MATHS QUEST

VCE FOUNDATION MATHEMATICS

MATHS SKILLS

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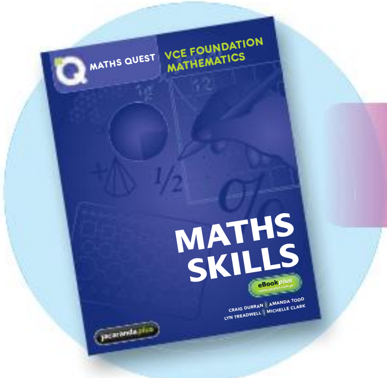
Maths Quest VCE Foundation Mathematics is an innovative approach to the teaching and learning of the VCE Maths curriculum.



Maths skills covers the essential core key skills from the VCE Foundation Maths course. These skills are then built upon in the setting of the themed booklets.

The other seven books cover the remainder of the content at a deeper level by taking a practical approach.

The order of the themed booklets can be tailored to the needs and interests of your class.

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INTRODUCTION

Maths skills

We use mathematical skills every day, quite often without even realising it. This book contains activities that help to develop and refine some more commonly used mathematical processes.

There are many different ways to approach questions, and we have all learned different ways of getting to the same answer. If you have your own methods that are mathematically correct, you may wish to stay with these more familiar steps. Check with your teacher that your processes are acceptable.

This book has topics that will overlap with the subjects that are covered in other books in the set, so you may choose to come back and revise some ideas from this book before continuing with the themed books in the set.

contents

KEY SKILL 1

Fractions

Every day of our lives we make decisions that involve fractions. We might be cutting a cake into portions or dividing money among a group of friends. Changing a recipe to cater for more or fewer people requires an understanding of fractions. Many occupations require a knowledge of how to calculate fractions of quantities.

Language of fractions

Numerator: the top number

Denominator: the bottom number

Simplest form: when there are no numbers that can divide exactly into the numerator and denominator

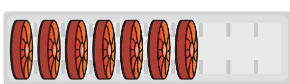
Proper fraction: a fraction with a numerator smaller than the denominator

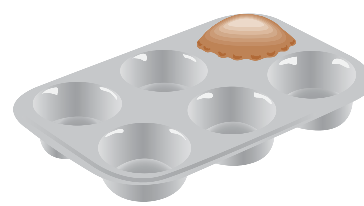
Improper fraction: a fraction with a numerator larger than the denominator

Mixed number: a whole number and a proper fraction

QUESTIONS

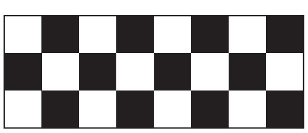
1 Write the **fraction** for the amount shown.

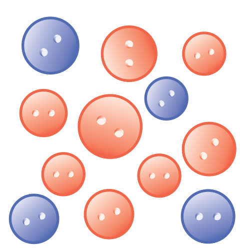


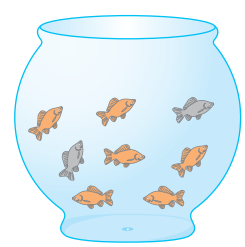


a = **b** = **c** =

2 Write out the fraction that is described, and **then** cancel down this fraction into its simplest form.







a White squares **b** Blue buttons **c** Orange fish

3 Cancel each of these fractions into their simplest form by finding the largest number that divides into **both** the numerator and denominator.

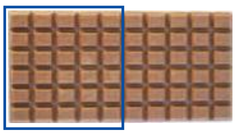
a $\frac{10}{15} = \frac{\quad}{\quad}$ **b** $\frac{20}{40} =$ **c** $\frac{21}{35} =$

d $\frac{40}{25} =$ **e** $\frac{25}{75} =$ **f** $\frac{160}{400} =$

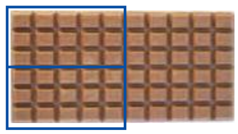
KEY SKILL 2

Equivalent fractions

Equivalent fractions are equal to each other: they are worth the **same** amount. Equivalent fractions can be found by either multiplying or dividing **both** numerator and denominator by the **same amount**.



$\frac{1}{2}$



$\frac{2}{4}$

$$\frac{1}{2} \underset{\times 2}{\overset{\times 2}{=}} \frac{2}{4} = \frac{3}{6} = \frac{4}{8}$$

×3 ×4 ×3 ×4

WORKED EXAMPLE

Fill in the missing amounts: $\frac{2}{5} = \frac{4}{\quad} = \frac{6}{15} = \frac{\quad}{30}$.

THINK	WRITE
To make a 2 into a 4 you need to × 2.	$\frac{2}{5} \underset{\times 2}{\overset{\times 2}{=}} \frac{4}{10}$
To make a 5 into a 30 you need to × 6.	$\frac{2}{5} \underset{\times 6}{\overset{\times 6}{=}} \frac{12}{30}$

QUESTIONS

Draw in your own links and find the missing numbers.

1 $\frac{4}{5} = \frac{\quad}{10} = \frac{\quad}{20} = \frac{24}{\quad}$

2 $\frac{2}{3} = \frac{4}{\quad} = \frac{\quad}{12} = \frac{20}{\quad}$

3 $\frac{2}{5} = \frac{\quad}{10} = \frac{\quad}{25} = \frac{12}{\quad}$

4 $\frac{2}{7} = \frac{4}{\quad} = \frac{16}{\quad} = \frac{20}{\quad}$

5 $\frac{5}{9} = \frac{\quad}{18} = \frac{\quad}{45} = \frac{50}{\quad}$

6 $\frac{7}{11} = \frac{14}{\quad} = \frac{35}{\quad} = \frac{\quad}{121}$

7 Ben ate 15 chocolates from a box of 25 chocolates.

a Write this as a fraction.

b Write the fraction in its simplest form.

c What fraction is left?

KEY SKILL 3

Multiplying fractions

Multiplying fractions is an important skill to have as it will not just be used for fractions but also when calculating **percentages**.

Being able to cancel down is important because it minimises the size of the numbers that are being used.

Remember that you can cancel the **numerator** and the **denominator** from one fraction or cancel **diagonally** across two fractions.

Remember the saying: **cancel one from the top with one from the bottom**.

WORKED EXAMPLE

a Multiply $\frac{3}{4} \times \frac{5}{7}$. **b** Multiply $\frac{6}{7} \times \frac{5}{12}$. **c** Multiply $\frac{4}{5} \times 100$.

THINK	WRITE
a Can any numbers on the top lines cancel down with numbers on the bottom? No.	$\frac{3}{4} \times \frac{5}{7}$
Write out the two numbers on the top lines together on one single top line, and write out the two bottom numbers together on a single bottom line.	$\frac{3 \times 5}{4 \times 7}$
Multiply the top numbers, and multiply the bottom numbers.	$\frac{15}{28}$
b Can any numbers on the top lines cancel down with numbers on the bottom? Yes.	$\frac{6}{7} \times \frac{5}{12}$
Cancel down by finding what number will divide exactly into the top and bottom numbers.	$\frac{^{1}\cancel{6}}{7} \times \frac{5}{_{2}\cancel{12}}$
Multiply what remains after cancelling down.	$\frac{1}{7} \times \frac{5}{2}$
Multiply the top numbers, and multiply the bottom numbers.	$\frac{5}{14}$
c Make 100 into a fraction by putting it over 1.	$\frac{4}{5} \times \frac{100}{1}$
Check to see if there is any cancelling to be done.	$\frac{4}{_{1}\cancel{5}} \times \frac{\cancel{100}^{20}}{1}$
Multiply the top numbers, and multiply the bottom numbers.	$\frac{4}{1} \times \frac{20}{1} = \frac{80}{1} = 80$

QUESTIONS

1 Check to see what can be cancelled down, and then multiply these fractions.

a $\frac{5}{6} \times \frac{3}{10}$

b $\frac{7}{10} \times \frac{5}{21}$

c $\frac{2}{15} \times \frac{10}{11}$

d $\frac{3}{8} \times \frac{12}{13}$

e $\frac{25}{63} \times \frac{9}{35}$

f $\frac{15}{42} \times \frac{14}{25}$

g $\frac{20}{50} \times \frac{100}{1}$

h $\frac{25}{75} \times \frac{6}{7}$

2 Multiply each of the fractions with the whole number.

a $\frac{3}{5} \times 100$

b $\frac{25}{75} \times 100$

c $\frac{1}{5} \times 100$

d $\frac{49}{50} \times 100$

e $\frac{6}{9} \times 45$

f $\frac{2}{3} \times 90$

g $\frac{1}{6} \times 54$

h $\frac{20}{55} \times 110$

3 a In a box of 50 matches, only $\frac{4}{5}$ of them would strike. How many matches is this?

b In a school, $\frac{6}{7}$ of a group of 84 Year 11 students have a part-time job. How many is this?

c In a bag of 720 lollies, $\frac{2}{9}$ of them are jelly beans. How many jelly beans are there?

d In a box of 300 nails, $\frac{1}{20}$ are faulty and cannot be used. How many nails **can** be used?

KEY SKILL 4

Decimal numbers

We work with decimal numbers (decimals) every day. Money is given in decimal numbers. Many measurements are given in decimals. When using a calculator, often the answers are decimal numbers, sometimes with many numbers after the decimal point. It is vital that that we can accurately reduce these large numbers to something more useful by **rounding off**. Probably the most common amount to **round off** to is **2** decimal places. All money is **rounded off** to 2 places, giving dollars before the decimal point and cents after it.

WORKED EXAMPLE

Round off the following numbers to 2 decimal places: 2.47423 and 76.4285.

THINK	WRITE	
Underline the first two numbers after the decimal point.	2.<u>47</u>423	76.<u>42</u>85
Draw a line to cut through the number immediately after the underlined numbers.	2.<u>47</u>/423	76.<u>42</u>/85
Look at the number that is immediately after the line that has cut through the original decimal number.	4	8
If it is **between 0 and 4**, all numbers after the cutting line can be removed. If it is **between 5 and 9**, add 1 to the last number before the cutting line and then remove all of the numbers after the cutting line.	2.47/423 = 2.47	76.<u>42</u>/85 = 76.43

QUESTIONS

1 Round off these numbers to 2 decimal places by filling in the missing numbers.

a 234.023674
= 234.<u>02</u>/3674
=

b 48.5822233
= 48.<u>58</u>/22233
=

c 0.165201
= 0.<u>16</u>/5201
=

d 200.171436
= 200.<u>17</u>/1436
=

e 0.9878900
= 0.<u>98</u>/78900
=

f 0.00982315
= 0.<u>00</u>/982315
=

2 Using the same method, round these numbers off to 3 decimal places.

a 0.5962017
= 0.<u>596</u>/2017
=

b 48.5822233
=
=

c 0.165801
=
=

KEY SKILL 5

Fractions to decimals

The easiest way to convert fractions to decimals is by using a calculator.

WORKED EXAMPLE

a Turn $\frac{4}{5}$ into a decimal number. **b** Turn $\frac{20}{16}$ into a decimal number.

THINK	WRITE
a $\frac{4}{5}$ means '4 divided by 5'.	$\frac{4}{5}$ is $4 \div 5$.
Use the calculator to turn $\frac{4}{5}$ into a decimal.	$4 \div 5 = 0.8$
b $\frac{20}{16}$ means '20 divided by 16'.	$\frac{20}{16}$ is $20 \div 16$.
Use the calculator to turn $\frac{20}{16}$ into a decimal.	$20 \div 16 = 1.25$

QUESTIONS

1 Fill in the table by using your calculator to convert these fractions into decimals.

a $\frac{1}{8}$	**b** $\frac{2}{3}$	**c** $\frac{75}{100}$
d $\frac{1}{4}$	**e** $\frac{3}{4}$	**f** $\frac{90}{100}$
g $\frac{1}{3}$	**h** $\frac{25}{75}$	**i** $\frac{25}{100}$
j $\frac{1}{2}$	**k** $\frac{50}{100}$	**l** $\frac{30}{40}$

2 Turn these improper fractions into decimal numbers.

a $\frac{15}{4}$	**b** $\frac{9}{2}$	**c** $\frac{56}{20}$
d $\frac{35}{2}$	**e** $\frac{150}{6}$	**f** $\frac{31}{5}$
g $\frac{226}{5}$	**h** $\frac{93}{5}$	**i** $\frac{221}{10}$
j $\frac{37}{4}$	**k** $\frac{450}{8}$	**l** $\frac{59}{3}$

KEY SKILL 6

Percentage skills

The three topics of decimals, fractions and percentages are very closely related and the skills used in one topic may be useful for others.

It is useful to remember that when you think of **percentages**, think of the number **100**. It's always the best place to start. For example:

50% means:

50 out of 100 or

50/100 or

50 ÷ 100 or

0.50

QUESTIONS

Complete the following table. The first two have been done for you.

	Percentage	Fraction	Will it cancel down?	Calculator steps	Decimal number
1	10%	$\frac{10}{100}$	$\frac{1}{10}$	10 ÷ 100	0.1
2	20%	$\frac{20}{100}$	$\frac{1}{5}$	20 ÷ 100	0.2
3	25%				
4	30%				
5	50%				
6	75%				
7	80%				
8	90%				
9	12.5%				
10	150%				
11	33.33%				
12	66.67%				

13 Mara collected shells at the beach. She collected 100 shells, of which 70 were in perfect condition.

a What percentage was in perfect condition?

b Write as a fraction the number of perfect shells out of the total number of shells.

c Write as a decimal the number of perfect shells out of the total number of shells.

KEY SKILL 7

Percentages

Quantities are often expressed as a percentage of an amount; for example, 2% of pet owners have a rabbit. This statement gives a proportion; for example, 2 out of 100 pet owners have a rabbit.

WORKED EXAMPLE

a Find 40% of 620. **b Find 12.5% of 180.**

THINK	WRITE
a Make 40% into $\frac{40}{100}$.	$\frac{40}{100}$
Multiply this by 620.	$\frac{40}{100} \times 620$
Use the calculator for this calculation.	$40 \div 100 \times 620 = 248$
b Make 12.5 into $\frac{12.5}{100}$.	$\frac{12.5}{100}$
Multiply this by 180.	$\frac{12.5}{100} \times 180$
Use the calculator for this calculation.	$12.5 \div 100 \times 180 = 22.5$

QUESTIONS

1 Fill in the missing numbers and solve these problems.

a Find 20% of 380.

= ×

=

b Find 15% of 175.

= ×

=

2 Now create your own working out for the following.

a 60% of 80

b 12.5% of 204

c 250% of 84

d 18% of 44

e 15.5% of 360

f 33.33% of 180

g $55\frac{3}{4}$% of 96

h $18\frac{1}{4}$% of 688

KEY SKILL 8

Fractions into percentages

A percentage is another way of writing a fraction, but in this case the denominator is always 100. It is a useful way to make comparisons.

As an example, we can say that 30% is the same as $\frac{30}{100}$ or 90% is the same as $\frac{90}{100}$.

WORKED EXAMPLE

What percentage is 15 out of 50?

THINK	WRITE
15 out of 50 means 15 **divided by** 50.	$15 \div 50$
Now multiply by 100 to make a percentage.	$\frac{15}{50} \times 100$
Use the calculator for this calculation.	$5 \div 50 \times 100 = 30\%$

QUESTIONS

1 What percentage is:

a 45 out of 90 **b** 5 out of 8 **c** 12 out of 60?

2 The table below shows the results for two Maths tests. Turn each score into a percentage, and then shade in or circle the *best* test score for each student. Round off to 2 decimal places if required.

Student	Test 1 (out of 80)	Working out	Score (%)	Test 2 (out of 60)	Working out	Score (%)
Michelle	75	$75 \div 80 \times 100 =$	93.75%	54		
Yang	15			15		
Simon	40			32		
Alba	49			45		
Christina	65			55		

3 Convert the following amounts into percentages. (Round off to 2 decimal places if required.)

a 12 seconds out of 60 seconds **b** 15 kg out of 75 kg **c** 35 cents out of $2.00

KEY SKILL 9

Ratios

A ratio is a comparison between two or more amounts (or values). The symbol : is used to separate out the values.

A ratio could be written like this — 5:4. This ratio means 'five **compared** to four', or we might say 'five to four'.

The ratio 7:10:9 could be described as 'seven to ten to nine'.

WORKED EXAMPLE

The Foundation Maths class has nine boys and thirteen girls in it. Write this as a ratio.

THINK	WRITE
The values, in the order of the question, are 9 and 13.	9 boys and 13 girls
Use the ratio symbol to separate the values.	9:13

QUESTIONS

1 Write the following as ratios.

a 10 compared to 13 = ... : ....

b Five compared to seven = ... : ....

c 100 compared to 1 = ... : ....

d 11 to 3 = ... : ....

e 6 to 30 = ... : ....

f 12 to 7 = ... : ....

2 Write these out as ratios.

a A farmer had 350 cows and 7 bulls. .... : ....

b A car travelled 150 km in 2 hours. .... : ....

c Peter spent $3 on 2 ice-creams. .... : ....

d A cake requires 3 cups of flour and 2 eggs. .... : ....

e Cordial needs 4 parts of water and 1 part of cordial syrup. .... : ....

f A jet travelled 640 km in one hour. .... : ....

g A bag of lollies had 10 jelly beans, 15 snakes and 9 mint leaves in it. .... : .... : ....

h A bowl of fruit contained 4 bananas, 2 apples, 35 grapes and 2 oranges. .... : .... : .... : ....

KEY SKILL 10

Using ratios

A common example of a ratio is the **cement to water** ratio of 4:1, which is used in making concrete. This means that the amount of cement used is four times greater than the amount of water used. The actual amounts of cement and water used or the amount of cement being made is not stated, because the ratio is a comparison of the two quantities.

WORKED EXAMPLE

Shade these bricks into the ratio of 3:2.

You could shade them to look like this:

Or you could re-organise them to look like this:

QUESTIONS

1 Shade in these rows of bricks, in the ratios given:

a 4:1 

b 3:4 

c 5:1 

d 2:3 

2 On the pictures below, draw a dividing line to separate them in the ratio given.

a 7:2

b 3:2

c 1:1

d 2:1

KEY SKILL 11

Simplifying ratios

Ratios are like fractions — sometimes they can be cancelled down into smaller numbers (or simplest form).

WORKED EXAMPLE 1

Cancel down 12:2 into its simplest form.

THINK	WRITE
Find the highest common factor (the biggest number that divides into all parts of the ratio).	12 and 2 both divide by 2.
Divide all parts of the ratio by this number.	$\frac{12}{2} \div \frac{2}{2}$ $= 6:1$

QUESTIONS

1 Cancel these down into their simplest form.

a 6:2 **b** 15:10 **c** 9:3

d 30:12 **e** 9:6 **f** 20:16:12

2 On a necklace there are 15 black beads and 10 white beads. What is the ratio of black to white beads in simplest form?

3 In a fruit bowl there are 6 mandarins and 2 bananas. What is the ratio of mandarins to bananas in simplest form?

4 A school has 320 boys and 360 girls. What is the ratio of boys to girls in simplest form?

PROJECT 1

In the kitchen

Use the skills you have been practising on the previous pages to answer these questions and solve these problems.

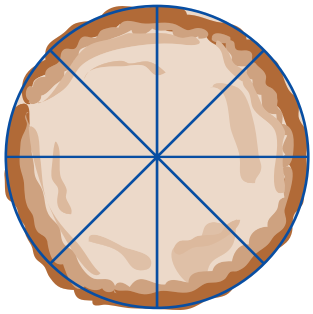
1 When cooking for a large number of people, recipes need to be scaled up to make sure there is enough made for everyone.

A basic chocolate cake requires: 2 cups of flour, $\frac{2}{9}$ cup of cocoa, 60 g of butter, $1\frac{1}{2}$ cups of milk (375 mL), 1 cup of sugar and 1 egg.

How much of each ingredient would you need for 2, 3, 4, 5 or 10 cakes?

	1	**2**	**3**	**4**	**5**	**10**
Flour (cup)	2					
Cocoa (cup)	$\frac{2}{9}$					
Sugar (cup)	1					
Butter (g)	60					
Egg	1					
Milk (cup)	$1\frac{1}{2}$					

2 Each one of these chocolate cakes is cut into 8 slices for serving. How many cakes would you need to make for 120 guests at a function to all have one slice of chocolate cake?



3 Write out the quantities of each of the chocolate cake ingredients that you will be required to buy in order to make the cakes for the 120 guests described in question **2**.

4 The bakery that is chosen to make these chocolate cakes charges $5.00 for each cake. What is the total cost of the cakes required in question **2**?

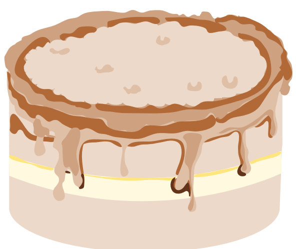
5 The baker has calculated that the cost of electricity to heat the ovens and cook the cakes is 10% of the cost of a cake.

a What is the cost of the electricity to cook one cake?

b What is the total cost of electricity to cook all of the cakes that have been ordered?

6 The baker has offered to fill the chocolate cakes with fresh cream for an increase of 15% to the cost.

a If the original cost of a single cake were $5.00, how much would the cream cost for each cake?



b What is the new cost of a single cake?

c What is the total cost of chocolate cakes, with cream, to serve 120 guests (from question **2**)?

7 You are helping to organise a child's party and your first job is to make up the lolly bags for the guests to take home. The instructions you are given are:

- each bag must contain 20 lollies
- the lollies are to be snakes, jelly babies, mint leaves and black jelly beans, in the ratio of 4:6:7:3.

a How many of each of the lollies will you have to place in a bag?

Snakes

Jelly babies

Mint leaves

Black jelly beans

b If there are to be 30 guests who will receive a lolly bag, how many of **each** of the four types of lollies will you need to purchase?

8 Your next task is to purchase the hot pastries (party pies, mini sausage rolls and mini pasties) for the lunch. You are assuming that each guest will eat four items.

a What is the total number of pastries you will have to buy?

b The mix of pastries is to be $\frac{1}{3}$ party pies, $\frac{1}{2}$ sausage rolls and $\frac{1}{6}$ pasties. How many of each type will you need to buy?

9 Your final task is to order the soft drinks. Allow 800 mL for each child.

a How much soft drink is required (in mL)?

b Change this into litres.

c You decide to order 20% more to cover any spillage.

i What is the extra amount you will need to purchase?

ii What is the total amount of soft drink you will need to buy?

KEY SKILL 12

Measurement

Taking measurements is one of the most common uses of our mathematical skills. We use the metric system, and some of the more common units of measurements are listed below, as well as their abbreviations.

t	tonne	**km**	kilometre	**L**	litre
kg	kilogram	**m**	metre	**mL**	millilitre
g	gram	**cm**	centimetre		
mg	milligram	**mm**	millimetre	**ha**	hectare

Length

1 cm = 10 mm

1 m = 100 cm

1 km = 1000 m

Conversion table

$$\begin{tikzcd} \text{mm} \arrow[r, bend left, "\div 10"] & \text{cm} \arrow[l, bend left, "\times 10"] \arrow[r, bend left, "\div 100"] & \text{m} \arrow[l, bend left, "\times 100"] \arrow[r, bend left, "\div 1000"] & \text{km} \arrow[l, bend left, "\times 1000"] \end{tikzcd}$$

WORKED EXAMPLE

Convert 150 cm into metres.

THINK	WRITE
Choose the appropriate table.	150 cm = ... m
Read the directions given and multiply or divide as required.	$\begin{tikzcd} \text{cm} \arrow[r, bend left, "\div 100"] & \text{m} \arrow[l, bend left, "\times 100"] \end{tikzcd}$ 150 cm = 150 ÷ 100 = 1.5 m

QUESTIONS

Use the conversion tables to change these measurements into the units shown.

1 950 mm = ... cm
2 520 mm = ... cm
3 48.2 m = ... cm
4 13 km = ... m
5 3.5 m = ... cm
6 18.7 cm = ... mm
7 2 790 000 cm = ... m
8 15 m = ... mm
9 63 950 mm = ... m
10 8492 m = ... km
11 2.96 cm = ... m
12 3.76 km = ... cm

Note: When adding or subtracting metric amounts, the measurements **must all be in the same units**.

KEY SKILL 13

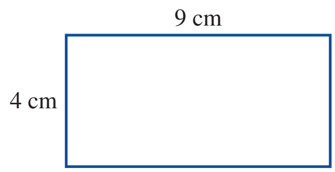
Perimeter

The perimeter is the total distance around a shape. To find out the perimeter we can either take direct measurements or add up all of the side lengths. The units for perimeter include mm, cm, m and km.

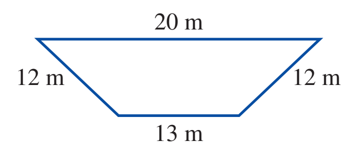
WORKED EXAMPLE

Find the perimeter of these shapes.

a



b

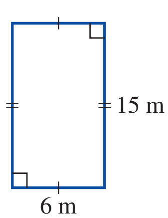


THINK	WRITE
a Add up the side lengths.	4 + 4 + 9 + 9 = 26 cm
b Add up the side lengths.	12 + 12 + 13 + 20 = 57 m

QUESTIONS

1 Find the perimeter of each of the shapes. Remember to give the units of measurement.

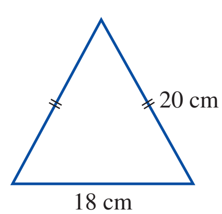
a



.... + ... + ... + ...

= .... m

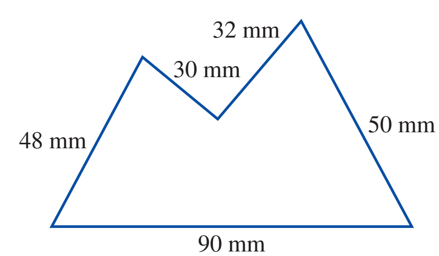
b



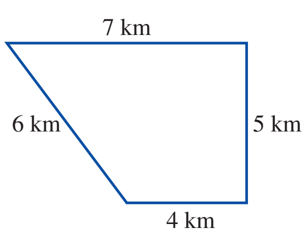
.... + ... + ...

= .... cm

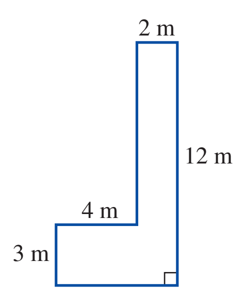
c



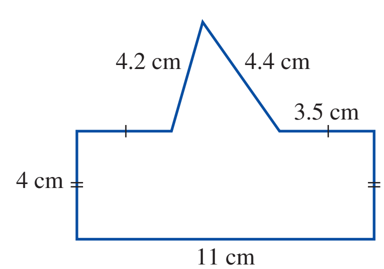
d



e

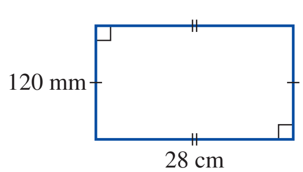


f

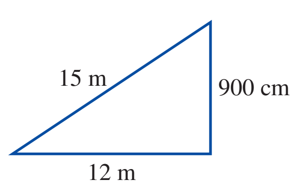


2 Make sure that all measurements are in the same units and find the perimeter of these shapes.

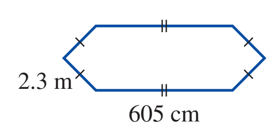
a



b



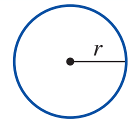
c



KEY SKILL 14

Perimeter of a circle

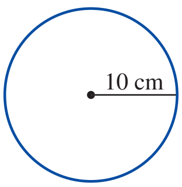
The formula for perimeter (or circumference) of a circle is $2\pi r$. For convenience, use the value 3.14 to equal π. Always use the distance halfway across the circle (the radius). The easiest way to calculate the circumference is by using a calculator.



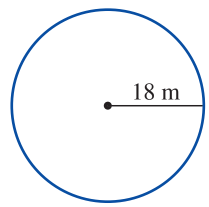
WORKED EXAMPLE

Find the circumference of these circles.

a



b

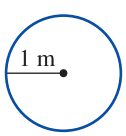


THINK	WRITE
a Circumference = $2 \times \pi \times r$	$= 2 \times 3.14 \times 10$ $= 62.8$ cm
b Circumference = $2 \times \pi \times r$	$= 2 \times 3.14 \times 18$ $= 113.04$ m

QUESTIONS

1 Find the circumference of each of the following circles.

a

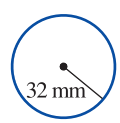


$r =$

$C = 2 \times 3.14 \times$

$=$

b



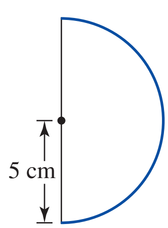
$r =$

$C = 2 \times 3.14 \times$

$=$

2 Find the perimeter of the following.

a



$r =$

$C = 2 \times 3.14 \times$

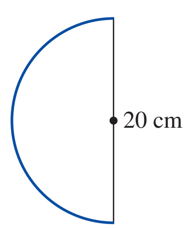
$=$

Half of circle =

Add on straight line = +

Total of whole shape =

b



$r =$

$C = 2 \times 3.14 \times$

$=$

Half of circle =

Add on straight line = +

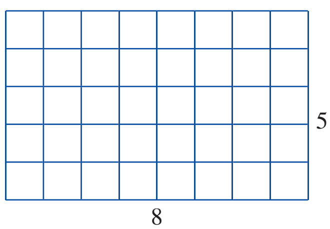
Total of whole shape =

KEY SKILL 15

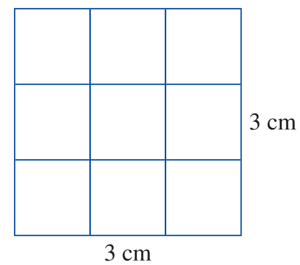
Area

Area is the amount of flat space inside an object or shape. Area can be calculated by counting squares (which is time consuming), or it can be calculated by choosing and then using the correct formula. The unit in the final answer will always be squared.

WORKED EXAMPLE



= 40 squares

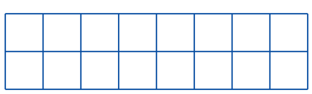


= 9 cm^2

QUESTIONS

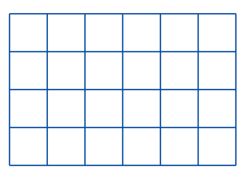
1 Find the area (in squares) of the following shapes.

a



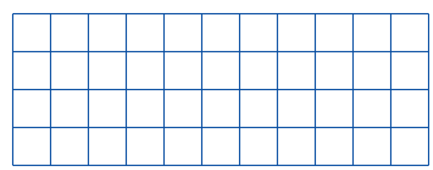
= .... squares

b



= .... squares

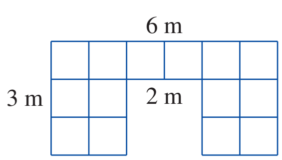
c



= .... squares

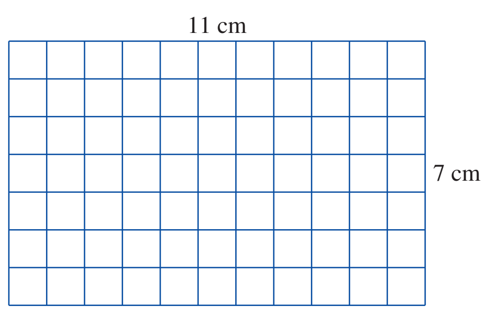
2 Calculate the area inside these shapes.

a



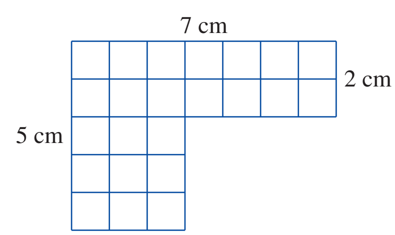
= .... m^2

b



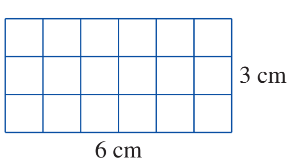
= .... cm^2

c



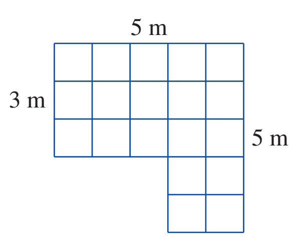
= .... cm^2

d



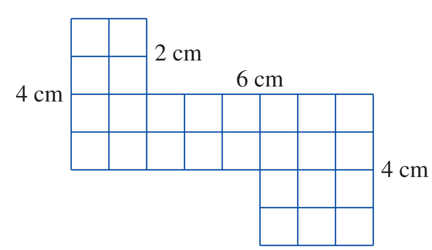
= .... cm^2

e



= .... m^2

f



= .... cm^2

KEY SKILL 16

Formulas for area

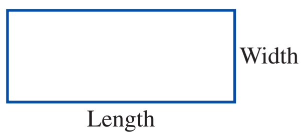
Squares and rectangles

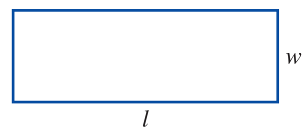
For **squares** and **rectangles**, you need two side measurements — length and width. The formula is:

area = length × width.

It can also be written as:

$A = l \times w$ or $A = lw$.

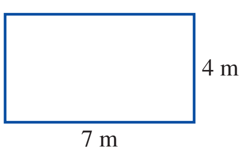




QUESTIONS

Find the area of each shape.

1

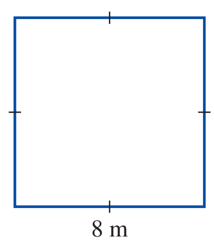


Area = $l \times w$

= .... × ....

= .... m^2

2

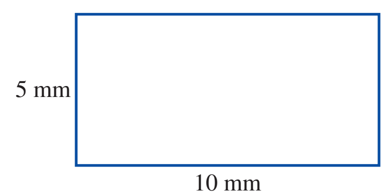


Area = $l \times w$

= .... × ....

= .... m^2

3



Area = $l \times w$

= .... × ....

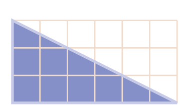
= .... mm^2

Triangles

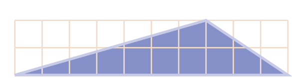
Because a triangle fills up only half of the rectangle or square drawn around it, the formula used for area is:

area = $\frac{1}{2}$ × base × height.

It can also be written as $\frac{1}{2}bh$, and we can think of it as area = $b \times h \div 2$.



Area = $b \times h \div 2$
= $6 \times 3 \div 2$
= 9 squares

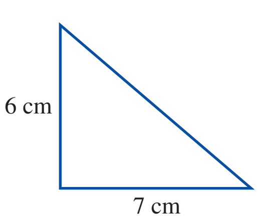


Area = $b \times h \div 2$
= $10 \times 2 \div 2$
= 10 squares

QUESTIONS

Find the area of each shape.

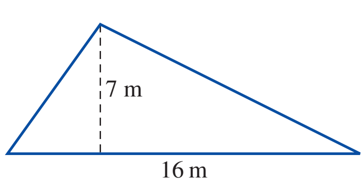
1



Area = $b \times h \div 2$

=

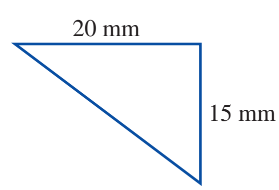
2



Area = $b \times h \div 2$

=

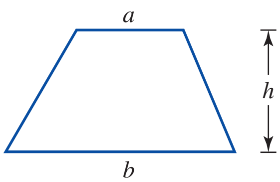
3



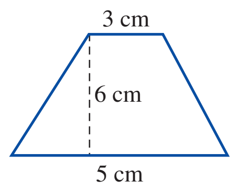
Area = $b \times h \div 2$

=

Trapezium



Area $= \frac{1}{2} \times (a + b) \times h$

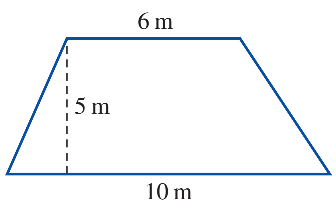


$$\begin{aligned}\text{Area} &= \tfrac{1}{2} \times (3 + 5) \times 6\\ &= \tfrac{1}{2} \times (8) \times 6\\ &= \tfrac{1}{2} \times 48\\ &= 24\ \text{cm}^2\end{aligned}$$

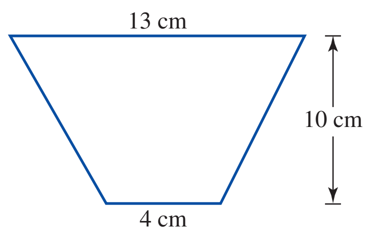
QUESTIONS

Find the area of each trapezium.

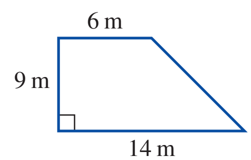
1



2



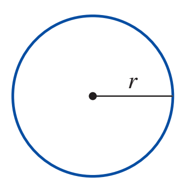
3



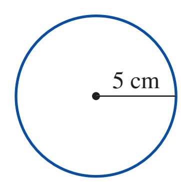
Circle

The formula for the area of a circle is: area $= \pi r^2$.

Always make sure that the distance halfway across the circle (the **radius**) is used.



Area $= \pi \times r \times r$



$r = 5$

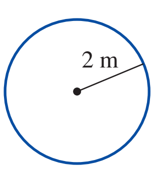
Area $= 3.14 \times 5 \times 5$

$= 78.5\ \text{cm}^2$

QUESTIONS

Find the area of each circle.

1

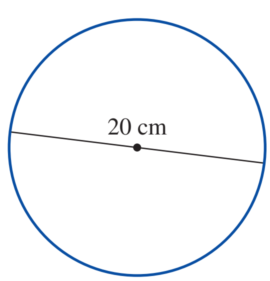


$r =$ ....

Area $= 3.14 \times$ .... $\times$ ....

$=$

2

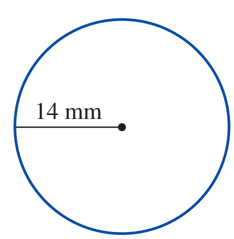


$r =$ ....

Area $= 3.14 \times$ .... $\times$ ....

$=$

3



$r =$ ....

Area $= 3.14 \times$ .... $\times$ ....

$=$

KEY SKILL 17

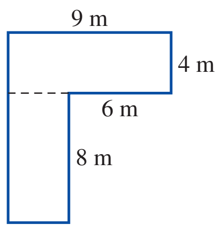
Area of composite shapes

In many cases, it is a good idea to divide the shape into smaller sections that are familiar. Once divided up, formulas can be used to work out each small section. At the end, a **total** is calculated.

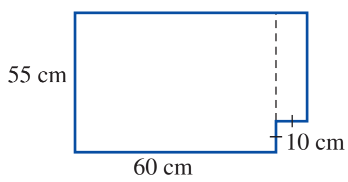
QUESTIONS

1 The following shapes have been divided into smaller segments for you. Find the area of each segment then find the total area.

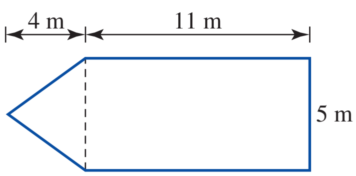
a



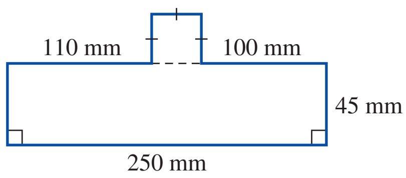
b



c

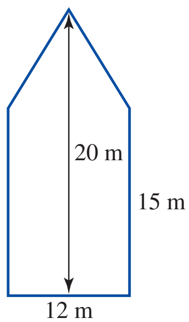


d

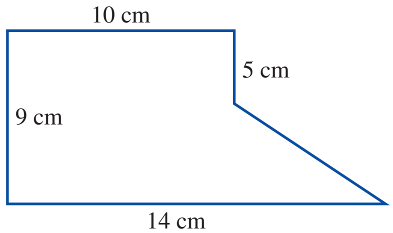


2 Divide these shapes into smaller segments, write in any side lengths that may be required, calculate the areas of each segment and find the total surface area.

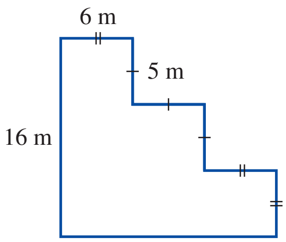
a



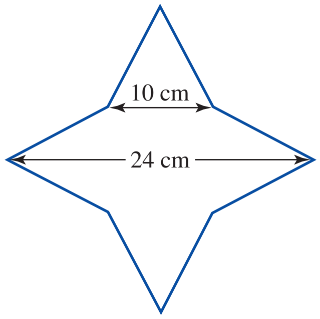
b



c

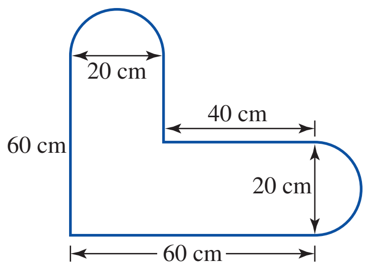


d

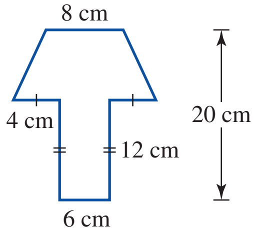


3 Divide these shapes into appropriate segments, find the areas of each segment and then calculate the total area.

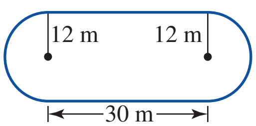
a



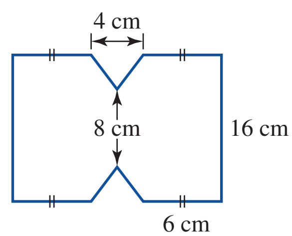
b



c

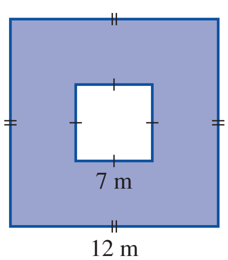


d



4 Find the area of the shaded section of the shape, by subtracting one area from the other.

a



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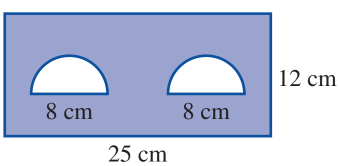

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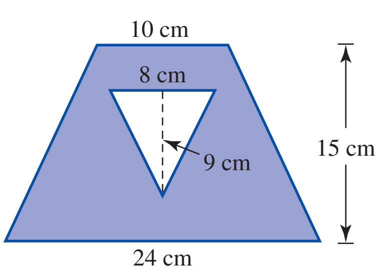

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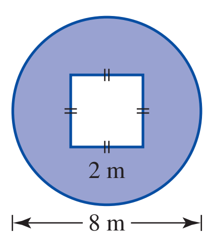
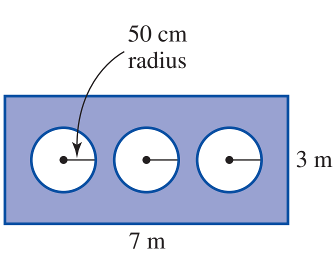


e



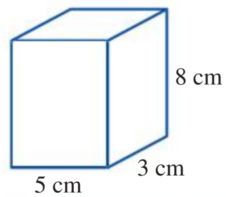
KEY SKILL 18

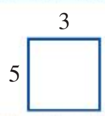
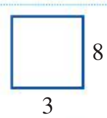
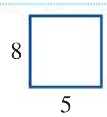
Surface area in 3D

Before starting the working out, decide how many sides the shape has.

WORKED EXAMPLE 1

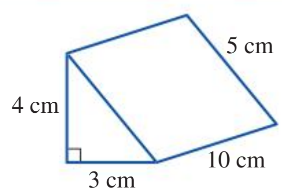
Find the surface area of this rectangular prism.

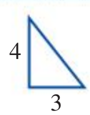
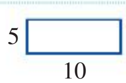
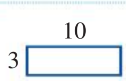
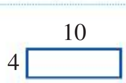


Sketch of sides	Working out	Number of equal sides	Total area of side(s)
	$3 \times 5 = 15$	2	30
	$3 \times 8 = 24$	2	48
	$5 \times 8 = 40$	2	80
		Total area	158 cm^2

WORKED EXAMPLE 2

Find the surface area of this triangular prism.

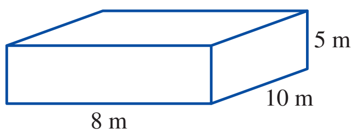


Sketch of sides	Working out	Number of equal sides	Total area of side(s)
	$4 \times 3 \div 2 = 6$	2	12
	$10 \times 5 = 50$	1	50
	$10 \times 3 = 30$	1	30
	$10 \times 4 = 40$	1	40
		Total area	132 cm^2

QUESTIONS

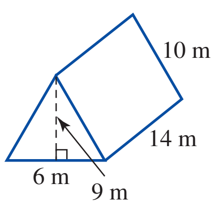
Find the total surface area of the shapes by completing the tables.

1



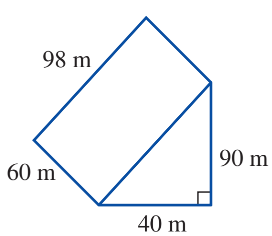
Sketch of sides	Working out	Number of equal sides	Total area of side(s)
		Total area	

2



Sketch of sides	Working out	Number of equal sides	Total area of side(s)
		Total area	

3



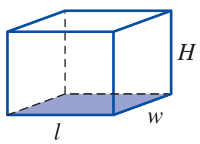
Sketch of sides	Working out	Number of equal sides	Total area of side(s)
		Total area	

KEY SKILL 19

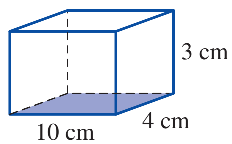
Volume — the space within

A **prism** has one face, whose shape remains **unchanged** if you were to slice through the object a number of times. Cubes and rectangular prisms have more than one option to choose as the unchanging face. In the diagrams below, this surface has been shaded in the examples of shapes that are prisms. Always look for (and shade in) this surface when calculating volume. The unit in the final answer will always be cubed.

Cubes and rectangular prisms



Volume = $l \times w \times H$



Volume = $l \times w \times H$

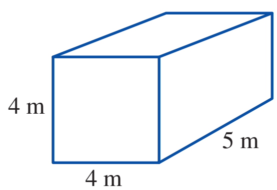
$= 10 \times 4 \times 3$

$= 120\text{ cm}^3$

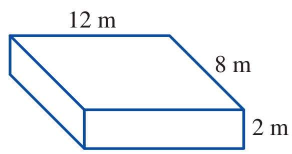
QUESTIONS

Find the volume of these prisms.

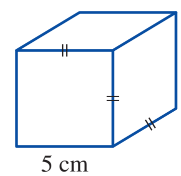
1



2

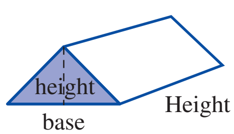


3



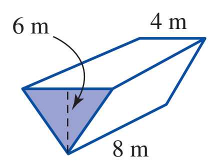
Triangular prisms

Find the 'flat' area of the shaded triangle, and then multiply by the overall height of the shape.



Volume

$= (\frac{1}{2} \times \text{base} \times \text{height}) \times \text{Height}$



Volume $= (\frac{1}{2} \times 4 \times 6) \times 8$

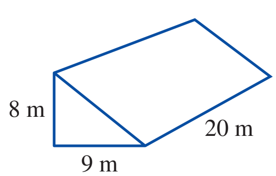
$= (12) \times 8$

$= 96\text{ m}^3$

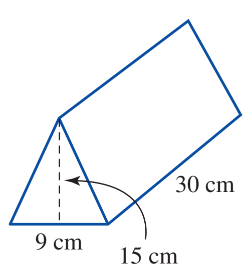
QUESTIONS

Find the volume of these triangular prisms.

1



2



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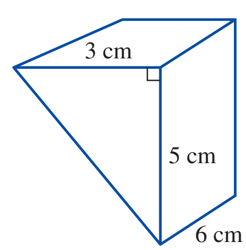
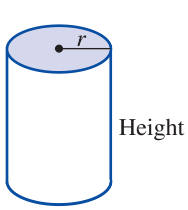
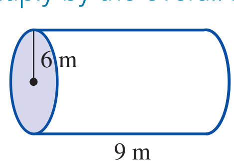


Cylinders

Find the 'flat' area of the shaded circle, and then multiply by the overall height of the shape.



Volume = $(\pi \times r \times r) \times \text{Height}$



Volume $= (\pi \times 6 \times 6) \times 9$

$= (3.14 \times 6 \times 6) \times 9$

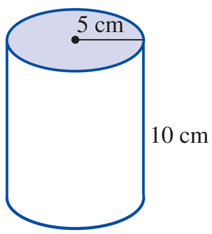
$= (113.04) \times 9$

$= 1017.36\text{ m}^3$

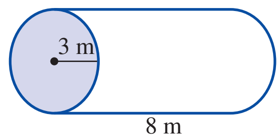
QUESTIONS

Find the volume of these cylinders.

1



2



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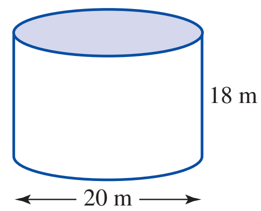

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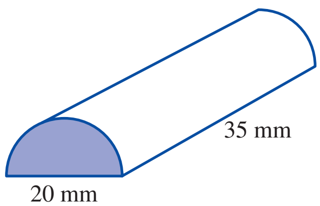
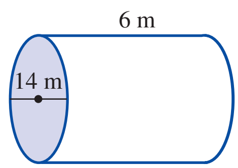
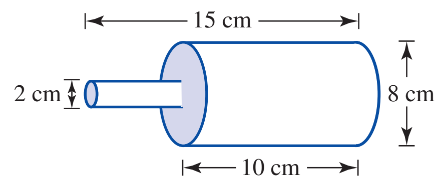


5

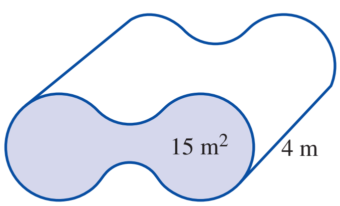


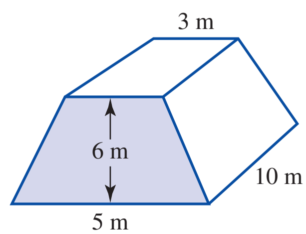
6



Irregular shapes

Find the 'flat' area of the shaded shape (it may have already been calculated for you), and then multiply by the overall height of the shape.





Volume = (area of flat surface) × Height

= 15×4

= 60 m^3

Volume = (area of trapezium) × Height

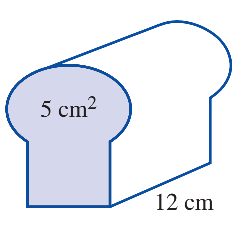
= $[\frac{1}{2} \times 6 \times (3 + 5)] \times 10$

= 240 m^3

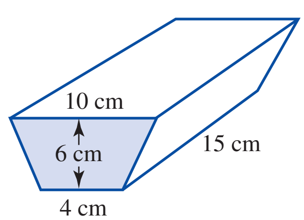
QUESTIONS

Find the volume of these irregular shapes.

