

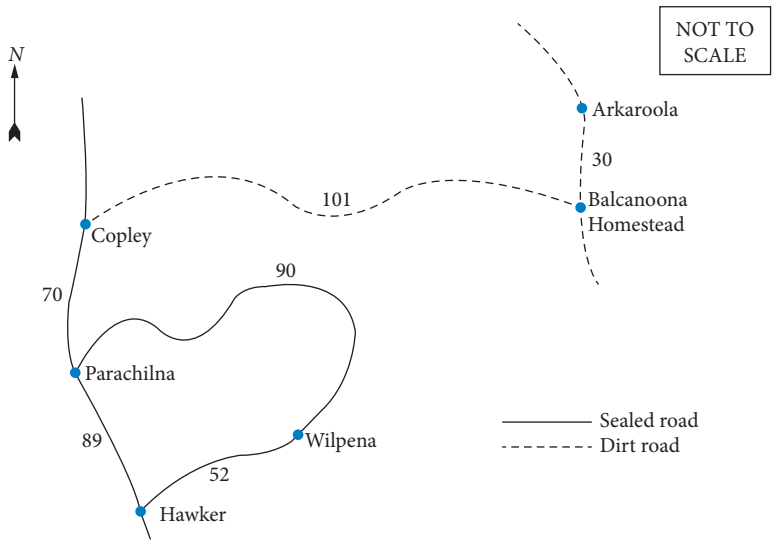
c The children want to see some kangaroos. The park manager gives them these directions to a place frequented by kangaroos.

'Travel northeast from Quorn for 24 km and turn left onto a dirt track. Travel another 24 km, then take the track to the right.'

Where do they go to see the kangaroos?

d Zoe Wynter wants to see the Horseshoe Ranges. She asks for directions to get there from Quorn. What could the directions be?

6 The next part of the road trip involves travel from Hawker to Arkaroola.



a How far is it from Hawker to Arkaroola via the shortest route?

b The recommended average speed from Hawker to Copley is 80 km/h and from Copley to Arkaroola is 40 km/h. The Wynters follow the recommended average speeds. How long does it take them to drive from Hawker to Arkaroola?

7 At Arkaroola, the Wynters have a choice of 2 luxury lodges: Greenwood Lodge and Mawson Lodge.

Greenwood Lodge	Room rates per night
Basic charge	$199 (per double or single)
Additional adult	$36 (each)
Children aged 2 to 12 (sharing with adults)	$30 (each)
Family room size	1 double bed and 1 single bed

Mawson Lodge	Room rates per night
Basic charge	$219 (per double or single)
Additional adult	$36 (each)
Children aged 2 to 12 (sharing with adults)	$30 (each)
Family room size	1 double bed and 3 single beds

The Wynter children are aged 13, 11 and 8.

a Explain why Mawson Lodge is the more suitable accommodation for the family.

b Calculate the cost of one night's accommodation for the family in Mawson Lodge.

8 The family flies from Arkaroola to Adelaide. The flight takes 2 hours and their plane back to Brisbane leaves Adelaide at 1700. Flights leave Arkaroola at 0600, 0715, 0900, 1345, 1445 and 1600.

a What flight do you recommend they catch from Arkaroola to Adelaide to be on time for their flight home to Brisbane? Give a reason for your answer.

b The flight from Adelaide to Brisbane takes 2 hours and 40 minutes. Calculate the local time when the flight arrives in Brisbane.

Investigation | Where is Arkaroola?

What is there to see in Arkaroola? Use the internet to find out some interesting information about Arkaroola and prepare a travel poster to advertise the best features of this location.



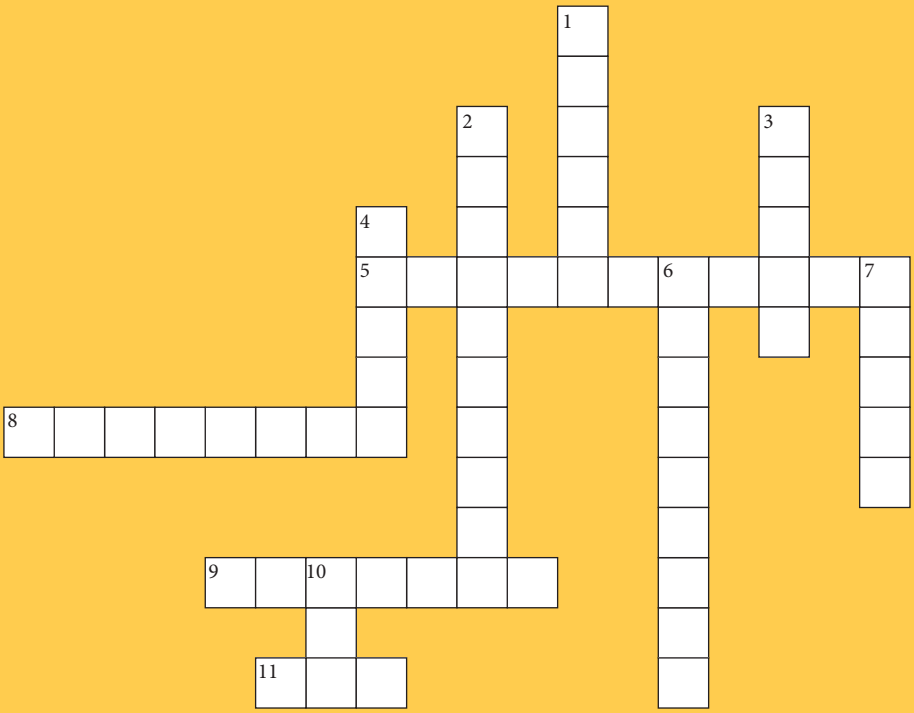
David Foster/Alamy Stock Photo

Keyword activity

TRAVEL CROSSWORD

ANSWERS p. 398

Copy or download 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 $s = \frac{d}{t}$.

9 A type of direction; for example, north, south, east or west.

11 An electronic device that uses satellites to show you your location.

Down

1 What 's' stands for in the speed units m/s.

2 Speed is often measured in _____ per hour.

3 On a map, this is usually the compass 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.

Puzzle
Travel crossword

Solution to the chapter problem

Problem

Nina and Mitch are planning a 9 km bushwalk. They plan to walk at a speed of 2.5 km/h over the steep and bushy land. They will leave the car park at 10 am and for safety they will log their walk with the park ranger. At what time should Nina and Mitch tell the park ranger to expect them back at the car park?

Solution

STAGE 1: WHAT IS THE PROBLEM? WHAT DO WE KNOW?	
 WHAT?	To work out when the bushwalk will finish. Leaving 10 am Walking at 2.5 km/h 9 km walk
STAGE 2: SOLVE THE PROBLEM	
 SOLVE	Use a formula to calculate time taken. $t = \frac{d}{s}$ $= \frac{9}{2.5}$ $= 3.6$ hours $= 3$ hours 36 minutes Nina and Mitch will start the walk at 10 am and finish 3 h 36 min later. They will finish around 1:36 pm.
STAGE 3: CHECK THE SOLUTION	
 CHECK	Walking 2.5 km/h means covering 5 km in 2 hours and 10 km in 4 hours, so a 9 km walk in 3.6 hours sounds reasonable. The solution sounds correct.
STAGE 4: PRESENT THE SOLUTION	
 PRESENT	Nina and Mitch should tell the park ranger to expect them to return before 2 pm.

16 Test yourself

Going places

ANSWERS p. 398

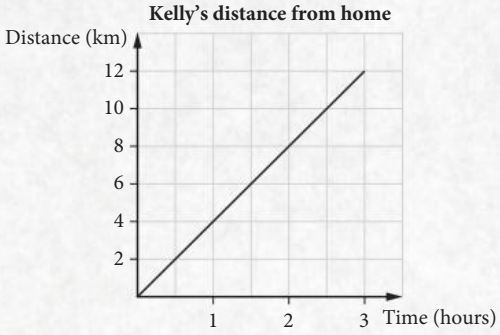
1 EXERCISE 16.1 How long will it take Bianca to ride 24 km at an average speed of 8 km/h?

2 EXERCISE 16.1 Kane is driving at an average speed of 60 km/h. How far will he drive in 15 minutes?

3 EXERCISE 16.1 Ava travelled 900 m in 45 seconds. Calculate her average speed in m/s.

4 EXERCISE 16.1 Convert a speed of 90 km/h to a speed in m/s.

5 EXERCISE 16.1 The graph shows the distance that Kelly was from home.
What was Kelly's average speed?



6 EXERCISE 16.1 Gurinder is riding his bike. For the first 3 hours, he rode at 12 km/h, and for the last 2 hours he rode at 8 km/h.

a Explain why the calculation $(12 + 8) \div 2$ doesn't give Gurinder's average speed for the whole 5-hour trip.

b How far did Gurinder ride during the 5-hour trip?

c Calculate his average speed.

Use Map 17 from Exercise 16.3 on page 341 to answer questions **7**, **8** and **9**.

7 EXERCISE 16.3 What village is located at A11?

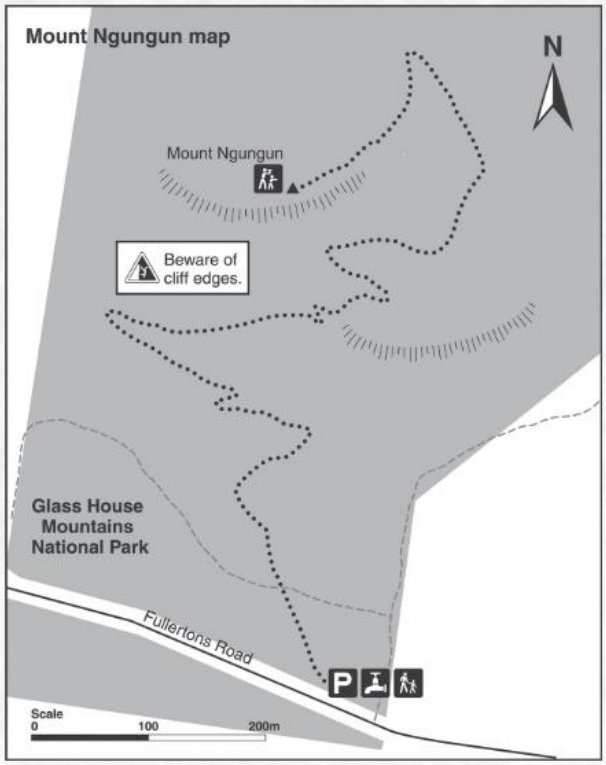
8 EXERCISE 16.3 Approximately how far is it from the traffic lights in A13 along Binstead Way to the lights at the motorway off-ramp in E13?

9 EXERCISE 16.3 Describe a route you could follow to walk from Cannington Place (E9) to Wilmington Ct (F7).

9780170484589

10 EXERCISES 16.2, 16.4 The map shows the Mount Ngungun walking trail in the Glasshouse Mountains.

Chris is going to walk from the cark park at P to the top of Mount Ngungun.



Source: Mount Ngungun, Glass House Mountains Walking Tracks Info and maps. The image is reproduced with the permission of the Department of National Parks, Sport and Racing, Queensland Government. © State of Queensland.

a In what compass direction will Chris travel for the first part of the walk?

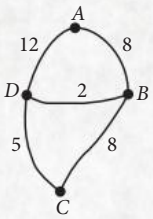
b Use the scale to calculate the length of the walk.

c The walk is quite challenging and Chris will only be able to walk at an average speed of 24 m/min. Approximately how long will the walk to the top take?

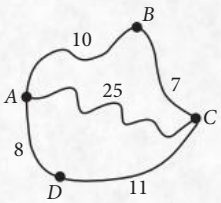
d Chris plans to leave the car park at 9 am and walk to the top, spend 40 minutes at the top and then walk back to the car park. At approximately what time will he be back at the car park?

11 EXERCISE 16.5 Find the shortest distance from A to C in each diagram.

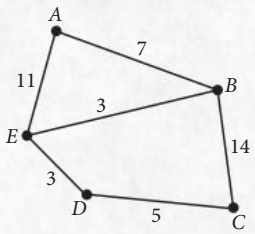
a



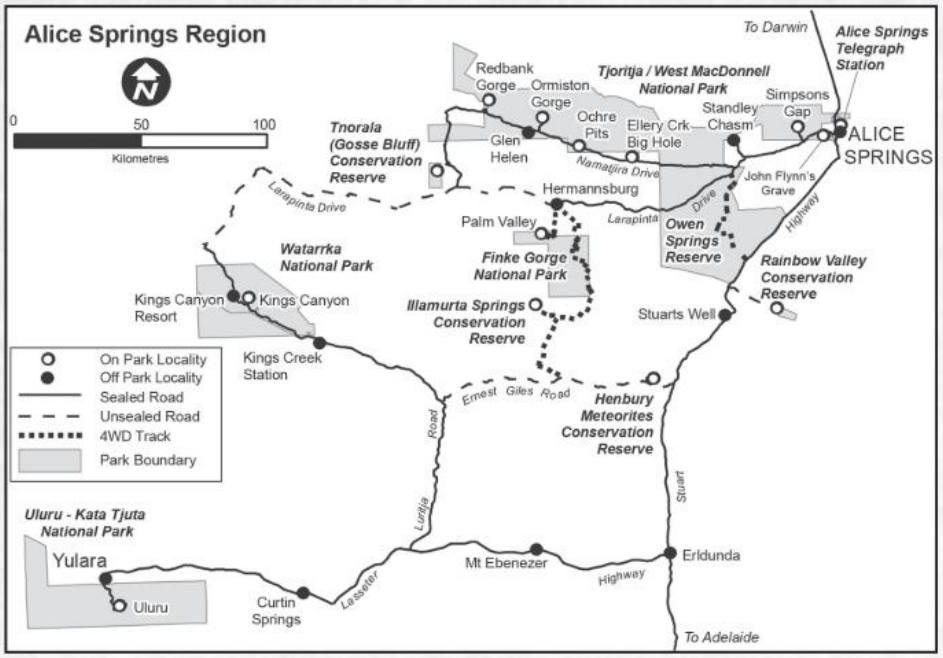
b



12 EXERCISE 16.5 Calculate the shortest distance from A to C on this mud map.



13 EXERCISES 16.2, 16.6 The map shows the central region of the Northern Territory, which contains Uluru.



Source: 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?

14 EXERCISE 16.7 Use a GPS app or website to answer this question.

Molly is in Stanthorpe for her best friend's wedding. She is staying at Stanthorpe Villa, 8 Brunckhorst Ave and is being driven to the wedding at Stanthorpe Baptist Church in Railway St.

a How much further is it from the villa to the church via National Highway 15 (New England Highway) than via Hale Haven Drive and Sugarloaf Rd?

b How long will it take to drive from the villa to the church?

c Calculate the speed the app uses to calculate the trip via the shorter route. Answer to the nearest km/h.

Practice set 4

ANSWERS p. 399

A mapping app is required for question **10** of Section B. Refer to maps in Chapter 16 where indicated.

Section A Multiple choice questions

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

1 EXERCISE 14.1 Joshua creates 3 graphs showing the information he found in his survey. What step is this in the statistical investigation process?

A collecting data **B** organising data **C** representing data **D** analysing data

2 EXERCISE 15.1 Miriam is surveying students about takeaway food. She writes the question 'How much do you like eating pizza?' This is *not* a good question because

A the question doesn't give answer options to make answering and analysing easy.

B the meaning of the question is not clear.

C the question is biased.

D the question doesn't respect the privacy of the person answering.

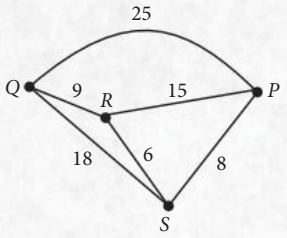
3 EXERCISE 16.5 What is the shortest path from P to Q?

A P to Q

B P to S to Q

C P to R to Q

D P to S to R to Q



4 EXERCISE 14.2 For which situation would you use a **census** rather than a sample to investigate?

A Testing coffee for the best taste

B Finding the number of migrants from Japan in Australia

C Opinions on road safety in Queensland

D People's views on whether Australia should become a republic

5 EXERCISE 15.3 Which of the following methods would give an unbiased sample?

A Asking people lining up to attend a cricket match for their favourite sport

B Selecting every 10th person on an alphabetical list of voters to ask whether they will vote Liberal

C Standing on a street corner at 11 am and asking passersby what public transport they use.

