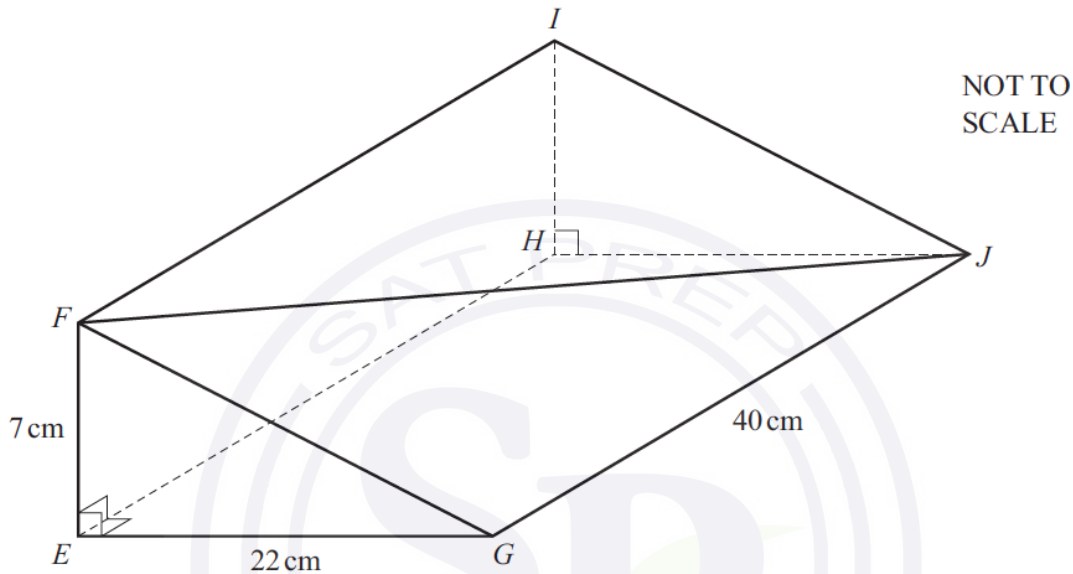


Extended Mathematics
Topic : Mensuration
Year: May 2013-May 2024
Paper -4
Question Booklet

Question 1



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]

(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]

Continue on the next page...

- (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.

Answer(e)(i) cm² [2]

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

Answer(e)(ii) cm² [1]

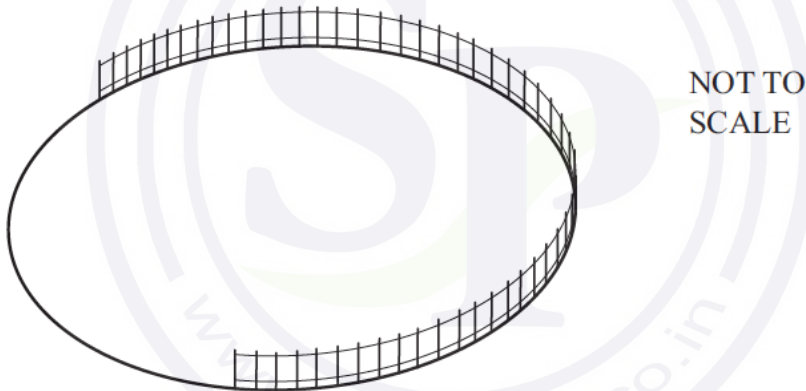
Question 2

A circular lake in the nature reserve has a radius of 45 m.

- (i) Calculate the area of the lake.

Answer (i) m² [2]

- (ii)



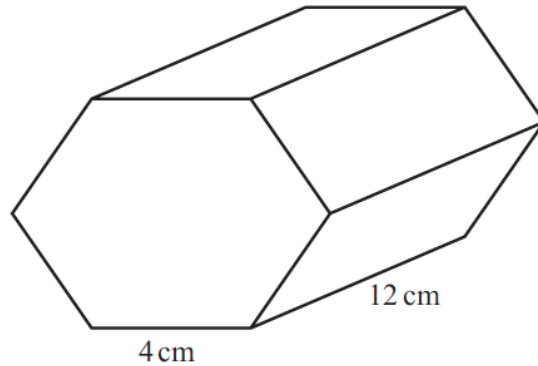
A fence is placed along part of the circumference of the lake.
 This arc subtends an angle of 210° at the centre of the circle.

Calculate the length of the fence.

Answer(b)(ii) m [2]

Question 3

(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.

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

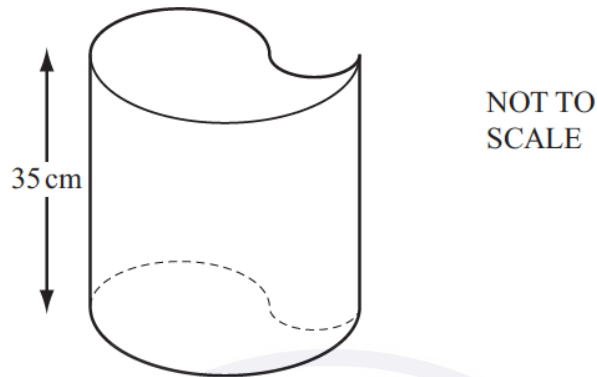
(ii) When the 12 litre bucket is emptied into a circular pool, the water level rises by 5 millimetres.

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

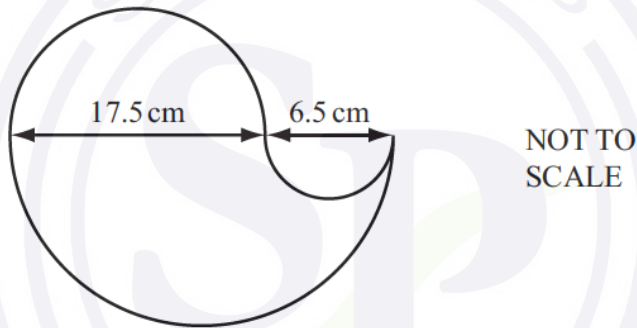
Answer(b)(ii) cm [5]

Question 4

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



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



(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.

Answer(b) cm² [4]

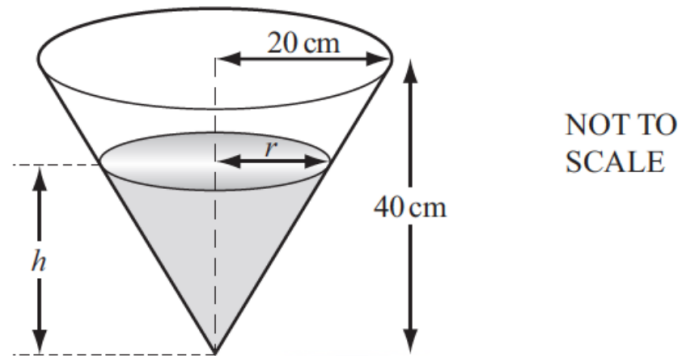
(c) The container has a height of 35 cm.

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

Answer(c) litres [3]

Continue on the next page...

- (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 $V = \frac{1}{3}\pi r^2 h$.]

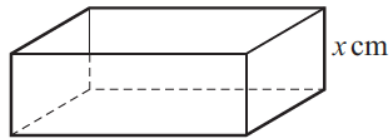
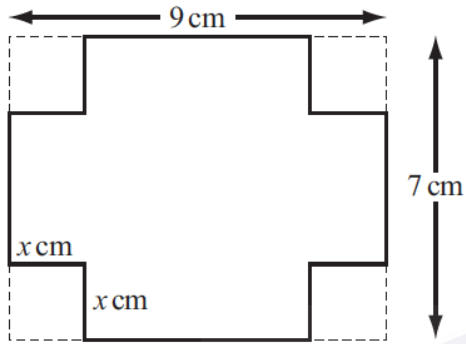
Answer(d)(ii) $h = \dots\dots\dots$ cm [3]

Question 5

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 =

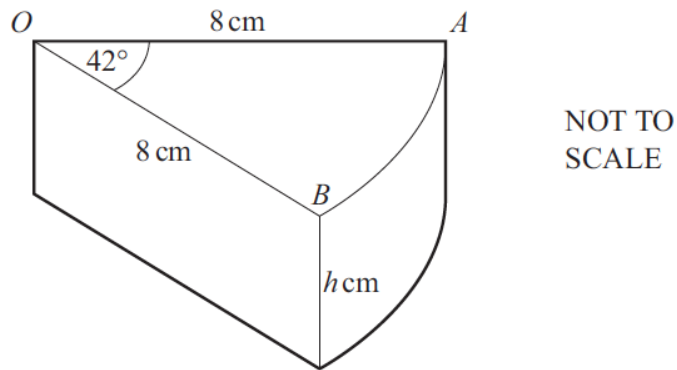
Width = [2]

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

Answer(b)

[2]

Question 6



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.

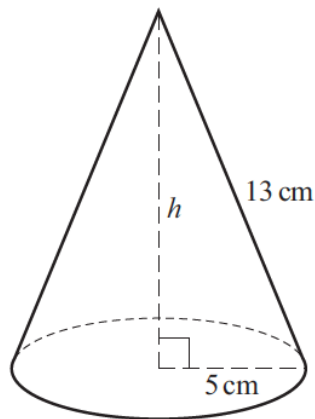
Answer(a)(ii) cm^2 [5]

- (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]

Question 7



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]

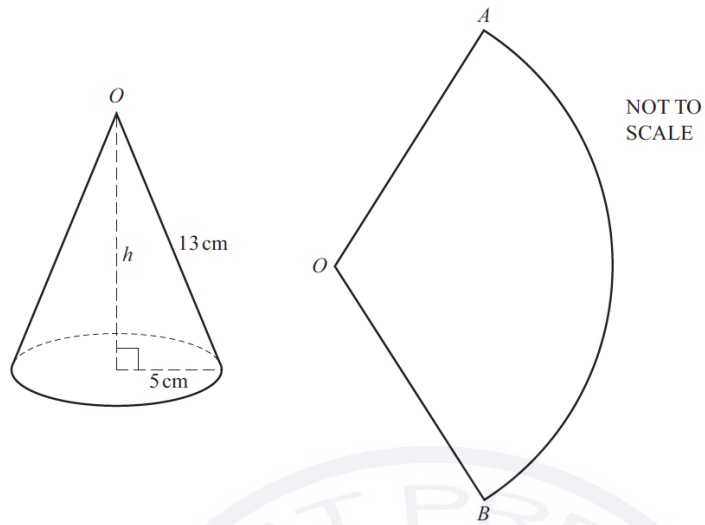
(iv) Write your answer to **part (a)(iii)** in cubic metres.

Give your answer in standard form.

Answer(a)(iv) m³ [2]

Continue on the next page...

(b)



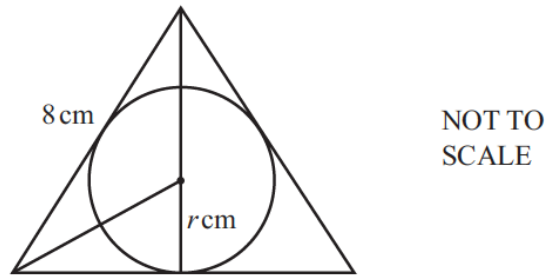
The cone is now cut along a slant height and it opens out to make the sector AOB of a circle.

Calculate angle AOB .

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

Question 8

(a)



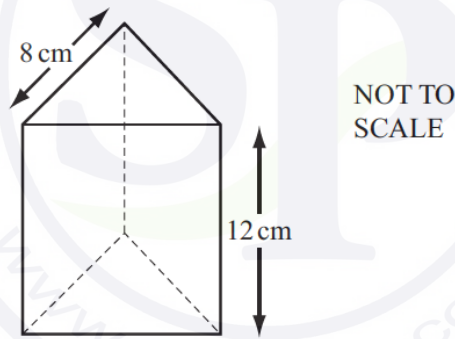
The three sides of an equilateral triangle are tangents to a circle of radius r cm. The sides of the triangle are 8 cm long.

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

Answer(a)

[3]

(b)

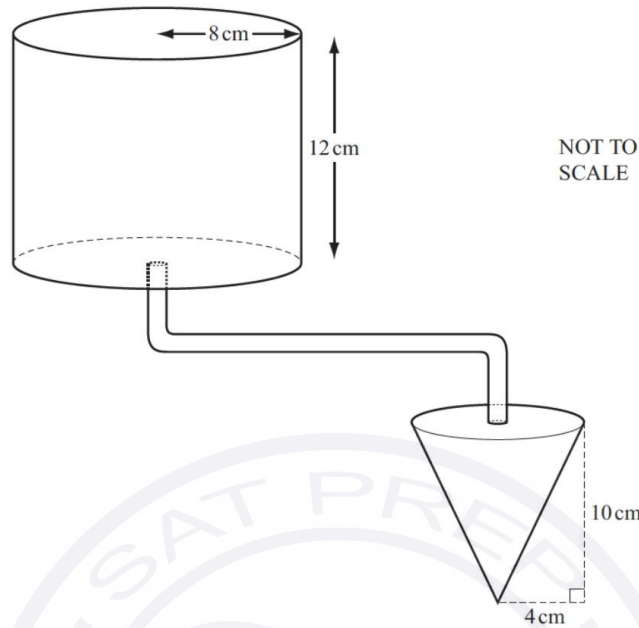


The diagram shows a box in the shape of a triangular prism of height 12 cm. The cross section is an equilateral triangle of side 8 cm.

Calculate the volume of the box.

Answer(b) cm³ [4]

Question 9



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)

[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.

