



KING EDWARD VI  
HANDSWORTH GRAMMAR  
SCHOOL FOR BOYS



KING EDWARD VI  
ACADEMY TRUST  
BIRMINGHAM

# Year 9

## 2025 Mathematics 2026

### Unit 13 Booklet – Part 1

HGS Maths



Tasks



Dr Frost Course



Name: \_\_\_\_\_

Class: \_\_\_\_\_



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# Year 9

## 2025 Mathematics 2026

### Unit 13 Booklet – Part 2

HGS Maths



Tasks



Dr Frost Course



Name: \_\_\_\_\_

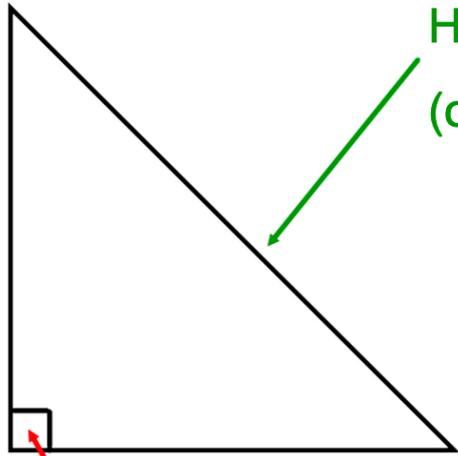
Class: \_\_\_\_\_

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- 3 [Plans and Elevations](#)
- 4 [Volume and Surface Area of Prisms](#)
- 5 [Area and Volume Unit Conversions](#)
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# 1 2D Pythagoras' Theorem

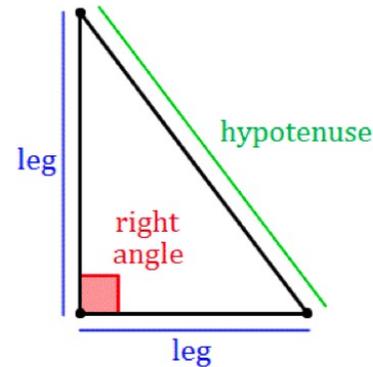
# Hypotenuse



Hypotenuse  
(opposite the right angle)

Right Angle  
(90°)

From the Greek derived *hypo* meaning 'under' and *teinein* meaning 'to stretch'.

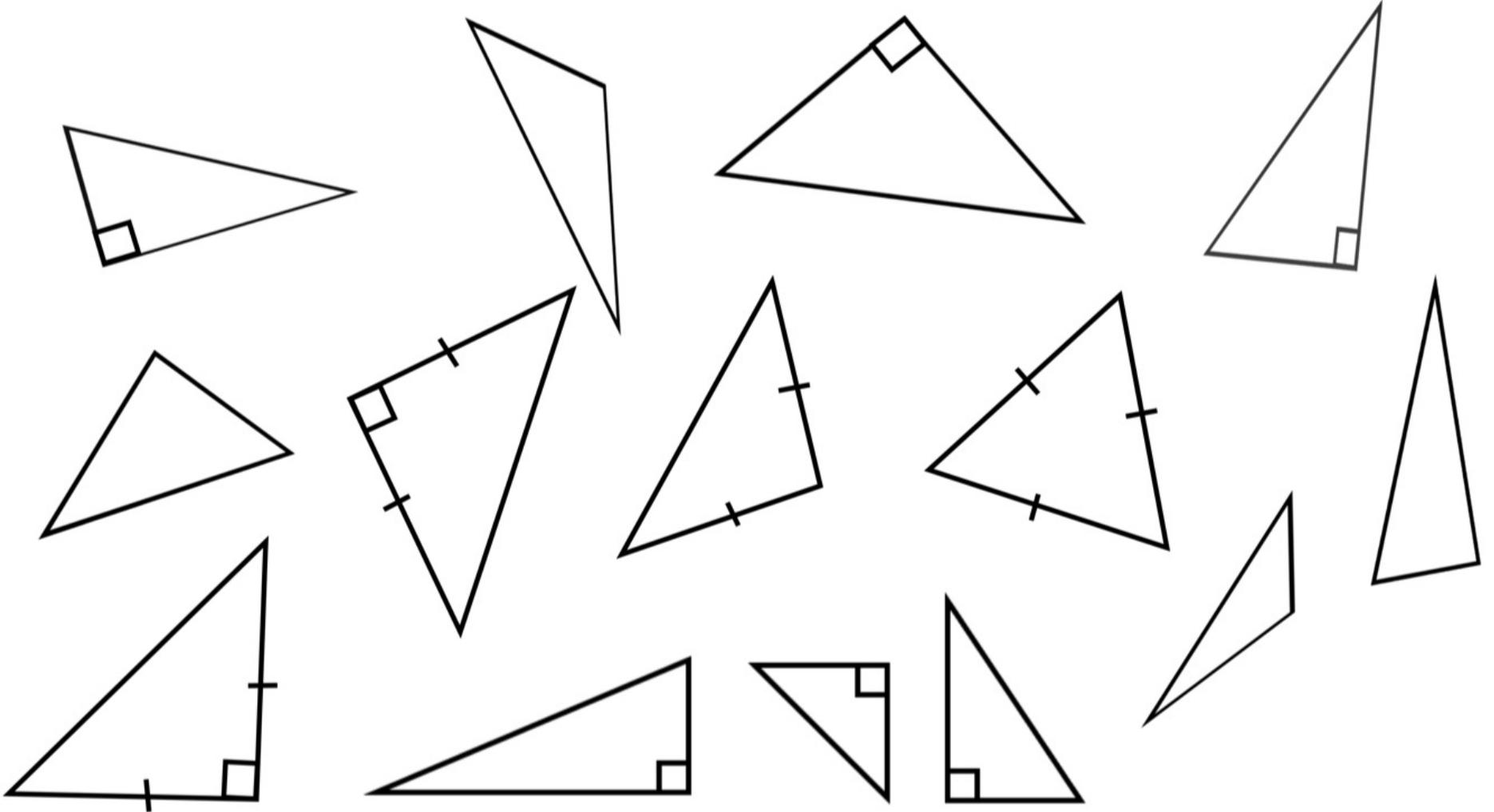


The two sides that aren't the hypotenuse are known as legs.

The hypotenuse is the side that stretches from one leg to another.

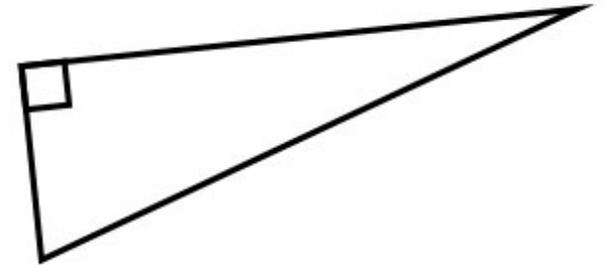
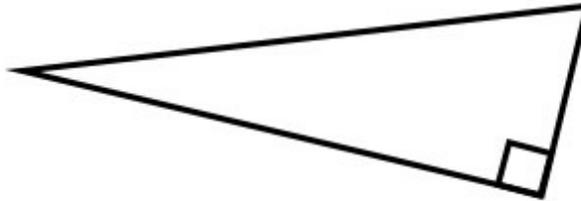
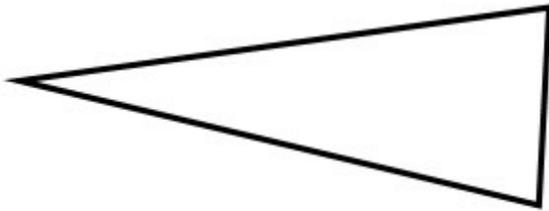
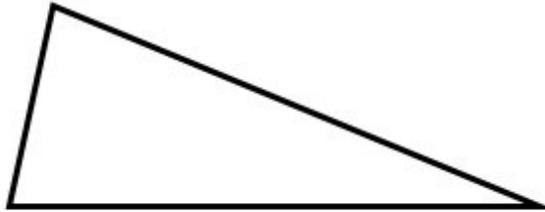
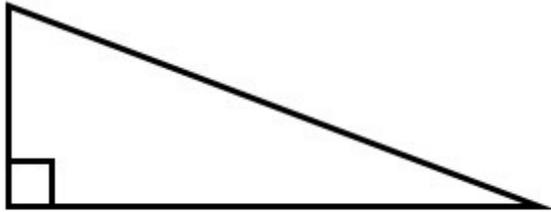
# Fluency Practice

In each triangle that has a hypotenuse, label the hypotenuse with a letter C

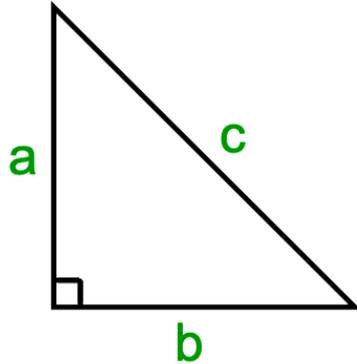


## Fluency Practice

- Cross out all shapes which Pythagoras' Theorem won't apply to.
- In each remaining shape, label the hypotenuse  $c$  and the legs  $a$  and  $b$ .



## Pythagoras' Theorem

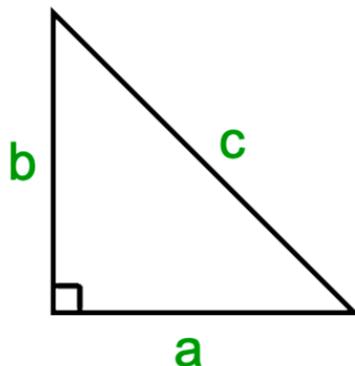


In any *right angled triangle*, the square of the hypotenuse is equal to the sum of the squares of the other two sides.

In other words:

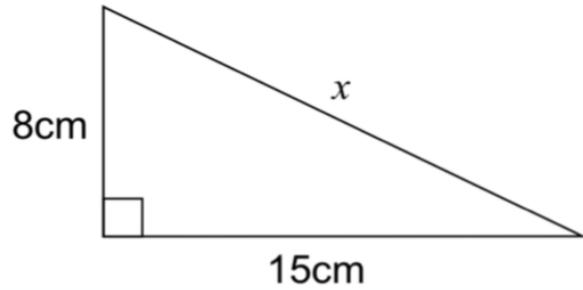
$$a^2 + b^2 = c^2$$

Note: a and b can be labelled in any order but c has to be the hypotenuse i.e the triangle could be labelled like this:



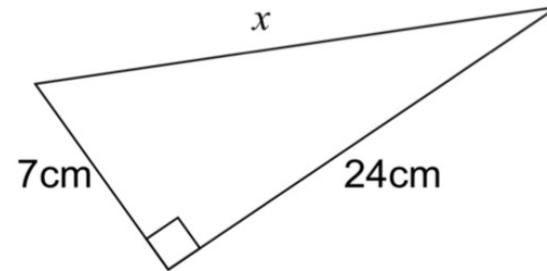
### Worked Example

Calculate the unknown side in this triangle.



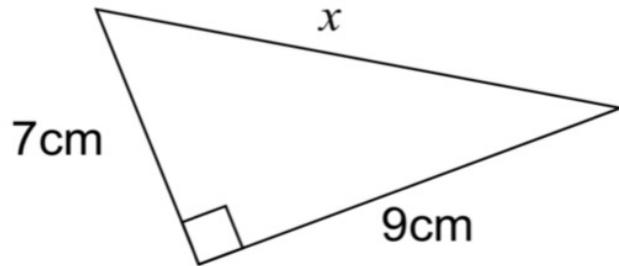
### Your Turn

Calculate the unknown side in this triangle.



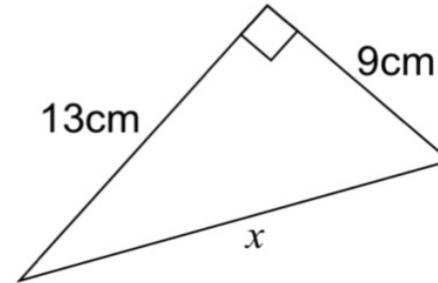
### Worked Example

Calculate the unknown side in this triangle. Give your answer to 2 decimal places.



### Your Turn

Calculate the unknown side in this triangle. Give your answer to 2 decimal places.



## Converse of Pythagoras' Theorem

Pythagoras' Theorem has an 'If ... then ...' structure.

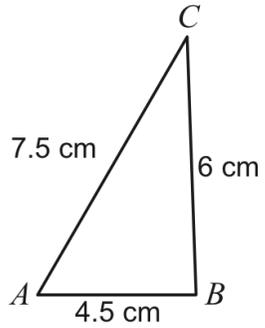


The converse of Pythagoras' Theorem is also true.



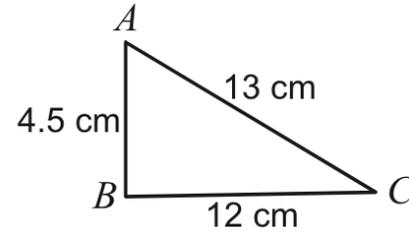
### Worked Example

Determine whether the triangle below is right-angled.



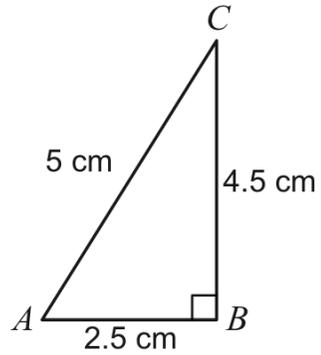
### Your Turn

Determine whether the triangle below is right-angled.



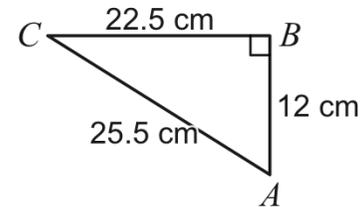
### Worked Example

Determine whether it is possible to construct the triangle with the lengths and angles given in the diagram below.



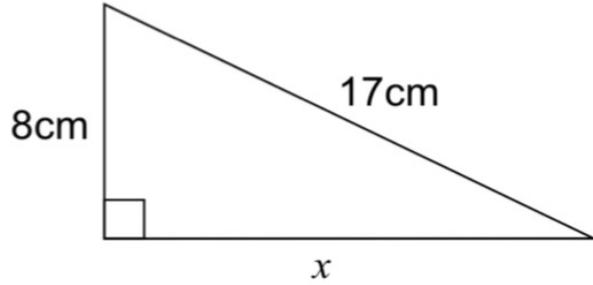
### Your Turn

Determine whether it is possible to construct the triangle with the lengths and angles given in the diagram below.



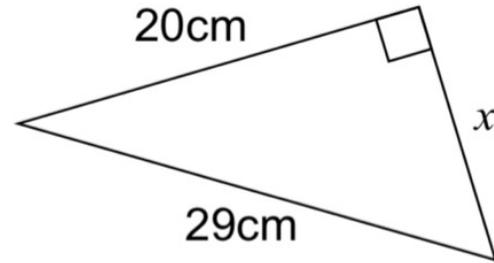
### Worked Example

Calculate the unknown side in this triangle.



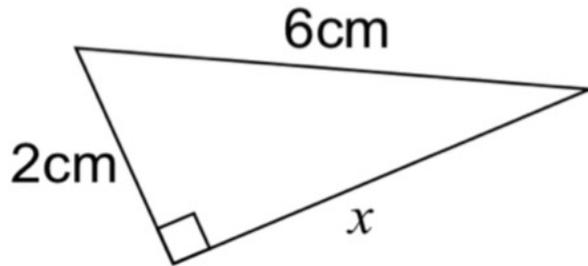
### Your Turn

Calculate the unknown side in this triangle.



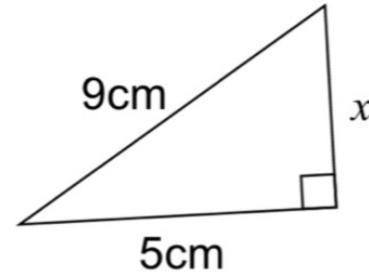
### Worked Example

Calculate the unknown side in this triangle. Give your answer to 2 decimal places.



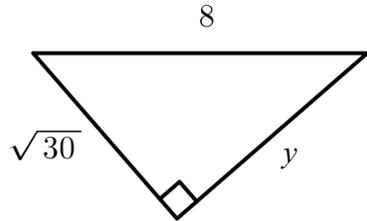
### Your Turn

Calculate the unknown side in this triangle. Give your answer to 2 decimal places.



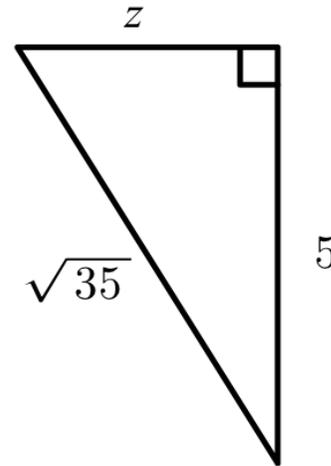
### Worked Example

Given that all lengths are in centimetres, work out the exact value of  $y$



### Your Turn

Given that all lengths are in centimetres, work out the exact value of  $z$



### Worked Example

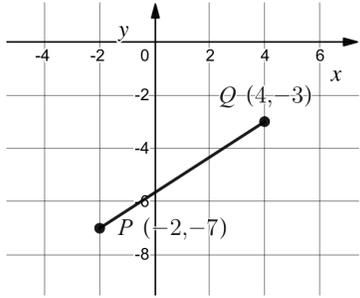
From point  $A$ , Tim walks 100 m due west to point  $B$ . From  $B$ , they then walks  $x$  m due north to point  $C$ . Tim is now 180 m from point  $A$ . Find the value of  $x$ . Round your answer to 1 decimal place.

### Your Turn

From point  $A$ , Fatima walks 90 m due east to point  $B$ . From  $B$ , she then walks  $x$  m due north to point  $C$ . Fatima is now 280 m from point  $A$ . Find the value of  $x$ . Round your answer to 1 decimal place.

## Worked Example

The line segment that connects  $P(-2, -7)$  and  $Q(4, -3)$  is drawn on the coordinate grid.

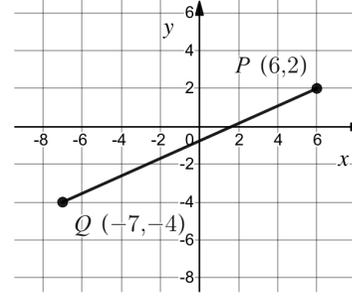


Determine the length  $PQ$ .

Give your answer correct to 1 decimal place.

## Your Turn

The line segment that connects  $P(6, 2)$  and  $Q(-7, -4)$  is drawn on the coordinate grid.



Determine the length  $PQ$ .

Give your answer correct to 1 decimal place.

### Worked Example

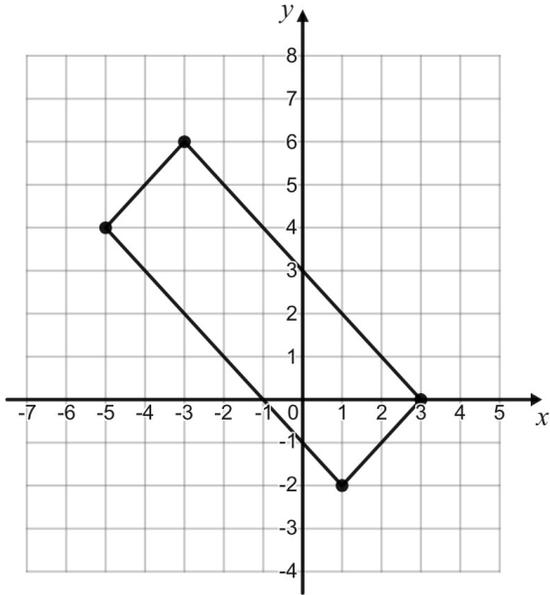
The line segment connects  $P(-6, -4)$  and  $Q(-3, 3)$   
Determine the length  $PQ$ .  
Give your answer correct to 1 decimal place.

### Your Turn

The line segment connects  $P(-6, -1)$  and  $Q(-2, 6)$   
Determine the length  $PQ$ .  
Give your answer correct to 1 decimal place.

## Worked Example

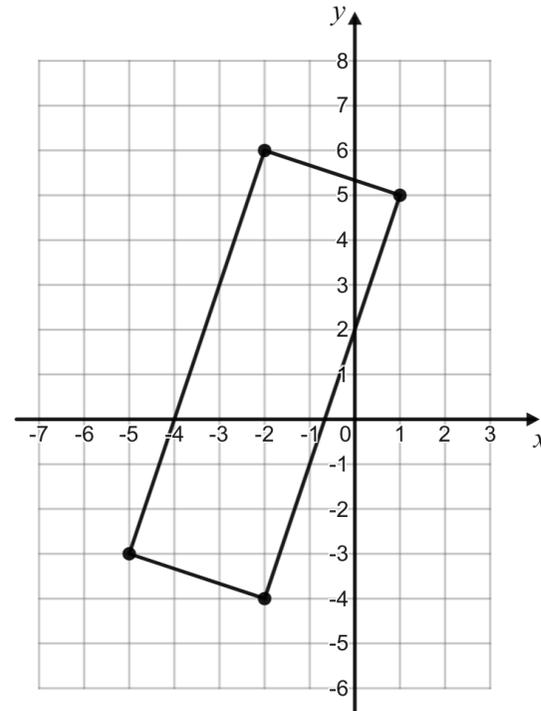
A rectangle is drawn on the coordinate grid below.



Calculate the perimeter of the rectangle.  
Give your answer correct to 2 decimal places.

## Your Turn

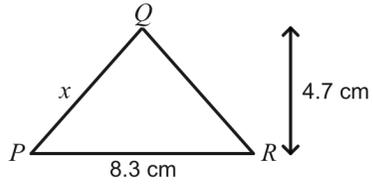
A rectangle is drawn on the coordinate grid below.



Calculate the perimeter of the rectangle.  
Give your answer correct to 1 decimal place.

## Worked Example

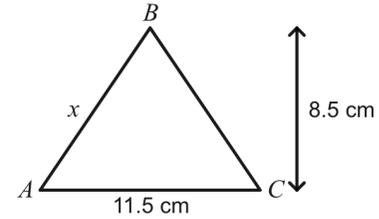
$PQR$  is an isosceles triangle where  $PQ = QR$ .



Find the length marked  $x$  on the diagram.  
Give your answer correct to 1 decimal place.

## Your Turn

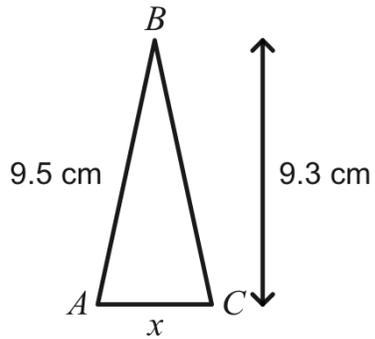
$ABC$  is an isosceles triangle where  $AB = BC$ .



Work out the length marked  $x$  on the diagram.  
Give your answer correct to 1 decimal place.

### Worked Example

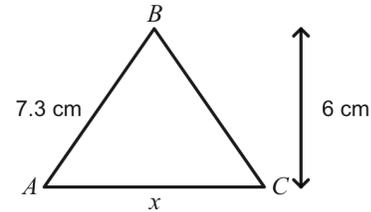
$ABC$  is an isosceles triangle where  $AB = BC$ .



Find the length marked  $x$  on the diagram.  
Give your answer to correct to 1 decimal place.

### Your Turn

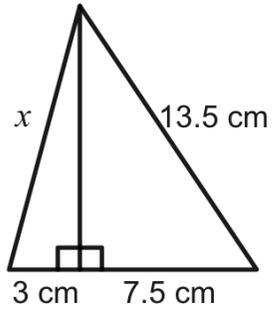
$ABC$  is an isosceles triangle where  $AB = BC$ .



Calculate the length marked  $x$  on the diagram.  
Give your answer to correct to 1 decimal place.

## Worked Example

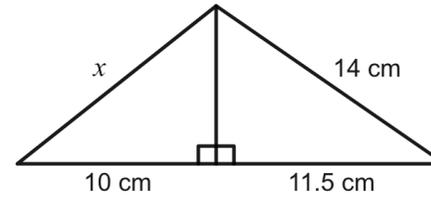
Work out the value of  $x$ .



Give your answer correct to 1 decimal place.

## Your Turn

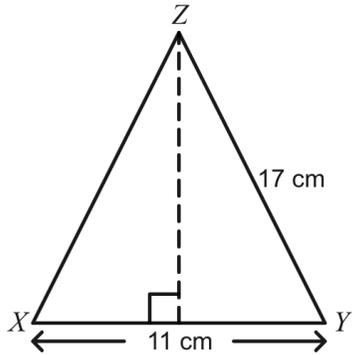
Work out the value of  $x$ .



Give your answer correct to 1 decimal place.

## Worked Example

The diagram below shows the isosceles triangle  $XYZ$ .

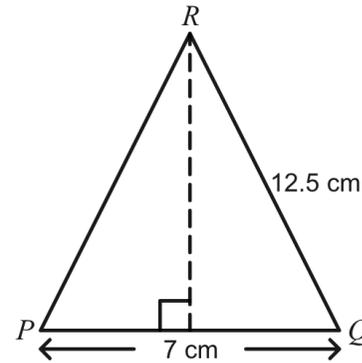


Find the area of triangle  $XYZ$ .

Give your answer to 1 decimal place.

## Your Turn

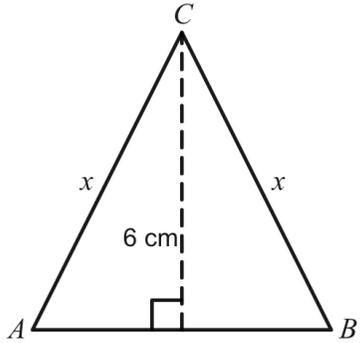
The diagram below shows the isosceles triangle  $PQR$ .



Find the area of triangle  $PQR$ .

## Worked Example

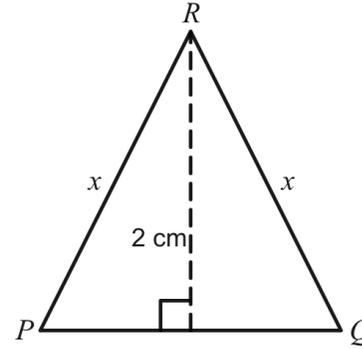
The diagram below shows the isosceles triangle  $ABC$ .



The area of triangle  $ABC$  is  $15\text{ cm}^2$   
Find the length marked  $x$  in the diagram.

## Your Turn

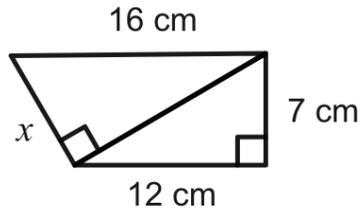
The diagram below shows the isosceles triangle  $PQR$ .



The area of triangle  $PQR$  is  $3\text{ cm}^2$   
Find the length marked  $x$  in the diagram.

