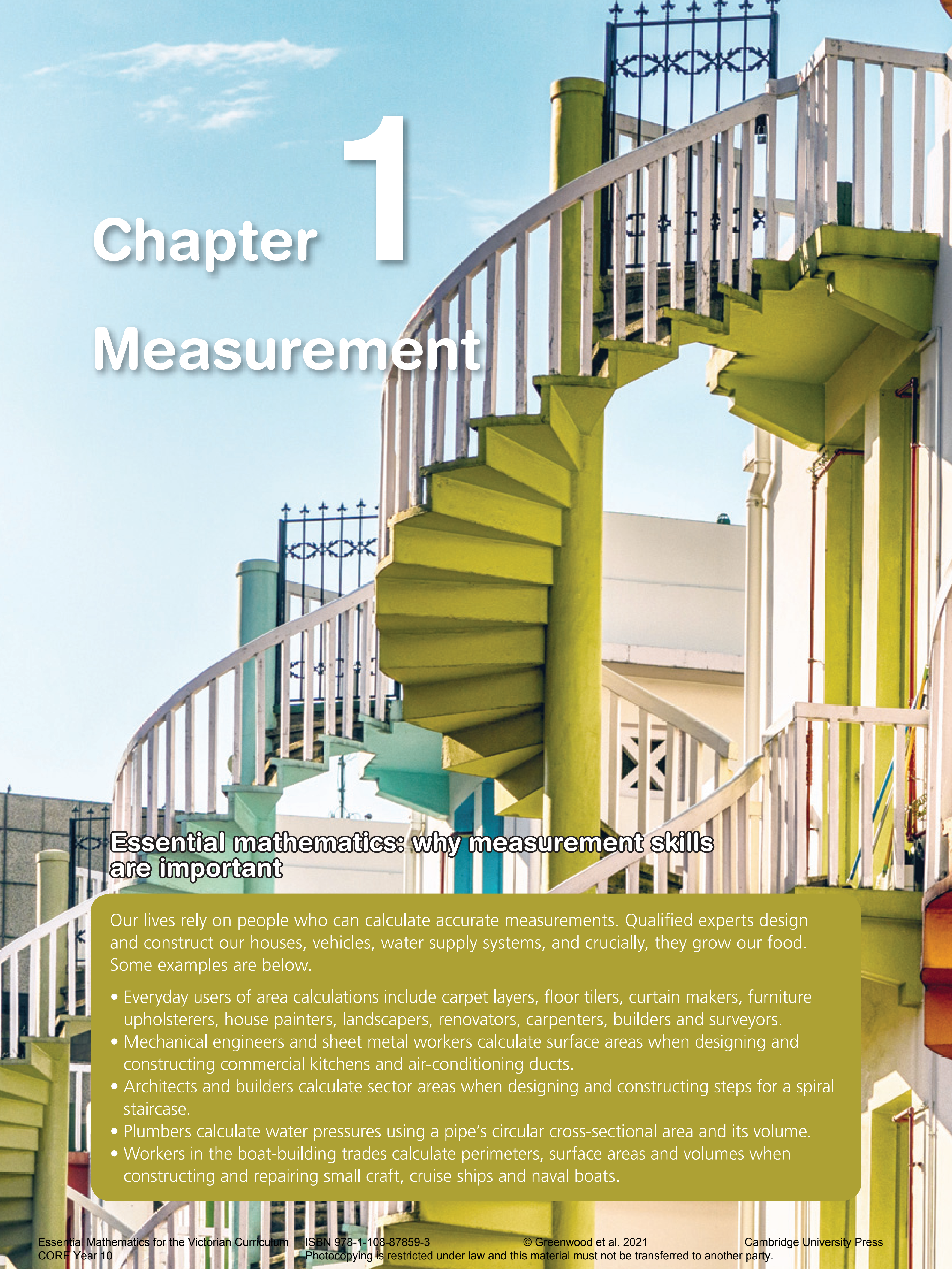


Chapter 1

Measurement

Essential mathematics: why measurement skills are important

Our lives rely on people who can calculate accurate measurements. Qualified experts design and construct our houses, vehicles, water supply systems, and crucially, they grow our food. Some examples are below.

- Everyday users of area calculations include carpet layers, floor tilers, curtain makers, furniture upholsterers, house painters, landscapers, renovators, carpenters, builders and surveyors.
- Mechanical engineers and sheet metal workers calculate surface areas when designing and constructing commercial kitchens and air-conditioning ducts.
- Architects and builders calculate sector areas when designing and constructing steps for a spiral staircase.
- Plumbers calculate water pressures using a pipe's circular cross-sectional area and its volume.
- Workers in the boat-building trades calculate perimeters, surface areas and volumes when constructing and repairing small craft, cruise ships and naval boats.

Essential Mathematics for the Victorian Curriculum CORE Year 10 ISBN 978-1-108-87859-3

In this chapter

Victorian Curriculum

MEASUREMENT

Using units of measurement

Solve problems involving surface area and volume for a range of prisms, cylinders and composite solids (VCMMG343)

NUMBER AND ALGEBRA

Patterns and algebra

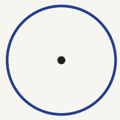
Substitute values into formulas to determine an unknown and re-arrange formulas to solve for a particular term (VCMNA333)

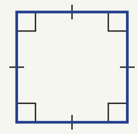
Online resources

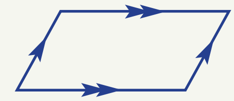
A host of additional online resources are included as part of your Interactive Textbook, including HOTmaths content, video demonstrations of all worked examples, auto-marked quizzes and much more.

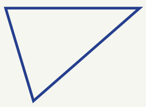
Warm-up quiz

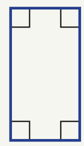
1 Name these shapes. Choose from the words *trapezium*, *triangle*, *circle*, *rectangle*, *square*, *semicircle*, *parallelogram* and *rhombus*.

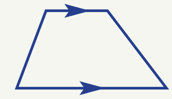
a 

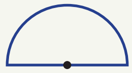
b 

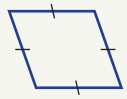
c 

d 

e 

f 

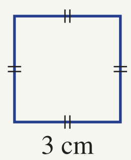
g 

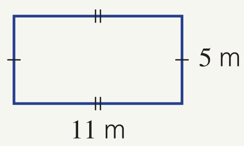
h 

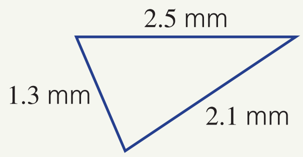
2 Write the missing number.

a 1 km = ☐ m
b 1 m = ☐ cm
c 1 cm = ☐ mm
d 1 L = ☐ mL
e 0.5 km = ☐ m
f 2.5 cm = ☐ mm

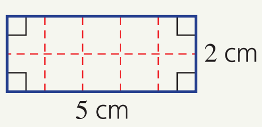
3 Find the perimeter of these shapes.

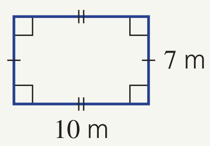
a 

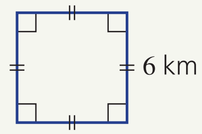
b 

c 

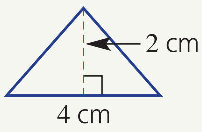
4 Find the area of these shapes.

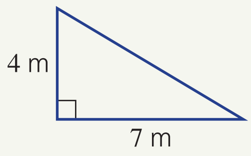
a 

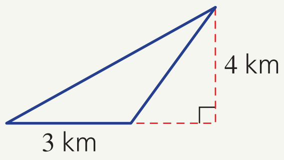
b 

c 

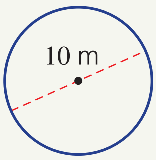
5 Find the area of these triangles using $A = \frac{1}{2}bh$.

a 

b 

c 

6 Use $C = \pi d$ and $A = \pi r^2$ to find the circumference and area of this circle. Round your answer to two decimal places.



$d = 10,\ r = 5$

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1A Conversion of units CONSOLIDATING

Learning intentions

- To review the metric units of measurement
- To be able to convert between metric units for length, area and volume

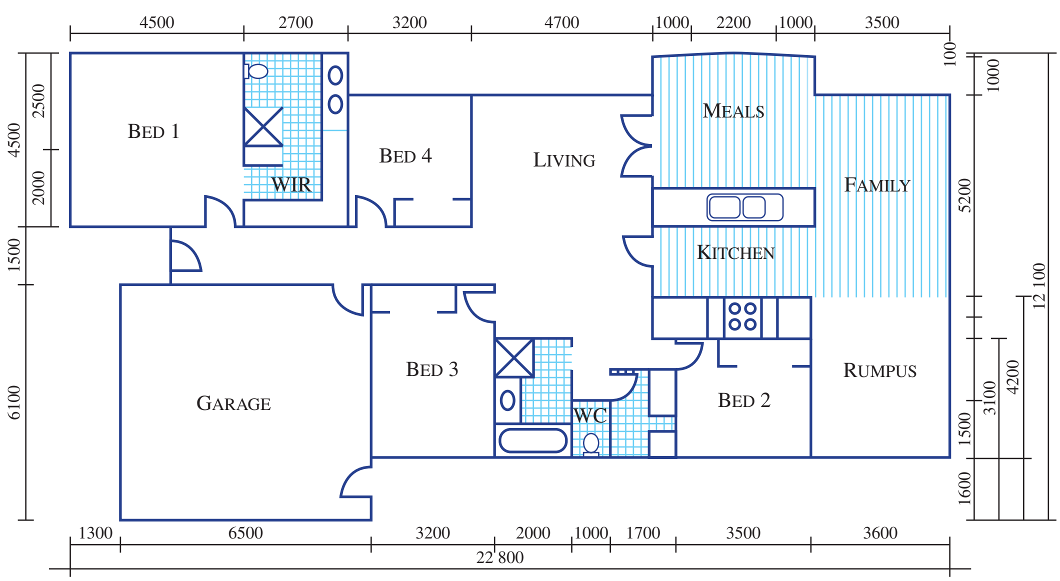
Key vocabulary: unit, length, area, volume

To work with length, area or volume measurements, it is important to be able to convert between different units. For example, timber is widely used in buildings for frames, roof trusses and windows, therefore it is important to order the correct amount so that the cost of the house is minimised. Although plans give measurements in millimetres and centimetres, timber is ordered in metres (often referred to as lineal metres), so we have to convert all our measurements to metres.

Building a house also involves many area and volume calculations and unit conversions.

Lesson starter: House plans

All homes start from a plan, which is usually designed by an architect and shows most of the basic features and measurements that are needed to build the house. Measurements are given in millimetres.



- How many bedrooms are there?
- What are the dimensions of the master bedroom (i.e. BED 1)?
- What are the dimensions of the master bedroom, in metres?
- Will the rumpus room fit a pool table that measures $2.5\,\text{m} \times 1.2\,\text{m}$, and still have room to play?
- How many cars do you think will fit in the garage?

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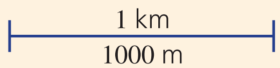
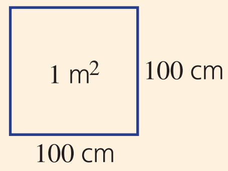
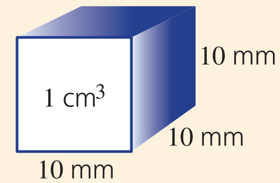
Key ideas

- To convert units, draw an appropriate diagram and use it to find the conversion factor. For example:







$1\text{ km} = 1000\text{ m}$

$1\text{ m}^2 = 100 \times 100$
$= 10\,000\text{ cm}^2$

$1\text{ cm}^3 = 10 \times 10 \times 10$
$= 1000\text{ mm}^3$

- Conversions:

Length

$$\text{km} \underset{\div 1000}{\overset{\times 1000}{\rightleftarrows}} \text{m} \underset{\div 100}{\overset{\times 100}{\rightleftarrows}} \text{cm} \underset{\div 10}{\overset{\times 10}{\rightleftarrows}} \text{mm}$$

Area

$$\text{km}^2 \underset{\div 1000^2}{\overset{\times 1000^2}{\rightleftarrows}} \text{m}^2 \underset{\div 100^2}{\overset{\times 100^2}{\rightleftarrows}} \text{cm}^2 \underset{\div 10^2}{\overset{\times 10^2}{\rightleftarrows}} \text{mm}^2$$

Volume

$$\text{km}^3 \underset{\div 1000^3}{\overset{\times 1000^3}{\rightleftarrows}} \text{m}^3 \underset{\div 100^3}{\overset{\times 100^3}{\rightleftarrows}} \text{cm}^3 \underset{\div 10^3}{\overset{\times 10^3}{\rightleftarrows}} \text{mm}^3$$

- To multiply by 10, 100, 1000 etc. move the decimal point one place to the right for each zero;
  e.g. $3.425 \times 100 = 342.5$
- To divide by 10, 100, 1000 etc. move the decimal point one place to the left for each zero;
  e.g. $4.10 \div 1000 = 0.0041$
- $10^2 = 10 \times 10 = 100$

  $100^2 = 100 \times 100 = 10\,000$

  $1000^2 = 1000 \times 1000 = 1\,000\,000$

  $10^3 = 10 \times 10 \times 10 = 1000$

  $100^3 = 100 \times 100 \times 100 = 1\,000\,000$

  $1000^3 = 1000 \times 1000 \times 1000$

  $= 1\,000\,000\,000$

Exercise 1A

Understanding

1–3 | 3

1 Write the missing numbers in these sentences involving length.

a There are $\square$ m in 1 km.

b There are $\square$ mm in 1 cm.

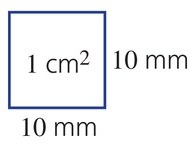
c There are $\square$ cm in 1 m.

2 Write the missing numbers in these sentences involving area units.

a There are $\square$ mm^2 in 1 cm^2.

b There are $\square$ cm^2 in 1 m^2.

c There are $\square$ m^2 in 1 km^2.



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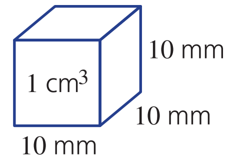
3 Write the missing numbers in these sentences involving volume units.



a There are ☐ mm^3 in 1 cm^3.
b There are ☐ m^3 in 1 km^3.
c There are ☐ cm^3 in 1 m^3.

Fluency | 4–6 | 4–6(½)

Example 1 Converting length measurements

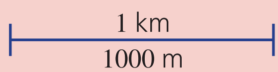
Convert these length measurements to the units shown in the brackets.

a 8.2 km (m) **b** 45 mm (cm)

Solution

a 8.2 km = 8.2 × 1000
= 8200 m

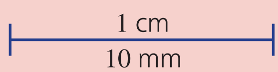
Explanation



1 km = 1000 m

Multiply when converting to a smaller unit.

b 45 mm = 45 ÷ 10
= 4.5 cm



1 cm = 10 mm

Divide when converting to a larger unit.

Now you try

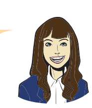
Convert these length measurements to the units shown in the brackets.

a 4.6 m (cm) **b** 3200 m (km)

4 Convert the following measurements of length to the units given in the brackets.

a 4.32 cm (mm) **b** 327 m (km) **c** 834 cm (m)
d 0.096 m (mm) **e** 297.5 m (km) **f** 0.0127 m (cm)

Hint: When converting to a smaller unit, multiply. Otherwise, divide.



Example 2 Converting area measurements

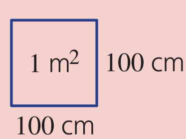
Convert these area measurements to the units shown in the brackets.

a 930 cm^2 (m^2) **b** 0.4 cm^2 (mm^2)

Solution

a 930 cm^2 = 930 ÷ 10 000
= 0.093 m^2

Explanation



1 m^2 = 100 × 100
= 10 000 cm^2

When dividing by 10 000, move the decimal point 4 places to the left.

