

Solid Geometry

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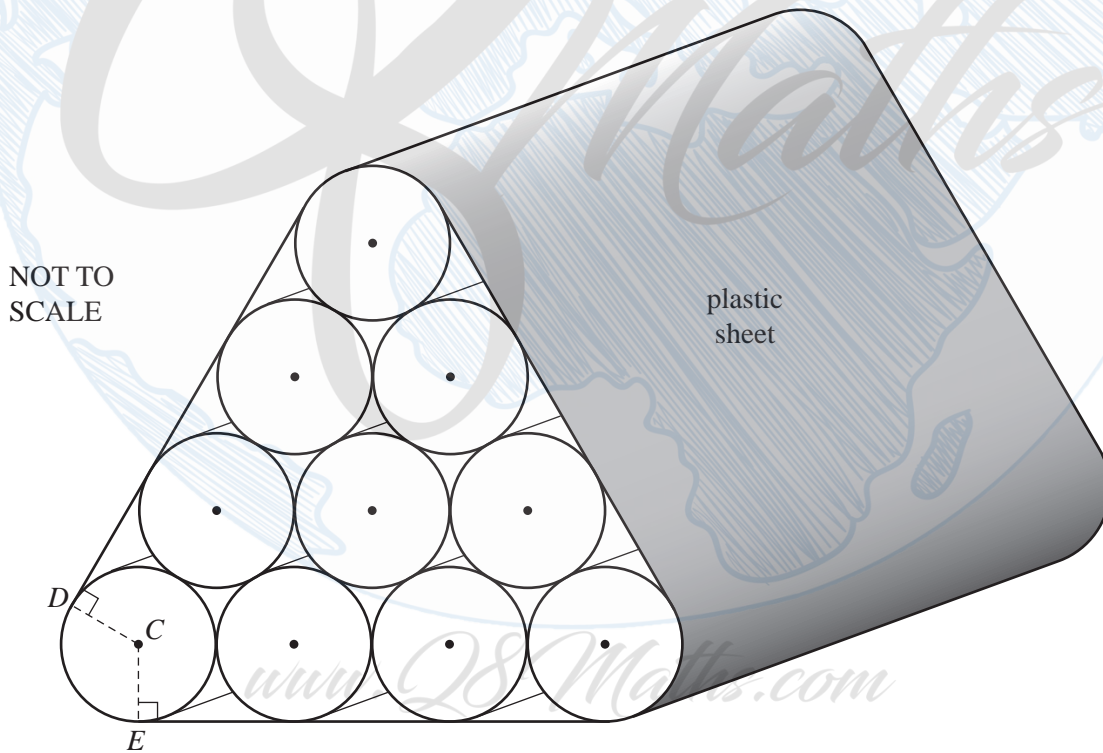
- 7 (a) Calculate the volume of a cylinder of radius 31 centimetres and length 15 metres.
Give your answer in cubic metres.

Answer(a) m³ [3]

- (b) A tree trunk has a circular cross-section of radius 31 cm and length 15 m.
One cubic metre of the wood has a mass of 800 kg.
Calculate the mass of the tree trunk, giving your answer in tonnes.

Answer(b) tonnes [2]

(c)



The diagram shows a pile of 10 tree trunks.
Each tree trunk has a circular cross-section of radius 31 cm and length 15 m.
A plastic sheet is wrapped around the pile.

C is the centre of one of the circles.
 CE and CD are perpendicular to the straight edges, as shown.

(i) Show that angle $ECD = 120^\circ$.

Answer(c)(i)

[2]

(ii) Calculate the length of the arc DE , giving your answer in metres.

Answer(c)(ii) m [2]

(iii) The edge of the plastic sheet forms the perimeter of the cross-section of the pile.
The perimeter consists of three straight lines and three arcs.
Calculate this perimeter, giving your answer in metres.

Answer(c)(iii) m [3]

(iv) The plastic sheet does not cover the two ends of the pile.
Calculate the area of the plastic sheet.

Answer(c)(iv) m^2 [1]

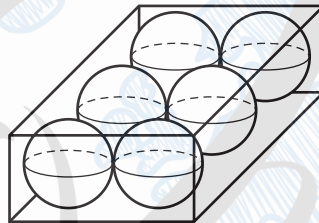
6 A spherical ball has a radius of 2.4 cm.

(a) Show that the volume of the ball is 57.9 cm^3 , correct to 3 significant figures.

[The volume V of a sphere of radius r is $V = \frac{4}{3}\pi r^3$.]

Answer(a)

(b)



NOT TO SCALE

[2]

Six spherical balls of radius 2.4 cm fit exactly into a **closed** box. The box is a cuboid.

Find

(i) the length, width and height of the box,

Answer(b)(i) cm, cm, cm [3]

(ii) the volume of the box,

Answer(b)(ii) cm^3 [1]

(iii) the volume of the box **not** occupied by the balls,

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Answer(b)(iii) cm^3 [1]

(iv) the surface area of the box.

Answer(b)(iv) cm^2 [2]

(c)



NOT TO
SCALE

The six balls can also fit exactly into a **closed** cylindrical container, as shown in the diagram.

Find

(i) the volume of the cylindrical container,

Answer(c)(i) cm^3 [3]

(ii) the volume of the cylindrical container **not** occupied by the balls,

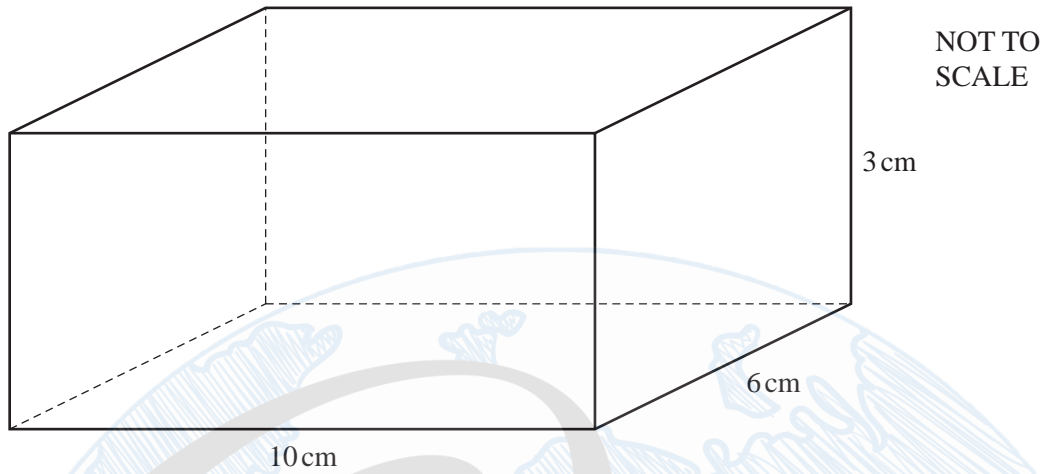
Answer(c)(ii) cm^3 [1]

(iii) the surface area of the cylindrical container.

Answer(c)(iii) cm^2 [3]

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8



A solid metal cuboid measures 10 cm by 6 cm by 3 cm.

- (a) Show that 16 of these solid metal cuboids will fit exactly into a box which has internal measurements 40 cm by 12 cm by 6 cm.

Answer(a)

[2]

- (b) Calculate the volume of **one** metal cuboid.

Answer(b) cm³ [1]

- (c) One cubic centimetre of the metal has a mass of 8 grams.
The box has a mass of 600 grams.

Calculate the **total** mass of the 16 cuboids **and** the box in

- (i) grams,

Answer(c)(i) g [2]

- (ii) kilograms.

Answer(c)(ii) kg [1]

(d) (i) Calculate the surface area of **one** of the solid metal cuboids.

Answer(d)(i) cm² [2]

(ii) The surface of each cuboid is painted. The cost of the paint is \$25 per **square metre**
Calculate the cost of painting all **16** cuboids.

Answer(d)(ii) \$ [3]

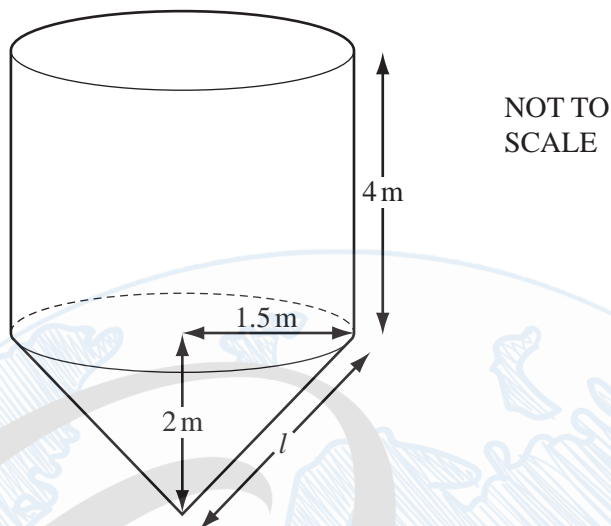
(e) **One** of the solid metal cuboids is melted down.
Some of the metal is used to make 200 identical solid spheres of radius 0.5 cm.
Calculate the volume of metal from this cuboid which is **not** used.

[The volume, V , of a sphere of radius r is $V = \frac{4}{3} \pi r^3$.]

Answer(e) cm³ [3]

(f) 50 cm³ of metal is used to make 20 identical solid spheres of radius r .
Calculate the radius r .

Answer(f) $r =$ cm [3]



An **open** water storage tank is in the shape of a cylinder on top of a cone. The radius of both the cylinder and the cone is 1.5 m. The height of the cylinder is 4 m and the height of the cone is 2 m.

- (a) Calculate the **total** surface area of the **outside** of the tank.
 [The curved surface area, A , of a cone with radius r and slant height l is $A = \pi rl$.]

Answer(a) m² [6]

(b) The tank is completely full of water.

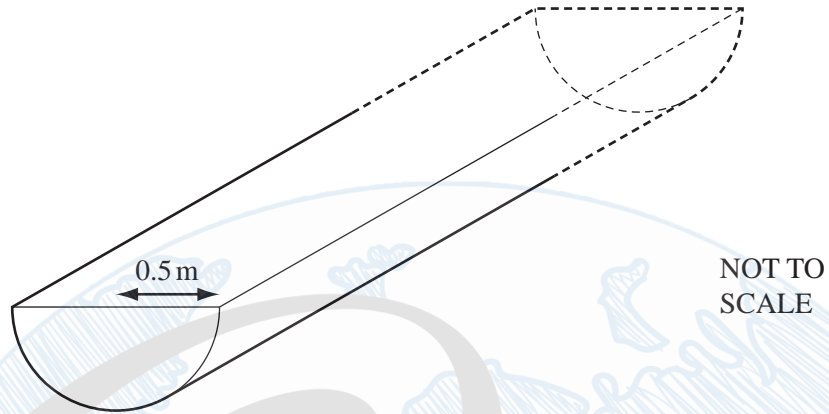
- (i) Calculate the volume of water in the tank and show that it rounds to 33 m³, correct to the nearest whole number.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

Answer(b)(i)

[4]

(ii)



The cross-section of an irrigation channel is a semi-circle of radius 0.5 m. The 33 m^3 of water from the tank completely fills the irrigation channel.

Calculate the length of the channel.

Answer(b)(ii) m [3]

(c) (i) Calculate the number of litres in a full tank of 33 m^3 .

