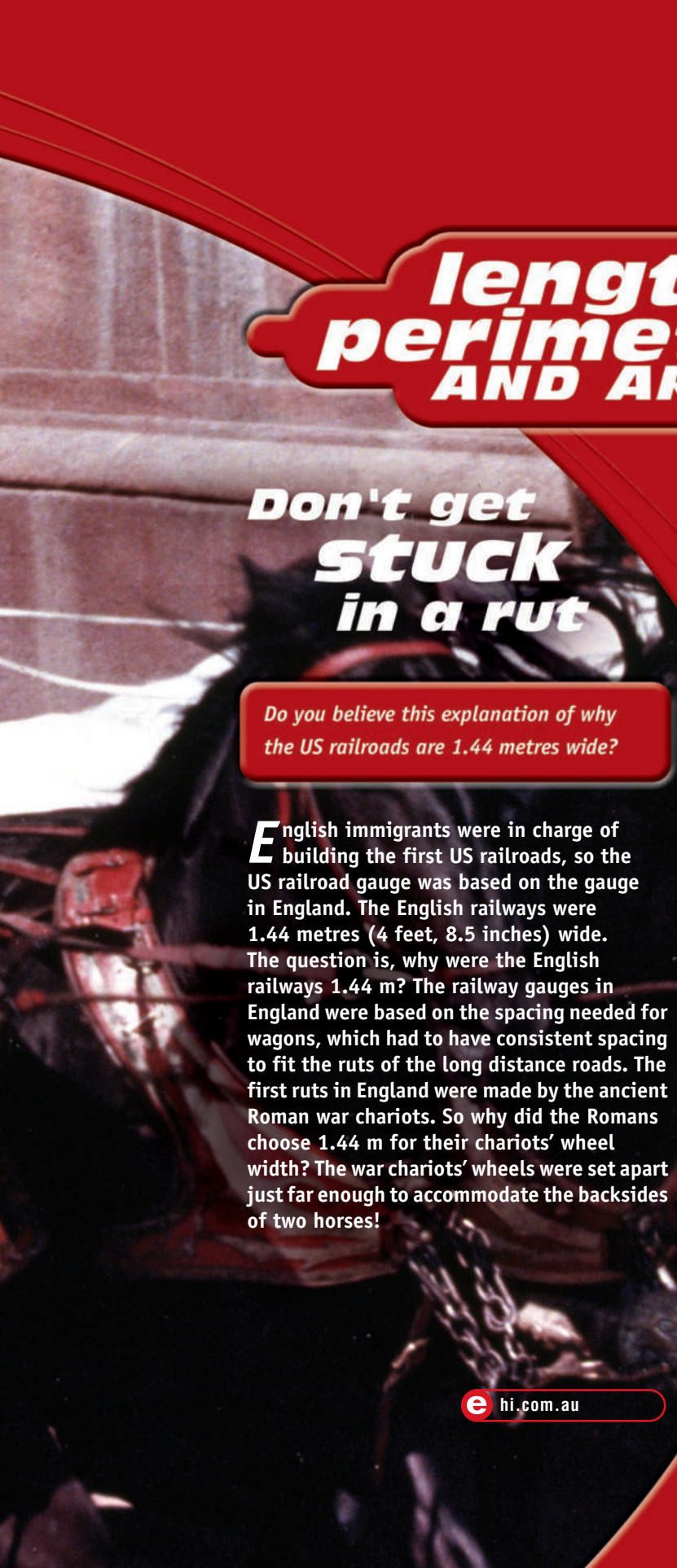
7 length, perimeter AND AREA



Don't get stuck in a rut

Do you believe this explanation of why the US railroads are 1.44 metres wide?

English immigrants were in charge of building the first US railroads, so the US railroad gauge was based on the gauge in England. The English railways were 1.44 metres (4 feet, 8.5 inches) wide. The question is, why were the English railways 1.44 m? The railway gauges in England were based on the spacing needed for wagons, which had to have consistent spacing to fit the ruts of the long distance roads. The first ruts in England were made by the ancient Roman war chariots. So why did the Romans choose 1.44 m for their chariots' wheel width? The war chariots' wheels were set apart just far enough to accommodate the backsides of two horses!

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outcomes

After completing this chapter you will be able to:

- choose appropriate units for measuring
- estimate common measurements using standard units
- convert between metric units of length
- describe the limit of accuracy of measurements
- find the perimeters of a variety of shapes
- find the areas of rectangles and triangles.

prepzone7

Prepare for this chapter by attempting the following questions. If you have difficulty with a question, click on the Replay Worksheet icon on your *eMaths Zone* CD or ask your teacher for the Replay Worksheet.

Worksheet R7.1

1 Calculate the following.

(a) 3.4 + 6.8 + 4.2 + 2.1 **(b)** 45.6 – 5.28

(c) 6 × 4 **(d)** 9.2 × 10.1

(e) 18.96 × 1000 **(f)** 2780 ÷ 100

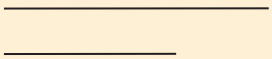
Worksheet R7.2

2 Measure the length of each line below to the nearest millimetre.

(a) **(b)**

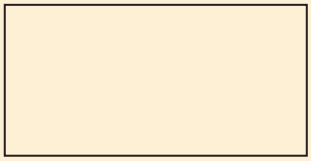
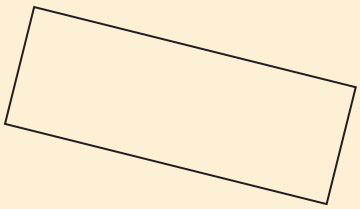
Worksheet R7.3

3 Find the difference in length between each pair of lines to the nearest millimetre.

(a)  **(b)**

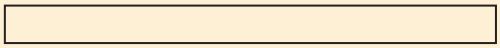
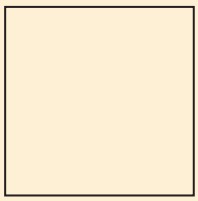
Worksheet R7.4

4 Measure the length and breadth of each rectangle below to the nearest millimetre.

(a)  **(b)** 

Worksheet R7.5

5 Which of the shapes below has the bigger area?

A  **B** 

KEY WORDS

area	hectare	measurement	perimeter
base	height	metre	square metre
breadth	kilometre	metric	
centimetre	length	millimetre	

7.1 Units of length

We can run into all sorts of problems if we haven't agreed on fixed units of **length**.

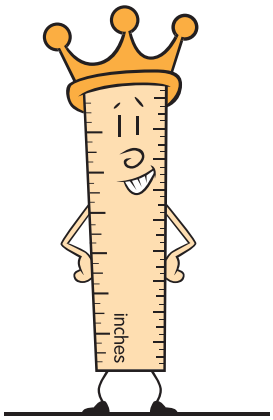
In Australia, the **metric** system of **measurement** was introduced in 1970.

The system used in Australia before the introduction of the metric system was the imperial or British system, which uses units such as inches, feet, yards, miles, links, rods, chains and furlongs. In this system it is awkward to convert between the different units.

The metric units of length used most often are:

The **kilometre** (km)—roughly equal to 3 laps of a sporting oval.
The **metre** (m)—about the length of an adult's 'stretched pace'.
The **centimetre** (cm)—roughly equal to the width of a little finger.
The **millimetre** (mm)—the approximate thickness of a metal ruler.

Most rulers are about 30 cm long, and show centimetre and millimetre divisions.



An imperial ruler

The metric units of length are related as follows:

1 kilometre = 1000 metres
1 metre = 100 centimetres
1 centimetre = 10 millimetres

You would measure something like the distance between two capital cities in kilometres, the length of a driveway in metres, the distance around your waist in centimetres, and the thickness of a pencil in millimetres.

exercise 7.1 Units of length

Preparation: Prep Zone Q2

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Hint

Core

1 State which metric unit would be most appropriate for measuring:

(a) the length of your foot
(b) the distance from Sydney to Melbourne
(c) the height of a footstool
(d) the distance around an athletics track
(e) the length of a shoe-lace
(f) the distance run in a marathon
(g) the length of your bed

2 Choose the correct answer.

(a) The thickness of a slice of bread would be best measured in:
A metres **B** centimetres **C** millimetres **D** kilometres

(b) The width of a student's desk top would be best measured in:
A metres **B** centimetres **C** millimetres **D** kilometres

(c) Which of the following gives the best estimate of the distance across a suburban street?
A 50 cm **B** 500 mm
C 50 m **D** 5 m

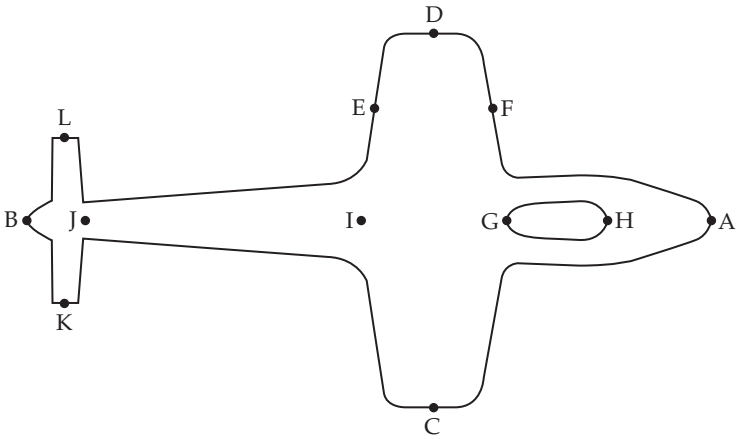
(d) Which of the following gives the best estimate of the length of a mouse's tail?
A 1 cm **B** 10 cm
C 100 cm **D** 1000 cm

3 Name three different objects whose lengths should be measured in metres.

4 Measure in centimetres the following lengths from the diagram of a model aircraft shown below.

Hint

Write 5 cm 7 mm as 5.7 cm because there are 10 millimetres in a centimetre.



(a) The length of the aircraft (*AB*).
(b) The wingspan (*CD*).

(c) The breadth of a wing at its middle (*EF*).
(d) The length of the cockpit dome (*GH*).
(e) The length of the fuselage section (*IJ*).
(f) The distance from the front of the cockpit to the tip of the nose (*HA*).
(g) The tail width (*LK*).
(h) The distance from the back of the wings to the end of the tail (*IB*).

Extension

5 Estimate the following.

(a)

The height of this building.

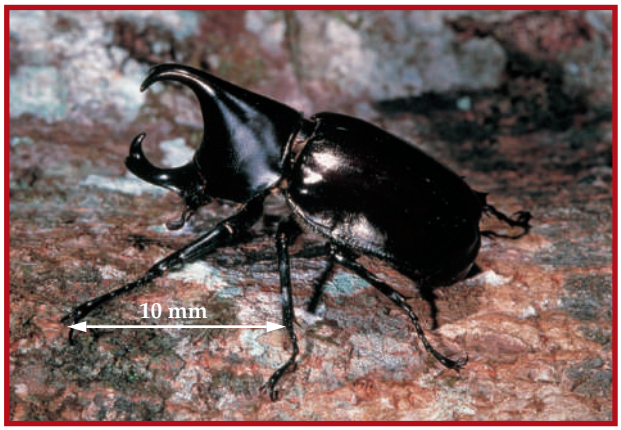
(b)

The length of this speed boat.

(c)

The giraffe's height.

(d)

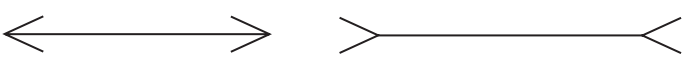


The length of the beetle.

6 Guess the answer to each of the following then use your ruler to help you decide.

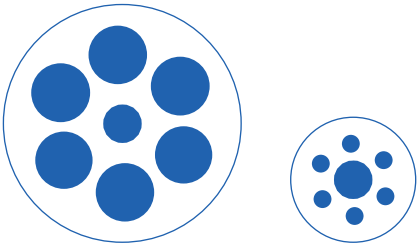
Hint

(a) Which horizontal line is longer?



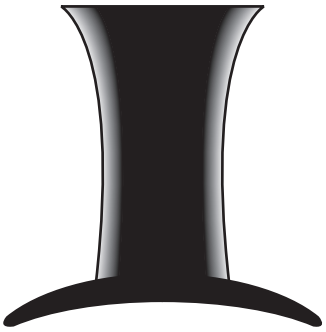
A **B**

(b) Which diagram has the larger central circle?

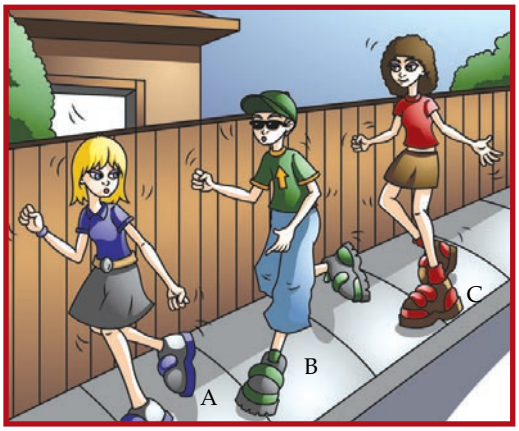


A **B**

(c) Is the hat shown below as wide as it is tall?



(d) Which person is the tallest?



7 Explain each illusion or effect in Question **6** and why you think it happens.

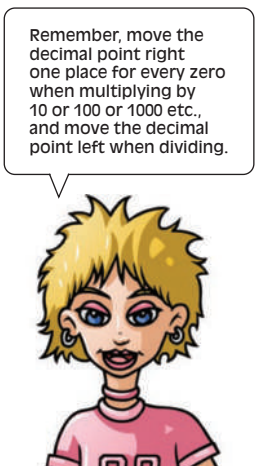
Worksheet A7.1

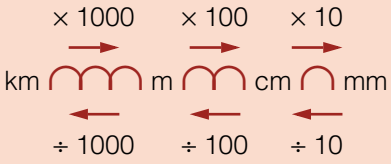
7.2 Converting units of length

The ease with which we can convert between units is the great advantage of the metric system.

