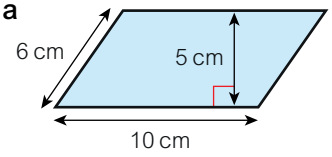
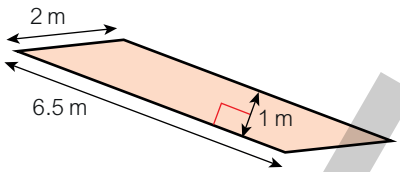
4.1 Master
Area of triangles, parallelograms and trapezia

1 Work out the area of each parallelogram.

a



b



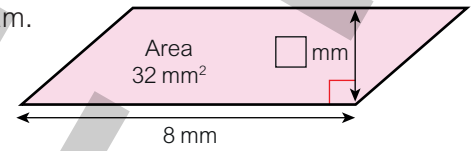
Area of a parallelogram = base length × perpendicular height
= $b \times h$
= bh
The perpendicular height is the height measured at right angles to the base.

Guided

Area of a parallelogram = bh

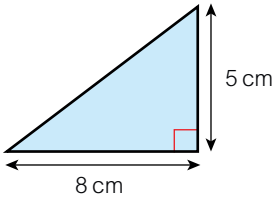
= 10 × 5 = ...

2 Work out the missing measurement for this parallelogram.

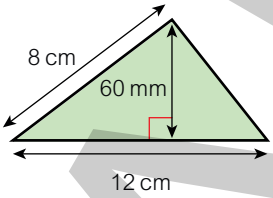


3 Work out the area of each triangle.

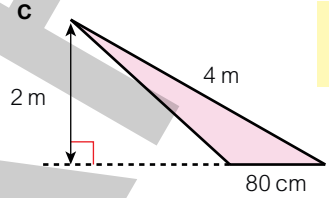
a



b



c



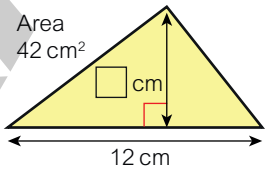
Area of a triangle = $\frac{1}{2}bh$

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

= $\frac{1}{2}$ × ..... × ..... = ...

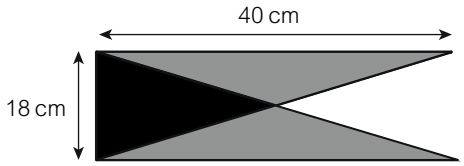
Make sure all the lengths for each shape are in the same units.

4 Work out the missing measurement for this triangle.



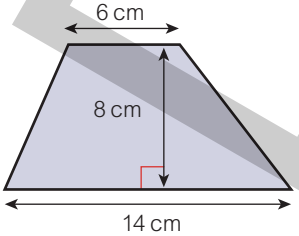
Substitute the values you know into the formula for area, then solve the equation.

5 **Problem-solving** Sachita makes a flag from black and grey cloth. The three triangles are isosceles. Work out the total area of cloth Sachita needs.

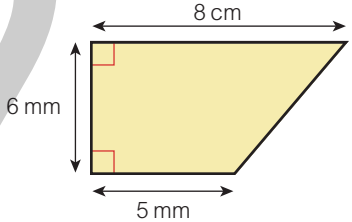


6 Work out the area of each trapezium.

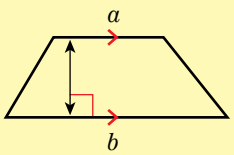
a



b



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



Check

Tick each box as your **confidence** in this topic improves.

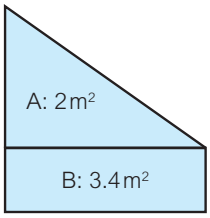
☹ 😐 ☺

Need extra help? Go to page 37 and tick the boxes next to Q1, 2 and 4. Then try them once you've finished 4.1–4.8.

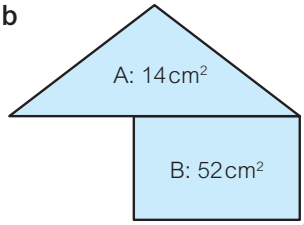
Area of compound shapes

1 Calculate the total area of each shape.

a

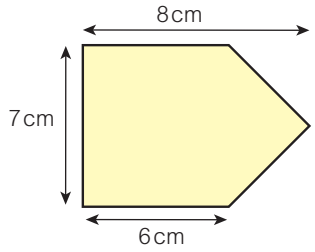


b

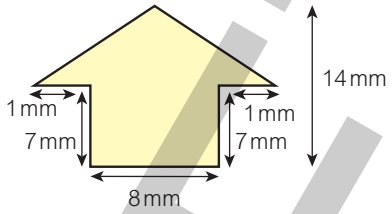


2 Calculate the area of each shape.

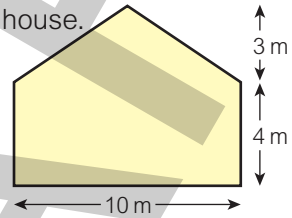
a



b



3 **Real** Kasia wants someone to paint the side of her house. It looks like this.



Split the wall into a rectangle and a triangle.

