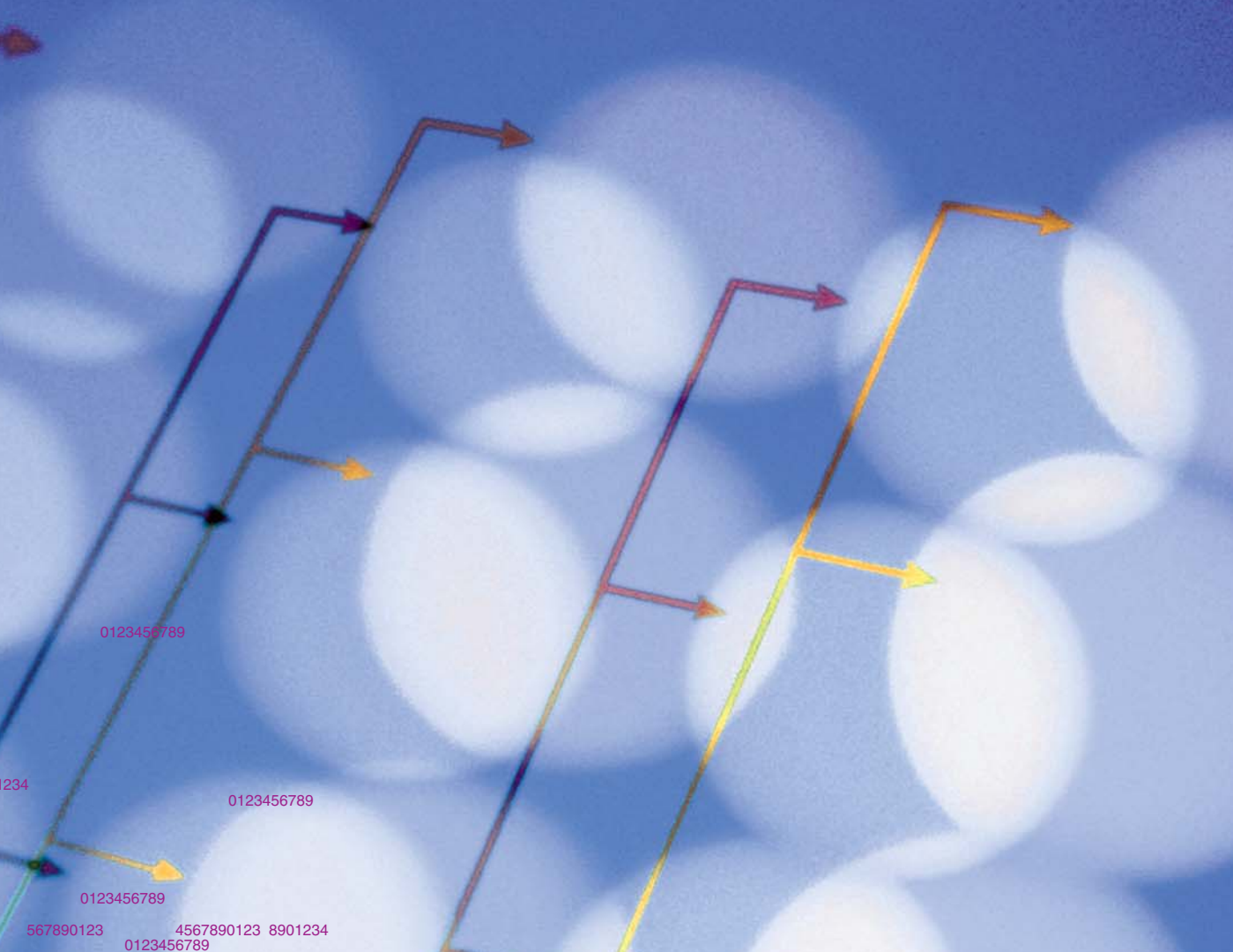


# Length and area

8

[illegible]



## In this chapter you will:

- select and use appropriate metric units
- convert between metric units of length
- interpret scales on measuring instruments
- describe the limits of accuracy of measuring instruments ( $\pm 0.5$  unit of measurement)
- recognise that all measurements are approximate
- estimate and measure lengths, distances and areas
- find the perimeter and area of squares, rectangles, triangles and simple composite figures
- convert between metric units of area
- use the hectare and square kilometre to describe large areas.

## Wordbank:

- **accuracy** The closeness of a measured value to the true value.
- **area** The amount of surface enclosed by a shape.
- **composite shape** A shape made up of two or more shapes.
- **hectare** The area of a square that measures 100 m by 100 m.
- **metric system** A system of measurement based on powers of 10.
- **perimeter** The distance around the outside of a shape.
- **square metre** The area of a square that measures 1 m by 1 m.

# Start up



Worksheet  
8-01

Brainstarters 8



Skillsheet  
8-01

Multiplying by 10, 100,  
1000

1 Evaluate the following.

**a**  $23 \times 10$

**b**  $4.5 \times 100$

**c**  $9.7 \times 10$

**d**  $4 \times 1000$

**e**  $10.32 \times 100$

**f**  $9.45 \times 10$

**g**  $0.4 \times 1000$

**h**  $2.7 \times 1000$

**i**  $0.9 \times 100$

**j**  $6.3 \times 10$

**k**  $2000 \div 100$

**l**  $43\,000 \div 1000$

**m**  $650 \div 10$

**n**  $3750 \div 100$

**o**  $95 \div 10$

**p**  $8200 \div 1000$

**q**  $4230 \div 100$

**r**  $720 \div 1000$

**s**  $85 \div 100$

**t**  $109 \div 10$

2 Evaluate the following.

**a**  $6.5 + 3.27$

**b**  $7.95 - 2.08$

**c**  $1.4 + 2 + 7.3 + 5.64$

**d**  $6.4 - 4.95$

**e**  $12.92 + 8 + 9.1$

**f**  $18.57 - 9.88 - 4.2$

**g**  $15 - 7.85$

**h**  $4.2 + 6.53 - 2.9$

**i**  $20.2 - 12.45$

**j**  $2.1 + 3 + 0.85 - 1.3$

3 What instrument and unit would you use to measure:

**a** the distance from the street to your front door?

**b** the length of your foot?

**c** the length of an ant?

**d** the length of your bed?

**e** the width of a basketball court?

**f** the depth of a river?

**g** the distance around a football field?

**h** the length of a long-jump pit?

**i** the height of a door?

**j** the length of a fingernail?

**k** an athlete's time in a race?

4 Measure the following intervals (in millimetres).

**a** \_\_\_\_\_

**b** \_\_\_\_\_

**c** \_\_\_\_\_

**d** \_\_\_\_\_

**e** \_\_\_\_\_

**f** \_\_\_\_\_

5 Measure the following intervals (in centimetres).

**a** \_\_\_\_\_

**b** \_\_\_\_\_

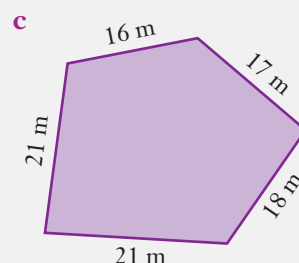
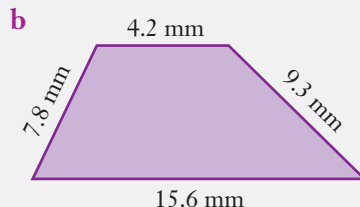
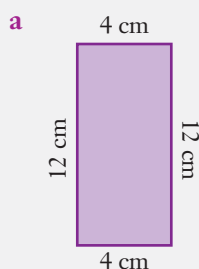
**c** \_\_\_\_\_

**d** \_\_\_\_\_

**e** \_\_\_\_\_

**f** \_\_\_\_\_

6 Find the perimeter of the following figures.



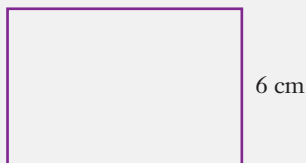


7 Copy and complete the following.

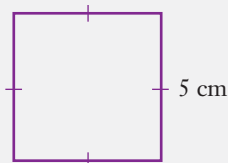
**a** 1 km = \_\_\_\_ m    **b** 1 m = \_\_\_\_ cm    **c** 1 m = \_\_\_\_ mm    **d** 1 cm = \_\_\_\_ mm

8 Find the area of each of these shapes.

**a** 9 cm



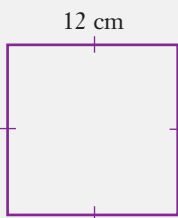
**b**



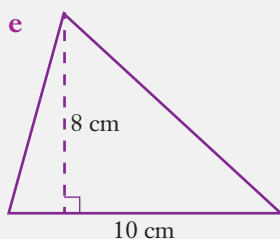
**c**



**d**



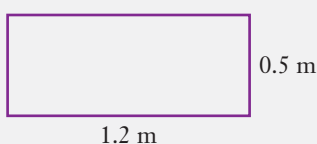
**e**



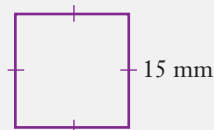
**f**



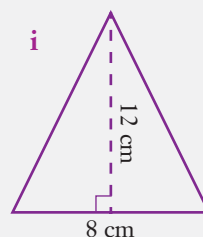
**g**



**h**

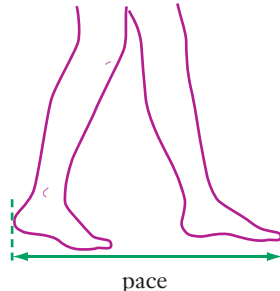
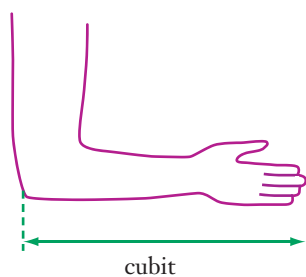
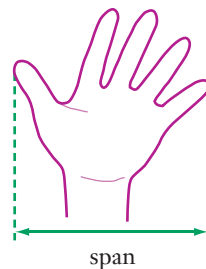
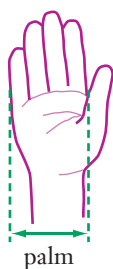
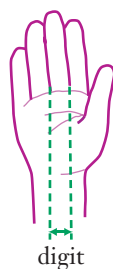


**i**



## 8-01 The metric system

No one really knows how the earliest civilisations measured lengths. However, we do know that the ancient Egyptians could measure with great accuracy using units based on parts of the body.

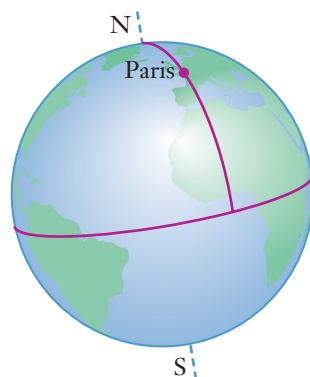


In Australia we measure using the **metric system**. This system began in France in the 1790s after the French revolution and, because it is based on powers of 10, it is logical and easy to use. The word 'metric' comes from the Greek word *metron* meaning 'to measure'.

The metre was originally defined as one ten-millionth of the distance from the North Pole to the Equator (along the meridian through Paris).

In 1970, the Metric Conversion Board was established in Australia and Australia started the change to metric units.

The following metric units are most commonly used.



Quantity	Name of unit	Abbreviation
Length	metre	m
	millimetre	mm
	centimetre	cm
	kilometre	km
Mass	kilogram	kg
	gram	g
	milligram	mg
	tonne	t
Area	square metre	m <sup>2</sup>
	square centimetre	cm <sup>2</sup>
	square kilometre	km <sup>2</sup>
	hectare	ha
Volume	cubic metre	m <sup>3</sup>
	cubic centimetre	cm <sup>3</sup>
Capacity	litre	L
	millilitre	mL
	kilolitre	kL
Temperature	degree Celsius	°C

## Exercise 8-01

- Look carefully at each of these photographs. Then make up a measurement question for each picture. Ask what could be measured and choose the best unit for measuring it.





- 2 Compare your questions and units from Question 1 with those of others in your group.
- 3 Tell what is being measured each time and what unit of measurement could be used.
  - a How long is your favourite song?
  - b How hot was it in the town in Western Australia that recorded the hottest day?
  - c How thick is the ozone layer?
  - d How big was the 'Welcome Stranger' gold nugget mined in Ballarat in 1859?
  - e When is the next low tide?
  - f How long is the Hume Highway between Sydney and Melbourne?
  - g How long is your school day?
  - h If Concorde flew the 7000 km from London to New York in 5.5 hours, how fast was it travelling?
  - i How much soft drink will the bottle hold?
  - j How big is the school playground?
- 4 Tell what each of these newspaper headlines is measuring and suggest a suitable unit.
  - a FISHERMAN MAKES RECORD CATCH
  - b RECORD-BREAKING WINDS LASH QUEENSLAND COAST
  - c HIGH JUMP RECORD BROKEN
  - d STATE SIZZLES — FIRE ALERT
  - e OLYMPIC STADIUM LARGEST IN WORLD
- 5 Make up five newspaper headlines similar to those in Question 4. Explain what is being measured and suggest a suitable unit.

## Ancient measures

- 1 Each person in the group should follow these instructions.
  - a Use your *pace* to measure the length of the room.
  - b Use your *span* to measure the width of your desk.
  - c Use your *palm* to measure the length of this book.
  - d Choose a suitable unit and measure:
    - i the height of the door
    - ii the length of the board.
  - e Choose two other items in the room and measure them using a suitable unit.
- 2 a As a group compare your answers for each of the measurements in Question 1. Are they the same?  
 b Note any problems you found in using the measures required.
- 3 Measure (in centimetres) how long each of these are for you.
 

a a pace	b a foot	c a cubit
d a span	e a palm	f a digit
- 4 How accurate is this method of measuring? Explain your answer.

## The British Imperial system

King Henry I, who ruled England from AD 1100–1135, allowed his body measurements to be used as common units for the British people.

This Imperial system was used in Australia until the 1970s, and is still used in Great Britain and the USA.

- 1 Find out how long an inch, a foot, a yard and a mile are in metric units.
- 2 Find as many other units in the Imperial system as you can.
- 3 Ask your parents if they know of other units of measurement used in other countries.
- 4 What is the meaning of the word ‘imperial’? Why is it used to describe the old British system of measurement?



## History of the metric system

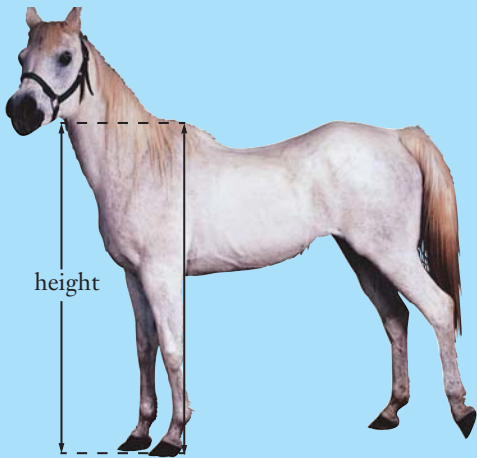
Research the history of the metric system. Find out how the basic units (metre, kilogram and litre) are measured. Find out what each of the prefixes milli, centi and kilo means.



# Hands high

How tall are you? You will probably give the answer in centimetres or metres. However, the height of a horse is measured in hands and is measured not from the top of the head to the ground, but from the ground to the shoulder blades.

How many centimetres are in a 'hand'?  
How many hands tall are you?



## 8-02 Converting units of length

The basic unit of length is the metre.  
The metric system uses the prefixes **milli**, **centi** and **kilo** to combine units of measure.

Prefix	Meaning	Example
milli	one thousandth	1 millimetre = $\frac{1}{1000}$ of 1 metre = 0.001 m
centi	one hundredth	1 centimetre = $\frac{1}{100}$ of 1 metre = 0.01 m
kilo	one thousand	1 kilometre = 1000 metre

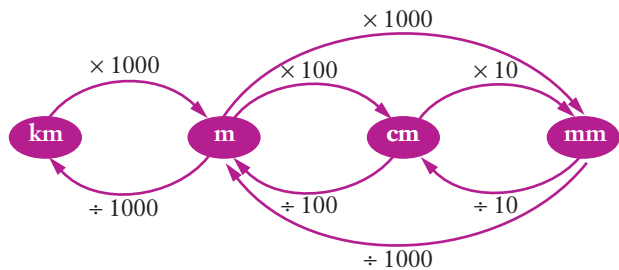
Note: 1 mm is the thickness of a fingernail.  
1 cm is the width of a fingernail.  
1 m is the height of a typical door handle.  
1 km is the distance covered in a 20-minute walk around the block.



10 mm = 1 cm      1000 mm = 1 m  
100 cm = 1 m      1000 m = 1 km



This diagram shows how to convert between different units of length.







In general:

- to change from larger units to smaller units, multiply by 10 or 100 or 1000.
- to change from smaller units to larger units, divide by 10 or 100 or 1000.



