KING EDWARD VI HANDSWORTH GRAMMAR SCHOOL FOR BOYS

KING EDWARD VI ACADEMY TRUST BIRMINGHAM

Year 9

2024 Mathematics 2025

Unit 13 Booklet – Part 1

HGS Maths

Tasks

Dr Frost Course

Name: ______________________________

Class: ______________________________

KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS

KING EDWARD VI
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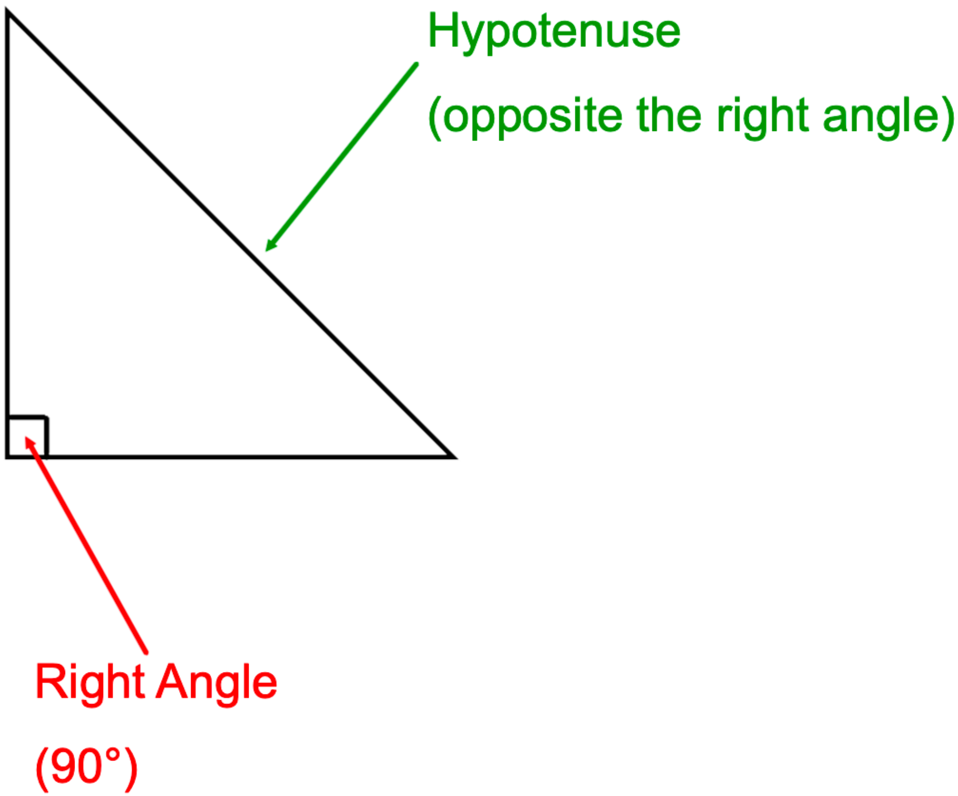
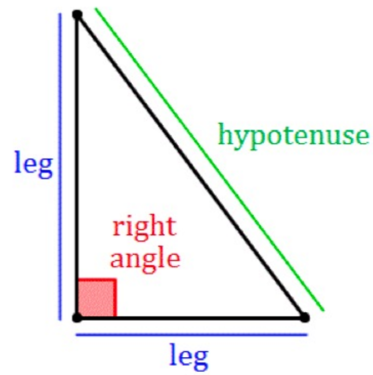
1 2D Pythagoras' Theorem

Hypotenuse



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

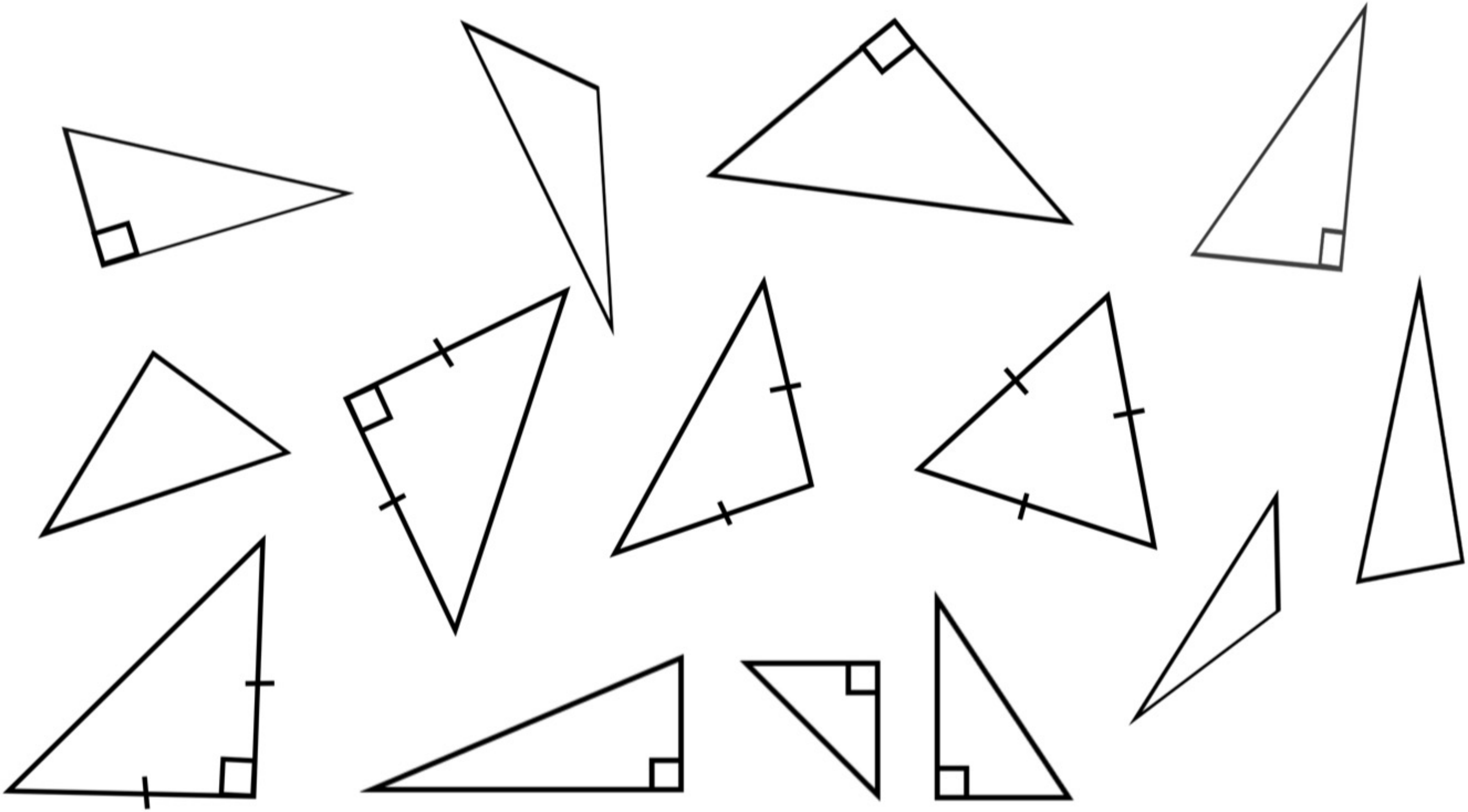


The two sides that aren't the hypotenuse are known as legs.

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

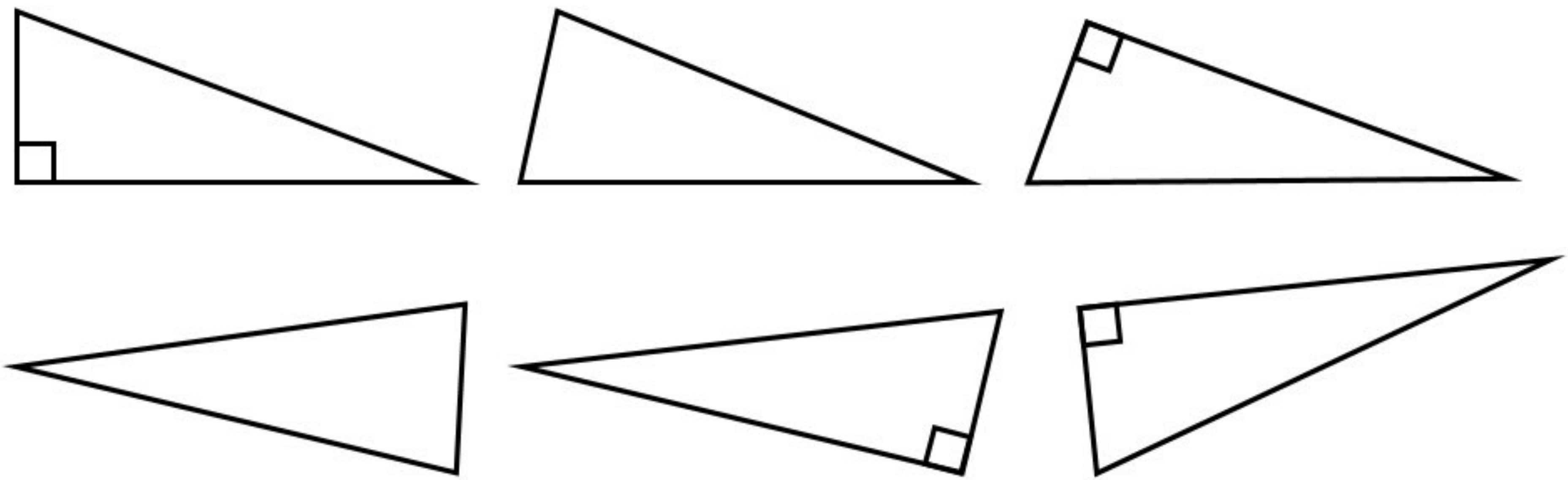
Fluency Practice

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

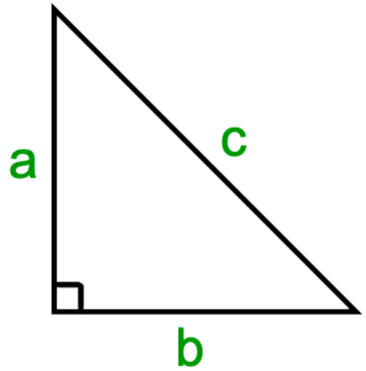


Fluency Practice

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



Pythagoras' Theorem

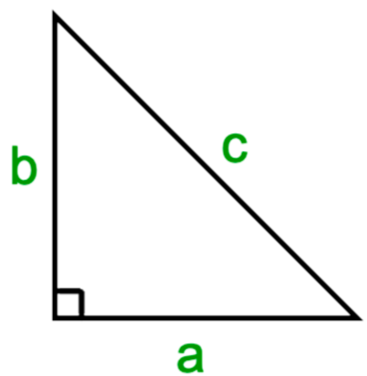


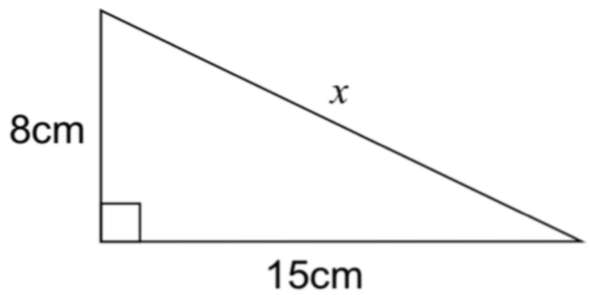
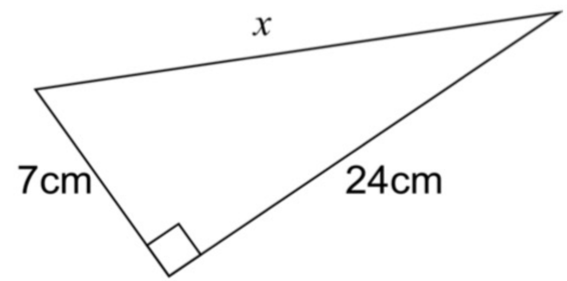
In any *right angled triangle*, the square of the hypotenuse is equal to the sum of the squares of the other two sides.

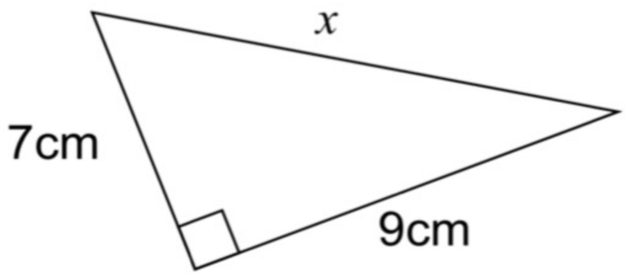
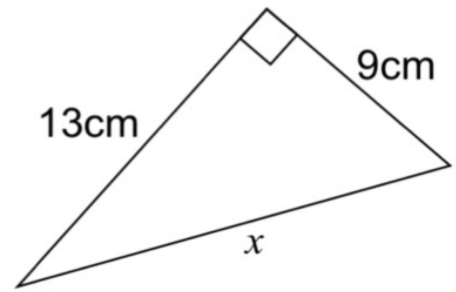
In other words:

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

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	Your Turn
Calculate the unknown side in this triangle.  	Calculate the unknown side in this triangle. 

Worked Example	Your Turn
Calculate the unknown side in this triangle. Give your answer to 2 decimal places.  	Calculate the unknown side in this triangle. Give your answer to 2 decimal places. 

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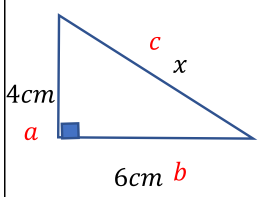
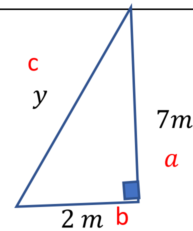
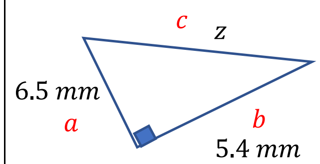
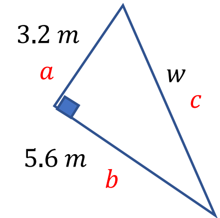
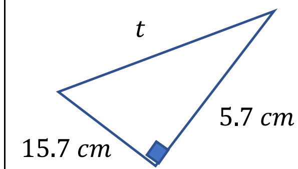
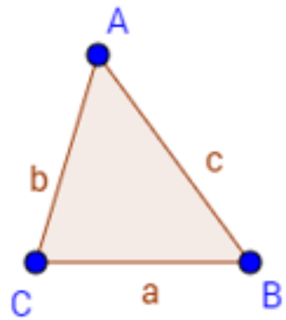
Fill in the Gaps

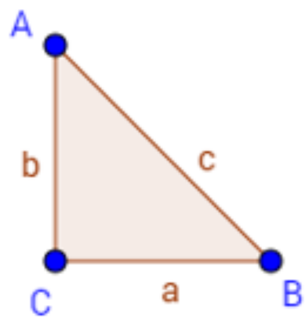
Finding Missing Lengths Part 1. Complete the examples in the table by finding the value of the hypotenuse. Round your answers to 1 decimal place.

Question Label diagram					
Write down Pythagoras' Theorem	$c^2 = a^2 + b^2$	$c^2 = a^2 + b^2$	$c^2 = a^2 + b^2$	$c^2 = a^2 + b^2$	
Substitute in the values	$x^2 = 4^2 + 6^2$	$y^2 = 7^2 + 2^2$	$z^2 = 6.5^2 + 5.4^2$		
Evaluate the squares and add together	$x^2 = 16 + 36$ $x^2 = 52$	$y^2 = 49 + 4$ $y^2 = 53$	$z^2 = 42.25 + 29.16$ $z^2 = 71.41$		
Square root to solve the equation	$x = \sqrt{52}$	$y = \sqrt{53}$			
Round your answer (where appropriate) and give units	$x = 7.2\ cm\ (1dp)$				

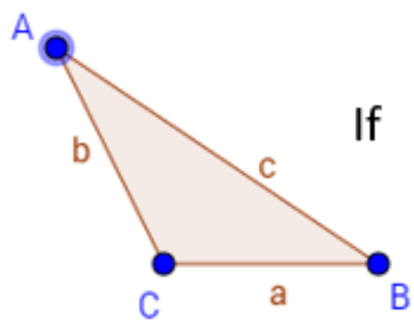
Converse of Pythagoras' Theorem



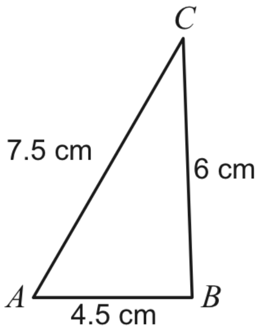
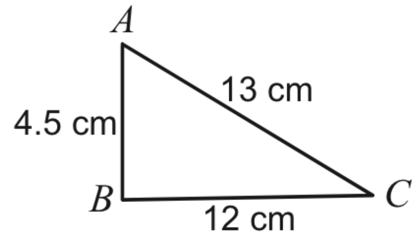
If $c^2 < a^2 + b^2$ then ABC is an acute triangle

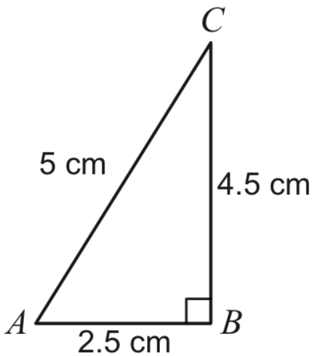
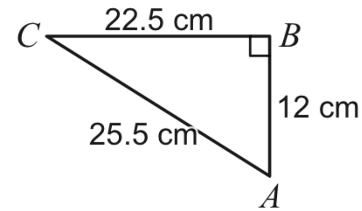


If $c^2 = a^2 + b^2$ then ABC is right triangle



If $c^2 > a^2 + b^2$ then ABC is an obtuse triangle

Worked Example	Your Turn
Determine whether the triangle below is right-angled.  	Determine whether the triangle below is right-angled. 

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

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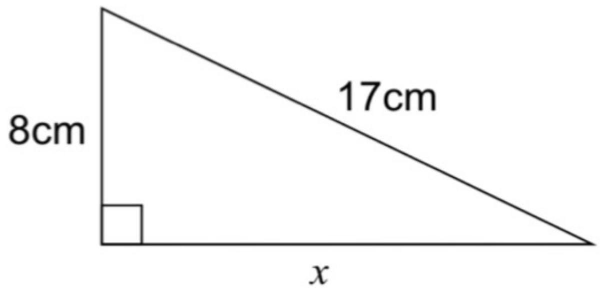
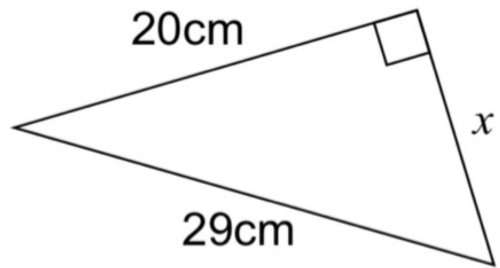
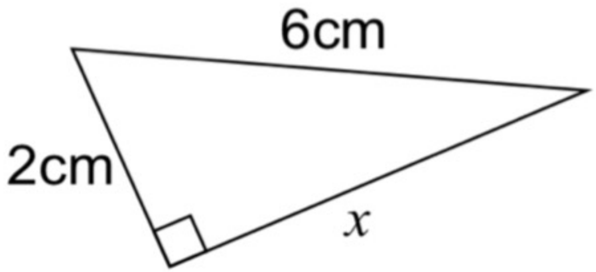
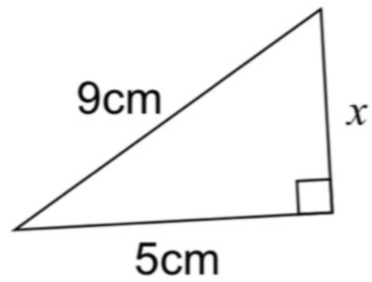
Worked Example	Your Turn
Calculate the unknown side in this triangle.  	Calculate the unknown side in this triangle. 

Worked Example	Your Turn
Calculate the unknown side in this triangle. Give your answer to 2 decimal places.  	Calculate the unknown side in this triangle. Give your answer to 2 decimal places. 