Answer(c)(i) litres [1]

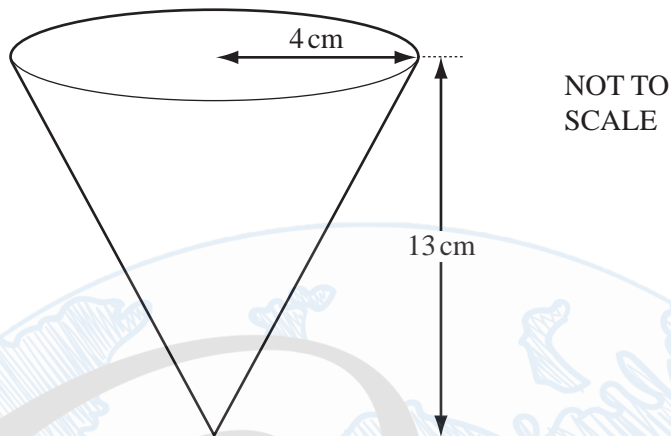
(ii) The water drains from the tank at a rate of 1800 litres per minute.

Calculate the time, in minutes and seconds, taken to empty the tank.

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Answer(c)(ii) min s [2]

4 (a)



The diagram shows a cone of radius 4 cm and height 13 cm.
 It is filled with soil to grow small plants.
 Each cubic centimetre of soil has a mass of 2.3g.

(i) Calculate the volume of the soil inside the cone.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

Answer(a)(i) cm³ [2]

(ii) Calculate the mass of the soil.

Answer(a)(ii) g [1]

(iii) Calculate the greatest number of these cones which can be filled **completely** using 50 kg of soil.

Answer(a)(iii) [2]

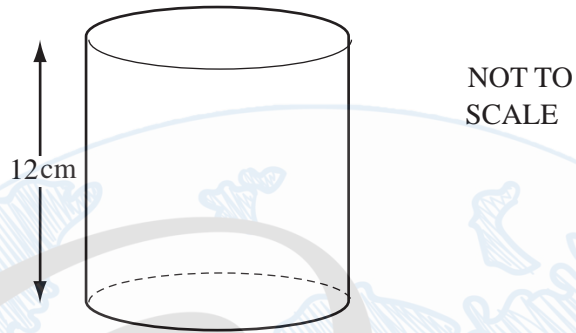
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(b) A **similar** cone of height 32.5 cm is used for growing larger plants.

Calculate the volume of soil used to fill this cone.

Answer(b) cm³ [3]

(c)



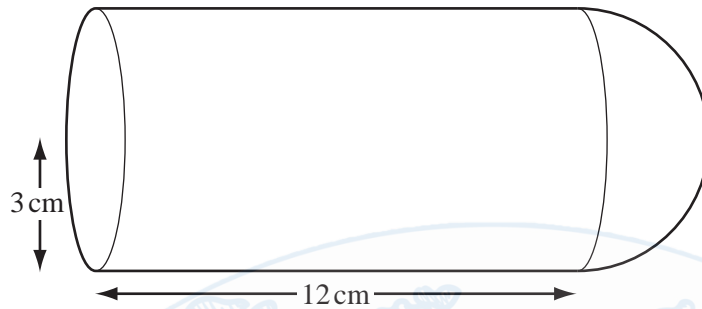
Some plants are put into a cylindrical container with height 12 cm and volume 550 cm^3 .

Calculate the radius of the cylinder.

Answer(c) cm [3]

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8

NOT TO
SCALE

The diagram shows a solid made up of a hemisphere and a cylinder.
The radius of both the cylinder and the hemisphere is 3 cm.
The length of the cylinder is 12 cm.

(a) (i) Calculate the volume of the solid.

[The volume, V , of a **sphere** with radius r is $V = \frac{4}{3}\pi r^3$.]

Answer(a)(i) cm³ [4]

(ii) The solid is made of steel and 1 cm³ of steel has a mass of 7.9 g.
Calculate the mass of the solid.
Give your answer in kilograms.

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Answer(a)(ii) kg [2]

- (iii) The solid fits into a box in the shape of a cuboid, 15 cm by 6 cm by 6 cm.
Calculate the volume of the box **not** occupied by the solid.

Answer(a)(iii) cm³ [2]

- (b) (i) Calculate the **total** surface area of the solid.
You must show your working.

[The surface area, A , of a **sphere** with radius r is $A = 4\pi r^2$.]

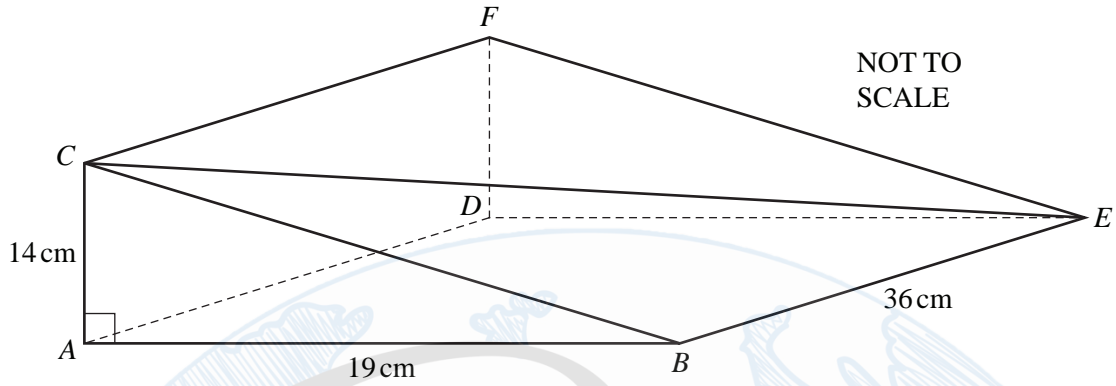
Answer(b)(i) cm² [5]

- (ii) The surface of the solid is painted.
The cost of the paint is \$0.09 per millilitre.
One millilitre of paint covers an area of 8 cm².
Calculate the cost of painting the solid.

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Answer(b)(ii) \$ [2]

6



In the diagram, $ABCDEF$ is a prism of length 36 cm. The cross-section ABC is a right-angled triangle. $AB = 19$ cm and $AC = 14$ cm.

Calculate

- (a) the length BC ,

Answer(a) $BC = \dots\dots\dots$ cm [2]

- (b) the total surface area of the prism,

Answer(b) $\dots\dots\dots$ cm² [4]

- (c) the volume of the prism,

Answer(c) $\dots\dots\dots$ cm³ [2]

- (d) the length CE ,

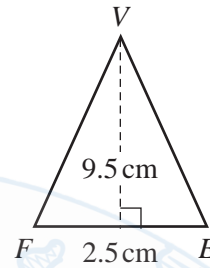
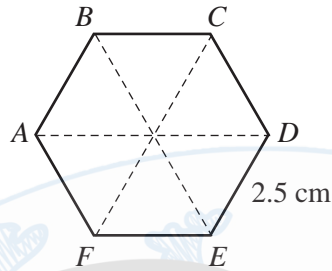
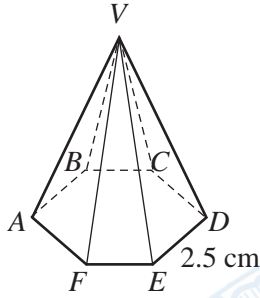
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Answer(d) $CE = \dots\dots\dots$ cm [2]

- (e) the angle between the line CE and the base $ABED$.

Answer(e) [3]

7 (a)



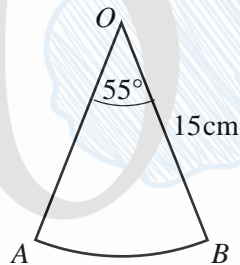
NOT TO SCALE

A solid pyramid has a **regular hexagon** of side 2.5cm as its base. Each sloping face is an isosceles triangle with base 2.5 cm and height 9.5cm.

Calculate the **total** surface area of the pyramid.

Answer(a) cm² [4]

(b)



NOT TO SCALE

A sector OAB has an angle of 55° and a radius of 15 cm.

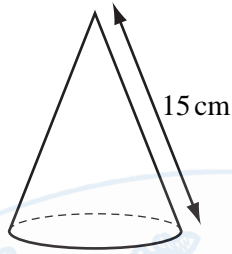
Calculate the area of the sector and show that it rounds to 108 cm^2 , correct to 3 significant figures.

Answer (b)

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[3]

(c)



NOT TO SCALE

The sector radii OA and OB in **part (b)** are joined to form a cone.

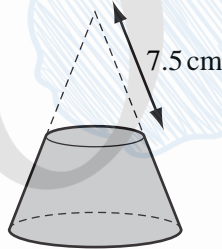
- (i) Calculate the base radius of the cone.
[The curved surface area, A , of a cone with radius r and slant height l is $A = \pi r l$.]

Answer(c)(i) cm [2]

- (ii) Calculate the perpendicular height of the cone.

Answer(c)(ii) cm [3]

(d)



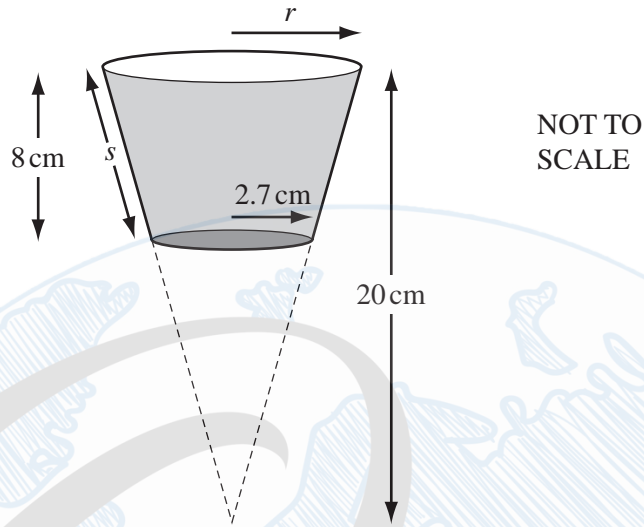
NOT TO SCALE

A solid cone has the same dimensions as the cone in **part (c)**.
A small cone with slant height 7.5 cm is removed by cutting parallel to the base.

Calculate the volume of the remaining solid.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3} \pi r^2 h$.]

Answer(d) cm³ [3]



The diagram shows a plastic cup in the shape of a cone with the end removed.
 The vertical height of the cone in the diagram is 20 cm.
 The height of the cup is 8 cm.
 The base of the cup has radius 2.7 cm.

- (a) (i) Show that the radius, r , of the circular top of the cup is 4.5 cm.

Answer(a)(i)

[2]

- (ii) Calculate the volume of water in the cup when it is full.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3} \pi r^2 h$.]

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Answer(a)(ii) cm³ [4]

(b) (i) Show that the slant height, s , of the cup is 8.2 cm.

Answer(b)(i)

[3]

(ii) Calculate the curved surface area of the outside of the cup.
[The curved surface area, A , of a cone with radius r and slant height l is $A = \pi rl$.]

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Answer(b)(ii) cm² [5]

- 4 Boris has a recipe which makes 16 biscuits.

The ingredients are

160 g flour,
160 g sugar,
240 g butter,
200 g oatmeal.

- (a) Boris has only 350 grams of oatmeal but plenty of the other ingredients.

- (i) How many biscuits can he make?

Answer(a)(i) [2]

- (ii) How many grams of butter does he need to make this number of biscuits?

Answer(a)(ii) g [2]

- (b) The ingredients are mixed together to make dough.

This dough is made into a sphere of volume 1080 cm^3 .

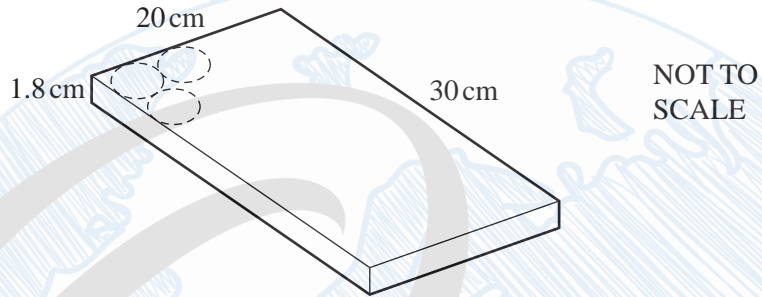
Calculate the radius of this sphere.