## Example 1

**a** Change 34 cm to mm.

**Solution**

$$\begin{aligned} 34 \text{ cm} &= (34 \times 10) \text{ mm} && \text{(larger unit to smaller unit)} \\ &= 340 \text{ mm} && \text{(cm to mm: } \times 10) \end{aligned}$$

**b** Change 350 m to km.

**Solution**

$$\begin{aligned} 350 \text{ m} &= (350 \div 1000) \text{ km} && \text{(smaller unit to larger unit)} \\ &= 0.35 \text{ km} && \text{(m to km: } \div 1000) \end{aligned}$$

## Exercise 8-02

Ex 1

**1** Convert these lengths to centimetres (cm).

- |                 |                 |                  |                   |
|-----------------|-----------------|------------------|-------------------|
| <b>a</b> 2 m    | <b>b</b> 15 m   | <b>c</b> 0.5 m   | <b>d</b> 3.5 m    |
| <b>e</b> 0.25 m | <b>f</b> 1.25 m | <b>g</b> 15.48 m | <b>h</b> 12.6 m   |
| <b>i</b> 3 km   | <b>j</b> 25 km  | <b>k</b> 12.5 km | <b>l</b> 20.25 km |
| <b>m</b> 420 mm | <b>n</b> 65 mm  | <b>o</b> 7 mm    | <b>p</b> 125 mm   |

**2** Convert to millimetres (mm).

- |                  |                |                  |                   |
|------------------|----------------|------------------|-------------------|
| <b>a</b> 3 cm    | <b>b</b> 8 m   | <b>c</b> 40 cm   | <b>d</b> 25 m     |
| <b>e</b> 11.5 cm | <b>f</b> 4.2 m | <b>g</b> 3.25 cm | <b>h</b> 15.75 m  |
| <b>i</b> 5 km    | <b>j</b> 12 km | <b>k</b> 8.4 km  | <b>l</b> 32.75 km |
| <b>m</b> 78 cm   | <b>n</b> 2 m   | <b>o</b> 125 cm  | <b>p</b> 0.7 m    |

**3** Convert to metres (m).

- |                  |                   |                  |                  |
|------------------|-------------------|------------------|------------------|
| <b>a</b> 200 cm  | <b>b</b> 3000 mm  | <b>c</b> 850 cm  | <b>d</b> 9800 mm |
| <b>e</b> 1250 cm | <b>f</b> 2750 mm  | <b>g</b> 80 cm   | <b>h</b> 250 mm  |
| <b>i</b> 75 cm   | <b>j</b> 325 mm   | <b>k</b> 6 km    | <b>l</b> 18 km   |
| <b>m</b> 23.6 km | <b>n</b> 48.25 km | <b>o</b> 1380 cm | <b>p</b> 0.8 km  |

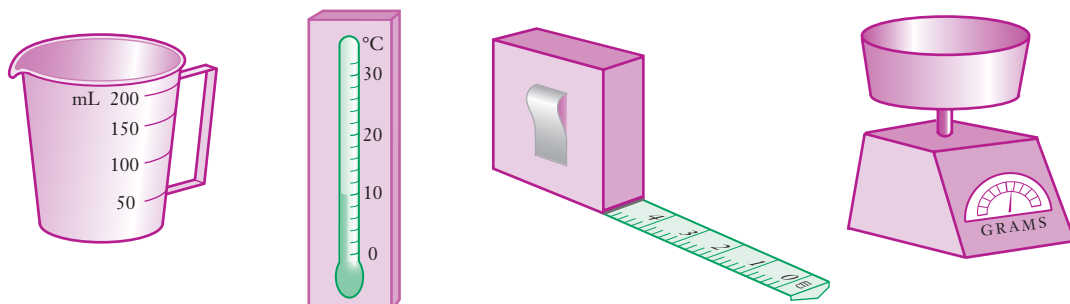
**4** Convert to kilometres (km).

- |                     |                       |                     |                     |
|---------------------|-----------------------|---------------------|---------------------|
| <b>a</b> 2000 m     | <b>b</b> 1385 m       | <b>c</b> 140 000 cm | <b>d</b> 293 870 cm |
| <b>e</b> 375 m      | <b>f</b> 98 m         | <b>g</b> 23 500 cm  | <b>h</b> 6480 cm    |
| <b>i</b> 500 000 mm | <b>j</b> 2 700 000 mm | <b>k</b> 3200 m     | <b>l</b> 607 000 cm |

- 5 Which length is the longest?
- a 8 m or 1200 cm                      b 2800 cm or 5700 mm  
c 10 000 mm or 20 m                  d 3500 m or 24 km  
e 1.5 km or 25 000 cm                f 0.65 km or 78 m  
g 230 000 mm or 2.3 km              h 6 m or 580 cm or 4000 mm  
i 250 cm or 1.5 m or 1800 mm      j 0.2 km or 120 m or 18 000 cm
- 6 Place each of these sets of lengths in order, from smallest to largest.
- a 200 cm, 3 m, 2500 mm              b 3200 mm, 240 cm, 4 m  
c 900 cm, 0.8 m, 700 mm              d 0.045 km, 450 m, 4800 cm  
e 650 mm, 60 cm, 0.69 m              f 1.5 km, 150 m, 1500 cm  
g 1750 mm, 0.18 m, 180 cm            h 120 cm, 1.3 m, 0.011 m
- 7 Which length is the shortest? Select **A**, **B**, **C** or **D**.
- A** 0.3 m                      **B** 29 cm                      **C** 300 mm                      **D** 160 mm
- 8 Karla and Cassie measured these objects in the classroom.
- length of pencil                      12 cm
  - width of computer screen            33 cm
  - width of door                          80 cm
  - width of ruler                          3.5 cm
  - length of room                          740 cm
- a Karla wrote her measurements in millimetres. What did she write?  
b Cassie wrote her measurements in metres. What did she write?  
c What unit would you use (cm, mm or m)? Would you use different units for different objects? If so, what would they be?
- 9 Copy and complete the following.
- a the prefix meaning 1000 is \_\_\_\_\_  
b the prefix meaning  $\frac{1}{100}$  is \_\_\_\_\_  
c the prefix meaning  $\frac{1}{1000}$  is \_\_\_\_\_
- 10 Find other prefixes that are used in the metric system (for example 'micro' and 'mega'). Write their meanings.

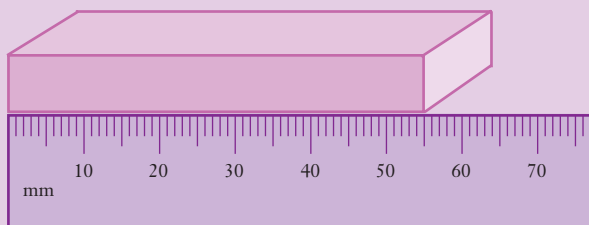
## 8-03 Reading measurement scales

Many measuring devices use markings called scales. Your ruler is a good example.



## Example 2

How long is the eraser?



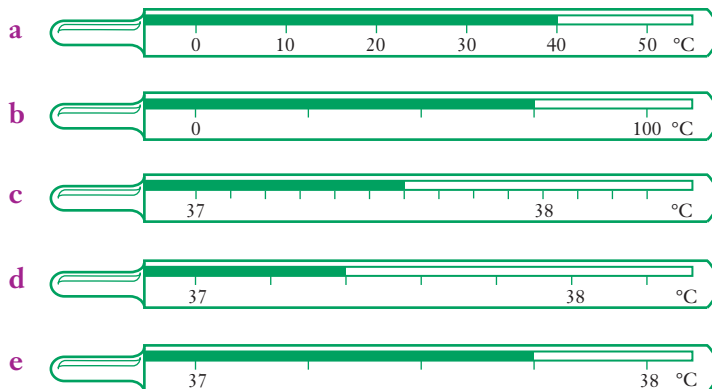
### Solution

The length of the eraser is halfway between 50 mm and 60 mm.

The answer is 55 mm.

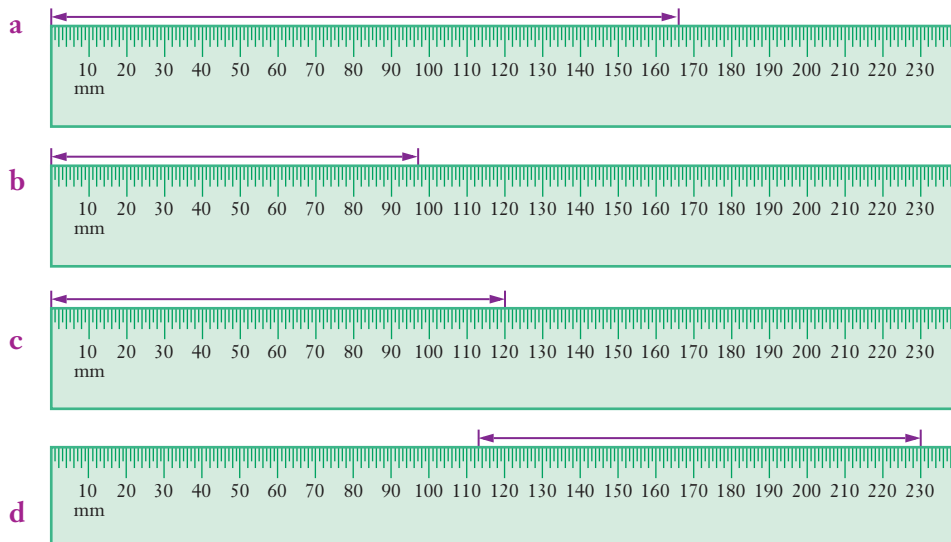
## Exercise 8-03

1 Read the temperature, in degrees Celsius, from the scale on each thermometer.

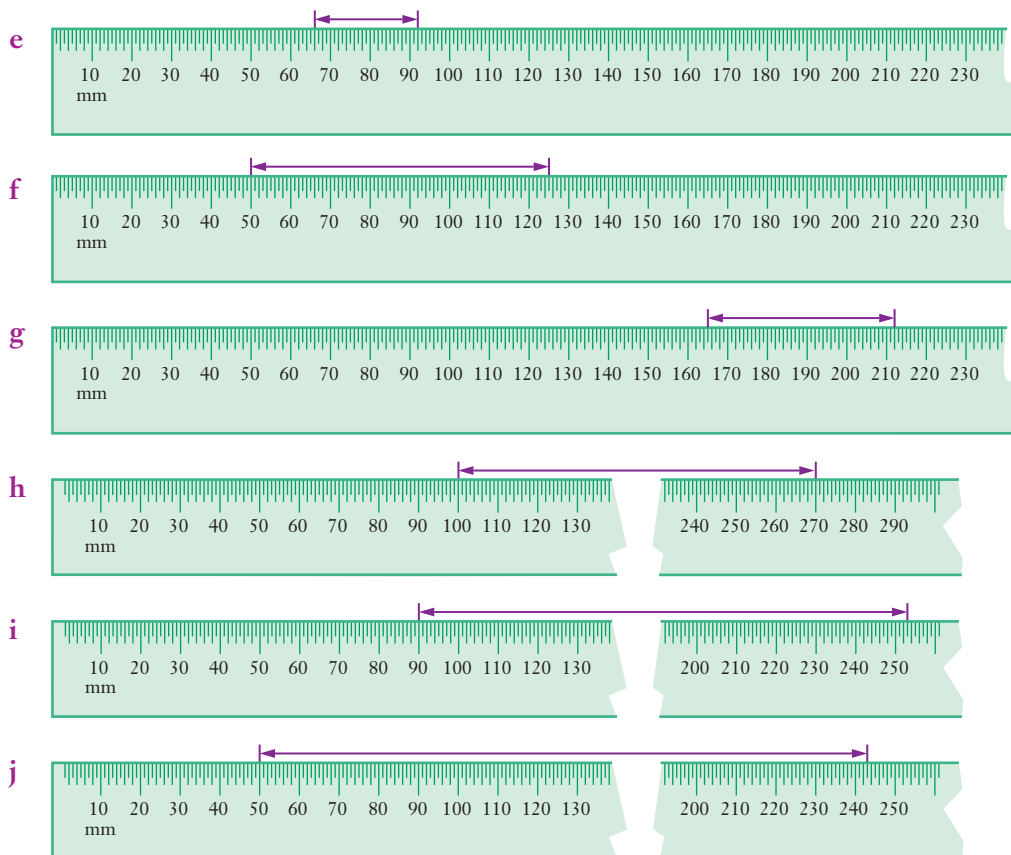


Ex 2

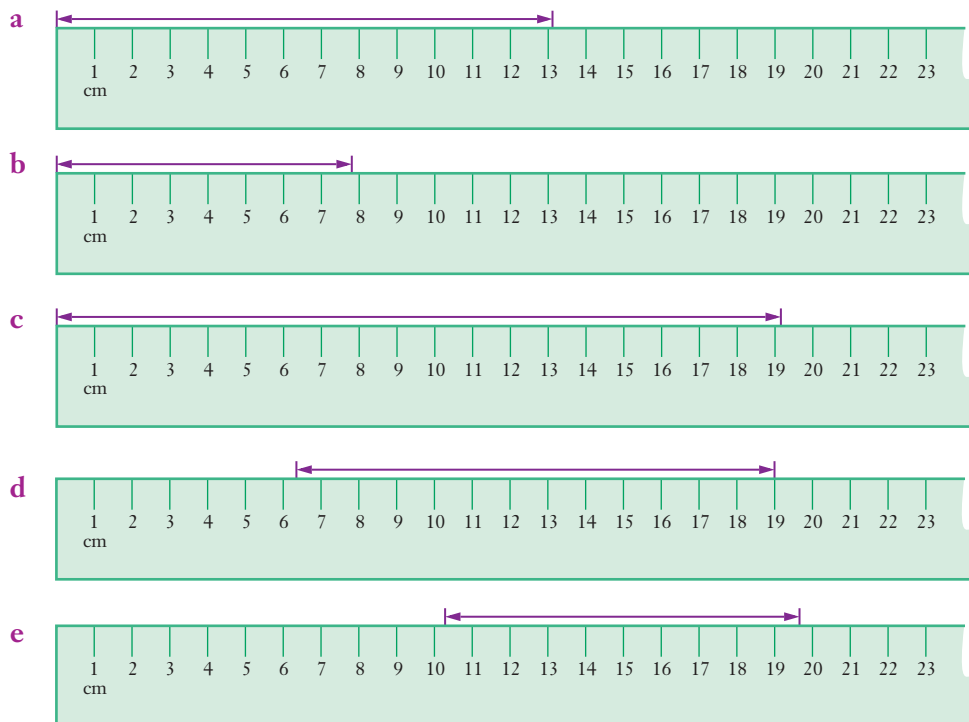
2 Read the scale on the ruler to find the length of each given line segment, to the nearest millimetre.



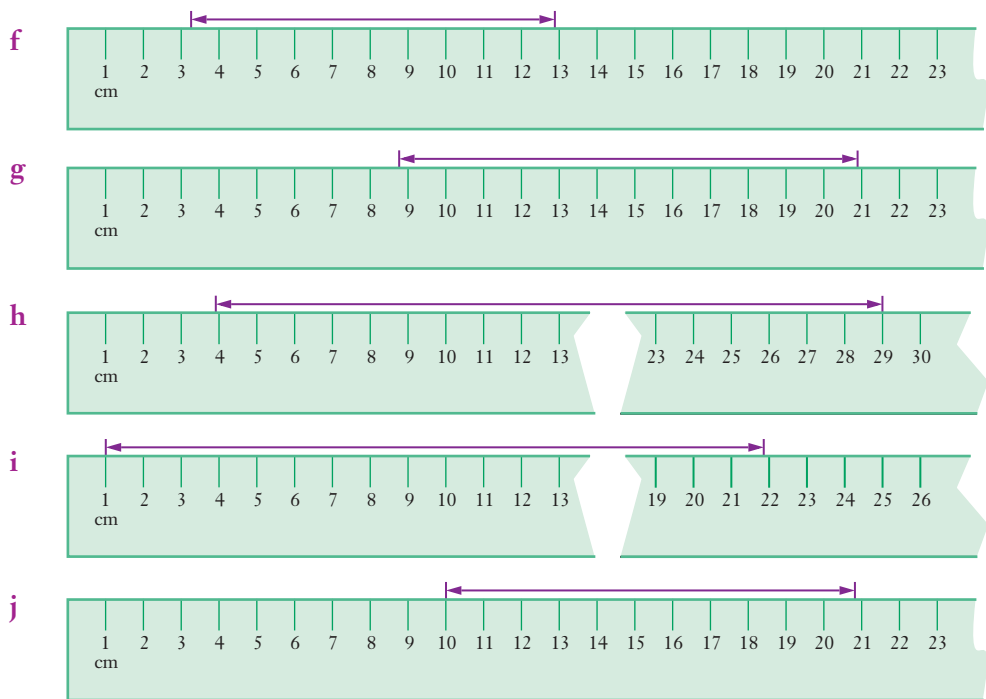




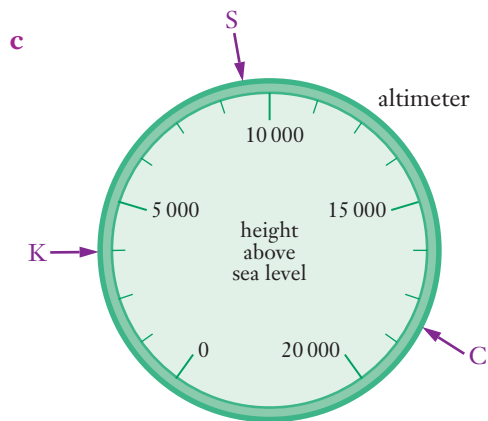
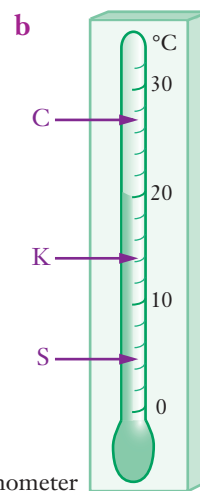
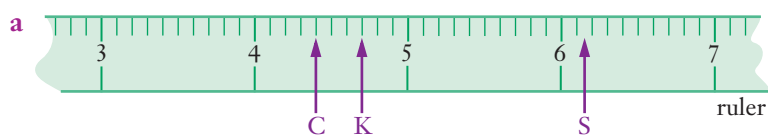
3 Read the scale on the ruler to find the length of each given line segment, to the nearest centimetre.