Continued on next page

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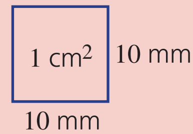
1A

b $0.4\,\text{cm}^2 = 0.4 \times 100$
$= 40\,\text{mm}^2$



$1\,\text{cm}^2 = 10 \times 10$
$= 100\,\text{mm}^2$

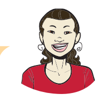
Now you try

Convert these area measurements to the units shown in the brackets.

a $320\,\text{mm}^2$ (cm^2) **b** $0.00024\,\text{km}^2$ (m^2)

5 Convert the following area measurements to the units given in the brackets.

a $3000\,\text{cm}^2$ (mm^2) **b** $0.5\,\text{m}^2$ (cm^2)
c $5\,\text{km}^2$ (m^2) **d** $2\,980\,000\,\text{mm}^2$ (cm^2)
e $537\,\text{cm}^2$ (mm^2) **f** $0.023\,\text{m}^2$ (cm^2)



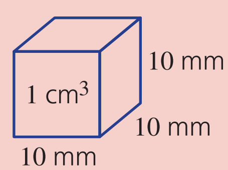
Hint:
$1\,\text{cm}^2 = 100\,\text{mm}^2$
$1\,\text{m}^2 = 10\,000\,\text{cm}^2$
$1\,\text{km}^2 = 1\,000\,000\,\text{m}^2$

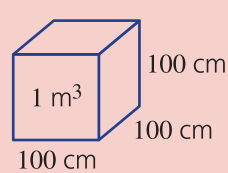
Example 3 Converting volume measurements

Convert these volume measurements to the units shown in the brackets.

a $3.72\,\text{cm}^3$ (mm^3) **b** $4300\,\text{cm}^3$ (m^3)

Solution	Explanation
a $3.72\,\text{cm}^3 = 3.72 \times 1000$ $= 3720\,\text{mm}^3$	$1\,\text{cm}^3 = 10 \times 10 \times 10$ $= 1000\,\text{mm}^3$
b $4300\,\text{cm}^3 = 4300 \div 1\,000\,000$ $= 0.0043\,\text{m}^3$	$1\,\text{m}^3 = 100 \times 100 \times 100$ $= 1\,000\,000\,\text{cm}^3$





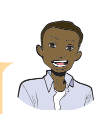
Now you try

Convert these volume measurements to the units shown in the brackets.

a $0.21\,\text{m}^3$ (cm^3) **b** $94\,000\,\text{mm}^3$ (cm^3)

6 Convert these volume measurements to the units given in the brackets.

a $2\,\text{cm}^3$ (mm^3) **b** $0.2\,\text{m}^3$ (cm^3)
c $5700\,\text{mm}^3$ (cm^3) **d** $0.015\,\text{km}^3$ (m^3)
e $28\,300\,000\,\text{m}^3$ (km^3) **f** $762\,000\,\text{cm}^3$ (m^3)



Hint:
$1\,\text{cm}^3 = 1000\,\text{mm}^3$
$1\,\text{m}^3 = 1\,000\,000\,\text{cm}^3$
$1\,\text{km}^3 = 1\,000\,000\,000\,\text{m}^3$

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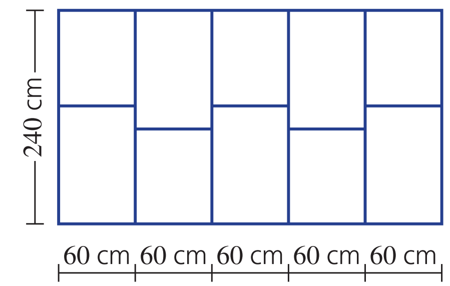
Problem-solving and reasoning — 7–9 | 8–11

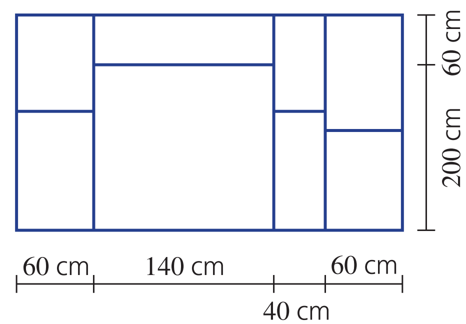
7 An athlete has completed a 5.5 km run. How many metres did the athlete run?

8 Determine the metres of timber needed to construct the following frames.

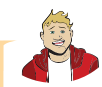
a



b



9 Find the total sum of the measurements given, expressing your answer in the units given in the brackets.



Hint: Convert to the units in brackets. Add up to find the sum.

- **a** 10 cm, 18 mm (mm)
- **b** 1.2 m, 19 cm, 83 mm (cm)
- **c** 453 km, 258 m (km)
- **d** 400 mm^2, 11.5 cm^2 (cm^2)
- **e** 0.3 m^2, 251 cm^2 (cm^2)
- **f** 0.000 03 km^2, 9 m^2, 37 000 000 cm^2 (m^2)
- **g** 482 000 mm^3, 2.5 cm^3 (mm^3)
- **h** 0.000 51 km^3, 27 300 m^3 (m^3)

10 A snail is moving at a rate of 43 mm every minute. How many centimetres will the snail move in 5 minutes?

11 Why do you think that builders measure many of their lengths using only millimetres, even their long lengths?

Special units — — | 12

12 Many units of measurement apart from those relating to mm, cm, m and km are used in our society. Some of these are described here.

Length	Inches	1 inch ≈ 2.54 cm = 25.4 mm
	Feet	1 foot = 12 inches ≈ 30.48 cm
	Miles	1 mile ≈ 1.609 km = 1609 m
Area	Squares	1 square = 100 square feet
	Hectares (ha)	1 hectare = 10 000 m^2
Volume	Millilitres (mL)	1 millilitre = 1 cm^3
	Litres (L)	1 litre = 1000 cm^3

Convert these special measurements to the units given in the brackets. Use the conversion information given above to help.

- **a** 5.5 miles (km)
- **b** 54 inches (feet)
- **c** 10.5 inches (cm)
- **d** 2000 m (miles)
- **e** 5.7 ha (m^2)
- **f** 247 cm^3 (L)
- **g** 8.2 L (mL)
- **h** 5.5 m^3 (mL)
- **i** 10 squares (sq. feet)
- **j** 2 m^3 (L)
- **k** 1 km^2 (ha)
- **l** 152 000 mL (m^3)

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1B Perimeter CONSOLIDATING

Learning intentions

- To be able to calculate the perimeter of a shape
- To be able to find an unknown length given the perimeter

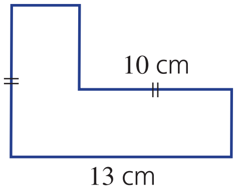
Key vocabulary: perimeter

Perimeter is a measure of length around the outside of a shape. We calculate perimeter when ordering ceiling cornices for a room or materials for fencing a paddock or when designing a house.

Lesson starter: L-shaped perimeters

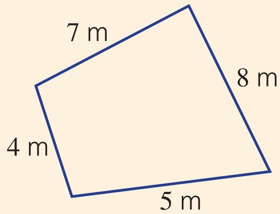
The L-shaped figure on the right includes only right (90°) angles. Only two measurements are given.

- Can you figure out any other side lengths?
- Is it possible to find its perimeter? Why?



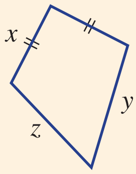
Key ideas

- **Perimeter** is the distance around the outside of a two-dimensional shape.
  - To find the perimeter, we add all the lengths of the sides in the same units.



$P = 4 + 5 + 7 + 8 = 24\text{ m}$

  - When two sides of a shape are the same length they are labelled with the same markings.



$P = 2x + y + z$

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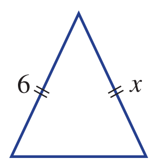
Exercise 1B

Understanding — 1, 2 | 2

1 Write the missing word: The distance around the outside of a shape is called the ________.

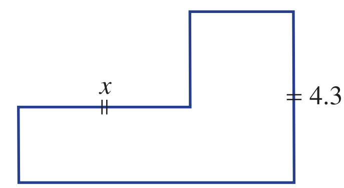
2 Write down the value of x for these shapes.

a



b

c

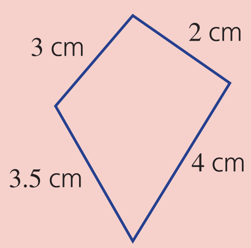


Fluency — 3, 4 | 3–4(½)

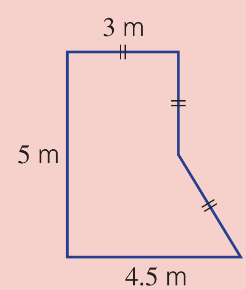
Example 4 Finding perimeters of basic shapes

Find the perimeter of these shapes.

a



b

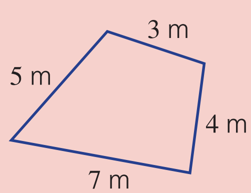


Solution	Explanation
a Perimeter $= 3 + 2 + 4 + 3.5$ $= 12.5\text{ cm}$	Add all the lengths of the sides together.
b Perimeter $= 5 + 4.5 + 3 \times 3$ $= 18.5\text{ m}$	Three lengths have the same markings and therefore are the same length.

Now you try

Find the perimeter of these shapes.

a



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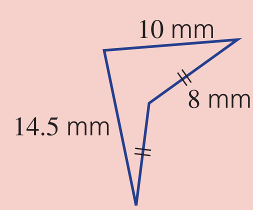

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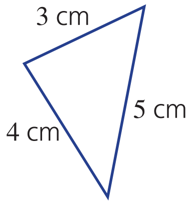
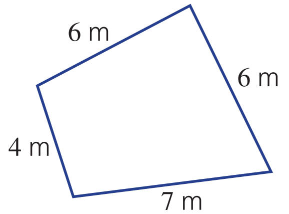
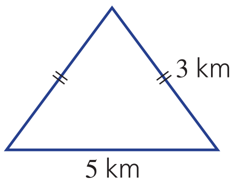
1B

3 Find the perimeter of these shapes.

a


b


Hint: Sides with the same markings are the same length.

c


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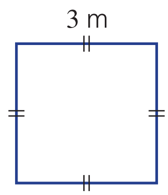

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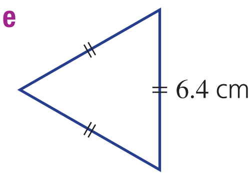

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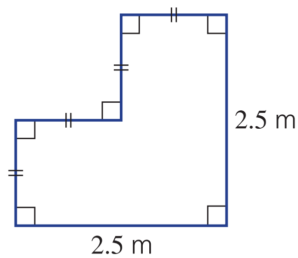
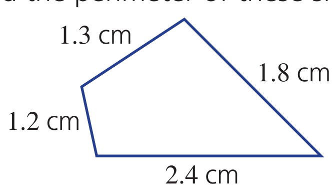


4 Find the perimeter of these shapes.

a


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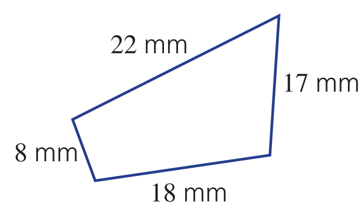

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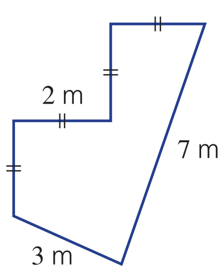

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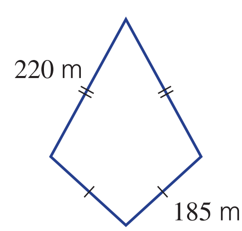

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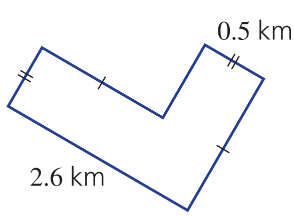

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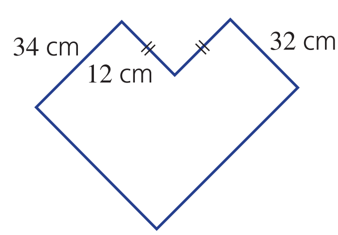

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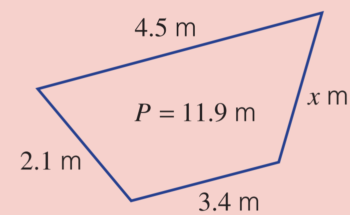
Problem-solving and reasoning

5–7 | 6–10

Example 5 Finding a missing side length

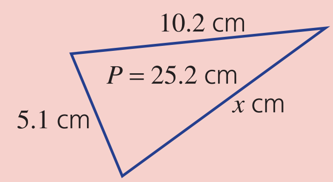
Find the value of x for this shape with the given perimeter.



Solution	Explanation
$4.5 + 2.1 + 3.4 + x = 11.9$	All the sides add to 11.9 in length.
$10 + x = 11.9$	Simplify.
$x = 1.9$	Subtract 10 from both sides to find the value of x.

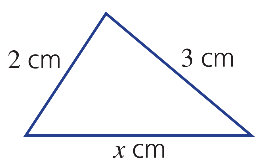
Now you try

Find the value of x for this shape with the given perimeter.



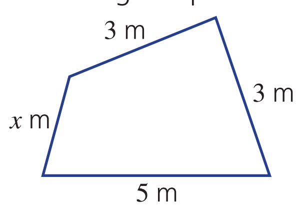
5 Find the value of x for these shapes with the given perimeters.

a



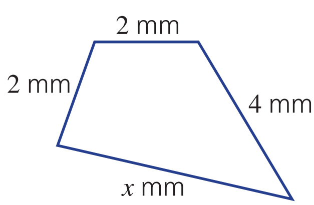
Perimeter = 9 cm

b



Perimeter = 13 m

c

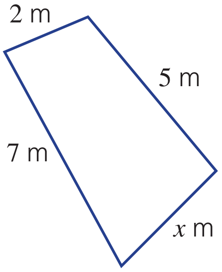


Perimeter = 14 mm

Hint: Add up all the sides and then determine the value of x to suit the given perimeters.

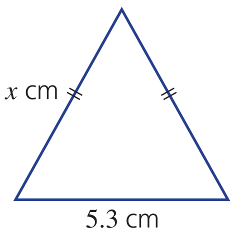
6 Find the value of x for these shapes with the given perimeters.

a



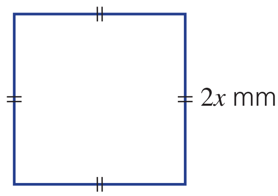
Perimeter = 17 m

b



Perimeter = 22.9 cm

c



Perimeter = 0.8 mm

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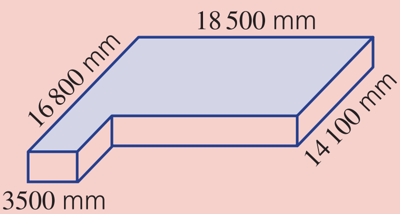
1B

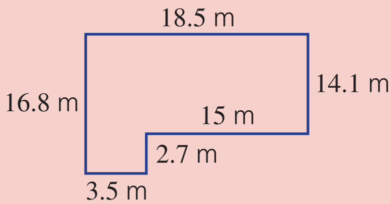
Example 6 Working with perimeter with three dimensions

A concrete slab has the measurements shown.

a Draw a new diagram, showing all the measurements in metres.

b Determine the lineal metres of timber needed to surround it.



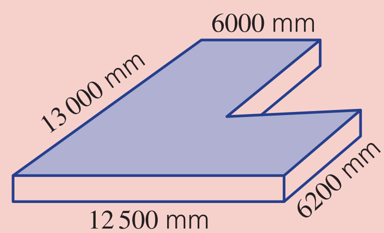
Solution	Explanation
a 	Convert your measurements and place them all on the diagram. $1\text{ m} = 100 \times 10 = 1000\text{ mm}$ Add or subtract to find the missing measurements.
b $\text{Perimeter} = 18.5 + 16.8 + 3.5 + 2.7 + 15 + 14.1$ $= 70.6\text{ m}$	Add all the measurements.
The lineal metres of timber needed is 70.6 m.	Write your answer in words.

Now you try

A concrete slab has the measurements shown.

a Draw a new diagram showing all the measurements in metres.

b Determine the lineal metres of timber needed to surround it.

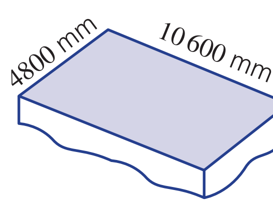


7 Six concrete slabs are shown below.

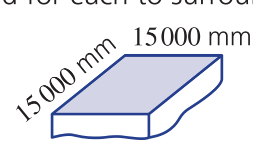
i Draw a new diagram for each with the measurements in metres.

ii Determine the lineal metres of timber needed for each to surround it.

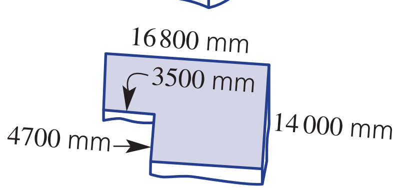
a



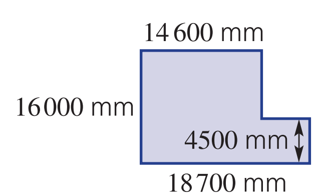
b



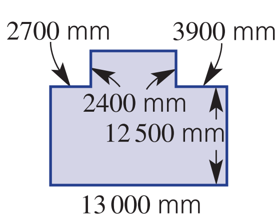
c



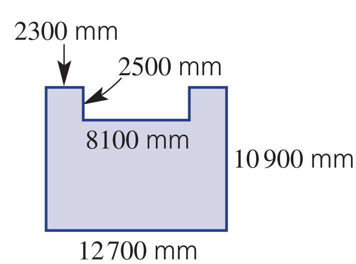
d



e



f



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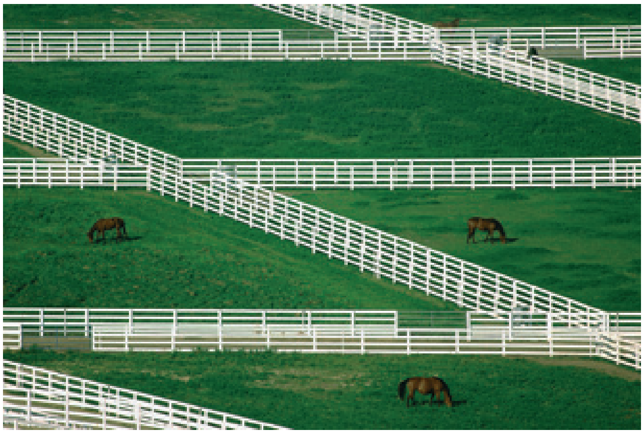
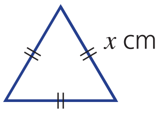
8 A rectangular paddock has perimeter 100 m. Find the width of the paddock if its length is 30 m.

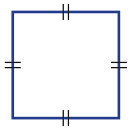


9 The equilateral triangle shown has perimeter 45 cm. Find its side length.

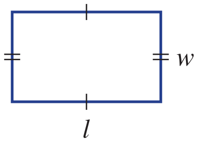


10 Write formulas for the perimeter of these shapes, using the pronumerals given.

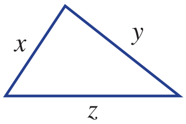
a



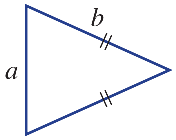
b



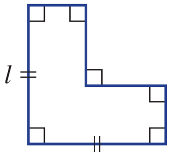
c



d



e



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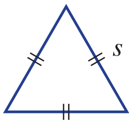

Hint: A formula for perimeter could be $P = l + 2w$ or $P = a + b + c$.