D Surveying your parents and their friends on who they will vote for in the next election

6 EXERCISE 16.4 A map has a scale of 1 : 50 000. What distance is represented by 64 mm on the map?

A 0.32 km **B** 3.2 km **C** 32 km **D** 320 km

7 EXERCISE 14.3 A radio station asks listeners to complete an online survey about their favourite music. What type of sample is this?

A random **B** self-selected **C** stratified **D** systematic

8 EXERCISE 16.2 A boat travels 24 km in 90 minutes. What is its average speed?

A 12 km/h **B** 16 km/h **C** 18 km/h **D** 36 km/h

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Section B Short answer questions

1 EXERCISE 14.3 How often is the Australian Census conducted and when will the next one be held?

2 EXERCISE 16.3 Use Map 17 in Exercise 16.3, on page 341, to answer these questions.

a What feature is at A20?

b What are the position coordinates of Careel Reserve?

3 EXERCISE 15.1 Jim's survey asks, 'How often do you go out for dinner?' Suggest a series of tick boxes that Jim could provide with the question for people to record their answers.

4 EXERCISE 14.3 Melinda wants to survey student views on the school uniform and she uses a self-selected sample. Why could such a sample be biased?

5 EXERCISE 16.1 Tyrone walks to school each day. It takes him 20 minutes to walk the 1500 m to school. Find his walking speed in

a metres per minute **b** kilometres per hour.

6 EXERCISE 15.2 Yasmin's survey included the question:

Rate your meal at the fabulous Diggies' Steak House:

Great Yummy Quite nice

a In what way is this question biased?

b Rewrite it so it is not biased.

7 EXERCISE 16.2 Use the map of Tasmania in Exercise 16.2, question **1,** on page 336 to find the compass direction from:

a Miena to Bothwell

b Bruny Island to Hobart

c Dover to Strahan.

8 EXERCISE 15.3 Henri stands near the base of the Brisbane Wheel and asks every 15th person who walks past to complete a short questionnaire about Queensland theme parks.

a In what way is this sample biased?

b How could you ensure that an accurate sample of all Queenslanders is found?

9 EXERCISE 14.4 Melinda decides to use a stratified sample of 10% of students to survey their views on school uniform. She has the following data from the school office.

Total students	840
Male	390
Female	450

Year 7	165
Year 8	128
Year 9	171

Year 10	155
Year 11	127
Year 12	94

a How many students should complete the survey?

b How many female students should be part of the survey?

c How many Year 8 students will be surveyed?

10 EXERCISE 16.7 Dane is travelling from regional Queensland to visit relatives in Thallon St, Rochedale South, in Brisbane. He will be arriving at Brisbane Airport where he will either take public transport or use a taxi.

Use a mapping app to answer the following questions.

a How long does a public transport trip from the airport to Rochedale South take?

b Describe a possible route from the airport to Thallon St in Rochedale South by public transport.

c What walking speed is required to complete the walk from Rochedale Rd to Thallon St?

d Describe 3 routes Dane could follow if he decides to hire a car and drive to Thallon St.

e Approximately how far is the trip by car?

f If Dane picks up a car from the airport at 2:45 pm, at what time can he expect to arrive at Thallon St?

Answers

CHAPTER 1

EXERCISE 1.1

1 **a** 14 **b** 16 **c** 20 **d** 33

2 **a** 16 **b** 18 **c** 20 **d** 28
e 44 **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 1.2

1 **a** 46 **b** 90

2 180 (3 × triple 20)

3 Many answers are possible, e.g. 20 + 10 + 7 or 13 + 17 + 7.

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

10 160; explanations will vary.

11 **a** 4 **b** Renata on turn 2
c 58 on turn 3 **d** 2
e 2 throws for combined 10, then double
f 29 is an odd number (no number on the board doubles to make 29)
g Teacher to check

EXERCISE 1.3

1 Brett

2 –7

3 **a** 70 strokes **b** 5 strokes

4 **a** The temperature is 10° 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, e.g. batter gets out twice and scores 0 on the other 2 balls.

EXERCISE 1.4

1 **a** false, $4 + 2 \times 3 = 10$ **b** true
c true **d** true
e false, $2 \times 4^2 = 2 \times 16 = 32$
f false, $48 \div 4 \times 3 = 12 \times 3 = 36$
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

3 **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** $(28 - 4 \times 5) \times 2 = 16$

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 17 points

6 **a** She calculated from left to right instead of using BIDMAS.
b Explain the order of operations.
c $(48 - 8) \times 3$

EXERCISE 1.5

1 $6870

2 $47 400

3 $126

4 **a** $1320 **b** $68 640

5 $2.20

6 4.5 hours

7 **a** 9 h 45 min **b** 113 h 45 min

8 12 minutes

9 Rockets by 2

10 Neither team is in front. The score is 110 each.

11 $1060.50

EXERCISE 1.6

1 B **2** B **3** C

4 B **5** B

6 **a** 1600 m **b** 4

7 $18

8 **a** $34 **b** yes **c** yes

9 **a** Paige knits approximately 2 rows per minute.
b approximately 25 minutes

EXERCISE 1.7

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, e.g. 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 198.9c is close to $2

b $160 **c** $157.75 **d** $2.25

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 1.8

1 **a** 1600 envelopes **b** 3 boxes

c 200, 400, 600, 800 **d** 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.

6 154

7 **a** 17, 16, 17 **b** 104, 103, 103

c 325, 324, 325 **d** 73, 72, 72

8 18.6

EXERCISE 1.9

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 overs **b** 18 overs and 3 balls

c Teacher to discuss

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

1 **a** 9 **b** 13 **c** 22 **d** 23

2 **a** 34 **b** 84

3 Max 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 $3.20

8 **a** 15 **b** 16.8

9 **a** 28 kg **b** 135 m **c** 5 mm

10 15

11 about 141

CHAPTER 2

EXERCISE 2.1

1 **a** $33 **b** 84 kg

c 252 cm **d** $307.50

e 216 marks **f** 595 000 people

g 152.29 kg **h** 5 m

i 294 students **j** $312.70

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** $2437.50

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 2.2

1 **a** 80% **b** 55%

c 80% **d** 88.75%

2 **a** 87.5% **b** no

3 16.4%

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 2.3

1 **a** 152 kg **b** $2650

c 157.5 m **d** 13.3 L

2 $9 **3** $682

4 $35.37 **5** $234

6 $26 950

7 **a** $940 800 **b** $1 580 800
8 24 hectares **9** $2041.20
10 $184 **11** $1126.65
12 **a** $516.25 **b** $567.88
c He would probably round to the nearest dollar.

EXERCISE 2.4

1 **a** $64.50 **b** 1440 L
c 105.05 kg **d** 714 students
e 7.2 hours **f** 3 weeks
2 $247.50 **3** 31 141
4 $679.15 **5** 1438
6 **a** $427.50 **b** $877.50
7 813 students
8 **a** $39.57 **b** $1939.13
9 $172.01 **10** $27 993 **11** $1032
12 **a** **i** $670 **ii** $549.40
b $494.46

EXERCISE 2.5

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** 11.8%
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** 12%
9 **a** $315 **b** $324 **c** profit, 2.9%
10 45.8%

EXERCISE 2.6

1 80% **2** 38 385
3 **a** 19.7% **b** 22.4 g
4 $16 475 **5** $11 200 **6** 7.6%
7 $703.80 **8** 69.02 g **9** $754.40
10 $801 850 **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

TEST YOURSELF 2

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

CHAPTER 3

EXERCISE 3.1

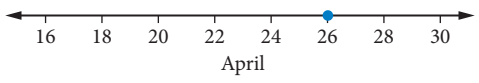
1 $21 is too small. She will earn 18 + 18 + 18, which is more than $21.
2 After he has paid for the t-shirt he will have less on his credit card, not more.
3 65 minutes is more than an hour. If she catches the 8 am bus, she will get to work after 9 am.
4 Stuart spends less than an hour at the gym each day. The answer should be less than 5.
5 $65 is too much. Two 500 g bags make 1 kg. One bag costs less than $20. Two bags will cost less than $40.
6 The answer should be in litres, not km.
7 The answer is too much. Interest for each year is less than the amount Dimitri has in his account.
8 10 mm fit inside each cm. There should be a lot more mm than the number of cm.
9 Wrong: the answer should be more than $135.
10 Could be right.
11 Wrong: 550 is more than half of 800. The answer should be more than 50%.
12 Could be right. The answer should be a bit more than 32c.
13 Wrong: her profit was $5, which is less than her cost. The profit is less than 100%.
14 Could be right. The answer should be a bit less than $450 000.

EXERCISE 3.2

1 **a** How many days without rain did Danica have in Fiji?
b It rained on 25% of 12 days.
2 How much did Mark's car cost? The price is 5% more than $36 000.
3 How much will Charlotte have to pay? The bill is 5% less than $72.
4 What was the percentage increase? Price went up from $50 to $54.
5 What dates are required for Grandma's check-ups? 12 March and 8 days, 6 weeks
6 Does 1 bottle hold enough? 8 mL, 3 times/day, 5 days.

EXERCISE 3.3

1 **a**



b 18th and 24th
c draw a diagram; work backwards
2 **a** 18 children, $158
b 15 children, 215: 4 adults and 16 children is correct
c guess, check and improve

3 **a** 16

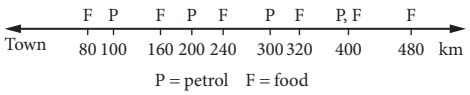
Day	1	2	3	4	5
Number of treats	32	16	8	4	2

b total number = 62 **c** make a table or list

4 **a** 12 m, multiply **b** 187.425 km

c solve a simpler problem; draw a diagram

5 **a**



b 400 km **c** draw a diagram

6 **a** $460 000 **b** $10 000, $11 500, $21 500

c break it into smaller pieces

EXERCISE 3.4

1 share, divide
2 per, multiply
3 deducts, subtract
4 how many more, subtract
5 per, multiply
6 reduce, subtract
7 total, add
8 at this rate, divide
9 groups of, multiply
10 shared equally, multiply
11 doubled, divide by 2
12 discount, addition

Each activity in questions **10** to **12** has happened already and we're working backwards.

13 Answers from Exercise 3.2:

1 percentage of, multiply
2 percentage, multiply and increase, add
3 percentage, multiply and discount, subtract
4 increased, subtract
5 no word clues
6 per day, multiply

EXERCISE 3.5

Part A

1 The amount of concentrate and of paddock grass required each day. We know

- the horse weighs 500 kg
- a horse needs 2% of its weight in food each day
- the horse requires 70% of its food to be concentrate and 30% to be paddock grass

2 2% of → multiply
70% of → multiply
30% of → multiply

3 $0.02 \times 500 = 10$ kg
0.70×10
0.30×10

4 7 kg concentrate, 3 kg paddock grass

5 Correct, mostly concentrate and $7 + 3 = 10$.

6 Saskia should give her horse 7 kg of concentrated food per day and allow the horse to eat 3 kg of paddock grass each day.

Part B

1 There were 9 fine days.
2 The new price of the car is $37 800.
3 Charlotte will have to pay $68.40.
4 The store owner increased prices by 8%.
5 Grandma's first appointment is on March 20 and her second is on April 23.
6 Yes, there is exactly the required amount in the bottle.

TEST YOURSELF 3

1 **a** Incorrect, it's not enough. The cost is about $9 \times \$50 = \$450$.

b Incorrect, the price including GST has to be more than the price without GST.

c Incorrect, it's too much. She will save a small part of $380.

d Could be correct.

2 **a** How much wire will be left?

b The roll is 20 m long and she will use $8 + 3.6$ m.

3 **a** The bus leaves on the hour. The trip takes 1 h 20 min. It takes 30 min to get to the bus. You have to arrive before 3:45 pm.

b What's the latest time you can leave home and get to the game before it starts?

4 **a** share, divide **b** cheaper, subtract
c per, multiply **d** discount, subtract

5 **a** 12 **b** 2 pm

CHAPTER 4

EXERCISE 4.1

1 **a** 50 km/h **b** 25 words/min
c 50 L/h **d** $17.50/kg
e 7.27 m/s **f** $26/h
g 250 g/L **h** 600 revs/min

2 18 L/m^2

3 1350 L/h

4 **a** 40 L/container **b** 4 L/day
c $5\frac{1}{3}$ g/cm^3 **d** $3.20/bar
e 35 mm/day **f** 14.5 km/L
g $22.40/m **h** 256 vibrations/s
i 40 sheep/ha **j** $2.10/L

5 9 m^2/L

6 $120/day

7 **a** $8.50/kg **b** $15.90/kg **c** $2.85/kg
d 65c/roll **e** $3.35/bottle

8 Teacher to check

EXERCISE 4.2

1 **a** 5.6 m/s **b** 13.9 m/s
c 22.2 m/s **d** 30.6 m/s

2 **a** 4.8 km/h **b** 1.3 m/s

3 **a** 45 km/h **b** 144 km/h **c** 3.5 km/h

4 40 kg/ha

5 1.8 L/h

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6 **a** 1.2 g/mm **b** 1.2 t/km
c the same **d** 12 g/cm
7 **a** 3500 L/h **b** 58.3 L/min **c** 1.0 L/s
8 **a** $4.80/L **b** 0.48c/mL
9 **a** 10.4 m/s **b** 37.44 km/h
10 garden pots (76 mL/m²)

EXERCISE 4.3

1 **a** $3.60 **b** $4.75 **c** $4.15
2 **a** 50 mL: 92c/10 mL; 80 mL: 89c/10 mL
b 80 mL
3 **a** 65c and 64c
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 $4.38
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 $13 per L.

EXERCISE 4.4

1 **a** 112 **b** 196 **c** 336
2 $394
3 **a** 3 h **b** 1.5 h
c 4.8 h or 4 h 48 min
4 6.25 kg
5 **a** 720 kg **b** 15 trees
6 **a** 5460 km
b **i** 2.0 h **ii** 3.1 h
iii 4.1 h **iv** 15.2 h
7 **a** 960 **b** 270 **c** 25 m² **d** 95 m²
8 768 kg
9 **a** 750 mL **b** 1500 mL **c** 1.5 L
d 36 L **e** 40 min **f** 40 h
10 **a** $8000 **b** 35 weeks **c** 3 weeks
11 **a** 18 h **b** 35 h **c** 24 h
12 **a** 21.6 m **b** $486 **c** 10 m
d 5 windows
13 **a** 504 L **b** $1134 **c** $2232 **d** 15 h

EXERCISE 4.5

1 **a** 50.15 L **b** $95.29
2 13.9 L/100 km
3 820 km
4 9.5 L/100 km
5 **a** 10.1 L/100 km **b** 8.8 L/100 km
c 8.5 L/100 km **d** 7.3 L/100 km
e 7.8 L/100 km
6 800 km
7 **a** 7.15 L **b** $13.30
8 **a** 47 L **b** $110.92
9 **a** They both use 1.8 L to complete the job.
b Answers may vary. Josh could use either as they have the same fuel usage: There will be less noise pollution with the ride-on as it is quicker; he would get more exercise with the push mower.
10 **a** 0.4 L/h **b** 3.2 L **c** 7.5 h

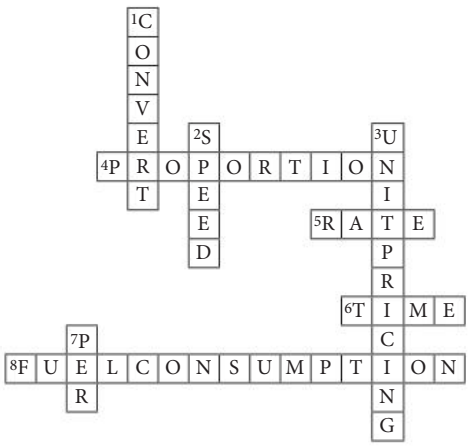
EXERCISE 4.6

1 **a** $C = kL$ **b** 1.8 **c** $C = 1.8L$ **d** $135
2 **a** 11 kg **b** $M = kE$ **c** $k = \frac{1}{6}$
d $M = \frac{1}{6}E$ **e** 14 kg **f** 264 kg
3 **a** $205.80 **b** $k = 29.4$ **c** pay/h
d $1087.80 **e** 17 hours
4 **a** Teacher to check. Answers may vary; for example, as the charge time doubles, the distance travelled doubles.
b 15
c the distance travelled in km for each hour of charging
d 37.8 h **e** 15 h 41 min
5 **a** $400 **b** 450 **c** $2
d $A = 2n$ **e** $2750 **f** 1600
6 **a** $D = kL$ **b** 12.5 **c** $D = 12.5L$
d 937.5 km **e** 20 L
f Teacher to check. Answers may vary, for example, speed, bad weather, traffic and poor road conditions may affect the fuel consumption of a car.
7 **a**

A	1	2	10	100	1.54	3.85	7.69
P	13 000	26 000	130 000	1 300 000	20 000	50 000	100 000

b $P = 13\,000A$ **c** 3 250 000 kip
d 32 **e** $2.31

KEYWORD ACTIVITY



Clues for the crossword will vary. Teacher to check.

