

# Maths Level 1

## Chapter 5

### Working with shape and space

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# Maths Level 1

Carol Roberts

## Draft for pilot centres

- Chapter 1:** Working with Whole Numbers
- Chapter 2:** Working with Fractions, Decimals & Percentages
- Chapter 3:** Working with Ratio, Proportion, Formulae and Equations
- Chapter 4:** Working with Measures
- Chapter 5:** Working with Shape & Space
- Chapter 6:** Working with Handling Data
- Chapter 7:** Working with Probability
- Chapter 8:** Test preparation & progress track

### *How to use the Functional mathematics materials*

The skills pages enable learners to develop the skills that are outlined in the QCA Functional Skills Standards for mathematics. Within each section, the units provide both a summary of key learning points in the *Learn the skill* text, and the opportunity for learners to develop skills using the *Try the skill* activities. The *Remember what you have learned* units at the end of each section enable learners to consolidate their grasp of the skills covered within the section.

All Functional Skills standards are covered in a clear and direct way using engaging accompanying texts, while at the same time familiarising learners with the kinds of approaches and questions that reflect the Edexcel Functional Skills SAMs (see <http://developments.edexcel.org.uk/fs/> under 'assessment').

The *Teacher's Notes* suggest one-to-one, small-group and whole-group activities to facilitate learning of the skills, with the aim of engaging all the learners in the learning process through discussion and social interaction. Common misconceptions for each unit are addressed, with suggestions for how these can be overcome.

One important aspect of Functional mathematics teaching is to ensure that learners develop the necessary process skills of *representing, analysing* and *interpreting*. At Level 1, learners should select the methods and procedures and adopt an organised approach to the task.

The teacher may provide guidance, but learners should make their own decisions about finding the solutions to the task.

The inclusion of *Apply the skills* in the *Teacher's Notes* for each section, aims to provide real-life scenarios to encourage application of the skills that have been practised. To make the most of them, talk through how the tasks require the use of the skills developed within the section. The tasks can be undertaken as small-group activities so that the findings from each group can be compared and discussed in a whole-group activity. The scenarios can be extended and developed according to the abilities and needs of the learners. As part of the discussion, learners should identify other real-life situations where the skills may be useful.

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# H Working with perimeter, area and volume

You should already know how to:

- ✓ read, measure and compare metric units of length.

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

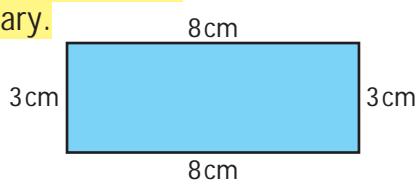
- ▶ work out the perimeters of simple shapes
- ▶ work out the areas of rectangles
- ▶ work out volumes of simple solids, such as cuboids
- ▶ identify acute, right and obtuse angles
- ▶ identify lines of symmetry on a shape
- ▶ identify shapes which tessellate.

## 1 Calculating perimeter

### Learn the skill

▶ The perimeter of a shape is the distance all the way around its boundary.

Example: What is the perimeter of the shape?



Add all the side lengths:  $8 + 3 + 8 + 3 = 22\text{ cm}$  Answer: 22 cm

### Remember

Perimeter is a length, measured in units such as kilometres (km), metres (m) or centimetres (cm).

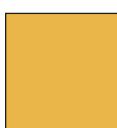
### Try the skill

1. Work out the perimeters of the following shapes.

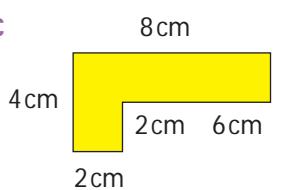
a 6cm



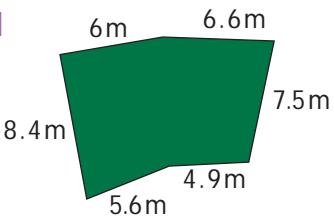
b 3mm



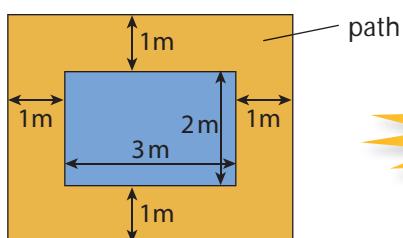
c



d



2. A woman wants to build a fence around the edge of the path that surrounds her garden pond. What length of fencing does she need to buy?



Challenge question!