Converting between metric units of length is made easy because we only ever need to multiply or divide by 10, 100, 1000 etc. to change to different units. This is done by simply moving the decimal point in the value being converted.

Converting between metric units is made easier still by using the decimal point movement chart on the following page.





dangerzone

Remember that when you convert larger units to smaller ones, your answer must be bigger. For example, converting km to m:

2 km = 2000 m

worked example 1

Convert:

(a) 62 km to m **(b)** 875 cm to km

Steps

(a) 1. Write 62 km as 62.0 km.

2. Place your finger on km on the chart above and move it to m. Note how many places and in which direction you moved. (3 places to the right.)

3. Now move the decimal point 3 places to the right also, i.e. multiply by 1000.

4. Fill in the spaces with zeros.

(b) 1. This conversion requires a decimal point movement of 5 places to the left, i.e. divide by 100 000.

2. Fill in the spaces with zeros, and place a zero in the units place to emphasise the placement of the decimal point.

Solutions

(a)

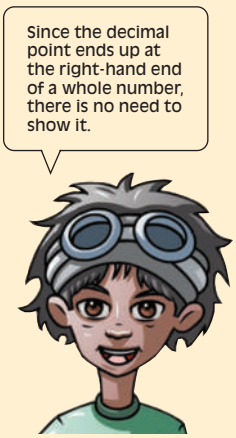
62.0 km

= 62 000 m

(b)

875.0 cm

= 0.008 75 km



exercise 7.2 converting units of length

Preparation: Prep Zone Q1

Core

1 Copy and complete the following conversions.

(a) 5 km = ___ m **(b)** 23 km = ___ m **(c)** 20 km = ___ m

(d) 3.6 km = ___ m **(e)** 9.7 km = ___ m **(f)** 10.6 km = ___ m

Hint

Worksheet C7.1

(g) 0.2 km = ___ m **(h)** 0.03 km = ___ m **(i)** 0.008 km = ___ m
(j) 700 m = ___ cm **(k)** 9 m = ___ cm **(l)** 65 m = ___ cm
(m) 3 m = ___ cm **(n)** 0.55 m = ___ cm **(o)** 5.6 m = ___ cm
(p) 4 cm = ___ mm **(q)** 12 cm = ___ mm **(r)** 80 cm = ___ mm
(s) 17.2 cm = ___ mm **(t)** 2.9 cm = ___ mm **(u)** 20.4 cm = ___ mm

2 Copy and complete:

Hint

(a) 4.7 km = ___ cm **(b)** 9.05 km = ___ cm
(c) 0.003 km = ___ cm **(d)** 0.7 km = ___ mm
(e) 0.342 km = ___ mm **(f)** 0.002 km = ___ mm
(g) 4.95 m = ___ mm **(h)** 3.2 m = ___ mm

3 Copy and complete the following conversions.

Hint

(a) 61 mm = ___ cm **(b)** 20 mm = ___ cm
(c) 104 mm = ___ cm **(d)** 42.3 mm = ___ cm
(e) 100.7 mm = ___ cm **(f)** 30.9 mm = ___ cm
(g) 0.9 mm = ___ cm **(h)** 0.07 mm = ___ cm
(i) 0.1 mm = ___ cm **(j)** 800 cm = ___ m
(k) 1200 cm = ___ m **(l)** 90 cm = ___ m
(m) 86 cm = ___ m **(n)** 712 cm = ___ m
(o) 3 cm = ___ m **(p)** 2000 m = ___ km
(q) 4200 m = ___ km **(r)** 8097 m = ___ km
(s) 9 m = ___ km **(t)** 50 m = ___ km

4 Copy and complete the following conversions.

Hint

(a) 560 mm = ___ m **(b)** 2400 mm = ___ m
(c) 97 mm = ___ m **(d)** 9000 cm = ___ km
(e) 34 500 cm = ___ km **(f)** 567 cm = ___ km
(g) 50 000 mm = ___ km **(h)** 7800 mm = ___ km

5 Copy and complete the following conversions.

(a) 56.3 m = ___ cm **(b)** 289 mm = ___ cm
(c) 4567 m = ___ km **(d)** 700 km = ___ m
(e) 8.7 cm = ___ mm **(f)** 30.9 cm = ___ m
(g) 567 000 mm = ___ km **(h)** 0.63 m = ___ mm
(i) 830 mm = ___ m **(j)** 780 cm = ___ km
(k) 1.92 km = ___ cm **(l)** 0.006 km = ___ mm

6 Choose the correct answer.

(a) 5.9 km is equal to:
A 0.000 59 m **B** 0.0059 m **C** 5900 m **D** 59 000 m

(b) 670 cm is equal to:
A 0.67 m **B** 6.7 m **C** 670 m **D** 6.7 km

7 What do the prefixes 'milli', 'centi' and 'kilo' mean?

8 A snow gum in the Snowy Mountains was measured to be 2976 cm. How many metres is this?

Hint

9 In 1937, a giant earthworm in South Africa was measured to be 6.7 m in length. Write this length in centimetres.

Some Australian earthworms

10 The bird-eating spider of South America has a body length of 89 mm and a leg-span of 254 mm. Write these measurements in centimetres.

11 The dinosaur Tyrannosaurus rex is thought to have been 548 cm high and 1433 cm long. Convert these dimensions to metres.

Extension

12 Give two lengths in metres that are less than 3 cm.

13 Andrew walked 850 m from his home to the school gates, then another 220 m to his classroom. What is the total distance in metres that he walked to his classroom? What is this distance in kilometres?

14 Claire is building a desk and she wants it to be wide enough that she can fit the length of two A4 sheets across it. If the length of an A4 sheet is 298 mm, how wide does Claire's desk have to be in millimetres? What is this length in centimetres?

Hint

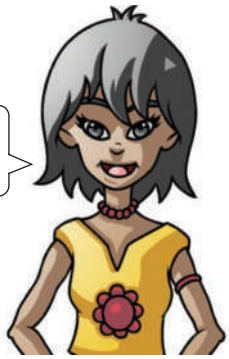
15 The following are some mistakes made by a class when doing conversions. For each, explain what mistake has been made and write the correct answer.

(a) 27 m = 0.27 cm **(b)** 765 mm = 7.65 cm **(c)** 3800 m = 3.08 km
(d) 0.8 km = 0.8000 m **(e)** 54 cm = 504 mm **(f)** 1356 cm = 1.356 m

7.3 Using metric units of length

Many situations involve lengths measured in different units.

It is essential that all lengths be expressed in the *same units* before performing any operations, such as *adding* or *subtracting*. As a general rule, we usually convert to the smaller unit so that whole numbers are involved.



worked example 2

Add each of the following pairs of lengths, giving your answer in the units in brackets.

(a) 12.4 cm and 250 mm (mm) **(b)** 420 m and 2.8 km (m)

Steps	Solutions
(a) 1. Convert to the unit indicated in brackets.	**(a)** 12.4 cm = 12.4 × 10 = 124 mm
2. Add the values together and state the answer.	124 + 250 = 374 mm
(b) 1. Convert to the unit indicated in brackets.	**(b)** 2.8 km = 2.8 × 1000 = 2800 m
2. Add the values together and state the answer.	420 + 2800 = 3220 m

exercise 7.3 Using metric units of length

Preparation: Prep Zone Q1 and 3, Ex 7.2

Core

1 Add each of the following lengths, giving your answer in the units stated in brackets.

(a) 45.2 cm and 870 mm (mm)
(b) 560 m and 3.1 km (m)
(c) 3.54 m and 56.3 cm (m)
(d) 2100 mm and 7.9 m (mm)
(e) 50 300 cm and 0.589 km (km)
(f) 2.08 m and 597 cm (cm)
(g) 5900 mm and 2.3 km (m)
(h) 25 m and 32 000 mm (cm)
(i) 1080 cm and 92 000 mm (m)
(j) 32 500 m and 786 000 cm (km)

Hint

2 Choose the correct answer.

(a) The total length obtained when 2.5 m and 43 cm are added is equal to:
A 45.5 m **B** 45.5 cm **C** 293 cm **D** 293 m

(b) The total distance travelled by an athlete who cycles 6 km then runs 800 m is:
A 806 m **B** 608 m **C** 14 km **D** 6800 m

3 Find the difference between each of the following pairs of lengths, expressing your answer in the units stated in brackets.

(a) 73.6 m and 0.54 km (km)
(b) 5.02 m and 78.5 cm (m)
(c) 780 mm and 5.8 cm (cm)
(d) 55.6 cm and 430 mm (mm)
(e) 5200 cm and 28 500 mm (m)
(f) 6.8 m and 2900 mm (cm)
(g) 2870 m and 6000 cm (km)
(h) 380 000 cm and 9.785 km (m)

Hint

4 Write two lengths in metres that have a difference of 6 cm.

Animation

5 A painter can reach a height of 2.8 m when her feet are on the ground. How high could she reach standing on a 72 cm high chair? (Answer in metres.)

Hint

6 To repair damage to a fence, Horace requires pieces of railing timber 2.5 m, 3.7 m and 925 mm long. What total length (in metres) does he need?

7 Cordelia's racing car breaks down only 230 m from the finish of a 25 km race. What distance did she complete before this tragedy? (Answer in kilometres.)

8 A photo 127 mm long is to be put in a frame 9.6 cm long. How many millimetres must be trimmed from the photo?

Extension

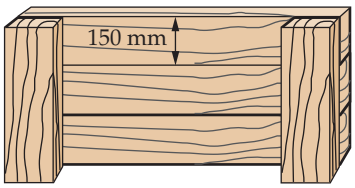
9 A brickie stacks some leftover bricks behind a garage. He finds that in order to fit them in the space available, he must make a pile 14 bricks high. If each brick is 74 mm high, how many metres up the garage wall does the stack reach?

10 A builder orders 60 pickets for a fence. If each picket is 183 cm long, and the wood costs 95 cents per metre, how much does the order cost?

Hint

11 A grocer builds a display of cereal boxes 8 boxes high. If each box is 33 cm tall, how many metres high is the display?

12 A sleeper wall is constructed as shown. If each sleeper is"150 mm wide, how tall is the wall in metres?



13 An accountant is assured by her stationery supplier that the pencils she has bought will write for at least 600 metres each. If she bought a packet of 12 pencils, how many kilometres can she look forward to writing with them?

Hint

14 Paula goes jogging around a nearby track at every opportunity, and one day manages to jog around the track a total of 17 times. If the track is 470 m around, how many kilometres did she jog this day?

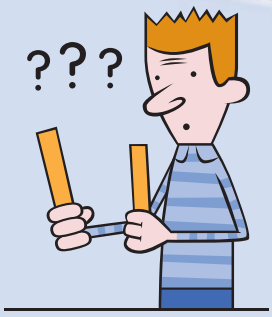
15 Lauren is preparing some shasliks for a barbecue. She wishes to place pieces of marinated meat 4 cm long on 30 cm bamboo skewers, leaving 3 cm of skewer free at each end. How many pieces of meat will she be able to place on each skewer?

Working mathematically

problem solving

Ralph's rulers

Ralph is planning a woodwork model and needs to draw a line 6 cm long. He has been using as rulers 2 straight pieces of wood with no markings, but he knows their lengths are 10 cm and 8 cm. How can he use these pieces of wood to measure a 6 cm line?



Act it out.

7.4 Perimeter

Perimeter is a term used to describe the boundary of an object or area.

A hockey field has a white boundary line marked along its perimeter. A frame goes around the perimeter of a picture. A cushioned wall forms the perimeter of a billiard table.

Perimeter is the distance around the outside of a shape.

eTutorial

exercise 7.4 Perimeter

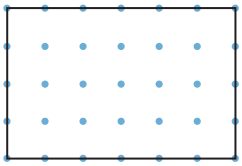
Preparation: Prep Zone Q1 and 4, Exs 7.2 and 7.3

Core

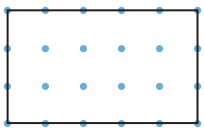
1 Find the perimeter of each of the following rectangles. (The dots are 0.5 cm apart vertically and horizontally.)

Hint

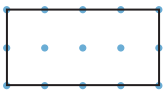
(a)



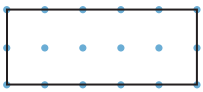
(b)



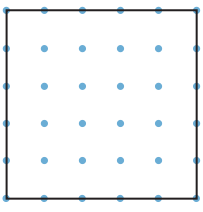
(c)



(d)



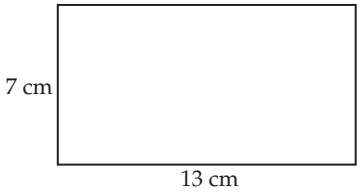
(e)



(f)

2 Can you find a shortcut method for calculating the perimeter of a square or rectangle? If so, describe your method/s.

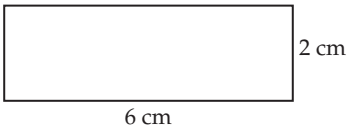
3 Choose the correct answer.
The perimeter of the rectangle is:
A 13 cm
B 20
C 40 cm
D 91 cm



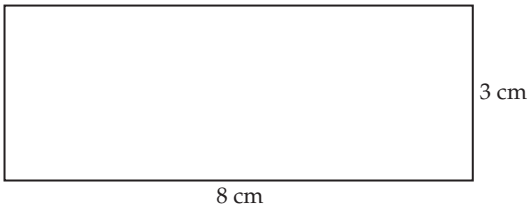
4 Find the perimeter of each of the following rectangles.