How many different tables? | — | 11, 12

11 A large dining table is advertised with a perimeter of 12 m. The length and width are a whole number of metres (e.g. 1 m, 2 m, …). How many different-sized tables are possible?

12 How many rectangles (using whole number lengths) have perimeters between 16 m and 20 m, inclusive?

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1C Circumference CONSOLIDATING

Learning intentions

- To know the formula for the circumference of a circle
- To be able to find the circumference of a circle
- To be able to find the circumference of circle portions and simple composite shapes

Key vocabulary: circumference, pi, radius, diameter, circle

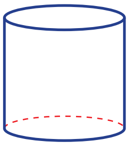
To find the distance around the outside of a circle – the circumference – we use the special number called pi (π). Pi provides a direct link between the diameter of a circle and the circumference of that circle.

The wheel is one of the most useful components in many forms of machinery and its shape, of course, is a circle. One revolution of a vehicle's wheel moves the vehicle a distance equal to the wheel's circumference.

Lesson starter: When circumference = height

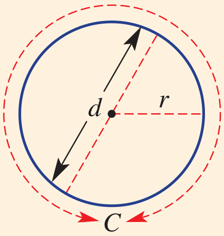
Here is an example of a cylinder.

- Try drawing your own cylinder so that its height is equal to the circumference of the circular top.
- How would you check that you have drawn a cylinder with the correct dimensions? Discuss.



Key ideas

- The **radius (r)** is the distance from the centre of a **circle** to a point on the circle.
- The **diameter (d)** is the distance across a circle through its centre.
  - Radius $= \frac{1}{2}$ diameter or diameter $= 2 \times$ radius
- **Circumference (C)** is the distance around a circle.
  - $C = 2\pi \times$ radius
    $= 2\pi r$
    or $C = \pi \times$ diameter
    $= \pi d$
  - π **(pi)** is a special number and can be found on your calculator.
    It can be approximated by $\pi \approx 3.142$.



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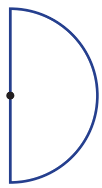
Exercise 1C

Understanding | 1–3 | 3

1 **a** The distance from the centre of a circle to its outside edge is called the ________.
b The distance across a circle, through its centre is called the ________.
c The distance around a circle is called the ________.

2 Write the formula for the circumference of a circle using:
a d for diameter
b r for radius

3 What fraction of a circle is shown here?

a


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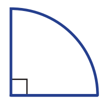

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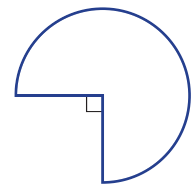
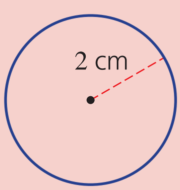


Fluency | 4, 5 | 4–5(½)

Example 7 Finding the circumference of a circle

Find the circumference of these circles to two decimal places.

a


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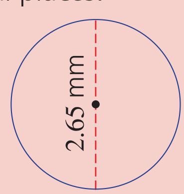
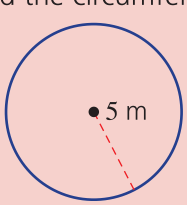
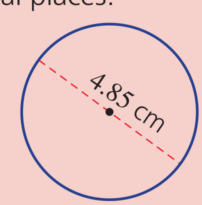


Solution	Explanation
a $C = 2\pi r$	Write the formula involving the radius, r.
$= 2\pi(2)$	Substitute $r = 2$.
$= 12.57$ cm (to 2 d.p.)	Round your answer to two decimal places.
b $C = \pi d$	Write the formula involving diameter.
$= \pi(2.65)$	Substitute $d = 2.65$.
$= 8.33$ mm (to 2 d.p.)	Round your answer to two decimal places.

Now you try

Find the circumference of these circles to two decimal places.

a


b


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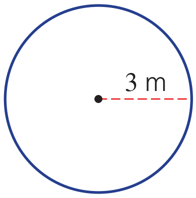
1C

4 Find the circumference of these circles, to two decimal places.

a


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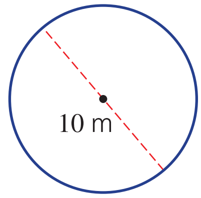

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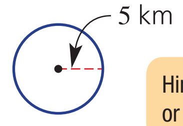
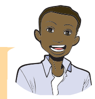


Hint: Use $C = 2\pi r$ or $C = \pi d$.



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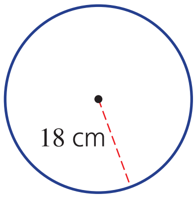
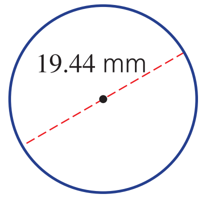


e


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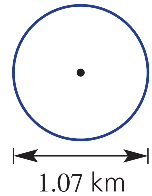
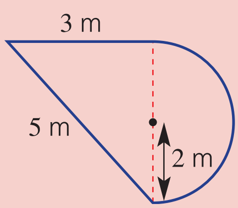


Example 8 Finding perimeters of composite shapes

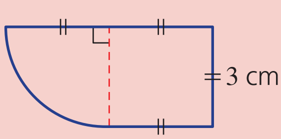
Find the perimeter of this composite shape, to two decimal places.



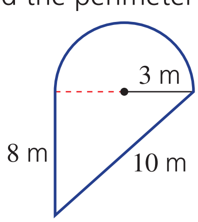
Solution	Explanation
$P = 3 + 5 + \frac{1}{2} \times 2\pi(2)$	Add all the sides, including half a circle.
$= 8 + 2\pi$	Simplify.
$= 14.28$ m (to 2 d.p.)	Round your answer as instructed.

Now you try

Find the perimeter of this composite shape, to two decimal places.



5 Find the perimeter of these composite shapes, correct to two decimal places.

a


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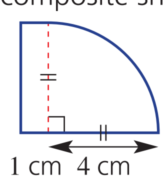

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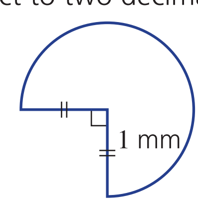
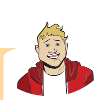


Hint: Don't forget to add the straight sides to the fraction $\left(\frac{1}{4}, \frac{1}{2} \text{ or } \frac{3}{4}\right)$ of the circumference.



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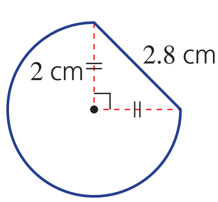

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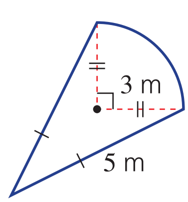

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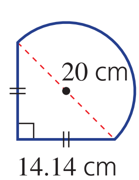

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Problem-solving and reasoning 6–8 7–10

6 David wishes to build a circular fish pond. The diameter of the pond is to be 3 m.

a How many lineal metres of bricks are needed to surround it? Round your answer to two decimal places.

b What is the cost if the bricks are \$45 per metre? (Use your answer from part **a**.)

7 The wheels of a bike have a diameter of 1 m.

a How many metres will the bike travel (to two decimal places) after:

i one full turn of the wheels?

ii 15 full turns of the wheels?

Hint: For one revolution, use $C = \pi d$.

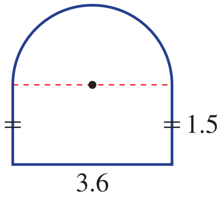
b How many kilometres will the bike travel after 1000 full turns of the wheels? (Give your answer correct to two decimal places.)

8 What is the minimum number of times a wheel of diameter 1 m needs to spin to cover a distance of 1 km? You will need to find the circumference of the wheel first. Give your answer as a whole number.

9 Find the perimeter of these composite shapes, correct to two decimal places.

Hint: Make sure you know the radius or diameter of the circle you are dealing with.

a



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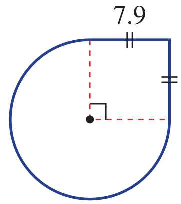

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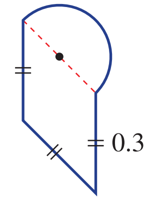

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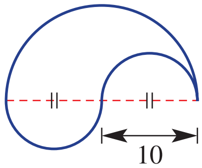

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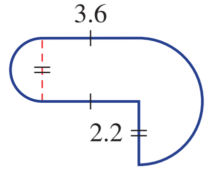

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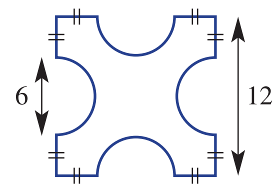

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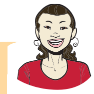
1C

10 **a** Rearrange the formula for the circumference of a circle, $C = 2\pi r$, to write r in terms of C.

b Find, to two decimal places, the radius of a circle with the given circumference.

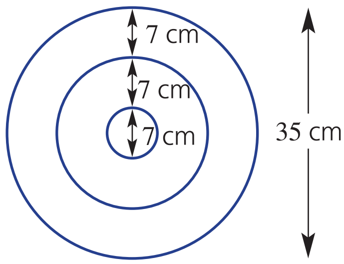
- **i** 35 cm
- **ii** 1.85 m
- **iii** 0.27 km

Hint: To make r the subject, divide both sides by 2π.



Target practice — 11

11 A target is made up of three rings, as shown.



a Find the radius of the smallest ring.

b Find, to two decimal places, the circumference of the:

- **i** smallest ring
- **ii** middle ring
- **iii** outside ring

c If the circumference of a different ring is 80 cm, what would be its radius, correct to two decimal places?

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1D Area

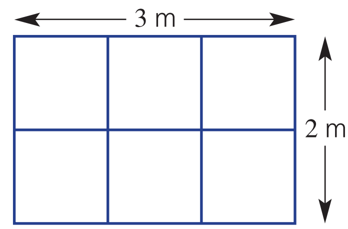
Learning intentions

- To know the formulas for the areas of simple shapes
- To be able to find the area of simple shapes

Key vocabulary: area, square, rectangle, triangle, rhombus, parallelogram, trapezium, perpendicular

In this simple diagram, a rectangle, with side lengths 2 m and 3 m, has an area of 6 square metres or 6 m^2. This is calculated by counting the number of squares (each measuring a square metre) that make up the rectangle.

We use formulas to help us quickly count the number of square units contained within a shape. For this rectangle, for example, the formula $A = lw$ simply tells us to multiply the length by the width to find the area.

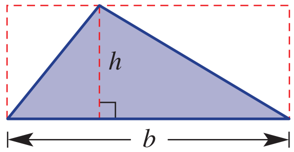


Area = 6 m^2

Lesson starter: How does $A = \frac{1}{2}bh$ work for a triangle?

Look at this triangle, including its rectangular red dashed lines.

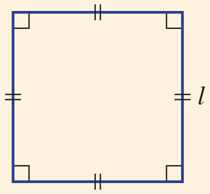
- How does the shape of the triangle relate to the shape of the outside rectangle?
- How can you use the formula for a rectangle to help find the area of the triangle (or parts of the triangle)?
- Why is the rule for the area of a triangle given by $A = \frac{1}{2}bh$?



Key ideas

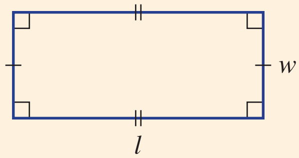
- The **area** of a two-dimensional shape is the number of square units contained within its boundaries.
- Some of the common area formulas are as follows.

Square



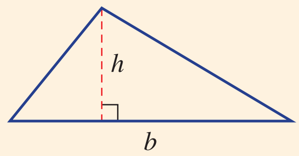
Area = l^2

Rectangle



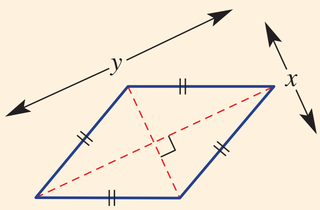
Area = lw

Triangle



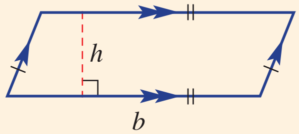
Area = $\frac{1}{2}bh$

Rhombus



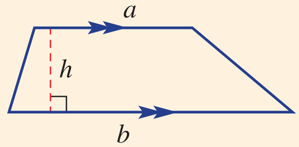
Area = $\frac{1}{2}xy$

Parallelogram



Area = bh

Trapezium



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

- The 'height' in a triangle, parallelogram or trapezium should be **perpendicular** (at 90°) to the base.

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Exercise 1D

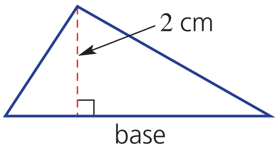
Understanding	1, 2	2

1 Match each shape (**a**–**f**) with its area formula (**A**–**F**).

a square
b rectangle
c rhombus
d parallelogram
e trapezium
f triangle

A $A = \frac{1}{2}bh$
B $A = lw$
C $A = bh$
D $A = \frac{1}{2}(a + b)h$
E $A = l^2$
F $A = \frac{1}{2}xy$

2 These shapes show the base and a height length. Write down the given height of each shape.

a


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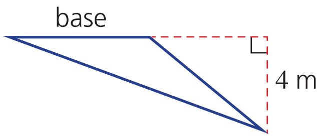
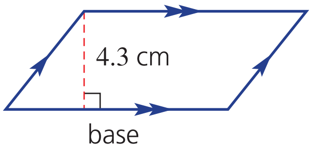


c


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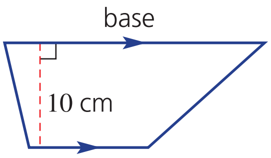

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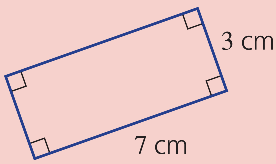
Fluency

3, 4 | 3–4(½)

Example 9 Using area formulas

Find the area of these basic shapes.

a



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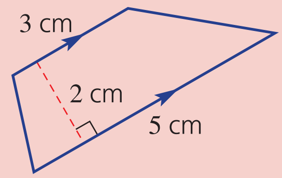
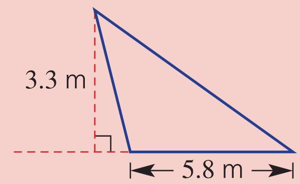


c

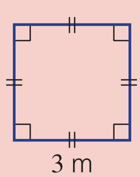


Solution	Explanation
a Area $= lw$	Write the formula for the area of a rectangle.
$= 7 \times 3$	Substitute the lengths $l = 7$ and $w = 3$.
$= 21\text{ cm}^2$	Simplify and include the units.
b Area $= \frac{1}{2}(a+b)h$	Write the formula for the area of a trapezium.
$= \frac{1}{2}(3+5) \times 2$	Substitute the lengths $a = 3$, $b = 5$ and $h = 2$.
$= 8\text{ cm}^2$	Simplify and include the units.
c Area $= \frac{1}{2}bh$	Write the formula for the area of a triangle.
$= \frac{1}{2} \times 5.8 \times 3.3$	Substitute the lengths $b = 5.8$ and $h = 3.3$.
$= 9.57\text{ m}^2$	Simplify and include the units.

Now you try

Find the area of these basic shapes.

a



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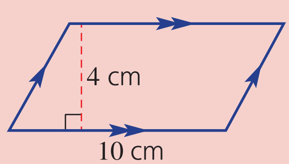

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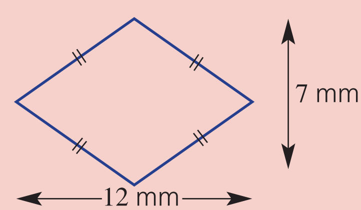
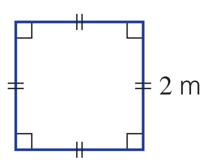


3 Find the area of these basic shapes.

a



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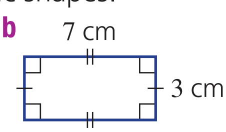
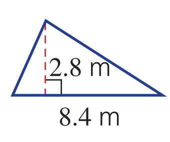
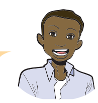


c



Hint: First, choose the correct formula and substitute for each pronumeral (letter).



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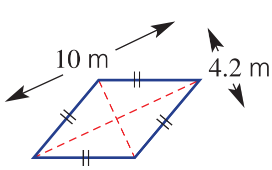

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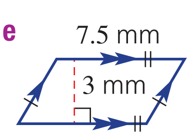

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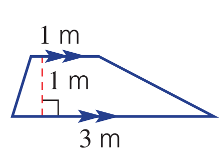

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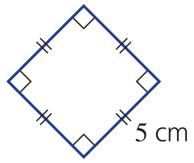
1D

4 Find the area of these basic shapes.

a


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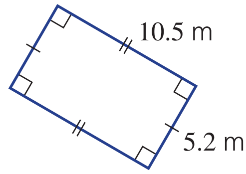

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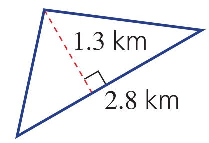

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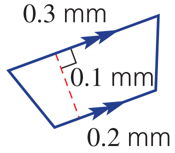

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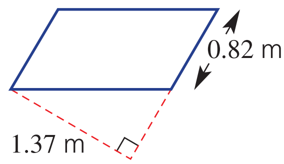

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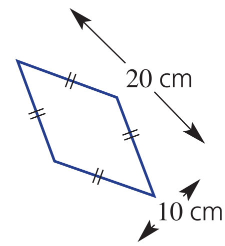
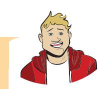


Problem-solving and reasoning

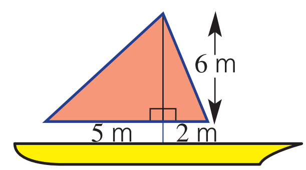
5–8 | 7–11

5 A rectangular table top is 1.2 m long and 80 cm wide.
Find the area of the table top using:
- a square metres (m^2)
- b square centimetres (cm^2)

Hint: First convert to the units that you want to work with.