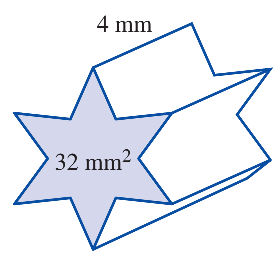
1



2



3



eBookplus ACTIVITIES

Key skill 1 Fractions

Digital doc

- Worksheet 1.1: apply your knowledge of fractions

Interactivity

- Equivalent fractions (int-0001): explore the prime factors of fractions and predict the simplest form

eLesson

- Types of fractions (eles-0002): discover the different types of fractions

Key skill 2 Equivalent fractions

Digital doc

- Worksheet 1.2: apply your knowledge of equivalent fractions

Interactivity

- Fraction wall (int-0002): explore the relationships between fractions of $\frac{1}{6}$ or larger

Key skill 3 Multiplying fractions

Digital doc

- Worksheet 1.3: apply your knowledge of multiplying fractions

Key skill 4 Decimal numbers

Digital doc

- Worksheet 1.4: apply your knowledge of decimal fractions

Key skill 5 Fractions to decimals

Digital doc

- Worksheet 1.5: apply your knowledge of converting decimals to fractions

eLesson

- Converting percentages (eles-0005): learn about percentages and how to work out your discount when you shop

Key skill 6 Percentage skills

Digital doc

- Worksheet 1.6: apply your knowledge of percentage skills

Key skill 7 Percentages

Digital doc

- Worksheet 1.7: apply your knowledge of percentages

Interactivity

- Percentages (int-0004): discover the sale price of a product when it is discounted by a percentage

Key skill 8 Fractions into percentages

Digital doc

- Worksheet 1.8: apply your knowledge of converting fractions to percentages

Key skill 9 Ratios

Digital doc

- Worksheet 1.9: apply your knowledge of ratios

Key skill 10 Using ratios

Digital doc

- Worksheet 1.10: apply your knowledge of using ratios

eLesson

- Dividing in ratios (eles-0041): calculate how much pizza each person receives based on the ratio of payment

Key skill 11 Simplifying ratios

Digital doc

- Worksheet 1.11: apply your knowledge of simplifying ratios

Key skill 12 Measurement

Digital doc

- Worksheet 1.12: apply your knowledge of measurements

Key skill 13 Perimeter

Digital doc

- Worksheet 1.13: apply your knowledge of perimeter

Key skill 14 Perimeter of a circle

Digital doc

- Worksheet 1.14: apply your knowledge of perimeter of a circle

Key skill 15 Area

Digital doc

- Worksheet 1.15: apply your knowledge of area

Key skill 16 Formulas for area

Digital doc

- Worksheet 1.16: apply your knowledge of formulas for area

Key skill 17 Area of composite shapes

Digital doc

- Worksheet 1.17: apply your knowledge of composite shapes

Key skill 18 Surface area in 3D

Digital doc

- Worksheet 1.18: apply your knowledge of surface area in 3D

eLesson

- Total surface area (eles-0006): calculate the surface area of a 3-dimensional object by considering its 2-dimensional faces

Key skill 19 Volume — the space within

Digital doc

- Worksheet 1.19: apply your knowledge of volumes

CHAPTER REVIEW

Digital docs

- Word search swf (int-0639): search for the terms covered in this book
- Crossword swf (int-0640): test your knowledge of the terms covered in this book
- Puzzle page pdf 1.20: crack the code

Interactivity

- Test yourself (int-0641): take the end-of-chapter online multiple-choice quiz

To access eBookPLUS activities, login at **www.jacplus.com.au**

ANSWERS

KEY SKILL 1 — Fractions

1 a $\frac{7}{10}$ b $\frac{5}{8}$ c $\frac{1}{6}$

2 a $\frac{1}{2}$ b $\frac{1}{3}$ c $\frac{3}{4}$

3 a $\frac{2}{3}$ b $\frac{1}{2}$ c $\frac{3}{5}$
d $\frac{8}{5}$ e $\frac{1}{3}$ f $\frac{2}{5}$

KEY SKILL 2 — Equivalent fractions

1 $\frac{8}{10}, \frac{16}{20}, \frac{24}{30}$

2 $\frac{4}{6}, \frac{8}{12}, \frac{20}{30}$

3 $\frac{4}{10}, \frac{10}{25}, \frac{12}{30}$

4 $\frac{4}{14}, \frac{16}{56}, \frac{20}{70}$

5 $\frac{10}{18}, \frac{25}{45}, \frac{50}{90}$

6 $\frac{14}{22}, \frac{35}{55}, \frac{77}{121}$

7 a $\frac{15}{25}$ b $\frac{3}{5}$ c $\frac{2}{5}$

KEY SKILL 3 — Multiplying fractions

1 a $\frac{1}{4}$ b $\frac{1}{6}$ c $\frac{4}{33}$ d $\frac{9}{26}$
e $\frac{5}{49}$ f $\frac{1}{5}$ g 40 h $\frac{2}{7}$

2 a 60 b $\frac{100}{3}$ c 20 d 98
e 30 f 60 g 9 h 40

3 a 40 b 72 c 160 d 285

KEY SKILL 4 — Decimal numbers

1 a 234.02 b 48.58 c 0.17 d 200.17
e 0.99 f 0.01

2 a 0.596 b 48.582 c 0.166

KEY SKILL 5 — Fractions to decimals

1 a 0.125 b 0.67 c 0.75 d 0.25
e 0.75 f 0.9 g 0.33 h 0.33
i 0.25 j 0.5 k 0.5 l 0.75

2 a 3.75 b 4.5 c 2.8 d 17.5
e 25 f 6.2 g 45.2 h 18.6
i 22.1 j 9.25 k 56.25 l 19.67

KEY SKILL 6 — Percentage skills

3 $\frac{25}{100}, \frac{1}{4}$, 1 ÷ 4, 0.25

4 $\frac{30}{100}, \frac{3}{10}$, 3 ÷ 10, 0.3

5 $\frac{50}{100}, \frac{1}{2}$, 1 ÷ 2, 0.5

6 $\frac{75}{100}, \frac{3}{4}$, 3 ÷ 4, 0.75

7 $\frac{80}{100}, \frac{4}{5}$, 4 ÷ 5, 0.8

8 $\frac{90}{100}, \frac{9}{10}$, 9 ÷ 10, 0.9

9 $\frac{12.5}{100}, \frac{1}{8}$, 1 ÷ 8, 0.125

10 $\frac{150}{100}, \frac{3}{2}$, 3 ÷ 2, 1.5

11 $\frac{33.33}{100}, \frac{1}{3}$, 1 ÷ 3, 0.33

12 $\frac{66.67}{100}, \frac{2}{3}$, 2 ÷ 3, 0.67

13 a 70% b $\frac{7}{10}$ c 0.7

KEY SKILL 7 — Percentages

1 a 76 b 26.25

2 a 48 b 25.5 c 210 d 7.92
e 55.8 f 60 g 53.52 h 125.56

KEY SKILL 8 — Fractions into percentages

1 a 50% b 62.5% c 20%

2

	Test 1	Test 2
Michelle	93.75%	90%
Yang	18.75%	25%
Simon	50%	53.33%
Alba	61.25%	75%
Christina	81.25%	91.67%

3 a 20% b 20% c 17.5%

KEY SKILL 9 — Ratios

1 a 10:13 b 5:7 c 100:1 d 11:3
e 6:30 f 12:7

2 a 350:7 b 150:2 c 3:2 d 3:2
e 4:1 f 640:1 g 10:15:9 h 4:2:35:2

KEY SKILL 10 — Using ratios

1 a


b


c


d


2 Check with your teacher.

KEY SKILL 11 — Simplifying ratios

1 a 3:1 b 3:2 c 3:1 d 5:2
e 3:2 f 5:4:3

2 3:2

3 3:1

4 8:9

(continued)

ANSWERS

PROJECT 1 — In the kitchen

1

	1	2	3	4	5	10
Flour (cup)	2	4	6	8	10	20
Cocoa (cup)	$\frac{2}{9}$	$\frac{4}{9}$	$\frac{2}{3}$	$\frac{8}{9}$	$\frac{10}{9}$	$\frac{20}{9}$
Sugar (cup)	1	2	3	4	5	10
Butter g	60	120	180	240	300	600
Egg	1	2	3	4	5	10
Milk (cup)	$1\frac{1}{2}$	3	$4\frac{1}{2}$	6	$7\frac{1}{2}$	15

2 15

3 Flour = 30, cocoa = 3.3, sugar = 15, butter = 900, eggs = 15, milk = 22.5

4 $75

5 a 50c b $7.50

6 a 75c b $5.75 c $86.25

7 a Snakes = 4, jelly babies = 6, mint leaves = 7, black jelly beans = 3
b Snakes = 120, jelly babies = 180, mint leaves = 210, black jelly beans = 90

8 a 120
b Party pies = 40, mini sausage rolls = 60, pasties = 20

9 a 24 000 mL b 24 L c i 4.8 L ii 28.8 L

KEY SKILL 12 — Measurement

1 95 cm
2 52 cm
3 4820 cm
4 13 000 m
5 350 cm
6 187 mm
7 27 900 m
8 15 000 mm
9 63.95 m
10 8.492 km
11 0.0296 m
12 376 000 cm

KEY SKILL 13 — Perimeter

1 a 42 m b 58 cm c 250 mm d 22 km e 36 m f 34.6 cm

2 a 80 cm b 36 m c 21.3 m

KEY SKILL 14 — Perimeter of a circle

1 a 6.28 m b 200.96 mm

2 a 25.7 cm b 51.4 cm

KEY SKILL 15 — Area

1 a 16 b 24 c 44

2 a 14 m^2 b 77 cm^2 c 23 cm^2 d 18 cm^2 e 19 m^2 f 26 cm^2

KEY SKILL 16 — Formulas for area

Squares and rectangles

1 28 m^2 2 64 m^2 3 50 mm^2

Triangles

1 21 cm^2 2 56 m^2 3 150 mm^2

Trapezium

1 40 m^2 2 85 cm^2 3 90 m^2

Circle

1 12.56 m^2 2 314 cm^2 3 615.44 mm^2

KEY SKILL 17 — Area of composite shapes

1 a 60 m^2 b 3750 cm^2 c 65 m^2 d 12 850 mm^2

2 a 210 m^2 b 98 cm^2 c 187 m^2 d 240 cm^2

3 a 2314 cm^2 b 160 cm^2 c 1172.16 m^2 d 240 cm^2

4 a 95 m^2 b 249.76 cm^2 c 219 cm^2 d 46.24 m^2 e 18.645 m^2

KEY SKILL 18 — Surface area in 3D

1 340 m^2 2 418 m^2 3 17 280 m^2

KEY SKILL 19 — Volume — the space within

Cubes and rectangular prisms

1 80 m^3 2 192 m^3 3 125 cm^3

Triangular prisms

1 720 m^3 2 2025 cm^3 3 45 cm^3

Cylinders

1 785 cm^3
2 226.08 m^3
3 5652 m^3
4 5495 mm^3
5 923.16 m^3
6 518.1 cm^3

Irregular shapes

1 60 cm^3 2 630 cm^3 3 128 mm^3

MATHS QUEST

VCE FOUNDATION MATHEMATICS

FINANCE

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INTRODUCTION

Finance

This topic will help you understand the mathematics involved in everyday situations such as paying bills, budgeting your money, using a credit card and paying tax. By having some knowledge of how these things work, we are able to spend our money more wisely and avoid paying too much money.

By having a budget, you can see where your money is spent and can help control spending, especially if you have a savings goal.

Knowing how to work out what item at the supermarket is better value for money is also a useful skill in avoiding overspending.

Credit cards can be a very convenient and useful resource to have, but the money you spend usually needs to be repaid with interest. Understanding how this interest is calculated is important in knowing how to avoid long-term debt.

Everyone who earns an income above a certain amount is required by law to pay tax. The skills you will learn in this topic will help you understand how the government calculates how much you need to pay in tax as well as give you the knowledge to be able to prepare your own tax return.

contents

KEY SKILL 1

Monthly amounts

TAKE A LOOK BACK AT **BOOK 1, PP. 6, 7**

A budget is a financial plan set within a specific time frame. It outlines all amounts of income, expenditure and savings. A budget is useful because it helps you determine where your money is spent, as well as helping you achieve your savings goals. Budgets can be prepared for any time frame, but are usually over twelve months. Many bills and items of expenditure are required to be paid on a weekly, bi-monthly (every two months), quarterly (every three months) or annual (once-a-year) basis. Knowing how much money you need in advance will help you be prepared for when you have to pay your bills.

WORKED EXAMPLE

Convert $300 from a a quarterly, b a bi-monthly, c an annual and d a weekly amount to a monthly amount.

THINK	WRITE
a There are 4 lots of 3 months in a year, so you need to multiply this amount by 4 and then divide by 12.	$\frac{\$300 \times 4}{12}$
Write the answer as $ per month.	= $100 per month
b There are 6 lots of 2 months in a year, so you need to multiply this amount by 6 and then divide by 12.	$\frac{\$300 \times 6}{12}$
Write the answer as $ per month.	= $150 per month
c There are 12 months in a year, so you need to divide this amount by 12.	$\frac{\$300}{12}$
Write the answer as $ per month.	= $25 per month
d You need to first convert this amount into a yearly amount by multiplying it by 52 weeks.	$\$300 \times 52$ $= \$15\,600$
Convert this annual amount into a monthly amount by dividing by 12.	$\frac{\$15\,600}{12}$
Write the answer as $ per month.	= $1300 per month

QUESTIONS

1 Convert these weekly bills into monthly amounts.

a $15 phone bill
b $100 food bill
c $80 petrol usage
d $50 spent on entertainment

2 Convert these quarterly bills into monthly amounts.

a Health insurance of $600
b Electricity bill of $280
c Internet account of $180
d Water-usage charge of $225

3 Convert these annual figures into monthly amounts.

a Council rates of $1099
b Car registration of $557
c Gym-membership fees of $1200
d Car servicing cost of $350

4 Convert these bi-monthly figures into monthly amounts.

a Gas bill of $300
b School fees of $100
c Car insurance of $85
d Loan repayment of $120

5 a Convert the six-monthly fee and the weekly fee into an annual amount.

b How much would you have to budget each week to afford option A?

c Compare options C and D. How many times per week would you need to use the gym to get the best value for your money?

d From the four options, which membership option is better value for money?

e Which option would you choose? What other factors do you need to consider other than money?

Gym membership

Options	Duration	Fees
Option A	Yearly	$999
Option B	6 months	$599
Option C	Weekly	$30
Option D	Pay per use	$9

INVESTIGATION 1

Your budget

WHAT TO DO

Brainstorm your income and expenses here. In column A, include all items that you spend money on throughout the year. Examples could include mobile phone costs, takeaway food, birthday gifts, clothing, haircuts, toiletries and other personal items. A couple of items have already been filled in for you. In column B write down how much each item is, and in column C write down if it is a weekly, monthly, bi-monthly, quarterly or annual amount.

(A)	(B) Amount	(C) Frequency
Income		
Allowance		
Wages		
Expenses		
Mobile phone		
Clothing		
Entertainment		
Food		

Using the template provided on the next page, you are to prepare your own annual budget. Ensure that you fill in all of your expenses. Remember to convert all of your income and expenses into monthly amounts using the skills you practised on the previous pages.

Calculate your total income and total expenses for the year. To calculate your net surplus/deficiency, subtract your expenses from your income (total income minus total expenses).

If your income is more than your expenditure, you have a surplus — congratulations! This extra money could be put towards a savings goal.

If your expenses are more than your income, you have a deficit, which means you need to spend less money or find another source of income.

Income	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Yearly total**
Wages													
Allowance													
Total income													
Expenses													
Total income													
Total expenses													
Net surplus/ deficiency													

KEY SKILL 2

Unit prices

TAKE A LOOK BACK AT **BOOK 1, PP. 7, 16**

It's a good idea to compare prices when shopping if you want to get as much value for your money as possible. It is easier to compare prices for items that are identical in quantity than those that come in varying quantities. For example, how would you know which was better value for money — a 150 g chocolate bar for \$2.50 or a 375 g block for \$6.20? One way to determine which item is better value for money is to calculate unit prices for the item. We will work in cost per 100 g or 100 mL for this topic.

WORKED EXAMPLE

a **A 220 g item sells for \$5.95. Calculate the unit price for a 100 g quantity.**
b **A 300 mL item sells for \$2.50. Calculate the unit price for 100 mL capacity.**
c **Which is better value for money — a 350 mL carton of milk for \$1.75 or a 1.5 L bottle of milk for \$4.50?**

THINK	WRITE	
a Divide the cost of the item by the quantity.	$\frac{\$5.95}{220\text{ g}}$ = \$0.027 per g	
Multiply by 100 to get the cost per 100 g.	0.027 × 100	
Write the answer as \$ per 100 g.	= \$2.70 per 100 g	
b Divide the cost of the item by the capacity.	$\frac{\$2.50}{330\text{ mL}}$ = \$0.008 per mL	
Multiply by 100 to get the cost per 100 mL.	0.008 × 100	
Write the answer as \$ per 100 mL.	= \$0.83 per 100 mL	
c Calculate the unit prices per 100 mL for each item. Remember to change litres into millilitres first.	$\frac{\$1.75}{350\text{ mL}}$	$\frac{\$4.50}{1500\text{ mL}}$
Compare the unit price per 100 mL.	0.005 × 100 = \$0.50 per 100 mL	0.003 × 100 = \$0.30 per 100 mL
State which item is better value for money and explain why.	\$0.30 per 100 mL is cheaper than \$0.50 per 100 mL, so the 1.5 L bottle of milk is better value for money.	

QUESTIONS

Note: Remember to change kilograms into grams and litres into millilitres **before** calculating the unit price.

1 Calculate the unit price per 100 g or 100 mL for the following items.

a 180 g tin of Milo for \$4.60

$\frac{\$4.60}{180\text{ g}} = \$0.025$ per g

$0.025 \times 100 = \$2.56$ per 100 g

b 110 g tube of toothpaste for \$2.65

c 500 g packet of spaghetti for \$0.89

d 2 kg bag of potatoes for \$3.98

e 2 L carton of milk for \$2.98

f 5 L tub of ice-cream for \$7.80

g 1 L carton of orange juice for \$3.15

h 600 mL bottle of Coke for \$2.50

i 390 g jar of coffee for \$7.99

2 Calculate the unit price per 100 g or 100 mL for the following items.

a 220 g tin of Milo for \$5.50

b 175 g tube of toothpaste for \$3.00

c 1 kg packet of spaghetti for \$1.70

d 800 g bag of potatoes for \$1.65

e 1.25 L carton of milk for \$1.89

f 1.5 L tub of ice-cream for \$3.30

g 2 L carton of orange juice for \$6.26

h 1 L bottle of coke for \$3.00

i 450 g jar of coffee for \$8.99

3 Compare the unit prices from Questions **1** and **2** above and explain which item is better value for money.

4 Compare each bottle of soft drink to work out which item is better value for money per 100 mL.

a 2 L for \$2.99 b 1.5 L for \$2.50 c 1.25 L for \$2.00 d 600 mL for \$2.80

INVESTIGATION 2
Setting up house

QUESTIONS

1 Imagine you were moving out of home to live with some friends. What items from the supermarket would you need to purchase?

In groups of two or three determine a shopping list for the first week in your new home. Use supermarket catalogues or visit supermarket websites for ideas and pricing information.

Use the table below to create your shopping list.

Food	Bathroom	Laundry	Other

2 Choose five items from each category on the previous page and investigate which item is better value for money using items that are the same but in different amounts. Use the table below to list and compare your items, showing your calculations and final selections.

Item	Size	Price	Price per 100 g or 100 mL
Cornflakes	800 g	$6.25	$\frac{\$6.25}{800\text{ g}} \times 100 = \$0.78$ per 100 g → better value for money as it is cheaper per 100 g
Cornflakes	675 g	$5.50	$\frac{\$5.50}{675\text{ g}} \times 100 = \$0.81$ per 100 g

3 Consider that you have only $200 to spend for three people for the initial grocery shopping once you have moved in together. How would you spend it now? Justify your choices with reference to items that are better value for money.

4 It is now the second week in your household. What items would you buy now (that you perhaps put off from buying for your first shop)? What items don't need to be purchased every week? List some strategies for saving money on items that are expensive to purchase.

KEY SKILL 3

Compound interest

TAKE A LOOK BACK AT **BOOK 1, PP. 6, 7, 8, 9**

Credit cards provide immediate access to money that you don't have at the time. **If used wisely,** credit cards are a very convenient and useful resource. The charges to consider when using credit are:

- the current interest rate charged by the lender
- the interest-free period (if any)
- the annual card fee
- the minimum monthly repayment required.

WORKED EXAMPLE

a **How much compound interest is charged on a loan of \$500 at 8% per annum over a period of two years? How much in total do I need to repay?**

b **How much compound interest is charged on a credit card debt of \$300 at 8% per annum over a period of 2 days? How much in total do I need to repay?**

	THINK	WRITE
a	Multiply the loan amount by the interest rate.	$\$500 \times 8$
	Divide the answer by 100. This is how much interest is charged after one year.	$\frac{\$4000}{100}$
	Add the answer to your original loan amount.	$\$40 + \$500 = \$540$
	Multiply the amount by the interest rate.	$\$540 \times 8$
	Divide the answer by 100. This is how much interest is charged after the second year.	$\frac{\$4320}{100}$
	Add the answer to the amount owed after the first year to find the total to repay.	$\$43.20 + \$540 = \$583.20$
	To calculate the total interest charge, subtract the initial loan from the total amount owed at the end of the loan period.	$\$583.20 - \$500$ $= \$83.20$ total interest
b	Convert the annual interest rate into a daily interest rate by dividing by 365.	$\frac{8}{365} = 0.02$
	Multiply this by the credit card debt.	$0.02 \times \$300 = \$6$
	Divide the answer by 100. This is the interest after one day.	$\frac{\$6}{100} = 0.06$
	Add this to the original debt to get the amount owed after one day.	$\$0.06 + \$300 = \$300.06$
	Multiply this amount by 0.02 and divide by 100 to obtain the interest after the second day.	$0.02 \times \$300.06 = \$6.00$ $\$6.00 \div 100 = 0.06$
	Add this to the amount owed after one day to find the total to repay.	$\$300.06 + 0.06 = \$300.12$

QUESTIONS

1 Calculate the interest compounded annually for the following.

a $7000 at 10.5% interest p.a. over three years

Year 1 $\$7000 \times 10.5$

$= \dfrac{\$73\,500}{100}$

$= \$735 + \$7000$

Year 2 $\$7735 \times 10.5$

$= \dfrac{\$81217.50}{100}$

$= \$812.18 + \$7735$

Year 3 $\$8547.18 \times 10.5$

$= \dfrac{\$89\,745.39}{100}$

$= \$897.45 + \$8547.18$

$= \$9444.63$

Total interest = $9444.63 – $7000 = $2444.63

b $5500 at 12.5% interest p.a. over one year

c $23 000 at 13.8% interest p.a. over two years

d $50 000 at 11% interest p.a. over four years

2 How much in total needs to be repaid in each situation in Question **1**?

a

b

c

d

INVESTIGATION 3

Credit cards

Credit card statement

Account number:	154762S1
Card number:	4601 0087 1553
Statement period:	1 Sept. – 30 Sept.

Mr J Sparrow
30 Ocean Drive
BLACKROCK VIC 3193

Account summary

Credit limit	$500	**Payment due date**	26 October
Opening balance	$0.83 CR	Overdue amount	$0.00
Available balance	$501.96 CR	Current payment due	$0.00
Closing balance	**$1.96 CR**	**Total minimum payment due**	**$0.00**

Balance summary

Opening balance	Debit this period	Payments received	Closing balance
$0.83 CR	$303.87	$305.00	$1.96 CR

Interest summary

Annual percentage rate	Daily percentage rate
14.250%	

Account transactions

Effective date	Transaction date	Detail	Debit	Credit
9 Sept.	7 Sept.	Herald and Weekly Time Southbank	55.00	
9 Sept.		Payment		55.00
13 Sept.	9 Sept.	Kmart Doncaster	198.87	
13 Sept.	9 Sept.	Pizza Hut Beaumaris	50.00	
13 Sept.		Payment		50.00
13 Sept.		Payment		200.00
		Total	**303.87**	**305.00**

QUESTIONS

1 What do *debit* and *credit* mean on a credit card statement?

2 What does 'CR' (next to the closing balance figure) mean?

3 What is the credit limit on this credit card?

4 What is the total amount of debit for this statement?

5 What is the total minimum payment due?

6 How many days does this statement cover?

7 What are the total payments received for this statement?

8 What is the difference between the transaction date and the effective date?

9 Where did Jack shop on 9 September? How much money was spent?

10 What happened on 13 September?

11 If the annual percentage rate for this credit card is 14.25%, calculate the daily interest rate.

PROJECT 1
Planning a party

Your task is to prepare an annual budget for your own 18th birthday party. You have one year (52 weeks) to save for the costs associated with holding your party. The party is for a minimum of 50 people.

WHAT YOU NEED

You will need to obtain the costs for each of the following and convert the total of these amounts into a weekly figure:

- Hiring of a venue
- Plates
- Cutlery
- Glasses
- Tables and chairs
- Tablecloths
- Entertainment (DJ, music etc.)
- Catering or food
- Drinks
- Decorations
- Other items you can think of that you would need for a party (list these separately).

WHAT TO DO

Calculate how much money you would need to budget each week to afford the party expenses.

When you have all of the necessary information, prepare a short information sheet with the items and costs set out in a table. Here is an example of an appropriate table.

Item	Cost of hire	Conversion calculation	Weekly amount
Total weekly amount			$

On a sheet of A4 paper, design an invitation for your birthday party. What information is important for your guests?

Once your invitation is complete, investigate the costs associated with getting your invitations professionally printed. You will need one per person that you have invited. Use the internet or yellow pages to get some quotes.

Investigate the costs involved in sending your printed invitations — you will need to consider postage (costs versus speed of delivery, e.g., whether you need to consider Express Post) and stationery. For pricing information, use the Australia Post weblink in your eBookPLUS.

KEY SKILL 4

Mobile phone charges

TAKE A LOOK BACK AT **BOOK 1, PP. 7, 11, 12**

Whether you use prepaid credit or have a contract, it is useful to know how call charges are calculated so that you aren't spending money unnecessarily. This spread will show you how to calculate the cost of calls and text messages based on time and quantity. You will also be asked to make decisions about choosing an appropriate phone plan for your own use.

WORKED EXAMPLE 1

If calls cost 16 cents per minute and I use 300 minutes of calls, how much do I need to pay?

THINK	WRITE
Multiply the cost of the call by the number of minutes.	0.16×300
This is how much you need to pay.	= \$48

WORKED EXAMPLE 2

How much do you need to pay if you send 125 SMS messages and each one costs 25 cents?

THINK	WRITE
Multiply the charge by the number of SMS messages made.	$\$0.25 \times 125$
This is how much you need to pay.	= \$31.25

WORKED EXAMPLE 3

a How much does each call cost per minute if my bill is \$20 for 80 minutes of calls?
b How many SMS messages have been sent if your bill is \$50 and each SMS costs 20 cents?

THINK	WRITE
a Divide the total cost by the number of minutes used.	$\frac{20}{80}$
This is how much each call costs per minute.	= \$0.25 per minute
b Divide the total cost by the SMS charge.	$\frac{50}{0.20}$
This is how many SMS messages have been sent.	= 250

QUESTIONS

1 Calculate the call charges for the following.

a 40 minutes of calls at 20 cents per minute

b 215 minutes of calls at 18 cents per minute

2 How much do each of these calls cost per minute?

a $15 for 40 minutes

b $72 for 200 minutes

3 Calculate the following SMS charges.

a 116 SMS messages at 25 cents per message

b 200 SMS messages at 19 cents per message

4 Calculate how many SMS messages have been sent for each of the following.

a $200 at 20 cents per message

b $70 at 25 cents per message

5 Consider the two mobile phone plans shown. Plan A offers 500 minutes of calls and 100 SMS messages for $75.00. Plan B offers 100 minutes of calls and 300 SMS messages for $70.00.

a If calls are 16 cents per minute and SMS messages are 19 cents per message, which plan is better value for money?

b What other factors do you need to consider when deciding on a phone plan? Is cost the only factor?

Phone Plan

Plan	Calls	Messages	Amount
Plan A	500 minutes	100 SMS	$75.00
Plan B	100 minutes	300 SMS	$70.00

INVESTIGATION 4

Mobile phones

Mobile phone bill statement

Customer Account Number: **22212212**

Previous Account	*Payments*	*Balance Forward*
$44.12	$45.00	$0.88CR

Ms Alex Bonnici
57 Anywhere Street
Pascoe Vale VIC 3046

New Charges: **$36.89**

New Charges Due: **13 Oct 08**

Total Amount Due: **$**

Issue Date: 29 Sep 08
Account period: 24 Aug–23 Sep 08
Mobile No: 0413 863 362

ACCOUNT DETAILS

Payments

Details	**Date**	**Amount**
Payment received – thank you	12 Sep	$45.00CR

USAGE CHARGES
Short Messaging Charges

Details		**Amount**
SMS Billed Messages	120 units @ 0.163	$______

Call Charges

Details		**Amount**
Mobile Call Charges	24 Aug–23 Sep 08	$13.43

TOTAL USAGE CHARGES	$
+ GST	$ 3.35
TOTAL AMOUNT DUE	$

QUESTIONS

1 According to the statement above calculate the total amount due, using the payments and previous account figures.

2 Calculate the amount due for SMS messaging charges.

3 Using the table below calculate the amount due for all call charges.

4 How many calls were made for this period?

5 What was the total duration of all calls including 'Voicemail Retrieval' made for this period?

6 What is the average cost per call for this period?

7 Calculate the total amount due for this bill. Remember to include amounts for all calls, SMS messaging and GST.

Date	Time	Origin	Destination	Tel no.	Min:sec	Amount ($)
24 Aug.	9.56 am	Geelong	National	03955087XX	2:30	2.182
25 Aug.	3.54 am	Glenroy	National	04196542XX	1:30	1.005
25 Aug.	3.58 pm	Pascoe Vale	Voicemail	Retrieval	1:00	0.545
25 Aug.	4.51 pm	Coburg	National	04135453XX	0:30	0.391
02 Sept.	3.07 pm	Pascoe Vale	National	03930425xx	1:30	1.400
08 Sept.	6.31 pm	Brunswick	National	03955013xx	1:30	1.543
08 Sept.	6.33 pm	Brunswick	National	03955113xx	1:30	1.543
08 Sept.	7.35 pm	Preston	National	03956423xx	0:30	0.618
13 Sept.	10.21 am	Geelong	National	03955087xx	8:30	6.998
13 Sept.	10.29 am	Coburg	Voicemail	Retrieval	1:00	0.545
13 Sept.	10.31 am	Pascoe Vale	National	04132344xx	0:30	0.391
17 Sept.	1.41 pm	Glenroy	National	04138909xx	2:30	2.235
17 Sept.	1.43 pm	Pascoe Vale	Voicemail	Retrieval	1.00	0.545
20 Sept.	5.47 pm	Hadfield	National	04197765xx	2:30	2.235
20 Sept.	5.51 pm	Pascoe Vale	Voicemail	Retrieval	1.00	0.545

KEY SKILL 5

Taxable income

Tax is usually taken out of your pay by your employer each time you are paid through the PAYE (Pay As You Earn) system. The employer pays the tax to the Australian Taxation Office (ATO) on your behalf. Taxable income is different to total income because allowable deductions (expenses related to your work) are subtracted from your total income amount. This is your taxable income — income which is taxed. The more allowable deductions you have, the lower your taxable income and therefore, the lower the amount of tax you need to pay.

WORKED EXAMPLE 1

Calculating taxable income for someone who has incomes of $15 000, $250 and $50 and allowable deductions of $2000 and $210.

THINK	WRITE
Add up all sources of income.	$15 000 + $250 + $50 = $15 300
Add up all allowable deductions.	$2000 + $210 = $2210
Take the deductions away from the total income figure.	$15 300 – $2210
This is the taxable income figure.	= $13 090

WORKED EXAMPLE 2

Kevin is employed as a plumber. Kevin claims deductions of $1400 to buy tools, $25 for gumboots, $200 for two pairs of work overalls, $5 per week for dry-cleaning the overalls and $1.50 per week for work-related telephone calls. Calculate Kevin's total deductions.

THINK	WRITE
Calculate Kevin's total dry-cleaning and telephone deductions.	Dry-cleaning = $5 × 52 = $260 Telephone = $1.50 × 52 = $78
Add up all allowable deductions.	$1400 + $25 + $200 + $260 + $78 = $1963

QUESTIONS

1 Calculate the total income in the following.

a $23 654 + $1029 + $172

b $17 000 + $320 + $55

c $30 000 + $800 + $259

d $10 000 + $90 + $199

2 Calculate the total allowable deductions below.

a $2000 + $47 + $52 + $70

b $550 + $230 + $80 + $99

c $1500 + $110 + $70

d $600 + $400 + $35

3 Calculate the taxable income using your answer from Questions **1** and **2** above.

a

b

c

d

4 Kelly works as a waiter. Kelly must wear a uniform, comprising a white shirt with black pants, belt and bow tie. Kelly buys three shirts at $45.00 each, two pairs of pants at $76.90 each, a belt for $15 and a bow tie for $14.90. Kelly's uniform must be dry-cleaned each week at a cost of $5.70. Kelly has other tax deductions of $345 for union fees, $60 for having his tax return prepared by an accountant and makes $50 in charity donations. Calculate Kelly's total tax deductions.

INVESTIGATION 5
Salary and tax

QUESTIONS

Use the Salary Expectations weblink in your eBookPLUS to help you answer the following questions.

1 What is the average annual salary for the following careers?

a Mechanic

b Police officer

c Solicitor

d Electrician

e Store manager

f Childcare worker

2 Investigate the possible tax deductions allowed for each of the following professions.

a Mechanic

b Police officer

c Solicitor

d Electrician

e Store manager

f Childcare worker

3 Investigate the maximum size of each allowable deduction listed in Question **2**.

4 Calculate the taxable income for each job listed above once the deductions have been subtracted.

5 Calculate the weekly wage for each of the jobs above based on the annual salary figure in Question **1**.

6 Investigate a career of your choice (must be different to those in Question **1**) and determine the average salary, the allowable deductions for that profession and the weekly wage before tax has been deducted.

Superannuation

QUESTIONS

1 What is superannuation and how is it paid?

2 What is the current rate for compulsory superannuation? (Employers must pay their employees this in addition to their wage.)

3 What incentives are there from the government to encourage people to contribute to their own superannuation?

4 Using the current rate, calculate how much superannuation you would receive in addition to your salary each year, based on Question **6** on the previous page.

5 What is salary sacrificing?

6 If you sacrifice $50 of your salary a week, how much extra would this add on to your superannuation amount for a year?

7 Using an online superannuation calculator investigate the following:

a How much superannuation would you need to have if you wanted to retire at 60 and have an annual income of $40 000?

b Assuming you were earning a salary of $60 000, how much extra money would you need to salary sacrifice each month if you were 30 years old, had $30 000 in superannuation, wanted to retire at 60 and have an annual income of $50 000?

c How would this change if you wanted to retire at 55?

d What difference does salary sacrificing $100 each month make to the total superannuation figure?

KEY SKILL 6

Calculating tax

A tax table is used to calculate how much tax needs to be paid on your taxable income.

Tax rates 2008–09

Taxable income	Tax on this income
\$0–\$6 000	Nil
\$6 001–\$34 000	15c for each \$1 over \$6 000
\$34 001–\$80 000	\$4 200 plus 30c for each \$1 over \$34 000
\$80 001–\$180 000	\$18 000 plus 40c for each \$1 over \$80 000
\$180 001 and over	\$58 000 plus 45c for each \$1 over \$180 000

WORKED EXAMPLE 1

Calculate the tax owed on a taxable income of \$45 000.

THINK	WRITE
Locate the row where \$45 000 is within the taxable income range and take one less than the lower figure away from \$45 000.	\$45 000 – \$34 000 = \$11 000
Multiply the answer by 30 cents.	= \$11 000 × \$0.30 = \$3300
Add the answer to \$4200.	= \$3300 + \$4200
This is the tax owed on \$45 000.	= \$7500

WORKED EXAMPLE 2

You have already paid \$9000 in tax throughout the year, and you are required to pay \$7500 to the ATO. Calculate whether extra tax needs to be paid or if a refund is due.

THINK	WRITE
Take away the tax owed sum from the tax paid amount.	\$9000 – \$7500
If your answer is a positive number, this is a refund. If it is a negative number, you are required to pay extra tax.	= \$1500 (refund)

QUESTIONS

Calculate the total income, the total deductions, the taxable income and how much tax needs to be paid for the following scenarios. Use the Tax rates table from the worked example.

1 Katie works as a hairdresser. Her gross income this year was $35 000 and she received $200 in bank interest. Her allowable tax deductions were a $500 union membership, a $100 donation to the Salvation Army and $800 for the cost of tools and equipment she purchased for work.

2 Anthony is a police officer and earned a salary of $55 000 this year. He received $800 in bank interest and a bonus of $300. His allowable deductions included a gym membership fee of $900, a first-aid course for $115 and $1500 in travelling expenses.

3 Jan is a teacher and her salary for the year was $75 000. She also earned $1800 for exam marking and bank interest of $1000. Her allowable deductions included $300 on stationery, $500 on professional development courses, $1200 on purchasing books for her professional library and $600 for union fees.

4 Charlie is a cleaner. He earned wages totalling $40 000. He also received a bonus of $200 and bank interest from a joint account with his wife of $700. His deductions were $600 on income protection insurance, $500 for self-education expenses and $400 for work uniforms.

5 For each of the above scenarios, calculate whether a refund is due or if extra tax needs to be paid.

a Katie has paid $5000 in tax instalments.

b Anthony has paid $10 800 in tax instalments.

c Jan has paid $16 200 in tax instalments.

d Charlie has paid $4500 in tax instalments.

INVESTIGATION 6

Tax returns

Obtain a TaxPack for the current year. Inside the pack you will find two copies of a tax return form. Use one now to complete the following task and keep one for later, when you will be required to prepare your own tax return.

Consider the following scenario:

Jodie McMillan works as a police officer and earned a salary of $47 000 for the year. Her current address is
40 Smith Street, Melbourne, 3000, and her phone number is
03 9448 2000. She was born on 11 August 1980. She has not had any changes to her name or address. Her tax file number is 200133426.

Her employer's ABN number is 11 234 521 874.

Jodie would like to receive any refund owed by cheque (not EFT).

Apart from her salary, Jodie also received $500 in allowances and $1500 from Austudy (for studying part-time).

Jodie's deductions included $800 for travel expenses, $75 for self-education, $100 for uniform cleaning, $200 for car expenses, $1000 for her gym membership and $225 for her first-aid training course. Jodie also donated $50 to Guide Dogs Victoria and paid her tax agent $110 for preparing her tax return last year.

Using the current 'Tax Return for Individuals' form, fill in the above information in the appropriate areas.

QUESTIONS

1 What is the tax payable on Jodie's taxable income? Use the tax table on page 24. Show your working.

2 If Jodie's employer has withheld $15 000 in tax during the year, is Jodie owed a refund or does she have to pay extra tax? Show your working.

Using the second 'Tax return for individuals' form, prepare your own tax return using your own information.

If you are not employed and are not earning any sort of income, use the information you gathered earlier in the investigation 'Salary and tax' on page 22 (question 6). You must have at least four allowable deductions.

3 Using the tax table on page 24, determine how much tax you are required to pay on your taxable income.

4 Assuming you have already paid $7000 in tax throughout the year, calculate whether you are entitled to a refund or if you are required to pay extra tax.

PROJECT 2
Credit cards

1 Investigate a range of different credit cards (at least ten) and research the following for each card.

a What is the annual fee?

b What is the credit limit?

c What is the interest-free period?

d What is the daily or annual interest rate?

e What are some other advantages or incentives for having this card?

2 Prepare a comparison table containing the above information.

3 What does *balance transfer* mean?

4 If you have spent $2000 on credit, calculate the interest accrued over one year (assuming you made only the minimum payments each time) for each card. Which cards had the lowest and highest amount owing at the end of the year?

5 What factors do you need to consider when deciding upon a credit card?

6 From the ten you have chosen to investigate, which one would you choose? Why?

7 Some stores issue their own credit cards with which you can buy now and pay later for goods that you can take home with you on the day. List some examples of stores that have their own cards. What are the advantages and disadvantages of using a store card compared to using a bank credit card?

8 List at least five different occasions when you might need to use a credit card.

9 Some debit cards are also credit cards. What is a debit card, and what is the difference between the two?

10 What factors do you need to consider when choosing a credit card?

11 What is the minimum age at which someone can apply for a credit card?

12 How is interest calculated on the amount borrowed using a credit card? Why is it important to be able to pay the amount owing within the interest-free period?

13 What is a 'cash advance'? Why do you think there are no interest-free days on cash advances?

14 Calculate the interest charged per day on a cash advance of $500 at an annual interest rate of 14.50%. How much interest would this be over a year?

15 A minimum payment must be paid each month — it is either 2.5% of the total amount owing or $25, whichever is greater.

- **a** Calculate the minimum payment owing on a credit card balance of $700.

- **b** Calculate the minimum payment owing on a credit card balance of $1500.

16 Calculate the interest charged on an amount of $1000 after 60 days at a rate of 16.2% p.a.

17 List three strategies that can prevent you from getting into debt with a credit card.

18 Discuss three things that can happen with a credit card when used inappropriately.

eBookplus ACTIVITIES

Key skill 1 Monthly amounts

Digital doc

- Worksheet 2.1: apply your knowledge of monthly amounts

Key skill 2 Unit prices

Digital doc

- Worksheet 2.2: apply your knowledge of unit prices

Key skill 3 Compound interest

Digital docs

- Worksheet 2.3: apply your knowledge of compound interest
- Simple interest 2.7: investigate simple interest using a spreadsheet
- Compound interest 2.8: investigate compound interest using a spreadsheet

Interactivity

- Compound interest (int-0193): explore the effect of compounding interest

Project 1 Planning a party

Weblink

- Australia Post: www.auspost.com.au

Key skill 4 Mobile phone charges

Digital doc

- Worksheet 2.4: apply your knowledge of mobile phone charges

Key skill 5 Taxable income

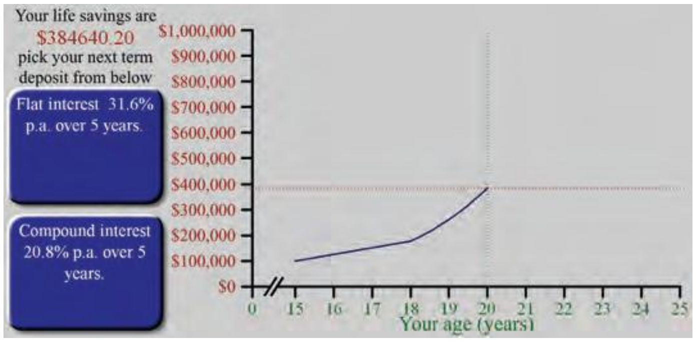
Digital docs

- Worksheet 2.5: apply your knowledge of taxable income
- Payroll calculator 2.9: learn about payroll calculations using a spreadsheet

Investigation 5 Salary and tax

Weblink

- Salary expectations: http://content.mycareer.com.au/salary-centre/



Key skill 6 Calculating tax

Digital docs

- Worksheet 2.6: apply your knowledge of calculating tax
- Tax calculator 2.10: learn about calculating the tax payable using a spreadsheet

CHAPTER REVIEW

Digital docs

- Word search swf (int-0642): search for the terms covered in this book
- Crossword swf (int-0643): test your knowledge of the terms covered in this book
- Puzzle page pdf 2.11: crack the code

Interactivity

- Test yourself (int-0644): take the end-of-chapter online multiple-choice quiz

ANSWERS

KEY SKILL 1 — Monthly amounts

1 a $65 b $433.33 c $346.67 d $216.67
2 a $200 b $93.33 c $60 d $75
3 a $91.58 b $46.42 c $100 d $29.17
4 a $150 b $50 c $42.50 d $60
5 a $1198, $1560 b $19.21
c 4 times per week d Option A
e Frequency of use

INVESTIGATION 1 — Your budget

Answers will vary.

KEY SKILL 2 — Unit prices

1 a $2.56/100 g b $2.41/100 g c 0.18c/100 g
d 0.20c/100 g e 0.15c/100 mL f 0.16c/100 mL
g 0.32c/100 mL h 0.42c/100 mL i $2.05/100 g
2 a $2.50/100 g b $1.71/100 g c 0.17c/100 g
d 0.21c/100 g e 0.15c/100 mL f 0.22c/100 mL
g 0.31c/100 mL h 0.30c/100 mL i $2.00/100 g
3 a 2a b 2b c 2c d 1d e Same
f 2f g 2g h 2h i 2i
4 a 0.15c/100 mL b 0.17c/100 mL
c 0.16c/100 mL d 0.47c/100 mL
∴ 2-L bottle is better value.

INVESTIGATION 2 — Setting up house

Answers will vary.

KEY SKILL 3 — Compound interest

1 b $687.50 c $6786.01 d $25 903.52
2 b $6187.50 c $29 786.01 d $75 903.52

INVESTIGATION 3 — Credit cards

1 Debit — money going out of the account, credit — money coming into the account
2 Credit
3 $500
4 $303.87
5 $0
6 30 days
7 $305
8 Transaction date — when the credit card was used, Effective date — when the money was taken from the account
9 Kmart and Pizza Hut, $248.87
10 Payments of $250 were made, and money from Kmart and Pizza Hut was debited.
11 0.039%

PROJECT 1 — Planning a party

Answers may vary.

KEY SKILL 4 — Mobile phone charges

1 a $8.00 b $38.70
2 a 0.38c b 0.36c
3 a $29.00 b $38.00
4 a 1000 b 280
5 a Plan A is the better option as you get $99 worth of calls for $75.
b Various answers

INVESTIGATION 4 — Mobile phones

1 $36.01
2 $19.56
3 $22.72
4 11 calls, 4 voicemail calls
5 27 min 30 secs
6 $1.51
7 Total amount due = total usage + GST – credit
= $42.28 + $4.23 – $0.85
= $45.63

KEY SKILL 5 — Taxable income

1 a $24 855 b $17 375 c $31 059 d $10 289
2 a $2169 b $959 c $1680 d $1035
3 a $22 686 b $16 416 c $29 379 d $9254
4 $1070.10

INVESTIGATION 5 — Salary and tax

Answers may vary.

KEY SKILL 6 — Calculating tax

1 $4170
2 $10 075.50
3 $16 560
4 $5820
5 a $830 refund b $724.50 refund
c $360 extra tax d $1320 extra tax

INVESTIGATION 6 — Tax returns

Answers may vary.

PROJECT 2 — Credit cards

Answers may vary.

MATHS QUEST

VCE FOUNDATION MATHEMATICS

SPORT

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INTRODUCTION

Sport

Australians are famous — or infamous — for being sports-mad. We play it, we watch it, and we love it.

When people play sport, there needs to be some way of accurately comparing performances: whether on a tennis court or a sprint track, measures are needed to separate the winners from the losers, to sort the quickest to the slowest and to identify the champions of an era.

Measurement is an essential element of all sports in two ways. First, measurements are taken to determine the outcome of an event, such as which runner was fastest or which shot-putter threw the furthest. Second, measurements are used to communicate the agreed rules and regulations of a particular sport. It would be unfair, for example, to claim a world record in the hundred-metre sprint if the athletics track were a few centimetres short of the required length or if the timer were faulty.

contents

KEY SKILL 1

Statistics

TAKE A LOOK BACK AT **BOOK 1, PP. 6, 7**

The study of statistics uses mathematics to make sense of data. Data is any information that can be collected or ranked. There are different ways to interpret information, and they include graphs and measures of centre.

The measures of centre are the mean, mode and median. The range measures spread.

- **Mean** — found by adding all values and dividing that by the total number of values.
- **Mode** — the most frequently occurring number. If there is no number that repeats, then there are no modal values.
- **Median** — the middle value when the data is placed in order from smallest to largest. If there are two values in the middle, simply add the values together and then divide by two.
- **Range** — the spread of the values. It is found by subtracting the lowest value from the highest value.

We are familiar with sporting averages, which are used to measure the performance of an athlete or team. For example, Sir Donald Bradman's test average was 99.94. This means that on average he scored 99.94 runs when he went out to bat.

The mean is found by adding all the values and then dividing the total of the numbers by the amount of numbers in the set of data.

WORKED EXAMPLE

Use the values 2, 15, 7, 9, 2 to find the a mean, b mode, c median and d range.

THINK	WRITE
a Add up all the results.	$2 + 15 + 7 + 9 + 2 = 35$
Count the number of results/observations.	There are 5 values
The mean is the sum of all data divided by the number of observations.	$\text{Mean} = \dfrac{\text{total of results}}{\text{number of results}} = \dfrac{35}{5} = 7$
b List the observations in order.	2, 2, 7, 9, 15
Find the middle term.	2, 2, 7, 9, 15 The middle term is 7
c Find the result that recurs the most.	2
d Find the lowest result.	2
Find the highest result.	15
The range is the highest minus the lowest.	$\text{Range} = 15 - 2 = 13$

QUESTIONS

1 The Melbourne Vixens Netball team have won five games, and their winning margins were: 2, 4, 7, 12 and 15. Find **a** the mean winning margin and **b** the range of the values.

a Mean $= \dfrac{2+4+7+12+15}{5} = \dfrac{\square}{5} = \square$

b Range = highest value – lowest value

.... – .... = ...

2 A junior golfer won a series of golf tournaments by margins of 5, 6, 1, 6, 3, 3, 4 and 7 shots. What were:

a the mean winning margin

b the median winning margin

c the mode winning margin

d the range of winning margins?

3 Renee and Laurie are sisters and play in different netball teams. Find the range, mean, mode and median for each player.

Renee has played eight games and scored: 14, 23, 5, 60, 23, 19, 30 and 26 goals.
Laurie has played ten games and scored: 15, 18, 20, 26, 28, 30, 46, 10, 5 and 32 goals.

Renee Mean = Median = Mode = Range =

Laurie Mean = Median = Mode = Range =

4 The Rovers Basketball team has seven players with the heights shown. Find the following statistical information.

a The team's mean height.

b The team's median height.

c The range of heights.

190 cm 190 cm 187 cm 191 cm 201 cm 190 cm 181 cm

INVESTIGATION 1

Rates: Speed

A rate is a comparison between two quantities that are different types.

The most commonly used rate is speed, where the formula is:

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time taken}}.$$

This means: divide the distance or amount by the amount of time allocated.

WORKED EXAMPLE

A sprinter completes the 100-m dash in 10.1 s. Find the speed in metres per second. Round to 1 decimal place.

THINK	WRITE
Divide the total distance by the total time.	$\text{Average speed} = \frac{\text{distance travelled}}{\text{time taken}}$ $= \frac{100\text{ m}}{10.1\text{ s}}$ $= 9.9\text{ m/s}$ That means for each second, the sprinter covers 9.9 m.

QUESTIONS

1 Geelong footballer James Bartel covered 18 km in 2 hours of a match. Find his average speed in kilometres per hour (km/h).

$$\text{Average speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$= \frac{18\text{ km}}{\phantom{2\text{ h}}}$$

$$= \text{..........}\ \text{km/h}$$

2 Cathy Freeman ran the 400-m final in 49.11 s. Find her average speed in metres per second.

$$\text{Average speed} = \frac{\text{distance travelled}}{\text{time taken}} = \text{..........} = \text{..........}\ \text{m/s}$$

3 USA runner Michael Johnson ran the 400-m final in 43.18 s and the 200-m final in 19.32 s. Find the average speed in metres per second for both distances.

4 Rex Hunt once caught 320 fish in 4 hours of fishing. Find the rate of fish caught per hour.

Investigation of your speed

You may need a calculator to work out the speeds for the following athletes.

World of athletics — male and female records (as of 1 October 2008)

Women				Men			
Event	Athlete	Time	Speed (m/s)	Event	Athlete	Time	Speed (m/s)
100 m	Florence Griffith Joyner	10.49 s		100 m	Usain Bolt	9.69 s	
200 m	Florence Griffith Joyner	21.34 s		200 m	Usain Bolt	19.30 s	
400 m	Marita Koch	47.60 s		400 m	Michael Johnson	43.18 s	
800 m	Jarmila Kratochvilova	113.28 s		800 m	Wilson Kipketer	101.11 s	
1000 m	Svetlana Masterkova	148.98 s		1000 m	Noah Ngeny	131.96 s	

Task

Measure out 100-m and 200-m lengths with a trundle wheel or tape measure, and time yourself at these distances. Ensure you have done a warm-up to minimise the chance of injury.

Event	Athlete (you)	Time (s)	Speed (m/s)
100 m			
200 m			

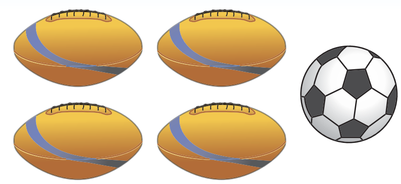
Extension

Research to find the gold-medal winners of the men's and women's 100-metres at the last seven Summer Olympics. Calculate the speed (in metres per second) for each competitor. Graph the results of the competitors.

KEY SKILL 2

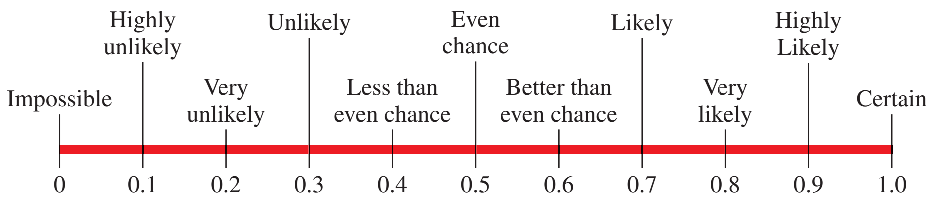
Chance and fractions

Fractions are part of a whole. The top number (the numerator) tells you how many parts you have, and the bottom number (the denominator) tells you how many parts there are in total. A fraction consists of two whole numbers that are separated by a line (the vinculum). For example, $\frac{4}{5}$ means '4 parts out of 5'.



Chance

The chance (probability) of an event occurring is measured with a scale ranging from and including 0 (impossible) to 1 (a certain event).



A certain event is, for example, getting either Heads or Tails when flipping a coin, or getting a number from 1 to 6 when rolling a six-sided die. An example of an impossible event is getting a 7 when rolling a six-sided die.

Predicting probability

A six-sided die makes it easy to understand chance. The chance of rolling, for example, a '5' is 1 in 6 — there is one favoured outcome (the 5) out of six different possible outcomes (1, 2, 3, 4, 5, 6).

For a game to be fair the sum of all the probabilities must add to 1.

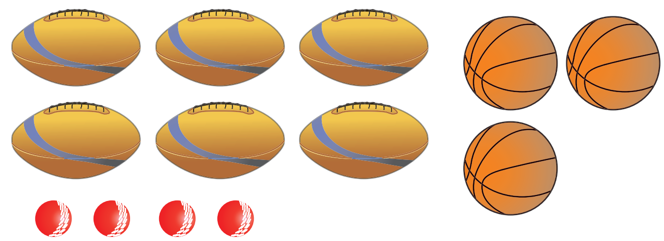
WORKED EXAMPLE

When a standard six-sided die is rolled, what is the probability of rolling a a 2 and b an even number?

THINK	WRITE
a The number 2 occurs once on a die.	Number of favourable outcomes = 1
The possible outcomes are 1, 2, 3, 4, 5, 6.	Number of possible outcomes = 6
Calculate the chance of rolling a 2.	$\frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}} = \frac{1}{6}$
b The even numbers are 2, 4, 6.	Number of favourable outcomes = 3
The possible outcomes are 1, 2, 3, 4, 5, 6.	Number of possible outcomes = 6
Calculate the chance of rolling a even number.	$\frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}} = \frac{3}{6} = \frac{1}{2}$

QUESTIONS

1 In the figure shown, what is the fraction of:



a cricket balls

b basketballs

c footballs?

2 Adam and Trent are brothers and share all of their sporting equipment. Trent has seven of the ten pieces of equipment.

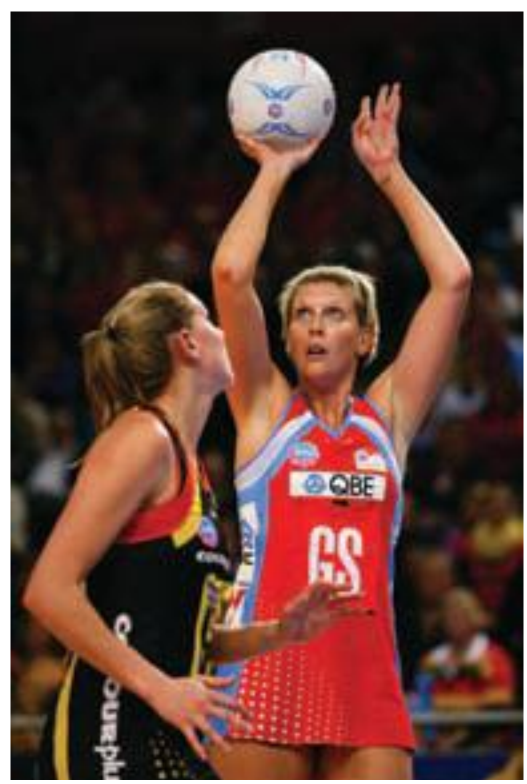
a How many pieces does Adam have?

b What percentage is this?

c What are the odds of randomly picking an item that belongs to Trent? List this as a percentage and a fraction.

d Is an item picked at random more or less likely to be Adam's? Why?

3 Catherine Cox is a champion goal shooter for Australia. On average, she makes 9 out of 10 shots.



a Out of 10 shots, how many would she be expected to miss?

b If she had 20 shots, how many would you expect to go in?

c If she had 100 shots how many would you expect to go in?

d Catherine scores roughly 80% of the team's points. Find out how much you would expect her to score if her team scored:

i 100 points
ii 50 points
iii 120 points
iv 80 points.

INVESTIGATION 2
Cricket

Cricket is now played in three different formats. A test match goes for five days. A one-day game goes for approximately eight hours, during which each team bowls a maximum of 50 overs. There is a new format called Twenty20, which goes for approximately four hours. Each team bowls a maximum of 20 overs. Twenty20 makes for extremely exciting games.

Dice cricket

Brent (out number is 5)			John (out number is 2)		
Batsman	**Score**	**Total**	**Batsman**	**Score**	**Total**
1	1, 3, 6, 2, 5	12	1	5, 6, 1, 4, 1, 2	17
2	4, 4, 4, 1, 2, 3, 5	18	2	1, 2	1
3	5	0	3	6, 4, 1, 3, 2	
4	1, 4, 3, 2, 5	10	4	6, 6, 1, 1, 2	
5	2, 4, 6, 1, 5		5	2	0
6	1, 2, 4, 1, 2, 5		6	1, 1, 1, 1, 5, 2	
7	1, 4, 6, 5		7	5, 5, 3, 2	
8	1, 2, 5		8	3, 4, 4, 2	
9	1, 1, 2, 6, 6, 5		9	2	
10	6, 6, 1, 5		10	3, 3, 6, 2	
11	1, 1, 5		11	5, 2	
Total	49	108	Total	40	

Dice cricket is played by rolling a six-sided die and recording the numbers rolled. Once the 'out' number is rolled the batsman is out and the previous scores (not including the out number) are added up. The other player 'bats' until rolling their out number. You continue to alternate until both players' 11 batsman are out.

Brent and John are playing a game of dice cricket. Brent decides to make the number 5 his out value. John decides to make the number 2 his out value. Complete the scoring in the game shown in the table.

QUESTIONS

1 Who won the game of dice cricket between Brent and John? What were the scores and what was the winning margin?

	Brent					
Number	1	2	3	4	5	6
Tally	𝍸 𝍸 𝍸 III = 13	𝍸 III = 8	III = 3			
Percentage	$\left(\frac{13}{49}\right) \times 100$ = 27%	$\left(\frac{8}{49}\right) \times 100$ = 16%	$\left(\frac{3}{49}\right) \times 100$ = 6%			
	John					
Number	1	2	3	4	5	6
Tally						
Percentage						

2 Tally up the number of times each number was rolled for each player. Find the fraction and percentage that each number occurred for each player.

3 What number would you select, using the results for Brent and John, to make as your out number? Give reasons.

4 Do the percentages add up to 100%? Why?

Extension: play your own game!

YOU WILL NEED

Dice or a random number generator. Blank scoresheet.

WHAT TO DO

With a partner, play a game of dice cricket. Choose your 'out' number, which is the number that, when rolled, means your batsman is dismissed. Make sure you write down your 'out' number. Record your scores on a blank scoresheet.

