

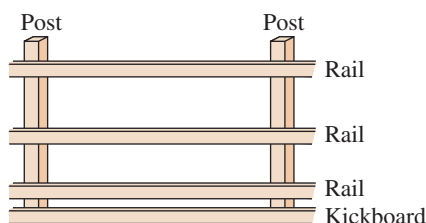
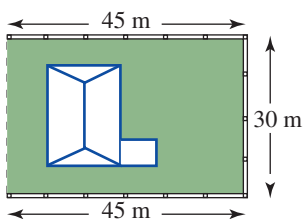
# Length and perimeter

## 8

Marc and Cathy are seeking quotes on the cost of building a timber fence on three sides of their property.

The fence requires three rails and a kickboard as well as posts and palings. What length of timber will be needed for the kickboard? If the timber for the rails costs \$2.25 per metre, what will be the total cost of the timber for the railings?

These are just some of the calculations needed to produce a quote. By the end of this chapter, you will have developed and practised further skills in measurement to complete an estimate of the total costs involved.



# Are you READY?

Try the questions below. If you have difficulty with any of them, extra help can be obtained by completing the matching **SkillSHEET**. Either click on the **SkillSHEET** icon next to the question on the *Maths Quest 7 CD-ROM* or ask your teacher for a copy.



- 1 a For each metric unit of length, match the name with the correct abbreviation.

i	centimetre	m
ii	kilometre	mm
iii	metre	cm
iv	millimetre	km

- b Give an example to describe the length of each unit in part a.



- 2 For the scales shown, how much is each interval worth?



- 3 a Measure the length of this line to the nearest mm. \_\_\_\_\_

- b Measure the length of this line in cm. \_\_\_\_\_



- 4 The distance from your home to school is measured in both metres and kilometres. Which unit would you have more of for this measurement?



- 5 a Convert 18 km to m.                      b Convert 6000 m to km.

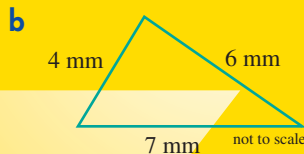
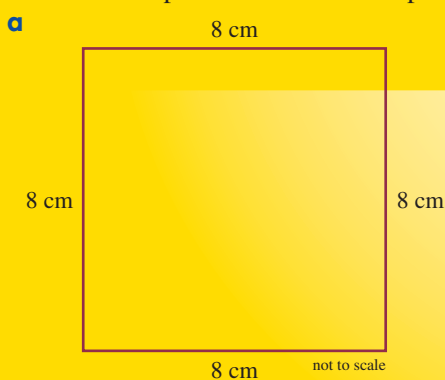


- 6 Arrange the following in order from smallest to largest.

- a 25 mm, 2.3 cm, 0.2 m                      b 1.8 m, 1700 mm, 185 cm



- 7 Calculate the perimeter of each shape shown below.



# Metric units of length

The metric system was developed during the French Revolution (1789–1799) to provide a standardised, easy-to-use system based on the number 10. The base unit of this system, the metre, derives its name from the Greek word *metron* meaning ‘measure’. The metre was defined to be  $\frac{1}{10\,000\,000}$  of the distance from the North Pole to the equator along the Earth’s surface. This definition has changed a number of times. In 1983 it was defined as the distance travelled by a beam of light in a vacuum in  $\frac{1}{299\,792\,458}$  of a second. The other units of length in the metric system are related to the metre by powers of 10.

The most commonly used units of length (in Australia, and most other countries) with their abbreviations (shortened versions of unit names) and some approximate examples are shown below.

## 1. Kilometre (km)



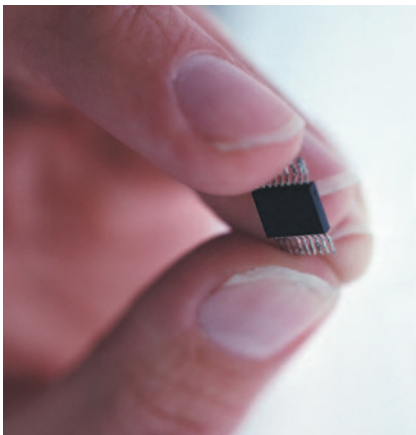
The distance travelled by a car travelling at the speed limit of 60 kilometres per hour in one minute

## 2. Metre (m)



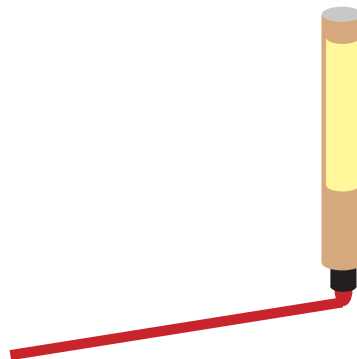
The length of an adult’s stride

## 3. Centimetre (cm)



The width of each of your fingers

## 4. Millimetre (mm)



The width of a line drawn with a new texta pen

Measuring lengths is easiest if we use units that give us convenient values; that is, values that are not too large or too small. For example, you’d be more likely to measure the height of a blade of grass using millimetres, while the distance from Sydney to Newcastle would be best measured in kilometres.

**WORKED Example 1**

You have been given the task of measuring the length of a piece of rope to be used around the boundary of a cricket ground. Which metric units of length would you use?

**THINK**

Estimate the length involved. In this case, it is in the order of 100s of metres. Would other units give a more manageable figure? (Would using centimetres, for example, 10 000 cm, be more convenient? No! What about kilometres? No — the length would be less than 1 kilometre.)

**WRITE**

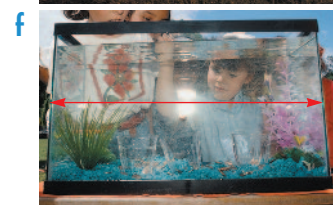
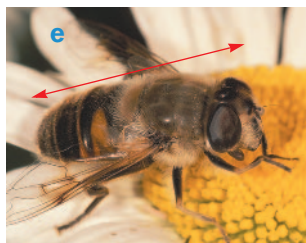
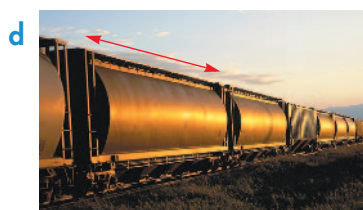
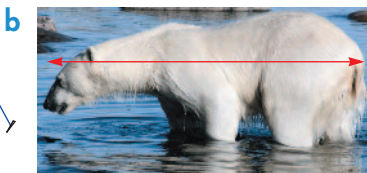
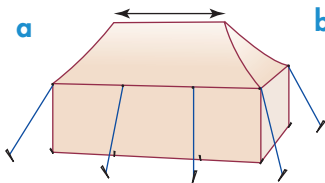
metres (or m)

**remember**

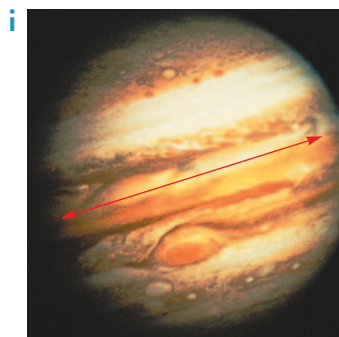
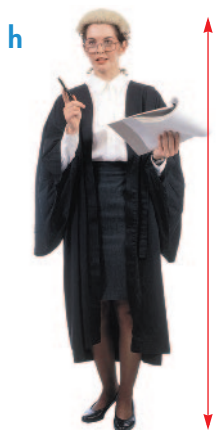
1. The most commonly used units to measure length are kilometres (km), metres (m), centimetres (cm) and millimetres (mm).
2. When measuring length, it is easiest to use units that give us convenient values (not too large and not too small).

**EXERCISE 8A****Metric units of length****WORKED Example 1**

- 1 Which units (mm, cm, m or km) would be most suitable for measuring the real lengths marked in each photograph? (You may give two different units if you think both would be suitable.)







- 2** Which metric units of length would you use for measuring the following (you may give two different units if you think both could be used)?
- a** The length of a netball court
  - b** The diameter of a netball
  - c** A photo frame's width
  - d** The thickness of a slice of bread
  - e** The length of a worm
  - f** The distance between Melbourne and Sydney
  - g** The depth of an Olympic swimming pool
  - h** The depth of a bowl of soup
  - i** The length of a mathematics textbook
  - j** The thickness of a magazine
  - k** The distance around the shores of a reservoir
  - l** The length of a cut-out shape on a GeoMat mathematics template

**3 multiple choice**

The thicknesses of two different brands of chocolate biscuit would be best compared by measuring in:

- A** millimetres      **B** kilometres      **C** metres      **D** centimetres

**4 multiple choice**

Girouk wishes to measure the length of his mathematics folder to see what size paper he could fit into it. Which of the following would be the best measuring instrument to use?