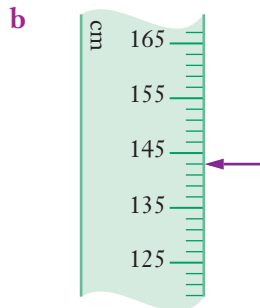
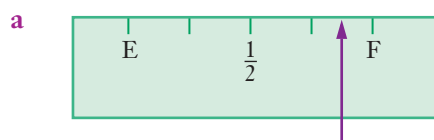
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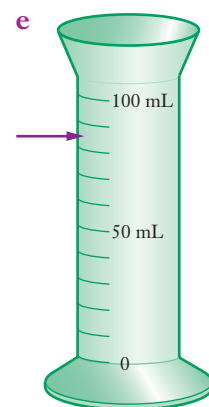
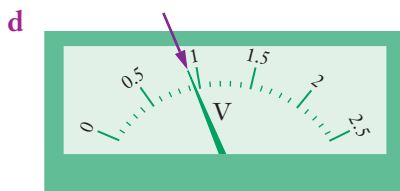
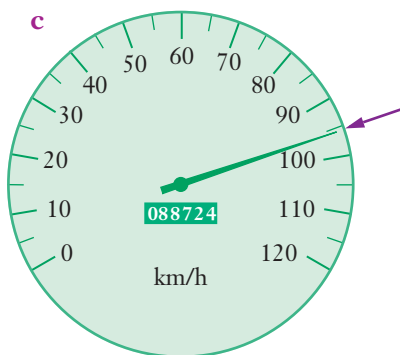


4 Write the values shown by **C**, **K** and **S** on each of these scales.



5 Write the value shown by the arrow marker each time.





**6** Find other mathematical uses of the word ‘scale’.

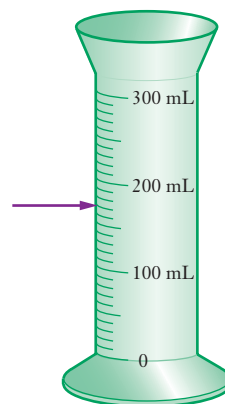
**7** What value is shown by the arrow? Select A, B, C or D.

**A** 170 mL

**B** 107 mL

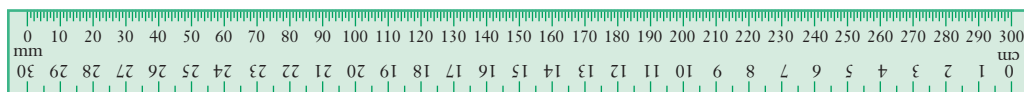
**C** 17 mL

**D** 152 mL



**8 a** State where each of the following instruments could be used.

**i** a ruler



**ii** a tape measure



**iii** a trundle wheel



**b** Find other instruments used to measure distances, such as Vernier calipers, and give examples of where they would be used.



## The metric system

1 Copy and complete each of the following.

a  $7.3 \times 100$

b  $84 \div 10$

c  $240 \div 10$

d  $5.91 \times 100$

e  $60 \div 1000$

f  $4.5 \text{ kg} = \text{___ g}$

g 3 hours = \_\_\_ minutes

h 750 mL = \_\_\_ L

i 240 mm = \_\_\_ cm

j 12 kL = \_\_\_ L

k 5.2 m = \_\_\_ cm

l 420 s = \_\_\_ min

m 2 days = \_\_\_ hours

n  $8.65 \text{ t} = \text{___ kg}$

2 Copy and complete each of these.

a  $2.2 \text{ L} = \text{___ mL}$

b  $800 \text{ mm} = \text{___ m}$

c  $235 \text{ cm} = \text{___ m}$

d  $360 \text{ mg} = \text{___ g}$

e  $5\frac{1}{2} \text{ hours} = \text{___ min.}$

f  $4900 \text{ L} = \text{___ kL}$

g  $270 \text{ kg} = \text{___ t}$

h 4 years = \_\_\_ months

i  $10.8 \text{ km} = \text{___ m}$

j  $16.9 \text{ L} = \text{___ mL}$

k 1 year = \_\_\_ days

l  $740 \text{ cm} = \text{___ m}$

m 72 hours = \_\_\_ days

n  $65 \text{ mm} = \text{___ m}$

o  $0.96 \text{ kL} = \text{___ L}$

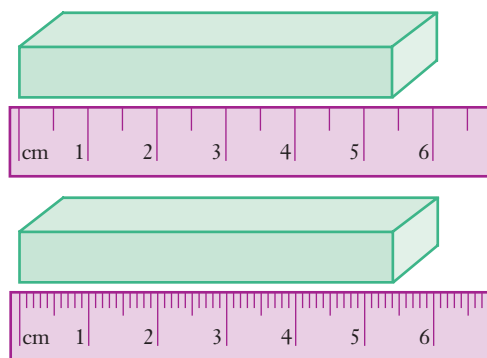
p  $740 \text{ kg} = \text{___ g}$

## 8-04 The accuracy of measuring instruments

All measurements are only approximations.  
No measurement is ever *exact*.

We might measure this eraser to be 5.5 cm long, because the scale on the ruler measures to the nearest 0.5 cm.

If we used a ruler with a more precise scale, such as 0.1 cm markings, then we may find the length to be 5.4 cm.



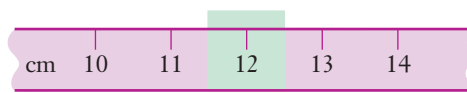
If we could find an instrument such as a micrometer that measured to the nearest 0.01 cm, we may find that the measured length is 5.41 cm.

Notice that we can always find a more accurate measurement (for example, 5.413 cm or 5.4129 cm) using a more precise instrument. So all measurements are approximations.

### Limits of accuracy

The **accuracy of a measurement** is how close that measurement is to the true value. This is restricted or limited by the accuracy of the measuring instrument.

The ruler shown on the right is marked in centimetres, so any length measured with it can only be given to the nearest centimetre.



For example, any measurement in the shaded region could be recorded as 12 cm. The measured length is 12 cm, but the actual length is  $12 \pm 0.5$  cm, meaning '12 centimetres, give or take 0.5 centimetres'. The **limits of accuracy** of this ruler then are  $\pm 0.5$  cm or 'plus or minus half a centimetre'.

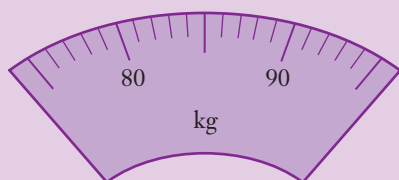
The limits of accuracy of a measuring instrument are  $\pm 0.5$  of the unit shown on the instrument's scale.



### Example 3

For each of these measuring scales, state the size of one unit on the scale and state the limit of accuracy.

a



b



#### Solution

- a The size of one unit is 1 kg. The limits of accuracy are  $\pm 0.5 \times 1 \text{ kg} = \pm 0.5 \text{ kg}$ .  
 b The size of one unit is 5 mL. The limits of accuracy are  $\pm 0.5 \times 5 \text{ mL} = \pm 2.5 \text{ mL}$ .

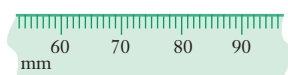
### Exercise 8-04

1 For each measuring instrument below, state:

i the size of one unit

ii its limits of accuracy.

a



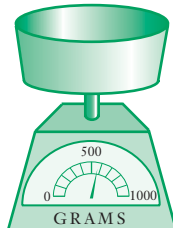
b



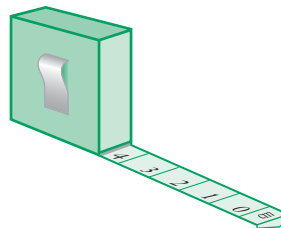
c



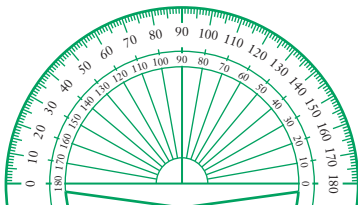
d



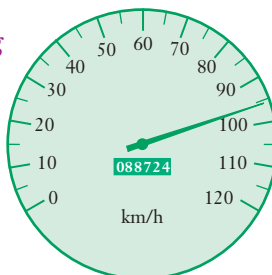
e



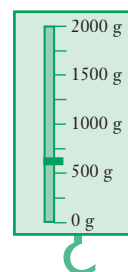
f

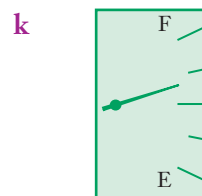
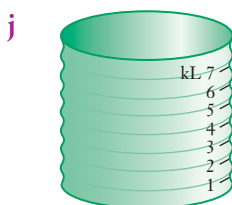
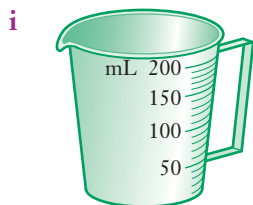


g



h





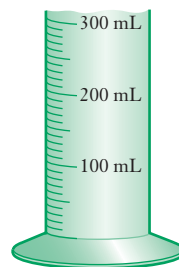
2 State the limits of accuracy for the instrument on the right. Select **A**, **B**, **C** or **D**.

**A**  $\pm 0.5$  mL

**B**  $\pm 10$  mL

**C**  $\pm 20$  mL

**D**  $\pm 5$  mL



## Working mathematically

Reflecting and applying strategies

### 'Guess the length' game

Up to six people may play this game.

*Step 1:* Each player uses a ruler to draw a straight line on a separate piece of blank paper. The pieces of paper are then shuffled.

*Step 2:* A piece of paper is selected. Each player writes an estimate of the line length.

*Step 3:* The line is accurately measured and guesses compared with the measurement.

*Step 4:* Play several games to see if the players' estimation skills improve.

*Scoring:* If there are five players:

- the person closest to the measured length gets 6 points
- the person second closest gets 4 points
- the person third closest gets 3 points
- the person fourth closest gets 2 points
- the person furthest from the measure gets 1 point.

If there are four players, the person closest gets 5 points; for three players the person closest gets 4 points; and so on.

*Step 5:* Record scores (see the sample scoresheet below).

*Sample:*

Scoresheet			
Line	Guess	Exact measure	Points
1	9 cm	11.5 cm	2
2	8.5 cm	9 cm	4
3	14 cm	12.6 cm	3
4	6.5 cm	6.4 cm	5
5	3.1 cm	2.9 cm	4
			<b>Total 18</b>

*Step 6:* Repeat steps 2 to 4 until all the pieces of paper are used.

*Step 7:* Make up your own variations using:

- a** lines with bends in them
- b** curved lines
- c** the total length of two separate lines.

Worksheet  
8-03

Guessing heights game

Skillsheet  
8-02

Measuring length



# Measuring long distances

Use the library or the Internet to help you answer these questions.

- 1 How are long distances (for example, between countries) measured?
- 2 How would you measure the distance from Sydney to Perth?
- 3 What is a **nautical mile** and what is it used for?
- 4 What is a **light year** and what is it used for?
- 5 If space travel is your dream, then you need to know what a **parsec** is. Find out.

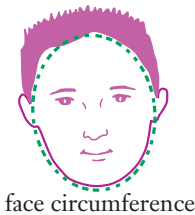
## 8-05 Estimating and measuring length

Worksheet  
8-04

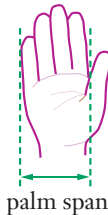


Measuring objects

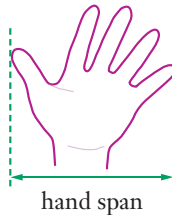
### Exercise 8-05



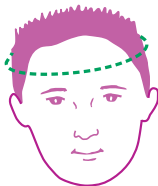
face circumference



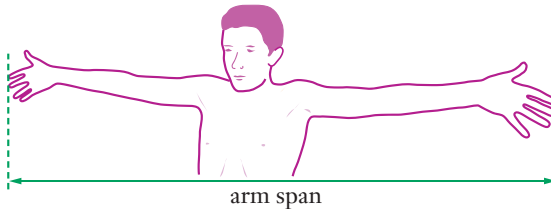
palm span



hand span



head circumference



arm span

1 a Use a tape measure to measure yourself. Copy and complete this table.

	Body Part	Measurement (to nearest cm)
i	Wrist	
ii	Neck	
iii	Waist	
iv	Head circumference (distance around head)	
v	Face circumference (distance around face)	
vi	Height	
vii	Hand span	
viii	Arm span (fingertip to fingertip)	
ix	Palm span	
x	Middle finger (length)	
xi	Foot (length)	

7890  
01234567890123  
234567890123456  
23456  
01234  
1123456789012345  
5678901234567890  
1123456789012345  
1567890123456789  
012345678901234  
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2345678901234567  
7890123456789012  
234567890123456  
56789012345678901  
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6789012345678901  
1123456789012345  
5678901234567890  
0123456789012345  
1567890123456789  
8012345678901234  
4567890123456789  
8901234567890123  
3456789012345678  
8901234567890123

- b Compare your neck and wrist measurements. Compare them with those of some classmates. Write a conclusion.
  - c Compare your arm span and your height. Compare them with those of some classmates. Write a conclusion.
  - d Write a conclusion about the head and face circumference for the human race.
- 2 a Estimate the length of a basketball court.
- b In pairs, measure the length by counting paces. How close were you to your estimate? Explain your results by looking at the length of your paces.
  - c Use a trundle wheel or tape measure to measure the basketball court. Which unit of length do you think is more appropriate?



Worksheet  
8-05

A page of composite  
shapes

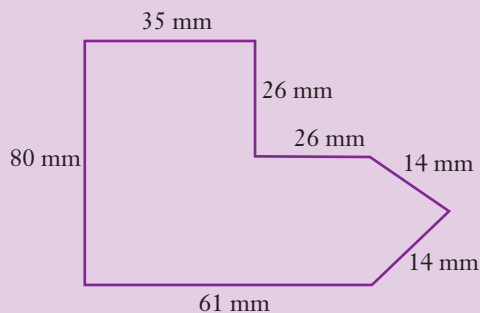
## 8-06 Perimeter



The perimeter of a shape is the distance around the shape. It is the sum of the lengths of the sides of the shape.

### Example 4

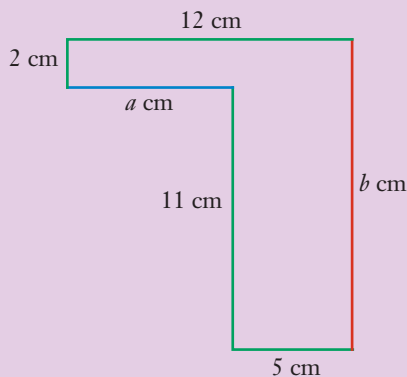
- a Find the perimeter of this shape.



#### Solution

$$\begin{aligned}\text{Perimeter} &= 80 + 35 + 26 + 26 + 14 + 14 + 61 \\ &= 256 \text{ mm}\end{aligned}$$

- b Find the perimeter of this shape.



#### Solution

First, we need to find the lengths of the unknown sides,  $a$  and  $b$ .