## 2 Calculating area



### Learn the skill

**Area** is a measure of the amount of surface a shape has.

The rectangle is made up of eight unit squares.

Each unit square measures 1 cm by 1 cm and its area is 1 cm<sup>2</sup> or 1 centimetre squared.

The area of the rectangle is 8 cm<sup>2</sup>.

There are 4 columns and 2 rows:  $4 \times 2 = 8 \text{ cm}^2$

**The area of a rectangle = length × width.**

**Example 1:** A rectangular garden is 9.8 metres wide and 20 metres long. What is the area of the garden?

First, identify the length (20 m) and the width (9.8 m).

To find the area, multiply the length by the width:

$$9.8 \times 20 \text{ m}^2 = 9.8 \times 2 \times 10 \text{ m}^2 = 19.6 \times 10 \text{ m}^2 = 196 \text{ m}^2$$

**Answer:** 196 m<sup>2</sup>

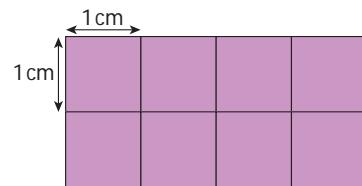
**Example 2:** A gardener wants to reseed a client's lawn. The lawn is a rectangle 18.75 metres long and 8.59 metres wide. What calculation can he do to roughly work out the area of the lawn?

First, round the length and width to the nearest whole numbers. For a rough estimate, 20 m and 10 m will be 'good enough'.

18.75 rounds up to 20, and 8.59 rounds up to 10.

Area is calculated by multiplying length and width.

**Answer:**  $20 \times 10$



### Remember

Centimetre squared is sometimes written as square centimetres.

cm<sup>2</sup> is the abbreviated form.

### Tip

Length is the longer horizontal dimension.

Width is the shorter horizontal dimension.

Height is the vertical dimension.

### Remember

Area is measured in **two dimensions**, so it is always measured in **square units**, such as cm<sup>2</sup> or m<sup>2</sup>.

### Tip

To multiply a number by 20, multiply first by 2 and then multiply the result by 10.

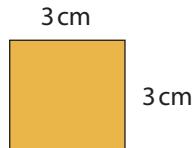
## Try the skill

1. Find the area of each of these rectangles.

a



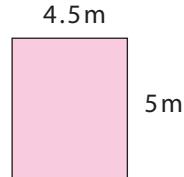
b



c



d



2. A window is 50 centimetres high and 2 metres long.  
What is its area?

3. A corridor is a rectangular shape of length 8 metres and width 1.5 metres. Find its area.

4. A carpet layer is ordering new carpet for a living room.  
The floor of the room is 5.92 metres long and 3.74 metres wide. Which two numbers should he multiply together to work out an approximate area of the floor?

5. The front of a house is being repainted. The front is rectangular in shape and is 12.18m wide and 14.8m high.  
What is the approximate area that will be repainted?

6. **Challenge question!**

Jonathon is designing a rectangular path for his garden using paving stones.

The paving stones are square in shape and are 50 cm wide.  
If the path is to be 8m long and 1m wide, how many paving stones will Jonathon need to buy?

### Tip

First change units so that both measurements are either in centimetres or metres – you decide which is easier for you!

# 3 Calculating volume



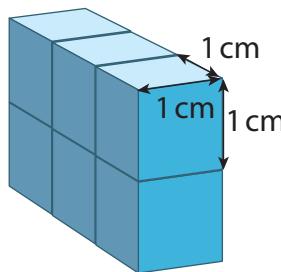
## Learn the skill



**Volume** is the amount of space taken up by a three-dimensional (3-D) shape.

In this cuboid there are 6 (=  $3 \times 2$ ) cubes.

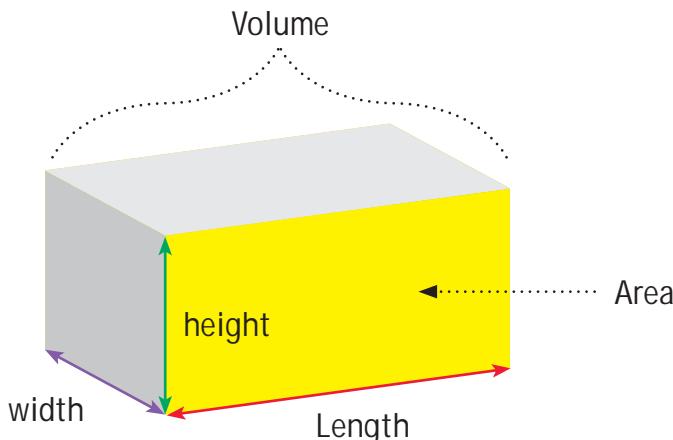
Each cube measures 1 cm by 1 cm by 1 cm so its volume is  $1\text{cm}^3$ , or 1 centimetre cubed.