Dr Frost 288b

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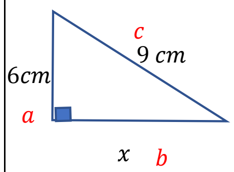
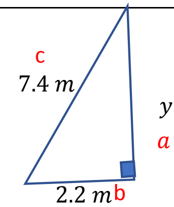
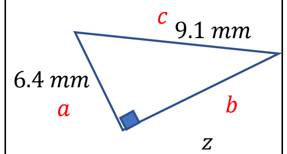
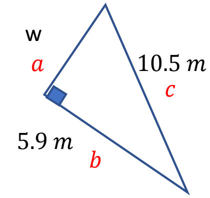
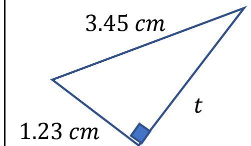
Finding Missing Lengths Part 2. Complete the examples in the table by finding the value of the leg. Round your answers to 1 decimal place.

Question Label diagram					
Write down Pythagoras' Theorem	$c^2 = a^2 + b^2$	$c^2 = a^2 + b^2$	$c^2 = a^2 + b^2$	$c^2 = a^2 + b^2$	
Substitute in the values	$9^2 = 6^2 + x^2$	$7.4^2 = y^2 + 2.2^2$	$9.1^2 = 6.4^2 + z^2$		
Evaluate the squares and rearrange the equation to get the unknown square on its own.	$81 = 36 + x^2$ -36 -36 $45 = x^2$ $x^2 = 45$	$54.76 = y^2 + 4.84$ -4.84 -4.84 $49.92 = y^2$ $y^2 = 49.92$	$82.81 = 40.96 + z^2$ -40.96 -40.96 $41.85 = z^2$ $z^2 = 41.85$		
Square root to solve the equation	$x = \sqrt{45}$	$y = \sqrt{49.92}$			
Round your answer (where appropriate) and give units	$x = 6.7\ cm\ (1dp)$				

Worked Example	Your Turn
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.	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.

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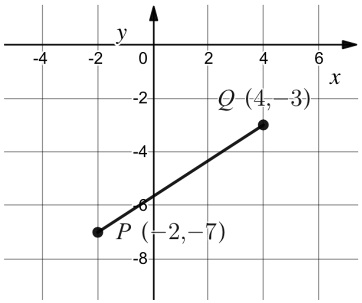
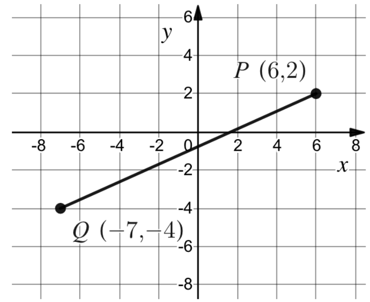
Worked Example	Your Turn
The line segment that connects $P(-2,-7)$ and $Q(4,-3)$ is drawn on the coordinate grid.  Determine the length PQ. Give your answer correct to 1 decimal place.	The line segment that connects $P(6,2)$ and $Q(-7,-4)$ is drawn on the coordinate grid.  Determine the length PQ. Give your answer correct to 1 decimal place.

Worked Example	Your Turn
The line segment connects $P(-6,-4)$ and $Q(-3,3)$ Determine the length PQ. Give your answer correct to 1 decimal place.	The line segment connects $P(-6,-1)$ and $Q(-2,6)$ Determine the length PQ. Give your answer correct to 1 decimal place.

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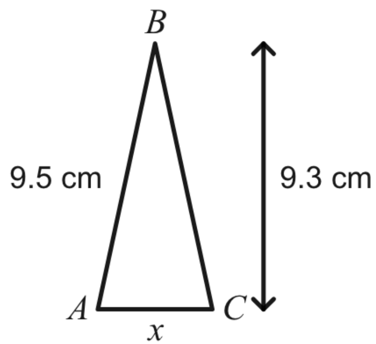
<table>
<tr><th>Worked Example</th><th>Your Turn</th></tr>
<tr><td>

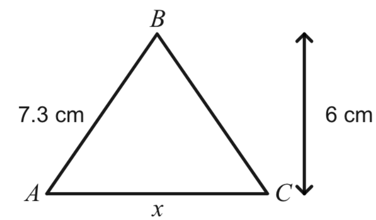
ABC is an isosceles triangle where $AB = BC$.



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

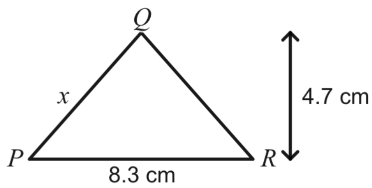
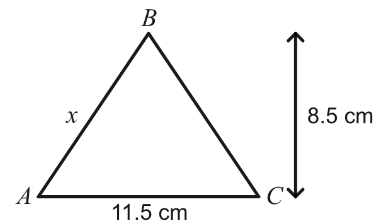
</td><td>

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.

</td></tr>
</table>

Worked Example	Your Turn
PQR is an isosceles triangle where $PQ = QR$.  Find the length marked x on the diagram. Give your answer correct to 1 decimal place.	ABC is an isosceles triangle where $\mathrm{AB} = BC$.  Work out the length marked x on the diagram. Give your answer correct to 1 decimal place.

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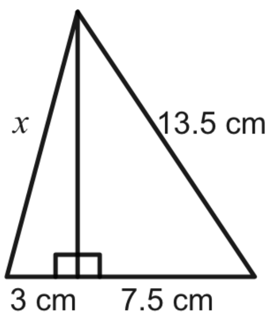
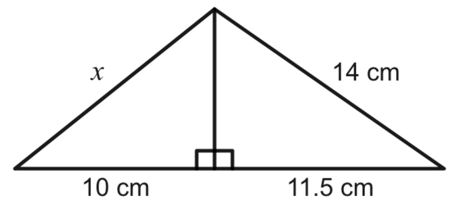
Worked Example	Your Turn
Work out the value of x.  Give your answer correct to 1 decimal place.	Work out the value of x.  Give your answer correct to 1 decimal place.

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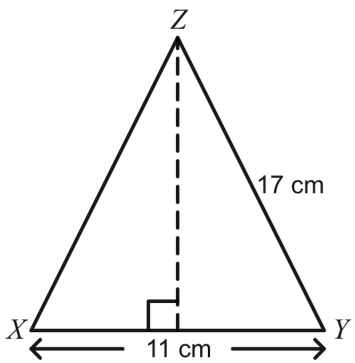
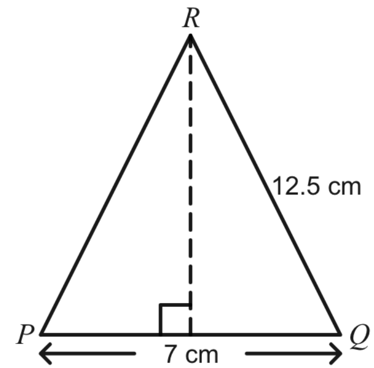
Worked Example	Your Turn
The diagram below shows the isosceles triangle XYZ.  Find the area of triangle XYZ. Give your answer to 1 decimal place.	The diagram below shows the isosceles triangle PQR.  Find the area of triangle PQR.

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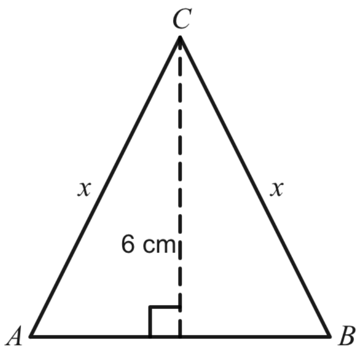
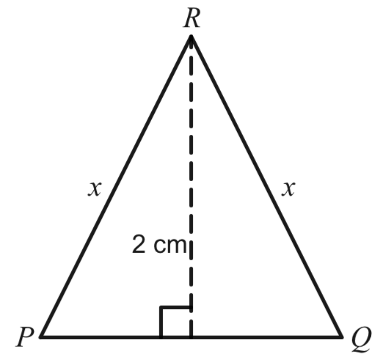
Worked Example	Your Turn
The diagram below shows the isosceles triangle ABC.  The area of triangle ABC is 15 cm^2 Find the length marked x in the diagram.	The diagram below shows the isosceles triangle PQR.  The area of triangle PQR is 3 cm^2 Find the length marked x in the diagram.

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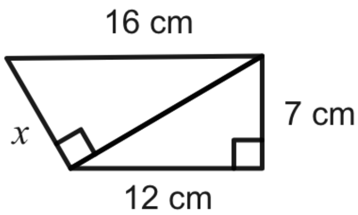
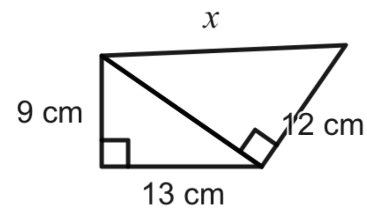
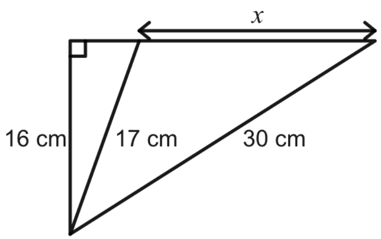
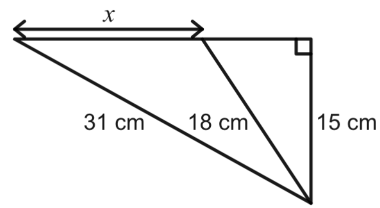
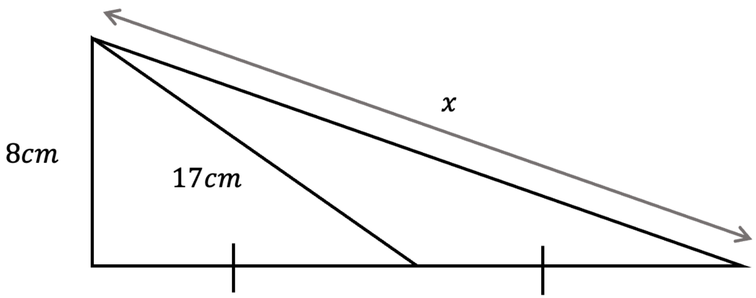
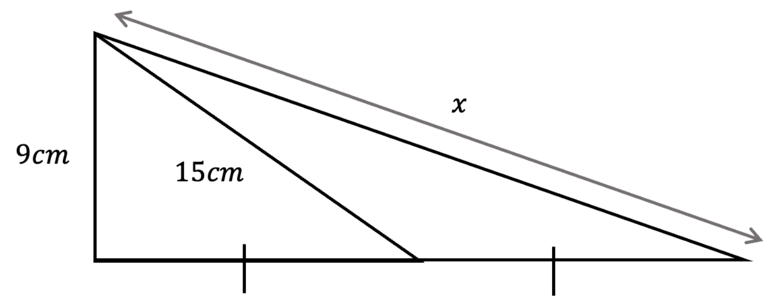
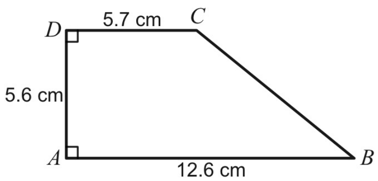
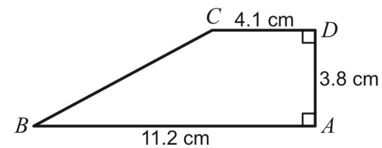
Worked Example	Your Turn
Find the value of x.  Give your answer correct to 1 decimal place.	Calculate the value of x.  Give your answer correct to 1 decimal place.

Worked Example	Your Turn
Find the value of x.  Give your answer correct to 1 decimal place.	Find the value of x.  Give your answer correct to 1 decimal place.

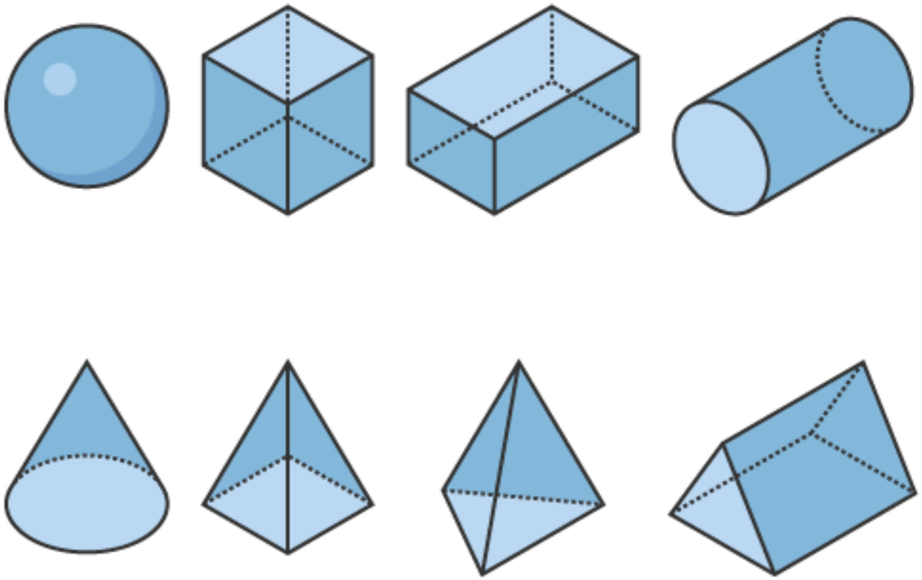
Worked Example	Your Turn
Find the value of x to 2dp. 	Find the value of x to 2dp. 

Worked Example	Your Turn
The diagram shows a trapezium $ABCD$.  Find the length BC. Give your answer to 2 decimal places.	The diagram shows a trapezium $ABCD$.  Find the length BC. Give your answer to 2 decimal places.

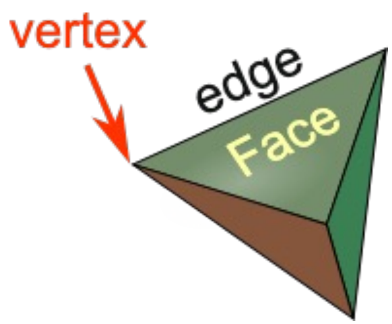
Dr Frost 288o

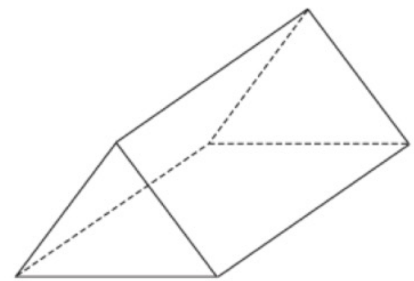
Extra Notes

2 Properties of 3D Shapes

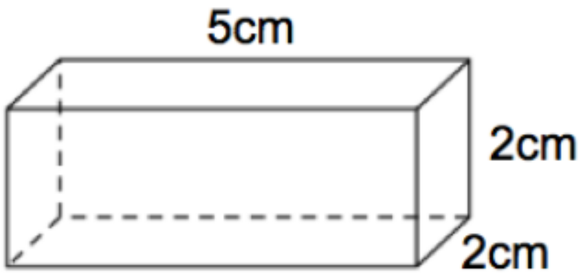


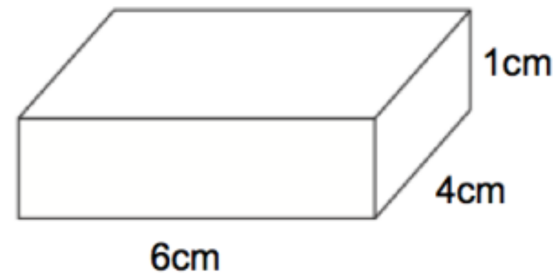
A **vertex** is a corner.
An **edge** is a line segment between faces.
A **face** is a single flat surface.



Worked Example	Your Turn
For the cuboid, write down the:  Number of faces (F) The number of edges (E) The number of vertices (V) Calculate $V - E + F$	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	Your Turn
Draw a net for the cuboid.	Draw a net for the cuboid.



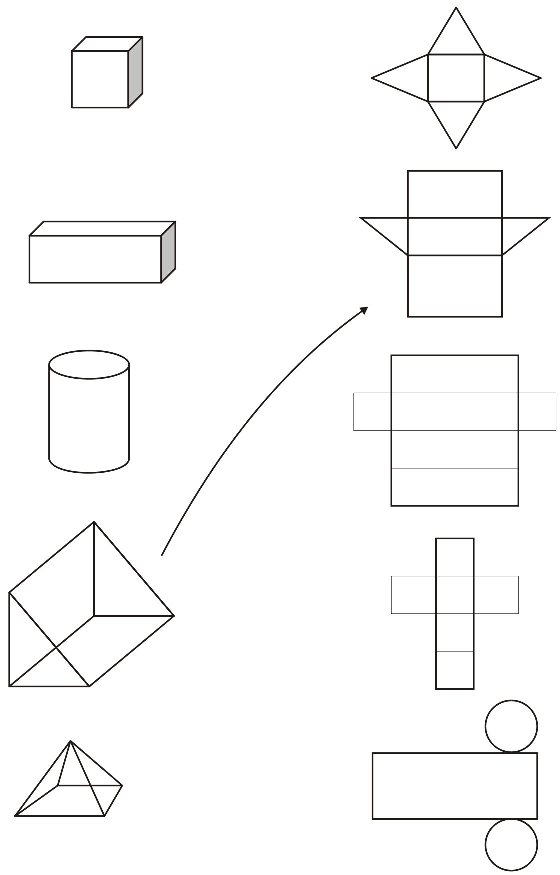


Each square represents 1 cm^2

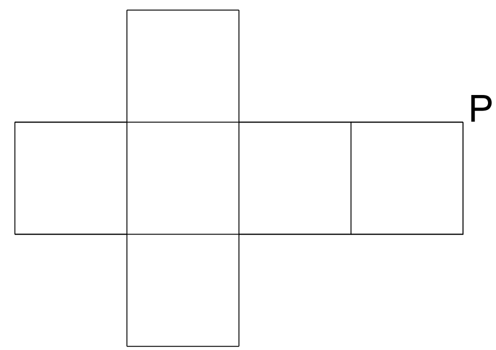
Each square represents 1 cm^2

Fluency Practice

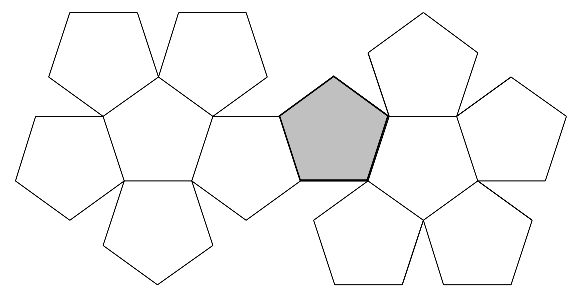
1. Match the 3D solids with their net



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

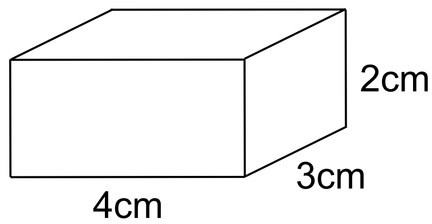


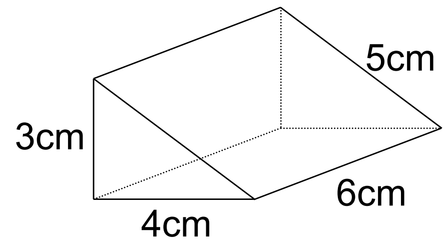
3. The net shown is folded to make a dodecahedron. Label the face which is opposite the shaded one



Fluency Practice

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

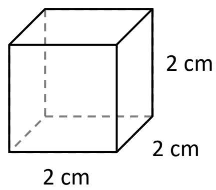




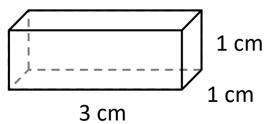
Fluency Practice

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

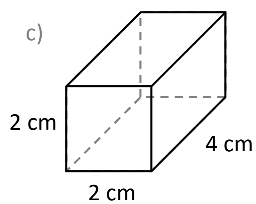
a)



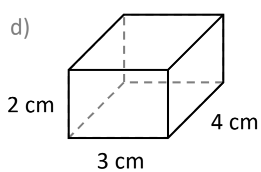
b)



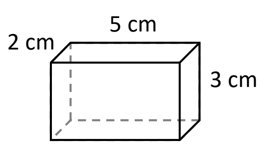
c)

