EDEXCEL FUNCTIONAL SKILLS PILOT

Maths Level 2

Chapter 5

Working with shape and space

EDEXCEL FUNCTIONAL SKILLS: INTERIM SUPPORT MATERIAL

Maths Level 2

Su Nicholson

Chapter 5: Working with space and shape

Use these free pilot resources to help build your learners' skill base
We are delighted to continue to make available our free pilot learner resources and teacher notes, to help teach the skills learners need to pass Edexcel FS Mathematics, Level 2.

But use the accredited exam material and other resources to prepare them for the real assessment
We developed these materials for the pilot assessment and standards and have now matched them to the final specification in the table below. They'll be a useful interim measure to get you started but the assessment guidance should no longer be used and you should make sure you use the accredited assessments to prepare your learners for the actual assessment.

New resources available for further support
We're also making available new learner and teacher resources that are completely matched to the final specification and assessment – and also providing access to banks of the actual live papers as these become available. We recommend that you switch to using these as they become available.

Coverage of accredited specification and standards
The table below shows the match of the accredited specification to the unit of pilot resources. This table supersedes the pilot table within the teacher notes.

Coverage and Range	Exemplification	Learner Unit
Recognise and use 2-D representations of 3-D objects	• Sketch 3-D solids • Nets • Plans, elevations • Draw 3-D shapes on isometric grids	**H4** 2-D Representations of 3-D objects Wider coverage can be found in our new publishing (see below)
Find area, perimeter and volume of common shapes	• Perimeter and area of triangles and rectangles • Circumference and areas of circles • Volume of cuboids and cylinders • Formulae will be given • Composite shapes may be used	**H1** Perimeter **H2** Area **H3** Volume
		H5 Remember what you have learned

Where to find the final specification, assessment and resource material
Visit our website **www.edexcel.com/fs** then:
- **for the specification and assessments:** under **Subjects**, click on **Mathematics (Levels 1–2)**
- **for information about resources:** under **Support**, click on **Published resources**.

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H Working with perimeter, area, volume and nets

You should already know how to:

- ✓ work out the perimeters of simple shapes
- ✓ work out the areas of rectangles
- ✓ work out volumes of simple solids, such as cuboids
- ✓ solve problems, using the mathematical properties of regular 2-D shapes
- ✓ draw 2-D shapes in different orientations
- ✓ tesselate 2-D shapes.

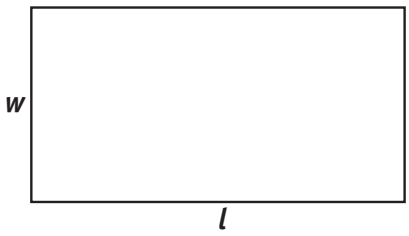
By the end of this section you will know how to:

- find perimeters and areas of regular shapes
- find areas of composite shapes
- find volumes of regular shapes
- solve problems in three dimensions
- use 2-D representations of 3-D objects.

1 Perimeter

Learn the skill

The **perimeter** of a shape is the total length of its **boundary**.



For a rectangle, the perimeter, P, is given by the formula:

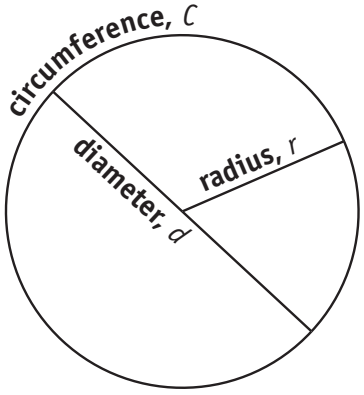
$P = 2(l + w)$

where l is the length and w is the width.

The perimeter of a circle is called its **circumference**.