Hint

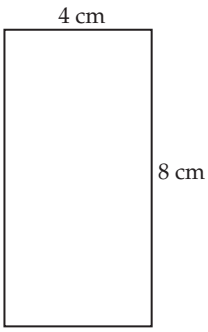
(a)



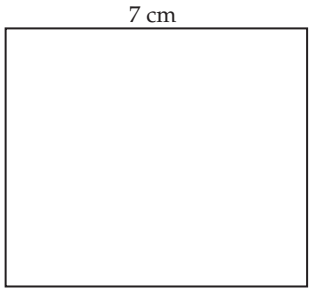
(b)



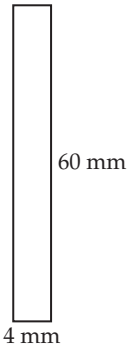
(c)



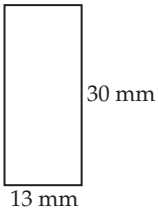
(d)



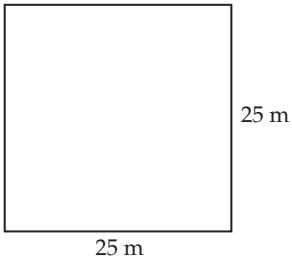
(e)



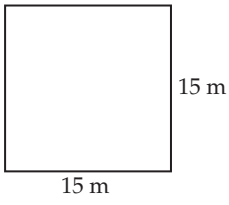
(f)



(g)



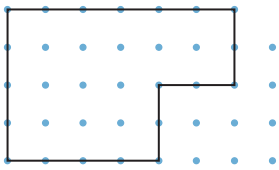
(h)



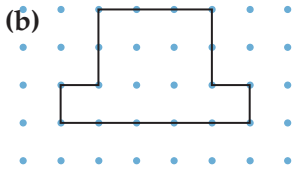
5 Find the perimeter of each shape on the half-centimetre dot grid below.

Hint

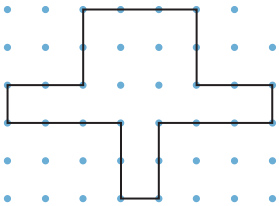
(a)



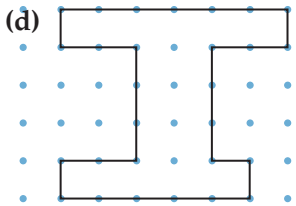
(b)



(c)



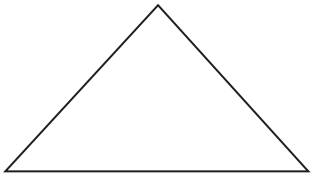
(d)



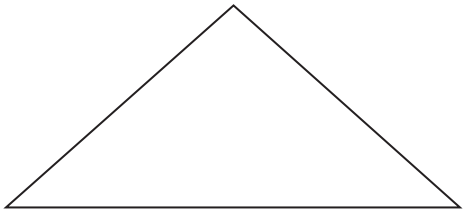
6 Measure the lengths of the sides of the shapes below and calculate their perimeters to the nearest cm.

Hint

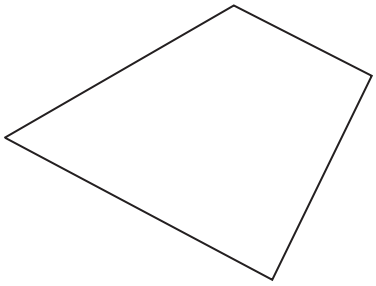
(a)



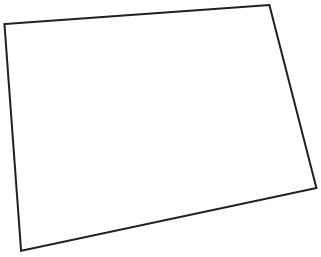
(b)



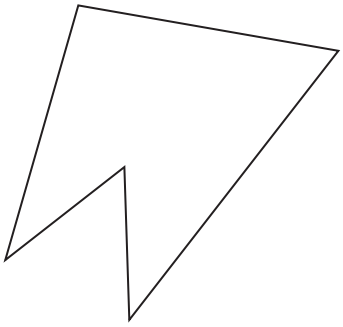
(c)



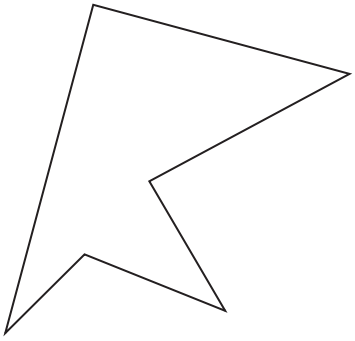
(d)



(e)



(f)

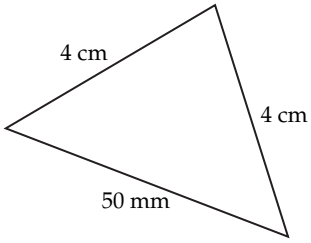


(g)

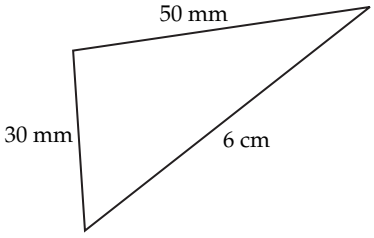
(h)

7 Convert each side length to the same units and calculate the perimeter of each of the following.

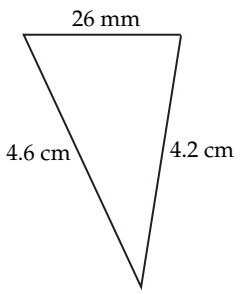
(a)



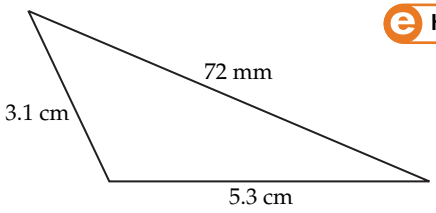
(b)



(c)

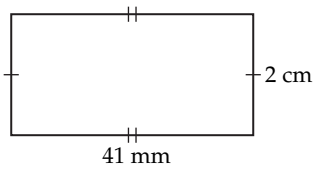


(d)

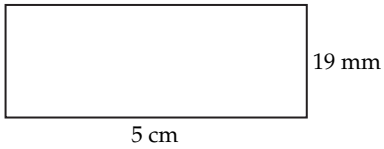


Hint

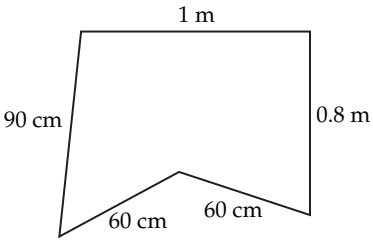
(e)



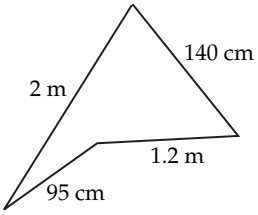
(f)



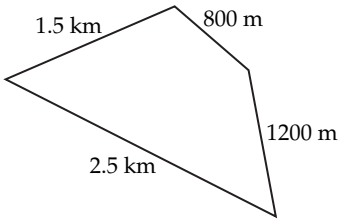
(g)



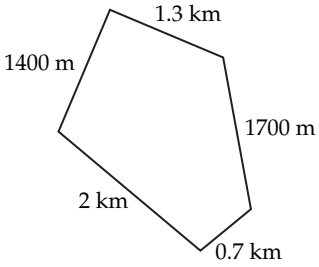
(h)



(i)



(j)

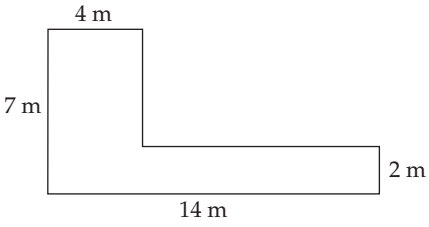


8 Each figure below has one or more side lengths missing. Find the perimeter of each one.

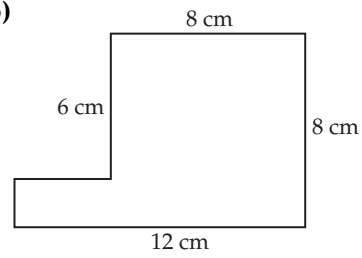
Worksheet C7.2

Hint

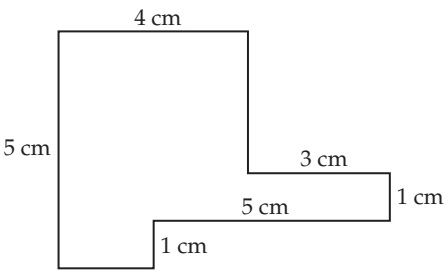
(a)



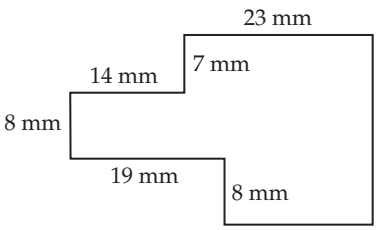
(b)



(c)



(d)



9 Find the perimeter of a rectangle of length 67 mm and width 23 mm.

10 Find the perimeter of a square whose sides measure 55 m.

Extension

11 The length and breadth of a rectangle are both whole numbers in centimetres. Write down possible dimensions if its perimeter is 84 cm.

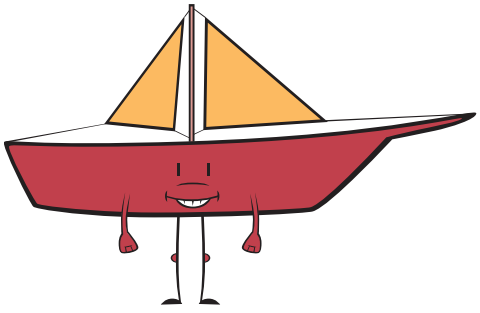
12 Find the side length of a square with a perimeter of 36 cm.

13 Find the breadth of a rectangle with a perimeter of 32 cm and a length of 10 cm.

14 A netball court measures 30.5 m by 15.25 m. Calculate its perimeter.

Hint

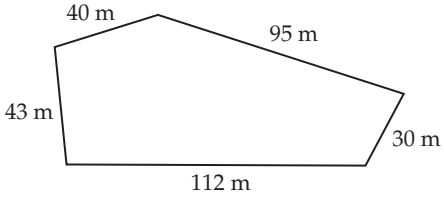
15 A yacht sails three straight legs of a course which form a triangle. The length of the legs are 2.5 km, 1.7 km and 3.9 km. What distance does the yacht sail to complete the course?



16 A group of phys. ed. students run around the perimeter of a court in their gymnasium which is rectangular and has dimensions 38 m by 16 m. What distance will they run if they complete 6 laps?

17 Bob wishes to run two strands of wire around his property to mark its boundary. A plan of the property is shown opposite. If he can obtain the necessary wire for 60 cents per metre, how much will the wire cost him?

Hint



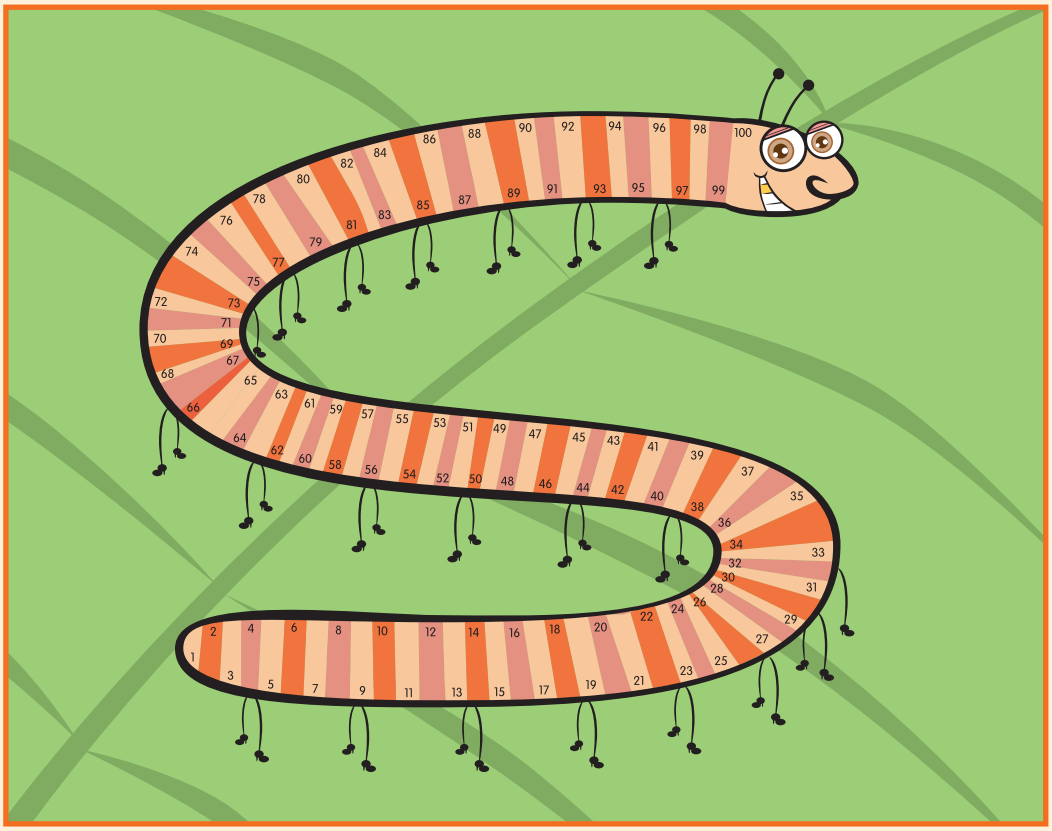
18 The local swimming pool is rectangular, of dimensions 25 m by 12 m. If it has a 1 m wide path around its perimeter, what is the distance around the outer edge of the path?

eQuestions

Worksheet A7.2

Homework 7.1

laughzone



Answer the following, showing your working, and then arrange the letters in the order shown by the corresponding answers to find the cartoon caption.