- A** A science department metre ruler      **B** A 10-cm mini ruler  
**C** A 30-cm plastic ruler      **D** A 20-m flexible tape measure

- 5** Give three examples (not mentioned earlier in this exercise) of something that would be best measured in:

- a** metres      **b** millimetres      **c** kilometres      **d** centimetres.

- 6** Give an example of a length which each of the following people might measure in their jobs. (For example, a carpet layer would measure the length of a room.)

- |                             |                                   |                                  |
|-----------------------------|-----------------------------------|----------------------------------|
| <b>a</b> veterinary surgeon | <b>b</b> cartographer (map maker) | <b>c</b> costume designer        |
| <b>d</b> carpenter          | <b>e</b> doctor                   | <b>f</b> landscape gardener      |
| <b>g</b> plumber            | <b>h</b> computer technician      | <b>i</b> track and field athlete |
| <b>j</b> weather reporter   |                                   |                                  |

# History of mathematics

## JOSEPH-LOUIS LAGRANGE (1736–1813)



Joseph-Louis Lagrange —  
the father of the metric  
system

During his life:  
Captain James Cook  
landed in Botany Bay,  
Ludwig van Beethoven  
wrote his first  
symphony, America  
declared independence,

Napoleon invaded Russia, and

Joseph Michel and Jacques Etienne Montgolfier  
became the first people known to fly when they  
developed the hot air balloon.

Joseph-Louis Lagrange was one of the most brilliant, courteous and generous mathematicians of the eighteenth century. He helped develop the metric system — in fact some refer to him as the father of the metric system. He also made many valuable contributions to science including physics, in which he laid some of the groundwork for Einstein's theory of relativity.

Lagrange's wealthy father lost his fortune in the early 1700s, forcing Joseph-Louis to pursue a career in mathematics as he no longer had an inheritance! Although he initially found mathematics boring, Lagrange soon began to succeed, and became a professor of mathematics before he was eighteen. He later made contributions in calculus, astronomy, sound, mechanics and probability.

In 1764, Lagrange won the first of many Grand Prix (not the race, but a mathematical award of the French Academy) for explaining why the same part of the surface of the moon is always visible from Earth.

In 1766, Lagrange replaced Leonhard Euler (another very famous mathematician) as court mathematician to Frederick the Great in the Berlin Academy.

Lagrange's first marriage was to a younger cousin. When she died at a young age, Lagrange threw himself into his work.

Eventually, overwork broke Lagrange's spirit. By 1783, he had become so depressed that he could no longer work in mathematics. He was sacked from the Berlin Academy in 1786, and accepted a job with the French Academy, but could still not shake his depression. It was said that when an important piece of his mathematical work was published in 1788, he left it unopened on his desk for two years, preferring to concentrate on other subjects.

The French Revolution began in 1789. Many scholars fled to avoid the terror inflicted on certain individuals during the Revolution, but Lagrange did not.

In 1792, at the age of 56, Lagrange was snapped out of his sadness by the daughter of an astronomer friend of his. Despite the difference in their ages, they married.

In 1797, Lagrange was appointed to a position at the Ecole Polytechnique, where he was required to supervise the development of the metric system. Some mathematicians wanted to base the system on the number 12, but Lagrange insisted that 10 be used. At one stage, in order to confuse his opponents, he argued that 11 be used! Eventually, Lagrange got his way, and the metric system was based on the number 10.

The famous general, Napoleon, is said to have thought very highly of Lagrange, who died in 1813, aged 77.

### Questions

1. In which year was Lagrange born?
2. List some areas of study (besides mathematics) to which Lagrange contributed.
3. What was Lagrange required to do in his position at Ecole Polytechnique?
4. Why do you think 10 was used as the base for the metric system and not 11 or 12?
5. Can you think of any measurement systems that use 12 as a base?
6. Draw a timeline showing the major events in Lagrange's life.

# Reading scales and measuring length

A scale can be used to measure different amounts of the same type of quantity. For example, the distances obtained by members of the long jump team at a school sports meeting can all be measured using a measuring tape.

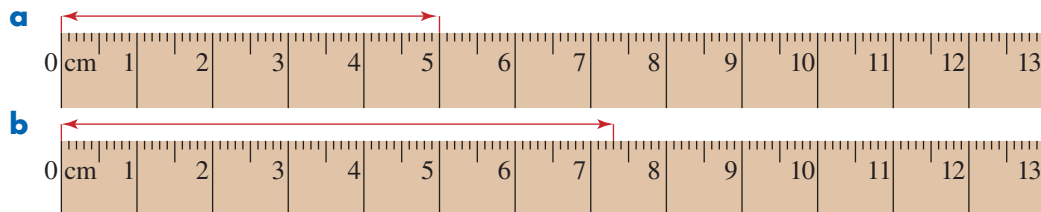
When reading from a scale you need to work out what each interval represents; that is, what length is represented by the distance from one scale division mark to the next.

It is important to realise that all measurements are approximations. For example, when measuring a child's height, we take our reading to the nearest millimetre mark on the measuring tape; yet children grow continuously — not in millimetre increments. Clearly, we are approximating when we take a measurement.



## WORKED Example 2

What reading is indicated by the arrow in each case below?



### THINK

- 1 Check that the line starts at 0. It does.
- 2 Note the units printed on the ruler (cm).
- 3 Read the last centimetre mark (5).
- 4 Does the line go past the last centimetre mark? No.
- 5 Write the value with units.

### WRITE

**a**

5 cm

Continued over page

**THINK**

- b**
- 1 Check that the line starts at 0. It does.
  - 2 Note the units printed on the ruler (cm).
  - 3 Read the last centimetre mark (7).
  - 4 Consider how many smaller intervals there are between the numbered divisions. There are 10, so each smaller division represents 0.1 of a unit.
  - 5 How many small divisions are there past the last centimetre mark? 3.
  - 6 Write the answer.

**WRITE****b**

7.3 cm

**remember**

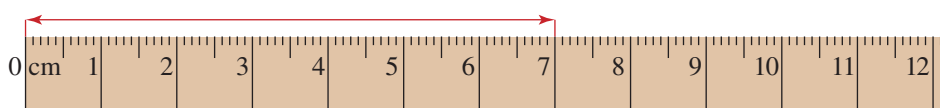
When reading scales and measuring length:

1. check that the scale starts from zero
2. check the value of each small division. Check by counting along the scale to the next major mark.
3. always give units (for example, centimetres) with your answer.

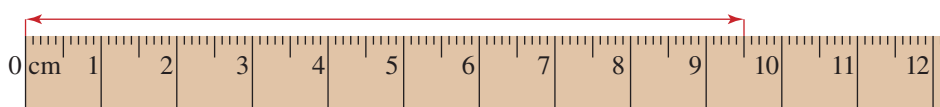
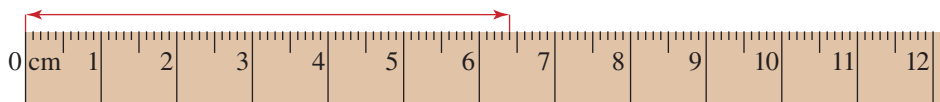
**EXERCISE 8B****Reading scales and measuring length**

**WORKED  
Example**  
2a

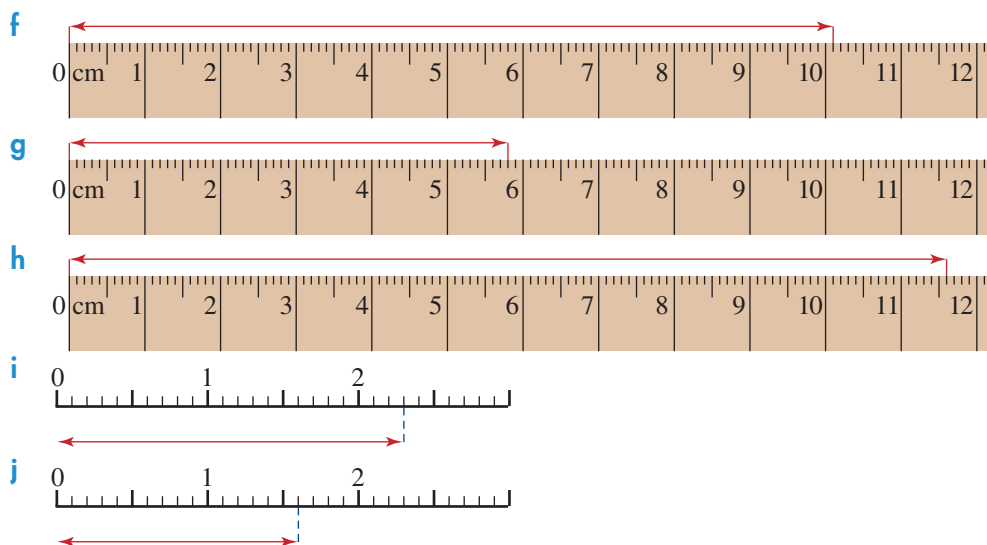
- 1 What reading is indicated by the arrow in each of the following cases?