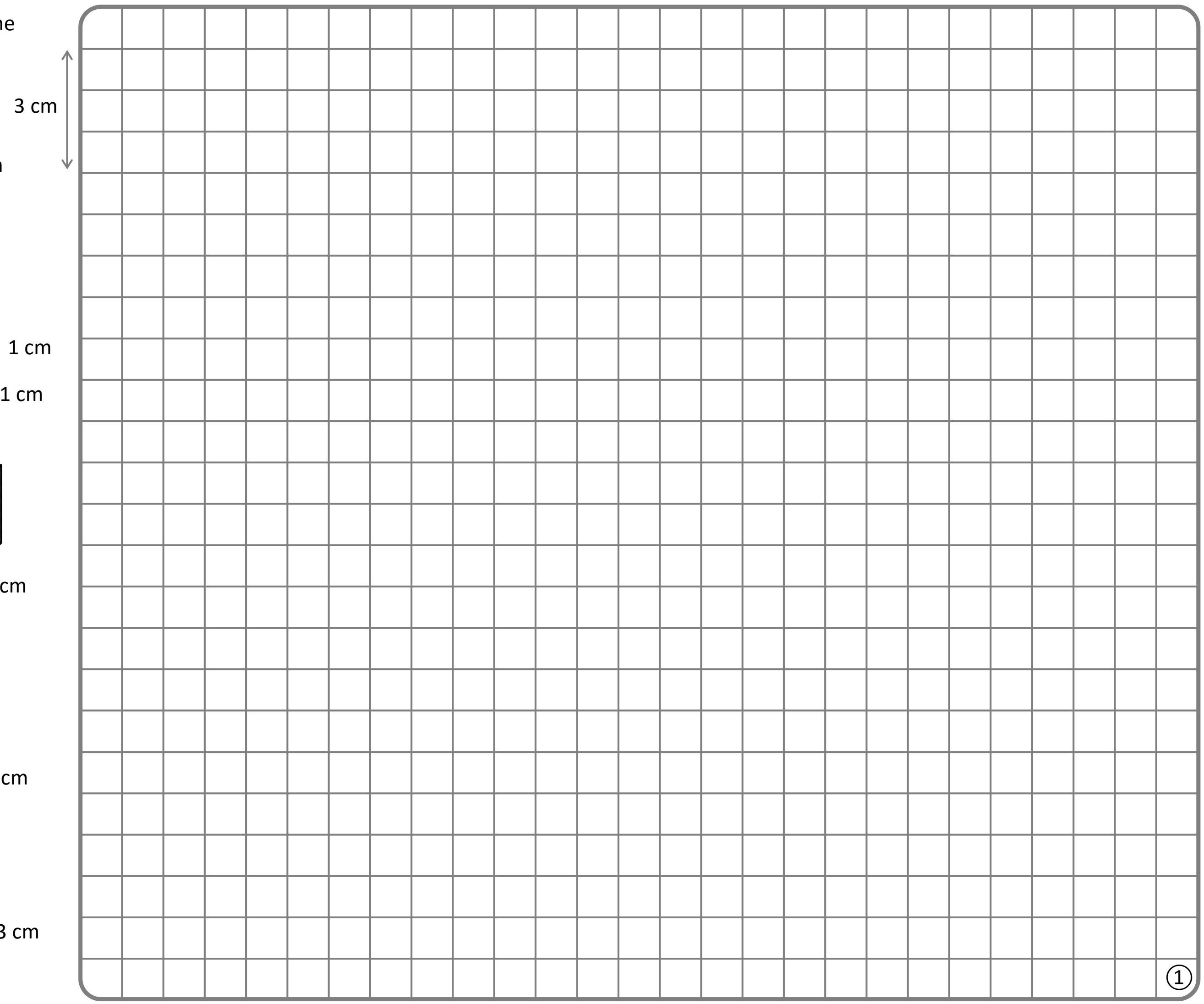


d)



e)

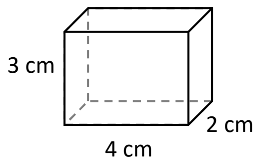




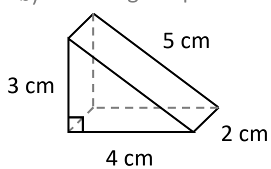
Fluency Practice

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

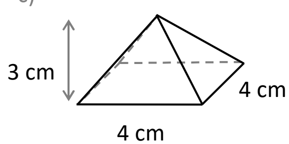
a) cuboid



b) triangular prism

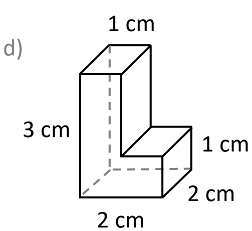


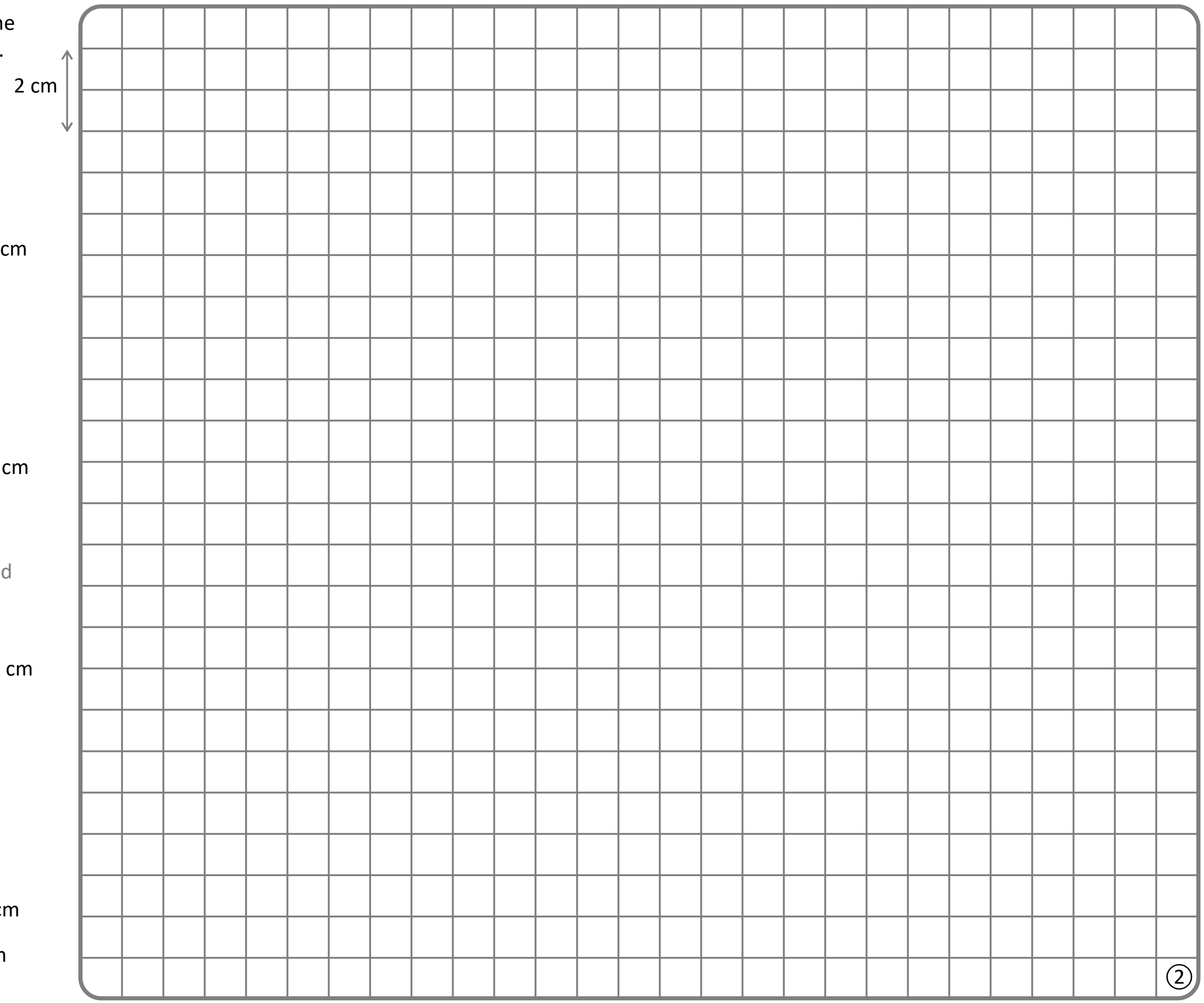
c) regular pyramid



rectilinear prism

d)



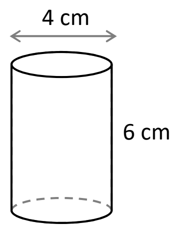


Fluency Practice

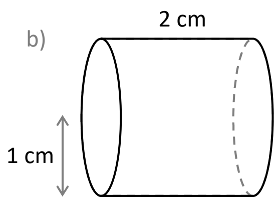
On the scale grid draw the **NET** for each type of cylinder.

Label the lengths of each rectangle.

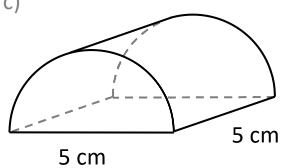
a)



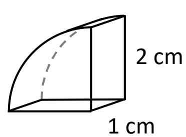
b)

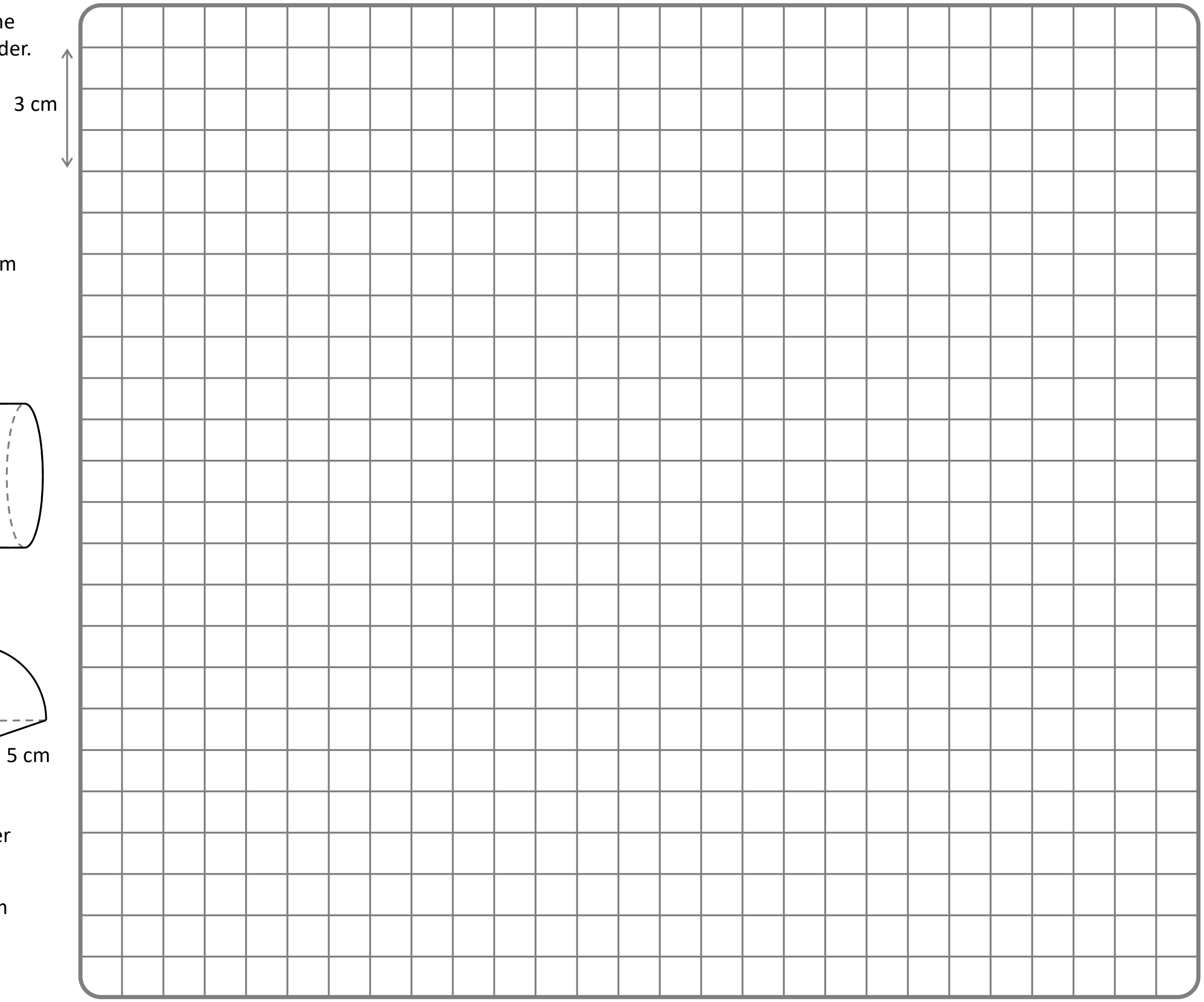


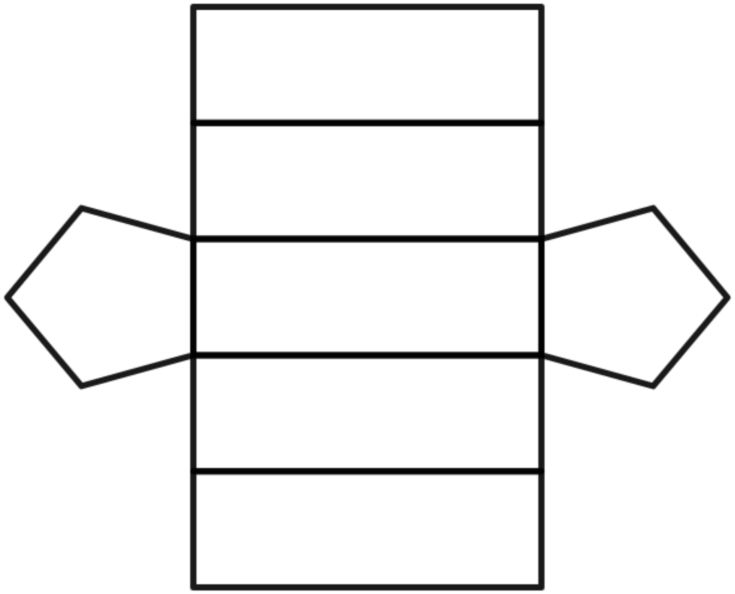
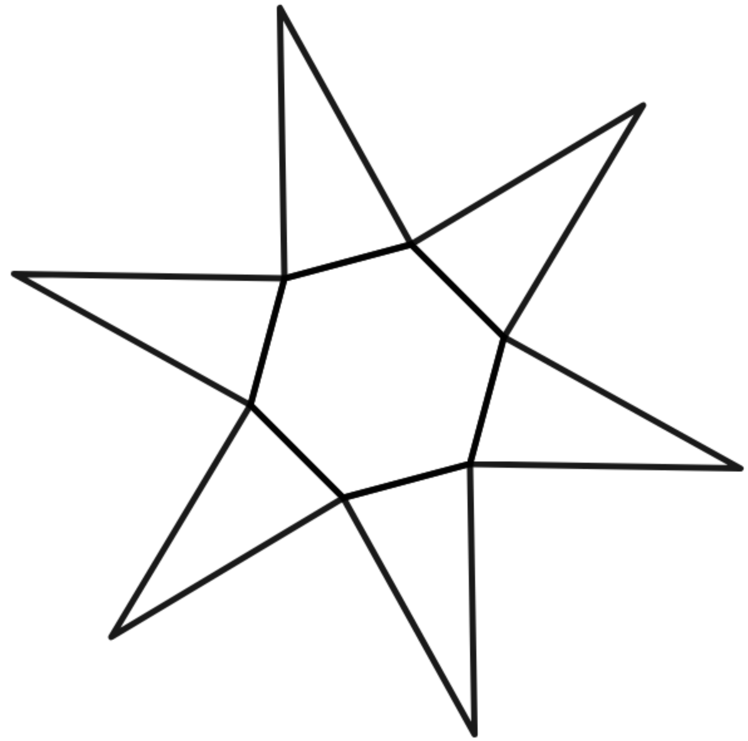
c) half cylinder



d) quarter cylinder





Worked Example	Your Turn
How many edges does this shape have? 	How many edges does this shape have? 

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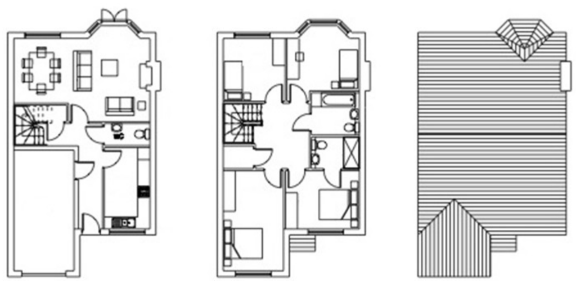
Extra Notes

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.



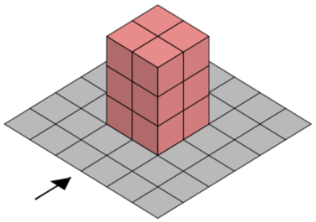
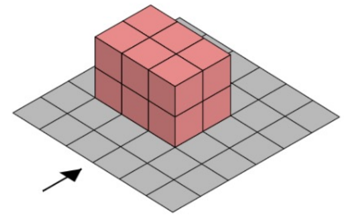
plans

front elevation

side elevation

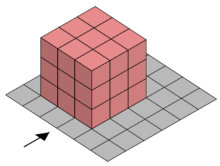
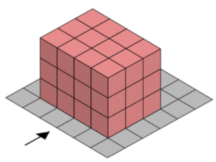
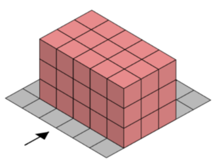
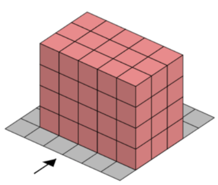
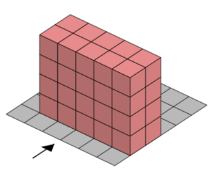
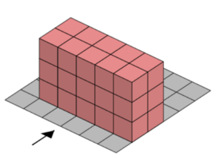
back elevation

side elevation

Worked Example	Your Turn
 Plan: Front (with arrow): Side (from right):	 Plan: Front (with arrow): Side (from right):

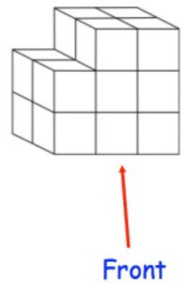
Fluency Practice

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
a 			
b 			
c 			
d 			
e 			
f 			

Worked Example

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



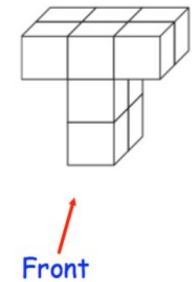
Front:

Left Side:

Plan:

Your Turn

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



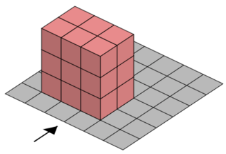
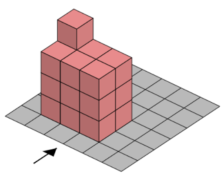
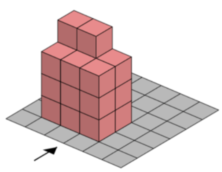
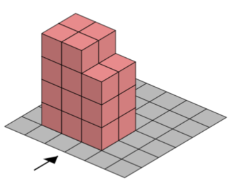
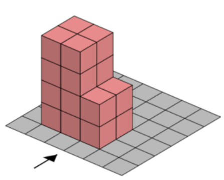
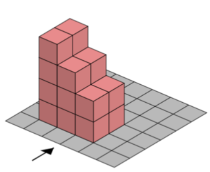
Front:

Left Side:

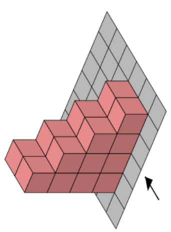
Plan:

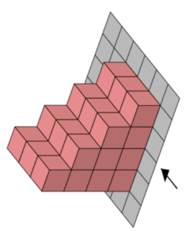
Fluency Practice

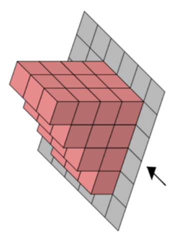
1 For each of the shapes below, draw the plan view, front view (shown with the arrow) and side view (from the right).

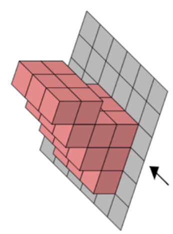
	Plan View	Front View	Side View
a 			
b 			
c 			
d 			
e 			
f 			

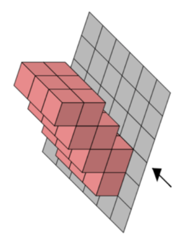
Fluency Practice

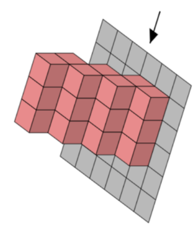

g

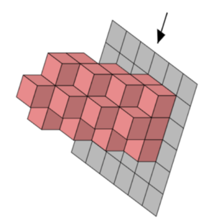

h


i


j


k


l

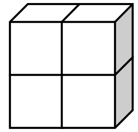

m

4 Cubes

4 cubes can be arranged in 8 different ways.