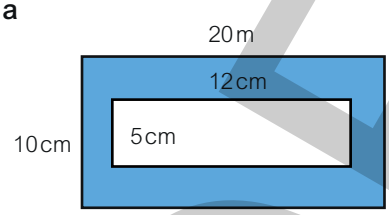
a What is the area of the side of her house? Give your answer in square metres.

Danilo charges $4.50 per square metre for painting.

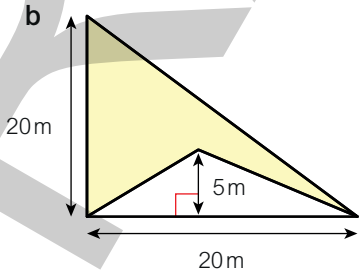
b How much will Danilo charge for painting the side of the house?

4 **Problem-solving** Work out the shaded area of each shape.

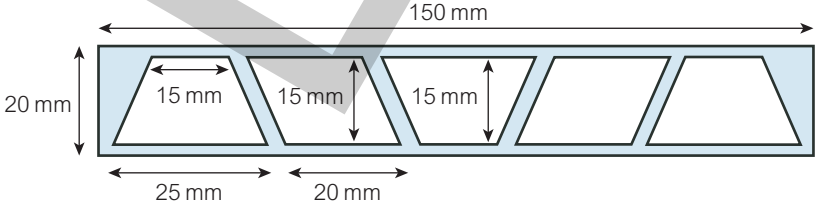
a



b



5 **Real / Problem-solving** Three congruent trapeziums and two congruent parallelograms are pressed out of a metal strip. What area of the metal strip is unused?



Check

Tick each box as your **confidence** in this topic improves.

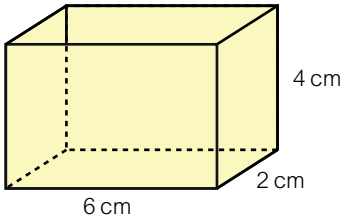
☹ 😐 ☺

Need extra help? Go to page 37 and tick the box next to Q3. Then try it once you've finished 4.1–4.8.

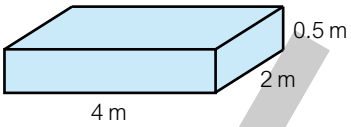
Properties of 3D solids

1 Sketch a **net** for each cuboid.

a

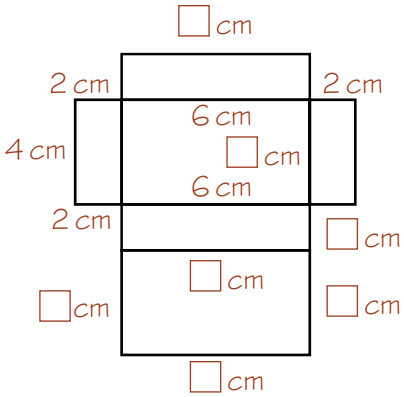


b



A **net** is a 2D shape that folds to make a 3D solid.

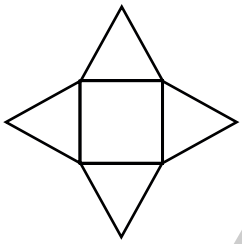
Guided



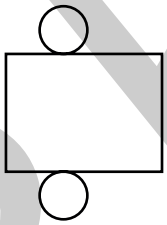
For a sketch you should use a ruler and a pencil, but you don't need to measure the lengths accurately.

2 Look at these nets.

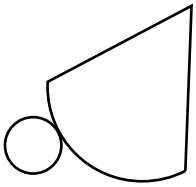
A



B

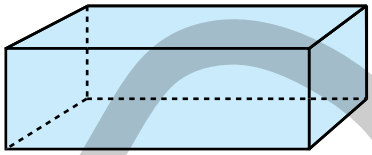


C



Which one folds to make **a** a cone ..... **b** a square-based pyramid ..... **c** a cylinder? .....

3 Write down the number of **faces**, **edges** and **vertices** in this cuboid.

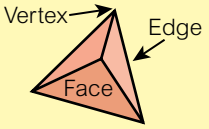


faces .....

edges .....

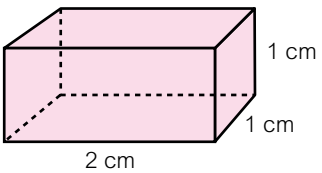
vertices .....

3D solids have **faces** (flat surfaces), **edges** (where two faces meet) and **vertices** (corners). A single corner is called a **vertex**.



4 **Problem-solving** Look at this cuboid.
You can cut a cuboid into two equal parts.
Sketch the new 3D solids you would make if you cut it

a horizontally **b** vertically **c** diagonally.



Check

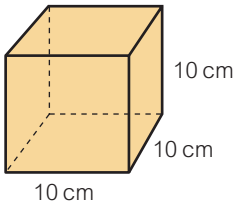
Tick each box as your **confidence** in this topic improves.

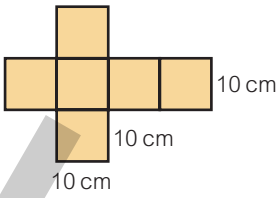
☹ 😐 ☺

Need extra help? Go to page 37 and tick the box next to Q5. Then try it once you've finished 4.1–4.8.