The circumference, C, of a circle can be written in two ways:

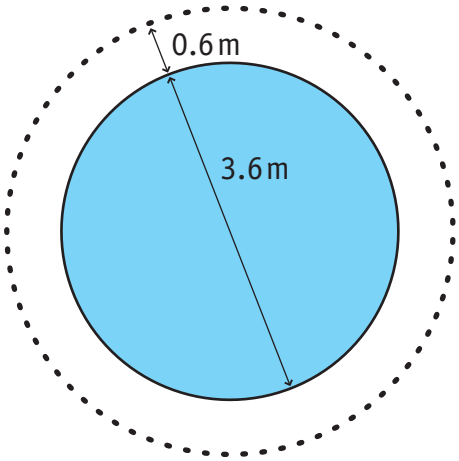
- $C = \pi d$ where d = **diameter**
- $C = 2\pi r$ where r = **radius**



Tip

π is a special number, equal to the ratio of the circumference of a circle to its diameter.
π is an **irrational number**, which means it cannot be written as a fraction.
π is approximately equal to 3.142.
The π key on your calculator gives π to more places of decimals 3.141592654

Example 1: A circular pond, 3.6 metres in diameter, has a fence around it, at a constant distance of 0.6 metres from the edge. Find the length of the fence.



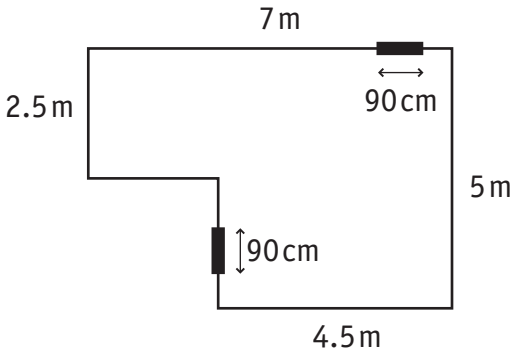
You first need to find the radius of the outer circle which is dotted in the diagram. The diameter of the pond is 3.6 metres, so the radius is $\frac{3.6}{2}$ metres = 1.8 metres. This means the radius of the outer circle is 1.8 + 0.6 = 2.4 m. Circumference = $2\pi r$, so the length of the fence is 2 x π x 2.4. Using the π key on your calculator gives 15.07964474 metres. Your answer can only be as accurate as the information you are given. As the lengths are given to 0.1 m, the length of the fence should be given as 15.1 metres.

Answer: 15.1 metres

Try the skill

1. A cake shop sells birthday cakes that are 20 cm in diameter. What is the shortest length of ribbon that would fit round the outside of the cake?

2. The plan shows the dimensions of an L-shaped sitting room. The house owner wants to buy skirting board to go around the edge of the room, leaving gaps at the doors. What is the shortest length of skirting board he can buy?



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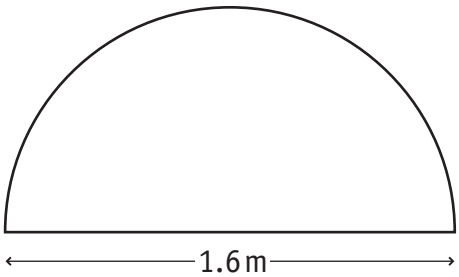
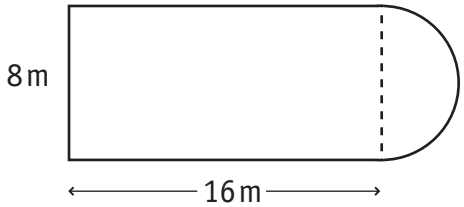
3. A semicircular window has a diameter of 1.6 m. The window frame is made of plastic strips along the outside edge. What is the total length of the plastic strip around the window frame?



4. A lawn has the shape of a rectangle with one semicircular end. There is concrete edging around the outside of the lawn. What is the length of the concrete edging?



2 Area

Learn the skill

The **area** of a shape is a measure of the amount of space it covers.

For a circle the area, A, is given by the formula: $A = \pi r^2$, where r is the **radius**.

Example 1: The diameter of a dart board is 45 centimetres. What is the area of the dart board?

The radius of the dart board is $\frac{45}{2} = 22.5$ cm .

Area $= \pi r^2 = \pi \times 22.5^2 = 1590.43$ cm^2

Answer 1590 m^2

Tip

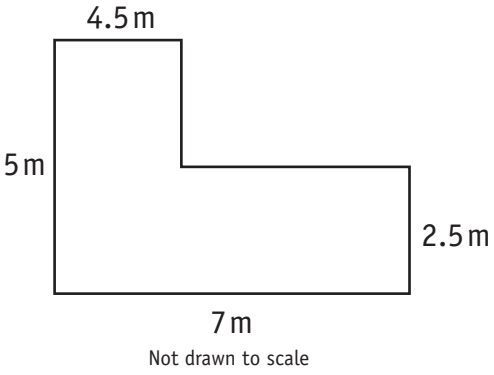
Metric units of area are mm^2, cm^2, m^2 and km^2.