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

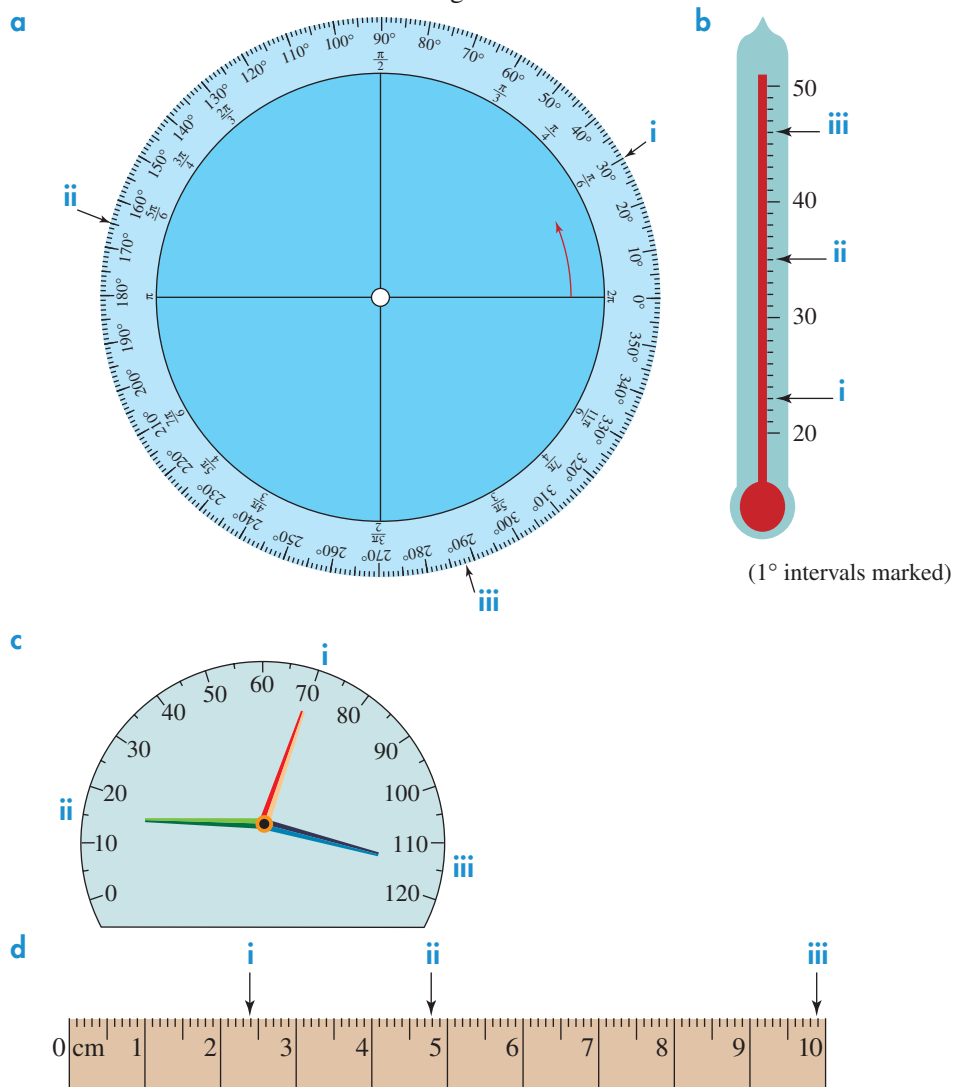
**WORKED  
Example**  
2b

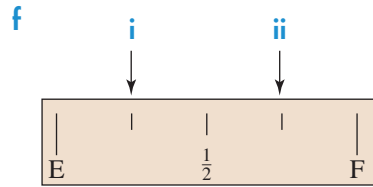
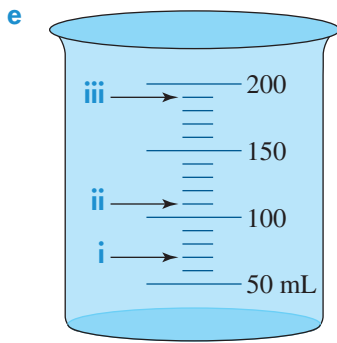
**d****e**



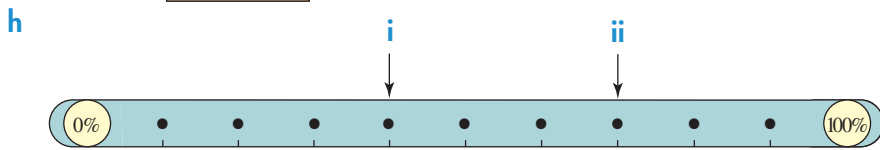
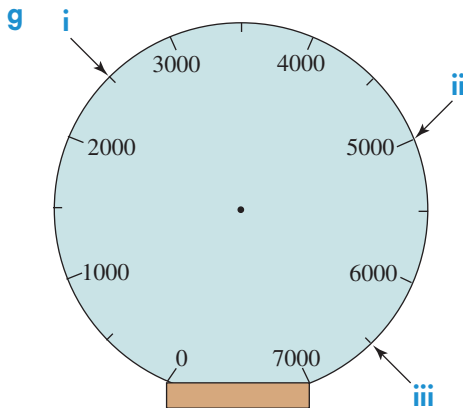


**2** Read the values shown on the following scales.





(Note: E is empty, F is full.)



### 3 multiple choice

The reading on the scale below is:



A 22

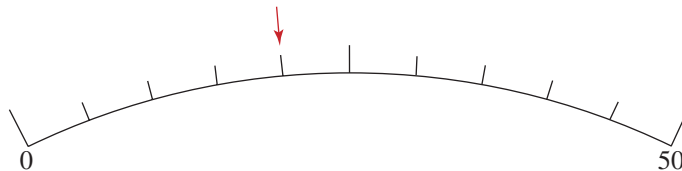
B 24

C 25

D 33

### 4 multiple choice

The reading on the scale below is:



A 4

B 8

C 20

D 40

### 5 Measure each of the following in centimetres.

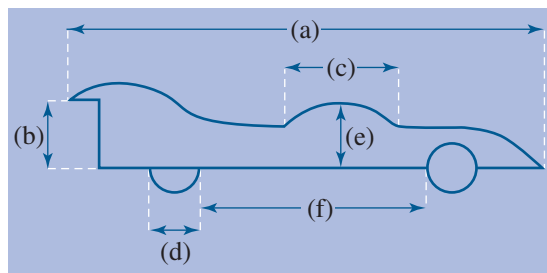
- a \_\_\_\_\_  
b \_\_\_\_\_  
c \_\_\_\_\_

d \_\_\_\_\_  
 e \_\_\_\_\_  
 f \_\_\_\_\_ g \_\_\_\_\_  
 h \_\_\_\_\_

6 Measure each of the following to the nearest millimetre.

a \_\_\_\_\_  
 b \_\_\_\_\_  
 c \_\_\_\_\_  
 d \_\_\_\_\_ e \_\_\_\_\_  
 f \_\_\_\_\_  
 g \_\_\_\_\_ h \_\_\_\_\_