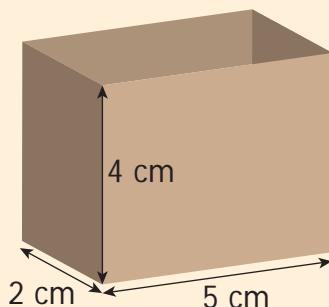
The volume of the cuboid is  $6\text{cm}^3$ :  $3\text{cm} \times 2\text{cm} \times 1\text{cm} = 6\text{cm}^3$ .



The **volume** of a cuboid = **length** × **width** × **height**.



**Example 2:** A box has length 5 cm, width 2 cm and height 4 cm. What is its volume?



First, identify the length (5 cm), the width (2 cm), and the height (4 cm).

$$\text{volume} = \text{length} \times \text{width} \times \text{height}$$

$$5 \times 2 \times 4 = 40\text{cm}^3$$

Answer:  $40\text{cm}^3$

## Remember

Centimetre cubed is sometimes written as cubic centimetres.  $\text{cm}^3$  is the abbreviated form.

## Remember

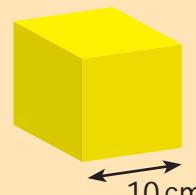
Volume is measured in **three dimensions**, so it is always measured in **cubic units**: cubic millimetres ( $\text{mm}^3$ ), cubic centimetres ( $\text{cm}^3$ ) or cubic metres ( $\text{m}^3$ ).

## Remember

A cuboid is the mathematical name for a box. A cube is a special type of cuboid: its sides are all the same length.

## Tip

**Volume** is the amount of space a solid takes up, whereas **capacity** is the maximum amount a container can hold.

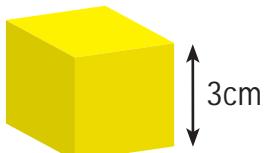


This cube has a volume of  $1000\text{cm}^3$  and can hold a capacity of 1 litre.

## Try the skill

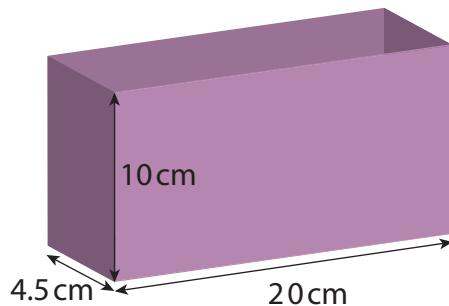
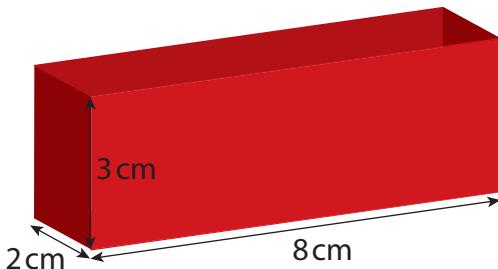
1. What metric unit would you use to measure:
  - a the volume of a cardboard box \_\_\_\_\_
  - b the volume of a swimming pool \_\_\_\_\_
  - c the amount of water in a swimming pool? \_\_\_\_\_

2. What is the volume of this cube?



---

3. Find the volume of these cuboids.



a \_\_\_\_\_

b \_\_\_\_\_

4. An ice cube has length, width and height of 3 cm. What is its volume?

---

5. The dimensions of a room are:

length 8 metres, width 5.5 metres, height 3 metres.  
What is the volume of the room?

- 
6. A brick is 20cm long, 10cm wide and 8cm high. What is its volume?

- 
7. A fish tank is 30cm long, 20cm wide and 40cm high.  
How much water can it hold when it is full to the top?

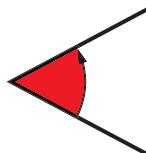
- 
8. A tall city building is 160m high, 20m from side to side and 15m from front to back. What is the volume of the building?

# 4 Angles



## Learn the skill

Where two lines meet, an angle is formed.



Angles are measured in **degrees**.

The angle on the floor between two walls in the corner of a rectangular room is called a **right angle**.