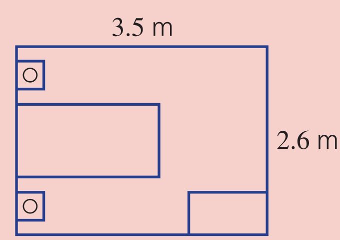


6 Two triangular sails have side lengths as shown. Find the total area of the two sails.



Example 10 Applying area formulas

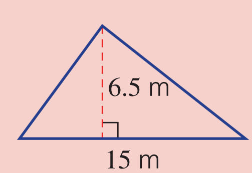
Christine decides to use carpet to cover the floor of her rectangular bedroom, shown at right. Determine:
- a the area of floor to be covered
- b the total cost if the carpet costs \$32 per square metre



Solution	Explanation
a Area of floor $= l \times w$ $= 3.5 \times 2.6$ $= 9.1\ m^2$	The room is a rectangle, so use $A = l \times w$ to calculate the total floor space.
b Cost of carpet $= 9.1 \times 32$ $= \$291.20$	Every square metre of carpet costs \$32.

Now you try

Richo decides to lay lawn on his triangular backyard, shown at right. Determine:
- a the area of lawn to be laid
- b the total cost if lawn costs \$11 per square metre



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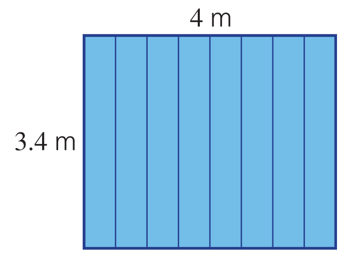
7 Jack's shed is to have a flat rectangular roof, which he decides to cover with metal sheets.

a Determine the total area of the roof.

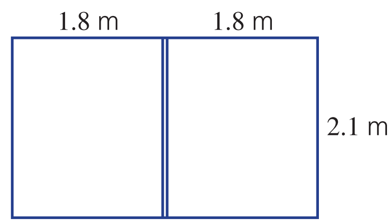
b If the metal roofing costs \$11 a square metre, how much will it cost in total?



8 A sliding door has two glass panels. Each of these is 2.1 m high and 1.8 m wide.

a How many square metres of glass are needed?

b What is the total cost of the glass if the price is \$65 per square metre?

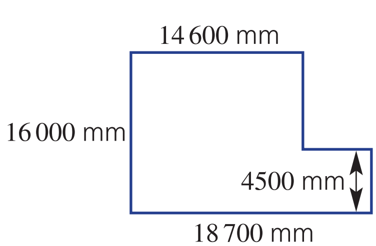


9 A rectangular window has a whole number measurement for its length and width and its area is 24 m^2. Write down the possible lengths and widths for the window.

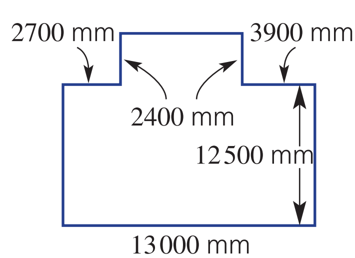
10 Determine the area of the houses shown (if all angles are right angles), in square metres (correct to two decimal places).

Hint: Note that there are 1000 mm in 1 m.

a



b



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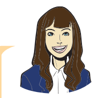
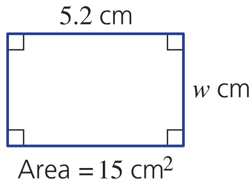
1D

11 Find the value of the pronumeral in these shapes, rounding your answer to two decimal places each time.



Hint: First, write the appropriate formula and substitute for the area and length pronumerals. Then solve for the unknown.

a


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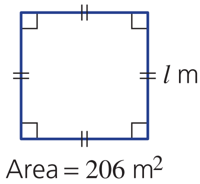

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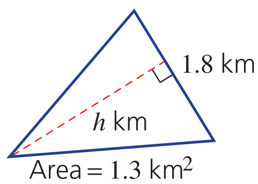

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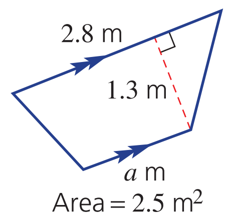

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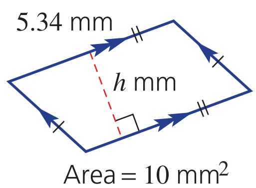

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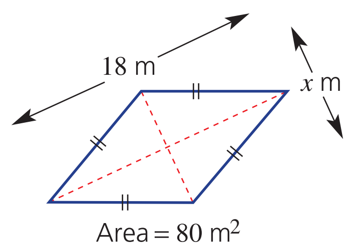
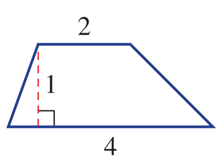


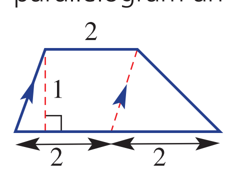
Four ways to find the area of a trapezium — 12

12 Find the area of this trapezium using each of the suggested methods.

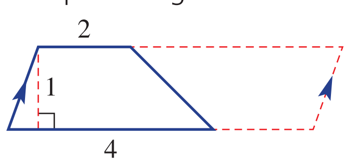
a formula $A = \frac{1}{2}(a + b)h$



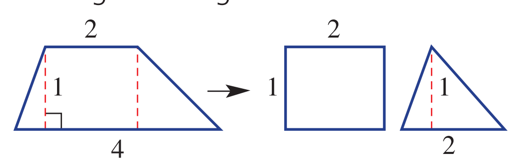
b parallelogram and triangle



c half-parallelogram



d rectangle + triangle



ISBN 978-1-108-87859-3

1E Area of circles and sectors

Learning intentions

- To know the formula for the area of a circle
- To be able to calculate what fraction of a circle is represented by a sector
- To be able to find the area of circles and sectors

Key vocabulary: sector, circle, radius, diameter, pi

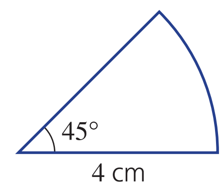
Like its circumference, a circle's area is linked to the special number pi (π). The area is the product of pi and the square of the radius, so $A = \pi r^2$.

Knowing the formula for the area of a circle helps us build circular objects, plan water sprinkler systems and estimate the damage caused by an oil slick from a ship in calm seas.

Lesson starter: What fraction is that?

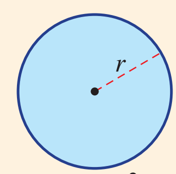
When finding areas of sectors, we first need to decide what fraction of a circle we are dealing with. This sector, for example, has a radius of 4 cm and a 45° angle.

- What fraction of a full circle is shown in this sector?
- How can you use this fraction to help find the area of this sector?
- How would you set out your working to find its area?



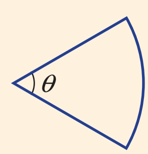
Key ideas

- The formula for finding the area (A) of a circle of radius r is given by the equation: $A = \pi r^2$.
- When the diameter (d) of the circle is given, determine the radius before calculating the area of the circle: $r = d \div 2$.



$A = \pi r^2$

- A **sector** is a portion of a circle including two radii.
- The angle of a sector of a circle determines the fraction of the circle. A full circle is 360°.
  - This sector is $\dfrac{\theta}{360}$ of a circle.



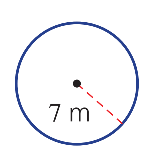
  - The area of a sector is given by $A = \dfrac{\theta}{360} \times \pi r^2$

Exercise 1E

Understanding	1–3	3

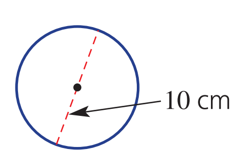
1 Which is the correct working step for the area of this circle?

A $A = \pi(7)$ **B** $A = 2\pi(7)$ **C** $A = \pi(14)^2$
D $A = (\pi 7)^2$ **E** $A = \pi(7)^2$



2 Which is the correct working step for the area of this circle?

A $A = \pi(10)^2$ **B** $A = (\pi 10)^2$
C $A = \pi(5)^2$ **D** $A = 2\pi(5)$
E $A = 5\pi$



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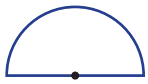
1E

3 What fraction of a circle is shown by these sectors? Simplify your fraction.

a



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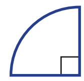

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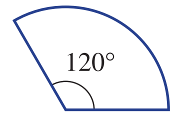
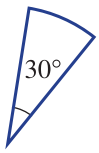


d



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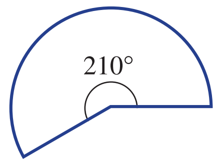

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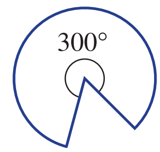
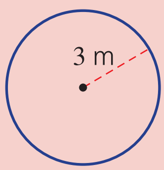


Fluency   4, 5   4–5(½)

Example 11 Finding areas of circles

Find the area of these circles, correct to two decimal places.

a



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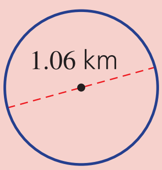
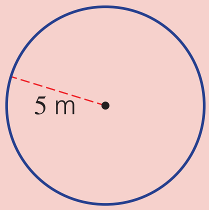


Solution	Explanation
a $A = \pi r^2$	Write the formula.
$= \pi(3)^2$	Substitute $r = 3$.
$= \pi \times 9$	Evaluate $3^2 = 9$ and then multiply by π.
$= 28.27\ \text{m}^2$ (to 2 d.p.)	
b Radius $r = 1.06 \div 2 = 0.53\ \text{km}$	Find the radius, given the diameter of 1.06.
$A = \pi r^2$	Write the formula.
$= \pi(0.53)^2$	Substitute $r = 0.53$.
$= 0.88\ \text{km}^2$ (to 2 d.p.)	Write your answer to two decimal places with units.

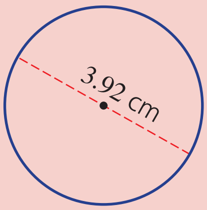
Now you try

Find the area of these circles, correct to two decimal places.

a



b



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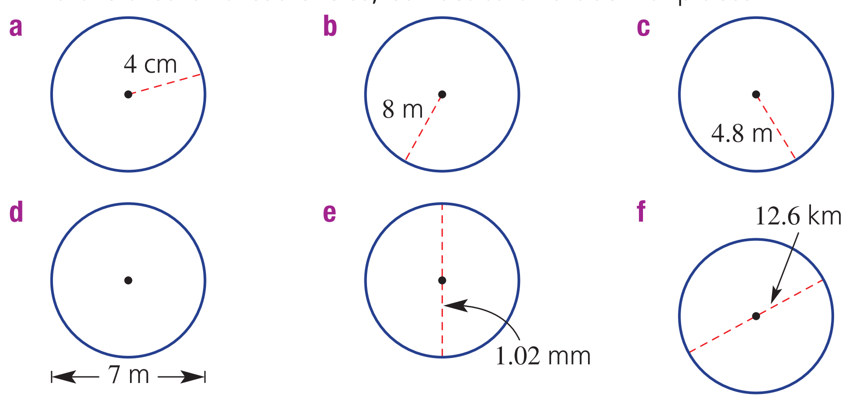
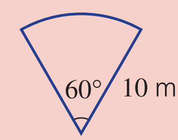
4 Find the area of these circles, correct to two decimal places.



Hint: Remember: $r = d \div 2$

Example 12 Finding areas of sectors

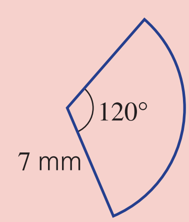
Find the area of this sector, correct to two decimal places.



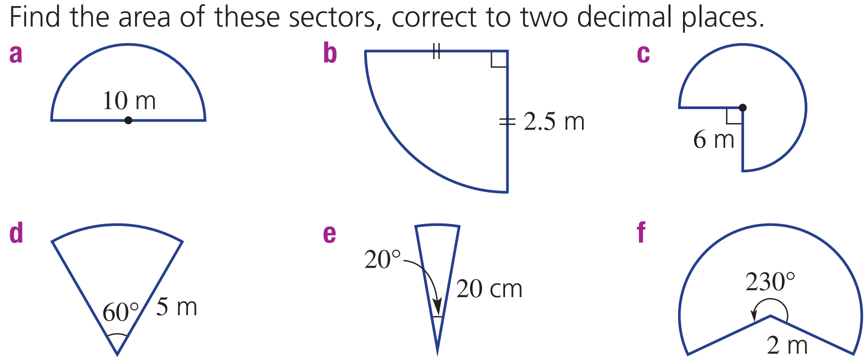
Solution	Explanation
Fraction of circle $= \frac{60}{360} = \frac{1}{6}$	The sector uses 60° out of the 360° in a whole circle.
Area $= \frac{1}{6} \times \pi r^2$	Write the formula, including the fraction.
$= \frac{1}{6} \times \pi(10)^2$	Substitute $r = 10$.
$= 52.36\ \text{m}^2$ (to 2 d.p.)	Write your answer to two decimal places.

Now you try

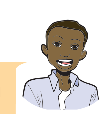
Find the area of this sector, correct to two decimal places.



5 Find the area of these sectors, correct to two decimal places.



Hint: First determine the fraction of a full circle that you are dealing with.



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1E

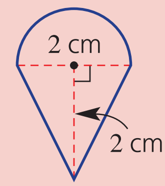
Problem-solving and reasoning

6–8 | 7, 8, 9(½)

6 A pizza with 40 cm diameter is divided into eight equal parts. Find the area of each portion, correct to one decimal place.

Example 13 Finding areas of composite shapes

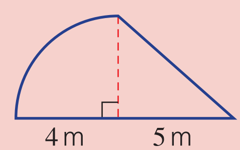
Find the area of this composite shape, correct to two decimal places.

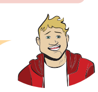


Solution	Explanation
$A = \frac{1}{2}\pi r^2 + \frac{1}{2}bh$	The shape is made up of a semicircle and a triangle. Write the formulas for both shapes.
$= \frac{1}{2}\pi(1)^2 + \frac{1}{2}(2)(2)$	Substitute $r = 1$, $b = 2$ and $h = 2$.
$= 1.5707... + 2$	
$= 3.57\text{ cm}^2$ (to 2 d.p.)	Write your answer to two decimal places with units.

Now you try

Find the area of this composite shape, correct to two decimal places.

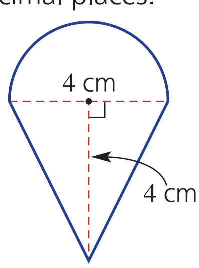




Hint: For Question 7, find the area of each shape that makes up the larger shape, then add them. For example, triangle + semicircle.

7 Find the area of these composite shapes, correct to two decimal places.

a



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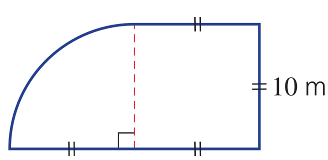

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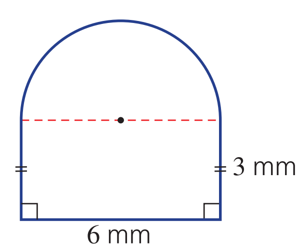
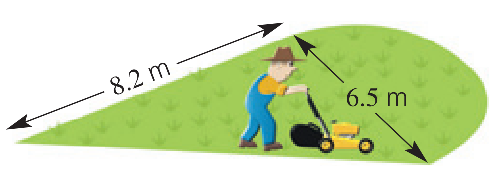


8 The lawn area in a backyard is made up of a semicircular region with diameter 6.5 m and a right-angled triangular region of length 8.2 m, as shown. Find the total area of lawn in the backyard, correct to two decimal places.



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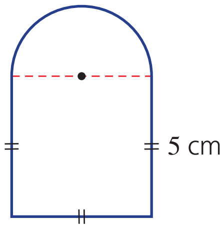
9 Find the area of these composite shapes, correct to one decimal place.

a


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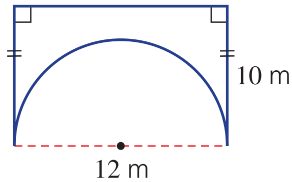

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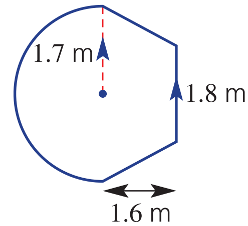
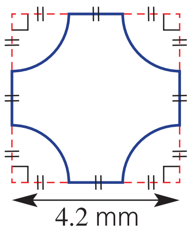


Hint: Use addition or subtraction, depending on the shape given.

d


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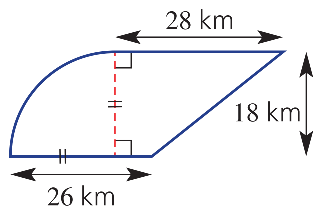

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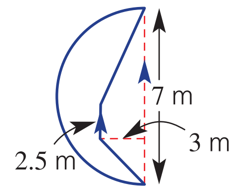
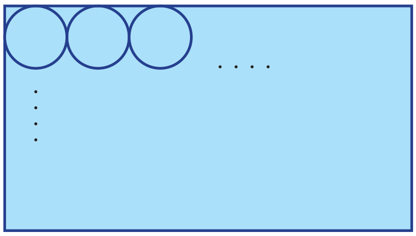


Circular pastries — 10

10 A rectangular piece of pastry is used to create small circular pastry discs for the base of Christmas tarts. The rectangular piece of pastry is 30 cm long and 24 cm wide, and each circular piece has a diameter of 6 cm.



a How many circular pieces of pastry can be removed from the rectangle?

b Find the total area removed from the original rectangle, correct to two decimal places.

c Find the total area of pastry remaining, correct to two decimal places.

d If the remaining pastry was collected and re-rolled to the same thickness, how many circular pieces could be cut? (Assume that the pastry can be re-rolled and cut many times.)