7 On the technical diagram at right, measure the lengths a to f in cm.

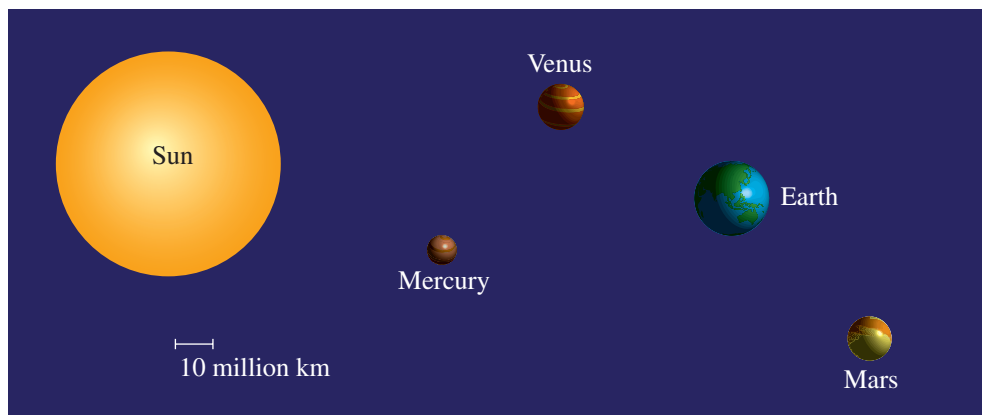


8 In each of the following illustrations, use the given length to estimate the other lengths mentioned.

a The length of part of the abseiling rope shown in the photograph on the right



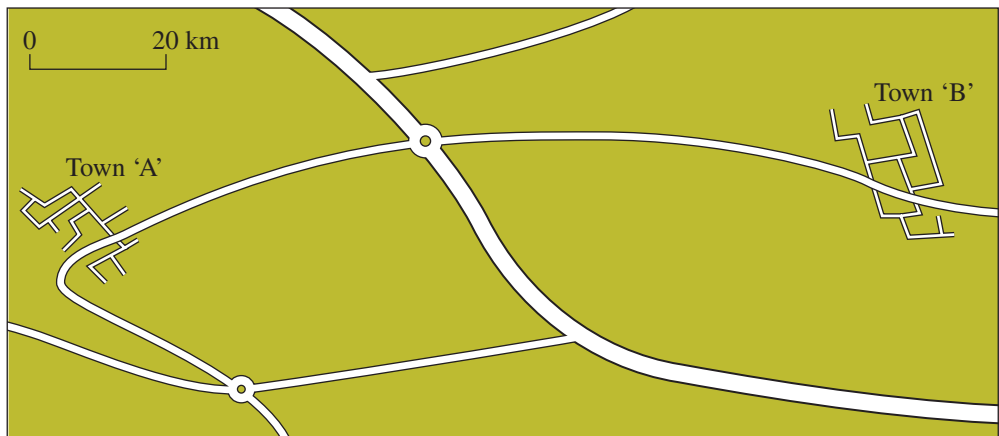
b The distance from the Earth to the Sun



c The length of the train if it has four carriages



- d The distance from Town 'A' to Town 'B'



- e The height of the tyrannosaurus



- f The height of the building in the foreground



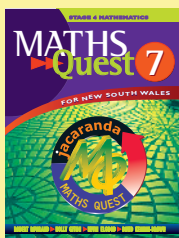
## Measuring lengths

### 1 Estimate and measure

Select several items whose length you can conveniently measure. Estimate the length before you measure, and present your results in a table similar to the one that follows.

Item	Estimated length	Measured length	Error
Desk width/length			
Door width			
Room length/width			
Length of walking pace			

(Note: Error is found by calculating the difference between the estimated length and the measured length.)



### 2 Paper thickness

Explain how you could use a normal ruler to find the thickness of a sheet of paper in this book.

Calculate the thickness of a page in this and one other book.



### 3 Pace lengths

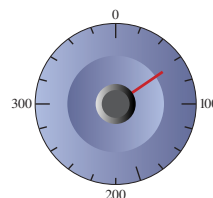
#### You will need

A long tape measure (30 m or so preferably) or trundle wheel.

Devise a way of measuring the length of a student's pace during the following activities: walking, jogging, running.

## 10 QUICK QUESTIONS 1

- Which metric unit of length would be best for measuring the length of your fingernail?
- Which metric unit of length would be best for measuring the length of a netball court?
- How long is the snail shown below?
- What is the reading on the dial shown below?





- 5 What is the length of this line segment? \_\_\_\_\_
- 6 Estimate the length of the yacht below.



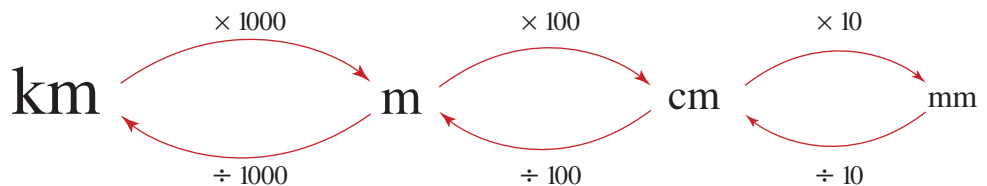
- 7 True or false? The height of a student would be best measured in kilometres.
- 8 Arrange the following in ascending order according to the size of the unit: metres, kilometres, millimetres, centimetres.
- 9 Construct a line measuring 8.2 cm.
- 10 Construct a line measuring 23 mm.

## Converting units of length

The main metric units of length are related as follows:

$$1 \text{ km} = 1000 \text{ m} \quad 1 \text{ m} = 100 \text{ cm} \quad 1 \text{ cm} = 10 \text{ mm}.$$

In chart form, the mathematical relationship can be shown in a way that is easy to remember. The numbers next to each arrow are called *conversion factors*.



Notice that when converting to a smaller unit, we need to multiply by the conversion factor and, when converting to a larger unit, we need to divide by the conversion factor.

**WORKED Example 3**

Complete each of the following metric conversions.

**a**  $4.0 \text{ km} = \underline{\hspace{2cm}} \text{ m}$

**b**  $560 \text{ m} = \underline{\hspace{2cm}} \text{ mm}$

**c**  $480 \text{ cm} = \underline{\hspace{2cm}} \text{ km}$

**THINK**

- a** Recall the metric conversion chart (see page 312). To convert kilometres to metres, multiply by 1000. (Move the decimal point 3 places to the right.)

- b** **1** This conversion involves two steps in the chart. Convert metres to centimetres by multiplying by 100 (move the decimal point 2 places to the right), then convert centimetres to millimetres by multiplying by 10 (move the decimal point 1 place to the right).
- 2** Overall, we need to multiply by  $100 \times 10$  or 1000.

- c** To convert 480 centimetres to kilometres involves two division steps. From centimetres to metres, divide by 100. From metres to kilometres, divide by 1000.

**WRITE**

**a**  $4.0 \text{ km} = 4.0 \times 1000 \text{ m}$   
 $= 4000 \text{ m}$

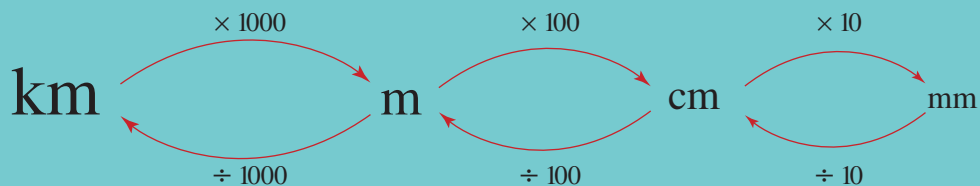
**b**  $560 \text{ m} = 560 \times 100 \text{ cm}$   
 $= 56\,000 \text{ cm}$   
 $= 56\,000 \times 10 \text{ mm}$   
 $= 560\,000 \text{ mm}$

**c**  $480 \text{ cm} = 480 \div 100 \text{ m}$   
 $= 4.8 \text{ m}$   
 $= 4.8 \div 1000 \text{ km}$   
 $= 0.0048 \text{ km}$

**remember**

When converting units of length, it is useful to note the points below.

1. Imagine a decimal point at the right hand end of any whole numbers; for example, the number 35 can be thought of as having a decimal point after the 5 (35.).
2. Look at or draw a conversion chart.



3. When converting to a smaller unit, multiply by the conversion factor.
4. When converting to a larger unit, divide by the conversion factor.

## EXERCISE 8C

## Converting units of length


**WORKED  
Example**  
3a

1 Complete each of the following metric conversions.

- |   |                     |   |                    |
|---|---------------------|---|--------------------|
| a | 2.0 km = _____ m    | b | 7.0 km = _____ m   |
| c | 65.0 km = _____ m   | d | 5.3 km = _____ m   |
| e | 0.66 km = _____ m   | f | 9.0 m = _____ cm   |
| g | 0.25 m = _____ cm   | h | 28.0 cm = _____ mm |
| i | 200.0 cm = _____ mm | j | 700.0 m = _____ cm |

2 Convert to the units indicated.

- |   |                   |   |                      |
|---|-------------------|---|----------------------|
| a | 8000 m = _____ km | b | 6500 m = _____ km    |
| c | 700 m = _____ km  | d | 50 m = _____ km      |
| e | 10.5 m = _____ km | f | 6000 cm = _____ m    |
| g | 300 cm = _____ m  | h | 57 cm = _____ m      |
| i | 9 cm = _____ m    | j | 45 mm = _____ cm     |
| k | 835 mm = _____ cm | l | 25 600 mm = _____ cm |

3 Copy and complete.

- |   |                     |   |                    |
|---|---------------------|---|--------------------|
| a | 8 km = _____ cm     | b | 5400 mm = _____ m  |
| c | 101 m = _____ mm    | d | 7800 cm = _____ km |
| e | 60.25 km = _____ mm | f | 112.8 cm = _____ m |
| g | 72.33 m = _____ mm  | h | 40.5 mm = _____ cm |
| i | 5.05 km = _____ m   | j | 30.35 mm = _____ m |

4 **multiple choice**

A distance of 6.25 km is the same as:

- |   |       |   |            |   |            |   |            |
|---|-------|---|------------|---|------------|---|------------|
| A | 625 m | B | 0.006 25 m | C | 625 000 mm | D | 625 000 cm |
|---|-------|---|------------|---|------------|---|------------|