Surface area

1 The diagrams show a cube and its net. Work out the surface area of the cube.

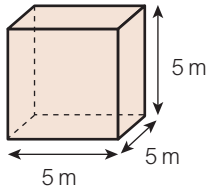




The surface area of a 3D shape is the total area of all its faces.

2 What is the surface area of each cube?

a

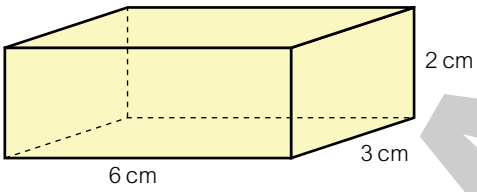


b a 2 mm by 2 mm by 2 mm cube

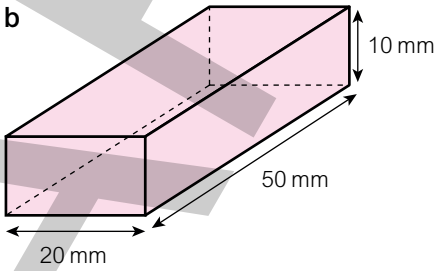
c a cube with edge length 1 cm

3 Work out the surface area of each cuboid.

a



b



Guided

Surface area

Area of top face = 6 × 3 = 18 cm²

Area of front face = 6 × ..... = ... cm²

Area of side face = ... × ..... = ... cm²

Sum of 3 faces = ... + ... + ... = ... cm²

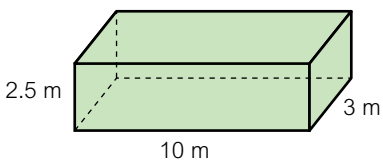
Total surface area = 2 × ..... = ... cm²

4 **Problem-solving** A cube has a surface area of 96 cm².

a What is the area of each face? .....

b What is the length of one edge? .....

5 **Real / Problem-solving** Farouq wants to paint the outside of this metal container. He cannot paint underneath the container. He has 4 cans of paint. Each can covers 20 m². Will this be enough? Explain your answer.



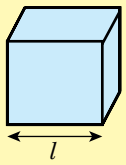
Worked example

Volume

Guided

1 A cube has a side length of 5 cm. What is the **volume** of the cube?

Volume of a cube = side length (l) cubed = $l^3 = 5^3 =$ ..... cm^3



2 Problem-solving A cube has a surface area of 96 cm^2.

a What is the area of one face? .....

b What is the length of one side? .....

c What is the volume of the cube? .....

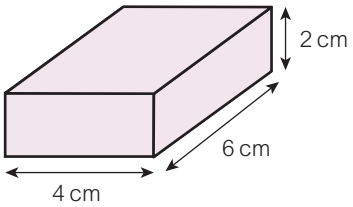
Strategy hint

Sketch a cube.

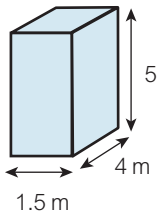
The **volume** of a solid shape is the amount of 3D space it takes up. The units of volume are cubic units (e.g. mm^3, cm^3, m^3).

3 Calculate the volume of each cuboid.

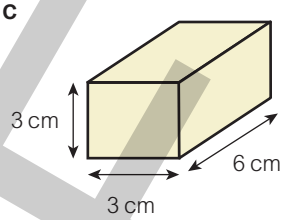
a



b



c



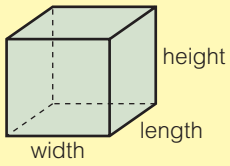
Guided

Volume = lwh

= 6 × 4 × 2

= ..... cm^3

Volume of a cuboid
= length × width × height
= $l \times w \times h$
= lwh

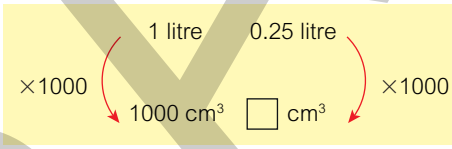


4 Complete these conversions.

a 0.25 litres = ... cm^3

b 5 cm^3 = ... ml

c ..... litres = 5125 cm^3



The capacity of a container is how much it can hold. The units of capacity are cm^3, millilitres (ml) and litres (l).
- 1 millilitre (ml) = 1 cm^3
- 1 litre (l) = 1000 cm^3

5 Real / Reasoning For a drive through Spain in the summer, Greg buys a car-fridge with internal measurements 25 cm by 20 cm by 30 cm.

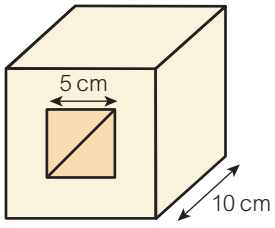
a Work out the capacity in cm^3. .....

b Work out the capacity in litres. .....

Greg estimates that he will be able to fit seven 2-litre bottles of water in the fridge.

c Explain why he might be wrong.

6 Problem-solving A 10 cm by 10 cm by 10 cm cube has a 5 cm by 5 cm square hole cut right through it. What is the volume of the remaining solid?



What is the volume of the piece cut out of the cube?

Check

Tick each box as your **confidence** in this topic improves.

☹ 😐 ☺

Need extra help? Go to page 38 and tick the box next to Q7. Then try it once you've finished 4.1–4.8.

STEM: Measures of area and volume

1 Which unit of area would be sensible for measuring

a the area of a smartphone .....

b the area of Italy .....

c the area of a netball court? .....