### Worked Example

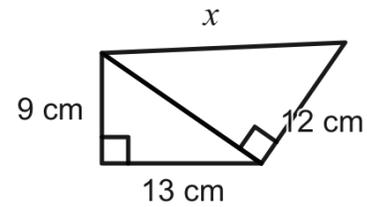
Find the value of  $x$ .



Give your answer correct to 1 decimal place.

### Your Turn

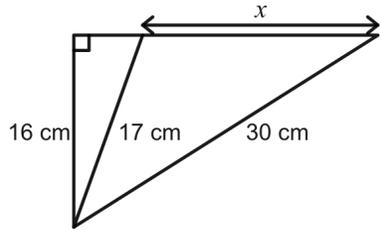
Calculate the value of  $x$ .



Give your answer correct to 1 decimal place.

## Worked Example

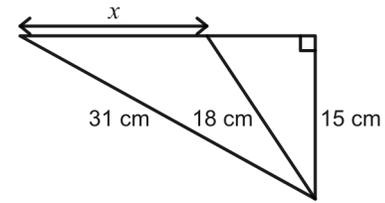
Find the value of  $x$ .



Give your answer correct to 1 decimal place.

## Your Turn

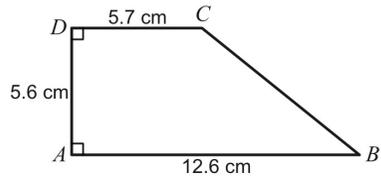
Find the value of  $x$ .



Give your answer correct to 1 decimal place.

## Worked Example

The diagram shows a trapezium  $ABCD$ .

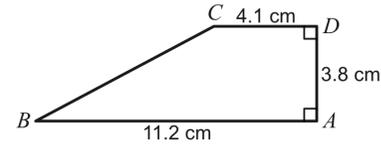


Find the length  $BC$ .

Give your answer to 2 decimal places.

## Your Turn

The diagram shows a trapezium  $ABCD$ .

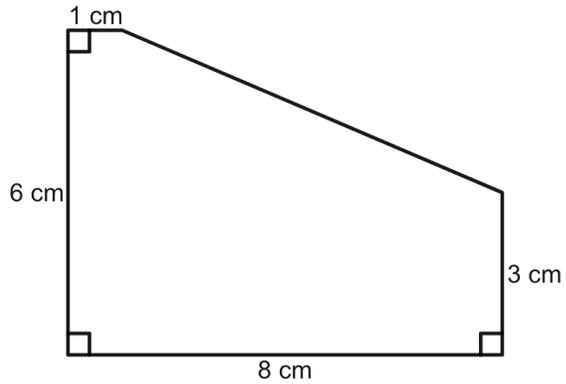


Find the length  $BC$ .

Give your answer to 2 decimal places.

## Worked Example

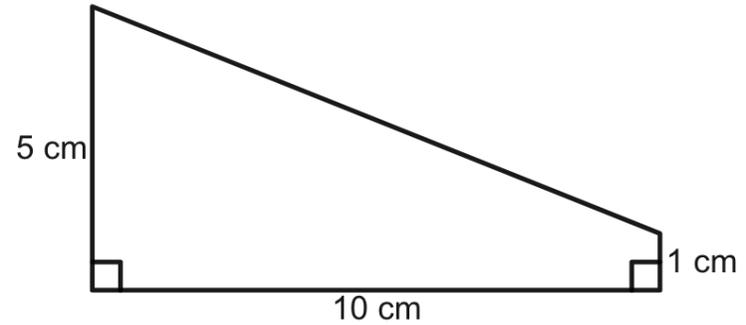
Work out the perimeter of the following shape.



Give your answer in surd form.

## Your Turn

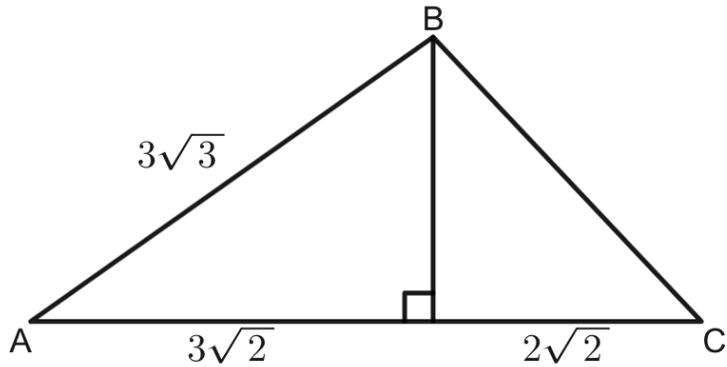
Work out the perimeter of the following shape.



Give your answer in surd form.

### Worked Example

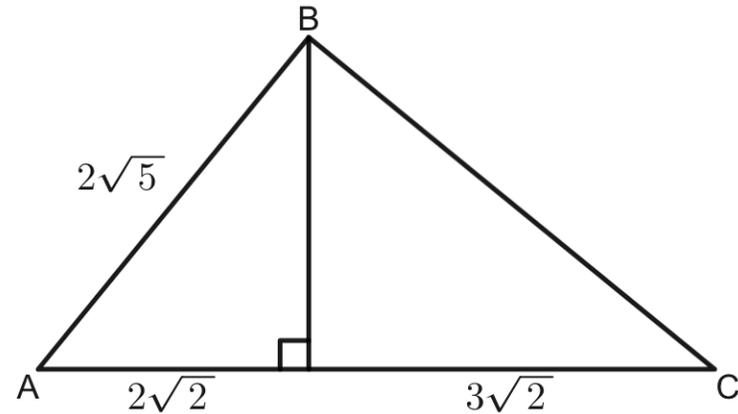
Given that all lengths are in centimetres, find the area of the triangle  $ABC$



Give your answer in simplified surd form.

### Your Turn

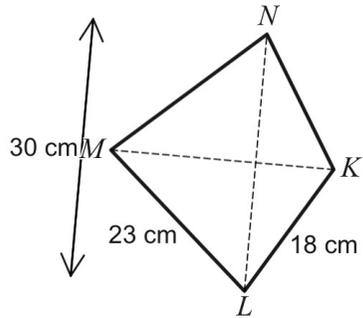
Given that all lengths are in centimetres, find the area of the triangle  $ABC$



Give your answer in simplified surd form.

## Worked Example

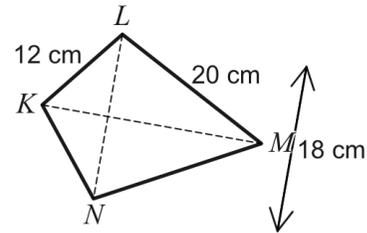
The diagram shows the kite  $KL MN$



Calculate the area of the kite.  
Give your answer correct to 1 decimal place.

## Your Turn

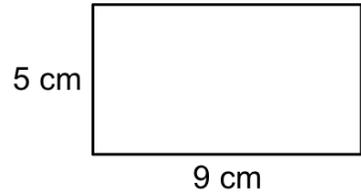
The diagram shows the kite  $KL MN$



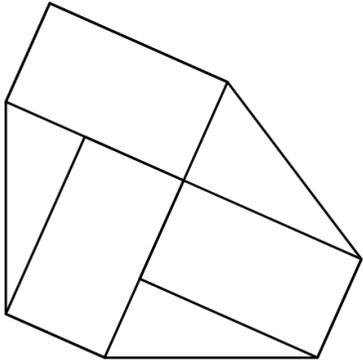
Calculate the area of the kite.  
Give your answer correct to 1 decimal place.

## Worked Example

Here is a rectangle.



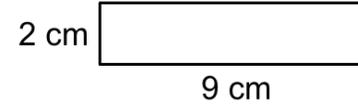
The 7-sided shape below is made from 3 of these rectangles and 3 right-angled triangles.



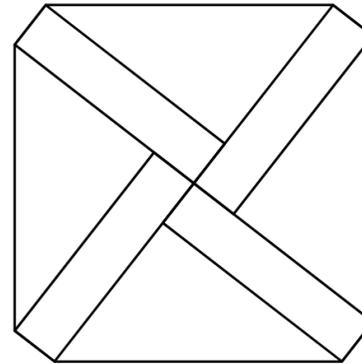
Work out the perimeter of the 7-sided shape.  
Give your answer to 1 decimal place.

## Your Turn

Here is a rectangle.

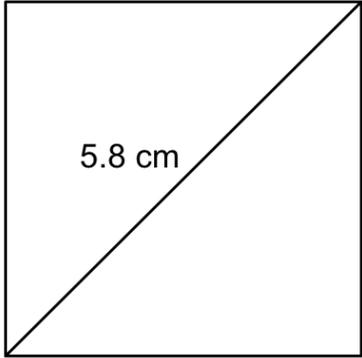


The 8-sided shape below is made from 4 of these rectangles and 4 right-angled triangles.



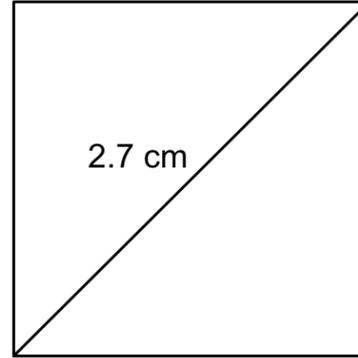
Work out the perimeter of the 8-sided shape.  
Give your answer to 1 decimal place.

### Worked Example



The diagram shows a square with diagonal 5.8 cm.  
Find the perimeter of the square.  
Give your answer correct to 2 decimal places.

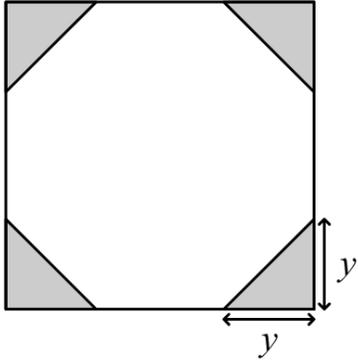
### Your Turn



The diagram shows a square with diagonal 2.7 cm.  
Find the perimeter of the square.  
Give your answer correct to 2 decimal places.

### Worked Example

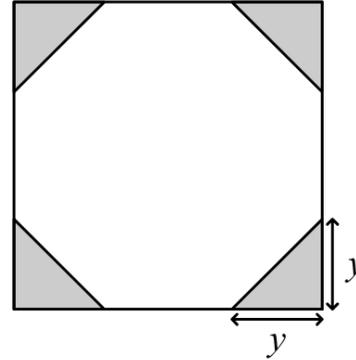
I have a square piece of card of side length 6 cm.  
I cut a triangle from each corner so that the remaining shape is in the shape of a regular octagon.



Work out the length  $y$   
Give your answer correct to 2 decimal places.

### Your Turn

I have a square piece of card of side length 10 cm.  
I cut a triangle from each corner so that the remaining shape is in the shape of a regular octagon.



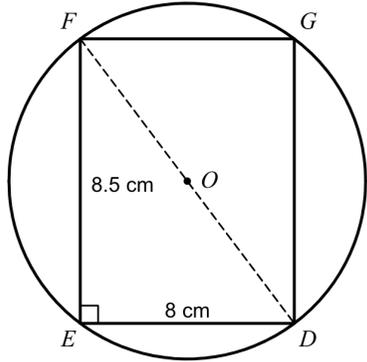
Work out the length  $y$   
Give your answer correct to 2 decimal places.

## Worked Example

The diagram below shows a rectangle  $DEFG$  inscribed in a circle, centre  $O$ .

The lengths of the sides of the rectangle are 8 cm and 8.5 cm.

$DF$  is a diameter of the circle.



- Calculate the area of the circle.
- Calculate the circumference of the circle.

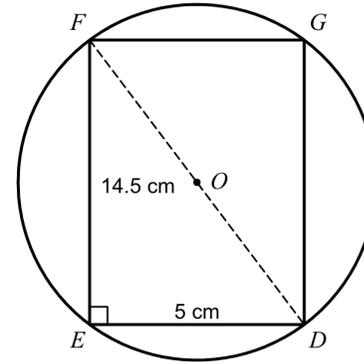
Give your answers correct to 1 decimal place.

## Your Turn

The diagram below shows a rectangle  $DEFG$  inscribed in a circle, centre  $O$ .

The lengths of the sides of the rectangle are 5 cm and 14.5 cm.

$DF$  is a diameter of the circle.



- Calculate the area of the circle.
- Calculate the circumference of the circle.

Give your answers correct to 1 decimal place.

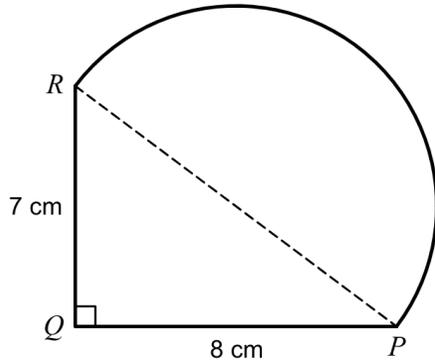
### Worked Example

The shape below consists of a right-angled triangle  $PQR$  and a semicircle.

$PQ$  has length 8 cm and  $QR$  has length 7 cm.

Calculate the area of the shape.

Give your answer correct to 1 decimal place.



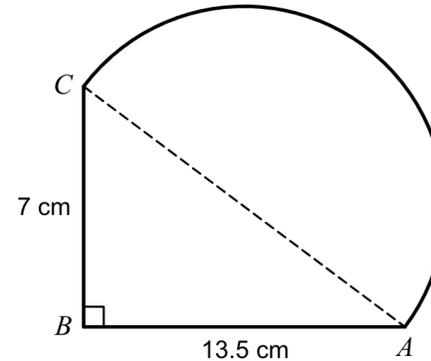
### Your Turn

The shape below consists of a right-angled triangle  $ABC$  and a semicircle.

$AB$  has length 13.5 cm and  $BC$  has length 7 cm.

Calculate the area of the shape.

Give your answer correct to 1 decimal place.



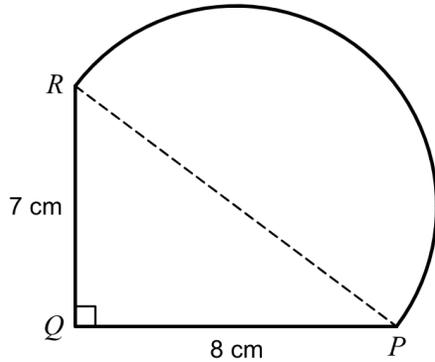
## Worked Example

The shape below consists of a right-angled triangle  $PQR$  and a semicircle.

$PQ$  has length 8 cm and  $QR$  has length 7 cm.

Calculate the perimeter of the shape.

Give your answer correct to 1 decimal place.



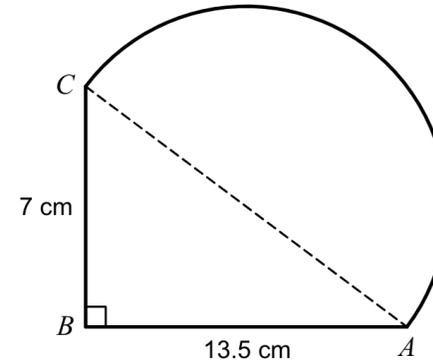
## Your Turn

The shape below consists of a right-angled triangle  $ABC$  and a semicircle.

$AB$  has length 13.5 cm and  $BC$  has length 7 cm.

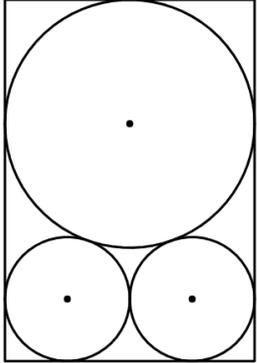
Calculate the perimeter of the shape.

Give your answer correct to 1 decimal place.



### Worked Example

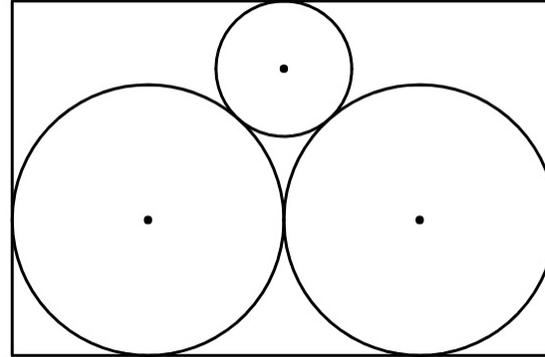
The diagram shows two identical circles and a third, larger, circle inside a rectangle.  
Each circle touches the other two circles and the sides of the rectangle, as shown in the diagram.



The radius of each of the smaller circles is 5 cm.  
Work out the perimeter of the rectangle.  
Give your answer correct to 1 decimal place.

### Your Turn

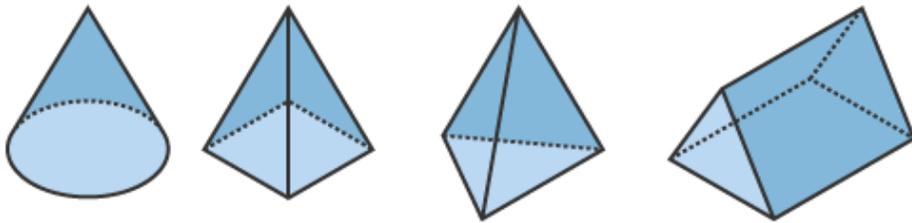
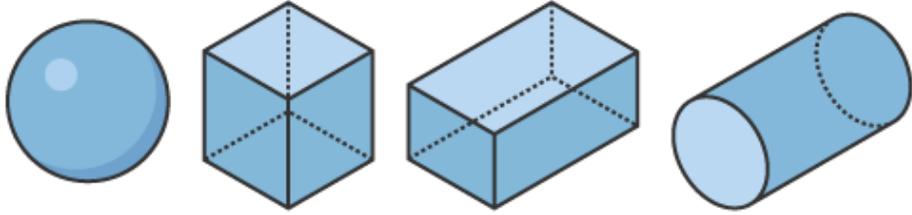
The diagram shows two identical circles and a third, smaller, circle inside a rectangle.  
Each circle touches the other two circles and the sides of the rectangle, as shown in the diagram.



The radius of each of the identical circles is 10 cm, and the radius of the smaller circle is 5 cm.  
Work out the area of the rectangle.  
Give your answer correct to 1 decimal place.

## Extra Notes

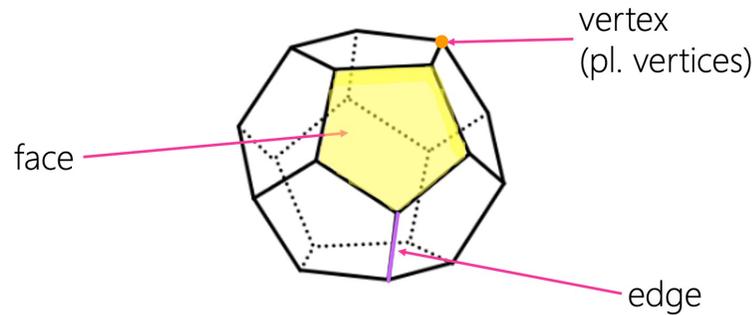
## 2 Properties of 3D Shapes



A **vertex** is a corner.

An **edge** is a line segment between faces.

A **face** is a single flat surface.



## Worked Example

For the cuboid, write down the:



Number of faces ( $F$ )

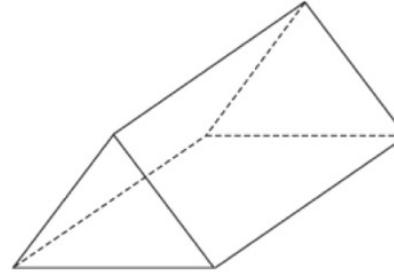
The number of edges ( $E$ )

The number of vertices ( $V$ )

Calculate  $V - E + F$

## Your Turn

For the triangular prism, write down the:



Number of faces ( $F$ )

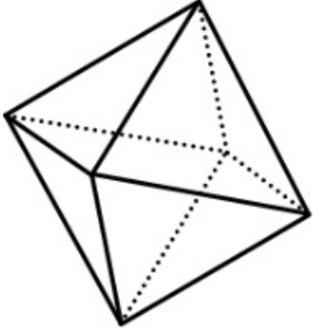
The number of edges ( $E$ )

The number of vertices ( $V$ )

Calculate  $V - E + F$

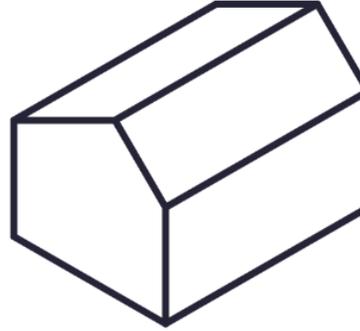
## Worked Example

Here is an octahedron.  
How many faces, edges and vertices does it have?



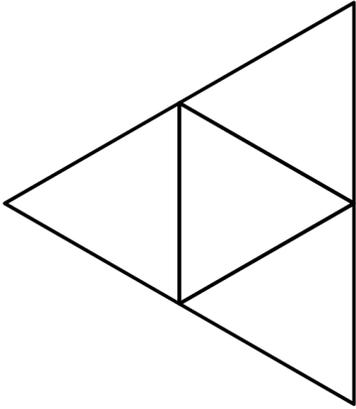
## Your Turn

Here is a pentagonal prism.  
How many faces, edges and vertices does it have?



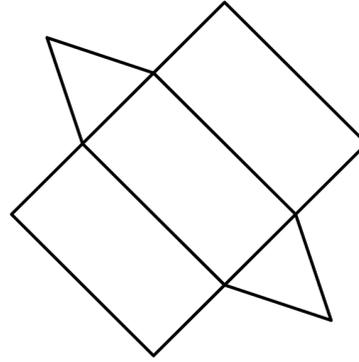
## Worked Example

Which 3D shape is this a net of?



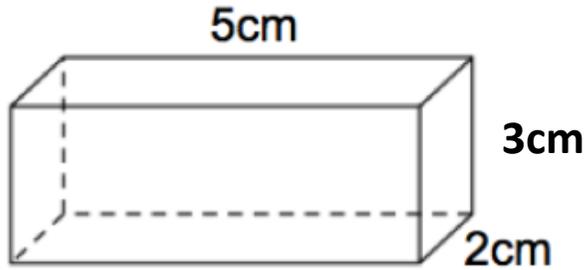
## Your Turn

Which 3D shape is this a net of?

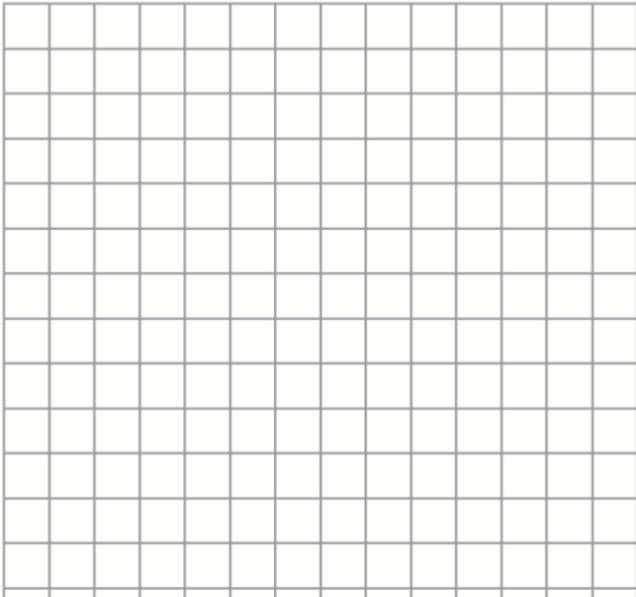


## Worked Example

Draw a net for the cuboid.

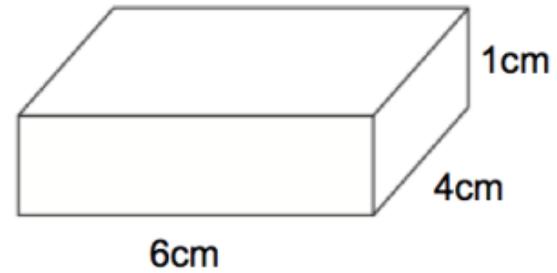


Each square represents  $1 \text{ cm}^2$

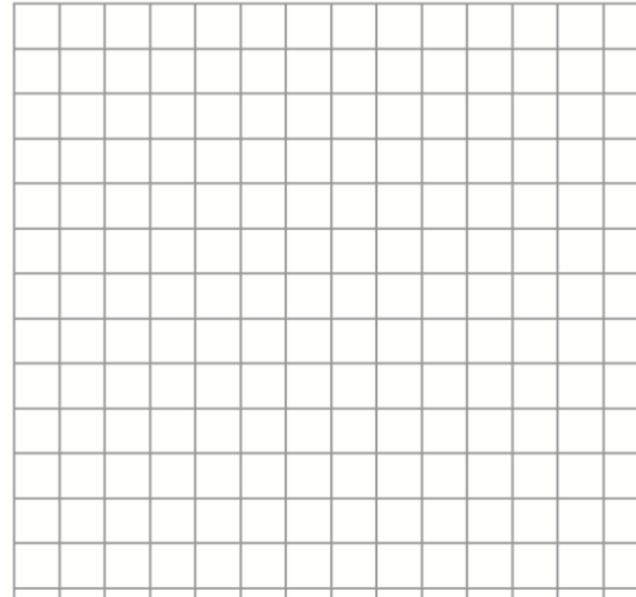


## Your Turn

Draw a net for the cuboid.

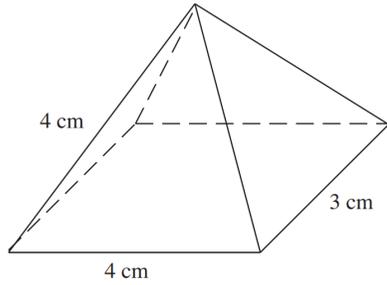


Each square represents  $1 \text{ cm}^2$

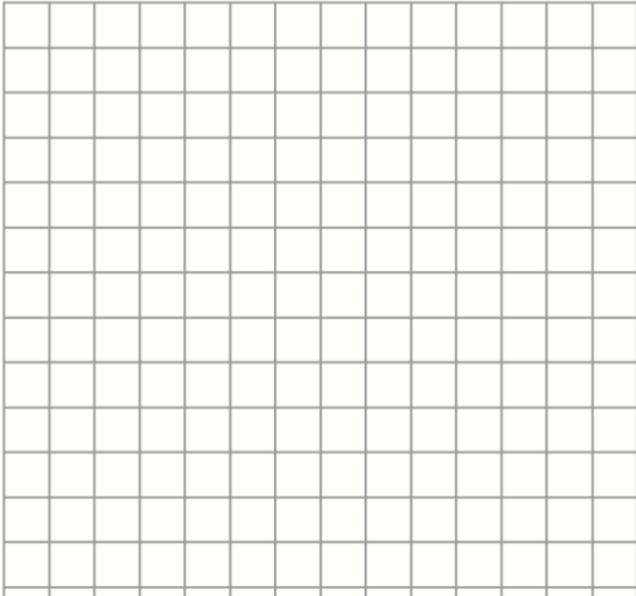


## Worked Example

Draw a net for the solid.