5 **multiple choice**

A distance of 7 860 000 cm is equal to:

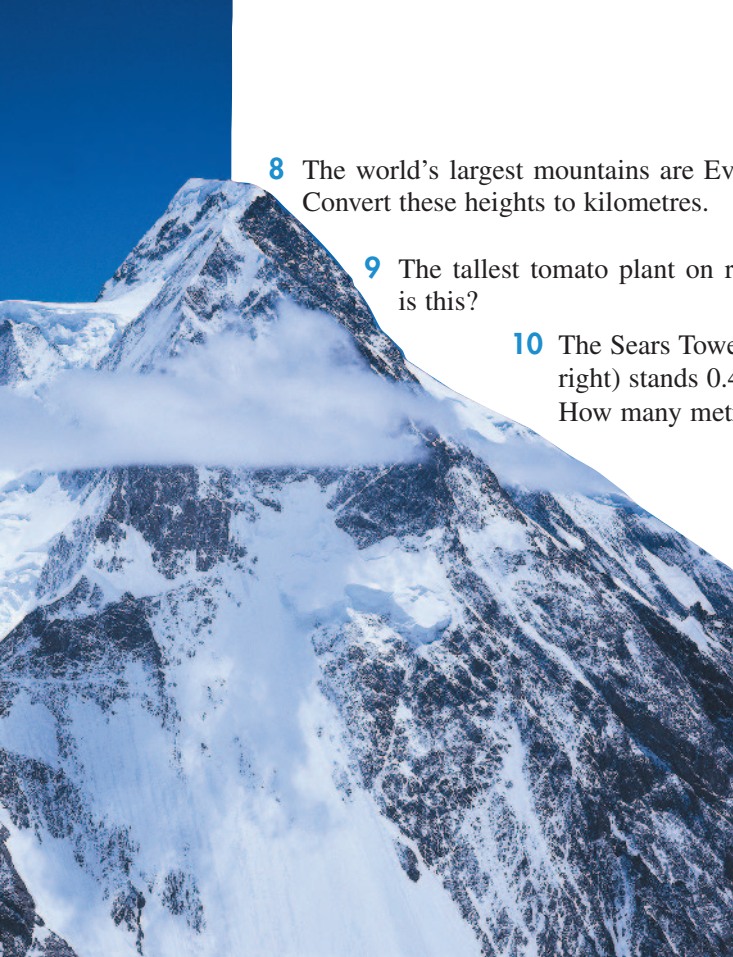
- |   |         |   |       |   |        |   |            |
|---|---------|---|-------|---|--------|---|------------|
| A | 78.6 km | B | 786 m | C | 786 km | D | 786 000 mm |
|---|---------|---|-------|---|--------|---|------------|

6 Convert to the units indicated.

- |   |               |   |                  |
|---|---------------|---|------------------|
| a | 67.7 km to m  | b | 45.2 m to km     |
| c | 560 mm to m   | d | 450 000 cm to km |
| e | 8.75 cm to mm | f | 0.0006 km to cm  |
| g | 7.21 m to mm  | h | 3.09 km to cm    |
| i | 48 mm to cm   | j | 11.655 m to mm   |

- 7 The longest snake ever held in captivity was a female reticulated python named 'Colossus'. It was measured to be 8.68 m long. Convert this to centimetres and compare it to the adult length of the shortest species of snake, the West Indian *Leptotyphlops bilineata*, which grows to only 108 mm.





**8** The world's largest mountains are Everest (8863 m) and 'K2' in Pakistan (8607 m). Convert these heights to kilometres.

**9** The tallest tomato plant on record reached 16.3 m. How many centimetres is this?

**10** The Sears Tower (shown at right) stands 0.448 km high. How many metres is this?



**11** Arrange the following in order from smallest to largest.

**a** 12.5 m, 150 cm, 0.02 km

**c** 50 km, 500 m, 50 000 mm

**e** 0.052 cm, 0.0052 mm, 0.000 052 m

**b** 350 cm, 0.445 m, 3000 mm

**d** 1700 cm, 1.7 m, 0.17 km

**f** 990 cm, 0.909 m, 9000 mm

**12** Add the following lengths, giving your answer in either unit.

**a** 75 cm and 3 m

**b** 2700 m and 7.5 km

**c** 3800 mm and 52 cm

**d** 1.66 m and 58.2 cm

**e** 208 cm and 1.83 m

**f** 5500 mm and 20.1 m

**g** 40 km and 7800 m

**h** 0.000 675 km and 87.8 cm

**13** Find the difference between each of the following lengths, giving your answer in either unit.

**a** 72 km and 5600 m

**b** 418 000 mm and 7.6 m

**c** 34.6 cm and 0.45 m

**d** 2.8 km and 450 000 cm

**14** A particular brand of computer CD is 1.2 mm thick. How high (in centimetres) would a pile of 23 such CDs be?

**15** A builder needs to build a wall 3.5 m high. If each layer of bricks adds 8 cm of height, how many layers high will the wall be?

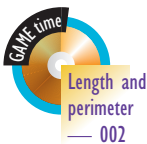
**16** Deanne buys a length of rope and cuts it into three smaller sections, each of length 7200 cm. How many metres long was the original piece of rope?

**17** Norbert is 1.53 m tall in bare feet. If he wears shoes with 6.3 cm thick soles, how high would he stand then? Give your answer in metres.





- 18** Adrian is driving a truck with a rooftop 3.4 m above road level, when he approaches an overpass bridge which has a clearance of 376 cm. Will Adrian's truck get under the bridge? If so, how much room does he have to spare? Give your answer in centimetres.
- 19** A childcare centre has three large cardboard boxes which the children stack up in various combinations. What stack heights are possible for a stack if the boxes' individual heights are 600 mm, 45 cm and 1.1 m? Give your answer in centimetres.
- 20** Finita attaches a trellis that is 0.6 m high to the top of her 180 cm high fence. How high is it to the top of the new trellis? Give your answer in metres.
- 21** Zvenglo is stacking identical boxes of height 330 mm. How high would a stack be if it contained six boxes? Give your answer in centimetres.
- 22** Waldo's noticeboard is 1.5 m long and 1.2 m wide. If he pins a calendar of length 70 cm and width 60 cm exactly in the middle of the board, how much space is there above and below the calendar?
- 23** A licorice strap machine takes 3.75 m lengths of licorice, and chops them into 10 cm long pieces. How many pieces does each 3.75 m length produce?



## A metric unit converter

The instructions below show one way of using an Excel spreadsheet to convert metric units of length. Alternatively, you may wish to use a pre-written spreadsheet 'Length conversions' on the *Maths Quest* CD-ROM to perform some conversions. The screen on the right shows how your spreadsheet should look once you have followed the numbered steps below and completed the suggested task.

	A	B	C	D	E	F
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

- 1** In cell B6, type: kilometre converter
- 2** In cell B7, type: 4
- 3** In cell C7, type: km =
- 4** In cell D7, type: = B7\*1
- 5** In cell E7, type: km
- 6** In cell E8, type: m
- 7** In cell E9, type: cm
- 8** In cell E10, type: mm
- 9** In cell D8, type: = B7\*1000
- 10** In cell D9, type: = B7\*100 000
- 11** In cell D10, type: = B7\*10 000 000

Can you see the conversions? Now try entering a different value in cell B7. Does your spreadsheet update?

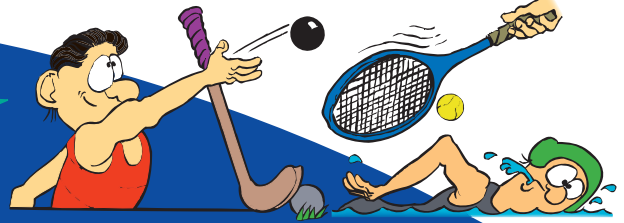
Now try to complete a new section on your spreadsheet to convert metres into the other units. You will need to use a forward slash (/) as a division sign.





# U.S. Open winner 1997 and 1998. Which sport?

Convert the lengths given to the units indicated to find the answer code.