Remember

Follow the BIDMAS rule and work out r^2 first. r^2 means $r \times r$.

You work out the area of a **composite shape** by splitting it into simple shapes.

Example 2: This kitchen floor is to be covered in cushioned vinyl. What area of cushioned vinyl is needed?



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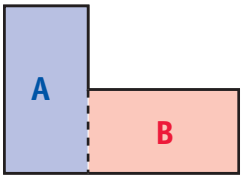
Split the L-shaped room into two rectangles A and B.

Area of A

$= 4.5 \times 5$

$= 22.5$ m^2



Area of B

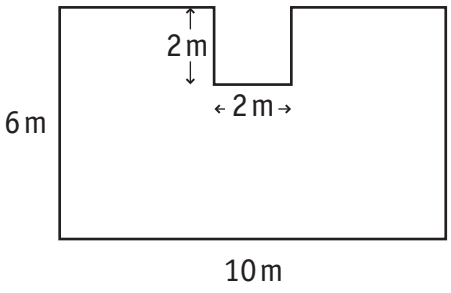
$= 2.5 \times (7 - 4.5)$

$= 2.5 \times 2.5 = 6.25$ m^2

Total area = 22.5 + 6.25 = 28.75 m^2

Answer: 28.75 m^2

Example 3: The diagram shows the plan of a patio. The patio is to be paved with square paving slabs with sides of 0.5 metres. How many paving slabs will it take?



Not drawn to scale

Work out how many paving slabs would be needed for the full rectangle and then take away the number that would be needed in the cut-out piece.

The slabs are 0.5 m long, so two are needed for every metre.

For the 10 m width, 20 slabs are needed.

For the 6 m length, 12 slabs are needed.

Number of slabs for the whole rectangle = 20 × 12 = 240.

The cut-out piece is 2 m by 2 m.

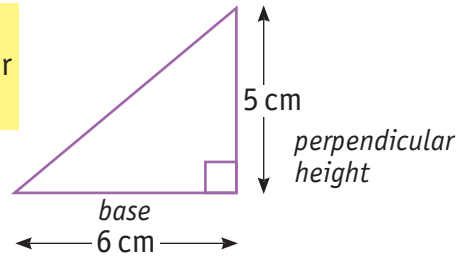
This would take 4 × 4 = 16 slabs.

The total is 240 – 16 = 224 paving slabs.

Answer: 224

You sometimes need to find the area of a triangle.

The area of a triangle = $\frac{1}{2}$ × base × perpendicular height

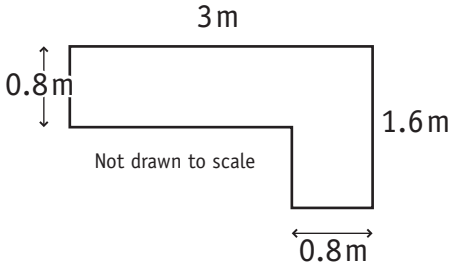


Tip

The area of this triangle is $\frac{1}{2} \times 6 \times 5 = 15\,cm^2$

Try the skill

1. The diagram shows a work surface in a kitchen.

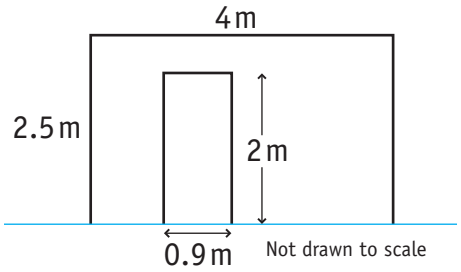


a What is the area of the work surface?

b The worktop is to be covered with square tiles, each measuring 4 cm by 4 cm. How many tiles are needed to cover the worktop?

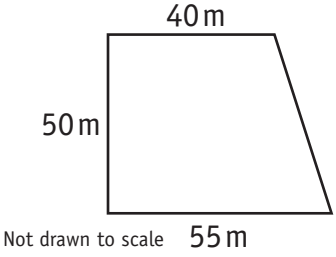
2. In the 2006 World Cup, circles of cloth were used to cover the centre circle at the start of each match. The radius of a centre circle is 9.15 m and 12 football pitches were used. Estimate the total area of cloth used.