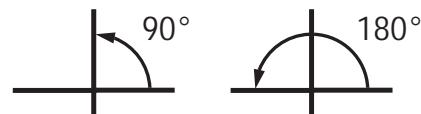
A right angle is the same as  $90^\circ$  and is also a  $\frac{1}{4}$  turn.

Two right angles make a  $\frac{1}{2}$  turn.

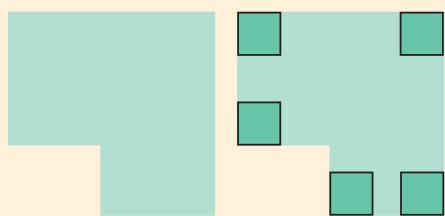
Two right angles equals  **$180^\circ$** .

### Remember

The symbol for degrees is °



**Example 1:** This is the floor plan for a new office. Mark in all the right angles between office walls.

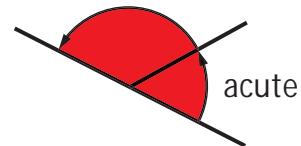


Note where the corners are.

Angles which are **less than  $90^\circ$**  are called **acute angles**.

Angles which are **more than  $90^\circ$  but less than  $180^\circ$**  are called **obtuse angles**.

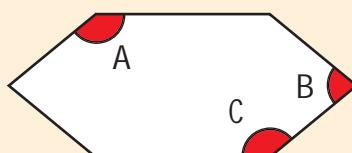
obtuse



**Example 2:** This is hexagon or a 6-sided shape.

- Which angles are acute?
- Which angles are obtuse?

- B** is acute.
- A** and **C** are obtuse.

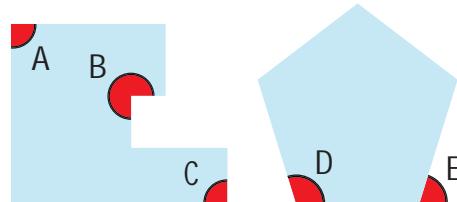


## Try the skill

- Which angles are right angles in the shape below?
- a Is angle D acute or obtuse? \_\_\_\_\_  
b Is angle E acute or obtuse? \_\_\_\_\_
- State whether the following angles are acute, right or obtuse angles.

$45^\circ$  \_\_\_\_\_  $90^\circ$  \_\_\_\_\_  $120^\circ$  \_\_\_\_\_

$179^\circ$  \_\_\_\_\_  $10^\circ$  \_\_\_\_\_  $89^\circ$  \_\_\_\_\_

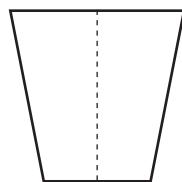


# 5 Line symmetry



## Learn the skill

A shape has line symmetry if it can be folded in half so that the two halves exactly match one another. The fold line that is made is called the **line of symmetry**.



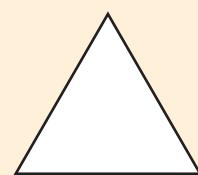
Examples: how many lines of symmetry do these shapes have? Draw them in.



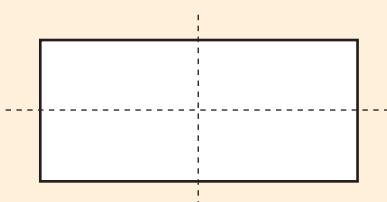
rectangle



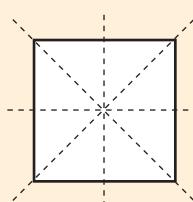
square



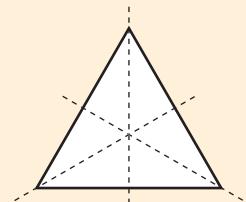
equilateral triangle



2 lines of symmetry



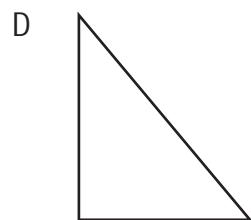
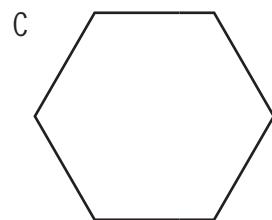
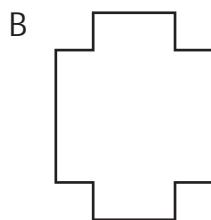
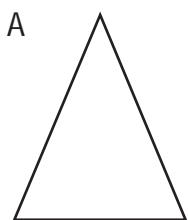
4 lines of symmetry



3 lines of symmetry

## Try the skill

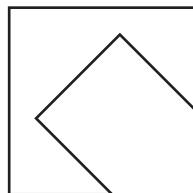
- Identify the number of lines of symmetry for each shape and draw them in.