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

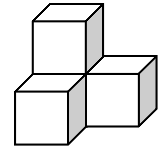
Why are there only 8 arrangements?



Plan

Front Elevation

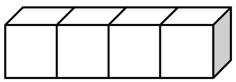
Side Elevation



Plan

Front Elevation

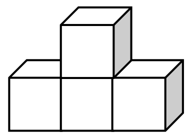
Side Elevation



Plan

Front Elevation

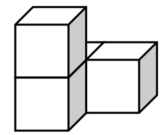
Side Elevation



Plan

Front Elevation

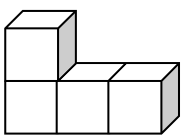
Side Elevation



Plan

Front Elevation

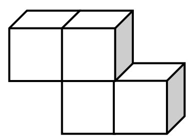
Side Elevation



Plan

Front Elevation

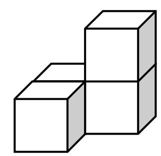
Side Elevation



Plan

Front Elevation

Side Elevation



Plan

Front Elevation

Side Elevation

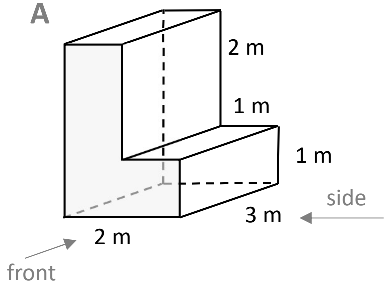
Fluency Practice

not to scale

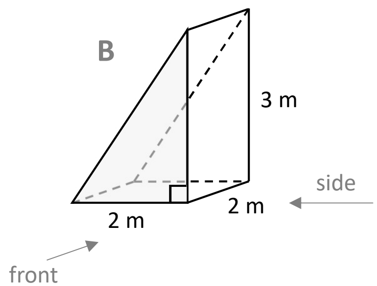
Plans & Elevations

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

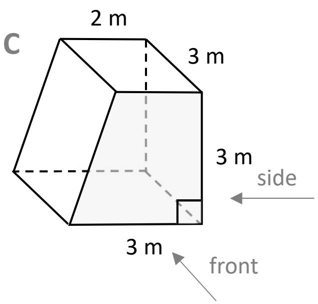
A



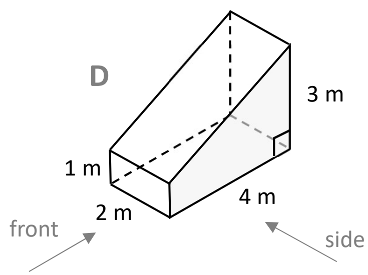
B



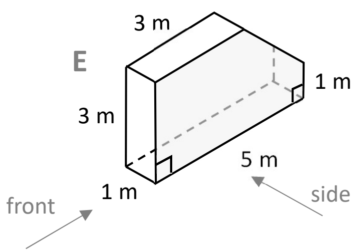
C

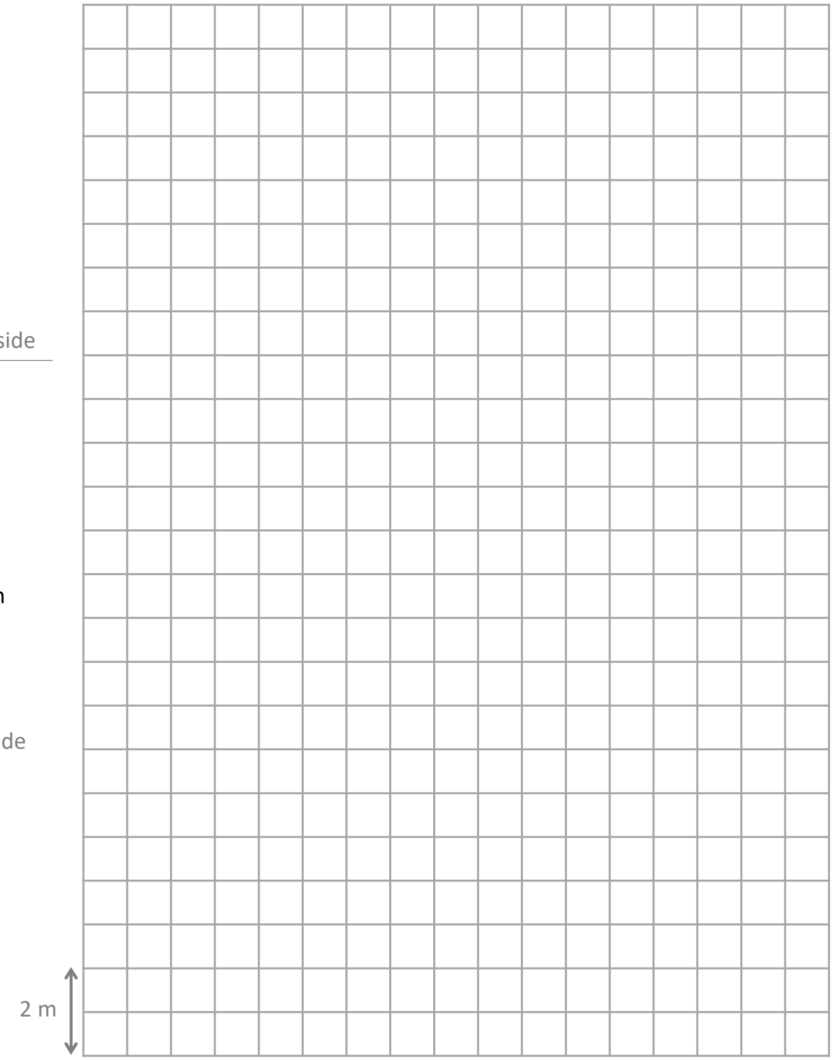


D



E





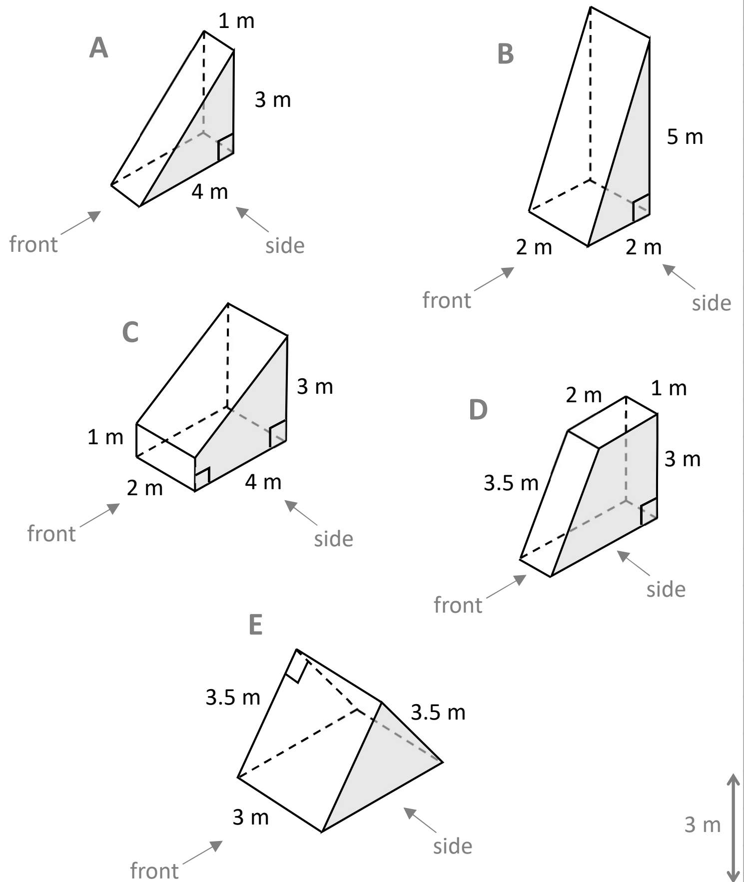
Fluency Practice

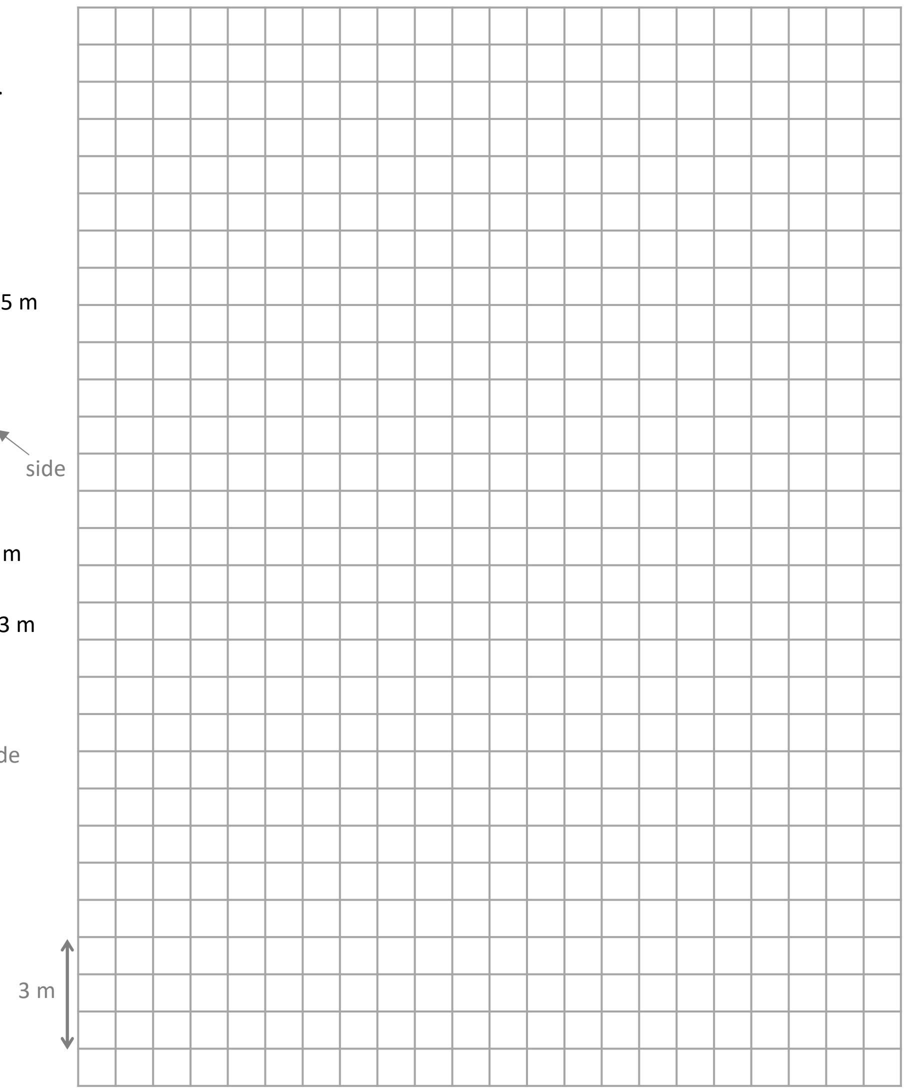
Pythag & Plans & Elevations

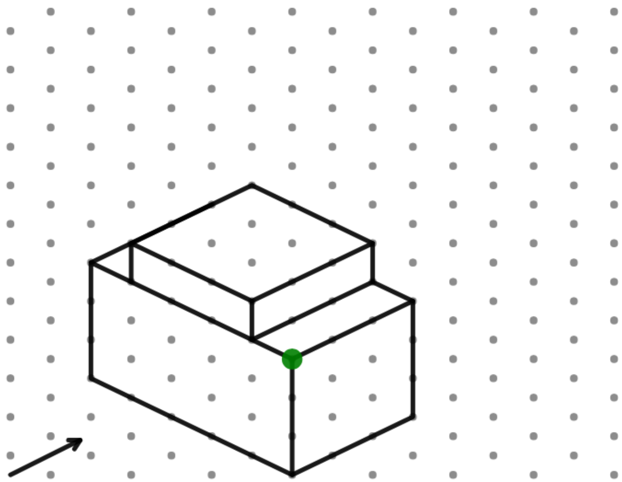
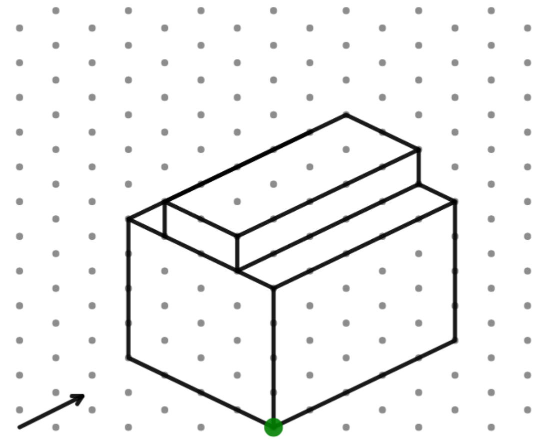
not to scale

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	Your Turn
The arrow indicates the front elevation of the 3D shape.  Draw the plan of the 3D shape.	The arrow indicates the front elevation of the 3D shape.  Draw the side elevation of the 3D shape.

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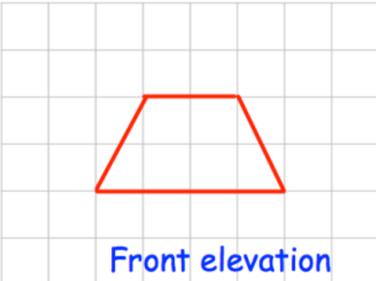
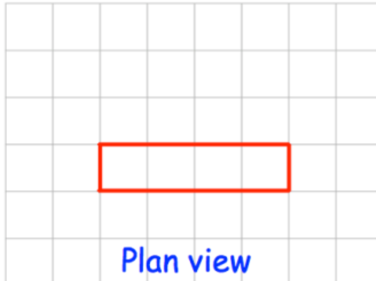
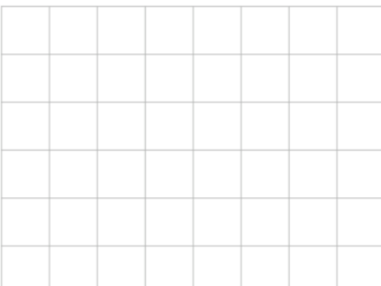
Worked Example

Given the elevations





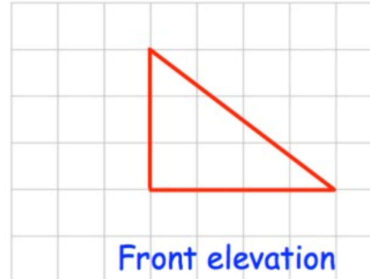
Draw the side elevation



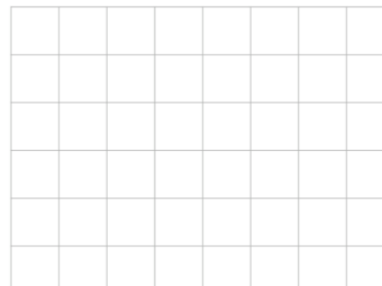
Sketch the solid shape

Your Turn

Given the elevations



Draw the plan view



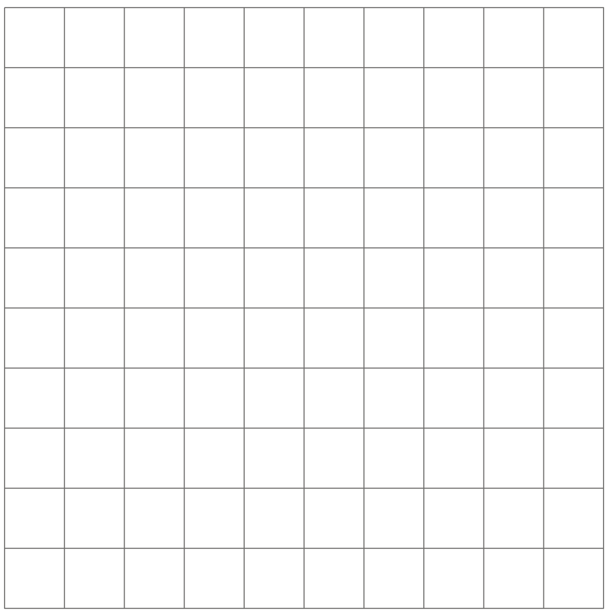
Sketch the solid shape

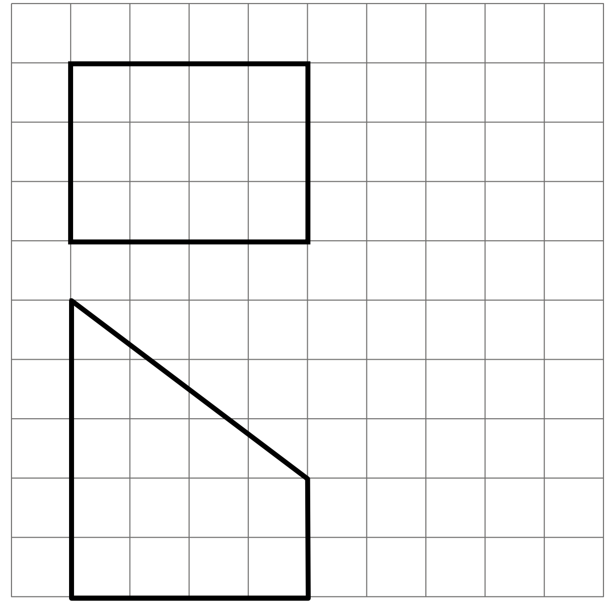
Fluency Practice

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.

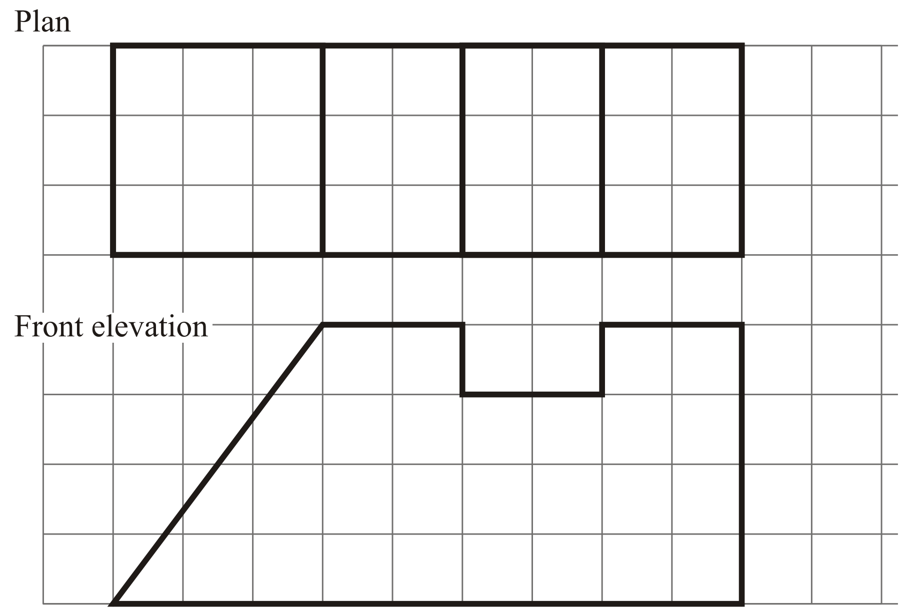




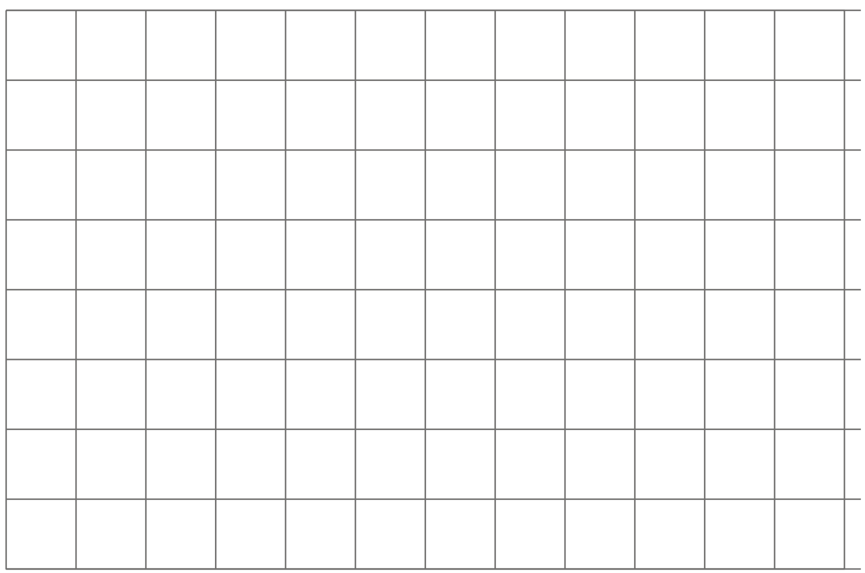
(b) In the space below, draw a 3-D sketch of the prism.