3. The diagram shows a wall of a room, 4 m wide and 2.5 m high, which is to be painted. The door is 0.9 m wide and 2 m high. What area of wall needs to be painted?



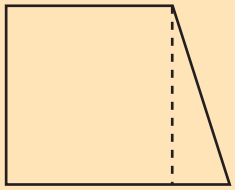
4. A sheet of card is 20 centimetres by 30 centimetres. What is the maximum number of circular name badges, of diameter 60 millimetres, that can be cut from this piece of card?

5. The diagram shows the floor plan of an office. What is the area of the floor?



Tip

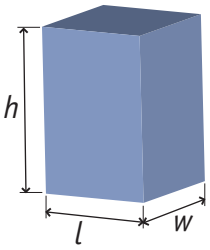
Split into a rectangle and a triangle.

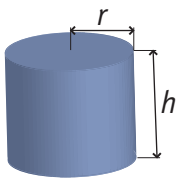


3 Volume

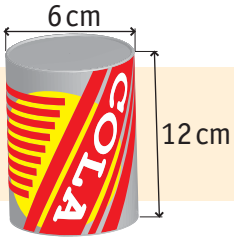
Learn the skill

- The volume of a 3-D shape is a measure of the amount of space it occupies.
- The volume of a cuboid is $l \times w \times h$ where l = length, w = width and h = height.
- The volume, V, of a cylinder is: $V = \pi r^2 h$ where r is the base **radius** and h is the **height**.





Example 1: A can of cola has a diameter of 6 cm and a height of 12 cm. What is the volume of the can?



Not drawn to scale

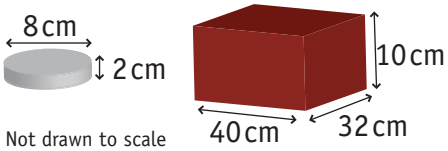
The diameter is 6 cm so the radius is 3 cm.

Volume = $\pi r^2 h = \pi \times 3^2 \times 12 = 329\ \text{cm}^3$

Answer: 324 cm^3

You may need to solve problems in **three dimensions**.

Example 2: A tin of shoe polish is 8 cm in diameter and 2 cm high. The shoe polish must be stored in an upright position. How many tins of shoe polish will fit into a carton that is 40 cm long by 32 cm wide by 10 cm high?



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The base of the carton is 40 cm by 32 cm.
The tins are 8 cm wide.
This means that $\frac{40}{8} = 5$ tins will fit along one edge and $\frac{32}{8} = 4$ tins will fit along the other edge.

So a total of $5 \times 4 = 20$ tins will fit on the bottom of the carton.

The carton is 10 cm high, which means $\frac{10}{2} = 5$ tins will fit, one on top of another.

The total number of tins in the carton is $20 \times 5 = 100$.

Answer: 100

Remember

Metric units of volume are mm^3, cm^3, m^3 and km^3.

Remember

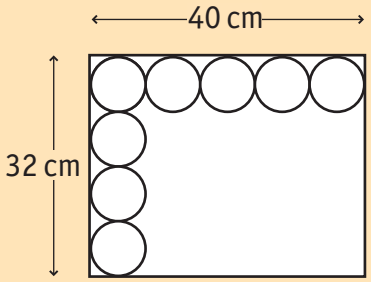
$\pi r^2 h$ means $\pi \times r^2 \times h$
Follow the BIDMAS rule and work out r^2 first.

Remember

1 litre = 1 000 cm^3 = 1 000 ml
This means the can will hold 324 ml of liquid.

Test tip

A sketch diagram can help you understand the question:

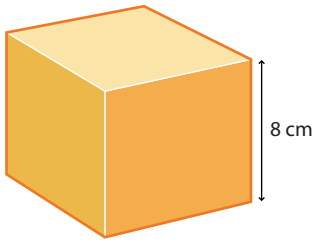


Tip

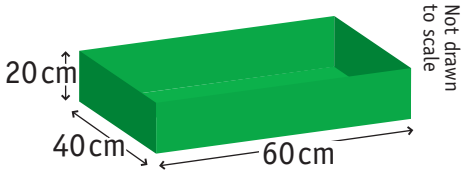
A **plan** is a view from above. A view from the front is called a **front elevation**.