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1F Surface area of prisms

Learning intentions

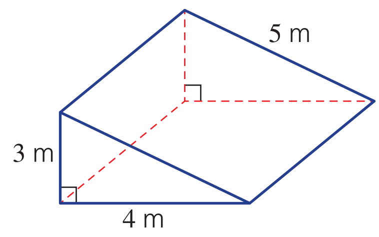
- To know that the surface area of a solid can be represented using a net
- To be able to calculate the total surface area of a prism

Key vocabulary: total surface area, prism, net, cross-section

The total surface area of a three-dimensional object can be found by finding the sum of the areas of each of the shapes that make up the surface of the object.

Lesson starter: Which net?

The solid below is a triangular prism with a right-angled triangle as its cross-section.

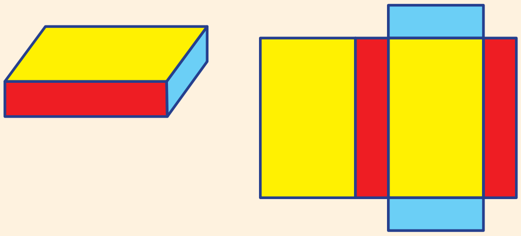


- How many different types of shapes make up its outside surface?
- What is a possible net for the solid? Is there more than one?
- How would you find the total surface area?

Key ideas

- A **prism** is a solid with a constant **cross-section** shape.
- To calculate the **total surface area (TSA)** of a solid or prism:
  - Draw a **net** (i.e. a two-dimensional drawing that includes all the surfaces).
  - Determine the area of each shape inside the net.
  - Add the areas of each shape together.

Solid **Net**



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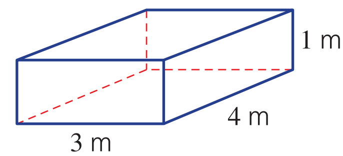
Exercise 1F

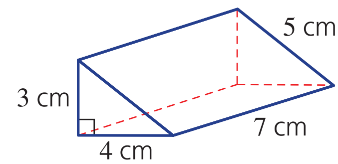
Understanding	1–3	3

1 A two-dimensional drawing of all the faces of a solid is called a _________.

2 For a rectangular prism, answer the following.
  a How many faces does the prism have?
  b How many *different* rectangles form the surface of the prism?



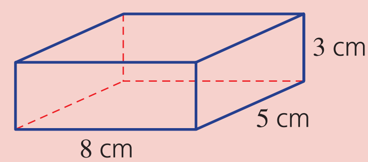
3 For this triangular prism, answer the following.
  a What is the area of the largest surface rectangle?
  b What is the area of the smallest surface rectangle?
  c What is the combined area of the two triangles?
  d What is the total surface area?



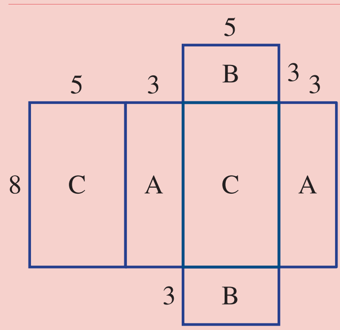
Fluency	4, 5	4–6

Example 14 Finding the TSA of a rectangular prism

Find the total surface area (TSA) of this rectangular prism by first drawing its net.



Solution



Explanation

Draw the net of the solid, labelling the lengths and shapes of equal areas.

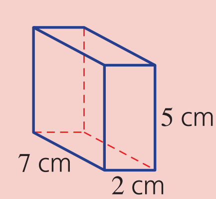
TSA = 2 × area of A + 2 × area of B + 2 × area of C — Describe each area.

$= 2 \times (8 \times 3) + 2 \times (5 \times 3) + 2 \times (8 \times 5)$ — Substitute the correct lengths.

$= 158\ \text{cm}^2$ — Simplify and include units.

Now you try

Find the total surface area (TSA) of this rectangular prism by first drawing its net.



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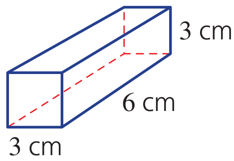
1F

4 Find the total surface area (TSA) of these rectangular prisms by first drawing their nets.

a



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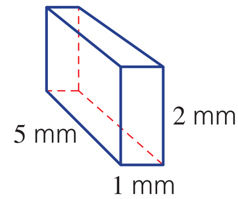

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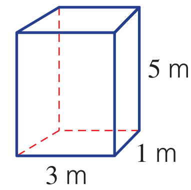
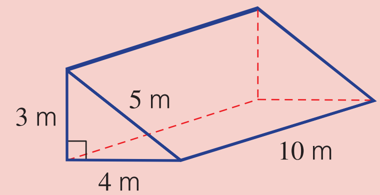
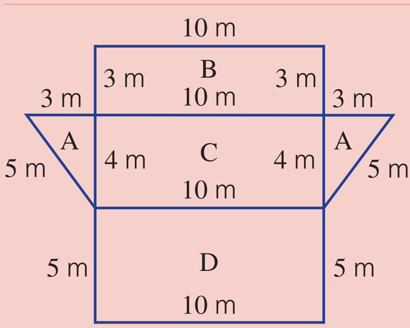


Example 15 Finding the TSA of a triangular prism

Find the TSA of the triangular prism shown.



Solution



Explanation

Draw a net of the object with all the measurements and label the sections to be calculated.

Total surface area

$= 2 \times \text{area A} + \text{area B} + \text{area C} + \text{area D}$

$= 2 \times \left(\frac{1}{2} \times 3 \times 4\right) + (3 \times 10) + (4 \times 10) + (5 \times 10)$

$= 12 + 30 + 40 + 50$

$= 132\ \text{m}^2$

There are two triangles with the same area and three different rectangles.

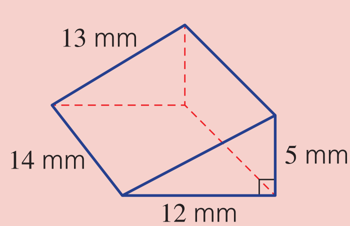
Substitute the correct lengths.

Calculate the area of each shape.

Add the areas together.

Now you try

Find the TSA of the triangular prism shown.



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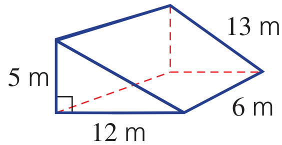
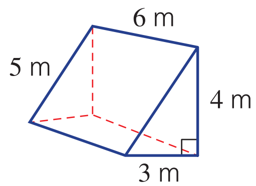
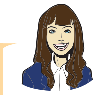
5 Find the total surface area of the following prisms.

a



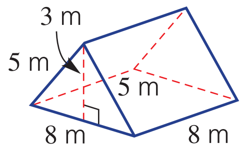
b



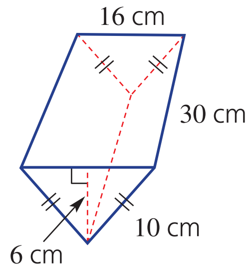


Hint: There are three rectangles and two identical triangles.

c

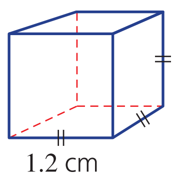


d



6 Find the TSA of these objects by first drawing a net.

a



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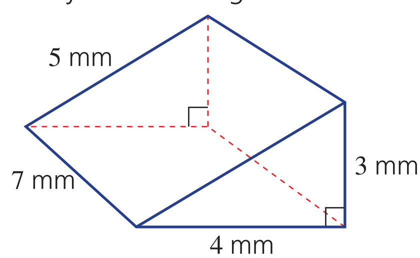

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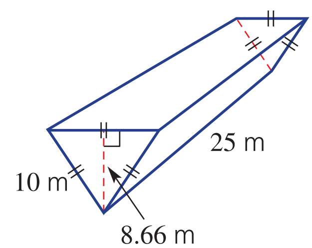
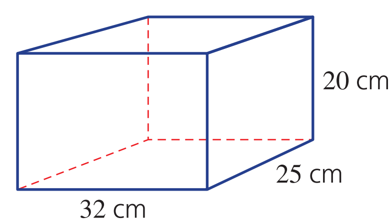


Problem-solving and reasoning

7–9	9–12

7 A cube with side lengths of 8 cm is to be painted all over with bright red paint. What is the total surface area that is to be painted?

8 What is the minimum amount of paper required to wrap a box with dimensions 25 cm wide, 32 cm long and 20 cm high?



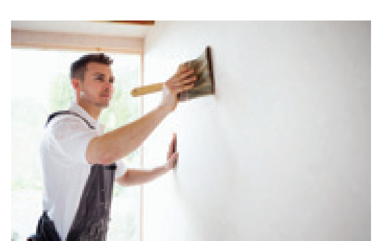
9 An open-topped box is to be covered inside and out with a special material. If the box is 40 cm long, 20 cm wide and 8 cm high, find the minimum amount of material required to cover the box.

Hint: Count both inside and outside but do not include the top.

10 David wants to paint his bedroom. The ceiling and walls are to be the same colour. If the room measures 3.3 m × 4 m and the ceiling is 2.6 m high, find the amount of paint needed if:

a each litre covers 10 square metres

b each litre covers 5 square metres



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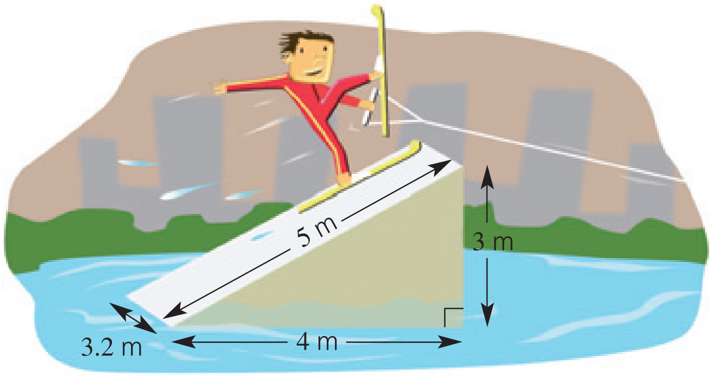
1F

11 A ski ramp in the shape of a triangular prism needs to be painted before the Moomba Classic waterskiing competition in Melbourne is held. The base and sides of the ramp require a fully waterproof paint, which covers 2.5 square metres per litre. The top needs special smooth paint, which covers only 0.7 square metres per litre.

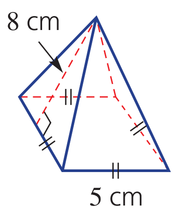


a Determine the amount of each type of paint required. Round your answers to two decimal places where necessary.

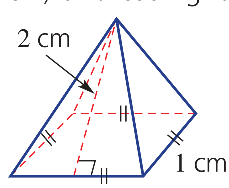
b If the waterproof paint is \$7 per litre and the special smooth paint is \$20 per litre, calculate the total cost of painting the ramp, to the nearest cent. (Use the exact answers from part **a** to help.)

12 Find the total surface area (TSA) of these right square-based pyramids.

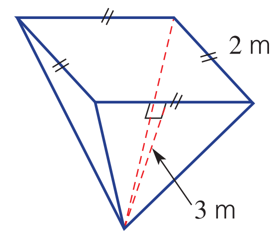
a



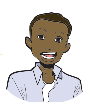
b



c

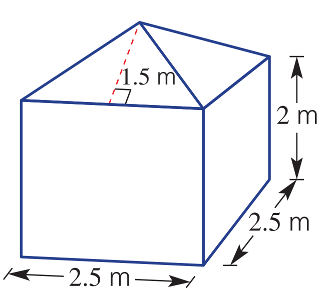


Hint: There is one square and four identical triangles.



Will I have enough paint? — 13

13 I have 6 litres of paint and on the tin it says that the coverage is $5.5\,\text{m}^2$ per litre. I wish to paint the four outside walls of a shed and the roof, which has four identical triangular sections. Will I have enough paint to complete the job?



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Progress quiz

1A

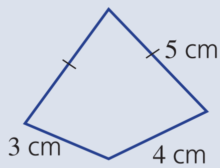
1 Convert the given measurements to the units shown in brackets.

a 9 km (m) **b** $4.5\ \text{m}^2$ (cm^2) **c** $145\ \text{cm}^3$ (mm^3)

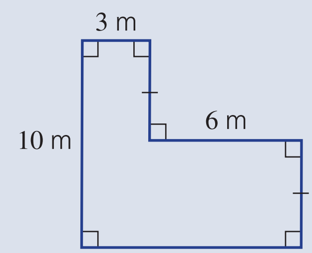
1B

2 Find the perimeter of these shapes.

a



b

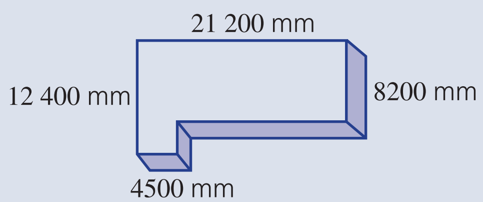


1B

3 A concrete slab is shown below.

a Draw a new diagram, showing all the measurements in metres.

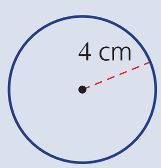
b Determine the lineal metres of timber needed to surround it.



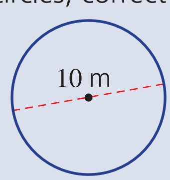
1C/E

4 Find the circumference (C) and area (A) of these circles, correct to two decimal places.

a



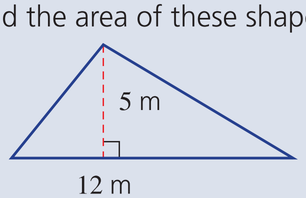
b



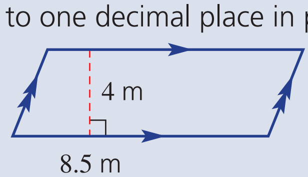
1D/E

5 Find the area of these shapes. Round your answer to one decimal place in part **d**.

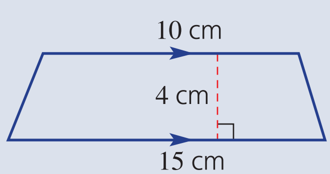
a



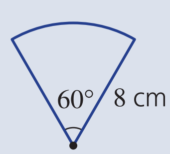
b



c



d



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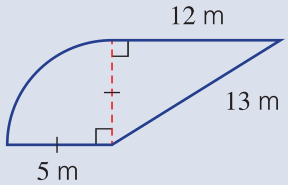
1D

6 A rectangular kitchen floor is to be replaced with wooden floorboards. If the floorboards cost \$46 per square metre, determine the cost to cover the kitchen floor if its dimensions are 4.4 m by 3 m.

1C/E

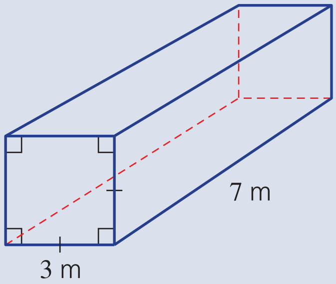
7 Find the area (A) and perimeter (P) of the composite shape shown. Round each answer to one decimal place.



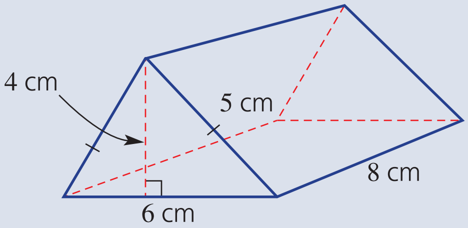
1F

8 Find the TSA of the following prisms. (Drawing a net may help you.)

a



b



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1G Surface area of a cylinder ★

Learning intentions

- To understand how the net of a cylinder can be drawn to show the total surface area
- To know the formula for the total surface area of a cylinder
- To be able to calculate the total surface area of a cylinder

Key vocabulary: cylinder, area, prism, circumference, net, cross-section

Like a prism, a cylinder has a uniform cross-section with identical circles as its two ends. The curved surface of a cylinder can be rolled out to form a rectangle that has a length equal to the circumference of the circle.

A can is a good example of a cylinder. We need to know the area of the ends and the curved surface area in order to cut sections from a sheet of aluminium to manufacture the can.

Lesson starter: Why $2\pi rh$?

We can see from the net of a cylinder (see the diagram below in Key ideas) that the total area of the two circular ends is $2 \times \pi r^2$ or $2\pi r^2$. For the curved part, though, consider the following.

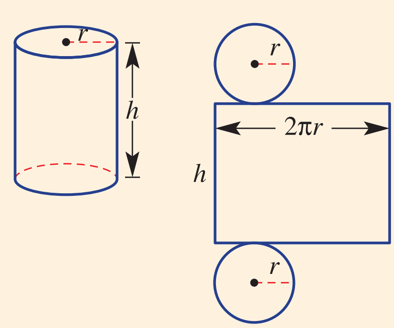
- Why can it be drawn as a rectangle? Can you explain this using a piece of paper?
- Why are the dimensions of this rectangle h and $2\pi r$?
- Where does the formula TSA $= 2\pi r^2 + 2\pi rh$ come from?

Key ideas

- A **cylinder** is a solid with a circular **cross-section**.
  - The net contains two equal circles and a rectangle. The rectangle has one side length equal to the circumference of the circle.
  - TSA $= 2$ circles $+ 1$ rectangle

    $= 2\pi r^2 + 2\pi rh$
  - Another way of writing $2\pi r^2 + 2\pi rh$ is $2\pi r(r + h)$.