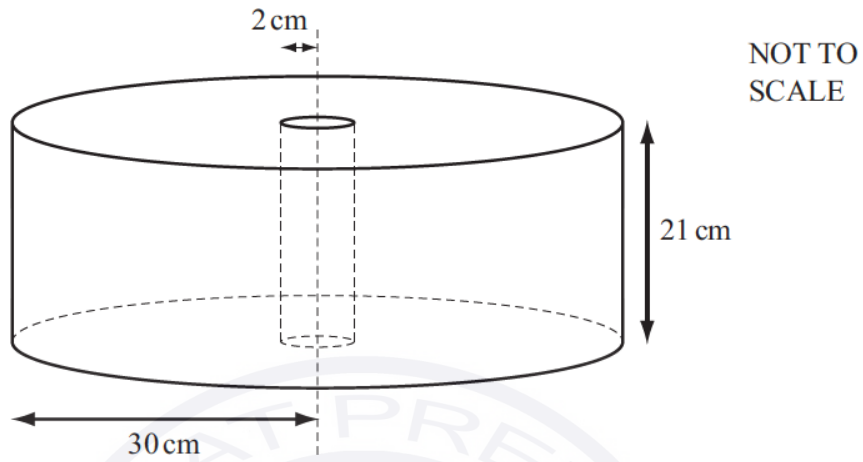
[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3} \pi r^2 h$.]

Answer(b) min s [4]

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

Answer(c) [3]

Question 10



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 (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.

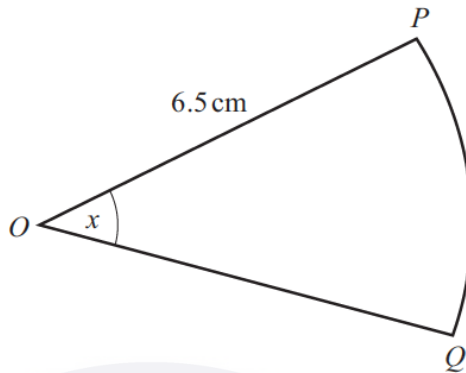
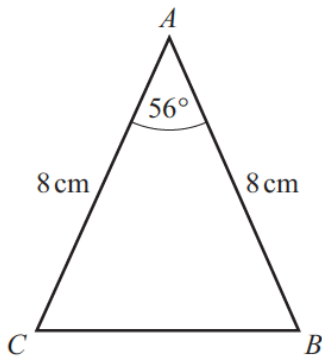
- (a) Change 0.125 millimetres into centimetres.

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

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

Answer (ii)(b) cm³ [4]

Question 11



NOT TO SCALE

The diagram shows a triangle and a sector of a circle.
 In triangle ABC , $AB = AC = 8$ cm and angle $BAC = 56^\circ$.
 Sector OPQ has centre O , sector angle x and radius 6.5 cm.

- (a) Show that the area of triangle ABC is 26.5 cm^2 correct to 1 decimal place.

Answer(a)

[2]

- (b) The area of sector OPQ is equal to the area of triangle ABC .

- (i) Calculate the sector angle x .

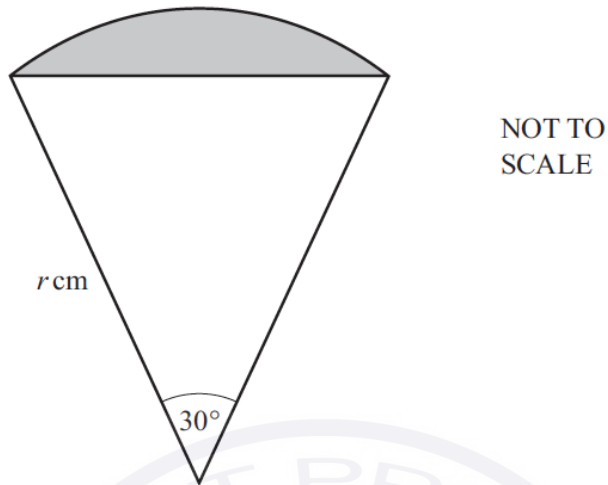
Answer(b)(i) [3]

- (ii) Calculate the perimeter of the sector OPQ .

Answer(b)(ii) cm [3]

Continue on the next page...

(c) The diagram shows a sector of a circle, radius r cm.



(i) Show that the area of the shaded segment is $\frac{1}{4}r^2\left(\frac{1}{3}\pi - 1\right)$ cm².

Answer(c)(i)

[4]

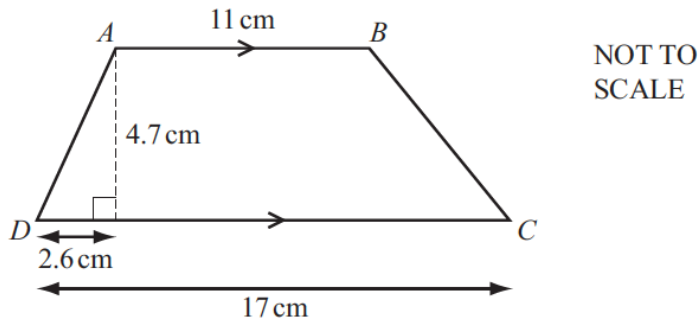
(ii) The area of the segment is 5 cm².

Find the value of r .

Answer(c)(ii) $r = \dots\dots\dots$ [3]

Question 12

(a) $ABCD$ is a trapezium.



(i) Calculate the length of AD .

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

(ii) Calculate the size of angle BCD .

Answer(a)(ii) Angle $BCD = \dots\dots\dots$ [3]

(iii) Calculate the area of the trapezium $ABCD$.

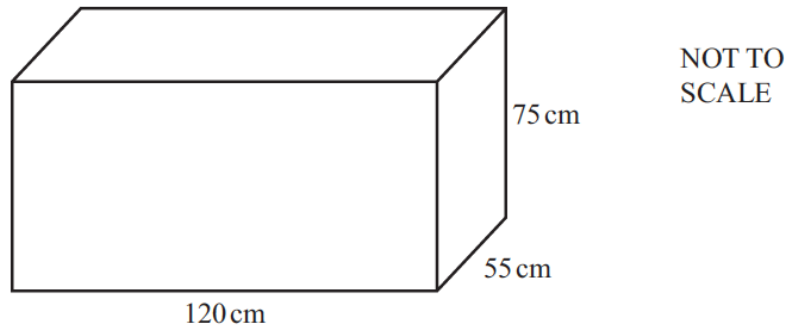
Answer(a)(iii) $\dots\dots\dots$ cm^2 [2]

(b) A **similar** trapezium has perpendicular height 9.4 cm.

Calculate the area of this trapezium.

Answer(b) $\dots\dots\dots$ cm^2 [3]

Question 13



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.

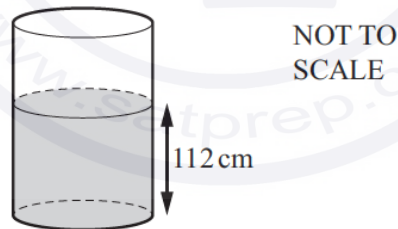
Answer(a)

[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.

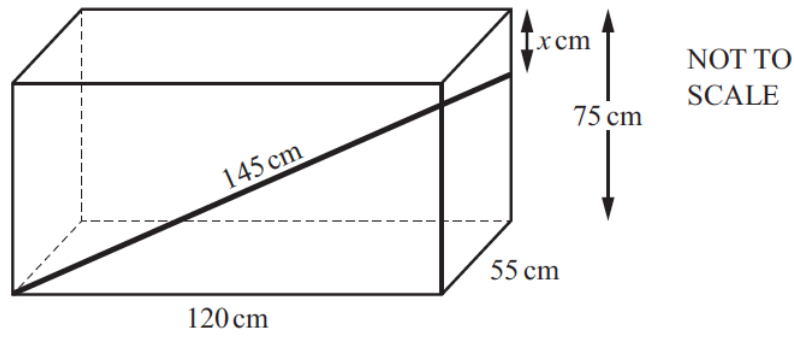


Calculate the radius of the cylinder.

Answer(b)(ii) cm [3]

Continue on the next page...

(c)



A rod of length 145 cm is placed inside the water tank.
One end of the rod is in the bottom corner of the tank as shown.
The other end of the rod is x cm below the top corner of the tank as shown.

Calculate the value of x .

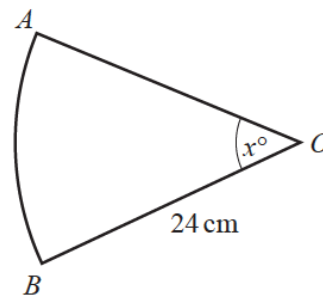
Answer(c) $x =$ [4]

(d) Calculate the angle that the rod makes with the base of the tank.

Answer(d) [3]

Question 14

- (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

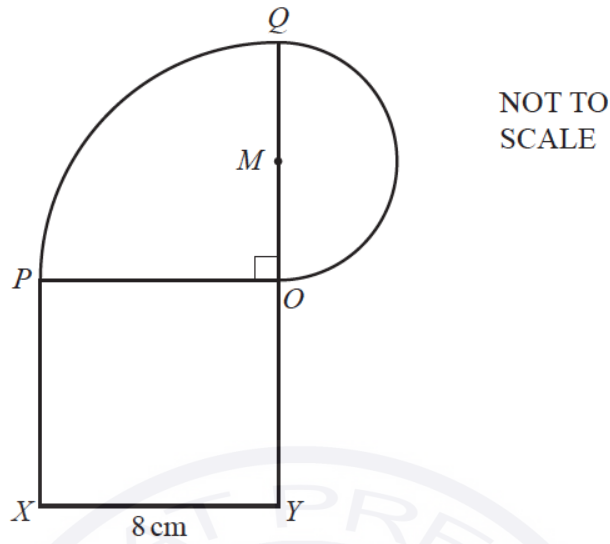
Calculate the volume of the cone.

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

Answer(a)(ii) $\dots\dots\dots$ cm^3 [6]

Continue on the next page...

(b)



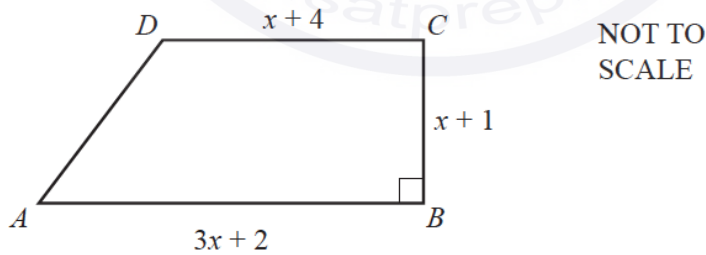
The diagram shows a shape made from a square, a quarter circle and a semi-circle.
 $OPXY$ is a square of side 8 cm.
 OPQ is a quarter circle, centre O .
The line OMQ is the diameter of the semi-circle.

Calculate the area of the shape.

Answer(b) cm^2 [5]

Question 15

In this part, all lengths are in centimetres.



$ABCD$ is a trapezium with area 15 cm^2 .

(i) Show that $2x^2 + 5x - 12 = 0$.

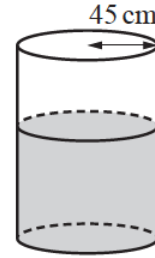
Answer

[3]

Question 16

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

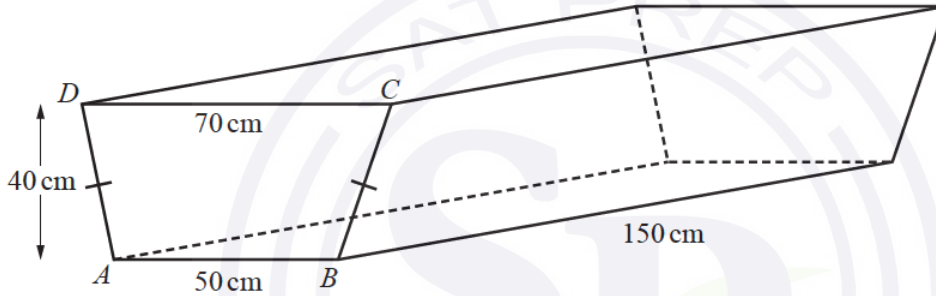
Calculate the height of water in the tank.



NOT TO SCALE

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]

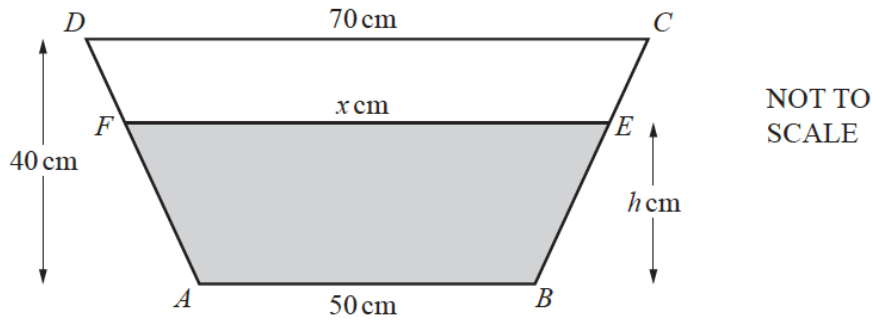
- (c) The $180\,000\text{ cm}^3$ of water flows from the tank in **part (a)** into the tank in **part (b)** at a rate of $15\text{ cm}^3/\text{s}$.

Calculate the time this takes.
Give your answer in hours and minutes.

Answer(c) h min [3]

Continue on the next page...

(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 .

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

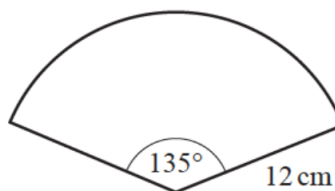
(iv) Find the value of h .

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

Question 17

(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 .

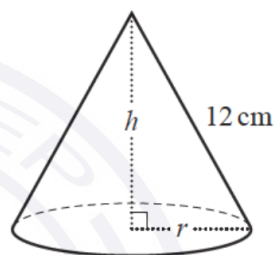


NOT TO SCALE

Answer(a)(i) cm [2]

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

(a) Calculate the base radius, r .



NOT TO SCALE

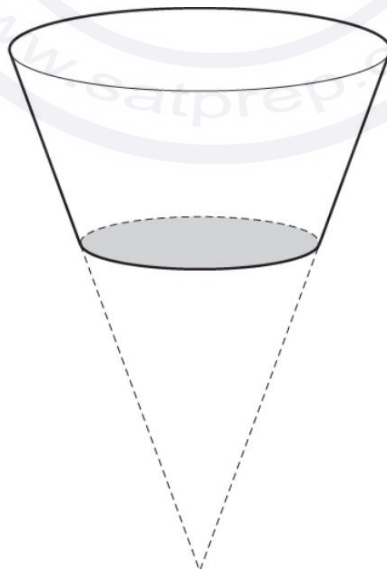
Answer(a)(ii)(a) $r =$ cm [2]

(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.