Find each length in metres.

120 cm	**E**	0.012 km	**I**
18 cm + 1.3 m	**R**	1.6 m + 280 cm	**N**
0.013 km – 4800 mm	**C**	1280 mm – 36 cm	**A**

The perimeter of a rectangle measuring 1.2 m by 0.9 m	**M**
The perimeter of a rectangle measuring 36 cm by 82 cm	**T**
The perimeter of a square of side length 35 cm.	**E**
The side length of a square with perimeter 8.4 m.	**E**
The longer side of a rectangle that has a perimeter of 4.6 m and one side of length 1 m.	**T**

‘											’
	0.92	8.2	1.4	4.4	2.36	12	4.2	1.2	1.3	1.48	2.1

7.5 Area

Using our example of a billiard table again (page 241), the green cloth surface that the billiard ball rolls around on represents the **area** of the table.

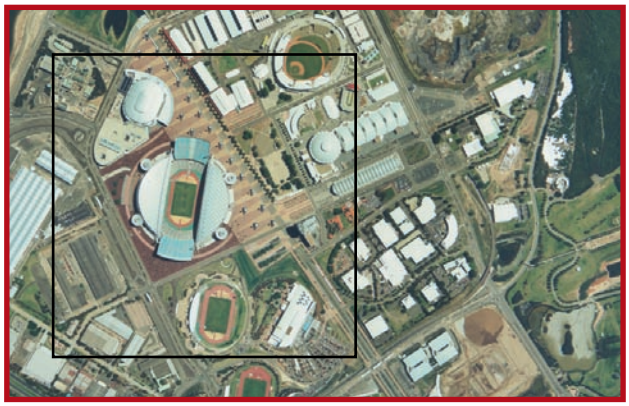
Area is the amount of space contained by a plane (flat) shape.

Area may be measured in square millimetres (mm^2), square centimetres (cm^2), **square metres** (m^2), square kilometres (km^2) or **hectares** (ha).

A square millimetre (actual size)

A square centimetre (actual size)

A square metre



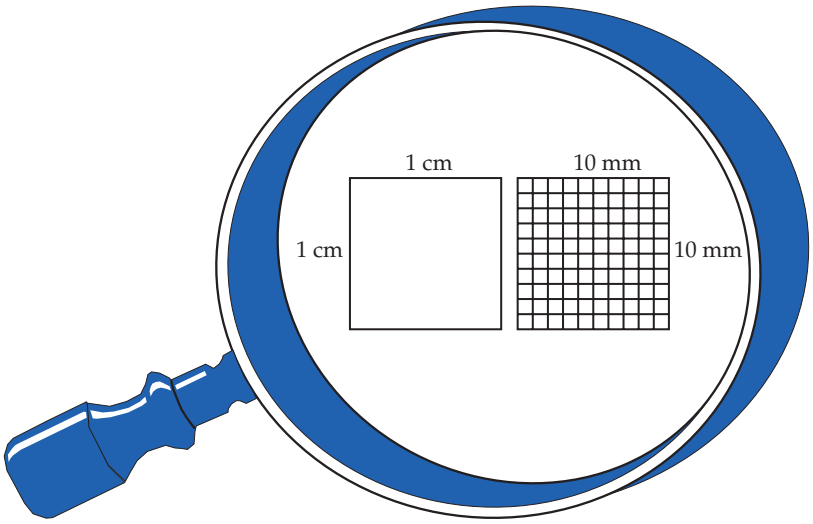
A square kilometre

A hectare is in between a square metre and a square kilometre.

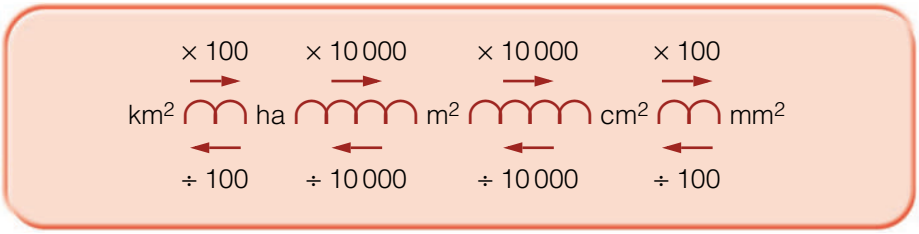
$$1 \text{ ha} = 10\,000 \text{ m}^2$$

When we find the area of something we are stating how many squares fit into the area. For example, if the front cover of a book has an area of 160 cm^2, this means that 160 square centimetres can fit onto the front cover of the book.

Converting areas is different to converting lengths. One square centimetre is not equal to ten square millimetres. You need to imagine how many squares with a side length of one millimetre fit inside a square with a side length of one centimetre. There are 100 (10 rows of 10). This is shown under the magnifying glass on the following page.



To convert units of area, use the following helpful summary.



When finding areas, it is often easier to convert the units first, then do the calculations.

exercise 7.5 Area

Preparation: Prep Zone Q5, Exs 7.2 and 7.4

Interactive

Core

1 State which of the units of area—mm^2, cm^2, m^2 or km^2—would be most suitable for measuring the area of:

(a) a sheet of writing paper
(b) your little toe-nail
(c) the city of Hobart
(d) a pizza
(e) a house block
(f) Stadium Australia at Sydney Olympic Park
(g) New South Wales
(h) a small watch face
(i) a sheet of newspaper
(j) the floor of a classroom

Hint

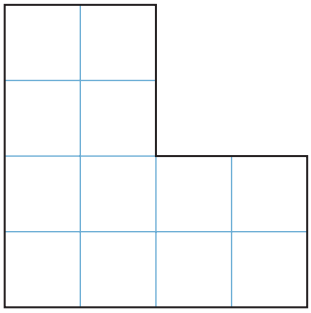
2 Copy and complete the following conversions.

(a) 5 m^2 = ___ cm^2
(b) 12 ha = ___ m^2
(c) 94 cm^2 = ___ mm^2
(d) 0.976 cm^2 = ___ mm^2
(e) 0.0065 m^2 = ___ cm^2
(f) 1.003 ha = ___ m^2

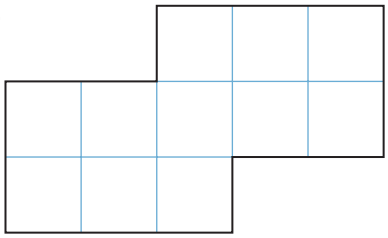
(g) 50 000 m^2 = ___ ha
(h) 9800 mm^2 = ___ cm^2
(i) 67 000 cm^2 = ___ m^2
(j) 950 cm^2 = ___ m^2
(k) 23.6 ha = ___ km^2
(l) 3400 m^2 = ___ ha
(m) 460 cm^2 = ___ m^2
(n) 345 cm^2 = ___ mm^2
(o) 9 000 000 m^2 = ___ ha
(p) 5570 ha = ___ km^2
(q) 0.076 56 m^2 = ___ cm^2
(r) 98.6 mm^2 = ___ cm^2

3 The following areas have been drawn on centimetre grid paper. Find the total number of cm^2 in each one.

(a)

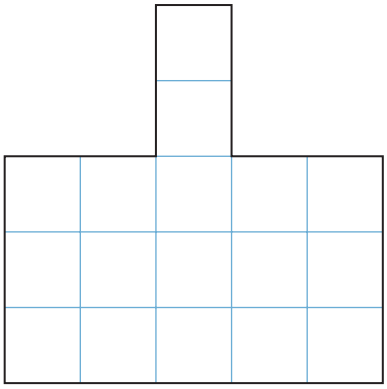


(b)

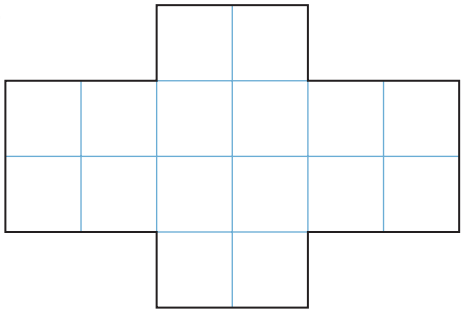


Hint

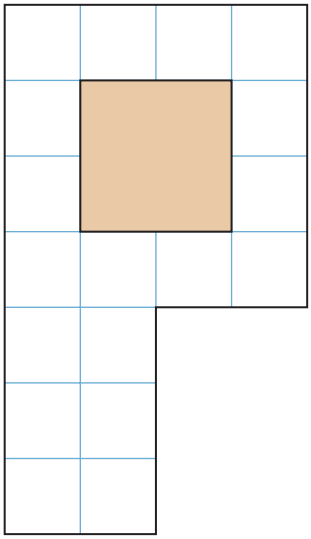
(c)



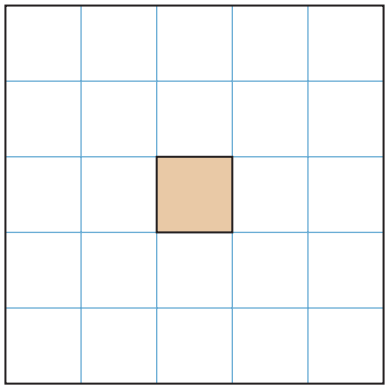
(d)



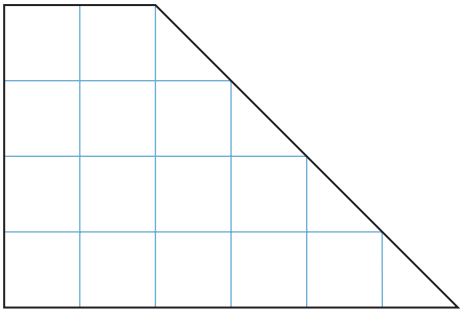
(e) Do not include the shaded area.



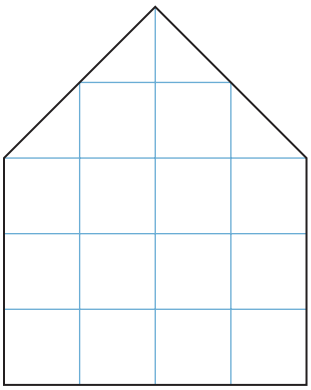
(f) Do not include the shaded area.



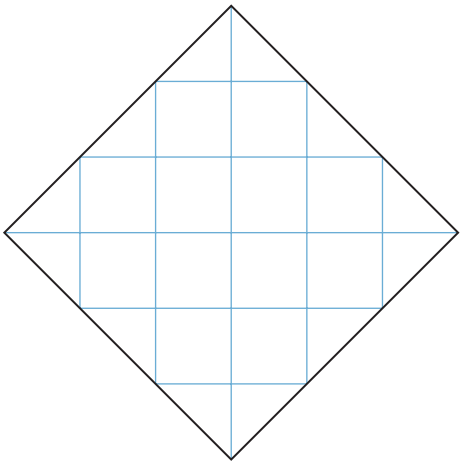
(g)



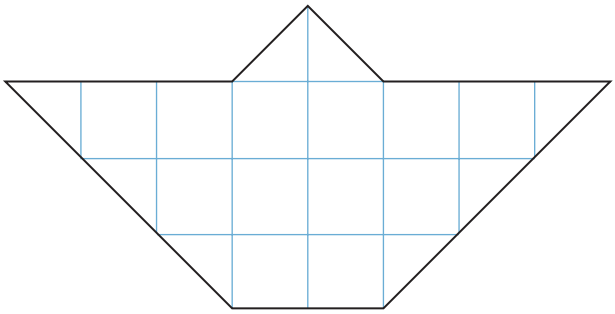
(h)



(i)



(j)

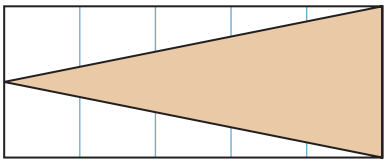


4 Choose the correct answer.
A rectangle that has three rows each of four square centimetres has an area of:

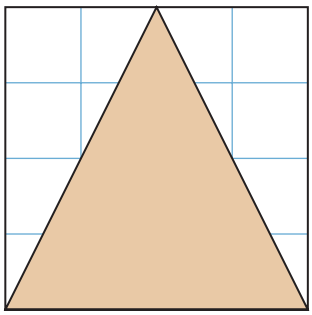
A 7 cm^2 **B** 12 cm^2 **C** 14 cm^2 D 24 cm^2

5 The following areas have been drawn on centimetre grid paper.
Find the shaded area in each case.

(a)

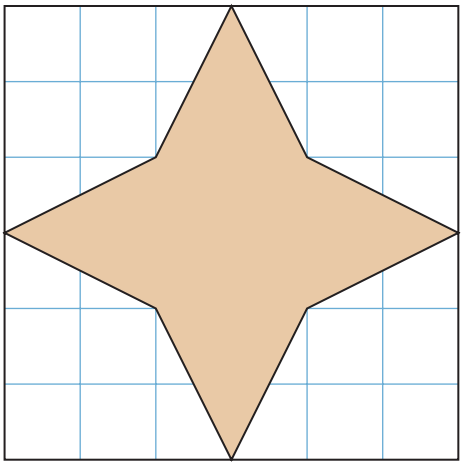


(b)

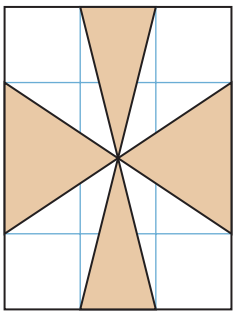


Hint

(c)



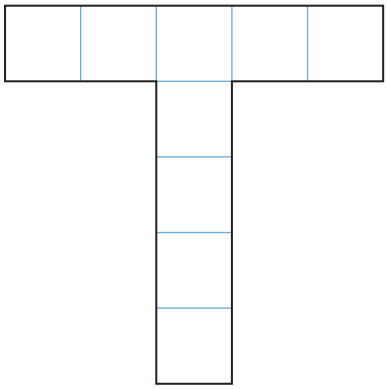
(d)



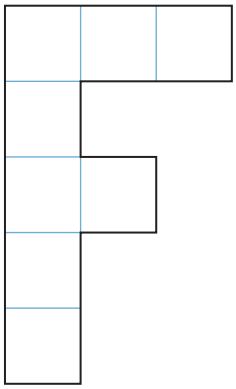
6 The following areas have been drawn on centimetre grid paper.
Find **(i)** the perimeter and **(ii)** the area of each one.