240 0.24 0.78 92 32 56 78 7.8 3.2 0.078 9.2 560 320 0.32 2.4 920 5.6 0.56 24

**A**

3200 m

\_\_\_\_\_ km

**C**

0.56 m

\_\_\_\_\_ cm

**E**

2400 mm

\_\_\_\_\_ m

**F**

7800 cm

\_\_\_\_\_ km

**I**

0.000 32 km

\_\_\_\_\_ cm

**K**

0.078 km

\_\_\_\_\_ m

**N**

56 mm

\_\_\_\_\_ cm

**P**

24 cm

\_\_\_\_\_ mm

**R**

0.32 m

\_\_\_\_\_ mm

**S**

24 million mm

\_\_\_\_\_ km

**T**

78 cm

\_\_\_\_\_ m

**A**

240 m

\_\_\_\_\_ km

**T**

32 cm

\_\_\_\_\_ m

**E**

0.000 56 km

\_\_\_\_\_ mm

**I**

0.000 005 6 km

\_\_\_\_\_ cm

**R**

78 mm

\_\_\_\_\_ cm

**N**

9.2 m

\_\_\_\_\_ cm

**T**

0.92 cm

\_\_\_\_\_ mm

**R**

0.092 km

\_\_\_\_\_ m

# 10 QUICK QUESTIONS 2

- 1 Name the unit most suitable for measuring the length of a skateboard.
- 2 Give two examples of things that would be best measured in millimetres.
- 3 Convert 4.3 km to m.      4 Convert 87 000 mm to m.      5 Convert 2.1 km to cm.
- 6 Arrange the following in ascending order: 67 m, 2000 cm, 1345 mm, 0.04 km, 9 m.
- 7 Add 56 cm and 23 mm, giving your answer in the smallest unit.
- 8 In 1997 Ronnie was 182 cm tall. In 2000 his height was 2.1 m. How much did Ronnie grow in 3 years? Express your answer in centimetres.
- 9 A pile of cardboard to be recycled has become quite high. If there are 945 boxes and each is 32 mm thick when flattened, how high is the pile of boxes? Express your answer in two different units.
- 10 Asako is getting ready to go to the Melbourne Cup. If she is 167 cm tall and wears high heels which measure 8 cm and a hat which is 16 cm tall, find Asako's total height in metres.

## Perimeter

A perimeter is the distance around the outside (border) of a shape. Fences go around the perimeter of many sporting fields.

Don't confuse perimeter with area (which would be represented by the grass surface of the playing field).



### WORKED Example 4

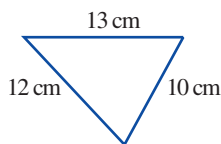
Find the perimeter of each shape below.

a

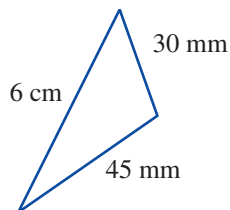


Note: The dots are 1 unit apart.

b

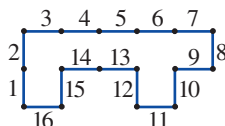


c



#### THINK

- a 1 Count the number of unit intervals around the outside of the shape (16).



- 2 Write the number.

#### WRITE

a

16 units

**THINK**

- b**
- 1 Check that the measurements are in the same units. They are.
  - 2 Add the measurements.
  - 3 Write the total, with units.
- c**
- 1 Notice the measurements are not all the same. Convert to the smaller unit. (6 cm = 60 mm).
  - 2 Add the measurements that now have the same unit (mm).
  - 3 Write the total using the smaller unit.

**WRITE**

$$\begin{array}{r} \text{b} \quad 12 \\ 13 \\ + 10 \\ \hline 35 \text{ cm} \end{array}$$

$$\begin{array}{r} \text{c} \quad 6 \text{ cm} = 60 \text{ mm} \\ 60 \\ 30 \\ + 45 \\ \hline 135 \text{ mm} \end{array}$$

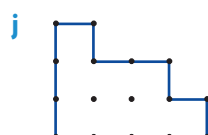
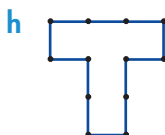
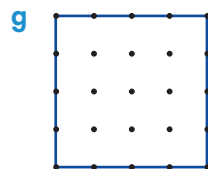
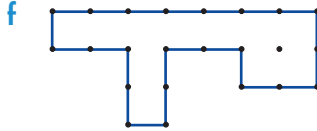
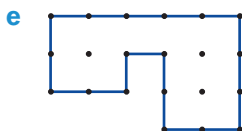
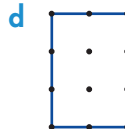
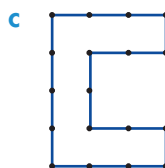
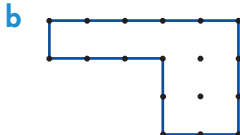
**remember**

1. The perimeter is the distance around the outside of a shape.
2. To calculate the perimeter, change all lengths to the same unit before adding them.

**EXERCISE 8D****Perimeter**

**WORKED  
Example**  
4a

- 1 Find the perimeter of each shape below. The dots are 1 unit apart.