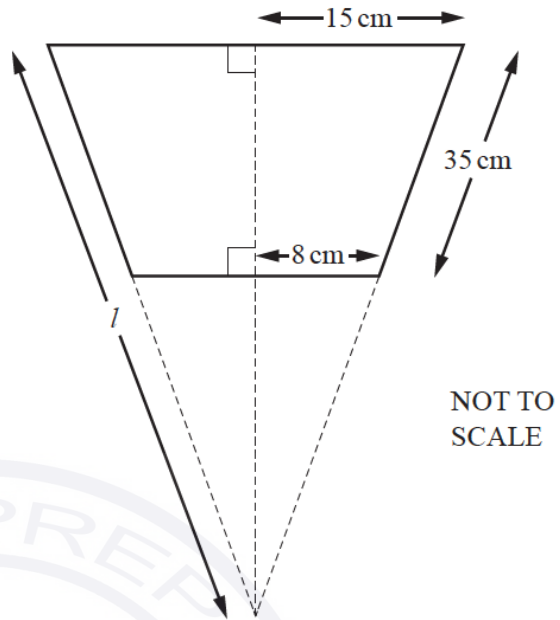


NOT TO SCALE

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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]

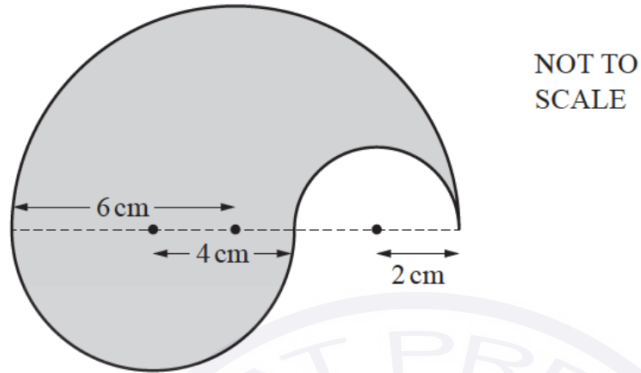
- (ii) Two of the cones have radii in the ratio 2 : 3.

Write down the ratio of their masses.

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

Question 18

The diagram shows a shaded shape formed by three semi-circular arcs. The radius of each semi-circle is shown in the diagram.



(i) Calculate the perimeter of the shaded shape.

Answer (i)cm [2]

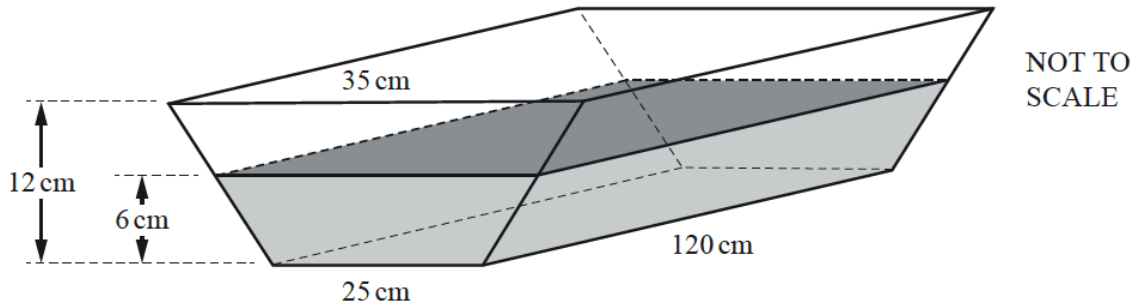
(ii) The shaded shape is made from metal 1.6 mm thick.

Calculate the volume of metal used to make this shape.
Give your answer in cubic millimetres.

Answer (ii)mm³ [5]

Question 19

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]

Continue on the next page...

(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) $r = \dots\dots\dots$ [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.

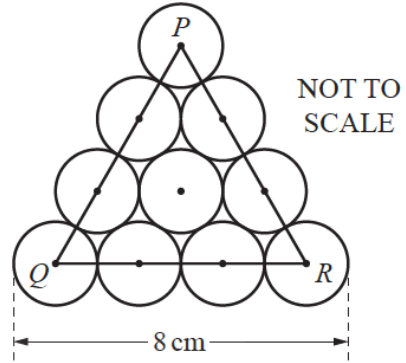
Answer(e) $\dots\dots\dots$ kg [2]



Question 20

- (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 .

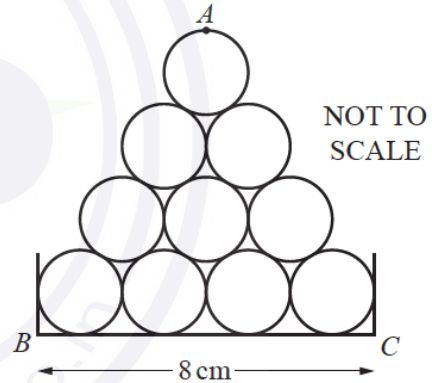


..... cm [3]

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

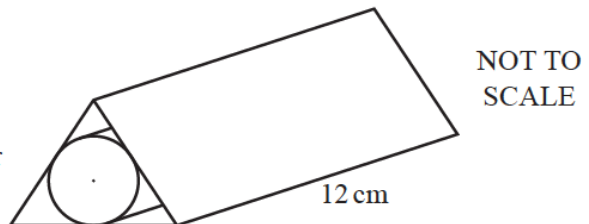
- (i) The diagram shows 10 pens stacked in a tray.
The tray is 8 cm wide.
The point A is the highest point in the stack.

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.

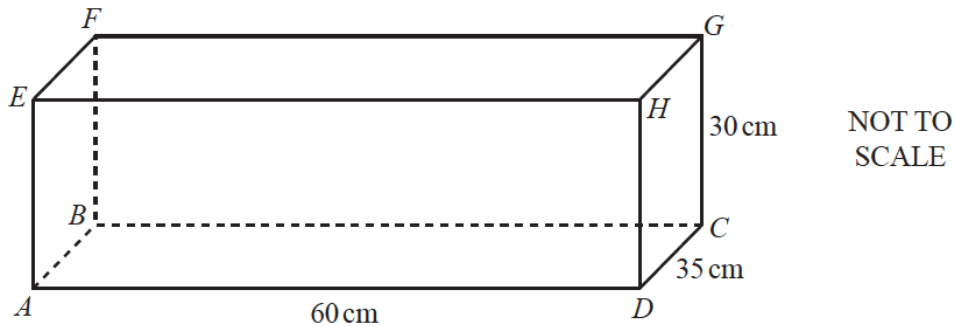


Calculate the volume of this box.

..... cm^3 [5]

Question 21

The diagram shows a cuboid.



$AD = 60$ 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 ,
 $AG =$ cm [4]

(ii) the angle between AG and the base $ABCD$.
 [3]

(ii) A cylinder of height 40 cm has the same volume as the cuboid.
 [1]

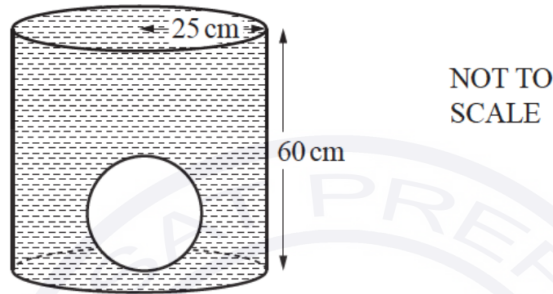
(d) (i) Show that the volume of the cuboid is $63\,000\text{ cm}^3$.
 Calculate the radius of the cylinder.
 cm [3]

Question 22

- (a) Calculate the volume of a metal sphere of radius 15 cm and show that it rounds to 14 140 cm³, correct to 4 significant figures.
 [The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

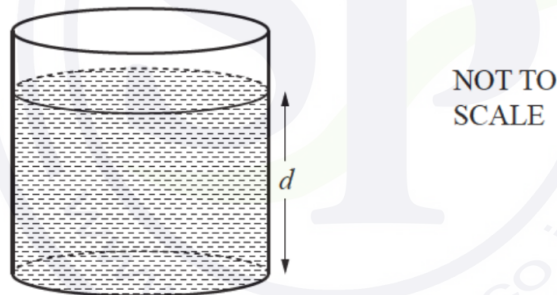
[2]

- (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.



Calculate the volume of water required to fill the tank.

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



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

$d = \dots\dots\dots$ cm [2]

- (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 $A = \pi rl$.]

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

Continue on the next page...

(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 $V = \frac{1}{3}\pi r^2 h$.]

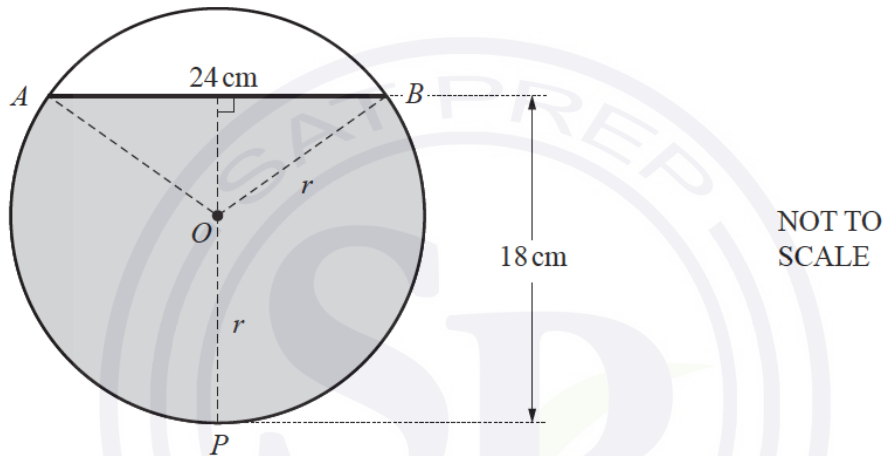
..... cm [3]

(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]

Question 23



The diagram shows the cross section of a cylinder, centre O , radius r , lying on its side. The cylinder contains water to a depth of 18 cm. The width, AB , of the surface of the water is 24 cm.

(a) Use an algebraic method to show that $r = 13$ cm.

[4]

(b) Show that angle $AOB = 134.8^\circ$, correct to 1 decimal place.

[2]

(c) (i) Calculate the area of the major sector $OAPB$.

..... cm² [3]

(ii) Calculate the area of the shaded segment APB .

..... cm² [3]

Continue on the next page...

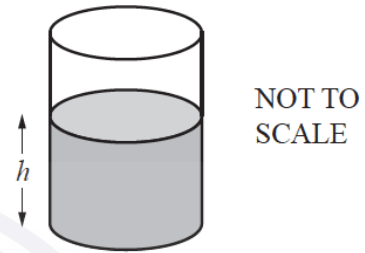
(iii) The length of the cylinder is 40 cm.

1 Calculate the volume of water in the cylinder.

.....cm³ [1]

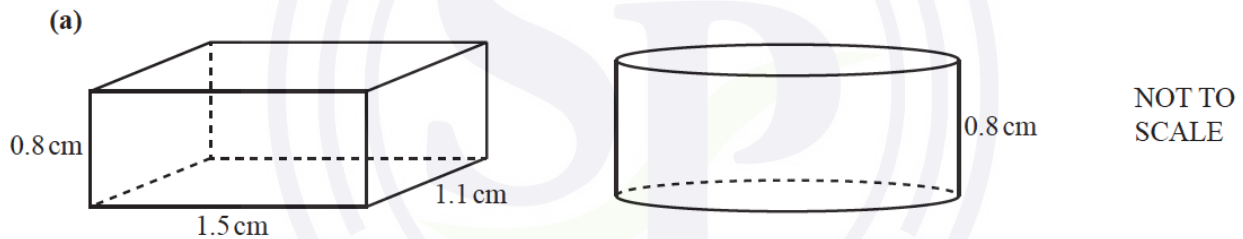
(d) The cylinder is turned so that it stands on one of its circular ends. In this position, the depth of the water is h .

Find h .



$h =$ cm [2]

Question 24



The diagram shows two sweets.
 The cuboid has length 1.5 cm, width 1.1 cm and height 0.8 cm.
 The cylinder has height 0.8 cm and the same volume as the cuboid.

(i) Calculate the volume of the cuboid.

.....cm³ [2]

(ii) Calculate the radius of the cylinder.

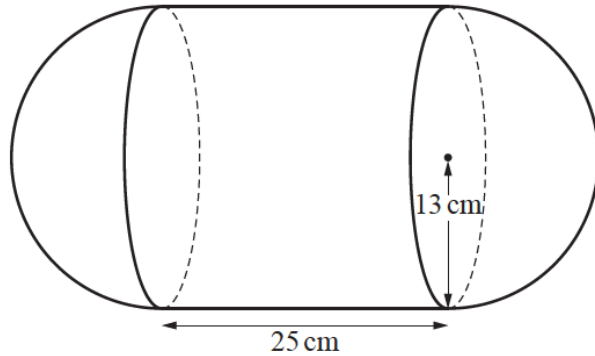
..... cm [2]

(iii) Calculate the difference between the surface areas of the two sweets.

.....cm² [5]

Question 25

(a)



NOT TO SCALE

The diagram shows a solid made up of a cylinder and two hemispheres.
The radius of the cylinder and the hemispheres is 13 cm.
The length of the cylinder is 25 cm.

(i) One cubic centimetre of the solid has a mass of 2.3 g.

Calculate the mass of the solid.
Give your answer in kilograms.

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

..... kg [4]

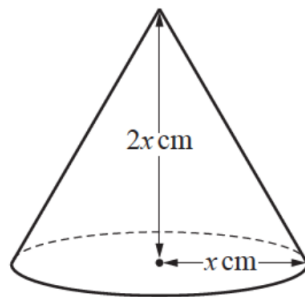
(ii) The surface of the solid is painted at a cost of \$4.70 per square metre.

Calculate the cost of painting the solid.

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

\$..... [4]

(b)



NOT TO SCALE

Continue on the next page...