Fluency Practice

2. Here are the plan and front elevation of a prism.
The front elevation shows the cross section of the prism.

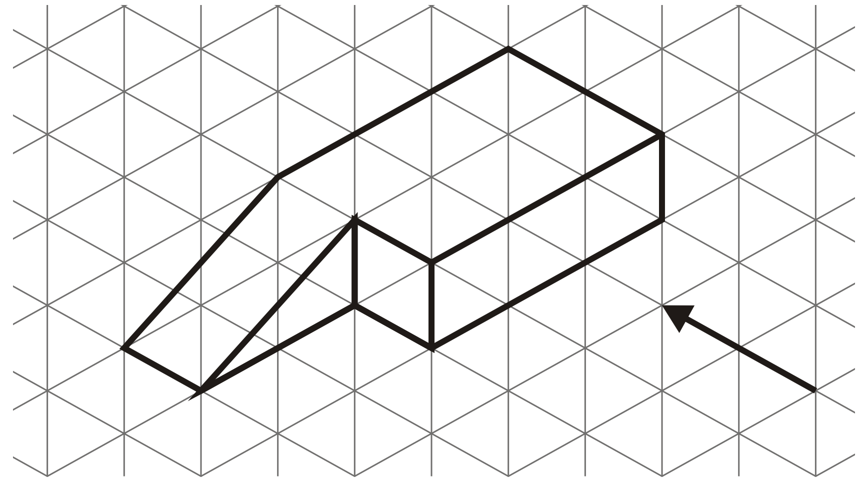


(a) On the grid below, draw a side elevation of the prism.



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

3. The diagram shows a solid object.



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

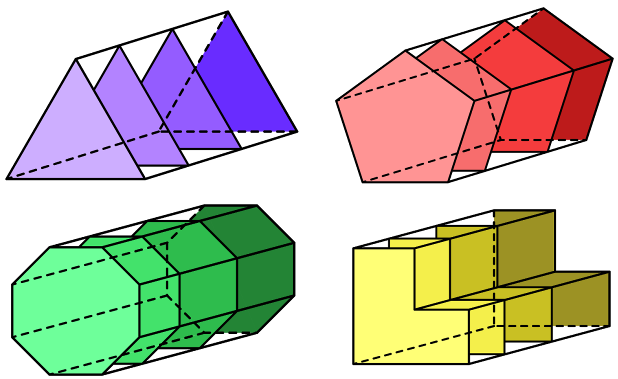
(b) In the space below, sketch the plan of the solid object.

Extra Notes

4 Volume and Surface Area of Prisms

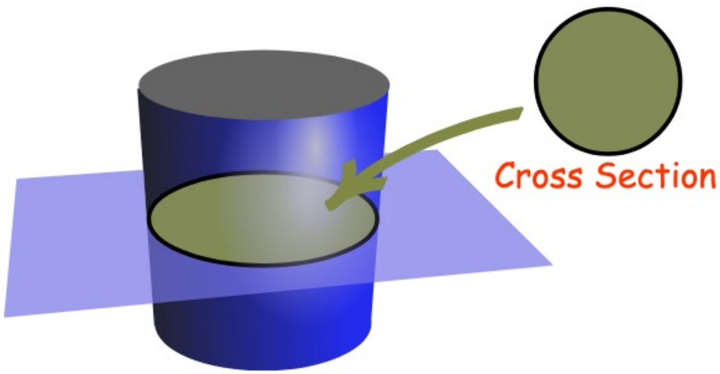
Prisms

A **prism** is a 3D shape which has the same *cross-section* along its length.

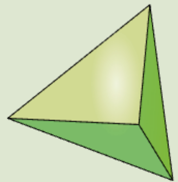
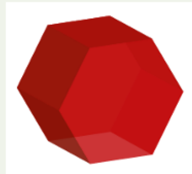
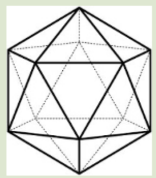
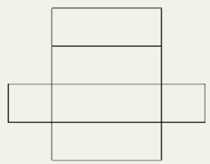
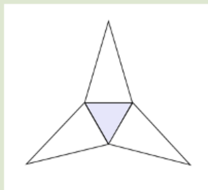


Cross-Section

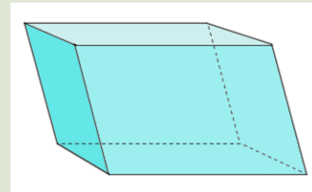
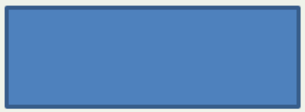
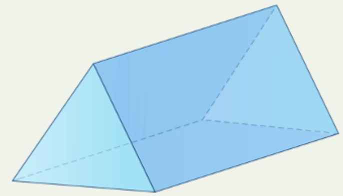
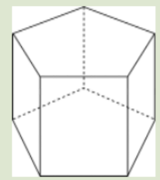
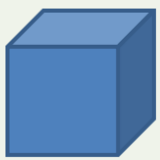
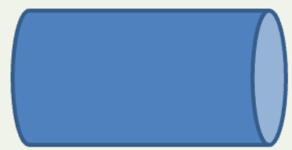
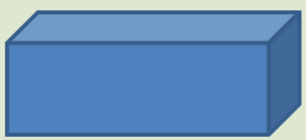
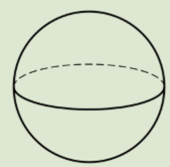
It is the shape made when a solid is cut through parallel to the base.



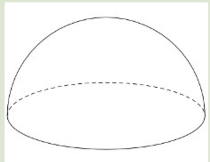
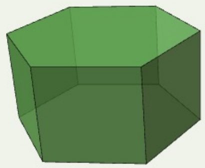
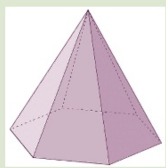
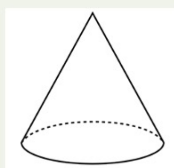
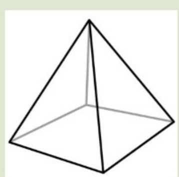
What is a Prism?

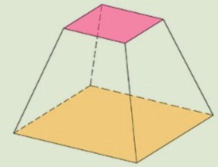
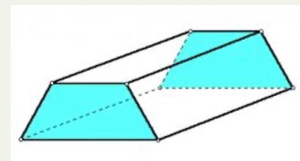
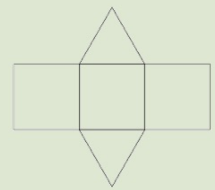
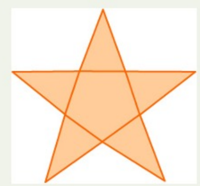
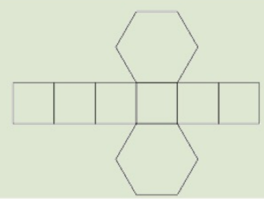
Shape	Prism?
	
	
	
Net 	
Net 	

Fluency Practice

Shape	Prism?	Shape	Prism?
			
			
			
			
			

Fluency Practice

Shape	Prism?
	
	
	
	
	

Shape	Prism?
	
	
Net 	
Net 	
Net 	

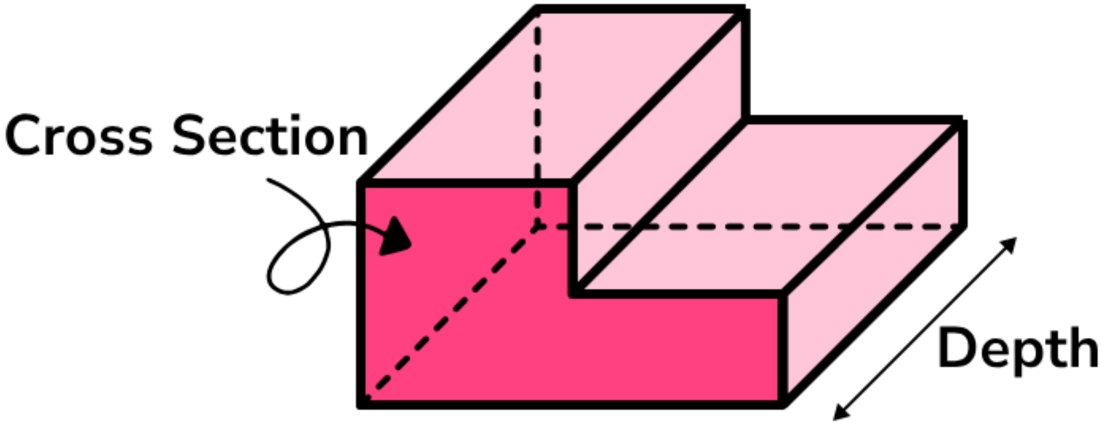
Frayer Model – Prism

Definition	Characteristics
Examples	**Non-Examples**

Volume of Prisms

Volume of Prism = Area of Cross Section × Depth

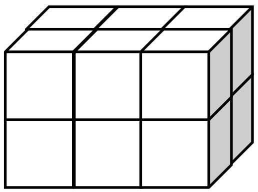
V = A × D



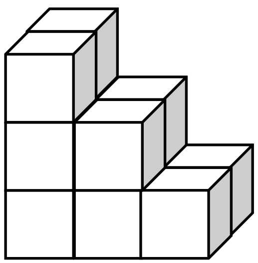
Worked Example

Write down the volume of the shape:

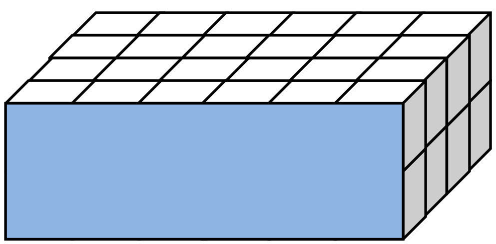
a)



b)



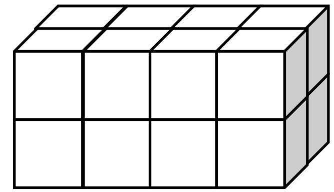
c)



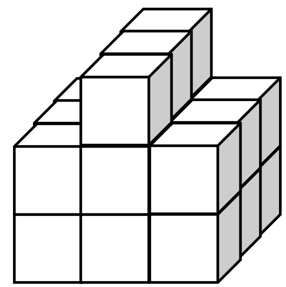
Your Turn

Write down the volume of the shape:

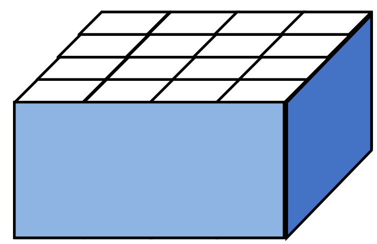
a)



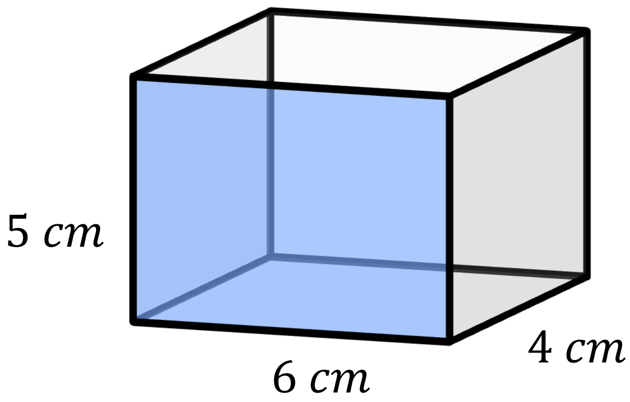
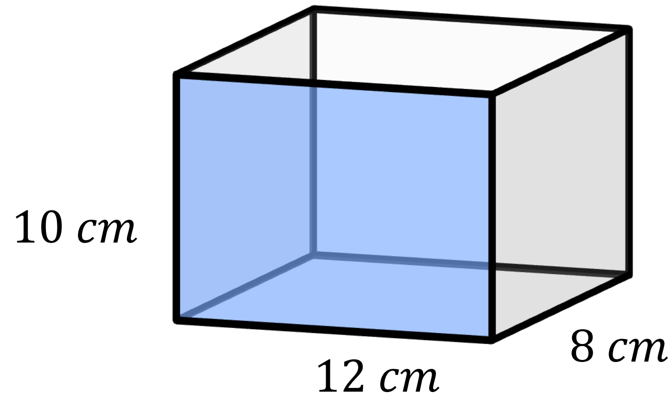
b)

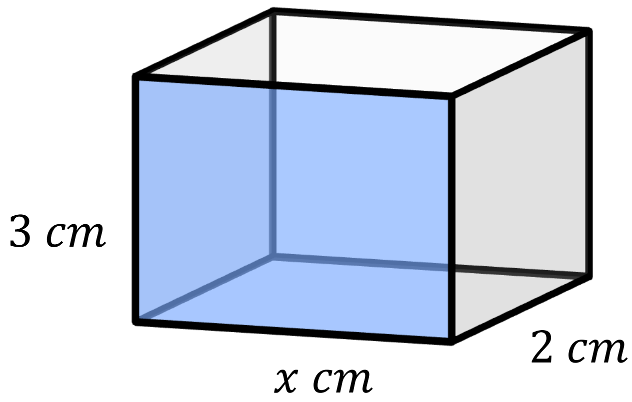
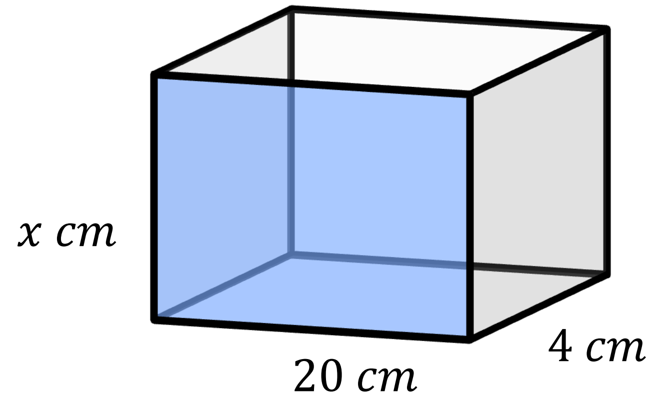


c)

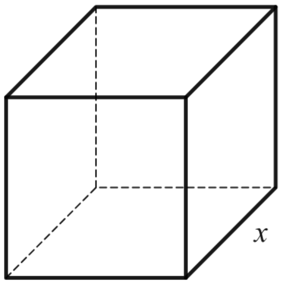
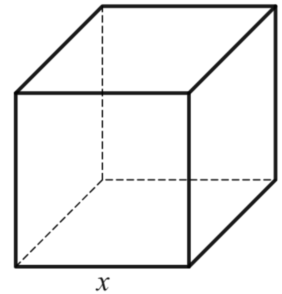


Dr Frost 144a and 231a

Worked Example	Your Turn
Calculate the volume of the cuboid: 	Calculate the volume of the cuboid: 

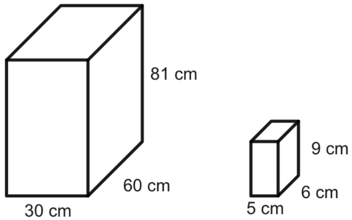
Worked Example	Your Turn
Find x, given that the volume of the cuboid is $60\ cm^3$ 	Find x, given that the volume of the cuboid is $480\ cm^3$ 

Dr Frost 230a

Worked Example	Your Turn
The diagram shows a cube with volume 343 cm^3  Find the length x	The diagram shows a cube with volume 5832 m^3  Find the length x

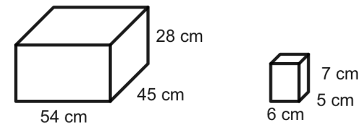
Dr Frost 230b

Worked Example



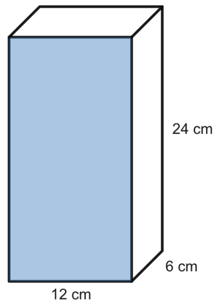
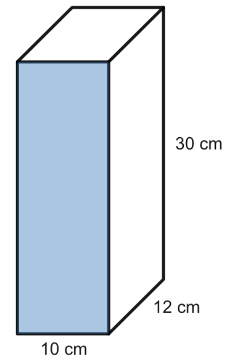
Connor has a crate in the shape of a cuboid which measures 30 cm by 60 cm by 81 cm. He has n cuboid-shaped bricks which he is going to completely fill the crate with. These measure 5 cm by 6 cm by 9 cm. Calculate the value of n.

Your Turn

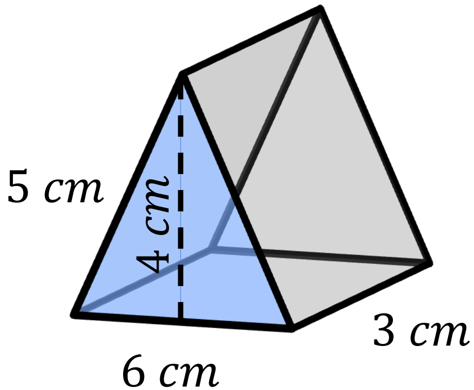
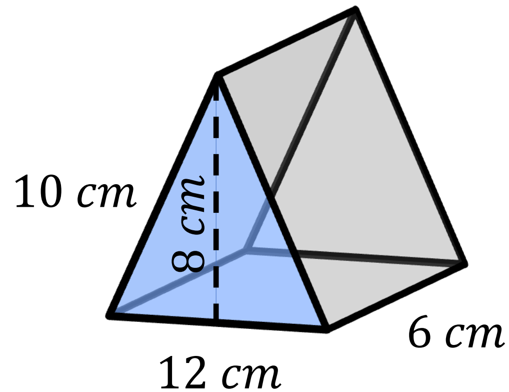


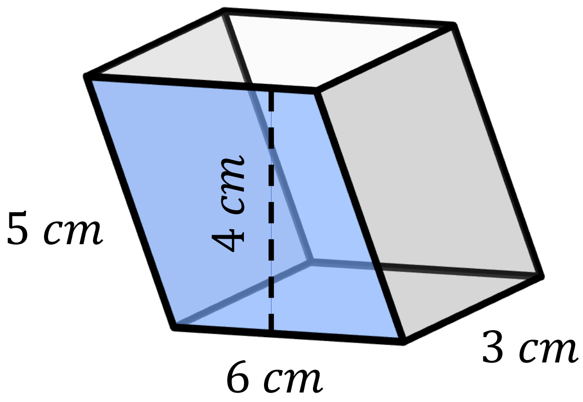
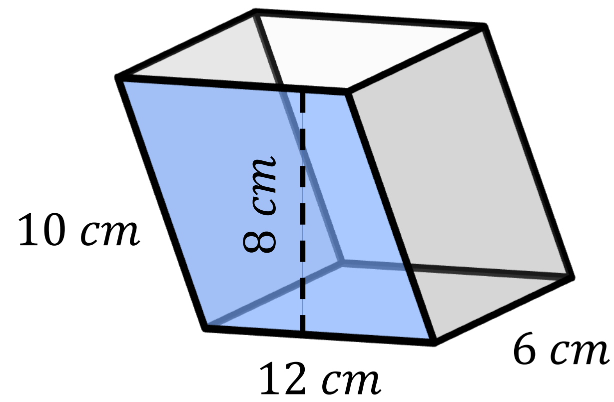
A cuboid-shaped create measures 54 cm by 45 cm by 28 cm. The crate is going to be completely filled with n bars. Each bar is a cuboid and measures 6 cm by 5 cm by 7 cm. Calculate the value of n.

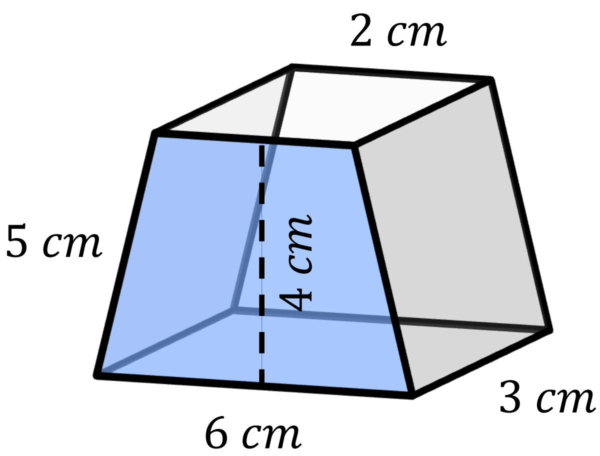
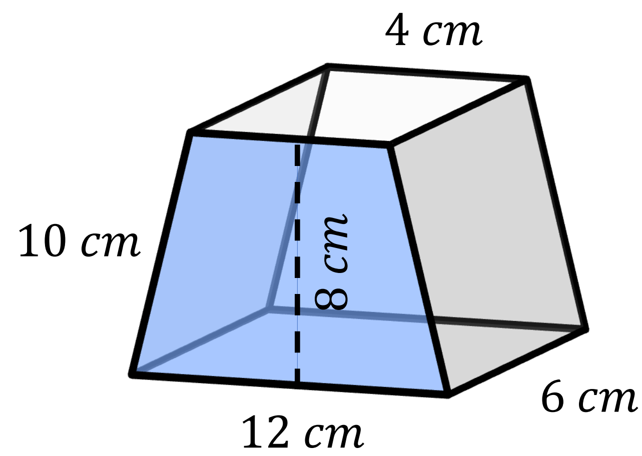
Dr Frost 230d

Worked Example	Your Turn
 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.	 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.