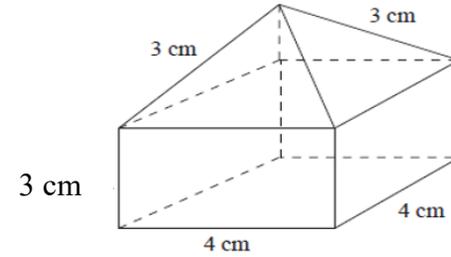


Each square represents  $1 \text{ cm}^2$

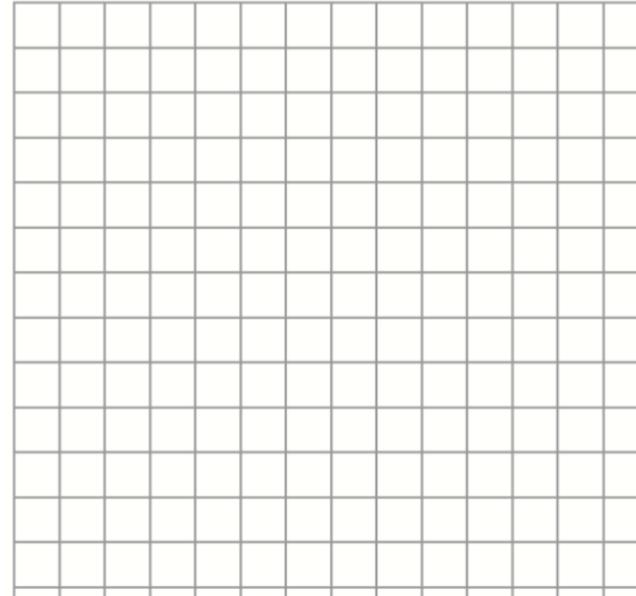


## Your Turn

Draw a net for the solid.

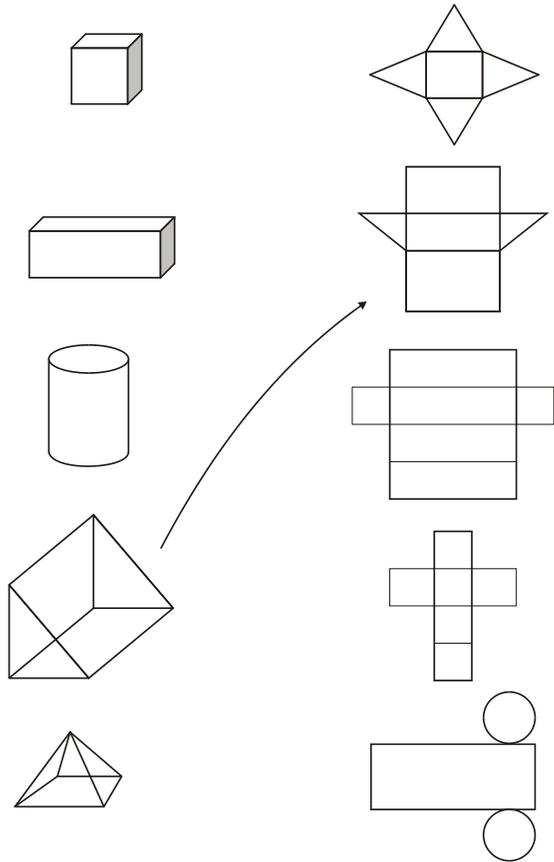


Each square represents  $1 \text{ cm}^2$

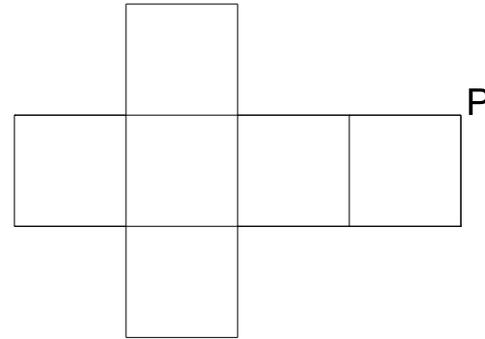


# Fluency Practice

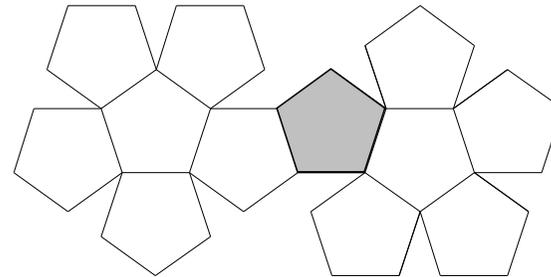
1. Match the 3D solids with their net



2. The net is folded to make a cube.  
Two other vertices meet at *P*.  
Mark each of these vertices with the letter *P*.

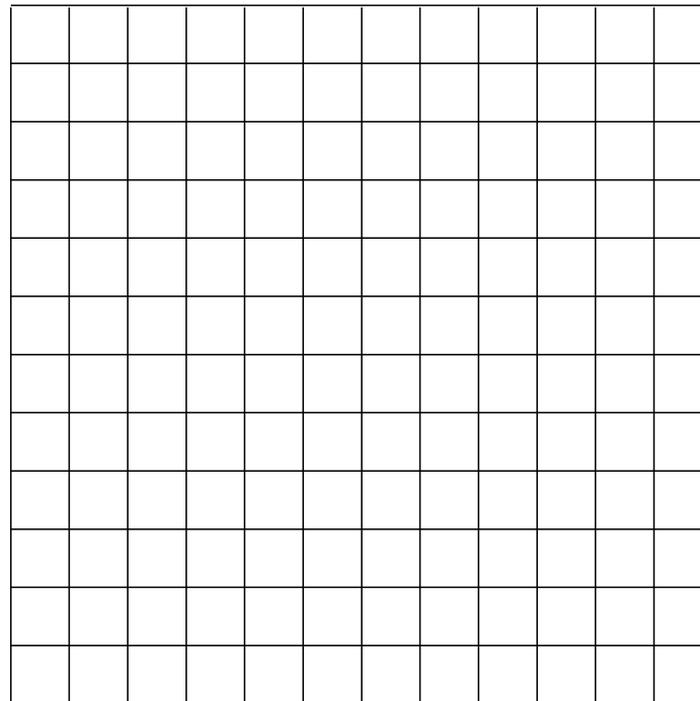
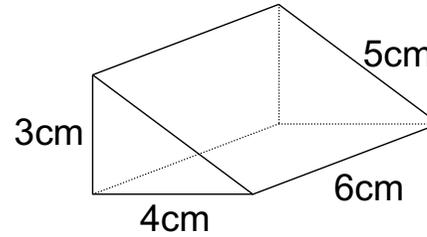
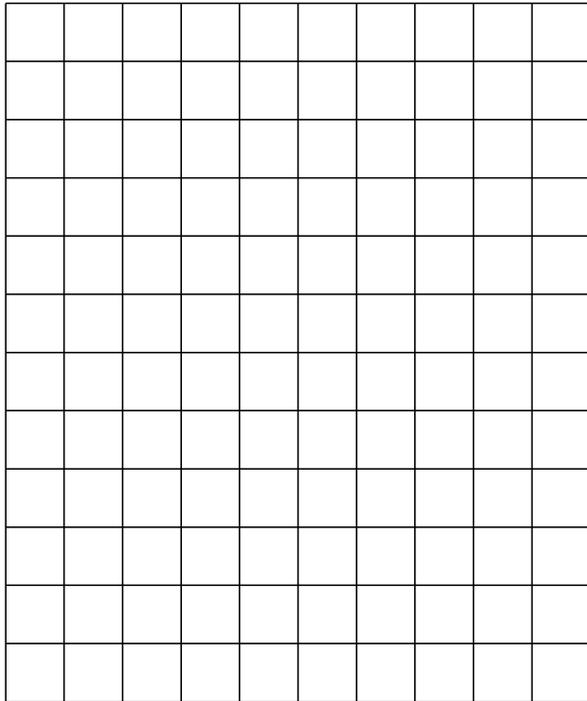
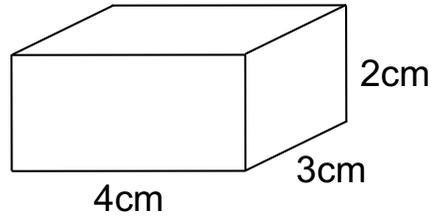


3. The net shown is folded to make a dodecahedron. Label the face which is opposite the shaded one



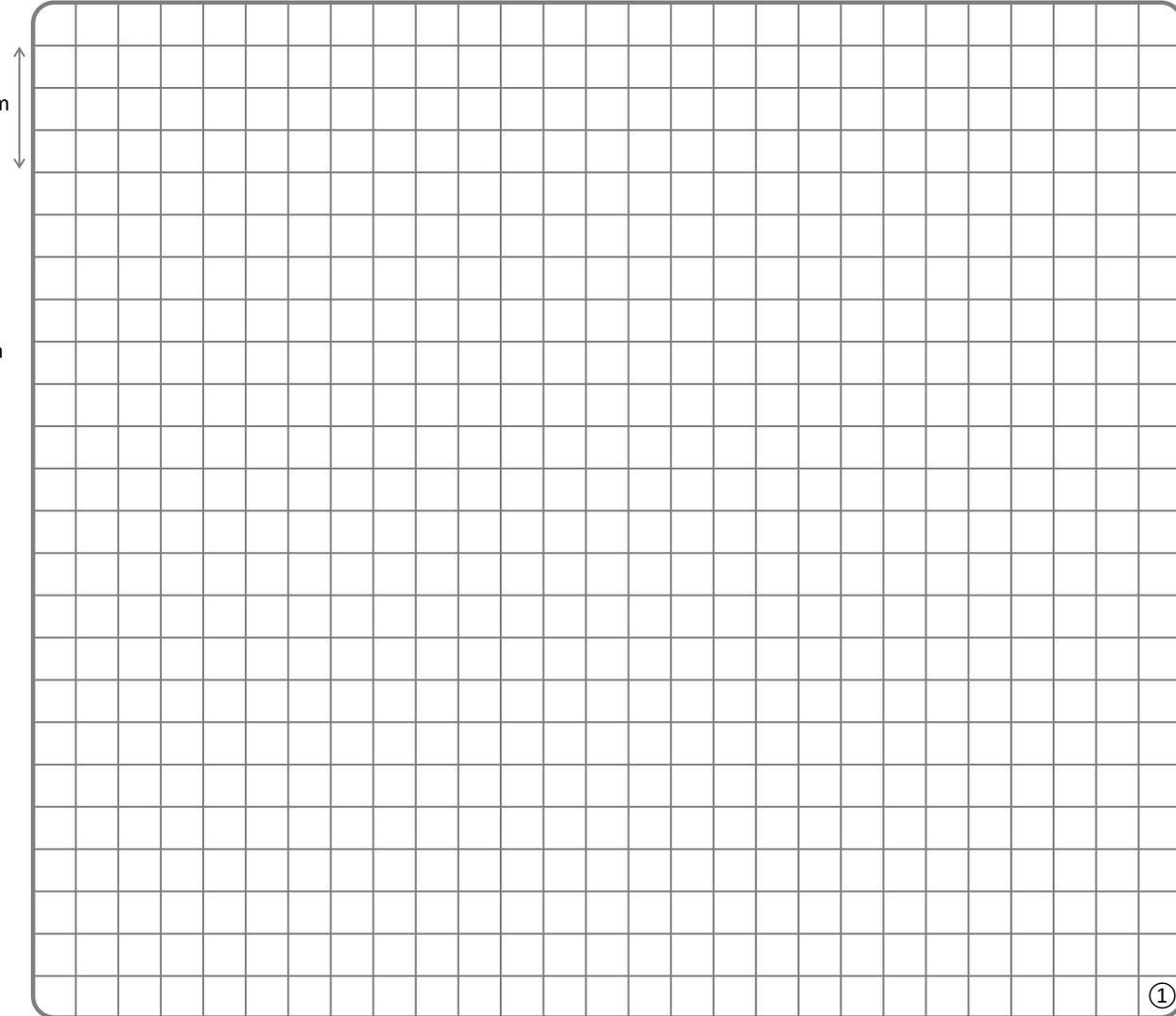
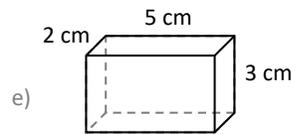
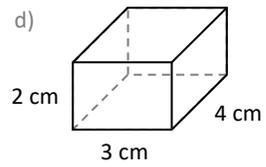
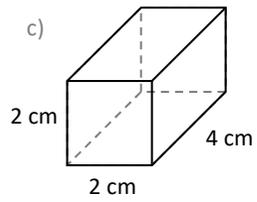
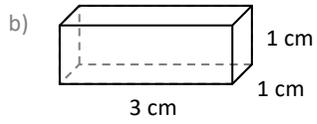
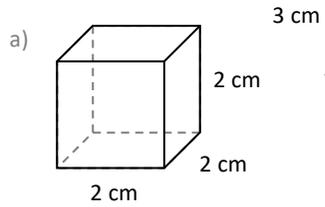
# Fluency Practice

4. Using the grid provided with 1 square = 1 cm, draw an accurate net of these solids



# Fluency Practice

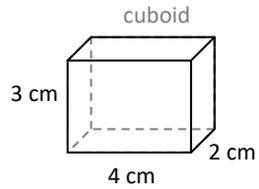
On the scale grid draw the **NET** for each cuboid.



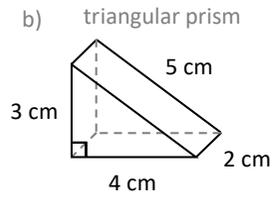
# Fluency Practice

On the scale grid draw the **NET** for each 3D shape.

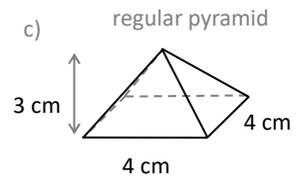
a)



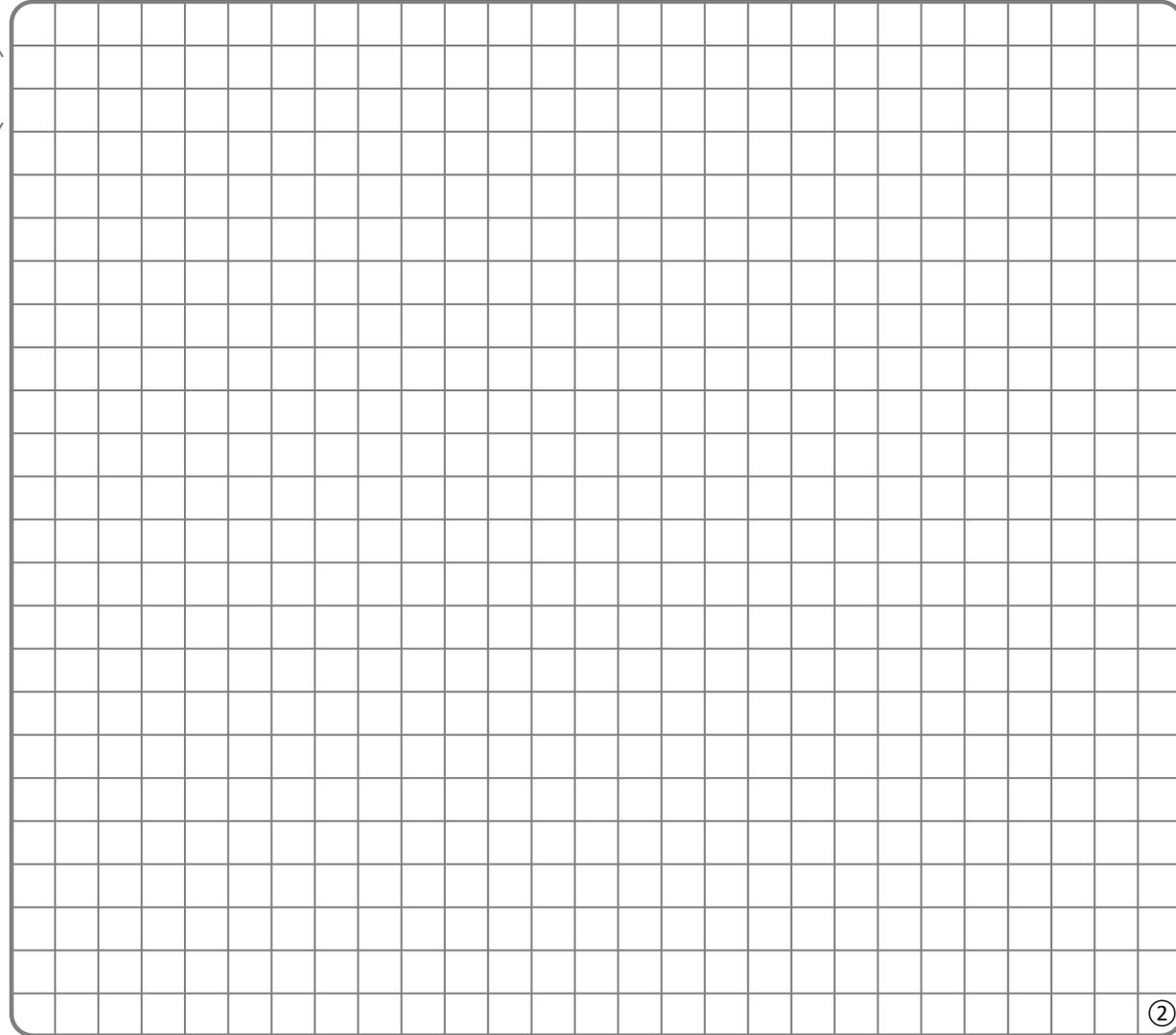
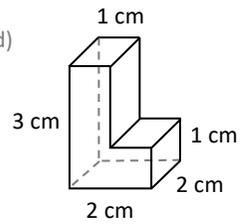
b)



c)

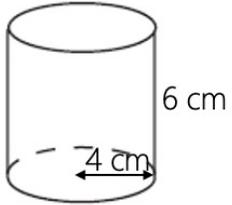


d)

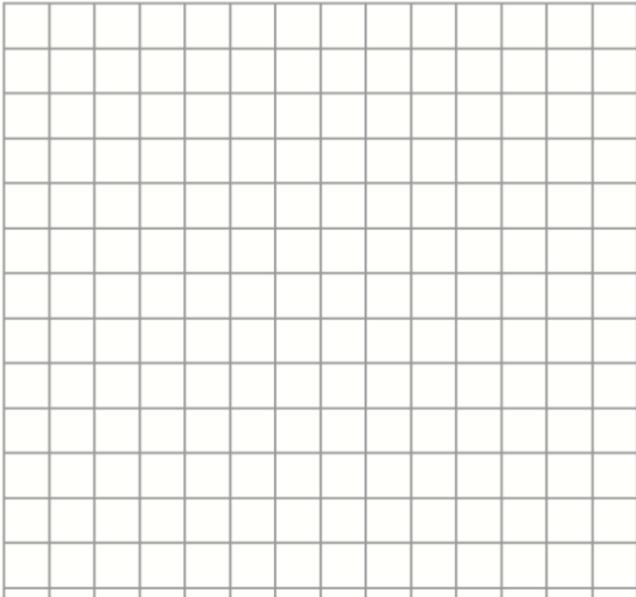


## Worked Example

Draw a net for the cylinder.

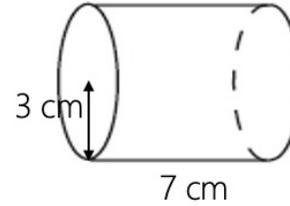


Each square represents  $1 \text{ cm}^2$

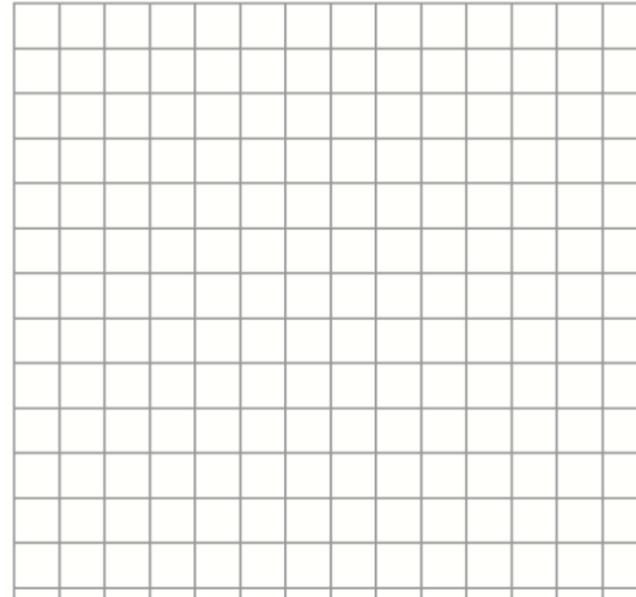


## Your Turn

Draw a net for the cylinder.



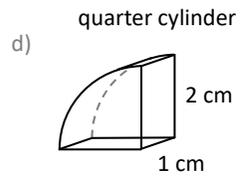
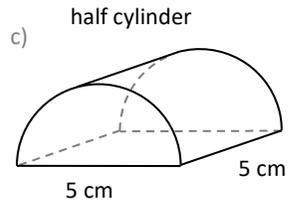
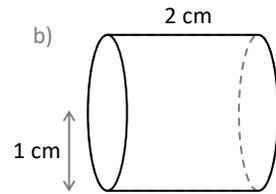
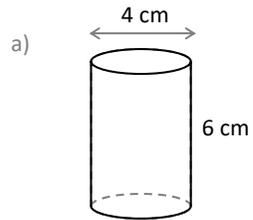
Each square represents  $1 \text{ cm}^2$



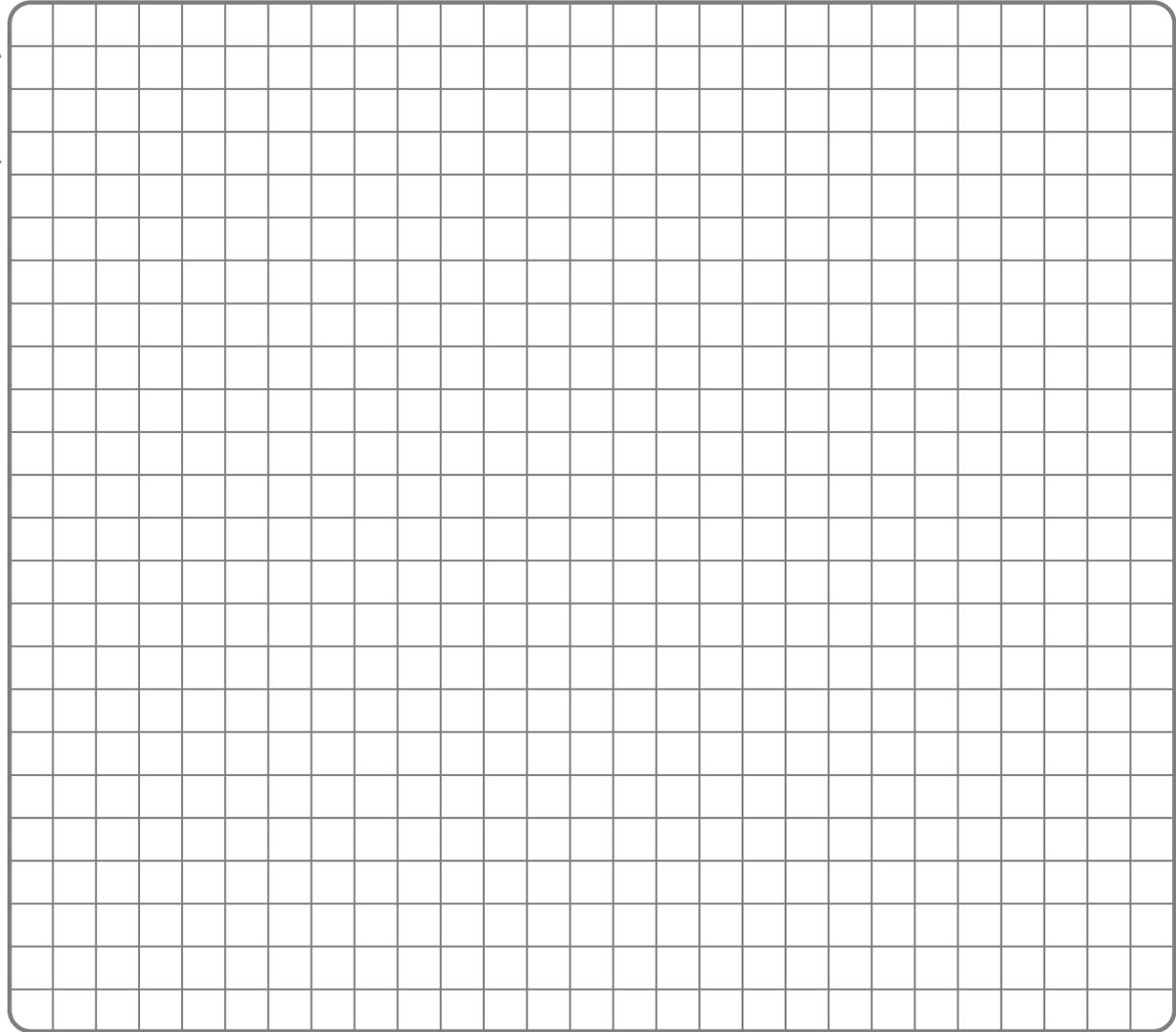
# Fluency Practice

On the scale grid draw the **NET** for each type of cylinder.

Label the lengths of each rectangle.

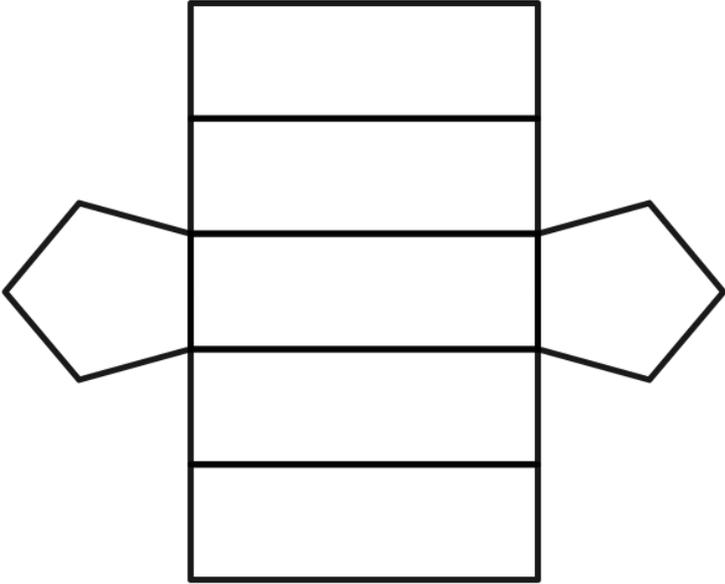


3 cm



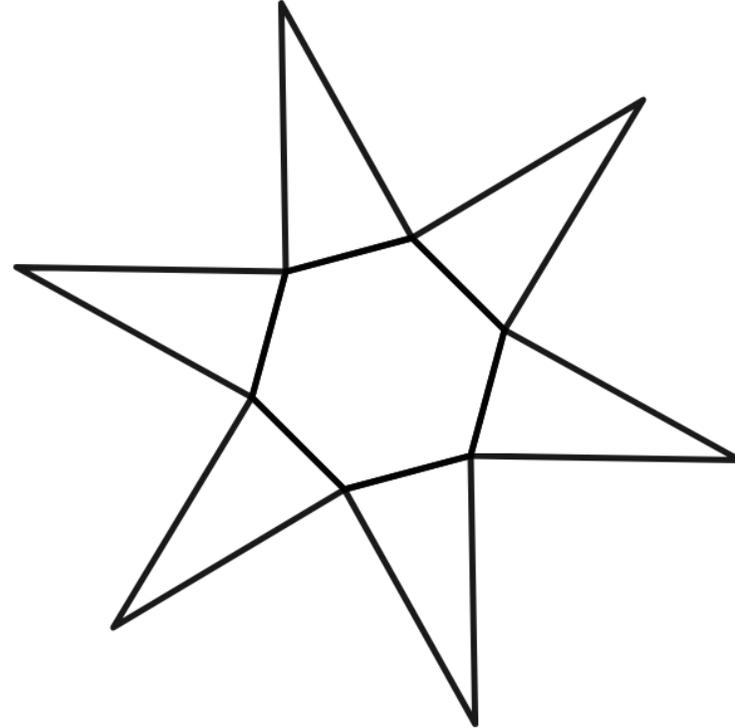
### Worked Example

How many edges does this shape have?