The cone in the diagram has radius x cm and height $2x$ cm.
 The volume of the cone is 500 cm^3 .

Find the value of x .

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

$x = \dots\dots\dots$ [3]

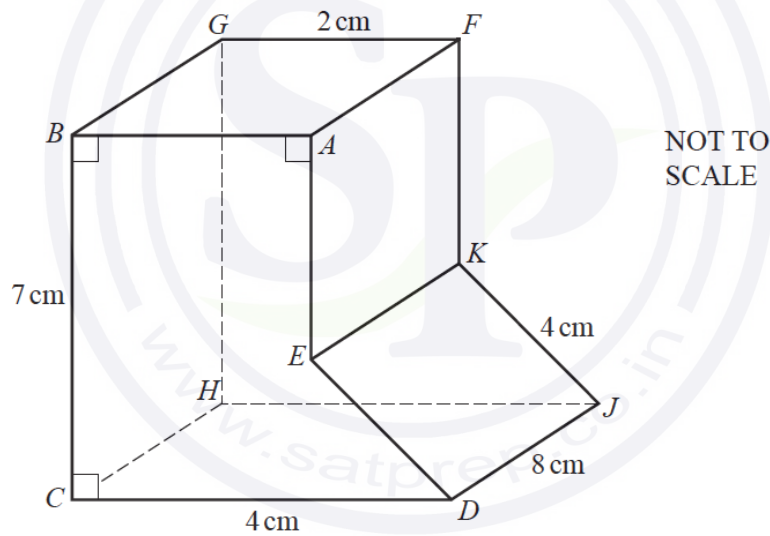
- (c) Two mathematically similar solids have volumes of 180 cm^3 and 360 cm^3 .
 The surface area of the smaller solid is 180 cm^2 .

Calculate the surface area of the larger solid.

$\dots\dots\dots\text{ cm}^2$ [3]

Question 26

- (a) The diagram shows a solid metal prism with cross section $ABCDE$.



- (i) Calculate the area of the cross section $ABCDE$.

$\dots\dots\dots\text{ cm}^2$ [6]

- (ii) The prism is of length 8 cm.

Calculate the volume of the prism.

$\dots\dots\dots\text{ cm}^3$ [1]

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(b) A cylinder of length 13 cm has volume 280 cm^3 .

(i) Calculate the radius of the cylinder.

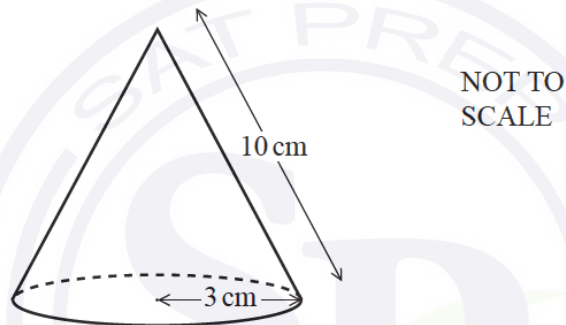
..... cm [3]

(ii) The cylinder is placed in a box that is a cube of side 14 cm.

Calculate the percentage of the volume of the box that is occupied by the cylinder.

..... % [3]

Question 27



The diagram shows a hollow cone with radius 3 cm and slant height 10 cm.

(a) (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 $A = \pi r l$.]

..... cm^2 [2]

(ii) Calculate the perpendicular height of the cone.

..... cm [3]

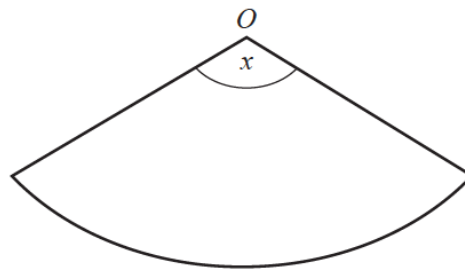
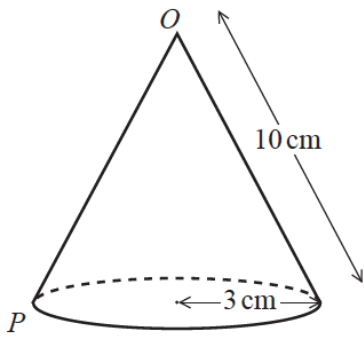
(iii) Calculate the volume of the cone.

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

..... cm^3 [2]

Continue on the next page...

(b)



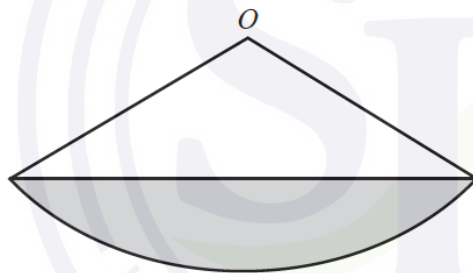
NOT TO SCALE

The cone is cut along the line OP and is opened out into a sector as shown in the diagram.

Calculate the sector angle x .

$x = \dots\dots\dots$ [4]

(c)



NOT TO SCALE

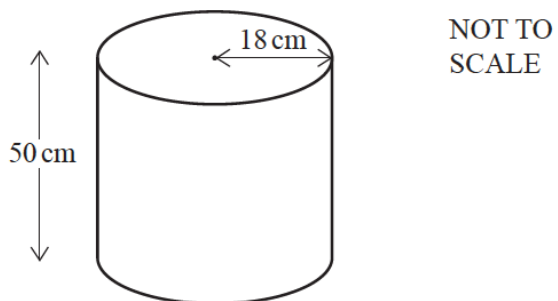
The diagram shows the same sector as in **part (b)**.

Calculate the area of the shaded segment.

$\dots\dots\dots$ cm^2 [4]

Question 28

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



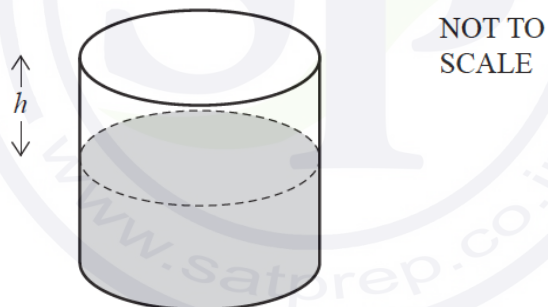
The container has a height of 50 cm and a radius of 18 cm.

(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.

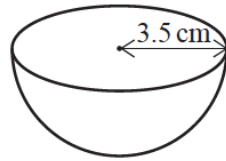
Work out the height, h , of the empty space in the container.



$h = \dots\dots\dots\text{ cm}$ [3]

Continue on the next page...

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



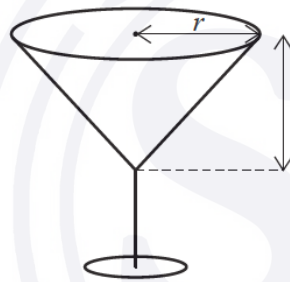
NOT TO SCALE

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 $V = \frac{1}{3}\pi r^2 h$.]

[3]

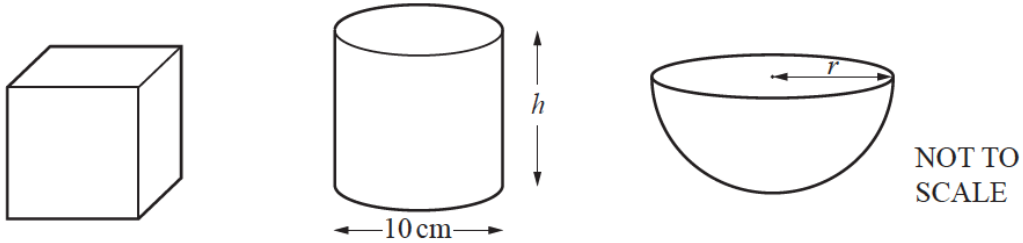
- (ii) Calculate the curved surface area of the cone.

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

..... cm^2 [4]

Question 29

(a)



The diagrams show a cube, a cylinder and a hemisphere.
The volume of each of these solids is 2000 cm^3 .

(i) Work out the height, h , of the cylinder.

$h = \dots\dots\dots \text{ cm [2]}$

(ii) Work out the radius, r , of the hemisphere.

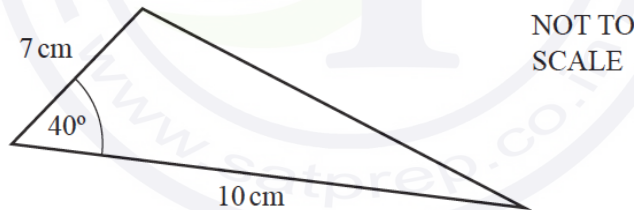
[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

$r = \dots\dots\dots \text{ cm [3]}$

(iii) Work out the surface area of the cube.

$\dots\dots\dots \text{ cm}^2 [3]$

(b)



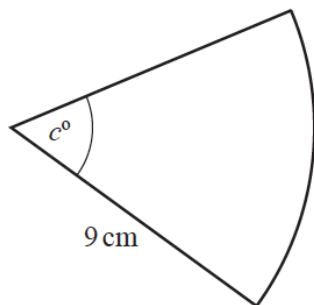
(i) Calculate the area of the triangle.

$\dots\dots\dots \text{ cm}^2 [2]$

(ii) Calculate the perimeter of the triangle and show that it is 23.5 cm, correct to 1 decimal place.
Show all your working.

Continue on the next page...

(c)



NOT TO SCALE

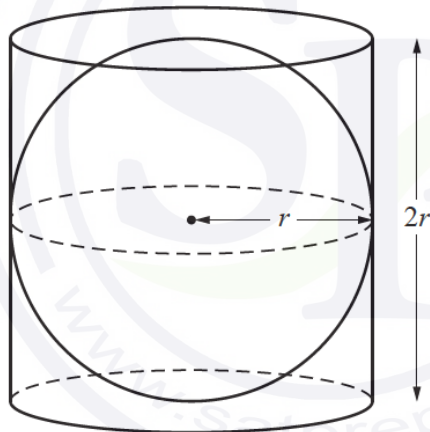
The perimeter of this sector of a circle is 28.2 cm.

Calculate the value of c .

$c = \dots\dots\dots$ [3]

Question 30

(a)



NOT TO SCALE

A sphere of radius r is inside a closed cylinder of radius r and height $2r$.

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

(i) When $r = 8$ cm, calculate the volume inside the cylinder which is **not** occupied by the sphere.

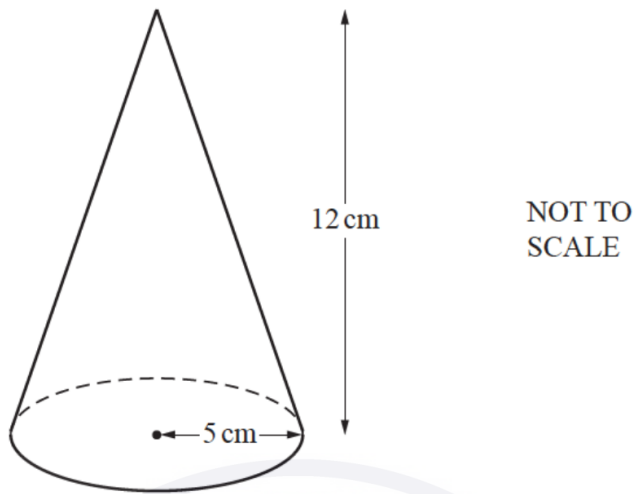
$\dots\dots\dots$ cm³ [3]

(ii) Find r when the volume inside the cylinder **not** occupied by the sphere is 36 cm³.

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

Continue on the next page...

(b)



The diagram shows a solid cone with radius 5 cm and perpendicular height 12 cm.

- (i) The **total** surface area is painted at a cost of \$0.015 per cm^2 .

Calculate the cost of painting the cone.

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

\$ [4]

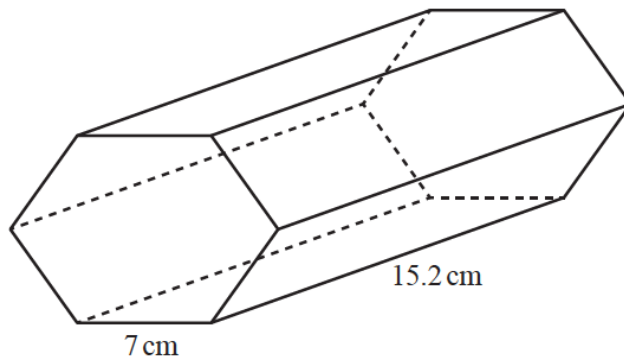
- (ii) The cone is made of metal and is melted down and made into smaller solid cones with radius 1.25 cm and perpendicular height 3 cm.

Calculate the number of smaller cones that can be made.

..... [3]

Question 30

(a)



NOT TO
SCALE

The diagram shows a solid prism with length 15.2 cm.
The cross-section of this prism is a **regular** hexagon with side 7 cm.

(i) Calculate the volume of the prism.

..... cm³ [5]

(ii) Calculate the total surface area of the prism.

..... cm² [3]

(b) Another solid metal prism with volume 500 cm³ is melted and made into 6 identical spheres.

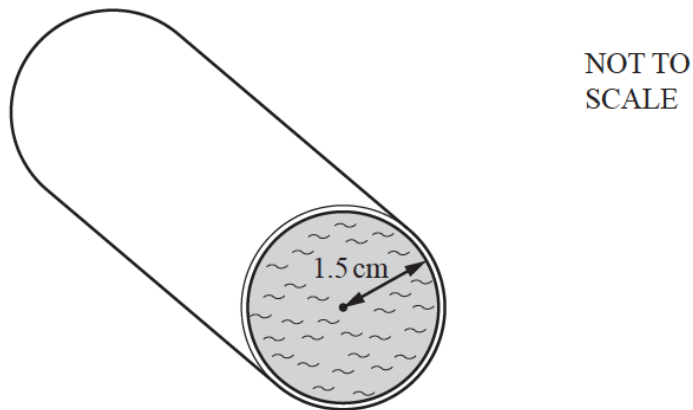
Calculate the radius of each sphere.