TEST YOURSELF 4

1 $120/h
2 20.8 m/s
3 108 000 km/h
4 **a** small: $1.81, medium: $1.73, large: $1.80
b 750 mL

5 $3990
6 $130
7 Choose $36.50/h. It pays $60 more per week.
8 **a** white car 8.5 L/100 km; red car 9.1 L/100 km
b white car
9 **a** $5400 **b** $R = kS$ **c** $k = 45$
d $R = 45S$ **e** $38 250 **f** 175 m^2

CHAPTER 5

EXERCISE 5.1

1 **a** 13:25 **b** 17:100 **c** 5:12
d 150:1 **e** 31:51:101
2 **a** 1:4 **b** 12:1 **c** 2:3
d 3:1 **e** 8:12:1 **f** 1:2:3
3 **a** $1
b **i** 3:2 **ii** 3:1 **iii** 2:1 **iv** 1:3
4 **a** 27:29 **b** 19:27 **c** 29:75
d 29:19 **e** 27:29:19
5 **a** 3:250 **b** 23:30 **c** 37:120
d 10:3 **e** 2:5 **f** 300:173
6 **a** black to red **b** purple to yellow
c green to grey **d** green to all
e green to red to black **f** yellow to purple to grey
7 **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
8 **a** 1:2 **b** 2:3 **c** 1:3 **d** 4:1
e 2:3 **f** 1:2 **g** 5:3 **h** 3:1
9 **a** 3:20 **b** 1:20 **c** 3:1
d 1:8 **e** 3:1:20
10 **a** 8:3 **b** 7:3 **c** 1:4
d 6:1 **e** 16:7:1
11 **a** 5:8 **b** 1:13 **c** 1:2
d 3:16 **e** 8:5:3
12 heavy-duty cleaning

EXERCISE 5.2

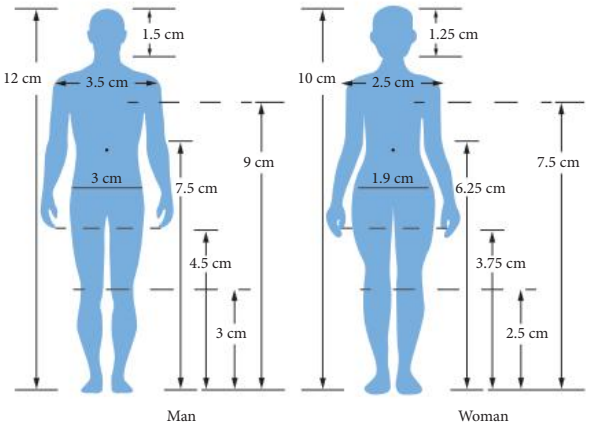
1 **a** 9:5 **b** $\frac{5}{14}$
2 **a** 6:2 **b** 3:1 **c** $\frac{3}{4}$
3 The ratios of red : yellow in the mixtures are 20 : 40 and 4 : 8. The ratios are equivalent. They both simplify to 1 : 2.
4 **a** 5:2000 **b** 1:400
5 It looks more green than blue. Possibly Lara got the ratio around the wrong way. Maybe she made a 1 : 4 ratio instead of 4 : 1.
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** 2.5 cm **ii** 6.7 cm
10 **a** 10 **b** 9
11 **a** zinc 25 g, nickel 5 g
b copper 112 g, zinc 40 g
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 5.3

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 cement 30 kg, sand 60 kg, gravel 90 kg
8 **a** Toby $840, Vinson $1260
b Toby $1750, Vinson $350
9 399 boys
10 20 silver beads, 15 porcelain balls, 10 crystal eyedrops
11 160 mL
12 **a** 2 g **b** gold 315 g, copper 84 g
13 **a** 150 mL **b** 400 mL **c** 200 mL

EXERCISE 5.4

1 **a** 1.5 cm **b** 3 cm **c** 4.5 cm
d 7.5 cm **e** 9 cm **f** 3.5 cm
g 3 cm
2 **a** 1.25 cm **b** 2.5 cm **c** 3.75 cm
d 6.25 cm **e** 7.5 cm **f** 2.5 cm
g 1.875 cm
3



EXERCISE 5.5

1 **a** 12 m **b** 30 m
c 4.5 m **d** 20 mm or 2 cm
e 16.2 m **f** 208 cm or 2.08 m
2 1100 m = 1.1 km
3 25 m
4 length 4 m, width 2.5 m
5 **a** 13.5 cm **b** 720 cm or 7.2 m
c 16 cm **d** 62.4 cm
6 4 m

7 6.4 km

8 **a** 1:250 **b** 8 cm, 14 cm
c Teacher to check **d** 25 m
e Use Pythagoras' theorem.

9 The diameter of the outer circle is approximately 35.5 m. It will just fit inside the park.

TEST YOURSELF 5

1 **a** 1:3 **b** 75%

2 **a** 2:5 **b** 2:1 **c** 5:2 **d** 3:5

3 250 mL

4 3 mL

5 **a** Manal $64, Eddie $16
b 24 km, 48 km

6 12 mL blue, 8 mL green and 4 mL white

7 42 mm

8 **a** 92 cm **b** 11.2 cm

9 28 m

PRACTICE SET 1

Section A

1 D 2 B 3 C 4 C
5 B 6 D 7 B 8 D

Section B

1 3024 mL

2 **a** 5 kg **b** $112 500
c 192 minutes **d** 6480 mL

3 **a** 79 **b** $\frac{1}{5}$ **c** 29 **d** −2

4 **a** 92% **b** 3% **c** 15% **d** 25%

5 **a** 85 m **b** 17 kg **c** $10

6 2500 mL

7 **a** 675 km **b** $104.95

8 $24 592 **9** 172 cm **10** 23.31%

11 504 L/day

12 **a** 135
b

Length of yarn (L cm)	0	5	10	15	20	25	30
Number of beads (B)	0	45	90	135	180	225	270

c $B = kL$ **d** $k = 9$ **e** $B = 9L$ **f** 85 cm

CHAPTER 6

EXERCISE 6.1

1 **a** $15 **b** 44 000 people **c** 1.05 kg
d 810 letters **e** 750 m^2 **f** 48 L
g 60 066 **h** 6 min **i** $21.08
j 60 people

2 **a** 7 days **b** 21 days

3 25 299 cars

4 **a** $29 **b** $2.44

5 **a** $9 **b** $234

6 113 students **7** $899.70

8 287 passengers

9 **a** 324 000 km **b** 314 160 km

10 **a** 60 **b** 77

11 O+ 9 934 000 A+ 7 698 850 B+ 1 986 800
AB+ 496 700 O− 2 235 150 A− 1 738 450
B− 496 700 AB− 248 350

EXERCISE 6.2

1 **a** 85% **b** 85% **c** 40% **d** 75%

2 **a** English 53.75%, Maths 81.18%, Design 58.46%, Science 65%, Business Studies 84.29%, Health 75.56%
b Business Studies, Maths, Health, Science, Design, English

3 Tiago 54.5%, Luke 62.2%. Luke was more successful.

4 Muesli bars 31.4%, Jam 49%. Jam has the higher percentage of sugar.

5 **a** Colombia 8.78%, Iran 7.07%
b Colombia
c Teacher to check

6 **a** 5% **b** 37.5% **c** 1.25% **d** 25%

7 **a** Monday 28.6%, Wednesday 35%, Saturday 30%
b Wednesday **c** 31.25%

8 A: 25%, B: 26.7%; B has the higher percentage of alcohol.

9 **a** Clarkson: 120.6, Bailden: 126.3
b Bailden

10 Victoria 3%, Western Australia 2.75%. Victoria has the higher rate of stamp duty.

EXERCISE 6.3

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 6.4

1 **a** $108 **b** $612 **c** $30.60
d $581.40
e No, 20% off gives a price of $576.

2 **a** $53 199.30 **b** $50 539.33
c No, 35% gives a price of $49 399.35.

3 **a** 1160 **b** 348 **c** 17.4%

4 **a** $262.20 **b** 24%

5 **a** $1552.50 **b** $747.50 **c** 32.5%

6 **a** $554.80 **b** 24%

7 **a** $34.63 **b** 17.5%

8 **a** $640 **b** $704

9 **a** $704 **b** Neither, they are the same.

ANSWERS

10 2786 people
11 $336.08
12 2517

EXERCISE 6.5

1 **a** $620.50 **b** $3029.50
2 **a** $10 400 **b** $26 400 **c** $440
3 **a** $273 **b** $300.30
c Teacher to check
d $268.13 so probably $269.
4 192 m² **5** 27%
6 **a** $2700 **b** $2430
c No, 20% off gives a value of $2400.
7 **a** $6650 **b** $332.50
8 39.6%
9 **a** $57 **b** $60.90
10 **a** $399.90 **b** $3599.10 **c** $4030
d $4429.90 **e** $430.90 **f** $215.45
g 5.99%
11 3.49%

TEST YOURSELF 6

1 **a** $414.72 **b** 105 students
2 **a** **i** Megan 74.19%, Jasmine 68.75%
ii Megan
b **i** Broncos 77%, Cowboys 79%
ii Cowboys
3 **a** $82.50 **b** $13.60
c $21, $231 **d** $1540, $16 940
4 $46.20 **5** $331.82
6 **a** $31 122 **b** $29 565.90
7 **a** $1871.28 **b** $727.72 **c** 28%
8 54.0%
9 **a** $614 **b** $2456 **c** $1964.80

CHAPTER 7

EXERCISE 7.1

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 7.2

1 **a**

Method of travel	Tally	Frequency
W	𝍸 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**

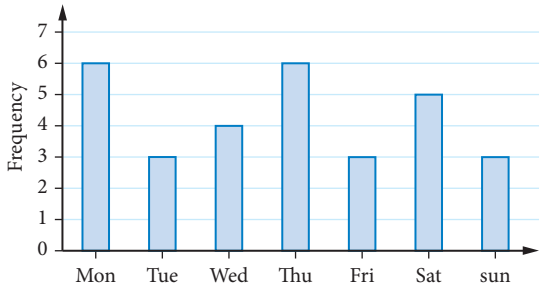
b children older than 8 years
c 20%

3 **a**

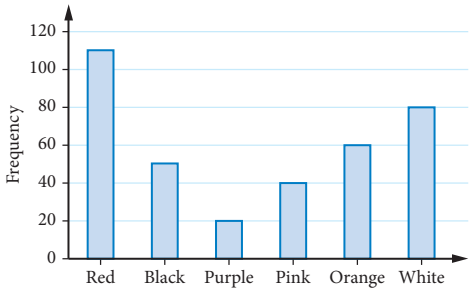
Make of car	Tally	Frequency
H	𝍸 ||||	9
F	𝍸 ||	7
T	𝍸 |	6
M	|||	3
S	|||	3
O	||	2
Total		**30**

b Hyundai
c 10%

4



5



EXERCISE 7.3

1 **a**

Number of hamburgers	Tally	Frequency
17	𝍸	5
18	||||	4
19	𝍸 ||	7
20	||||	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 ||||	9
4	𝍸	5
Total		**37**

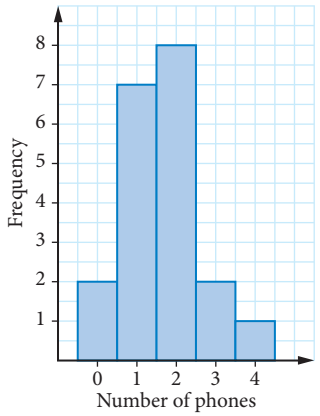
b 37 **c** 5 **d** 23 **e** 27%

3 a

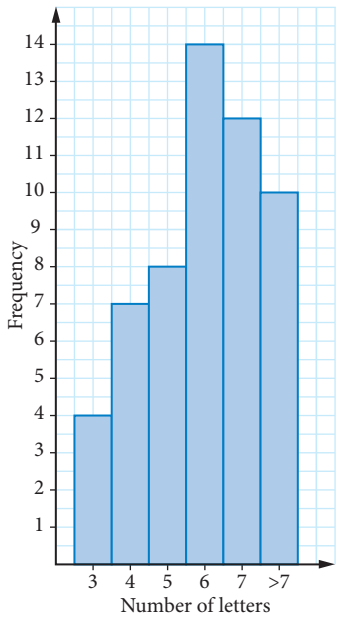
Age	Tally	Frequency
31–40	𝍸 ||||	9
41–50	𝍸 |||	8
51–60	𝍸 |	6
61–70	𝍸	4
71–80	|||| ||||	8
81–90	𝍸	5
Total		**40**

b 31–40 **c** 17 **d** 32.5%

4



5 a

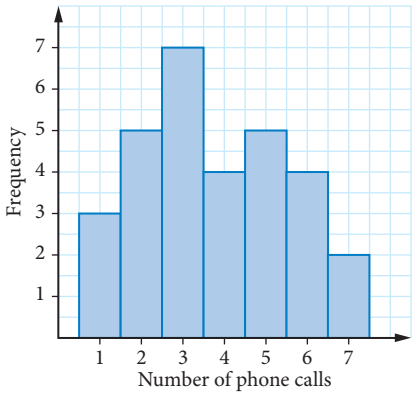


b 11 days **c** 6 letters

6 a

Number of phone calls	Tally	Frequency
1	|||	3
2	𝍸	5
3	𝍸 ||	7
4	||||	4
5	𝍸	5
6	||||	4
7	||	2
Total		**30**

b



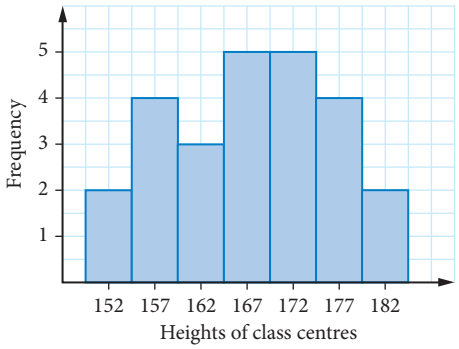
c 5 days **d** 3 phone calls

7 a

Heights	Tally	Frequency
150–154	||	2
155–159	||||	4
160–164	|||	3
165–169	𝍸	5
170–174	𝍸	5
175–179	||||	4
180–184	||	2
Total		**25**

b 25

c

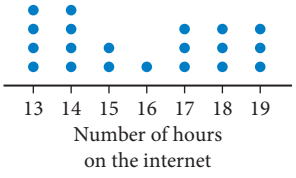


d 11 students

e 165–169 and 170–174

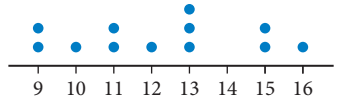
EXERCISE 7.4

1 a



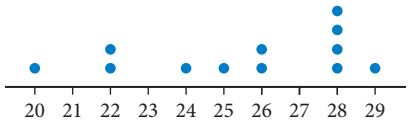
b 20 **c** 4 **d** 9

2 a



b 3 **c** 25% **d** 5

3 a



b 12 **c** \$28 **d** 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

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

b 8 **c** 22%

6 a

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

b 42 hours **c** 5 **d** 11

e 21 **f** 52%

EXERCISE 7.5

1 a frequency table

b grouped frequency table

c frequency table

d grouped frequency table

e grouped frequency table

f frequency table

g frequency table

h grouped frequency table

2 column graph, the data is categorical

3 dot plot, small range of numerical data

4 stem plot, larger amount of numerical data

5 histogram, may be grouped data

6 column graph as first answer would be Yes or No, then a histogram as the data may be grouped

7 a stem plot **b** dot plot

c histogram **d** stem plot

e dot plot **f** dot plot

g histogram or stem plot

h histogram **i** dot plot **j** histogram

EXERCISE 7.6

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 cm – definitely a wrongly recorded measurement, no Year 11 student would be this short.

c 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 \$245 000

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.