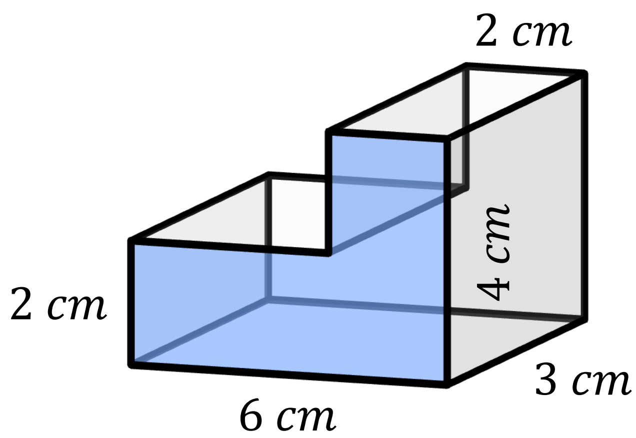
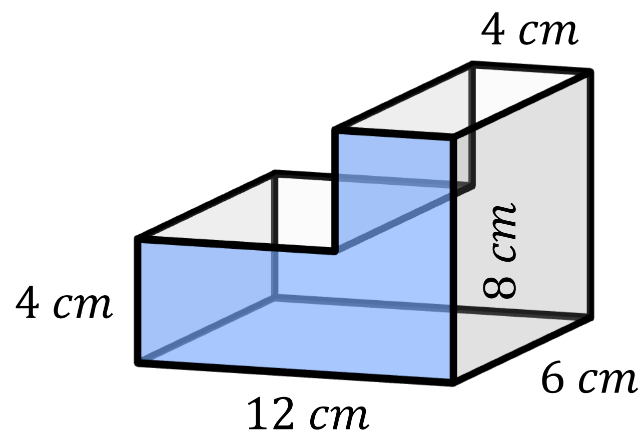
Dr Frost 230e

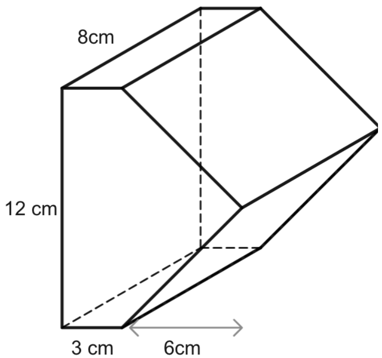
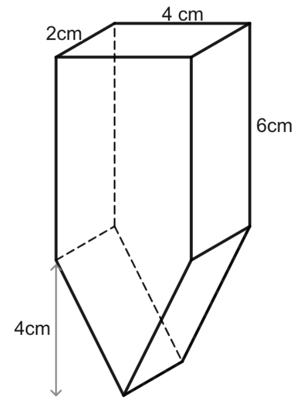
Worked Example	Your Turn
Calculate the volume of the triangular prism: 	Calculate the volume of the triangular prism: 

Worked Example	Your Turn
Calculate the volume of the parallelepiped: 	Calculate the volume of the parallelepiped: 

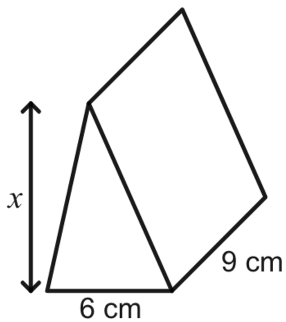
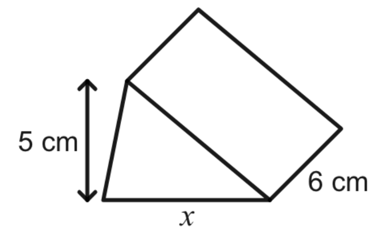
Worked Example	Your Turn
Calculate the volume of the trapezium prism: 	Calculate the volume of the trapezium prism: 

Dr Frost 231c

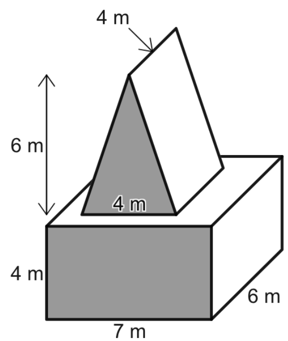
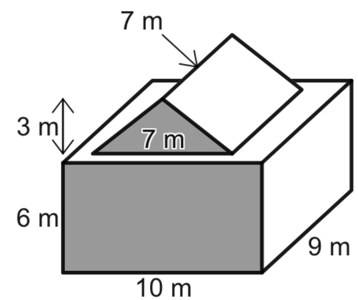
Worked Example	Your Turn
Calculate the volume of the L-shaped prism: 	Calculate the volume of the L-shaped prism: 

Worked Example	Your Turn
The diagram below shows a prism.  Work out the volume of the prism.	The diagram below shows a prism.  Find the volume of the prism.

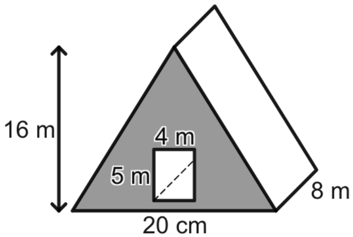
Dr Frost 231d

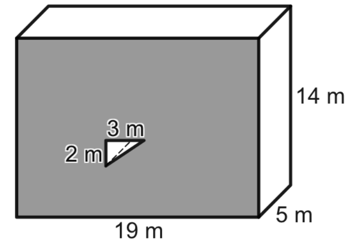
Worked Example	Your Turn
The volume of the prism is 243 cm³  Find the value of x	The volume of the prism is 105 cm³  Find the value of x

Dr Frost 231e

Worked Example	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.	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	Your Turn
Calculate the volume of the prism with the cut out removed.	Calculate the volume of the prism with the cut out removed.



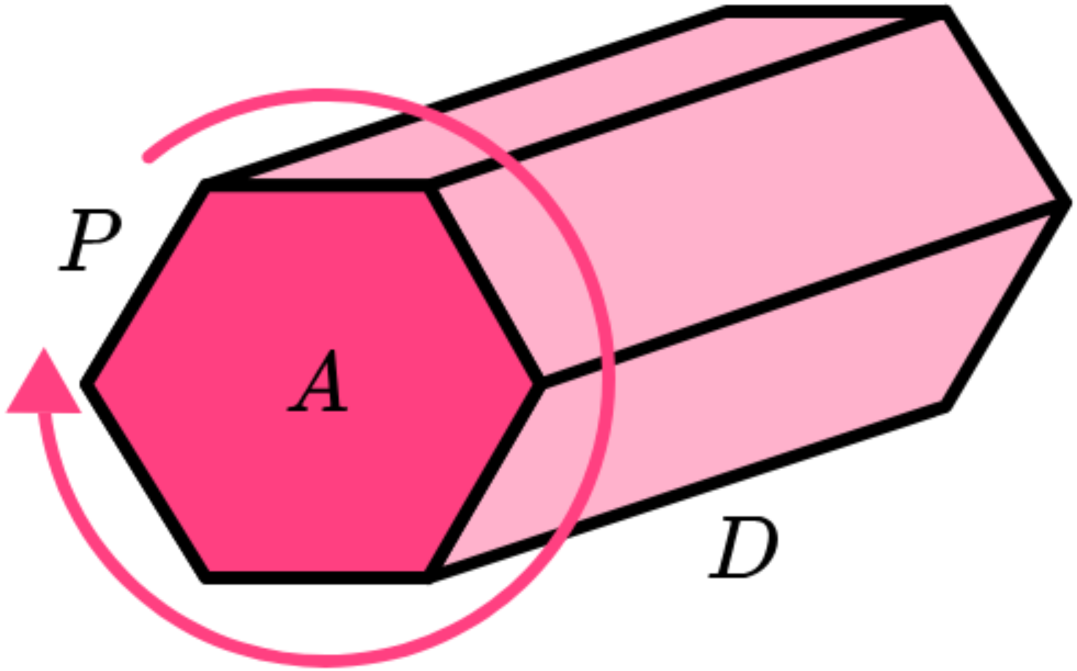


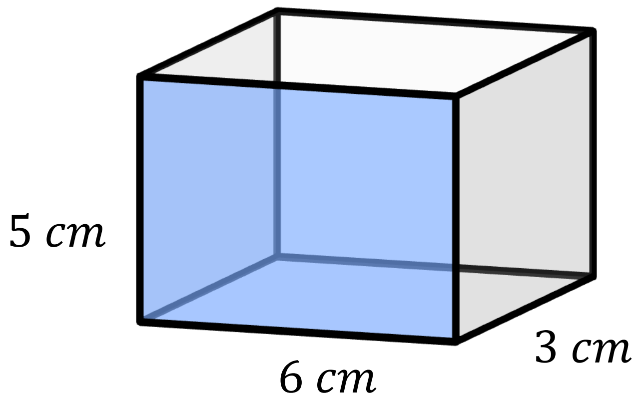
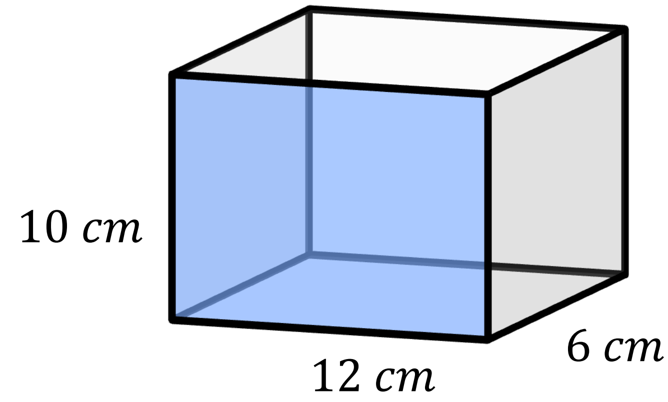
Dr Frost 231g

Surface Area of Prisms

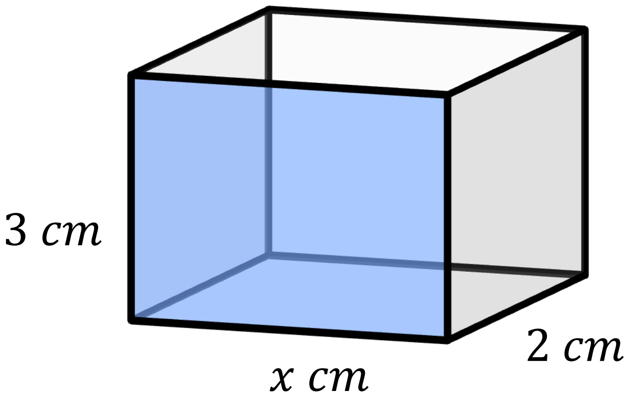
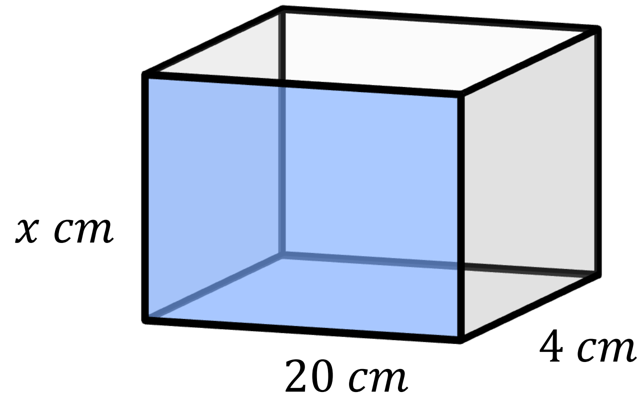
Surface Area of Prism = 2 × Area of Cross Section + Perimeter of Cross Section × Depth of Prism

SA = 2A + PD

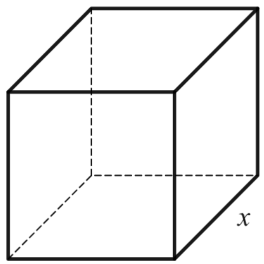
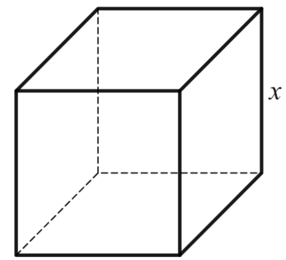


Worked Example	Your Turn
Calculate the surface area of the cuboid: 	Calculate the surface area of the cuboid: 

Dr Frost 232a

Worked Example	Your Turn
Find x, given that the total surface area is $112\ cm^2$ 	Find x, given that the total surface area is $448\ cm^2$ 

Dr Frost 232f

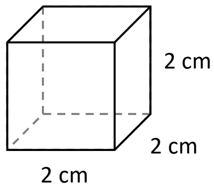
Worked Example	Your Turn
The diagram shows a cube with a surface area of 486 cm²  Calculate the length x	The diagram shows a cube with a surface area of 294 cm²  Work out the length x

Fluency Practice

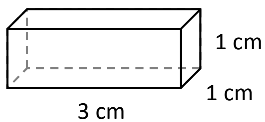
On the scale grid draw the **NET** for each cuboid.

Use the net to find the **total surface area** of each shape.

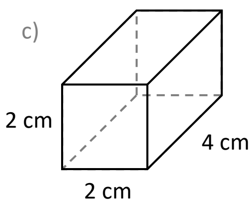
a)



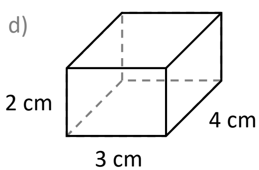
b)



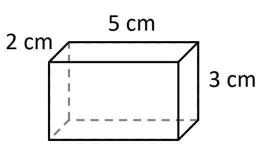
c)

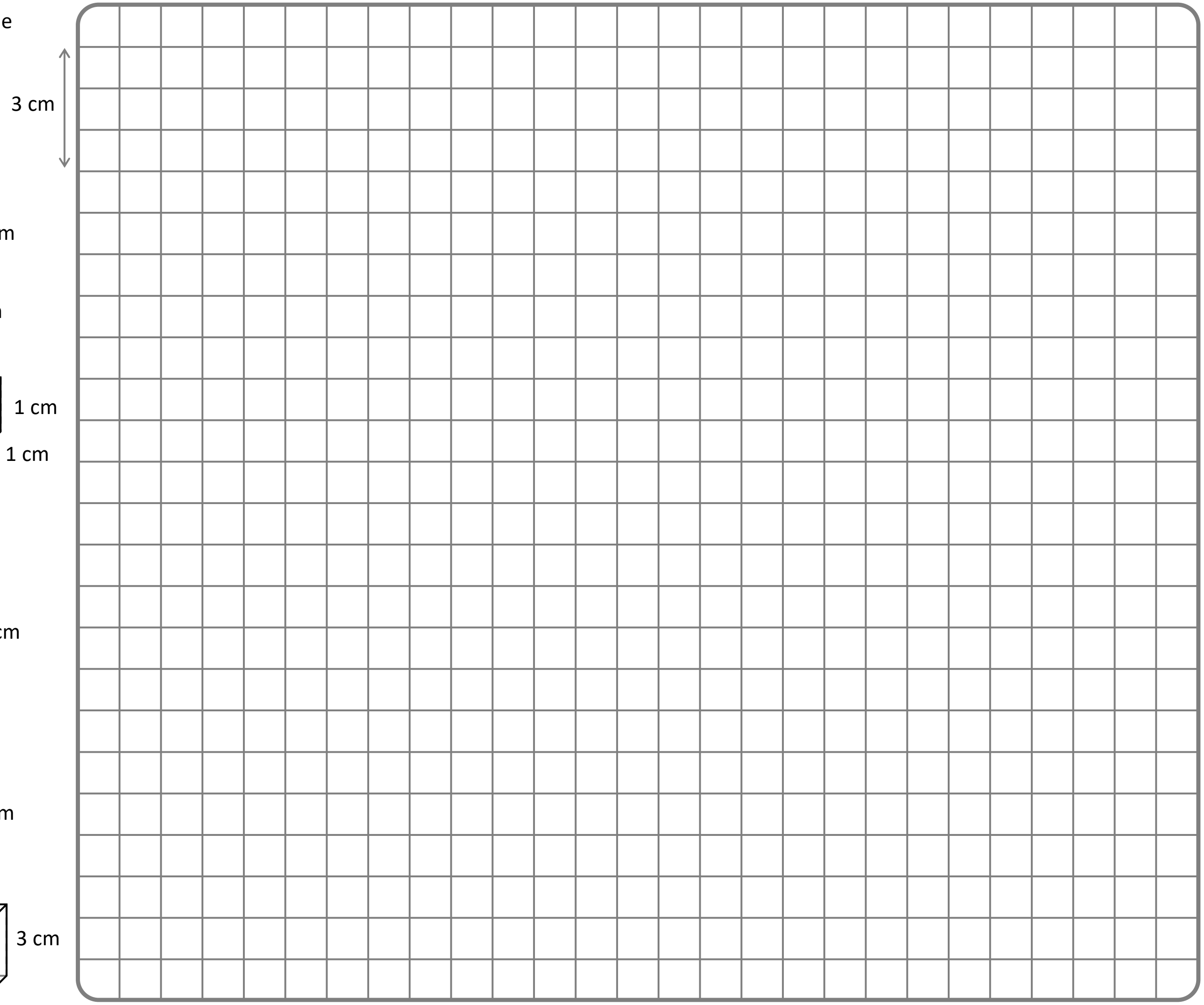


d)



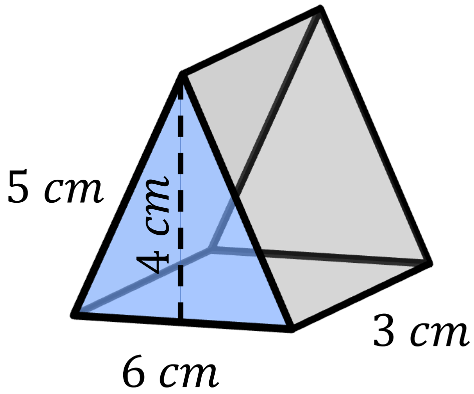
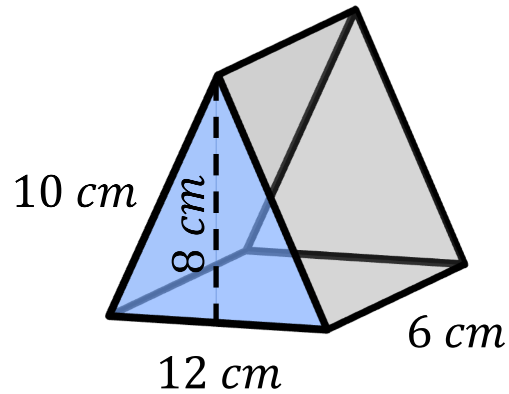
e)

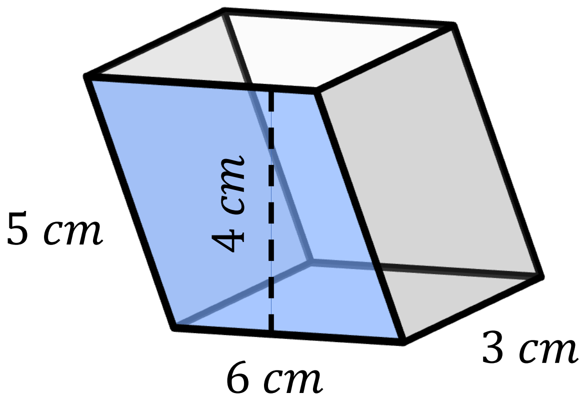
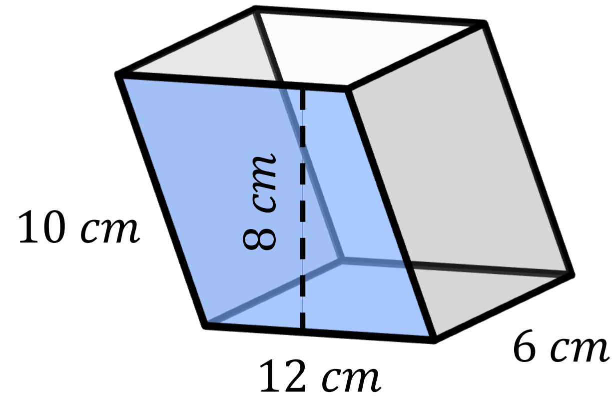