Diagram **Net**



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1G

Exercise 1G

Understanding | 1, 2 | 2

1 Write the missing word/expression.

a The shape of the cross-section of a cylinder is a __________.

b The TSA of a cylinder is TSA = $2\pi r^2 +$ __________.

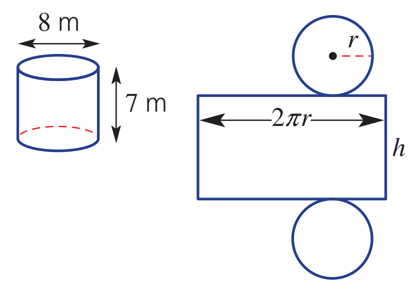
2 A cylinder and its net are shown here.

a What is the value of:

i r? **ii** h?

b Find the value of $2\pi r$, correct to two decimal places.

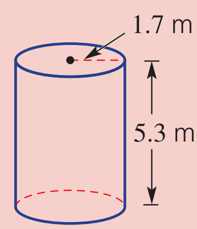
c Use TSA = $2\pi r^2 + 2\pi rh$ to find the total surface area, correct to two decimal places.

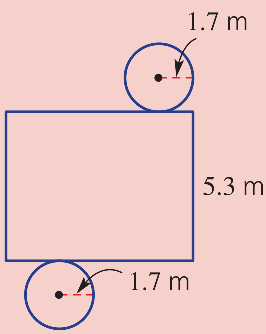


Fluency | 3, 4 | 3–5

Example 16 Finding the surface area of a cylinder

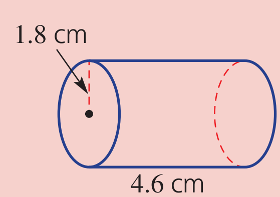
By first drawing a net, find the total surface area of this cylinder, correct to two decimal places.



Solution	Explanation
	Draw the net and label the appropriate lengths.
TSA = 2 circles + 1 rectangle	Write what you need to calculate.
$= 2\pi r^2 + 2\pi rh$	Write the formula.
$= 2\pi(1.7)^2 + 2\pi(1.7)(5.3)$	Substitute the correct values: $r = 1.7$ and $h = 5.3$.
$= 74.77\ \text{m}^2$ (to 2 d.p.)	Round your answer to two decimal places.

Now you try

By first drawing a net, find the total surface area of this cylinder, correct to two decimal places.



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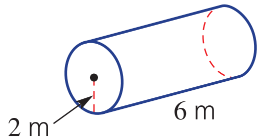
3 By first drawing a net, find the total surface area of these cylinders, to two decimal places.

Hint: Remember that radius = diameter ÷ 2.

a



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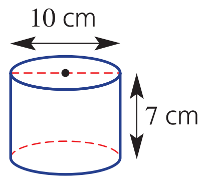
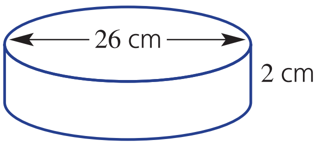


c



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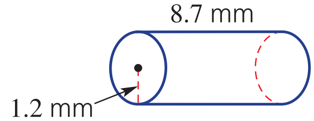
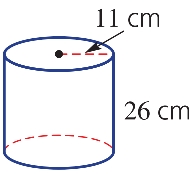


4 Use the formula TSA = $2\pi r^2 + 2\pi rh$ to find the total surface area of these cylinders, to one decimal place.

a



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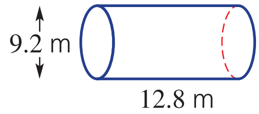
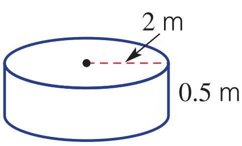


5 Find the area of only the curved surface of these cylinders, to one decimal place.

Hint: Find only the rectangular part of the net, so use $A = 2\pi rh$. Be careful with the units in part **b**!

a



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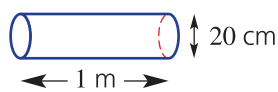

Problem-solving and reasoning

6, 7	6–9

6 Find the outside surface area of a pipe of radius 85 cm and length 4.5 m, to one decimal place. Give your answer in m^2.

7 The base and sides of a circular cake tin are to be lined on the inside with baking paper. The tin has a base diameter of 20 cm and is 5 cm high. What is the minimum amount of baking paper required, to one decimal place?

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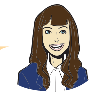
1G

8 The inside and outside of an open-topped cylindrical concrete tank is to be coated with a special waterproofing paint. The tank has diameter 4 m and height 2 m. Find the total area to be coated with the paint. Round your answer to one decimal place.

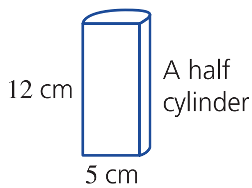
Hint: Include the base but not the top.



9 Find the TSA of these cylindrical portions, to one decimal place.

Hint: Carefully consider the fraction of a circle made up by the ends, and the fraction of a full cylinder made up by the curved part.

a



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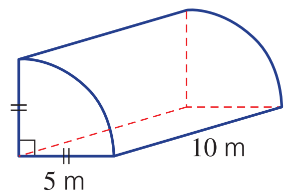

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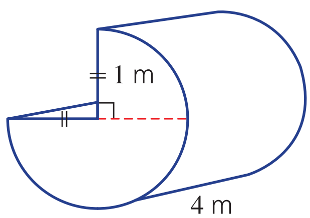

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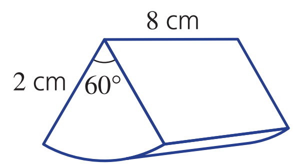

The steamroller — 10

10 A steamroller has a large, heavy cylindrical barrel that is 4 m wide and has a diameter of 2 m.

a Find the area of the curved surface of the barrel, to two decimal places.

b After 10 complete turns of the barrel, how much ground would be covered, to two decimal places?

c Find the circumference of one end of the barrel, to two decimal places.

d How many times would the barrel turn after 1 km of distance, to two decimal places?

e What area of ground would be covered if the steamroller travels 1 km?

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1H Volume of solids

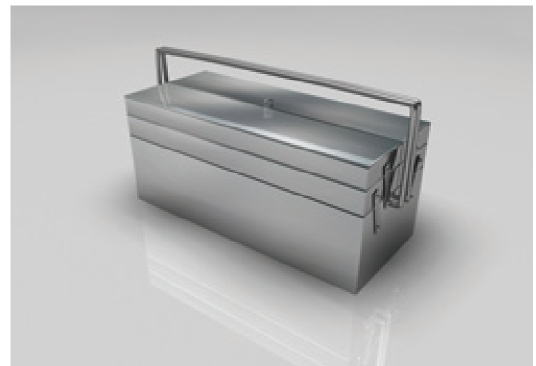
Learning intentions

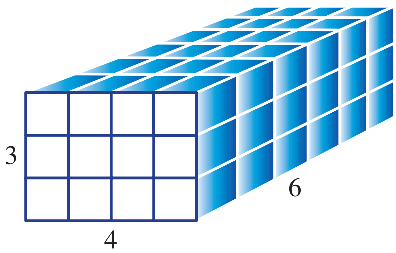
- To understand how the volume of solids relates to its constant cross-section and height
- To know the common units for capacity
- To know the formula for the volume of a solid with a uniform cross-section
- To be able to calculate the volume of a solid with a uniform cross-section

Key vocabulary: solid, volume, cross-section, uniform, prism, cylinder, perpendicular, capacity

The volume of a solid is the amount of space it occupies within its outside surface. It is measured in cubic units.

For solids with a uniform cross-section, the area of the cross-section multiplied by the perpendicular height gives the volume. Consider the rectangular prism below.





Number of cubic units (base) $= 4 \times 6 = 24$

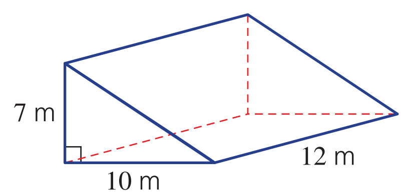
Area (base) $= 4 \times 6 = 24$ units^2

Volume = area (base) $\times 3 = 24 \times 3 = 72$ units^3

Lesson starter: Volume of a triangular prism

This prism has a triangular cross-section.

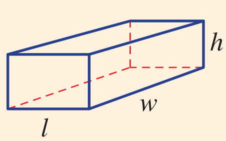
- What is the area of the cross-section?
- What is the 'height' of the prism?
- How can $V = A \times h$ be applied to this prism, where A is the area of the cross-section?



Key ideas

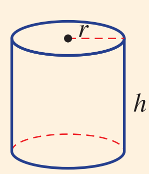
- **Volume** is the amount of three-dimensional space within an object.
- The volume of a solid with a uniform cross-section is given by $V = A \times h$, where:
  - A is the area of the cross-section.
  - h is the perpendicular (at 90°) height.

Rectangular prism



$V = lwh$

Cylinder



$V = \pi r^2 h$

- **Capacity** is the volume of a given object measured in litres or millilitres.
- Units for capacity include:
  - 1 L = 1000 mL
  - 1 cm^3 = 1 mL

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Exercise 1H

Understanding | 1–3 | 3

1 Match the solid (**a**–**c**) with the volume formula (**A**–**C**).

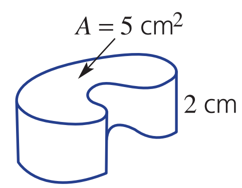
a cylinder
b rectangular prism
c triangular prism

A $V = lwh$
B $V = \frac{1}{2}bh \times \text{length}$
C $V = \pi r^2 h$

2 Write the missing number.

a There are __________ mL in 1 L.
b There are __________ cm^3 in 1 L.

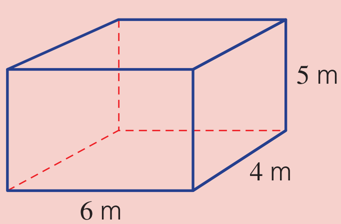
3 The area of the cross-section of this solid is given. Find the solid's volume, using $V = A \times h$.



Fluency | 4–6 | 4–7

Example 17 Finding the volume of a rectangular prism

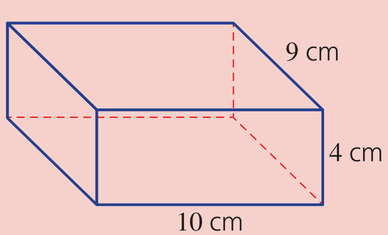
Find the volume of this rectangular prism.



Solution	Explanation
$V = A \times h$	Write the general formula.
$= 6 \times 4 \times 5$	$A = 6 \times 4$ and $h = 5$.
$= 120\ \text{m}^3$	Simplify and include units.

Now you try

Find the volume of this rectangular prism.



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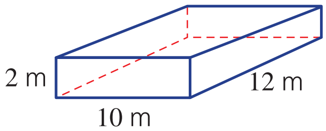
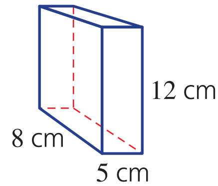
4 Find the volume of these rectangular prisms.

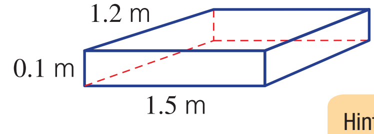
a



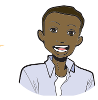
b



c

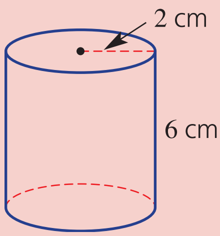


Hint: Use $V = lwh$.



Example 18 Finding the volume of a cylinder

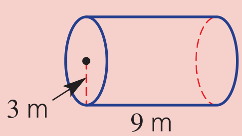
Find the volume of this cylinder, correct to two decimal places.



Solution	Explanation
$V = A \times h$	Write the general formula.
$= \pi r^2 \times h$	The cross-section is a circle.
$= \pi(2)^2 \times 6$	Substitute $r = 2$ and $h = 6$.
$= 75.40\text{ cm}^3$ (to 2 d.p.)	Simplify and write your answer as required, with units.

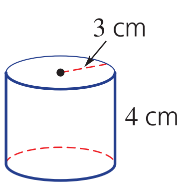
Now you try

Find the volume of this cylinder, correct to two decimal places.

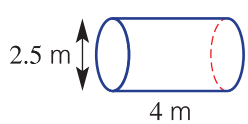


5 Find the volume of these cylinders, correct to two decimal places.

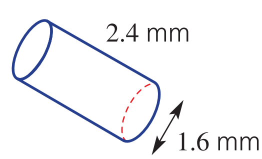
a



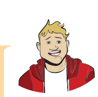
b



c



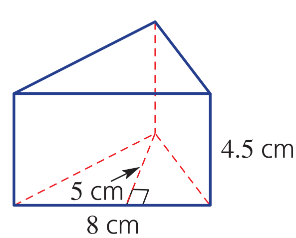
Hint: For a cylinder: $V = \pi r^2 \times h$



6 A triangle with base 8 cm and height 5 cm forms the base of a prism, as shown. If the prism stands 4.5 cm high, find:

a the area of the triangular base

b the volume of the prism



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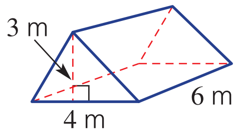
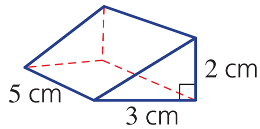
1H

7 Find the volume of these triangular prisms.

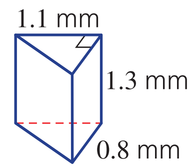
a



b



c



Hint: Use $V = A \times h$, where A is the area of a triangle.

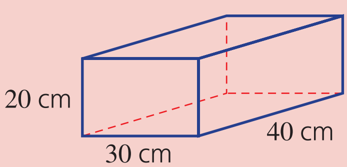
Problem-solving and reasoning

8–10 | 9–12

8 A cylindrical drum stands on one end with a diameter of 25 cm and water is filled to a height of 12 cm. Find the volume of water in the drum, in cm^3, correct to two decimal places.

Example 19 Working with capacity

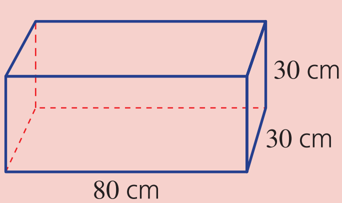
Find the number of litres of water that this container can hold.



Solution	**Explanation**
$V = 30 \times 40 \times 20$	First work out the volume in cm^3.
$= 24\,000\ cm^3$	Then divide by 1000 to convert to litres, since $1\ cm^3 = 1$ mL
$= 24$ L	and there are 1000 mL in 1 litre.

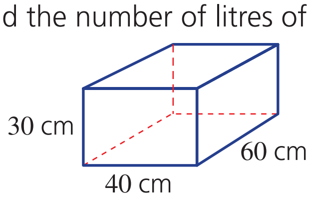
Now you try

Find the number of litres of water that this container can hold.



9 Find the number of litres of water that these containers can hold.

a



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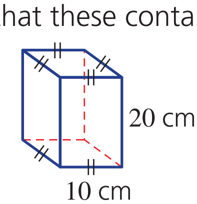

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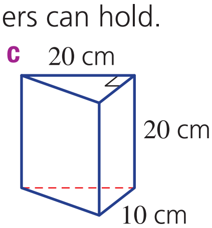
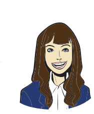


Hint: Use $1\text{ L} = 1000\ cm^3$.



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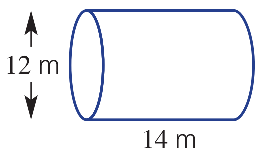
10 Find the volume of these solids, rounding your answers to two decimal places where necessary.

Hint: Find the area of the cross-section first.

a



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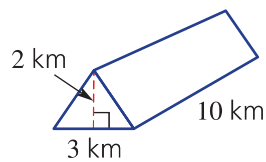
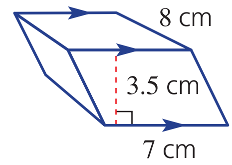
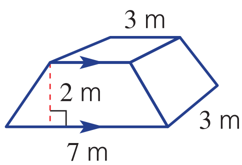


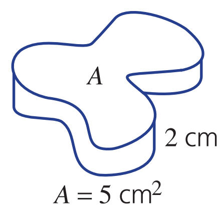
c



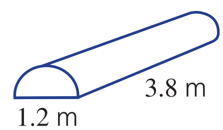
d



e



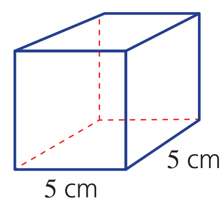
f



11 $100\,\text{cm}^3$ of water is to be poured into this container.

a Find the area of the base of the container.

b Find the depth of water in the container.



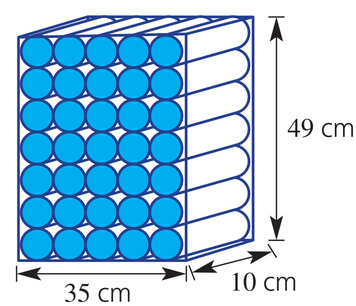
12 In a scientific experiment, solid cylinders of ice are removed from a solid block carved out of a glacier. The ice cylinders have diameter 7 cm and length 10 cm. The dimensions of the solid block are shown in the diagram.

a Find the volume of ice in the original ice block.

b Find the volume of ice in one ice cylinder, to two decimal places.

c Find the number of ice cylinders that can be removed from the ice block, using the configuration shown.

d Find the volume of ice remaining after the ice cylinders are removed from the block, to two decimal places.

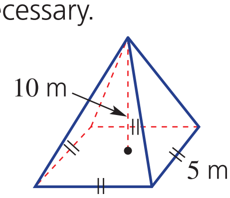


Volume of pyramids and cones — 13

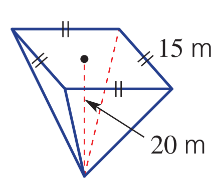
13 The volume of a pyramid or cone is exactly one-third the volume of the prism with the same base area and height; i.e. $V = \frac{1}{3} \times A \times h$.