- Many species in nature have line symmetry. Draw in the line of symmetry for these species.



- The diagram shows the aerial view of a corner cabinet for a kitchen. Draw in any lines of symmetry.



# 6 Tessellation

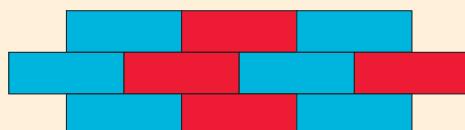


## Learn the skill

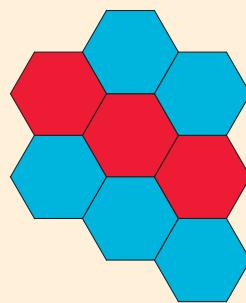
If identical shapes can slot together without leaving any gaps the shapes are **tessellate**.

When you tile a wall, you are tessellating with the tiles – you certainly do not want to leave any gaps in between tiles!

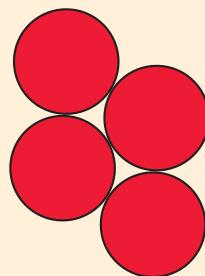
**Examples:**



rectangles tessellate



hexagons tessellate

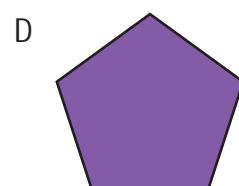
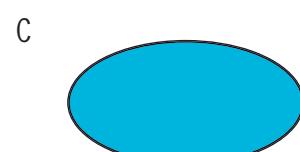
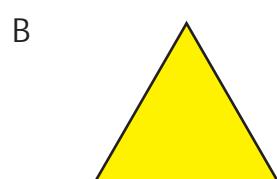
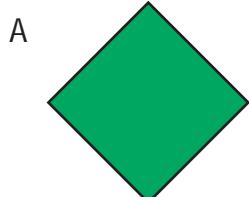


circles do not tessellate  
because there are gaps  
in between



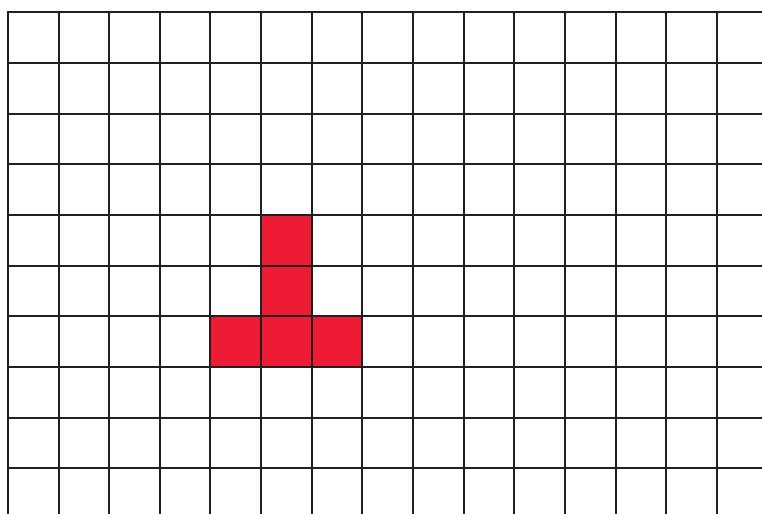
## Try the skill

- Identify which shapes tessellate.



### Challenge question!

- Copy the T-shape below at least 10 times onto squared paper. Cut out the shapes and see if you can tessellate them.



# 7 Remember what you have learned



## First complete this ...

- ▶ The \_\_\_\_\_ of a shape is the distance all the way around its boundary.
- ▶ \_\_\_\_\_ is the amount of space taken up by a shape.
- ▶ The area of a rectangle = \_\_\_\_\_  $\times$  \_\_\_\_\_.
- ▶ \_\_\_\_\_ is the amount of space taken up by a three-dimensional (3-D) solid.
- ▶ The volume of a cuboid =  
\_\_\_\_\_  $\times$  \_\_\_\_\_  $\times$  \_\_\_\_\_.

### Tip

If a question gives dimensions in different units, convert them so that all the units are the same before you work out perimeter, area or volume.