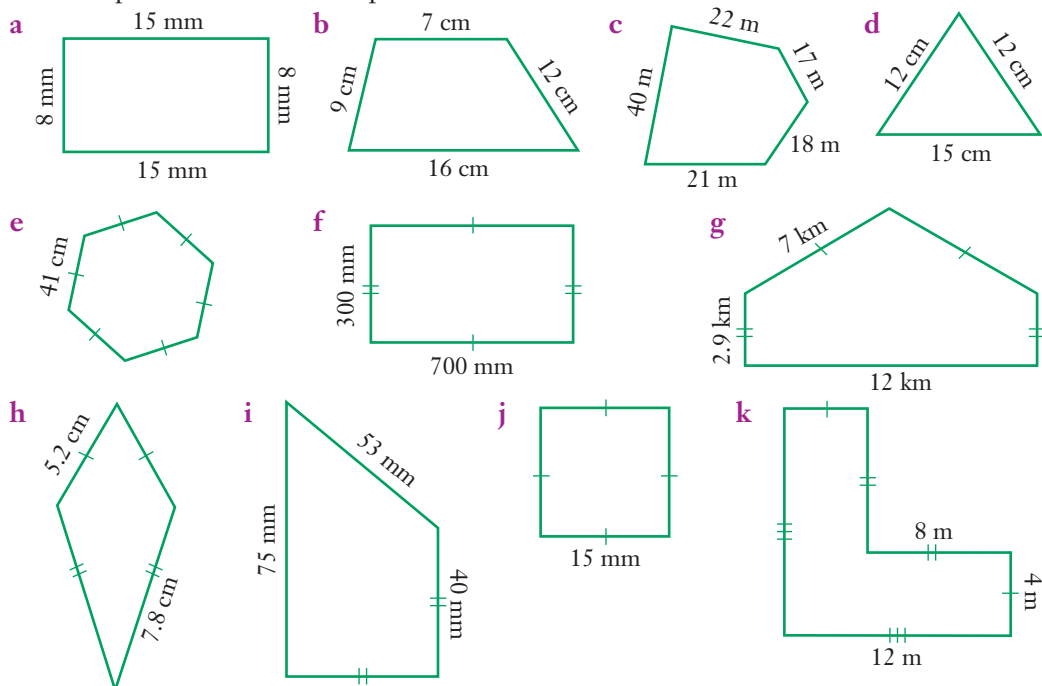
$$\begin{aligned}\text{The side shown by the red line } b &= 2 + 11 \\ &= 13 \text{ cm}\end{aligned}$$

$$\begin{aligned}\text{The side shown by the blue line } a &= 12 - 5 \\ &= 7 \text{ cm}\end{aligned}$$

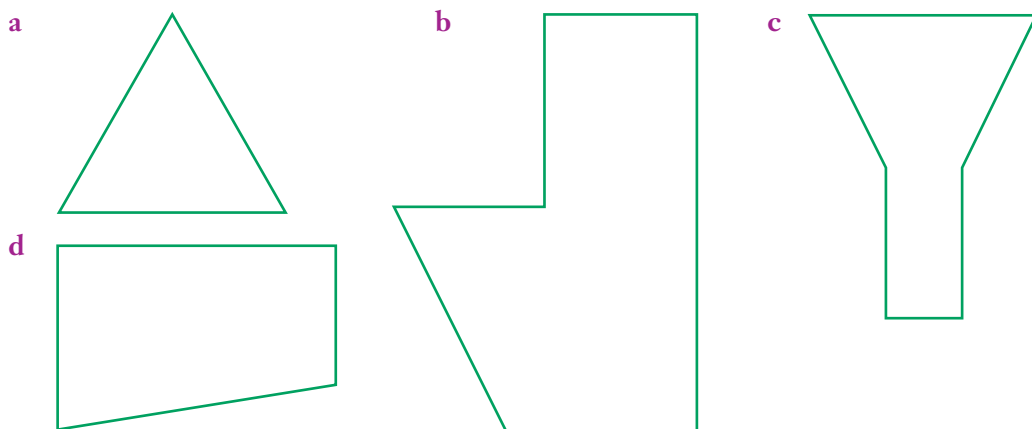
$$\begin{aligned}\text{Perimeter} &= 12 + 13 + 5 + 11 + 7 + 2 \\ &= 50 \text{ cm}\end{aligned}$$

## Exercise 8-06

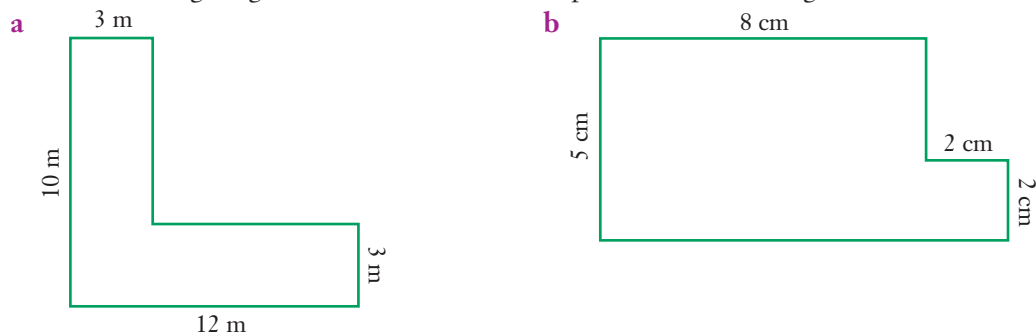
1 Find the perimeter of each shape.



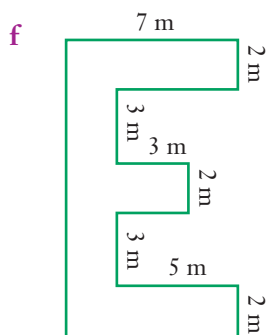
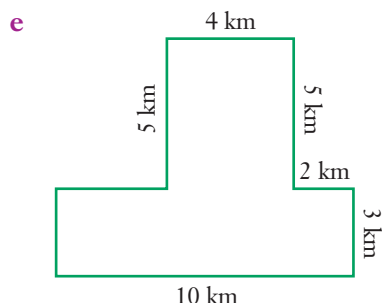
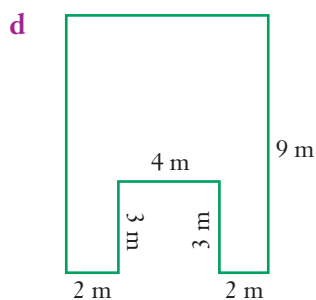
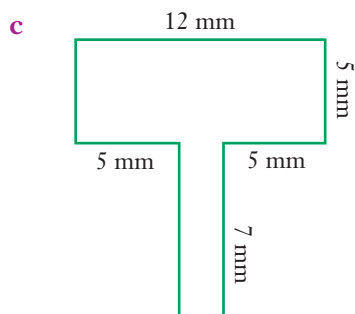
2 Measure the sides of each shape in mm and find the perimeter.



3 Find the missing lengths and then calculate the perimeter of each figure.

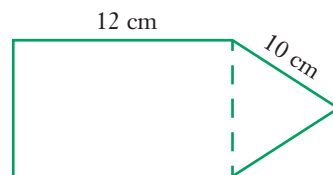


Ex 4



- 4 a** A square has a perimeter of 16 cm. Find the length of one side.  
**b** A rectangle has a perimeter of 40 cm. If its length is 12 cm, find its width.  
**c** A square has a perimeter of 56 cm. Find the length of one side.  
**d** A rectangle has a perimeter of 62 cm. If its width is 13 cm, find its length.  
**e** A square has a perimeter of 38 cm. Find the length of one side.  
**f** A rectangle has a perimeter of 45 cm. If its length is 15 cm, find its width.
- 5** A rectangle has a perimeter of 30 cm. Find a possible length and a possible width.
- 6** The figure on the right is made up of a rectangle and an equilateral triangle. Find its perimeter. Select **A**, **B**, **C** or **D**.

- A** 44 cm                      **B** 64 cm  
**C** 54 cm                      **D** 22 cm



## 8-07 Area

A person estimating the number of tiles needed to cover the floor of a room needs to know the size of a tile and the size of the room. In this case, the **area of the shape** gives its 'size'.





The area of a shape is the amount of surface that is enclosed by the shape. For example, the area of this trapezium has been coloured pink.



## Standard units of area

This table shows standard metric units of area.

Standard area unit		Abbreviation
square millimetre (each side measures 1 mm)	■	mm <sup>2</sup>
square centimetre (each side measures 1 cm)	■	cm <sup>2</sup>
square metre (each side measures 1 m)		m <sup>2</sup>

The **square metre** or m<sup>2</sup> is approximately the size of the floor of a large shower recess.  
A square centimetre is about the area of a fingernail.

## Example 5

Find the area of each of these shapes.

**a**

Shape A

**b**

Shape B

**c**

Shape C

**d**

Shape D

### Solution

- a** Area of Shape A = 4 cm<sup>2</sup>  
**b** Area of Shape B = 3 cm<sup>2</sup>  
**c** Area of Shape C = 5 cm<sup>2</sup>  
**d** Area of Shape D = 3 squares +  $\frac{1}{2}$  square +  $\frac{1}{2}$  square  
 = 4 cm<sup>2</sup>

Worksheet  
8-06

Areas on a grid

Worksheet  
Appendix 7

1 cm grid paper

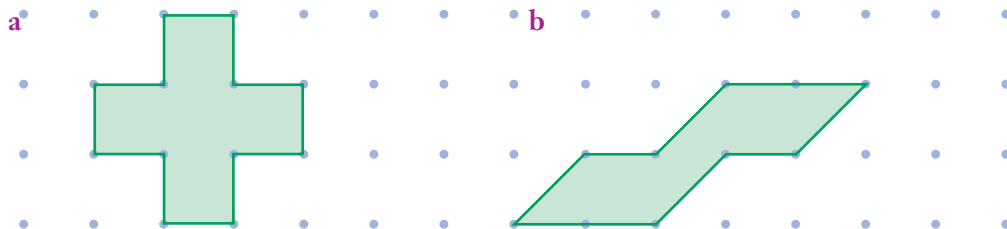
## Exercise 8-07



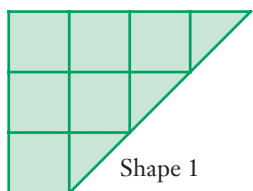
Worksheet  
Appendix 8

Square dot paper

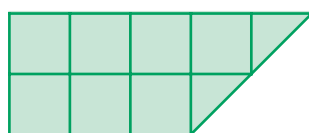
- 1 Use square dot paper to draw four different shapes which have the same area as each of these shapes.



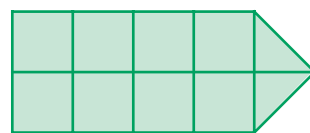
- 2 Which shape has the greatest area? Select **A**, **B**, **C** or **D**.



Shape 1



Shape 2



Shape 3

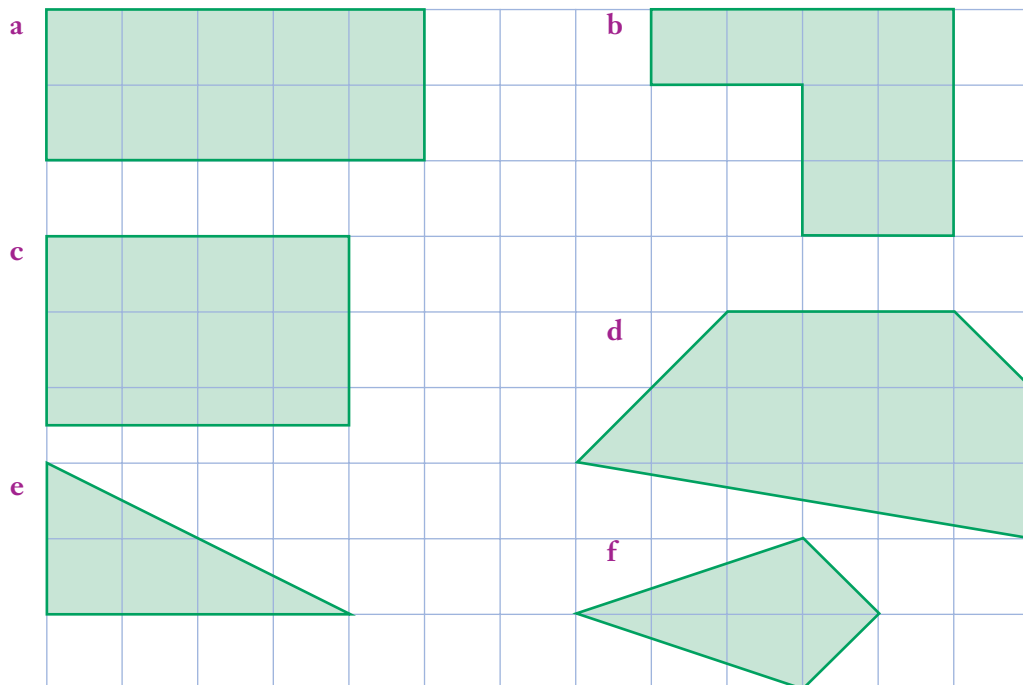
- A** Shape 1      **B** Shape 2      **C** Shape 3      **D** All the same

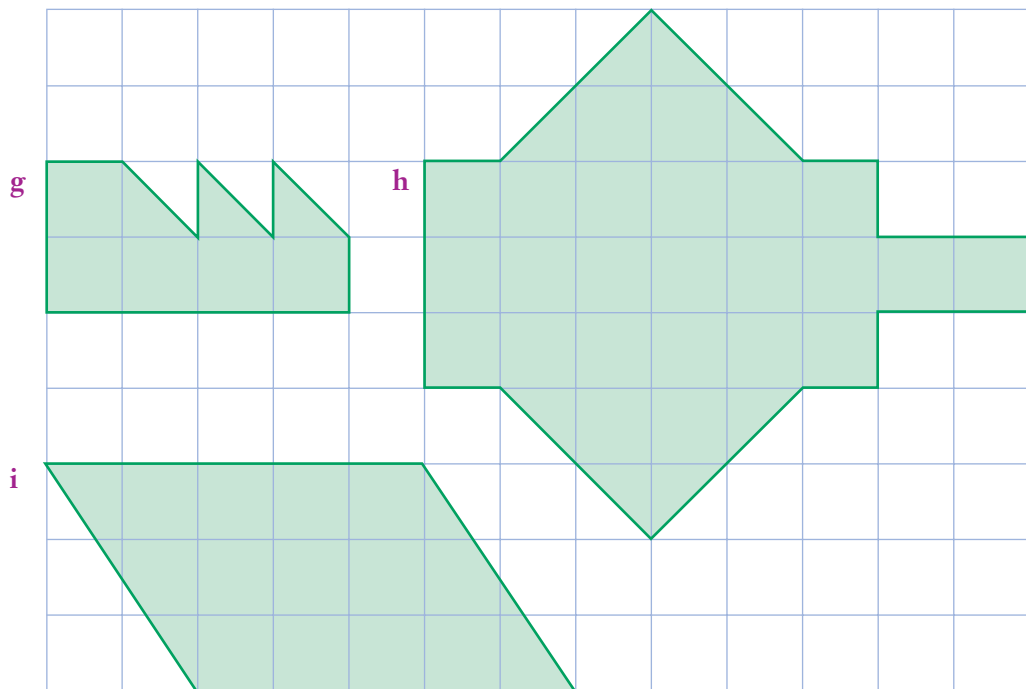
- 3 Use triangular dot paper to draw three different shapes which have the same area as each of these shapes.



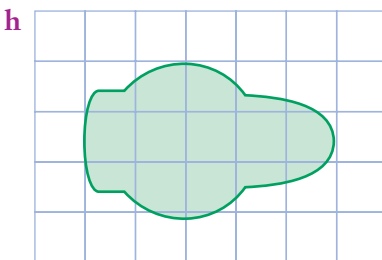
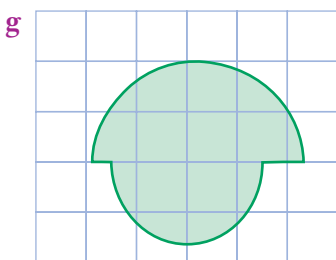
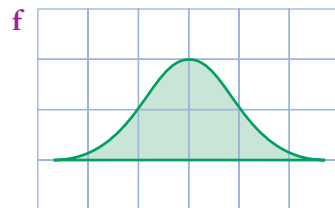
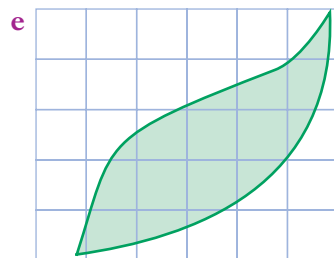
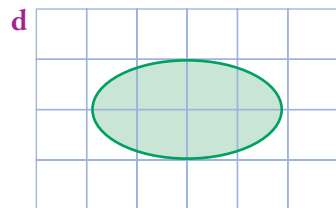
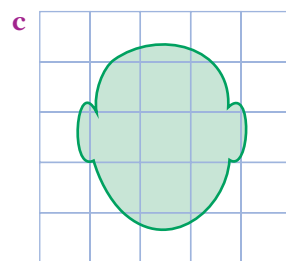
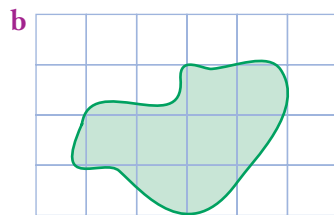
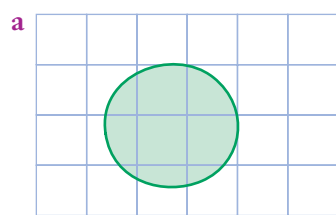
Ex 5

- 4 These shapes are drawn on a grid of 1 cm squares. Find the area of each shape.



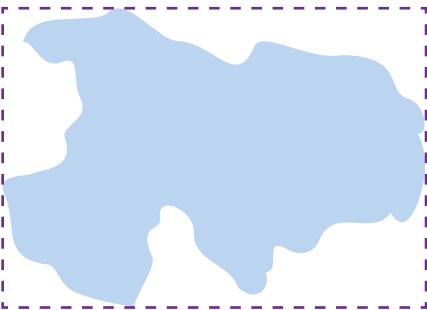


- 5 Finding the exact area of a shape that is not made of straight lines is difficult. It is easier to estimate the area by placing a grid over the shape. Count a square only if more than half of it is included in the shape. Find the approximate area of each of these shapes in square units.