KEYWORD ACTIVITY

categorical data	C
dot plot	B
frequency table	A
histogram	E
numerical data	F
outlier	D
stem plot	G

TEST YOURSELF 7

1 a C **b** N **c** N

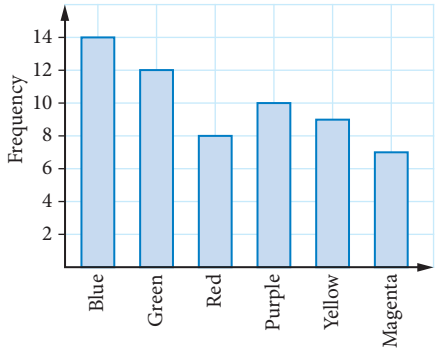
d C **e** N **f** C

2 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

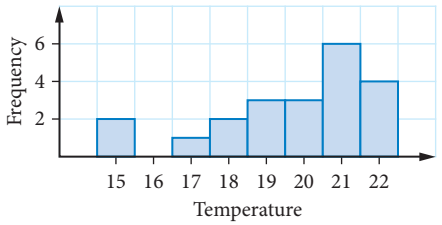


3 a

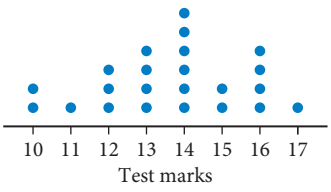
Temperature	Tally	Frequency
15	||	2
16		0
17	|	1
18	||	2
19	|||	3
20	|||	3
21	𝍸 |	6
22	|||	4
Total		**21**

b 21 days **c** 8 days

d



4 a



b 23 **c** 7

5 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%

6 Teacher to check justifications.

a dot plot **b** stem plot

c column **d** histogram

7 a 19 **b** 7 **c** 43.9 **d** 76

8 a 56 89 93 98 99 100 100 101 104 125

b 56 and 125 **c** Teacher to check

CHAPTER 8

EXERCISE 8.1

1 a $2625.04 **b** $5250.08 **c** $136 502.08

2 a $10 375 **b** $4788.46 **c** $2394.23

3 a $151 966

b A month is longer than 4 weeks (by 2 or 3 days).

c $12 666.33 **d** $83.51

4 a $313.76 **b** 4 hours

5 a $1033.08 **b** $1452.28

6 $27.83 **7** $5720 **8** $71.40

9 a job 2 **b** Teacher to discuss

INVESTIGATION: WAGES BY SPREADSHEET

1 $616

2 a total number of hours worked

b =E6*F17

3 Teacher to check

EXERCISE 8.2

1 a $25.80 **b** $34.40 **c** $21.54 **d** $28.72

e $36.90 **f** $49.20 **g** $46.88 **h** $62.50

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 $162.75

9 a $204.08 **b** 10:30 am **c** 30 min

d 3:30 pm **e** $153.06 **f** 10 am

EXERCISE 8.3

1 a $1377.06 **b** $3120.69

2 $741.25 **3** $1202 **4** $1463.30

5 a 20 Oct 2024 – 26 Oct 2024

b 27 Oct 2024

c No, it was paid into her bank account.

d $14.36

e 30c **f** $1.25 per shift

g **A** $129.24 **B** $129.23 **C** $129.23

D $7.20 **E** $5 **F, G, H, I** $399.90

h 38 **i** 220

j 1.2 or 20% more per hour

6 $1442.21 **7** $911.25

8 a **A** 8 **B** 7 **C** 4

D 5 **E** $16.32 **F** $24.48

G $24.48 **H** $32.31 **I** $130.56

J $171.36 **K** $97.92 **L** $161.57

b $561.41

EXERCISE 8.4

1 a $61.25 **b** $221.2

c $581.88 **d** $1206.63

2 a $626.50 **b** $3595.50

3 $3492

4 a $71 064.40 **b** $5466.49 **c** $956.64

5 $6536.62 **6** $5963 **7** $376

8 a $363.69 **b** $5420.89

9 $588

ANSWERS

10 $1972

11 Teacher to check

EXERCISE 8.5

1 **a** $2250 **b** $40 **c** $6000
d $12 500 **e** $6570 **f** $570

2 $117.25 **3** $4603.50

4 $554.40 **5** $70 600

6 **a** $18 **b** $61 **c** $159.50

7 **a** $18 **b** $48.91 **c** $214

8 $4057.50

9 More than $8.35, $8.50 or $9 would be suitable.

10 $88

11 $905 200

12 **a** $20 440 **b** $43 400

13 **a** $16.80 **b** $62.40 **c** 417

14 $2875

15 Melissa: $17 988.05; publisher $41 972.11

16 **a** $204 **b** $945.20 **c** $2363

EXERCISE 8.6

1 $1728.01

2 **a** $2955 **b** $985.00

3 **a** She worked more than 30 hours per month, not per week.
b $65.66

4 $6292

5 **a** $31 360 **b** $2613.33 **c** $603.08

6 **a** $1069.23 **b** $9675
c Sample answer: The Government wants only a small amount or nothing left in the fund when the person dies.

7 $1 015 200

KEYWORD ACTIVITY

1 J **2** F **3** G **4** I
5 K **6** L **7** A **8** C
9 N **10** E **11** H **12** M
13 D **14** B

TEST YOURSELF 8

1 **a** $656.25 **b** $1312.50 **c** $34 125

2 **a** $8000 **b** $3692.30

3 **a** $36.53 **b** $340.90

4 $21 **5** $115.85 **6** $875

7 $6227.50 **8** $40 500 **9** $782

10 $1594.23

CHAPTER 9

EXERCISE 9.1

1 **a** 14 800 kJ **b** 22%

2 **a** 8000 kJ **b** 2400 kJ

3 **a** 5000 kJ **b** 1000 kJ

4 **a** 2100 **b** 86 **c** 286
d 6 **e** 586 **f** 2571

5 **a** 2310 kJ **b** 46 Cal

6 **a** boys **b** 2 to 3 years **c** 3300 kJ
d 4 to 8 years **e** 56 000 kJ
f No, 1100 kJ too many. **g** increase

7 **a** 2000 kJ **b** 2 hours
c **i** 10 500 kJ **ii** 14 000 kJ
iii no (activities expend 14 000 kJ)
iv Eat more or exercise less.

8 **a** $m = 4.2$, $k = 4.2c$
b 9030 kJ **c** 238 Cal

EXERCISE 9.2

1 **a** 2659 kJ **b** 1463.5 kJ
c 5691 kJ **d** 725 kJ

2 **a** breakfast 4491 kJ, lunch 4335 kJ, dinner 7783 kJ, daily total = 16 609 kJ.
b Unless he is very, very active, he will put on weight.

3 Teacher to check

4 **a** 3450 kJ **b** 115 minutes

5 **a** 690 kJ **b** 765 kJ **c** 1020 kJ
d 3975 kJ **e** 1920 kJ **f** 8050 kJ

6 **a** 306 kJ **b** 888 kJ **c** 1152 kJ
d 14 754.6 kJ **e** 76 kg

EXERCISE 9.3

1

	Power rating (W)	kWh per day	Daily cost (cents)	Monthly cost ($)
a	800	19.2	653	195.90
b	2400	3.6	122	36.60
c	900	0.45	15	4.50
d	1100	1.1	37	11.10
e	100	0.6	20	6.00
f	380	0.19	6	1.80
g	1500	1.5	51	15.30
h	1500	0.375	13	3.90
i	1900	1.9	65	19.50
j	650	0.325	11	3.30
k	950	0.2375	8	2.40
l	40	0.2	7	2.10
m	1400	0.7	24	7.20
n	550	3.3	112	33.60
o	950	0.7125	24	7.20

2–4 Teacher to check

EXERCISE 9.4

1 **a** $18 **b** $338 **c** 22

2 **a** $18, $16 **b** Teacher to discuss

3 **a** 75 beats/min **b** 64 beats/min
c 130 beats/min

4 **a** 80 **b** 100 **c** 120
d 140 **e** 160 **f** 180
g 200

5 **a** 172 beats/min **b** 108 beats/min
c She's working too hard and should slow down.
6 28 breaths/min
7 **a** $\frac{1}{12}$ **b** 1.67 km
8 **a** 14 min **b** 50
9 **a** 255 watts **b** 3.315 kilowatts **c** $1.79
10 **a** 26.4 kilowatts **b** 9609.6 kilowatts
c $5189.18

KEYWORD ACTIVITY

1 **d** **2** **h** **3** **f**
4 **b** **5** **g** **6** **a**
7 **c** **8** **e**

TEST YOURSELF 9

1 **a** 1050 **b** 1370
2 **a** 500 kJ **b** 175 minutes = 2 h 55 min
3 **a** 1100
b Many answers possible, teacher to check
4 4790 kJ **5** 3600 kJ
6 0.5 kWh **7** 8.4c
8 66 beats/min **9** approx. 24c
10 6

CHAPTER 10

EXERCISE 10.1

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** $2402.04
6 **a** $112.40 **b** $574
7 $26 936

EXERCISE 10.2

1 **a** $90 880 **b** $89 920
2 $415
3 **a** $305 **b** refund of $127.50
4 **a** $3500 **b** $91 000
c Not refund nor bill. He has paid the correct amount of tax.
5 **a** $73 112 **b** $72 887
c $15 236 **d** $1080.72 refund
6 bill for $55.60
7 $129 095.20
8 **a** $116 220 **b** $28 609.36
c $116 021 **d** She will get a $435.55 refund.
9 **a** $420 **b** $1741.10
10 **a** $426 **b** $1774.65
11 **a** $2296 **b** $426
12 **a** 2024–2025 **b** $24 390
c $1396 **d** tools
e $884.38 **f** $23.46
g No, she owes $267.90 in tax debt.

EXERCISE 10.3

1 **a** $1060 **b** $22 103
c $46 635 **d** $70 297
e $0 **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 **a** $24 960 **b** $1284.40
c $24.70 **d** $455.30
e $216 **f** $264 **g** $191.30
6 yes, $88 **7** $520
8 **a** $88 131
b tax = $19 109.58, Medicare levy = $1762.62
c $3723.80
9 Incorrect. Paul's tax is $11 267, Garth's tax is $32 437. Garth's tax is almost 3 times Paul's tax.
10 **a** tax = $28 138, Medicare levy = $2318, total = $30 456
b $17 401
11 $48 000
12 **a** $39 520 **b** $5791.40 **c** $143 068.60
d tax = $38 002.38, Medicare levy = $5007.40
13 Because Anna didn't supply a TFN she was taxed 45c for every dollar she earned in interest.
tax = $2202.30, $4894 – $2202.30 = $2691.70
14 **a** $266 billion **b** $48 billion **c** $225 billion
d $130 billion received from Company tax, cost of health $109 billion. Company tax covers it.

EXERCISE 10.4

1 **a** before 15 August 2025
b $33.60 **c** $386.40
2 **a** 5 Curtis St, Bendigo **b** 21 Oct 2025
c on or before 12 Nov 2025 **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 Daily interest accrues on overdue amounts at a rate of 11% per annum.

4 **a** $548.30
b 30 November 2025
c $2193.20
d Many answers possible, for example $42.20
e Phone the revenue team on 07 555 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 by 2.1 kWh
h **i** 5.5 kWh **ii** 4.0 kWh

EXERCISE 10.5

1 **a** $5800 **b** $112

2 **a**

Income		Expenses	
Office	$820	Rent	$380
Club	$285	Food	$90
		Phone	$25
		Travel	$70
		Total fixed expenses	$565
		Entertainment	$90
		Savings	$390
		Clothes	$60
Total income	**$1105**	**Total expenses**	**$1105**

Other answers possible for entertainment, savings, clothes.

b

Income		Expenses	
Office	$820	Rent	$380
Club	$285	Food	$90
		Phone	$25
		Car loan	$100
		Car expenses	$75
		Entertainment	$80
		Savings	$275
		Clothes	$80
Total income	**$1105**	**Total expenses**	**$1105**

3 **a** $312 **b** $41 080 **c** $16 224

4 **a** income = $420, expenses = $280
b $1680 **c** Teacher to check

5 **a** $258 **b** $297
c approx. 85 weeks
d Teacher to check

KEYWORD ACTIVITY

ACROSS

3 income **10** budget
12 annual **15** discretionary
16 gross **18** taxation
20 private **22** weekly
23 refund

DOWN

1 medicare **2** fixed
4 net **5** monthly
6 fortnightly **7** tables
8 deductions **9** payg
11 quarterly **12** invoice
14 levies **17** taxable
19 rates **21** tfn

TEST YOURSELF 10

1 $746.62

2 refund of $1072.40

3 **a** $84 710 **b** $17 997.75

4 **a** 10 November 2025
b 2 December 2025
c $684.77 **d** $47.89 **e** $211.44
f approx. $50 to $60

5 **a** **i** $286 **ii** $342 **iii** $1260
b 47 fortnights (or 94 weeks)
c $35.75 per hour
d He will earn an extra $71.50 per fortnight. He could use the extra money to increase his savings to $321.50 per fortnight. Then he could save the $20 000 for the car in only 37 fortnights.

PRACTICE SET 2

Section A

1 C **2** D **3** A
4 D **5** A **6** C
7 D **8** C

Section B

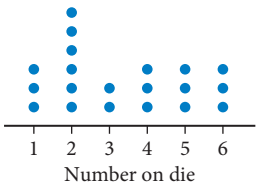
1 156 beats/min

2 7, 9

3 $1826

4 **a** $4192.31 **b** $1172.50

5 **a**



b 9 **c** 45%

6 **a** $3680 **b** $4048 **c** $2833.60

7 **a** $3880 **b** $679 **c** $4559

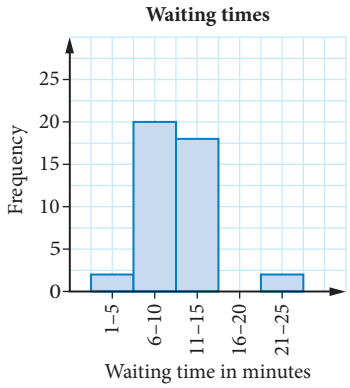
8 **a** 3.85 kWh **b** $1.31

9 **a**

Waiting time	Tally	Frequency
1–5	||	2
6–10	𝍸 𝍸 𝍸 𝍸	20
11–15	𝍸 𝍸 𝍸 |||	18
16–20		0
21–25	||	2

b 18 **c** 4.8%

d



10 **a** $8984 **b** $9883 **c** $824
d Teacher to check
11 **a** 1405 kJ **b** 42.15 minutes
12 **a** $17 384.64 **b** $16 640.25
c refund, $744.39

CHAPTER 11

EXERCISE 11.1

1 **a** 5 cars **b** 35
c 6 am–8 am **d** Teacher to check
2 **a** 13 **b** Friday
c 48 **d** Teacher to check
3 **a** 200 000 people or 0.2 million
b Sydney, 5 300 000
c Darwin, 150 000
d The scale means we can only estimate to the nearest 200 000 but the actual population is more exact than that.
e Adelaide **f** Teacher to check
4 **a** 2.3% **b** South Australia
c Tasmania and Northern Territory
d No, it only tells you the percentage increase, not the actual number.
e 2280
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 2024 **c** 2021, 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** $50 **c** about $58
d yes, since €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 $10 **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 11.2

1 **a** 120 **b** people aged over 30
c muffins **d** 36 **e** 80%
2 **a** **i** 5900 **ii** 16 100 **iii** 11 000
iv 11 000 **v** 22 000
b 22 000 **c** $\frac{59}{220}$
d 73.18% **e** 21.8%
3 **a** **i** 120 **ii** 95
iii 108 **iv** 215
b 215 **c** 64
d 50.23% **e** 35.8%
f More hamburgers, since a large proportion of men prefer them to chicken wraps.
4 **a** **i** 83 **ii** 187 **iii** 110
iv 185 **v** 160
b 24.06% **c** 59.46%
d Teacher to check
5 **a** **i** 3630 **ii** 9130 **iii** 8920
iv 3840 **v** 12 760
b 71.55% **c** 28.81%
d Teacher to check
6 **a** **i** 80 **ii** 10 **iii** 75
iv 45 **v** 120
b 120 **c** 95
d 79.2% **e** 18.8%

EXERCISE 11.3

1 **a** $120 **b** about $23 more
c about $90 **d** Teacher to check
2 **a** 3 months **b** about $1750
c These are for summer, when extra electricity is used for air conditioning and refrigerators.
d Teacher to check

3 **a** 15 months **b** approximately 181 MJ
c June to August, heating in winter, others 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** 34°C **b** June, July, August
c A lot of rain from November to March, little rain from April to October.