It is important to be able to choose the most suitable metric units for measuring. Some of the metric units that you already know are
- mm, cm, m, km (length)
- mm^2, cm^2, m^2, km^2, hectares (area)

2 **Real** A rectangular runway measures 2.4 km by 250 m. How many hectares is this?

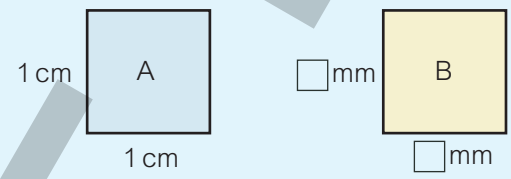
Convert km to m and then m^2 to hectares. A hectare is 10 000 m^2.

Guided

Area = 2.4 km × 250 m = 2400 × 250 = ... m^2

Number of hectares = ... ÷ ..... = ...

3 These squares are the same size.



a Write in the missing measurements.

b Work out the area of

i square A ..... cm^2 **ii** square B ..... mm^2

c Complete these sentences.

i To convert from cm^2 to mm^2 ..... by .....

ii To convert from mm^2 to cm^2 ..... by .....

Guided

4 Complete these conversions.

a 8 cm^2 = 8 × 10^2 = 800 mm^2

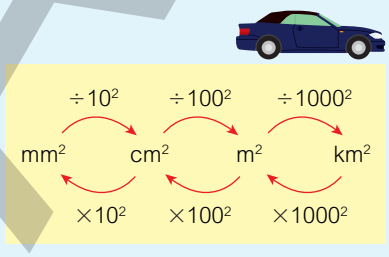
b 57 500 cm^2 = ... m^2

c ..... cm^2 = 950 mm^2

d ..... m^2 = 8.5 km^2

e 0.2 m^2 = ... cm^2

f 4500 m^2 = ... km^2



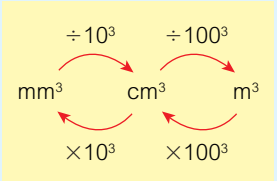
Worked example

5 **Problem-solving** The base of a swimming pool is to be tiled using small square tiles of side length 2 cm.
The base is a 12 m by 4 m rectangle. How many tiles are needed?

6 Complete these conversions.

a 12 cm^3 = ... mm^3 **b** ..... cm^3 = 66 mm^3

c 1.75 m^3 = ... cm^3 **d** ..... m^3 = 125 000 cm^3



7 **Problem-solving** A toy manufacturer needs to ship (transport) 100 000 toys from China to the USA. Each toy is in a box measuring 25 cm × 25 cm × 10 cm, and the shipping containers measure 12 m × 2.5 m × 2.5 m.
How many containers does the company need to transport all 100 000 toys at once?

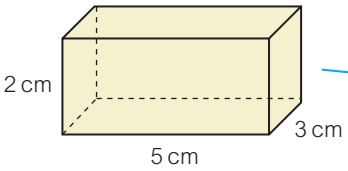
Check

Tick each box as your **confidence** in this topic improves.

Need extra help? Go to page 38 and tick the boxes next to Q8 and 9. Then try them once you've finished 4.1–4.8.

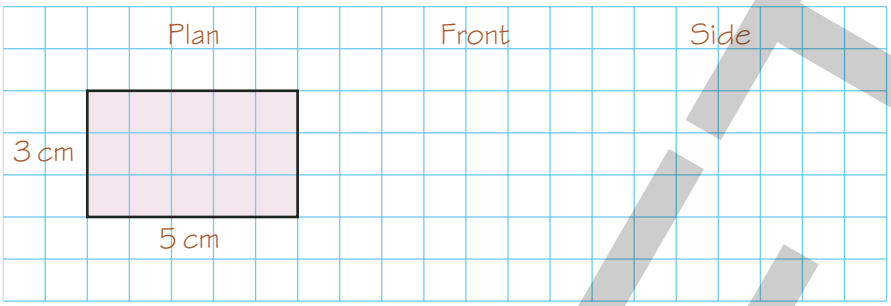
Plans and elevation

1 Draw the **plan**, the **front elevation** and the **side elevation** of the solid.

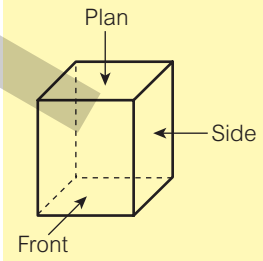


Label the lengths.

Guided



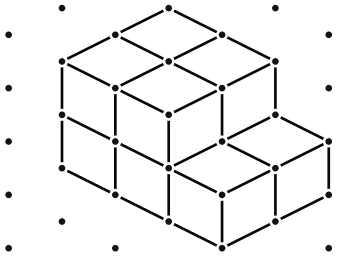
The **plan** is the view from above the object.
The **front elevation** is the view of the front of the object.
The **side elevation** is the view of the side of the object.



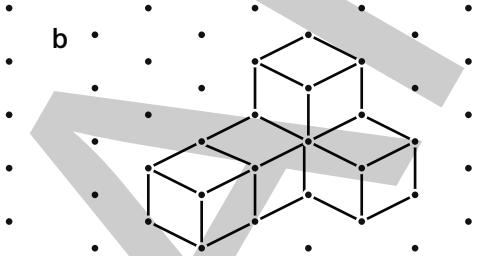
2 These solids, drawn on an isometric grid, are made from centimetre square cubes.
Draw the plan, the front elevation and the side elevation of each solid.