## The human lagoon

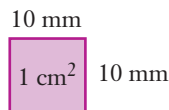
- 1
    - a Find a level area of concrete or bitumen. Carefully pour a litre of water over it to form a puddle.
    - b Use a metre ruler or tape measure to measure the dimensions of the smallest rectangle that surrounds the puddle.
    - c On graph paper marked in 1 cm squares, make a scale drawing of the rectangle which surrounds the puddle.
    - d Sketch the shape of your puddle inside the rectangle on the graph paper.
- 
- e Use the method of counting squares to find the area of the puddle formed by the litre of water.
- 2
    - a About 80% of the human body is made up of water. If 1 litre of water has a mass of 1 kilogram, measure your own mass and use it to calculate the number of litres of water in your body. Use this result, together with those from Question 1, to find the area of the puddle the water in your body would make.
    - b Go outside and mark out a rectangle that has the same area as the puddle you would make. Record the dimensions of this rectangle.
    - c Using the scale 1 cm = 1 m, draw a rectangle on graph paper that has the same area as the puddle you would make. Write a brief report of what this rectangle represents and how it was found.

## 8-08 Converting units of area

$$1 \text{ cm} = 10 \text{ mm}$$

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

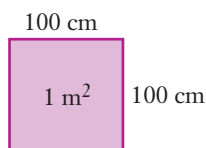
(double the number of zeros)



$$1 \text{ m} = 100 \text{ cm}$$

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

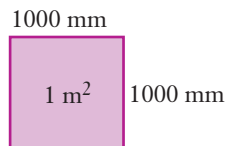
(double the number of zeros)



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

$$1 \text{ m}^2 = 1000 \times 1000 \text{ mm}^2 = 1\,000\,000 \text{ mm}^2$$

(double the number of zeros)





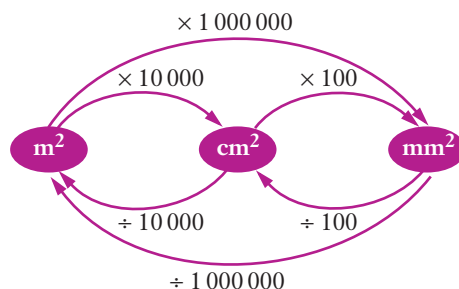
$$1 \text{ cm}^2 = 100 \text{ mm}^2$$

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

$$1 \text{ m}^2 = 1\,000\,000 \text{ mm}^2$$



This diagram shows how to convert between different units of area.



## Example 6

- a** Convert  $3 \text{ cm}^2$  to  $\text{mm}^2$ .

**Solution**

$$3 \text{ cm}^2 = (3 \times 100) \text{ mm}^2 \quad (\text{cm}^2 \text{ to mm}^2: \times 100)$$

$$= 300 \text{ mm}^2$$

- b** Convert  $4000 \text{ mm}^2$  to  $\text{m}^2$ .

**Solution**

$$4000 \text{ mm}^2 = (4000 \div 100) \text{ cm}^2 \quad (\text{mm}^2 \text{ to cm}^2: \div 100)$$

$$= 40 \text{ cm}^2$$

$$= (40 \div 10\,000) \text{ m}^2 \quad (\text{cm}^2 \text{ to m}^2: \div 10\,000)$$

$$= 0.004 \text{ m}^2$$

## Exercise 8-08

Ex 6

- 1** Copy and complete each of the following conversions.

- |   |  |
|---|--|
| <b>a</b> $15 \text{ cm}^2 = \underline{\hspace{2cm}} \text{ mm}^2$      | <b>b</b> $1\,500\,000 \text{ mm}^2 = \underline{\hspace{2cm}} \text{ m}^2$ |
| <b>c</b> $690 \text{ mm}^2 = \underline{\hspace{2cm}} \text{ cm}^2$     | <b>d</b> $6.5 \text{ m}^2 = \underline{\hspace{2cm}} \text{ cm}^2$         |
| <b>e</b> $0.5 \text{ m}^2 = \underline{\hspace{2cm}} \text{ mm}^2$      | <b>f</b> $12\,200 \text{ cm}^2 = \underline{\hspace{2cm}} \text{ m}^2$     |
| <b>g</b> $1250 \text{ mm}^2 = \underline{\hspace{2cm}} \text{ cm}^2$    | <b>h</b> $7.9 \text{ cm}^2 = \underline{\hspace{2cm}} \text{ mm}^2$        |
| <b>i</b> $0.75 \text{ m}^2 = \underline{\hspace{2cm}} \text{ mm}^2$     | <b>j</b> $865\,000 \text{ cm}^2 = \underline{\hspace{2cm}} \text{ m}^2$    |
| <b>k</b> $690\,000 \text{ mm}^2 = \underline{\hspace{2cm}} \text{ m}^2$ | <b>l</b> $0.47 \text{ m}^2 = \underline{\hspace{2cm}} \text{ cm}^2$        |

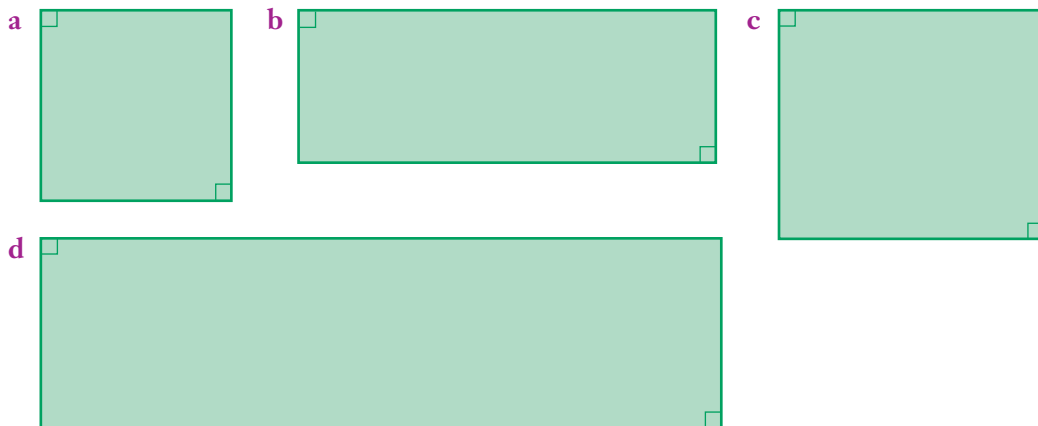
- 2** A square tile has an area of  $1024 \text{ cm}^2$ . What is this in:

- a**  $\text{mm}^2$ ?                      **b**  $\text{m}^2$ ?

- 3** Find the area of a square bowling green of side length  $5 \text{ m}$ . Write your answer first in  $\text{m}^2$ , then in  $\text{cm}^2$  and, finally, in  $\text{mm}^2$ .

- 4** Find the area of a desk top measuring  $180 \text{ mm}$  by  $60 \text{ mm}$ . Give your answer first in  $\text{mm}^2$ , then in  $\text{cm}^2$  and, finally, in  $\text{m}^2$ .

- 5 Find the area of each of these shapes by using a ruler to measure the length and breadth in millimetres. Give your answer first in  $\text{mm}^2$ , then in  $\text{cm}^2$ .



## Working mathematically

### Applying strategies and reasoning

## Standing room only!

*Step 1:* As a group, mark out a square metre in your classroom or school yard.

*Step 2:* Estimate how many students could stand in the square.

*Step 3:* Check your estimate by getting as many students as possible to stand in the square.

- 1 How could you estimate whether all the Year 7 students in your school could stand in your classroom?
- 2 How many Year 7 students could stand in your room?

## Student space in a classroom

*Step 1:* As a group, shift all the furniture to the sides of the classroom.

*Step 2:* Use a set of metre-long sticks and connectors to lay out a grid of square metres on the floor.

*Step 3:* Calculate or count the area of the floor in  $\text{m}^2$ .

*Step 4:* Sit two people to a square metre. Are you comfortable enough to stay within your square for a whole class?

*Step 5:* Sit one person to a square metre. How comfortable are you?

*Step 6:* Replace the furniture over the grid and sit at your desk.

- 1 How much area do you and your desk occupy?

- 2 Copy and complete these sentences.

My class has \_\_\_\_\_ students.

Today my maths class was held in a room with floor dimensions \_\_\_\_ by \_\_\_\_.

The area of the floor is approximately \_\_\_\_.

Each student is allocated \_\_\_\_\_ of floor space.

The floor space left over for aisles and the teacher is \_\_\_\_.

## TLF L 139

## Area counting with Coco

- 
- A 10x10 grid with five purple rectangles labeled i, ii, iii, iv, and v. Rectangle i is 5x4, ii is 4x6, iii is 1x6, iv is 6x4, and v is 6x5.

Rectangle	Length (cm)	Breadth (cm)	Area (cm <sup>2</sup> )
i	5	2	
ii	8		
iii			
iv			
v			

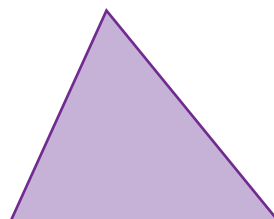
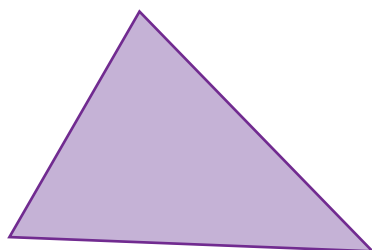
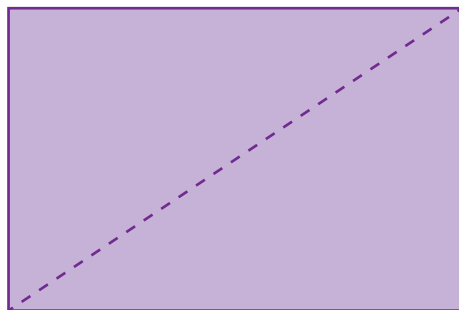
[illegible]

- b** Look at your results for part **a**. Write down a rule for finding the area of a rectangle from its length and breadth.

## 2 Area of right-angled triangles

You will need 1-cm grid paper.

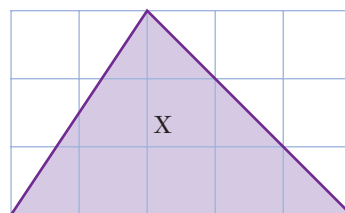
- a** On your grid paper, draw a rectangle 6 cm by 4 cm.
- b** Cut the rectangle in half along a diagonal. What shape have you made?
- c** Area of rectangle =  $\text{_____} \times \text{_____}$   
 $= \text{_____} \text{ cm}^2$
- d** What is the area of each triangle?
- e** Draw two other rectangles and repeat steps 2 to 4. What do you notice regarding the area of the triangle and the area of the rectangle?
- f** How can we find the area of triangles such as the following?



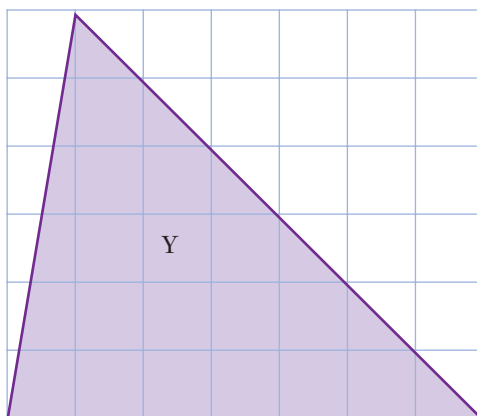
## 3 Area of triangles without right angles

You will need 1-cm grid paper and scissors.

- a** On your grid paper, draw triangle X as shown, and cut out the rectangle.
- b** Area of rectangle =  $\text{_____}$
- c** Cut out triangle X.
- d** Place the leftover pieces on triangle X. Do they cover triangle X exactly?
- e** Area of triangle =  $\text{_____}$



- 4** Repeat the steps in question 3 for triangle Y.





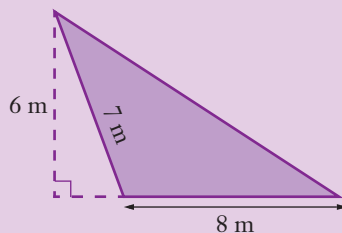


## Example 8

- 1 Find the area of this triangle.

**Solution**

$$\begin{aligned}\text{Area of triangle} &= \frac{1}{2} \times b \times h \\ &= \frac{1}{2} \times 8 \times 6 \\ &= 24 \text{ m}^2\end{aligned}$$

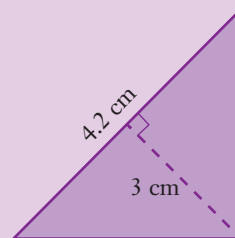


*Note:* The length of 7 m was not required to find this triangle's area.

- 2 Find the area of this triangle.

**Solution**

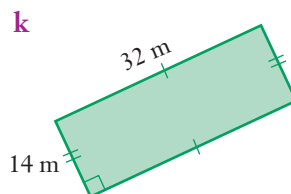
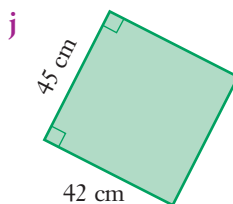
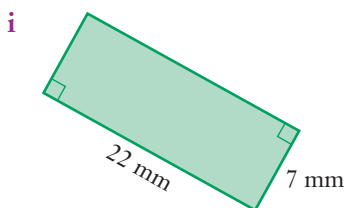
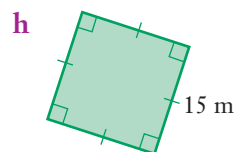
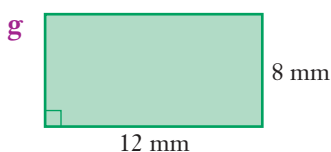
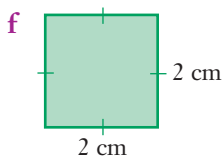
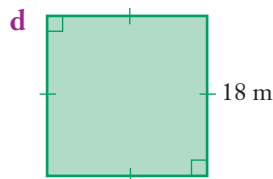
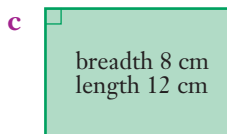
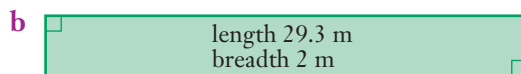
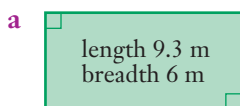
$$\begin{aligned}\text{Area of triangle} &= \frac{1}{2} \times b \times h \\ &= \frac{1}{2} \times 4.2 \times 3 \\ &= 6.3 \text{ cm}^2\end{aligned}$$



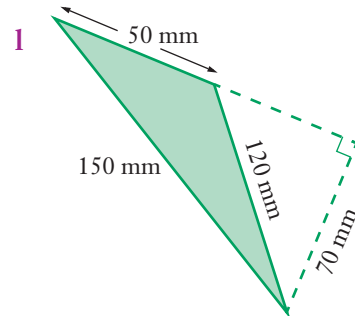
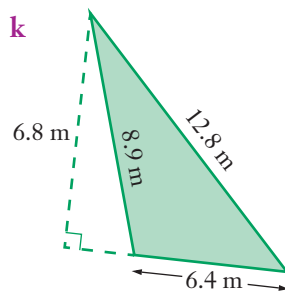
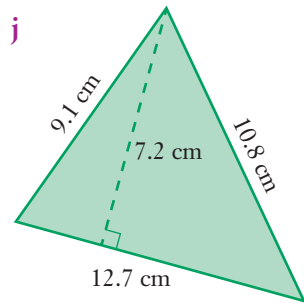
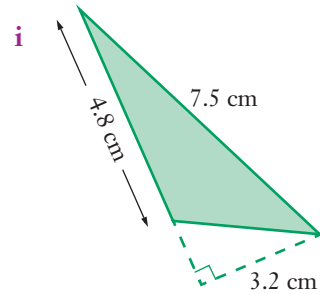
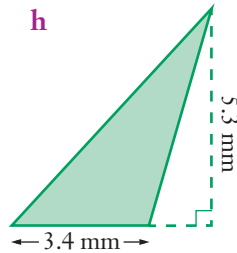
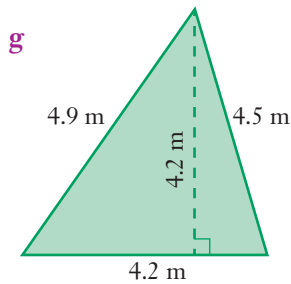
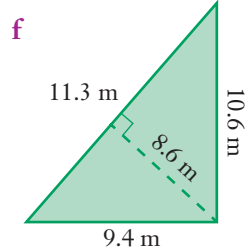
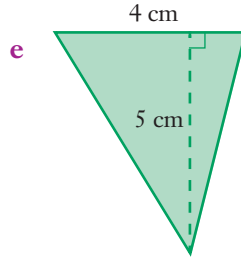
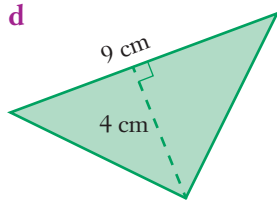
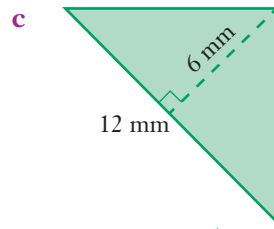
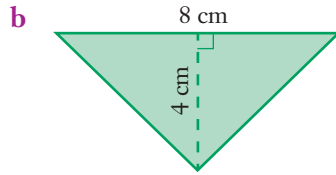
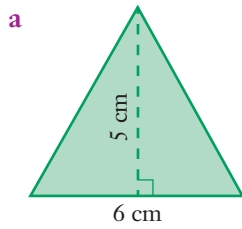
## Exercise 8-09

Ex 7

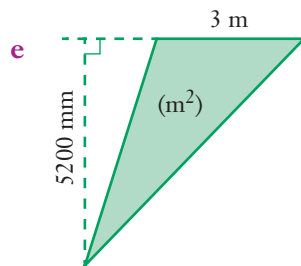
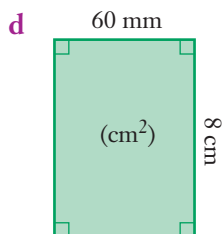
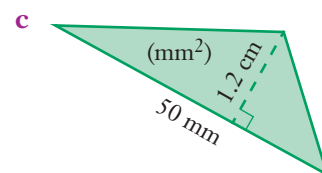
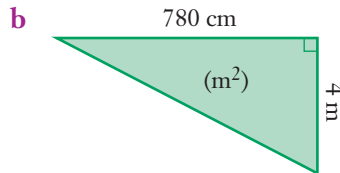
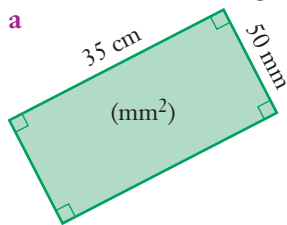
- 1 Find the area of each of these rectangles and squares.