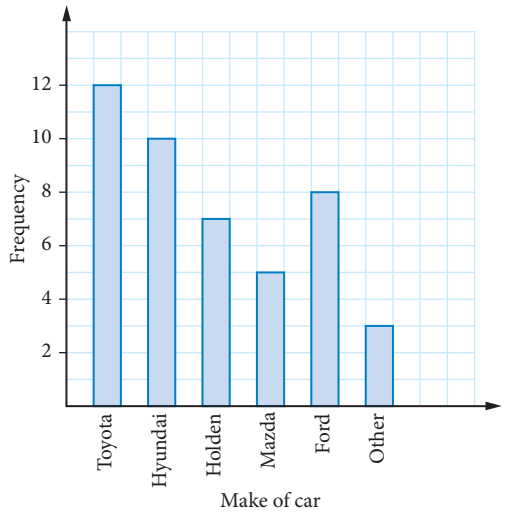
7 **a** June, July, August, September
b about 10°C
c about 30 mm
d Teacher to check

8 Northern hemisphere, because the warmest temperatures are in the middle of the year.

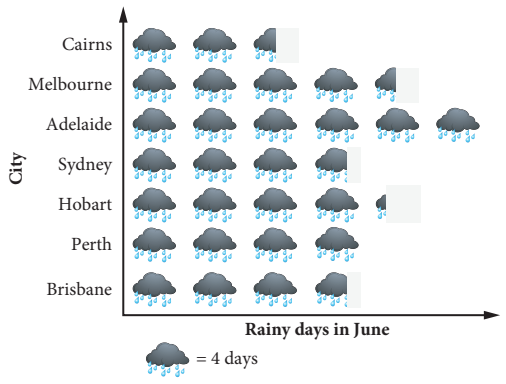
9 **a** 1% of donations **b–d** Teacher to check
e 9180 L

EXERCISE 11.4

1



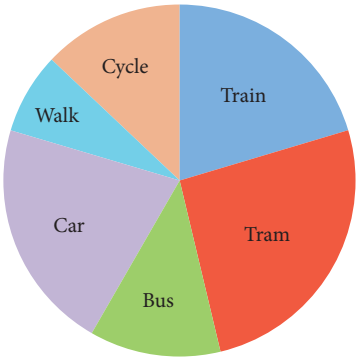
2



3 **a** 7% **b** other
c 31% **d** 548

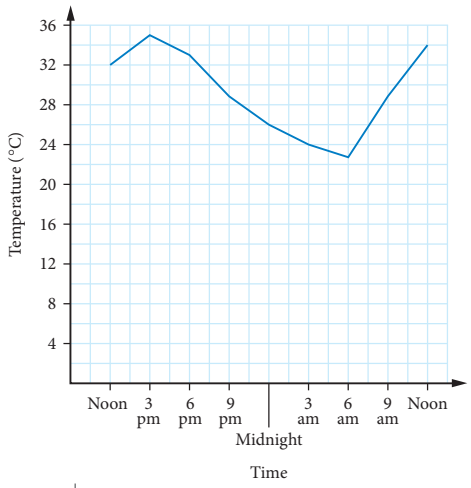
4 **a** 73°, 93°, 43°, 77°, 27°, 47°

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

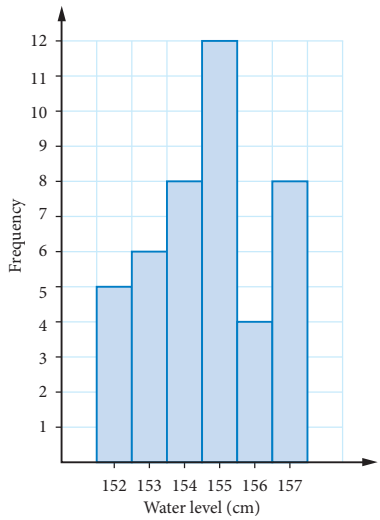


7

Stem	Leaf
3	7 7 8 8
4	1 3 4 4 5 5 6 6 8 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: 9|0 = 90 burglaries

8



9780170484589

9 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

10 Teacher to check reasons.

a line graph
b frequency histogram or polygon
c dot plot, column graph or line graph
d pie graph, divided bar graph or column graph
e column graph, pie graph, divided bar graph
f stem plot, frequency histogram or polygon
g sector graph, divided bar graph or column graph
h picture graph or column graph
i dot plot, column graph, pie graph or divided bar graph

11 a picture graph, column graph, pie graph or divided bar graph
b, c, d Teacher to check

12 a clustered column graph
b compares 2 data sets (Monday vs Tuesday sales)

EXERCISE 11.6

1 a i 6 kg **ii** 9.5 kg
b i 8 months **ii** 11 months
c 6 and 7 months
d approximately 6 months
e Teacher to check

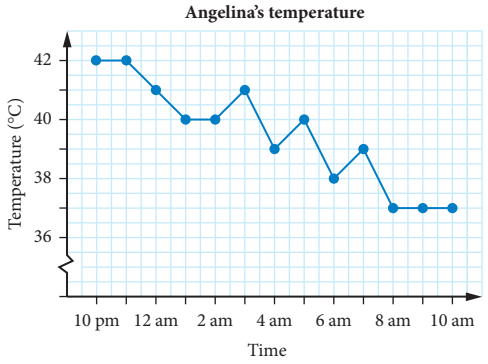
2 a 8%
b 40 to 50 years of age
c 7%
d more likely to die from cancer and heart disease
e true
f 40
g between 18 and 42

3 a A Melbourne, B Sydney, C Brisbane, D Adelaide, E Perth, F Darwin, G Canberra, H Hobart
b Jan 28°, Feb 27°, March 24.5°, April 19.5°, May 15°, June 12°, July 11°, Aug 13°, Sept 16°, Oct 19°, Nov 23°, Dec 26°.
c March and December, or April and November
d B June, C July, D May
e F **f** G, 15° in December
g 33°, F, November
h 0°, G, July

4 a April 22, 24°C
b 15°C **c** 9°C
d 1 unit = 1°C **e** 16°C
f 20 April, 21 April
g 16 April
h 5

5 a i Time, 4 hours
ii Temperature, 0.2°C
b 39.7°C
c midnight Thursday
d 40.4°C
e 12 hours **f** 2000 (8 pm) Saturday

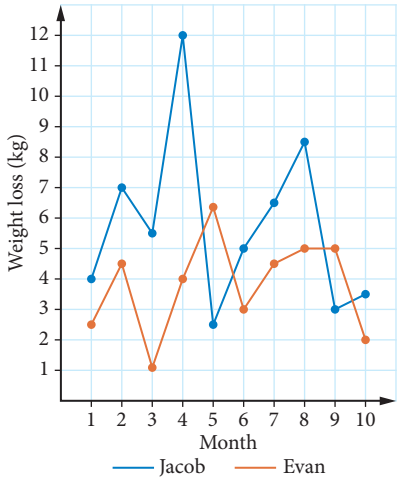
6



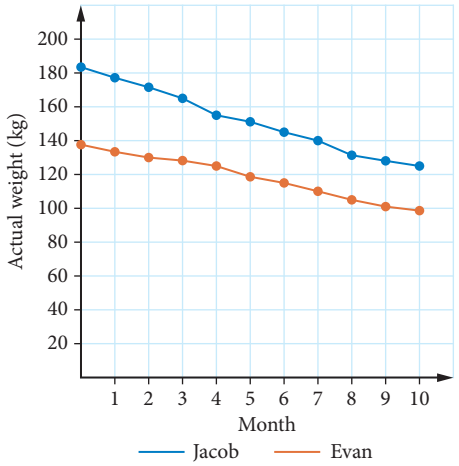
7 a

Month	Jacob		Evan	
	Weight loss (kg)	Weight (kg)	Weight loss (kg)	Weight (kg)
Start		183		137
1	4	179	2.5	134.5
2	7	172	4.5	130
3	5.5	166.5	1.1	128.9
4	12	154.5	3.9	125
5	2.5	152	6.4	118.6
6	5	147	3	115.6
7	6.5	140.5	4.6	111
8	8.5	132	5	106
9	3	129	5	101
10	4	125	2	99

b



c



d Teacher to check

e **i** 58 kg **ii** 38 kg

f Jacob 31.7%, Evan 27.7%

EXERCISE 11.7

1 **a** Green 31.5c, Octas 33c, System Two 32.5c

b 1c **c** the first graph

d The scale on the second graph starts at zero; the scale on the first graph only goes from 30 to 33.

e Green company, to make their calls seem cheap.

2 **a** Brisbane **b** Darwin **c** 189c

d about 14c

e Darius only used from 180c to 205c on the vertical scale and this makes the gaps look bigger.

3 Small: graph the actual population; Big: graph the increase in the population.

4 **a** 120c **b** $80

c The cost of petrol is in *cents*, the cost per barrel is in *dollars*: vertical scale is different for each graph

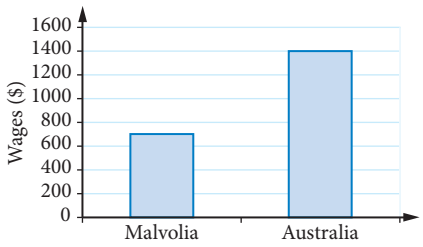
d The two graphs move up and down in a similar fashion: this suggests the two things are related.

5 **a** Australia's average weekly wages are *much* greater than in Malvolia.

b No vertical scale, using a 3D symbol instead of a column.

c a column

d



6 Teacher to check

TEST YOURSELF 11

1 **a** 40 **b** 6 am to 8 am

2 **a** 2 600 000 **b** 2 400 000

3 **a** 13% **b** approximately 1.6%

4 **a** €36 **b** $100

5 **a** motor racing **b** 595

6 **a**

	High-speed internet	No high-speed internet	Total
City	105	38	143
Country	89	42	131
Total	194	80	274

b 131 **c** 73% **d** 29%

7 **a** $120 **b** approximately $52

8 **a** approximately 32 MJ

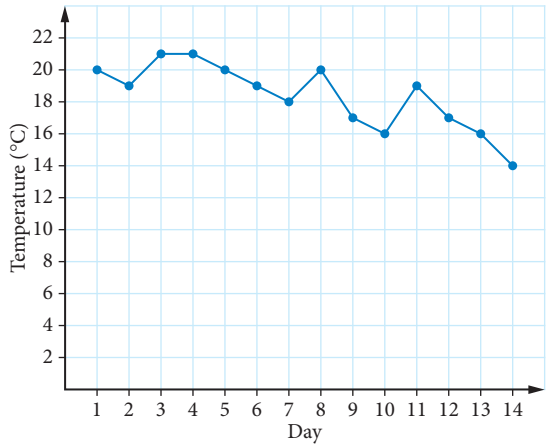
b December to February

c No heating in the summer months and possibly less cooking.

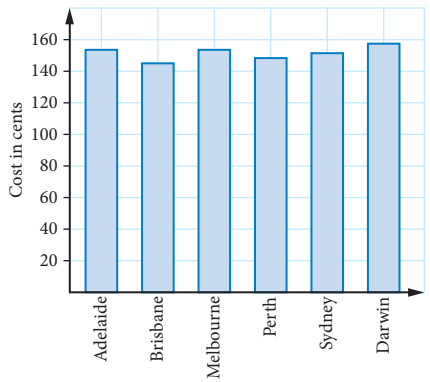
9 **a** 3.15% **b** $1375

10 categorical, pie graph, change, time, it keeps the detail of the data, histogram

11



12



CHAPTER 12

EXERCISE 12.1

1 **a** 360 min **b** 130 weeks

c 8 min **d** 10 years

e 4 days **f** 42 days

g 60 months **h** 12 fortnights

i 126 days **j** $6\frac{1}{2}$ years

2 195 min **3** 15 weeks

4 $1520 **5** 180

6 **a** $67 020 **b** $1288.85

7 **a** 3 h 32 min **b** 9 min 21 s

c 5 min 30 s **d** 2 h 15 min

e 6 h 49 min **f** 12 min 47 s

9780170484589

8 **a** 1400 s **b** 23 min 20 s
c 5:24 am
9 26 h 45 min
10 10 h 50 min
11 **a** Teacher to check **b** 3 h 26 min

EXERCISE 12.2

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 12.3

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 12.4

1

	NT	
AWST	ACST	AEST
$-1\frac{1}{2}$	0	$+\frac{1}{2}$

2 **a** ahead **b** ahead **c** same
d ahead **e** behind **f** ahead
g ahead **h** same **i** ahead
j behind
3 **a** 11 am **b** 9 am **c** 10:30 am
d 11 am **e** 11 am **f** 9 am
4 **a** 11 pm **b** 10:30 pm **c** 9 pm
d 10:30 pm **e** 11 pm **f** 11 pm
5 1:45 pm
6 **a** 5:30 pm **b** 7 pm
7 8:30 pm **8** 10 pm
9 **a–c** Teacher to check
d 3:30 pm
10 Teacher to check
11 Specific location may vary but must be in WA (e.g. Perth)
12 Perth, Adelaide (on Summer time)

EXERCISE 12.5

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 **a, b** Teacher to check
9 20 h 30 min
10 4, 9:45 pm, 5:15 am (next day), 8:20 am, 11:45 am
11 **a** 6 h 25 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
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 Teacher to check **d** Teacher to check
18 Teacher to check

EXERCISE 12.6

1 **a** 3:50 am **b** 3:43 am **c** 3:52 am
2 **a** 4:15 am **b** 4:37 am **c** 4:05 am
3 **a** 12 h 49 min **b** 0.62 m
4 **a** 5:48 am, 6:16 pm **b** 12 h 28 min
5 Mon 14, Wed 23, Thu 24, Sat 26
6 **a** Sat Oct 26 **b** It is getting earlier.
7 **a** Between 3 am and 9 am or between 3:30 pm and 9 pm.
b Between 4:30 am and 10 am or between 5 pm and 10 pm.
8 2:01 pm

ANSWERS

9 **a** 12 h 39 min **b** They are increasing.