[The volume, V , of a sphere of radius r is $V = \frac{4}{3} \pi r^3$.]

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Answer(b) cm [3]

(c)



The 1080 cm^3 of dough is then rolled out to form a cuboid $20 \text{ cm} \times 30 \text{ cm} \times 1.8 \text{ cm}$.

Boris cuts out circular biscuits of diameter 5 cm.

(i) How many whole biscuits can he cut from this cuboid?

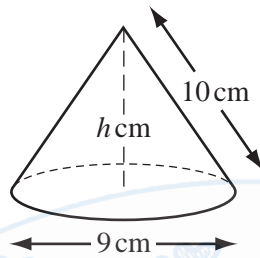
Answer(c)(i) [1]

(ii) Calculate the volume of dough left over.

Answer(c)(ii) cm^3 [3]

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6



NOT TO SCALE

A solid cone has diameter 9 cm, slant height 10 cm and vertical height h cm.

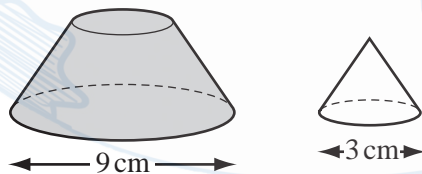
- (a) (i) Calculate the curved surface area of the cone.
 [The curved surface area, A , of a cone, radius r and slant height l is $A = \pi rl$.]

Answer(a)(i) cm² [2]

- (ii) Calculate the value of h , the vertical height of the cone.

Answer(a)(ii) $h =$ [3]

(b)



NOT TO SCALE

Sasha cuts off the top of the cone, making a smaller cone with diameter 3 cm.
 This cone is **similar** to the original cone.

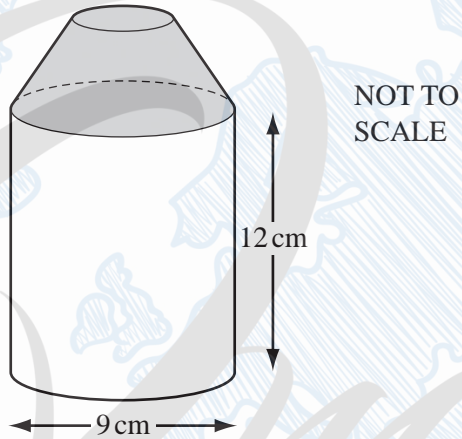
- (i) Calculate the **vertical** height of this small cone.

Answer(b)(i) cm [2]

(ii) Calculate the curved surface area of this small cone.

Answer(b)(ii) cm² [2]

(c)

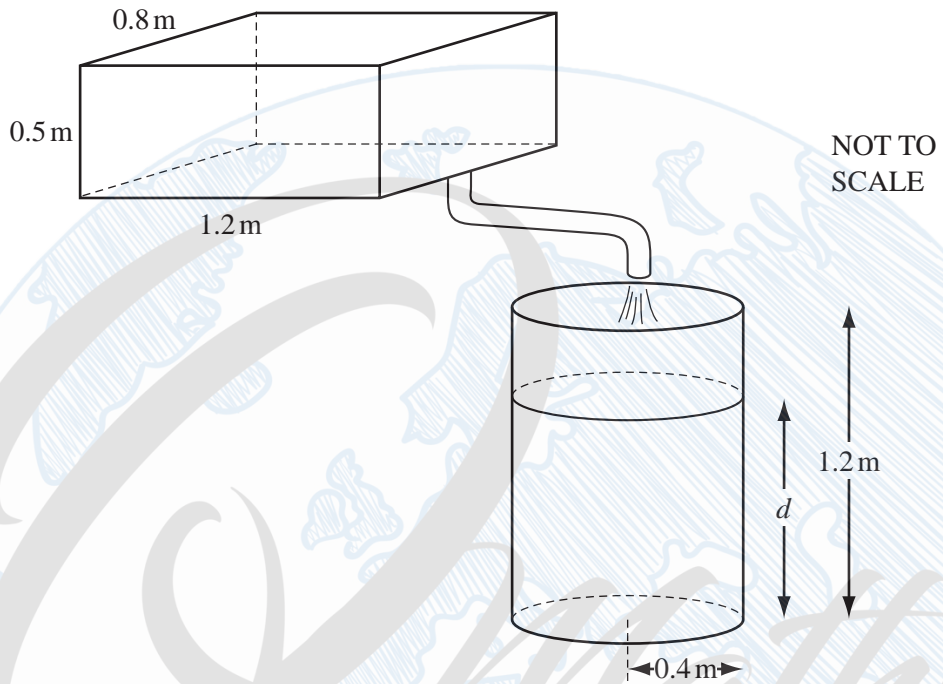


The shaded solid from **part (b)** is joined to a solid cylinder with diameter 9 cm and height 12 cm.
Calculate the **total** surface area of the whole solid.

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Answer(c) cm² [5]

1



A rectangular tank measures 1.2 m by 0.8 m by 0.5 m.

- (a) Water flows from the full tank into a cylinder at a rate of $0.3 \text{ m}^3/\text{min}$.

Calculate the time it takes for the full tank to empty.
Give your answer in minutes and seconds.

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Answer(a) min s [3]

(b) The radius of the cylinder is 0.4 m.

Calculate the depth of water, d , when all the water from the rectangular tank is in the cylinder.

Answer(b) $d =$ m [3]

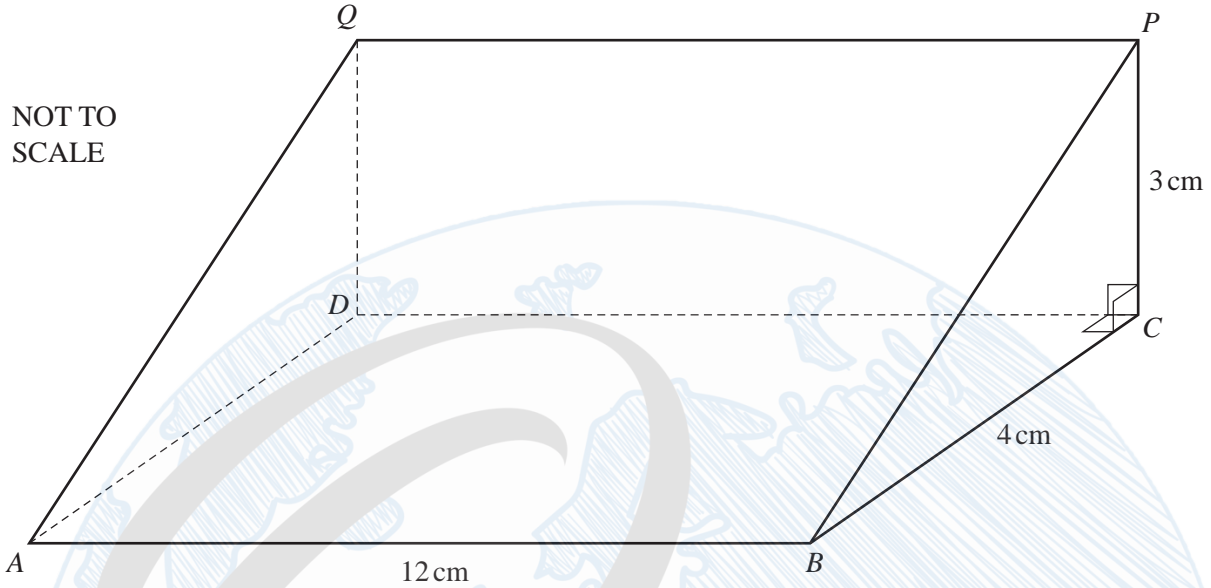
(c) The cylinder has a height of 1.2 m and is open at the top.
The inside surface is painted at a cost of \$2.30 per m^2 .

Calculate the cost of painting the inside surface.

Answer(c) \$ [4]

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6



The diagram shows a triangular prism of length 12 cm.

The rectangle $ABCD$ is horizontal and the rectangle $DCPQ$ is vertical.

The cross-section is triangle PBC in which angle $BCP = 90^\circ$, $BC = 4$ cm and $CP = 3$ cm.

(a) (i) Calculate the length of AP .

Answer(a)(i) $AP =$ cm [3]

(ii) Calculate the angle of elevation of P from A .

Answer(a)(ii) [2]

(b) (i) Calculate angle PBC .

Answer(b)(i) Angle $PBC =$ [2]

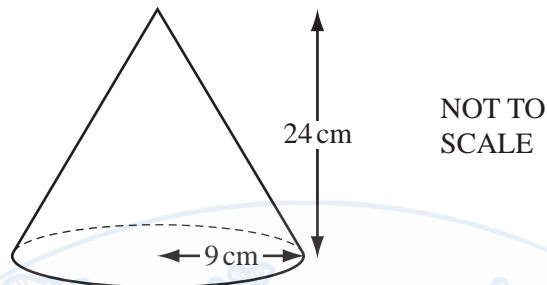
(ii) X is on BP so that angle $BXC = 120^\circ$.

Calculate the length of XC .

Answer(b)(ii) $XC =$ cm [3]

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10



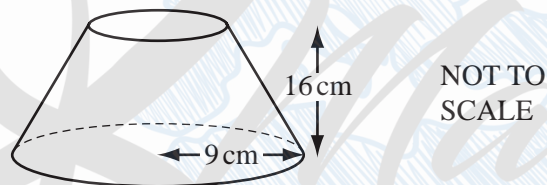
A solid metal cone has base radius 9 cm and vertical height 24 cm.

(a) Calculate the volume of the cone.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3} \pi r^2 h$.]

Answer(a) cm³ [2]

(b)



A cone of height 8 cm is removed by cutting parallel to the base, leaving the solid shown above. Show that the volume of this solid rounds to 1960 cm³, correct to 3 significant figures.

Answer (b)

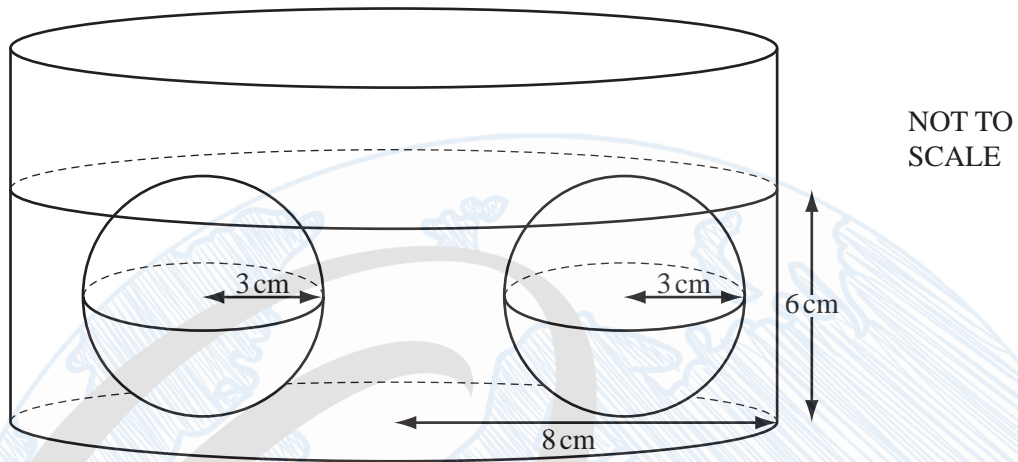
[4]

(c) The 1960 cm³ of metal in the solid in **part (b)** is melted and made into 5 identical cylinders, each of length 15 cm. Show that the radius of each cylinder rounds to 2.9 cm, correct to 1 decimal place.

Answer (c)

[4]

5



The diagram shows two solid spheres of radius 3 cm lying on the base of a cylinder of radius 8 cm. Liquid is poured into the cylinder until the spheres are just covered.