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

..... cm [3]

Question 31

(a)

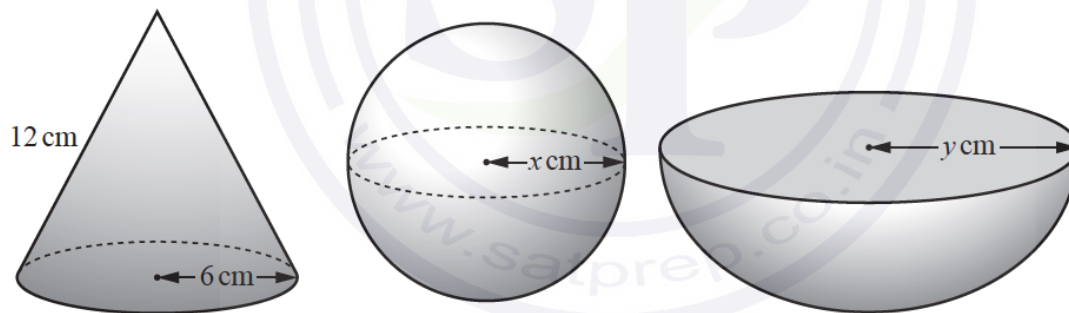


Water flows through a cylindrical pipe at a speed of 8 cm/s.
The radius of the circular cross-section is 1.5 cm and the pipe is always completely full of water.

Calculate the amount of water that flows through the pipe in 1 hour.
Give your answer in litres.

..... litres [4]

(b)



The diagram shows three solids.
The base radius of the cone is 6 cm and the slant height is 12 cm.
The radius of the sphere is x cm and the radius of the hemisphere is y cm.
The **total** surface area of each solid is the same.

(i) Show that the total surface area of the cone is $108\pi \text{ cm}^2$.

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

Continue on the next page...

.....[2]

- (ii) Find the value of x and the value of y .

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

$x = \dots\dots\dots$

$y = \dots\dots\dots$ [4]

Question 32

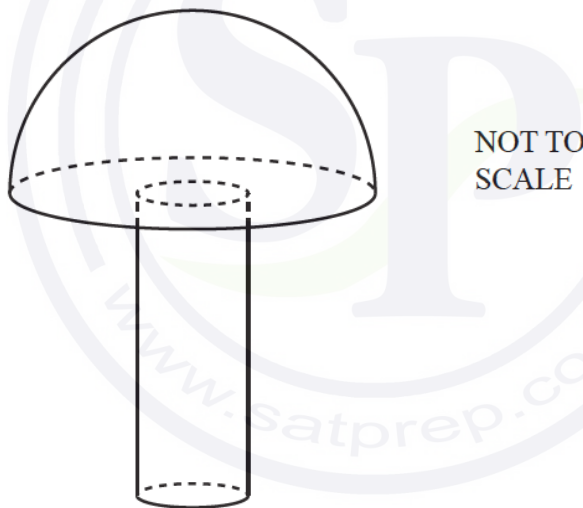
A solid hemisphere has volume 230 cm^3 .

- (a) Calculate the radius of the hemisphere.

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

$\dots\dots\dots$ cm [3]

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



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

- (i) Calculate the height of the cylinder.

$\dots\dots\dots$ cm [3]

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

Calculate the radius of the cylinder for this toy.

$\dots\dots\dots$ cm [3]

Question 33

- (a) The lake behind a dam has an area of 55 hectares.
When the gates in the dam are open, water flows out at a rate of 75 000 litres per second.

(i) Show that 90 million litres of water flows out in 20 minutes.

[1]

(ii) Beneath the surface, the lake has vertical sides.

Calculate the drop in the water level of the lake when the gates are open for 20 minutes.
Give your answer in centimetres.

[1 hectare = 10^4 m^2 , 1000 litres = 1 m^3]

.....cm[3]

(iii)



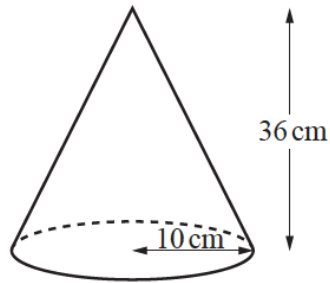
The cross-section of a gate is a sector of a circle with radius 8.5 m and angle 76° .

Calculate the perimeter of the sector.

..... m [3]

Continue on the next page...

(b)



NOT TO
SCALE

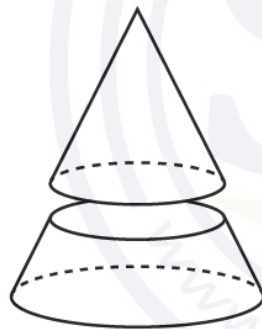
A solid metal cone has radius 10 cm and height 36 cm.

(i) Calculate the volume of this cone.

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

..... cm³ [2]

(ii) The cone is cut, parallel to its base, to give a smaller cone.



NOT TO
SCALE

The volume of the smaller cone is half the volume of the original cone.

The smaller cone is melted down to make two different spheres.

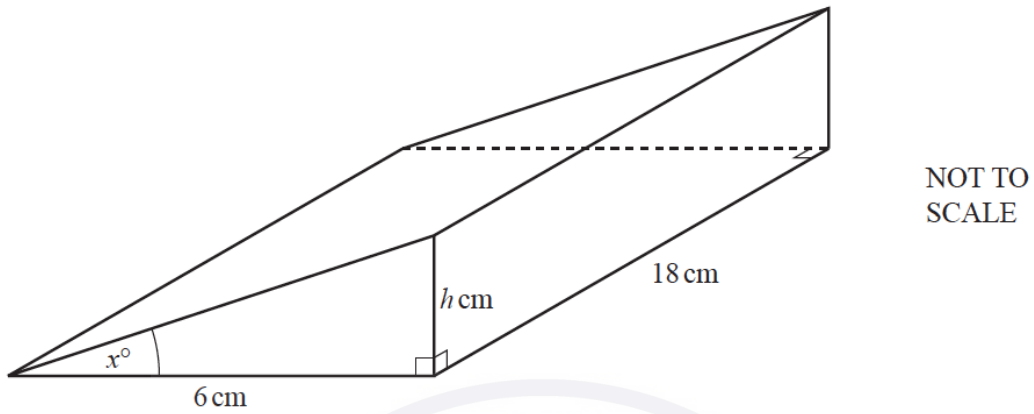
The ratio of the radii of these two spheres is 1 : 2.

Calculate the radius of the smaller sphere.

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

..... cm [4]

Question 34



The diagram shows a prism with length 18 cm and volume 253.8 cm^3 .
The cross-section of the prism is a right-angled triangle with base 6 cm and height h cm.

- (a) (i) Show that the value of h is 4.7. [3]
- (ii) Calculate the value of x . $x = \dots\dots\dots$ [2]
- (b) Calculate the total surface area of the prism. $\dots\dots\dots \text{ cm}^2$ [6]

Question 35



The diagram shows a hemispherical bowl of radius 5.6 cm and a cylindrical tin of height 10 cm.

- (i) Show that the volume of the bowl is 368 cm^3 , correct to the nearest cm^3 .
[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

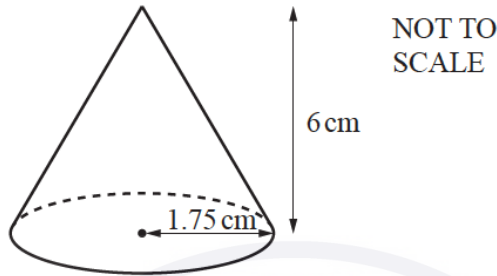
Continue on the next page... [2]

- (ii) The tin is completely full of soup.
When all the soup is poured into the empty bowl, 80% of the volume of the bowl is filled.

Calculate the radius of the tin.

..... cm [4]

(b)

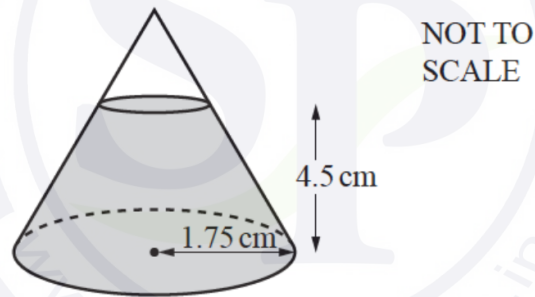


The diagram shows a cone with radius 1.75 cm and height 6 cm.

- (i) 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 [5]

(ii)



The cone contains salt to a depth of 4.5 cm.
The top layer of the salt forms a circle that is parallel to the base of the cone.

- (a) Show that the volume of the salt inside the cone is 18.9 cm³, correct to 1 decimal place.
[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

[4]

- (b) The salt is removed from the cone at a constant rate of 200 mm³ per second.

Calculate the time taken for the cone to be completely emptied.
Give your answer in seconds, correct to the nearest second.

..... s [3]

Question 36

(a) The volume of a solid metal sphere is $24\,430\text{ cm}^3$.

(i) Calculate the radius of the sphere.

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

..... cm [3]

(ii) The metal sphere is placed in an empty tank.
The tank is a cylinder with radius 50 cm, standing on its circular base.
Water is poured into the tank to a depth of 60 cm.

Calculate the number of litres of water needed.

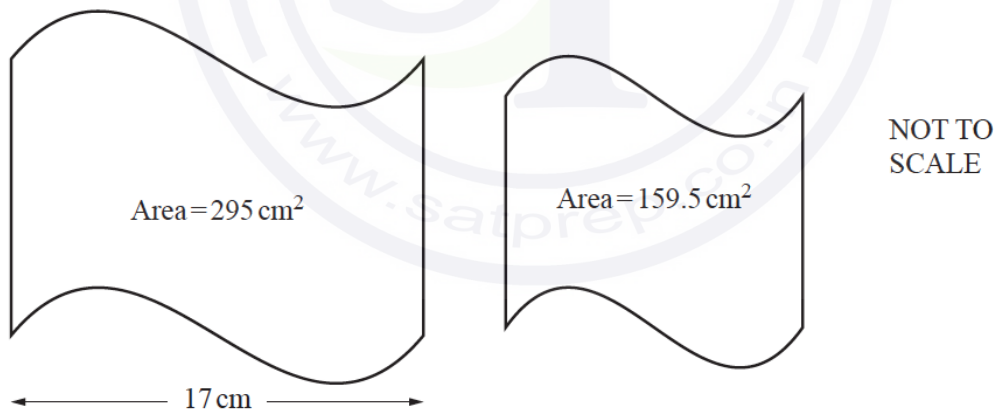
..... litres [3]

(b) A different tank is a cuboid measuring 1.8 m by 1.5 m by 1.2 m.
Water flows from a pipe into this empty tank at a rate of 200 cm^3 per second.

Find the time it takes to fill the tank.
Give your answer in hours and minutes.

..... hours minutes [4]

(c)



The diagram shows two mathematically similar shapes with areas 295 cm^2 and 159.5 cm^2 .
The width of the larger shape is 17 cm.

Calculate the width of the smaller shape.

..... cm [3]

Question 37

The volume of each of the following solids is 1000 cm^3 .

Calculate the value of x for each solid.

(a) A cube with side length $x \text{ cm}$.

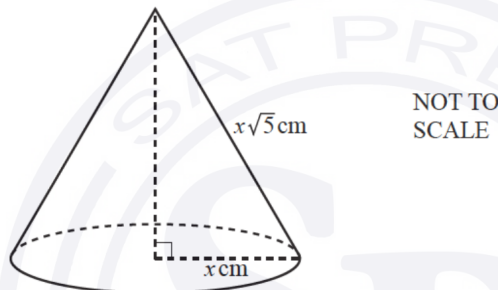
$x = \dots\dots\dots [1]$

(b) A sphere with radius $x \text{ cm}$.

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

$x = \dots\dots\dots [3]$

(c)

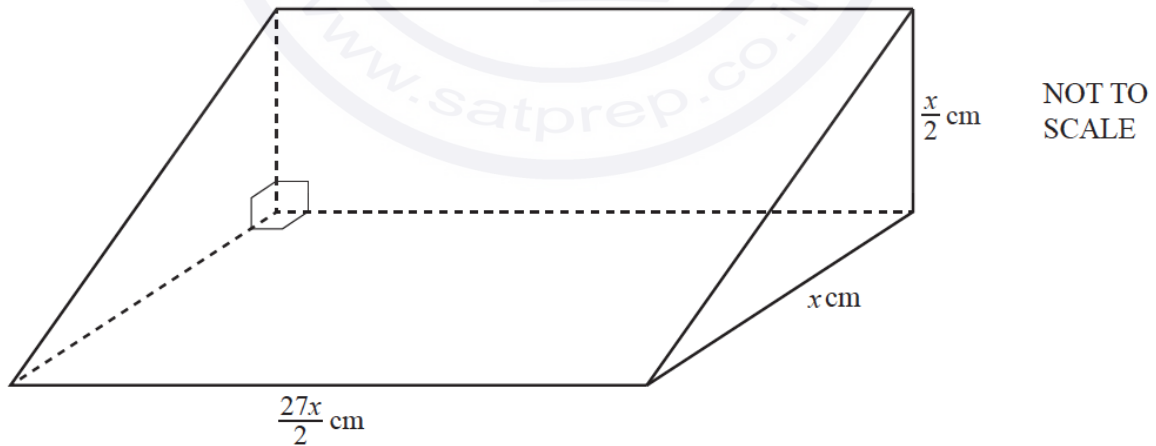


A cone with radius $x \text{ cm}$ and slant height $x\sqrt{5} \text{ cm}$.

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

$x = \dots\dots\dots [4]$

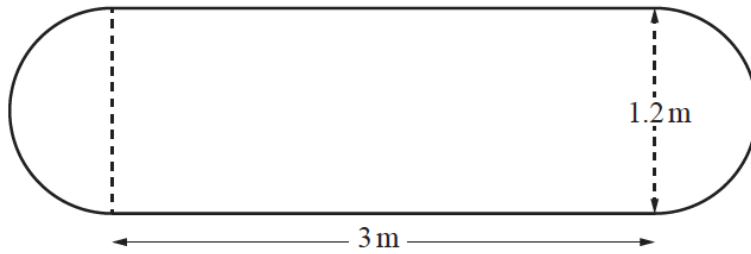
(d)



A prism with a right-angled triangle as its cross-section.