10 **a** 6 **b** 16, no (but close)

c 16, no (but close)

d 20 August

e 26 January to 3 February, 24 February to 4 March

11 Teacher to check

KEYWORD ACTIVITY

Descriptions will vary. Teacher to check

12-hour time – C

24-hour time – B

time zone – D

timetable – A

TEST YOURSELF 12

1 **a** 12 **b** 49

c 48 **d** 8

2 **a** 1877 seconds **b** 4 days

3 **a** **i** 0417 **ii** 1525 **iii** 1000

b **i** 6:15 am **ii** 4:40 pm **iii** 11 pm

4 **a** 11 hours, 35 minutes

b **i** 7 hours **ii** 2 hours, 35 minutes

iii 0113

5 **a** 4 hours, 25 minutes **b** 11:25 am

6 **a** 4 hours, 50 minutes **b** 10:40 pm

c March 2015

7 **a** Teacher to check **b** 1:30 pm

c 2:45 pm

8 **a** 8:50 am **b** 8:27 am **c** 5:01 pm

9 **a** 8 hours **b** 8:20 am

c Teacher to check

10 **a** 49 minutes **b** 11:15 am

11 **a** 2:35 am **b** 12 hours, 37 minutes

c 12 hours 16 minutes

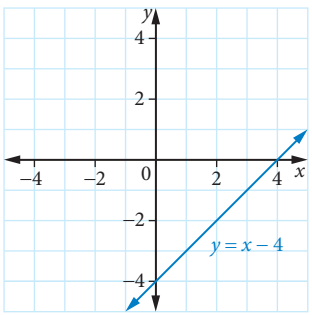
d 0.24 m

12 **a** 8 days **b** 29 days

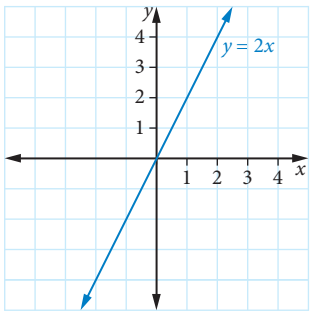
CHAPTER 13

EXERCISE 13.1

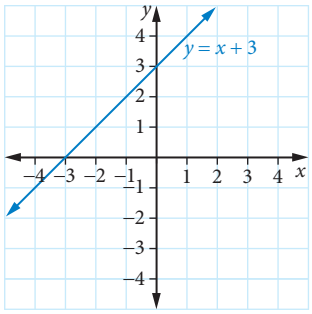
1 **a**



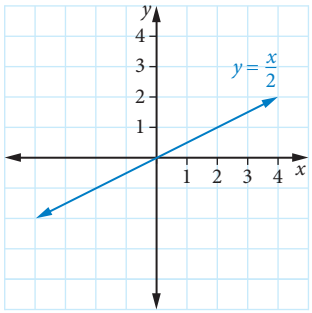
b



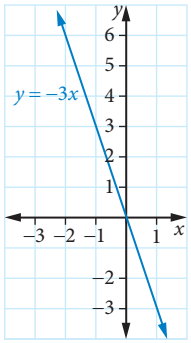
c



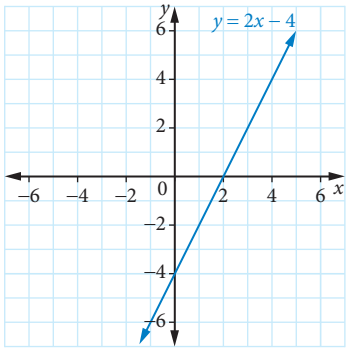
d



e

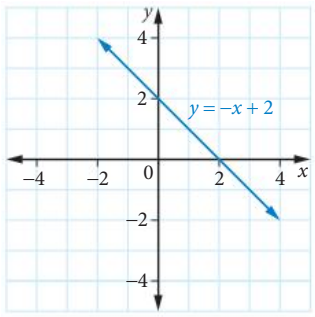


f

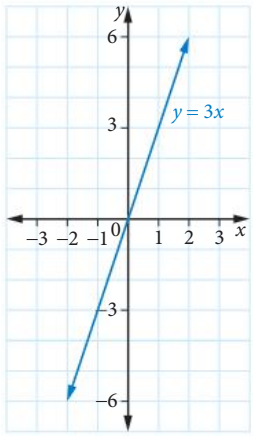


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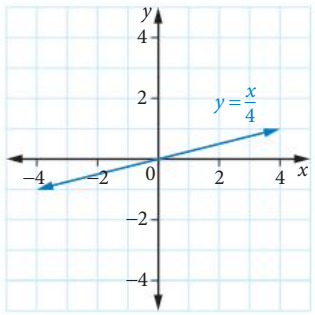
g



h



i



2 **a** $\frac{1}{2}$, 2 **b** 3, −1

c 1, 6 **d** $\frac{1}{2}$, 1

3 **a** **i** −1 **ii** 7 **iii** 7

b **i** 4 **ii** 0 **iii** 0

c **i** 3 **ii** 2 **iii** $-\frac{2}{3}$

d **i** −2 **ii** 3 **iii** $1\frac{1}{2}$

e **i** $\frac{1}{4}$ **ii** −2 **iii** 8

f **i** $-\frac{1}{3}$ **ii** −4 **iii** 12

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 13.2

1 **a** 40

b The number of chirps when the temperature is zero.

c 8

d The additional number of chirps per minute when the temperature increases by 1°C.

e 296 **f** 15°C

g 840, not realistic

2 **a** 0 **b** −3.5

c Number of degrees cooler at which water boils for every extra km in altitude.

d about 90°C **e** 68°C

f 28.6 km. It's a height that is almost 20 km higher than Mt Everest.

3 **a** Laura 14, Bevan 8, Jacob 3

b speed

c Jacob, he has the smallest gradient, or he didn't travel as far as the others in 1 hour.

d Laura bike, Bevan jog, Jacob walk

4 No, the graph says the head circumference should be about 35 cm, which it is.

5 **a** \$40 **b** $\frac{1}{4}$

c additional cost per ticket

d \$165 **e** $D = \frac{1}{2}n + 110$

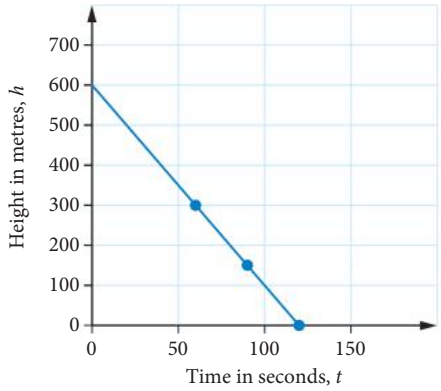
f 185

6 **a** \$50 **b** \$1 **c** $C = n + 50$

7 **a** 600 m **b** 5

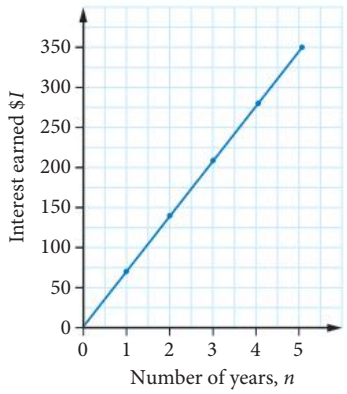
c She starts at 600 and is going down 5 m every second (−5).

d



e 120, the time taken for Belinda to reach the ground (120 s = 2 min)

8 **a**

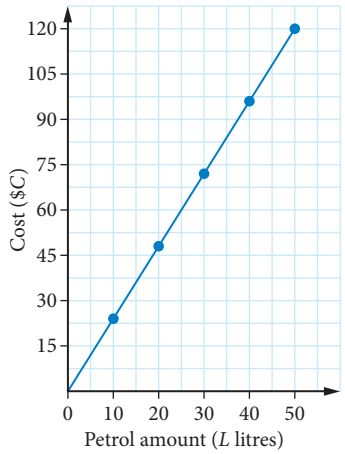


b 70, amount of interest each year

c 0, amount of interest at the start

d $490 **e** $2140

9 a

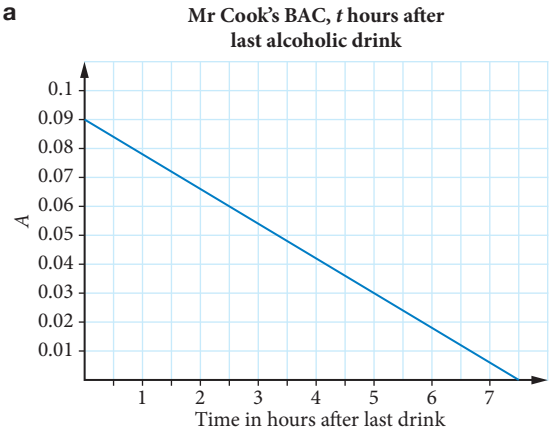


b 2.4 **c** $180

10 a Teacher to check **b** 2.5 m

c Yes, 4.2 m is more than 4 yards.

11 a



b 0.09

c BAC at 7 pm

d −0.012

e the amount the BAC goes down every hour

f $A = -0.012h + 0.09$

g 7.5 hours

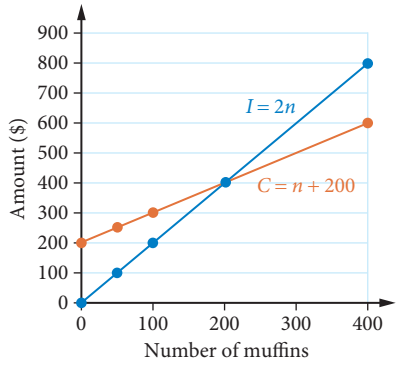
h the time when Mr Cook's BAC = 0, when there is no alcohol in his blood

i 10:20 pm (after $3\frac{1}{3}$ hours)

EXERCISE 13.3

1 a Teacher to check

b



c (200, 400) **d** break-even point

e No, he needs to sell more than 200 to break even.

f $30

2 a B **b** 3 min **c** B

3 a truck 72 km/h, car 96 km/h

b 2 **c** 2 seconds

d car: $m = -96 - 24t$, truck: $m = 72 - 12t$

e Both vehicles were slowing down.

f The (starting) speed of each vehicle when the brakes were applied.

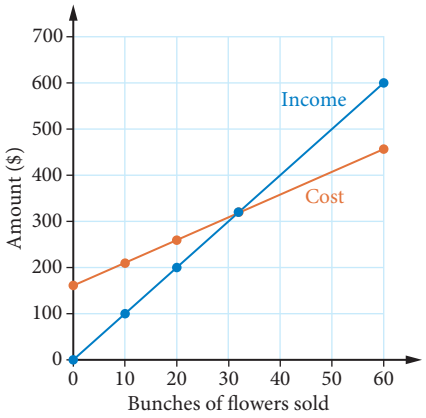
g The time when each vehicle came to a stop (zero speed).

h The truck was heavier.

4 a

Bunches of flowers sold	0	10	20	30	40	50	60
Income received ($)	0	100	200	300	400	500	600

b

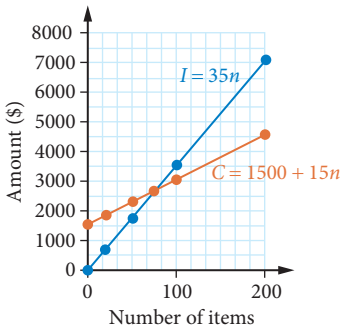


c The graphs intersect at (32, 320), which is the break-even point.

d More than 32 bunches

5 a income **b** expenses

c

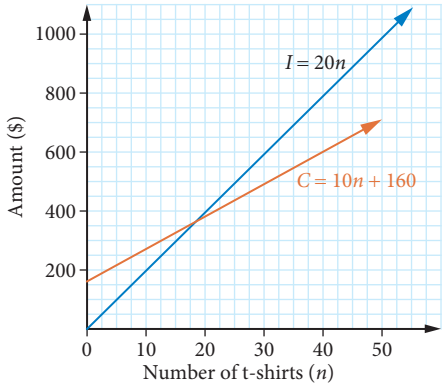


d 75 **e** $500

6 a $60 **b** 10 **c** $6

d It's the weekly cost of running the dog sleds, such as feeding the dogs. It doesn't change with the number of dog sled rides.

7 a $C = 10n + 160$ **b** $I = 20n$



d 16 **e** $740

8 a $40 **b** $10

c monthly service charge

d 20c **e** $D = 0.2n + 10$

f 150 **g** plan A

EXERCISE 13.4

1 a 800 m **b** 600 m

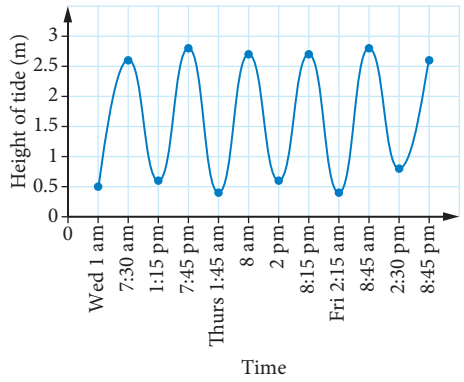
c 200 m **d** 360 m

2 5.5 m

3 a 45 m **b** 12 m **c** 100 m

4 a 33 m **b** 80 m **c** 72 m

5 a

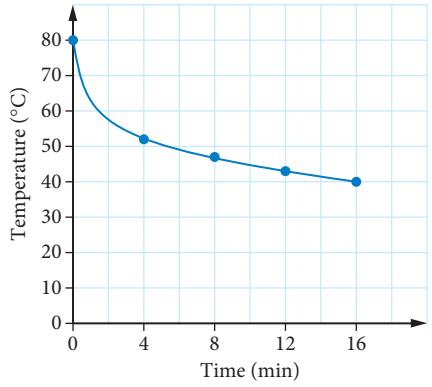


b approx. 1.5 m

c approx. 4:30 pm

6 a time

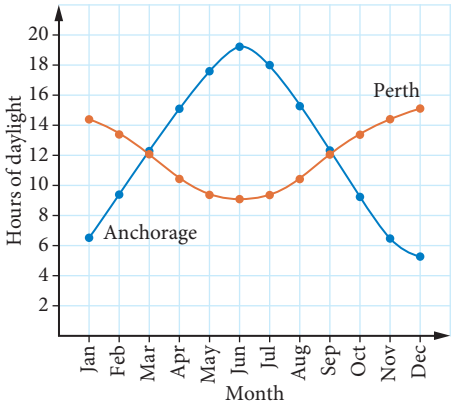
b



c approx. 74°C

d approx. 3 minutes

7 a



b They both begin and end at about the same place. Other answers possible.

c Anchorage starts low, goes up and comes down again – Perth is the opposite. Other answers possible.

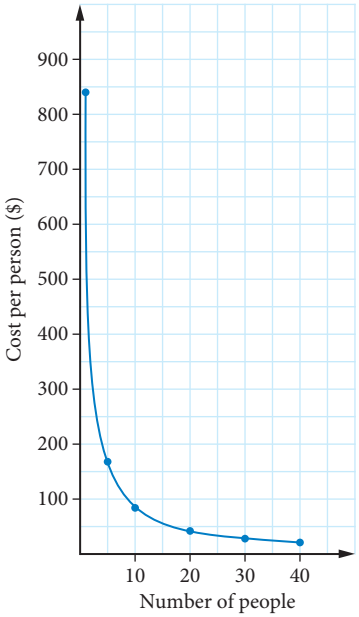
d March, September

e Anchorage is further north of the Equator than Perth is south of the Equator.