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

(a) Calculate the volume of liquid in the cylinder in

(i) cm^3 ,

(ii) litres.

Answer(a)(i) cm^3 [4]

Answer(a)(ii) litres [1]

(b) One cubic centimetre of the liquid has a mass of 1.22 grams.

Calculate the mass of the liquid in the cylinder.

Give your answer in kilograms.

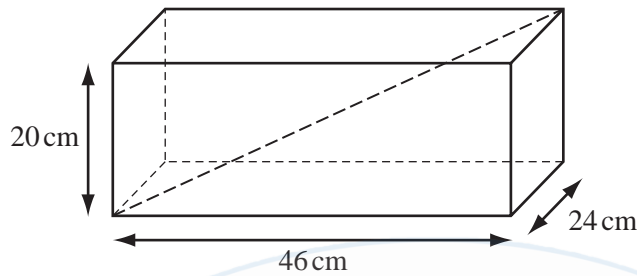
Answer(b) kg [2]

(c) The spheres are removed from the cylinder.

Calculate the new height of the liquid in the cylinder.

www.Q8Maths.com *Answer(c)* cm [2]

5 (a)



NOT TO SCALE

Jose has a fish tank in the shape of a cuboid measuring 46 cm by 24 cm by 20 cm.

Calculate the length of the diagonal shown in the diagram.

Answer(a) cm [3]

(b) Maria has a fish tank with a volume of $20\,000\text{ cm}^3$.

Write the volume of Maria's fish tank as a percentage of the volume of Jose's fish tank.

Answer(b) % [3]

(c) Lorenzo's fish tank is mathematically similar to Jose's and double the volume.

Calculate the dimensions of Lorenzo's fish tank.

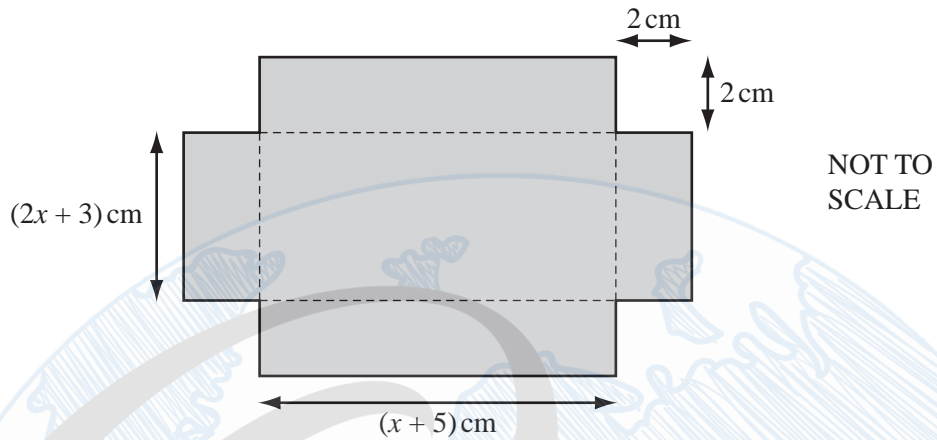
Answer(c) cm by cm by cm [3]

(d) A sphere has a volume of $20\,000\text{ cm}^3$. Calculate its radius.

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

Answer(d) cm [3]

- 8 A rectangular piece of card has a square of side 2 cm removed from each corner.



- (a) Write expressions, in terms of x , for the dimensions of the rectangular card before the squares are removed from the corners.

Answer(a) cm by cm [2]

- (b) The diagram shows a net for an open box.
Show that the volume, $V \text{ cm}^3$, of the open box is given by the formula $V = 4x^2 + 26x + 30$.

Answer(b)

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[3]

- (c) (i) Calculate the values of x when $V = 75$.
Show all your working and give your answers correct to two decimal places.

Answer(c)(i) $x =$ or $x =$ [5]

- (ii) Write down the length of the longest edge of the box.

Answer(c)(ii) cm [1]

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3 A metal cuboid has a volume of 1080 cm^3 and a mass of 8 kg.

- (a) Calculate the mass of one cubic centimetre of the metal.
Give your answer in grams.

Answer(a) g [1]

- (b) The base of the cuboid measures 12 cm by 10 cm.

Calculate the height of the cuboid.

Answer(b) cm [2]

- (c) The cuboid is melted down and made into a sphere with radius r cm.

- (i) Calculate the value of r .

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

Answer(c)(i) $r =$ [3]

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(ii) Calculate the surface area of the sphere.

[The surface area, A , of a sphere with radius r is $A = 4\pi r^2$.]

Answer(c)(ii) cm^2 [2]

(d) A larger sphere has a radius R cm.

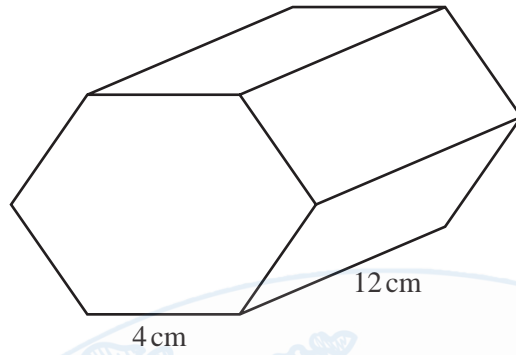
The surface area of this sphere is double the surface area of the sphere with radius r cm in part (c).

Find the value of $\frac{R}{r}$.

Answer(d) [2]

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9 (a)



NOT TO SCALE

The diagram shows a prism of length 12 cm.
The cross section is a regular hexagon of side 4 cm.

Calculate the total surface area of the prism.

Answer(a) cm² [4]

(b) Water flows through a cylindrical pipe of radius 0.74 cm.
It fills a 12 litre bucket in 4 minutes.

(i) Calculate the speed of the water through the pipe in centimetres per minute.

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Answer(b)(i) cm/min [4]

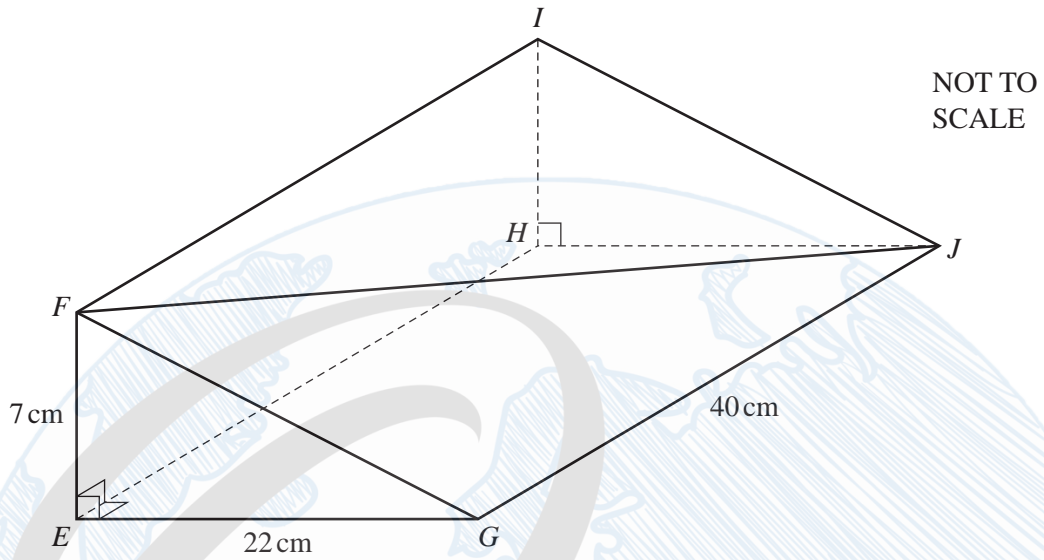
(ii) When the 12 litre bucket is emptied into a circular pool, the water level rises by 5 millimetres

Calculate the radius of the pool correct to the nearest centimetre.



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4



$EFGHIJ$ is a solid metal prism of length 40 cm.
 The cross section EFG is a right-angled triangle.
 $EF = 7$ cm and $EG = 22$ cm.

(a) Calculate the volume of the prism.

Answer(a) cm³ [2]

(b) Calculate the length FJ .

Answer(b) $FJ =$ cm [4]

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(c) Calculate the angle between FJ and the base $EGJH$ of the prism.

Answer(c) [3]

(d) The prism is melted and made into spheres.
Each sphere has a radius 1.5 cm.

Work out the greatest number of spheres that can be made.

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

Answer(d) [3]

(e) (i) A right-angled triangle is the cross section of another prism.
This triangle has height 4.5 cm and base 11.0 cm.
Both measurements are correct to 1 decimal place.

Calculate the upper bound for the area of this triangle.

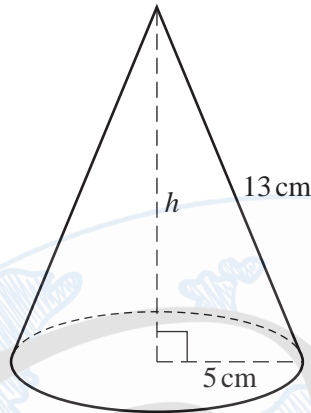
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Answer(e)(i) cm^2 [2]

(ii) Write your answer to **part (e)(i)** correct to 4 significant figures.

Answer(e)(ii) cm^2 [1]

3



NOT TO SCALE

(a) The diagram shows a cone of radius 5 cm and slant height 13 cm.

(i) Calculate the curved surface area of the cone.

[The curved surface area, A , of a cone with radius r and slant height l is $A = \pi rl$.]

Answer(a)(i) cm² [2]

(ii) Calculate the perpendicular height, h , of the cone.

Answer(a)(ii) $h =$ cm [3]

(iii) Calculate the volume of the cone.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3} \pi r^2 h$.]

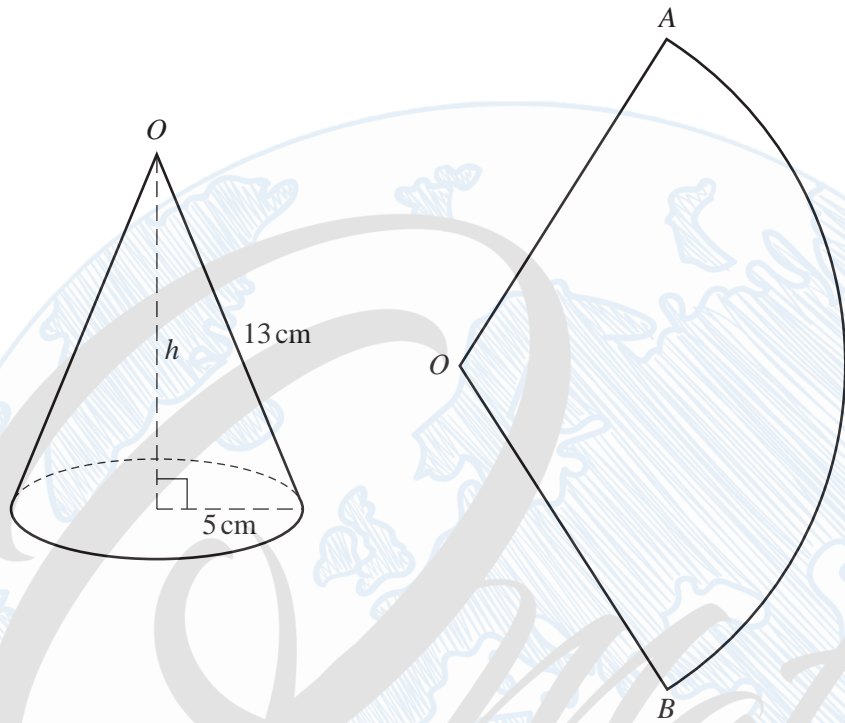
Answer(a)(iii) cm³ [2]

(iv) Write your answer to **part (a)(iii)** in cubic metres.