$x = \dots\dots\dots [4]$

Question 38



NOT TO
SCALE

The diagram shows the surface of a garden pond, made from a rectangle and two semicircles. The rectangle measures 3 m by 1.2 m.

(a) Calculate the area of this surface.

.....m² [3]

(b) The pond is a prism and the water in the pond has a depth of 20 cm.

Calculate the number of litres of water in the pond.

..... litres [3]

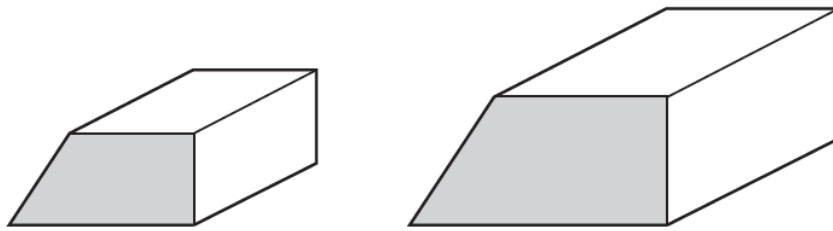
(c) After a rainfall, the number of litres of water in the pond is 1007.

Calculate the increase in the depth of water in the pond.

Give your answer in centimetres.

..... cm [3]

Question 39



NOT TO
SCALE

The diagram shows two mathematically similar solid metal prisms.
The volume of the smaller prism is 648 cm^3 and the volume of the larger prism is 2187 cm^3 .
The area of the cross-section of the smaller prism is 36 cm^2 .

- (i) Calculate the area of the cross-section of the larger prism.

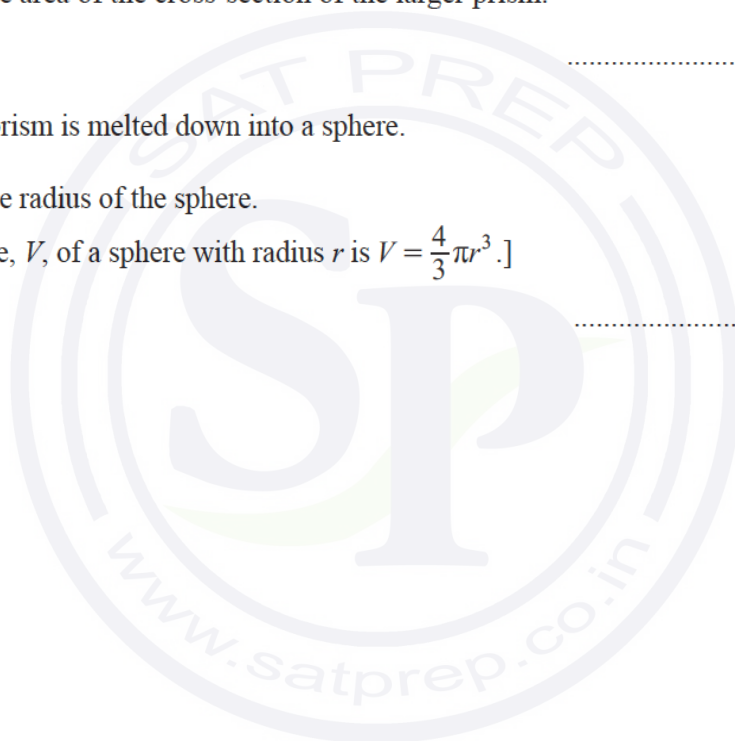
..... cm^2 [3]

- (ii) The larger prism is melted down into a sphere.

Calculate the radius of the sphere.

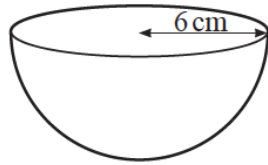
[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... cm [3]



Question 40

(a)



NOT TO SCALE

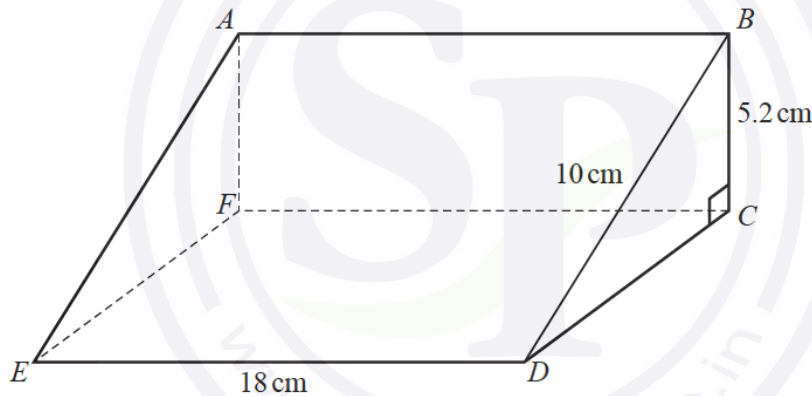
The diagram shows a hemisphere with radius 6 cm.

Calculate the volume.
Give the units of your answer.

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

.....[3]

(b)



NOT TO SCALE

The diagram shows a prism $ABCDEF$.
The cross-section is a right-angled triangle BCD .
 $BD = 10$ cm, $BC = 5.2$ cm and $ED = 18$ cm.

(i) (a) Work out the volume of the prism.

..... cm^3 [6]

(b) Calculate angle BEC .

Angle $BEC =$ [4]

(ii) The point G lies on the line ED and $GD = 7$ cm.

Work out angle BGE .

Angle $BGE =$ [3]

Question 41

(a) (i) Calculate the **external curved** surface area of a cylinder with radius 8 m and height 19 m.
..... m² [2]

(ii) This surface is painted at a cost of \$0.85 per square metre.

Calculate the cost of painting this surface.

\$ [2]

(b) A solid metal sphere with radius 6 cm is melted down and all of the metal is used to make a solid cone with radius 8 cm and height h cm.

(i) Show that $h = 13.5$.

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

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

..... [2]

(ii) Calculate the slant height of the cone.

..... cm [2]

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

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

..... cm² [1]

(c) Two cones are mathematically similar.

The total surface area of the smaller cone is 80 cm².

The total surface area of the larger cone is 180 cm².

The volume of the smaller cone is 168 cm³.

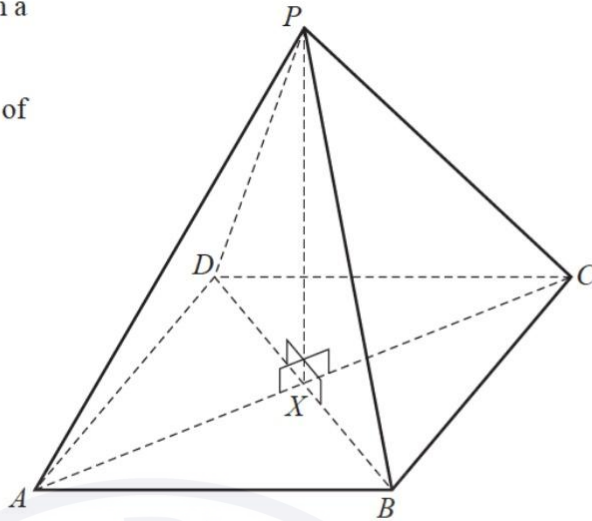
Calculate the volume of the larger cone.

..... cm³ [3]

Continue on the next page....

- (d) The diagram shows a pyramid with a square base $ABCD$.
 $DB = 8$ cm.
 P is vertically above the centre, X , of the base and $PX = 5$ cm.

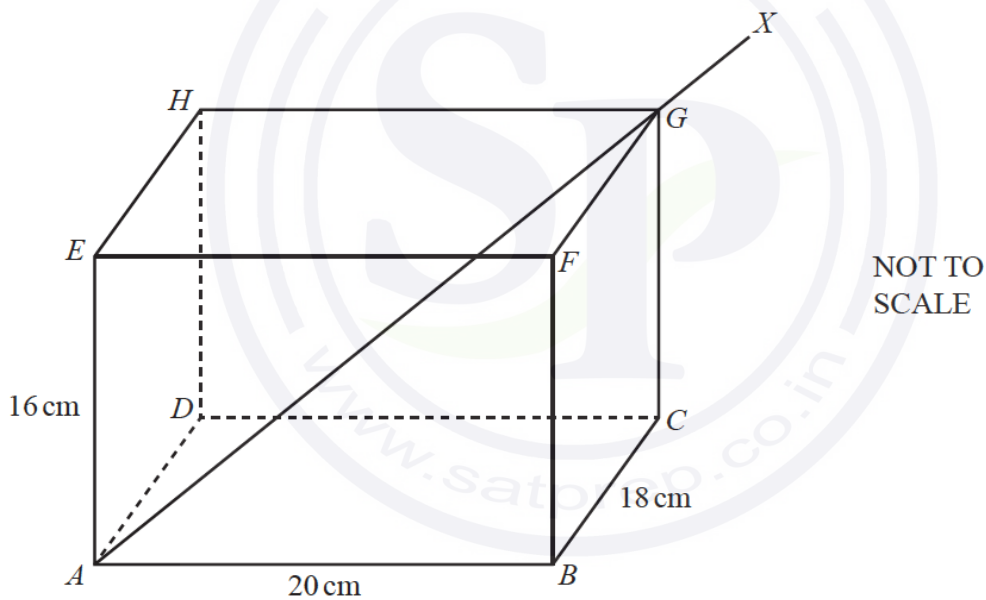
NOT TO SCALE



Calculate the angle between PB and the base $ABCD$.

..... [3]

Question 42



NOT TO SCALE

The diagram shows an open box $ABCDEFGH$ in the shape of a cuboid.
 $AB = 20$ cm, $BC = 18$ cm and $AE = 16$ cm.
 A thin rod AGX rests partly in the box as shown.
 The rod is 40 cm long.

- (i) Calculate GX , the length of the rod which is outside the box.

$GX =$ cm [4]

- (ii) Calculate the angle the rod makes with the base of the box.

..... [3]

Question 43

A solid metal cone has radius 1.65 cm and slant height 4.70 cm.

- (a) 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 [2]

- (b) Find the angle the slant height makes with the base of the cone.

..... [2]

- (c) (i) Calculate the volume of the cone.

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

.....cm³[4]

- (ii) A metal sphere with radius 5 cm is melted down to make cones identical to this one.

Calculate the number of complete identical cones that are made.

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

..... [4]

Question 44

- (a) Manjeet uses 220 litres of water each day.

She reduces the amount of water she uses by 15%.

Calculate the number of litres of water she now uses each day.

..... litres [2]

- (b) Manjeet has two mathematically similar bottles in her bathroom.

The large bottle holds 1.35 litres and is 29.7 cm high.

The small bottle holds 0.4 litres.

Calculate the height of the small bottle.

..... cm [3]

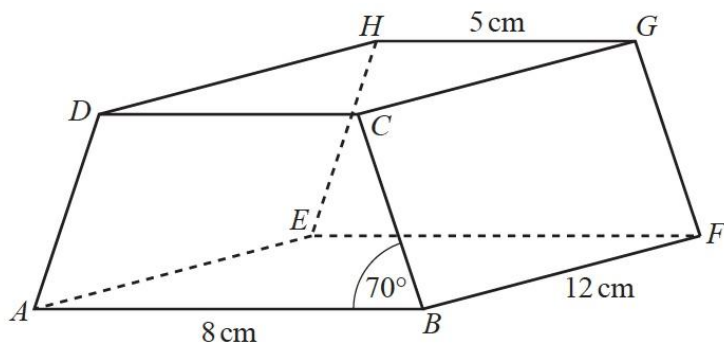
- (c) Water from Manjeet's shower flows at a rate of 12 litres per minute.

The water from the shower flows into a tank that is a cuboid of length 90 cm and width 75 cm.

Calculate the increase in the level of water in the tank when the shower is used for 7 minutes.

..... cm [3]

Question 45



NOT TO SCALE

The diagram shows a prism with a rectangular base, $ABFE$.
 The cross-section, $ABCD$, is a trapezium with $AD = BC$.
 $AB = 8$ cm, $GH = 5$ cm, $BF = 12$ cm and angle $ABC = 70^\circ$.

- (a) Calculate the total surface area of the prism.

..... cm² [6]

- (b) The perpendicular from G onto EF meets EF at X .

- (i) Show that $EX = 6.5$ cm.

[1]

- (ii) Calculate AX .

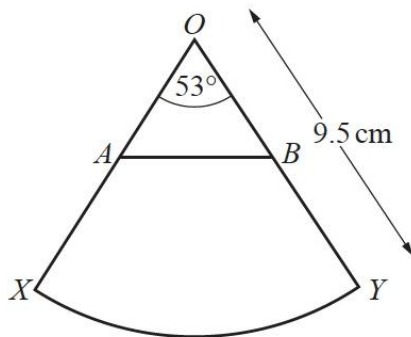
- (iii) Calculate the angle between the diagonal AG and the base $ABFE$.

$AX =$ cm [2]

..... [2]

Question 46

(a)



NOT TO SCALE

The diagram shows a sector OXY of a circle with centre O and radius 9.5 cm. The sector angle is 53° . A lies on OX , B lies on OY and $OA = OB$.

(i) Show that the area of the sector is 41.7 cm^2 , correct to 1 decimal place.

[2]

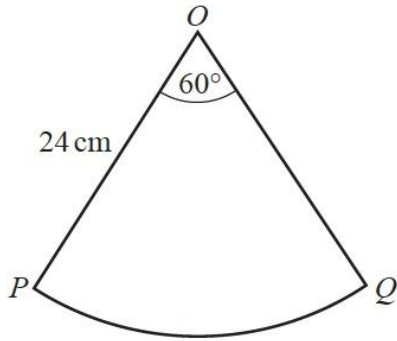
(ii) The area of triangle OAB is $\frac{1}{3}$ of the area of sector OXY .

Calculate OA .

$OA = \dots\dots\dots \text{ cm}$ [4]

Continue on the next page...