### Your Turn

How many edges does this shape have?



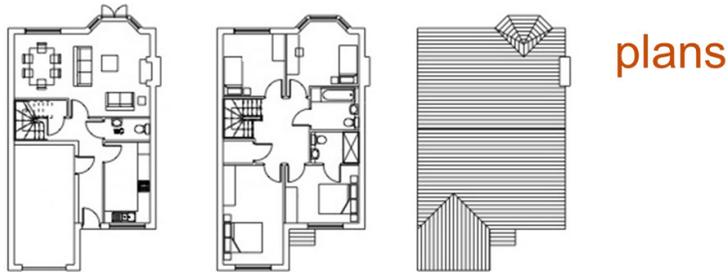
## Extra Notes

### 3 Plans and Elevations

The **plan** is the view from the top of a 3D solid.

**Elevations** are horizontal views of a 3D object:

- **Front elevation:** The view from the front of an object.
- **Back elevation:** The view from behind the object.
- **Side elevation:** The view from the side of an object.



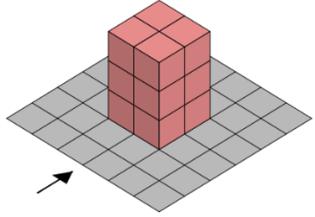
front  
elevation

side  
elevation

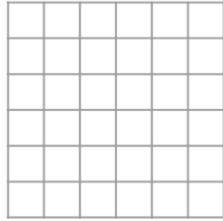
back  
elevation

side  
elevation

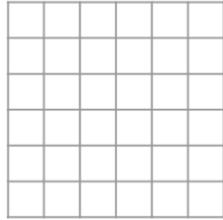
## Worked Example



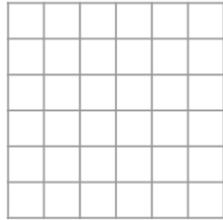
Plan:



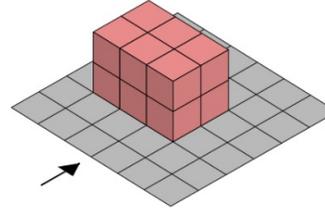
Front (with arrow):



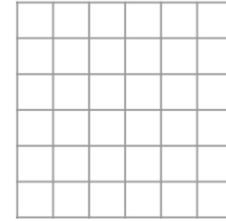
Side (from right):



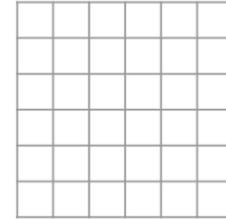
## Your Turn



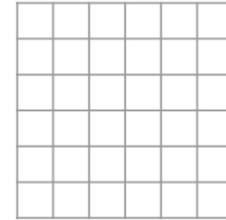
Plan:



Front (with arrow):

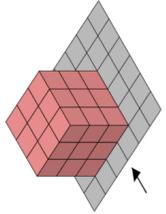
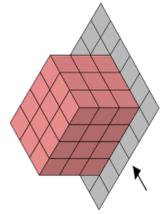
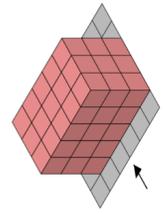
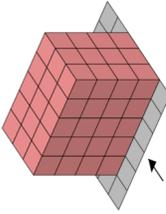
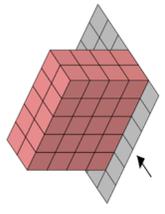
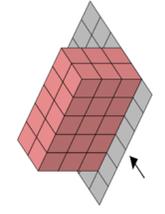


Side (from right):



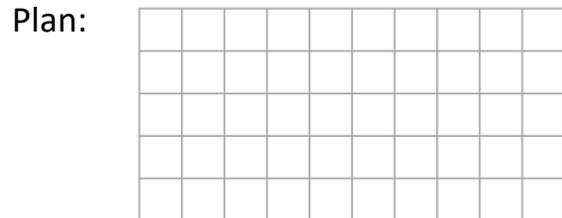
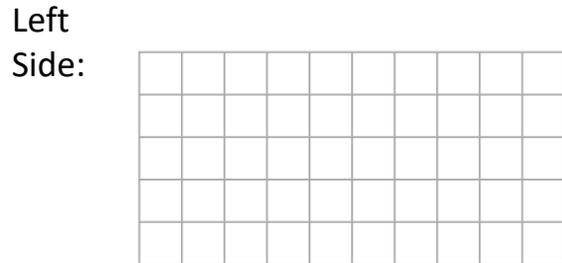
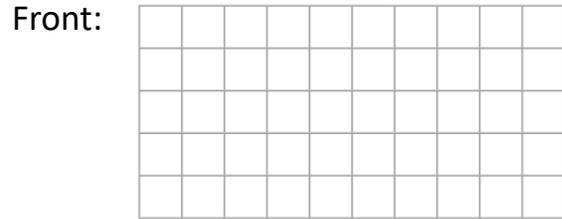
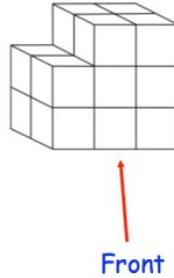
# Fluency Practice

1 For each of the shapes below, draw the plan view, front view (shown with the arrow) and side view (from the right).

	Plan View	Front View	Side View
 <b>a</b>			
 <b>b</b>			
 <b>c</b>			
 <b>d</b>			
 <b>e</b>			
 <b>f</b>			

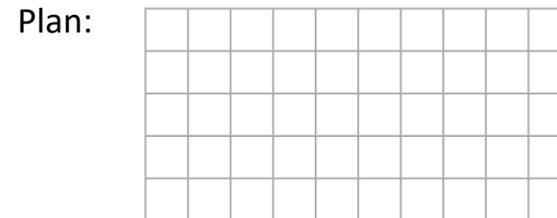
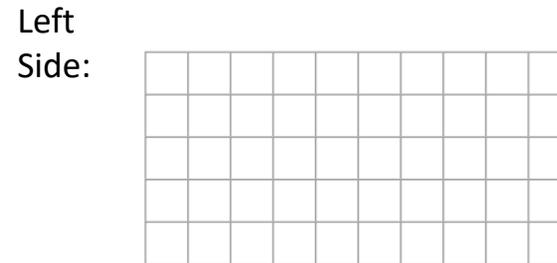
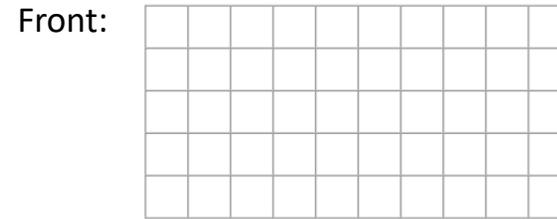
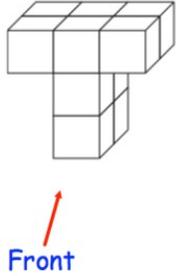
## Worked Example

A shape is made of centimetre cubes. On the centimetre square grid, draw the elevations:



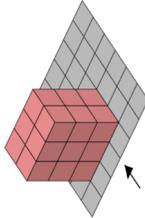
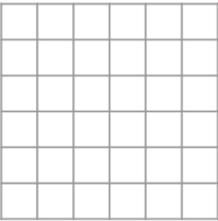
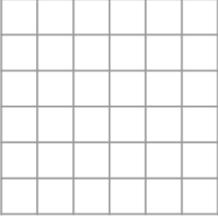
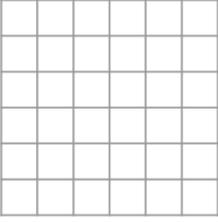
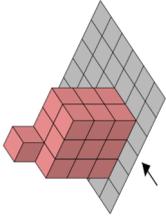
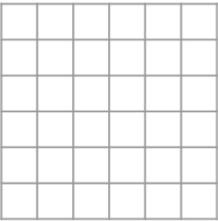
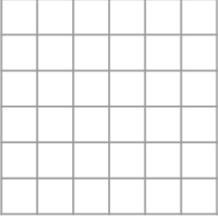
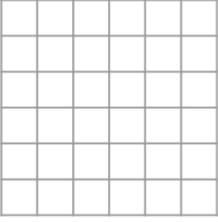
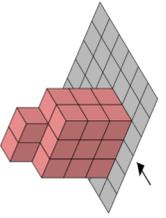
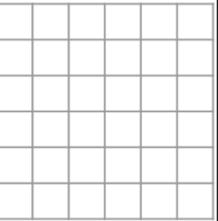
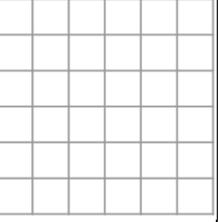
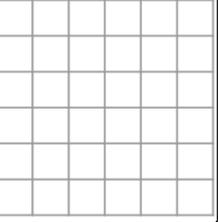
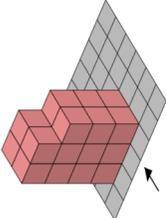
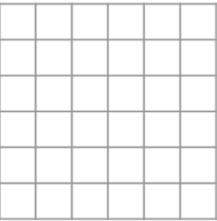
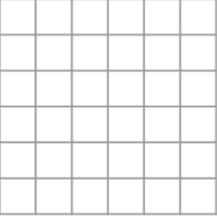
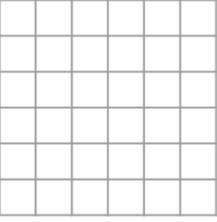
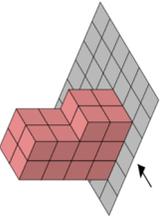
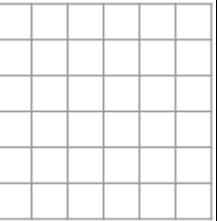
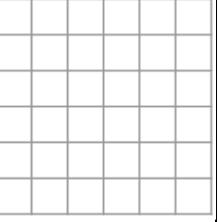
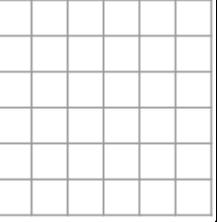
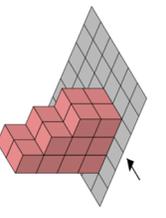
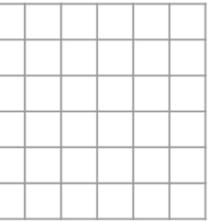
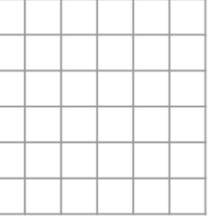
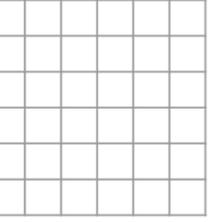
## Your Turn

A shape is made of centimetre cubes. On the centimetre square grid, draw the elevations:

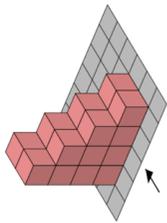
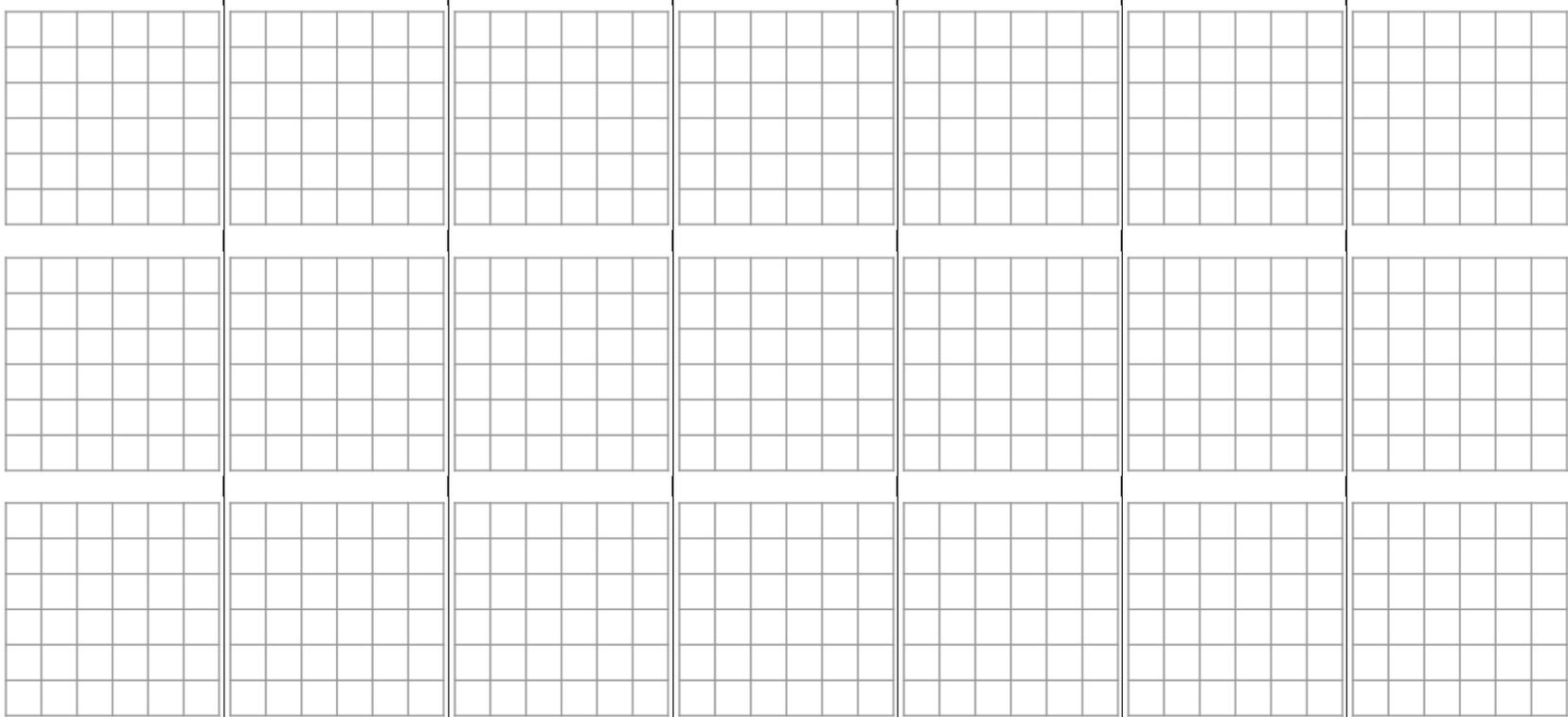


# Fluency Practice

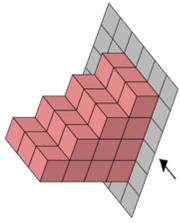
1 For each of the shapes below, draw the plan view, front view (shown with the arrow) and side view (from the right).

	Plan View	Front View	Side View
 <p><b>a</b></p>			
 <p><b>b</b></p>			
 <p><b>c</b></p>			
 <p><b>d</b></p>			
 <p><b>e</b></p>			
 <p><b>f</b></p>			

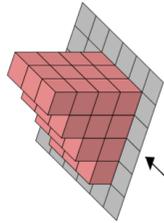
# Fluency Practice



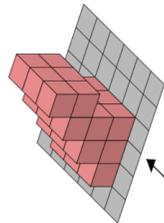
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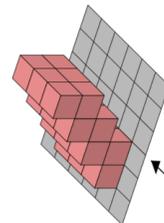
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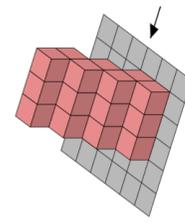
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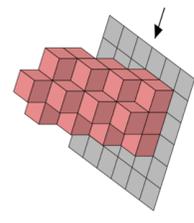
j



k



l



m

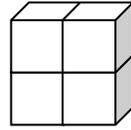
# Fluency Practice

## 4 Cubes

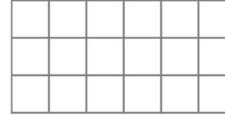
4 cubes can be arranged in 8 different ways.

Draw the plan, the front elevation and the side elevation for each arrangement.

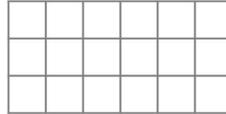
Why are there only 8 arrangements?



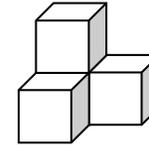
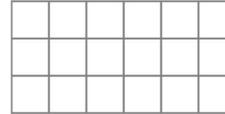
Plan



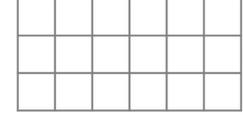
Front Elevation



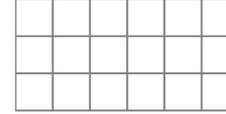
Side Elevation



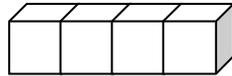
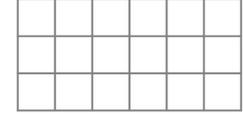
Plan



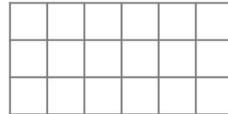
Front Elevation



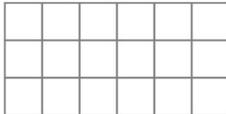
Side Elevation



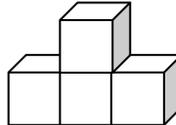
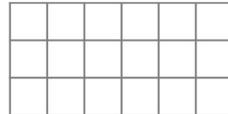
Plan



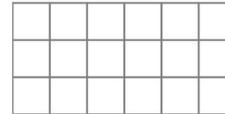
Front Elevation



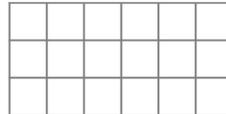
Side Elevation



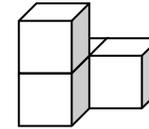
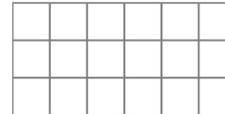
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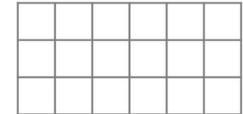
Front Elevation



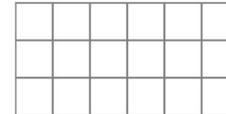
Side Elevation



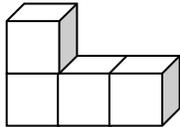
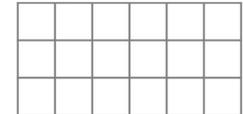
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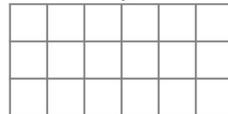
Front Elevation



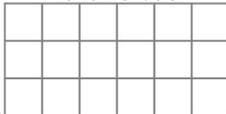
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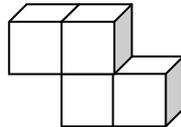
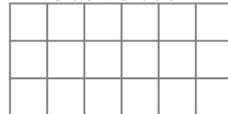
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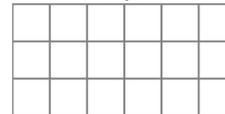
Front Elevation



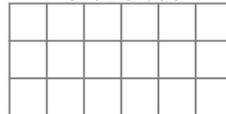
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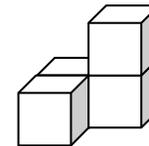
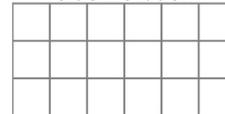
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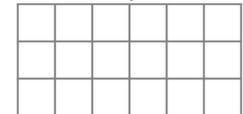
Front Elevation



Side Elevation



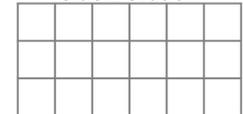
Plan



Front Elevation



Side Elevation

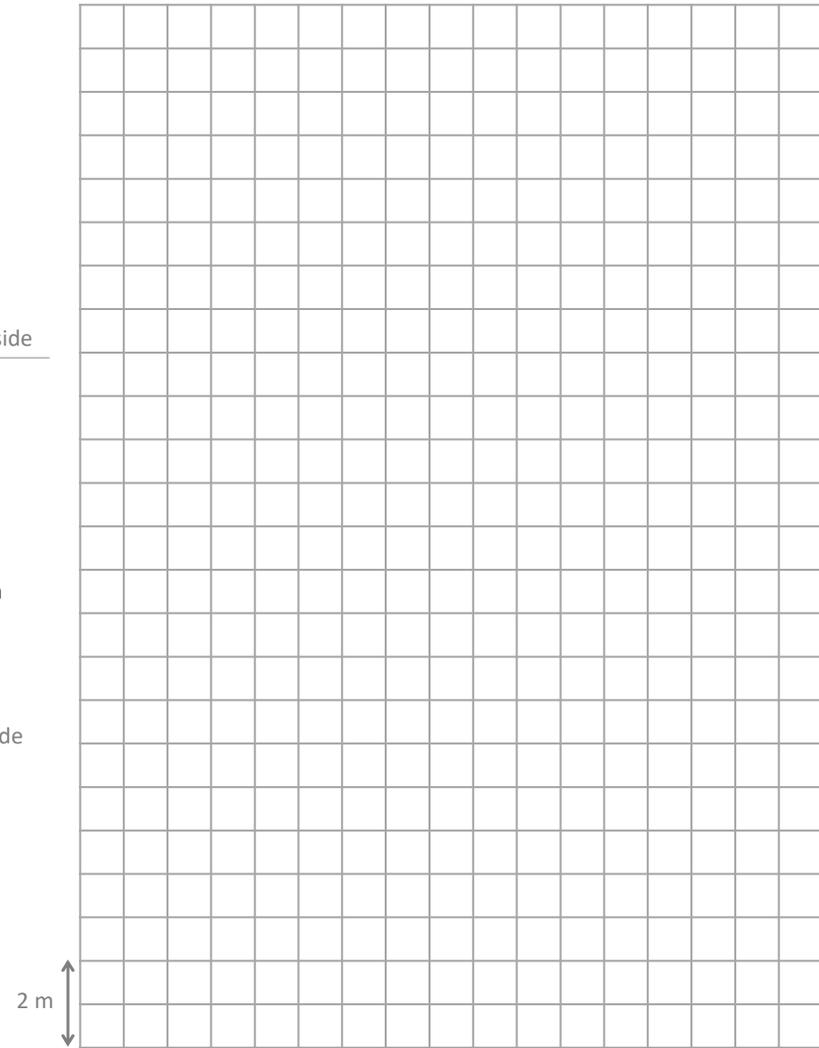
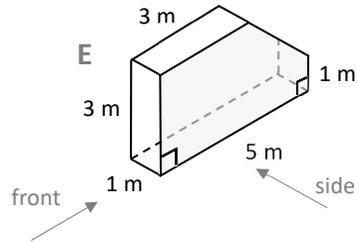
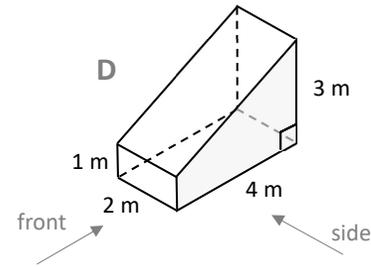
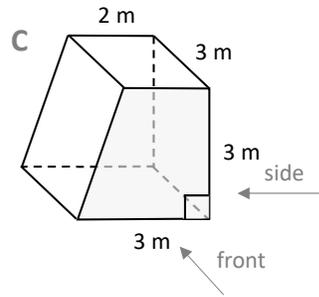
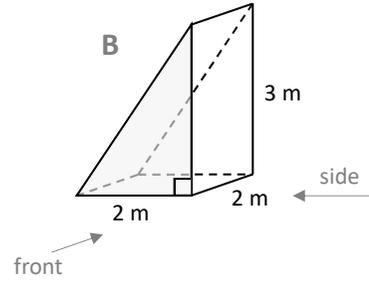
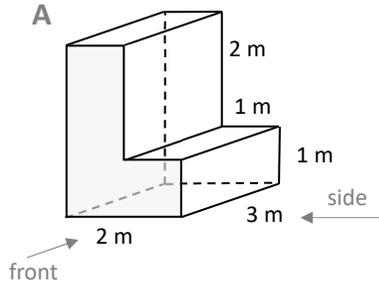


# Fluency Practice

not to scale

## Plans & Elevations

On the scale grid draw the **front & side elevations**, and the **plan**, for these prisms.