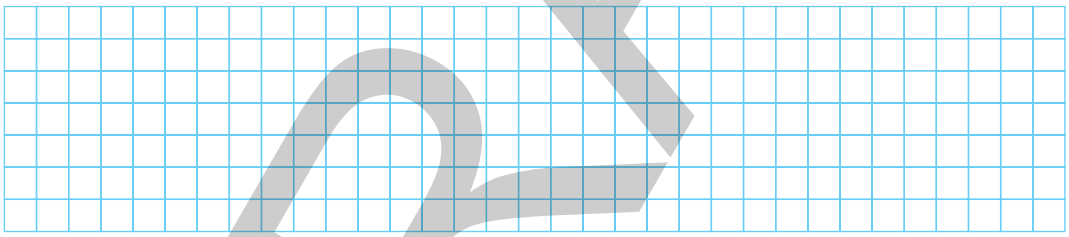
Worked example

a

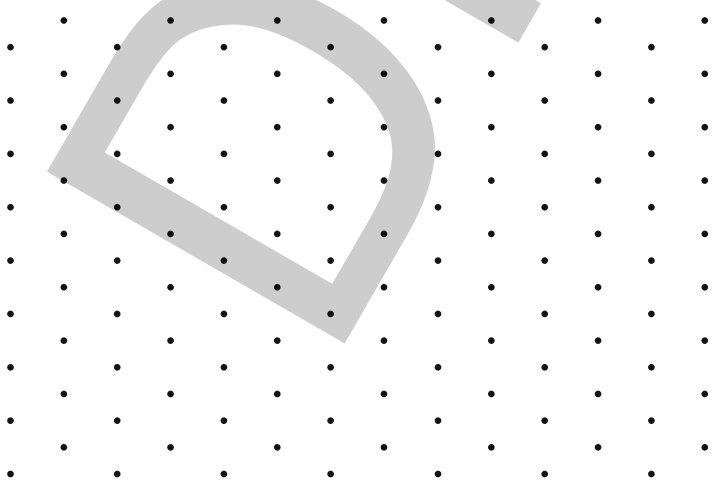


b

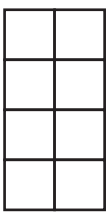




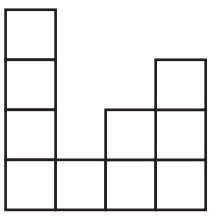
3 **Problem-solving** Here are the plan, front and side elevations of an irregular 3D solid.
If you have them, use cubes to make the solid.
Then draw it on the isometric grid (see Q2) below.



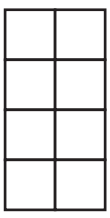
Plan



Front

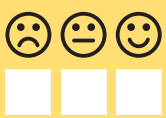


Side



Check

Tick each box as your **confidence** in this topic improves.



Need extra help? Go to page 38 and tick the box next to Q8. Then try it once you've finished 4.1–4.8.

4.8 Master
Solving problems with 3D solids and measures

1 **Problem-solving** A medicine bottle says, 'Take three 5 ml spoonfuls three times per day.' The bottle contains 0.2 litres. Ranjeev has to take the medicine for 5 days.
Is there enough medicine in the bottle? Explain your answer.

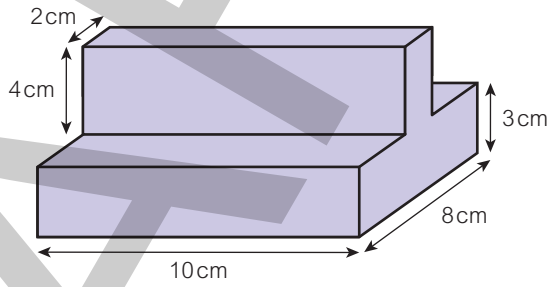
Units of capacity and units of volume can be converted.
1 ml = 1 cm^3, so 1 litre = 1000 cm^3

2 Ian is using his calculator to solve some problems.
Which value, A, B or C, should he enter for each measure?

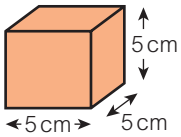
a 5 m 5 cm (in metres)	**A** 5.5	**B** 5.05	**C** 5.005
b 444 ml (in litres)	**A** 4.44	**B** 0.444	**C** 0.0444
c 3 kg 30 g (in grams)	**A** 33000	**B** 30030	**C** 3030
d 2 tonnes 2 kg (in tonnes)	**A** 2.2	**B** 2.02	**C** 2.002
e 1 litre 100 ml (in cm^3)	**A** 1100	**B** 11	**C** 0.0011

For part **d**, use
1 tonne (t) = 1000 kg

3 Work out the volume of this shape.



4 **Problem-solving** The diagram shows the dimensions of a small box in the shape of a cube.
A large box has dimensions 50 cm by 40 cm by 10 cm.
How many small boxes will fit into the large box?