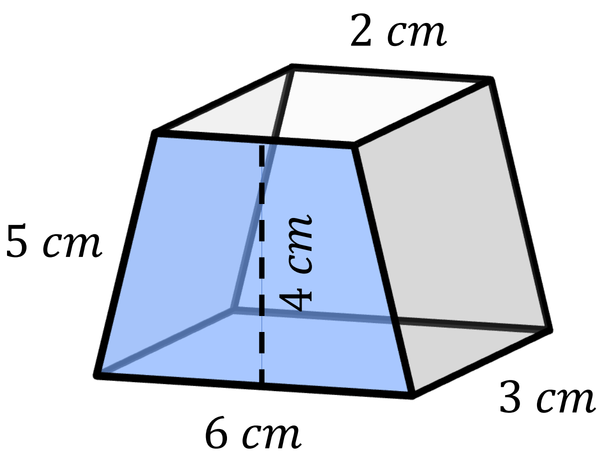
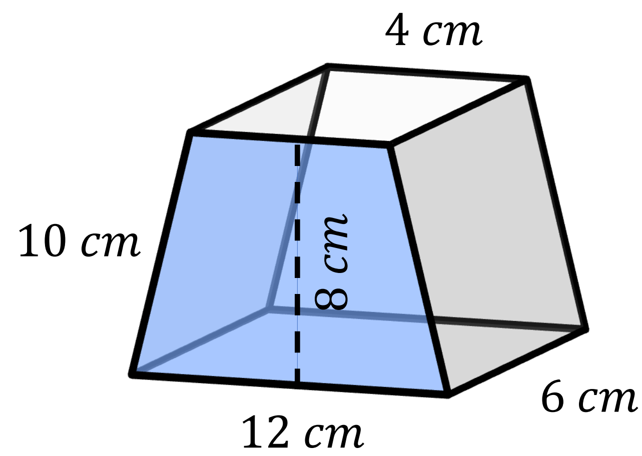
Fill in the Gaps

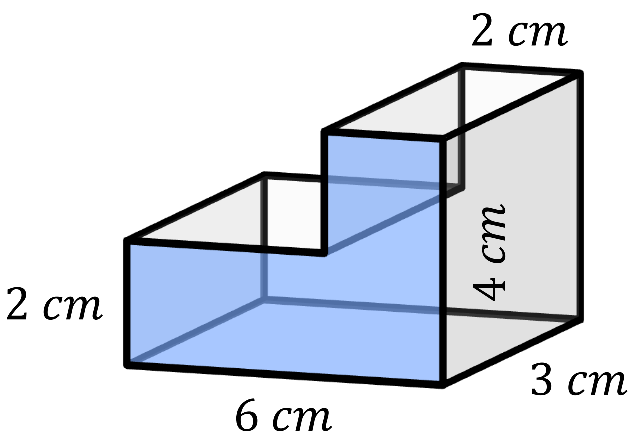
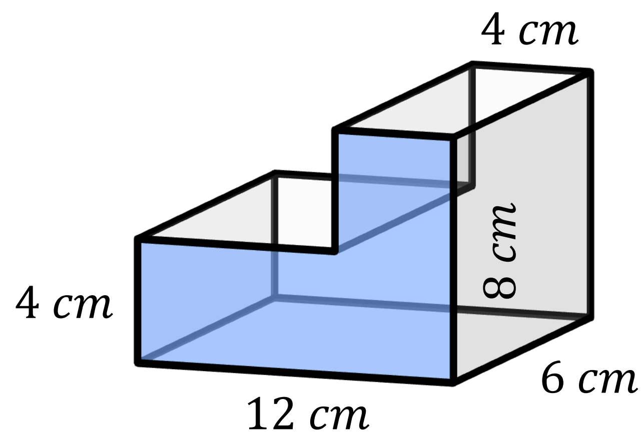
Cube or Cuboid	Length	Width	Height	Volume	Surface Area
$Cuboid$	$10\ cm$	$5\ cm$	$3\ cm$		$190\ cm^2$
$Cube$	$4\ cm$			$64\ cm^3$	
$Cuboid$	$12\ cm$	$8\ cm$	$2\ cm$		
$Cuboid$	$30\ mm$	$25\ mm$	$15\ mm$		
$Cube$		$1.8\ m$			
$Cuboid$	$10\ cm$	$7\ cm$		$350\ cm^3$	
$Cube$				$729\ cm^3$	
$Cuboid$		$3.6\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

Worked Example	Your Turn
Calculate the surface area of the triangular prism: 	Calculate the surface area of the triangular prism: 

Worked Example	Your Turn
Calculate the surface area of the parallelepiped:	Calculate the surface area of the parallelepiped:
	

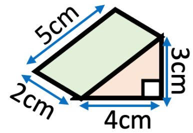
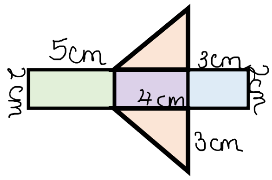
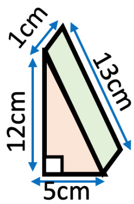
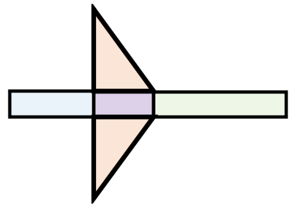
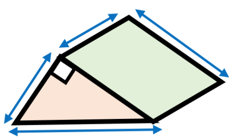
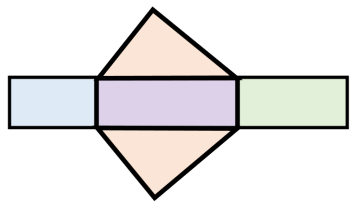
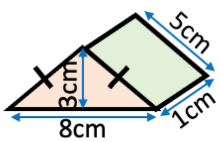
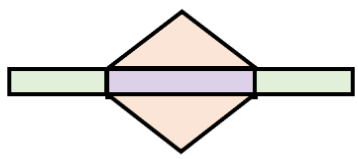
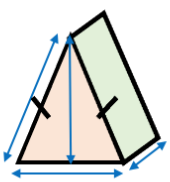
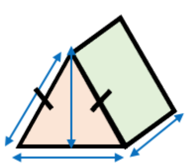
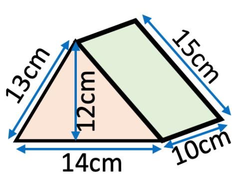
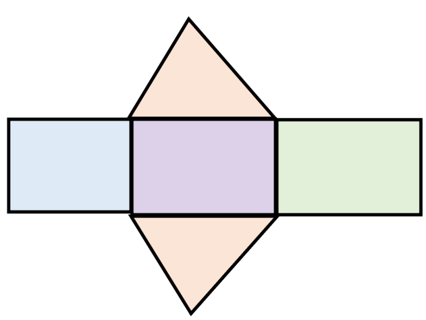
Dr Frost 232i

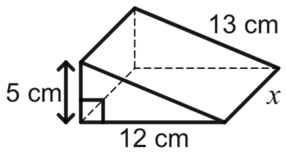
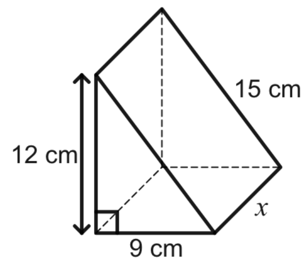
Worked Example	Your Turn
Calculate the surface area of the trapezium prism: 	Calculate the surface area of the trapezium prism: 

Worked Example	Your Turn
Calculate the surface area of the L-shaped prism: 	Calculate the surface area of the L-shaped prism: 

Fill in the Gaps

Fill In the table with labels, nets and surface area of each triangular prism

Triangular Prism	Net	Surface Area	Surface Area
			
			
		$2 \times \frac{8 \times 6}{2}$ $+8 \times 7$ $+6 \times 7$ $+10 \times 7$	
			
		$2 \times \frac{10 \times 12}{2}$ $+13 \times 1$ $+13 \times 1$ $+10 \times 1$	
		$2 \times \frac{12 \times 8}{2}$ $+10 \times ?$ $+10 \times ?$ $+12 \times ?$	$224cm^2$
			

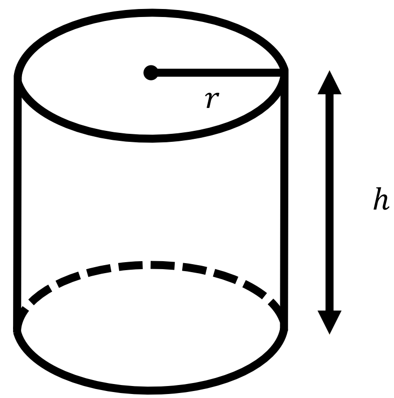
Worked Example	Your Turn
The diagram shows a prism with surface area 330 cm^2  Calculate the unknown length x	The diagram shows a prism with surface area 468 cm^2  Calculate the unknown length x

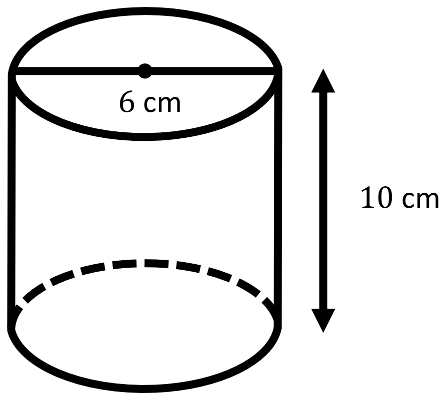
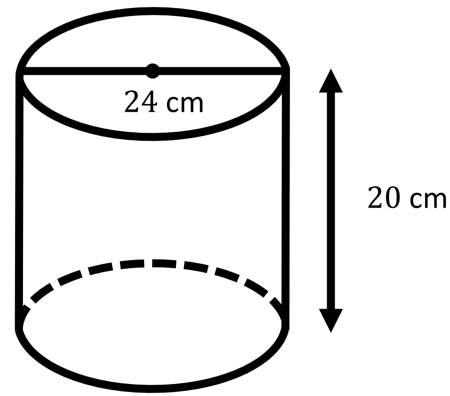
Dr Frost 232k

Volume of Cylinders

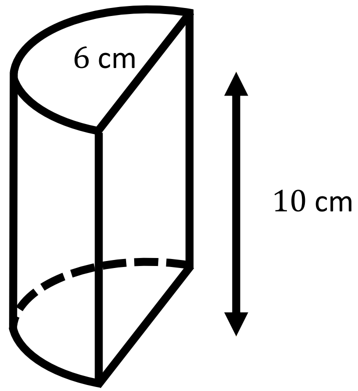
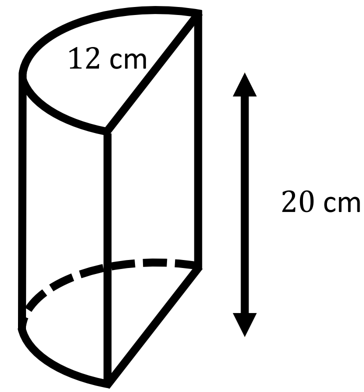
Volume of Cylinder = Area of circle × height
Volume of Cylinder = π × radius^2 × height

$V = \pi r^2 h$

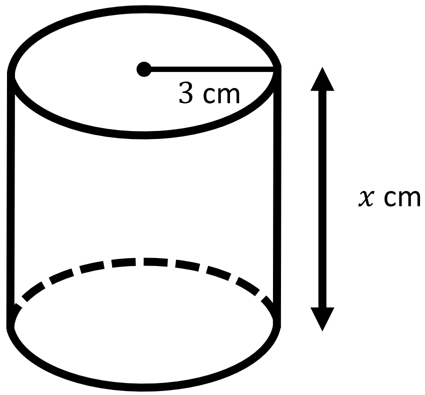
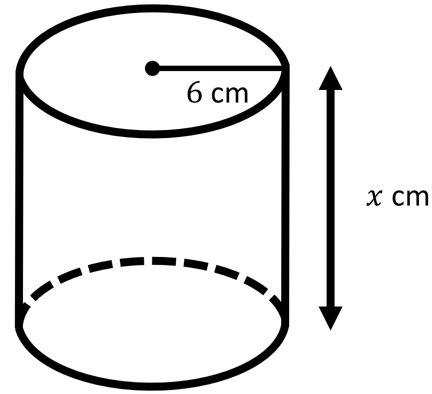


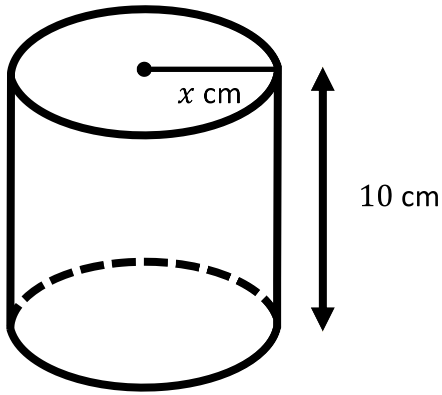
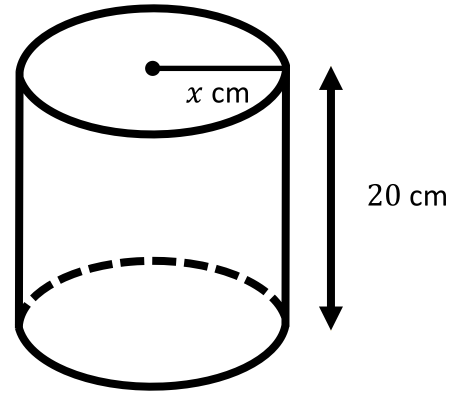
Worked Example	Your Turn
Calculate the volume of the following cylinder. Give your answer in terms of π and to 1 decimal place. 	Calculate the volume of the following cylinder. Give your answer in terms of π and to 1 decimal place. 

Dr Frost 233b

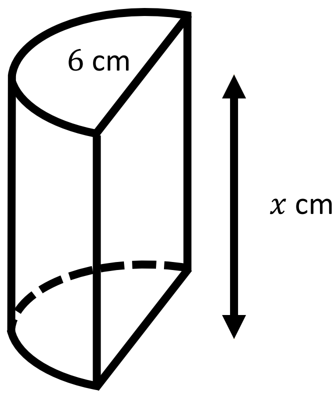
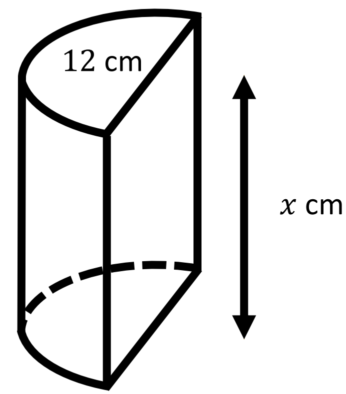
Worked Example	Your Turn
Calculate the volume of the following half cylinder. Give your answer in terms of π and to 1 decimal place.  	Calculate the volume of the following half cylinder. Give your answer in terms of π and to 1 decimal place. 

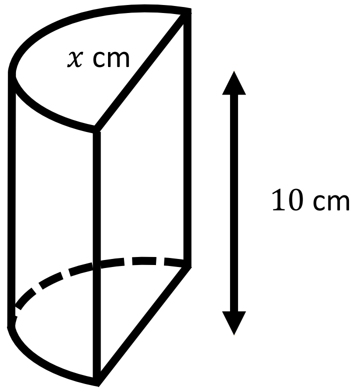
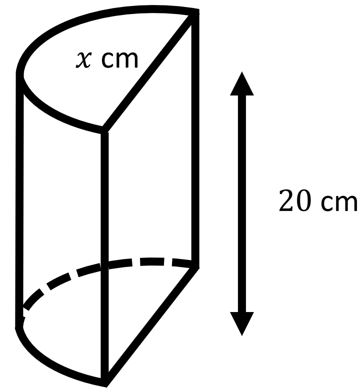
Dr Frost 233c

Worked Example	Your Turn
Find the height, x, given that the volume of the following cylinder is $282.7\ cm^3$. Give your answer to 1 decimal place. 	Find the height, x, given that the volume of the following cylinder is $2261.9\ cm^3$. Give your answer to 1 decimal place. 

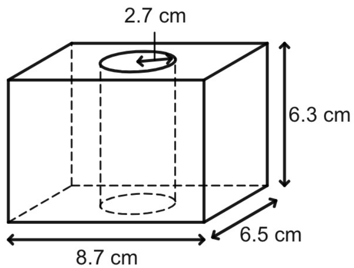
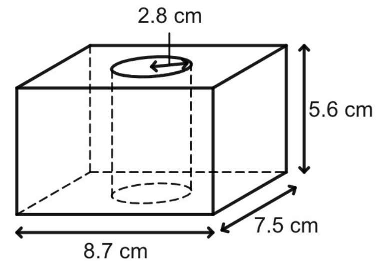
Worked Example	Your Turn
Find the radius, x, given that the volume of the following cylinder is $282.7\ cm^3$. Give your answer to 1 decimal place. 	Find the radius, x, given that the volume of the following cylinder is $2261.9\ cm^3$. Give your answer to 1 decimal place. 

Dr Frost 233d

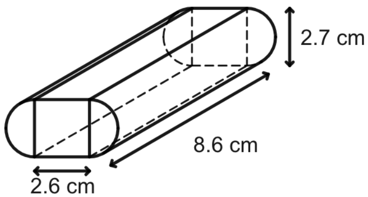
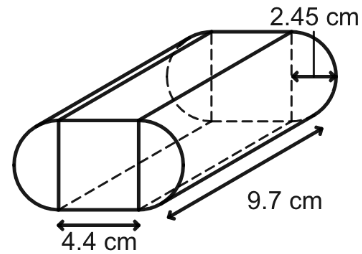
Worked Example	Your Turn
Find the height, x, given that the volume of the following half cylinder is $141.4\ cm^3$. Give your answer to 1 decimal place. 	Find the height, x, given that the volume of the following half cylinder is $1131.0\ cm^3$. Give your answer to 1 decimal place. 

Worked Example	Your Turn
Find the diameter, x, given that the volume of the following half cylinder is $141.4\ cm^3$. Give your answer to 1 decimal place.  	Find the diameter, x, given that the volume of the following half cylinder is $1131.0\ cm^3$. Give your answer to 1 decimal place. 

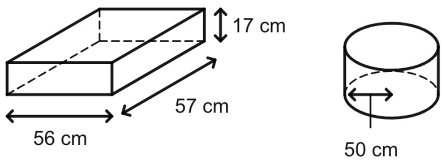
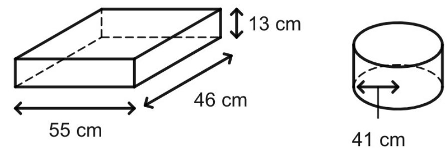
Dr Frost 233e

Worked Example	Your Turn
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.	A woodworker takes a cuboid with sides of length 8.7 cm, 7.5 cm and 5.6 cm and removed a central cylinder or 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.

Dr Frost 233g

Worked Example	Your Turn
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.	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.

Dr Frost 233h

Worked Example	Your Turn
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.	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.