Complete the following table, using the same techniques as in the example above.

Your score							**Your opponent's score**						
Number	1	2	3	4	5	6	Number	1	2	3	4	5	6
Tally							Tally						
%							%						

QUESTIONS

1 Did you win the game?

2 Explain why.

KEY SKILL 3

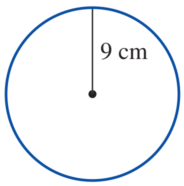
Measurement

TAKE A LOOK BACK AT **BOOK 1, PP. 18, 19, 20, 22, 24, 26**

Perimeter is the length of the outside boundary of a two-dimensional shape. The perimeter for most shapes is found by adding up the lengths of the edges of the shape. One shape that has its own formula for perimeter is a circle. The formula for the perimeter (or circumference) of a circle is 2 × 3.14 × radius. Radius is the measure from the centre to the edge of a circle.

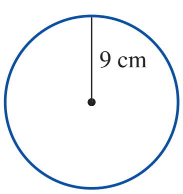
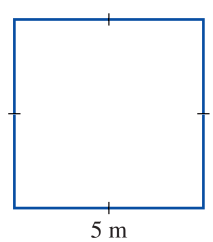
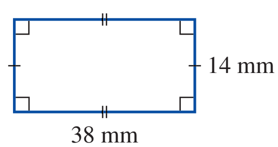
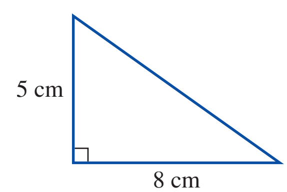
WORKED EXAMPLE

What is the perimeter (circumference) of the circle shown?



THINK	WRITE
The radius for the circle is 9 cm.	$r = 9$
Circumference = 2 × 3.14 × radius.	$= 2 \times 3.14 \times 9$ $= 56.52$ cm

Area is the amount of flat space inside a two-dimensional shape. Each shape has its own formula for calculating the area. The more commonly used shapes are shown below.

Circle	Square	Rectangle	Triangle
			
$A = 3.14 \times \text{radius} \times \text{radius}$ $= 3.14 \times 9 \times 9$ $= 254.34\ \text{cm}^2$	$A = \text{length} \times \text{length}$ $= 5 \times 5$ $= 25\ \text{m}^2$	$A = \text{length} \times \text{width}$ $= 38 \times 14$ $= 532\ \text{mm}^2$	$A = \text{base} \times \text{height} \times 0.5$ $= 8 \times 5 \times 0.5$ $= 20\ \text{cm}^2$

Volume is a three-dimensional measurement. It is calculated by finding the area of the cross-section and multiplying by the length of the shape.

QUESTIONS

1 An Olympic swimming pool is 50 metres long by 25 metres wide by 1.8 metres in depth.

a If AJ swam 10 laps of the pool, how many metres did he swim?

b If you were to swim the 400-m medley, how many laps would that be?

c Work out the surface area of the swimming pool. (*Hint:* The water's surface is a rectangle — area is length × width.)

50 metres long by 25 metres wide by 1.8 metres in depth

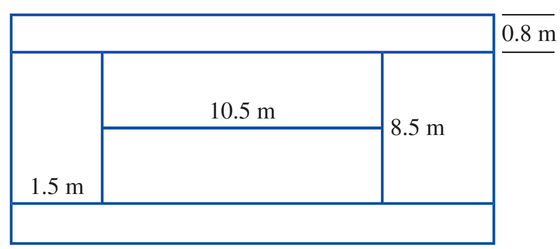
2 A circular ground is used for playing cricket. The radius of the field is 75 m.

a Calculate the perimeter (circumference) of the oval. (*Hint:* $C = 2 \times 3.14 \times$ radius)

b The cricket club needs new fencing. The fencing costs $10 per metre. Calculate the cost of the new fence.

c Work out the area of the cricket field. (Area = 3.14 × radius × radius)

3 Tennis is played on a rectangular court, with dimensions shown below.

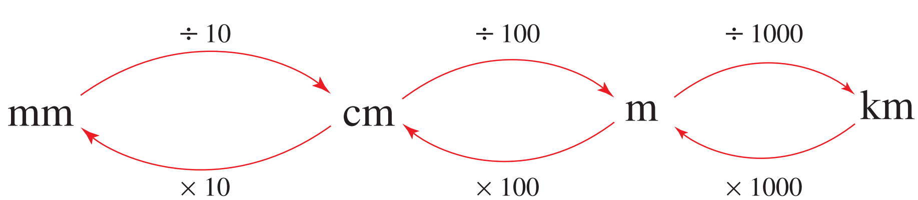


a Work out the length and width of the tennis court.

b What is the perimeter of the outside of the tennis court?

c What is the area of the tennis court?

4 Conversion of one unit to another is extremely important. Use the chart below to convert the following measurements.



a 100 m = ... km **b** 2 km = ... m **c** 100 cm = ... mm **d** 40 mm = ... cm

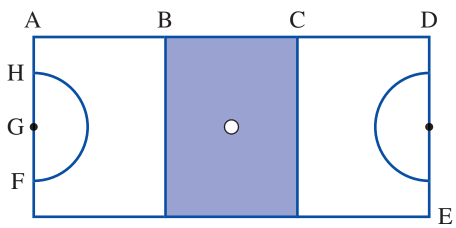
e 20 m = ... cm **f** 4.9 m = ... cm **g** 192 cm = ... m **h** 10 m = ... mm

i 2 km = ... cm **j** 187 cm = ... mm **k** 220 000 m = ... km **l** 2000 mm = ... m

INVESTIGATION 3

Who is the fittest?

If the Australian netball team was looking to play a game at your school, would your school netball court be suitable?



WHAT YOU NEED

Measuring tape, metre ruler, trundle wheel, pen and paper

WHAT TO DO

Measure your school's or local netball court using all of the above measuring devices.

Once you have completed your measurements, research either with the aid of the internet or with the aid of textbooks what the official size of a netball court is.

Section	Measuring tape	Metre ruler	Trundle wheel	Official size
A–B				
B–C				
C–D				
D–E				
F–G				
G–H				

QUESTIONS

1 Did each device get the same results? If not, discuss why.

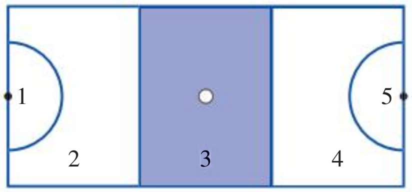
2 What techniques did you use to ensure accuracy? What could have you used to limit variation?

3 Did your school's court measure up to the Australian standard?

4 If the required paving paint costs $10 per square metre, work out how much it would cost to give the court two coats of paint. (*Hint:* You must first work out the area of the whole court.)

Netballers are extremely fit and athletic. They cover an amazing amount of the court during the game and most of their time is spent sprinting. Your task is to find out which player position has the most area to cover and how much. A formula that will assist you in your exploration is the formula for the area of a semicircle.

$$\text{Area of a semicircle} = \frac{3.14 \times \text{radius} \times \text{radius}}{2}$$



5 Using the table below, find the areas for all regions.

Area	1 Semicircle	2 Exclude the semicircle	3 Includes the circle	4 Exclude the semicircle	5 Semicircle
Working out	$\frac{3.14 \times 4.9 \times 4.9}{2}$				
Area	37.6957 m^2				

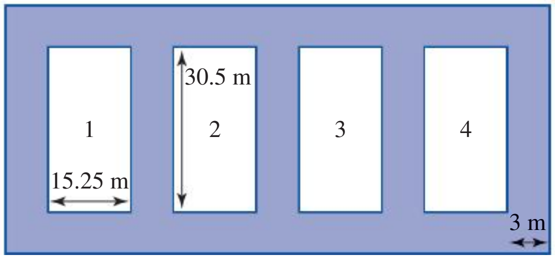
6 Add the areas together and find the specific areas, per position.

Position	Working out	Solution
Goal shooter/keeper Areas 1 and 2	Area 1 + area 2 = 37.6957 + ...	= .... m^2
Goal attack/defence Areas 1, 2 and 3		
Centre All areas except 1 and 5		
Wing attack/defence Areas 2 and 3		

7 Put in ascending order (lowest to highest) the amount of area each person can cover.

8 Do your results correspond with any ideas you had before you started measuring?

9 A school's netball court measures 15.25 m in width by 30.5 m in length, and there is a 3-m wide strip between each court and around the outside. Calculate the area in metres that the school would need for four netball courts that are arranged side by side with each other.



PROJECT 1

Kings High School

Kings High School's netball team played four games this season. The final scores are shown below.

Kings H.S. 45	Willow H.S. 21
Kings H.S. 20	Lynch H.S. 10
Kings H.S. 39	Johnson H.S. 36
Kings H.S. 40	Ferryville H.S. 25

1 Find Kings High School's average score.

2 What is the average score of Kings High School's opponents?

3 What is the range of Kings High School's scores?

4 What is the range of Kings High School's opponents' scores?

Kings High School's coach has a theory: if they can average at least 75% of their players (6 out of 8) who can run at least 5 m/s or quicker, then they will win the game. Below are the players, distances and times that have been calculated in physical education class.

Player	Distance	Time	Speed (m/s) — showing working
Jen	210 m	35 s	$\frac{210}{35} = 6$
Karen	90 m	12 s	
Bek	120 m	15 s	
Jan	20 m	5 s	
Carol	40 m	8 s	
Renee	100 m	25 s	
Laurie	100 m	20 s	
Kerrie	200 m	40 s	

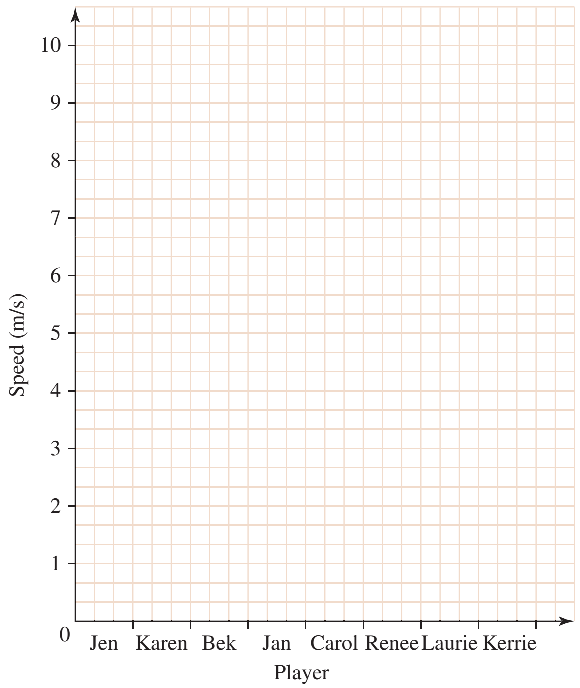
5 Does Kings High School have enough players that will suit their coach's speed requirements?

6 Place the players in order from quickest to slowest.

7 What is the average speed for the whole team? (You may use a calculator.)

8 Find the range of the students' average speeds.

9 Graph the students' average speed levels on a bar graph in the axes shown.



10 During a quarter of netball, the following data were collected measuring the length (in metres) of each pass.

Goal keeper (GK):	9, 11, 4, 5, 12, 7, 9, 11, 4, 6, 9, 12
Goal attack (GA):	2, 1, 3, 2, 1, 4, 2, 6, 2, 3, 2, 5, 1, 2, 1, 4, 3, 6, 2, 3, 4, 4, 2

a What is the mean, median, mode and range for:

i the GK

Mean

Median

Mode

Range

ii the GA?

Mean

Median

Mode

Range

b What conclusions can you draw from the averages to describe the way the GK plays?

c What conclusions can you draw from the averages to describe the way the GA plays?

d What are the differences between how the GK and GA play?

KEY SKILL 4

Rounding

Estimating or rounding a number is useful when an accurate answer is not required. Numbers can be rounded to different degrees of accuracy. For example, the attendance of 78 346 people at a football game can be stated in several different ways.

Rounding to the first digit would give 80 000.

Rounding to the second digit would give 78 000.

Rounding to the third digit would give 78 300.

Sometimes we require decimal approximations to be rounded to a form that is more useable. For example, if Essendon's percentage was 127.767 124 536, then to make this number more useable we would round it to 1 decimal place — 127.8.

Rule for rounding

When rounding, if the first digit past the required accuracy:

1 is a 0, 1, 2, 3 or 4, do not change the digit being considered
2 is a 5, 6, 7, 8, or 9, increase the selected digit.

WORKED EXAMPLE

Round a 127.67 and b 94.1257 to the nearest whole number.

	THINK	WRITE
a	Look at the digit to the right of the decimal.	127.67
	It is a 6, so you round up.	
	127.67 is closer to 128 than to 127.	The approximate answer is 128.
b	Look at the digit to the right of the decimal.	94.1257
	It is a 1, so you round down.	
	94.1257 is closer to 94 than to 95.	The approximate answer is 94.

QUESTIONS

1 Round the following percentages to the nearest whole number.

a Hawthorn: 145.92 **b** Fremantle: 82.24 **c** Sydney: 196.5 **d** Adelaide: 203.91

2 Place the following football teams in order from lowest to highest in their percentage. Use rounding to the nearest whole number to assist you.

Team	Percentage
Carlton	126.7
Essendon	162.3
Brisbane Lions	126
Western Bulldogs	125.379
Melbourne	123.99

3 Emma competes in surfing competitions. She has received the following scores on her rides: 8.94, 6.91, 7.59, 9.79 and 9.91.

a Round the values to 1 decimal place.

b Rank the values from best result to worst result.

c Find the average and range of the values once they have been rounded.

4 The photograph shows the crowd at a cricket match between Australia and South Africa at the Melbourne Cricket Ground. Use the information given with the photograph to calculate the estimated number of people in attendance.

Maximum seating capacity = 95 000. Estimated percentage of seats filled = 45%.

INVESTIGATION 4

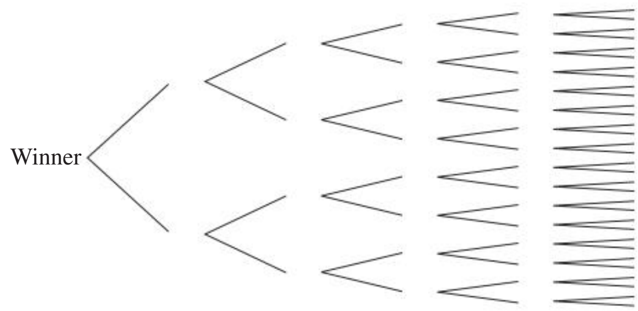
Knock-outs and leagues

Sporting competitions can involve many different types of tournaments, such as knockout, round robin, leagues and finals. The Australian Tennis Open is an example of a knockout competition, in which the winner progresses to the next round and the loser is knocked out. In round-robin competitions, each team plays each other team, generally with the top teams progressing to knock-out finals. The soccer world cup finals is an example of this.

Knockout tournaments

QUESTIONS

1 To run a knockout tournament with 5 rounds, how many people should you start with?



2 What do you notice about the numbers after each round?

3 How many players do you need to have seven full knockout rounds?

Rounds	1	2	3	4	5	6	7
Players	2	4					

4 If we had a ten-round competition, how many players would you need?

5 Complete the table to show the total number of games needed to be played in knockout competitions of the following number of rounds.

Rounds	1	2	3	4	5	6	7
Number of games	1	3					

6 What is the connection between the number of players and the number of games? How can you explain this relationship?

Byes

When you do not have the correct number of competitors, you can top up the competitor numbers by including byes. A bye is when you do not draw an opponent and automatically progress to the next round.

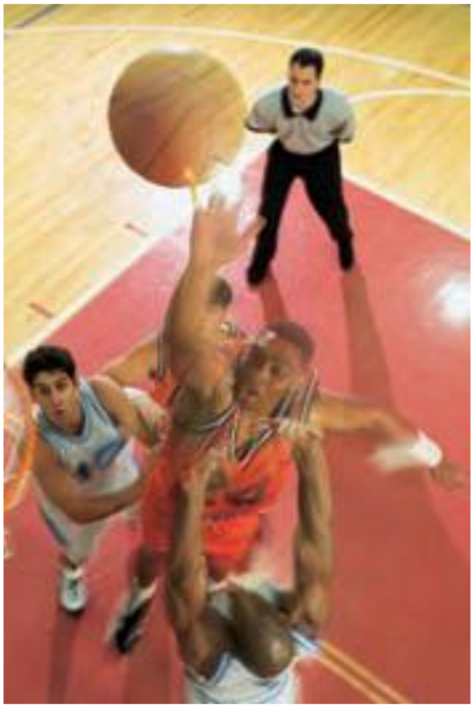
QUESTIONS

7 Complete the following table.

Competitors	7	13		61	122	250
Byes	1		2			
Total players	8	16	32			

Leagues and round-robin competitions

Consider a six-team basketball competition comprising teams A, B, C, D, E and F. Each game is played Saturday morning at 10 am at the same three-court basketball complex, so there is no home ground. The season consists of each team playing each other team once.



QUESTIONS

8 How many games will be played each Saturday?

9 How many rounds will be played over the entire season?

10 How many games will be played for the entire season?

11 Design a fixture for the league.

Round 1	Round 2	Round 3		
A vs B	vs	vs	vs	vs
C vs D	vs	vs	vs	vs
E vs F	vs	vs	vs	vs

12 If team G was added to the next season's competition, what changes would that make to the number of games played each Saturday? How would you account for one extra team?

13 How many rounds would the next season be played over? What is the formula for working this out?

14 How many games would be played in total next season? What is the formula for working this out?

15 If we had a 16-team competition, how many games would be played in the season?

KEY SKILL 5

Percentages

TAKE A LOOK BACK AT **BOOK 1, PP. 8, 9, 10**

Percentages are used a lot in sport. Percentages express amounts as parts of 100, where 100% is the original amount. The AFL uses percentages based on the standard of the opposition scoring 100 points. The percentage reflects how many points your team would have scored. In the history of the AFL, the Essendon team in 2000 had the best percentage at the end of the season, scoring 1897 points and conceding only 1113 points. This converts to a percentage of 170.44%, so for every 100 points the opposition scored, Essendon scored on average approximately 170 points.

WORKED EXAMPLE

After four rounds, Sale football club has scored a total of 412 points and has 380 points scored against them.
a What is their percentage?
b Sale win the next game 134 to 121. How does their percentage change?

THINK	WRITE
a Record the points for.	412
Record the points against.	380
Percentage = $\frac{\text{points for}}{\text{points against}} \times 100$	$\frac{412}{380} \times 100 = 108.42\%$
b Record the new points for.	$= 412 + 134 = 546$
Record the new points against.	$= 380 + 121 = 501$
Percentage = $\frac{\text{points for}}{\text{points against}} \times 100$	$\frac{546}{501} \times 100 = 108.98\%$
Calculate the change in percentage.	$108.98\% - 108.42\% = 0.56\%$

QUESTIONS

1 Below is the ladder during the AFL season. Complete the table by filling in any blanks. For each win a team gains 4 points, a draw is 2 points and a loss is nothing. Each team has played seven games.

Team	Win	Loss	Draw	Points	For	Against	%
St Kilda	7	0	0	28	811	561	$= \frac{811}{561} \times 100 = 144.6$
Geelong	7	0	0	28	872	604	$= \frac{872}{604} \times 100 = 144.4$
Hawthorn	6	0	1		916	672	$= \frac{916}{672} \times 100 =$
Western Bulldogs	5		0		717	602	$= \frac{717}{602} \times 100 =$
Essendon	4	2	1		651	671	$= \frac{651}{671} \times 100 =$
Melbourne	3	3		14	620	535	
Kangaroos	3	3	1	14	657	665	
Richmond		4	0	12	763	717	
Adelaide	3		0	12	725	719	
Carlton		4	0	12	700	698	
West Coast	3		0	12	702	725	
Collingwood		5	0	8	741	747	
Brisbane	2		0	8	683	914	
Sydney		6	0	4	614	729	
Fremantle	1	6	0		519	776	
Port Adelaide	1	6	0	4	549	905	

2 Which result gives you the better percentage?

A Winning by 40 points with scores of 160 to 120.

B Winning by 20 points with scores of 70 to 50.

3 Investigate what has been the lowest end-of-season percentage since the AFL was introduced in 1990.

4 Investigate the average percentage of the eighth-placed team at the end of the season. What conclusions can you draw about what minimum performance over the season is required to make the finals?

INVESTIGATION 5

Percentages in AFL

Football teams score at different rates during a match. Some will be slow starters and finish off the game well, while others will start strongly and come to a near standstill towards the end of the match. A good winning margin helps boost your percentage, which may affect a team's position on the ladder if multiple teams have won the same number of games.

Before we can start to see how the process works, we need to understand the scoring system. Points are given in two ways — a goal registers six points and a behind registers one point. For example, a score of 4.2 (26) represents 4 goals and 2 behinds for 26 points: $4 \times 6 + 2 \times 1 = 26$ (the total score).

Shown below are quarter-by-quarter scores of two matches in Round 7 of the 2008 season.

Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
West Coast vs Carlton									
2.1 (13)	0.6 (6)	6.2 ( )	3.5 ( )	80	2.4 (16)	8.3 ( )	2.1 ( )	5.1 ( )	111
Richmond vs St Kilda									
4.1 ( )	5.3 ( )	4.4 ( )	3.3 ( )	107	4.4 ( )	3.1 ( )	6.2 ( )	4.1 ( )	

To find a percentage of a quantity we must use the formula:

$$\text{percentage} = \frac{\text{score for the quarter}}{\text{total score}} \times 100$$

QUESTIONS

1 Complete the table below by using the above results. Your task is to find the percentage of the total match score made by each team. Round off to the nearest whole number. This is done on a quarter-by-quarter basis. Use the examples provided.

	Q1	Q2	Q3	Q4			Q1	Q2	Q3	Q4
West Coast result	13	6	38		vs	Carlton result	16	51		
% of score	$\frac{13}{80} \times 100$ $= 16\%$	$\frac{6}{80} \times 100$ $= 8\%$	$\frac{38}{80} \times 100$ $= 48\%$			% of score	$\frac{16}{111} \times 100$ $= 14\%$			
Richmond result	25				vs	St Kilda result	28			
% of score						% of score	$\frac{28}{110} \times 100$ $= 25\%$			

2 Using percentages to analyse the games, write a brief report about the performance of each team. List each team's best and worst quarters, and describe the progression of the game. Complete the tables below.

Melbourne vs Fremantle

Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
1.3 = 9	2.5 =	5.7 =	9.12 =	129	5.6 = 36	6.4 =	2.7 =	2.6 =	113

3 Complete the table below by finding the percentage of the score of the team quarter by quarter. Melbourne's first quarter has been done for you.

	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
Melbourne	9				Fremantle	36			
%	$\frac{9}{129} \times 100$ $= 7\%$				%	$\frac{36}{113} \times 100$ $= 32\%$			

4 Complete the table below showing each team's contribution to the total points scored for the game. Write a brief report of the game using your results.

	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
Melbourne	9				Fremantle	36			
%	$\frac{9}{242} \times 100$ $= 4\%$				%	$\frac{36}{242} \times 100$ $= 15\%$			

KEY SKILL 6

Displaying data

Resting heart rate

To improve your fitness level, you need to improve your cardiovascular endurance. Playing a sport will normally improve your cardiovascular endurance. The more common and easily accessible ways to improve this are:

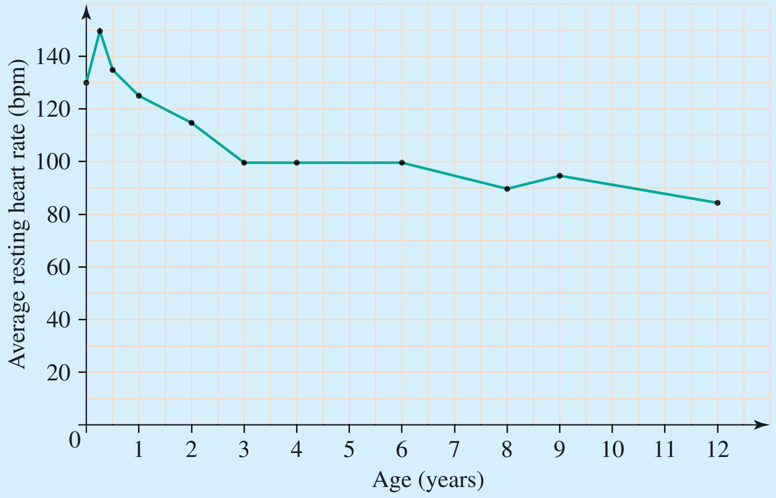
- walking
- running
- cycling
- swimming.

Your heart rate is the number of times your heart beats within a minute. You can measure your heart rate by feeling your pulse at an appropriate place such as your neck or wrist. The pulse that you feel is the flow of blood through the arteries. The table below shows the average resting heart rate for children.

Age	Newborn	3 months	6 months	1 year	2 year	3 year	4 year	6 year	8 year	9 year	12 year
Average resting heart rate (bpm)	130	150	135	125	115	100	100	100	90	95	85

WORKED EXAMPLE

Show the resting heart rate table above in a graph.

THINK	WRITE
Determine the highest values.	The ages range up to 12. The average resting heart rates range up to 150.
Draw axes to plot the points on. Plot the points.	

QUESTIONS

1 Find your resting heart rate and record it.

2 Find the average resting heart rate for your class.

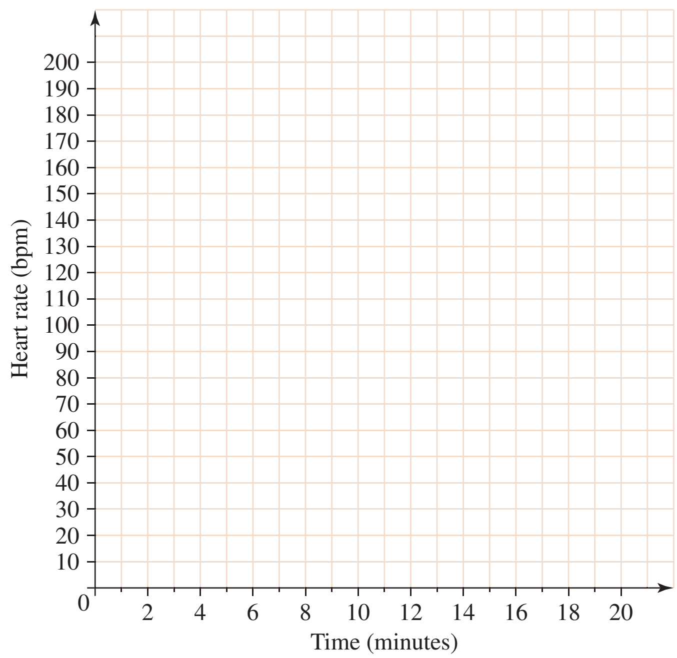
3 Is your resting heart rate above or below the line on the graph? Give reasons why it is or isn't.

Heart rate after exercise

Walk at a constant speed for 1 min, and then measure your pulse rate for 1 min and record it. Repeat this another four times. After you do this 10-min exercise, measure your pulse every 2 min for the next 10 min. Complete this table.

Time (min)	0	2	4	6	8	10	12	14	16	18	20
Pulse rate (bpm)											

4 Draw a graph on the axes below, showing your heart rate against time.



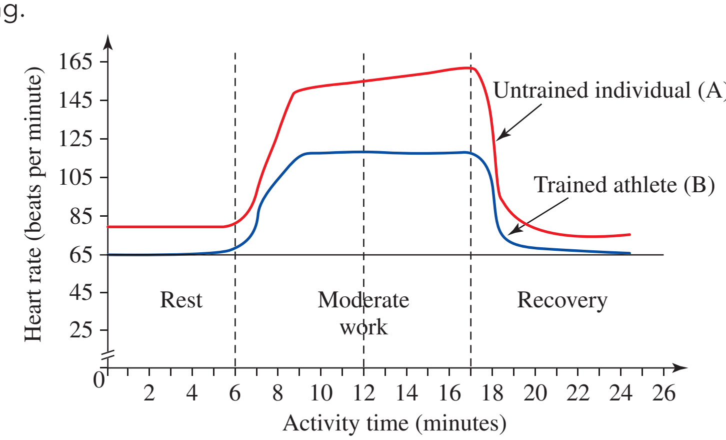
5 Plot three of your classmates' results in different colours on the same axis.

6 From the graph below, answer the following.

a Describe the difference between the resting heart rate of the trained athlete and the untrained athlete.

b What might explain the heart rate increasing between minute 5 and minute 6?

c Describe the heart rate between the 12 minute and 14 minute mark for both the trained and untrained athlete.



INVESTIGATION 6
Physical fitness

Reaction time is the time span from when a stimulus is detected by the brain to when the response begins to occur. Sprinters need excellent reaction times, which enable them to leave the blocks in the shortest time possible. Cathy Freeman had a reaction time of 0.223 s in her 400-m final. How fast is your reaction time?

YOU WILL NEED

A partner, a 30-cm ruler

WHAT TO DO

Hold your thumb and index finger 2 cm apart. Your partner will drop the ruler between your fingers, and you will try and catch the ruler between your thumb and index finger. Your partner should ensure your hand is at the same level of zero on the ruler. Attempt this activity five times and average your results. Perform this activity for both hands. Repeat for one hand with your eyes closed, responding to hearing alone.

Activity	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Average
Distance (cm), right hand						
Distance (cm), left hand						
Hearing only						

The table below shows a distance-to-time conversion chart.

Distance (cm)	1	2	3	4	5	6	7	8	9	10
Reaction time (s)	0.05	0.06	0.07	0.09	0.10	0.11	0.12	0.13	0.14	0.142
Distance (cm)	11	12	13	14	15	16	17	18	19	20
Reaction time (s)	0.15	0.156	0.162	0.169	0.175	0.180	0.186	0.191	0.197	0.202

QUESTIONS

1 Did your results improve with practice? If so, by how much?

2 List your averages and find out your corresponding reaction rates.

Right hand = Left hand = Hearing only =

Talent identification — rowing

There is a process called talent identification that involves screening young athletes and measuring them to see if they may succeed in a specific sport. It is based on the concept that some athletes will have certain characteristics that allow them to be successful in a sport. The sport in focus here is rowing.

For this activity you need a ruler and a tape measure. Is there a potential rower in your class? Measure your body dimensions listed in the table and record your results. Fill in the difference column by subtracting the larger results from the smaller result from your findings.

Characteristics	Male (cm)	Female (cm)	Students (cm)	Difference (cm)
Height (cm)	193	177		
Weight (kg)	90	72		
Sitting height (cm)	99	92		
Upper arm length (cm)	37	34		
Forearm length (cm)	29	26		
Thigh length (cm)	49	47		
Lower leg length (cm)	47	43		
Hip width (cm)	35	36		
Bicep girth (cm)	35	30		
Thigh girth (cm)	60	57		
Total				

QUESTIONS

3 Size is only one factor that influences success in rowing. List some other factors.

4 What other sports require a specific skill? List five sports and a main characteristic that you consider is required for success in each.

5 Seek out five more classmates' results and sketch them on the set of axes below. Sketch the total differences as a vertical bar graph.

PROJECT 2

Sir Donald Bradman

Sir Donald Bradman was one of the world's greatest batsmen. This can be simply summed up by the fact his batting average was a commanding 99.94. There are no other cricketers with a batting average even close to Bradman's average.

In his first club game, Bradman scored 110 runs in 128 minutes. Work out the rate of runs scored per minute.

Bradman scored 699 530 runs over the years from 1928 to 1948. Work out how many runs he scored per year on average.

He was famous for scoring runs at a quick rate. In one innings he scored 400 runs in 6 hours and 17 minutes. Work out the rate of runs per minute. (*Hint:* First convert 6 hours and 17 minutes to minutes.)

Bradman's test career was unique. Work out the percentage of runs scored against each country.

Country	Matches	Runs	Percentage (round to the nearest whole number)
England	37	5028	$= \frac{5028}{6996} \times 100 =$
India		715	
South Africa	5	806	
West Indies	5		
Total	52	6996	

In 1930, in England his scoring strokes were counted. Find the total number of runs scored.

Scoring shot	Frequency	Runs scored
1	80	$= 1 \times 80 = 80$
2	26	
3	6	
4	46	
Total	158	

Bradman's averages against each country are listed below. Round them to the nearest whole number.

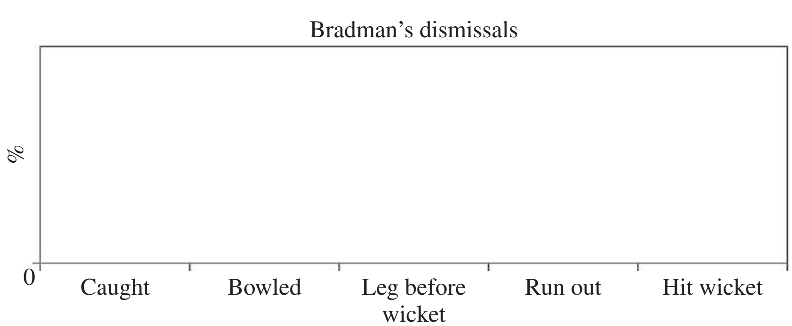
Country	Average	Rounded average
England	89.79	
India	178.75	
South Africa	201.50	
West Indies	74.50	

Complete the table of Bradman's cricketing history.

Matches	Innings	Percentage of games (round to the nearest whole number)	Runs	Averages
First class	338		28 067	95.14
Second class	331		22 664	84.80
Test matches	80		6 996	99.94
Tests vs England	63		5 028	89.78
Sheffield Shield	96		8 926	110.19
Grade cricket	93		6 598	86.80
Totals				

Bradman batted in 80 test matches. Calculate the percentage of each of the different ways that the Don was dismissed. He was not out 10 times. So, he was dismissed 70 times. Graph the percentages on the graph below and on a computer.

Dismissal	Frequency	Percentage of dismissals
Caught	39	$= \frac{39}{70} \times 100 =$
Bowled	23	
Leg before wicket	6	
Run out	1	
Hit wicket	1	
Totals		



Extension: Research your own sportsperson and find and analyse the statistics that are behind their careers.

eBook*plus* ACTIVITIES

Key skill 1 Statistics

Digital docs
- Worksheet 3.1: apply your knowledge of statistics
- Mean, median and mode 3.7: solve mean, median and mode using a spreadsheet

Interactivity
- Measures of centre (int-0084): explore the effects of the mean, median and mode

eLesson
- AFL stats (eles-0131): discover how the AFL statistics are counted

Investigation 1 Rates: speed

Digital doc
- Converting speeds 3.8: investigate converting speeds using a spreadsheet

Key skill 2 Chance and fractions

Digital doc
- Worksheet 3.2: apply your knowledge of chance and fractions

Investigation 2 Cricket

Interactivity
- Random numbers (int-0089): explore probability by running trials with four random number generators

Digital doc
- Dice cricket score sheet 3.9: blank scoresheet for dice cricket

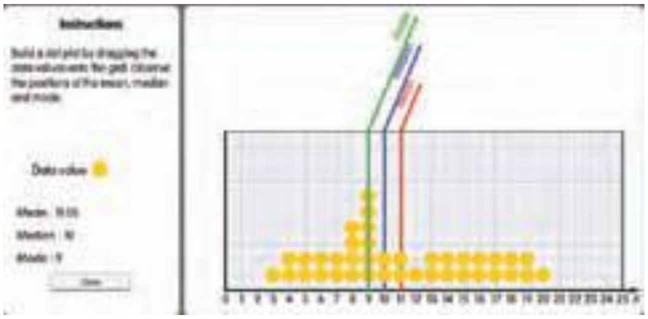
Key skill 3 Measurement

Digital doc
- Worksheet 3.3: apply your knowledge of measurements

eLesson
- Errors in measurement (eles-0045): explore the errors involved when measuring

Investigation 3 Who is the fittest?

Interactivity
- Energy intake (int-0213): explore the effects of energy intake



Key skill 4 Rounding

Digital doc
- Worksheet 3.4: apply your knowledge of rounding numbers

eLessons
- Rounding (eles-0001): learn about rounding to different digits to help you estimate crowd sizes at an AFL match

Key skill 5 Percentages

Digital doc
- Worksheet 3.5: apply your knowledge of percentages

Key skill 6 Displaying data

Digital docs
- Worksheet 3.6: apply your knowledge of displaying data
- Draw a graph in Excel 3.10: step-by-step on how to draw a graph in Excel

CHAPTER REVIEW

Digital docs
- Word search swf (int-0645): search for the terms covered in this book
- Crossword swf (int-0646): test your knowledge of the terms covered in this book
- Puzzle page pdf 3.11: crack the code

Interactivity
- Test yourself (int-0647): take the end-of-chapter online multiple-choice quiz

ANSWERS

Key skill 1 — Statistics

1 a 8 b 13

2 a 4.375 b 4.5 c 3, 6 d 6

3 Renee — mean: 25, median: 23, mode: 23, range: 55
Laurie — mean: 23, median: 23, mode: —, range: 41

4 a 190 cm b 190 cm c 20 cm

Investigation 1 — Rates: Speed

1 9 km/h 2 8.14 m/s

3 400: 9.26 m/s; 200: 10.35 m/s 4 80 fish/hour

Key skill 2 — Chance and fractions

1 a $\frac{4}{13}$ b $\frac{3}{13}$ c $\frac{6}{13}$

2 a 3 b 30% c 70%, $\frac{7}{10}$ d Less

3 a 1 b 18 c 90
d i 80 ii 40 iii 96 iv 64

Investigation 2 — Cricket

1 Brent had a score of 108. John had a score of 96. Brent won by 12 points

2

	1	2	3	4	5	6
Brent	27	16	6	14	22	14
John	25	28	13	10	13	13

3 Answers will vary. 4 Rounding errors

Key skill 3 — Measurement

1 a 500 m b 8 laps c 1250 m^2

2 a 471 m b $4710 c 17 662.5 m^2

3 a Length: 13.5 m, width: 10.1 m b 47.2 m
c 136.35 m^2

4 a 0.1 km b 2000 m c 1000 mm
d 4 cm e 2000 cm f 490 cm
g 1.92 m h 10 000 mm i 200 000 cm
j 1870 mm k 220 km l 2 m

Investigation 3 — Who is the fittest?

A–B = 10.2 m, B–C = 10.2 m, C–D = 10.2 m, D–E = 15.2 m, F–G = 4.9 m, G–H = 4.9 m

1 Inconsistent due to measuring techniques

2 Same technique each time, double checked

6 Goal shooter: 155.04 m
Goal attack: 310.08 m
Centre: 389.73 m
Wing attack: 272.38 m

7 Goal shooter, wing attack, goal attack, centre

9 2774 m^2

Project 1 — Kings High School

1 36 2 23 3 25 4 26

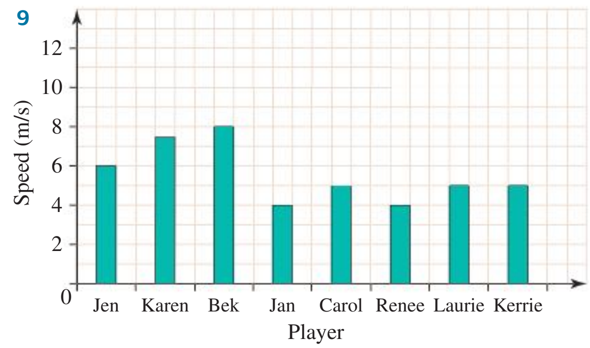
Player	Jen	Karen	Bek	Jan	Carol	Renee	Laurie	Kerrie
Speed (m/s)	6	7.5	8	4	5	4	5	5

5 Yes

6 Bek, Karen, Jen, Carol, Laurie, Kerrie, Jan, Renee

7 5.56 m/s 8 4 m/s

9



10 a

	Goal keeper	Goal attack
Mean	8.25	2.83
Median	9	2
Mode	9	2
Range	8	5

b Runs are 8 m long normally; long leads
c Shorter, sharp quick runs
d One runs short, one runs long but changes direction quickly.

Key skill 4 — Rounding

1 a 146 b 82 c 197 d 204

2 Melbourne, Western Bulldogs, Brisbane Lions, Carlton, Essendon

3 a 8.9, 6.9, 7.6, 9.8, 9.9 b 9.9, 9.8, 8.9, 7.6, 6.9
c Average: 8.6; range: 3

4 42 750

Investigation 4 — Knock-outs and leagues

1 32 2 They halve.

3 8, 16, 32, 64, 128 4 1024

5 7, 15, 31, 63, 127 6 Games = players – 1

7

7	13	30	61	122	250
1	3	2	3	6	6
8	16	32	64	128	256

8 3 9 5 10 15

11 Answers will vary

12 One team would have a break each week

13 7 14 21 15 120

(continued)

ANSWERS

Key skill 5 — Percentages

1 St Kilda 144.6%, Geelong 144.4%, Hawthorn 136.3%, Western Bulldogs 119.1%, Essendon 97%, Melbourne 115.9%, Kangaroos 98.8%, Richmond 106.4%, Adelaide 100.8%, Carlton 100.3%, West Coast 96.8%, Collingwood 99.2%, Brisbane 74.7%, Sydney 84.2%, Fremantle 66.9%, Port Adelaide 60.7%

2 B is better.

3 Fitzroy 1996 49.47% (at time of printing)

4 Answers will vary.

Investigation 5 — Percentages in AFL

1

	Q1	Q2	Q3	Q4			Q1	Q2	Q3	Q4
West Coast	16%	8%	48%	29%	vs	Carlton	14%	46%	12%	28%
Richmond	23%	31%	26%	20%	vs	St Kilda	25%	17%	35%	23%

2

Melbourne vs Fremantle									
Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total
1.3 = 9	2.5 = 17	5.7 = 37	9.12 = 66	129	5.6 = 36	6.4 = 40	2.7 = 19	2.6 = 18	113

3

	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
Melbourne	9	17	37	66	Fremantle	36	40	19	18
%	$\frac{9}{129} \times 100$ = 7%	$\frac{17}{129} \times 100$ = 13%	$\frac{33}{129} \times 100$ = 29%	$\frac{66}{129} \times 100$ = 51%	%	$\frac{36}{113} \times 100$ = 32%	$\frac{40}{113} \times 100$ = 35%	$\frac{19}{113} \times 100$ = 17%	$\frac{18}{113} \times 100$ = 16%

4

	Q1	Q2	Q3	Q4		Q1	Q2	Q3	Q4
Melbourne	4%	7%	15%	27%	Fremantle	15%	17%	8%	7%

Key skill 6 — Displaying data

Answers will vary.

Investigation 6 — Physical fitness

Answers will vary.

Project 2 — Sir Donald Bradman

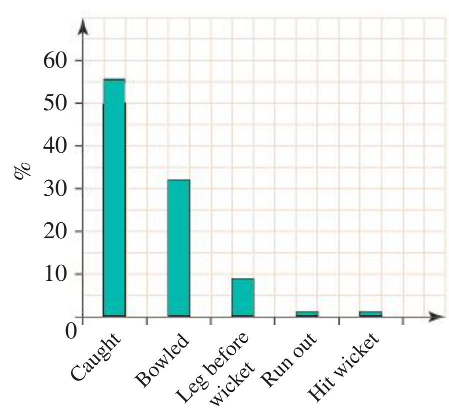
England 72%, India 10%, South Africa 12%, West Indies 6% (Total 100%)

1s 80, 2s 52, 3s 18, 4s 184 (Total 334)

England 90, India 179, South Africa 202, West Indies 75

First class 34%, Second class 33%, Test matches 8%, Tests vs England 6%, Sheffield shield 10%, Grade cricket 9% (Totals 100%)

Caught 56%, Bowled 33%, Leg before wicket 9%, Run out 1%, Hit wicket 1% (Total 100%)



MATHS QUEST

VCE FOUNDATION MATHEMATICS

THE HOUSE AND LAND PACKAGE

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LYN TREADWELL | MICHELLE CLARK

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INTRODUCTION

The house and land package

Buying a block of land, designing a house plan, and the building and final finishing of a house require a large number of mathematical calculations. Many measurements will be made, areas and distances calculated and costs decided. This unit will introduce you to some of the mathematical skills that would be used throughout the process of buying a block of land and building a home. The calculations don't end with the house. Creating the garden and the landscaping process can also be quite mathematical!

contents

KEY SKILL 1

Using scale

TAKE A LOOK BACK AT **BOOK 1, PP. 11, 16**

Plans for houses and other buildings are like the maps that we use to get around — they are scale drawings. Plans cannot be drawn at full size; they must be an accurate representation of real-life distances. A common scale we see used in plans for houses is shown below.

The line scale above tells us that every 1 cm we measure on the plan represents 1 m in real life. The scale as a ratio tells us that each unit we measure on the plan represents 100 of the units in real life. So 1 cm on the map is 100 cm in real life.

WORKED EXAMPLE 1

Change the ratio 1 : 200 into a ratio in centimetres, and then change the large value into metres.

THINK	WRITE
1 : 200 means 1 unit compared to 200 units.	1 : 200
Add cm to each number.	1 cm : 200 cm
Convert 200 cm to metres by dividing by 100.	$200 \div 100 = 2$
Write the new units in metres.	2 m
Write out the complete ratio with the new units.	1 cm : 2 m

WORKED EXAMPLE 2

A plan has been drawn to the scale 1 : 100. What real-life measurement does this line represent?

THINK	WRITE
Measure the line in cm.	This line measures 3 cm.
Read the scale provided to decide what to multiply the measurement by. The number on this scale is 100.	Multiply by 100.
Multiply this value with the length of the line that you measured.	3×100
This is the real-life measurement in cm.	Real-life measurement of 300 cm
Would it be more useful to change the units to metres?	300 cm = 3 m

QUESTIONS

1 Complete the table below. The first two questions are done for you.

Scale as a ratio	cm : cm	Change to units shown
1 : 10	1 cm : 10 cm	1 cm = 100 mm
1 : 1000	1 cm : 1000 cm	1 cm = 10 m
1 : 2500		1 cm = m
1 : 30 000		1 cm = m
1 : 100 000		1 cm = km
1 : 5000		1 cm = m
1 : 2		1 cm = mm

2 Complete the table below. Use a ruler to measure the lengths of each line in column 1.

Lines to measure	Scale to work with	Length of line in cm	Length in real life
	1 : 10	3	3 × 10 = 30 cm
	1 : 100	4.5	4.5 × 100 = 450 cm
	1 : 10		
	1 : 50		
	1 : 100		
	1 : 100		
	1 : 1000		

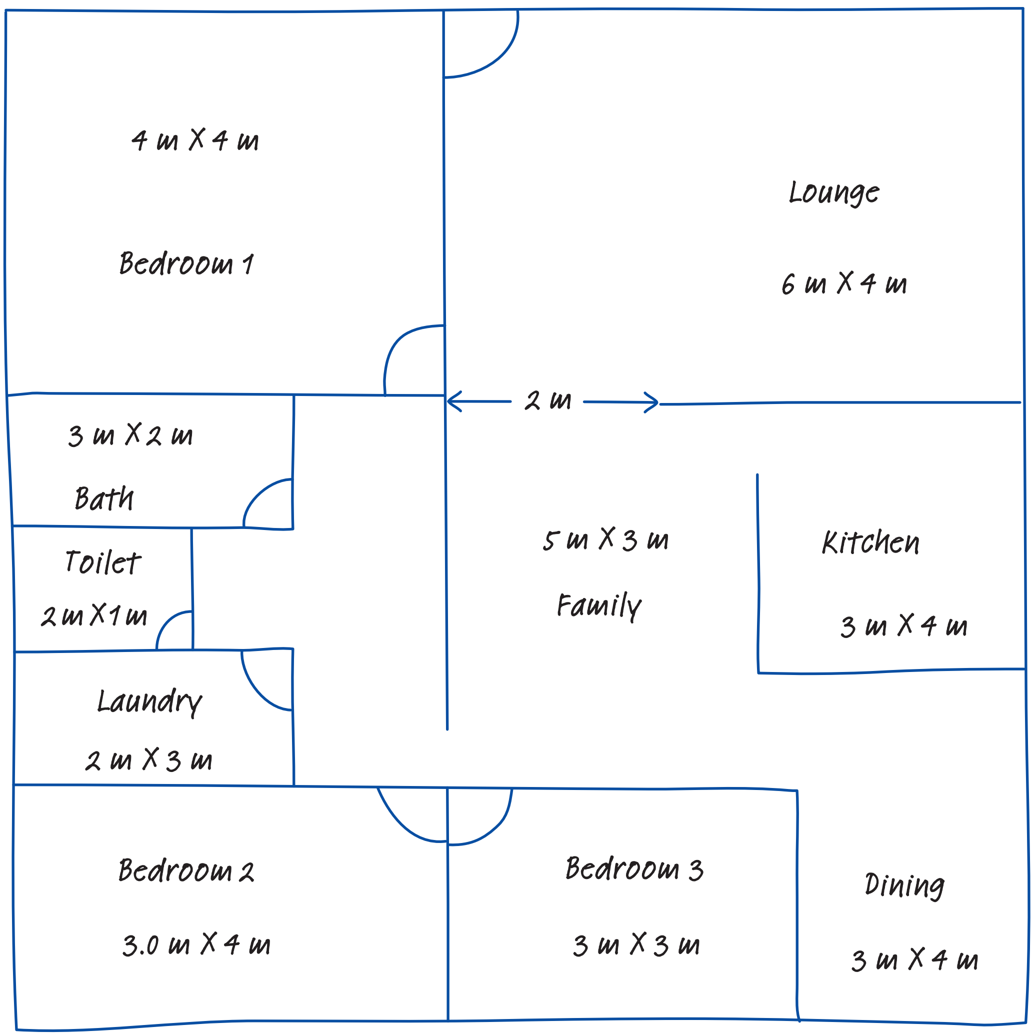
3 Sometimes lengths measured on the building site have to be drawn onto a plan with a given scale. Complete the following table which gives some real measurements in mm which must be drawn on a house plan.

Length measured at building site (mm)	Scale as a ratio on the house plan	Length of the line that will be drawn on the house plan (mm)
700	1 : 10	700 ÷ 10 = 70 mm
85 000	1 : 100	85 000 ÷ 100 = 850 mm
1 200	1 : 100	
450 000	1 : 1000	
2 000	1 : 500	
1 250	1 : 10	
900	1 : 100	

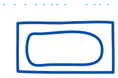
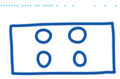
INVESTIGATION 1

Scale drawing

In the early planning stages of a house, the plans might just be hand-drawn sketches of the ideas. Below is a hand-drawn sketch of a house plan with the measurements written on the plan. It has not been drawn to scale.



On the grid paper provided, draw a scale drawing of the house. The scale you must use is 1 : 100. Use the symbols provided to represent windows, doors, bath, toilets etc.

Single hinge-opening door		Double hinge-opening door	
Shower		Bath	
Toilet		Kitchen sink	
Stove		Window (you can choose from 1-m, 2-m or 3-m widths)	

The scale drawing

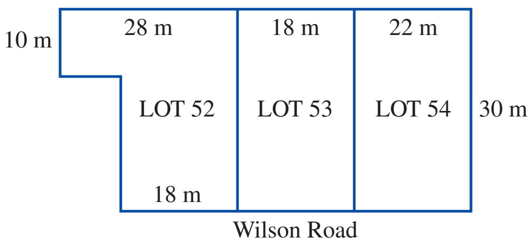
KEY SKILL 2

Using a survey plan

TAKE A LOOK BACK AT **BOOK 1, PP. 13, 19**

A survey plan shows the shape and size of house blocks, neighbouring blocks and access roads. Local councils have these types of plans. These survey plans will have a ratio that can be used to calculate distance and area.

Remember: The formula for calculating the area of a rectangle is: area = length × width.



WORKED EXAMPLE 1

What is the area of Lot 53?

THINK	WRITE
What are the measurements of Lot 53?	Length = 18 m, width = 30 m
Use the formula for the area of a rectangle.	Area = length × width
Find the answer.	Area = 18 × 30 = 540
Include the appropriate units of measurement.	540 m^2

WORKED EXAMPLE 2

What is the perimeter of Lot 54?

THINK	WRITE
Find all of the outside lengths of the shape.	Two sides are each 22 m and the other two sides are each 30 m.
Add up all of the side lengths.	(2 × 22) + (2 × 30) = 104
Include the appropriate units of measurement.	Perimeter = 104 m

When calculating areas measure to nearest 0.5 cm.

QUESTIONS

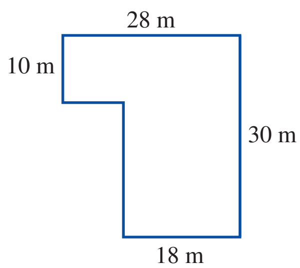
1 Find the area of Lot 54.

Area = length × width

= .... × ....

= ....

2 Find the area of Lot 52.



On this sketch draw a line to divide the block into 2 four-sided shapes. Now calculate the area of each of these shapes and add them together.

3 Calculate the perimeter of Lot 52.

4 Which of the three house blocks has the largest perimeter?

Lot: ....

5 Which house block has the largest area?

Lot: ....

INVESTIGATION 2

Shallow Waters

QUESTIONS

1 The scale on this survey plan is 1 : 1000. For every one centimetre on the map:

a how many centimetres are there in real life?

b how many metres is this?

2 Use the information from question 1 to complete the line scale on the survey plan, and then fill in the missing value in the equation below the line scale.

3 a Which block has the widest frontage to Yarra Bend Ave?

b Which block has the narrowest frontage to Yarra Bend Ave?

4 List the numbers of the blocks that could have a gate that would open directly onto the walking track.

5 List the numbers of the blocks that have road frontages of exactly 20 m.

6 a The length of Lot 720 is .... m. The width of this block is .... m.

b The area of Lot 720 is: .... × .... = ... m^2.

7 Find the area of:

a Lot 721: Length × width

.... × ....

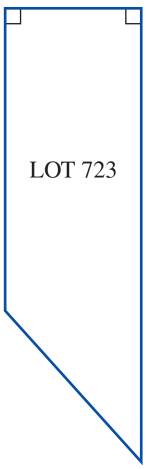
= ....

b Lot 725: Length × width

.... × ....

= ....

8 a Lot 723 is a composite shape. The diagram here has divided the block into a rectangle and a triangle. Find the area of each component and then find the total area of the block.



b What is the other way that the area of this block could have been calculated?

KEY SKILL 3

How much is the land?

TAKE A LOOK BACK AT **BOOK 1, PP. 19, 20**

Blocks of land vary in price. It is not just the size of the land that adds to the price — the location and surroundings can influence the price. The cost of the land at *Shallow Waters* is influenced by two factors: the size of the block and whether or not the block joins the walking track.

Lot 718 is for sale for \$160 000. It has an area of 800 m^2. This means that the price per square metre is \$200. The cost of a block next to the walking track costs \$250/m^2.

The cost of a standard paling fence being installed is \$50 per linear metre. Where a fence is shared between 2 neighbours, each pays half. Where the fence joins the walking track, the owner pays the full price. The front fence costs the full price, but a 3-m opening is to be left for the driveway.

WORKED EXAMPLE 1

How much will Lot 724 cost me?

THINK	WRITE
What shape is the block? What formula will be needed to calculate the area? The block is a trapezium, and the formula is: area = $\frac{1}{2}h(a + b)$.	 Area = $\frac{1}{2} \times h \times (a + b)$
Find the values of h, a and b, and put them into the formula.	$h = 22$ m, $a = 25$ m, $b = 40$ m Area = $\frac{1}{2} \times 22 \times (25 + 40)$
Make the calculation and then add the units of measurements.	$= 11 \times 65$ $= 715$ m^2

WORKED EXAMPLE 2

How much will Lot 724 cost to fence, if the front fence has a 3-m opening for the driveway?