8 a

Number of people	1	5	10	20	30	40
Cost per person ($)	840	168	84	42	28	21

b

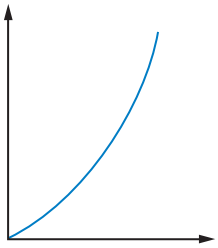


c approximately 30 **d** $30

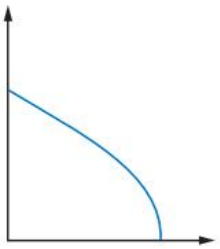
EXERCISE 13.5

1 a C **b** A **c** B

2



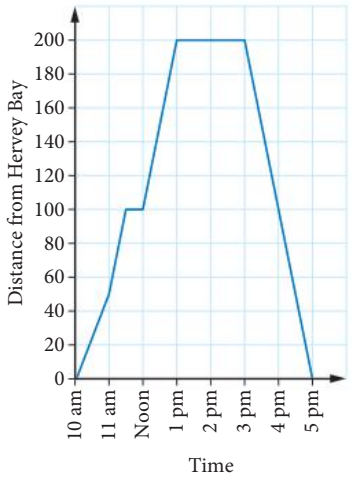
3



4–7 Teacher to check

8 a Teacher to check

b



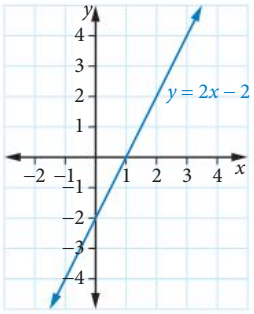
9 Teacher to check

KEYWORD ACTIVITY

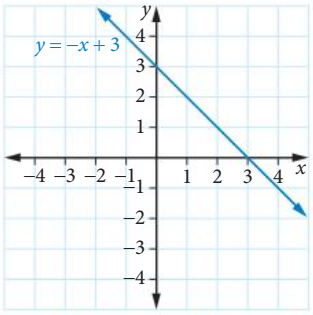
1 linear	**2** straight
3 gradient	**4** *y*-intercept
5 model	**6** intersecting
7 point	**8** income
9 costs	**10** expenses
11 break-even	**12** profit
13 loss	**14** curved

TEST YOURSELF 13

1 a



b



2 a 1, –3, 3 **b** $-2, 1, \frac{1}{2}$

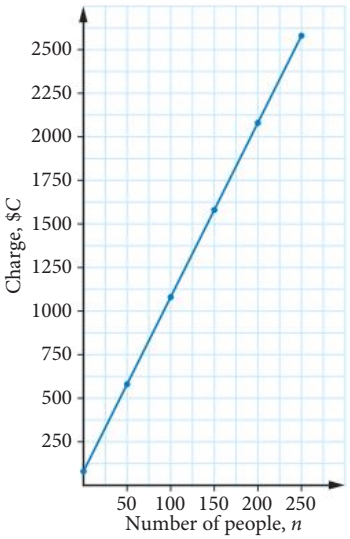
3 a $4, -3, \frac{3}{4}$ **b** –1, 2, 2 **c** $\frac{1}{3}, 0, 0$

4 a 3 min **b** 2

c time to pack an item

d 6 items **e** 33 minutes

5 a



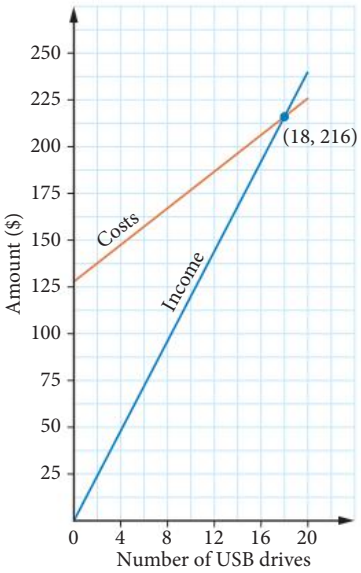
b $1780 **c** 75

d 80, the fixed charge

e 10, the cost per person

6 a $C = 5n + 126$ **b** $I = 12n$

c

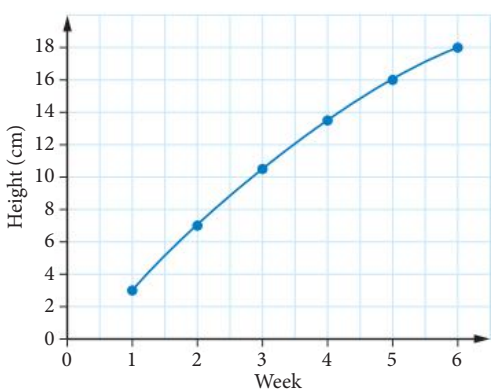


d 18 **e** $364

7 a approximately 48 m **b** 80 km/h

c 43 m

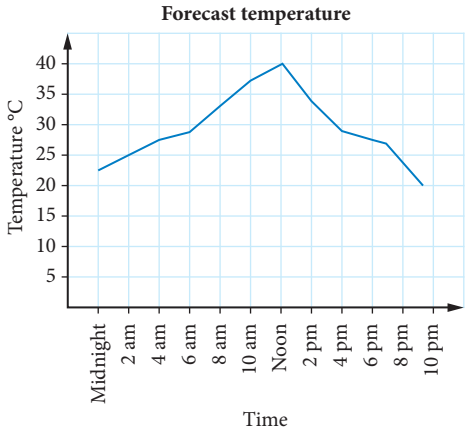
8



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9–10 Teacher to check

11 a



b Start before 5:30 am (to fit in one hour) or start after 4 pm.

PRACTICE SET 3

Section A

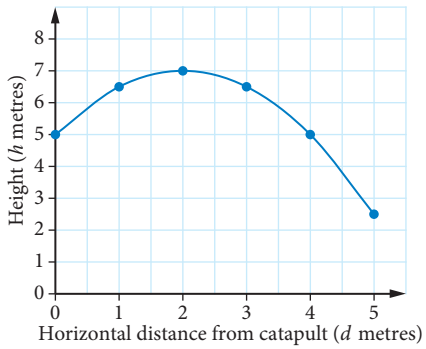
1 A **2** C **3** A
4 A **5** B **6** D
7 B **8** A

Section B

1 a 28 **b** 7
c 4.5 **d** 11

2 a 2019 **b** inner city **c** 2019, about 150

3 a

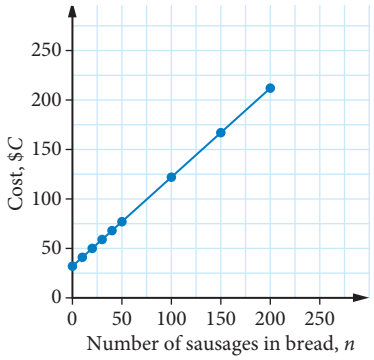


b 7 m

4 a 9:30 pm **b** 12:15 am the next day

5 Teacher to check

6 a



b approximately $185
c 32, this represents the fixed cost
d 0.9, this represents the cost per sausage in bread
e Profit: income $150, costs approximately $100

7 a 8:09 am
b 7:18 am, 7:48 am, 8:18 am
c 5:39 pm

8 a

Age group	Regular exercise	No regular exercise	Total
Under 40	60	50	110
40 and over	65	25	90
Total	125	75	200

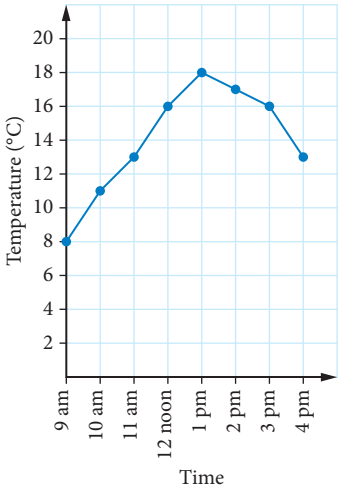
b 37.5% **c** 52%

9 a 20 toys **b** $500
c $C = 15n + 500$

10 a i 3:30 pm **ii** 2 pm
b i 12 midday **ii** 10 am

11 Teacher to check

12



CHAPTER 14

EXERCISE 14.1

1 Teacher to check

2 a CD **b** DD **c** AD
d PQ **e** WR **f** OD
g AD **h** CD **i** PQ
j DD **k** WR **l** OD

3–5 Teacher to check

EXERCISE 14.2

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 Qld schools
b people of voting age in Qld
c listeners of a radio station, or readers of a magazine, or musicians
d students at my school
e people of Qld
f the general population
g Year 12 students
h rich people
i people who shop at supermarkets
j the Australian cricket team

9780170484589

k internet banking customers of the bank
l customers of the communications company
m the population of the town and surrounding areas

EXERCISES 14.3, 14.4

Teacher to check

EXERCISE 14.5

1 a systematic **b** random
c self-selected **d** stratified
e self-selected **f** random
g systematic **h** self-selected
i systematic **j** stratified
k systematic **l** self-selected
m random **n** stratified
o systematic **p** stratified

2–4 Teacher to check

EXERCISE 14.6

1–3 Teacher to check
4 a 81 **b** 57 **c** 24
5 a 33 **b** 19
6 a 99 **b** 47 **c** 52
7 a 48 **b** 27
8 a No. He only surveys people who work in the centre of Brisbane. He misses country people and people who work elsewhere.
b Teacher to check

KEYWORD ACTIVITY

1 J **2** H **3** D
4 F **5** B **6** A
7 I **8** C **9** E
10 G

TEST YOURSELF 14

1 Teacher to check
2 Sample, too expensive and time-consuming to do a census
3 a i families in the street **ii** census
b i companies operating in Qld **ii** sample
c i voting population of Australia **ii** sample
d i school students of Qld **ii** sample
4 Australian Bureau of Statistics; every 5 years in years ending with a 1 or 6.
5, 6 Teacher to check
7 a 75 **b** 59 **c** 16

CHAPTER 15

EXERCISE 15.1

1 3
2 4
3 Some people would have nowhere to tick, for example, a 30-year-old.
☐ 30 years or under
☐ From 31 to 40 years
☐ From 41 to 50 years
☐ Over 50 years
Other answers possible.
4 Which of the following do you attend?
☐ Concerts ☐ Special events
☐ Films ☐ Trips away
☐ Fundraisers ☐ Other
Other answers possible.
5 ☐ Weekly
☐ Once a month
☐ Once every 3 months
☐ Once every 6 months
Other answers possible.
6 For the activities you attend, the cost is:
☐ cheap
☐ OK
☐ expensive
☐ I don't attend activities because they are too expensive
Other answers possible.
7 Teacher to check
8 A box could be provided. Other answers possible.
9 Teacher to check

EXERCISE 15.2

1 a use of 'fascinating' and 'wet'
b use of 'disgusting'
c no negative options
d use of 'exciting' and 'boring'
e second half of question shouldn't be used
f no positive options
g use of 'quiet'
h use of 'greatest', yes/no response only
i use of 'one of those' and 'lame'
j no negative options
2 Teacher to check

EXERCISES 15.3, 15.4

Teacher to check

TEST YOURSELF 15

1 a Knowing what time frame to consider.
other answers possible.
b Make the question 'How often do you drink each week?'
☐ Once a week
☐ 2 to 3 times a week
☐ More than 3 times a week
☐ I don't drink
2–4 Teacher to check

CHAPTER 16

EXERCISE 16.1

1 **a** $T = 5$ **b** $D = 240$

2 **a** 180 km **b** 4 hours

3 80 km/h **4** 275 km **5** 8 km

6 **a** 0.15 hours **b** 9 min

7 7.5 minutes

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.

15 **a** 8 km **b** 4 km **c** 1 hour

d 4 km/h **e** 2 hours **f** 6 km/h

g The second hour is uphill. In the first hour, his speed was 8 km/h and in the second hour his speed was only 4 km/h.

16 **a** **i** 2 pm **ii** 11 am

b 12:45 pm **c** 48 km **d** 4.5 h

e **i** 16 km/h **ii** 6.4 km/h **iii** 9.6 km/h **iv** 9.6 km/h

17 **a** 240 km

b Sam, steeper graph, ending journey earlier.

c 120 km **d** 180 km

e 10 am, 160 km

f after 9:15 am, graph is steeper

g 40 km/h **h** B

18

Graph	Person	Distance from school
A	Luke	10 km
B	Peta	8 km
C	Wayne	4 km
D	Shelby	2 km

19 Teacher to check

EXERCISE 16.2

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 16.3

1 **a** Helensvale Primary

b churches

c Helensvale Plaza

d red cross

2 **a** H14 **b** A6 **c** J9 or J10

3 **a** west **b** north

c south **d** east

4 **a** 250 m **b** 3.5 km

c 2.5 km **d** 3 km

5 Doyalson Place

6 Walk north along Discovery Drive for approximately 500 m. Turn right into Ashford Rd. Quirindi Ct is the third street on the right.

7 Turn right at the next set of traffic lights into Discovery Drive. Follow Discovery Drive for approximately 3 km until you get to the roundabout at Helensvale High School. Turn left into Helensvale Rd. Follow Helensvale Rd to the motorway on-ramp.

8 Drive north on Kingston and take the first right into Habana St. Take the first left into Milaroo Drive. Follow Milaroo Drive to the intersection with the Gold Coast Highway.

9 **a** east **b** 560 m

10 **a** Walk northwest along Port Hacking Rd, then follow the road around to the right. Turn down Blamey Ave, the first on the left. Keep walking until you reach Mirral Rd. Alternative routes using Regatta Ave or Mirral Rd via Turriell Bay Rd also possible.

b 590 m **c** 9 minutes

EXERCISE 16.4

1 **a** 300 m **b** 1160 m **c** 1900 m

2 **a** 1 : 10 000 **b** 1 km **c** 680 m

d 1.4 km **e** 11:28 am

3 **a** 800 m **b** approximately 13 minutes

4 **a** 200 km **b** 36 km/h

c The average speed is low. The road is probably not sealed and rough in places.

5 **a** 20 m **b** 60 m and 115 m

c $4900

6 **a** Even numbers from 156 to 190 and 175, 177, 181.

b 131 m **c** 311 m **d** around 21 m

e It will flood during 1-in-50-year floods.

7 **a** 11.6 km **b** 2 h 54 min

c southwest of North Era

EXERCISE 16.5

1 **a** *ABCD*, *AFD*, *AED*

b 27 km, 25 km, 24 km

c *AED*

2 **a** *A* to *B* via the curve is 17 km, *ADB* 16 km, *ACB* 17 km

b 15 km **c** *ACDB*

ANSWERS

3 **a** *ADC, ABC, ABDC, ADBC*
b *ADBC*

4 **a** via the hotel **b** 6 km **c** 7 km

5 The shortest routes involve going directly to Southside, then taking the appropriate road to the fire.

6 Head north-west along East Esplanade for 200 m and turn right into Belgrave St. Drive for 400 m and turn left onto Raglan St. Manly Oval is on your left when you turn in.

EXERCISE 16.6

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** approximately 37 km/h

8 $182

9 **a** 2:30 pm **b** $18 each **c** $11 each

10 10:59 am

EXERCISE 16.7

Note: Answers will vary for those questions requiring the use of a GPS mapping app or website.

1 **a** 36 min **b** $26 **c** 1 h 8 min
d every 30 min **e** 11:19 am **f** 2 min

2 **a** 1.9 km **b** 28 min **c** 9:32 am
d southwest **e** left
f No, it's mostly flat.

3 **a** 1.2 km **b** 3 min **c** 17 min
d Teacher to check, or see worked solution.

4 **a** Walk southeast on Ward St, turn right onto Eden Ave then slight right at Hill St. Turn left onto Oceanway then follow Oceanway for 1.7 km.
b Yes, it's mostly flat. **c** 2 km
d 27 min **e** 1:33 pm
f Answers may vary, for example, Board Shorts Barista.

5 **a** 1.9 km **b** 12 min
c Walk up Lake View Dr towards the lake. Turn left, walk about 400 m along Goodchap St to the bus stop near Ridge St. Catch the bus. Get off the bus at Pointciana Ave at Ward Park, turn left into Moorindil St. Walk about 120 m and the church will be on the left.
d Answers may vary; for example, 1:45 pm may be a bit late, leaving only 3 minutes to spare. She should refer to the bus timetable and check the bus is running on time. It is good to be seated for a funeral before the starting time.

6 **a** 273 km **b** 3 h 9 min **c** 90 km/h
d Answers may vary; for example, Yurika Charging Station, Alma St, Rockhampton.
e Open 24 hours.

7 **a** yes **b** 21 min **c** 23.68 km
d 68 km/h **e** 3:24 pm
f Answers may vary, for example, Hunter Café, head south on Dunbar St for 700 m (2 min).

8 **a** 595 km **b** 7 h 40 min **c** State Route 62
d 8:20 am
e Answers may vary, for example, it's too far to drive without several stops. He should leave by 6 am and stop for rest breaks on the way.
f 42 L

EXERCISE 16.8

1 **a** 7:30 am **b** 45 min **c** 6 hours
d 93 km/h **e** 3:17 am **f** 18 min
g 10:20 am **h** 26 hours 50 min
i $861
j $11. Many answers possible, for example, they wanted to see more of the countryside; or, the airline might charge more to include luggage; or, they didn't want a long stopover.

2 $170

3 **a** northwest **b** 75 km/h

4 **a** $210 **b** $20
c They need 2 caravans, but only 1 cabin.
d No; teacher to discuss

5 **a** Moockra Tower Lookout
b Bruce
c Middle Gorge
d Teacher to check

6 **a** 290 km **b** 5 h 16 min

7 **a** They only need 1 room, but they would need 2 rooms at the Greenwood Lodge.
b $315

8 **a** 0900. The 1345 flight lands at 1545, which only leaves 75 minutes to allow for any delays and checking in for their flight. It may not be sufficient time and they could miss their flight home.
b 2010 or 8:10 pm

KEYWORD ACTIVITY

Across

5 coordinates **8** distance
9 compass **11** GPS

Down

1 second **2** kilometres
3 south **4** scale
6 northwest **7** speed
10 map

TEST YOURSELF 16

1 3 hours **2** 15 km
3 20 m/s **4** 25 m/s
5 4 km/h

6 **a** Average speed
= total distance travelled ÷ total time taken

b 52 km **c** 10.4 km/h

7 Studio Village

8 1 km

9 At the end of Cannington Pl, turn left into Lindfield Rd. Take the second street on the right (Discovery Drive), then first left and second right.