Find the volume of these pyramids and cones. Round your answer to one decimal place where necessary.

a



b



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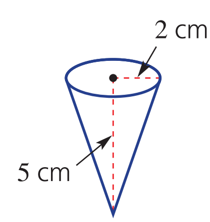

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1I Accuracy of measuring instruments

Learning intentions

- To understand that accuracy depends on how measurements are recorded
- To know the limits of accuracy for a given recorded measurement
- To be able to calculate the limits of accuracy for given measurements

Key vocabulary: accuracy, precision, rounding

Humans and machines measure many different things, such as the time taken to swim a race, a length of timber needed for a building and the volume of cement needed to lay a concrete path around a swimming pool. The degree or level of accuracy required usually depends on what is being measured and what the information is being used for.

All measurements are approximate. Errors can come from the equipment being used or the person using the measuring device.

Accuracy is the measure of how true to the 'real' the measure is, whereas **precision** is the ability to obtain the same result over and over again.

Lesson starter: Rounding a decimal

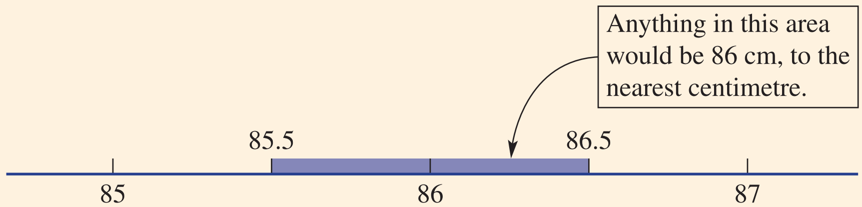
1 A piece of timber is measured to be 86 cm, correct to the nearest centimetre. What is the smallest decimal that it could be rounded from and what is the largest decimal that, when rounded to the nearest whole, is recorded as 86 cm?

2 If a measurement is recorded as 6.0 cm, correct to the nearest millimetre, then:
  - **a** What units were used when measuring?
  - **b** What is the smallest decimal that could be rounded to this value?
  - **c** What is the largest decimal that would have resulted in 6.0 cm?

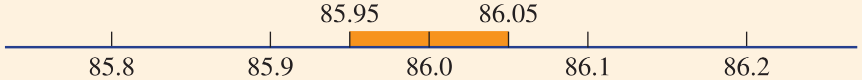
3 Consider a square with sides given as 7.8941 km each. What is the perimeter of the square if the side length is:
  - **a** left unchanged with four decimal places?
  - **b** rounded to one decimal place?
  - **c** truncated (i.e. chopped off) at one decimal place?

Key ideas

- The limits of **accuracy** tell you what the upper and lower boundaries are for the true measurement.
  - Usually, it is $\pm 0.5 \times$ the smallest unit of measurement.
  - Note that values are stated to 1 decimal place beyond that of the given measurement. For example, when measuring to the nearest centimetre, 86 cm has limits from 85.5 cm up to 86.5 cm.



- When measuring to the nearest millimetre, the limits of accuracy for 86.0 cm are 85.95 cm to 86.05 cm.



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Exercise 1I

Understanding | 1–3 | 3

1 Write down a decimal that, when rounded from two decimal places, gives 3.4.

2 Write down a measurement of 3467 mm, correct to the nearest:
a centimetre b metre

3 What is the smallest decimal that, when rounded to one decimal place, could result in an answer of 6.7?

Fluency | 4, 5 | 4, 5

Example 20 Stating the smallest unit of measurement

For each of the following, write down the smallest unit of measurement.
a 89.8 cm b 56.85 m

Solution	Explanation
a 0.1 cm or 1 mm	The measurement is given to one decimal place. That means the smallest unit of measurement is tenths.
b 0.01 m or 1 cm	This measurement is given to two decimal places. Therefore, the smallest unit of measurement is hundredths or 0.01.

Now you try

For each of the following, write down the smallest unit of measurement.
a 24.3 m b 4.75 km

4 For each of the following, state the smallest unit of measurement.
a 45 cm b 6.8 mm c 12 m
d 15.6 kg e 56.8 g f 10 m
g 673 h h 9.84 m i 12.34 km

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1I

Example 21 Finding limits of accuracy

Give the limits of accuracy for these measurements.

a 72 cm **b** 86.6 mm

Solution	Explanation
a $72 \pm 0.5 \times 1$ cm $= 72 - 0.5$ cm to $72 + 0.5$ cm $= 71.5$ cm to 72.5 cm	Smallest unit of measurement is one whole cm. Error $= 0.5 \times 1$ cm This error is subtracted and added to the given measurement to find the limits of accuracy.
b $86.6 \pm 0.5 \times 0.1$ mm $= 86.6 \pm 0.05$ mm $= 86.6 - 0.05$ mm to $86.6 + 0.05$ mm $= 86.55$ mm to 86.65 mm	Smallest unit of measurement is 0.1 mm. Error $= 0.5 \times 0.1$ mm This error is subtracted and added to the given measurement to find the limits of accuracy.

Now you try

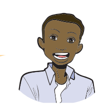
Give the limits of accuracy for these measurements.

a 36 cm **b** 15.1 m

5 Give the limits of accuracy for each of these measurements.

a 5 m	**b** 8 cm	**c** 78 mm
d 5 ns	**e** 2 km	**f** 34.2 cm
g 3.9 kg	**h** 19.4 kg	**i** 457.9 t
j 18.65 m	**k** 7.88 km	**l** 5.05 s

Hint: Give measurement $\pm 0.5 \times$ smallest unit of measurement.



Problem-solving and reasoning 6–8 6, 8–11

6 Write the following as a measurement, given that the lower and upper limits of the measurements are as follows.

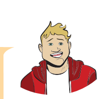
a 29.5 m to 30.5 m **b** 144.5 g to 145.5 g **c** 4.55 km to 4.65 km

7 Martha writes down the length of her fabric as 150 cm. As Martha does not give her level of accuracy, give the limits of accuracy of her fabric if it was measured correct to the nearest:

a centimetre **b** 10 centimetres **c** millimetre

8 A length of copper pipe is given as 25 cm, correct to the nearest centimetre.

Hint: Use upper and lower limits of accuracy for max and min lengths.



a What are the limits of accuracy for this measurement?

b Ten pieces of pipe, each with a given length of 25 cm, are joined.

i What is the minimum length that it could be?

ii What is the maximum length that it could be?

9 The sides of a square are recorded as 9.2 cm, correct to one decimal place.

a What is the minimum length that each side of this square could be?

b What is the maximum length that each side of this square could be?

c Find the upper and lower boundaries for this square's perimeter.

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10 Johan measures the mass of an object to be 6 kg. Amy says the same object is 5.8 kg and Thomas gives his answer as 5.85 kg.

a Explain how all three people could have different answers for the same measurement.

b Write down the level of accuracy being used by each person.

c Are all their answers correct? Discuss.

11 Write down a sentence explaining the need to accurately measure items in our everyday lives and the accuracy that is needed for each of your examples. Give three examples of items that need to be measured correct to the nearest:

a kilometre **b** millimetre **c** millilitre **d** litre

Practical measurement — 12

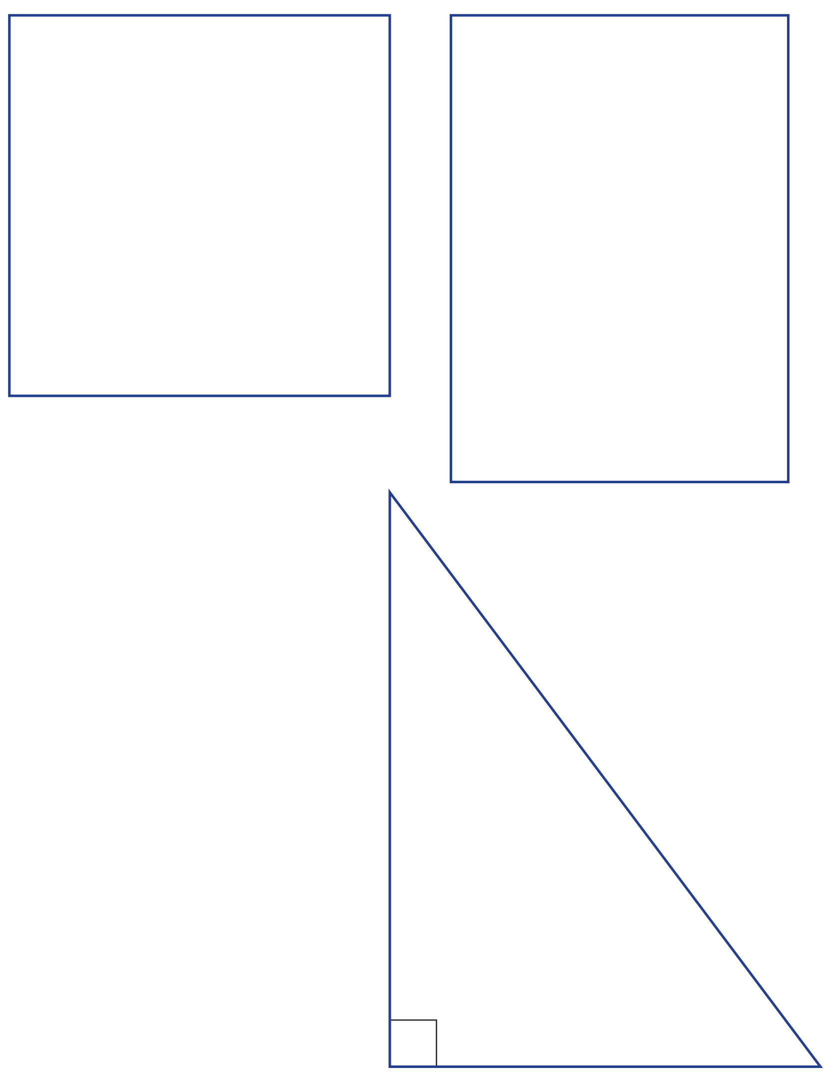
12 **a** Measure each of the shapes below, correct to the nearest:

i cm **ii** mm

b Use your measurements to find the perimeter and area of each shape.

c After collating your classmates' measurements, find the average perimeter for each shape.

d By how much did the lowest and highest perimeters vary? How can this difference be explained?



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Maths@Work: Bricklayer

A bricklayer has a physically challenging job that requires stamina and strength and also good communication skills, as they often work as part of a team.

Bricklayers must have a solid understanding of how the construction process works and the ability to read plans and blueprints.

Mathematical skills are essential in this trade. Bricklayers must understand ratios for mixing mortar and cement. Good measurement skills are also important, as bricklayers must be able to work out the number of bricks required for a job, convert between different units and take accurate measurements at the work site, using the most appropriate tool. An understanding of geometry and trigonometry is also required.

Complete these questions that a bricklayer may face in their day-to-day job.

1 A standard house brick has dimensions $l \times w \times h = 230$ mm $\times$ 76 mm $\times$ 110 mm and the standard thickness of mortar when laying bricks is 10 mm. The bricks are laid so that $l \times h$ is the outer face.

Hint: $A = l \times w$
$V = l \times w \times h$

- **a** What is the length and height of each brick in centimetres and metres?
- **b** Determine the area in cm^2 and m^2 of the outer face of one brick.
- **c** Determine the volume in cubic centimetres of each brick.
- **d** Calculate the length, in metres (to two decimal places), when laying the following number of bricks in a line with mortar between each join.
  - **i** 10 bricks
  - **ii** 100 bricks

Hint: For 10 bricks, there would be 9 mortar joins.

- **e** Calculate the height, in millimetres, of a wall of 25 rows of standard house bricks. Remember to consider the thickness of the mortar.
- **f** Estimate how many standard house bricks are needed to build a wall 4 m by 1.5 m, by dividing the area of the wall by the area of a brick's face.

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2 Ready-mix mortar comes in 20 kg bags that cost \$7.95 per bag. One bag of mortar is used to lay 20 standard house bricks.
Using standard house bricks (see dimension details in Question 1), a brick wall is to be built that has a finished length of 8630 mm, a height of 2750 mm and is one brick deep.
- a Calculate the exact number of standard house bricks needed to build this wall. Remember to consider the thickness of the mortar.
- b How many Ready-mix mortar bags must be purchased for this wall?
- c If each house brick costs 60 cents, find the total cost, to the nearest dollar, of the materials needed for this wall.

3 A type of large brick is chosen for an outside retaining wall. These bricks are sold only in whole packs and each pack covers 12.5 square metres when laid. How many whole packs of these bricks must be bought to build a wall with dimensions:
- a 6 m by 1.5 m?
- b 9 m by 2 m?

Hint: You can't buy half a pack, so round up to the next whole number.

4 Fastwall house bricks are larger and lighter than standard bricks and can be used for single-storey constructions. They are sold in pallets of 1000 for \$1258.21, including delivery and GST. Each Fastwall brick has dimensions $l \times w \times h = 305 \text{ mm} \times 90 \text{ mm} \times 162 \text{ mm}$ and the standard thickness of mortar is 10 mm.
- a If a pallet has 125 bricks per layer, how many layers does each pallet have?
- b If the wooden base of the pallet has a height of 30 cm, what is the total height of the pallet, in cm, when loaded with bricks?
- c Find the exact number of bricks needed to build a wall that is 20.15 m long and 6.87 m high. Remember to consider the thickness of the mortar.
- d Determine the cost of the bricks, to the nearest dollar, required to be bought for building the wall in part c.

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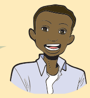
Using technology



Hint: For E5 the formula would be $= G5 \times A5 + (G5 - 1) \times 10$
For G6 the formula would be $= (E6 + 10)/(230 + 10)$

5 Copy the following table into a spreadsheet. Then enter formulas into the shaded cells and, hence, determine the missing values.

	A	B	C	D	E	F	G	H	I
1	Brick Wall Calculations								
2	Note: All dimensions are in mm								
3	Single brick dimensions			Mortar	Brick wall dimensions		Number of bricks used		
4	Length	Width	Height	Width	Length	Height	Per layer (row)	Number of layers	Total
5	230	76	110	10			24	18	
6	230	76	110	10	21350	6230			

Hint: Copy the total number of bricks used from the first table.

6 Copy the following table into your spreadsheet underneath the table from Question **5**. Enter the formulas into the shaded cells and, hence, determine the missing values. Assume there are 1000 bricks per pallet and that one bag of mortar is used per 20 bricks laid.

	A	B	C	D	E	F	G	H	I	J
	Cost calculations									
	Bricks		Cost of pallets				Cost of mortar			
	Number of bricks used	Decimal number of pallets	number of whole pallets	cost per pallet (including GST)	total cost of pallets	Decimal number of mortar bags	number of whole bags	cost per bag (including GST)	total cost of mortar	Total cost of mortar and pallets
12				$1,358.24				$7.95		
13				$1,541.56				$8.45		

In cell B13 enter = ROUNDUP (B12, 0), which will round the number from cell B12 up to the nearest whole number; e.g. 1.3 will be rounded up to 2.

7 Use your spreadsheet tables to find the total cost of materials for the following brick walls made from Fastwall bricks. (See Question **4** for Fastwall brick dimensions.) The spreadsheet formulas will not need to be changed.

a A wall of 44 bricks per layer (row) and 30 layers (rows) if pallets cost $1258.36, including GST, and mortar is $7.55 per bag.

b A wall 20.15 m long by 7.79 m high if pallets cost $1364.32, including GST, and mortar is $9.25 per bag.

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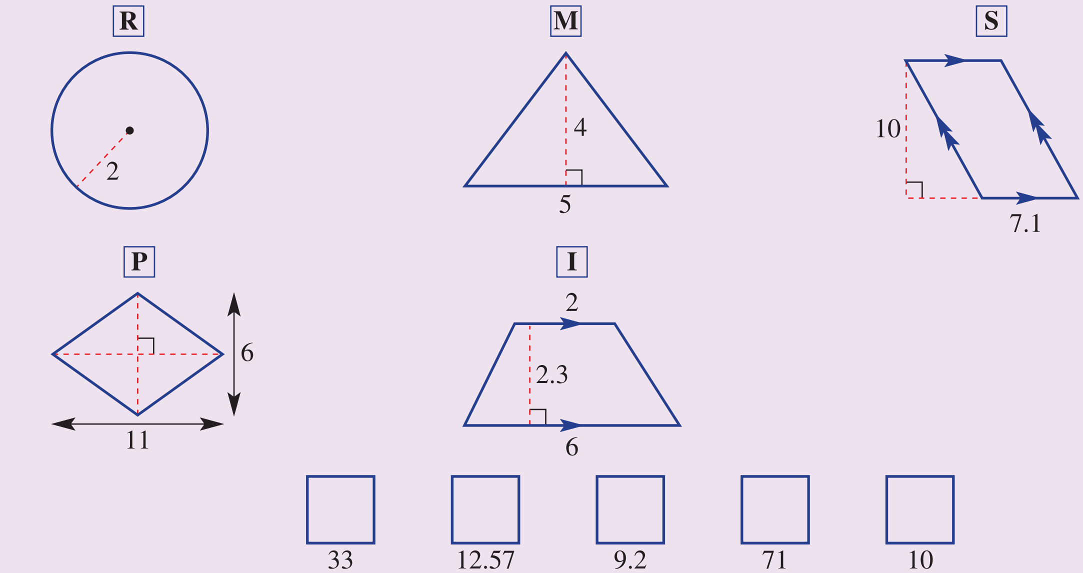
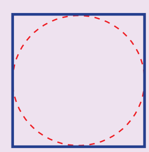
1 'I am the same shape all the way through. What am I?' Find the area of each shape. Match the letters to the answers below to solve the riddle.