Hint

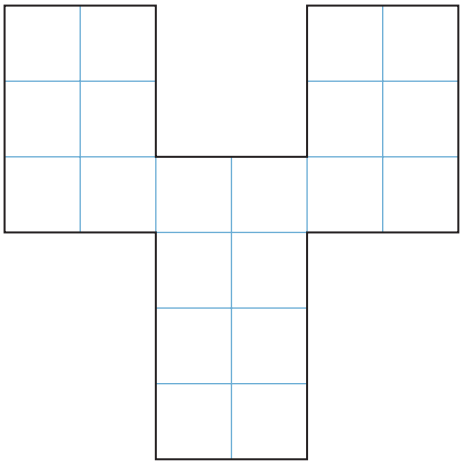
(a)



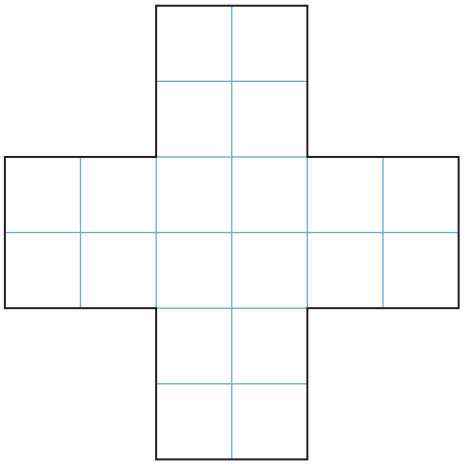
(b)



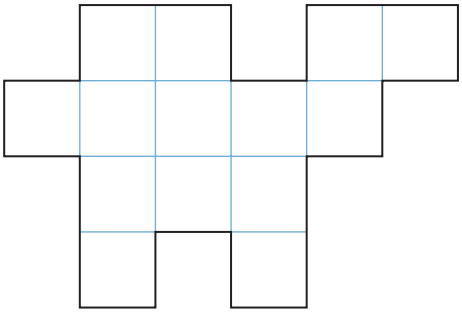
(c)



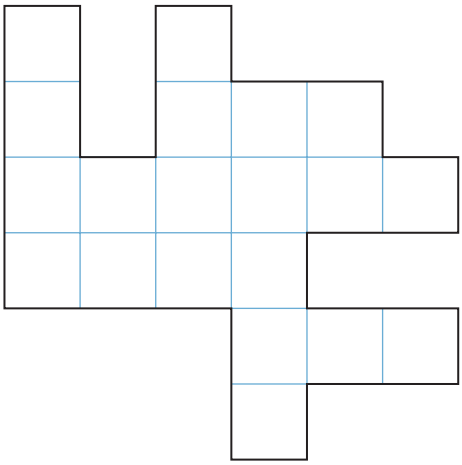
(d)



(e)



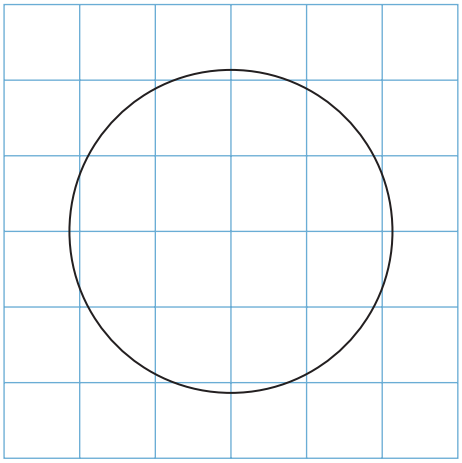
(f)



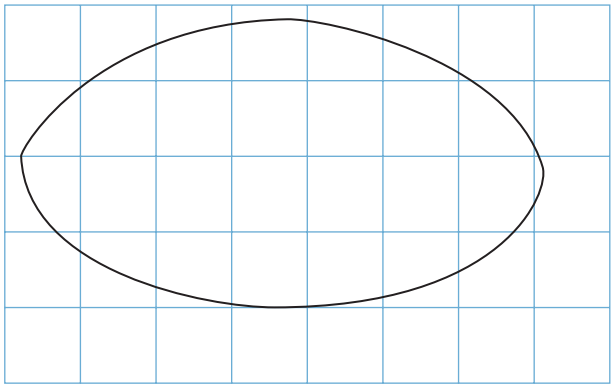
Extension

7 The following 'odd' shapes have been drawn on centimetre grid paper.
Estimate the area of each shape.

(a)



(b)



8 Estimate the area of the following, using appropriate units.

Hint

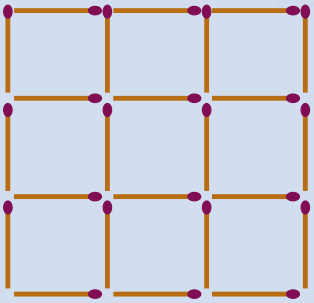
(a) your classroom floor
(b) your school grounds
(c) the suburb your school is in
(d) Australia
(e) a standard postage stamp
(f) the front cover of this textbook

eQuestions

Working mathematically

problem solving

Removing matchsticks



Starting with the arrangement of matchsticks shown, how could you:

(a) remove 4 matches to leave 5 identical squares

(b) remove 8 matches and leave 4 identical squares

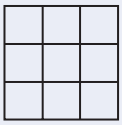
(c) remove 6 matches to leave 3 different squares?

Working mathematically

investigation

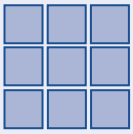
How many squares on a chessboard?

Before trying to answer this question, first consider a 3×3 square board.

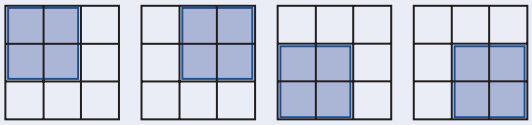


This grid contains:

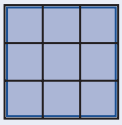
nine 1×1 squares



four 2×2 squares



and one 3×3 square



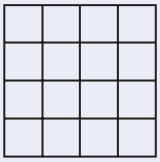
making a total of 14 squares.

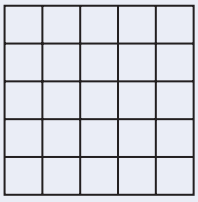
For the following questions you may like to work in pairs to make sure all squares are counted.

1 How many squares are there in each of the following grids?

(a)

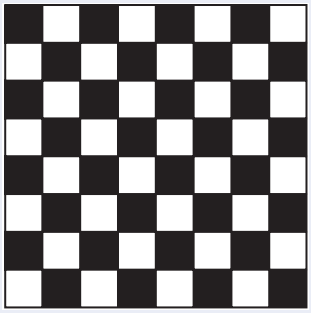
(b)

(c) 

(d) 

2 Copy and complete the following table for square grids.

Grid	*Number of squares*
1×1	
2×2	
3×3	14
4×4	
5×5	
6×6	
7×7	
8×8	



Can you determine the number of squares in a chessboard (an 8×8 grid)?

7.6 Area of a rectangle

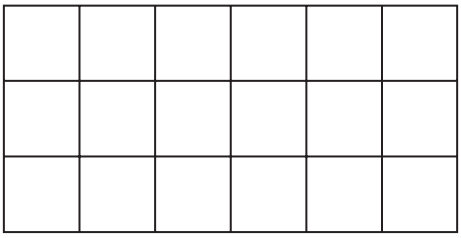
Consider a rectangle of length 6 cm and **breadth** 3 cm.

The rectangle contains 3 rows of 6 squares, so its area is equal to $3 \text{ cm} \times 6 \text{ cm} = 18 \text{ cm}^2$. We could also have calculated $6 \text{ cm} \times 3 \text{ cm} = 18 \text{ cm}^2$.

In other words, the area of a rectangle is equal to its length multiplied by its breadth. Using the pronumerals A for area, l for length and b for breadth, $A = l \times b$ or more simply,

$$A = lb$$

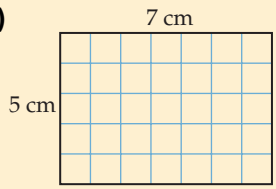
This is the *formula* for area of a rectangle.



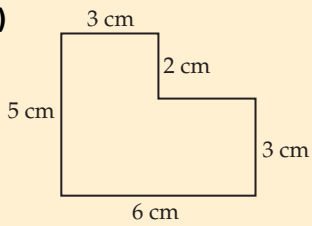
worked example 3

Find the area of each of the following shapes.

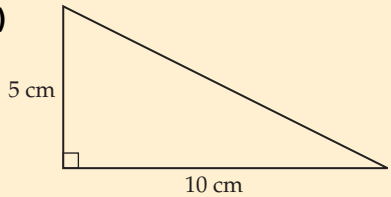
(a)

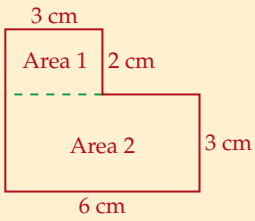
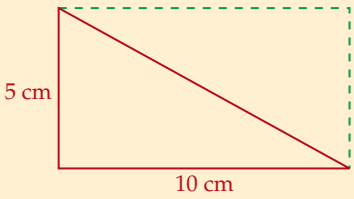


(b)

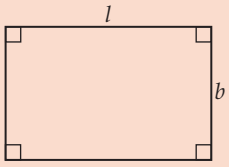


(c)



Steps	Solutions
(a) 1. Write down the formula for the area of a rectangle.	**(a)** $A = lb$
2. Substitute the value 7 for l and 5 for b.	$A = 7 \times 5$
3. Calculate the result.	$A = 35 \text{ cm}^2$
(b) 1. Divide the composite shape into rectangles. This may be done in different ways.	**(b)** 
2. Calculate the area of each part.	Area 1 = $3 \times 2 =$ 6 cm^2 Area 2 = $6 \times 3 =$ 18 cm^2
3. Add the areas.	Total area = 24 cm^2
(c) 1. Imagine a rectangle containing the triangle.	**(c)** 
2. Calculate the area of this rectangle.	$A = lb$ $A = 5 \times 10$ $A = 50 \text{ cm}^2$
3. Halve to get the area of the triangle.	$A = 50 \div 2$ Area required = 25 cm^2

Area of a rectangle:
$A = lb$



eTutorial

exercise 7.6 Area of a rectangle

Preparation: Prep Zone Q1 and 5, Exs 7.4 and 7.5

Core

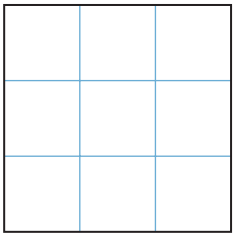
1 Calculate the areas of the following rectangles drawn on centimetre grids.

(a)

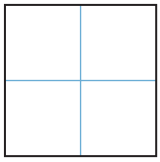
(b)

Hint

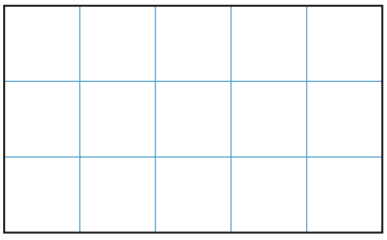
(c)



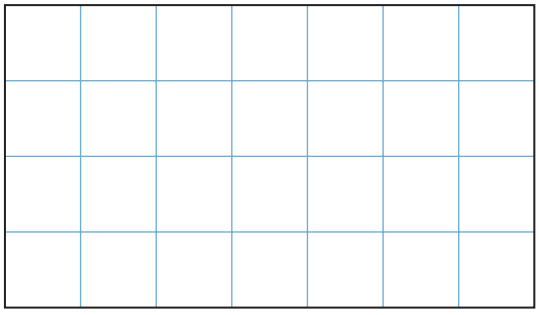
(d)



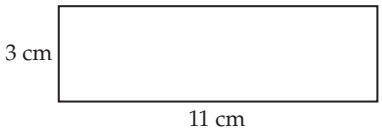
(e)



(f)



2 Choose the correct answer.
The area of the following rectangle is:



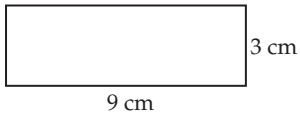
A 14 cm^2 **B** 28 cm^2
C 33 cm^2 **D** 66 cm^2

3 Find the areas of the following rectangles.

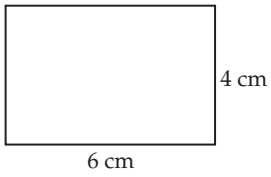
Hint

Worksheet C7.3

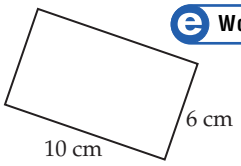
(a)



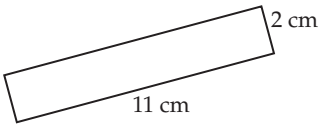
(b)



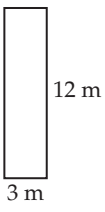
(c)



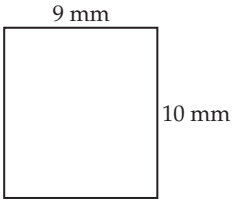
(d)



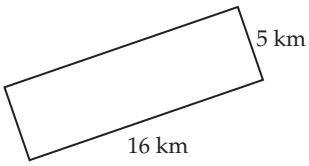
(e)



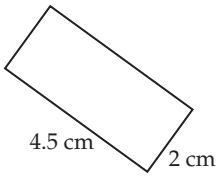
(f)



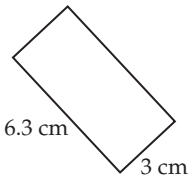
(g)



(h)



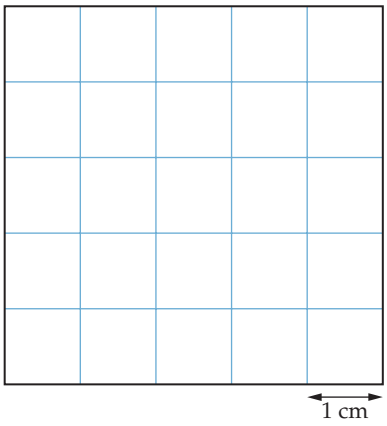
(i)



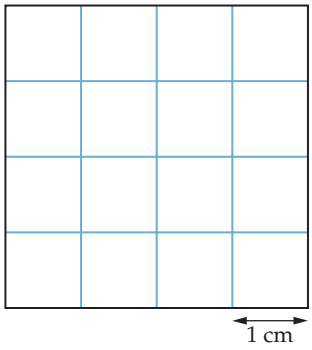
4 Since the breadth of a square is the same as its length, the formula for the area of a square is $A = l \times l$ or simply $A = l^2$. Use this formula to find the area of each of the following squares.