10 **a** northwest

b approximately 1400 m

c approximately 1 hour

d approximately 11:40 am

11 **a** 15 (*ABDC*) **b** 17 (*ABC*)

12 18 (*ABEDC*)

13 **a** 4WD (4-wheel-drive) vehicle

b Alice Springs – Eridunda – Mt Ebenezer – Luntja Rd

c Head south on Luntja Rd, turn right at Lasseter Highway.

d 200 km **e** Curtin Springs

f west **g** northeast

14 Answers may vary.

a 900 m **b** 7 min **c** 43 km/h

PRACTICE SET 4

Section A

1 C **2** A **3** D

4 B **5** B **6** B

7 B **8** B

Section B

1 Every 5 years: 2026, 2031.

2 **a** Pacific Pines High School

b J9, J10

3 Teacher to check. For example:

- ☐ More than twice per week
- ☐ 1–2 times per week
- ☐ Not every week but more than twice per month
- ☐ 1–2 times per month
- ☐ Not every month but more than twice per year
- ☐ 1–2 times per year
- ☐ Never

4 If students are choosing whether or not to participate in the survey, then the sample is not random and may not represent the views of all students, including perhaps a silent majority.

5 **a** 75 m/min **b** 4.5 km/h

6 **a** only positive responses available

b Teacher to check

7 **a** SE **b** N **c** NW

8 **a** restricted to Brisbane people and tourists visiting the Wheel

b Survey people all over Queensland and not only by face-to-face interview but by phone and video call as well.

9 **a** 84 **b** 45 **c** 13

10 Answers may vary.

a 1 h 32 min

b Walk to Airtrain Station and catch the train to South Bank. Take a 4-minute walk to South Bank busway station. Take the Logan Hyperdome bus 555. Travel 7 stops to Rochedale Rd near Packman Ave. The 450 m walk to Thallon St will take about 6 minutes.

c 4.5 km/h

d M1 on the toll road, M1 and Rochedale Rd/State Route 30 or Moreton Dr and M1.

e 27 km

f 3:07 pm, traffic dependent

Glossary and index

12-hour time Time expressed using am or pm; for example, 2:35 pm. (p. 247)

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 representing 2:35 pm. (p. 247)

allowable tax deductions 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. 184)

allowances (worker's) Money paid to a worker for job-related expenses (for example, travel, special clothing, working in isolated or dangerous areas). (p. 147)

annual Per year. (pp. 13, 141)

annual leave loading Extra pay given to a worker during annual leave, usually 17.5% of 4 weeks pay. (p. 151)

Australian Central Standard Time (ACST) The time zone for central Australia: the Northern Territory and South Australia. (p. 251)

Australian Eastern Standard Time (AEST) The time zone for eastern Australia: Queensland, NSW, the ACT, Victoria and Tasmania. (p. 251)

Australian Western Standard Time (AWST) The time zone for Western Australia. (p. 251)

bar chart *See* **column graph**.

bias In statistics, an unwanted influence that stops a sample or survey from being representative of a population. (p. 315)

BIDMAS *See* **order of operations**.

bonus Extra pay for doing good work, or meeting targets or deadlines. (p. 147)

break-even point The point or value of sales at which a business stops making a loss and starts making a profit. (p. 279)

budget A plan for managing money. (p. 198)

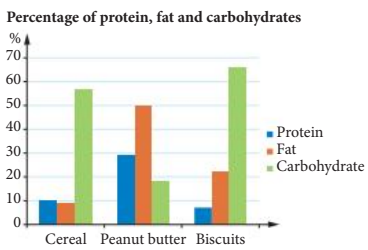
calories (Cal) An imperial measure of the energy contained in food. (p. 167)

categorical data Information represented as a category rather than a number; for example, the makes of cars or the colours of eyes. (p. 123) Differs from **numerical data**.

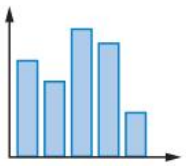
census Collection of information about every item or person of a population. (p. 301)

climate graph A graph that shows the 12-month pattern of rainfall and temperature of a city by showing a column graph of rainfall and line graphs of maximum and minimum temperatures. (p. 223)

clustered column graph A column graph with 2 or more columns stuck together for each category on the horizontal axis. (p. 215)



column graph (or **bar chart**) A graph consisting of columns of equal width and used to display categorical data. (p. 124)



commission The earnings of a salesperson or agent; usually a percentage of the value of items sold. (p. 39)

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) and southwest (SW). (p. 335)

constant A number on its own in an equation. For example, in the equation $y = 2x + 3$, the constant is 3. (p. 271)

constant of proportion The k in $y = kx$. (p. 74)
See also **direct proportion**.

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. 217)

coordinates (on a map) A pair of values and/or letters for describing a location on a map; for example, D4. (p. 338)

cost price The price it costs a shop to buy a product from the factory or wholesaler. (p. 34)

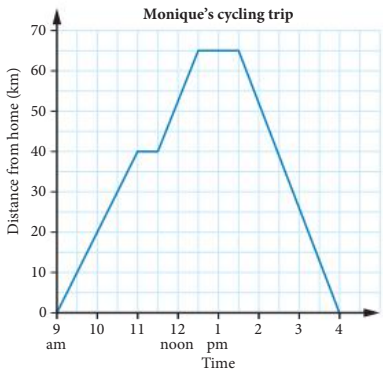
data Statistical information. (p. 123)

decrease To make smaller. (p. 35)

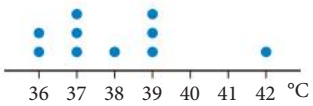
direct proportion (or **direct variation**) A linear relationship between 2 variables x and y such that $y = kx$, where k is a constant number called the **constant of proportion.** y is directly proportional to x. When x increases, y increases. (p. 74)

discount Money deducted from the usual marked price. (p. 35)

distance–time graph A line graph that describes a journey, by comparing distance on the vertical axis with time on the horizontal axis. The slope or steepness of the graph measures speed. (p. 329)



dot plot A graph that uses dots to show frequencies of data scores. (p. 129)



double time A rate of overtime pay that is 2 times the normal hourly rate. (p. 145)

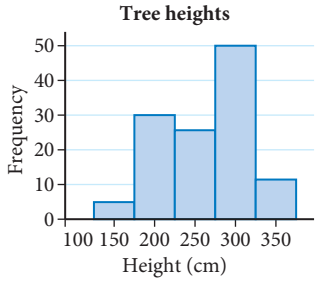
estimate To make an educated guess for a numerical answer. (p. 15)

expense The cost of spending. (p. 198)

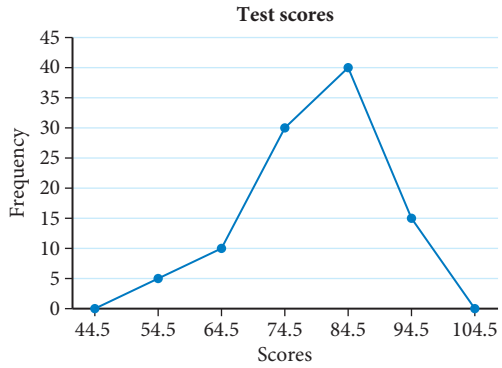
fortnight Two weeks. (p. 13)

frequency The number of times a data value or group of values occurs in a data set. (p. 124)

frequency histogram A column graph in which the height of each column represents the frequency of a data value or of grouped values. There is no space between the columns. (p. 126)



frequency polygon A line graph formed by joining the midpoints of the tops of the columns of a frequency histogram. (p. 227)



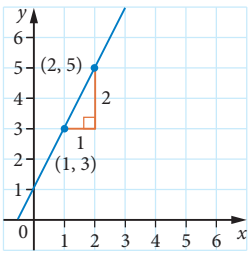
frequency table A table that lists the frequency of each item in a data set. (p. 124)

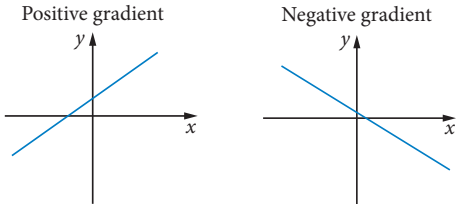
fuel consumption The rate at which a vehicle uses fuel, measured in litres/100 km. (p. 71)

global positioning system (GPS) A system of identifying your position on Earth on your phone or computer using satellite technology and the internet. (p. 355)

goods and services tax (GST) Good and services tax, currently 10% in Australia. (pp. 33, 110)

gradient The steepness of a line. For the line graphed, gradient $= \frac{2}{1} = 2$. (p. 269)





gross income Your pay before the tax is taken out. (p. 183) *See also* **net income**.

GST *See* **goods and services tax**.

heart rate *See* **pulse**.

histogram *See* **frequency histogram**.

holiday loading *See* **annual leave loading**.

horizontal intercept *See* ***x*-intercept.**

income Money that is earned or gained (usually regularly). (p. 198)

income tax A tax paid to the government based on the amount of income you earn. (p. 183)

increase To make bigger. (p. 33)

integer A positive or negative whole number or zero; for example, –3, 7, 0. (p. 9)

kilo- One thousand.

kilogram 1000 grams.

kilojoules (kJ) A measure of the energy contained in food. (p. 167)

kilometre 1000 metres.

kilowatt (kW) A unit of electrical power equal to 1000 watts. (p. 173)

kilowatt hour (kWh) A unit of electrical energy equivalent to that used by one kilowatt of power in one hour. (p. 173)

leading digit approximation A method of approximating the value of a calculation by rounding each number to the first digit. For example, $19.5 \times 324.98 \times 0.008\,67 \approx 20 \times 300 \times 0.009 = 54$. (p. 15)

leave loading *See* **annual leave loading**.

line graph A graph made of lines joining data points, often used to represent data that changes over time (p. 216)

loss The amount of money lost by a shop on an item; loss = cost price – selling price. (p. 37)

map scale *See* **scale**.

mark-up An increase in the price of an item. (p. 34)

Medicare levy A tax to cover the costs of the public health system, calculated as a percentage of a person's income. (p. 188)

net income Your pay after the tax has been taken out. (p. 183) *See also* **gross income**.

numerical data Data that involves numbers, such as heights or the number of cars owned. (p. 123)

order of operations The order in which to 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. 11)

outlier An extreme (high or low) score in a data set that is very different from the other scores. (p. 133)

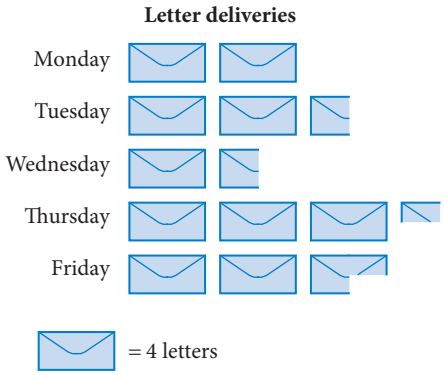
overtime Work beyond normal hours, paid at a higher rate. (p. 145)

PAYG payment summary A statement from your employer, published at the end of a financial year, stating how much you earned and how much PAYG tax was taken out of your pay over the year. (p.184)

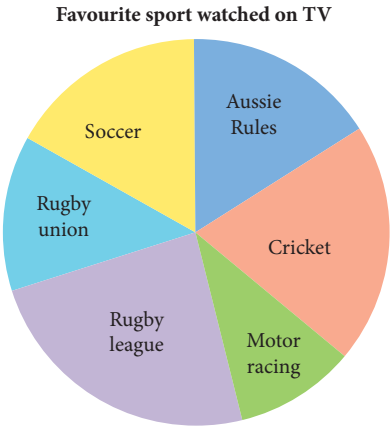
PAYG tax Pay As You Go tax; regular deductions from your pay, an advance payment of your income tax due at the end of the financial year. (p. 183)

per annum (p.a.) Per year. (p. 142)

picture graph A type of graph in which pictures are used to indicate quantities. (p. 213)



pie graph (or **sector graph**) A graph using a circle divided into parts called sectors. (p. 219)



piecework A type of work in which a worker is paid per item produced or processed, such as dressmaking or craftwork. (p. 153)

profit The amount of money gained or made by a shop on an item; profit = selling price – cost price. (p. 37)

proportion *See* **direct proportion**.

pulse (or **heart rate**) The rate at which a heart beats, measured in beats per minute. (p. 175)

quarterly Every 3 months (quarter of a year). (p. 196)

random sample A sample for which every member of a population has an equal chance of selection. (p. 306)

rate A comparison of 2 quantities with different units; for example, km/h. (p. 63)

ratio A comparison of 2 quantities with the same units; for example, 2 : 3. (p. 83)

retainer A fixed amount of money paid to a salesperson that does not depend on sales; paid before commission is added. (p. 40)

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. 153)

salary Fixed earnings quoted as a yearly amount, but paid weekly, fortnightly or monthly. (p. 141) *See also* **wage**.

sample A group of items selected from a population for surveying. (p. 301)

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. (p. 93)

scale drawing A diagram of an object, usually smaller, whose lengths are in the same ratio as the actual lengths of the object. (p. 93)

sector graph *See* **pie graph**.

self-selected sample A sample in which people volunteer to be part of the sample, such as an SMS poll or a website survey, so it is not actually random. (p. 306)

selling price The price a shop sells a product for. (p. 34)

solution The detailed answer to a problem, or the method of solving it. (p. 47)

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).

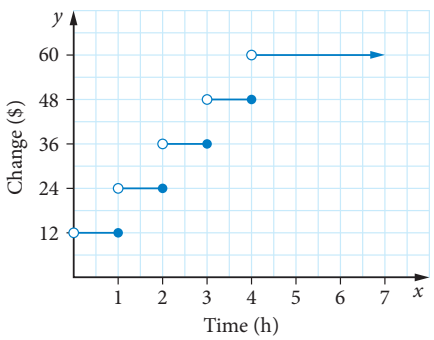
$$\text{speed} = \frac{\text{distance}}{\text{time}} \text{ (p. 63)}$$

statistics The study of collecting, organising, analysing and presenting data. (p. 301)

stem plot or **stem-and-leaf plot** A 'number graph' that lists all the data scores, in groups. For example, this stem-and-leaf plot shows 12 test scores, from 42 to 82. (p. 129)

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. 218)



stratified sample A sample consisting of a percentage of items from each 'strata' or 'layer' of a population. For example, a stratified sample from a population of 35% children and 65% adults should contain 35% children and 65% adults. (p. 306)

superannuation A retirement fund that your employer pays into each time you are paid at work. It provides an income for you after you have completed your formal working life. (p. 158)

systematic sample A sample chosen by using a set pattern For example, choosing every 10th person in a database. (p. 306)

tax debt The amount by which the amount of **PAYG tax** already paid is below the amount of tax due. This is owed by the taxpayer to the Australian Tax Office (ATO). (p. 184)

tax deduction *See* **allowable tax deduction**.

tax refund The amount by which the amount of **PAYG tax** already paid is above the amount of tax due. This is given back to the taxpayer by the Australian Tax Office. (p. 184)

tax return A form completed at the end of a financial year to state income earned, allowable deductions and tax already paid. Used to calculate a **tax refund** or **tax debt**. (p. 184)

taxable income The part of a person's income that is taxed. It is equal to yearly income minus allowable deductions. (p. 184)

time-and-a-half A rate of overtime pay that is 1.5 times the normal hourly rate. (p. 145)

time zone A vertical zone where all locations have the same time of day; for example, central Australia (Northern Territory and South Australia) uses the Australian Central Standard Time zone (ACST). (p. 251)

timetable A table displaying a schedule of events; for example, the times trains arrive and depart. (p. 253)

two-way table A table that shows 2 characteristics of a set of data. (p. 220)

	Right-footed	Left-footed	Total
Right-handed	50	10	60
Left-handed	12	8	20
Total	62	18	80

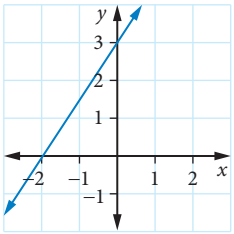
unit price In supermarket pricing, the price of one unit such as 100 g or 1 L. (p. 66)

vertical intercept *See* ***y*-intercept**.

wage An amount paid for work as a rate in dollars per hour. (p. 141)

***x*-intercept** (or **horizontal intercept**) The value at which a graph cuts the x-axis. For example, the x-intercept of the graph at bottom of this column is -2. (p. 269)

***y*-intercept** (or **vertical intercept**) The value at which a graph cuts the y-axis. For example, the y-intercept of this graph is 3. (p. 269)



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