THINK	WRITE
Use the scale to calculate the lengths of each side of the block.	Front fence = 22 m − 3 m (for driveway) Back fence = 27 m Side fence = 25 m
Add up the lengths that will cost the full price.	19 m + 27 m + 25 m = 71 m
Multiply this length by \$50.	71 × \$50 = \$3550
Add up the lengths that will be half price.	37 m side
Multiply this amount by \$25.	37 × \$25 = \$925
Add the two costs to get the total cost of fencing the block.	\$3500 + \$925 = \$4425 for fencing Lot 724

QUESTIONS

1 Calculate the area of Lot 716.

2 Calculate the area of block 729.

3 a Lot 722 is a composite shape. Sketch the block below and show where you would divide the shape so that the total area could be calculated.

b Find the area of each of these shapes, and then find the total area of the block.

4 Calculate the cost of fencing Lot 721.

5 Calculate the cost of fencing Lot 729.

6 The final block for sale is Lot 712. You decide to buy it!

a Make a scale drawing below of the block, using the scale 1 : 500.

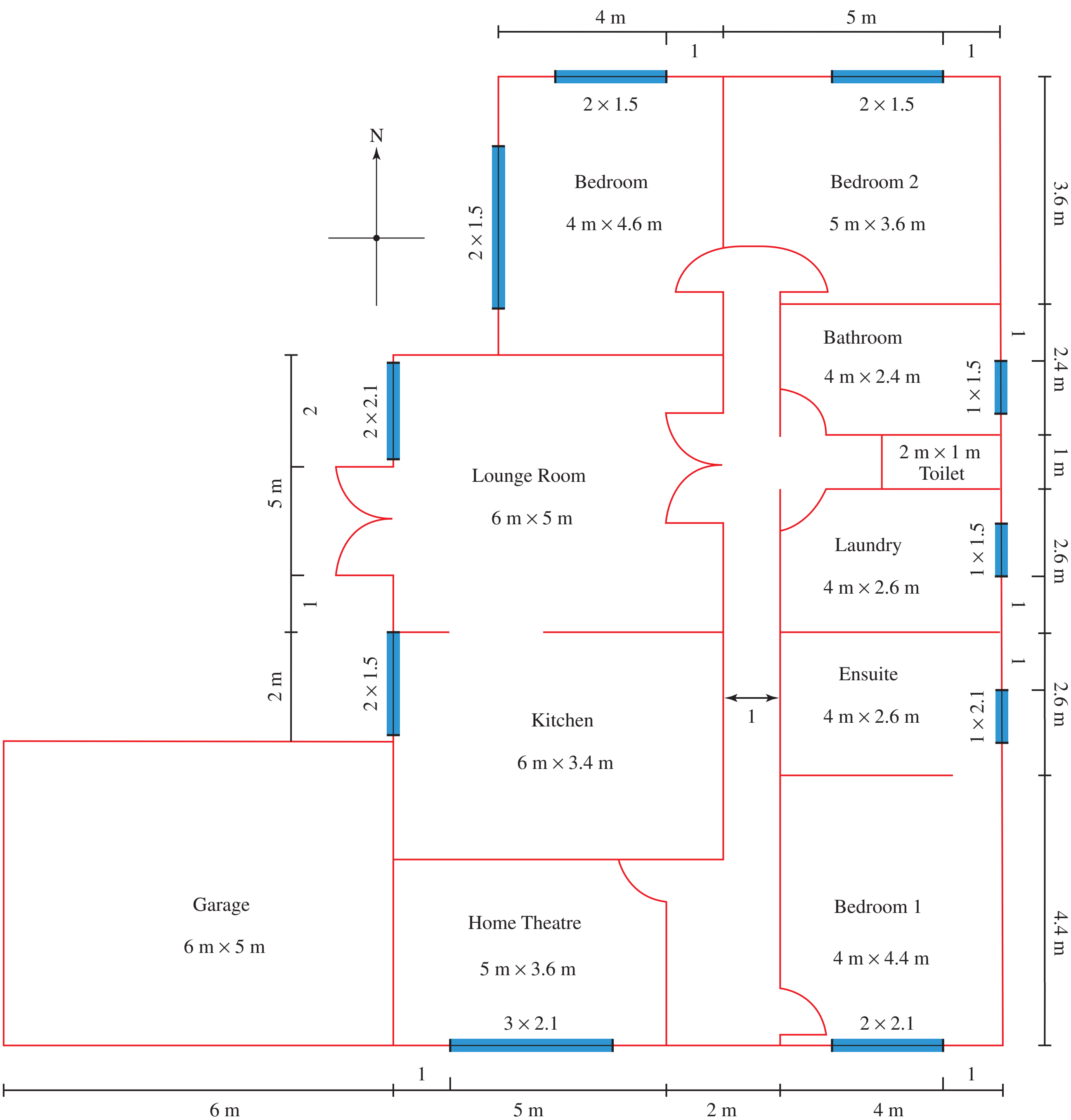
b Calculate the area of the block, and then find the cost per square metre (go back to page 10).

c Find the price you will have to pay.

INVESTIGATION 3

The house plan

The plan below is of the house that will be built on your new block of land. The measurements of each room are given in metres. (For this activity the width of each wall will not be part of the calculations. Walls can be drawn as single solid lines.) Using the ratio 1 : 100, create a scale drawing of your new house on the graph paper below. Make sure you label each room. The windows will be either: 1 m, 2 m or 3 m wide. Full-length windows will be 2.1 m high; half-length windows will be 1.5 m high. Doors are 0.8 m wide and 2.1 m high. All hallways are 1 m wide.



The scale drawing

Using the information given, carefully create your 1 : 100 scale drawing of the house that will be built on your new block of land. (*Hint:* It is a good idea to make this kind of drawing in grey lead pencil first as it is very easy to make mistakes!)

PROJECT 1

Floor coverings

Deciding what kind of floor coverings you want for your house is a very important task. Decisions are based on cost and what is suitable for each room. Shag pile carpet is not really suitable for the kitchen! The choices you have are: carpet, floating laminate boards, tiles and vinyl.

This is your house, so you can choose any combination you like. The one restriction placed on you by the local council is that all rooms that have taps or water outlets must have a tiled or vinyl floor.

Fill in the chart below to summarise the good and bad points of each floor covering. Discuss each type of flooring with other members of the class, or do some research out of class.

Vinyl

$40/m²

Carpet

$35/m²

Tiles

$30/m²

Laminated floor boards

$52/m²

Flooring type	Positive features	Negative features
Vinyl		
Tiles		
Carpet		
Laminated floor boards		

The following table could be set up in an Excel spreadsheet, or you could use the one below.

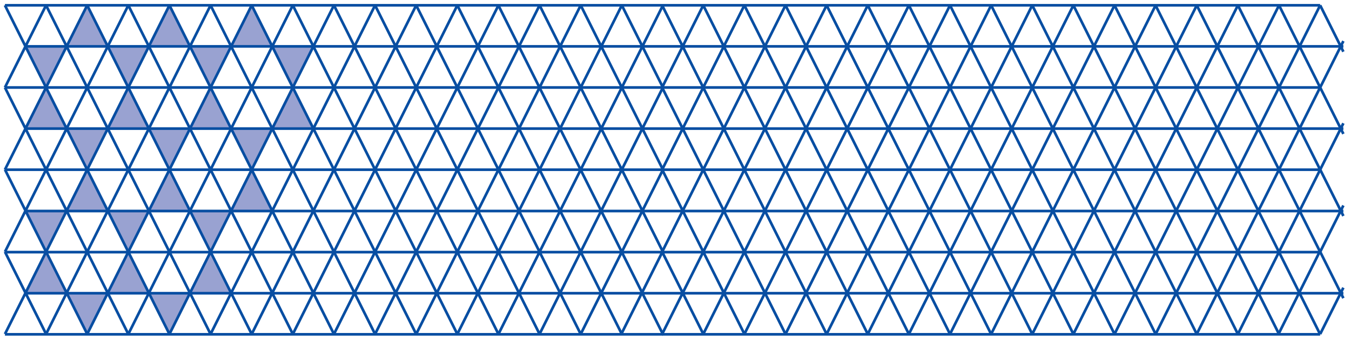
Room	Choice of flooring	Cost per m²	Size of room (m²)	Cost for room ($)
Bedroom 1				
Bedroom 2				
Bedroom 3				
Ensuite				
Bathroom				
Toilet				
Laundry				
Kitchen				

Room	Choice of flooring	Cost per m^2	Size of room (m^2)	Cost for room ($)
Hall & entry				
Home theatre				
Dining/lounge				

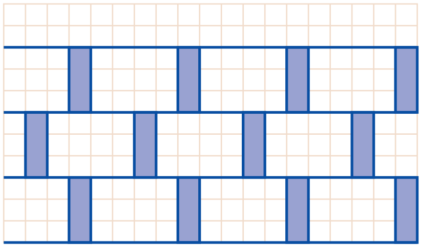
Choosing the floor coverings

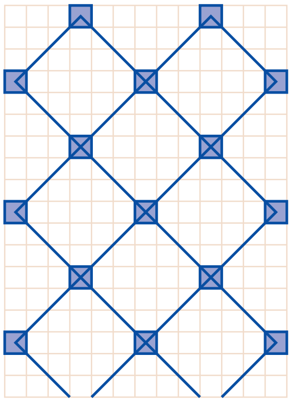
Floor tiles come in many shapes and sizes. Not all floor tiles are square. Some are very small, with side lengths of only a few centimetres. Some have sides longer than 40 centimetres! At right are some examples of the differences in size and shape of tiles.

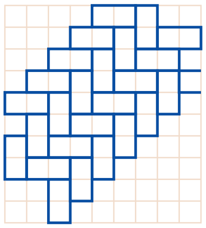
Some home builders like to create interesting repeating patterns of their floor tiles. When a pattern is repeated over and over to fill a space, we call it a *tessellation*. Landscape gardeners like to create 'tessellated pathways' with different coloured and shaped pavers. Below is a grid with a tessellated pattern started for you. Complete the rest of this grid to reveal the overall effect of the pattern.



Your task now is to create a tessellated tiling pattern for one of your rooms, collect photocopies of some different grids and transfer your pattern on to the grid. You are not limited to one colour, but your pattern must repeat. Some examples can be seen below.







KEY SKILL 4

Painting

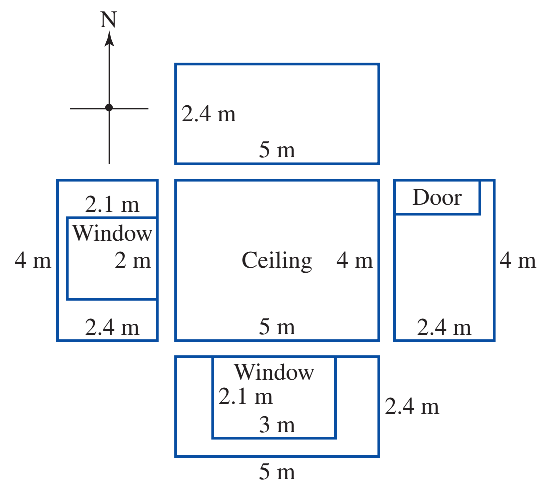
TAKE A LOOK BACK AT **BOOK 1, PP. 19, 20, 22, 24**

The interior of the new house will need painting. Walls and ceilings will need to be done. Doors and trims will also be painted but not with wall paint.

In order to purchase the correct amount of paint, the area of all of the walls will need to be calculated. All of the walls in your house are 2.4 m high. All walls and ceilings are plastered. Because the plaster is new, it will need one coat of sealer before painting. Then, two coats of paint will be applied. The rate of coverage is as follows.

Plaster sealer	1 litre covers 12 m^2.
Ceiling paint	1 litre covers 10 m^2.
Wall paint	1 litre covers 15 m^2.
Enamel paint for trims etc.	1 litre covers 12 m^2.

The best way to begin is to make a sketch plan of all walls with windows and doors included. At right is an example of a room as drawn on a house plan. Notice that the measurements of doors and windows are included. The height of the walls is 2.4 m.



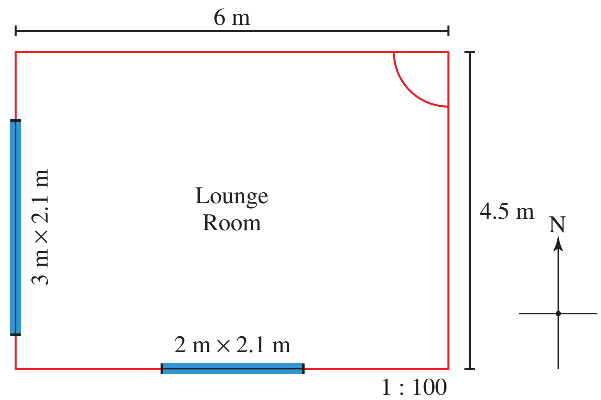
WORKED EXAMPLE

a What is the area of the west wall that needs to be painted?
b How much paint is needed for the west wall?

THINK	WRITE
a What formula is needed for the area of a rectangle?	Area = length × width
Put in the values and calculate the area.	$2.4\text{ m} \times 4\text{ m} = 9.6\text{ m}^2$
Use the formula to calculate the area of the window that does not need painting.	$2\text{ m} \times 2.1\text{ m} = 4.2\text{ m}^2$
Subtract the window measurement from the whole-wall measurement to find the area for painting.	$9.6\text{ m}^2 - 4.2\text{ m}^2$ $= 5.4\text{ m}^2$ to be painted
b What is the total area of the west wall that will be painted?	$9.6\text{ m}^2 - 4.2\text{ m}^2$ $= 5.4\text{ m}^2$ to be painted
Multiply by the number of coats required.	5.4×2 $= 10.8\text{ m}^2$
Divide the total amount of area of all coats by the coverage rate of the chosen paint.	$10.8\text{ m}^2 \div 15$ = 0.72 L. You must buy a 1-L tin.

QUESTIONS

At right is a floor plan of a lounge room that needs to be painted. The ceiling needs one coat of plaster sealer and two coats of ceiling paint. The walls all need one coat of plaster sealer and two coats of wall paint. All walls are 2.4 m high. Doors are 0.8 m wide and 2.1 m high, and window measurements are written next to the window symbol on the diagram.



1 On graph paper, draw the 'folded out' view of this room. Use the scale 1 : 100.

2 Use the formula area = $l \times w$ to complete the following.

Area of ceiling	Area of north wall	Area of east wall	Area of south wall	Area of west wall
		Area of door	Area of window	Area of window
		Wall area – door area =	Wall area – window area =	Wall area – window area =

3 **a** Total of all areas that require plaster sealer = ... + ... + ... + ... + ... = ... m^2

b How many litres of plaster sealer must be purchased? ....

4 **a** Complete the following.

Total of all areas that need wall paint = ... + ... + ... + ... = ... m^2

Two coats of paint = ... $m^2 \times 2$ = ... m^2

b How many litres of wall paint need to be purchased? ....

5 **a** Total area that needs ceiling paint = ... m^2

Two coats of paint = ... $m^2 \times 2$ = ... m^2

b How many litres of ceiling paint need to be purchased? ....

INVESTIGATION 4
Time to paint

Now it is time to make the calculations for the paint needed for your house. Most builders, painters, landscapers, interior designers etc. make lots of sketches of their work. You should do the same thing. Sometimes it is useful to make a proper scale drawing; other times a rough sketch with the measurements written in will do. The decision has been made to paint the home-theatre room and the dining/lounge in the same colour scheme. Each wall will be 'Gentle dove grey'. The ceiling will be 'Bright white'. All of the plaster surfaces will need to be painted with one coat of plaster sealer before the paint can be applied.

When calculating how much paint to buy, you must always round up an answer to the next full litre. You cannot buy less than you need.

QUESTIONS

1 Go back and review your scale drawing of your house. Remember that the height of all rooms is 2.4 m. On graph paper, draw the fold-out view of the home theatre room. Use this diagram to complete the table below.

2 Fill in the values for the home theatre room.

Area of ceiling	Area of north wall	Area of east wall	Area of south wall	Area of west wall
		Area of door	Area of window	
		Wall area – door area =	Wall area – window area =	

Now follow the same procedure for the lounge room.

Note: Both sets of double doors are 2 m wide and 2.1 m high.

The opening into the kitchen is 2 m wide and is open to the ceiling.

3 Complete your fold-out view on graph paper.

4 Summarise the measurements of the lounge room.

Area of ceiling	Area of north wall	Area of east wall	Area of south wall	Area of west wall
		Area of doors	Area of opening	Area of window
		Wall area – door area	Wall area – window area	Area of door
				Wall area – (window + door) area

5 Summarise the areas that will need one coat of plaster sealer. Add the areas for both rooms and put this total in the table below.

Ceiling	North wall	East wall	South wall	West wall
			Total area for sealer	

6 Summarise the areas that will be painted in 'Gentle dove grey' paint. Add the areas for both rooms and put this total in the table below.

North wall	East wall	South wall	West wall
		Total area for 'Gentle dove grey' paint	
		Multiply this value by 2 (for two coats)	

The plaster sealer and the wall paints come in different-sized tins. The costs of these tins are as follows.

Plaster sealer (1 L)	Plaster sealer (4 L)	Ceiling paint (1 L)	Ceiling paint (4 L)	Wall paint (1 L)	Wall paint (4 L)	Gloss enamel (1 L)	Gloss enamel (4 L)
\$34	\$62	\$27	\$50	\$35	\$72	\$35	\$64

7 Fill in the table below to calculate the total cost of all paints and sealer needed to finish the dining/lounge room and the home-theatre room.

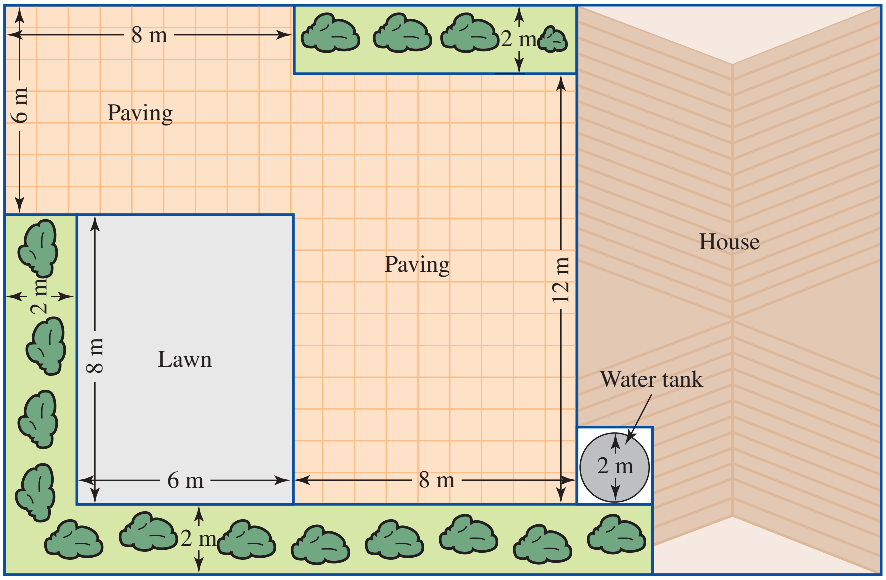
	Plaster sealer (1 L covers 10 m^2)	Ceiling paint (1 L covers 12 m^2)	Wall paint (1 L covers 15 m^2)
Area to paint ÷ coverage rate = litres to buy			
Number of tins and size of tins	4 litre: 1 litre:	4 litre: 1 litre:	4 litre: 1 litre:
Cost of tins of paint			
		Total paint & sealer cost	

KEY SKILL 5

Paths and driveways

TAKE A LOOK BACK AT **BOOK 1, PP. 19, 20, 22, 26**

It is not just the inside of a new house that needs work and attention. The garden needs to be planned and work needs to be done. Lots of calculations need to be done to work out areas to be paved and concreted, volumes of sand and soil to be ordered for gardens, areas to be mulched, and the volume of water that can be stored in water tanks.



WORKED EXAMPLE 1

Consider the garden plan above. How much paving is needed for the garden?

THINK	WRITE
Find the measurements of all areas to be measured. (*Hint:* A sketch may be a good idea.)	8 m × 12 m and 6 m × 8 m
Use the formula area = $l \times w$ for each component.	Area 1 = 8×12 = 96 Area 2 = 6×8 = 48
Add the totals together. Include appropriate units of measurement.	$96 + 48 = 144\text{ m}^2$

WORKED EXAMPLE 2

To create the lawn area, the old clay soil is removed and new topsoil is added. The new soil must be 15 cm deep. Soil is ordered in cubic metres. The volume of the area is required. How much topsoil should be ordered for the garden?

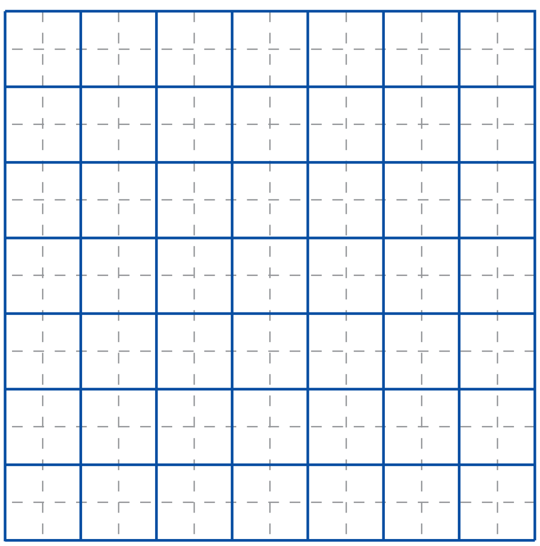
THINK	WRITE
Identify the shape and choose the appropriate formula.	The shape is a rectangular prism. Volume = $l \times w \times h$
Make sure all units are the same.	Change 15 cm into 0.15 m.
Substitute all values into the formula and solve.	Volume = $8 \times 6 \times 0.15$ = 7.2
Add appropriate units for volume.	Soil to be ordered is 7.2 m^3.

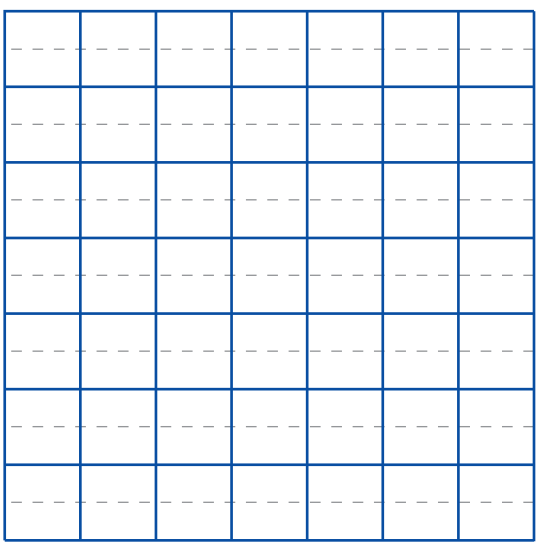
QUESTIONS

1 One type of square paving tile has sides that are 40 cm long. How many of these tiles would you have to purchase to cover the entire area to be paved?

2 Another type of square paving tile has sides that are 50 cm long. How many of these tiles would be needed to cover the entire area to be paved?

3 In the end you decide to purchase tiles of two sizes that can be used together. One type of tile is square with sides of 40 cm. The other tile is rectangular with sides of 20 cm and 40 cm. On the grids below, create two different patterns using a mixture of the two types of paving tiles.





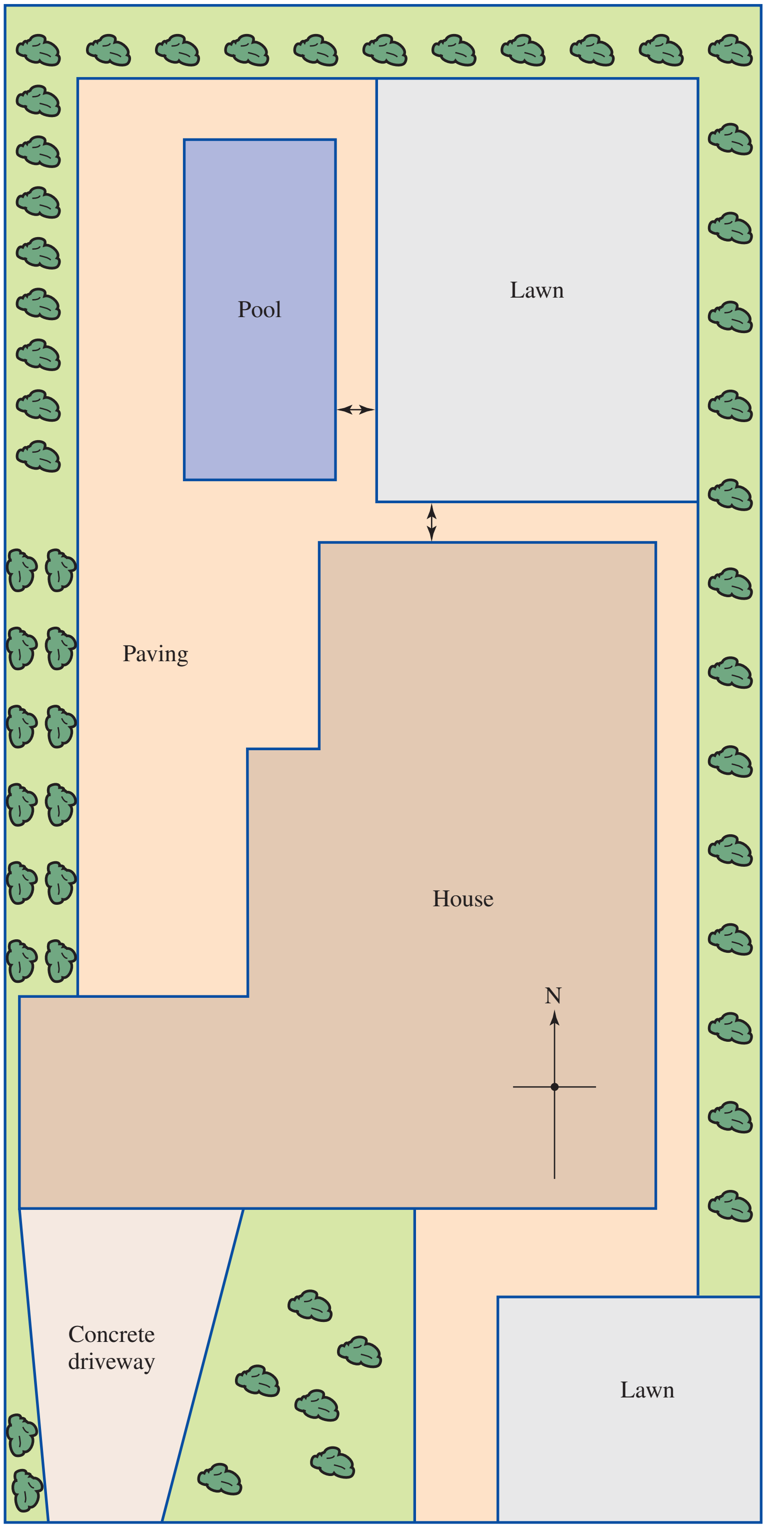
4 Next to the house is an area 2 m × 2 m that will have a water tank sitting there. It has been decided to concrete this area. The concrete will be 10 cm (or 0.1 m) in thickness.

a Using the volume formula for a rectangular prism, find the volume of concrete (in m^2) that will be ordered.

b On advice of the tank company, it is decided that the concrete should be 15 cm deep. What volume will need to be ordered now?

INVESTIGATION 5
Paving the garden

After consulting with a landscaper, the plan for your front and back garden has been decided. There will be a pool, a small amount of lawn and a paved area that will be used for entertaining. The site plan below shows the amount of space taken up by the house and all of the areas of the garden to be landscaped.



Scale: 1 : 200

QUESTIONS

1 The scale of this diagram is .... : ....

a This means that 1 cm measured on the plan is .... cm in real life.

b This scale can be changed to show that 1 cm : .... m in real life.

2 The front driveway is to be concreted. The concrete will be 10 cm deep. Find the volume of the concrete that will need to be ordered in square metres.

....

....

....

....

3 There are two areas that will be sown with lawn seed. Calculate the surface area of each piece of lawn, and then find the total area of lawn.

....

....

....

....

4 Before the lawn seed can be sown, a 20 cm deep layer of special sandy topsoil must be laid. What is the total amount of sandy soil that must be ordered?

5 Lawn seed is bought in 1-kg or 2-kg bags. One kilogram will cover an area of 20 m^2. How many kilograms of lawn seed will need to be purchased to cover all of the new lawn on your block?

6 Once the lawn seed has been sown, a fertiliser is required to help the new grass grow. It can be purchased in 1 kg or 2 kg bags. It is spread at a rate of 100 g/m^2 of newly seeded soil. How many kilograms of this fertiliser needs to be purchased?

Garden borders

All of the garden beds, both in the front and back garden, will need borders that will keep the soil in place. One option for garden-bed edging is railway sleepers. The standard length of a railway sleeper is 2.4 m. A railway sleeper is 20 cm wide. Sleepers can be stacked on top of each other so that a garden edge could be 20 cm high, 40 cm high, 60 cm high and so on.

Where a garden is up against a fence, the fence side will not need any sleepers. Where the garden is up against a house wall, there must be sleepers put up against the house wall to prevent damage to the wall.

QUESTIONS

7 **a** Using the scale on the garden plan, measure the lengths of the two garden beds in the front yard that will need borders. Make a sketch of these beds in the space at right, and write on your sketches all the measurements of the sides that will need sleepers.

b Use the scale provided to calculate the total length of garden-bed edging needed for the garden beds in the backyard and the garden bed that runs down the east side of the house.

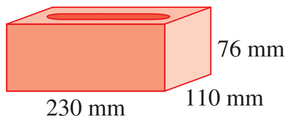
8 How many railway sleepers will you need to purchase to make a retaining wall for the back fence (house side)? Explain how they could be positioned allowing for a small gap between sleepers.

KEY SKILL 6

Bricks and BBQs

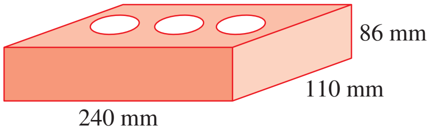
TAKE A LOOK BACK AT **BOOK 1, PP. 6, 16, 17**

Bricks are not just used for the walls of a house — they can be used in the construction of retaining walls, garden edging or barbeques. A common house brick measures 230 mm by 76 mm by 110 mm.



The most common arrangement of bricks we see in a wall is called stretcher bond. The bricks on one layer overlap the joins between bricks in the layer below, as we see in the picture at left. A horizontal row of bricks is called a *course*. The material in between bricks is called mortar; it is usually a mix of sand and cement.

When calculating how many bricks might be required for a wall, it is important to include the thickness of the mortar surrounding a brick. Bricklayers place 10 mm of mortar between each brick (both on the top and bottom, as well as the sides). When the thickness of the mortar is included in a calculation, we could say that the effective size of the face of a brick is (230 mm + 10 mm) by (76 mm + 10 mm). The depth of the brick, including mortar on the top and the side (110 mm), remains unchanged.



WORKED EXAMPLE

a How many bricks are needed for the first course of a 3 m long wall?
b How high is a wall if it was 10 courses high?

THINK	WRITE
a Only the length of the brick is important.	Total length = 230 mm + 10 mm = 240 mm
Make sure all measurements are the same units — change 240 mm into metres.	240 ÷ 1000 = 0.24 m
Divide the length of one brick into the length of the wall.	3 m ÷ 0.24 m = 12.5 bricks
Round up to the nearest whole brick.	= 13 bricks
b Only the height of the brick is important.	Total height = 76 mm + 10 mm = 86 mm
Multiply the height of one brick by 10 courses.	86 × 10 = 860
Write the answer using appropriate units.	860 mm or 86 cm

QUESTIONS

1 Approximately how many bricks would be needed to complete a wall that was 4.8 m long and 3 courses high?

a One brick is 240 mm long or .... m long

b 4.8 m long wall ÷ .... m long brick = ... bricks for one course

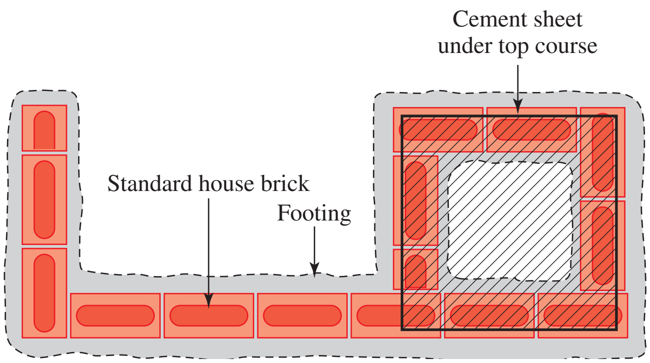
c 3 courses = ... × 3 = ... bricks

2 How many bricks would be needed to build a fence 18 m long and 8 courses high?

a .... m long wall ÷ .... m long brick = ... bricks for one course

b 8 courses = ... × .... = ... bricks

3 Below is a plan for a brick BBQ. The open area on the left-hand side will have a gas BBQ fitted to it, and the enclosed section on the right-hand side will have a top fitted so it can be used as a table.



Brick pattern for gas barbecue (viewed from above)

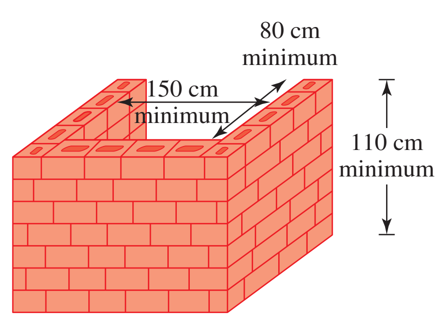
a How many whole bricks will be used to build the bottom course? ....

b How many half-bricks will be used to build the bottom course? ....

c How many bricks in total will be needed for the bottom course? ....

d If the BBQ is nine courses high, what is its total height in cm? .... × .... = ...

4 You now decide to build a three-sided structure in brick that can be used to hide the rubbish and recycle bins. The minimum width inside the structure has to be 150 cm, the minimum depth has to be 80 cm, and the minimum height must be 110 cm.



a Draw a top view of your plan and include measurements. Make sure the individual bricks can be seen.

b How many courses will your structure be?

....

c How many bricks will you need? ....

INVESTIGATION 6

Watering the plants

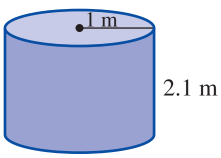
As Australia's climate is changing, we have less water available to us. Many people now are buying water tanks and catching the rainwater off the roof of the house and even the garage or garden shed. The companies that make plastic water tanks now have tanks of different shapes and sizes. This stored water can be used to water the garden and lawn, wash the car or top up the pool.

QUESTIONS

1 Find the volume of each of these water tanks correct to the nearest L. Use the formula volume = $\pi \times r^2 \times$ height of tank.

Note: If all measurements are in centimetres, it is easy to change the volume into litres because 1 litre = 1000 cm^3.

a



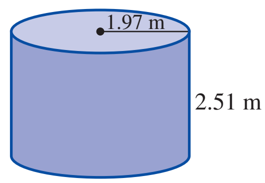
$V = 3.14 \times 100 \times 100 \times 210$

= .... cm^3

= .... $cm^3 \div 1000$

= L

b



$V = 3.14 \times$ .... $\times$ .... $\times$ ....

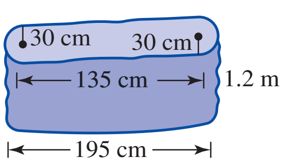
= .... cm^3

= .... $cm^3 \div 1000$

= L

2 Not all modern water tanks are just cylindrical in shape anymore. To fit tanks into small places in gardens, manufacturers use composite shapes. Find the volume of each of these water tanks, correct to the nearest L.

a



The height of this tank is 1.2 m.

Surface area of top of tank

= $(3.14 \times 30 \times 30) + (135 \times 60)$

= 2826 + 8100

= .... cm^2

Volume of tank

= 10 926^2 cm $\times$ height

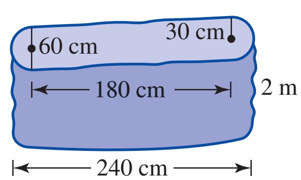
= $10\,926 \times 120$

= 1 311 120 cm^3

= 1 311 120 $cm^3 \div 1000$

= L

b



The height of this tank is 2 m.

Surface area of top of tank

= (3.14 $\times$ .... $\times$ ....) + (........ $\times$ ....)

= .... + ...

= .... cm^2

Volume of tank

= .... $\times$ height

= .... $\times$ ....

= .... cm^3

= .... $\div 1000$

= L

The amount of rainfall an area receives will influence the size of the tanks needed and how quick they are to refill.

The rainfall (in mm) for 2007 of three different suburbs is shown below.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Cranbourne	29	0	18	21	71	66	118	50	43	41	75	129
Diggers Rest	19	2	8	20	45	47	40	15	9	6	67	64
St Albans	25	0.5	10	16	48	42	48	18	9	11	85	62

3 What was the total yearly rainfall for the three suburbs?

a Cranbourne .... **b** Diggers Rest .... **c** St Albans ....

4 It is easy to calculate how much rain will enter a tank if we know the area of the roof of the building that is collecting the rain. Remember that 1 L = 1000 cm^3. So 1 m^2 of roof is 100 cm × 100 cm and 1 mm of rain is 0.1 cm of rain.

The volume of 1 mm of rain falling on 1 m^2 of roof = 100 × 100 × 0.1 = 1000 cm^3 = 1 L.

Go back to the house plan on page 12 and calculate how many square metres of roof are available to catch rainfall for a tank assuming that the roof is flat. Include the garage roof area as well.

....

5 How many litres of rainwater to the nearest L would you collect off this roof in 2007 if the house were located in Cranbourne?

= Total annual rainfall (in mm) × area of roof (in m^2) = 661 × .... = ... L

6 How many litres of rainwater to the nearest L could you have collected in St Albans in 2007?

.... × .... = ... L

7 How many litres of rainwater to the nearest L could you have collected in Diggers Rest in 2007?

.... × .... = ... L

The only space available for a tank is on the north wall of the garage, sitting on the paving. The biggest tank that can be placed here is 2 m in diameter and 2.1 m high. The answer to Question **1a** on page 26 shows how many litres can be stored in a tank this size.

8 If a hand-held spray nozzle on the end of a hose was set to spray at 5 L/min, how much water would be used after one hour of continuous watering? L

9 How long would it take to empty the entire tank using the hose spraying at 5 L/min?

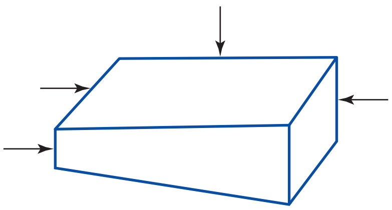
....

PROJECT 2

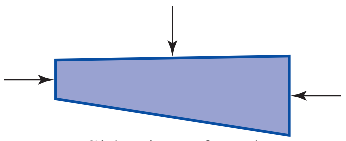
Putting in the pool

Prepare a presentation outlining the process of installing a pool. Use the questions to help guide your project. The pool that is being put in the backyard is 4 m wide and 9 m long. The south end is the shallow end and it is 1 m deep. The north end is the deep end and it is 2.4 m deep.

1 On the diagram below, label the lengths of the sides marked with arrows.



2 Below is a sketch of the side view of the pool. On the diagram label the required side lengths and, using the formula for area of a trapezium, find the surface area of this side of the pool.



Side view of pool

3 Multiply the side area of the pool with the width of the pool to find the volume of soil that must be removed.

Volume = ... × .... = ... m^3

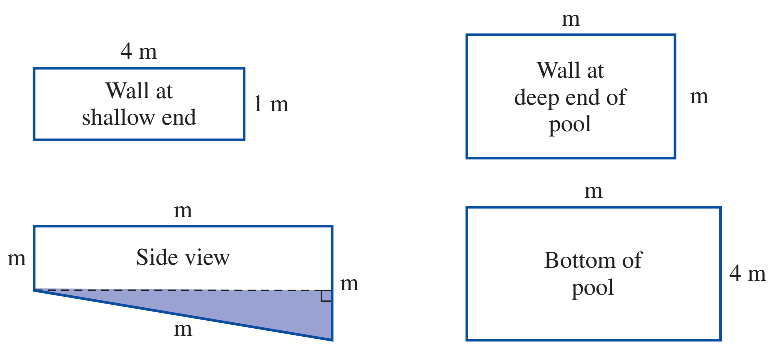
Because there is only a narrow pathway running from the front to the back of the house, the only way to move the soil out of the backyard is to use a small stand-on loader. The loader has a bucket on the front that can carry a maximum of $0.12\ m^3$ of soil or similar material.

4 How many trips to the front of the house will be needed to remove all of the soil from the new pool?

5 A person using a wheelbarrow could move $0.08\ m^3$ of soil in one trip. How many trips from the backyard to the front yard would be required to remove all of the soil from the pool being built?

Once the pool walls have been concreted and sealed, they will need 3 coats of paint specially designed for pool walls. This paint has a coverage rate of $9\ m^2/L$ of paint.

6 a Calculate the total surface area of the pool correct to one decimal place. Remember that you have already calculated the surface area of the trapezium-shaped sides in question 2. (*Hint:* You will need to use Pythagoras' theorem to calculate the length of the bottom of the pool.)



b How many litres of paint are needed to cover the pool walls and floor?

Total surface area of pool ÷ coverage rate

= .... ÷ ....

= .... litres of paint × 3 coats = ... litres

You have chosen tiles for the edge of the pool that are 25 cm long. They are going to be laid around all 4 sides of the pool.

7 How many tiles will you need in total for the edge of the pool?

It is important to know how many litres of water a pool can hold. This information is often used to calculate the quantities of pool chemicals needed. There are many ways that this calculation can be made. One way is to use the volume measured in cubic metres and convert that into cubic centimetres and that into litres. Another way is to use all side measurements in centimetres, find the volume in cubic centimetres and then convert to litres by dividing the answer by 1000.

8 By using a method of your choice, calculate the volume of water (in litres) your swimming pool can hold.

9 Using the volume of water held in the tank you have in the garden, how many tanks full of water would be required to fill your pool?

10 If you lived at Diggers Rest, would the total rainfall for 2007 on your roof have been enough to fill the new pool? Show the working out for your answer.

eBookplus ACTIVITIES

Key skill 1 Using scale

Digital doc

- Worksheet 4.1: apply your knowledge of using scales

Key skill 2 Using a survey plan

Digital doc

- Worksheet 4.2: apply your knowledge of using a survey plan

Interactivities

- Plans, evaluations and cross-sections (int-0009): explore the relationships between the different views
  Sketching in 3D (int-0078): investigate how to draw in 3D

Key skill 3 How much is the land?

Digital doc

- Worksheet 4.3: apply your knowledge of land costs

Key skill 4 Painting

Digital docs

- Worksheet 4.4: apply your knowledge of mathematics when painting
  Paint quantities 4.7: explore how to use a spreadsheet to find the quantity of paint required to paint a room

Interactivity

- Surface area and volume (int-0750): explore the relationship between surface area and volume

Key skill 5 Paths and driveways

Digital doc

- Worksheet 4.5: apply your knowledge of the mathematics behind creating paths and driveways

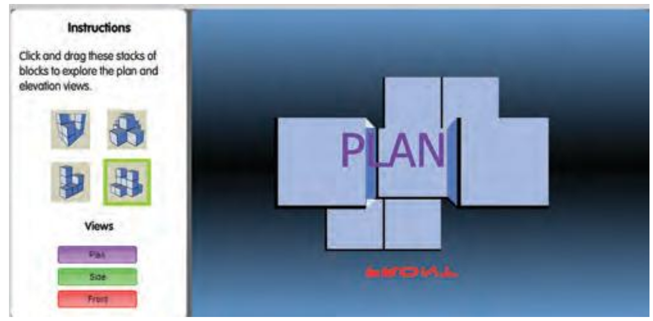
Key skill 6 Bricks and BBQs

Digital doc

- Worksheet 4.6: apply your knowledge of the mathematics behind building garden beds

eLesson

- The mathematics of building (eles-0122): learn about how mathematics is involved in building constructions



Investigation 6 Watering the plants

Interactivity

- Finding pi (int-0079): explore the relationship between the radius and circumference

CHAPTER REVIEW

Digital docs

- Word search swf (int-0648): search for the terms covered in this book
- crossword swf (int-0649): test your knowledge of the terms covered in this book
- puzzle page pdf 4.8: crack the code

Interactivity

- Test yourself (int-0650): take the end-of-chapter online multiple-choice quiz

ANSWERS

KEY SKILL 1 — Using scale

1 1 cm : 2500 cm, 25 m; 1 cm : 30 000 cm, 300 m; 1 cm : 100 000 cm, 1 km; 1 cm : 5000 cm, 50 m; 1 cm : 2 cm, 20 mm

2 5 cm, 50 cm; 3 cm, 150 cm; 2.5 cm, 250 cm; 4 cm, 400 cm; 3.5 cm, 3500 cm

3 12 mm, 450 mm, 4 mm, 125 mm, 9 mm

KEY SKILL 2 — Using a survey plan

1 660 m^2 2 640 m^2

3 116 m 4 Lot 52

5 Lot 54

INVESTIGATION 2 — *Shallow Waters* — Answers may vary depending on accuracy of measurements

1 **a** 1000 **b** 10

3 **a** Lot 721 **b** Lot 722

4 714, 715, 722, 723, 724, 725, 726, 727, 728, 729

5 710, 711, 712, 716, 717, 718, 719, 720

6 **a** 40 m, 20 m **b** 800 m^2

7 **a** 1240 m^2 **b** 195 m^2

8 **a** 900 m^2 **b** Trapezium formula

KEY SKILL 3 — How much is the land?

1 800 m^2 2 990 m^2

3 **b** 1350 m^2 4 $4175

5 $5650

6 **b** 800 m^2 × 200 **c** $160 000

KEY SKILL 4 — Painting

2

27 m^2	14.4 m^2	9.12 m^2	10.2 m^2	4.5 m^2

3 **a** 65.22 m^2 **b** 5.4 L ∴ buy 6L

4 **a** 38.22 m^2, 76.44 m^2 **b** 5.096 L

5 **a** 27 m^2, 54 m^2 **b** 5.4

INVESTIGATION 4 — Time to paint

2

18 m^2	12 m^2	6.96 m^2	5.7 m^2	8.64 m^2

4

30 m^2	14.4 m^2	7.8 m^2	9.6 m^2	3.6 m^2

5

48 m^2	26.4 m^2	14.76 m^2	15.3 m^2	12.24 m^2
				116.7 m^2

6

26.4 m^2	14.76 m^2	15.3 m^2	12.24 m^2
			68.7 m^2
			137.4 m^2

7

11.67 L	8 L	9.16 L
4 L = 3	4 L = 2	4 L = 2
		1 L = 2
$186	$100	$214

Total cost of paint and sealer = $500

KEY SKILL 5 — Paths and driveways

1 900 2 576

3 Check with your teacher

4 **a** 0.4 m^3 **b** 0.6 m^3

INVESTIGATION 5 — Paving the garden

1 1 : 200 **a** 200 cm **b** 2 m

2 3.3 m^2

3 124.16 m^2

4 24.83 m^3

5 7 kg

6 Head 12.4 kg ∴ buy six 2L bags and one 1L bag.

7 **a** Check with your teacher **b** 69.4 m

8 6 sleepers placed horizontally and one at each end to start vertical rows down the side

KEY SKILL 6 — Bricks and BBQs

1 **a** 0.24 m **b** 20 **c** 60

2 **a** 75 **b** 600

3 **a** 13 **b** 2 **c** 14 **d** 77.4 cm

4 **b** Minimum of 13 **c** 195

INVESTIGATION 6 — Watering the plants

1 **a** 6594 L **b** 30 587 L

2 **a** 1311 L **b** 2725 L

3 **a** 661 mm **b** 342 mm **c** 374.5 mm

4 203.4 m^2 5 134 447 L

6 76 173 L 7 69 563 L

8 300 L 9 22 h

PROJECT 2 — Putting in the pool

2 15.3 m^2

3 61.2 m^3

4 510 loads

5 765 loads

6 **a** 80.6 m^2 **b** 26.87 L

7 104

8 61 200 litres

9 9.28 tanks

10 Yes

MATHS QUEST

VCE FOUNDATION MATHEMATICS

TRAVELLING

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INTRODUCTION

Travelling

Travelling can be a great experience. It offers many opportunities for exploration and adventures. Within Australia you will experience a range of environments — from dusty outback to sandy palm-fringed beaches, rainforests to amazing alpine regions. If overseas travel is your wish, you can learn different languages, customs and see amazing man-made and natural wonders. Whether your dream is to travel right around Australia or to go overseas, the skills that will be learned by completing this book will make your trip easier.

contents

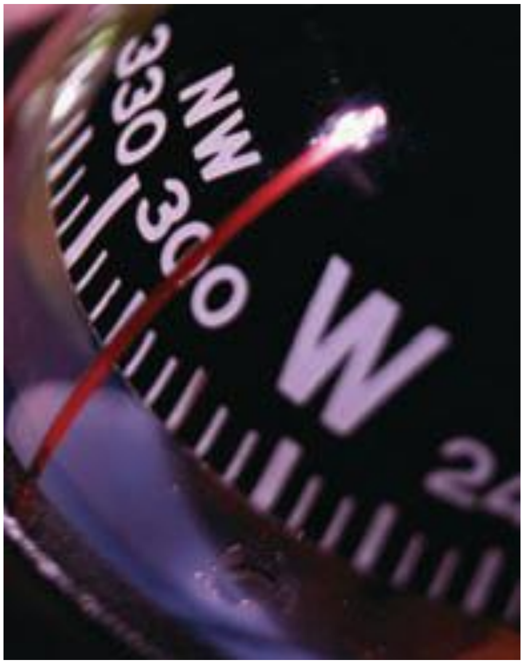
KEY SKILL 1

Maps

In order to navigate from one place to another, people normally use maps. Maps can help us navigate across town, a state or even the world. Maps must always be accurate or else they can be very misleading.

Locating position

Being able to understand the distance is one thing, but being able to specify the direction in which we are going is another. The four main compass directions are north, east south and west. It can easily be remembered as 'Never Eat Soggy Weetbix' (NESW). We can also specify more directions, for example, the direction halfway between north and east is called north-east.



Locating with grids

Atlases, street directories and maps generally use a square grid so that locations can be found easily. Usually the grid is labelled with letters from west to east and with numbers from north to south.

Each square on the grid can be recognised by specifying a letter and a number. We always use the letter first and then the number, for example, A2. Once you combine the letter and the number, that combination is called a grid reference.

WORKED EXAMPLE

What symbol is in a A2 and b C5?

	A	B	C	D
1			#	
2	%			
3		!		]
4				
5	=		+	

THINK	WRITE
a A2 means?	Across to column A, down to row 2.
Move to the square.	The symbol is %.
b C5 means?	Across to column C, down to row 5.
Move to the square.	The symbol is +.

QUESTIONS

1 Find the words located in the following grid references.

a B6 = ...

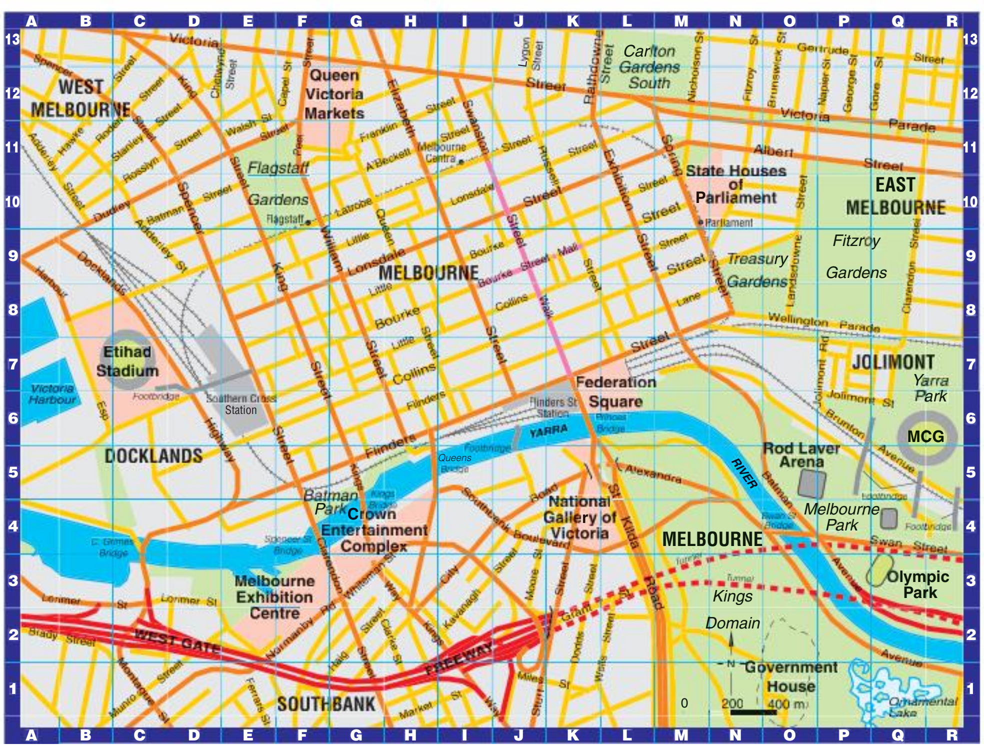
b D2 = ...

c E1 = ...

d A1 = ...

	A	B	C	D	E	F	G
1	Cake		Water		Bird		
2				Duck		Milk	Pears
3	Apple		Biscuit		Horse		
4		Cat					Rhino
5	Tea			Cow		Dog	
6		Pig					

2 A map of the Melbourne CBD is shown below. Find the following destinations and give grid references.



City of Melbourne

a Carlton Gardens South

b Treasury Gardens

c Batman Park

d Melbourne Cricket Ground

e Queen Victoria Markets

f Melbourne Exhibition Centre

g Corner of Collins St and Swanston St

h Corner Victoria Parade/ Rathdowne St

INVESTIGATION 1

Scales

Reading a scale map correctly is extremely important. Without accuracy in map reading and navigation, the world would be very different. What would have happened if Captain Cook had arrived in Australia but then couldn't use his maps to get back to England?

To accurately represent distance on a map we must understand the scale. The scale of a map shows, for example, how many kilometres or metres on the ground is represented by one centimetre on the map. A map must be drawn to scale in order to be accurate, and the scale should be shown so that the reader can work out the actual distances. There are three possible ways of showing a scale.

- Words or figures: 1 cm = 10 km. 1 cm represents 10 km.
- Ratio: 1 : 100 000. This means every centimetre measured represents 100 000 cm or 1000 m or 1 km.
- Scale bar: a graphical representation of scale. In the map below, each interval on the scale bar equals 25 km.

QUESTIONS

1 Using the scale on the map below, find the approximate distance between the following locations.

a Melbourne to Torquay = 4 cm = 4 × 25 = 100 km

b Geelong to Colac = 3.75 cm = 3.75 × 25 = 93.75 km

c Colac to Warrnambool =

= = km

d Warrnambool to Port Fairy =

= = km

e Port Fairy to the Port Campbell =

= = km

f Apollo Bay to Portland =

= = km

2 What is the map reference for the following locations?

a Chelsea

b Mt Martha

c St Leonards

d Altona

3 Find the approximate distance across Port Phillip Bay at its widest position.

4 Estimate the amount of distance travelled around the bay starting at Sorrento and finishing at Queenscliff.

5 What distance would you travel if you sailed from Frankston to Portarlington?

6 If you travelled clockwise around the bay from Aspendale, what is the next major suburb listed on the map?

KEY SKILL 2

Time

Over the centuries, time has been measured in many different ways: from burning candles to sundials to sand hourglasses.

Units of time

60 seconds = 1 minute	7 days = 1 week	10 years = 1 decade
60 minutes = 1 hour	14 days = 1 fortnight	100 years = 1 century
24 hours = 1 day	365 days = 1 year	1000 years = 1 millennium
	366 days = 1 leap year	

Digital and analogue clocks

Digital clocks use digital displays of numerals to represent time. An analogue clock uses the position of an hour, a minute and, occasionally, a second hand on a numbered dial to represent time.

am and pm

We can use am or pm to describe the time of day. *Ante meridian* (am) means 'before noon' and *post meridian* (pm) means 'after noon'. Noon is 12 o'clock (midday). For example; from midnight until noon, times are referred to as am; for example, 8 o'clock in the morning is 8 am. From noon until midnight, times are referred to as pm; for example, 8 o'clock in the evening is 8 pm.