Try the skill

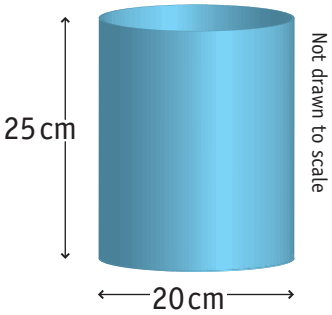
1. A cube has sides of length 8 cm. What is the volume of the cube?



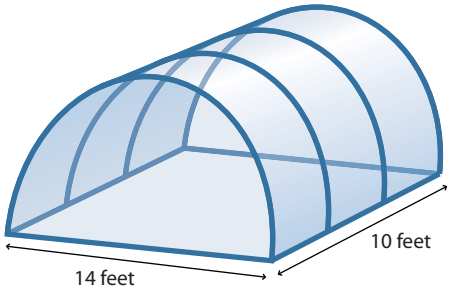
2. What is the volume of the recycling box shown in the diagram?



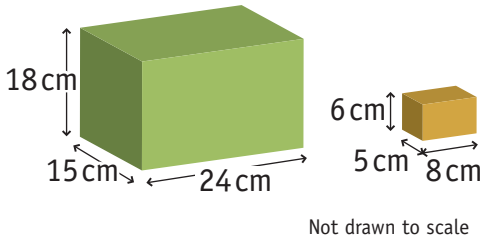
3. A waste bin is in the shape of a cylinder. The diameter of the base is 20 cm and the height is 25 cm. What is the volume of the waste bin?



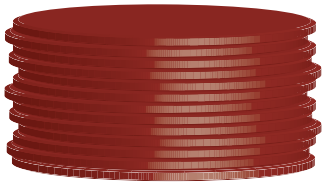
4. A polytunnel for growing plants has a semi-circular opening. The diameter of the opening is 14 feet and the length is 10 feet. The air inside the polytunnel needs to be heated to grow the plants. What is the volume of air inside the polytunnel in cubic feet?



5. A crate is 24 cm by 18 cm by 15 cm. It is to be packed with boxes that are 8 cm by 6 cm by 5 cm. What is the largest number of boxes that can fit in the crate?



6. A firm makes circular drink mats, of radius 4.5 cm, that are 3 mm thick. They want to produce a rectangular box to hold a pile of 12 mats. What are the minimum dimensions of the box?



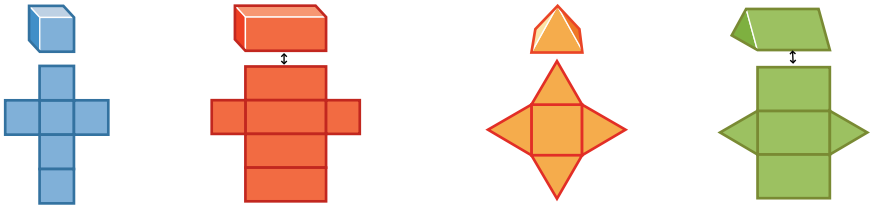
4 2-D representations of 3-D objects

Learn the skill

Three dimensional shapes have edges, vertices, (corners) and faces. You should familiarize yourself with the following 3-D shapes and the number of faces, edges and vertices.

3-D shape	Number of faces	Number of edges	Number of vertices
cube 	6	12	8
cuboid 	6	12	8
cylinder 	3	2	0
square-based pyramid 	5	8	5
triangular prism 	5	9	6

A shape which can be folded up to form a 3-D shape is called a **net.** The following are examples of nets for common 3-D shapes.



Try the skill

1. Draw a net for a cylinder.

2. Draw a net for a triangular based pyramid.
   a how many faces, edges and vertices does a triangular based pyramid have?

3. Draw a net for a cube with sides of length 4 centimetres.
   a what is the total area of your net?
   b what is the total length of the edges of the cube?