Hint

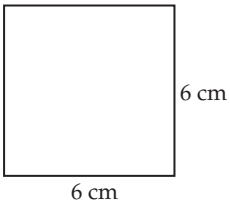
(a)



(b)



(c)



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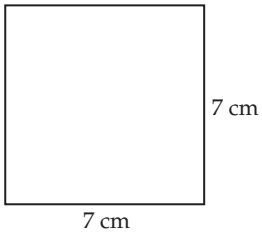

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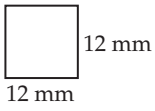

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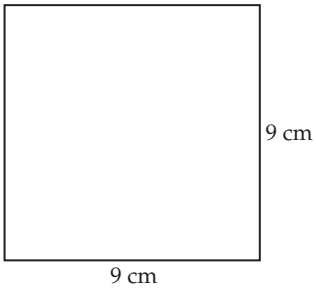
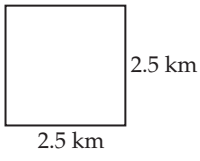


(g)



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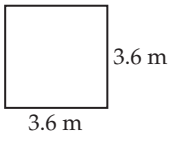
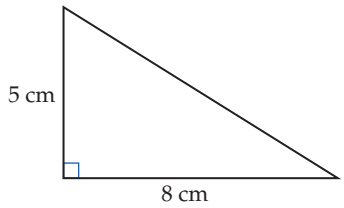


5 Find the area of each of the following triangles by first considering a rectangle.

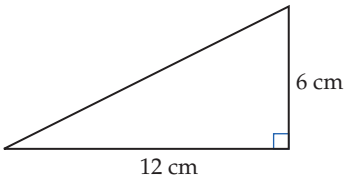
Worksheet C7.4

Hint

(a)



(b)



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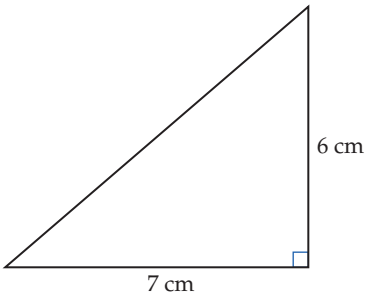

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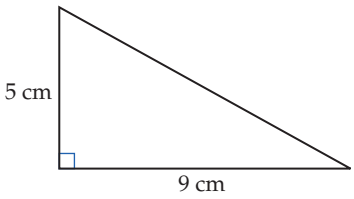

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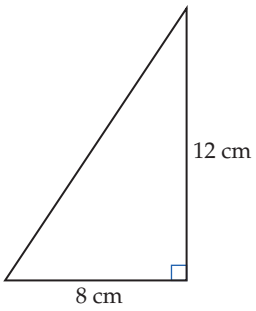

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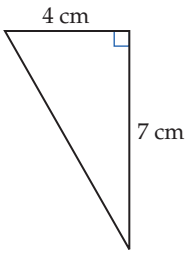
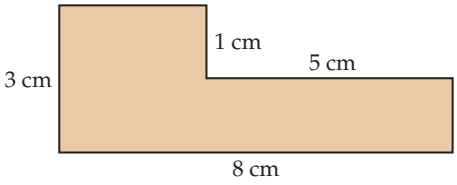


6 Determine the area of each shaded region. All angles are right angles.

Worksheet C7.5

Hint

(a)



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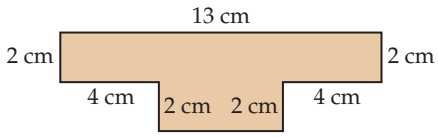

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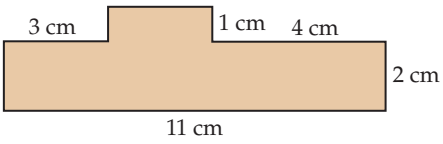

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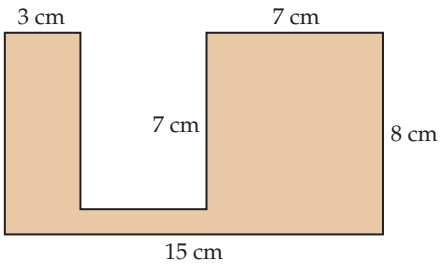

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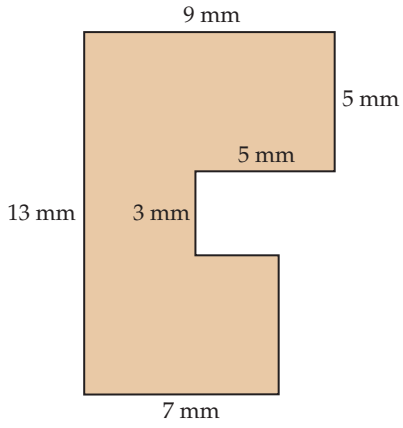

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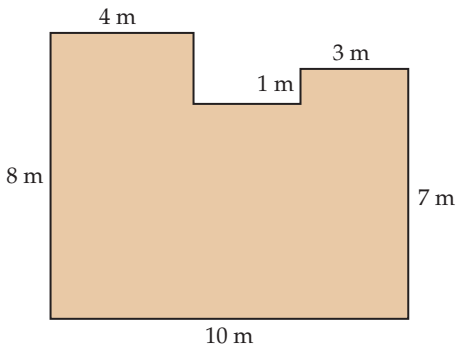

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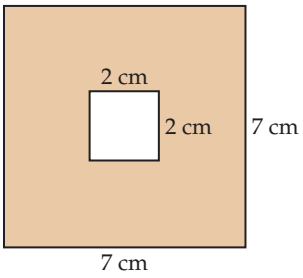

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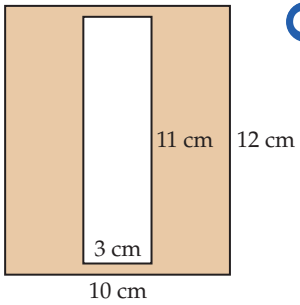
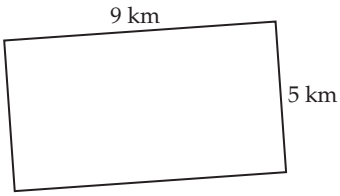


Worksheet C7.6

7 Find **(i)** the perimeter and **(ii)** the area of each shape below. All angles are right angles.

(a)



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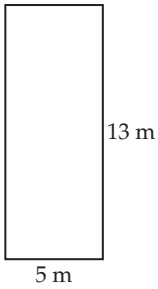

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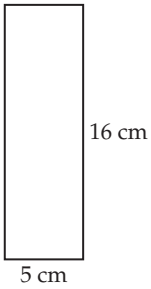

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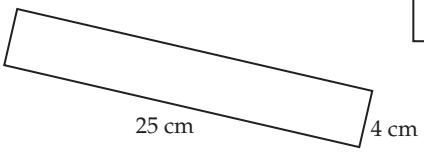

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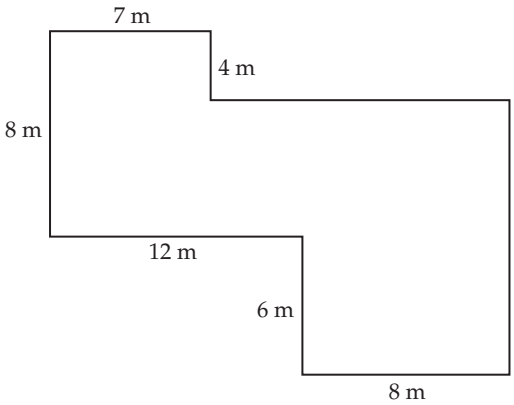

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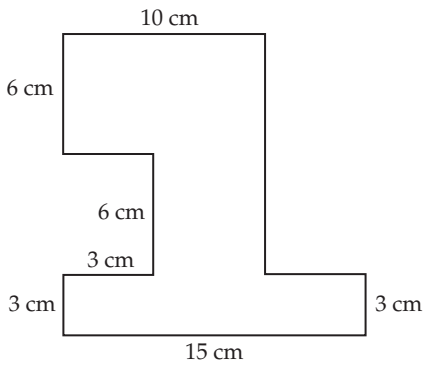


8 Find the area of a rectangle of length 32 cm and breadth 9 cm.

Hint

9 Find the area in km^2 of a rectangle of length 3 km and breadth 800 m.

10 What is the area in cm^2 of a rectangle of length 450 mm and breadth 70 cm?

11 Find the perimeter and area of a square whose sides measure 5.6 cm.

12 **(a)** Write down the possible dimensions of a rectangle with an area of 24 cm^2.

(b) Do all rectangles with an area of 24 cm^2 have the same perimeter? Explain.

13 Find the breadth of a rectangle with length 7 cm and area 28 cm^2.

14 Find the length of a rectangle with breadth 2.6 m and area 13.52 m^2.

Extension

15 Olga wishes to cover a table-top that is 2.4 m long and 1.2 m wide with laminex.

Hint

(a) Find the area of laminex she will require, in cm^2.

(b) What length strip does she need to purchase to go around the sides of the table-top?

16 Tricia has obtained a quote of $21 per square metre for her driveway to be re-surfaced. If her driveway is rectangular and measures 12 m long and 3.2 m wide, what will the job cost her at the rate quoted?

17 Guy wishes to grass a rectangular section of his yard which is 8.5 m long and 6.9 m wide.

(a) How many grams of seed will he need to use if the recommended seed coverage is 60 grams per square metre?

(b) What length of wood would Guy need to purchase to create a timber surround for the section?

18 Terry is having a doorway put in one of the walls in his house.

Hint

(a) If the wall is 5 m long and 2.4 m high and the doorway measures 2 m by 0.82 m, what area of wall will remain after the doorway is completed?

(b) The architraves go along the sides and top of the doorway. What length of architraves is needed?

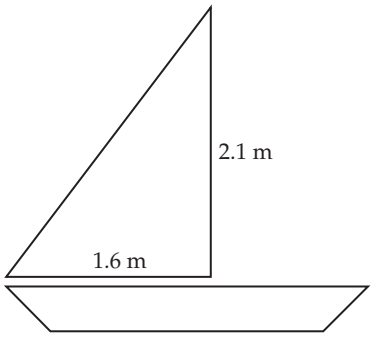
19 A builder wishes to estimate the number of bricks required to build a wall 4.2 m wide and 2.6 m high. If 1 square metre of brick wall contains 48 bricks, how many are needed?

20 **(a)** What is the perimeter of a rectangle of area 20 cm^2 and breadth 2 cm?

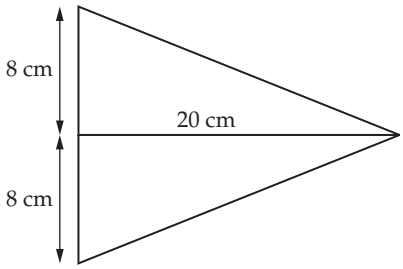
(b) Is this perimeter the same as for a rectangle of the same area but with a breadth of 4 cm?

21 Find the area of the triangular sail shown.

Hint



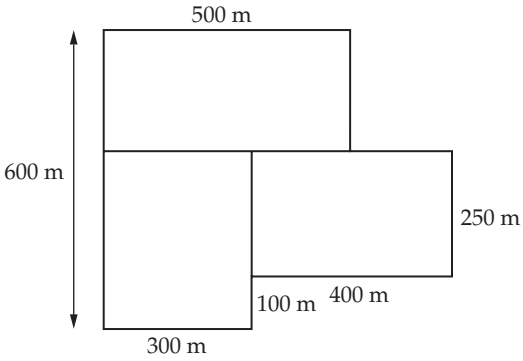
22 Find the wing area of the paper plane.



23 **(a)** Find the area of the farm using the plan provided.

(b) What length of fencing is needed to go around the outside of the property?