24-hour time

Many digital clocks or phones can display time in 24-hour time format. The hour numbers are in base 24 instead of base 12, but the minutes are still base 60.

QUESTIONS

1 Complete the conversions of 12-hour time to 24-hour time.

12-hour time	Midnight	1 am	3:20 am	Noon	7:25 pm	2:45 am					
24-hour time							2315	0720	2200	2130	1015

2 Write down the following times in words and in 24-hour time.

a

b

c

3 Find the length of time between the following.

a 10 am and 5:15 pm =

b 1:30 am and 10:45 am =

c 9:30 pm Friday to 11:00 pm Sunday =

4 Find the length of time between the following in terms of minutes.

a 10 am and 5:15 pm =

b 1:30 am and 10:45 am =

c 9:30 pm Friday to 11:00 pm Sunday =

5 Complete the following statements with the correct unit of time.

a 2 hours = minutes

b 300 seconds = minutes

c 3 days = hours

d 5 decades = years

e 98 days = weeks

f 2.5 years = months

g 1095 days = years

h 28 days = fortnights

INVESTIGATION 2
Units of time

When you have to find times in certain units, you must convert all of the time units to the unit that has been specified. Once you have converted all the times to the units that you require, simply add the values in correct place values.

QUESTIONS

1 The departure and arrival times of a flight from Melbourne to Sydney are shown.

Depart	Melbourne	1125
Arrive	Sydney	1330

a How many hours and minutes was this flight?

b Convert the travel time to minutes.

c Convert the travel time to seconds.

2 The time displayed is the time you arrive at the train station. If the next train departs at 1015, how many minutes and seconds until the train departs?

3 A school camp runs from 4 December at 0600 and arrives back at school on 16 December at 2100.

a How many hours were the students away on camp?

b How many minutes were the students away on camp?

4 The calendar we use is the Gregorian calendar. Investigate the history of the Gregorian calendar and the origins of the names of the months.

5 It is estimated that a person sleeps for 218 150 hours over their lifetime. Is this a reasonable estimate? Support your answer with mathematics.

6 The average moderately active person takes about 7500 steps a day. How far will they walk in their lifetime? Support your answer with mathematics.

KEY SKILL 3

Timetables

When travelling by planes, trains or buses, we need to check a timetable to see the times and possibly the days of a particular service. Timetables normally indicate the departure times and the arrival times, including various stopovers.

A simple way to find out how long a trip takes is to find the difference between the arrival and departure times. You do this by using the skill of subtraction. For example, a train leaves Footscray at 7:20 pm and arrives in Geelong at 8:15 pm. The difference in time is nearly one hour, in fact, 5 minutes short of an hour, so the solution is 55 minutes.

WORKED EXAMPLE

Nobi lives in Kyneton and needs to be in Melbourne for breakfast at 9:30 am. She estimates that it will take her about 30 minutes to reach the café once she arrives in Melbourne.

Castlemaine	Kyneton	Woodend	St Albans	Melbourne
6:28 am	6:50 am	6:59 am	7:41 am	8:06 am
7:07 am	7:30 am	7:38 am	8:17 am	8:40 am
8:10 am	8:31 am	8:40 am	—	9:29 am

a What train should Nobi catch from Kyneton?
b How long is the train trip?

THINK	WRITE
a What time does he need to arrive in Melbourne?	9:30 am – 30 min = 9:00 am
What is the latest train to get to Melbourne by 9:00 am?	8:40 am is the latest train to arrive in Melbourne before 9:00 am.
When does the 8.40 am train leave Kyneton?	7.30 am
b The train leaves Kyneton at 7.30 am and arrives in Melbourne at 8.40 am.	The time taken is 1 hour and 10 minutes.

QUESTIONS

1 The following table shows a selection of flights from Melbourne to Sydney.

Flight	MQ801	MQ803	MQ807	MQ809	MQ811	MQ817	MQ821	MQ825	MQ829	MQ831	MQ833	MQ837	MQ841
Arrives	0720	0735	0805	0820	0835	0905	0935	1005	1035	1105	1135	1235	1335
Departs	0600	0615	0645	0700	0715	0745	0815	0845	0915	0945	1015	1115	1215

a How many flights shown leave Melbourne for Sydney?

b Are the flights all the same duration throughout the day?

c Which flights would you catch to arrive in Sydney by noon but leaving later than the start of a school day?

d What is the earliest flight that leaves Melbourne?

2 Shown below is the ferry timetable from Darling Harbor to Circular Quay.

From	am	am	am	am	am	am	am	pm	pm	pm	pm
Darling Harbour (Aquarium)	7.19	8.13	9.08	9.55	10.47	11.10	11.40	12.10	12.40	1.10	1.40
Pyrmont Bay	7.22	8:15	9.10	10:00	10.52	11:15	11:45	12:15	12:45	1:15	1:45
Balmain East	7:30	8.22	9.17	10.07	11:00	11.22	11.52	12.22	12.52	1.22	1.52
Balmain	7.38	…	…	…	…	…	…	…	…	…	…
McMahons Point	7.48	8.29	9.24	10.14	11.07	11.29	11.59	12.29	12.59	1.29	1.59
Milsons Point/Luna Park	7.51	8.31	9.26	10.16	11.09	11.31	12.01	12.31	1.01	1.31	2.01
Circular Quay	7.57	8.36	9.31	10.21	11.14	11.36	12.06	12.36	1.06	1.36	2.06

a Find the earliest time that a ship leaves Darling Harbour.

b Find the time differences between the following locations on the first ferry.

i Darling Harbour to Milsons Point **ii** Balmain to Circular Quay

c Are the time differences the same throughout the day?

d How many minutes difference is there between the first ferry and the fifth ferry?

e How many minutes difference is there between the second ferry and the seventh ferry?

f What does the symbol '. . .' in the Balmain row indicate?

INVESTIGATION 3

Using timetables

QUESTIONS

1 Below is an example of the ferry timetable from Circular Quay to Darling Harbour in Sydney. As you can see there are many stop-offs along the way.

From	am	am	am	am	am	am	am	am	pm	pm	pm
Departing Circular Quay	6:45	7.50	8:45	9:30	10:15	10:45	11:15	11:45	12:15	12:45	1:15
Milsons Point/Luna Park	6.52	7.56	8.51	9.36	10.21	10.51	11.21	11.51	12.21	12.51	1.21
McMahons Point	6.55	7.58	8.53	9.38	10.23	10.53	11.23	11.53	12.23	12.52	1.23
Balmain	7.05	....	....	....	10.33	....	....	....	....	....	....
Balmain East	7.10	8.05	9:00	9:45	10.38	11:00	11:30	12:00	12:30	1:00	1:30
Darling Harbour (Sydney Aquarium)	7.19	8.13	9.08	9.55	10.47	11.10	11.40	12.10	12.40	1.10	1.40

a Find the earliest time that the ferry leaves Circular Quay.

b Find the time differences between the following locations on the last ferry.

i Milsons Point and Balmain East **ii** Circular Quay and Darling Harbour.

c Are the time differences the same throughout the day?

2 The following timetable has flights from Cairns to Melbourne.

Departs	Arrives	Flight	Stops	Aircraft
12:40	16:00	MQ648	Non-stop	73G
17:15	20:35	MQ650	Non-stop	73G
20:15	23:35	MQ652	Non-stop	73G
20:35	23:55	MQ653	Non-stop	73G

a What is the duration of the flight?

b What time is the latest arrival at Melbourne?

c If you needed to arrive in Melbourne by 11:30 pm, which flight would you take?

3 The timetable below shows the estimated travel times for a train that stops at all stations between Melbourne and Sydney. Estimate the travel times in minutes of the following trips.

Southern Cross (Melbourne) dep.		8:30
Benalla		10:22
Wangaratta		10:47
Albury		11:47
Culcairn	a	12:19
Henty	a	12:30
The Rock	a	12:51
Wagga Wagga		13:09
Junee		13:52
Cootamundra		14:37
Harden	a	15:13
Yass Junction		16:01
Gunning	a	16:33
Goulburn		17:09
Moss Vale		17:59
Campbelltown	d	19:07
Strathfield	d	19:41
Central (Sydney) arr.		19:55

a Southern Cross to Wangaratta

b Southern Cross to Sydney (Central)

c Wagga Wagga to Sydney (Central)

d Moss Vale to Sydney (Central)

e Harden to Strathfield

f The Rock to Sydney (Central)

PROJECT 1

Puffing Billy

Puffing Billy is a steam train that runs on its original mountain track from Belgrave to Gembrook. It was opened in 1900. A landslide in 1953 closed the track. It was partially re-opened in 1962, and finally completed in 1998.

Puffing Billy **timetable: Belgrave to Gembrook and Gembrook to Belgrave**

Destination	Time	24-hour time	Destination	Time	24-hour time
Belgrave	11:30 am		Gembrook	2:40 pm	
Menzies Creek	12:03 pm		Cockatoo	3:06 pm	
Emerald	12:18 pm		Lakeside arrive	3:23 pm	
Lakeside arrive	12:33 pm		Lakeside depart	3:45 pm	
Lakeside depart	12:45 pm		Emerald	4:00 pm	
Cockatoo	1:02 am		Menzies Creek	4:12 pm	
Gembrook	1:30 pm		Belgrave	4:57 pm	

QUESTIONS

1 Convert all the times to 24-hour time in the table above.

2 What is the total time taken on the journey from Belgrave to Gembrook?

3 How does this compare with the return journey from Gembrook to Belgrave? Is there a difference? If so, by how much?

4 How long are the stops at Lakeside in both directions?

5 How long would you have at Gembrook if you caught the train there and needed to catch the train back?

6 Using the photo at right, answer the following questions.

a How many carriages are in the photo?

b If there were 15 people per carriage, how many people are there in total in the photo?

7 The Puffing Billy Great Train Race is a fun run held annually. Runners race *Puffing Billy* from Belgrave to Emerald Lake, which is a distance of 13.2 km.

a If the train travels at 14 km/h, approximately how long does the train take to complete the race?

b The fastest male completed the race in 41 minutes. Work out his average speed in kilometres per minute. (*Hint:* Speed = $\frac{\text{distance}}{\text{time}}$.)

c The fastest female completed the race in 49 minutes. Work out her average speed for the distance.

Extension

Research another famous train and find the following facts.

1 What is the distance of the line?

2 What is the cost of travel on the train?

3 Approximately how long does the trip take?

4 What is the train's average speed for the journey?

5 When did the rail line begin?

KEY SKILL 4

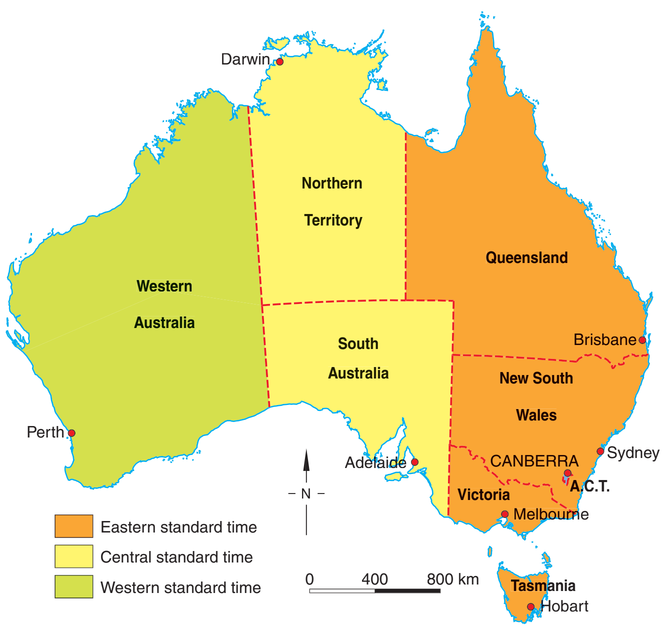
Time zones

Many people in Australia aspire to travel overseas. Some travel to experience other cultures and climates, and some for life-changing experiences. When travelling overseas, you need to be aware of time differences. If you travel in certain directions, you will either lose time or gain time. For example, if you departed Melbourne at midnight 18 April for Bangkok, you would land in Bangkok around 7 am on 18 April (7 hours). However, the flight takes approximately 11 hours — you lost 4 hours due to the time difference. This will be the same for the return flight, except you will add 4 hours to your flight.

Earth is divided into 24 one-hour time zones, and for convenience the boundaries between zones often bend around country or state borders.

Australian time zones

Australian time zones are shown on the map at right. The eastern states are on eastern standard time (EST). South Australia and Northern Territory are on central standard time (CST) and are half an hour behind EST. Western Australia is on western standard time and is 2 hours behind EST. For example, if it is noon in Melbourne, it will be 11:30 am in Adelaide and 10 am in Perth.



Australian time zones

WORKED EXAMPLE

The time in Perth is 2 pm. What are the times in a Adelaide and b Melbourne?

THINK	WRITE
a What is the time difference between Perth and Adelaide?	1.5 h in front
Add 1.5 h.	2 pm + 1.5 h = 3:30 pm
b What is the time difference between Perth and Melbourne?	2 h in front
Add 2 h.	2 pm + 2 h = 4:00 pm

QUESTIONS

1 Complete the table of time differences within Australia.

Western standard time	Central standard time	Eastern standard time
7:00 am		
	5:30 pm	
		1:15 am
	2300	

2 Complete the table if it is 8 pm EST in Victoria.

State	New South Wales	Northern Territory	Queensland	South Australia	Tasmania	Western Australia
Time						

3 The Indian Pacific is a train line that connects Sydney and Perth. An example of the timetable is shown below.

Monday	Dep. Sydney	3:00 pm EST
Tuesday	Dep. Broken Hill	9:20 am CST
	Arr. Adelaide	3.55 pm CST
	Dep. Adelaide	6:30 pm CST
Wednesday	Dep. Kalgoorlie	10:30 pm WST
Thursday	Arr. Perth	9:00 am WST

a If James phoned his friend Oprah in Perth just as the train was leaving Sydney, what time was it in Perth when he rang?

b How many hours does it take for the train to travel from Sydney to Perth? (You must also count the time in waiting.) Convert the total time to minutes.

c The train travels 4352 km from Sydney to Perth. Calculate the average speed of the trip. (*Hint:* Speed = $\frac{\text{distance}}{\text{time}}$.) Give the average speed in both km/h and km/min rounded to 1 decimal place.

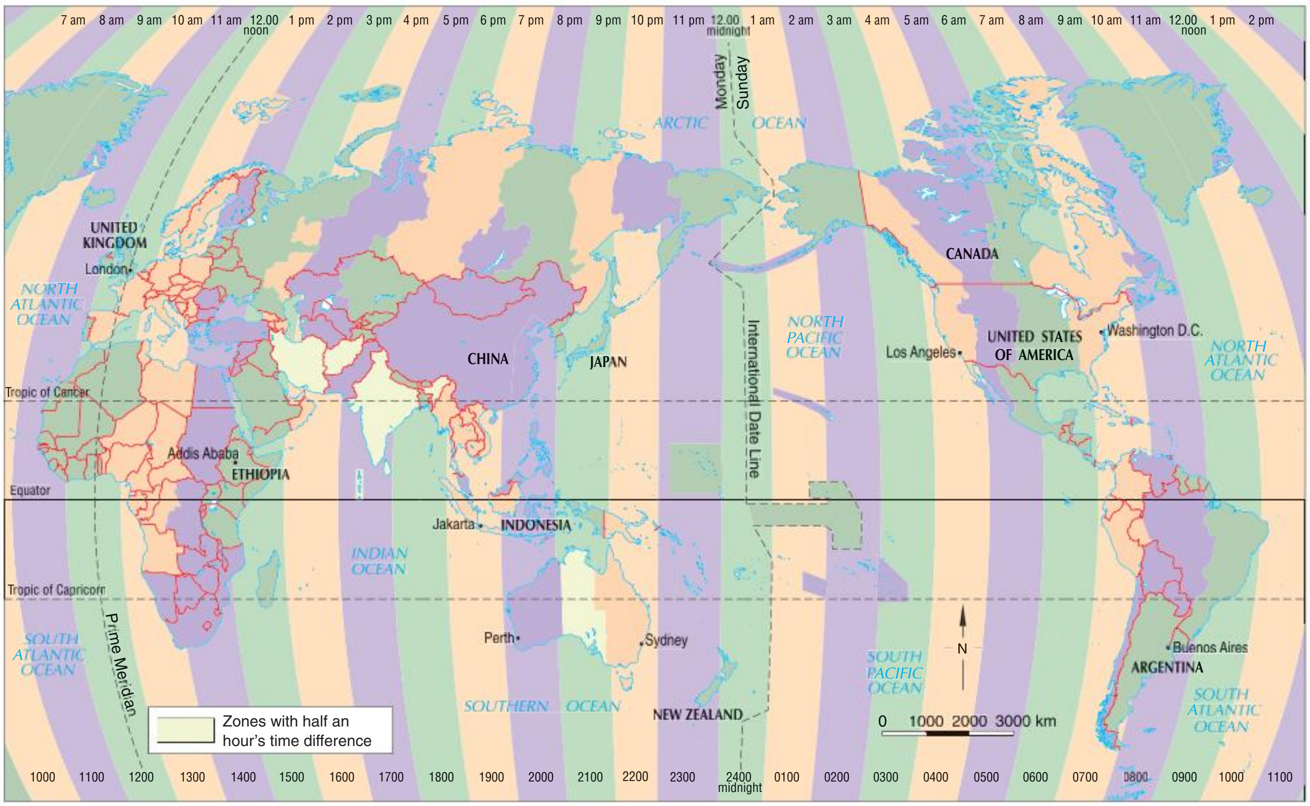
4 a If Kerrie wants to phone her son in Perth on Friday at 9 pm Perth time, what time does she need to phone from Melbourne?

b The following week Kerrie was in Sydney. At what time would she need to ring if she wanted to contact her son at the same time as last week?

INVESTIGATION 4

World time zones

By international agreement it was decided that time would be measured from Greenwich, near London. This became known as Greenwich Mean Time (GMT).



World time zones

The International Date Line passes through the Pacific Ocean between Australia and the United States of America. The calendar dates on either side of the line differ by one day. For example, when it is 11:59 pm on Monday in the time zone to the west of the international date line, it will be 11:59 pm on Sunday in the time zone to the east of the international date line.

QUESTIONS

1. John lives in Melbourne and phones his sister in London at 7 pm on New Year's Day in Australia. London is 11 hours behind Australian eastern summer time. What is the day and time in London at the time of the call?
2. Jayden flies from Melbourne to Auckland (New Zealand), leaving at 0930 EST. New Zealand is 2 hours ahead of EST. If the flight takes 2 hours and 55 minutes, what is the time in Auckland when he arrives?
3. Eastern standard time in Australia is 10 hours ahead of GMT. Complete the table at the top of the facing page to show what the times are in each place when it is 0900 EST on Monday. (*Hint:* Subtract 10 h from EST to get GMT.)

Place	Time compared with GMT	Time when it is 0900 EST on Monday in Melbourne
Athens	GMT + 0200	0100 Monday
Beijing	GMT + 0800	
Delhi	GMT + 0530	
Fiji	GMT + 1200	
Hawaii	GMT – 1000	
Jakarta	GMT + 0700	
New York	GMT – 0500	1800 Sunday
Singapore	GMT + 0800	
Mexico City	GMT – 0600	

4 A businesswoman wanted to set up a conference call with people from Jakarta, New York and Perth at 2 pm in Melbourne on Saturday. What time will be the local time for the other people in the meeting?

5 Life in the Arctic Circle is affected by extremes in the duration of daylight. Investigate when these extremes occur and the effects they have on living there.

Midnight sun in Alaska

KEY SKILL 5

Travelling by road

TAKE A LOOK BACK AT **BOOK 1, PP. 2, 3, 16**

Fuel consumption is a major concern when purchasing a car or when travelling in a car. Increasing petrol costs directly affect our bank balance! People are now looking at fuel-efficient cars such as hybrids, which use a combination of fuel and electricity.

To work out fuel consumption, we simply follow this easy formula. It is the number of litres used per 100 kilometres.

$$\text{Fuel consumption} = \frac{\text{number of litres consumed}}{\text{hundreds of kilometers travelled}}$$

WORKED EXAMPLE

Car A uses 50.5 L to travel 425 km and Car B uses 86.6 L to travel 615 km. Which car is more fuel efficient?

THINK	WRITE
$\text{Fuel consumption} = \frac{\text{number of litres consumed}}{\text{hundreds of kilometres travelled}}$	Car A: $\frac{50.5}{4.25} = 11.88$ L/100 km Car B: $\frac{86.6}{6.15} = 14.08$ L/100 km
Lowest fuel consumption is best.	Car A uses less petrol to travel 100 km.

QUESTIONS

1 What is the fuel consumption of a truck that travels 1123 km using 649 litres?

2 The size of a car's engine can affect the fuel consumption of the vehicle. (Round answers to 2 decimal places.)

Car	Litres	Hundreds of kilometres	Economy
4-cylinder manual	8.98	1.76	$\frac{8.98}{1.76} = 5.10$
4-cylinder automatic	15.69	2.53	
6-cylinder manual	34.87	3.71	
6-cylinder automatic	21.58	1.98	
8-cylinder manual	12.90	0.97	
8-cylinder automatic	38.86	2.54	

3 Which size car engine has the lowest rate of fuel consumption?

4 The route from Sydney to Melbourne is about 1000 km. Based on the results of your answers to Question 2, how much extra fuel would you expect to use if you drove an 8-cylinder automatic instead of a 6-cylinder automatic?

5 Driving from your house to a holiday house 415 km away, you use 36 litres of petrol. When you tow your family caravan, you use 54 litres. By how much does towing a caravan affect the fuel economy of the car?

INVESTIGATION 5
Cost of road travel

The formula for calculating the number of litres used is:

$$\text{litres used} = \text{fuel consumption (L/100 km)} \times \frac{\text{distance travelled (km)}}{100}$$

A 6-cylinder automatic gets 10.9 L/100 km. The number of litres used when travelling the 32 km to Barwon Heads from Geelong is:

$$10.9 \times \frac{32}{100} = 3.488\text{ L}$$

To work out the cost of petrol for this short trip, you must multiply the cost of petrol per litre by the number of litres used.

Petrol prices

Type	Cost per litre
Unleaded	\$1.60
Diesel	\$1.75
Autogas	\$0.75

$$\begin{aligned}\text{Cost} &= \text{litres used} \times \text{cost of petrol}\\ &= 3.488 \times 1.60\\ &= \$5.58\end{aligned}$$

For the return trip, double that amount. Therefore, the cost of the trip to Barwon Heads is \$11.16.

QUESTIONS

1 If Steve drove from Greensborough to the city (30 kilometres) in a 4-cylinder automatic, work out:

a the amount of unleaded petrol used (in litres)

b the cost of the trip.

(*Hint:* Use the table for fuel consumption on page 21.)

2 BJ drove from Torquay to Melbourne (90 kilometres) in an 8-cylinder automatic.

a How many litres of unleaded petrol did the car consume for the trip?

b What was the cost of the petrol consumed in driving from Torquay to Melbourne?

c If BJ returned to Melbourne the same day, work out the total cost of the trip (i.e. Torquay to Melbourne and back again).

3 Fill in the table below in terms of litres used for the following trips to 2 decimal places. Show your working out.

Trip	Distance (km)	4-cylinder manual	6-cylinder manual	8-cylinder manual
Melbourne to Sydney	1037	$= \left(\frac{5.1}{100}\right) \times 1037$ $= 52.8$ L	$= \left(\frac{9.4}{100}\right) \times 1037$ $= 97.48$ L	
Melbourne to Adelaide	921			
Melbourne to Rockhampton	1964			
Melbourne to Karumba	2909			

4 Assuming an unleaded-petrol price of $1.60 per litre, calculate the fuel costs for the above trips.

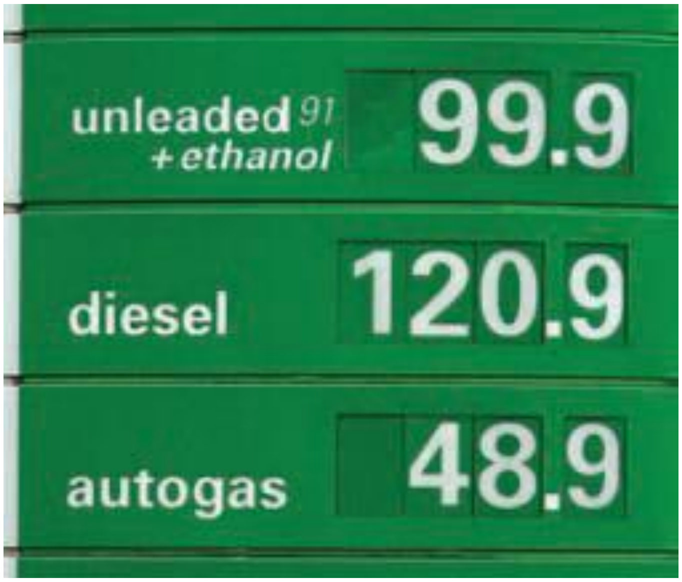
Trip	4-cylinder manual	6-cylinder manual	8-cylinder manual
Melbourne to Sydney	= 52.8 L × $1.60/L = $84.48	= 97.48 L × $1.60/L = $155.97	
Melbourne to Adelaide			
Melbourne to Rockhampton			
Melbourne to Karumba			

5 Referring to the figure below, how much would each fill of the following fuels cost?

a 35 L of premium unleaded

b 40 L of autogas

c 29 L of unleaded diesel



KEY SKILL 6

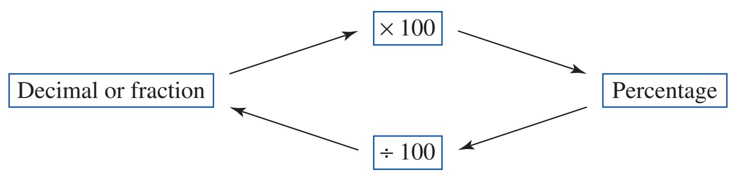
Percentages

TAKE A LOOK BACK AT **BOOK 1, PP. 8, 9, 10**

In the real world, it is sometimes useful to write fractions with a denominator of 100, relating them to decimals. These fractions are called percentages, and the symbol for percent is %. An easy way to think of percentages is as a number of cents out of a dollar. Percentages express amounts as parts of 100. For example, 35% means '35 parts out of 100 parts' or $\frac{35}{100}$. The line in a fraction is a division symbol. Therefore, $\frac{35}{100} = 35 \div 100 = 0.35$.

Conversions chart

To convert a fraction or decimal to a percentage, we multiply by 100. To convert a percentage into a decimal or fraction, we divide by 100.



The following table shows the conversions of the basic fractions into percentages.

Half	$\frac{1}{2} = 0.5 = 50\%$	Quarters	$\frac{1}{4} = 0.25 = 25\%$
Thirds	$\frac{1}{3} = 0.3 = 33.33\%$		$\frac{2}{4} = 0.50 = 50\%$
	$\frac{2}{3} = 0.6 = 66.67\%$		$\frac{3}{4} = 0.75 = 75\%$
	$\frac{3}{3} = 1 = 100\%$		$\frac{4}{4} = 1 = 100\%$

Percentages always must be equal to 100%. Therefore, if 40% of your trip is spent travelling, the rest of your trip is spent doing other things, which will be 60% of the time. This is called 'complementary percentages'.

WORKED EXAMPLE

a **Convert $\frac{3}{5}$ to a percentage.** **b** **Find the complementary percentage.**

THINK	WRITE
a Convert the fraction to a decimal.	$\frac{3}{5} = 3 \div 5 = 0.6$
Convert the decimal to a percentage.	$0.6 \times 100 = 60\%$
b Complementary percentage = 100% – percentage	$100\% - 60\% = 40\%$

QUESTIONS

1 Brooke spent 23% of her holiday reading.

a Write down this percentage as a decimal.

b What is the complementary percentage?

2 Jono drove for 450 km of the entire 600-km trip. Kade drove the rest of the trip.

a What percentage did Jono drive?

b What percentage did Kade drive?

3 Complete the table below by using the conversions chart.

Decimal	Percentage	Decimal	Percentage
0.45	45%	0.62	
0.95	95%	0.20	
1.20		0.13	
0.65		0.10	10%
0.40		1	100%

4 If a trip from Geelong to Torquay is 32 km and there is a stretch of 20 km without traffic lights, work out the percentage of the distance without traffic lights.

5 Peter and Jen drove from Cairns to Port Douglas. The journey was 55 km and Jen drove 40 km of the trip.

a Find the percentage (rounded to 1 decimal place) driven by both people.

b They were passed by 10 vehicles (4 cars, 3 trucks, 2 utes and 1 motorcycle). What percentage of the 10 vehicles was each different type of vehicle that passed their car?

INVESTIGATION 6
Budgets

QUESTIONS

1 Monique's budget for her 14-day holiday is:

- transportation: $2300
- accommodation: $1200
- food: $700
- activities: $840
- incidentals: $140.

a Work out the total amount of money she is prepared to spend.

b Work out the percentage of money allocated for accommodation in her budget.

c Work out the average amount of money spent on food, activities and incidentals each day.

2 Indi was planning a trip to the Gold Coast. She had $2000 to spend on transport. Her options were: flying for $900, driving her car for $350, bus for $250 or renting a car and driving for $750.

a Work out how much money is left over after each option.

b Work out the percentage of transport for each option.

i Flying

ii Driving her car

iii Bus

iv Renting a car and driving

3 Richard and Gail had $10 000 to spend on a trip to Bali.

a Work out the amount of money spent in each area of their holiday.

i Accommodation (25%)

ii Flights (25%)

iii Entertainment (20%)

b How much money was left over? What percentage was left over?

When spending money overseas, your Australian money is converted into the local currency. The exchange rates between currencies continually change as they respond to market forces.

4 Why is there a buy rate and a sell rate?

5 To convert money you multiply the amount of money by the exchange rate.

a Using the rates shown above, how many Euros does A$1000 buy?

b Now convert the Euros back to Australian dollars.

c What do you notice?

6 Use the Oz Forex weblink in your eBookPLUS to investigate the exchange rate between the Australian dollar and the US dollar over the last 5 years. If you had $2000 Australian dollars:

a when was the best time to have exchanged your money? How many US$ would you have received?

b when was the worst time to have exchanged your money? How many US$ would you have received?

c what was the difference between the best and worst exchange rates?

PROJECT 2

Port Douglas

You will have to create a budget that does not go over $3500 for all travel costs and you must show where the money went. In order to do this, you will need to research what everything costs. Your trip will be for 2 weeks.

To help you organise, break your budget down into the following areas:

- *transportation* — getting there and back again and while at Port Douglas
- *food* — what type of food and a daily allowance
- *accommodation* — you can select from three different types of accommodation
- *activities* — what you are going to do and what attractions you may see.

Organisation and creativity

You will learn to balance your wants and needs according to your means. For example, sometimes you can afford a day in a luxury spa if you plan to spend the next two days on the beach with your own homemade sandwiches.

Transportation

Use the Hertz Car Rental, Flight Centre and Queensland Tourism weblinks in your eBookPLUS to find out the costs associated with your trip. Find out what choices exist and how much each costs. You will need to record the destination, price of petrol and car insurance if you are renting a car. You must be able to explain your daily expenses for transportation.

Food

You will need to create a realistic budget for your daily food allowance and your lodging. You must be able to explain and validate your daily expenses for food. There are three ways you can eat:

- high roller — eats out for all meals at exclusive restaurants. $250 per day.
- middle class — eats out for all meals but at affordable restaurants and cafés. $80 per day.
- backpacker — prepares all meals, food bought from supermarket. $40 per day.

Accommodation

You will need to explore accommodation prices at your destination. Your options are:

- camping — at a caravan park only (not in your car)
- backpackers — low range
- hotel/motel — middle range
- five-star hotel — high class.

Activities

You need to find out what there is to do, and what it all might cost. Do your best to find exciting activities. Remember, not everything has to be expensive — walking along the beach is free. You must be able to explain your daily expenses for activities.

Outcome

You must be able to coordinate and display the results of the budget, either using Excel or by hand, with the responsibility of showing how you spent the money. You can do this in a format of diary entries or a group of data.

Check to make sure you have included money in your budget for incidentals (suntan lotion, water, snacks) and prices that may have gone up slightly.

Analysis

Did you spend all of the money? Where did it go and how was it spent? Work out what percentage of your money went to each section (travel, accommodation, food and activities). An example of the percentage cost is:

$$\frac{\text{cost of all your travel expenses}}{\text{total cost of the holiday}} \times 100$$

eBookplus ACTIVITIES

Key skill 1 Maps

Digital docs
- Worksheet 5.1: apply your knowledge of maps
- Contour maps (doc-0001): learn how to draw a contour map using the free Google Sketch-Up software

Interactivities
- Bearings (int-0080): use the on-screen protractor to calculate your bearings on a number of journeys around Melbourne
- Navigation and specifications of locations (int-0190): explore the navigation and specifications of locations

eLessons
- Map distances (eles-0046): discover the different types of fractions
- Constructing triangles (eles-0044): learn how navigators and rescue workers use triangulation to locate lost and stranded people

Key skill 2 Time

Digital doc
- Worksheet 5.2: apply your knowledge of time

Interactivity
- Fraction wall (int-0002): explore the relationships between fractions of $\frac{1}{6}$ or larger

Key skill 3 Timetables

Digital doc
- Worksheet 5.3: apply your knowledge of timetables

Key skill 4 Time zones

Digital doc
- Worksheet 5.4: apply your knowledge of time zones

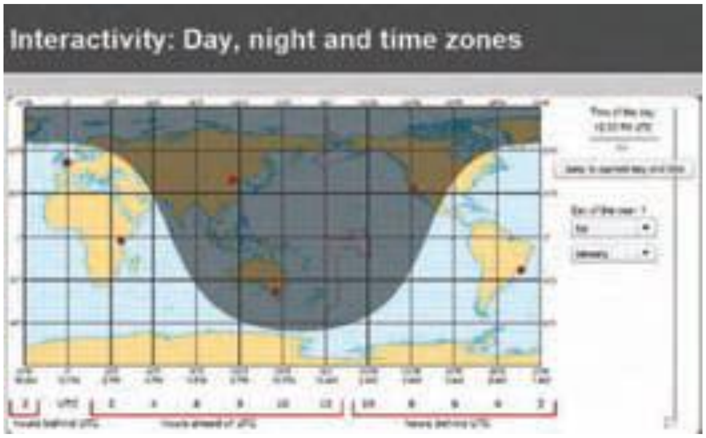
Interactivity
- Day, night and time zones (int-0006): explore the interaction of the effects of time-of-day, day-of-the-year and length of daylight

eLesson
- Daylight savings (eles-0007): learn about daylight saving and Australia's many time zones

Key skill 5 Travelling by road

Digital doc
- Worksheet 5.5: apply your knowledge of mathematics to travelling by road

eLesson
- Map distances (eles-0046): learn how to calculate your driving distance from one place to another with a map, ruler and a piece of string



Key skill 6 Percentages

Digital doc
- Worksheet 5.6: apply your knowledge of percentages

INVESTIGATION 6 Budgets

Weblink
- Aus Forex: www.chartflow.com/fx/historybasic.asp

PROJECT 2 Port Douglas

Weblinks
- Hertz Car Rental: www.hertz.com
- Flight Centre: www.flightcentre.com.au/flights/
- Queensland Tourism: www.queenslandtourism.com

CHAPTER REVIEW

Digital docs
- Word search swf (int-0651): search for the terms covered in this book
- crossword swf (int-0652): test your knowledge of the terms covered in this book
- puzzle page pdf: crack the code

Interactivity
- Test yourself (int-0653): take the end-of-chapter online multiple-choice quiz

ANSWERS

Key skill 1 — Maps

1 **a** Pig **b** Duck **c** Bird **d** Cake

2 **a** L12 **b** N9 **c** G4 **d** Q6
e F12 **f** E3 **g** J8 **h** K12
(and neighbouring reference also in some cases)

Investigation 1 — Scales

1 **a** 100 km **b** 87.5 km **c** 120 km
d 30 km **e** 90 km **f** 230 km

2 **a** G6 **b** F4 **c** D5 **d** E8

3 60 km

4 Between 150 and 200 km

5 40 km

6 Chelsea

Key skill 2 — Time

1

12-hour time	24-hour time
Midnight	0000
1 am	0100
3:20 am	0320
Noon	1200
7:25 pm	1925
2:45 am	0245
11:15 pm	2315
7:20 am	0720
10:00 pm	2200
9:30 pm	2130
10:15 am	1015

2 **a** Ten to four or three fifty; 0350 or 1550
b Twenty-three past ten or ten twenty-three; 1023 or 2223
c Seven forty-two; 0742 or 1942

3 **a** 7 hr, 15 min **b** 9 h, 15 min **c** 49 h, 30 min

4 **a** 435 min **b** 555 min **c** 2970 min

5 **a** 120 min **b** 5 min **c** 72 h
d 50 years **e** 14 weeks **f** 30 months
g 3 years **h** 2 fortnights

Investigation 2 — Units of time

1 **a** 2 h, 5 min **b** 125 min **c** 7500 s

2 114 min or 6840 s

3 **a** 303 h **b** 18 180 min

Key skill 3 — Timetables

1 **a** 13 **b** Yes, 80 min
c MQ829, MQ831, MQ833 **d** MQ801, departs at 0600

2 **a** 7:19 am
b **i** 32 min **ii** 19 min
c No
d 208 min
e 207 min
f No stops

Investigation 3 — Using timetables

1 **a** 6:45 am or 0645
b **i** 9 min **ii** 25 min
c No

2 **a** 3 h, 20 min (200 min)
b 2355 or 11:55 pm
c MQ648 arrives at 4:00 pm; MQ650 arrives at 8:35 pm

3 **a** 137 min **b** 685 min **c** 406 min
d 116 min **e** 268 min **f** 424 min

Project 1 — *Puffing Billy*

1 1130, 1203, 1218, 1233, 1245, 1302, 1330, 1440, 1506, 1523, 1545, 1600, 1612, 1657

2 2 h

3 2 h, 17 min; difference of 17 min

4 12 min to Gembrook; 22 min to Belgrave

5 70 min

6 **a** 12 **b** 180

7 **a** 56.57 min **b** 0.32 km/min **c** 0.27 km/min

Key skill 4 — Time zones

1

7:00 am	8:30 am	9:00 am
4:00 pm	5:30 pm	6:00 pm
11:15 pm	12:45 am	1:15 am
2130	2300	2330

2 NSW = 8:00 pm, NT = 7:30 pm, Qld = 8:00 pm, SA = 7:30 pm, Tas. = 8:00 pm, WA = 6:00 pm

3 **a** 1 pm **b** 66 h = 3960 min
c 65.9 km/h; 1.1 km/min

4 **a** 11 pm **b** 11 pm

Investigation 4 — World time zones

1 8 am New Year's Day

2 2:25 pm

ANSWERS

3

Athens	0100 Monday
Beijing	0700 Monday
Delhi	0430 Monday
Fiji	1100 Monday
Hawaii	1300 Sunday
Jakarta	0600 Monday
New York	1800 Sunday
Singapore	0700 Monday
Mexico City	1700 Sunday

4 Jakarta: 11 am Saturday; New York: 11 pm Friday; Perth: noon Saturday

Key skill 5 — Travelling by road

1 57.79 L/100 km

2

4-cylinder automatic	6.20
6-cylinder manual	9.40
6-cylinder automatic	10.90
8-cylinder manual	13.30
8-cylinder automatic	15.30

3 4-cylinder manual at 5.10 L/100 km

4 6-cylinder automatic: 109 L; 8-cylinder automatic: 153 L
∴ 44 L extra

5 Car: 8.67 L/100 km; car towing van: 13.01 L/100 km; difference of 4.34 L/100 km

Investigation 5 — Cost of road travel

1 **a** 1.86 L **b** $2.98

2 **a** 13.77 L **b** $22.03 **c** $44.06

3

Trip	4-cylinder manual	6-cylinder manual	8-cylinder manual
Melbourne to Sydney	52.8 L	97.48 L	137.92 L
Melbourne to Adelaide	46.97 L	86.57 L	122.49 L
Melbourne to Rockhampton	100.16 L	184.62 L	261.21 L
Melbourne to Karumba	148.36 L	273.45 L	386.90 L

4

Trip	4-cylinder manual	6-cylinder manual	8-cylinder manual
Melbourne to Sydney	$84.48	$155.97	$220.67
Melbourne to Adelaide	$75.15	$138.51	$195.98
Melbourne to Rockhampton	$160.26	$295.39	$417.94
Melbourne to Karumba	$237.38	$437.52	$619.04

5 **a** $34.97 **b** $19.56 **c** $35.06

Key skill 6 — Percentages

1 **a** 0.23 **b** 77%

2 **a** 75% **b** 25%

3

Decimal	Percentage	Decimal	Percentage
0.45	45%	0.62	62%
0.95	95%	0.20	20%
1.20	120%	0.13	13%
0.65	65%	0.10	10%
0.40	40%	1	100%

4 62.5%

5 **a** Peter: 27.3%; Jen: 72.7%
b Cars 40%, trucks 30%, utes 20%, motorcycles 10%

Investigation 6 — Budgets

1 **a** $5180 **b** 23.2% **c** $120/day

2 **a** $1100, $1650, $1750, $1250
b **i** 45% **ii** 17.5% **iii** 12.5% **iv** 37.5%

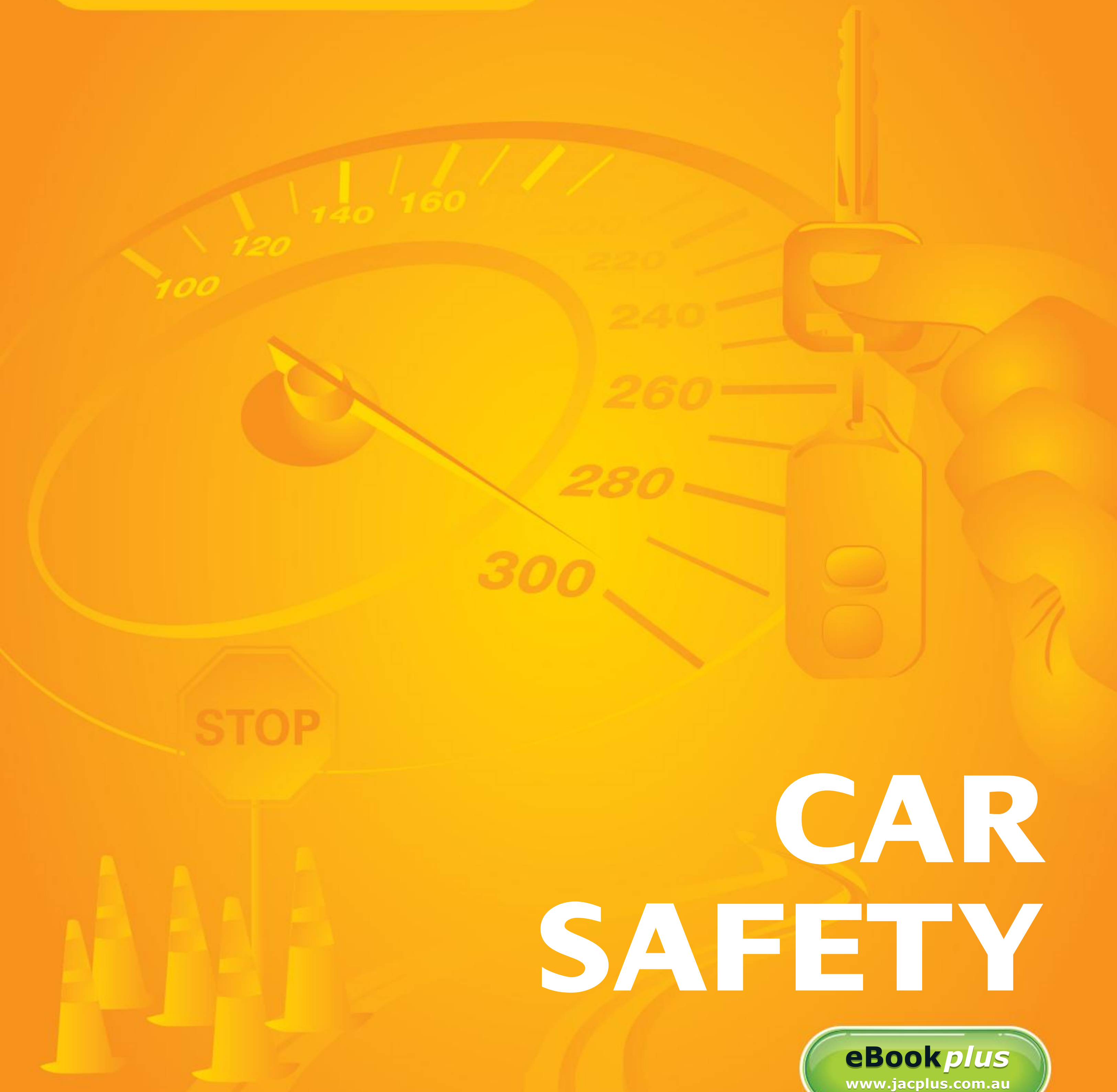
3 **a** **i** $2500 **ii** $2500 **iii** $2000
b $3000, 30%

4 Better exchange rates

5 **a** €577 **b** A$883.50
c Decrease in money in A$

MATHS QUEST

VCE FOUNDATION MATHEMATICS



CAR SAFETY

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INTRODUCTION

Car safety

Most teenagers are extremely eager to get their licence as soon as possible. First they must get their learner's permit and then their provisional licence. This is a sign of becoming an adult and gaining greater freedom; however, significant responsibility comes with being a driver.

contents

KEY SKILL 1

Speed

TAKE A LOOK BACK AT **BOOK 1, PP. 3, 16**

The metric units of length used most often are:

The *kilometre* (km) — roughly equal to three laps of a sports oval.

The *metre* (m) — about the length of an adult's 'stretched pace'.

The *centimetre* (cm) — roughly equal to the width of a little finger.

The *millimetre* (mm) — the approximate thickness of a metal ruler.

You would measure the distance between two capital cities in kilometres, the length of a driveway in metres, the distance around your waist in centimetres, and the thickness of a pencil in millimetres.

Speed is a description that relates to the change in distance over a period of time.

Speed is defined as $\dfrac{\text{change in distance}}{\text{change in time}}$.

WORKED EXAMPLE

Bill walks quickly, covering 4.5 km in 0.75 hours.
a What is his speed in km/h?
b What is his speed in m/s?

THINK	WRITE
a Speed = $\dfrac{\text{change in distance}}{\text{change in time}}$	Speed = $\dfrac{4.5}{0.75}$
Write with units.	6 km/h
b Convert km to m.	$4.5\text{ km} \times 1000 = 4500\text{ m}$
Convert hours to seconds.	$0.75 \times 60 = 45\text{ mins} = 45 \times 60 = 2700\text{ s}$
Speed = $\dfrac{\text{change in distance}}{\text{change in time}}$	Speed = $\dfrac{4500}{2700}$
Write with units.	1.67 m/s

QUESTIONS

1 Convert the following units.

a $2.4\,m = 2.4 \times 100 = 240\,cm$

b $6\,km = 6 \times$ .... = m

c $460\,mm =$ .... = cm

d $12\,000\,cm =$ .... = m

2 Compare and put in order the following measurements from smallest to largest.

210 cm, 6 m, 0.8 km and 6100 mm.

3 Calculate the average speed in km/h for the following.

a A car travelling 400 km in 5 h

b A marathon runner taking 3 h to run 42 km

c An aeroplane travelling a distance of 875 km in 3.5 h

4 Calculate the average speed in m/s (rounded to 1 decimal place) for the following.

a A cyclist travels 50 km in 5 hours.

b A horse gallops 3 km in 5 min.

c A walker covers 10 km in 1 h 15 min.

5 The sound in air travels approximately 340 metres per second.

a If you were standing 150 metres away from the starter of a running race, how long after the start of the race would you hear the starter's pistol? (Round answers to 2 decimal places.)

b A thunderclap is heard 6 seconds after the lightning flash. How far away is the storm?

c How long does it take for sound to travel 1 km? (Round to 1 decimal place.)

INVESTIGATION 1
Stopping distance

Many drivers drive in a false belief that if the car in front suddenly started braking, they would be able to react and brake, stopping a safe distance apart. The total stopping distance of a vehicle is made up of four components:

- human perception time
- human reaction time
- vehicle reaction time
- vehicle braking capability.

The human perception time is how long the driver takes to see the hazard, and how long the brain takes to realise it is a hazard requiring an immediate reaction. This perception time can be as long as one-quarter to one-half of a second.

Type of car	Stopping distance (m) at 90 km/h	Stopping distance (m) at 120 km/h
Audi A4	43.5	80.7
Mazda MX-5	45.6	76.8
Mercedes C36	36	63
Saab 9000 Aero	36.6	66.3
Toyota Camry V6	43.5	82.2
Porsche 911 Carrera 4	37.8	66.9

Source: www.sdt.com.au/safedrive-directory-STOPPINGDISTANCE.htm.

To work out the difference between the stopping distance of a car travelling at 90 km/h and 120 km/h, subtract the larger value from the smaller value.

QUESTIONS

1 From the table on stopping distances above, rank the cars from shortest to longest stopping distance for the two speeds.

	Stopping distance at 90 km/h	Stopping distance at 120 km/h
1		
2		
3		
4		
5		
6		

2 Find the differences between the two stopping distances of the cars from the stopping distance table on the previous page. Give your answers in metres and centimetres.

Car	Difference in m	Difference in cm
Audi A4		
Mazda MX-5		
Mercedes C36		

Reaction times

3 In the moments between seeing an obstacle in the path of your vehicle and applying the brakes, you continue to drive at a constant speed. If a car is travelling at 60 km/h:

a how many metres would it travel in one hour? (*Hint:* × 1000)

b how many metres would it travel in one minute? (*Hint:* ÷ 60)

c how many metres (rounded to 1 decimal place) would it travel in one second? (*Hint:* ÷ 60)

d how many metres would it travel in half a second? (*Hint:* ÷ 2)

4 Complete the table of distance travelled before you start braking.

Speed	Distance in metres travelled in 1 h	Distance in metres travelled in 1 min	Distance in metres travelled in 1 s	Distance in metres travelled in 0.5 s
10 km/h				
40 km/h				
90 km/h				
100 km/h				

5 If you are travelling at 90 km/h and it takes half a second to react, what is the total stopping distance from when you first see the obstacle?

Car	Stopping distance (m)	Reaction distance (m)	Total distance (m)
Saab 9000 Aero	36.6		
Toyota Camry V6	43.5		
Porsche 911 Carrera 4	37.8		

KEY SKILL 2

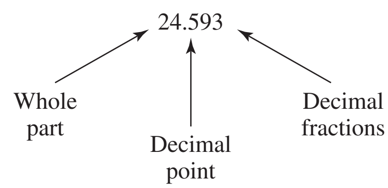
Fractions and decimals

TAKE A LOOK BACK AT **BOOK 1, PP. 2, 3, 6, 7**

Percentages are measures out of 100, so 50% means 50 parts out of 100 parts. The fraction is written as $\frac{50}{100}$. To find the decimal value, you must first know that the line in the fraction of $\frac{50}{100}$ actually represents a division. So, to find the decimal of $\frac{50}{100}$, you should divide 50 by 100: $50 \div 100 = 0.50$.

Decimals

A decimal is a number that contains a whole number part and a part less than one, with a point (called the decimal point) between two parts.



The place value of a decimal is extremely important. For example the table below shows the value of the number 24.593.

This means that in the number 24.593 there are 2 tens, 4 units, 5 tenths $\left(\frac{5}{10}\right)$, 9 hundredths $\left(\frac{9}{100}\right)$ and 3 thousandths $\left(\frac{3}{1000}\right)$.

Place value

Hundreds (100's)	Tens (10's)	Units (1's)	Decimal .	Tenth (/10)	Hundredth (/100)	Thousandth (/1000)
	2	4		5	9	3

WORKED EXAMPLE 1

Find the value of 6 in the following numbers.
a 125.376 **b** 92.69

THINK	WRITE
a 125.376	$\frac{6}{1000}$, 6 thousandths
b 92.69	$\frac{6}{10}$, 6 tenths

Estimating is an important part of mathematics and a very handy tool for everyday life. It is good to get into the habit of estimating amounts of money, lengths of time, distances and many other physical quantities.

Rounding off is a form of estimating. To round off decimals:

1. find the place value you want (the 'rounding digit') and look at the digit to the right of it
2. if that digit is less than 5, do not change the rounding digit but drop all digits to the right of it
3. if that digit is greater than or equal to five, add one to the rounding digit and drop all digits to the right of it.

QUESTIONS

1 What is the value of 3 in the following numbers?

a 32 b 54.3 c 45.773

2 Round the following numbers to 2 decimal places.

a 0.159 b 0.059 c 0.109

3 Write down the value of each digit in the values below.

a 24.61 b 13.409 c 9.298

4 Round the following numbers to the nearest whole numbers (no decimals).

a 24.61 b 13.409 c 9.298

5 Round the total of the following coins to the nearest dollar.

6 Round the following numbers to 1 decimal place.

a 132.09 b 155.922 c 609.231

7 Round the following petrol prices to the nearest cent.

a 132.4c b 122.9c c 165.91c

INVESTIGATION 2

Converting units

TAKE A LOOK BACK AT **BOOK 1, P. 6**

To be able to convert between commonly used volumes, it is important to know basics. Litres and millilitres are the two most commonly used units of liquid volume. Remember, there are 1000 mL in 1 litre.

QUESTIONS

1 Convert the following measurements from litres to millilitres.

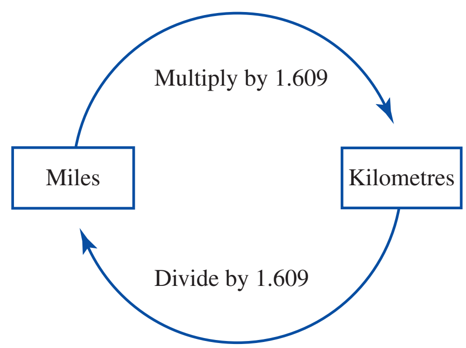
a 6 L **b** 2.1 L **c** 0.9 L

2 Convert the following measurements from millilitres to litres.

a 1200 mL **b** 800 mL **c** 375 mL

3 Sort the capacities from questions **1** and **2** from smallest amount to largest amount.

Some countries, such as the UK and the USA, use non-metric units to measure distances and volumes. If you travelled in these countries, you would notice the road signs give distances in miles and speeds in miles per hour. To convert miles into kilometres, you need to multiply by 1.609.



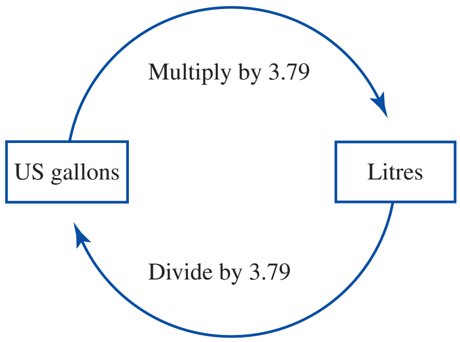
4 If the distance between Tampa and Jacksonville is 196 miles, how far is that in kilometres?

5 If the distance between Miami and Orlando is 381 kilometres, how far is that in miles, rounded to 2 decimal places?

6 The speed limit in Florida on highways is 70 miles per hour. Convert that to kilometres per hour.

7 The speed limit in New Jersey is 104.585 km/h. What is the speed limit in miles per hour?

In the USA, petrol is sold by the gallon. One US gallon is approximately 3.79 litres.