4. Complete the following table:

3-D shape	Shape of faces
cube	
cuboid	
cylinder	
square based pyramid	
triangular prism	

5 Remember what you have learned

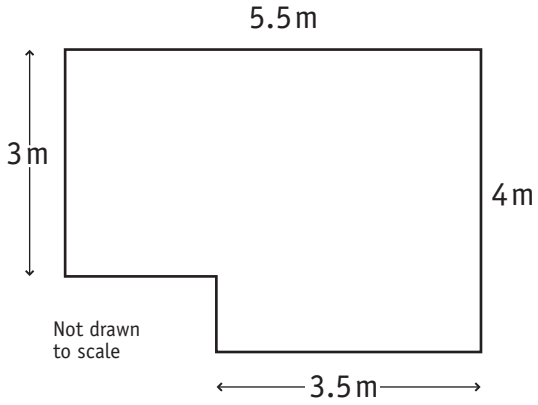
Learn the skill

- The _____ of a shape is the total length of its boundary.
- The perimeter of a circle is called its _____.
- The _____ of a shape is the amount of space it covers.
- The _____ of a 3-D shape is the amount of space it occupies.
- You should know these formulae:
  - _____ of a _____ = πd or $2\pi r$
  - _____ of a _____ = length × width
  - _____ of a _____ = $\frac{1}{2}$ × base × perpendicular height
  - _____ of a _____ = πr^2
  - _____ of a _____ = length × width × height
  - _____ of a _____ = $\pi r^2 h$

Use the skill

1. The diagram shows the floor plan of an office.

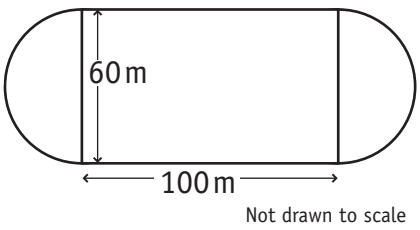
What is the area of the floor?



A ☐ 16.5 m²
B ☐ 20 m²
C ☐ 20.5 m²
D ☐ 22 m²

2. The diagram shows a running track made up of a rectangle with two semicircular ends.

What is the total length around the outside edge of the running track?



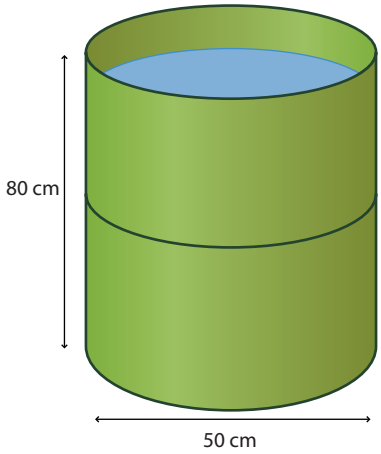
A ☐ 294 m
B ☐ 326 m
C ☐ 389 m
D ☐ 577 m

3. What is the total area of the running track?

A ☐ 6000 m²
B ☐ 6296 m²
C ☐ 8827 m²
D ☐ 11655 m²

4. A cylindrical water butt has a diameter of 50 cm and is 80 cm high.

What is the maximum amount of water it can hold?



A ☐ 15.7 litres

B ☐ 62.8 litres

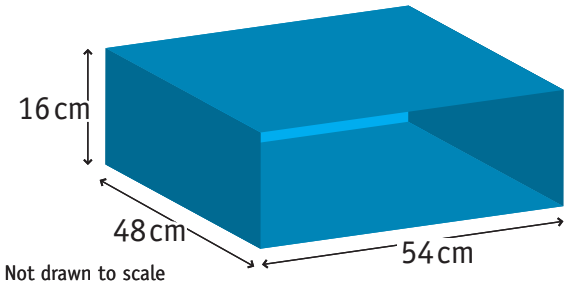
C ☐ 157 litres

D ☐ 628 litres

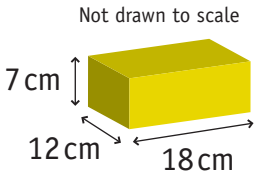
Remember

1 litre = 1000 cm^3

5. The diagram shows the dimensions of the baskets inside a freezer.



The baskets are packed with blocks of ice-cream, in packets with dimensions as shown in the diagram.



What is the maximum number of ice-cream blocks that can fit into the basket?

A ☐ 7

B ☐ 12

C ☐ 14

D ☐ 24

6. Plastic ice cube trays make ice cubes that measure 2 cm by 2 cm by 2 cm.

How many ice cubes can be made from 5 litres of water?

A ☐ 625

B ☐ 833

C ☐ 834

D ☐ 1250