Give your answer in standard form.

Answer(a)(iv) m³ [2]

(b)

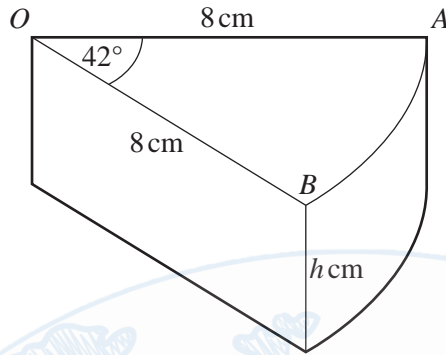


The cone is now cut along a slant height and it opens out to make the sector AOB of a circle.

Calculate angle AOB .

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Answer(b) Angle $AOB = \dots\dots\dots$ [4]



NOT TO SCALE

A wedge of cheese in the shape of a prism is cut from a cylinder of cheese of height h cm. The radius of the cylinder, OA , is 8 cm and the angle $AOB = 42^\circ$.

- (a) (i) The volume of the wedge of cheese is 90 cm^3 .

Show that the value of h is 3.84 cm correct to 2 decimal places.

Answer(a)(i)

[4]

- (ii) Calculate the **total** surface area of the wedge of cheese.

Answer(a)(ii) cm^2 [5]

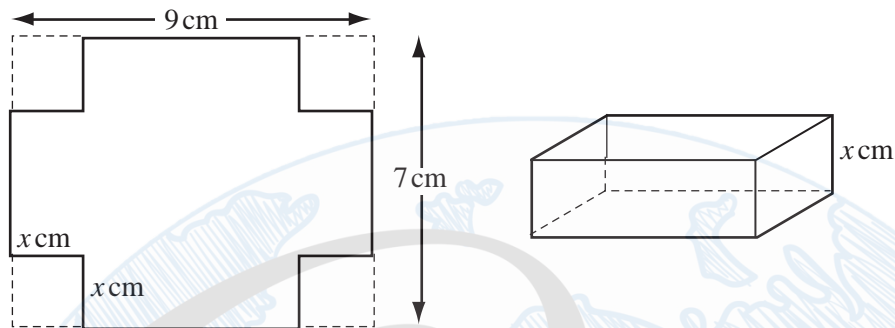
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- (b) A mathematically similar wedge of cheese has a volume of 22.5 cm^3 .

Calculate the height of this wedge.

Answer(b) cm [3]

- 3 A rectangular metal sheet measures 9 cm by 7 cm.
 A square, of side x cm, is cut from each corner.
 The metal is then folded to make an open box of height x cm.



NOT TO SCALE

- (a) Write down, in terms of x , the length and width of the box.

Answer(a) Length =

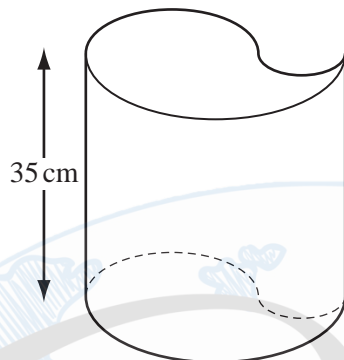
Width = [2]

- (b) Show that the volume, V , of the box is $4x^3 - 32x^2 + 63x$

Answer(b)

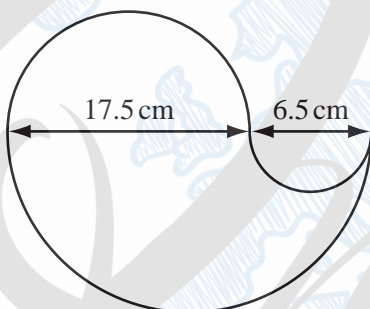
[2]

- 6 Sandra has designed this open container.
The height of the container is 35 cm.



NOT TO SCALE

The cross section of the container is designed from three semi-circles with diameters 17.5 cm, 6.5 cm and 24 cm.



NOT TO SCALE

- (a) Calculate the area of the cross section of the container.

Answer(a) cm² [3]

- (b) Calculate the external surface area of the container, including the base.

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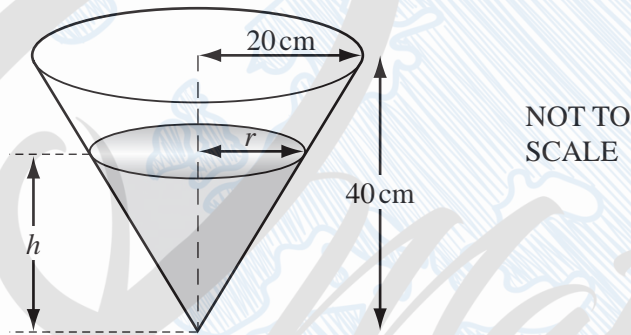
Answer(b) cm² [4]

(c) The container has a height of 35 cm.

Calculate the capacity of the container.
Give your answer in litres.

Answer(c) litres [3]

(d) Sandra's container is completely filled with water.
All the water is then poured into another container in the shape of a cone.
The cone has radius 20 cm and height 40 cm.



(i) The diagram shows the water in the cone.

Show that $r = \frac{h}{2}$.

Answer(d)(i)

[1]

(ii) Find the height, h , of the water in the cone.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

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Answer(d)(ii) $h =$ cm [3]

- 3 (a) The running costs for a papermill are \$75 246.
This amount is divided in the ratio labour costs : materials = 5 : 1.

Calculate the labour costs.

Answer(a) \$ [2]

- (b) In 2012 the company made a profit of \$135 890.
In 2013 the profit was \$150 675.

Calculate the percentage increase in the profit from 2012 to 2013.

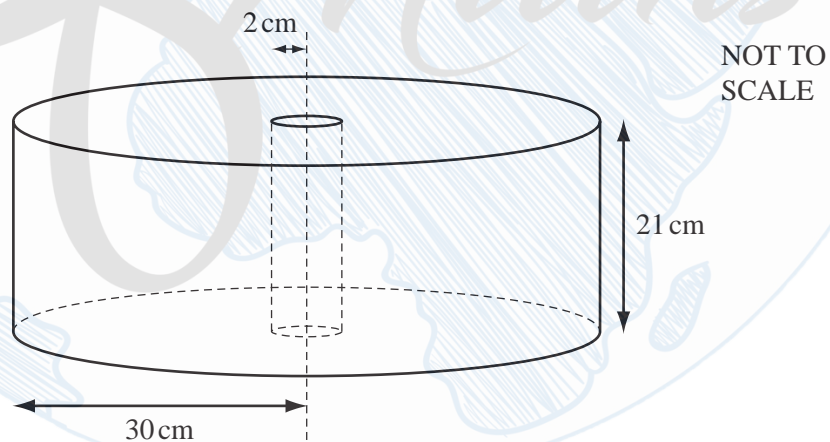
Answer(b) % [3]

- (c) The profit of \$135 890 in 2012 was an increase of 7% on the profit in 2011.

Calculate the profit in 2011.

Answer(c) \$ [3]

- (d)



Paper is sold in cylindrical rolls.
There is a wooden cylinder of radius 2 cm and height 21 cm in the centre of each roll.
The outer radius of a roll of paper is 30 cm.

- (i) Calculate the volume of paper in a roll.

Answer(d)(i) cm³ [3]

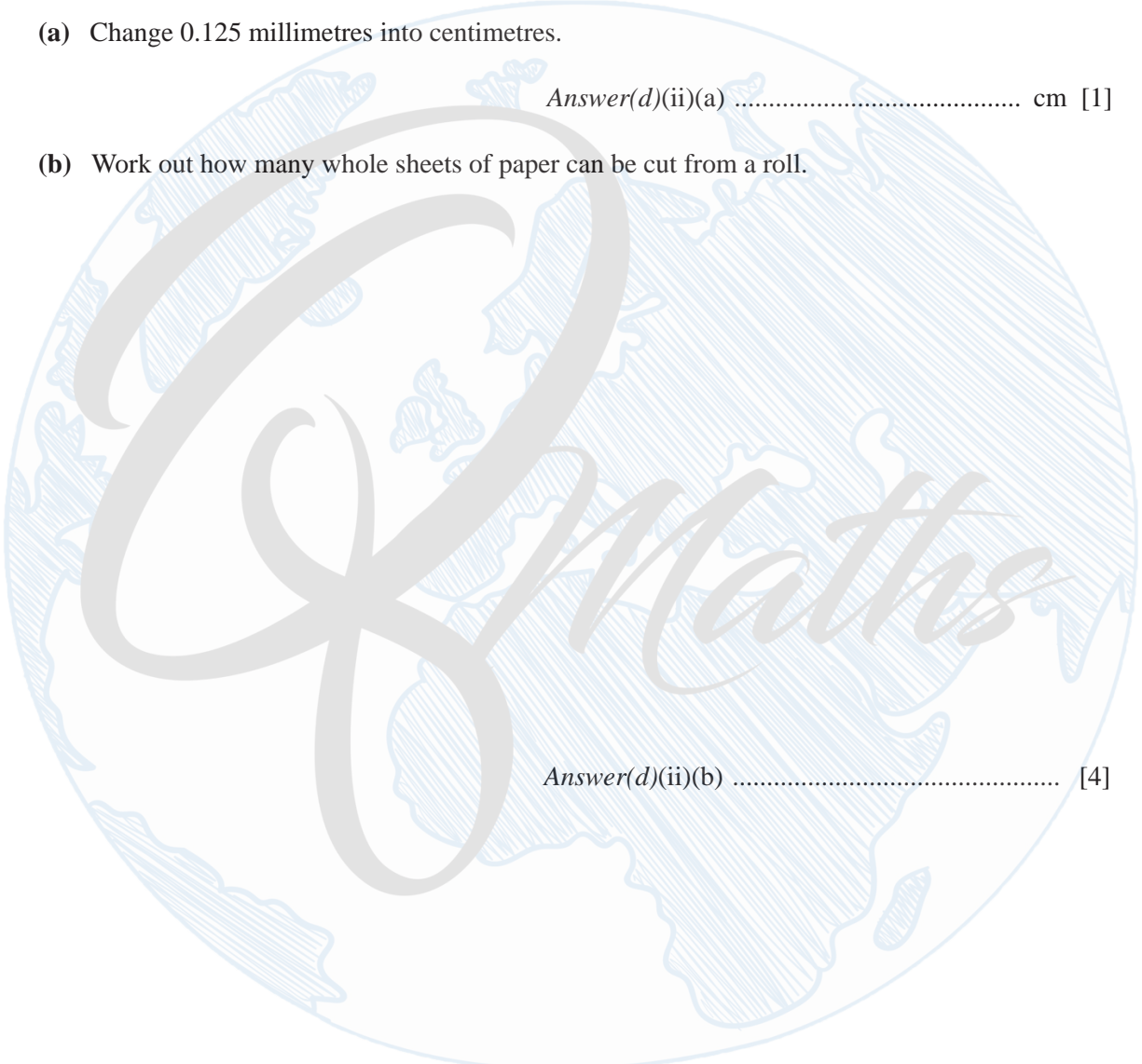
(ii) The paper is cut into sheets which measure 21 cm by 29.7 cm.
The thickness of each sheet is 0.125 mm.

(a) Change 0.125 millimetres into centimetres.