2 Find the area of each of these triangles.



3 Find the area of each of these figures. Be careful with the mixed units. Answer in the units shown on the figure.



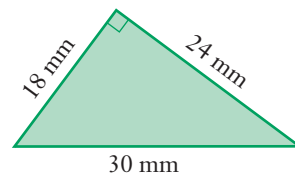
4 What is the area of this triangle? Select from A, B, C or D.

A  $360 \text{ cm}^2$

B  $432 \text{ cm}^2$

C  $270 \text{ cm}^2$

D  $216 \text{ cm}^2$



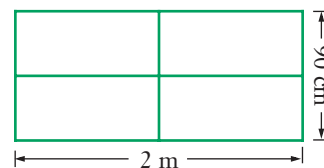
5 A window is 2 metres long and 90 centimetres wide. Find, in square metres, the area of glass in the window. Select A, B, C or D.

A  $180 \text{ cm}^2$

B  $1800 \text{ cm}^2$

C  $1.8 \text{ m}^2$

D  $18 \text{ m}^2$

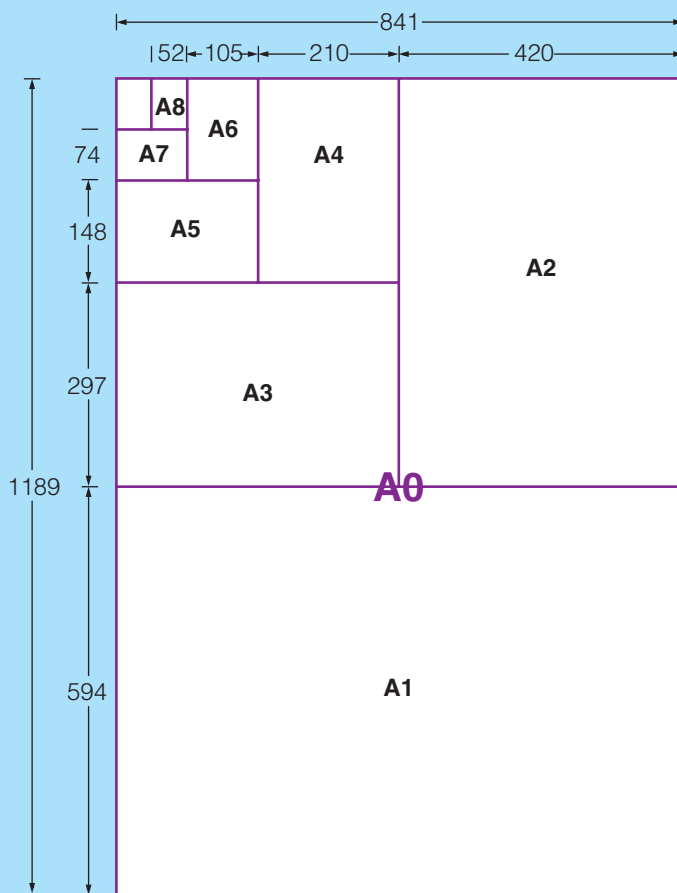


## Just for the record

### Paper sizes

Paper comes in different sizes. A sheet of normal A4 paper has a length of 297 mm and a width of 210 mm. A sheet of A3 paper has twice the area of a sheet of A4 paper. A sheet of A4 paper has twice the area of a sheet of A5 paper.

**Find the area of a sheet of A3 paper and a sheet of A5 paper.**



MEASUREMENTS IN MM



## Calculating areas

### 1 Squares and rectangles

- a Set up a spreadsheet as shown below.

	A	B	C
1	length (cm)	width (cm)	area (sq.cm.)
2	5.2	4.9	
3	13.1	8.6	
4	1.35	7.5	
5	12.5	12.5	

- b In cell C1, enter a formula to calculate the area of the rectangle with the length shown in cell A2 and the width shown in B2.

- c **Fill Down** to cell C5 to calculate each area.

- d Enter more pairs of dimensions (from the table on the right) into columns A (length) and B (width). Be careful to convert units to centimetres.

**Fill Down** the formula from cell C5 to calculate each area.

Length	Width
15.675 cm	34.2 cm
18 mm	500 mm
20.5 mm	20.5 mm
516 m	63 m

- e Highlight the answer cells. Right click, choose **Format Cells, Number** and increase the number of decimal places to see more accurate answers.

### 2 Triangles

- a Open a new spreadsheet. Enter the data as shown below.

	A	B	C
1	Base (cm)	Height (cm)	Area (sq cm)
2	15	16	
3	3.4	2.8	
4	40	87	
5	159	99	

- b In cell C2, enter a formula to calculate the area of the triangle with the base shown in cell A2 and the perpendicular height shown in B2.

- c **Fill Down** to cell C5 to calculate each triangle's area.

- d Enter more pairs of dimensions (from the table on the right) into columns A (length) and B (width). Be careful to convert units to centimetres.

**Fill Down** the formula from cell C5 to calculate each area.

Length	Width
11.8 cm	5 cm
6 m	150 cm
82 mm	82 mm
220 cm	99 mm

- e Highlight the answer cells. Right click, choose **Format Cells, Number** and increase the number of decimal places to see more accurate answers.

## Perimeter and areas

Farmer Jones has 60 m of fencing to make a rectangular chicken pen.

- 1 Open a new spreadsheet and enter the labels, values and formula for calculating the perimeter of a rectangle as shown below.

	A	B	C	D
1	Chicken Pens			
2				
3	Length (m)	Width (m)	Perimeter (m)	Area (sq m)
4	10	20	=2*A4+2*B4	
5				

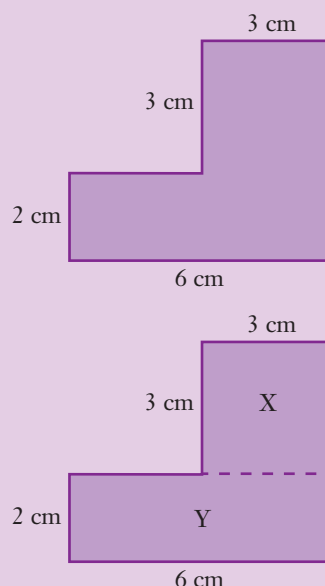
- 2 In cell D4, enter a formula for the area of the rectangle rule:  $= \text{length} \times \text{width}$
- 3 Find at least five pairs of dimensions (whole numbers only) for this rectangle and enter them into your spreadsheet.  
**Fill Down** from cells C4 and D4 to complete the perimeter and area calculations.
- 4 There are more than 10 pairs of whole-number dimensions (lengths and widths) for the rectangular chicken pen. Extend your spreadsheet and find any missing pairs of dimensions.
- 5 Which dimensions make the largest area for the chicken pen?

## 8-10 Areas of composite shapes

A **composite shape** is made up of two or more shapes.

### Example 9

Find the area of this shape.



### Solution

#### Method 1

Separate the shape into a square (X) and a rectangle (Y).

Area of shape = area of rectangle Y + area of square X

$$= 6 \times 2 + 3 \times 3$$

$$= 12 + 9$$

$$= 21 \text{ cm}^2$$

Worksheet  
8-05

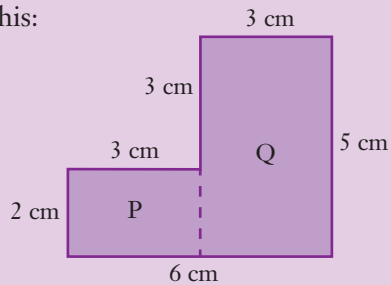
A page of composite  
shapes

Worksheet  
8-07

Composite areas

### Method 2

Another way to divide the shape into rectangles is like this:

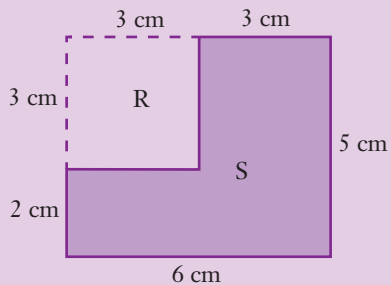


$$\begin{aligned}\text{Area of shape} &= \text{area of small rectangle P} + \text{area of large rectangle Q} \\ &= 3 \times 2 + 5 \times 3 \\ &= 6 + 15 \\ &= 21 \text{ cm}^2\end{aligned}$$

### Method 3

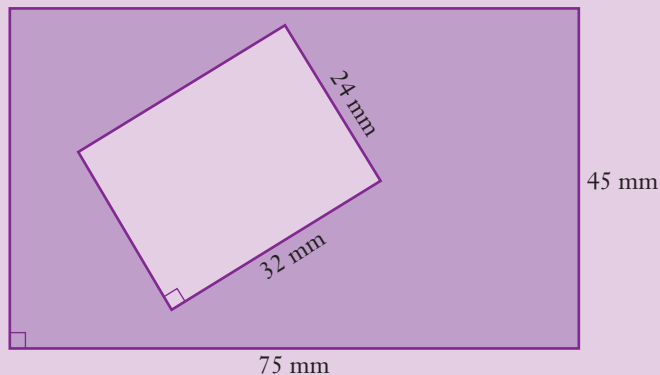
This can also be done by subtracting areas.

$$\begin{aligned}\text{Area of shape} &= \text{area of rectangle S} - \text{area of square R} \\ &= 6 \times 5 - 3 \times 3 \\ &= 30 - 9 \\ &= 21 \text{ cm}^2\end{aligned}$$



## Example 10

This shaded shape is made by cutting out the small rectangle from the big rectangle. What is the area of the purple shape?

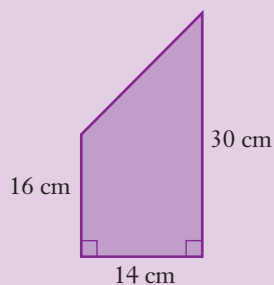


### Solution

$$\begin{aligned}\text{Area of purple shape} &= \text{area of big rectangle} - \text{area of small rectangle} \\ &= 75 \times 45 - 32 \times 24 \\ &= 3375 - 768 \\ &= 2607 \text{ mm}^2\end{aligned}$$

## Example 11

Find the area of this shape.

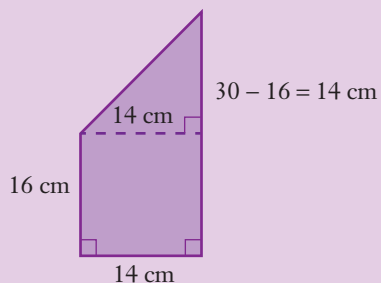


### Solution

Divide the shape into a triangle and a rectangle.

Area of shape = area of rectangle + area of triangle

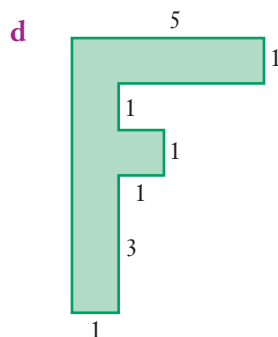
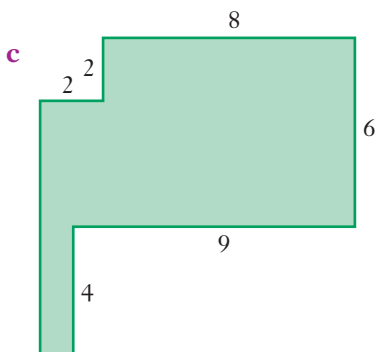
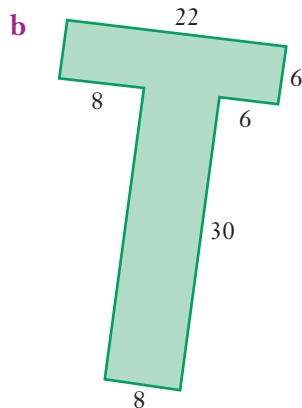
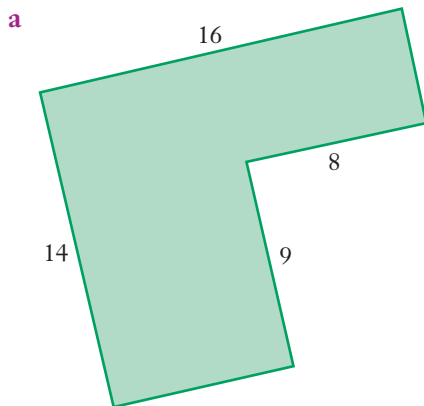
$$\begin{aligned} &= 16 \times 14 + \frac{1}{2} \times 14 \times 14 \\ &= 224 + 98 \\ &= 322 \text{ cm}^2 \end{aligned}$$



## Exercise 8-10

Ex 9

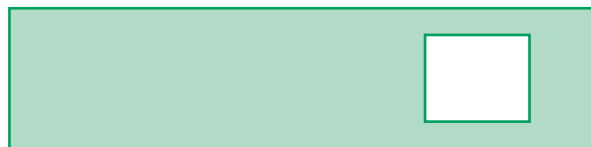
1 Find the area of each of these shapes. All measurements are in centimetres.



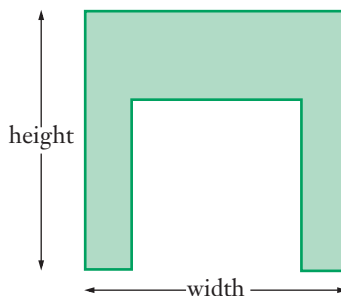
2 Find the area of each of these green shapes.

Ex 10

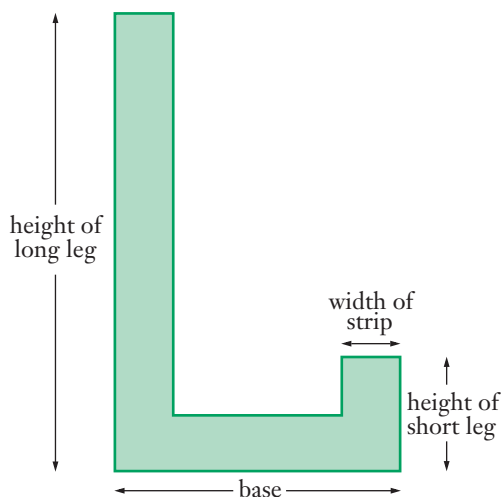
a Outside dimensions:  $230\text{ cm} \times 55\text{ cm}$ . Hole dimensions:  $40\text{ cm} \times 35\text{ cm}$



b Total height:  $30\text{ cm}$   
Total width:  $30\text{ cm}$   
Dimensions of cut-out:  $20\text{ cm} \times 20\text{ cm}$

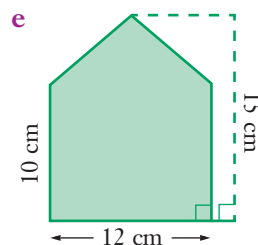
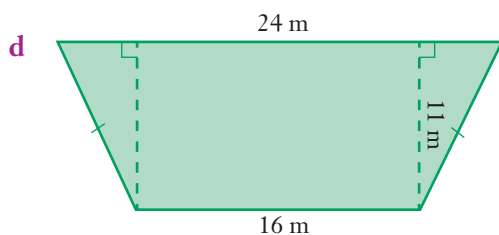
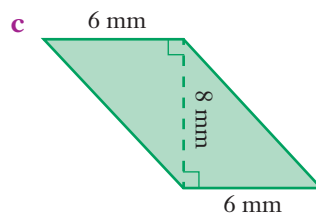
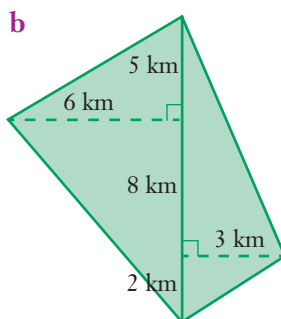
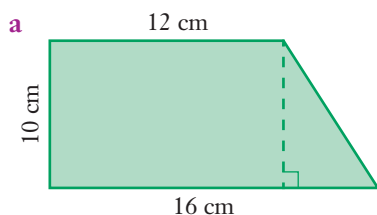


c This shape is formed from strips of metal  $10\text{ cm}$  wide. The height of the long leg is  $80\text{ cm}$ . The base is  $50\text{ cm}$  wide. The height of the short leg is  $20\text{ cm}$ .