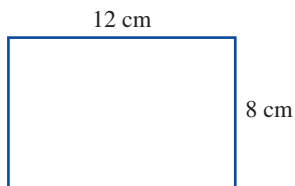


**WORKED**  
**Example**  
**4b**

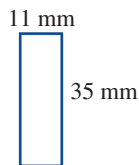


**2** Find the perimeter of each of the following.

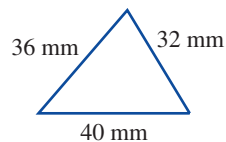
**a**



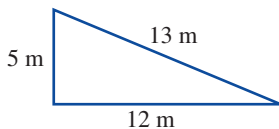
**b**



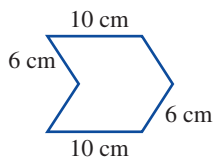
**c**



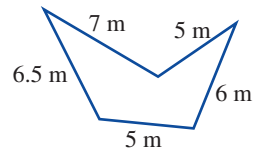
**d**



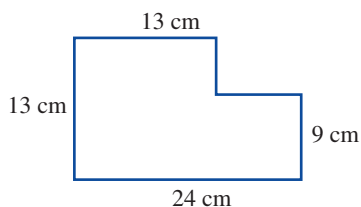
**e**



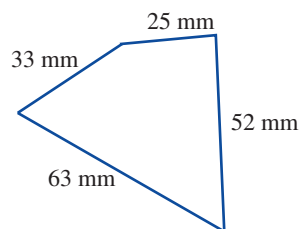
**f**



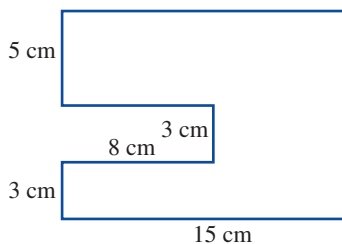
**g**



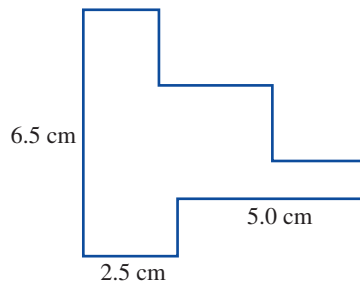
**h**



**i**



**j**

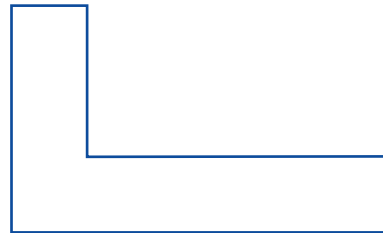


**3** Measure the perimeter of each of the following, giving your answers in centimetres.

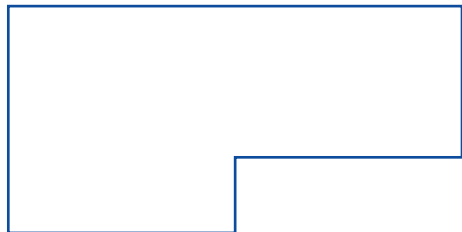
**a**



**b**

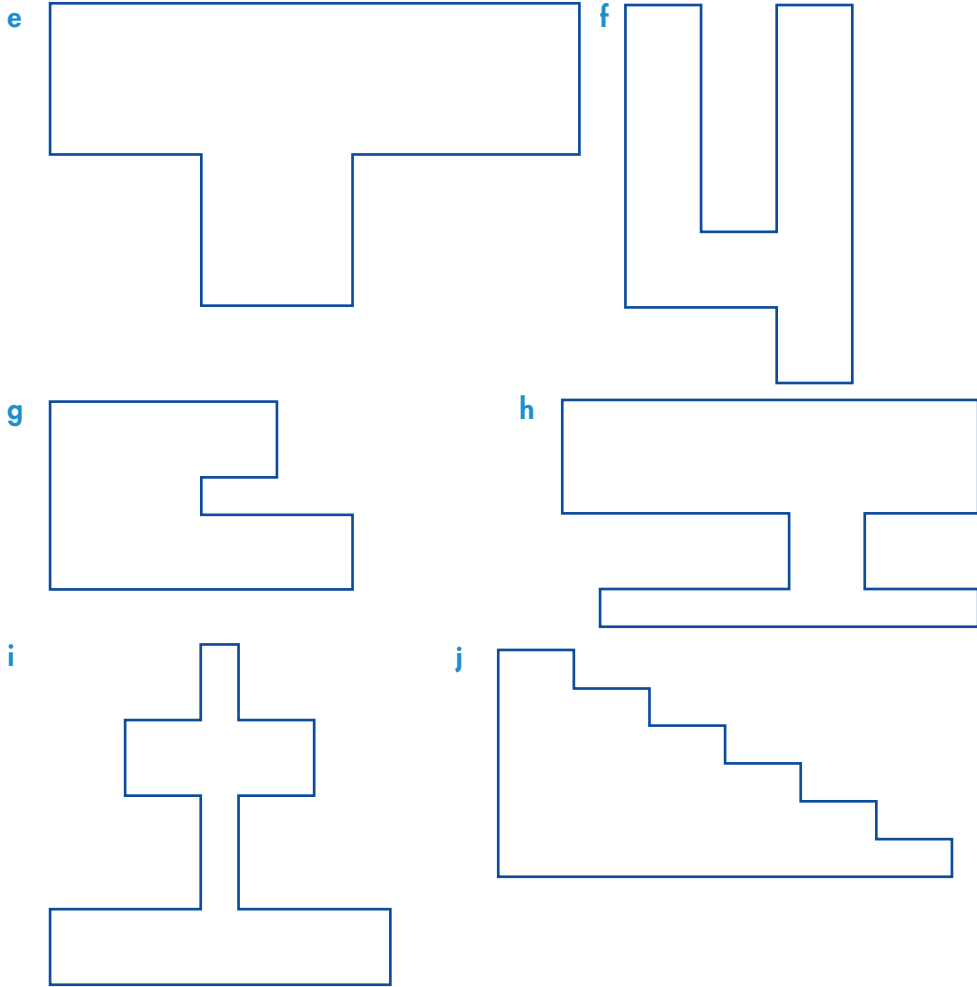


**c**



**d**

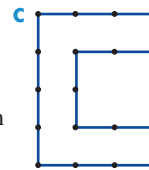
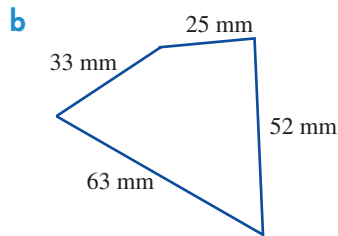
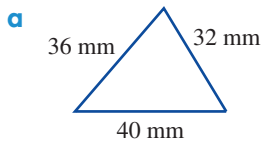




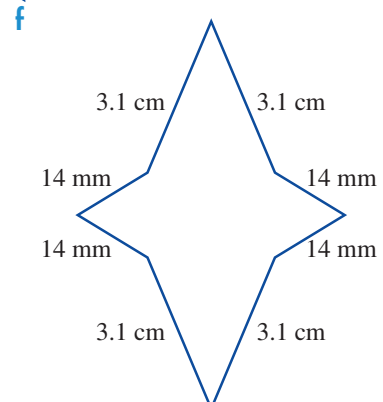
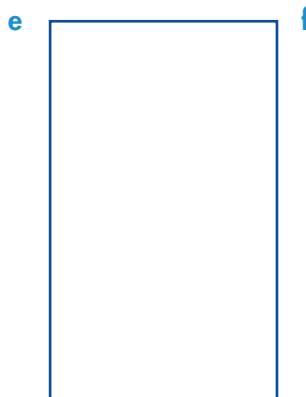
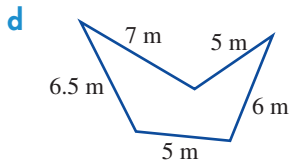
**WORKED  
Example**

4c

- 4 Determine the perimeter of each of the following, giving answers in the smaller unit in each case.



*Note: The dots are 1 unit apart.*

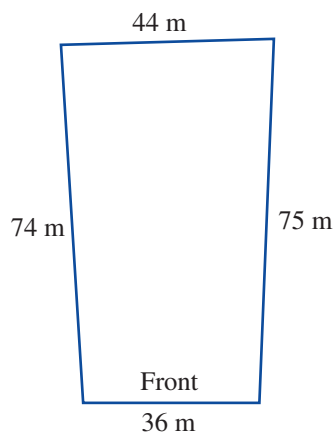




63 cm

- 11** Phang's property boundary dimensions are shown on the right.

- How many metres of fencing will he need to fence all but the front boundary?
- If the fencing costs \$19 per metre, what will the total cost be?



- 12** Lucille has a quote of \$37 per metre for new tennis court fencing. A tennis court is 23.77 m long and 10.97 m wide. There should be a 3.6-m space between the sides of the court and the fence, and a 6.4-m gap between the ends of the court and the fence.

- Draw a diagram showing all given measurements.
- How many metres of fencing are needed?
- What will the total cost of the quote be?

- 13** Zedken wishes to install three strands of barbed wire at the top of the fences around a rectangular work site. The length of the site is 34.5 m, and its width is 19.8 m. What length of wire will Zedken need?

- 14** A new game, 'Bop-ball' is played on a triangular field, where each side of the triangle measures 46.6 m. A greenkeeper is marking the field's perimeter using a chalk dispensing trundle wheel. How far will the greenkeeper walk in marking the field?



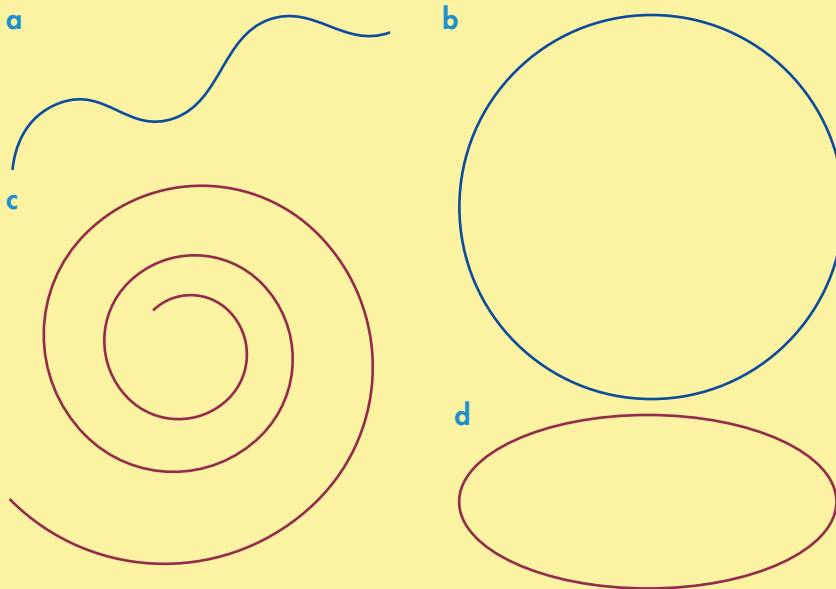
- On planet Mathematico, the main units of length are the yot, the blot and the snop. There are 13 yots in a blot and 17 blots in a snop. How many yots are there in 23 snops?
- A square garden is enclosed by a fence. Each side of the fence has 10 posts. How many posts are there? (The answer is not 40.)
- If a stock of food can feed 20 chickens for 24 days, how long would the same food stock last if there were 16 chickens?
- Look for a pattern in the following letters.  
A B C D E F G A B C D E F G A B C D E F G ...  
What will be the 500th letter in this pattern?



## Measuring curves

Each figure below consists of a curved line.

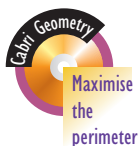
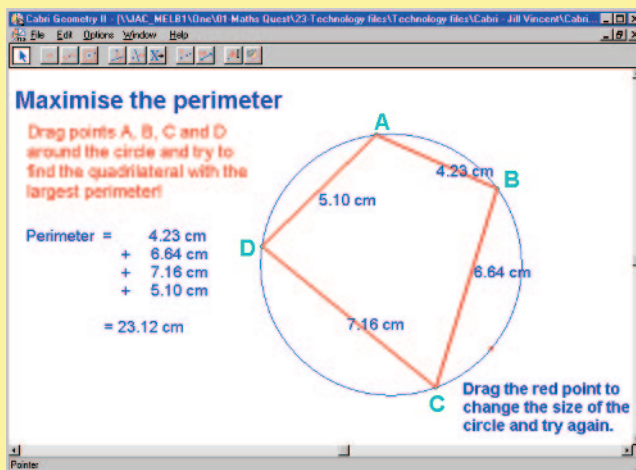
- 1 Work out a method for measuring the length of each line and describe how it works.
- 2 Measure each line and compare your results with those of a classmate.
- 3 For which of the figures is the length of the line also called the perimeter?



## Maximise the perimeter

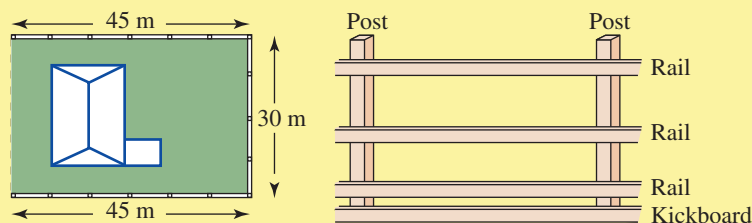
Open the Cabri Geometry file 'Maximise the perimeter', or start a new file and construct a circle with four points on it joined by line segments. Measure the lengths of each segment, and calculate the total of the segment lengths. You could even try this activity without a computer, using a pencil and paper.