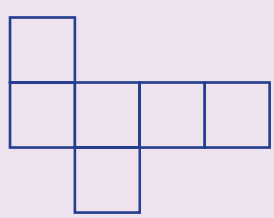


2 One litre of water is poured into a container in the shape of a rectangular prism. The dimensions of the prism are 8 cm by 12 cm by 11 cm. Will the water overflow?

3 A circular piece of pastry is removed from a square sheet with side length 30 cm. What percentage of pastry remains?

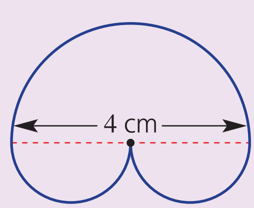


4 How many different nets are there for a cube? Do not count reflections or rotations of the same net. Here is one example.



5 Give the radius of a circle whose value for the circumference is equal to the value for the area.

6 Find the area of this special shape.



7 A cube's surface area is 54 cm^2. What is its volume?

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Chapter summary

Measurement

Conversion of units

Length

km $\xrightarrow{\times 1000}$ m $\xrightarrow{\times 100}$ cm $\xrightarrow{\times 10}$ mm

km $\xleftarrow{\div 1000}$ m $\xleftarrow{\div 100}$ cm $\xleftarrow{\div 10}$ mm

Area

$\text{km}^2 \xrightarrow{\times 1000^2} \text{m}^2 \xrightarrow{\times 100^2} \text{cm}^2 \xrightarrow{\times 10^2} \text{mm}^2$

$\text{km}^2 \xleftarrow{\div 1000^2} \text{m}^2 \xleftarrow{\div 100^2} \text{cm}^2 \xleftarrow{\div 10^2} \text{mm}^2$

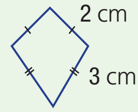
Volume

$\text{km}^3 \xrightarrow{\times 1000^3} \text{m}^3 \xrightarrow{\times 100^3} \text{cm}^3 \xrightarrow{\times 10^3} \text{mm}^3$

$\text{km}^3 \xleftarrow{\div 1000^3} \text{m}^3 \xleftarrow{\div 100^3} \text{cm}^3 \xleftarrow{\div 10^3} \text{mm}^3$

Perimeter

The distance around the outside of a shape.

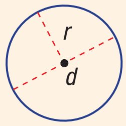


$P = 2 \times 2 + 2 \times 3$
$= 10$ cm

Circumference

The distance around the outside of a circle.

$C = 2\pi r$ or $C = \pi d$



Area of basic shapes

Square: $A = l^2$

Rectangle: $A = lw$

Triangle: $A = \frac{1}{2}bh$

Rhombus: $A = \frac{1}{2}xy$

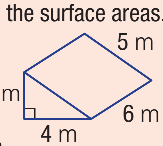
Parallelogram: $A = bh$

Trapezium: $A = \frac{1}{2}(a + b)h$

Total surface area

Draw a net and sum the surface areas.

Triangular prism

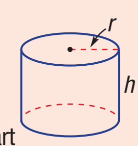


$TSA = 2 \times \frac{1}{2} \times 4 \times 3$
$+ 6 \times 4 + 6 \times 3 + 6 \times 5$
$= 84 \text{ m}^2$

Cylinder ⭐

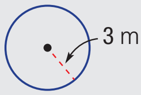
$TSA = 2\pi r^2 + 2\pi rh$

2 ends curved part



Area of a circle

$A = \pi r^2$
$= \pi \times 3^2$
$= 28.27 \text{ m}^2$ (to 2 d.p.)



Volume

Rectangular prism
$V = lwh$

Cylinder
$V = \pi r^2 h$

Capacity: 1 L = 1000 mL
$1 \text{ cm}^3 = 1$ mL

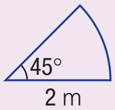
Accuracy ⭐

Accuracy depends on any error associated with the measuring instruments and how they are used.

Limits of accuracy are usually $\pm 0.5 \times$ the smallest unit.

Area of sectors

$A = \frac{45}{360} \times \pi r^2$
$= \frac{1}{8} \times \pi \times 2^2$
$= 1.57 \text{ m}^2$ (to 2 d.p.)



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Chapter checklist

A version of this checklist that you can print out and complete can be downloaded from your Interactive Textbook.

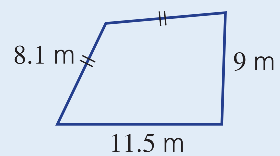
✔

1A **1 I can convert between metric units of length.**
e.g. Convert these measurements to the units shown in the brackets.
a 2.3 m (cm) **b** $270\,000$ cm (km)

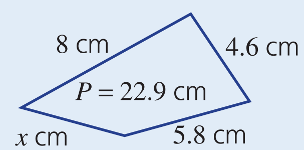
1A **2 I can convert between metric units of area.**
e.g. Convert these measurements to the units shown in the brackets.
a $32\,000$ m^2 (km^2) **b** 7.12 cm^2 (mm^2)

1A **3 I can convert between metric units of volume.**
e.g. Convert these measurements to the units shown in the brackets.
a 3.7 cm^3 (mm^3) **b** $5\,900\,000$ cm^3 (m^3)

1B **4 I can find the perimeter of basic shapes.**
e.g. Find the perimeter of this shape.

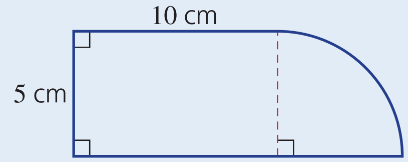


1B **5 I can find a missing side length given the perimeter.**
e.g. Find the value of x for this shape with the given perimeter.

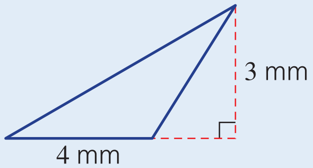


1C **6 I can find the circumference of a circle.**
e.g. Find the circumference of a circle with a diameter of 5 m, correct to two decimal places.

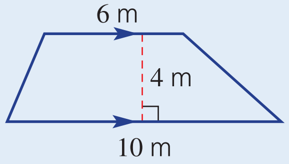
1C **7 I can find the perimeter of simple composite shapes.**
e.g. Find the perimeter of this composite shape, correct to two decimal places.



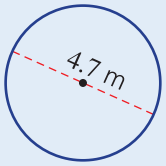
1D **8 I can find the area of squares, rectangles and triangles.**
e.g. Find the area of this triangle.



1D **9 I can find the area of rhombuses, parallelograms and trapeziums.**
e.g. Find the area of this trapezium.



1E **10 I can find the area of a circle.**
e.g. Find the area of this circle, correct to two decimal places.



Chapter checklist

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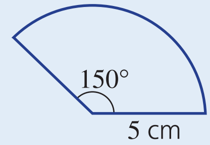
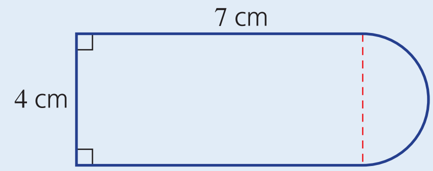
Chapter checklist

✔

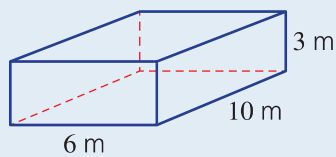
1E **11 I can find the area of a sector.**
e.g. Find the area of this sector, correct to two decimal places.



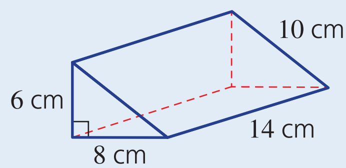
1E **12 I can find the area of simple composite shapes involving sectors.**
e.g. Find the area of this composite shape, correct to two decimal places.



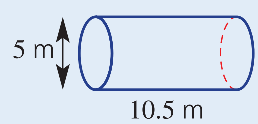
1F **13 I can find the total surface area of a rectangular prism using a net.**
e.g. Find the total surface area of this rectangular prism.



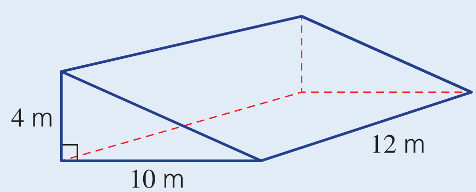
1F **14 I can find the total surface area of a triangular prism using a net.**
e.g. Find the total surface area of this triangular prism.



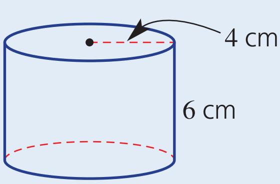
1G **15 I can find the total surface area of a cylinder.**
e.g. Find the total surface area of this cylinder, correct to two decimal places.



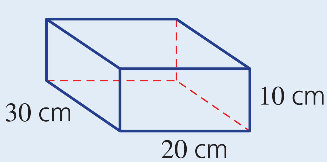
1H **16 I can find the volume of a prism.**
e.g. Find the volume of this triangular prism.



1H **17 I can find the volume of a cylinder.**
e.g. Find the volume of this cylinder, correct to two decimal places.



1H **18 I can find the volume of a prism, giving an answer in L or mL.**
e.g. Find the volume of this triangular prism in litres.



1I **19 I can state the smallest unit for a given measurement.**
e.g. Write down the smallest unit of measurement for 27.3 cm.

1I **20 I can find the limits of accuracy for a given measurement.**
e.g. Give the limits of accuracy for the measurement 65.3 m.

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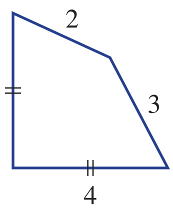
Short-answer questions

1A **1** Convert these measurements to the units shown in the brackets.

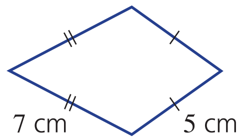
a 5.3 km (m) **b** 27 000 cm^2 (m^2) **c** 0.04 cm^3 (mm^3)

1B **2** Find the perimeter of these shapes.

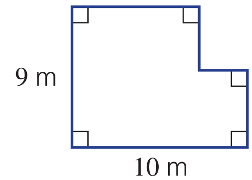
a



b

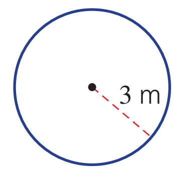


c



1C/E **3** For the circle shown, find, to two decimal places:

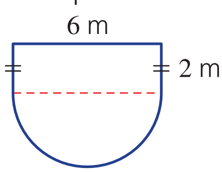
a the circumference **b** the area



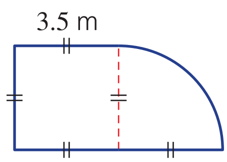
1E **4** For these composite shapes, find, to two decimal places:

i the perimeter **ii** the area

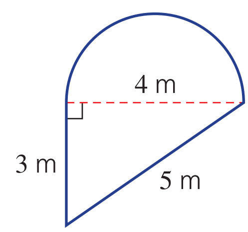
a



b

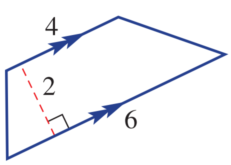


c

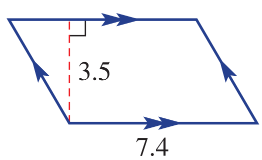


1D **5** Find the area of these shapes.

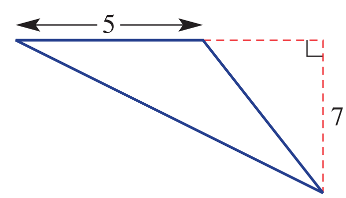
a



b

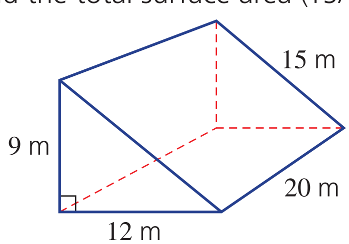


c

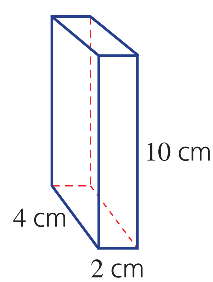


1F **6** Find the total surface area (TSA) of these prisms.

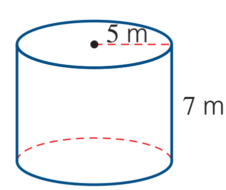
a



b



1G **7** Determine the total surface area of this cylinder, to two decimal places.



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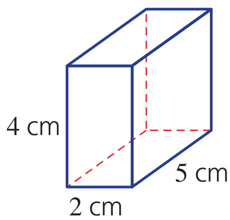
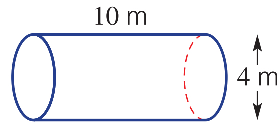
Chapter review

1H 8 Find the volume of these solids, to two decimal places where necessary.

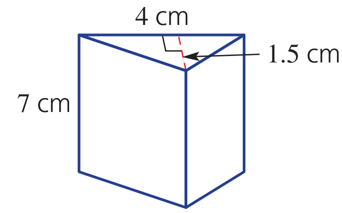
a



b



c



1I 9 Give the limits of accuracy for these measurements.

a 6 cm **b** 4.2 kg **c** 16.21 m

Multiple-choice questions

1A 1 The number of centimetres in a kilometre is:

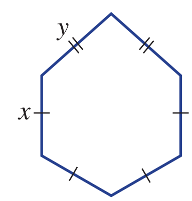
A 10 **B** 100 **C** 1000 **D** 10 000 **E** 100 000

1B 2 The perimeter of a square with side lengths 2 cm is:

A 4 cm **B** 8 cm **C** 4 cm^2 **D** 8 cm^2 **E** 16 cm

1B 3 The perimeter of the shape shown is given by the formula:

A $x - y$ **B** $2x + y$ **C** $4x + 2y$
D $x - 2y$ **E** $4x + y$



1C 4 A correct expression for determining the circumference of a circle with diameter 6 cm is:

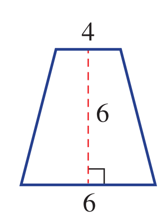
A $\pi \times 6$ **B** $\pi \times 3$ **C** $2 \times \pi \times 6$ **D** 2×6 **E** $\pi \times 6^2$

1D 5 The area of a rectangle with side lengths 3 cm and 4 cm is:

A 12 cm^2 **B** 12 cm **C** 7 cm^2 **D** 14 cm **E** 14 cm^2

1D 6 The correct expression for calculating the area of this trapezium is:

A $(6 - 4) \times 6$ **B** $\frac{1}{2}(6 + 4) \times 6$ **C** $\frac{1}{2} \times 6 \times 4$ **D** $6 \times 6 - 4$
E $6 \times 6 + 6 \times 4$



1E 7 A sector's centre angle measures 90°. This is equivalent to:

A $\frac{1}{5}$ of a circle **B** $\frac{1}{2}$ of a circle **C** $\frac{3}{4}$ of a circle
D $\frac{2}{3}$ of a circle **E** $\frac{1}{4}$ of a circle

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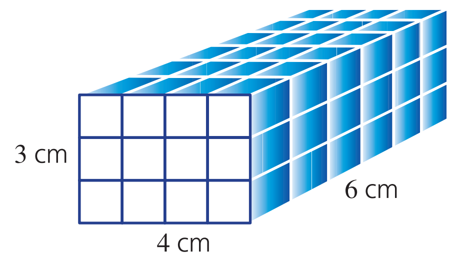
1H **8** The volume of the shape shown is:

A 13 cm^3 **B** 27 cm^3
C 72 cm^2 **D** 72 cm^3
E 27 cm^2

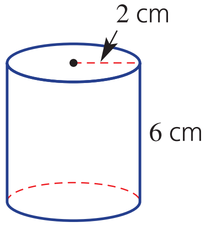


1H **9** The volume of a cube of side length 3 cm is:

A 9 cm^3 **B** 27 cm^3 **C** 54 cm^2 **D** 54 cm^3 **E** 27 cm^2

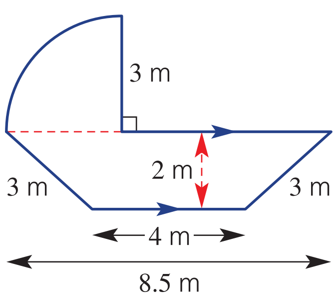
1G **10** The curved surface area for this cylinder is closest to:

A 87.96 cm^2 **B** 12.57 cm^2
C 75.40 cm^2 **D** 75.39 cm^2
E 113.10 cm^2



Extended-response question

1 A new playground is being built with the shape and dimensions as shown below.

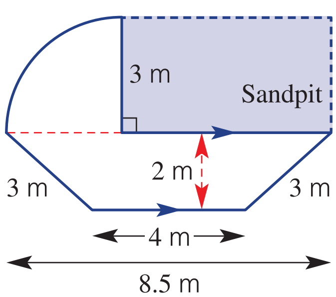


a The playground will be surrounded by wooden planks.
  i Determine the perimeter of the playground correct to two decimal places.
  ii If the wood to be used costs \$16.50/m, what will be the cost of surrounding the play area to the nearest dollar?

b The playground area is to be covered with a layer of woodchips. Find the area of the playground correct to one decimal place.

c If a bag of woodchips from the hardware store covers 7.5 m^2, how many bags would be required to cover the playground area?

d A rectangular sandpit is to be included as shown. If sand is to be spread flat and filled to a height of 40 cm, determine the volume of sand required in m^3.



2 A cylindrical tank has diameter 8 m and height 2 m.

a Find the surface area of the curved part of the tank, to two decimal places.
b Find the TSA, including the top and the base, to two decimal places.
c Find the total volume of the tank, to two decimal places.
d Find the total volume of the tank in litres, to two decimal places.
Note: There are 1000 litres in 1 m^3.

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