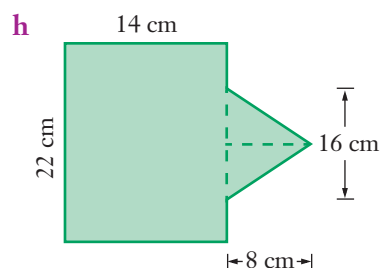
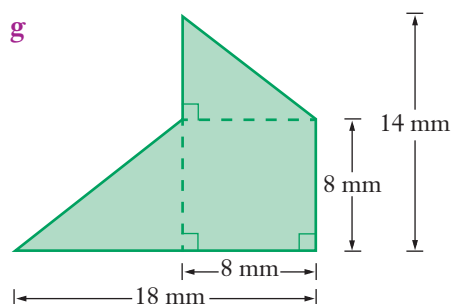
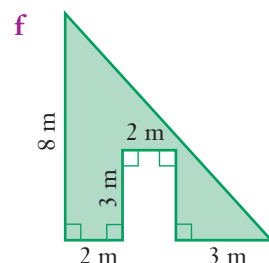
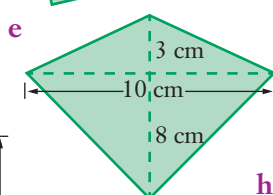
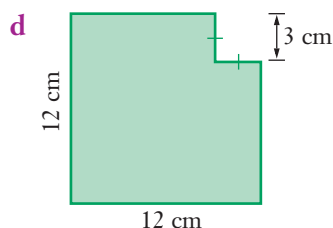
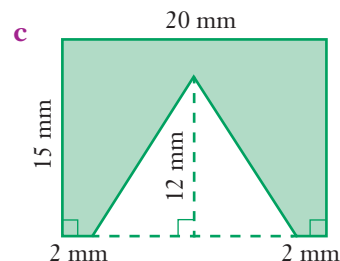
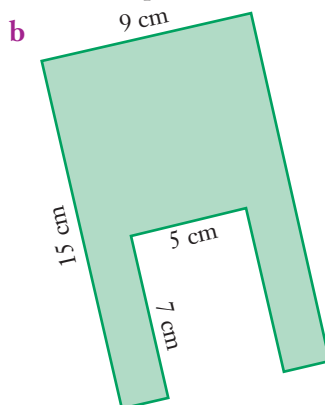
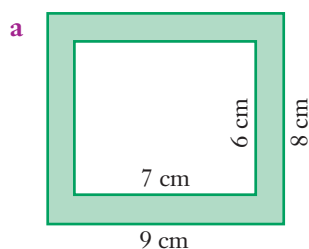
3 Find the area of each of these shapes.

Ex 11





4 Find the shaded area of each of these shapes.



5 Find the area of turf needed to grass the front and back yards of a house. The front yard measures 20 m by 8 m and the back yard measures 35 m by 7.5 m.

6 A 4 m  $\times$  5 m room has a ceiling height of 3.2 m.

**a** Ignoring windows and doors, find:

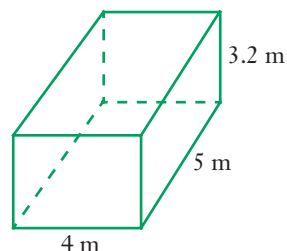
**i** the area of the floor of the room

**ii** the area of the ceiling

**iii** the area of one of the smaller walls.

**b** How many square carpet tiles measuring 50 cm on each side are needed to cover the floor of the room?

**c** How many litres are needed to paint the walls of the room, if 1 L covers 16 m<sup>2</sup>?



7 A rectangular lawn contains two square flower gardens, each measuring 3 m by 3 m. If the lawn measures 9.5 m by 6.4 m, find the area of the grass.

8 A garden measuring 5 m by 6 m has a 2 m wide strip of paving around its border. What is the area of the paving?

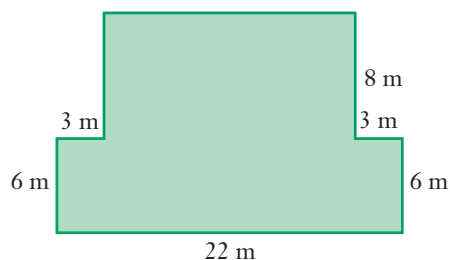
9 The diagram on the right shows a swimming pool in a holiday resort. All angles are right angles. What is the area of the surface of the pool? Select **A**, **B**, **C** or **D**.

**A** 156 m<sup>2</sup>

**B** 180 m<sup>2</sup>

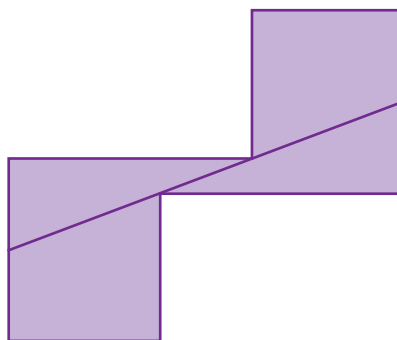
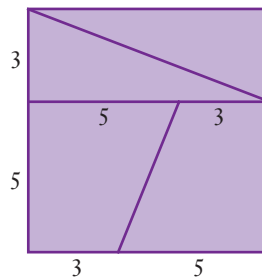
**C** 72 m<sup>2</sup>

**D** 260 m<sup>2</sup>

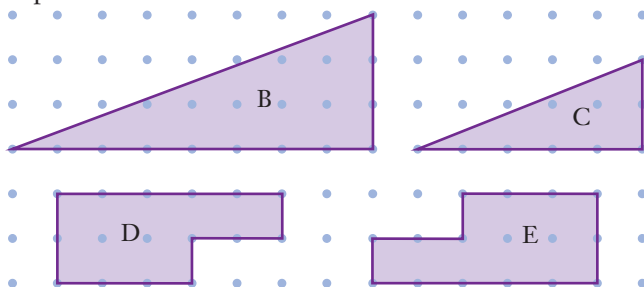


# Area puzzles

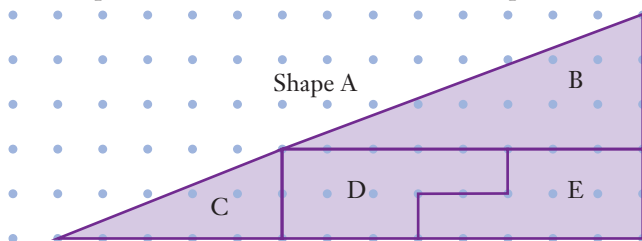
- 1 Draw this square on 1 cm dot paper or use the link to print out Worksheet 8-08. What is its area in  $\text{cm}^2$ ?
- 2 a Cut out the square, then cut along the marked lines.  
b Arrange the four pieces to make a rectangle. Find its length and width. Use these to find its area.
- 3 Is the calculated area of the rectangle the same as the area of the original square? Should it be? Explain this mystery.
- 4 Use the same four pieces to make this shape. Calculate its area. Is this the same as the area of the original square? Should it be? Why?



- 5 a Use 1 cm dot paper to draw each of the shapes B, C, D and E as shown, or use the link to print them out.



- b Find the area of each shape in  $\text{cm}^2$ , then find the sum of the areas.
- c Cut out the shapes and combine them to form Shape A, as shown.



- 6 a Shape A looks like a right-angled triangle. Find its height and the length of its base. Use these to find its area.
- b Does the area of the triangle equal the sum of the areas of B, C, D and E from Question 1? Explain the mystery about the area of the triangle, the area of Shape A and the sum of the areas of B, C, D and E.

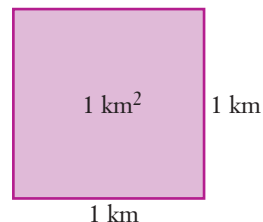
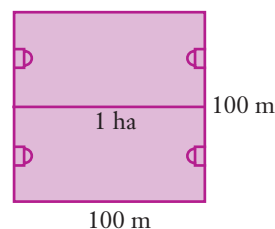


## 8-11 Measuring large areas

Square metres are fine for measuring the area of floors and gardens, but we need a larger unit to measure large areas such as farms and fields. One such unit is the **hectare** (ha). One hectare has the same area as a square with 100 m sides. It is about the size of two football fields.

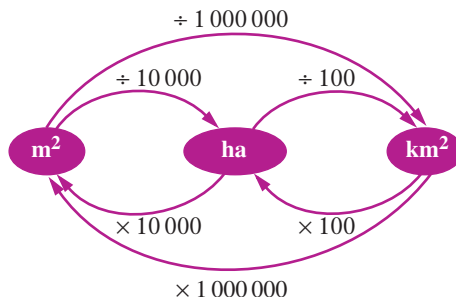
An even larger unit of area is the **square kilometre** (km<sup>2</sup>). One square kilometre has the same area as a square with 1 km sides. It is about the size of a large theme park, such as Dreamworld on the Gold Coast. How many hectares are there in a square kilometre?

$$\begin{aligned} 1 \text{ km}^2 &= 1000 \times 1000 \text{ m}^2 \\ &= 1\,000\,000 \text{ m}^2 \\ &= (1\,000\,000 \div 10\,000) \text{ ha} \\ &= 100 \text{ ha} \end{aligned}$$



**1 hectare = (100 × 100) m<sup>2</sup>**  
**1 ha = 10 000 m<sup>2</sup>**  
**1 km<sup>2</sup> = 100 ha = 1 000 000 m<sup>2</sup>**

This diagram shows how to convert between large units of area.



### Example 12

A nature reserve has an area of 9 577 000 000 m<sup>2</sup>.

**a** What is its area in hectares?

**b** What is its area in square kilometres?

#### Solution

**a** Area of reserve = 9 577 000 000 m<sup>2</sup> (m<sup>2</sup> to ha: ÷ 10 000)  
 $= (9\,577\,000\,000 \div 10\,000) \text{ ha}$   
 $= 957\,700 \text{ ha}$

The area of the reserve is 957 700 hectares.

**b** Area of reserve = 9 577 000 000 m<sup>2</sup> (m<sup>2</sup> to km<sup>2</sup>: ÷ 1 000 000)  
 $= (9\,577\,000\,000 \div 1\,000\,000) \text{ km}^2$   
 $= 9577 \text{ km}^2$

The area of the reserve is 9577 square kilometres.

## Exercise 8-11

Ex 12

1 Write each of these areas in hectares.

a  $2\,450\,000\text{ m}^2$

b  $34\,452\,000\text{ m}^2$

c  $12\,750\,200\,000\text{ m}^2$

d  $1500\text{ m}^2$

e  $854\text{ m}^2$

f  $2000\text{ m}^2$

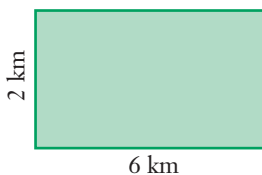
2 Write the areas in Question 1, parts a, b and c in  $\text{km}^2$ .

3 Find the area of each of these shapes in:

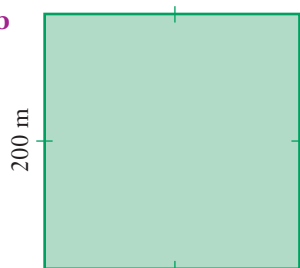
i square units ( $\text{m}^2$  or  $\text{km}^2$ )

ii hectares.

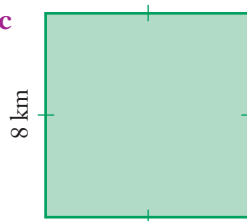
a



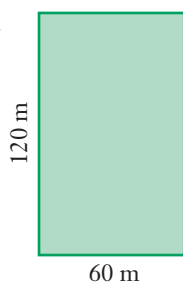
b



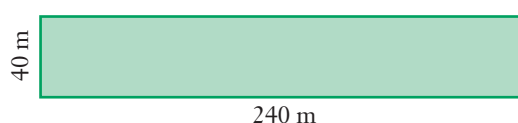
c



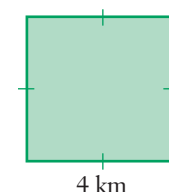
d



e



f



4 A large cattle station in South Australia has an area of  $30\,028\text{ km}^2$ . What is this in hectares?

5 The Cradle Mountain–St Clair National Park in Tasmania has an area of 134 805 ha. What is this in  $\text{km}^2$ ?

6 The centre of Sydney is approximately a rectangle bounded by George Street, Circular Quay, Macquarie and College Streets and Liverpool Street. This rectangle is about 1.75 km by 0.5 km. What is the area in:

a  $\text{km}^2$ ?

b hectares?

7 The area of a rectangle is 1 ha. Give its width in metres if the length is:

a 1000 m

b 500 m

c 400 m

d 2 km

e 1.25 km

f 5 km

8 The area of a rectangle is  $1\text{ km}^2$ . Give its length in metres if the width is:

a 100 m

b 160 m

c 250 m

d 0.5 km

e 0.08 km

f 2 km

9 Sydney Airport has an area of 881 hectares. Sydney Harbour has an area of about 5500 hectares. How many 'Sydney Airports' would fit into Sydney Harbour?

10 The area of Australia is  $7\,682\,300\text{ km}^2$ . Switzerland's area is  $41\,290\text{ km}^2$ . How many times bigger than Switzerland is Australia?

11 The area of the USA is  $9\,629\,091\text{ km}^2$ . The area of Italy is  $301\,230\text{ km}^2$ . About how many 'Italys' would make the USA?

- 12** Western Australia has an area of 2 526 000 km<sup>2</sup>. Approximately what fraction of Australia is Western Australia? (See Question 10 for the total area of Australia.)
- 13** The United Kingdom is made up of about 240 000 km<sup>2</sup> of land and 3000 km<sup>2</sup> of water. What fraction of the United Kingdom is water?
- 14** In Britain, a town is defined as a centre of business or population with an area of at least 2.5 square kilometres. What is the smallest area of a town in hectares? Select **A**, **B**, **C** or **D**.

A 2500

B 0.025

C 250

D 2 500 000

## Just for the record

### Trafalgar Square

Trafalgar Square is found in central London and is one of Britain's great tourist attractions. It commemorates the Battle of Trafalgar in 1805 between the British navy, led by Admiral Nelson, and Napoleon's French navy. It is London's only metric square, having been designed to be one **hectare** in area.

**Find when the square was built and what famous British landmark stands in the centre of it.**



## Working mathematically

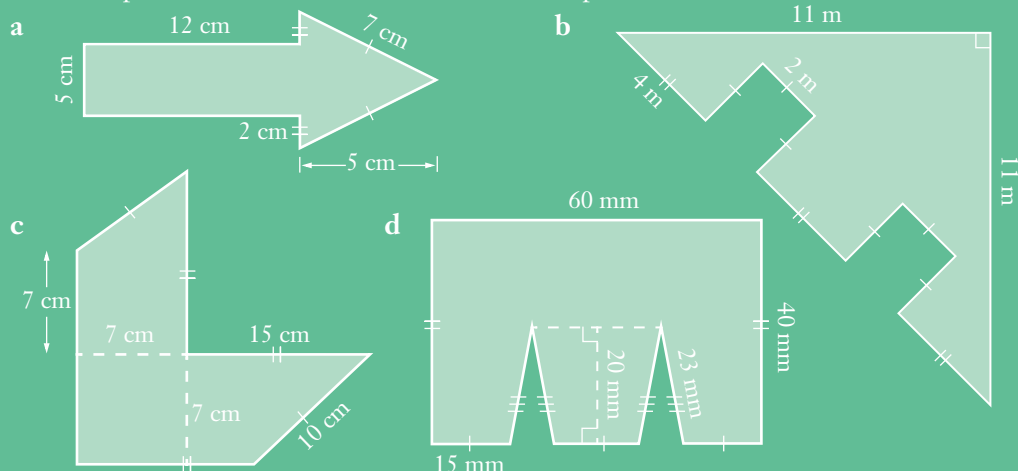
### Applying strategies

### Local areas

- 1 a** Use a map or street directory to find a recreation area (park, garden or reserve) near where you live.
- b** Find the scale for measuring distance used on your map or street directory.
- c** Estimate the area of the park, garden or reserve.
- 2 a** Rule lines on a sheet of tracing paper to make a grid of squares scaled like your map or street directory. Trace your park, garden or reserve from Question 1 on to the paper.
- b** Approximate the area (in m<sup>2</sup> and ha) of your park, garden or reserve. Use the method of counting squares. (It may be more accurate to subdivide each square on the grid into smaller shapes.)