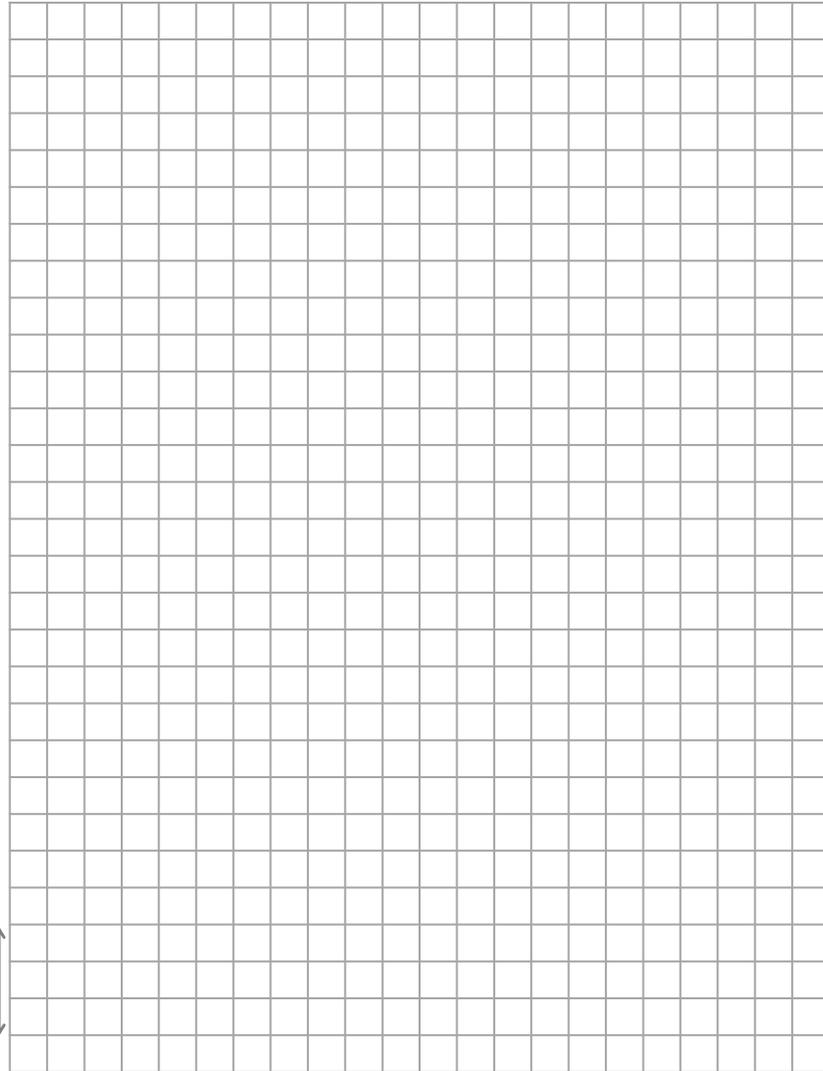
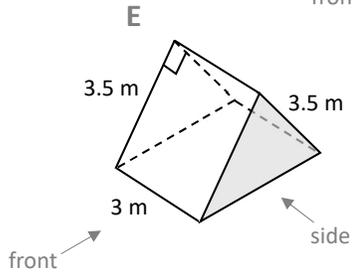
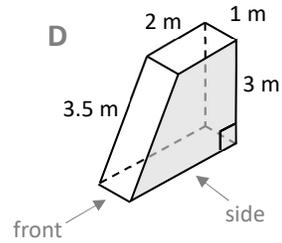
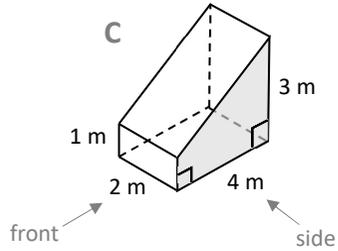
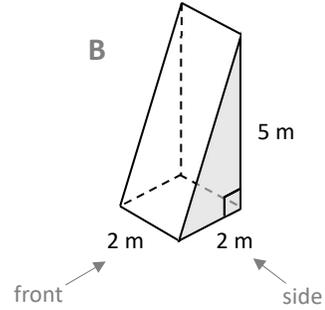
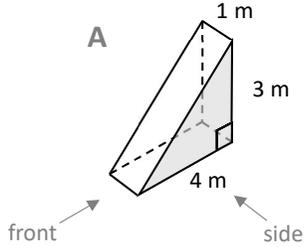
# Fluency Practice

## Pythag & Plans & Elevations

not to scale

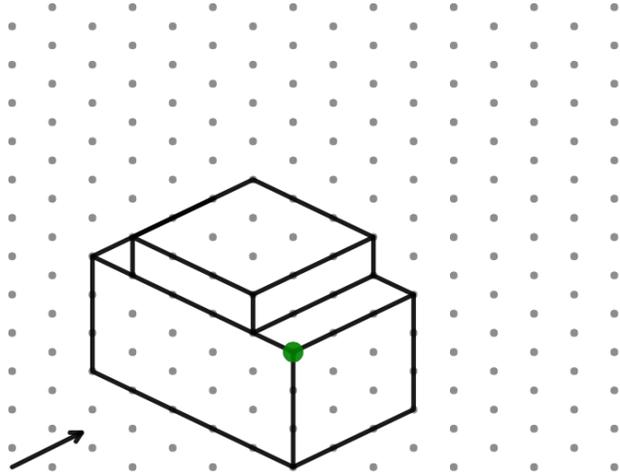
On the scale grid draw the **front & side elevations**, and the **plan**, for these **prisms**.

Label lengths that are not on the diagrams below.



## Worked Example

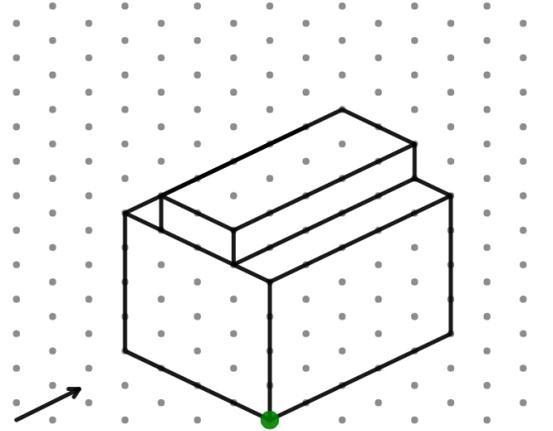
The arrow indicates the front elevation of the 3D shape.



Draw the plan of the 3D shape.

## Your Turn

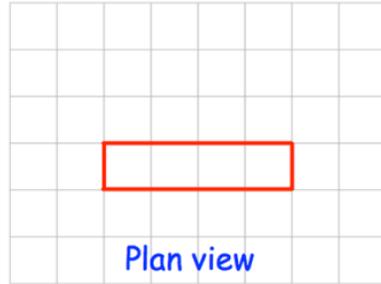
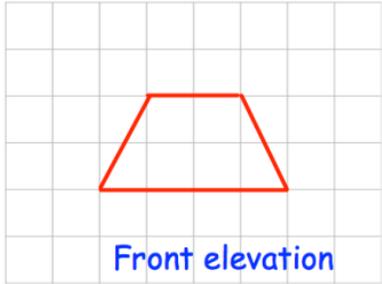
The arrow indicates the front elevation of the 3D shape.



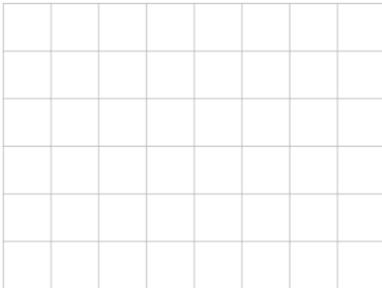
Draw the side elevation of the 3D shape.

## Worked Example

Given the elevations



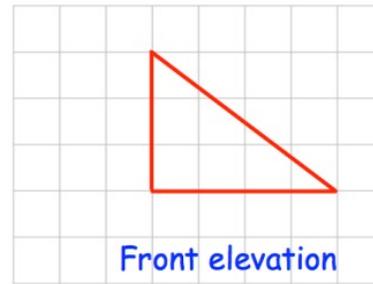
Draw the side elevation



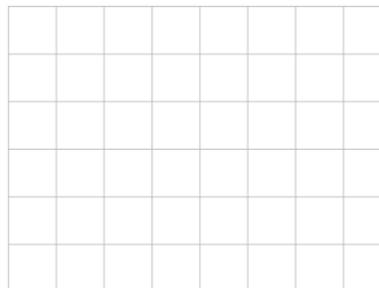
Sketch the solid shape

## Your Turn

Given the elevations



Draw the plan view



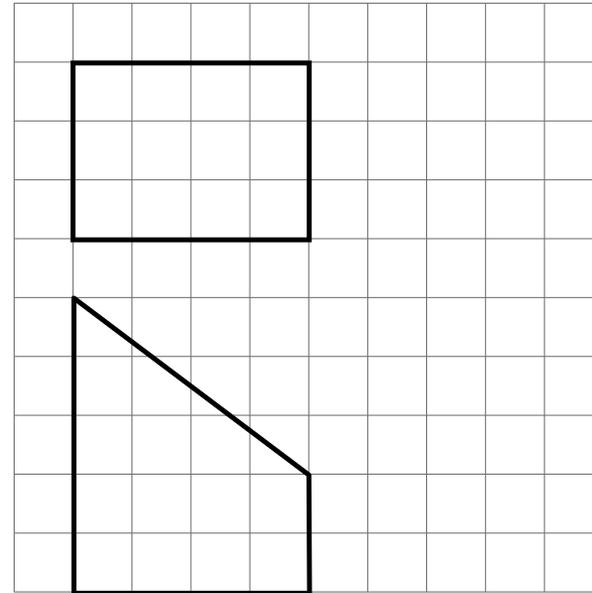
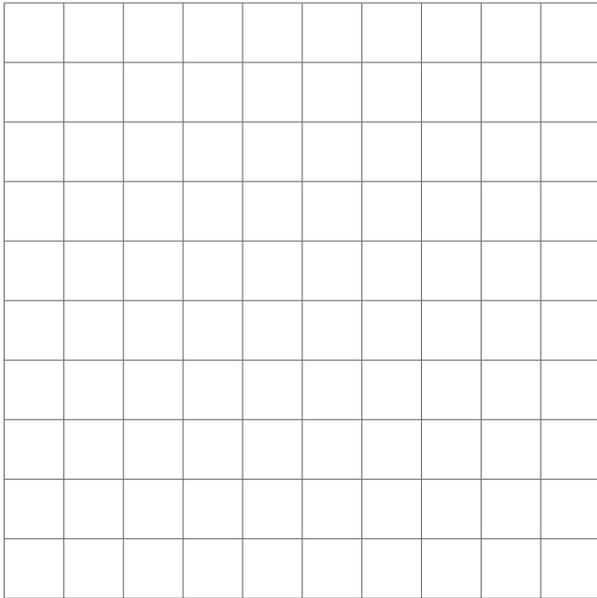
Sketch the solid shape

## Fluency Practice

1. Here is the plan and side elevation of a prism.

The side elevation shows the cross section of the prism.

On the grid below, draw the front elevation of the prism.



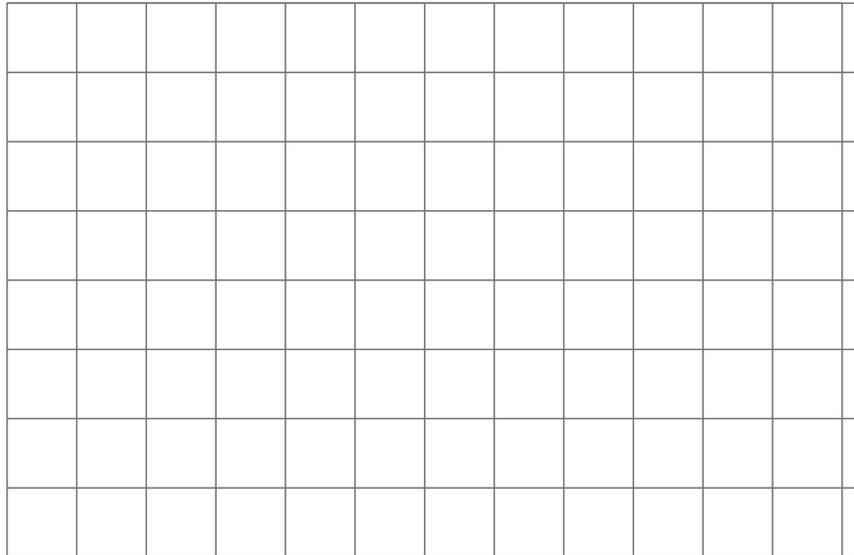
(b) In the space below, draw a 3-D sketch of the prism.

## Fluency Practice

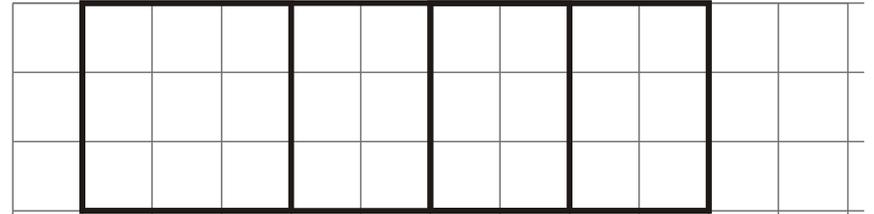
2. Here are the plan and front elevation of a prism.

The front elevation shows the cross section of the prism.

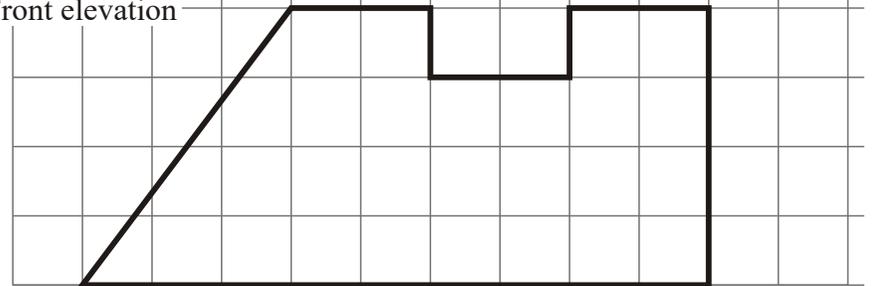
(a) On the grid below, draw a side elevation of the prism.



Plan



Front elevation

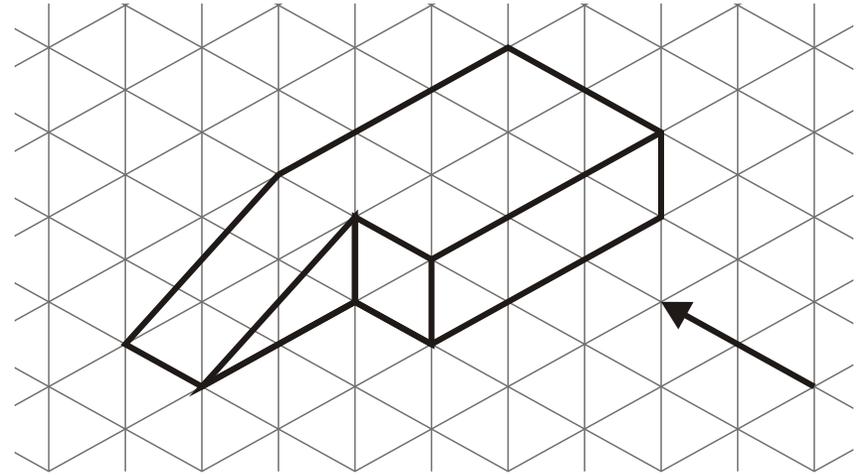


(b) In the space below, draw a 3-D sketch of the prism.

## Fluency Practice

3. The diagram shows a solid object.

(a) In the space below,  
sketch the front elevation  
from the direction  
marked with an arrow.



(b) In the space below, sketch the plan of the solid object.

## Extra Notes

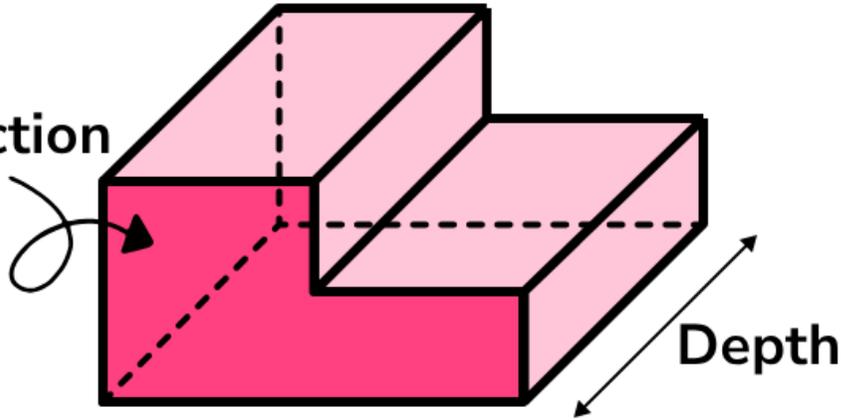
## 4 Volume and Surface Area of Prisms

## Volume of Prisms

Volume of Prism = Area of Cross Section  $\times$  Depth

$$V = A \times D$$

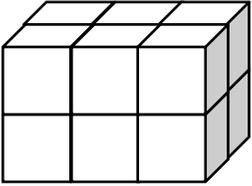
Cross Section



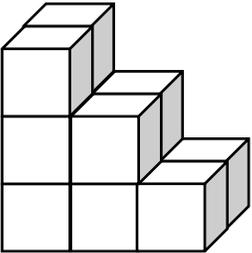
## Worked Example

Write down the volume of the shape:

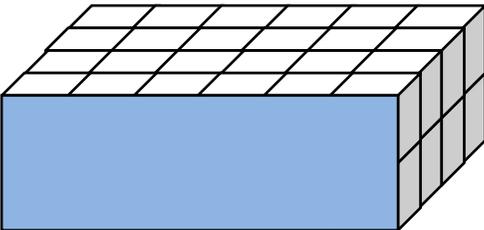
a)



b)



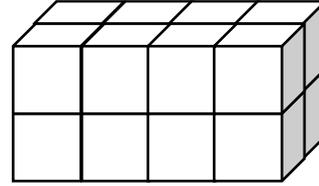
c)



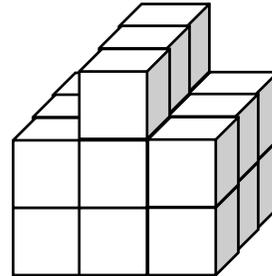
## Your Turn

Write down the volume of the shape:

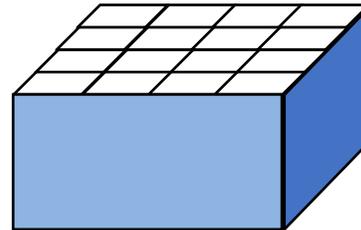
a)



b)

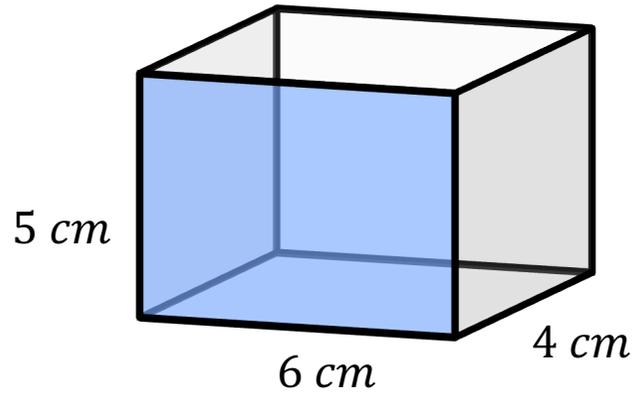


c)



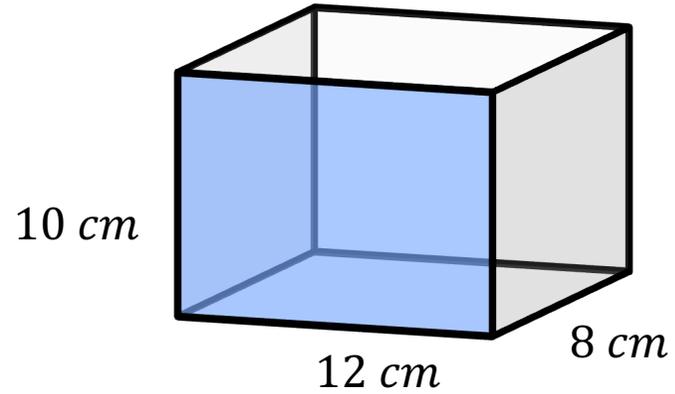
### Worked Example

Calculate the volume of the cuboid:



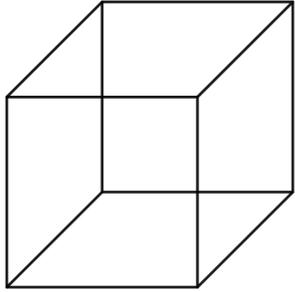
### Your Turn

Calculate the volume of the cuboid:



## Worked Example

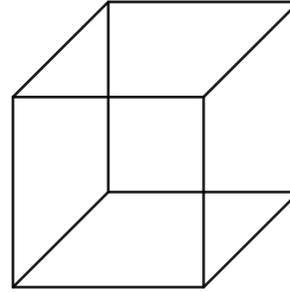
Calculate the volume of the cube.



6 cm

## Your Turn

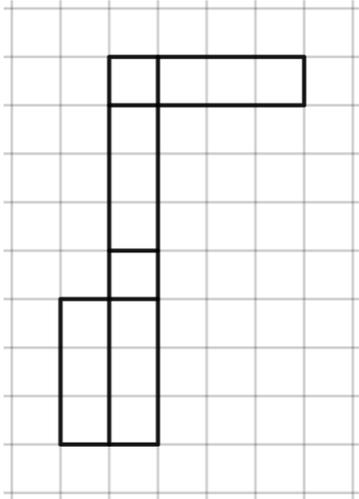
Calculate the volume of the cube.



4 cm

### Worked Example

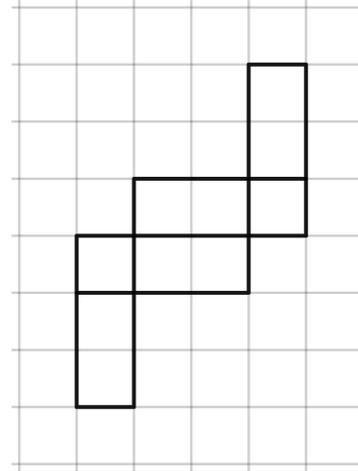
Below is the net of a cuboid drawn on metre squared paper.



Determine the volume of the cuboid.

### Your Turn

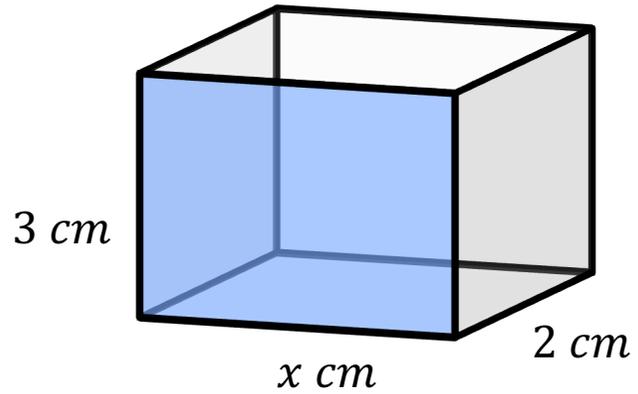
Below is the net of a cuboid drawn on metre squared paper.



Determine the volume of the cuboid.

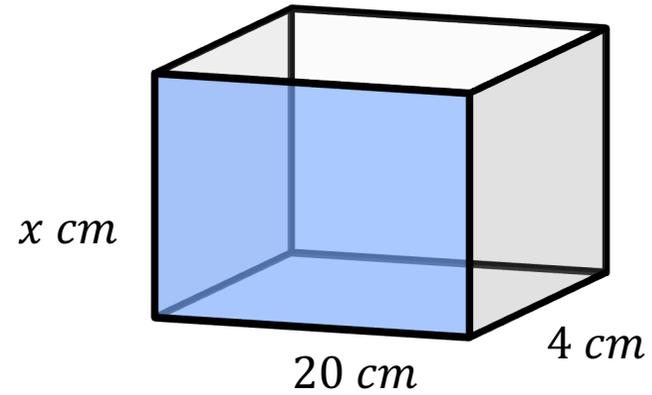
### Worked Example

Find  $x$ , given that the volume of the cuboid is  $60 \text{ cm}^3$



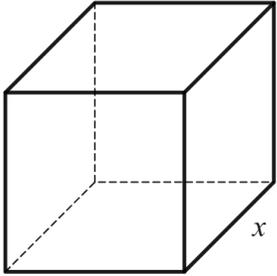
### Your Turn

Find  $x$ , given that the volume of the cuboid is  $480 \text{ cm}^3$



## Worked Example

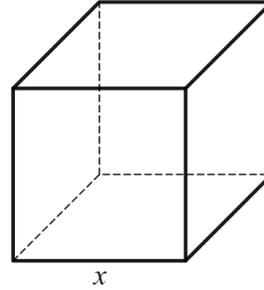
The diagram shows a cube with volume  $343 \text{ cm}^3$



Find the length  $x$

## Your Turn

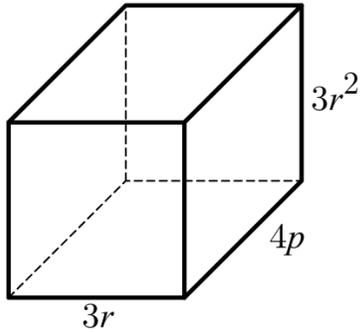
The diagram shows a cube with volume  $5832 \text{ m}^3$



Find the length  $x$

## Worked Example

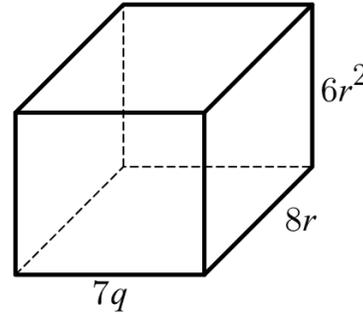
A cuboid is drawn below.  
The expression for the length of each side is given on the diagram.



Write an expression for the total volume of the cuboid.  
Give your answer in its simplest form.

## Your Turn

A cuboid is drawn below.  
The expression for the length of each side is given on the diagram.



Write an expression for the total volume of the cuboid.  
Give your answer in its simplest form.

## Worked Example

The volume of the cuboid is  $672 \text{ cm}^3$

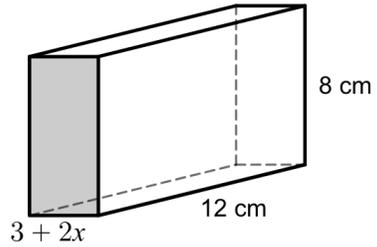


Diagram **not** accurately drawn.

Form an equation and find the value of  $x$

## Your Turn

The volume of the cuboid is  $5248 \text{ cm}^3$

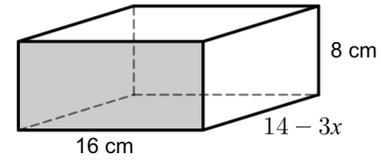
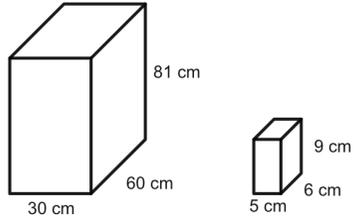


Diagram **not** accurately drawn.

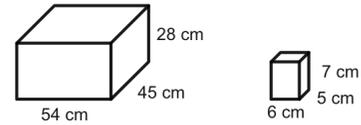
Form an equation and find the value of  $x$

## Worked Example



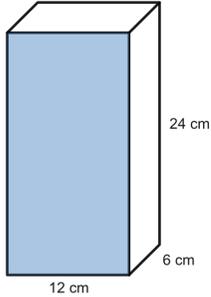
Connor has a crate in the shape of a cuboid which measures 30 cm by 60 cm by 81 cm. He has  $n$  cuboid-shaped bricks which he is going to completely fill the crate with. These measure 5 cm by 6 cm by 9 cm. Calculate the value of  $n$ .

## Your Turn



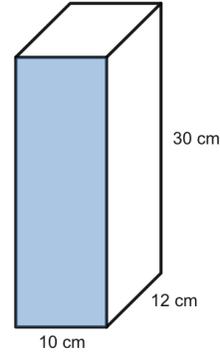
A cuboid-shaped crate measures 54 cm by 45 cm by 28 cm. The crate is going to be completely filled with  $n$  bars. Each bar is a cuboid and measures 6 cm by 5 cm by 7 cm. Calculate the value of  $n$ .