Dr Frost 233i

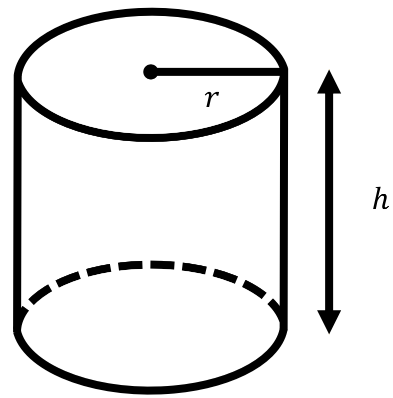
Surface Area of Cylinders

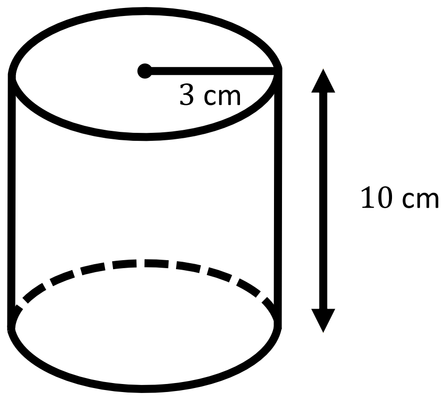
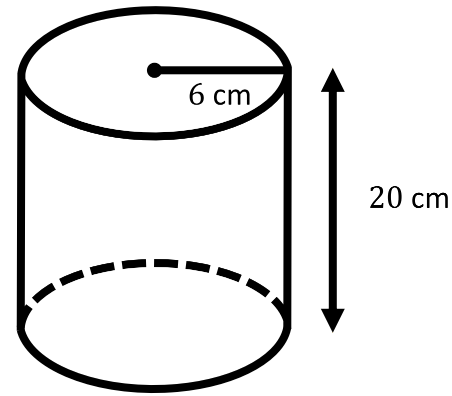
Curved Surface Area of Cylinder = 2 × π × radius × height

CSA = 2πrh

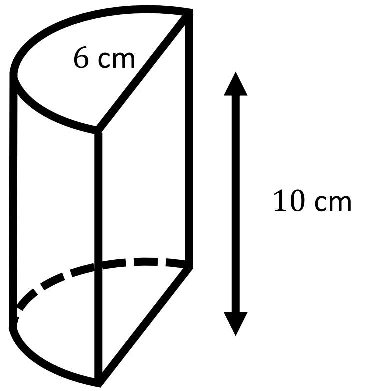
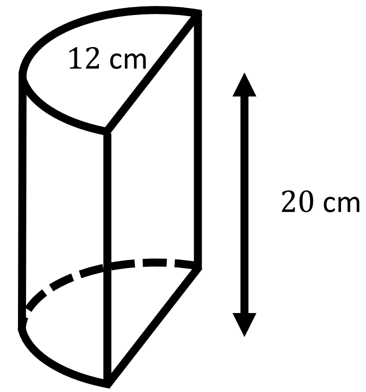
Total Surface Area of Cylinder = 2 × π × radius × height + 2 × π × radius²

TSA = $2\pi rh + 2\pi r^2$



Worked Example	Your Turn
Calculate the total surface area of the following cylinder. Give your answer in terms of π and to 1 decimal place.  	Calculate the total surface area of the following cylinder. Give your answer in terms of π and to 1 decimal place. 

Dr Frost 234a

Worked Example	Your Turn
Calculate the total surface area of the following half cylinder. Give your answer in terms of π and to 1 decimal place. 	Calculate the total surface area of the following half cylinder. Give your answer in terms of π and to 1 decimal place. 

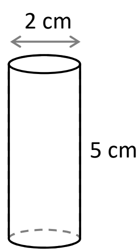
Dr Frost 234c

Fluency Practice

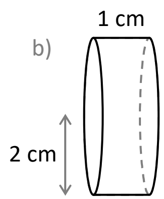
On the scale grid draw the **NET** for each type of cylinder.

Use your diagram to calculate the **surface area** of each shape.

a)

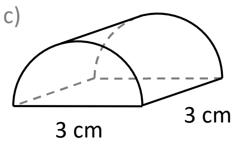


b)



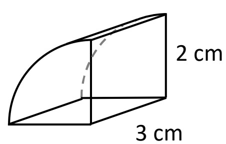
half cylinder

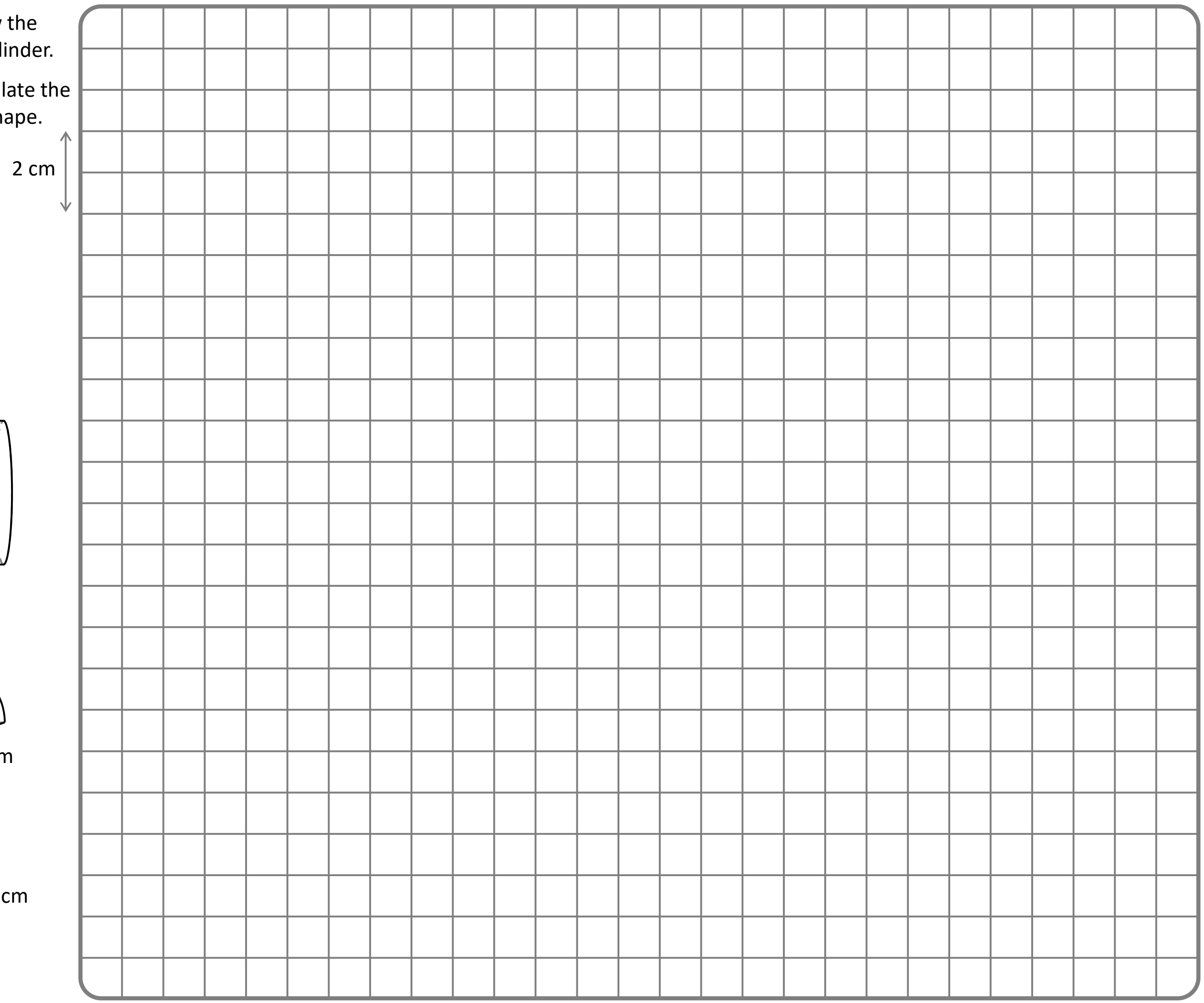
c)

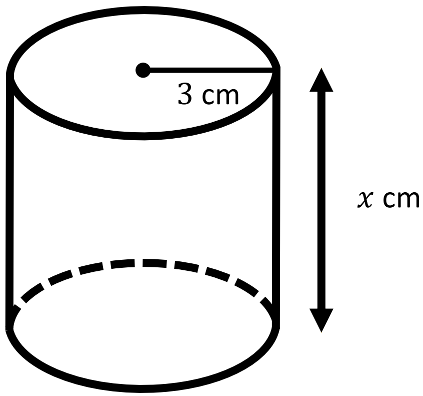
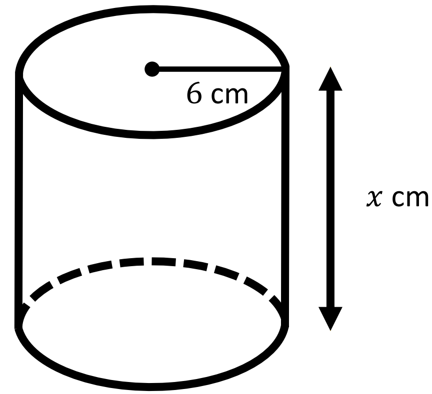


quarter cylinder

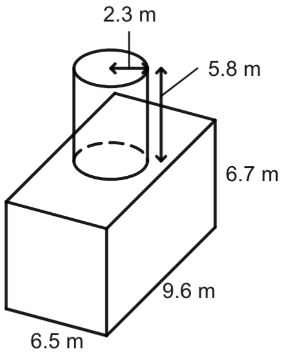
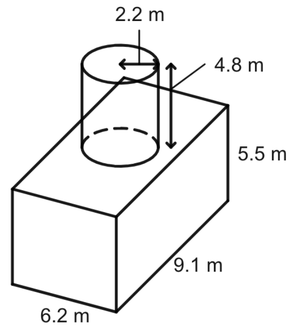
d)





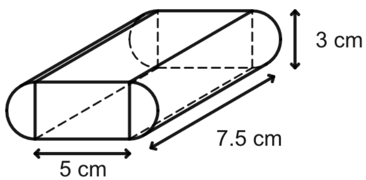
Worked Example	Your Turn
Find the height, x, given that the total surface area of the following cylinder is $245.0\ cm^2$. Give your answer to 1 decimal place. 	Find the height, x, given that the total surface area of the following cylinder is $980.2\ cm^2$. Give your answer to 1 decimal place. 

Dr Frost 234d

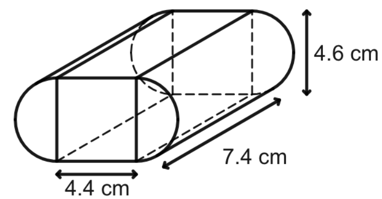
Worked Example	Your Turn
The diagram shows a shape made from a solid cylinder attached to a solid cuboid. The cuboid has sides of length 6.5, 9.6 and 6.7 m. The cylinder has a radius of 2.3 m and a height of 5.8 m.  Calculate the total surface area of the solid shape. Give your answer correct to 3 significant figures.	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.

Dr Frost 234g

Worked Example	Your Turn
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.	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.

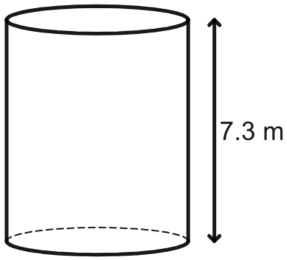
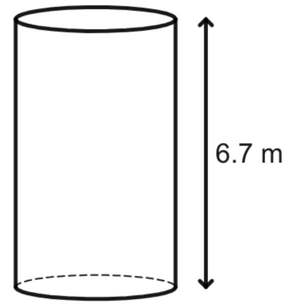


Find the surface area of the composite object.
Give your answer correct to 1 decimal place.



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

Dr Frost 234h

Worked Example	Your Turn
The diagram shows a solid cylinder with height 7.3 m.  The volume of the cylinder is 65.7π m³. Calculate the total surface area of the cylinder. Give your answer correct to 1 decimal place.	The diagram shows a solid cylinder with height 6.7 m.  The volume of the cylinder is 26.8π m³. Calculate the total surface area of the cylinder. Give your answer correct to 1 decimal place.

Dr Frost 234f

Fill in the Gaps

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

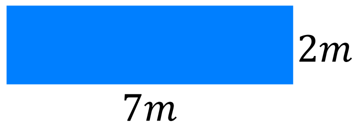
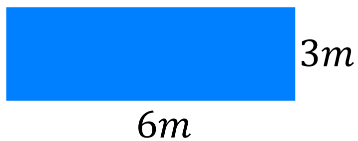
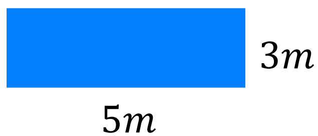
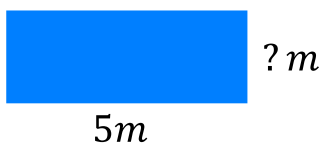
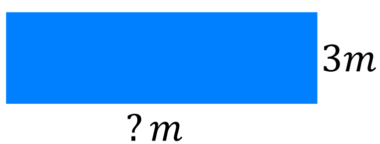
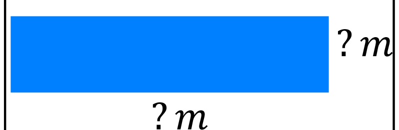
Extra Notes

5 Area and Volume Unit Conversions

Worked Example	Your Turn
Convert: a) 7 cm^2 to mm^2 b) 2500 cm^2 to m^2	Convert: a) 7 km^2 to m^2 b) 2500 mm^2 to cm^2

Dr Frost 323a and 323b

Fill in the Gaps

Shape	Area in m²	Area in cm²	Area in mm²
			
			
			
		$200\,000\ cm^2$	
			$21\,000\,000\ mm^2$
	$22\ m^2$		

Worked Example	Your Turn
Convert: a) 7 cm^3 to mm^3 b) 5 mm^3 to cm^3	Convert: a) 7 m^3 to cm^3 b) 5 cm^3 to m^3

Dr Frost 323c and 323d

Worked Example	Your Turn
Convert: a) 241 litres to cm^3 b) 83400 cm^3 to litres	Convert: a) 4500 litres to cm^3 b) 813 000 cm^3 to litres

Dr Frost 323e and 323f

Fill in the Gaps

Area		
mm^2	cm^2	m^2
	10000	
		2
500000		
		0.07
	92000	
13000000		
	62	
		7.81
42900		
		0.363

Volume			
mm^3	cm^3	m^3	$litres$
	1000		1
7000000			
			20
		0.6	
3400000			
	28000		
		1.7	
			0.45
	379000		
8520000			

Extra Notes

6 Compound Measures

Worked Example	Your Turn
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.	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.

Dr Frost 331d

Speed

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

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

Worked Example	Your Turn
A car travels 50 miles in 2 hours. What speed does it travel at?	A car travels 60 miles in 2 hours. What speed does it travel at?
A car travels at $50mph$ (miles per hour) for 2 hours. How far does it travel?	A car travels at $60mph$ (miles per hour) for 2 hours. How far does it travel?
A car travels 50 miles at $25mph$ (miles per hour). How long does it take?	A car travels 30 miles at $60mph$ (miles per hour). How long does it take?

Dr Frost 325a, 325c and 325d

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

not simplified ⇨ *denominator of 1*

Speed Distance Time	Distance	Time	$\frac{distance}{time}$	$\frac{distance}{time}$	Speed	Compound Units
	60 kilometres	2 hours	$\frac{60}{2}$	= $\frac{\ }{1}$		km/h
	80 kilometres	4	$\frac{\ }{4}$	= $\frac{\ }{1}$		
	90 miles	6 hours		=		mph
		12 hours	$\frac{60}{\ }$	= $\frac{\ }{1}$		kmph
	50	30 minutes	$\frac{\ }{0.5}$	= $\frac{\ }{1}$		km/h
	7 miles	30 minutes		= $\frac{\ }{1}$		mph
	20 kilometres	15 minutes		= $\frac{\ }{1}$		kmph
	60		$\frac{\ }{1.5}$	=		km/h
	75	2 hours 30 minutes		= $\frac{\ }{1}$		kph
	36 miles	4 hours 30 minutes		= $\frac{\ }{1}$		
		45 minutes	$\frac{9}{\ }$	=		km/h
			$\frac{36}{0.75}$	=		kmph
	12 miles	minutes	$\frac{\ }{0.1}$	= $\frac{\ }{1}$		mph
	32	24 minutes		= $\frac{\ }{1}$		km/h
	392	2 hours 48 minutes		=		kph

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	Your Turn
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.	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.

Dr Frost 326c

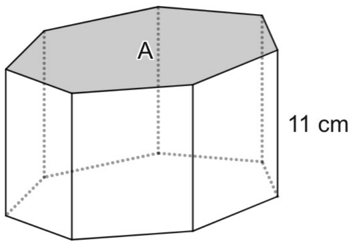
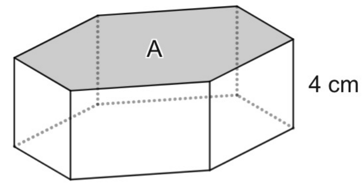
Density

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

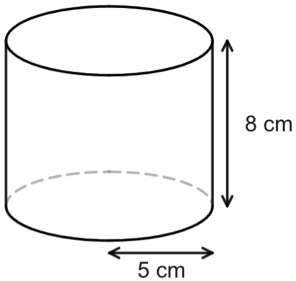
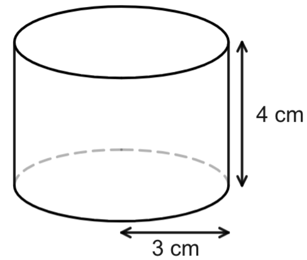
$$\rho = \frac{m}{V}$$

Worked Example	Your Turn
The mass of an object is $50\ g$. The volume is $10\ cm^3$. What is the density of the object?	The mass of an object is $100\ g$. The volume is $25\ cm^3$. What is the density of the object?
The density of an object is $10\ g/cm^3$. The volume is $5\ cm^3$. What is the mass?	The density of an object is $10\ g/cm^3$. The volume is $25\ cm^3$. What is the mass?
The density of an object is $10\ g/cm^3$. The mass is $50\ g$. What is the volume?	The density of an object is $10\ g/cm^3$. The mass is $25\ g$. What is the volume?

Dr Frost 328a, 328b and 328c

Worked Example	Your Turn
A heptagonal metal prism with base area A of 274 cm² and length 11 cm has a density of 12.51 g/cm³ as shown below. Find the mass in g to the nearest gram. 	A hexagonal wooden prism with base area A of 94 cm² and length 4 cm has a mass of 233 g as shown below. Find the density in g/cm³ to 2 decimal places. 

Dr Frost 328d

Worked Example	Your Turn
A wooden cylinder with radius 5 cm and height 8 cm has a density of 0.36 g/cm^3.  Find the mass of the wooden cylinder. Give your answer correct to the nearest whole number.	A metal cylinder with radius 3 cm and height 4 cm has a density of 2.55 g/cm^3.  Find the mass of the metal cylinder. Give your answer correct to the nearest whole number.

Dr Frost 328e

Worked Example	Your Turn
Liquid A has a density of 1.15 g/cm^3. Liquid B has a density of 1.23 g/cm^3. 76 cm^3 of liquid A and 116 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.	Liquid A has a density of 1.11 g/cm^3. Liquid B has a density of 1.3 g/cm^3. 41 cm^3 of liquid A and 143 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	Your Turn
Metal A has a density of 9.57 g/cm³. Metal B has a density of 14.18 g/cm³. 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.	Metal A has a density of 6.47 g/cm³. Metal B has a density of 11.94 g/cm³. 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.

Dr Frost 328g

Pressure

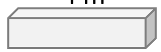
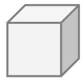
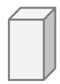
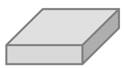
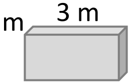
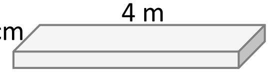
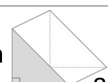
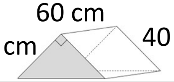
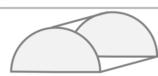
Pressure = $\frac{\text{Force}}{\text{Area}}$

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

Worked Example	Your Turn
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 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 $50N/cm^2$. 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 $100N/cm^2$. 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 $50N/cm^2$. The force exerted on the surface is $10N$. What is the surface area in contact with the object?	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?

Fill in the Gaps

Cuboid Compound Measures The objects are resting on Earth (Gravitational acceleration = 10 m/s²). Answer to 3 sf.

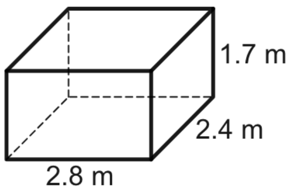
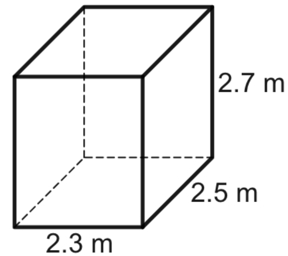
	Object	Mass	Volume	Density	**Force** (Weight)	Contact **Area**	Pressure
1	square-based  4 m, 1 m	400 kg					
2	cube 	1,000 kg	8 m³				
3	cube  50 cm	3 kg					
4	square-based  3 m		12 m³		500 N		
5	 0.5 m, 2 m	20 kg				6 m²	
6	 0.5 m, 3 m, 2 m	20 kg					
7	 80 cm, 4 m, 20 cm				1,500 N		
8	isosceles  60 cm, 80 cm	4 kg					
9	 60 cm, 50 cm, 40 cm	3.5 kg					
10	 50 cm				8 N		40 N/m²

Fill in the Gaps

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

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

Other Compound Measures

Worked Example	Your Turn
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. $1 \text{ m}^3 = 1000$ litres	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. $1 \text{ m}^3 = 1000$ litres

Extra Notes