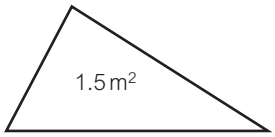


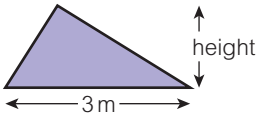
Strategy hint
Start by working out how many small boxes will fit along the length of the large box.

5 **Problem-solving** A cuboid has a height of 7 cm and a width of 9 cm. Its volume is 661.5 cm^3.
Work out the surface area of the cuboid.

Use the volume to work out the length of the cuboid first.

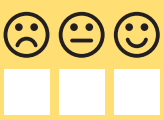
6 **Problem-solving** The white triangle has an area of 1.5 m^2.
The area of the purple triangle is $\frac{1}{5}$ smaller than the area of the white triangle.
Work out the height of the purple triangle.





Check

Tick each box as your **confidence** in this topic improves.



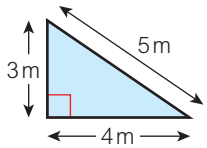
Need extra help? Go to page 38 and tick the box next to Q10. Then try it once you've finished 4.1–4.8.

Area of shapes

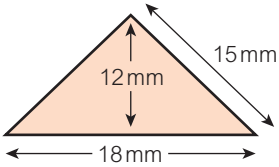
1 Use the formula
area of a triangle = $\frac{1}{2}$ × base length × perpendicular height
to work out the area of each triangle.

The base length and the perpendicular height must be at right angles (90°) to each other.
For part **a**, area = $\frac{1}{2} \times b \times h = \frac{1}{2} \times 4 \times 3 = 2 \times 3 =$ ☐ m²

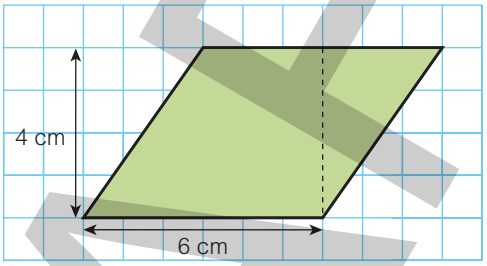
a



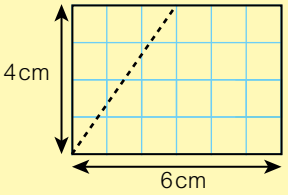
b



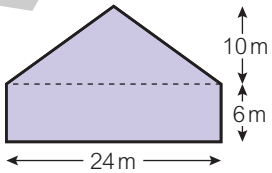
2 Calculate the area of the parallelogram.



Imagine making the parallelogram into a rectangle by moving part of the shape to the other side.



3 Work out the area of this shape.



Guided

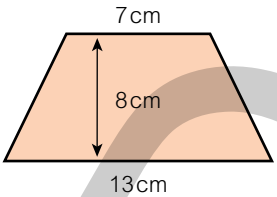
Area of rectangle $= l \times w = 24 \times$ .....
$=$ ..... m²

Area of triangle $= \frac{1}{2} \times b \times h = \frac{1}{2} \times 24 \times$ .....
$=$ ..... m²

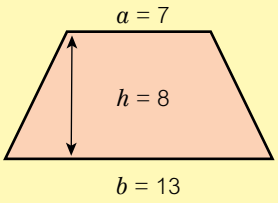
Area of shape = area of rectangle + area of triangle = ... + ... = ... m²

4 Calculate the area of the trapezium.

Guided



Area $= \frac{1}{2}(a + b)h$
$= \frac{1}{2} \times ($ ..... + ... $) \times$ .....
$= \frac{1}{2} \times$ ..... $\times$ .....
$=$ ..... cm²

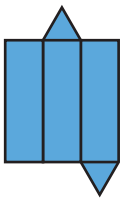


Worked example

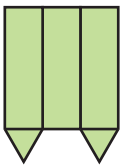
Working with 3D solids

5 Which of these nets will fold to make a triangular prism?

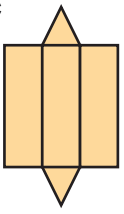
a



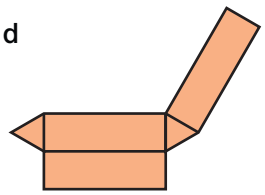
b



c



d

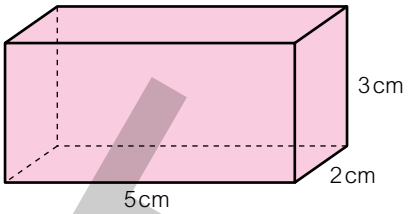


You could draw the shapes and cut them out. Try to fold each one into a triangular prism.