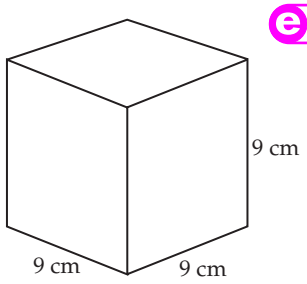
Hint



24 Kasia wants to cover both sides of a poster with clear contact adhesive. If the poster measures 63 cm by 87 cm, what area of covering will she need if she wishes to overlap the poster by 5 cm all around?

25 How many square centimetres of cardboard are needed to construct a cube of edge length 9 cm?

Animation



Worksheet C7.7

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eQuestions

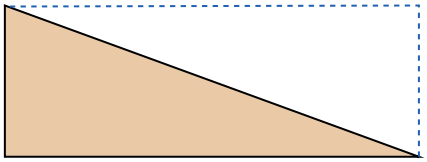
Worksheet T7.1

Worksheet A7.3

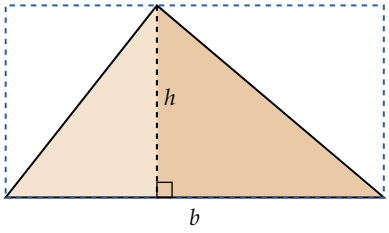
Worksheet A7.4

7.7 Area of a triangle

We have seen that the area of a right-angled triangle is equal to half the area of a rectangle.



The area of *any* triangle can be shown to be equal to half the area of a rectangle of the same **base** length and **height**.
The area of the rectangle shown is $b \times h$ or bh (b = base length, h = height), so the area of the triangle is given by:



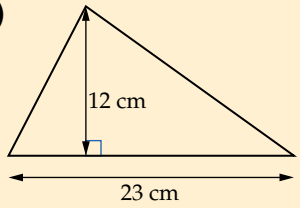
$$A = \frac{1}{2}bh$$

Note also that the height measurement is perpendicular, i.e. at 90° to the base measurement. It represents the biggest possible vertical measurement between the top of the triangle and the base, or its extension.

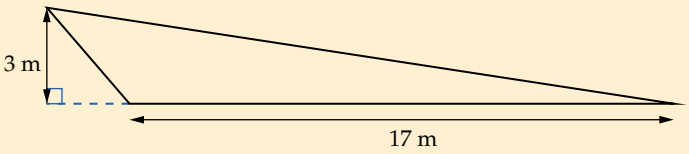
worked example 4

Find the area of the following triangles.

(a)



(b)



Steps

(a) 1. Write down the formula for area of a triangle.
2. Substitute in the values $b = 23$ and $h = 12$.
3. Evaluate.

(b) 1. Write down the formula.
2. Substitute in the values 17 for b and 3 for h.
3. Evaluate.

Solutions

(a) $A = \frac{1}{2}bh$
$A = \frac{1}{2} \times 23 \times 12$
$A = 138 \text{ cm}^2$

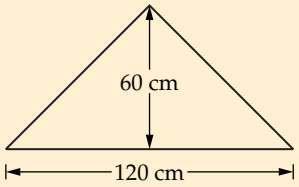
(b) $A = \frac{1}{2}bh$
$A = \frac{1}{2} \times 17 \times 3$
$A = 25.5 \text{ m}^2$

dangerzone

When calculating area, you may be asked to give your answer in units different from the ones given in the question or there may be mixed units in the question. In both cases, you need to convert your original values to the required units first, then calculate the area using the appropriate formula.

worked example 5

Find the area of the following triangle in m^2.



Steps	Solution
1. Write down the formula for area of a triangle.	$A = \frac{1}{2}bh$
2. Convert b and h values into metres.	$b = 1.2$ m $h = 0.6$ m
3. Substitute $b = 1.2$ and $h = 0.6$ into the formula.	$A = \frac{1}{2} \times 1.2 \times 0.6$
4. Evaluate.	$A = 0.36$ m^2

eTutorial

exercise 7.7 Area of a triangle

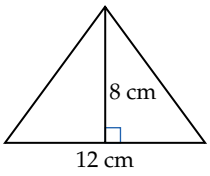
Preparation: Prep Zone Q1 and 5, Exs 7.5 and 7.6

Core

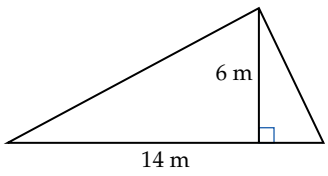
1 Calculate the area of each triangle below.

Hint

(a)



(b)



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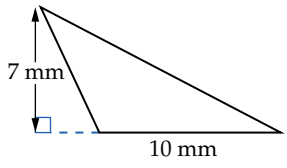

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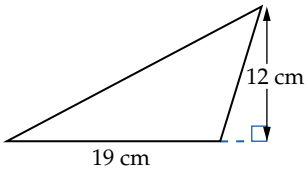

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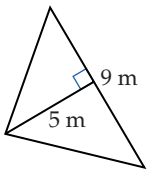

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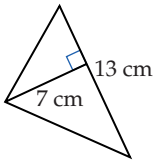

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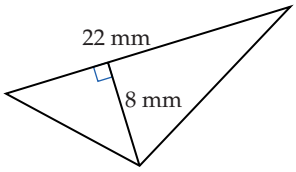

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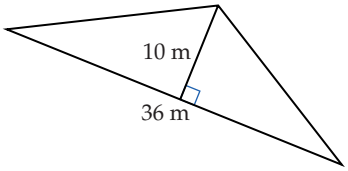
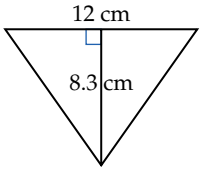


(i)



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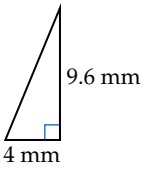
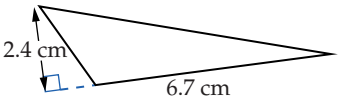
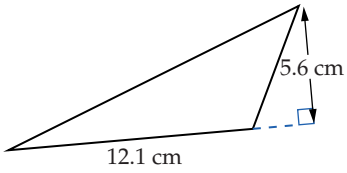


(k)



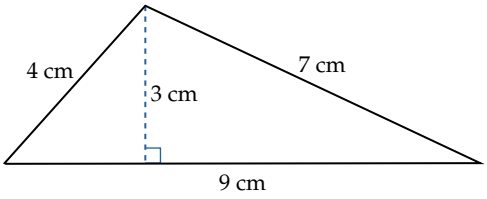
(l)



2 Choose the correct answer.

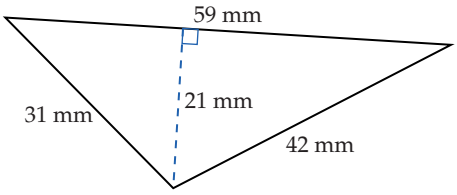
(a) In the diagram, the height of the triangle is:

A 3 cm
B 4 cm
C 7 cm
D 9 cm



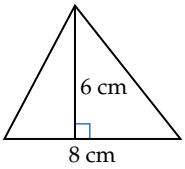
(b) The base length of the triangle is:

A 21 mm
B 31 mm
C 42 mm
D 59 mm



(c) The area of the triangle shown is:

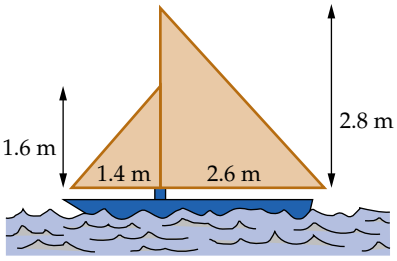
A 14 cm^2
B 24 cm^2
C 28 cm^2
D 48 cm^2



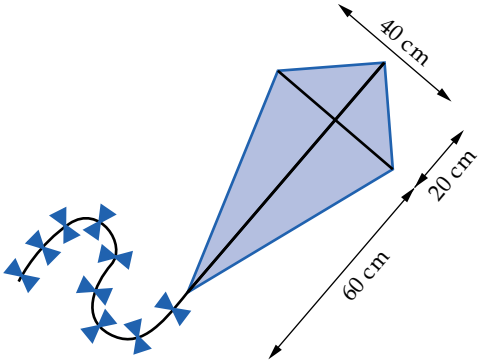
3 A triangle has an area of 36 cm^2. Give two possible combinations for the triangle's base length and height.

4 Find the total sail area for this yacht.

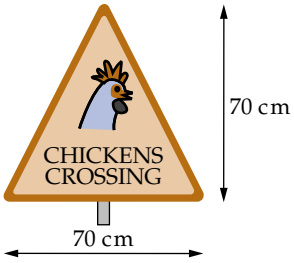
Hint



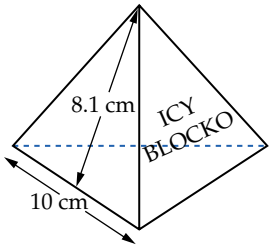
5 Find the area of paper required to build the kite shown. Give your answer in m^2.



6 Find the area of sheet metal required for this road sign in m^2.

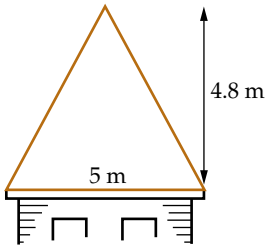


7 Find the total area of the four equal faces of the container of frozen drink (a Tetrapak) shown.



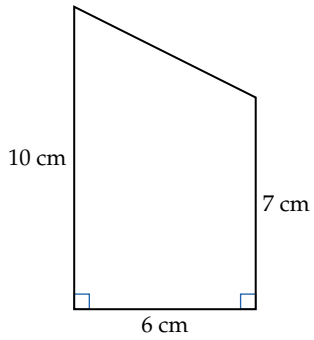
8 The label on a tin of paint claims the contents will coat 4 square metres. How many tins would be needed to paint the triangular gable pictured?

Hint



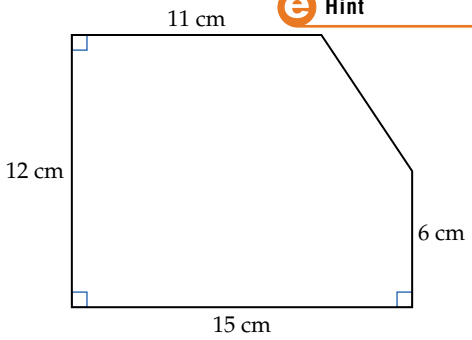
9 Find the area of each of the following composite shapes.

(a)

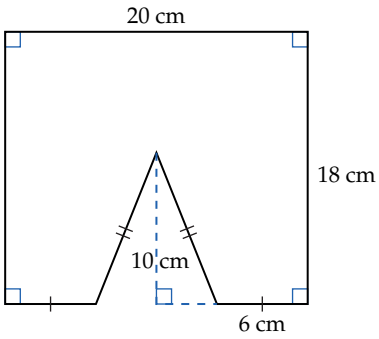


(b)

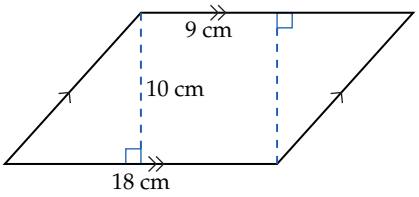
Hint



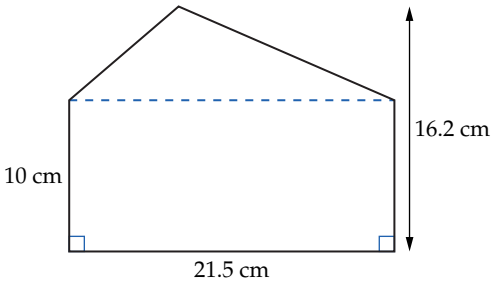
(c)



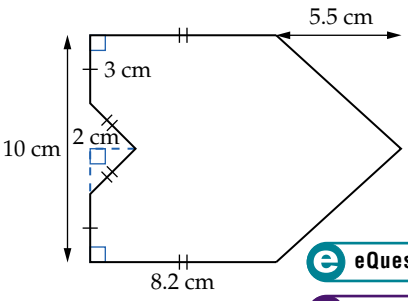
(d)



(e)



(f)



eQuestions

Homework 7.2

speedingzone

Do these in your head as quickly as you can and write down the answers.

Time target: 2 minutes

1 80×12

2 $0.96 + 0.08$

3 $-6400 \div 8$

4 $\sqrt{8100} - 7^2$

5 $132 - 200$

6 $\frac{1}{4}$ of \$10.00

7 \$2.50 plus 78 cents

8 What is the second largest factor of 64?

9 Take 19 from the product of 12 and 8.

10 What time is it three and a quarter hours after 11.35 a.m.?

Print finisher: Vicki Standing

Company: Canberra Press
Qualifications/Experience: five years as bindery assistant; three years of trade school; four-year apprenticeship
Related occupations: binder, printer, typesetter

In my job, my duties include understanding what a book or publication is supposed to look like and the setting up of machinery for such tasks as cutting paper with a guillotine, folding, collating and binding books—basically everything that happens after something has been printed. I'm responsible for the quality of the work, and time deadlines, and for directing the machine assistants. I chose this job after previous careers as a book-keeper and a bank employee because I was looking for an interesting challenge at work with the chance of future opportunities.

My favourite part of mathematics at school was achieving the correct answer when doing algebra. Maths was very important in my earlier careers and is also important in my current one. I use maths for tasks like ensuring the right amount of material is used, estimating how long different parts of production take, maximising the number of pages to be cut from a large sheet, and calculating pay rates and overtime loading at the end of a pay week.