## Try the skill

1. A rugby pitch measures 200 metres long and 90 metres wide.

What is the area of the pitch?

- A  290 m<sup>2</sup>
- B  18 000 m<sup>2</sup>
- C  380 m<sup>2</sup>
- D  1800 m<sup>2</sup>

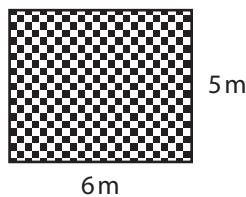
2. A woman wants to gravel over her garden. She estimates the garden to be 8.4 metres long by 7.5 metres wide.

What is the approximate area of her garden?

- A  64 m<sup>2</sup>
- B  56 m<sup>2</sup>
- C  58 m<sup>2</sup>
- D  70 m<sup>2</sup>

3. In a house, the kitchen floor is 6 metres long by 5 metres wide. The floor area is calculated to be 30 units.

What is the unit for the floor area?

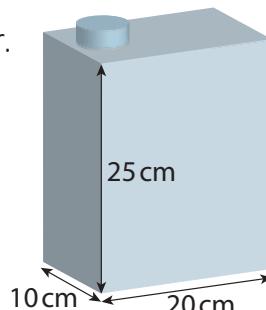


- A  m
- B  m<sup>2</sup>
- C  m<sup>3</sup>
- D  cm<sup>2</sup>

4. This diagram shows a water container. What is the volume the container?

### Tip

A litre is the same as 1000 cm<sup>3</sup>

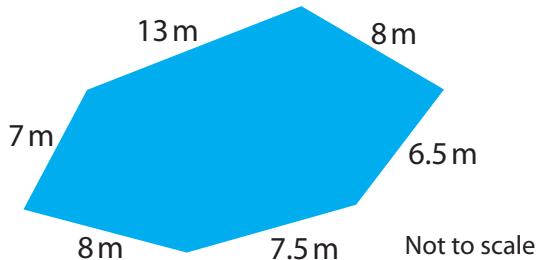


- A  55 cm<sup>3</sup>
- B  500 cm<sup>3</sup>
- C  755 cm<sup>3</sup>
- D  5000 cm<sup>3</sup>

5. A second water container has a capacity of  $5000\text{ cm}^3$ .  
What is  $5000\text{ cm}^3$  in litres?

A  0.5l  
B  5l  
C  50l  
D  500l

6. How long would a fence need to be in order to enclose this boating lake?



7. A man wants to put new carpet on the floor in his office. The floor is 6.92 metres long and 4.84 metres wide.  
Which of the following calculations should he use to find a quick estimate of the area of the floor?

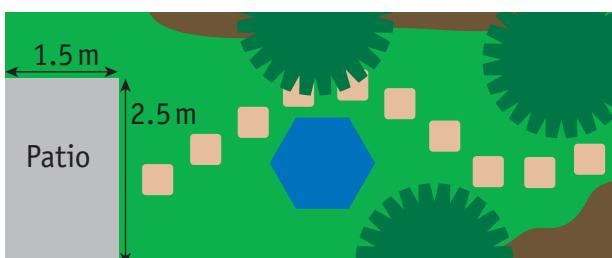
A  50 m  
B  60 m  
C  80 m  
D  100 m

8. The diagram shows a cardboard box used to package perfume. The box is a cube of side length 10cm.  
What is its volume?



A   $6 \times 4$   
B   $6 \times 5$   
C   $7 \times 4$   
D   $7 \times 5$

9. A rectangular area in a garden is to be paved for a patio.

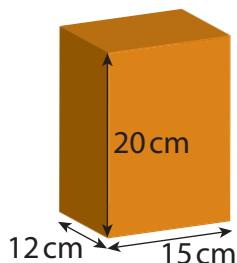


A   $1000\text{ cm}^2$   
B   $100\text{ cm}^3$   
C   $100\text{ cm}^2$   
D   $1000\text{ cm}^3$

What is the area to be paved for the patio?

A   $1.25\text{ m}^2$   
B   $3.50\text{ m}^2$   
C   $3.75\text{ m}^2$   
D   $4.00\text{ m}^2$

10. How do you work out the correct volume of this box?



A  Add 12, 15 and 20 together.  
B  Add 12, 15 and 20 together, then multiply by 2.  
C  Add 20 to 15, then multiply by 12.  
D  Multiply 20 by 15 by 12.