6 Complete the table to find the surface area of the cuboid.

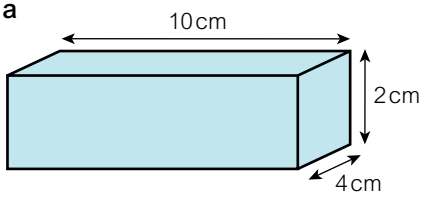
Guided

Face	Area
Top	$5 \times 2 = 10\,cm^2$
Bottom	
Front	$5 \times 3 = 15\,cm^2$
Back	
Left	$2 \times 3 = 6\,cm^2$
Right	
Total surface area	

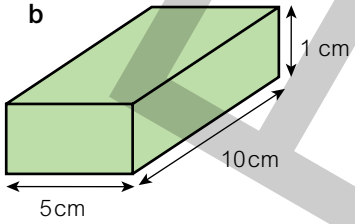


7 Calculate the volume of each cuboid.

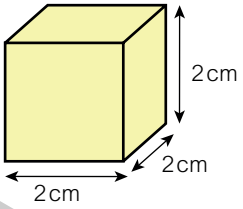
a



b



c



Guided

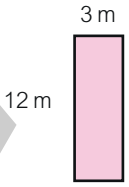
Volume $= l \times w \times h$

$= 10 \times 4 \times 2$

$=$ ..... cm^3

Measures of area and volume

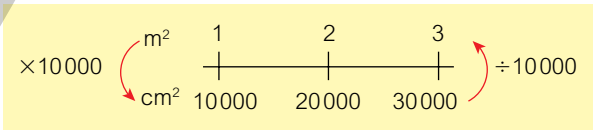
8 **a** Work out the area of the rectangle in m^2.



Guided

Area = ... × ..... = ...

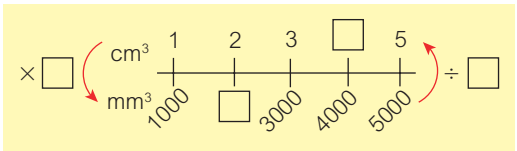
b Convert the area of the rectangle to cm^2.



9 Complete these conversions.

a **i** 8 cm^3 = ... mm^3 **ii** ..... cm^3 = 22 500 mm^3

b **i** 0.03 m^3 = ... cm^3 **ii** ..... m^3 = 6.5 million cm^3



10 A cube has a surface area of 54 cm^2.

a Find the length of each side of the cube.

How many faces does a cube have? What is the area of each face?

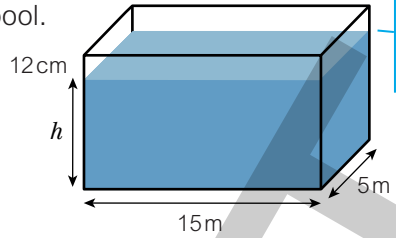
b Work out the volume of the cube.

1 The volume of water in a swimming pool in the shape of a cuboid is 120 m^3. The pool is 15 m long and 5 m wide. The water comes to 12 cm from the top of the pool.

Guided

a Calculate the depth of water in the pool.

Volume = base × height × width

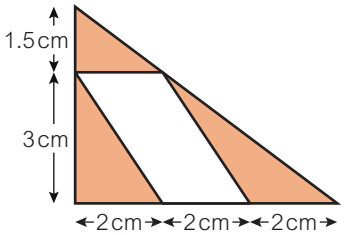


Sketch the water in the pool. Put the measurements you know on your sketch.

Worked example

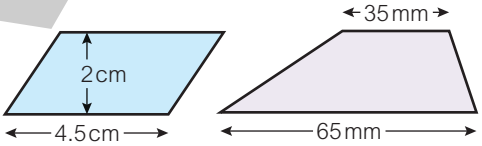
b How much more water is required to fill the pool to 2 cm from the top?

2 **Problem-solving** The diagram shows a badge in the shape of a right-angled triangle.
What percentage of the badge is white?
Write your answer to the nearest whole number.



Percentage of white = $\frac{\text{area of white}}{\text{area of triangle}} \times 100$
Work out the areas of the triangle and the parallelogram.

3 **Problem-solving** This parallelogram and this trapezium have the same area.
What is the perpendicular height of the trapezium?

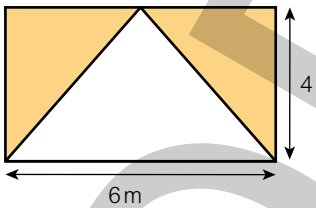


Strategy hint
Make sure all measurements are in the same units.

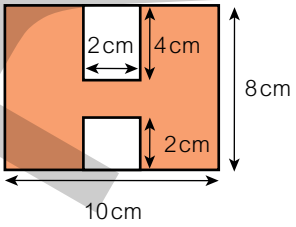
Worked example

4 Work out the shaded area of each shape.

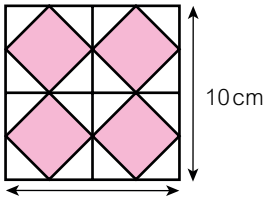
a



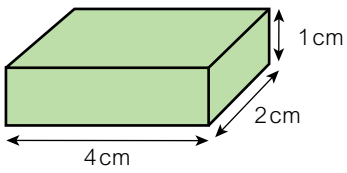
b



c



5 **Reasoning** Look at this cuboid.

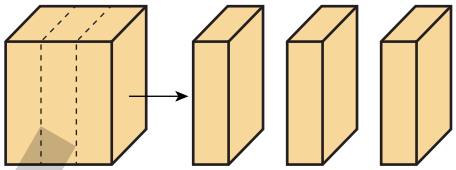


a Calculate the volume of the cuboid. .....

b Calculate the surface area of the cuboid.