Answer(d)(ii)(a) cm [1]

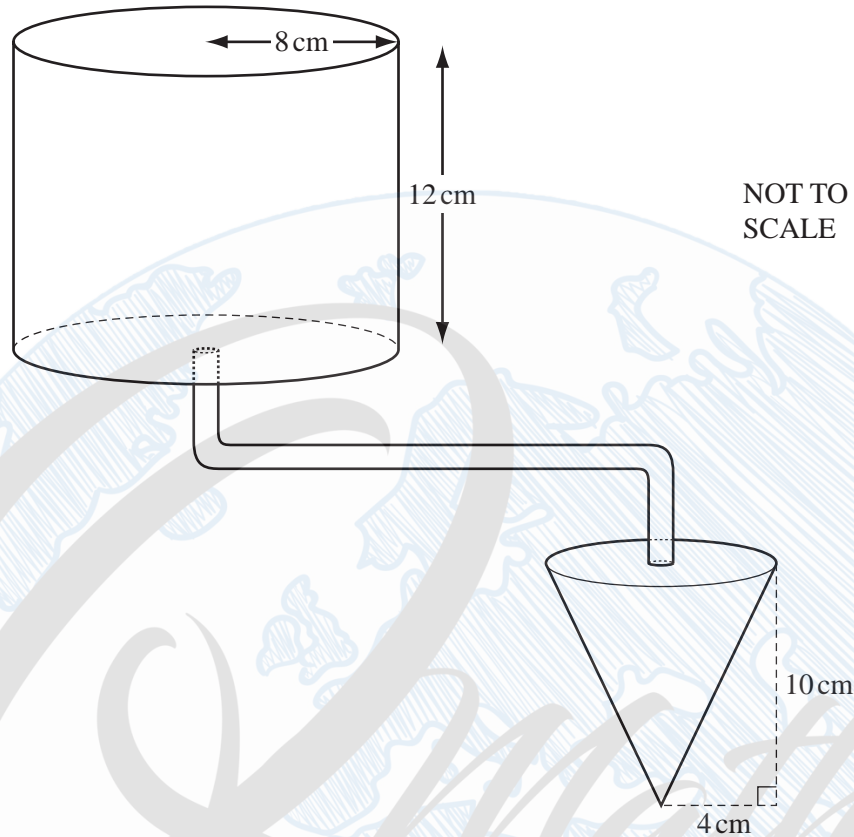
(b) Work out how many whole sheets of paper can be cut from a roll.

Answer(d)(ii)(b) [4]



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5



The diagram shows a cylinder with radius 8 cm and height 12 cm which is full of water. A pipe connects the cylinder to a cone. The cone has radius 4 cm and height 10 cm.

- (a) (i) Calculate the volume of water in the cylinder.
Show that it rounds to 2410 cm^3 correct to 3 significant figures.

Answer(a)(i)

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[2]

- (ii) Change 2410 cm^3 into litres.

Answer(a)(ii) litres [1]

(b) Water flows from the cylinder along the pipe into the cone at a rate of 2 cm^3 per second.

Calculate the time taken to fill the empty cone.

Give your answer in minutes and seconds correct to the nearest second.

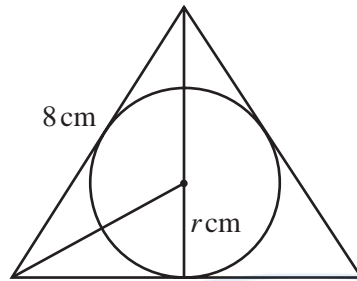
[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

Answer(b) min s [4]

(c) Find the number of empty cones which can be filled completely from the full cylinder.

www.Q8Maths.com *Answer(c)* [3]

10 (a)



NOT TO SCALE

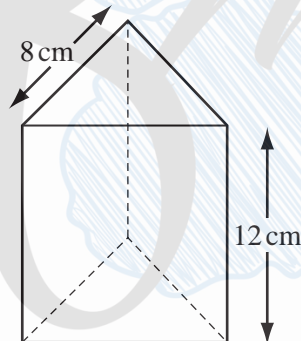
The three sides of an equilateral triangle are tangents to a circle of radius r cm. The sides of the triangle are 8 cm long.

Calculate the value of r . Show that it rounds to 2.3, correct to 1 decimal place.

Answer(a)

[3]

(b)



NOT TO SCALE

The diagram shows a box in the shape of a triangular prism of height 12 cm. The cross section is an equilateral triangle of side 8 cm.

Calculate the volume of the box.

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Answer(b) cm³ [4]

- (c) The box contains biscuits.
Each biscuit is a cylinder of radius 2.3 centimetres and height 4 millimetres.

Calculate

- (i) the largest number of biscuits that can be placed in the box,

Answer(c)(i) [3]

- (ii) the volume of one biscuit in cubic centimetres,

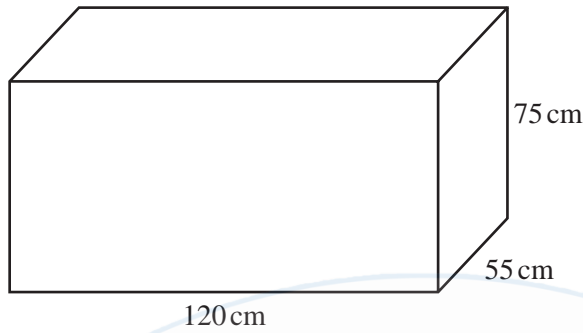
Answer(c)(ii) cm^3 [2]

- (iii) the percentage of the volume of the box **not** filled with biscuits.

Answer(c)(iii) % [3]

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7



NOT TO SCALE

The diagram shows a water tank in the shape of a cuboid measuring 120 cm by 55 cm by 75 cm. The tank is filled completely with water.

(a) Show that the capacity of the water tank is 495 litres.

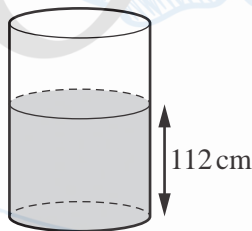
Answer(a)

[2]

(b) (i) The water from the tank flows into an empty cylinder at a uniform rate of 750 millilitres per second. Calculate the length of time, in minutes, for the water to be completely emptied from the tank.

Answer(b)(i) min [2]

(ii) When the tank is completely empty, the height of the water in the cylinder is 112 cm.



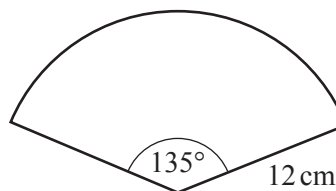
NOT TO SCALE

Calculate the radius of the cylinder.

Answer(b)(ii) cm [3]

4 (a) A sector of a circle has radius 12 cm and an angle of 135° .

- (i) Calculate the length of the arc of this sector.
Give your answer as a multiple of π .

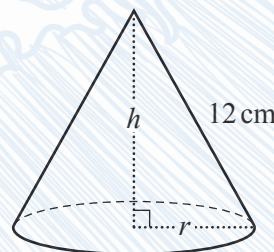


NOT TO SCALE

Answer(a)(i) cm [2]

(ii) The sector is used to make a cone.

- (a) Calculate the base radius, r .



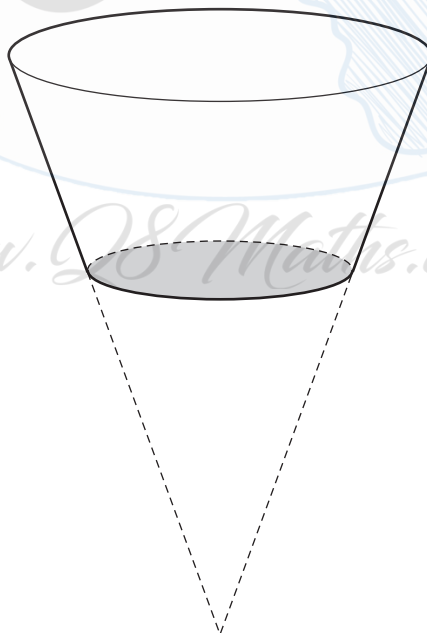
NOT TO SCALE

Answer(a)(ii)(a) $r =$ cm [2]

- (b) Calculate the height of the cone, h .

Answer(a)(ii)(b) $h =$ cm [3]

- (b) The diagram shows a plant pot.
It is made by removing a small cone from a larger cone and adding a circular base.

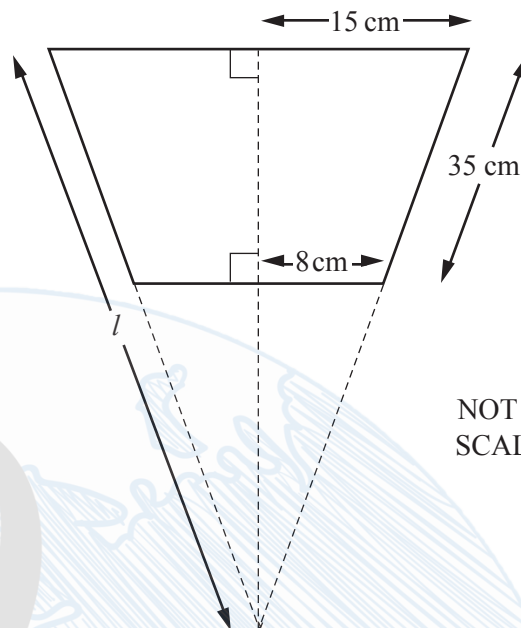


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This is the cross section of the plant pot.

(i) Find l .



Answer(b)(i) $l = \dots\dots\dots$ cm [3]

(ii) Calculate the total surface area of the outside of the plant pot.
 [The curved surface area, A , of a cone with radius r and slant height l is $A = \pi r l$.]

Answer(b)(ii) $\dots\dots\dots$ cm² [3]

(c) Some cones are mathematically similar.
 For these cones, the mass, M grams, is proportional to the cube of the base radius, r cm.
 One of the cones has mass 1458 grams and base radius 4.5 cm.

(i) Find an expression for M in terms of r

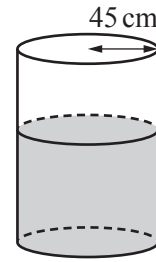
Answer(c)(i) $M = \dots\dots\dots$ [2]

(ii) Two of the cones have radii in the ratio 2 : 3.

Write down the ratio of their masses.

Answer(c)(ii) $\dots\dots\dots$: $\dots\dots\dots$ [1]

- 8 (a) A cylindrical tank contains $180\,000\text{ cm}^3$ of water.
The radius of the tank is 45 cm.

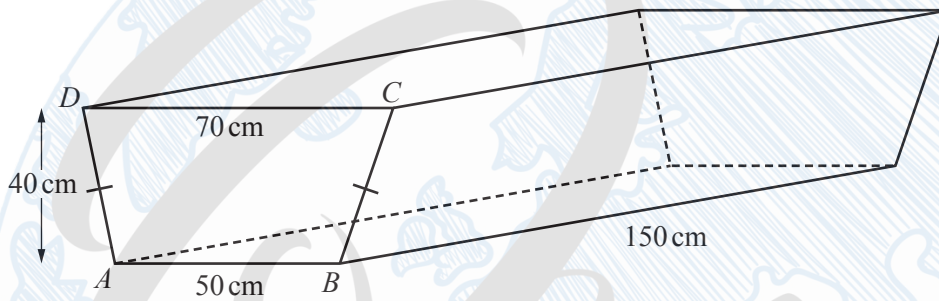


NOT TO SCALE

Calculate the height of water in the tank.

Answer(a) cm [2]

(b)



NOT TO SCALE

The diagram shows an empty tank in the shape of a horizontal prism of length 150 cm.
The cross section of the prism is an isosceles trapezium $ABCD$.
 $AB = 50\text{ cm}$, $CD = 70\text{ cm}$ and the vertical height of the trapezium is 40 cm.

- (i) Calculate the volume of the tank.

Answer(b)(i) cm^3 [3]

- (ii) Write your answer to **part (b)(i)** in litres.