1 Find the perimeter and area of each of these shapes.



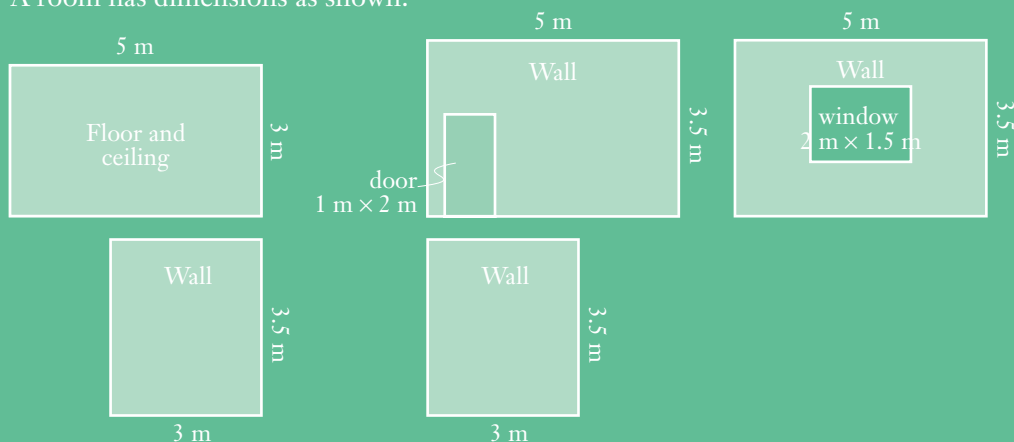
2 A rectangle has a perimeter of 30 cm.

- List some possible dimensions for this rectangle.
- For each pair of dimensions, calculate the area of the rectangle.
- Which dimensions give the greatest area?

3 A right-angled triangle has an area of  $18 \text{ cm}^2$ .

- List some possible dimensions for this triangle.
- By drawing each possible triangle and measuring the third side, find the triangle with the shortest perimeter.

4 A room has dimensions as shown.



- The four walls and the ceiling are to be painted (not including the door and window). Calculate how many square metres are to be painted.
- Each surface requires two coats of paint, and 1 L of paint covers approximately  $12 \text{ m}^2$ . How many litres of paint are needed?
- Paint comes in 4 L cans which cost \$45.95. Calculate how many 4 L cans are needed and calculate the cost of the paint.
- The floor is to be recarpeted. How many square metres of carpet are needed?

# Chapter 8 review



Worksheet  
8-10

Measurement crossword

## Language of maths

*accuracy*

*area*

*centimetre*

*composite shape*

*estimate*

*hectare*

*height*

*kilometre*

*length*

*metre*

*metric system*

*millimetre*

*perimeter*

*perpendicular height*

*scale*

*square metre*

*square kilometre*

*tape measure*

*trundle wheel*

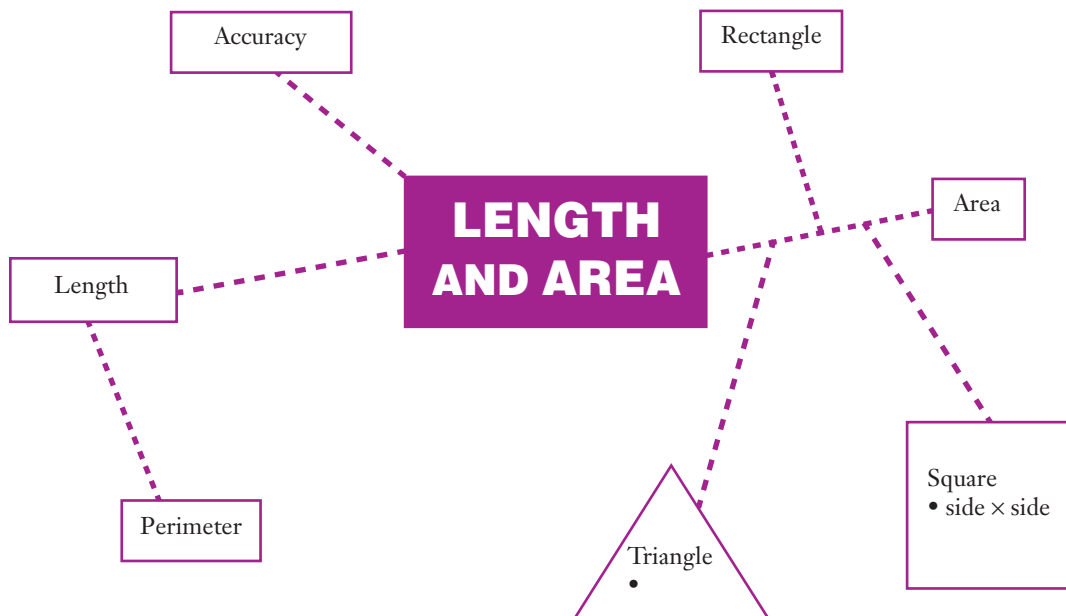
*width*

- 1 Which Latin prefix means:  
**a** one thousandth? **b** one thousand?
- 2 Why is any measurement never exact?
- 3 What is another name for 10 000 square metres?
- 4 What is the name given to the non-metric system of measurement used in the USA?
- 5 Explain the difference between the 'perimeter' and the 'area' of a figure.
- 6 What is the 'perpendicular height' of a triangle?

## Topic overview

- What have you learnt about measurement?
- What type of people use area as part of their jobs?
- List at least two measuring situations in which accuracy is important.
- Is there anything you did not understand about the topic? Ask a friend or your teacher for help.

Copy this summary into your workbook and complete it. Have your overview checked



# Chapter revision

Topic test 8



Exercise 8-01

Exercise 8-01

Exercise 8-02

Exercise 8-02

Exercise 8-03

Exercise 8-04

Exercise 8-06

Exercise 8-06

1 State what is being measured and what unit of measurement could be used.

- a How long it takes you to run 100 metres
- b How long it takes to travel to Brisbane by car
- c How much rain fell in the last shower
- d How warm the water is in the bath

2 Give an example of an item that is:

- a 1 cm long
- b 1 m long
- c 1 mm wide

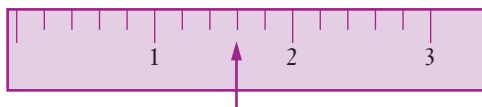
3 How many:

- a centimetres in 3 m?
- b millimetres in 8 m?
- c metres in 3000 km?
- d kilometres in 6500 m?
- e centimetres in 750 mm?
- f millimetres in 2.5 cm?
- g metres in 7800 mm?
- h metres in 520 cm?

4 Which of the following is closest to the length of a house brick? Select **A**, **B**, **C** or **D**.

- A 23 mm
- B 230 mm
- C 230 cm
- D 23 m

5 Write the value shown by the arrow.

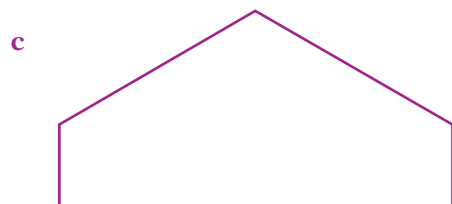
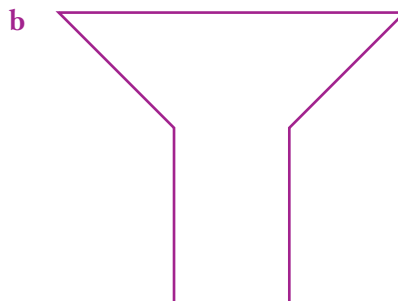


6 a What is the temperature shown on this thermometer?

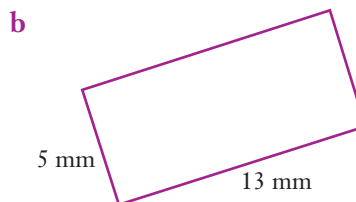
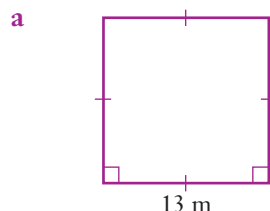


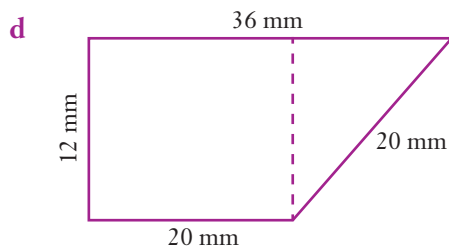
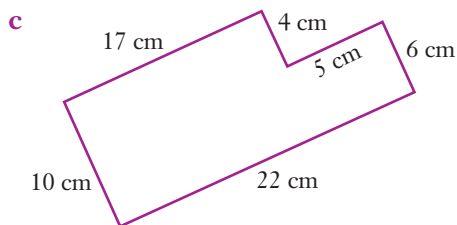
- b What is the size of one unit on the thermometer's scale?
- c What are the limits of accuracy of the thermometer?

7 Measure the side lengths of each shape and find the perimeter in mm and then cm.



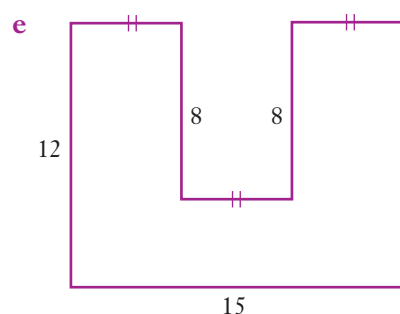
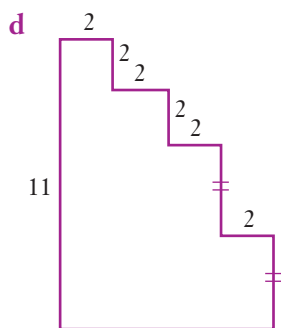
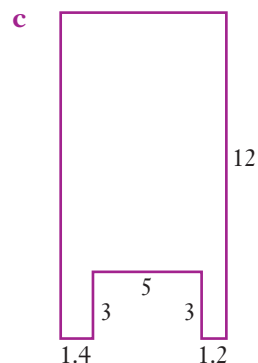
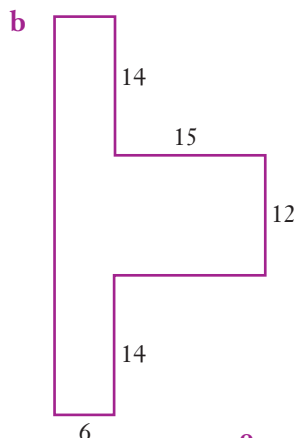
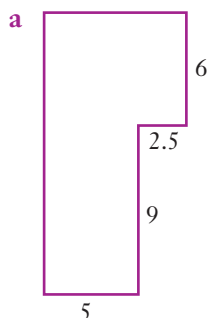
8 Find the perimeter of each of these shapes.





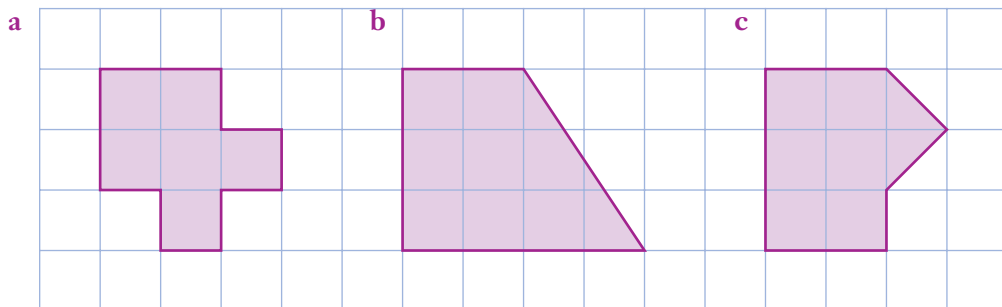
**Exercise 8-06**

- 9 First find the missing lengths, then find the perimeter of each shape. (All lengths are in metres.)



**Exercise 8-07**

- 10 Find the area of each shape if the grid is made up of 1-cm squares.



**Exercise 8-08**

- 11 How many:

**a**  $\text{cm}^2$  in  $9.1 \text{ m}^2$ ?

**c**  $\text{m}^2$  in  $4 \text{ ha}$ ?

**e**  $\text{m}^2$  in  $38\,000 \text{ cm}^2$ ?

**g**  $\text{cm}^2$  in  $240 \text{ mm}^2$ ?

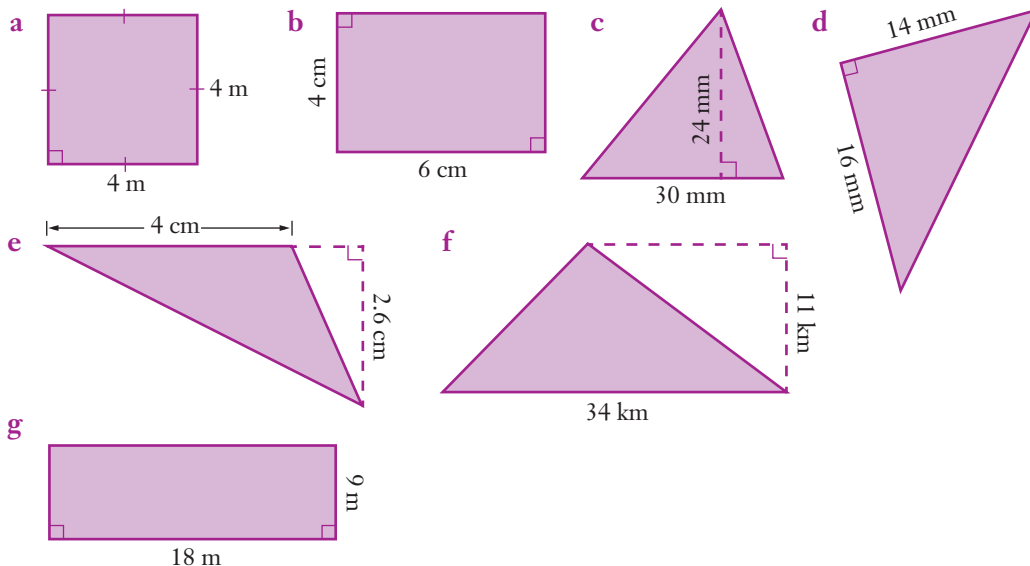
**b**  $\text{mm}^2$  in  $2.5 \text{ cm}^2$ ?

**d**  $\text{m}^2$  in  $1 \text{ km}^2$ ?

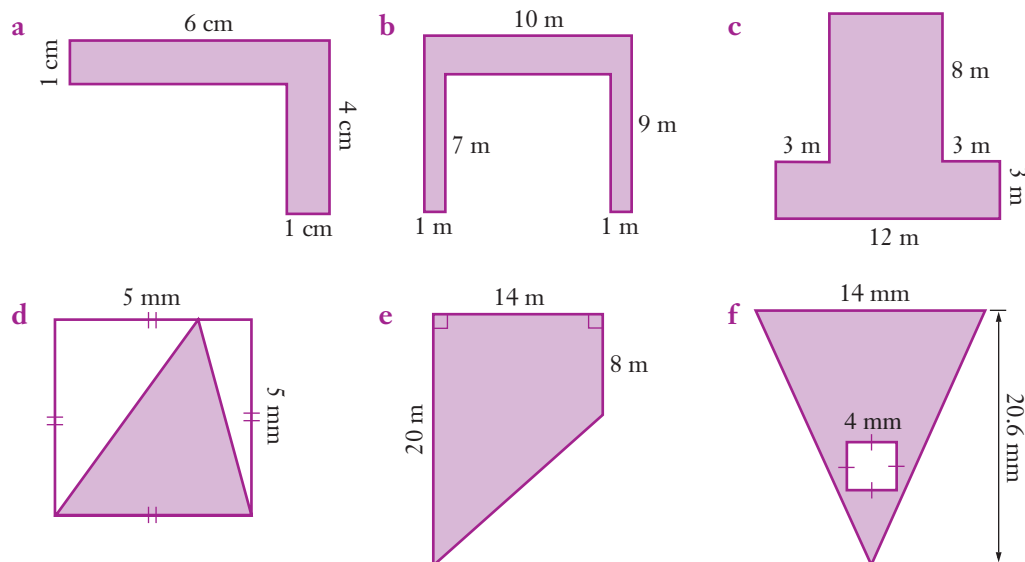
**f**  $\text{mm}^2$  in  $8.6 \text{ m}^2$ ?

**h**  $\text{m}^2$  in  $175\,000 \text{ cm}^2$ ?

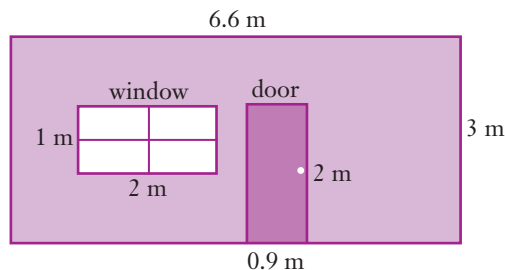
12 Find the area of each of the following.



13 Find the shaded area in each of the following.



14 The wall shown on the right needs painting. If one litre of paint covers  $3 \text{ m}^2$  of wall, how many whole litres should be bought?



- 15 a Water covers about 391 000 ha of Zimbabwe. How many square kilometres is this?  
 b Tasmania has an area of  $68\,000 \text{ km}^2$ . The Australian mainland has an area of  $7\,682\,300 \text{ km}^2$ . How many 'Tasmanias' would fit into mainland Australia?  
 c What is the area of Tasmania in hectares?