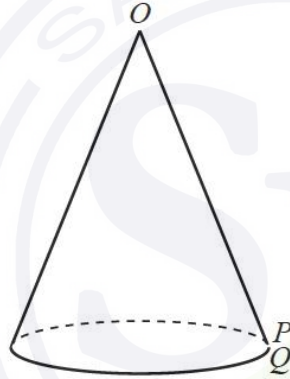
(b)



NOT TO
SCALE

The diagram shows a sector OPQ of a circle with centre O and radius 24 cm.
The sector angle is 60° .

A cone is made from this sector by joining OP to OQ .



NOT TO
SCALE

Calculate the volume of the cone.

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

..... cm^3 [6]

Question 47

(a) A solid cuboid measures 20 cm by 12 cm by 5 cm.

(i) Calculate the volume of the cuboid.

..... cm^3 [1]

(ii) (a) Calculate the total surface area of the cuboid.

..... cm^2 [3]

(b) The surface of the cuboid is painted.
The cost of the paint used is \$1.52 .

Find the cost to paint 1cm^2 of the cuboid.
Give your answer in cents.

..... cents [1]

(b) A solid metal cylinder with radius x and height $\frac{9x}{2}$ is melted.
All the metal is used to make a sphere with radius r .

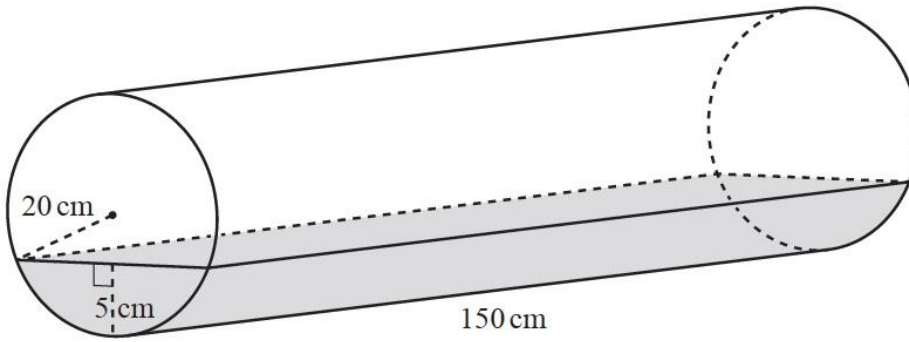
Find r in terms of x .

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

$r =$ [3]

Continue on the next page

(c)

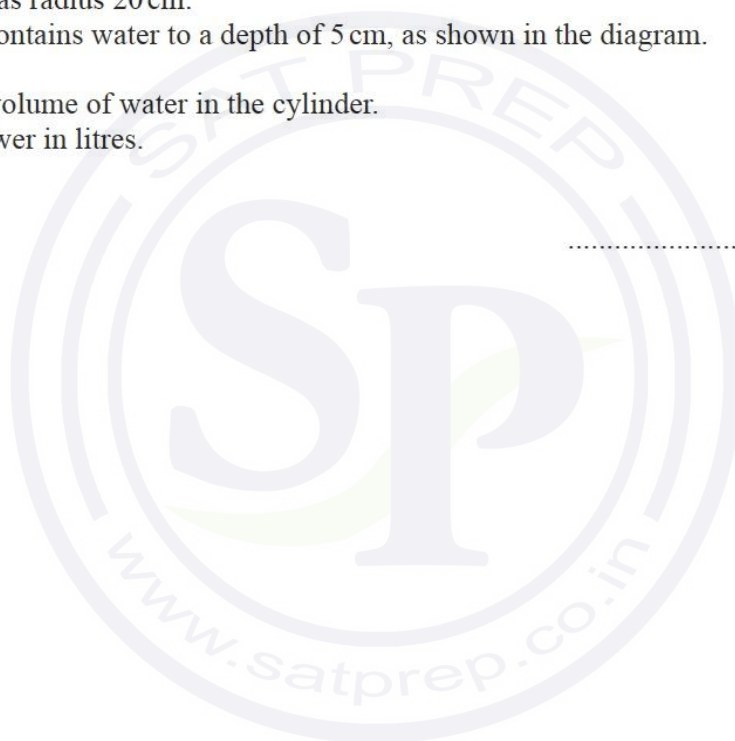


NOT TO
SCALE

The diagram shows a cylinder of length 150 cm on horizontal ground.
The cylinder has radius 20 cm.
The cylinder contains water to a depth of 5 cm, as shown in the diagram.

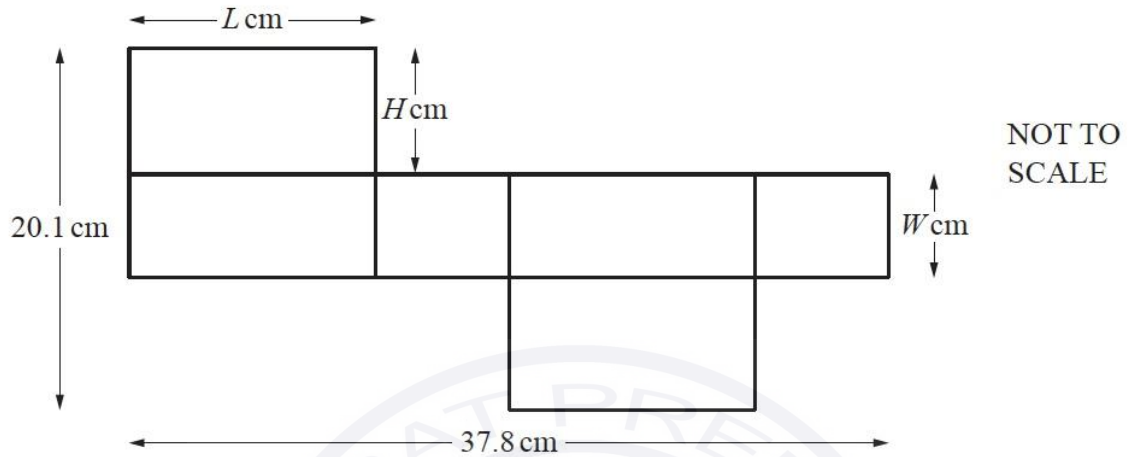
Calculate the volume of water in the cylinder.
Give your answer in litres.

..... litres [7]



Question 48

(a) A cuboid has length L cm, width W cm and height H cm.



The diagram shows the net of this cuboid.
The ratio $W : L = 1 : 2$.

Find the value of L , the value of W and the value of H .

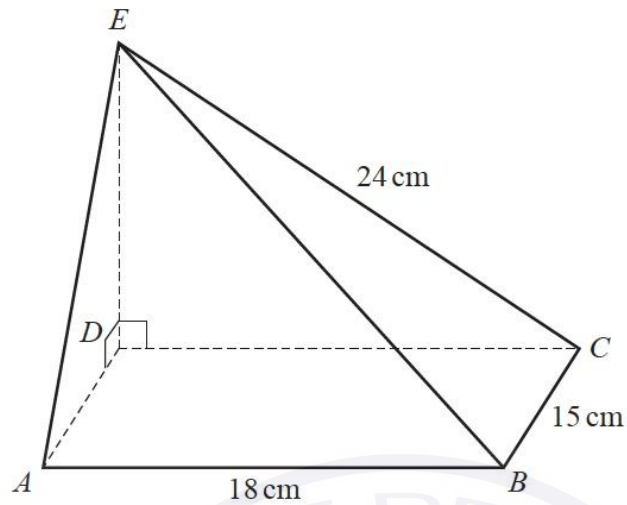
$L =$

$W =$

$H =$ [5]

Continue on the next page

(b)



NOT TO
SCALE

The diagram shows a solid pyramid with a rectangular base $ABCD$.
 E is vertically above D .
Angle $EDC = \text{angle } EDA = 90^\circ$.
 $AB = 18 \text{ cm}$, $BC = 15 \text{ cm}$ and $EC = 24 \text{ cm}$.

- (i) The pyramid is made of wood and has a mass of 800 g.

Calculate the density of the wood.
Give the units of your answer.

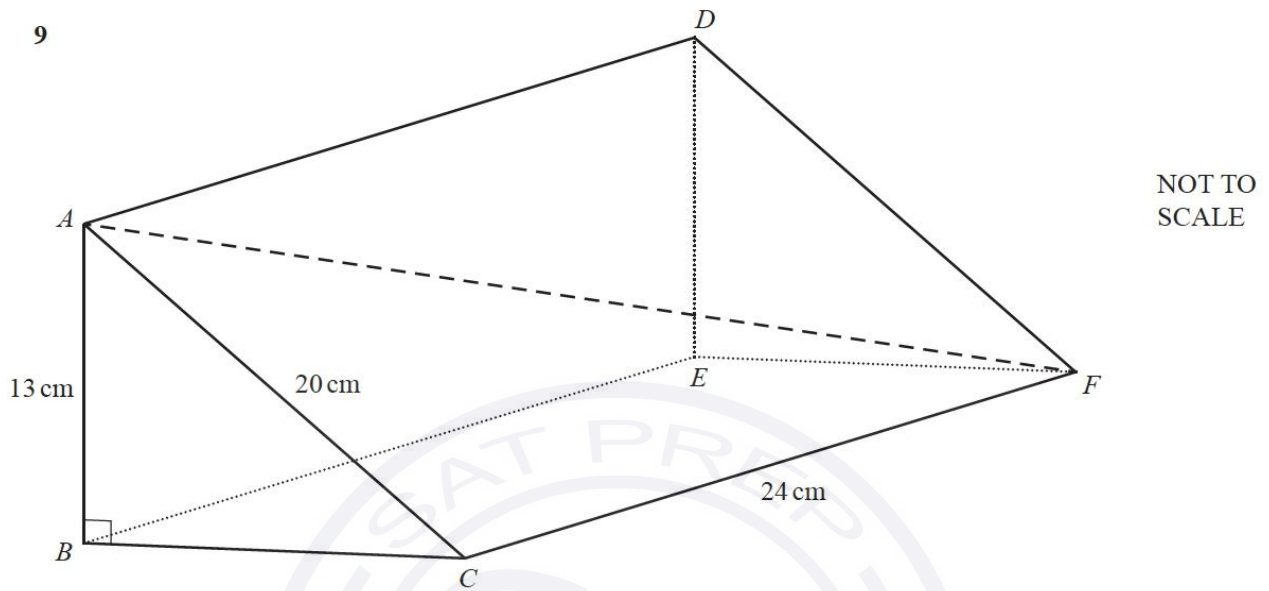
[The volume, V , of a pyramid is $V = \frac{1}{3} \times \text{area of base} \times \text{height}$.]
[Density = mass \div volume]

..... [5]

- (ii) Calculate the angle between BE and the base of the pyramid.

..... [4]

Question 49



The diagram shows a prism, $ABCDEF$.
 $AB = 13$ cm, $AC = 20$ cm, $CF = 24$ cm and angle $ABC = 90^\circ$.

(a) Calculate the total surface area of the prism.

..... cm^2 [6]

(b) Calculate the volume of the prism.

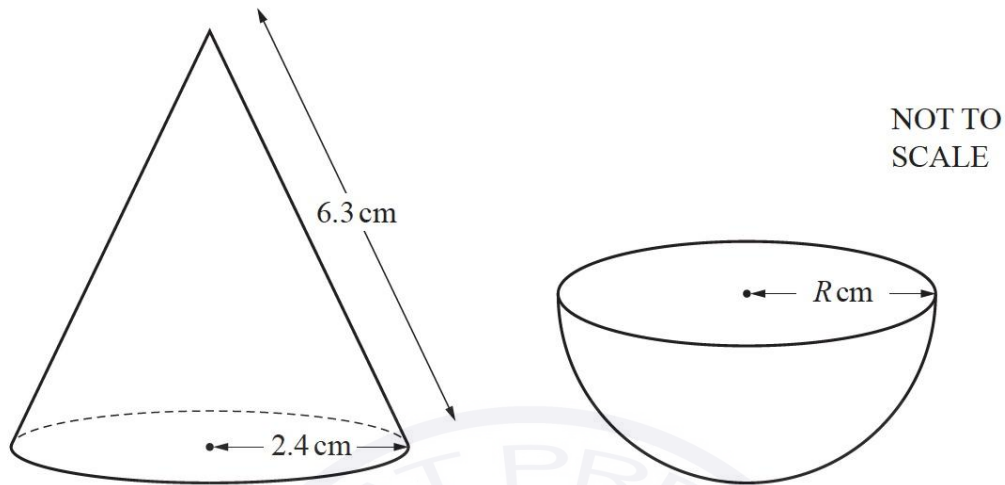
..... cm^3 [1]

(c) Calculate the angle that AF makes with the base $BCFE$.

..... [4]

Question 50

(a)



The diagram shows a solid cone and a solid hemisphere.
The cone has radius 2.4 cm and slant height 6.3 cm.
The hemisphere has radius R cm.
The **total** surface area of the cone is equal to the **total** surface area of the hemisphere.

Calculate the value of R .

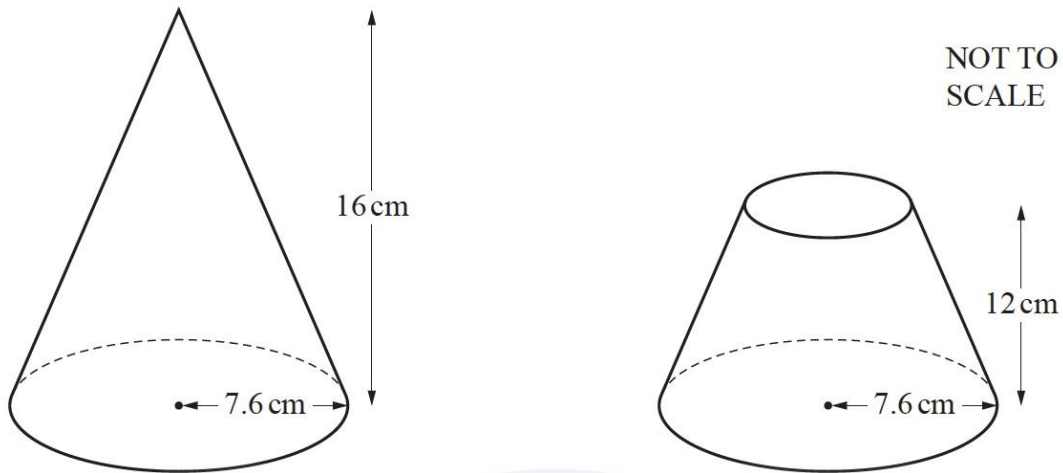
[The curved surface area, A , of a cone with radius r and slant height l is $A = \pi r l$.]