Answer(b)(ii) litres [1]

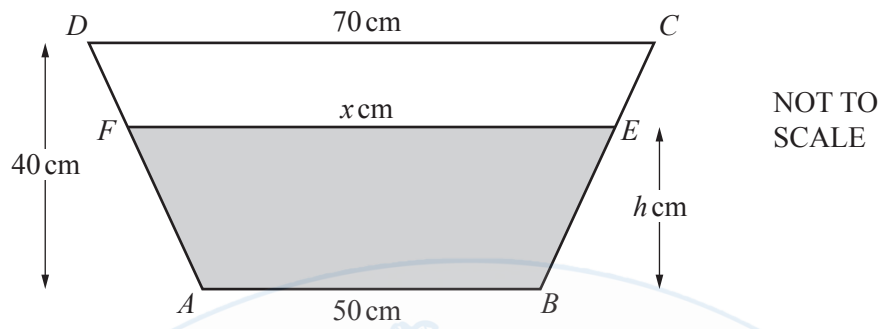
- (c) The $180\,000\text{ cm}^3$ of water flows from the tank in **part (a)** into the tank in **part (b)** at a rate of $15\text{ cm}^3/\text{s}$.

Calculate the time this takes.

Give your answer in hours and minutes.

Answer(c) h min [3]

(d)



The $180\,000\text{ cm}^3$ of water reaches the level EF as shown above.
 $EF = x\text{ cm}$ and the height of the water is $h\text{ cm}$.

(i) Using the properties of similar triangles, show that $h = 2(x - 50)$.

Answer(d)(i)

[2]

(ii) Using $h = 2(x - 50)$, show that the shaded area, in cm^2 , is $x^2 - 2500$.

Answer(d)(ii)

[1]

(iii) Find the value of x .

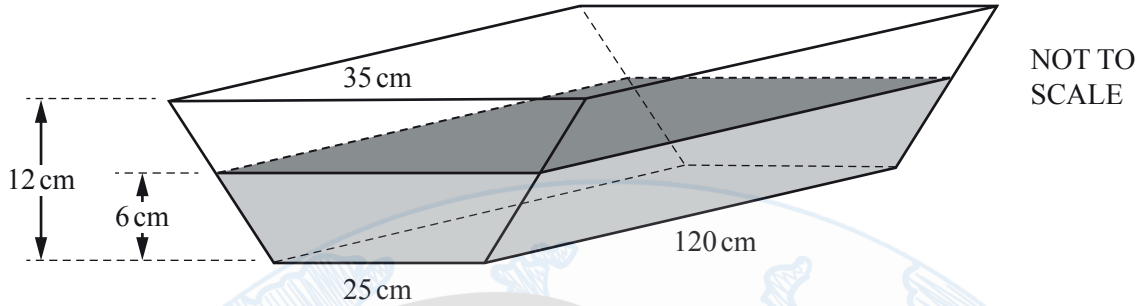
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Answer(d)(iii) $x = \dots\dots\dots$ [2]

(iv) Find the value of h .

Answer(d)(iv) $h = \dots\dots\dots$ [1]

3 The diagram shows a horizontal water trough in the shape of a prism.



The cross section of this prism is a trapezium.
 The trapezium has parallel sides of lengths 35 cm and 25 cm and a perpendicular height of 12 cm.
 The length of the prism is 120 cm.

(a) Calculate the volume of the trough.

Answer(a) cm³ [3]

(b) The trough contains water to a depth of 6 cm.

(i) Show that the volume of water is 19 800 cm³.

Answer (b)(i)

[2]

(ii) Calculate the percentage of the trough that contains water.

Answer(b)(ii) % [1]

(c) The water is drained from the trough at a rate of 12 litres per hour.

Calculate the time it takes to empty the trough.
Give your answer in hours and minutes.

Answer(c) h min [4]

(d) The water from the trough just fills a cylinder of radius r cm and height $3r$ cm.

Calculate the value of r .

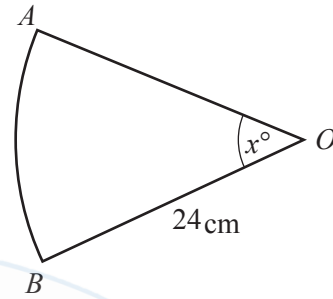
Answer(d) $r =$ [3]

(e) The cylinder has a mass of 1.2 kg.
1 cm³ of water has a mass of 1 g.

Calculate the total mass of the cylinder and the water.
Give your answer in kilograms.

Answer(e) kg [2]

- 8 (a) The diagram shows a sector of a circle with centre O and radius 24 cm.



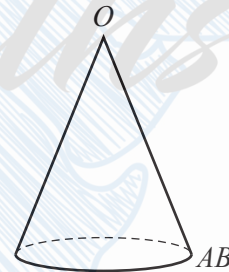
NOT TO SCALE

- (i) The total perimeter of the sector is 68 cm.

Calculate the value of x .

Answer(a)(i) $x = \dots\dots\dots$ [3]

- (ii) The points A and B of the sector are joined together to make a hollow cone. The arc AB becomes the circumference of the base of the cone.



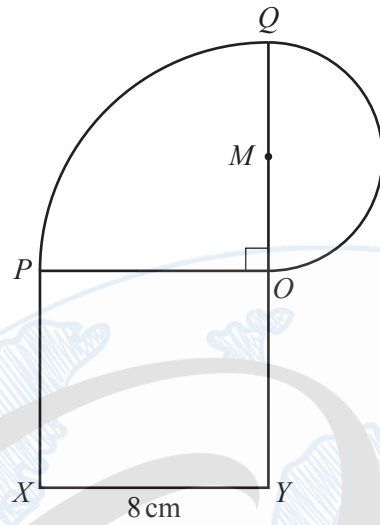
NOT TO SCALE

Calculate the volume of the cone.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

Answer(a)(ii) $\dots\dots\dots$ cm³ [6]

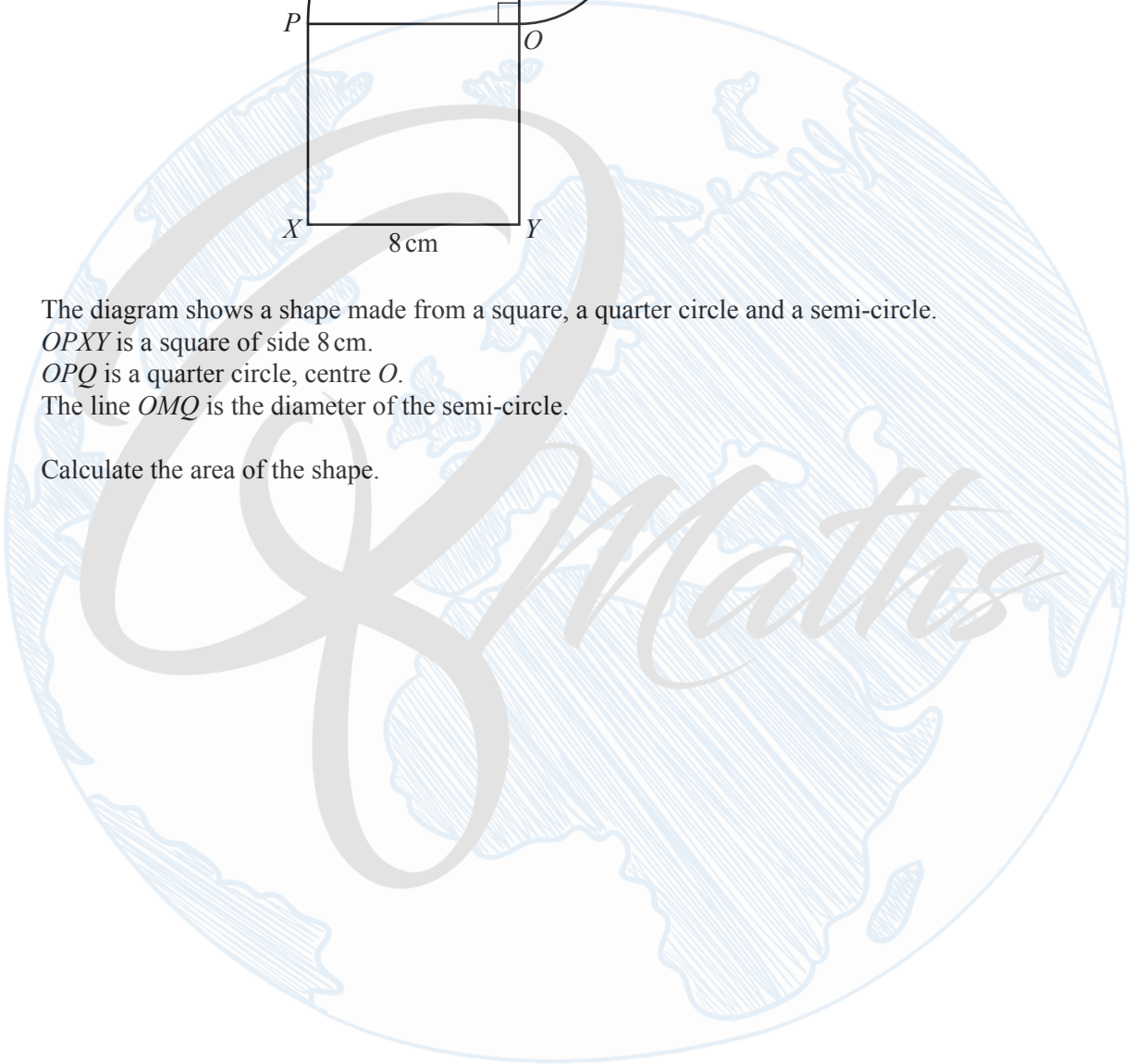
(b)



NOT TO
SCALE

The diagram shows a shape made from a square, a quarter circle and a semi-circle.
 $OPXY$ is a square of side 8 cm.
 OPQ is a quarter circle, centre O .
The line OMQ is the diameter of the semi-circle.

Calculate the area of the shape.

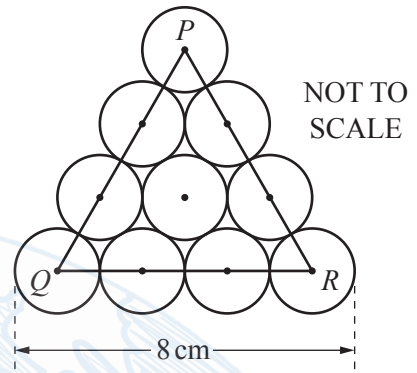


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Answer(b) cm² [5]

- 10 (a) The ten circles in the diagram each have radius 1 cm.
The centre of each circle is marked with a dot.

Calculate the height of triangle PQR .

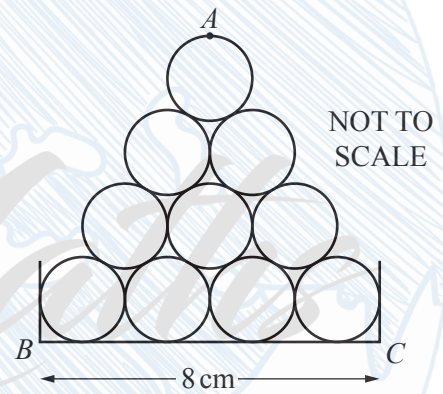


..... cm [3]

- (b) Mr Patel uses whiteboard pens that are cylinders of radius 1 cm.

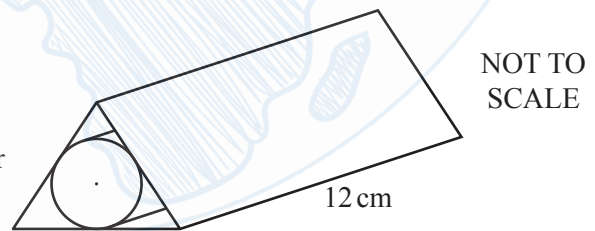
- (i) The diagram shows 10 pens stacked in a tray.
The tray is 8 cm wide.
The point A is the highest point in the stack.

Find the height of A above the base, BC , of the tray.