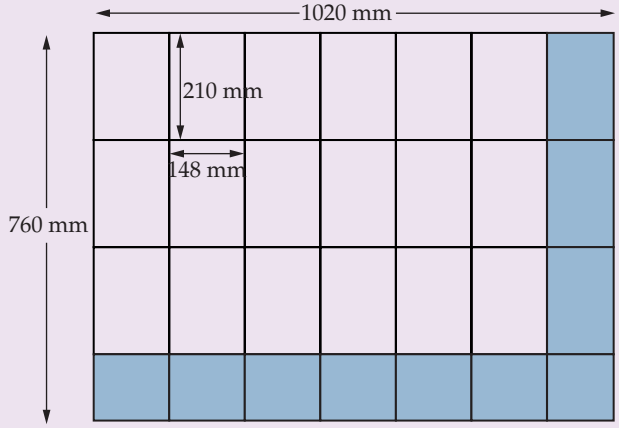
The print finisher's problem

Printers buy sheets of paper in large standard sizes. One of the most common standard sizes is 760 mm × 1020 mm. Vicki has to work out which way to cut these sheets so that she gets the maximum number of A5 sheets. A5 sheets are 210 mm × 148 mm. To do this, she does the following calculations:

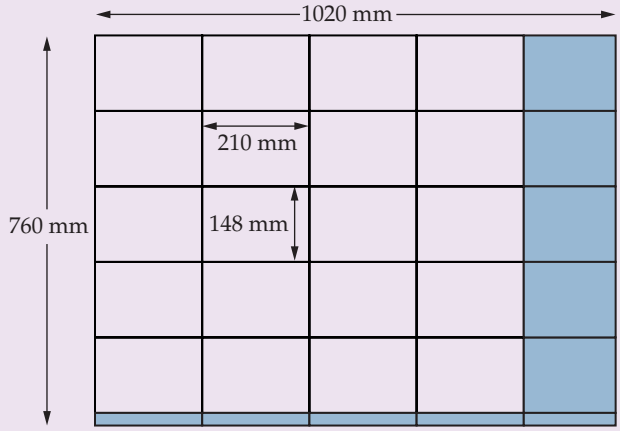
	760 × *1020*		
210 × 148	760 ÷ 210 = 3.6	1020 ÷ 148 = 6.9	3 × 6 = 18
148 × 210	760 ÷ 148 = 5.1	1020 ÷ 210 = 4.9	5 × 4 = 20

This table shows that cutting the A5 sheets out of the large sheets vertically gives 18 A5 sheets per large sheet, while cutting them horizontally gives 20 A5 sheets per large sheet. This means that the better way to cut is horizontally.

The following guillotine diagram shows the A5 sheets being cut vertically. The shaded parts represent the excess paper and are called offcuts.



This guillotine diagram shows the A5 sheets being cut horizontally.



1 What does the number after the decimal point in the table tell us?

2 Why do we round 6.8 to 6 and not 7 for this sort of problem?

3 Vicki has to cut A4 (210 mm × 297 mm) sheets from a standard large sheet (760 mm × 1020 mm). Draw a table and two guillotine diagrams to find out the maximum number of A4 sheets that can be cut out.

4 If Vicki needs 4000 A4 sheets, how many large sheets will she need to cut to get this many?

5 Vicki has worked out a way of cutting eight sheets of size 370 mm × 250 mm from one standard large sheet of paper of size 760 mm × 1020 mm. Can you work out how she did it? Draw a guillotine diagram to help you.

languagezone

Summary

Copy and complete the following summary of this chapter using the words and phrases from the list. A word or phrase may be used more than once.

1 _____ is the distance around the outside of a shape.

2 To calculate the _____ of a rectangle, you multiply the _____ by the breadth.

3 There are 1000 millimetres in a _____.

4 There are 100 000 _____ in a kilometre.

5 The area of a rectangle that measures 3 m by 2 m is 6 _____.

6 The area of a triangle is half the _____ times the _____.

7 10 000 square metres is equivalent to one _____.

Key words

area
base
breadth
centimetres
hectare
height
kilometre
length
measurement
metre
metric
millimetre
perimeter
square metres

Questions

1 Write the units of length from the above key words in order from largest to smallest.

2 Write in words what is meant by cm^2, m^2 and km^2.

3 There are 100 centimetres in a metre. Find two other words that start with 'cent' and write their meanings.

4 Describe a real-life situation where it is necessary to calculate a perimeter.

5 Describe a real-life situation where it is necessary to calculate an area.

6 Make at least five words of at least three letters from the letters in the grid. All words must include the middle letter. Can you find the word that uses all nine letters?

T	E	R
P	E	I
M	E	R

7 The word 'length' is a noun. Write a verb and an adjective that come from the word 'length'.

Worksheet L7.1

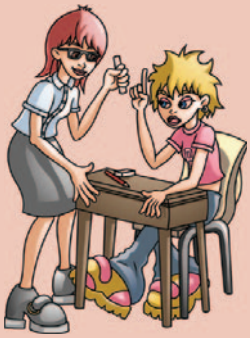
Worksheet L7.2

chapter 7 REVIEW

FAQs

I can't remember when to divide and when to multiply when converting units. Is there an easy way to remember this?

Just think logically about it. When converting from centimetres to metres, for example, think that because metres are bigger than centimetres we need less of them. So this means you will need to divide. To go from kilometres to millimetres you need to multiply because you need more millimetres, because they are smaller.



Core

1 Choose the correct answer in each case. **7.1**

(a) The length of a paper clip is approximately:
A 3 mm **B** 3 cm **C** 0.3 m **D** 300 mm

(b) The height of an average house ceiling is roughly:
A 260 mm **B** 0.26 km **C** 0.026 km **D** 2.6 m

2 Copy and complete the following length conversions. **7.2**

(a) 45.9 km = ____ m **(b)** 58 000 cm = ____ km
(c) 9.2 m = ____ mm **(d)** 42 m = ____ cm
(e) 980 m = ____ km **(f)** 0.006 73 km = ____ mm
(g) 564.7 cm = ____ m **(h)** 8.52 cm = ____ m
(i) 609 mm = ____ cm **(j)** 6700 m = ____ km

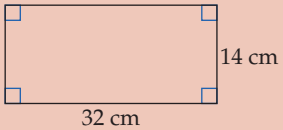
3 Add the following lengths, giving your answer in the units stated in brackets. **7.3**

(a) 13.5 cm and 540 mm (cm) **(b)** 340 m and 2.7 km (m)
(c) 450 000 cm and 0.62 km (km) **(d)** 2.78 cm and 30 mm (mm)

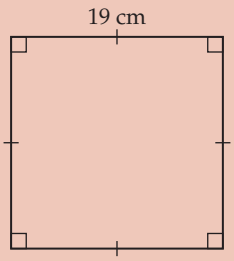
4 Graeme decides to start jogging each day and begins one day by jogging 1 km. If he increases the distance he jogs by 600 m each day, how far will he have jogged altogether after 4 days? **7.3**

5 Find the perimeter of each of the following shapes. **7.4**

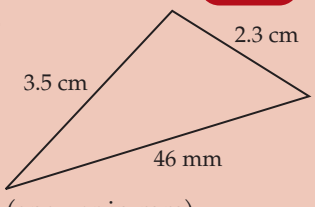
(a)



(b)

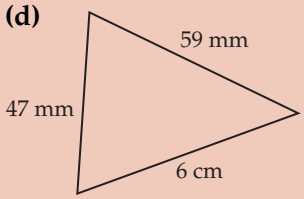


(c)



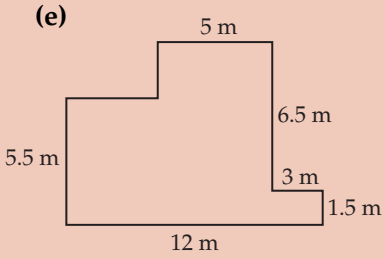
(answer in mm)

(d)

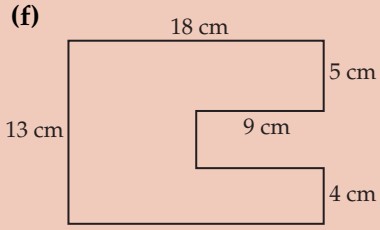


(answer in cm)

(e)



(f)



6 Find the perimeter of a squash court 9.75 m long and 6.4 m wide. **7.4**

7 Copy and complete the following area conversions. **7.5**

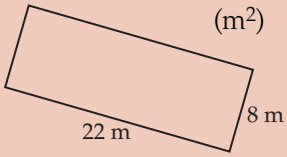
(a) 4.2 cm^2 = ____ mm^2 **(b)** 20 000 m^2 = ____ ha

(c) 682 500 cm^2 = ____ m^2 **(d)** 528 ha = ____ km^2

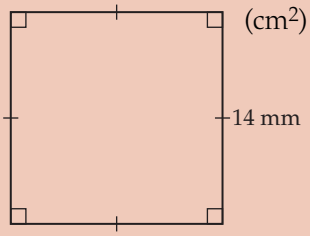
(e) 80.7 ha = ____ m^2 **(f)** 0.009 m^2 = ____ cm^2

8 Find the area of each figure below in the units indicated in brackets. **7.6**

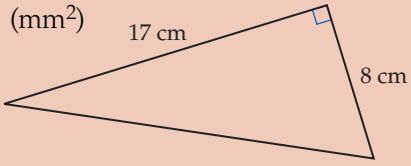
(a) (m^2)



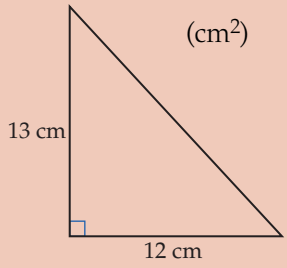
(b) (cm^2)



(c) (mm^2)

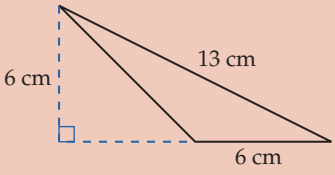


(d) (cm^2)

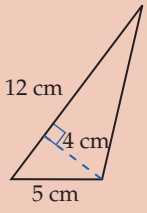


9 Find the area of the following triangles. **7.7**

(a)



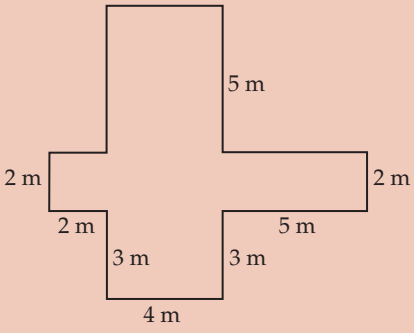
(b)



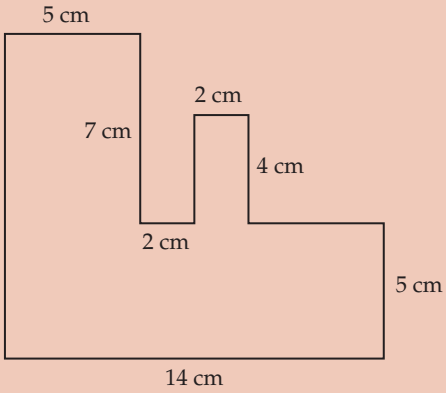
Extension

10 Find the area of each figure. 7.6

(a)



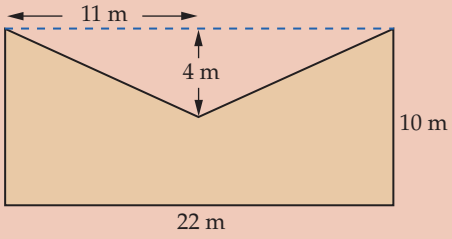
(b)



11 What is the area of a rectangle with a perimeter of 32 cm and a length of 10 cm? 7.6

12 What is the perimeter of a square with an area of 25 cm^2? 7.6

13 Below is a map of the available floor space (shaded) in an unoccupied car show-room. Calculate the area available for a display. 7.7



REPLAY

1 Copy and complete the following magic squares. 1.3

(a)

		5
	11	
17		13

(b)

		10
		3
4		8

2 Round these numbers off to the first digit. 1.5

(a) 29 **(b)** 7390 **(c)** 5

3 Arrange the following sets of numbers in order from smallest to largest. 2.2

(a) 0, -8, 10, -15, -2 **(b)** 102, -56, -156, 110, 78

(c) -63, -38, -78, 21, 0

4 Evaluate the following: 2.8

(a) $3 + (9 - 7) \times (-2)$ **(b)** $5 \times (-4) \div (-1 + 3)$

(c) $24 \div (-6 + 10) \times (-1)$

5 Which of these numbers are divisible by 6? 3.2

2356, 876, 444, 6783, 900 006, 50 784

6 List all the factors of the following numbers. 3.3

(a) 25 **(b)** 101 **(c)** 42 **(d)** 70

7 Copy these patterns and fill in the missing numbers. 4.1

(a) -10, -6, -2, ___, ___, ___ **(b)** 1, ___, 9, 16, ___, ___

8 Look at the following tables and use the pronumerals given in each case to write the rule out as a formula. 4.3

(a)

x	y
14	7
-16	-8
20	10
402	201
-10	-5
0	0

(b)

a	b
-10	2
100	112
3	15
-6	6
-50	-38
0	12

(c)

m	n
5	9
20	39
-100	-201
0	-1
50	99
-30	-61

9 Draw angles of the following sizes. 5.3

(a) 270° **(b)** 32° **(c)** 108° **(d)** 320°

10 Which one of the following is a pair of supplementary angles? 5.5

A 0° and 90° **B** 40° and 140°

C 50° and 150° **D** 300° and 60°

11 Calculate: 6.4

(a) 4.67 + 8.8 **(b)** 8.93 + 0.006 35 **(c)** 19.87 + 21.075

12 Calculate: 6.10, 6.11

(a) 1.86 ÷ 600 **(b)** 0.42 ÷ 1000 **(c)** 10.605 ÷ 0.005

Assignment 7