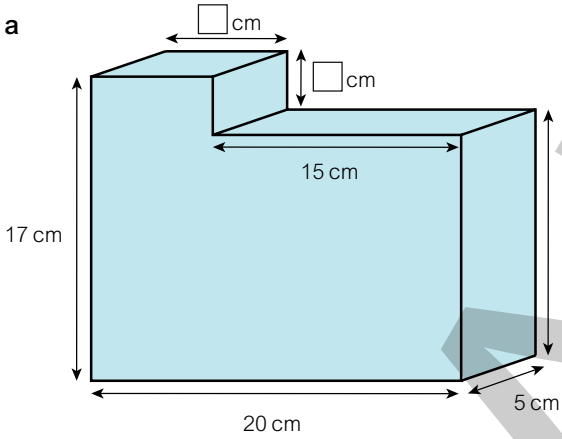
c How can four of these cuboids be put together to make a cuboid with the smallest surface area?

6 A cube has a volume of $27cm^3$. The cube is cut into three equal cuboids.
What is the surface area of one of the cuboids?

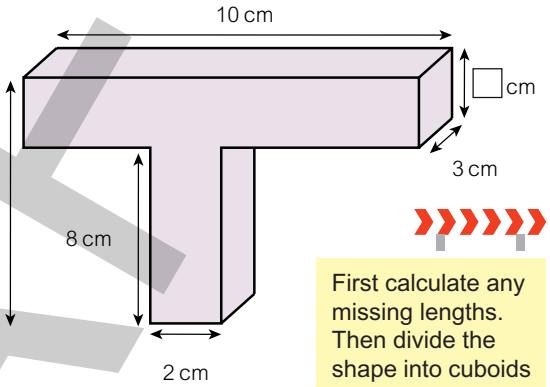


7 Calculate the volume of each solid.

a

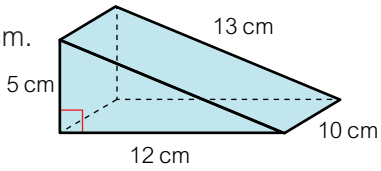


b

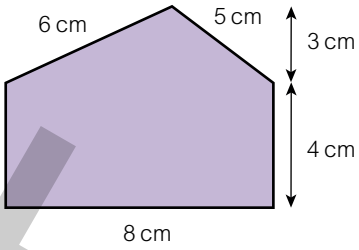


First calculate any missing lengths. Then divide the shape into cuboids and work out the volume of each cuboid separately.

8 Calculate the surface area of this triangular prism.

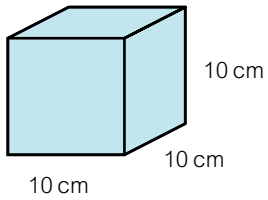


1 Work out the area of this shape.

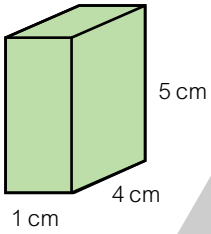


2 For each shape work out **i** the volume **ii** the surface area.

a

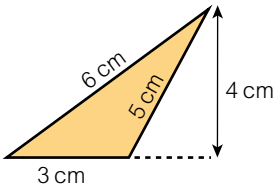


b

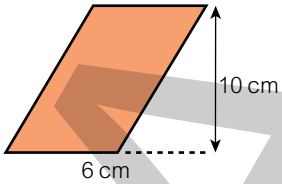


3 Work out the area of each shape.

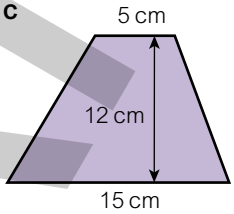
a



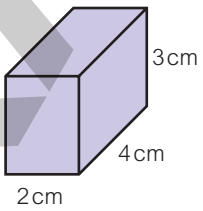
b



c



4 The diagram shows a cuboid.



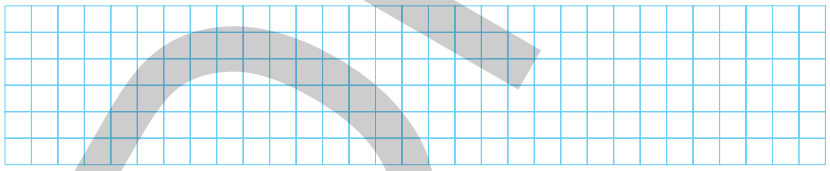
a Draw the cuboid on the isometric grid.

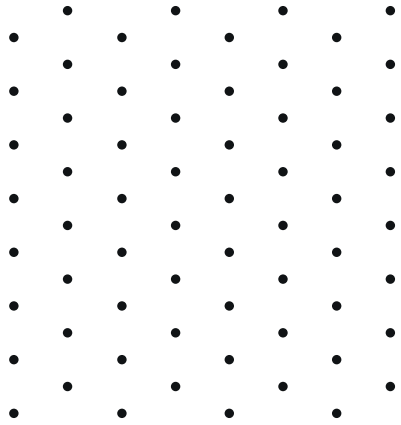
On the square grid, draw

b the plan of the cuboid

c the front elevation of the cuboid

d the side elevation of the cuboid.





5 Complete these conversions.

a 7.2 m^3 = ... cm^3 **b** ..... cm^3 = 9900 mm^3 **c** 630 ml = ... cm^3

6 The diagram shows a shape made up of cuboids. Work out

a the volume

b the surface area