..... cm [1]

- (ii) The diagram shows a box that holds one pen.
The box is a prism of length 12 cm.
The cross section of the prism is an equilateral triangle.
The pen touches each of the three rectangular faces of the box.



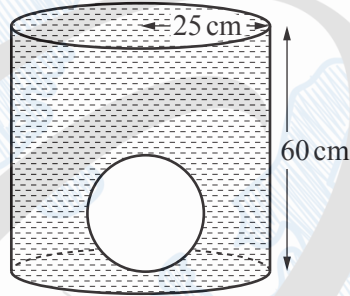
Calculate the volume of this box.

..... cm^3 [5]

- 4 (a) Calculate the volume of a metal sphere of radius 15 cm and show that it rounds to $14\,140\text{ cm}^3$, correct to 4 significant figures.
 [The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

[2]

- (b) (i) The sphere is placed inside an empty cylindrical tank of radius 25 cm and height 60 cm. The tank is filled with water.

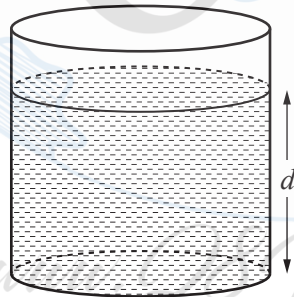


NOT TO SCALE

Calculate the volume of water required to fill the tank.

..... cm^3 [3]

- (ii) The sphere is removed from the tank.



NOT TO SCALE

Calculate the depth, d , of water in the tank.

$d =$ cm [2]

(c) The sphere is melted down and the metal is made into a solid cone of height 54 cm.

(i) Calculate the radius of the cone.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

..... cm [3]

(ii) Calculate the **total** surface area of the cone.

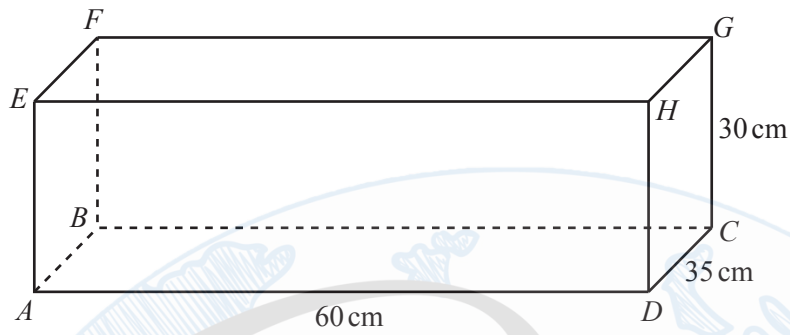
[The curved surface area, A , of a cone with radius r and slant height l is $A = \pi r l$.]

..... cm² [4]



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6 The diagram shows a cuboid.



NOT TO SCALE

$AD = 60$ cm, $CD = 35$ cm and $CG = 30$ cm.

(a) Write down the number of planes of symmetry of this cuboid.

..... [1]

(b) (i) Work out the surface area of the cuboid.

..... cm^2 [3]

(ii) Write your answer to **part (b)(i)** in square metres.

..... m^2 [1]

(c) Calculate

(i) the length AG , *www.Q8Maths.com*

$AG =$ cm [4]

(ii) the angle between AG and the base $ABCD$.

..... [3]

(d) (i) Show that the volume of the cuboid is $63\,000\text{ cm}^3$.

[1]

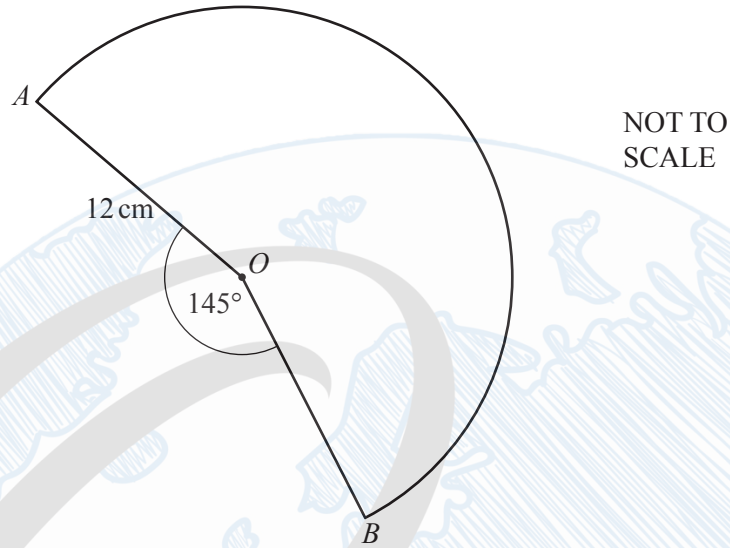
(ii) A cylinder of height 40 cm has the same volume as the cuboid.

Calculate the radius of the cylinder.

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..... cm [3]

9



The diagram shows a sector, centre O , and radius 12 cm.

- (a) Calculate the area of the sector.

..... cm² [3]

- (b) The sector is made into a cone by joining OA to OB .

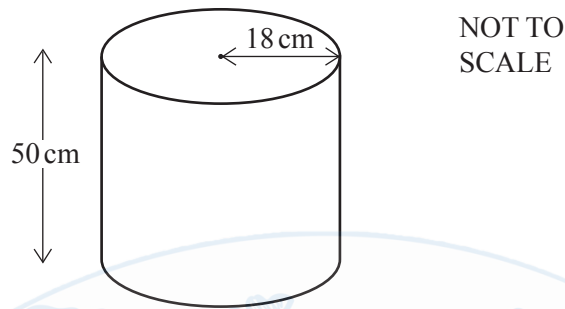
Calculate the volume of the cone.

[The volume, V , of a cone with base radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

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..... cm³ [6]

- 5 (a) The diagram shows a cylindrical container used to serve coffee in a hotel.



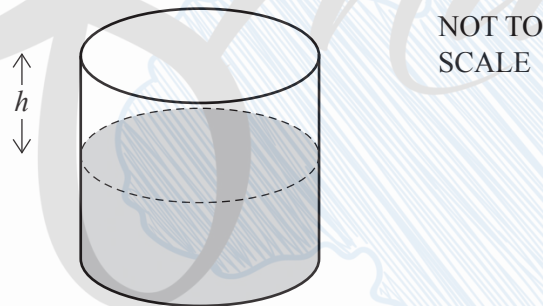
The container has a height of 50 cm and a radius of 18 cm.

- (i) Calculate the volume of the cylinder and show that it rounds to $50\,900\text{ cm}^3$, correct to 3 significant figures.

[2]

- (ii) 30 litres of coffee are poured into the container.

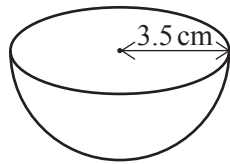
Work out the height, h , of the empty space in the container.



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$h = \dots\dots\dots$ cm [3]

- (iii) Cups in the shape of a hemisphere are filled with coffee from the container.
The radius of a cup is 3.5 cm.



NOT TO
SCALE

Work out the maximum number of these cups that can be completely filled from the 30 litres of coffee in the container.

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... [4]

- (b) The hotel also uses glasses in the shape of a cone.



NOT TO
SCALE

The capacity of each glass is 95 cm^3 .

- (i) Calculate the radius, r , and show that it rounds to 3.3 cm, correct to 1 decimal place.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

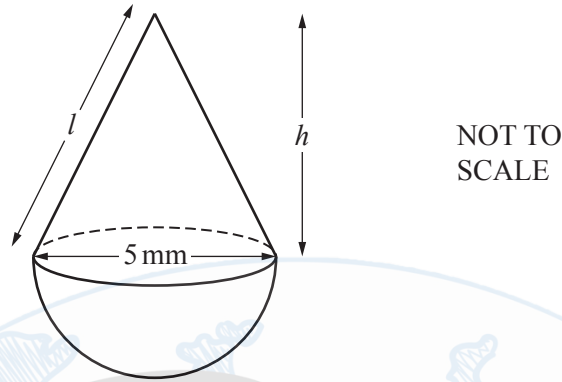
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[3]

- (ii) Calculate the curved surface area of the cone.

[The curved surface area, A , of a cone with radius r and slant height l is $A = \pi r l$.]

..... cm^2 [4]



The diagram shows a solid made from a hemisphere and a cone.
The base diameter of the cone and the diameter of the hemisphere are each 5 mm.

- (a) The total surface area of the solid is $\frac{115\pi}{4}$ mm².

Show that the slant height, l , is 6.5 mm.

[The curved surface area, A , of a cone with radius r and slant height l is $A = \pi r l$.]

[The surface area, A , of a sphere with radius r is $A = 4\pi r^2$.]

[4]

- (b) Calculate the height, h , of the cone.

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$h = \dots\dots\dots$ mm [3]

(c) Calculate the volume of the solid.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

(d) The solid is made from gold.
1 **cubic centimetre** of gold has a mass of 19.3 grams.
The value of 1 gram of gold is \$38.62 .

Calculate the value of the gold used to make the solid.

.....mm³ [4]

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\$..... [3]

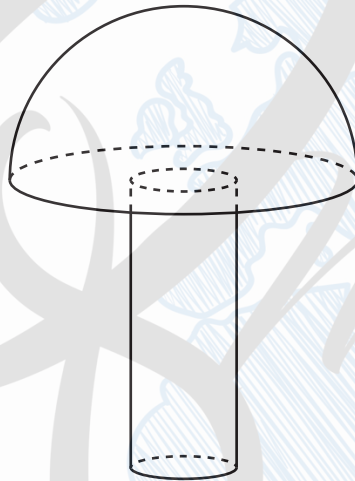
6 A solid hemisphere has volume 230 cm^3 .

(a) Calculate the radius of the hemisphere.

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... cm [3]

(b) A solid cylinder with radius 1.6 cm is attached to the hemisphere to make a toy.



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The total volume of the toy is 300 cm^3 .

(i) Calculate the height of the cylinder.

..... cm [3]

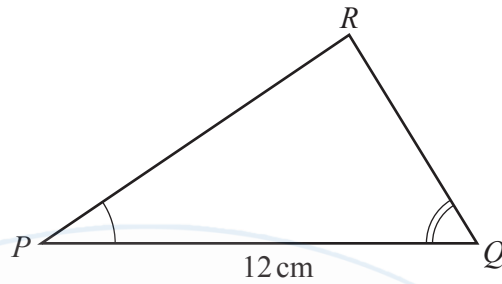
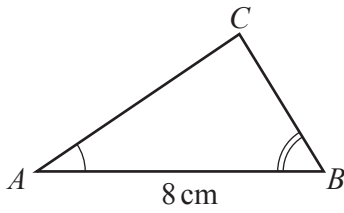
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(ii) A mathematically similar toy has volume 19200 cm^3 .

Calculate the radius of the cylinder for this toy.



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Triangle ABC is mathematically similar to triangle PQR .
The area of triangle ABC is 16 cm^2 .

(i) Calculate the area of triangle PQR .

..... cm^2 [2]

(ii) The triangles are the cross-sections of prisms which are also mathematically similar.
The volume of the smaller prism is 320 cm^3 .

Calculate the length of the larger prism.

..... cm [3]

- (b) A cylinder with radius 6 cm and height h cm has the same volume as a sphere with radius 4.5 cm.

Find the value of h .

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

$h = \dots\dots\dots$ [3]

- (c) A solid metal cube of side 20 cm is melted down and made into 40 solid spheres, each of radius r cm.

Find the value of r .

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

$r = \dots\dots\dots$ [3]

- (d) A solid cylinder has radius x cm and height $\frac{7x}{2}$ cm.

The surface area of a sphere with radius R cm is equal to the total surface area of the cylinder.

Find an expression for R in terms of x .

[The surface area, A , of a sphere with radius r is $A = 4\pi r^2$.]

$R = \dots\dots\dots$ [3]

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