8 The car you are travelling in has a petrol tank that holds 55 litres. What is that capacity expressed in gallons?

9 If you bought 6.5 gallons of petrol, how many litres is that?

10 The car you are travelling in uses 5.1 litres per one hundred kilometres.

a What is the consumption rate (rounded to the nearest whole number) in miles per gallon?

b How many gallons (rounded to 1 decimal place) would you need to travel from Tampa to Jacksonville?

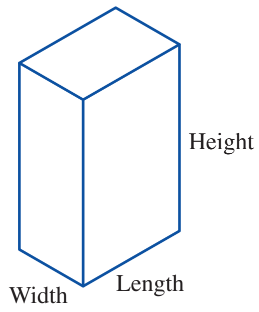
KEY SKILL 3

Measurement

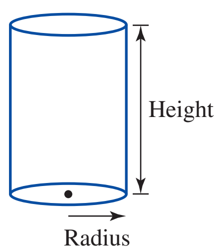
TAKE A LOOK BACK AT **BOOK 1, PP. 24, 26**

Volume is the quantity or amount of substance that fits inside a three-dimensional shape. To find the volume of most shapes you must multiply the area of the base by the height of the prism.

Volume of a rectangular prism = area of base × height
= length × width × height



Volume of a cylinder = area of base × height of prism



(Note: For calculations involving circles use $\pi = 3.14$)

WORKED EXAMPLE 1

Find the volume of a rectangular prism with width of 6 cm, depth of 3 cm and a height of 12 cm.

THINK	WRITE
Volume of a rectangular prism = length × width × height	$6 \times 3 \times 12 = 216\ \text{cm}^3$

WORKED EXAMPLE 2

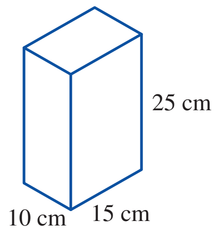
Find the volume of a cylinder with a radius of 5 cm and a prism height of 15 cm.

THINK	WRITE
Area of base = πr^2	$\pi \times 5\ \text{cm} \times 5\ \text{cm}$
Volume of a cylinder = area of base × height of prism	$\pi \times 5\ \text{cm} \times 5\ \text{cm} \times 15\ \text{cm}$
Calculate.	$= 3.14 \times 25\ \text{cm} \times 15\ \text{cm}$ $= 1117.5\ \text{cm}^3$

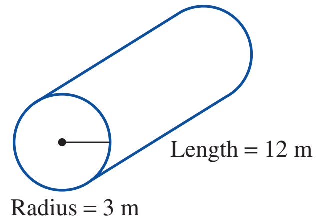
QUESTIONS

1 Find the volume of the following shapes.

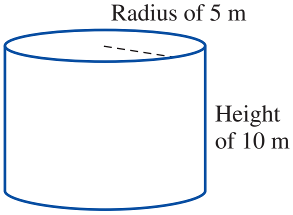
a



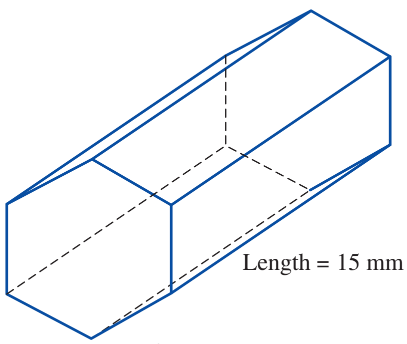
b



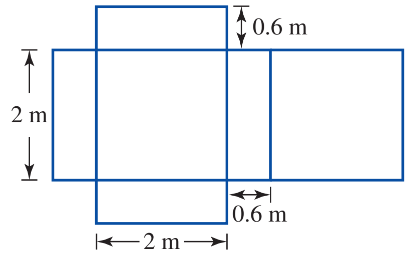
c



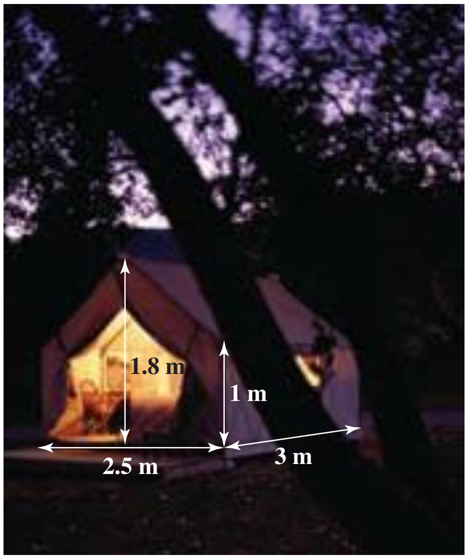
d



2 If a rectangular prism to be placed on the car's roof rack can be made from the following net, what is the volume of the prism?



3 During a driving holiday, you set up a tent with the dimensions shown.



a Calculate the area of material required to make the tent, including the floor.

b Calculate the amount of space inside the tent.

INVESTIGATION 3
BAC readings

In recent years there has been an effort to inform people about how much alcohol they drink and how alcohol affects what they do after drinking. Alcohol is involved in 50% of deaths for drivers aged between 21 and 25 years. Blood alcohol concentration (BAC) is a measure of how much alcohol is in your blood. It is measured in grams of alcohol per 100 millilitres of blood.

To have a BAC of 0.00 you must have no alcohol in your bloodstream. The legal BAC limit is 0.05, but any alcohol in your bloodstream will have an effect on your ability to drive safely, and is potentially a risk to public safety.

Alcohol affects people differently and the formulas for estimating BAC are:

$$\text{BAC}_{\text{male}} = \frac{(10N - 7.5H)}{6.8M} \quad \text{and} \quad \text{BAC}_{\text{female}} = \frac{(10N - 7.5H)}{5.5M}$$

where N is the number of standard drinks consumed, H is the number of hours of drinking and M is the person's mass in kilograms.

QUESTIONS

1 Investigate the effect each of the following has on a BAC reading.

- **a** Body size
- **b** Body fat
- **c** Gender
- **d** Food
- **e** Fitness

When authorities say a driver must stay under 0.05, that actually means that the driver must have a limit of five hundredths of alcohol in their blood stream. Anything greater than 0.05 will cause a driver to lose their licence if they are caught drink-driving.

2 A BAC of just 0.05 means the risk of having a crash is doubled compared with a driver with zero BAC. What is the place value of the 5 in the above statistic?

Because people come in all different shapes and sizes, there isn't an exact rule for working out the BAC level of a particular person. A general rule of thumb is that for every 1 mL of alcohol consumed, the blood alcohol content will by raised by 0.0015%.

The following formula can be used to approximate the number of hours you need to wait before driving if you've been drinking alcohol.

$$\text{Number of hours} = \frac{\text{BAC}}{0.015}$$

3 Complete the table by estimating the number of hours you need to wait before driving. (Round answers to 2 decimal places.)

BAC reading	Approximate number of hours to wait before driving
0.1	
0.2	
0.3	
0.4	
0.5	

4 How long (to the nearest whole number of hours) would it take for a person with a reading of 0.25 to have their BAC reduced to zero?

5 Create a pamphlet that informs people about the risk associated with drink driving. You should include facts that are from the Transit Accident Commission (TAC). Use the TAC weblink in your eBookPLUS.

What is a standard drink?

A standard drink is any drink that contains approximately 10 grams of alcohol. Ethanol is the chemical name of pure alcohol. Use the label on the bottle, can or cask to find out how many standard drinks there are inside the container. There are five main types of alcoholic beverages: spirits, champagne, wines, regular beer and light beer.

$$1 \text{ standard drink} = 10 \text{ grams of ethanol} = 12.5 \text{ mL of ethanol}$$

The main reason for using standard drinks is so that you can keep track of how much alcohol you have consumed. *It takes roughly one hour for your body to break down one standard drink.*

Here is a formula that you can use to calculate the number of standard drinks in each beverage:

$$\text{Standard drinks} = \text{drink volume (L)} \times \% \text{ alcohol} \times 0.789 \text{ (kg/L) (specific gravity of ethanol)}$$

Most glasses are not a standard size, so it is extremely difficult to know the volume.

6 Complete the table, converting the different drinks to standard drinks.

	Type of drink	Name of drink size	Volume of drink size	Percentage of alcohol by volume	Standard drinks to 1 decimal place
a	Beer	Pot	285 mL	4.9%	1.1 standard drink
b	Beer	Stubby/can	375 mL	4.9%	
c	Spirit	Shot/nip	30 mL	40%	
d	Premixed spirit	Can/bottle	375 mL	5%	
e	Port/Sherry	Glass	60 mL	18%	
f	Wine	Glass	170 mL	11.5%	
g	Champagne	Flute	180 mL	12%	

PROJECT 1
Purchasing a car

When you start to look for a car to buy, you have many decisions to make. Do you buy a new car or a used car? Do you want a sedan, a four-wheel drive or a station wagon?

The buying process

You've decided to buy a car. Where do you start? You wish to buy a car that will cost a minimum of $6000, but you have only $3000. Follow the questions and create a PowerPoint of the process of buying a car.

1 What type of car do you want to buy? Collect information on three different cars that you are interested in and record the information in a table. From the three, select the one that is best for you and explain your choice.

Loans

Now you need to find the money to bridge the gap in your funds.

2 Write down the money that you need to borrow. Collect information from three financial institutions on their personal loans. You can use a personal loan calculator via the internet.

a Create a table for each institution, giving:

i the total payment

ii the interest rate

iii the period of the loan

iv the repayment frequency

v the repayment amount.

b Which financial institution will you use? Why?

c How will you be able to make the basic repayments?

3 If you paid all of your money at the start of the loan, what would happen to the loan? Explain the benefits/negatives to doing this.

4 If you had $1000 to spare, when would it be best to pay that off the car? Explain why.

A car will lose value or depreciate over time. Find out what your car will be worth in the future.

5 What will the car be worth in 1 year if it depreciates by 10% over the year?

6 Create a table that shows the value of the car at the end of each year for 5 years, assuming that it depreciates 10% each year (per annum).

Year	At purchase	After 1 year	After 2 years	After 3 years	After 4 years	After 5 years
Value						

7 Graph the information showing the depreciation of the value of the car.

8 Use the graph in Question **7** to estimate the number of years for the car to halve in value.

Transferring the vehicle

When you buy a car, you must transfer the car into your name. Use the VicRoads weblink in your eBookPLUS to download the vehicle registration transfer form.

9 Fill in the form. What is the cost of one year's registration for your car?

Insurance

There are two main types of insurance: third party and comprehensive. The lowest rate of insurance is third party.

10 Explain what the features are for each insurance type.

11 Create a table listing the features.

12 What type of insurance will you select? Why?

13 Use the RACV weblink in your eBookPLUS to get an estimate for the type of insurance you have selected.

14 Obtain quotes from three other insurers. Which quote do you prefer most? Why?

Running costs

There are many running costs for a car, including servicing, tyres and fuel. We will focus on fuel.

15 Estimate how many kilometres that you will travel in an average week. Justify your answers.

Approximate fuel consumption rates for different size cars is as follows: a small car — 5.8 L/100 km, a medium car — 10 L/100 km and a large car — 13 L/100 km.

16 How much fuel would you use in a week and a year?

17 What is the cost for fuel for that week using current prices? For the year?

Totals

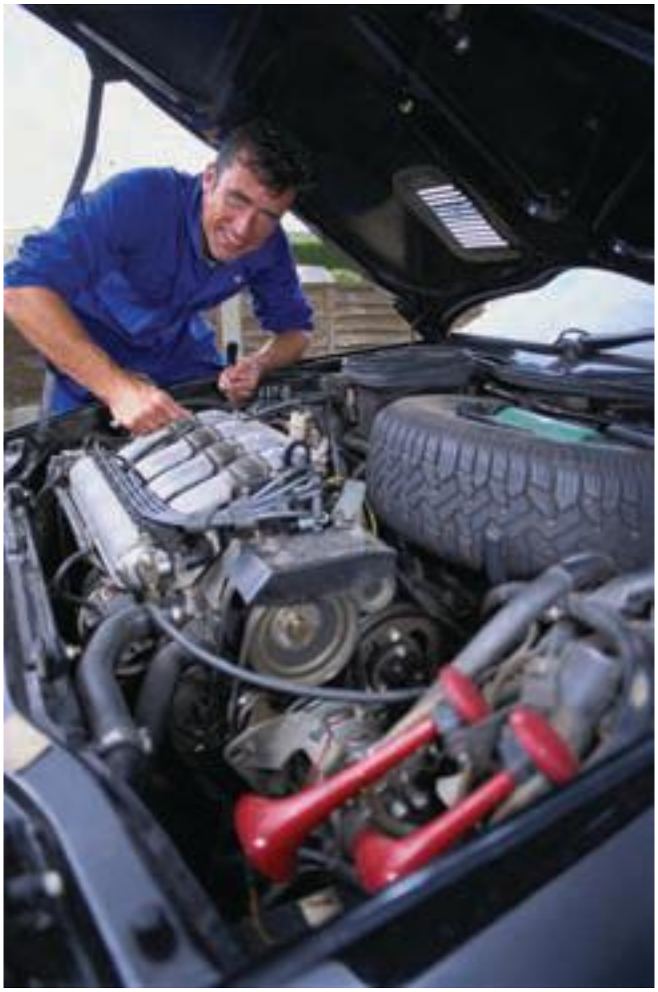
Find the total amount needed to get your car on the road. You must work out the weekly amount of the following: insurance, registration, repayments to the bank, petrol and transfer of car.

KEY SKILL 4

Fixed & variable

Costs come in two forms: fixed and variable. A fixed cost, as the name suggests, is fixed at a certain amount, regardless of the amount of time spent or quantity worked. Typical examples of fixed costs are rent of an office or factory. The fixed amount of rent is due each month (if paying monthly), and this amount doesn't change if you have the factory open 24 hours a day or 8 hours a day.

A variable cost varies depending on the time spent or number of units produced. In manufacturing, the more units you produce, the more raw materials you require. So the cost of materials is a variable cost.



WORKED EXAMPLE

A mechanic has a call-out fee of $100 and charges $70 an hour. The mechanic works 3 hours to service a car.
a What was the fixed cost?
b What was the variable cost?
c What was the total cost?

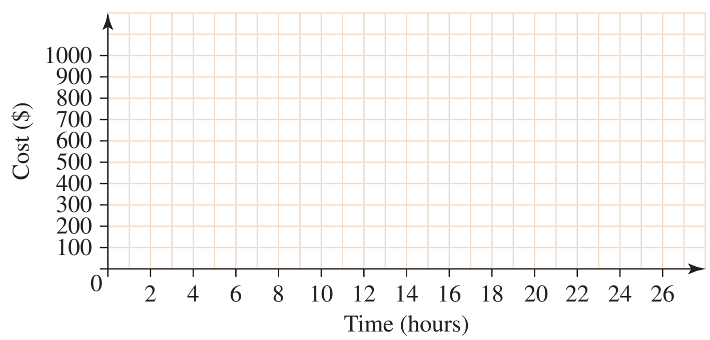
THINK	WRITE
a The fixed cost is the call-out fee.	$100
b The variable cost is the hours worked.	3 hours × $70 = $210
c Total cost is fixed and variable costs added together.	$100 + $210 = $310

QUESTIONS

1 Complete the table of total costs of hiring an auto-electrician to complete a job where the call-out fee is \$200 and the hourly rate is \$20.

Hours	Fixed	Variable	Total
1	\$200	$1 \times \$20 = \$20$	\$200 + \$20 = \$220
1.5			
4			
10			
15			
25			

2 Graph the results of the table in Question **1**.



3 From the graph in Question **2**, find:

a the cost for 22 hours

b the number of hours for a cost of \$420.

(Answers may vary slightly because of the small scale on the graph.)

4 The fixed cost of hiring a rental car is \$250 and the rental is \$0.20 per kilometre travelled. How far could you travel for a total rental of \$490?

INVESTIGATION 4

Public versus private

Thousands of people who work in the city face the decision of whether to use public transport or drive their car.

Trains

QUESTIONS

Nick lives in Chelsea, which is approximately 30 km south of the centre of Melbourne. His office is a short walk from Parliament station.

1 If Nick takes the train from Chelsea to Parliament station and then returns after work, investigate the advantages and disadvantages (including cost) for Nick to purchase each of the following types of ticket.

- **a** Two-hour ticket
- **b** All-day ticket
- **c** Weekly ticket
- **d** Monthly ticket
- **e** Yearly ticket

2 If Nick worked every weekday for a full year (ignore all public holidays), how much would the cost of his travel to and from work be for each of the following tickets?

a Two-hour ticket **b** All-day ticket **c** Weekly ticket **d** Monthly ticket **e** Yearly ticket

3 Investigate the choice of trains available to Nick to travel on between 7 am and 8 am.

- **a** How many trains leave Chelsea travelling to Parliament?
- **b** How long does each journey take?
- **c** If Nick needs to be at Parliament station by 8.46 am, which is the latest train he can catch?

Taxis

QUESTIONS

Melbourne's taxis use a variable system to determine the fare, based either on distance travelled or time taken. As of 1 January 2009, the critical speed was 21 km/h. If the taxi is travelling at under 21 km/h (which includes time when stopped) then the meter ticks over at a rate of \$0.566 per minute. Once the taxi is moving at over 21 km/h, the meter moves to the rate of \$1.67 per kilometre travelled.

4 Consider two people doing the same 2-km trip

a Frieda's taxi travels the first kilometre at 30 km/h and then gets caught behind a slow truck — the last kilometre is covered at a speed of 12 km/h.

i How long does the taxi take to cover the first kilometre?

ii What fare would be charged on the metre for the first kilometre?

iii What rate would the second kilometre be charged at?

iv What would be the total cost of Frieda's journey?

b Ashan's taxi travels at a constant 20 km/h for the 2-km trip.

i How long is his trip?

ii What would be the cost of his journey?

c Who has the cheaper trip — Frieda or Ashan?

5 Investigate the following charges when hiring a taxi.

a Booking fee **b** Flagfall **c** Late-night surcharge **d** CityLink charges **e** Melbourne Airport

Parking

QUESTIONS

Parking in the city often uses a segmented scale, where the one price applies to a range of times. A parking garage charges the rates in the table at right for parking.

Hours parked	Parking cost
Up to 1 hour	$4
1 to 2 hours	$7
2 to 4 hours	$9
4 to 8 hours	$12
More than 8 hours	$16

6 If you parked for 3 hours, how much would you be charged?

7 If you were charged $12 dollars, what is the possible range of times you were parked at the car park?

8 If you parked for 10 hours, how much would you expect to pay?

9 If you parked 5, 6, 5, 8, 9 and 3 hours on Monday, Tuesday, Wednesday, Thursday, Friday and Saturday respectively, what would your weekly parking bill be?

KEY SKILL 5

Handling data

TAKE A LOOK BACK AT **BOOK 1, PP. 7, 8, 9, 10**

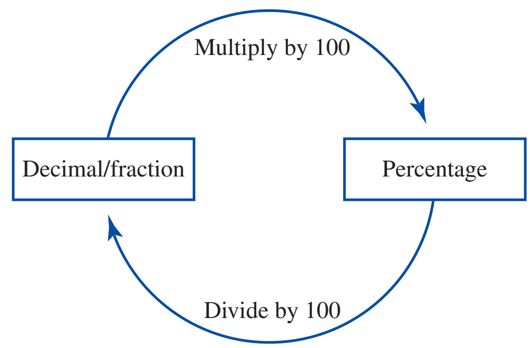
Percentages express amounts as parts of 100, where 100% is the original amount. An example of this is 45%, which is 45 parts out of 100 parts. The fraction is $\frac{45}{100}$.

To find the decimal value, you must first know that the line in the fraction of $\frac{45}{100}$ actually represents a division. So to find the decimal of the above question, you should divide 45 by 100, which equals 0.45.

To convert a fraction to a percentage, multiply by 100.

To convert a percentage to a fraction, divide by 100.

When finding percentages given two quantities, you must ensure that you have the quantities in the same units, e.g. both cm, kg or litres.



WORKED EXAMPLE 1

John has travelled for 350 kilometres of his 1200 kilometre journey. What percentage of his journey has John travelled?

THINK	WRITE
Write as a fraction multiplied by 100.	$\frac{350}{1200} \times 100$
Calculate.	$= 0.292 \times 100 = 29.2\%$

WORKED EXAMPLE 2

32% of drivers do not have a dual licence, which allows them to drive both automatic and manual cars. What percentage of 1 200 000 people would be permitted to drive only automatic cars?

THINK	WRITE
Write the percentage as a fraction multiplied by the quantity.	$\frac{32}{100} \times 1\,200\,000$
Calculate.	$= 0.32 \times 1\,200\,000$ $= 384\,000$

Hints

1 32% represents 32 out of 100

2 $\frac{32}{100} = 0.32$

3 'of' represents *multiply*

QUESTIONS

1 Convert the following values using the appropriate skills.

Fraction	Decimal	Percentage
	0.45	
$\frac{3}{5}$		
		9%
	0.25	
$\frac{80}{100}$		
		120%
	0.50	

2 Write down in words how to convert a fraction to a percentage.

3 Convert the following fractions to percentages.

a $\frac{40}{100}$ **b** $\frac{75}{100}$ **c** $\frac{4}{5}$

4 **a** Write down in words how to convert a percentage to a fraction.

b Convert the following percentages to fractions. (Express answers in simplest form.)

i 32% **ii** 20% **iii** 95%

5 If 91% of accidents with a BAC of 0.05 involve males, what percentage involves females? How do you know?

6 Complete the following table.

Age group	Percentage	Decimal	Fraction
20 or younger	6%		
21–29	47%		
30–39	29%		
40 or older	18%		

INVESTIGATION 5

Crash statistics

Reducing drink driving is a prominent public safety campaign in all Australian states and territories. The police conduct regular random breath tests (RBTs) to screen for drivers abusing alcohol and drugs. Now, standard police cars can also act as Booze Buses and conduct random breath tests.

In 2006, Victoria Police breath tested 1.37 million drivers and riders from Booze Bus operations. Over 5500 drivers and riders were caught with an illegal blood alcohol concentration (BAC) over this period. Of the 34 drivers and motorcyclists killed in 2006 in Victoria with a BAC of 0.05 or over:

- 91% were males
- 47% were between 21 and 29 years of age, 29% were aged between 30 and 39 years, 18% were aged over 40, and the remaining 6% were 20 years of age or younger
- 79% were involved in single-vehicle crashes
- 62% of fatalities occurred on country roads
- 82% died in crashes that occurred between the hours of 6 pm and 6 am.

QUESTIONS

1 What percentage of fatalities occurred on city roads in 2006?

2 If 82% of deaths occurred in accidents between the hours of 6 pm and 6 am,

a what is the decimal equivalent?

b what percentage of accidents occurred at other times?

c what times did the other accidents in **b** occur between?

3 What percentage of drivers were caught with an illegal BAC in 2006?

In 2007, more than one in four drivers and motorcyclists killed in Victoria tested at or over 0.05. Approximately 80% of those killed were male, and the majority killed were aged 21 to 39 years.

4 Express the ratio of drivers and motorcyclists killed in 2007 as a fraction, a percentage and a decimal.

5 In 2007, 80% of the drivers killed were male. There were 40 people killed on the roads that year — how many males does this percentage represent?

6 Below are statistics on what daytime road accidents have occurred. Find the percentage of crashes on each day. (*Hint:* First find the total number of accidents and round to 1 decimal place.)

Day of the week	Number of accidents	Percentage
Mon.	117	
Tues.	138	
Wed.	138	
Thurs.	117	
Fri.	166	
Sat.	186	
Sun.	154	
Total		100%

7 Use the Crash Database weblink in your eBookPLUS to find more information on crash statistics over the last five years, and write a short report.

KEY SKILL 6

Formulas

TAKE A LOOK BACK AT **BOOK 1, PP. 6, 16**

For a car to be allowed on the road, the car must be considered to be roadworthy. To test if a car is roadworthy, a check is done by a mechanic to test that the car can be driven safely. A large focus within the roadworthy check is the tyres. Tyres are the only parts of the car touching the ground. They must provide grip so that the car handles and brakes safely.

Stopping distances

For an average-size car with good tyres, the minimum controlled stopping distance in metres can be found by using the formula:

$$D = \frac{0.35s}{f}$$

where: s is the speed of the car in kilometres per hour

f is the coefficient of friction of the road surface.

The higher the coefficient of friction, the better the grip and the shorter the stopping distance. The value of friction will vary depending on the state of the tyres and the condition of the road. If the speed of the car is high, this will increase the stopping distance.

WORKED EXAMPLE

What is the stopping distance of a car travelling at 60 kilometres per hour on dry asphalt, which has a coefficient of friction of 0.8?

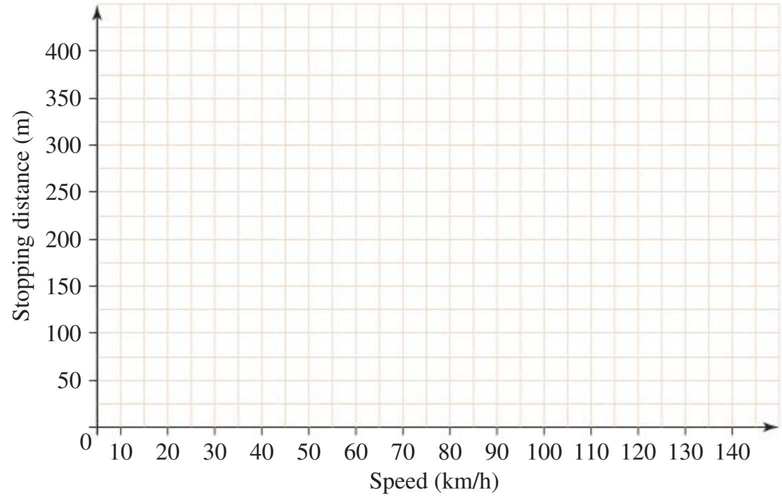
THINK	WRITE
Speed, $s = 60$ km/h Coefficient of friction, $f = 0.8$	$D = \frac{0.35s}{f}$ $= \frac{0.35 \times 60}{0.8}$
Calculate.	$= 26.25$ m

QUESTIONS

1 Complete the table of stopping distances.

Icy road ($f = 0.1$)		Wet road ($f = 0.4$)		Dry road ($f = 0.8$)	
Speed (km/h)	Stopping distance (m)	Speed (km/h)	Stopping distance (m)	Speed (km/h)	Stopping distance (m)
10	$= \frac{0.35 \times 10}{0.1}$	10		10	
20		20		20	
40		40		40	
80		80		80	
100		100		100	

2 Complete the graph of stopping distances for each of the three types of road conditions.



3 Use your graph in Question **2** to complete the following table, then check your answers using the formula.

Speed (km/h)	Stopping distance on a dry road (m)	Stopping distance on a wet road (m)	Stopping distance on an icy road (m)
15			
35			
65			
85			

INVESTIGATION 6

Tyres

A car tyre is usually defined by a number of descriptors, shown on the tyre's sidewall (see the figure below). The example given is 205/55 R16 94V. The descriptor and their meaning are given in the table below.

Descriptor	Example	Explanation
1 Section width (mm)	205	Width of 205 mm from inner sidewall to outer sidewall
2 Profile, or aspect ratio, of sidewall height to tyre width	55	55% of width; sidewall height is 112.75 mm
3 Construction type	R	Radial ply construction
4 Wheel rim diameter (inches)	16	
5 Load capacity index	94	At the speed indicated by the speed category symbol below, this tyre can carry 670 kg.
6 Speed category symbol	V	H, S = speeds up to 180 km/h V = speeds up to 240 km/h Z = speeds over 240 km/h

QUESTIONS

1 Describe a tyre with sidewall markings of 195/50 R16 84V.

2 Which descriptors differ between the following types of tyres:

a P195/65 R14 87H and P195/70 R14 87H

b P195/75 R14 85H and P195/75 R16 85H

c P205/75 R14 95S and P195/75 R14 95S.

Correct tyre pressure

Keeping the correct air pressure ensures your tyres last longer, saves fuel, enhances handling and prevents accidents. There is no set amount of pressure for a car's tyre. It depends on the car's size, the wheel's size and the temperature that the vehicle is kept in.

In Australia, we measure the pressure in our tyres in pounds per square inch (psi). You may also see measurements in kPa (kilopascals). The formula to convert kPa to psi is to divide the kPa value by 6.894.

Ensure that you check your tyres every second week as your tyres do lose pressure, slowly but surely, each day. A tyre will lose more pressure in warmer weather. This allows you to have less pressure in your tyres in cooler months (32 psi); however, in warmer months you should have more pressure (35 psi).

Up to 50% of tyres are worn out due to under-inflation. So a lot of tyres are wasted for no good reason. Also, a lot of extra petrol is wasted pushing cars around on under-inflated tyres. So, a small thing like maintaining correct pressure in our car tyres really does help minimise the environmental consequences of car travel.

3 Find the amount of pressure in psi in the following tyres to the nearest whole number.

a 250 kPa **b** 350 kPa **c** 400 kPa

4 Find the amount of pressure in kPa in the following tyres to the nearest whole number.

a 30 psi **b** 34 psi **c** 35 psi

5 Investigate the causes of tread wear.

6 What are the signs to look for that indicate that you should replace your tyres?

Environmentally, the disposal of old car tyres is a concern.

7 Investigate the extent to which used car tyres are recycled.

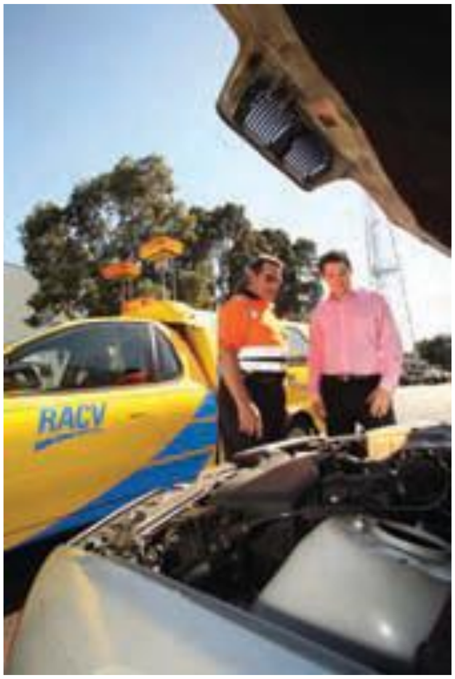
8 What happens to the tyres that are not able to be recycled?

9 What is the environmental effect of this?

PROJECT 2

Car safety

If a car is not roadworthy, legally it is not permitted on the road. If the police inspect your car and deem it not roadworthy, you have 14 days to fix the problem, or your car is not allowed on the road.



1 Investigate the list of requirements that need to be passed if your car is deemed to be roadworthy.

2 Research the locations and companies that can conduct these tests.

3 How much do they cost?

4 How long does a certificate last?

Modern cars now have safety features that help you prevent being involved in accidents and help keep you safe when you are involved in one.

5 a What are active safety features?

b How does an antilock braking system (ABS) help prevent accidents?

c How does electronic stability control (ESC) help prevent accidents?

6 a What are passive safety features?

b How do seatbelts help keep you safer when involved in an accident?

c How do airbags help keep you safer when involved in an accident?

d How do cargo barriers help keep you safer when involved in an accident?

7 What are some of the other features of modern cars that can help improve the driver's comfort, which in turn helps keep them alert?

Cars are grouped into sizes for comparison.

8 What are the measurements used to classify a car as either small, medium or large?

Safety ratings assess how well cars protect the driver and passengers. When comparing cars it is important to compare cars of the same size and age. The Used Car Safety Ratings (UCSR) is a list compiled by Monash University's Accident Research Centre from over 3 million police-reported road crashes.

9 What are the crash safety ratings used by the UCSR?

10 What were the highest-rated small cars?

11 What are the highest-rated medium-size cars?

The Australian New Car Assessment Program (ANCAP) tests all new cars so that the buyers can easily compare new models.

12 Describe the types of tests that the ANCAP conduct on the cars.

13 Use the How safe is your car? weblink in your eBookPLUS to access the full technical ANCAP reports for three models of cars you are familiar with. Write a report outlining their safety features.

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Key skill 1 Speed

Digital doc
- Worksheet 6.1: apply your knowledge of speed
- Speed convertor: use a spreadsheet to convert speeds

Interactivity
- Gear ratios (int-0663): explore how the size of the gear affects the overall speed

eLesson
- Equations and formulae (eles-0009): learn how equations and formulae can help us compare the length of a rugby field and gridiron field

Key skill 2 Fractions and decimals

Digital doc
- Worksheet 6.2: apply your knowledge of equivalent fractions

Interactivity
- Fraction wall (int-0002): explore the relationships between fractions of $\frac{1}{6}$ or larger

Key skill 3 Measurement

Digital doc
- Worksheet 6.3: apply your knowledge of measurement

INVESTIGATION 3 BAC readings

Weblink
- TAC: www.tac.vic.gov.au/jsp/corporate/homepage/home.jsp

PROJECT 1 Purchasing a car

Weblink
- RACV: www.racv.com.au
- VicRoads: www.vicroads.vic.gov.au/Home/Registration/BuyingSelling/

Key skill 4 Fixed & variable

Digital doc
- Worksheet 6.4: apply your knowledge of fixed and variable

Key skill 5 Handling data

Digital doc
- Worksheet 6.5: apply your knowledge of handling data

eLesson
- Converting percentages (eles-0005): learn about percentages and how to work out your discount when you shop

INVESTIGATION 5 Crash statistics

Weblink
- Transport Accident Commission: www.tacsafety.com.au/jsp/statistics/reportingtool.do?areaID=12&tierID=1&navID=20&globalNavID=20

Key skill 6 Formulas

Digital doc
- Worksheet 6.6: apply your knowledge of formulas

Interactivities
- Tyre size and speed (int-0067): investigate the effects of tyre size on the speed of a car
- Friction as driving force (int-0054): explore the effects of friction on a car

eLesson
- Friction (eles-0032): explore the effects of friction on a car

PROJECT 2 Car safety

Weblink
- How safe is your car? www.howsafeisyourcar.com.au/index.php

CHAPTER REVIEW

Digital docs
- Word search swf (int-0654): search for the terms covered in this book
- crossword swf (int-0655): test your knowledge of the terms covered in this book
- puzzle page pdf: crack the code

Interactivity
- Test yourself (int-0656): take the end-of-chapter online multiple-choice quiz

ANSWERS

KEY SKILL 1 — Speed

1 **a** 240 cm **b** 6000 m **c** 46 cm **d** 120 m

2 210 cm, 6 m, 6100 mm, 0.8 km

3 **a** 80 km/h **b** 14 km/h **c** 250 km/h

4 **a** 2.8 m/s **b** 10 m/s **c** 2.2 m/s

5 **a** 0.44 s **b** 2.040 km **c** 2.9 s

INVESTIGATION 1 — Stopping distance

1

	Stopping distance at 90 km/h	Stopping distance at 120 km/h
1	Mercedes C36	Mercedes C36
2	Saab 9000 Aero	Saab 9000 Aero
3	Porsche 911 Carrera 4	Porsche 911 Carrera 4
4	Toyota Camry V6	Mazda MX-5
4	Audi A4	Audi A4
6	Mazda MX-5	Toyota Camry V6

Note: At 90 km/h, the Camry and the A4 have the same stopping distance.

2

Car	Difference in m	Difference in cm
Audi A4	37.2 m	3720 cm
Mazda MX-5	31.2 m	3120 cm
Mercedes C36	27 m	2700 cm

3 **a** 60 000 **b** 1000 **c** 16.7 **d** 8.3

4

Speed	m/h	m/min	m/s	m/0.5 s
10 km/h	10 000	$166.\dot{6}$	$2.\dot{7}$	$1.3\dot{8}$
40 km/h	40 000	$666.\dot{6}$	$11.\dot{1}$	$5.\dot{5}$
90 km/h	90 000	1500	25	12.5
100 km/h	100 000	$1666.\dot{6}$	$27.\dot{7}$	$13.\dot{8}$

5

Car	Stopping distance (m)	Reaction distance (m)	Total distance (m)
Saab Aero	36.6	12.5	49.1
Toyota Camry	43.5	12.5	56
Porsche 911	37.8	12.5	50.3

KEY SKILL 2 — Fractions and decimals

1 **a** 3 tens **b** 3 tenths **c** 3 thousandths

2 **a** 0.16 **b** 0.06 **c** 0.11

3 **a** 2 tens, 4 units, 6 tenths, 1 hundredth

b 1 ten, 3 units, 4 tenths, 0 hundredths, 9 thousandths

c 9 units, 2 tenths, 9 hundredths, 8 thousandths

4 **a** 25 **b** 13 **c** 9

5 $8.55

6 **a** 132.1 **b** 155.9 **c** 609.2

7 **a** 132 c **b** 123 c **c** 166 c

INVESTIGATION 2 — Converting units

1 **a** 6000 mL **b** 2100 mL **c** 900 mL

2 **a** 1.2 L **b** 0.8 L **c** 0.375 L

3 375 mL, 800 mL, 0.9 L, 1200 mL, 2.1 L, 6 L

4 315.364 km 5 236.79 miles 6 112.63 km/h

7 65 mph 8 14.51 gallons 9 24.635 L

10 **a** 46 mpg **b** 3.4 gallons

KEY SKILL 3 — Measurement

1 **a** 3750 cm^3 **b** 339.29 m^3 **c** 785.4 m^3 **d** 300 mm^3

2 2.4 m^3 3 **a** 29.5 m^2 **b** 10.5 m^3

INVESTIGATION 3 — BAC readings

2 5 hundredths

3

BAC reading	Hours to wait before driving
0.1	6.67
0.2	13.33
0.3	20
0.4	26.67
0.5	33.33

4 Approximately 17 hours

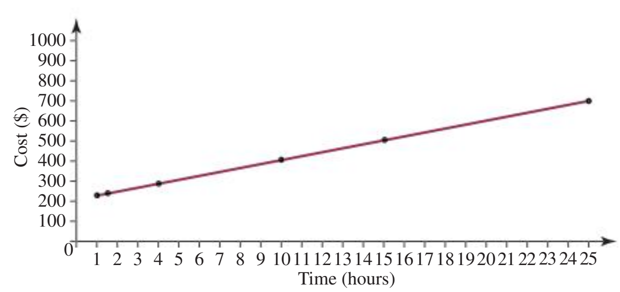
6 **b** 1.4 **c** 0.9 **d** 1.5 **e** 0.9 **f** 1.5 **g** 1.7

KEY SKILL 4 — Fixed & variable

1

Hours	Fixed	Variable	Total
1	$200	1 × $20 = $20	$200 + $20 = $220
1.5	$200	1.5 × $20 = $30	$200 + $30 = $230
4	$200	4 × $20 = $80	$200 + $80 = $280
10	$200	10 × $20 = $200	$200 + $200 = $400
15	$200	15 × $20 = $300	$200 + $300 = $500
25	$200	25 × $20 = $500	$200 + $500 = $700

2



3 **a** $640 **b** 11 hours 4 1200 km

ANSWERS

INVESTIGATION 4 — Public versus private

1 Zones 1 and 2 Adult Metcard

a $5.80 b $10.60 c $49.60 d $169.00 e $1808.00

2 Zones 1 and 2 Adult Metcard (Prices are subject to change over time.)

a $3016.00 (2 tickets/day, 5 days/week, 52 weeks)

b $2756.00 c $2579.20 d $2028.00 e $1808.00

4 a i 2 minutes ii $1.67 iii $0.566/minute iv $6.17

b i 6 minutes ii $3.40

c Ashan has the cheaper trip.

6 $9 7 4 to 8 hours 8 $16 9 $73

KEY SKILL 5 — Handling data

1

Fraction	Decimal	Percentage
$\frac{45}{100}\left(\frac{9}{20}\right)$	0.45	45%
$\frac{3}{5}$	0.60	60%
$\frac{9}{100}$	0.09	9%
$\frac{25}{100}\left(\frac{1}{4}\right)$	0.25	25%
$\frac{80}{100}$	0.80	80%
$\frac{120}{100}\left(1\frac{1}{5}\right)$	1.2	120%
$\frac{50}{100}\left(\frac{1}{2}\right)$	0.50	50%

2 Make the denominator equal 100, and the numerator value will be the percentage value.

3 a 40% b 75% c 80%

4 a Place the percentage value in the numerator of a fraction where the denominator is 100. Simplify the fraction if possible.

b i $\frac{8}{25}$ ii $\frac{1}{5}$ iii $\frac{19}{20}$

5 9%. If 91% (or 91 out of 100) crashes involve males, the remaining 9 out of 100 (or 9%) must involve females.

6

Decimal	0.06	0.47	0.29	0.18
Fraction	$\frac{6}{100}\left(\frac{3}{50}\right)$	$\frac{47}{100}$	$\frac{29}{100}$	$\frac{18}{100}\left(\frac{9}{50}\right)$

Investigation 5 — Crash statistics

1 38% 2 a 0.82 b 18% c 6 am and 6 pm

3 0.40% 4 $\frac{1}{4}$, 25%, 0.25 5 32

6

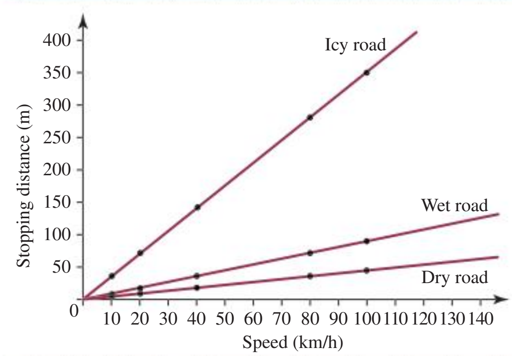
Day	Number of accidents	Percentage
Mon.	117	11.5%
Tues.	138	13.6%
Wed.	138	13.6%
Thurs.	117	11.5%
Fri.	166	16.3%
Sat.	186	18.3%
Sun.	154	15.2%
Total	1016	100%

KEY SKILL 6 — Formulas

1

	Braking distance (m)		
Speed (km/h)	Icy road	Wet road	Dry road
10	35	8.75	4.375
20	70	17.5	8.75
40	140	35	17.5
80	280	70	35
100	350	87.5	43.75

2



3

	Stopping distance (m)		
Speed (km/h)	Dry road	Wet road	Icy road
15	6.523	13.125	52.5
35	15.313	30.625	122.5
65	28.438	56.875	227.5
85	37.188	74.375	297.5

Answers using the graph may vary.

INVESTIGATION 6 — Tyres

1 Width of 195 mm, aspect ratio of 50%, radial, 16-inch wheel diameter, 84 load capacity index, maximum speed of 240 km/h

2 a Aspect ratio b Wheel diameter c Tyre width

3 a 36 psi b 51 psi c 58 psi

4 a 207 kPa b 234 kPa c 241 kPa

5 The major causes are emergency braking, incorrect tyre pressure and wheel misalignment.

6 Tread depth has reduced to 1.6 mm.

MATHS QUEST

VCE FOUNDATION MATHEMATICS

WATER WISE

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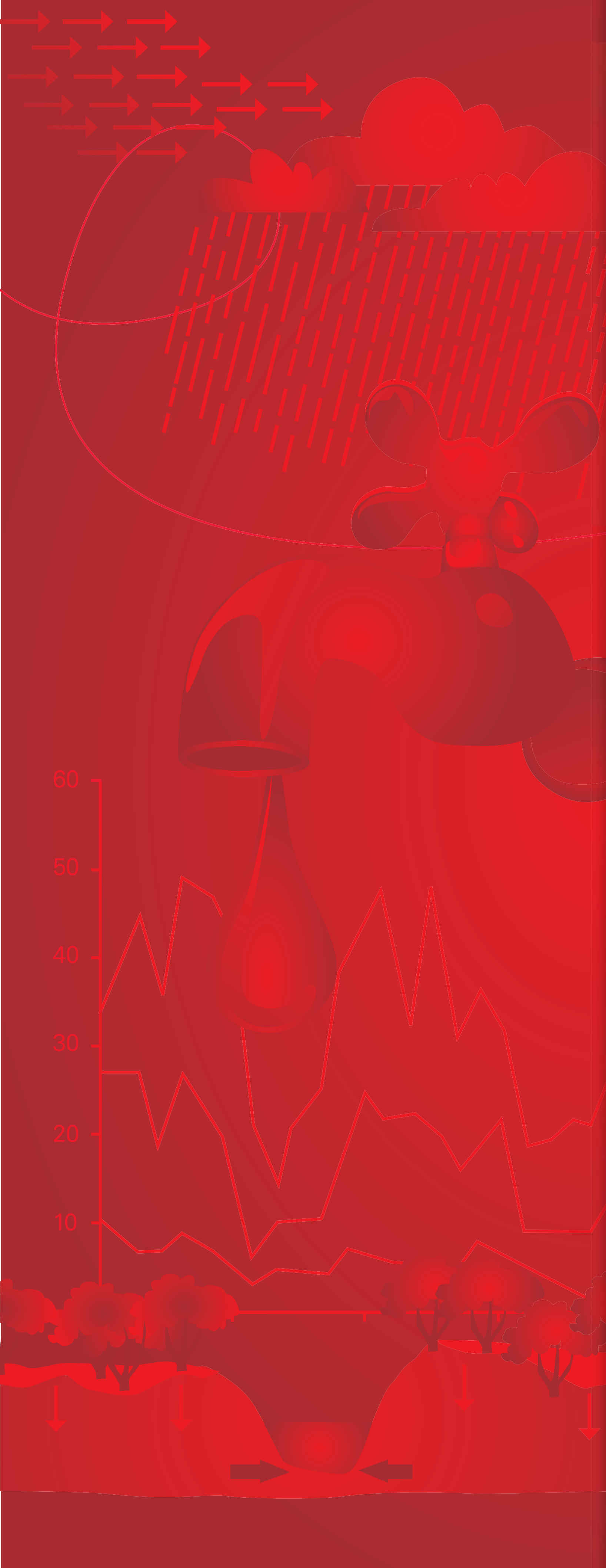


INTRODUCTION

Water wise

For much of its human history, Australia has been a predominantly dry continent. The need for fresh drinking water has shaped the cultures and patterns of migration and settlement throughout that time. Now more than ever the management of surface and underground water — in a way that keeps the quantity and quality as high as possible — is dependent on how well we monitor our water catchments. The mathematics of measurement has a key part to play in effective water-supply management for all Australians and their environment.

contents

KEY SKILL 1

Percentage changes

TAKE A LOOK BACK AT **BOOK 1, PP. 8, 9, 10**

You may have heard that Melbourne is rated as one of the most liveable cities in the world. One of the reasons that Melbourne has this reputation is that its water is so good. Up until recent times, the quantity of good-quality water was considered more than adequate for our needs, but we are starting to realise that it may not always be so. The growing population of Melbourne, and that of other large Australian cities, means that we need to plan for our future needs now in order to maintain a reliable supply of clean water. Mathematics has a big role to play in these plans.

WORKED EXAMPLE 1

In 2007, the Australian Bureau of Statistics put the population of Greater Melbourne at 3 805 000 people. It is predicted that by the year 2056, the population could be more like 6 789 000! What is the total percentage increase?

THINK	WRITE
First find the increase in the actual number of people.	$6\,789\,000 - 3\,805\,000 = 2\,984\,000$
Express this total increase as a number 'out of' (divided by) the original number.	$2\,984\,000 \div 3\,805\,000 = 0.7842$
To make this a percentage, multiply by 100.	$0.7842 \times 100 = 78.4\%$ (rounded to 78%)
Can this be summarised in a formula?	Percentage increase $= \dfrac{(\text{final number} - \text{original number})}{\text{original number}} \times 100$

WORKED EXAMPLE 2

Melbourne Water estimates that each person currently uses about 380 L/day. To help plan for a future where water will have to be used more wisely, a water-use reduction of at least 8% per person by the year 2050 is proposed. How much water is this?

THINK	WRITE
How much is 8% of 380?	8% of $380 = \dfrac{8}{100} \times 380 = 30.4$ L
What is the proposed amount of water use per person for 2050?	$380 - 30.4 = 349.6$ L/day
What is this rounded-off target for the year 2050?	By the year 2050, each person in Melbourne should be using about 350 L/day.
What is the formula for a new amount calculated from a percentage decrease?	New amount $=$ original amount $- \dfrac{(\text{percentage decrease} \times \text{original number})}{100}$

QUESTIONS

1 Shelley's rain gauge told her that in the first week of October her area received 10 mm of rainfall. In the second week, the total rainfall was 13 mm. What was the increase as a percentage?

$$\text{Percentage increase} = \frac{(\text{final number} - \text{original number})}{\text{original number}} \times 100$$

$$= \frac{(\ldots\ldots - \ldots\ldots)}{\ldots\ldots} \times \ldots\ldots$$

$$= \ldots\ldots$$

2 Leaving the tap running while he cleans his teeth, Gary uses 5 L of water. With the tap off, he uses 1.5 L. How much less, as a percentage, does Gary use when he is 'water wise' and turns the tap off? (*Hint:* Have a close look at the formula below and note how it differs slightly from that for a percentage increase.)

$$\text{Percentage decrease} = \frac{(\text{original number} - \text{final number})}{\text{original number}} \times 100$$

$$= \frac{(\ldots\ldots - \ldots\ldots)}{\ldots\ldots} \times \ldots\ldots$$

$$= \ldots\ldots$$

3 Donna and Chris already have a 2000-L rainwater tank but intend to install a 1500-L tank next to it. What will be the percentage increase in their possible rainwater storage with the two tanks combined?

4 Ahmet is going to buy a new washing machine. His old top-loader uses 170 L per wash. A new front-loader of a similar size uses 80 L per wash. What would be the percentage water saving with the new machine? (Answer to the nearest whole number.)

5 In the 1990s, the average water use in Melbourne during spring was 1246 megalitres (1246 ML). So far, the average water use in spring since 2003 is 9% less, so we are doing better. How much better? Express the answer in megalitres. (Answer to the nearest whole number.)

6 In August of 2008, Melbourne users consumed an average of 998 ML/day. They used 5% more in the next month. How much water (in ML) was used in September 2008? (*Hint:* This is an increase, not a decrease.)

INVESTIGATION 1

Melbourne water

Most of Melbourne's fresh drinking water comes from uninhabited mountain-ash forests that are closed to the public. With more than 157 000 hectares reserved for the purpose of collecting clean water, Melbourne is one of about five cities in the world that has such protected catchments. Melbourne's water-supply system includes the catchments, storage reservoirs, large transfer mains (big pipes), local service reservoirs and water-treatment facilities. Melbourne Water manages nine major reservoirs that, when full, can provide Melbourne with 1 773 000 million litres (1 773 000 ML) of water.

Periods of drought and the expanding suburbs have put a great deal of pressure on Melbourne's water resources in recent times. Water tanks were once used only by people who were not connected to the water mains. Now people in even the innermost suburbs of Melbourne (and other big cities) are being encouraged to supplement their water supply with their own catchments (the roofs of their houses) and reservoirs (rainwater tanks).

Work through each part of this investigation, sourcing the information as advised, and gathering your data in the tables provided on the opposite page.

1 This first investigation will set the stage for the rest of this unit about water, so you will need to find out some initial facts from reliable sources (internet, textbook or your teacher).

2 Use the Melbourne's Water Supply weblink in your eBookPLUS to find the water reservoir nearest you. (If you don't live in Melbourne, just choose one from the map.)

3 Use the Water Supply Fact Sheet weblink in your eBookPLUS to find the capacity of this reservoir.

4 Use your knowledge of percentage calculations to work out what percentage of the total capacity of the water system is provided by the reservoir nearest you.

5 Use the Rainfall & River Level Data weblink in your eBookPLUS to find the name of the catchment that feeds your reservoir.

6 Click on your catchment on the map. What types of numerical information can you find out about the quantity of water being collected in your area? Select a station of any type that is close to where you live on your local catchment map.

7 Now try to find out how much rainwater you could collect in a rainwater tank. Use the Home Water Investigator weblink in your eBookPLUS to launch the investigator, and then follow the prompts until you get to the section that asks you your postcode. Enter your postcode, and the average annual rainfall for your area will appear. (If you don't live in Melbourne, use a postcode book to find a postcode of the area you chose earlier.)

Next you will need to know the area of your roof. You might be able to source this information from home, or you might use this as a guide (just choose one option): small roof area — 100 m^2, medium roof area — 150 m^2, large roof area — 200 m^2. Now you should be able to complete the table for part 7 of this investigation.

1 Some useful quantities.

Unit name	millilitres	litres	kilolitres	megalitres	gigalitres
Unit symbol	mL	L			
Equivalent litres	0.001	1			
Would be used to measure amount of water used …	in a single drink from a glass.		by a household in a week.		

2 Water reservoir nearest where I live:

3 Capacity of this reservoir:

4 Percentage of the total water-system capacity is provided by this reservoir (show your calculations here):

5 Catchment that feeds this reservoir:

6 Three types of numerical information I found out about this catchment:

7 Which rainwater water tank will I need? Choose a capacity that can cope with the maximum amount of rain that you are likely to get but is not too much more, because the cost might be too much for what you need.

My postcode	Annual rainfall	Maximum water collected = roof area × annual rainfall	Which size tank? Circle the best one.
			600 L 1000 L 1600 L 2250 L 3600 L 4500 L

KEY SKILL 2

Summary statistics

You will have heard weather reports where the rainfall for a particular month is 'above average' or 'below average'. What does that actually mean? The number quoted is calculated by adding all of the daily rainfall amounts and then dividing by the number of days in that month. This calculated value is often called the 'common average' or the mean, and it is just one of three numbers used to give an idea of the middle value in a set of data. The other two are called the median (the actual middle number when all of the values are put in numerical sequence) and the mode (the most commonly occurring value in the data set). The mean, the median and the mode are collectively called 'measures of central tendency'.

A rain gauge

WORKED EXAMPLE

The students in the Foundation Maths class were set the task of each timing their shower to get a feel for how much water they used. Here are the results (in minutes) in the order they were collected.

5 15 4 5 10 8 10 10 5 4 15 20 6 7 7 5 11 12 5 6 10 7 12 11

To be able to display and analyse this data, you first need to find the range, mean, median and mode.

THINK	WRITE
Arrange the numbers in ascending order, making sure all numbers are included in the list.	4 4 5 5 5 5 5 6 6 7 7 7 8 10 10 10 10 10 11 11 12 15 15 20
The range is the difference between the lowest value and the highest value in the set.	Range = 20 − 4 = 16 min
The mean (or common average) of this data set has to be calculated.	Mean = (4 + 4 + 5 + 5 + 5 + 5 + 5 + 6 + 6 + 7 + 7 + 7 + 8 + 10 + 10 + 10 + 10 + 11 + 11 + 12 + 12 + 15 + 15 + 20) ÷ 24 = 8.75 min
The median is the central value in the ordered list. In this case, there is no one central value, so the median is calculated as the mean (average) of the two central values.	Median = (7 + 8) ÷ 2 = 7.5 min
The mode is the value that occurs most often. In this case, there are two values that occur the most, so the data is said to be 'bimodal'.	Modes are 5 and 10 (both occur 5 times each, the most of any of the values).

QUESTIONS

1 Lyndall kept track of her water intake for a week, recording the number of standard glasses of water she drank each day. From this data, calculate her mean daily intake.

Day	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
Intake	4 glasses	5 glasses	8 glasses	6 glasses	6 glasses	7 glasses	5 glasses

Mean daily water intake = (4 + ...) ÷ .... = ... glasses per day.

2 Polly recorded the rainfall for three weeks using her rain gauge. Here are the readings (in mm). Circle the readings that represent the modal value.

3	0	5	3	1	1	1	2	0	8	13	4	2	1	1	2	4	6	10	0	1

3 Put all the rest of Polly's readings in numerical order in the table below and circle the median value.

0	0																			

4 Here are two data sets of temperatures (all in °C) of two different days in Alice Springs. Calculate the range and average (mean) for each.

Time	6:00 am	12:00 pm	6:00 pm	12:00 am	Range (°C)	Average (mean) (°C)
3 January	5 °C	26 °C	37 °C	2 °C	37 – .... = ...	(..........) ÷ .... = ...
14 April	8 °C	27 °C	24 °C	9 °C		

Which of these two calculated results is the more meaningful for comparing how pleasant the temperatures were on the two days? Explain your answer.