Drag the points on the circle around until you think you've found the maximum possible perimeter of the four-sided shape. Check with your teacher about how close you were to finding the maximum.



## Cost of a new fence

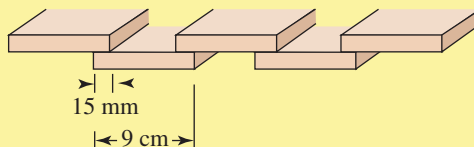
Marc and Cathy are seeking quotes on the cost of building a fence on three sides of their property. They want to calculate approximate costs for each item to decide whether the quotes supplied sound reasonable.



The new fence requires three rails, a kickboard, posts and palings.

- 1 What length of timber will be needed for the kickboard?
- 2 Calculate the cost of the kickboard if the timber required for this costs \$1.90 per metre.
- 3 If the timber for the rails costs \$2.25 per metre, what will be the total cost of the timber for the railings?
- 4 How many posts will be needed for the new fence if each post is to be 5 metres apart and there needs to be a post at the end of each straight section of fence?
- 5 Calculate the cost of the posts if the price of each post is \$13.65.

Palings are 9 cm wide and are nailed so they overlap each other by 15 mm.

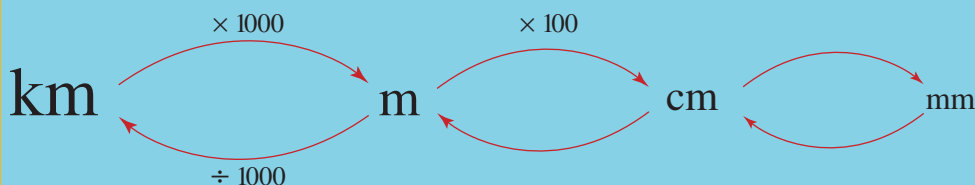


- 6 Calculate the approximate number of palings needed for the fence.
- 7 Palings cost \$1.05 each. How much money should be allowed for the total cost of the palings?
- 8 Write an itemised list of all the costs involved. Include an amount to cover labour charges and miscellaneous items like the cost of nails. This amount is around \$1000 (two people for two days at approximately \$30.00 per hour for an eight-hour day). Estimate the cost of the new fence. This will provide Marc and Cathy with information to use when comparing builders' quotes.

# summary

Copy the sentences below. Fill in the gaps by choosing the correct word or expression from the word list that follows.

- 1 The most appropriate unit for measuring an athletics track is \_\_\_\_\_.
- 2 When using a ruler to measure a line, the ruler's \_\_\_\_\_ mark should be on one end of the line.
- 3 The abbreviation km is short for \_\_\_\_\_.
- 4 The abbreviation m is short for \_\_\_\_\_.
- 5 The abbreviation \_\_\_\_\_ is short for centimetres.
- 6 The abbreviation \_\_\_\_\_ is short for millimetres.
- 7 Copy and complete:



- 8 To convert from kilometres to metres, you need to \_\_\_\_\_ by 1000.
- 9 To convert from metres to kilometres, you need to \_\_\_\_\_ by 1000.
- 10 To convert from kilometres to millimetres, you need to multiply by \_\_\_\_\_.
- 11 To convert from centimetres to metres, you need to divide by \_\_\_\_\_.
- 12 The \_\_\_\_\_ around the \_\_\_\_\_ of a shape is called the perimeter.
- 13 When adding lengths to find a perimeter, all lengths should be in the \_\_\_\_\_ units.

## WORD LIST

distance  
divide  
metre  
100

zero  
same  
 $\times 10$   
 $\div 100$

outside  
cm  
1 000 000  
kilometre

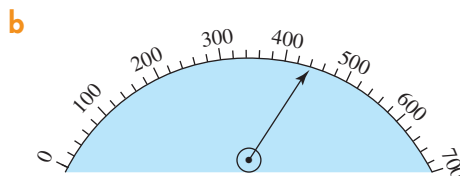
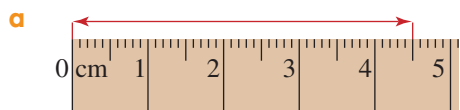
multiply  
mm  
 $\div 10$   
metres



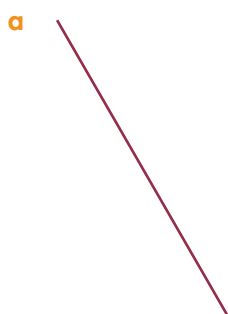
# CHAPTER review

- 1 Which metric unit would be most suitable for measuring:
- a the distance walked by a teacher at school during a week?
  - b the length of a piece of spaghetti?
  - c the width of a pencil?

- 2 What is the reading indicated by the arrow in each case?



- 3 Measure each of the following line segments.



- 4 Estimate the height of the tree on the right, given that the person in the diagram is 1.7 m tall.

- 5 Copy and complete the following conversions.

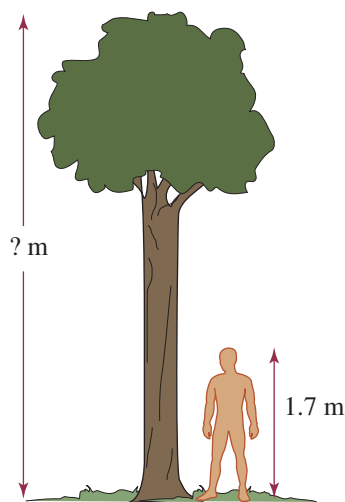
- a  $560 \text{ mm} = \underline{\hspace{2cm}} \text{ m}$
- b  $2300 \text{ cm} = \underline{\hspace{2cm}} \text{ km}$
- c  $17 \text{ m} = \underline{\hspace{2cm}} \text{ cm}$
- d  $0.75 \text{ km} = \underline{\hspace{2cm}} \text{ mm}$
- e  $2.09 \text{ m} = \underline{\hspace{2cm}} \text{ mm}$
- f  $6.8 \text{ cm} = \underline{\hspace{2cm}} \text{ m}$
- g  $22.5 \text{ mm} = \underline{\hspace{2cm}} \text{ cm}$
- h  $0.0063 \text{ km} = \underline{\hspace{2cm}} \text{ m}$
- i  $82\,000\,000 \text{ m} = \underline{\hspace{2cm}} \text{ km}$
- j  $5.9 \text{ mm} = \underline{\hspace{2cm}} \text{ cm}$

- 6 Arrange from smallest to largest: 44.5 m, 455 cm, 455 000 mm, 0.004 45 km.

- 7 a Add 45.6 km to 5600 m.

- b Find the difference between 80 m and 4300 cm.

- 8 During a rescue operation in calm seas, a 16.5 m rope is dangled from a helicopter hovering 20 m above sea level. A 175 cm tall man standing on the deck of a boat reaches 50 cm above his head for the rope. By how much does he fail to reach the rope if the deck is 1 m above sea level?



8A

8B

8B

8B

8C

8C

8C

8C

8C

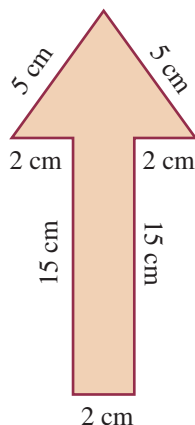
- 9 The Amazing Ape-Impersonating Gymnastic Troupe consists of two people who are 150 cm tall, and three people who are 1.8 m tall. When they form a tower five people high by standing on each other's heads, how high is the tower?



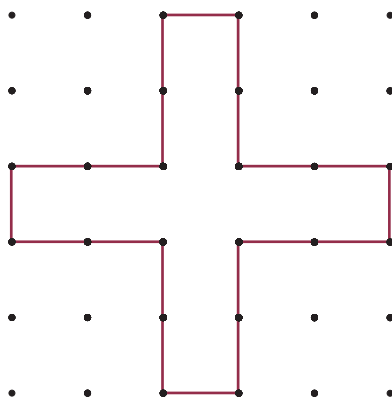
8D

- 10 Find the perimeter of each shape below.

a

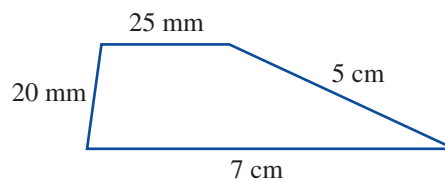


b

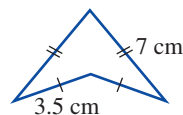


Note: The dots are 1 cm apart.

c



d



8D

- 11 Bonzo the clown monocycles three laps of the circuit shown at right. How far does he ride altogether?