## Worked Example



Diana has a carton of milk which is shaped like a cuboid. The base of the carton measures 12 cm by 6 cm. The height of the carton is 24 cm. The milk partially fills the carton to a depth of 8 cm. The carton is turned over so that the shaded side is facing upwards. The depth of milk in the carton is now  $d$  cm. Calculate the value of  $d$ .

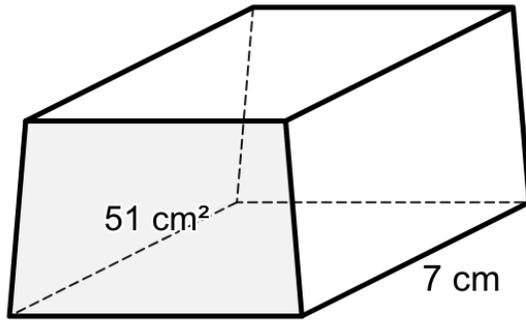
## Your Turn



Awa has a carton of milk which is shaped like a cuboid. The base of the carton measures 10 cm by 12 cm. The height of the carton is 30 cm. The oat milk partially fills the carton to a depth of 10 cm. The carton is turned over so that the shaded side is facing upwards. The depth of oat milk in the carton is now  $d$  cm. Calculate the value of  $d$ .

### Worked Example

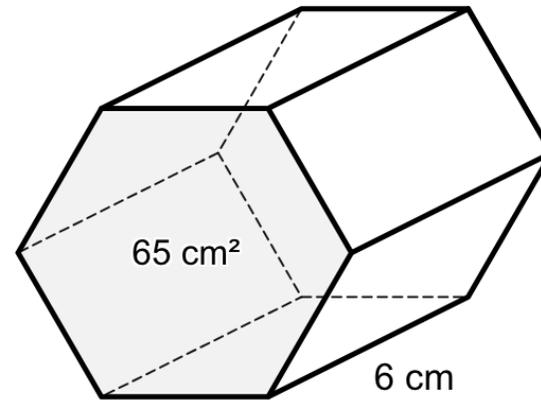
The diagram shows a prism with a cross-sectional area of  $51 \text{ cm}^2$



Find the volume of the prism.

### Your Turn

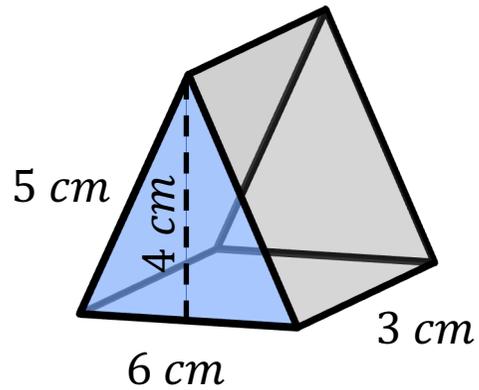
The diagram shows a hexagonal prism with a cross-sectional area of  $65 \text{ cm}^2$



Find the volume of the prism.

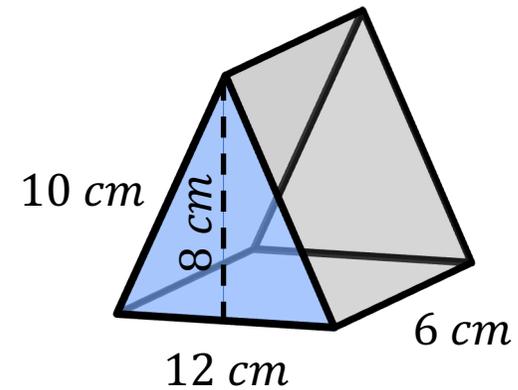
### Worked Example

Calculate the volume of the triangular prism:



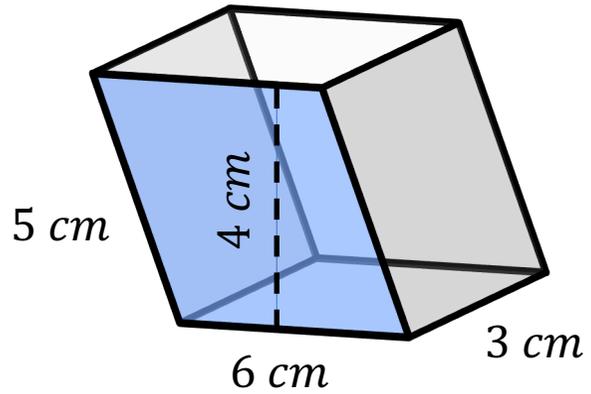
### Your Turn

Calculate the volume of the triangular prism:



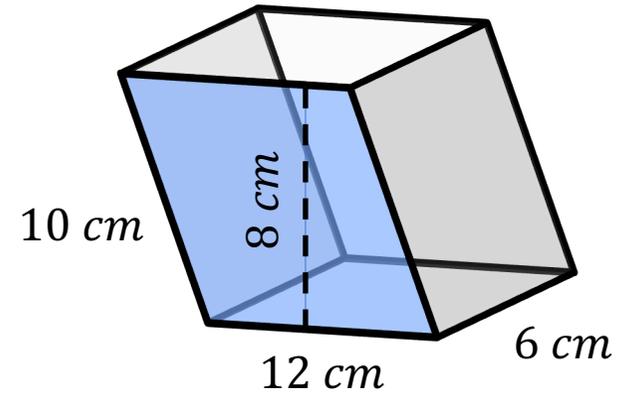
### Worked Example

Calculate the volume of the parallelepiped:



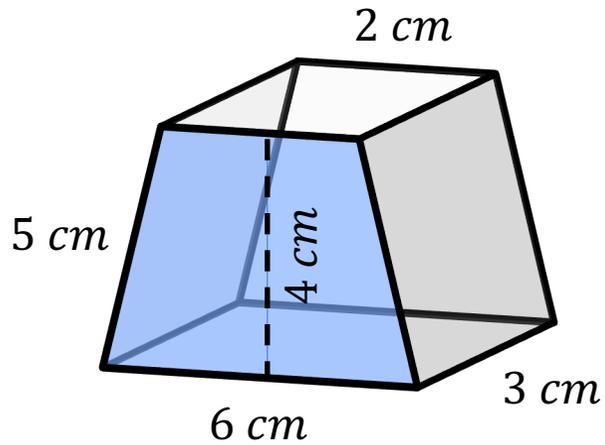
### Your Turn

Calculate the volume of the parallelepiped:



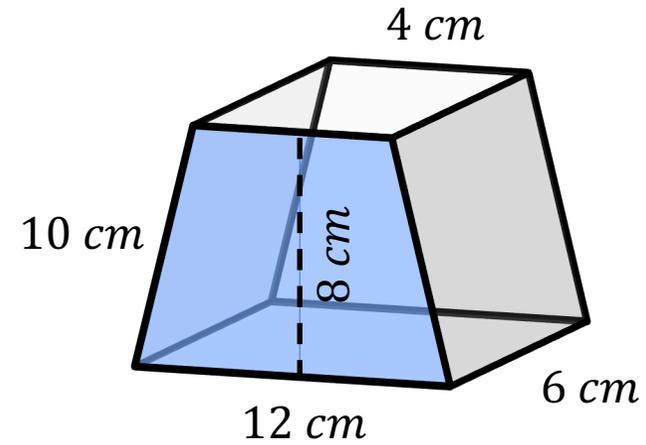
### Worked Example

Calculate the volume of the trapezium prism:



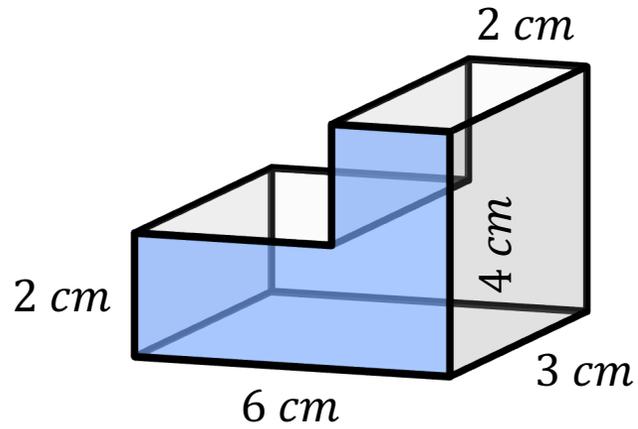
### Your Turn

Calculate the volume of the trapezium prism:



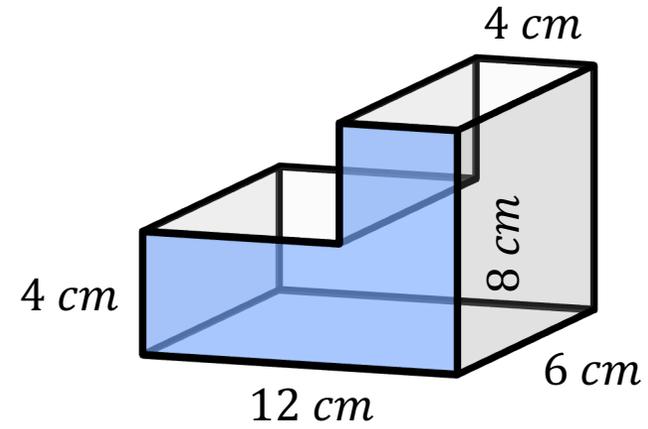
### Worked Example

Calculate the volume of the L-shaped prism:



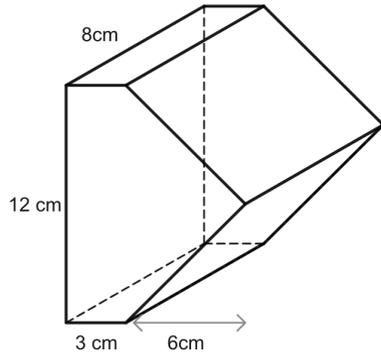
### Your Turn

Calculate the volume of the L-shaped prism:



## Worked Example

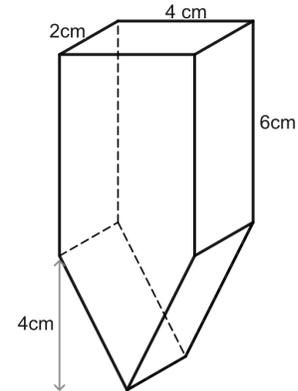
The diagram below shows a prism.



Work out the volume of the prism.

## Your Turn

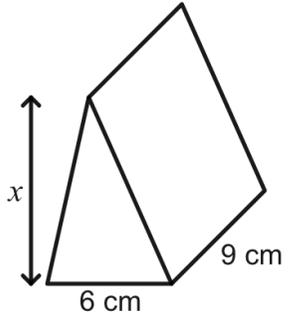
The diagram below shows a prism.



Find the volume of the prism.

## Worked Example

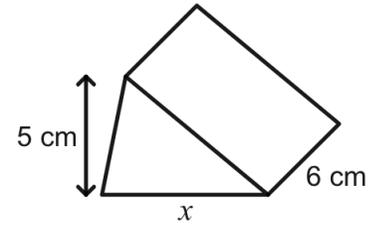
The volume of the prism is  $243 \text{ cm}^3$



Find the value of  $x$

## Your Turn

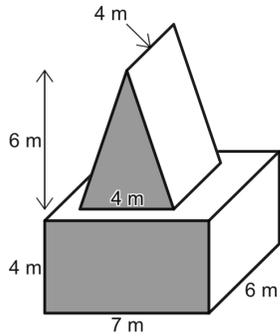
The volume of the prism is  $105 \text{ cm}^3$



Find the value of  $x$

## Worked Example

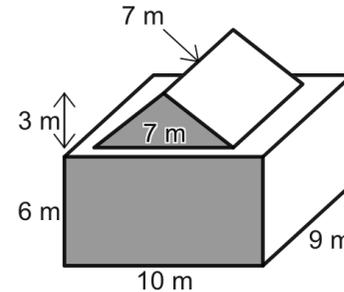
A composite solid is made from a cuboid and a triangular prism joined together, as shown in the diagram below.



Calculate the volume of the composite solid.

## Your Turn

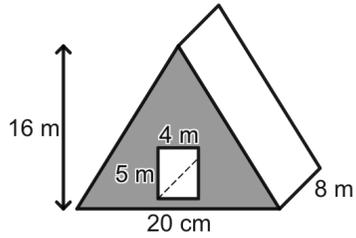
A composite solid is made from a cuboid and a triangular prism joined together, as shown in the diagram below.



Calculate the volume of the composite solid.

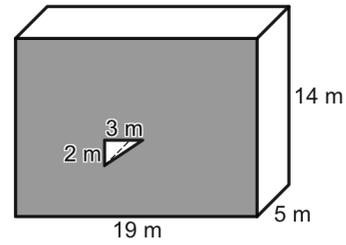
## Worked Example

Calculate the volume of the prism with the cut out removed.



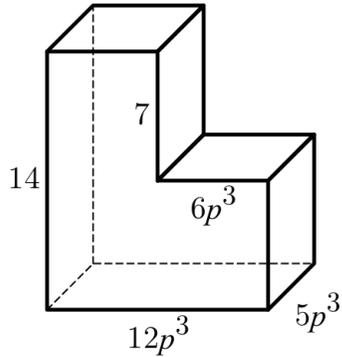
## Your Turn

Calculate the volume of the prism with the cut out removed.



## Worked Example

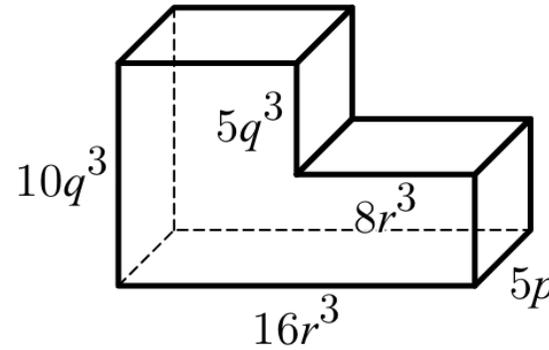
A prism is drawn below.  
The expressions for the widths, depth and heights are given on the diagram.



Write an expression for the total volume of the prism.  
Give your answer in its simplest form.

## Your Turn

A prism is drawn below.  
The expressions for the widths, depth and heights are given on the diagram.



Write an expression for the total volume of the prism.  
Give your answer in its simplest form.

## Worked Example

The volume of the trapezoidal prism is  $36 \text{ cm}^3$

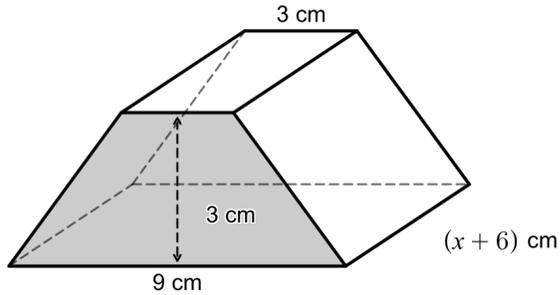


Diagram **not** accurately drawn.

Form an equation and find the value of  $x$

## Your Turn

The volume of the right-angled trapezoidal prism is  $27 \text{ cm}^3$

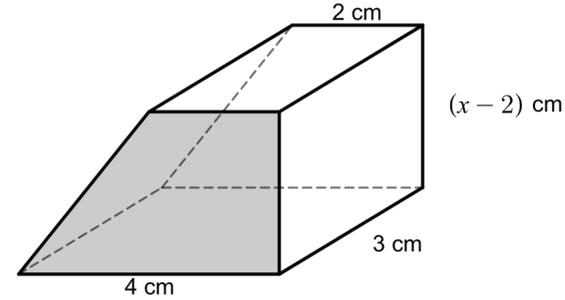


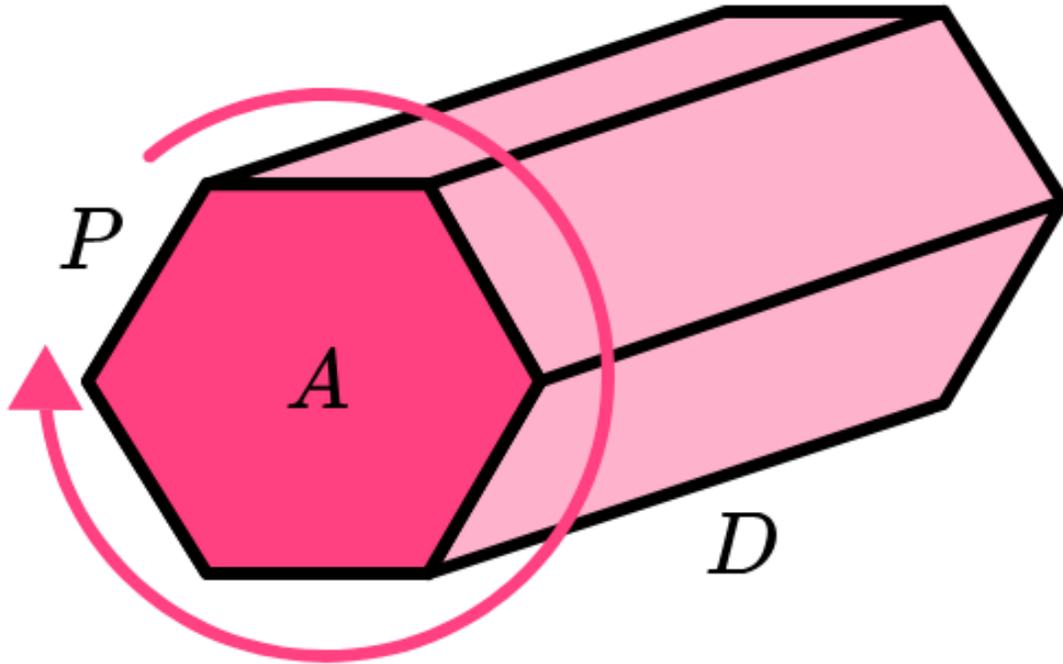
Diagram **not** accurately drawn.

Form an equation and find the value of  $x$

## Surface Area of Prisms

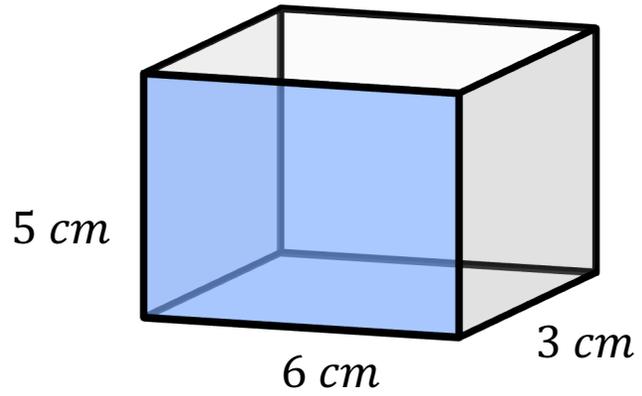
Surface Area of Prism =  $2 \times$  Area of Cross Section + Perimeter of Cross Section  $\times$  Depth of Prism

$$SA = 2A + PD$$



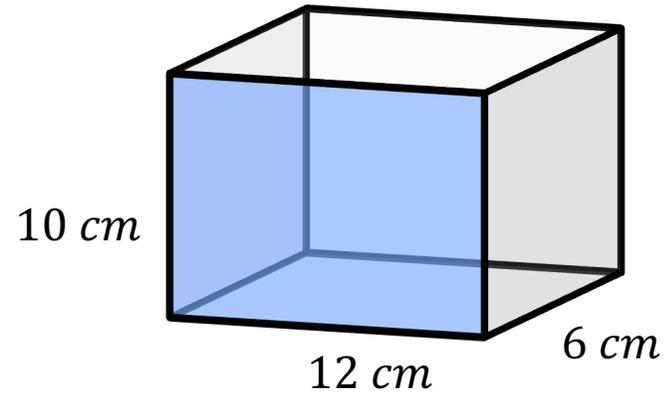
### Worked Example

Calculate the surface area of the cuboid:



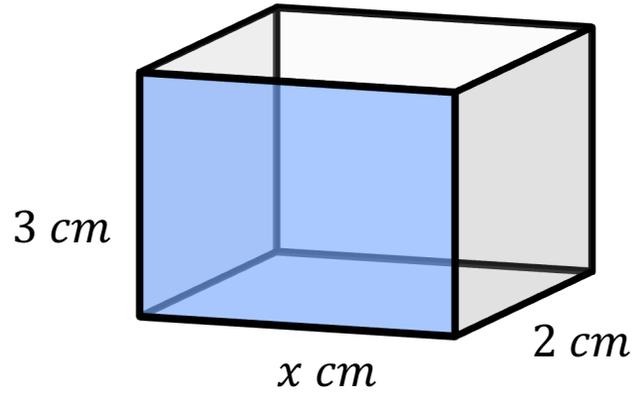
### Your Turn

Calculate the surface area of the cuboid:



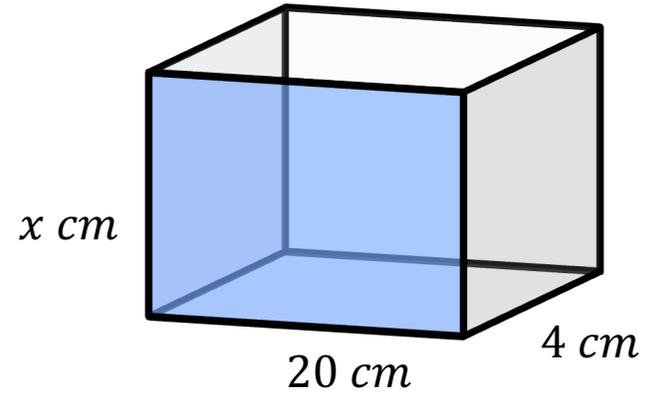
### Worked Example

Find  $x$ , given that the total surface area is  $112 \text{ cm}^2$



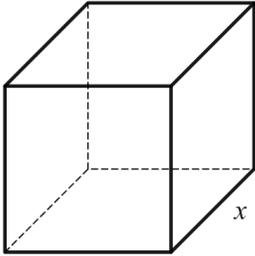
### Your Turn

Find  $x$ , given that the total surface area is  $448 \text{ cm}^2$



## Worked Example

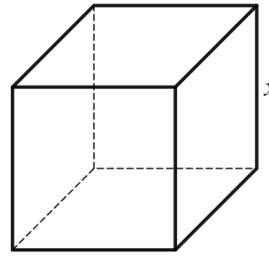
The diagram shows a cube with a surface area of  $486 \text{ cm}^2$



Calculate the length  $x$

## Your Turn

The diagram shows a cube with a surface area of  $294 \text{ cm}^2$



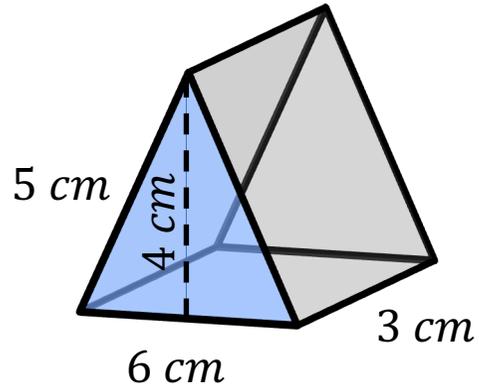
Work out the length  $x$

## Fill in the Gaps

Cube or Cuboid	Length	Width	Height	Volume	Surface Area
<i>Cuboid</i>	10 <i>cm</i>	5 <i>cm</i>	3 <i>cm</i>		190 <i>cm</i> <sup>2</sup>
<i>Cube</i>	4 <i>cm</i>			64 <i>cm</i> <sup>3</sup>	
<i>Cuboid</i>	12 <i>cm</i>	8 <i>cm</i>	2 <i>cm</i>		
<i>Cuboid</i>	30 <i>mm</i>	25 <i>mm</i>	15 <i>mm</i>		
<i>Cube</i>		1.8 <i>m</i>			
<i>Cuboid</i>	10 <i>cm</i>	7 <i>cm</i>		350 <i>cm</i> <sup>3</sup>	
<i>Cube</i>				729 <i>cm</i> <sup>3</sup>	
<i>Cuboid</i>		3.6 <i>cm</i>	20 <i>cm</i>	259.2 <i>cm</i> <sup>3</sup>	
<i>Cuboid</i>	45 <i>mm</i>	20 <i>mm</i>		22500 <i>mm</i> <sup>3</sup>	
<i>Cube</i>					294 <i>cm</i> <sup>2</sup>
<i>Cuboid</i>	4 <i>cm</i>		6 <i>cm</i>		228 <i>cm</i> <sup>2</sup>
<i>Cuboid</i>	20 <i>mm</i>	12 <i>mm</i>			1568 <i>mm</i> <sup>2</sup>
<i>Cuboid</i>		11 <i>cm</i>		528 <i>cm</i> <sup>3</sup>	404 <i>cm</i> <sup>2</sup>
<i>Cuboid</i>	2 <i>mm</i>			720 <i>mm</i> <sup>3</sup>	876 <i>mm</i> <sup>2</sup>

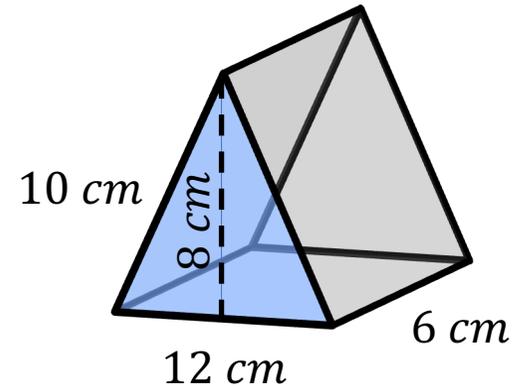
### Worked Example

Calculate the surface area of the triangular prism:



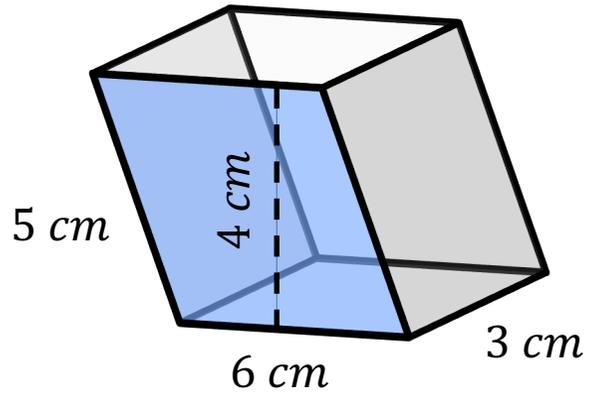
### Your Turn

Calculate the surface area of the triangular prism:



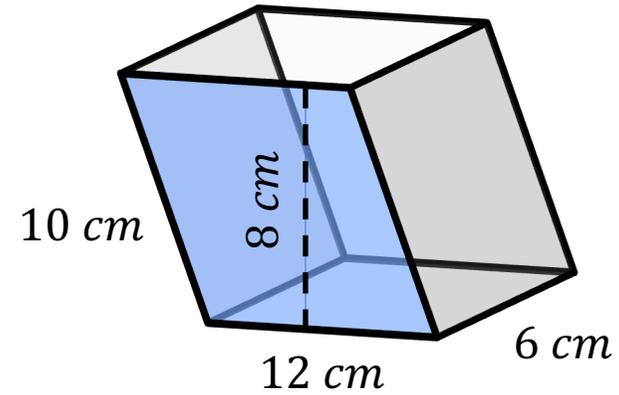
### Worked Example

Calculate the surface area of the parallelepiped:



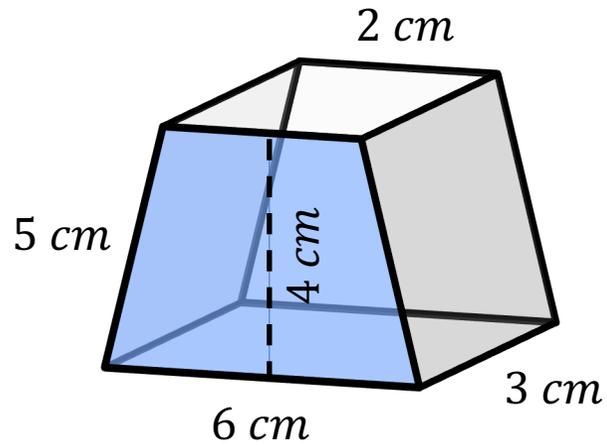
### Your Turn

Calculate the surface area of the parallelepiped:



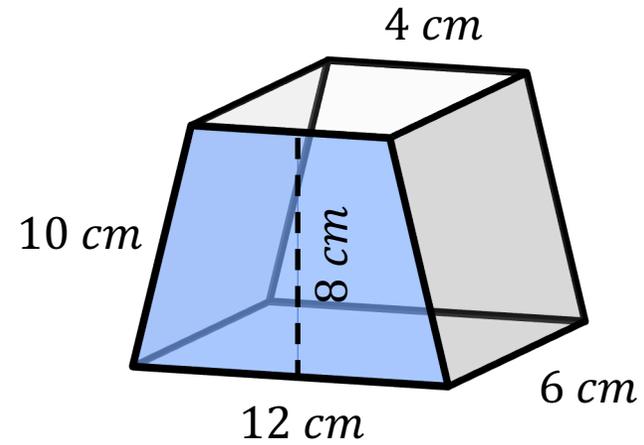
### Worked Example

Calculate the surface area of the trapezium prism:



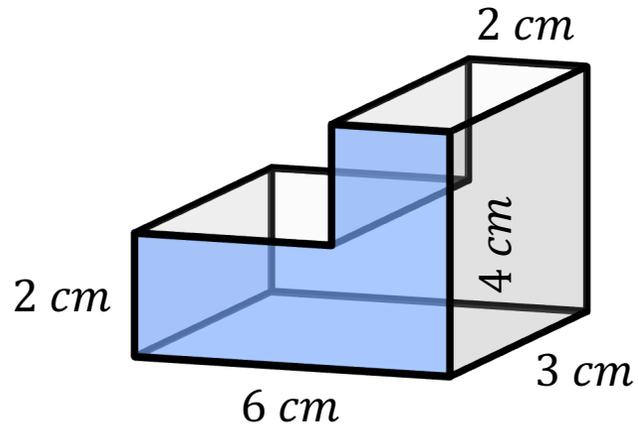
### Your Turn

Calculate the surface area of the trapezium prism:



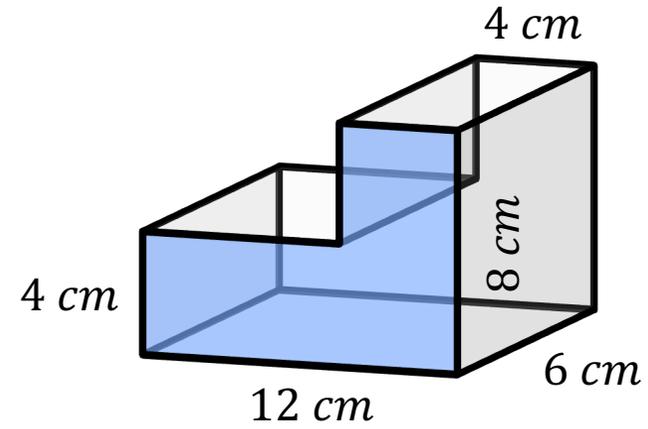
### Worked Example

Calculate the surface area of the L-shaped prism:



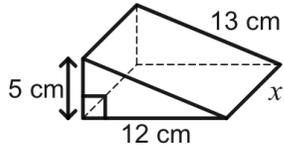
### Your Turn

Calculate the surface area of the L-shaped prism:



## Worked Example

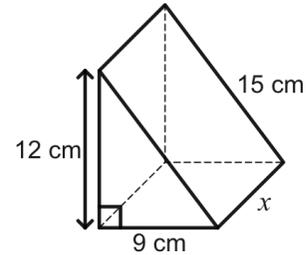
The diagram shows a prism with surface area  $330 \text{ cm}^2$



Calculate the unknown length  $x$

## Your Turn

The diagram shows a prism with surface area  $468 \text{ cm}^2$



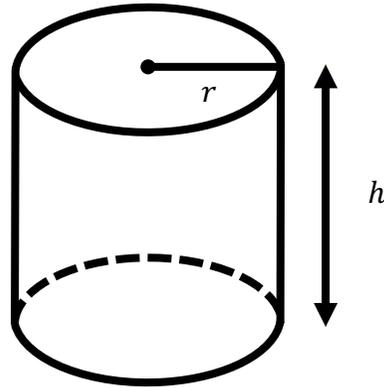
Calculate the unknown length  $x$

## Volume of Cylinders

Volume of Cylinder = Area of circle  $\times$  height

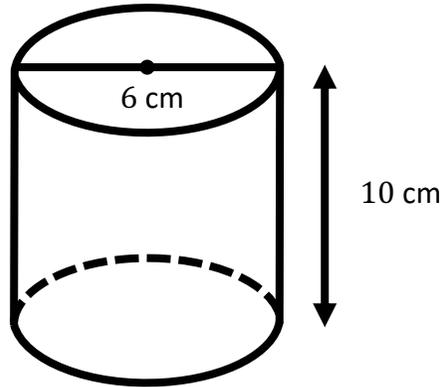
Volume of Cylinder =  $\pi \times \text{radius}^2 \times \text{height}$

$$V = \pi r^2 h$$



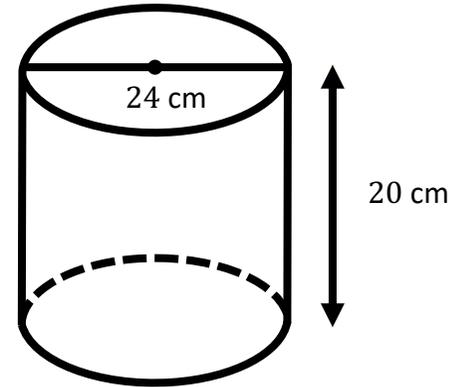
### Worked Example

Calculate the volume of the following cylinder. Give your answer in terms of  $\pi$  and to 1 decimal place.



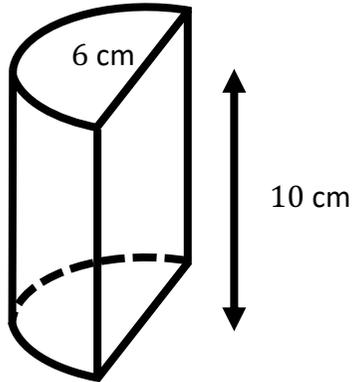
### Your Turn

Calculate the volume of the following cylinder. Give your answer in terms of  $\pi$  and to 1 decimal place.



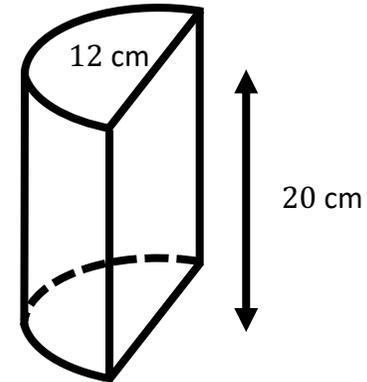
### Worked Example

Calculate the volume of the following half cylinder. Give your answer in terms of  $\pi$  and to 1 decimal place.



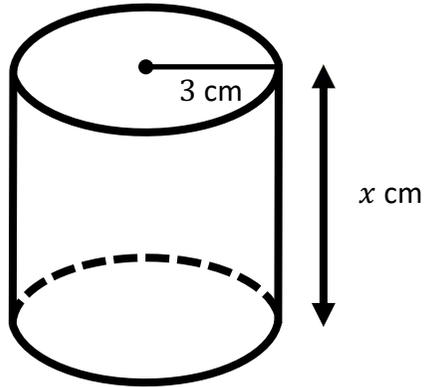
### Your Turn

Calculate the volume of the following half cylinder. Give your answer in terms of  $\pi$  and to 1 decimal place.



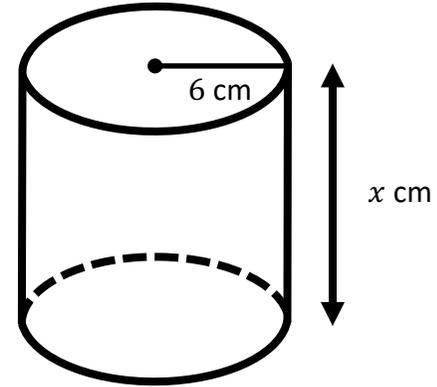
### Worked Example

Find the height,  $x$ , given that the volume of the following cylinder is  $282.7 \text{ cm}^3$ . Give your answer to 1 decimal place.



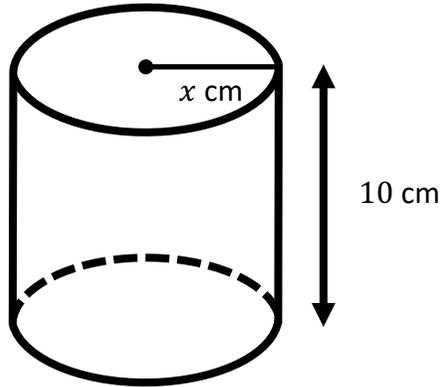
### Your Turn

Find the height,  $x$ , given that the volume of the following cylinder is  $2261.9 \text{ cm}^3$ . Give your answer to 1 decimal place.



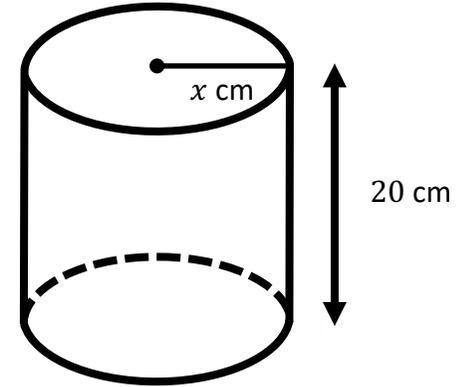
### Worked Example

Find the radius,  $x$ , given that the volume of the following cylinder is  $282.7 \text{ cm}^3$ . Give your answer to 1 decimal place.



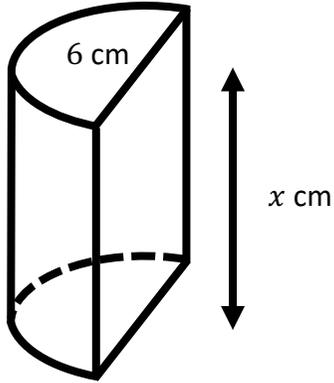
### Your Turn

Find the radius,  $x$ , given that the volume of the following cylinder is  $2261.9 \text{ cm}^3$ . Give your answer to 1 decimal place.



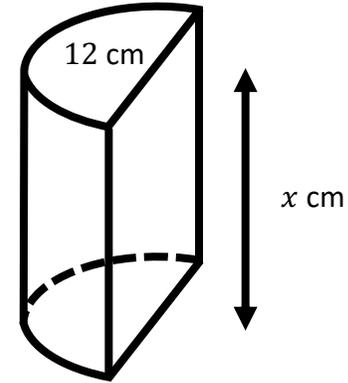
### Worked Example

Find the height,  $x$ , given that the volume of the following half cylinder is  $141.4 \text{ cm}^3$ . Give your answer to 1 decimal place.



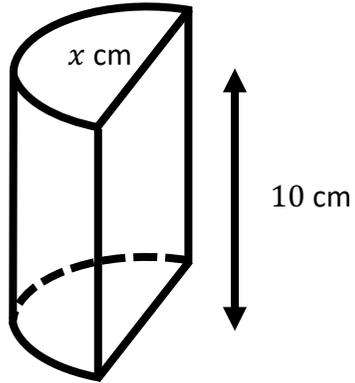
### Your Turn

Find the height,  $x$ , given that the volume of the following half cylinder is  $1131.0 \text{ cm}^3$ . Give your answer to 1 decimal place.



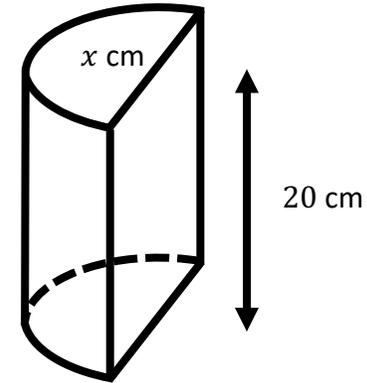
### Worked Example

Find the diameter,  $x$ , given that the volume of the following half cylinder is  $141.4 \text{ cm}^3$ . Give your answer to 1 decimal place.



### Your Turn

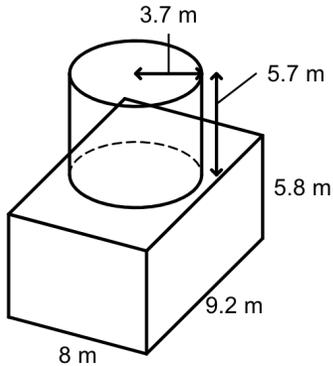
Find the diameter,  $x$ , given that the volume of the following half cylinder is  $1131.0 \text{ cm}^3$ . Give your answer to 1 decimal place.



## Worked Example

The diagram shows a shape made from a solid cylinder attached to a solid cuboid.

The cuboid has sides of length 8, 9.2 and 5.8 m.  
The cylinder has a radius of 3.7 m and a height of 5.7 m.

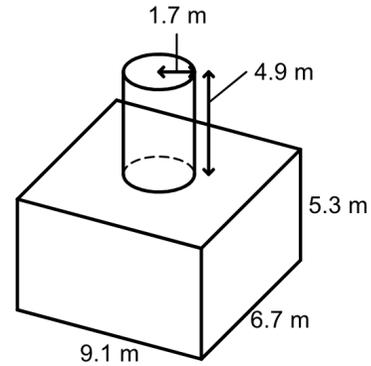


Calculate the total volume of the solid shape.  
Give your answer correct to 1 decimal place.

## Your Turn

The diagram shows a shape made from a solid cylinder attached to a solid cuboid.

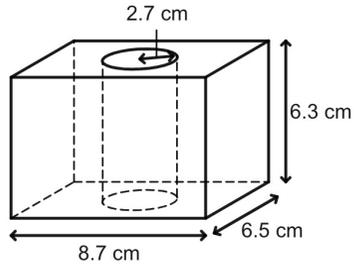
The cuboid has sides of length 9.1, 6.7 and 5.3 m.  
The cylinder has a radius of 1.7 m and a height of 4.9 m.



Calculate the total volume of the solid shape.  
Give your answer correct to 1 decimal place.

## Worked Example

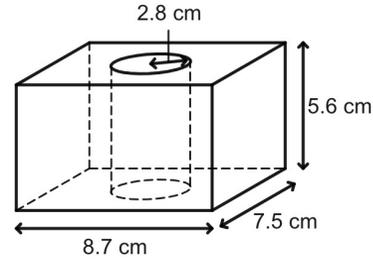
A vertical cylinder of radius 2.7 cm is removed from a cuboid with sides of length 8.7 cm, 6.5 cm and 6.3 cm, leaving behind the object shown below.



Determine the volume of the remaining object.  
Give your answer to 1 decimal place.

## Your Turn

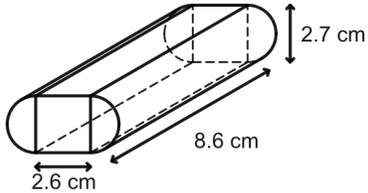
A woodworker takes a cuboid with sides of length 8.7 cm, 7.5 cm and 5.6 cm and removed a central cylinder of radius 2.8 cm from the middle of it, producing the following shape.



Evaluate the remaining volume after the cylinder has been removed.  
Give your answer to 1 decimal place.

## Worked Example

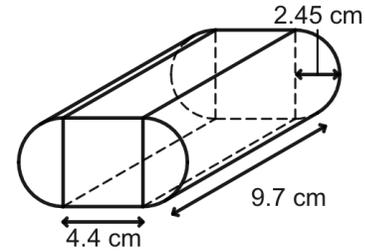
A composite shape is formed by attaching two semi-cylinders to the sides of a cuboid of width 2.6 cm, length 8.6 cm and height 2.7 cm as shown in the diagram below.



Find the volume of the composite shape.  
Give your answer correct to 1 Decimal palace.

## Your Turn

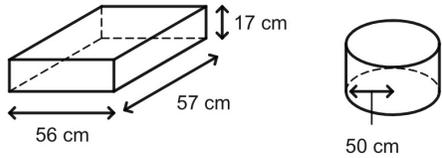
A composite shape is formed by attaching two semi-cylinders of radius 2.45 cm to the sides of a cuboid of width 4.4 cm, length 9.7 cm as shown in the diagram below.



Find the volume of the composite shape.  
Give your answer correct to 1 Decimal palace.

## Worked Example

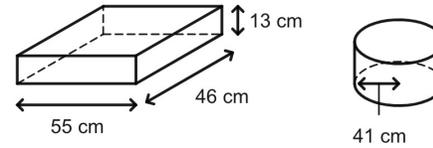
A rectangular tray measuring 56 cm by 57 cm by 17 cm is full of water. All of the water is then poured into a cylindrical container with radius 50 cm.



Find the height of the water while in the cylindrical container.  
Give your answer correct to one decimal place.

## Your Turn

A rectangular tray measuring 55 cm by 46 cm by 13 cm is full of water. All of the water is then poured into a cylindrical container with radius 41 cm.



Find the height of the water while in the cylindrical container.  
Give your answer correct to one decimal place.

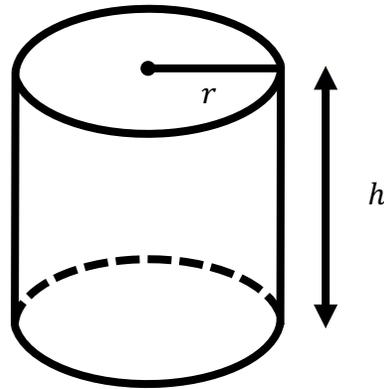
## Surface Area of Cylinders

Curved Surface Area of Cylinder =  $2 \times \pi \times \text{radius} \times \text{height}$

$$\text{CSA} = 2\pi rh$$

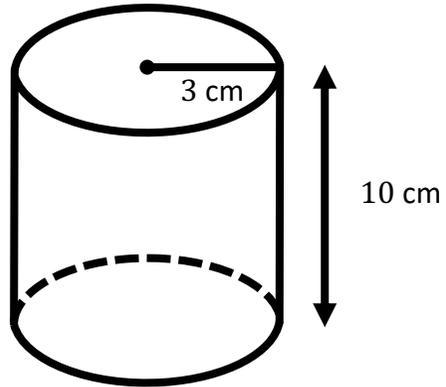
Total Surface Area of Cylinder =  $2 \times \pi \times \text{radius} \times \text{height} + 2 \times \pi \times \text{radius}^2$

$$\text{TSA} = 2\pi rh + 2\pi r^2$$



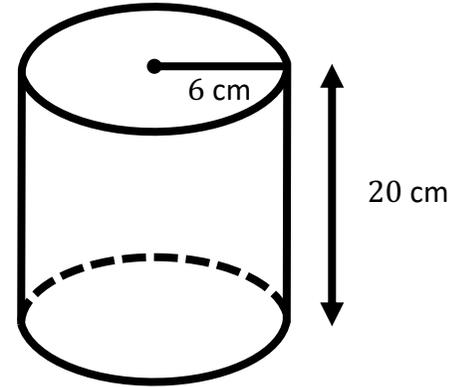
### Worked Example

Calculate the total surface area of the following cylinder. Give your answer in terms of  $\pi$  and to 1 decimal place.



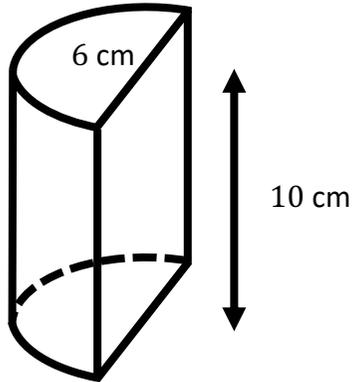
### Your Turn

Calculate the total surface area of the following cylinder. Give your answer in terms of  $\pi$  and to 1 decimal place.



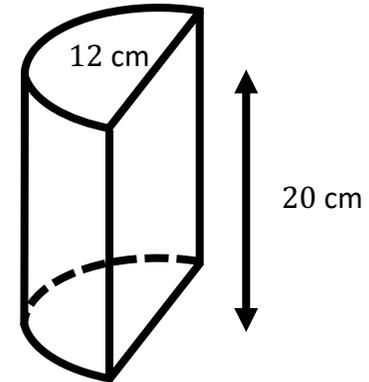
### Worked Example

Calculate the total surface area of the following half cylinder.  
Give your answer in terms of  $\pi$  and to 1 decimal place.



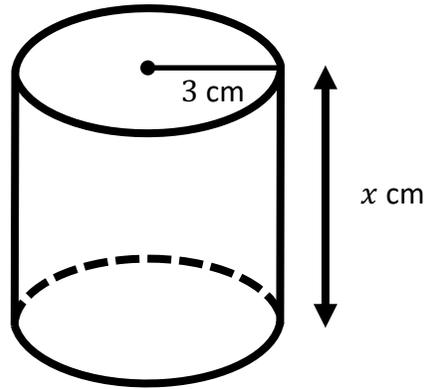
### Your Turn

Calculate the total surface area of the following half cylinder.  
Give your answer in terms of  $\pi$  and to 1 decimal place.



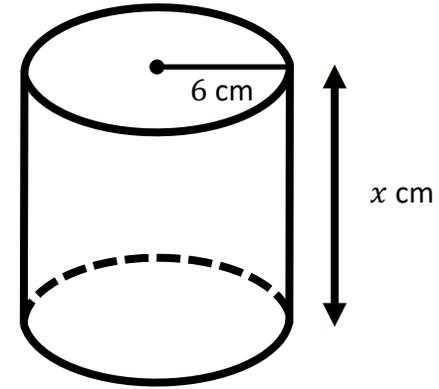
### Worked Example

Find the height,  $x$ , given that the total surface area of the following cylinder is  $245.0 \text{ cm}^2$ . Give your answer to 1 decimal place.



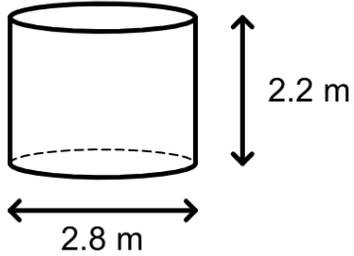
### Your Turn

Find the height,  $x$ , given that the total surface area of the following cylinder is  $980.2 \text{ cm}^2$ . Give your answer to 1 decimal place.



## Worked Example

Gael has to cover 4 tanks completely with paint.



Each tank is in the shape of a cylinder with a top and a bottom. The tank has a diameter of 2.8 m and a height of 2.2 m.

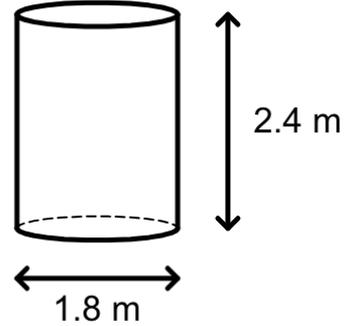
Each  $\text{m}^2$  costs £4.43 to paint.

Gael has £562.00 available.

Determine if Gael has enough money to cover completely the 4 tanks.

## Your Turn

Pari has to cover 7 tanks completely with paint.



Each tank is in the shape of a cylinder with a top and a bottom. The tank has a diameter of 1.8 m and a height of 2.4 m.

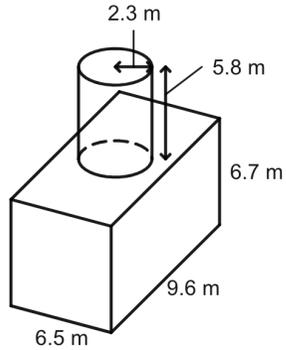
Each  $\text{m}^2$  costs £2.68 to paint.

Pari has £350.00 available.

Determine if Pari has enough money to cover completely the 7 tanks.

## Worked Example

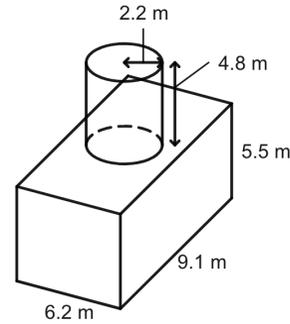
The diagram shows a shape made from a solid cylinder attached to a solid cuboid. The cuboid has sides of length 6.5, 9.6 and 6.7 m. The cylinder has a radius of 2.3 m and a height of 5.8 m.



Calculate the total surface area of the solid shape.  
Give your answer correct to 3 significant figures.

## Your Turn

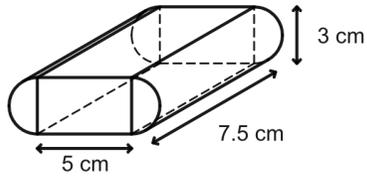
The diagram shows a shape made from a solid cylinder attached to a solid cuboid. The cuboid has sides of length 6.2, 9.1 and 5.5 m. The cylinder has a radius of 2.2 m and a height of 4.8 m.



Calculate the total surface area of the solid shape.  
Give your answer correct to 3 significant figures.

## Worked Example

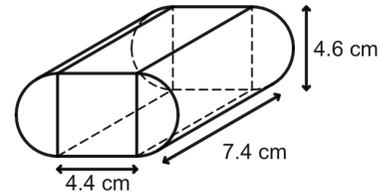
A cuboid of width 5 cm, length 7.5 cm and height 3 cm is joined to two semi-cylinders on its sides. The object created is shown below.



Find the surface area of the composite object.  
Give your answer correct to 1 decimal place.