5 Leon and Amanda wanted to calculate the average amount per month they spent on water. Here are the four water bills for the year (they got a bill every quarter): \$56.84, \$48.20, \$39.56 and \$42.44. Work out the monthly mean, showing all of your calculations.

INVESTIGATION 2

The rainfall archive

During the course of this investigation you will study Melbourne Water's rainfall archive, which is a huge bank of rainfall data collected on a monthly basis across Melbourne's suburbs. You will use this data bank to select your own data set and conduct your own data analysis based on your specific area of interest.

To get started, use the Rainfall & River Level Data weblink in your eBookPLUS to refresh your memory about the catchments by running the cursor over the map on this page, and then click on the link 'Where our rain falls'. Have a look at the coloured rainfall map. What do you notice about the distribution of rainfall? How is this related to the location of the big catchments and reservoirs?

Use the Rainfall Around Melbourne weblink in your eBookPLUS to look at the average rainfall so far this month for many recording stations around Melbourne. Use the Rainfall Archive weblink to choose a time period to investigate and understand what information is given.

You will find that the average rainfall for many different rain-gauge sites around Melbourne is given in monthly periods for the last five or so years. There is an enormous amount of data here for you to choose from, and your task is to design an investigation into one aspect of this rainfall record. To do this, you need to set yourself a topic question. Here are some examples:

- How has the average rainfall for Craigeburn in the month of October changed over the last 5 years?
- Which part of Melbourne — north, south, east or west — has been most affected by drought?
- Which part of Melbourne — north, south, east or west — had the most variable average rainfall during the course of one year? Was this the same situation the next year?

After some discussion, you should be able to come up with your own topic to investigate. Ask your teacher to check the validity of your topic question before collecting the data from the archive. Use the page opposite to tabulate your results and graph your selected data. You should then comment on your results in a meaningful way.

Notes

1 You may also need a map of Melbourne showing suburbs (a street directory or a street directory website should help).

2 Some of the archive averages do not cover a complete month. You will need to discuss with your teacher how to overcome this problem if you wish to use this data.

3 The rainfall recording stations have changed over the years — make sure you check that the place(s) you wish to use has (have) records for all of the months and years you wish to include in your study.

4 There are earlier records available but they are part of an archive in which weekly (rather than monthly) averages are detailed. If you wish to explore this archive, use the Weekly Water Update Archives weblink in your eBookPLUS.

The rainfall archive

The Topic Question:

My data extracted from the rainfall archive:

Graph(s):

Comments (data analysis):

KEY SKILL 3

The water bill

We pay for water that arrives at our house through the mains system. In addition, we pay for the upkeep of the pipes that bring the water in, we pay for the system that takes excess rainwater (stormwater drainage) from our property and our roads, and we pay for the sewerage system that takes away all of the greywater (soapy water from washing) and blackwater (the waste from our toilets). All of these charges should appear on your water bill, which usually arrives after an official meter-reader from the water company reads your water meter.

WORKED EXAMPLE 1

Bob and Lena's water bill for the period 29 November to 4 March came to $158.58. The price of the water used was $52.73. The rest was for other fixed charges. What percentage of the total cost was for water usage?

THINK	WRITE
$52.73 out of $158.58 was for the water used. This fraction can be calculated as a decimal.	$\frac{52.73}{158.58}$ $= 52.73 \div 158.58$ $= 0.33$
Multiply this by 100 to express it as a percentage.	$0.33 \times 100 = 33\%$

WORKED EXAMPLE 2

For this billing period, Bob and Lena's household used 59 kL (59 000 L). a **On average, how many kilolitres did they use in a day?** b **What was the daily cost of this water?**

THINK	WRITE
a Find how many days there are from 29 November to 4 March. Assume that the new year is not a leap year.	2 Nov. days + 31 Dec. days + 31 Jan. days + 28 Feb. days + 4 Mar. days = 96 days
Divide the amount of water used up evenly between the days.	59 kL ÷ 96 days = 0.615 kL/day = 0.615 × 1000 L = 615 L/day.
b The cost is spread over the 96 days also. Divide the cost by 96.	$52.73 ÷ 96 days = $0.55 = 55 cents per day.

QUESTIONS

1 The sewage-disposal charge is calculated by multiplying the water usage (59 kL) by a seasonal factor (0.6158) and a discharge factor (0.900) to get the sewage volume. This number is then applied to the price per kL, which in Bob and Lena's case was $1.10. Calculate the sewage charge for this bill.

59 × .... × .... = ... kL sewage

.... kL .... $1.10 = $ .... for sewage disposal

2 Now that you have calculated the sewage-disposal charge, calculate the percentage of the total bill ($158.58) that sewage disposal accounted for.

.... ÷ .... × .... = ... %

3 Now that you know the total bill amount, the water-usage amount and the sewage-disposal amount, work out the amount for the fixed charges that everyone has to pay.

4 If Bob and Lena wanted to reduce the costs on their next water bill, which part of the bill can they directly affect by their actions? Which one would be indirectly affected by their actions? Which one could they do nothing about? Comment on all three.

5 Useful information that came with Bob and Lena's bill tells them that they have used an average of 615 L/day, whereas a typical amount for their household should be about 372 L/day, and a really efficient household should use only 291 L/day. Calculate the percentage reduction they would need to make for each of these two targets.

6 The cost for water usage is step-priced, which helps to encourage people to use less water. What this means is that you pay so much per kilolitre for the first step up to a certain volume, and then you pay a higher rate over this volume. In Bob and Lena's case, the first step is $0.817/kL up to 42 kL. If their total water usage was 59 kL, how much water was paid for at the higher price?

7 For the volume of water over 42 kL, Bob and Lena pay $0.9992/kL. How much did this water cost?

INVESTIGATION 3

Water use at home

It is very easy to use more water than we actually need, and it is just as easy to cut down on water use by using less and by collecting and re-using some water. By using water more wisely, you not only put less pressure on a precious resource but also save quite a bit of money for your household as well.

To start yourself thinking about where water is used and how it can be saved, fill out this table for the rooms and outdoor areas of your house where you use water. Come up with some ideas as to how you could cut down on water or re-use the water in these places.

Room or area	Uses of water in this place	Ways of saving or re-using this water

You can get a rough idea of how much water your family uses by completing a survey at home and putting the answers into Melbourne Water's Home Water Investigator.

1 Use the Household Survey weblink in your eBookPLUS to print the survey out and take it home and complete the questions. You might need to get some help from a parent for some of the questions.

2 Once you have the survey completed, use the Home Water Investigator weblink in your eBookPLUS to launch the investigator, and follow the prompts until you have entered all of your survey data into the investigator. You can watch the litres of water (red tap icon) and sewage (green toilet icon) adding up in the bottom left-hand corner!

3 At the end, you will be asked if you want to save your data (which you should do). Click on 'reports' to see a graphical representation of your water-usage data, sewage contribution and some other useful information. You can print these out if you wish.

4 After looking at the reports, write some comments here about the results.

PROJECT 1

Water wise

Now that you have familiarised yourself with your home water use, you are in a good position to try out some water-saving measures. You are to design an experiment that involves 1–3 strategies for using less water, or re-using water in a safe way (obviously there is some water which is too contaminated to re-use).

For some initial ideas, you could visit the Melbourne Water website again, or other reliable sites, or you could discuss some ideas with classmates, teachers or parents. If your proposed experiment could involve reading your water meter, the eBook has the URLs of some background activities to do. Because this is an experiment, you should report on it as you would in Science. You should first show your proposal (below) to your teacher and an adult at home and have it approved before you start.

My proposal (a brief outline of my experiment):

Approved by teacher: .... Approved at home: ....

Aim: What I am trying to do is: ....

Materials and time needed: ....

Method: The details of how I carried out this experiment are: ....

Results: Below is a table and a graph of my records:

Discussion: My results show:

Difficulties I had:

Feasibility of maintaining these water-saving methods:

Conclusion: In summary,

KEY SKILL 4

Water quality

TAKE A LOOK BACK AT **BOOK 1, PP. 7, 8, 9, 10**

When viewed from space, Earth seems very much a 'planet of water', but — as you will already know — most of that water is not suitable for drinking by humans because it contains too much salt. The oceans contain 97% of the water on Earth, while 2% is frozen as ice on the tops of mountains, at the poles and in glaciers. The 1% that is left is considered fresh water and is found in lakes, rivers, swamps and underground aquifers, but only a small portion of that is suitable for us to drink. We need to keep the quality of our fresh water as high as possible because there is so little of it! This is made even clearer when the percentages are shown on a pie graph.

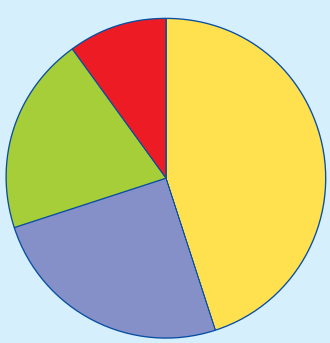
WORKED EXAMPLE 1

How many degrees does 1% represent?

THINK	WRITE
How many degrees in a circle?	$360°$
How many degrees do I need to draw to represent 1%?	1% of $360°$ $= \frac{1}{100} \times 360$ $= 1 \div 100 \times 360$ $= 3.6°$

WORKED EXAMPLE 2

Interpret a pie graph.

THINK	WRITE
 Measure the angle of the red sector with a protractor.	The sector in a pie graph (36°) is measured out by using a protractor.
Find what percentage of 360° this angle is.	Percentage represented $= \frac{\text{measured angle}}{360} \times 100$ $= 36 \div 360 \times 100$ $= 10\%$

QUESTIONS

1 How many degrees would be needed to represent 66% in a pie graph?

66% of 360° = 66 ÷ .... × .... = ...°

2 What percentage of a pie graph is represented by a sector of 124° ?

Percentage represented = 124 ÷ .... × .... = ...%

3 If a pie graph shows sectors for percentage amounts of 13%, 48% and 7%, how much is left?

....

....

4 A pie graph is drawn accurately with sectors of 74°, 181° and 53°. What is the angle of the sector of pie left?

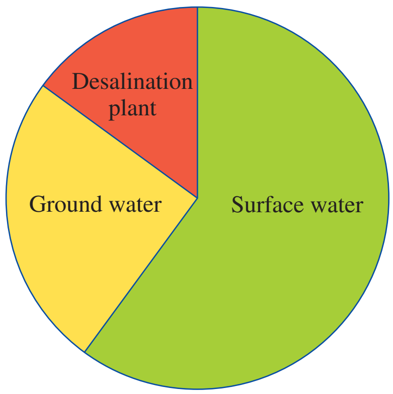
....

....

5 Construct a pie graph (using your compass and protractor) from the percentages shown in this table.

Season	% of total rainfall for the year
Summer	15%
Autumn	33%
Winter	22%
Spring	30%

6 Fill out the table with the percentages represented in this pie graph. Use your protractor to measure angles.



Water sources for South Australia in 2001	% out of total 524 GL supplied to mains
Surface water	
Ground water	
Desalination plants	

INVESTIGATION 4

A poster-sized graph

After discussion with your teacher and other members of the class, decide on a topic to investigate that bears some relationship to water in the Australian environment. Your topic needs to be one for which statistical information is available on the internet (or other sources) and that you can present in a pie graph.

Here are some starting points and suggestions:

- How healthy are the rivers in one of our catchments?
- How much of our water supply is provided by different sources?
- Where does our storm water go?
- Underground water resources in Australia.
- Water recycling in our home or school.

Organisations with websites that might be useful include the Australian Bureau of Statistics, the Bureau of Meteorology, your local (state, city or rural) water authority, CSIRO, and other environmental bodies (such as state departments of the environment).

Once you have established that you can find statistics for your chosen topic, and your teacher has approved it, gather your data and tabulate it. Convert any raw data into percentages (if it is not already expressed in percentages), and then calculate the angles needed to draw your pie chart.

In the space provided on the opposite page, do a sketch plan of your poster, complete with heading, sketch of your pie graph, key and a brief explanation of what the pie graph is demonstrating. It may be necessary to include maps or other graphical information to make your poster clear and informative. In any case, you should add to its impact by including a few other well-chosen and relevant illustrations, the position of which can be shown on your plan.

Finally, make your poster. The pie graph should be big, bold and colourful. Your circle could be traced around a dinner plate, or something similar. Make sure you use a protractor and ruler to construct the sectors neatly. Colour and label the sectors and include a key. Complete the poster with the other items that you included in your plan.

Plan your pie graph poster in this space.

KEY SKILL 5

Reading scales and graphs

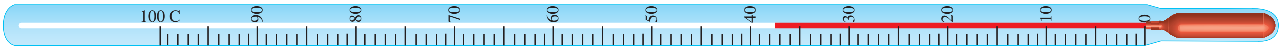
So far in this unit we have been concerned with the quantities (amounts) of water we need in our everyday lives. How clean and pure the water is (i.e. its quality) is also of vital concern for suppliers and users, and that is why catchments (which include creeks and rivers) must be kept in good condition. Throughout catchment areas, water samples are regularly tested for 'water-quality indicators' such as:

- water temperature
- dissolved oxygen
- salinity (salt content)
- pH level
- nitrate, ammonia, nitrogen and phosphorus levels (nutrients for algal growth)
- bacteria concentrations
- metals (including copper, lead, nickel and zinc).

A biologist checks oxygen levels in a stream.

WORKED EXAMPLE

What temperature is shown on this thermometer?



THINK	WRITE
The temperature shown is represented between which two divisions labelled with numbers?	Reading between = highest number – lowest number = 40 – 30 = 10 °C
How many smaller divisions are marked between the two numbers?	There are 10 divisions between 30 °C and 40 °C.
What is the value of each smaller marked division?	Value of small division = value between numbered divisions ÷ number of small divisions = 10 °C ÷ 10 = 1 °C for each small marked division
Can I be even more accurate by reading in between two small marks?	Yes, it is possible to estimate the reading halfway between two small divisions, that is, 0.5 °C.
What is the temperature reading shown on the scale?	The reading is: 30 + 7 + 0.5 = 37.5 °C.

QUESTIONS

1 Two consecutive numbered divisions on an electrical meter are 24 and 28. What is the value of the amount between numbered divisions?

Amount between = highest number – lowest number = ... – .... = ...

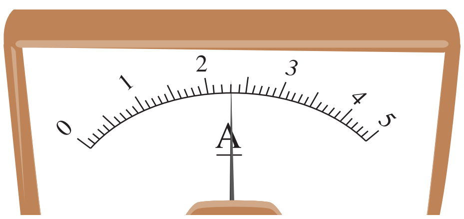
2 There are eight smaller divisions between the numbered marks in the previous question. What is their value?

Value of small division = value between numbered divisions ÷ number of small divisions

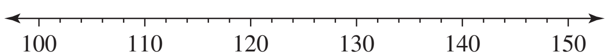
= .... ÷ .... = ... for each small marked division

3 What is the reading on this ammeter?

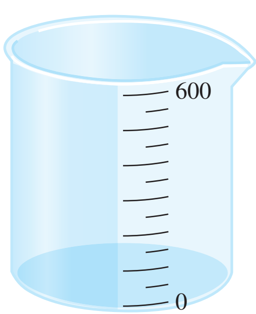
.... A + ... A = ... A



4 A water test revealed that a sample contained 135 ppm (parts per million) of a certain chemical. Show where this reading would plot on this scale.

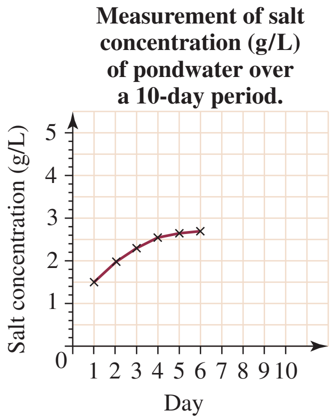


5 A glass beaker can be used for approximate measures. Put some other major divisions on this beaker and then show on the diagram where the level of water would be for approximately 250 mL.



6 Here is a graph showing the salt concentration of a shallow, saltwater pool over 6 days. The next 4 daily readings are in and need to be added to the graph. Add these points to a graph.

Day	7	8	9	10
Salt concentration (g/L)	3.52	4.20	4.67	4.56



INVESTIGATION 5

Measuring salinity

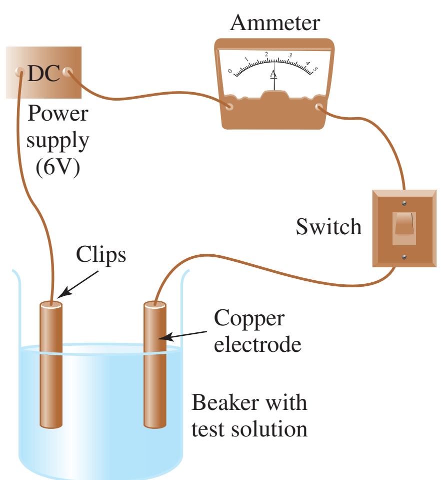
Australia has huge reserves of water stored naturally underground in porous rock layers called aquifers. This water (called ground water) is used in various ways, but the salt content varies. While humans cannot tolerate much salt in their drinking water, some farm animals and crops can, making ground water a useful addition to water supplies for agricultural and horticultural purposes.

If water pumped from underground is to be used, it is important to know the salt content so that it is not harmful to the living things that are consuming it. One of the easiest ways to measure this is by electrical conductivity — the more salt in the water, the more electrical current can pass through it. A simple electrical current device called an EC meter can be made in the school science laboratory, and once it is tested and calibrated, it can be used to test your local water supply. Your school may have a ready-made apparatus with which to do this, but is it easy to make your own in the science laboratory.

Building an EC meter

YOU WILL NEED

a DC power supply, two copper electrodes, an ammeter (0–5 A), wires, a switch, a clean 250 mL beaker, pure distilled water in a squirt bottle, 5 clean 1-L water bottles, table salt, an electronic balance, 4 small pieces of clean paper (about quarter A4), clean drinking water from the cold tap



WHAT TO DO

Set up the apparatus as shown in the diagram and test it with one of your prepared solutions (see the next section) to make sure you get a reading. Then turn off the power supply and rinse the electrodes and beaker with squirts of distilled water.

Here are some salt solutions you can make up that simulate those that can be used for consumption by humans, animals and crops.

Salt added (g/L)	0	0.48	1.5	6.0	17.0
Suitability	Good for humans and all farming uses.	OK for humans, but can taste salty. Fine for crops and livestock.	Suitable for livestock and some plants.	Not suitable for most crops, pigs or chickens.	Can only be tolerated by sheep and beef cattle.

1 For your first solution, fill a bottle about halfway with water.

2 Put a piece of paper on the electronic balance, zero the balance, and then weigh out 0.48 g of salt.

3 Carefully lift the paper off the balance, bend it up, and pour the salt into the bottle of water.

4 Fill the remainder of the bottle to near the top, put on the lid, and gently mix all the salt in by inverting the bottle several times.

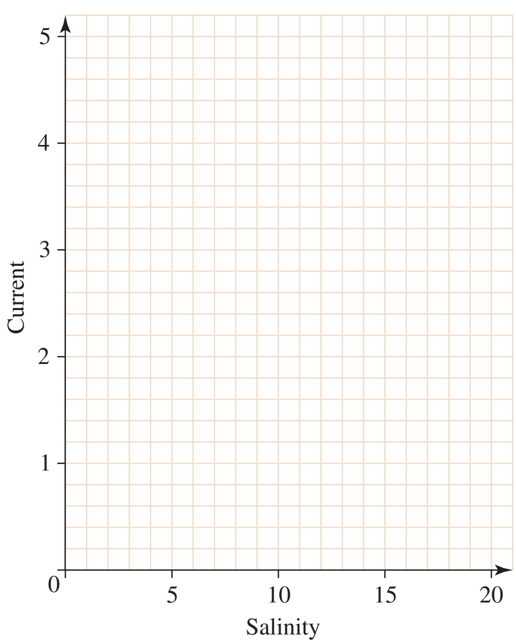
5 Label the bottle according to the first entry in the table.

6 Repeat this process for the other 3 salt solutions.

7 Fill the last bottle with water from the tap without adding any salt.

Once you have obtained or built your EC meter, you should be able to test these solutions. Each time you need to be sure to make the test fair, so consider how to keep these things the same each time: the amount of solution in the beaker, the depth to which the electrodes are immersed, the distance between the electrodes, and the voltage (6 V is recommended).

Record your current readings for each solution tested in a suitable table, and then make a line graph. Salinity (g/L) should be on the horizontal axis (the *x*-axis), and current (A) on the vertical axis (the *y*-axis).



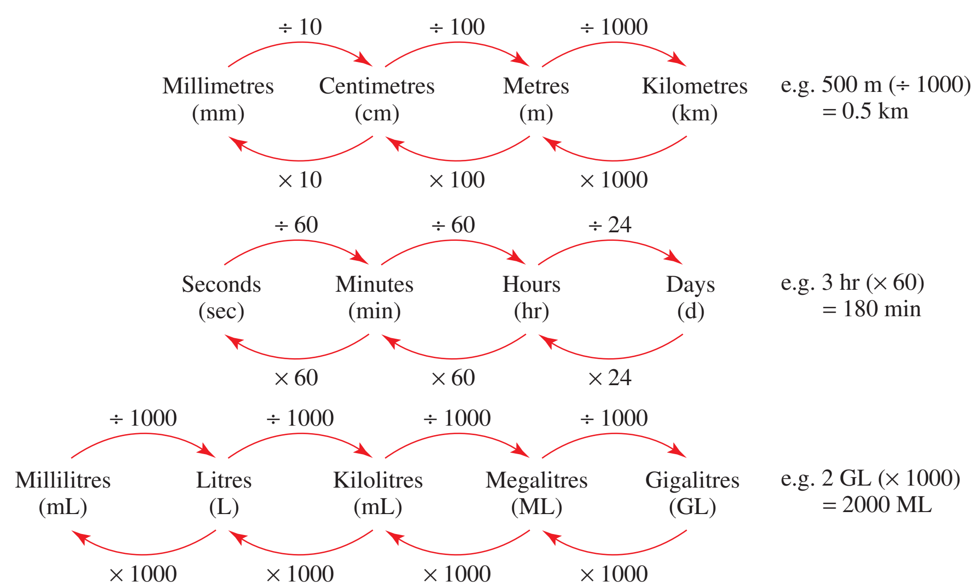
Now you are ready to obtain and test an unknown solution from your teacher or sample some water from local water bodies that you have access to (dam, creek, bore or rainwater tank). You can use your graph to read off the salinity once you know the current.

KEY SKILL 6

Flow rates

TAKE A LOOK BACK AT **BOOK 1, PP. 6, 16**

The speed at which water is allowed to move can affect its health. For example, a creek or river that flows freely is constantly exchanging gases with the atmosphere. This keeps the water oxygenated, which makes it healthy for aquatic animals. On the other hand, unusually violent movement (as in times of flood) can result in unusually high levels of mud from river banks, clouding the water and cutting out normal levels of sunlight that aquatic plants need. Ground water seeping slowly through rocks that contain soluble minerals (such as salt) can create natural mineral water, or it can pick up dangerous contaminants if it moves through poorly controlled landfill or mining waste. In contrast, rocks, sediments, soils and swamps can filter out some chemicals and germs, which results in the purification of water from one site to another. How fast water moves through soil, rock, river courses and caves and over waterfalls is one of the things that can be measured to assess the quality of a water body, and help predict the future health of a whole catchment system.



For this skill, these charts will be helpful.

$\text{Speed} = \dfrac{\text{distance}}{\text{time}}$ $\qquad$ Distance = speed × time $\qquad$ $\text{Time} = \dfrac{\text{distance}}{\text{speed}}$

WORKED EXAMPLE

A floating marker took 90 seconds to float downstream from one bridge to another, a distance of 800 m, during a flood.

a What was the speed of the river current in metres per second?
b What is the speed expressed in kilometres per hour?

THINK	WRITE
a The formula for speed is: speed = distance ÷ time.	Speed = 800 m ÷ 90 s = 8.89 m/s
b To convert metres to kilometres, divide by 1000 (using the chart above).	800 m ÷ 1000 = 0.8 km
To convert seconds to hours, divide by 60, and then divide by 60 again.	90 s ÷ 60 ÷ 60 = 0.025 h
Put these converted numbers into the speed formula.	Speed = distance ÷ time = 0.8 km ÷ 0.025 h = 32 km/h

QUESTIONS

1 Kingfisher Creek winds is way across Melvin's bottom paddock for 563 m. If it takes the water 27 min to float a marker down (without hitting any snags), how fast is the water travelling (in cm/s)? Answer to the nearest whole number.

27 min = ... × .... s = 1620 s   563 m = 563 × .... = ... cm

Speed = ... cm ÷ .... s = ... cm/s

2 The rate at which rainwater seeped into poorly covered sandy soil was measured. It was found to have reached a depth of 58 cm in 2 days of constant rain. At what rate is the water penetrating (in mm/hr)? Answer to the nearest whole number.

58 cm = 58 × .... = ... mm   2 days = 2 × .... = ... hr

Speed = distance ÷ time = ... mm ÷ .... hr = ... mm/hr

3 Water pumped along 40 km of an irrigation channel at 5 m/s would take how much time (in hours) to travel the distance?

Distance = 40 km = ... m

Time = ... ÷ .... = ... s

.... s = ... ÷ .... ÷ .... = ... hr

4 Harriet put a bucket under her shower and turned it on full blast. It took 1 minute and 16 seconds to fill the 12 L bucket. What is the flow rate of the shower head on full? (*Hint:* Convert the time completely to seconds.) Answer correct to 2 decimal places.

5 How much water would Harriet use if she had a 4-min shower (from Question 14) with the water on full?

6 A fluorescent dye was put at the start of a cave system into water that had been previously measured as flowing at a rate of 10 m/day. If it took 3 days and 6 hours for the dye to appear at the natural spring where the cave water emerged from underground, how far was the route through the cave system that the water had travelled?

INVESTIGATION 6

Infiltration rates

The rate at which water infiltrates soil affects the type of plants that can be grown in it, the ease with which the soil can be eroded, how well the soil filters the water, and the distribution of minerals and nutrients within the soil profile. Therefore, it is useful to be able to measure the water infiltration rate of a soil as part of the assessment of its overall suitability for certain uses.

YOU WILL NEED

A few different soil samples, which could include pure sand and pure clay

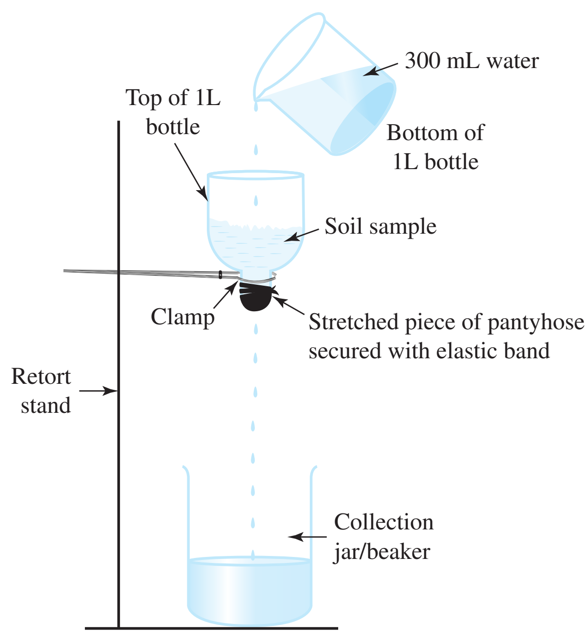
One large plastic soft-drink bottle per sample (all bottles must be the same)

One retort stand and clamp per bottle

A small piece of pantyhose and an elastic band for each bottle

One large beaker or jar per bottle

A large measuring cylinder



WHAT TO DO

Dry the soil samples you have obtained by spreading them out on trays or newspaper and leaving them in a dry place with no wind for a day or two.

Cut the bottom half off the soft-drink bottles and use the bottom halves for water storage.

Stretch a piece of pantyhose over the mouth of each bottle, securing the mesh tightly with an elastic band.

Invert the bottle tops and fill each one to the same level as the others with its own soil sample.

Use the measuring cylinder to measure out 300 mL of water into each of the bottle bottoms, which will hold the water until you are ready to pour.

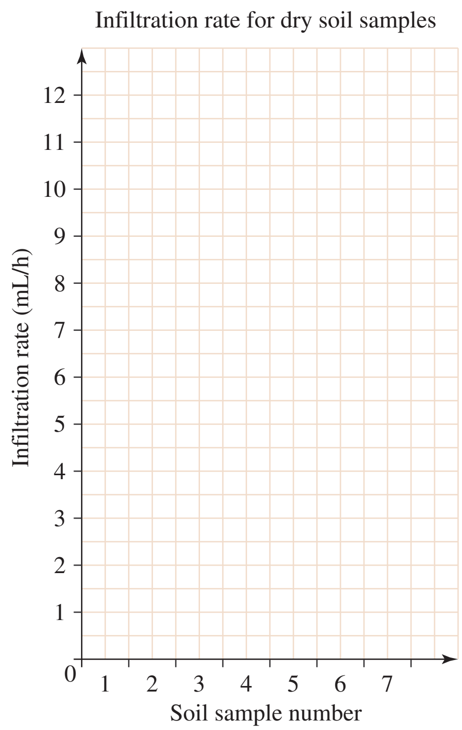
Note the time, and then quickly pour each of the water samples into a separate bottle.

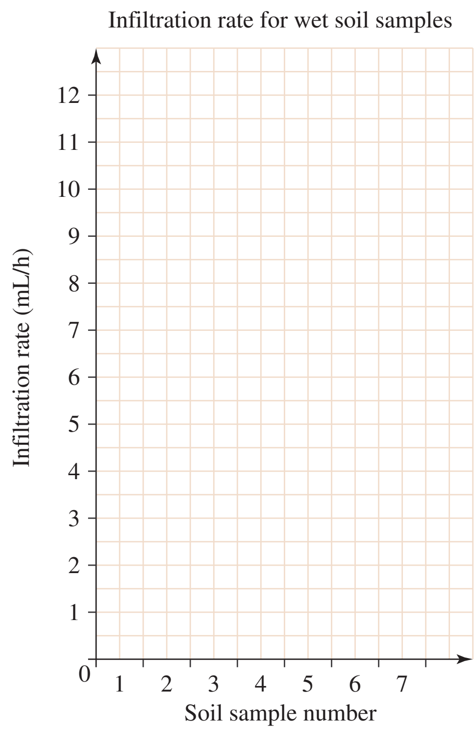
Leave the bottles to drain for an accurately measured amount of time (e.g. 10 minutes).

Remove the collection beakers all at once, and then use the measuring cylinder to accurately measure the yield of each soil, recording your results as you go in an appropriately constructed table recorded on the opposite page. (You may also wish to record the clarity of the water coming through each soil sample.)

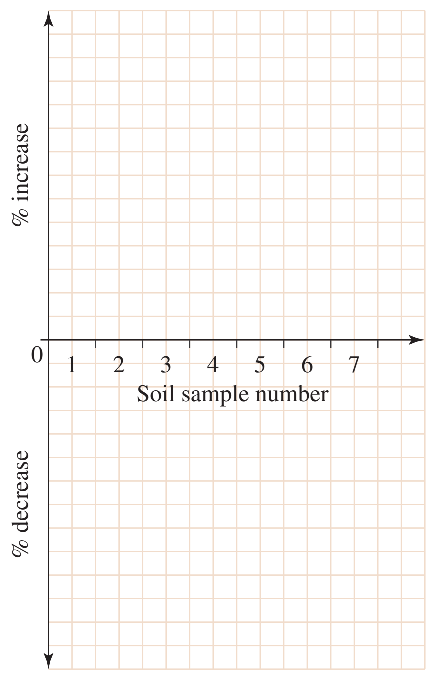
From these results, you should be able to calculate the infiltration rate for each soil type in mL/hr and construct a bar graph of your results.

As a follow-up, you could repeat the pouring of the 300 mL of water through the wet soils. The new data set could also be tabulated and graphed.





Finally, you could calculate the percentage increase or decrease in infiltration rate for each soil and graph this information to show which soil has its infiltration rate most affected by being already wet.



There are many other soil-infiltration tests you can try with this apparatus, including:

1. putting layers of different soils in the same bottle and varying the order in which the layers are put in
2. pouring water all at once versus pouring it in batches or sprinkling it slowly from a watering can
3. putting soil in loosely versus compacting the soil.

Choose one or invent your own to try. Use your calculation skills to compare infiltration rates for each test.

PROJECT 2

Our waterways

The single most effective action you can take to contribute to the health of our waterways is to prevent litter and other contaminants from entering the stormwater drains. This is true of the pipes that carry away water from city streets and also of the creeks, lakes and rivers that form the natural drainage pattern in rural areas.

With a small group of classmates, you are going to develop a project to investigate the contribution your school is making to the littering of local (and more distant) waterways.

Step 1 Your project will have several parts to it, and may include designing measurable ways of finding out things such as:

a which type of litter is the most common

b which type of litter is most likely to enter the stormwater drains

c how quickly each type of litter is most likely to enter the stormwater drains

d the locations of drains and which ones are most likely to receive litter (i.e. distances to litter sources)

e water flow rates needed to move certain litter types

f water flow rates into particular drains (which might vary due to slope, material over which water flows etc.).

There are many other considerations that you could discuss and list.

Step 2 You will need to discuss ways in which you could enlist the help of other people in the school (for example, asking them not to interfere with specially marked pieces of litter that you are tracking over several days) and how you will measure movements, rates and amounts of water and litter.

Step 3 Do an initial spot survey around your school to help you with your ideas and your planning. Take notes or digital photographs as you go, to help refine your ideas.

Step 4 Write a proposal for your project here, and include a statement of the aim of your project (which will give a clear indication of what you are specifically trying to find out). Include in your proposal equipment you will need, where you will source it from and for how long it will be needed. Then give enough detail about how the investigation will be carried out for your teacher to clearly understand what you propose to do.

Step 5 Carry out your investigation, collecting notes, images (which might include video footage) and measurements as you go.

Step 6 Present your results in a way that is colourful, meaningful and mathematical, using images, words and graphs.

Proposal for our project

Project title:

Aim:

Equipment needed:

Proposed method:

Mathematics will be used in these ways:

eBookplus ACTIVITIES

Key skill 1 Percentage changes

Digital doc

- Worksheet 7.1: apply your knowledge of percentage change

Investigation 1 Melbourne water

Weblinks

- Melbourne's water supply: http://education.melbournewater.com.au/content/secondary/water_supply.asp
- Water supply fact sheet: www.melbournewater.com.au/content/publications/fact_sheets/water/melbournes_water_supply_system.asp

Key skill 2 Summary statistics

Digital doc

- Worksheet 7.2: apply your knowledge of summary statistics

Investigation 2 The rainfall archive

eLesson

- The water cycle (eles-0062): learn about the water cycle

Weblink

- Rainfall & river level data: www.melbournewater.com.au/content/rivers_and_creeks/rainfall_and_river_level_data/rainfall_and_river_level_data.asp

Key skill 3 The water bill

Digital doc

- Worksheet 7.3: apply your knowledge of mathematics involved in creating a water bill

Weblink

Investigation 3 Water use at home

- Home water investigator: http://education.melbournewater.com.au/content/home_water_investigator/home_water_investigator.asp

Project 1 Water wise

Weblinks

- Rainfall around Melbourne: www.melbournewater.com.au/content/water/rainfall_data/rainfall_data.asp
- Rainfall archive: www.melbournewater.com.au/content/water/rainfall_data/rainfall_archive.asp
- Weekly water update archives: www.melbournewater.com.au/content/water/weekly_water_update/weekly_water_update_archives.asp
- Household survey: http://education.melbournewater.com.au/content/home_water_investigator/teacher_resources/resource_1.asp

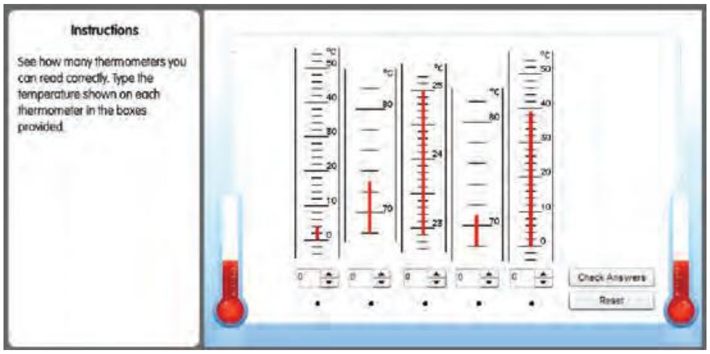
Key skill 4 Water quality

Digital doc

- Worksheet 7.4: apply your knowledge of mathematics in the analysis of water quality

eLessons

- Distillation (eles-0060): learn about the process of distillation
- Treating sewage (eles-0059): explore the process of treating sewage



Key skill 5 Reading scales and graphs

Digital doc

- Worksheet 7.5: apply your knowledge of reading scales and graphs

Interactivity

- Reading scales (int-0201): learn about percentages and how to work out your discount when you shop

Key skill 6 Flow rates

Digital doc

- Worksheet 7.6: apply your knowledge of the flow rates

Investigation 6 Infiltration rates

Interactivity

- Filtration (int-0223): explore the factors that influence the filtration rate

Project 2 Our waterways

Interactivity

- Threats to life (int-0218): learn about the facts that threaten our lives

CHAPTER REVIEW

Digital docs

- Word search swf (int-0657): search for the terms covered in this book
- crossword swf (int-0658): test your knowledge of the terms covered in this book
- puzzle page pdf: crack the code

Interactivity

- Test yourself (int-0659): take the end-of-chapter online multiple-choice quiz

ANSWERS

KEY SKILL 1 — Percentage changes

1. Percentage increase = $\frac{(13\text{ mm} - 10\text{ mm})}{10\text{ mm}} \times 100 = 30\%$
2. Percentage decrease = $\frac{(5\text{ mm} - 1.5\text{ mm})}{5\text{ mm}} \times 100 = 70\%$
3. 75% more (increase)
4. 53% less (decrease)
5. 9% of 1246 = $\frac{9 \times 1246}{100}$ = 112 ML less
6. New amount = 998 + $\frac{5 \times 998}{100}$ = 1048 ML

KEY SKILL 2 — Summary statistics

1. Mean = (4 + 5 + 8 + 6 + 6 + 7 + 5) ÷ 7 = 5.8 (or 6) glasses per day
2. All of the 1's should be circled.
3.

0	0	0	1	1	1	1	1	1	2	2	2	3	3	4	4	5	6	8	10	13	

↑

Median

4.

Time	Range (°C)	Average (mean) (°C)
3 January	37 – 2 = 35	(5 + 26 + 37 + 2) ÷ 4 = 17.5
14 April	27 – 8 = 19	(8 + 27 + 24 + 9) ÷ 4 = 17

The averages are almost the same, so this is not a good measure for comparison. The range shows that in January it gets unpleasantly hot during the day and unpleasantly cold at night, whereas the range in April shows that the temperature is much milder (more pleasant) throughout the 24 hours. Therefore the range is a better indicator.

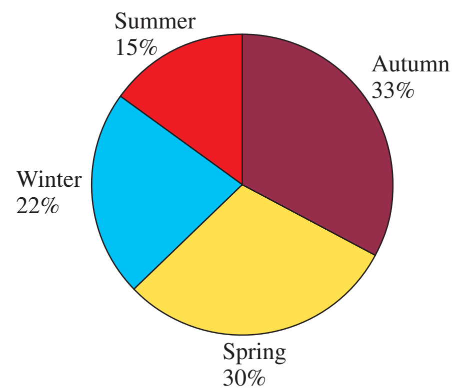
5. 56.84 + 48.20 + 39.56 + 42.44 = $187.04 for the year
   $187.04 ÷ 12 = $15.59 average per month

KEY SKILL 3 — The water bill

1. 59 × 0.6158 × 0.900 = 32.70 kL sewage
   32.69 kL × $1.10 = $35.97 for sewage disposal
2. $35.96 ÷ $158.58 × 100 = 22.68% (or 23%)
3. $158.58 – ($52.73 + $35.96) = $69.88 for other fixed charges
4. 'Water usage' will be directly affected, 'sewage disposal' will be indirectly affected and they can do nothing about the fixed additional charges.
5. To 372 L/day, % reduction = $\frac{(615 - 372)}{615} \times 100 = 39.5\%$ (or 40%)
   To 291 L/day, % reduction = $\frac{(615 - 291)}{615} \times 100 = 52.7\%$ (or 53%)
6. 59 – 42 = 17 kL
7. 17 × 0.9992 = $16.99

KEY SKILL 4 — Water quality

1. 66% of 360° = 66 ÷ 100 × 360 = 237.6°
2. Percentage represented = 124 ÷ 360 × 100 = 34.4%
3. 100 – (13 + 48 + 7) = 32% is left
4. 360 – (74 + 181 + 53) = 52° wedge of pie left
5.

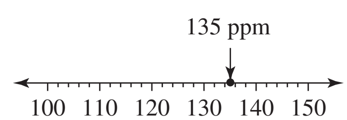


6. Answers here are approximate.

Water sources for South Australia in 2001	% out of total 524 GL supplied to mains
Surface water	60%
Groundwater	25%
Desalination plants	15%

KEY SKILL 5 — Reading scales and graphs

1. 28 – 24 = 4
2. Value of small division = 4 ÷ 8 = 0.5
3. 2 A + 0.3 A = 2.3 A
4.



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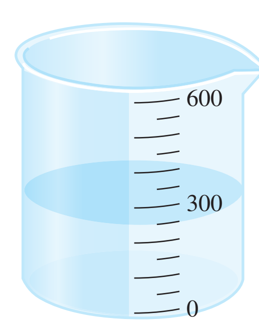
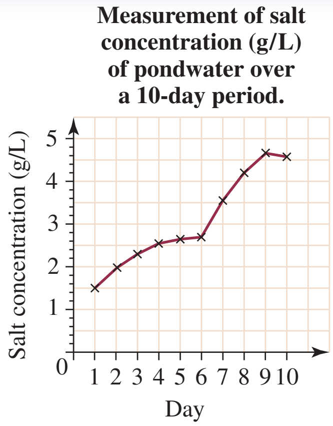


ANSWERS

6



KEY SKILL 6 — Flow rates

1 27 minutes = 27 × 60 = 1620 s

563 m = 563 × 100 = 56 300 cm

Speed = 56300 cm ÷ 1620 s = 35 cm/s

2 58 cm = 58 × 10 = 580 mm

2 days = 2 × 24 = 48 hours

Speed = distance ÷ time = 580 mm ÷ 48 hours = 12 mm/h

3 Distance = 40 km = 40 000 m

Time = distance ÷ speed = 8000 s

8000 ÷ 60 ÷ 60 = 2.2 hours

4 Flow rate = volume ÷ time = 12 L ÷ 76 s = 0.16 L/s (or 9.6 L/min)

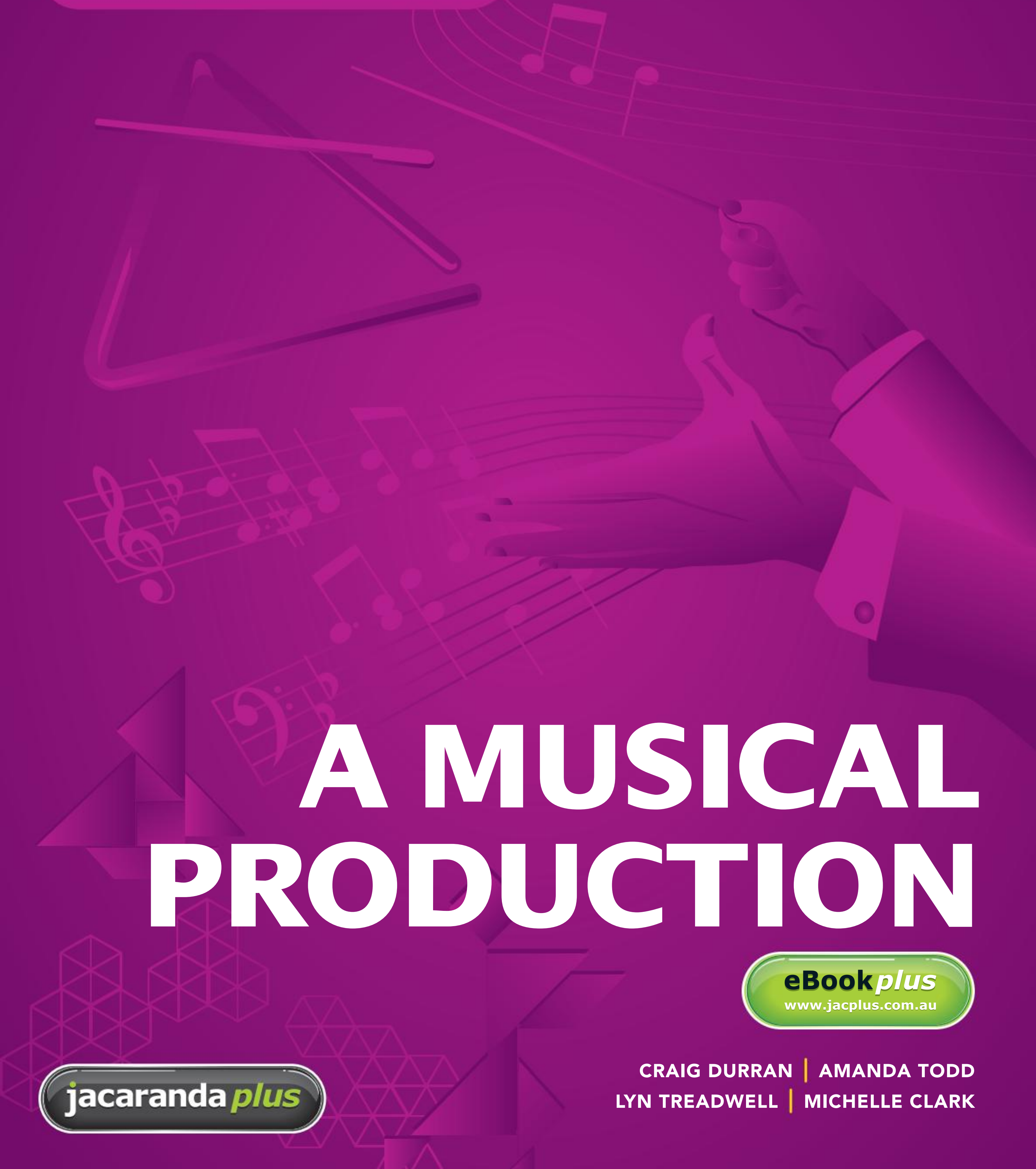
5 4 × 60 × 0.16 = 38.4 L

6 3 days 6 hours = 3.25 days

Distance = speed × time = 10 × 3.25 = 32.5 m

MATHS QUEST

VCE FOUNDATION MATHEMATICS



A MUSICAL PRODUCTION

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INTRODUCTION

A school musical

Anyone who has been involved in a stage production will know that the performance is only the tip of the iceberg of the total work involved. Even the most humble oral presentation for an English class can take weeks of planning, preparation, rehearsal, assembling of materials, printing of handouts and construction of visual aids. A school musical involves rehearsal schedules, construction of sets, designing and making of costumes, budgeting for promotional material, working out page designs for a glossy program, and many other activities, all of which require the use of mathematical skills. Imagine being involved in the production of the new musical *The Seven Roads to Wisdom* — a Chinese action–romance — and imagine your part in providing the mathematical skills needed in all areas of the production.

contents

KEY SKILL 1

Time calculations

TAKE A LOOK BACK AT **BOOK 1, PP. 6, 7**

Event management is a career option that interests many students. Event managers, who organise concert tours, football finals, school speech nights, weddings or the release of a new book, have to learn to plan how time will be spent on a number of activities in the weeks, months or even years leading up to the event, as well as what will happen on the day itself. A school musical is a complicated event with many time constraints, and planning how time will be allocated to various activities is essential if everything is to be ready and run smoothly on opening night.

WORKED EXAMPLE 1

The after-school rehearsal times are from 3.10 pm to 5.45 pm. How much time is this?

THINK	WRITE
How many minutes are there from 3.10 pm to 4.00 pm?	From 3.10 pm to 4.00 pm = 50 minutes
How many hours are there from 4.00 pm to 5.00 pm?	From 4.00 pm to 5.00 pm = 1 hour
How many minutes are there from 5.00 pm to 5.45 pm?	From 5.00 pm to 5.45 pm = 45 minutes
How many hours and minutes are there altogether?	1 hour + 50 minutes + 45 minutes = 1 hour + 95 minutes
Are the number of minutes more than 60? If so, make into hours and minutes, and then add to the hours already calculated.	1 hour + 95 minutes = 1 hour + 1 hour + 35 minutes = 2 hours 35 minutes

WORKED EXAMPLE 2

The producer schedules three after-school rehearsals (3.10 pm to 5.45 pm) in the final week before opening night. How much time is this?

THINK	WRITE
Multiply the hours by three.	$3 \times 2 = 6$ hours
Multiply the minutes by three.	$3 \times 35 = 105$ minutes
If the number of minutes is greater than 60, convert the amount into hours.	105 minutes = 60 minutes + 45 minutes = 1 hour + 45 minutes.
Add these hours and give the answer with the leftover minutes.	6 hours + 1 hour + 45 minutes = 7 hours 45 minutes of rehearsal time

QUESTIONS

1 Band rehearsals officially start at 3.10 pm and finish at 5:45 pm (a total of 2 hours, 35 minutes). The band takes 10 minutes to set up and 10 minutes to pack up. In addition, the director allows a 10 minute break in the middle of the rehearsal. How much time does the band spend actually rehearsing?

10 min + ... + ... = ... min

2 hours 35 min – .... min = ... hr .... min

2 Mona and Jeanette are the two mums in charge of wardrobe. The chorus (consisting of 24 students) needs robes, which Mona has designed. One Saturday she times herself making one robe from scratch — to get an idea of how long it takes. For each step below, work out how much time is taken. Then add up all the time to find the total in hours and minutes.

Laying out the pattern and cutting the pieces: 9.00 am to 9.47 am = ... minutes

Assembling, pinning and machine sewing: 10.00 am to 1.26 pm

10.00 am to 1.00 pm = ... hours 1.00 pm to .... = ...

Hemming and other hand sewing: 2.15 pm to 4.05 pm

.... to .... = ... hr .... to .... = ... min

Total time taken to make one robe = ... hours .... minutes

= .... hours + ... hours + ... mins = ... hours .... minutes

3 Round the answer from question 2 to the nearest hour. Now calculate how many hours would be needed to make 24 robes.

....

4 Jeanette realises this work needs to be divided up among a team of workers. She enlists 7 helpers (some more skilled than others) to make the robes. Obviously, you cannot divide the number of robes up evenly. What would you do? Justify your answer and show any working out that is relevant.

....

5 The stage manager is responsible for the backstage crew, which comprises lighting, sound and stage technicians. He estimates he will need to train his backstage crew over about four ordinary rehearsals before the first dress rehearsal. If each of the rehearsals is 2 hours 35 minutes long, how many hours of training do the backstage crew need to do?

....

INVESTIGATION 1
Rehearsal schedule

Imagine you are getting ready for school in the morning. There are some things you could do in only one order, while other things could be done in a variety of orders. For example, you would brush your teeth only after you had eaten breakfast; such a routine involves what we call 'sequential' activities (because they must happen in a sequence). However, when it comes to making your breakfast, you could:

1 finish eating your cereal, then cook and eat toast, and then put the kettle on to boil, or

2 have the toast cooking and the kettle boiling while you are eating your cereal.

The first alternative is sequential, but the second involves doing tasks 'in parallel', which saves time.

When scheduling an event as big as a school musical, it is useful to identify those things which have to be done sequentially (the dress rehearsal cannot be done until the costumes are made) and those things which can be done in parallel (the band can be rehearsing in the music room at the same time as the dancers are learning their choreography in the gymnasium). This sort of planning on a big scale is called 'critical path analysis' and is used for managing big events such as the Olympic Games, for the release of new car models, for political campaigns and even for making sure heart surgery goes according to plan.

Your first job is to use a number of highlighters to mark this calendar with these critical dates. Colour in the little boxes next to each of these items in this list to make a 'key' for the calendar and use the same colours on the calendar to construct a 'skeleton' for the schedule.

- ☐ Performance dates (first Thursday night in June, then the Friday night and then the Saturday night)
- ☐ 'Bump-in' (everything taken to the theatre for setting up) and technical rehearsal 2 days before opening night
- ☐ Dress rehearsal (1 day before opening night)
- ☐ Final full rehearsal (on the day of opening night)
- ☐ First term holidays (last week of March and first week of April)
- ☐ Rehearsal times Tuesdays and Thursdays from the first week of February to the last week of May (not in holidays)
- ☐ Three Saturday rehearsals spread fairly evenly throughout the months of rehearsal

Backstage lights on a rig

January						
S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

February						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

March						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

April						
S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

May						
S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

June						
S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Now you must use the calendar that you have marked to make a rehearsal schedule, which is a table showing when different groups of people must attend. Here are the requirements that the director has set.

- All lead parts must attend every rehearsal.
- The chorus must attend all Thursday and Saturday rehearsals.
- The band attends all rehearsals from the fourth week onwards.
- The wardrobe (costume) and props teams must attend the Saturday rehearsals.
- The stage crew attend the last Tuesday, Thursday and Saturday rehearsals.
- Hair and makeup people attend the last Saturday rehearsal.
- Sound and light technicians are required for the first time on bump-in day.
- Everyone must attend bump-in day, dress rehearsal, and final rehearsal on the day of opening night.

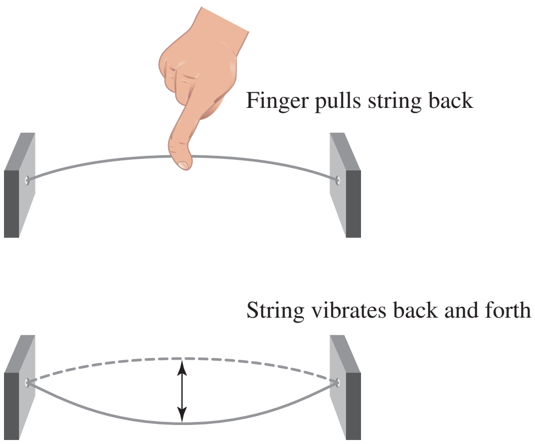
Prepare your schedule as a full-page table that clearly shows days, dates and times, and include columns to show who must attend which rehearsals (Tuesday and Thursday: 3.05 pm to 5.45 pm, Saturday: 10.00 am to 2.00 pm; other rehearsals mark as 'all day').

KEY SKILL 2

Using graphs

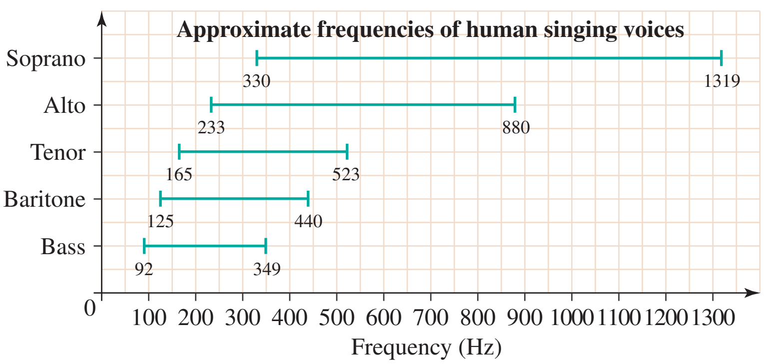
Sound is produced when air particles vibrate, and musical sounds are produced when instruments cause vibrations in the air around them. A stringed instrument such as a guitar or a violin produces sound by the movement of a string back and forth after it has been plucked or bowed.

The pitch of the musical sound (that is, how high or low it is) depends on how many vibrations are completed in one second. This vibration rate is called the frequency and it is measured in a unit called hertz (Hz). The higher the frequency, the higher the sound. In the case of a singer, the instrument producing the vibrations is the larynx (or voice box), which contains the vocal chords.