## Your Turn

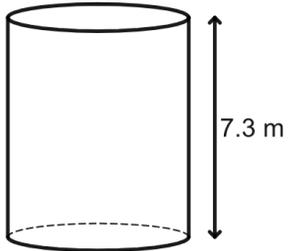
A cuboid of width 4.4 cm, length 7.4 cm and height 4.6 cm is joined to two semi-cylinders on its sides. The object created is shown below.



Find the surface area of the composite object.  
Give your answer correct to 1 decimal place.

### Worked Example

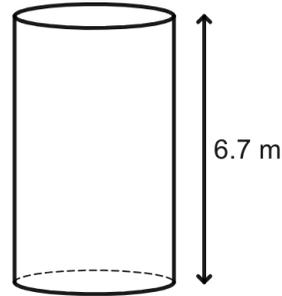
The diagram shows a solid cylinder with height 7.3 m.



The volume of the cylinder is  $65.7\pi \text{ m}^3$ .  
Calculate the total surface area of the cylinder.  
Give your answer correct to 1 decimal place.

### Your Turn

The diagram shows a solid cylinder with height 6.7 m.



The volume of the cylinder is  $26.8\pi \text{ m}^3$ .  
Calculate the total surface area of the cylinder.  
Give your answer correct to 1 decimal place.

## Fill in the Gaps

Radius	Height	Volume in terms of $\pi$	Volume to 3 s.f.	Curved Surface Area in terms of $\pi$	Total Surface Area in terms of $\pi$	Total Surface Area to 3 s.f.
5 cm	10 cm	$250\pi \text{ cm}^3$		$100\pi \text{ cm}^2$	$150\pi \text{ cm}^2$	
7 cm	15 cm			$210\pi \text{ cm}^2$		
16 mm	20 mm					
0.6 m	2.4 m					
10 cm		$500\pi \text{ cm}^3$				
	12 cm			$192\pi \text{ cm}^2$		
1.5 m					$\frac{39}{2}\pi \text{ m}^2$	
	20 mm				$312\pi \text{ mm}^2$	

## Extra Notes

## 5 Area and Volume Unit Conversions

## Worked Example

Convert:

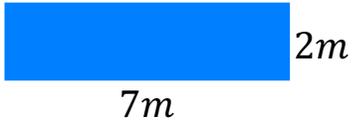
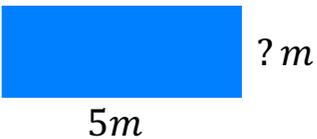
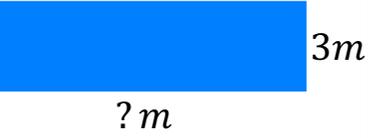
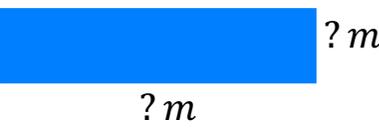
- a)  $7 \text{ cm}^2$  to  $\text{mm}^2$
- b)  $2500 \text{ cm}^2$  to  $\text{m}^2$

## Your Turn

Convert:

- a)  $7 \text{ km}^2$  to  $\text{m}^2$
- b)  $2500 \text{ mm}^2$  to  $\text{cm}^2$

## Fill in the Gaps

Shape	Area in $m^2$	Area in $cm^2$	Area in $mm^2$
			
			
			
		200 000 $cm^2$	
			21 000 000 $mm^2$
	22 $m^2$		

## Worked Example

Convert:

- a)  $7 \text{ cm}^3$  to  $\text{mm}^3$
- b)  $5 \text{ mm}^3$  to  $\text{cm}^3$

## Your Turn

Convert:

- a)  $7 \text{ m}^3$  to  $\text{cm}^3$
- b)  $5 \text{ cm}^3$  to  $\text{m}^3$

## Worked Example

Convert:

- a) 241 litres to  $\text{cm}^3$
- b)  $83400 \text{ cm}^3$  to litres

## Your Turn

Convert:

- a) 4500 litres to  $\text{cm}^3$
- b)  $813\,000 \text{ cm}^3$  to litres

## Fill in the Gaps

Area		
<i>mm<sup>2</sup></i>	<i>cm<sup>2</sup></i>	<i>m<sup>2</sup></i>
	10000	
		2
500000		
		0.07
	92000	
13000000		
	62	
		7.81
42900		
		0.363

Volume			
<i>mm<sup>3</sup></i>	<i>cm<sup>3</sup></i>	<i>m<sup>3</sup></i>	<i>litres</i>
	1000		1
7000000			
			20
		0.6	
3400000			
	28000		
		1.7	
			0.45
	379000		
8520000			

## Extra Notes

## 6 Compound Measures

### Worked Example

- a) Convert 3.1 m/s to km/h.  
Give your answer correct to 1 decimal place.
- b) Convert 84 km/h to m/s.  
Give your answer correct to 1 decimal place.

### Your Turn

- a) Convert 2.9 m/s to km/h.  
Give your answer correct to 1 decimal place.
- b) Convert 51 km/h to m/s.  
Give your answer correct to 1 decimal place.

# Speed

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$s = \frac{d}{t}$$

### Worked Example

A car travels 50 miles in 2 hours. What speed does it travel at?

A car travels at  $50\text{mph}$  (miles per hour) for 2 hours. How far does it travel?

A car travels 50 miles at  $25\text{mph}$  (miles per hour). How long does it take?

### Your Turn

A car travels 60 miles in 2 hours. What speed does it travel at?

A car travels at  $60\text{mph}$  (miles per hour) for 2 hours. How far does it travel?

A car travels 30 miles at  $60\text{mph}$  (miles per hour). How long does it take?

### Worked Example

Abdul drives the distance of 70 km between London and Plymouth. The journey took 1 hours and 5 minutes. Calculate the average speed of Abdul's journey in km/h. Give your answer correct to the nearest whole number.

### Your Turn

A plane takes 34 hours and 20 minutes to fly between Dubai and Singapore. The distance the plane flies is 18,326 miles. Calculate the average speed of the plane. Give your answer in mph, correct to the nearest whole number.

### Worked Example

Mahmoud leaves his home at 6 : 48 am in his car. Mahmoud drives 64 miles from his home to get to the airport to pick up a friend. He drives at an average speed of 40 mph. Work out the time that Mahmoud gets to the airport.

### Your Turn

Maelie leaves her home at 5 : 07 am in her car. Maelie drives 77 miles from her home to get to the airport to pick up a friend. She drives at an average speed of 55 mph. Work out the time that Maelie gets to the airport.

### Worked Example

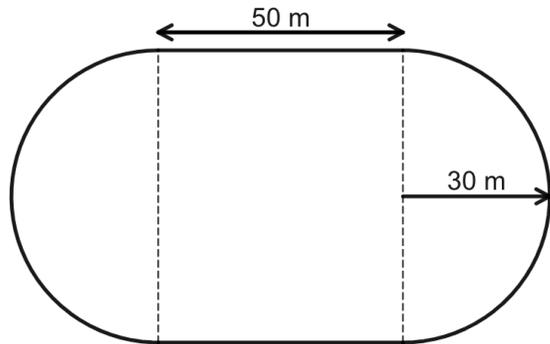
An aeroplane flew a distance of 155 km.  
The average speed was 200 km/h  
Calculate the time taken for the journey.  
Give your answer in minutes, correct to the nearest whole number.

### Your Turn

An aeroplane flew a distance of 70 km.  
The average speed was 160 km/h  
Calculate the time taken for the journey.  
Give your answer in minutes, correct to the nearest whole number.

### Worked Example

A running track has two identical semi-circular ends and two straight sides as shown.



Lyna completes one lap.

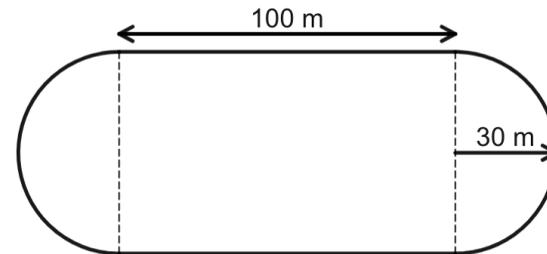
Her average speed was 8.6 m/s.

Work out how long it took her to complete the lap.

Give your answer in seconds to 1 decimal place.

### Your Turn

A running track has two identical semi-circular ends and two straight sides as shown.



Ruby completes one lap.

Her average speed was 11.1 m/s.

Work out how long it took her to complete the lap.

Give your answer in seconds to 1 decimal place.

## Fill in the Gaps

Distance	Time	Speed	Units of Speed
120 km	4 hours		km/h
55 m	5 seconds		m/s
8000 m	2 hours		km/h
450 km	180 minutes		km/h
	20 seconds	10	m/s
	3 hours	25	km/h
900 cm	3 seconds		m/s
132 m		12	m/s
640 km		80	km/h
	120 minutes	65	km/h
30 m	1 minute		m/s
1750 cm		2.5	m/s
	150 minutes	88	km/h
	1.5 minutes	8.5	m/s
20000 m	30 minutes	40	

## Fill in the Gaps

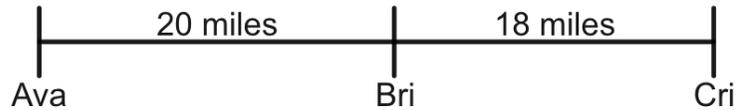
Distance	Time	Speed	Units of Speed
135 km	$4\frac{1}{2}$ hours		km/h
57.2m	5.2 seconds		m/s
8000 m	2 hours		km/h
450 km	180 minutes		km/h
	20 seconds	10.5	m/s
	3 hours	27.5	km/h
900 cm	3 seconds		m/s
170.4 m		12	m/s
348.5 km		82	km/h
	150 minutes	65	km/h
30 m	1 minute		m/s
1750 cm		2.5	m/s
	2 hours 20 minutes	87	km/h
	1 minute 18 seconds	8.5	m/s
358.4 miles	192 minutes		mph
20000 m	30 minutes	40	

## Fill in the Gaps

Sporting Speeds					
Sport		Distance	Time	Speed (km/h)	Speed (m/s)
Adam Peaty Swimming		100 m	56.88 seconds	6.33 km/h	
Battaash Horse Racing		1 km	50.9 seconds		
Mark Cavendish Cycling		200 m			21.7 m/s
Rafael Nadal's Tennis Ball			0.47 seconds		50 m/s
Usain Bolt 100 m Sprint		100 m	9.58 seconds		
Max Verstappen Formula 1			1 minute 14 seconds	157.8 km/h	
Lionel Messi's Football		23.4 m		130 km/h	
Mo Farah Marathon		42.24 km	2 hours 10 min 28 seconds		

## Worked Example

The distance from Ava to Bri is 20 miles.  
The distance from Bri to Cri is 18 miles.



Melissa is going to drive from Ava to Bri.  
Then she will drive from Bri to Cri.

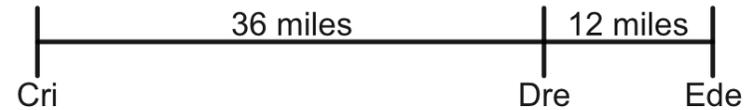
Melissa leaves Ava at 12 : 38

She drives from Ava to Bri at an average speed of 50 mph.  
She then drives from Bri to Cri at an average speed of 36 mph

Calculate the arrival time at Cri.  
Give your answer using the 24h clock.

## Your Turn

The distance from Cri to Dre is 36 miles.  
The distance from Dre to Ede is 12 miles.



Raphaël is going to drive from Cri to Dre.  
Then he will drive from Dre to Ede.

Raphaël leaves Cri at 09 : 14

He drives from Cri to Dre at an average speed of 60 mph.

Raphaël wants to get to Ede at 10 : 26

Work out the average speed Raphaël must drive at from Dre to Ede.

Give your answer correct to the nearest whole number.

### Worked Example

John travels 94 miles at a speed of 47 mph.  
John then travels 115 miles at a speed of 46 mph.  
Work out John's overall speed for the entire journey.  
Give your answer correct to 1 decimal place.

### Your Turn

Fred travels 105 km at a speed of 35 km/h.  
Fred then travels 126 km at a speed of 60 km/h.  
Work out Fred's overall speed for the entire journey.  
Give your answer correct to 1 decimal place.

### Worked Example

Reuben and Alice take part in the same charity running race.

Reuben completed the run in 210 minutes.

His average speed was 8 kilometres per hour.

Alice completed the run in 224 minutes.

Calculate Alice's average speed.

### Your Turn

Bruno and Jin set out at the same time to get to the rugby pitch for 6 : 30 pm.

Bruno's journey was 17 miles, and his average speed was 34 miles per hour.

Jin's average speed was 22 miles per hour.

Calculate the distance Jin travelled to get to the rugby pitch.

# Density

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\rho = \frac{m}{V}$$

### Worked Example

The mass of an object is  $50\text{ g}$ . The volume is  $10\text{ cm}^3$ . What is the density of the object?

The density of an object is  $10\text{ g/cm}^3$ . The volume is  $5\text{ cm}^3$ . What is the mass?

The density of an object is  $10\text{ g/cm}^3$ . The mass is  $50\text{ g}$ . What is the volume?

### Your Turn

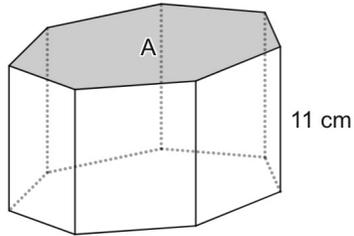
The mass of an object is  $100\text{ g}$ . The volume is  $25\text{ cm}^3$ . What is the density of the object?

The density of an object is  $10\text{ g/cm}^3$ . The volume is  $25\text{ cm}^3$ . What is the mass?

The density of an object is  $10\text{ g/cm}^3$ . The mass is  $25\text{ g}$ . What is the volume?

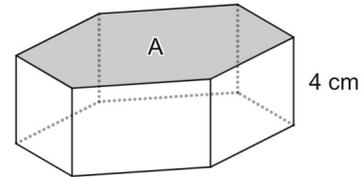
## Worked Example

A heptagonal metal prism with base area  $A$  of  $274 \text{ cm}^2$  and length  $11 \text{ cm}$  has a density of  $12.51 \text{ g/cm}^3$  as shown below. Find the mass in  $g$  to the nearest gram.



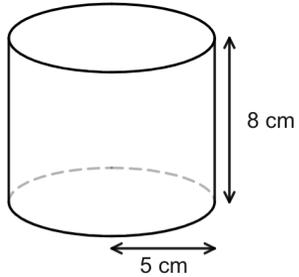
## Your Turn

A hexagonal wooden prism with base area  $A$  of  $94 \text{ cm}^2$  and length  $4 \text{ cm}$  has a mass of  $233 \text{ g}$  as shown below. Find the density in  $\text{g/cm}^3$  to 2 decimal places.



## Worked Example

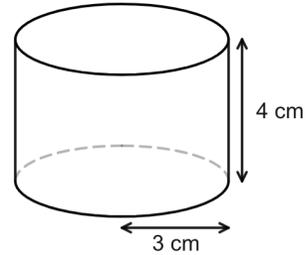
A wooden cylinder with radius 5 cm and height 8 cm has a density of  $0.36 \text{ g/cm}^3$ .



Find the mass of the wooden cylinder.  
Give your answer correct to the nearest whole number.

## Your Turn

A metal cylinder with radius 3 cm and height 4 cm has a density of  $2.55 \text{ g/cm}^3$ .

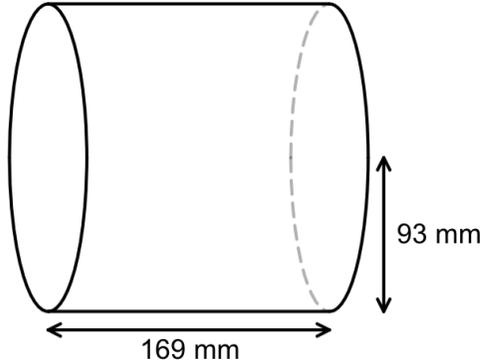


Find the mass of the metal cylinder.  
Give your answer correct to the nearest whole number.

### Worked Example

There are lots of small plastic cylinders of radius 93 mm and height 169 mm.

Some will be melted down to make one large heptagonal prism of mass 416 kg and density  $0.25 \text{ g/cm}^3$ .

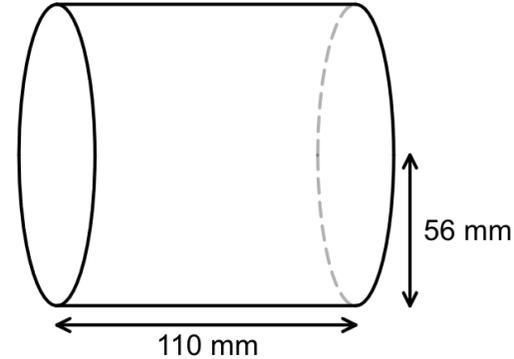


Find how many small cylinders are needed to make the large prism.

### Your Turn

There are lots of small metal cylinders of radius 56 mm and height 110 mm.

Some will be melted down to make one large cylinder of mass 6357 kg and density  $11.53 \text{ g/cm}^3$ .



Find how many small cylinders are needed to make the large cylinder.

### Worked Example

Liquid *A* has a density of  $1.15 \text{ g/cm}^3$ .  
Liquid *B* has a density of  $1.23 \text{ g/cm}^3$ .  
 $76 \text{ cm}^3$  of liquid *A* and  $116 \text{ cm}^3$  of liquid *B* are mixed to make liquid *C*.  
Work out the density of liquid *C*.  
Give your answer correct to 2 decimal places.

### Your Turn

Liquid *A* has a density of  $1.11 \text{ g/cm}^3$ .  
Liquid *B* has a density of  $1.3 \text{ g/cm}^3$ .  
 $41 \text{ cm}^3$  of liquid *A* and  $143 \text{ cm}^3$  of liquid *B* are mixed to make liquid *C*.  
Work out the density of liquid *C*.  
Give your answer correct to 2 decimal places.

### Worked Example

Metal *A* has a density of  $9.57 \text{ g/cm}^3$ .  
Metal *B* has a density of  $14.18 \text{ g/cm}^3$ .  
117 g of metal *A* and 247 g of metal *B* are mixed to make an alloy.  
Calculate the density of the alloy.  
Give your answer correct to 2 decimal places.

### Your Turn

Metal *A* has a density of  $6.47 \text{ g/cm}^3$ .  
Metal *B* has a density of  $11.94 \text{ g/cm}^3$ .  
136 g of metal *A* and 234 g of metal *B* are mixed to make an alloy.  
Calculate the density of the alloy.  
Give your answer correct to 2 decimal places.

# Pressure

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$P = \frac{F}{A}$$

### Worked Example

The force exerted by an object on a surface is  $50N$ . The surface area in contact with the object is  $10cm^2$ . What is the pressure exerted by the object?

The pressure exerted on a surface by an object is  $50N/cm^2$ . The surface area in contact with the object is  $10cm^2$ . What is the force exerted?

The pressure exerted on a surface by an object is  $50N/cm^2$ . The force exerted on the surface is  $10N$ . What is the surface area in contact with the object?

### Your Turn

The force exerted by an object on a surface is  $100N$ . The surface area in contact with the object is  $25cm^2$ . What is the pressure exerted by the object?

The pressure exerted on a surface by an object is  $100N/cm^2$ . The surface area in contact with the object is  $25cm^2$ . What is the force exerted?

The pressure exerted on a surface by an object is  $100N/cm^2$ . The force exerted on the surface is  $25N$ . What is the surface area in contact with the object?

### Worked Example

A pressure of  $0.19 \text{ N/cm}^2$  is applied to an area using a force of  $5510 \text{ N}$ .

Calculate the area the force is applied to.  
Give your answer in  $\text{m}^2$

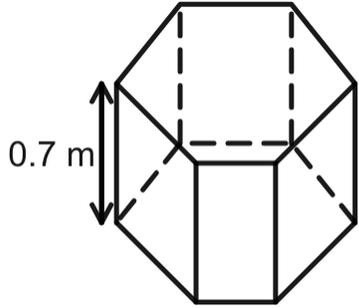
### Your Turn

An elephant puts a total force of  $82179 \text{ N}$  on its four feet.  
Each foot has an area of  $9925 \text{ cm}^2$

Calculate the pressure the elephant exerts on the ground.  
Give your answer in  $\text{N/m}^2$

## Worked Example

The diagram shows a water tank in the shape of a prism placed on a horizontal floor.



The height of the tank is 0.7 m and the volume is  $3.5 \text{ m}^3$

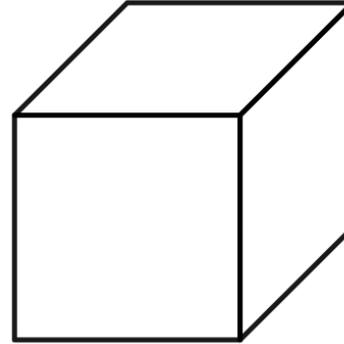
The pressure on the floor due to the tank is  $2000 \text{ N/m}^2$

Calculate the force exerted by the tank on the floor. Give your answer in newtons.

## Your Turn

The diagram shows a solid cube.

The cube is placed on a table so that the whole of one face of the cube is in contact with the table.



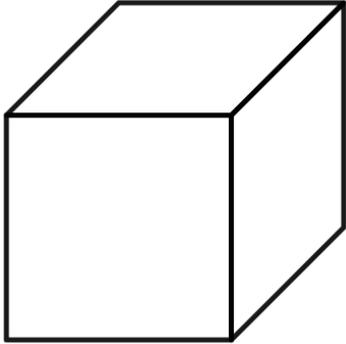
The cube exerts a force of 226.8 newtons on the table.  
The pressure exerted by the cube is  $0.7 \text{ N/cm}^2$

Calculate the volume of the cube.  
Give your answer in  $\text{cm}^3$

## Worked Example

The diagram shows a solid cube.

The cube is placed on the floor so that the whole of one face of the cube is in contact with the floor.

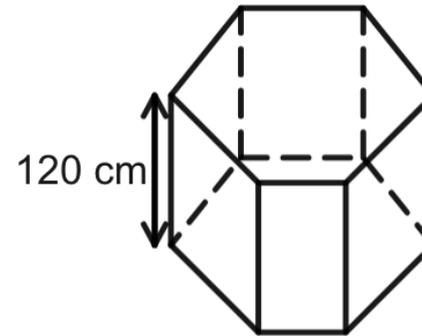


The cube exerts a force of 1587 newtons on the floor.  
The pressure exerted by the cube is  $0.03 \text{ N/cm}^2$

Calculate the width of the cube.  
Give your answer in metres.

## Your Turn

The diagram shows a water tank in the shape of a prism placed on a horizontal floor.



The height of the tank is 120 cm and the volume is  $4.8 \text{ m}^3$

The pressure on the floor due to the tank is  $2390 \text{ N/m}^2$

Calculate the force exerted by the tank on the floor.  
Give your answer in newtons.

## Fill in the Gaps

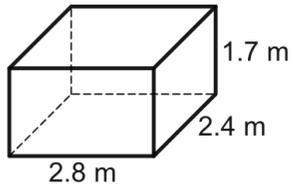
Mass	Volume	Density	
500 g	200 cm <sup>3</sup>		g/cm <sup>3</sup>
6.2 kg	0.004 m <sup>3</sup>		kg/m <sup>3</sup>
1.6 kg		2000	kg/m <sup>3</sup>
	2.25 cm <sup>3</sup>	1.6	g/cm <sup>3</sup>
	0.2 m <sup>3</sup>	750	kg/m <sup>3</sup>
264 g		0.88	g/cm <sup>3</sup>
0.24 kg	400 cm <sup>3</sup>		g/cm <sup>3</sup>
56000 g		800	kg/m <sup>3</sup>
	400000 cm <sup>3</sup>	2180	kg/m <sup>3</sup>
8000 g	0.0025 m <sup>3</sup>		g/cm <sup>3</sup>
13.8 kg	0.015 m <sup>3</sup>		g/cm <sup>3</sup>

Force	Area	Pressure	
7 N	0.4 m <sup>2</sup>		N/m <sup>2</sup>
60 N	2.4 m <sup>2</sup>		N/m <sup>2</sup>
	0.06 m <sup>2</sup>	70	N/m <sup>2</sup>
56 N		32	N/m <sup>2</sup>
	0.001 m <sup>2</sup>	3800	N/m <sup>2</sup>
99 N		450	N/m <sup>2</sup>
85 N	20000 cm <sup>2</sup>		N/m <sup>2</sup>
	80000 cm <sup>2</sup>	12.75	N/m <sup>2</sup>
174 N	725 cm <sup>2</sup>		N/m <sup>2</sup>
135 N	5000000 mm <sup>2</sup>		N/m <sup>2</sup>
	3600 mm <sup>2</sup>	1850	N/m <sup>2</sup>

## Other Compound Measures

## Worked Example

An empty tank is in the shape of a cuboid with dimensions 2.8 m by 2.4 m by 1.7 m as shown.

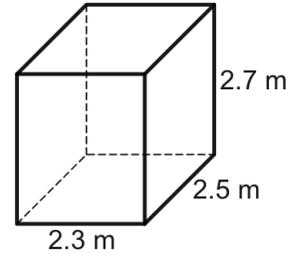


Water flows into the tank at a rate of 42 litres per minute.  
Find the time it takes to fill the tank.

$$1 \text{ m}^3 = 1000 \text{ litres}$$

## Your Turn

An empty tank is in the shape of a cuboid with dimensions 2.3 m by 2.5 m by 2.7 m as shown.

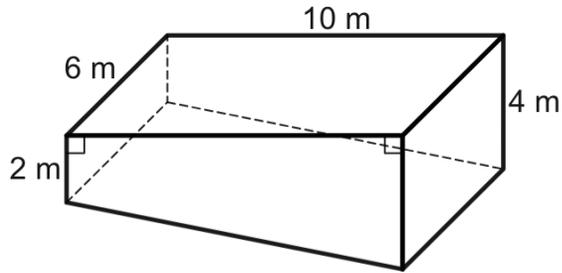


Water flows into the tank at a rate of 9 litres per minute.  
Find the time it takes to fill the tank.

$$1 \text{ m}^3 = 1000 \text{ litres}$$

## Worked Example

A swimming pool is in the shape of a prism with dimensions as shown. The cross section is a trapezium.



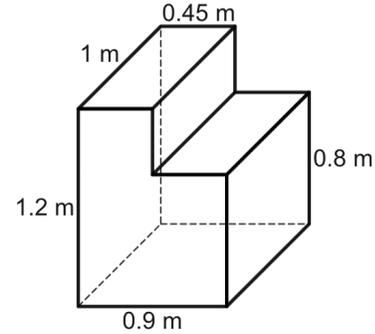
Water flows into the pool at a rate of 32 litres per minute.

$$1 \text{ m}^3 = 1000 \text{ litres}$$

Find the time it takes to fill the pool.

## Your Turn

A tank is in the shape of a prism with dimensions as shown.



The tank is full of water. Lexi opens the tap, and water starts to flow out of the tank at a rate of 18 litres per minute.

$$1 \text{ m}^3 = 1000 \text{ litres}$$

Find the time it takes to empty the tank.

## Extra Notes