WORKED EXAMPLE

a Which voice type reaches the highest notes, and what frequency produces these notes?
b Read the graph to give the frequency range of the human voice.

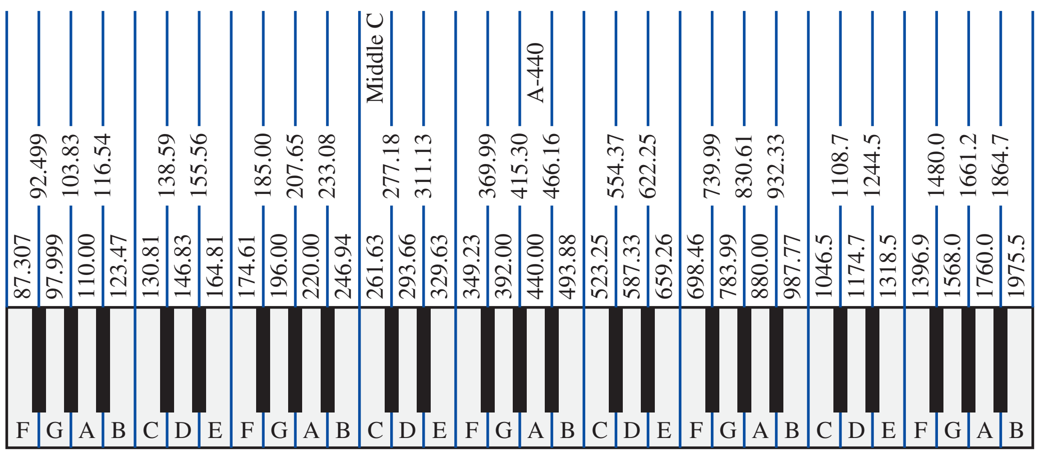


THINK	WRITE
a The highest note (pitch) is produced by the highest frequency.	The highest notes are produced by the soprano voice.
The highest frequency is shown by the line that extends to the highest number.	The highest frequency shown on the graph for the soprano voice is about 1319 Hz.
b The lowest pitch is a bass.	92 Hz
The highest pitch is a soprano. Range is the difference between these extremes.	1319 Hz 1319 – 92 = 1227 Hz

QUESTIONS

1 There is a range of frequencies where all of the five singing voices overlap. Use the graph to state the lower and upper limits of this range.

2 The diagram below shows the part of a piano keyboard that corresponds to the range of musical notes our singers use. The frequencies (in Hertz) of the notes made by the piano keys are shown. Use highlighters to show the ranges of each of the five singing voice types on the keyboard diagram.



3 A piano has strings inside that are struck by a hammer to make the vibrations. Each string has a set length so it has a fixed frequency. The length of the string determines the frequency. List the frequencies of the notes marked 'A'. What do you notice about these numbers?

4 From your answer to question 3, check out another set of notes with the same letter. Do these follow the same rule? Write a rule about the notes on the piano that connects the letter name of the note, the frequency and the pitch.

5 Our vocal chords can be stretched and slackened to change the frequency (they are like strings that can be changed in length). Can you explain why people can sing notes with frequencies in between the specific frequencies of the notes made by a piano?

INVESTIGATION 2
Who's in the band?

Graphs can convey information and connections in a way that is much more obvious than tables. The impressions they give, however, are only useful if they are set up properly. This means that the labelling of various parts of the graph has to be accurate and informative, and the graph itself has to be neat, clear and large enough to be read.

Use this table of approximate frequency ranges for various musical instruments to set up a graph similar to the voice range one on page 6. The frequency range for the piano is the greatest and should be used to construct the scale along the bottom of the graph (so the scale has been set up from 0 to just over 4000). The grid opposite should be used for the following task, and it is recommended that you turn your book on its side (in a landscape orientation) to allow you to work more easily. Don't forget to include all of the other features of a good graph.

Instrument	Frequency range (Hz)	Instrument	Frequency range (Hz)
Piano (K)	28–4186	Bassoon (W)	65–698
Accordion (K)	65–784	Flute (W)	311–2217
Bass guitar (S)	41–250	Piccolo (W)	659–3951
Guitar (S)	98–880	Alto saxophone (W)	165–932
Violin (S)	220–2489	Alto clarinet (W)	165–1568
Cello (S)	73–740	Xylophone (P)	156–2093
Trombone (B)	92–523	Chimes (P)	587–1397
Tuba (B)	44–440	Timpani (kettle drum) (P)	47–233
Trumpet (B)	196–880	Snare drum (P)	150–530
French horn (B)	65–523	Cymbals (P)	2000–4000

Key: K = keyboard, S = strings, B = brass, W = woodwind, P = percussion

Once you have drawn your graph, choose the musicians for the band using this information.

1 The band instruments must include keyboard, percussion, strings, woodwind and brass.

2 There is only room in the orchestra pit for 5 band members (plus the conductor).

3 Each band member can have up to three instruments (more than this will not fit).

4 The piano will cover all of the frequencies, but low and high notes on other instruments are needed for some of the musical numbers.

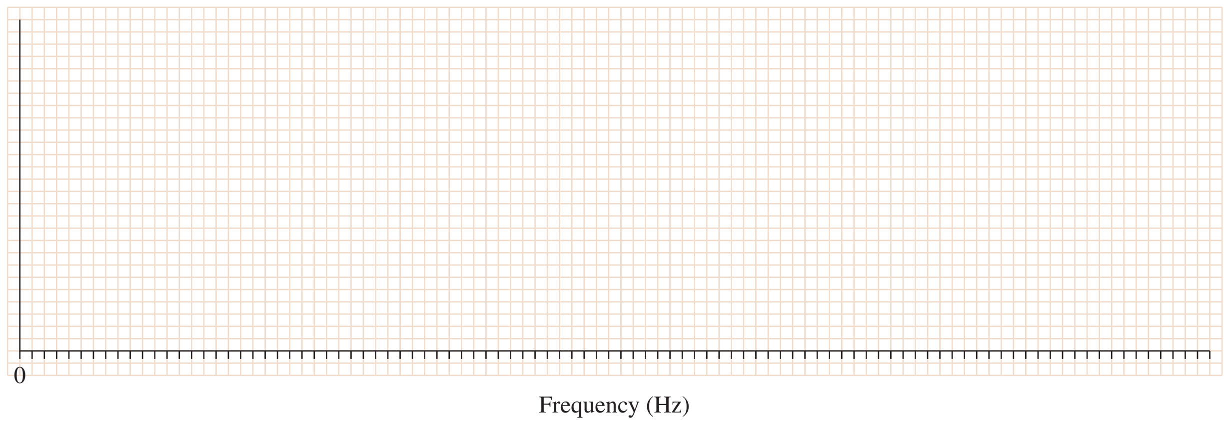
5 It is important that the frequency range where the singing voices overlap is covered by quite a few instruments to ensure a rich, full tone for the songs where the chorus is singing.

The musicians you have to choose from are listed in the table below, which also shows the instruments they each can play.

Musician	Instruments	Musician	Instruments
Lindsay	Piano, trumpet, xylophone, chimes, cymbals	James	Bass guitar, guitar, timpani, snare drum, cymbals
Emma	Flute, piccolo, piano	Michael	Clarinet, cello, bassoon
Alan	Trombone, tuba, timpani	Elke	Piano, xylophone, timpani, cymbals, chimes
Stephen	Accordion, clarinet, saxophone, French horn	Mario	Bassoon, snare drum, timpani, accordion
Phuong	Violin, cello, piano	Lelani	Piano, xylophone, chimes, violin

It might help you to highlight parts of your graph lines with a different colour for each musician, but other methods of identifying the selection of instruments played by each person could also be used.

Under your graph write a short explanation of why you chose certain musicians for your band, using the table above to help your justification of the inclusion of each person.



These are the choices I have made for the five band members.

I chose these for the following reasons:

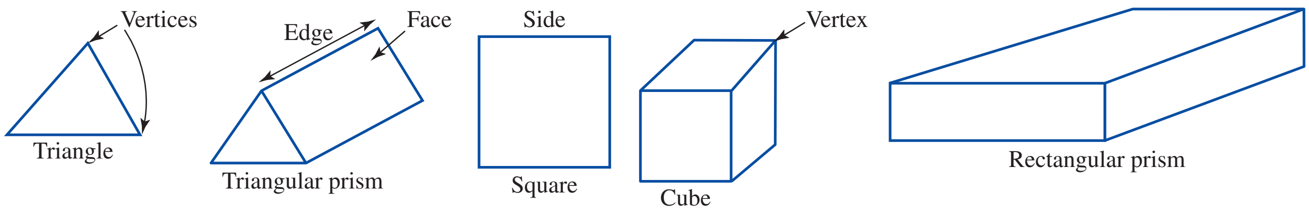
KEY SKILL 3

Areas of polygons

TAKE A LOOK BACK AT **BOOK 1, PP. 19, 20, 22**

A polygon is a closed two-dimensional shape that has sides and corners (or vertices, which is the plural of vertex) where the sides meet. The simplest polygon is a triangle, which has three sides and three vertices.

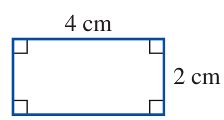
A prism is a closed three-dimensional shape. Both ends of a prism are the same polygonal shape, and the ends are joined together by rectangles or squares. A prism has faces, edges and vertices.



The area of a simple polygon can be calculated by drawing it to scale and breaking it up into squares, rectangles and right-angled triangles.

WORKED EXAMPLE 1

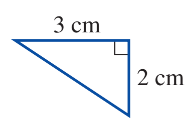
What is the area of a rectangle (or a square)?



THINK	WRITE
I need to know the height of the rectangle.	The height of this rectangle is 2 cm.
I need to know the length of this rectangle.	The length of this rectangle is 4 cm.
The area of the rectangle is the height multiplied by the length.	The area of the rectangle is $2\text{ cm} \times 4\text{ cm} = 8\text{ cm}^2$ (note the squaring of the unit).

WORKED EXAMPLE 2

What is the area of a right-angled triangle?



THINK	WRITE
The height of the triangle is one of the sides next to the right angle.	The height of this triangle is 3 cm.
The length is the other side next to the right angle.	The bottom length of this triangle is 2 cm.
The area of the triangle is the height multiplied by the length multiplied by 0.5 (halved).	The area of the triangle is $3\text{ cm} \times 2\text{ cm} \times 0.5 = 3\text{ cm}^2$ (note the squaring of the unit).

QUESTIONS

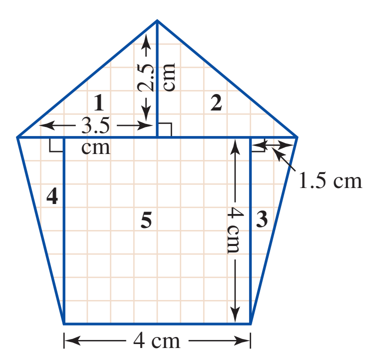
1 Complete this table with the correct names and numbers.

Polygon	Number of sides	Prism	Number of faces	Number of edges
	3	Triangular	5	
Rectangle	4		6	
Pentagon		Pentagonal	7	
	6	Hexagonal		
Heptagon				
Octagon	8			

2 Can you see a connection between the number of sides a polygon has and the number of faces its corresponding prism has? Can you use this connection to predict the number of faces on a prism that has at its ends a 24-sided polygon?

3 Choose three prisms from the table (but not the triangular or rectangular) and draw them neatly here.

4 Here is a pentagon that has been divided up into triangles and rectangles. Use the measurements given to calculate the area of each shape within the pentagon and write these on the picture. Add these areas together to get the overall area of the pentagon.



Area of Triangle 1 = ... × .... × 0.5 = ... cm². Triangle 2 is the same.

Area of Triangle 3 = ... × .... × 0.5 = ... cm². Triangle 4 is the same.

Area of Rectangle 5 = ... × .... = ... cm²

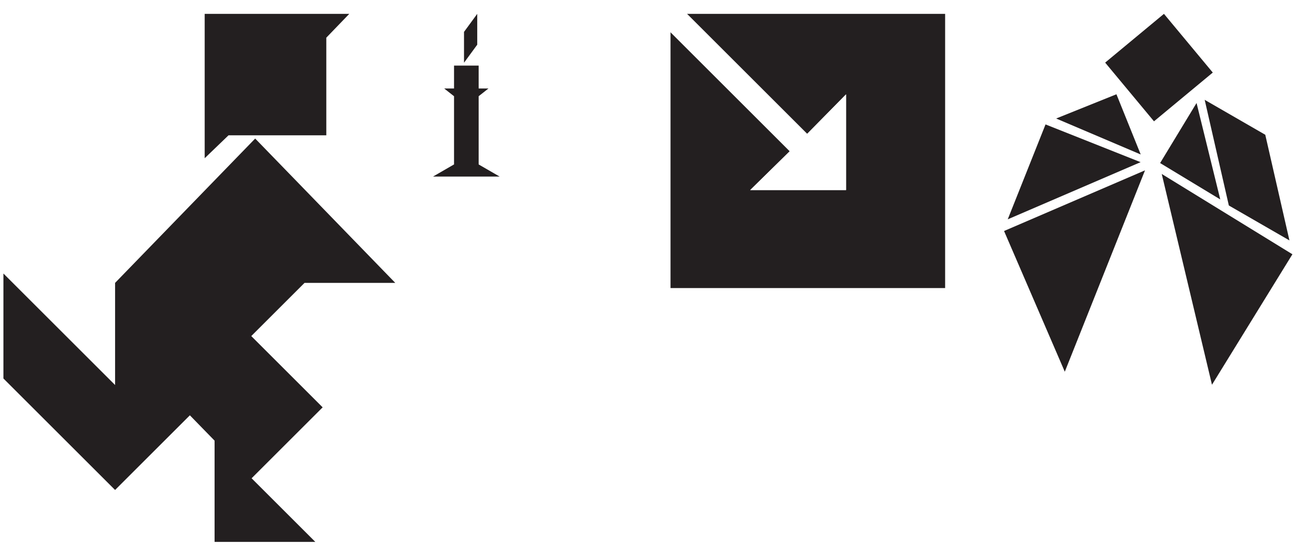
Total area of pentagon is .... cm² + ... cm² + ... cm² + ... cm² + ... cm² = ... cm²

INVESTIGATION 3

The Chinese tangram

The tangram is an ancient Chinese game. It looks very simple, but it is a puzzle that has hundreds of possible outcomes. It can be played for the amusement of one person or a competition between many. The Chinese name roughly translates into ‘the seven-board of cunning’, obviously because there are seven pieces. All of the pieces have to be used to create pictures that are solutions to problems posed by competitors.

Here are some examples of shapes and pictures you can make with a tangram puzzle.



The story told in the school musical is set in China, so the director has decided that the moving parts of the set will be a group of seven wooden prisms based on the pieces of the Chinese tangram. When standing on their polygonal ends the boxes will be used as platforms for actors to stand on, and when tipped on their sides and stacked they will form ‘back-sets’ — shapes behind a sheer curtain as a silhouette in the background.

Your job is to play with the tangram pieces (make your own by carefully copying the figure opposite) and come up with the designs for the moveable platform and for the stackable silhouette arrangements. Keep in mind that the designs have to be flat on the bottom because they will be sitting on the stage. Also, pieces must be supported so that they cannot fall over. When you have decided on the designs you like, sketch them neatly in the boxes below.

Four different arrangements for the moveable platforms

Design 1 Two separate square platforms of equal size	Design 2 Three separate platforms, each a different polygonal outline, but similar size
Design 3 A single polygon that is symmetrical, but not a square or a rectangle	Design 4 Your own completely free design

Four designs for the stackable back-set

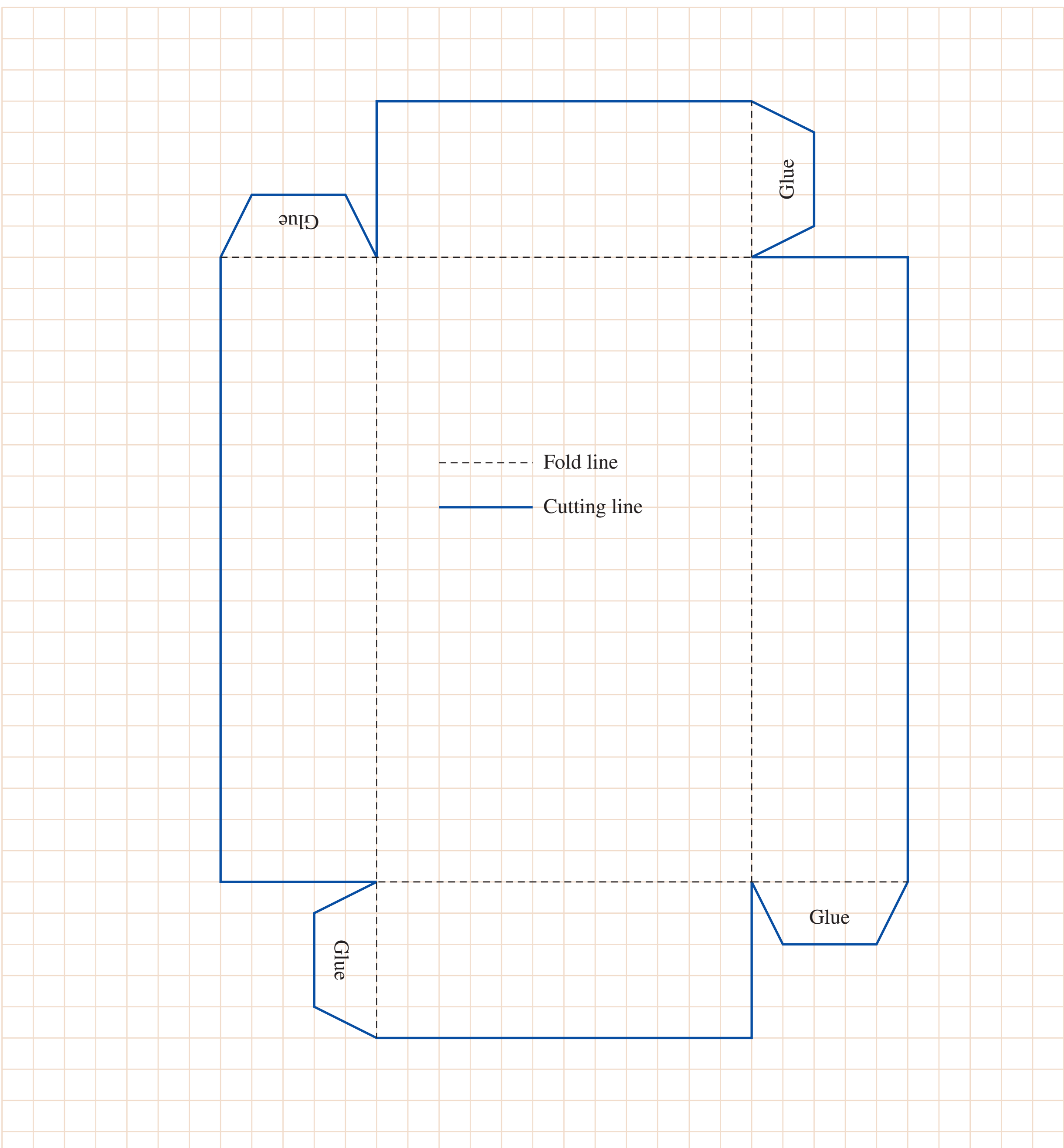
House on a sea cliff	A city skyline
Landscape with at least three mountain peaks in it	A water lily

PROJECT 1

Back-set prisms

The set construction team would like to see a scale model of the tangram prisms, so you are going to make the boxes out of paper. Each prismatic box will be hollow and have an open base so that only one polygon will be needed with the sides attached. The sides of all the boxes will need to be the same height so that when the boxes are put together with the polygons upward in any combination they will make a flat surface.

To make your boxes you will need to make a 'net diagram' of each on graph paper. Here is a net diagram for a rectangular prism that will be made for the conductor of the band to stand on. Study it carefully to note how it is drawn, and use it as a guide for your tangram nets.



Now obtain seven pieces of grid paper, similar to the one opposite. For each tangram piece, measure the polygon in the figure at the top of page 12 and double all of the measurements.

Carefully construct each polygonal piece in the middle of a separate piece of grid paper and add the sides (which are rectangles of the same height for each) and tabs.

Finally, cut out your nets, fold the tabs in and glue the boxes together.

Once you have finished the boxes, test them by arranging the platforms and back-sets you designed earlier. Do they all work? Specifically, do the boxes, stacked on their sides, stay up when arranged in their silhouette designs? If not, try some other ideas and discuss them with a partner.

Finally, if you were to paint the model boxes, you would have to work out the surface area to be covered. Use your knowledge of the areas of triangles and rectangles to do this. (*Hint:* After working out the area of each of the polygon tops, you would need to work out the area of the side rectangles only once and then count up the number of sides in the whole set.)

KEY SKILL 4

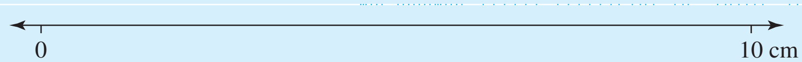
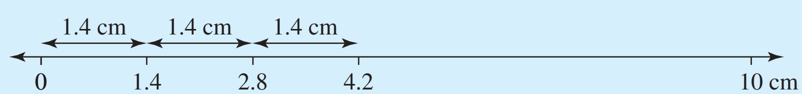
Drawing to scale

TAKE A LOOK BACK AT **BOOK 1, PP. 6, 16**

When doing scale modelling for a design, it is important that you accurately calculate the changes in the measurements from one scale to the other, and that you are precise in your drawing of lines and angles for the final product. There are many computer programs that will do this for you, but with a little patience and care, you can do just as good a job with a ruler, a sharp pencil, and other drawing instruments.

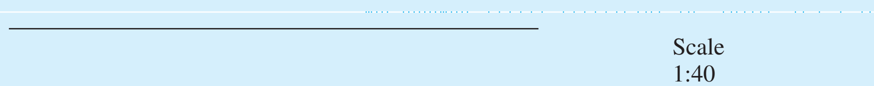
WORKED EXAMPLE 1

A line of 10 cm in length needs to be divided into 7 equal pieces. How is this done?

THINK	WRITE
Using a calculator, divide 10 by 7.	$10 \div 7 = 1.429$
Express the answer to 1 decimal place (1 mm).	This is 1.4 to the nearest millimetre.
Accurately draw a line of 10 cm in length.	
Start at one end and make seven marks along the line each separated by the calculated interval.	

WORKED EXAMPLE 2

Two beams of wood, one 2.8 m long and the other 4.6 m long, need to be drawn to scale on an A4 page. The scale given is 1:40. This means that the beam lengths in the diagram will be $\frac{1}{40}$ their actual size.

THINK	WRITE
The drawing will be done in centimetres, so the wood lengths will need to be converted from metres. To convert metres to centimetres, multiply by 100.	$2.8 \times 100 = 280$ cm $\quad$ $4.6 \times 100 = 460$ cm
The scale tells me to divide these by 40 to get the drawing lengths.	$280 \div 40 = 7$ cm $\quad$ $460 \div 40 = 11.5$ cm
Draw the two beams using a ruler and put the scale on the diagram.	

QUESTIONS

1 Rule a line exactly 5.8 cm long with 8 equal divisions along it.

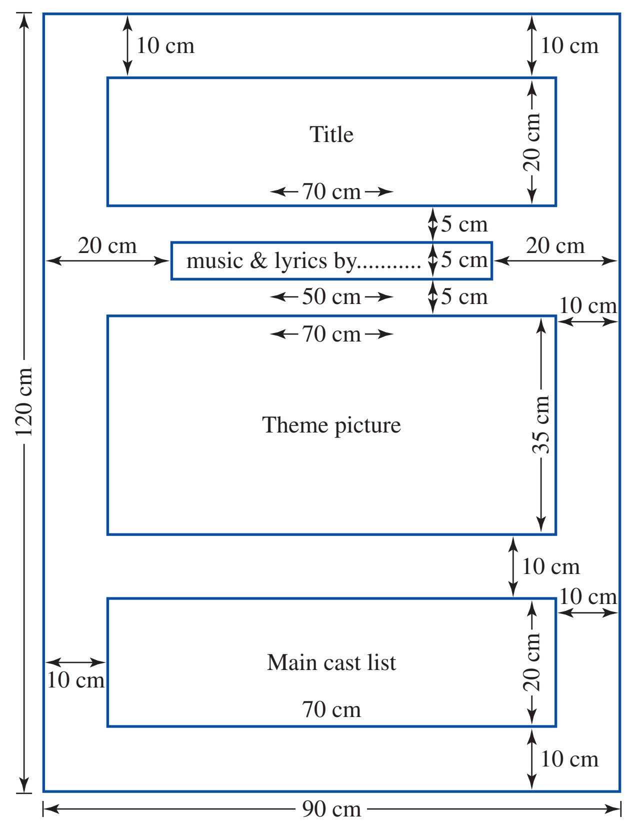
5.8 ÷ 8 = ... Rounded to the nearest mm = ...

Draw your marked line here:

2 Monique wishes to make a scale drawing of a flagpole that is 7 m tall. She is told to use a scale of 1:50. How long (in cm) would the line she draws on the paper be?

7 m × 100 = ... cm .... cm ÷ .... = ... cm

3 Rajath is in charge of the posters for the musical production. He has done a quick sketch with the size measurements, but he wants to do a small scale-drawing for the publicity team to work with. On a separate piece of A4 paper, rule up a diagram of the poster to the scale of 1:6, and show how you worked this out.



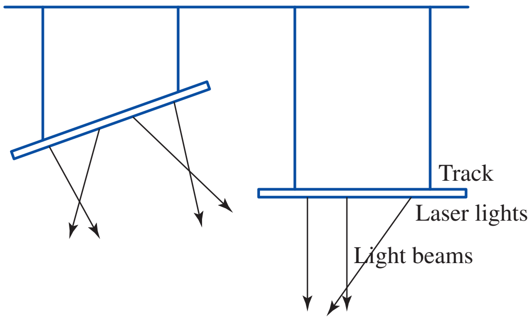
4 The props team have to make a giant kite for a backdrop in the play. In a scale drawing, the kite is 15 cm long and 12 cm across. The actual kite needs to be 3 m long and 2.4 m wide. Work out the scale ratio.

....

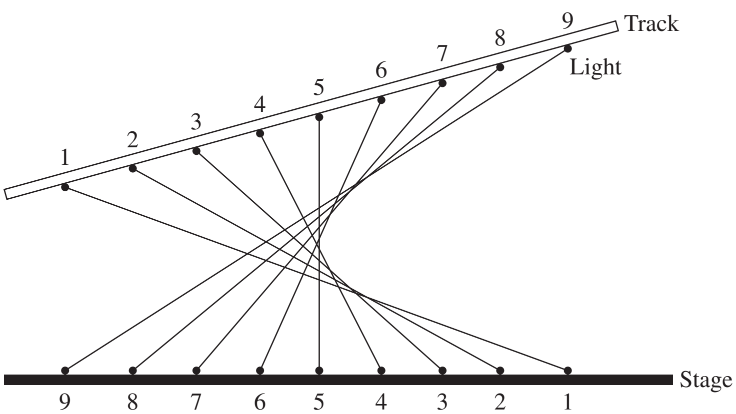
....

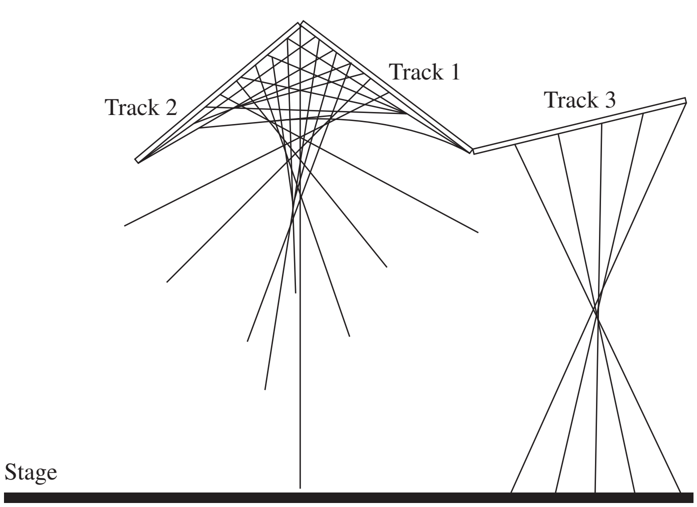
INVESTIGATION 4
Laser lighting design

The director and the stage manager agree that the new lighting equipment at the theatre should be used in the show. The lighting rig consists of three moveable tracks upon which up to 36 individual lasers can be mounted. The tracks are lightweight and can be suspended at a number of angles from thin cables. Each laser creates a thin, penetrating line of light and can be swivelled to be angled into the desired direction.



The stage manager suggests that 'curve stitching' designs should be used to create three different effects with the lights. He sketches out these examples to show the director how curve stitching can be used.





Your task is to create two very different designs by positioning the three lighting tracks different ways and arranging the lights along them. Each separate track is 4 metres long. Each can support up to 20 lights (you don't have to have the same number on each track), and they can be moved anywhere along the track.
You can have 36 lights. The lights come in 7 colours — but you can choose only four from red, green, blue, purple, pink, yellow and orange. Use pencil to start with, and then use ink over the top when you are happy with your designs.

KEY SKILL 5

Enlarging drawings

TAKE A LOOK BACK AT **BOOK 8, PP. 11, 12, 13, 16**

In Key skill 4, the emphasis was on scaling down an object to a drawing. In this key skill, the focus will be on going the other way — that is, taking a scale drawing and enlarging it to a workable size, or even full size.

There are a number of different ways to enlarge a drawing. These include the ratio method (the reverse process of the one you used in the previous lesson), the ray method, and the enlarging grid method. The exercises on the opposite page will build your skills in the first two methods, while Investigation 5 will require you to use the third method.

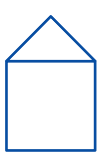
WORKED EXAMPLE 1

A scale drawing shows a line 4 cm long, and the scale is given as 1:200. What does this length represent in real life?

THINK	WRITE
1:200 means 1 cm on the drawing represents 200 cm on the real object.	1 cm : 200 cm
Convert 200 cm to m.	200 cm = 200 ÷ 100 m = 2 m
To find what 4 cm represents, multiply by 4.	4×2 m = 8 m

WORKED EXAMPLE 2

Enlarge this shape by using the ray method.



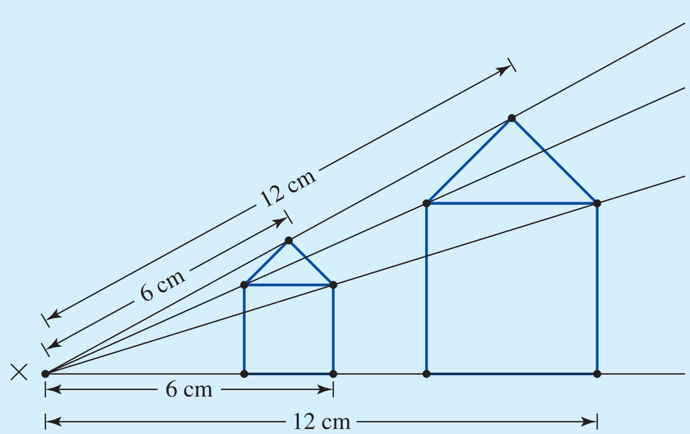
THINK

To enlarge this shape, rule three lines (rays) from a point (X) that touch vertices on the prism and extend the rays out beyond the shape.

Measure the distance from X to one touch point along one ray. Add this same distance again along the same ray and mark a new point.
Do this for all other points, along the other rays.

Join up the enlarged figure from the new points.

WRITE



QUESTIONS

1 The tangram square platform is drawn on an A4 page with a side measurement of 10 cm at a scale of 1:21. What would the side of the real platform measure?

1:21 means 1 cm on the drawing represents .... on the real platform.

Converted to m, ... cm ÷ .... = ... m.

10 cm on the drawing means the side of the platform is 10 .... m = ... m.

2 A model of the stage is made at a scale of 1:25. On the model, the front of the stage is 64 cm wide and 40 cm deep. What are the real width and depth measurements of the stage?

1:25 means ....

64 cm on the model means the front of the stage is .... m wide.

40 cm on the model .... m deep.

3 The big sheer curtain that will drop in front of the tangram back-sets is shown on the stage model as being 14 cm long by 5 cm wide. What are the actual dimensions of the curtain?

....

....

4 Mona makes a model of the robe on a doll that is 30 cm tall. The tallest chorus member is 1.84 m tall. Finish this sequence to find out the scale ratio Mona will have to use to get the length right when she makes the full-size robe.

Model : real person

30 cm : 1.84 m

30 cm : 1.84 × 100 cm

30 cm : .... cm

1 : .... is the scale ratio (*Hint:* Divide both sides by 30.)

5 Mona makes a miniature bamboo pole for her doll model that is 18 cm long. How long will the real bamboo pole be? Give your answer in centimetres, and then convert it to metres.

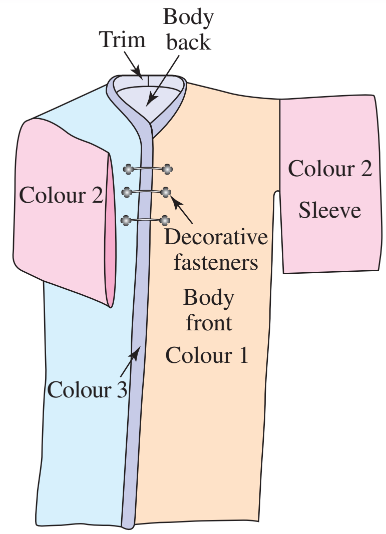
....

....

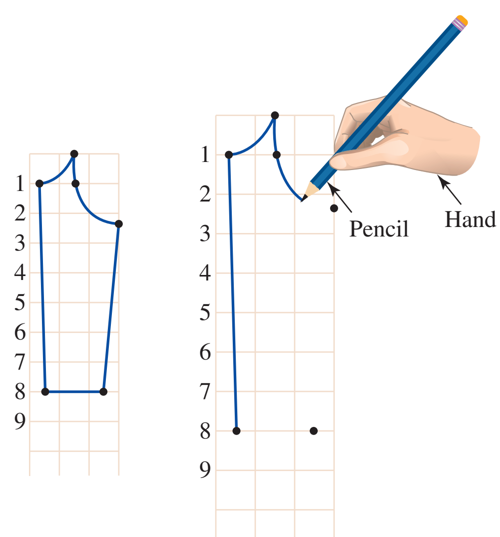
INVESTIGATION 5

Robes for the chorus

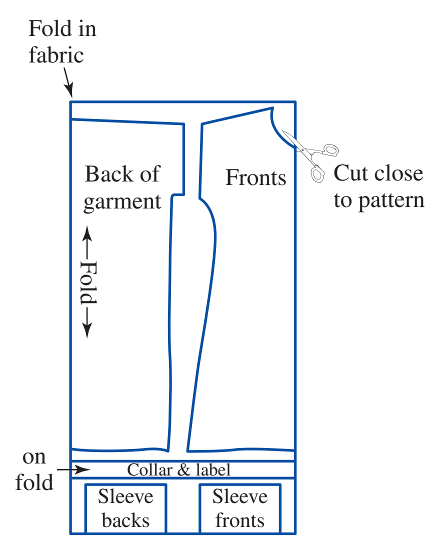
The costume designer wants to dress the chorus members in loose-fitting Chinese robes for two of the song and dance numbers, especially as these robes can be quickly put on over another costume (and removed just as easily) for quick scene changes. A sketch of the robe's design is shown here.



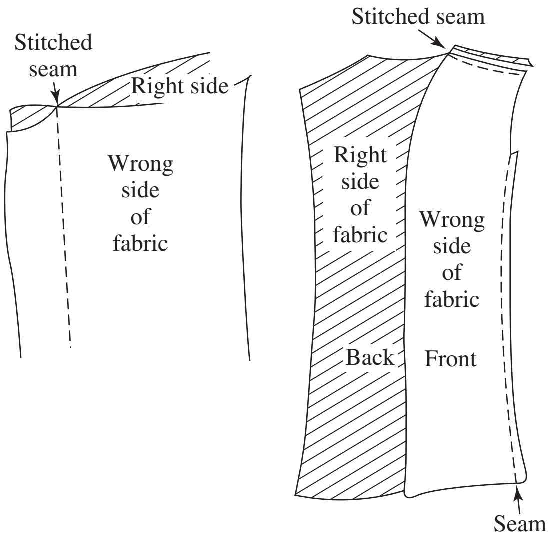
The design has been made into a dress pattern, the pieces of which are shown on the grid opposite. A common way of enlarging patterns is to use the grid method. First you enlarge the grid, and then you rule lines and draw curves freehand to match the smaller version on your new grid. It takes a bit of care and practice, and you must count grid squares carefully when you are drawing your enlarged version, but it is quite simple when you gain experience.



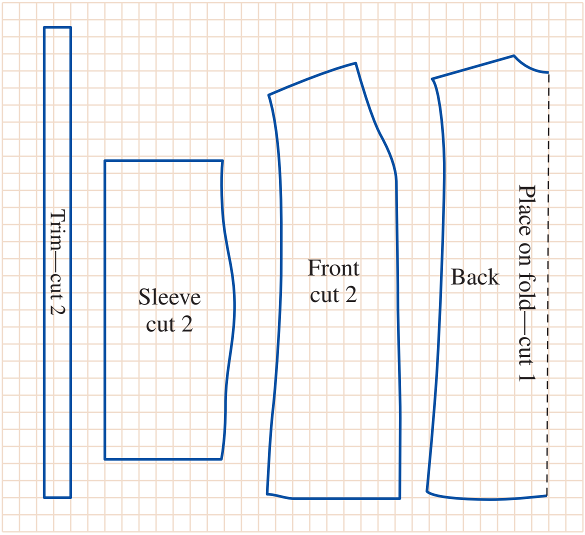
Next, the pieces are cut out, placed on the fabric for the best fit with the least wastage, and pinned. Usually the fabric is folded in two because some pieces (such as the back of this robe) are symmetrical and don't need a seam (join) in the middle, while other pieces come in pairs (such as sleeves and front panels) and have to be cut in duplicate. Then the fabric is cut carefully against the pattern pieces.



Finally, the pieces are sewn together in a specified order to put the garment together. The seams are sewn while the pieces have their wrong sides together so that the seams are tucked inside when the garment is finished. Adjustments for length of the sleeves and the hem are made by trying the garment on the person who is wearing it.



Here is the designer's pattern for the robe. Use a ruler and pencil to enlarge the grid to fit an A3 page, and then enlarge the pattern pieces onto your grid. Remember to rule straight lines, count squares carefully and draw curves smoothly so that the pieces look the same as the smaller version. Once you are satisfied with your enlarged pattern, make a model robe from coloured paper or even fabric. Just follow the procedure on the opposite page and use a suitable glue rather than sewing the pieces.



To make the scenes when the robes are worn really colourful, four colours will be used — purple, electric blue, fluoro green and hot pink. If each robe can have three colours each, how many different robes can be made with contrasting colours on bodies, sleeves and trims? How would you go about working this out?

KEY SKILL 6

Costing a design

One of the many costs that have to be budgeted for is the glossy program that goes on sale at the beginning of each performance. Cast lists, photos from rehearsals, profiles of the main leads, a synopsis of the story and acknowledgements of helpers and sponsors all have to be fitted into the program, and this all comes at a price. Fortunately, the cost of producing such a program is usually less than the amount made from their sales. The people involved in the production also like to buy one as a memento. In this way, the program book can also be a fundraiser and can help pay for some of the other costs of a big production. So it is worth making the program look great!

WORKED EXAMPLE 1

Photos and written profiles for the seven lead actors, the director, the stage manager, the choreographer and the two co-producers have to be spread evenly across 4 pages. How many people will fit to a page?

THINK	WRITE
Which mathematical operations do I have to use?	Addition and division.
Add the number of people first.	$7 + 1 + 1 + 1 + 2 = 12$ people
Then divide the number of people by the number of pages.	$12 \div 4 = 3$ people per page

WORKED EXAMPLE 2

Out of the 32 pages in the booklet, 4 of them will be in full colour and another 8 will be in two colours. The rest will be in black and white. What percentage of the booklet is in black and white?

THINK	WRITE
To find how many pages are coloured, add the number of full-colour and two-colour pages together.	$4 + 8 = 12$ coloured pages
To find how many pages are black and white, subtract the number of coloured pages from the total number of pages.	$32 - 12 = 20$ black and white pages
To find percentage of black and white in the booklet, make a fraction and multiply by 100.	$\frac{20}{32} \times 100 = 62.5\%$

QUESTIONS

1 There are to be three performances, and there are 450 seats in the theatre, all occupied. If we assume that 1 in every 2 people will buy a program, how many will be needed to cover this number?

3 × .... ÷ .... = ...

2 It is likely that the cast, crew, musicians and helpers will all want a souvenir program. There are 89 people involved in various ways in the production. With these and the audience copies, how many programs will be needed altogether? Round this figure to the nearest 100.

.... audience copies .... 89 other copies = ... (rounded to .... copies required)

3 The package offered by the printer will produce the required number of programs for $3200. How much is this per program?

$3200 .... = $ .... per copy

4 Together the sponsors have pledged $2500 towards publication. If the program costs are $3200, how much money does the school have to find to pay for the programs to be printed?

....

5 The programs are sold for $5 each. What percentage of the price to the purchaser is profit over the cost to produce the program?

$.......... out of every $5 is profit. % profit = $\frac{\cdots}{\cdots}$ × 100 = ... %

6 How much profit (in dollars) is made altogether if all of the programs are sold? How does this amount compare to the money the school had to put in after the sponsors' contributions?

....

....

7 Express the sponsors' dollar contribution as a percentage of the total cost for the programs' printing. (Answer to the nearest whole number.)

....

8 The printer has an offer for you to consider. For 6% more on the cost of the programs' printing, he will emboss the lettering on the front cover in gold. What would the printing costs be if this embossing were used on the front cover? Do you think it would be worth this much to have gold lettering?

....

....

INVESTIGATION 6

Sponsor's spreadsheet

The breakup of the \$3200 contributed by sponsors is shown in the table below.

Sponsor	Amount contributed	Percentage contributed	Area allocated (cm^2)
Gerry Built Hardware	\$800		
Joe Sparks Electrics, Inc.	\$640		
Crazy Daze Dance Studio	\$576		
Bev's Bath and Bedroom	\$480		
Floyd's Fast Fotos	\$320		
Golden Oak Chinese Restaurant	\$224		
Ming's Bargains Unlimited	\$96		
Maria's Pizza Palace	\$64		

The area in the program available for advertising is approximately 1120 cm^2 (the area of an A3 page, or a double A4 page). Each sponsor is to be allocated part of this space according to the amount of their contribution.

You could easily work out the figures with a calculator and two formulas for each sponsor, or you could get a spreadsheet to do it for you. You might even do both to check your calculations. Put spreadsheet formulas in the table below after discussion with your teacher.

	Calculating per cent contribution	Calculating area allocated
Formula for calculator	\$ amount ÷ 3200 × 100	% contribution ÷ 100 × 1120
Formula for spreadsheet		

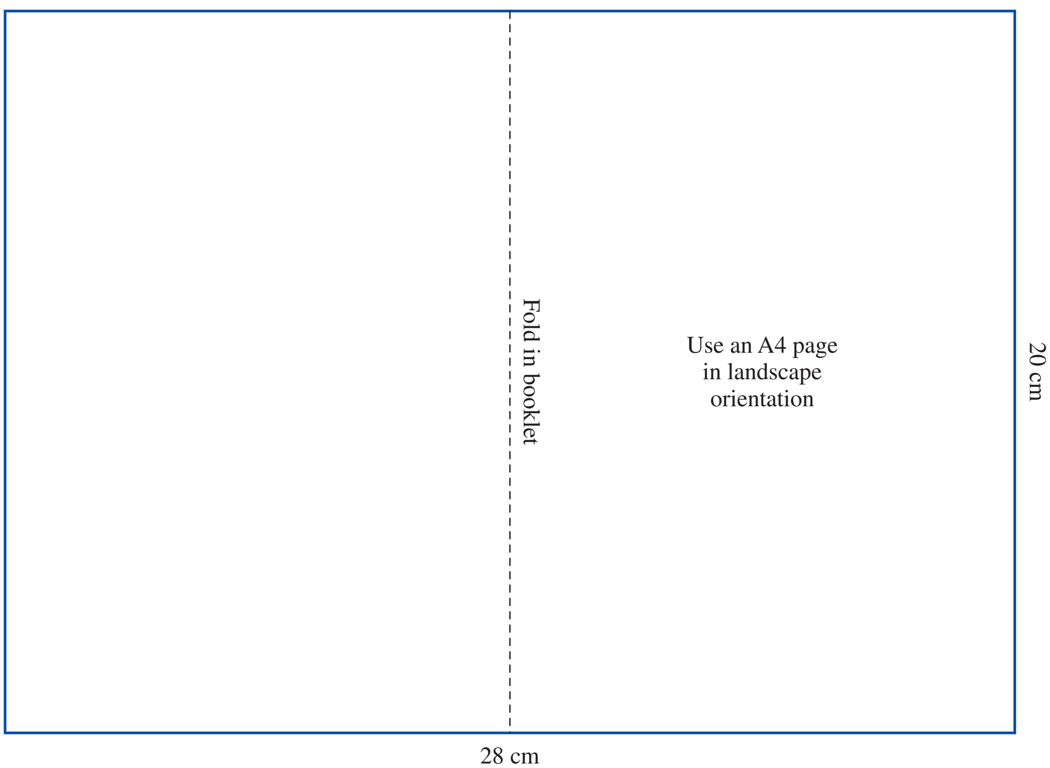
You can now put the information you have into a spreadsheet (which will look something like this).

	A	B	C	D	E
1	Sponsor	\$ contributed	% contributed	Area allocated	
2	Gerry Built Hardware	800			
3	Joe Sparks Electrics, Inc.	640			
4	Crazy Daze Dance Studio	576			
5					
6					

If you don't know how to do it already, your teacher can show you how to put the spreadsheet formulas in and fill them down columns and across rows.

Finally, add another column to your spreadsheet and work out what formula to use to halve your final area (column D numbers) for each sponsor. You need to do this because an A4 page, where you are going to lay out the advertisements, is half of the area of the final double-page spread in the program.

Now that you have your numbers, make advertisement 'blocks' for the sponsors that approximately correspond to the areas they have been allocated. There are many ways to go about this, so give it some thought!



PROJECT 2

Program design

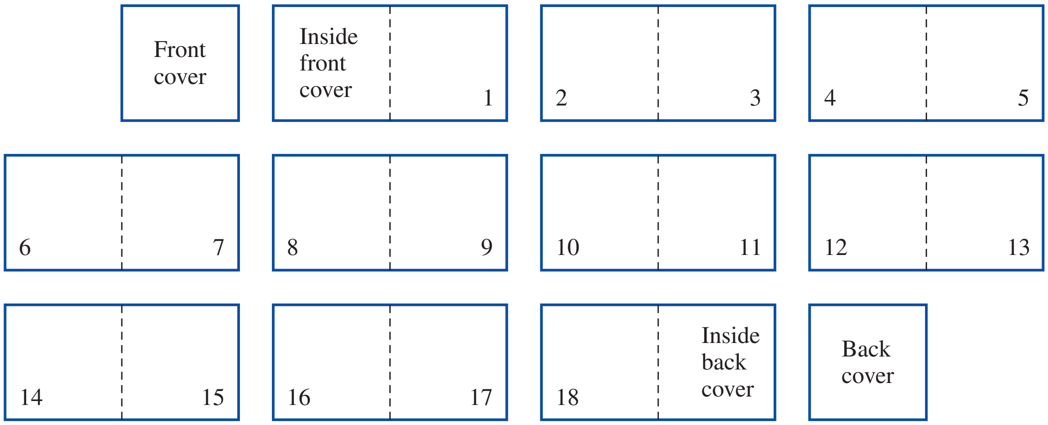
The program comprises sheets of A3 folded once to be A4 size. The sheets are stapled in the middle like this mathematics book. Such a book can have 32 pages like this one, or 16 pages or 20 pages, but not 18. Explain why.

Here is a list of items that are usually in the program, and the approximate number of pages you will need for each item. The information does not have to be in the program in the order given in this table.

Inclusion in the program	Pages
Title of the production, composer, name of school performing it, year of performance	1 (the cover)
Synopsis of the story	$\frac{1}{2}$ to 1
Introduction by the school principal	$\frac{1}{2}$ to 1
Profiles of lead actors, the director, the stage manager, the choreographer, and the two co-producers	3 to 4
Acts, scenes and songs (including interval information)	$\frac{1}{2}$ to 1
Cast list	1 to 2
Band members and instruments	$\frac{1}{2}$ to 1
Crew list in groups (lighting, sound, backstage, costumes etc.)	$\frac{1}{2}$ to 1
Sponsor page (has to be double-page spread)	2 (together)
Optional colour pages (usually of rehearsals)	4 (usually the centre-page spread)
Acknowledgements	$\frac{1}{2}$ to 1
A place for autographs	$\frac{1}{2}$ to 1

Your job is to allocate the required items to pages, using the page chart here. You have been given 20 pages, but it is up to you if your program is this long. You will be able to save money if it is shorter, or does not have colour pages, but the booklet would probably not be as exciting. Remember, the number of pages has to be a multiple of 4.

On the chart, make a note of each page number (e.g. p. 14), what is going on that page (e.g. actor profiles), and whether it is full colour, two colour or black and white. You should also indicate the front cover, the back cover, the inside front cover, the inside back cover and the centre-page spread.



On this page, you are to design the front cover of the program and produce it here as a coloured sketch with the actual sizes for each of the elements you want to include indicated clearly in the margins. The cover must have the title of the musical (*The Seven Roads to Wisdom*), the names of the writers (you can make these up — there are usually two), the name of the school presenting the play and the year. The design must incorporate either the tangram puzzle or a curved stitching design, or both. You can include other elements as well, and you may use any drawing and colouring materials you wish.

When you are happy with your sketch, your final task is to make a 'dummy' book. This is a full-size book made from A3 paper with the correct number of pages, stapled in the middle. The information from your chart must be neatly written on the correct pages. The only pages you must complete in detail are the front cover and the sponsor page (for which you should show at least the names and some invented contact details of the sponsors in their correctly sized spaces). How much or how little detail you sketch out on the other pages is up to you.

eBookplus ACTIVITIES

Key skill 1 Time calculations

Digital doc

▶ Worksheet 8.1: apply your knowledge of time calculations

Key skill 2 Using graphs

Digital doc

▶ Worksheet 8.2: apply your knowledge of using graphs

eLesson

▶ Music instruments (eles-0110): explore the relationships between musical instruments and the sounds they make

Key skill 3 Areas of polygons

Digital doc

▶ Worksheet 8.3: apply your knowledge of polygons

Interactivities

▶ Polygons (int-0008): explore the size and relationships of the exterior angles of a number of common shapes

▶ Area polygon (int-0005): learn how to work out the area of polygons

eLesson

▶ Angles in polygons (eles-0044): learn about the angles in a polygon

Investigation 3 The Chinese tangram

Interactivity

▶ Tangram (int-0664): explore the way a tangram can be manipulated to create new shapes

Key skill 4 Drawing to scale

Digital doc

▶ Worksheet 8.4: apply your knowledge of drawing to scale

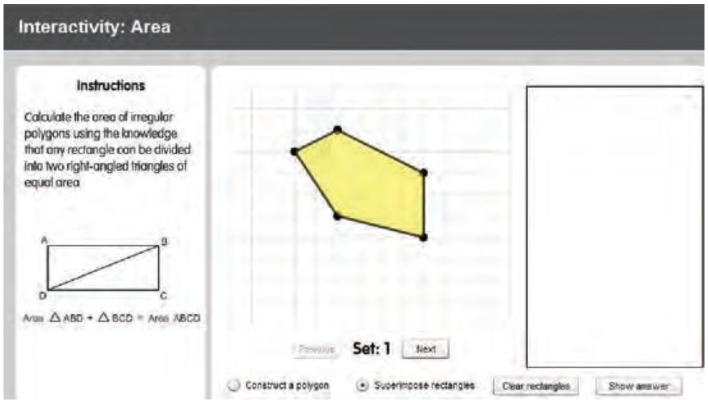
Interactivity

▶ Drawing to scale (int-0666): explore how to draw to scale

Investigation 4 Laser lighting design

Interactivity

▶ Curve sketching (int-0665): investigate the patterns formed with curve sketching



Key skill 5 Enlarging drawings

Digital doc

▶ Worksheet 8.5: apply your knowledge of enlarging by scale

Key skill 6 Costing a design

Digital doc

▶ Worksheet 8.6: apply your knowledge of costing a design

CHAPTER REVIEW

Digital docs

▶ Word search swf (int-0660): search for the terms covered in this book

▶ crossword swf (int-0661): test your knowledge of the terms covered in this book

▶ puzzle page pdf: crack the code

Interactivity

▶ Test yourself (int-0662): take the end-of-chapter online multiple-choice quiz

ANSWERS

KEY SKILL 1 — Time calculations

1 30 mins; 2 hr 5 min
2 6 hours, 3 minutes
3 144 hours
4 Answers will vary.
5 10 hrs; 20 mins

INVESTIGATION 1 — Rehearsal schedule

Answers will vary.

KEY SKILL 2 — Using graphs

1 330 Hz is lower; 349 Hz is upper.

2 Bass ranges from 2nd F#/G below middle C to E/F above middle C.

Baritone from 2nd C below middle C to A above middle C.

Tenor ranges from E/F below middle C to 1st B/C above middle C.

Alto ranges from B-flat (black key) below middle C to 2nd A above middle C.

Soprano ranges from E/F above middle C to 3rd E above middle C.

3 Frequencies of A notes: 110 Hz, 220 Hz, 440 Hz, 880 Hz, 1760 Hz. They double in value as you go up the frequency range.

4 Answers will vary. For example: For notes marked D frequencies from lowest to highest up the keyboard go 146.83 Hz, 293.66 Hz, 587.33 Hz, 1174.7 Hz.

Rule: The frequency of a note high on the keyboard is twice the frequency of the note with the same letter at the next lowest pitch.

5 The frequency is related to the number of vibrations per second (Hz). A piano string has a set frequency because it is stretched to a fixed amount. The strings either side also have been set to fixed frequencies and cannot change their vibration rate. The human vocal chords can change their frequencies by small fractions between those of the piano strings because they are not fixed in their amount of stretch and therefore not fixed in frequency.

INVESTIGATION 2 — Who's in the band?

Answers will vary.

KEY SKILL 3 — Areas of polygons

1

Polygon	Number of sides	Prism	Number of faces	Number of edges
Triangle	3	Triangular prism	5	9
Rectangle	4	Rectangular prism	6	12
Pentagon	5	Pentagonal prism	7	15
Hexagon	6	Hexagonal prism	8	18
Heptagon	7	Heptagonal prism	9	21
Octagon	8	Octagonal prism	10	24

2 26 faces
3 Answers will vary.
4 30.75 cm^2

INVESTIGATION 3 — The Chinese tangram

Answers will vary.

KEY SKILL 4 — Drawing to scale

1 0.7 cm (or 7 mm)
2 14 cm
3 All measurement shown on the sketch should be divided by 6 in the scale drawing.
4 1:20

KEY SKILL 5 — Enlarging drawings

1 2.1 m
2 16 m wide, 10 m deep
3 3.5 m long, 1.25 m wide
4 1:6.13 is the scale ratio (approximate)
5 1.1 m (approximate)

KEY SKILL 6 — Costing a design

1 675
2 764 (rounded to 800 copies required)
3 $4 per copy
4 $700
5 20%
6 $800 profit, $100 more than was put in by the school.
7 78%
8 $192

INVESTIGATION 6 — Sponsor's spreadsheet

Answers will vary.

PROJECT 2 — Program design

Answers will vary.