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

$R = \dots\dots\dots$ [4]

Continue on the next page...

(b)



The diagram shows a solid cone with radius 7.6 cm and height 16 cm. A cut is made parallel to the base of the cone and the top section is removed. The remaining solid has height 12 cm, as shown in the diagram.

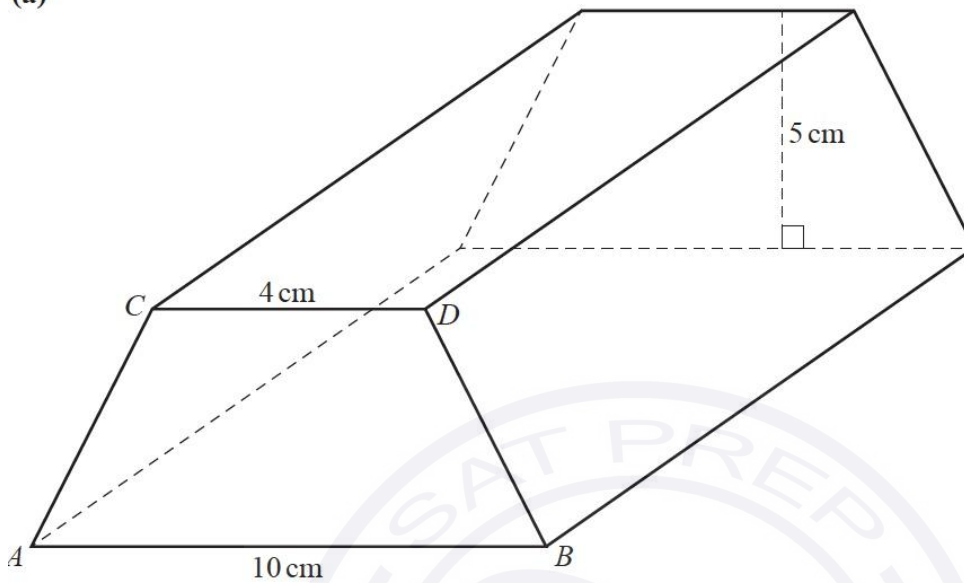
Calculate the volume of the remaining solid.

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

..... cm³ [4]

Question 51

(a)



NOT TO SCALE

The diagram shows a prism.
The cross-section of the prism is a trapezium with CD parallel to AB and $AC = BD$.

$AB = 10$ cm, $CD = 4$ cm and the height of the trapezium is 5 cm.
The volume of the prism is 525 cm³.

- (i) The prism is made of iron.
 1 cm³ of iron has a mass of 7.8 g.

Calculate the mass of the prism.
Give your answer in kilograms.

..... kg [2]

- (ii) Calculate the length of the prism.

..... cm [3]

- (iii) Calculate the total surface area of the prism.

Continue on the next page...

..... cm^2 [6]

(iv) In a mathematically similar prism, the height of the trapezium is 10 cm.

Calculate the volume of this prism.

..... cm^3 [3]

(b) A cuboid measures 10 cm by 4 cm by 6 cm.

Each side is measured correct to the nearest centimetre.

Complete the inequality for the volume, V , of this cuboid.

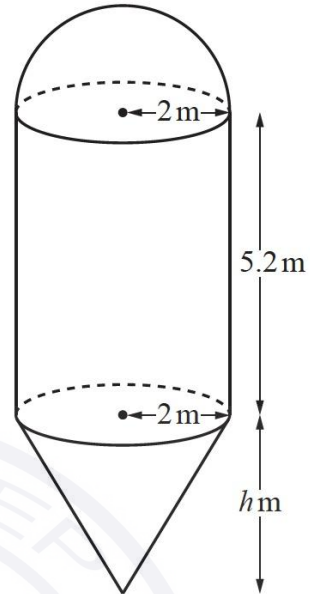
..... $\text{cm}^3 \leq V <$ cm^3 [3]



Question 52

(a) The diagram shows a container for storing grain.

The container is made from a hemisphere, a cylinder and a cone, each with radius 2 m. The height of the cylinder is 5.2 m and the height of the cone is h m.



NOT TO SCALE

- (i) Calculate the volume of the hemisphere.
Give your answer as a multiple of π .

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

..... m^3 [2]

- (ii) The total volume of the container is $\frac{88\pi}{3} \text{m}^3$.

Calculate the value of h .

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

$h =$ [4]

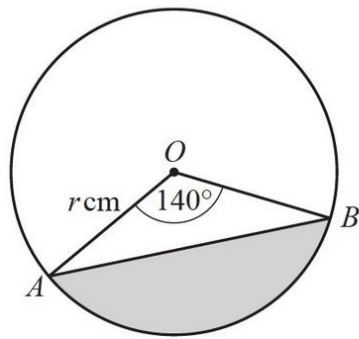
- (iii) The container is full of grain.
Grain is removed from the container at a rate of 35 000 kg per hour.
 1m^3 of grain has a mass of 620 kg.

Calculate the time taken to empty the container.
Give your answer in hours and minutes.

..... h min [3]

Continue on the next page...

(b)

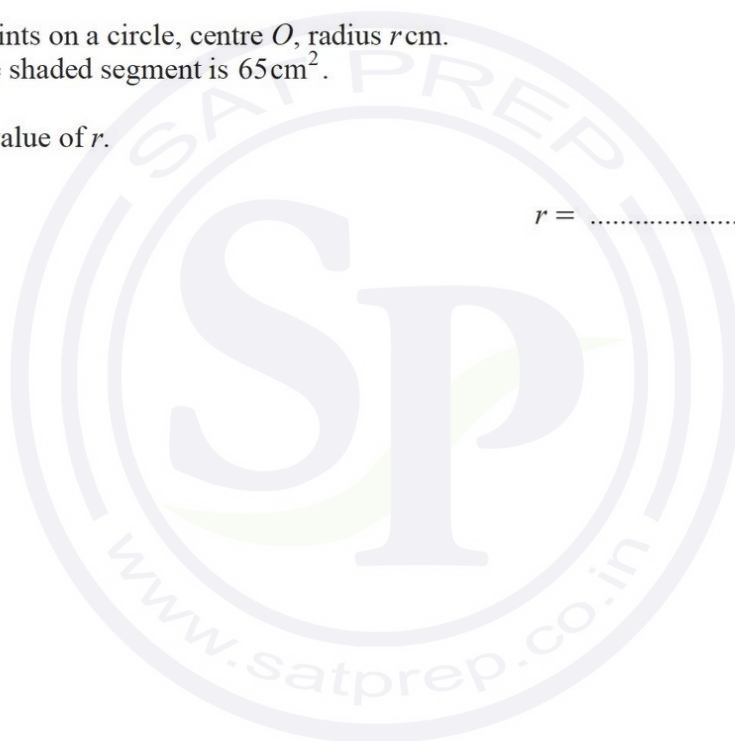


NOT TO
SCALE

A and B are points on a circle, centre O , radius r cm.
The area of the shaded segment is 65cm^2 .

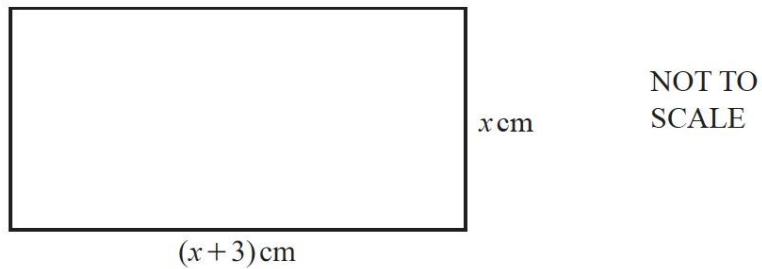
Calculate the value of r .

$r = \dots\dots\dots$ [4]



Question 53

(a)

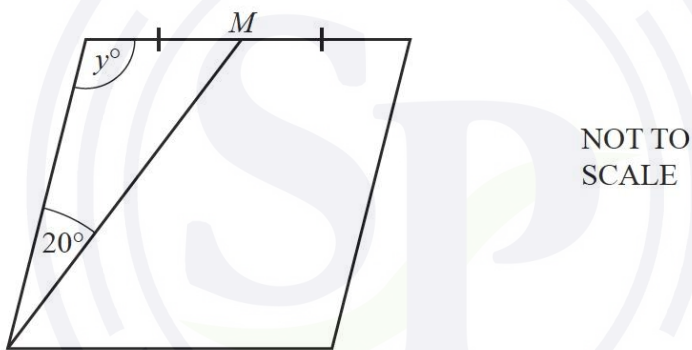


This rectangle has perimeter 20 cm.

Find the value of x .

$x = \dots\dots\dots$ [3]

(b)



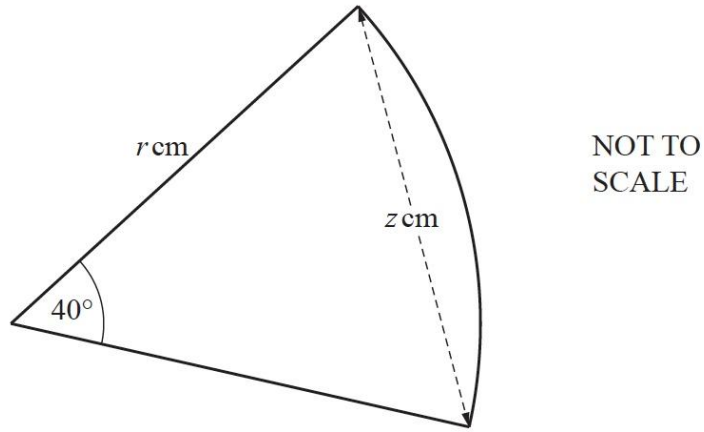
This rhombus has perimeter 20 cm and angle y is obtuse.
 M is the midpoint of one of the sides.

Find the value of y .

$y = \dots\dots\dots$ [5]

Continue on the next page...

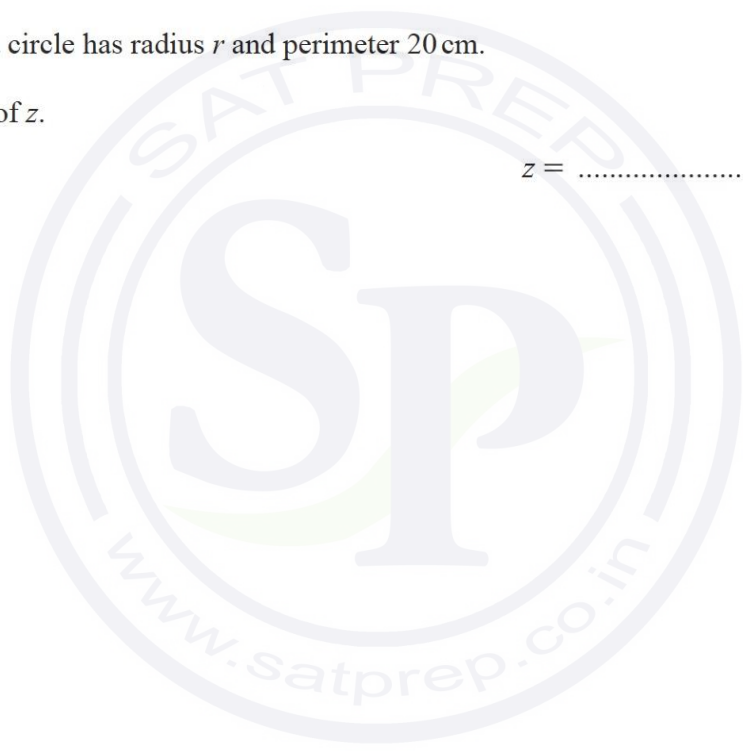
(c)



This sector of a circle has radius r and perimeter 20 cm.

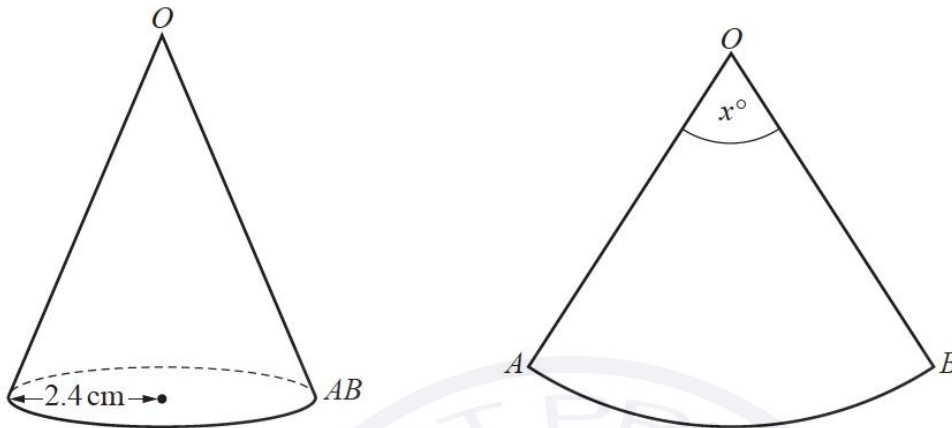
Find the value of z .

$z = \dots\dots\dots$ [6]



Question 54

(a)



NOT TO SCALE

The volume of a paper cone of radius 2.4 cm is 95.4 cm^3 .
 The paper is cut along the slant height from O to AB .
 The cone is opened to form a sector OAB of a circle with centre O .

Calculate the sector angle x° .

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

..... [6]

- (b) An empty fuel tank is filled using a cylindrical pipe with diameter 8 cm.
 Fuel flows along this pipe at a rate of 2 metres per second.
 It takes 24 minutes to fill the tank.

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

..... litres [4]

Question 55

Two rectangular picture frames are mathematically similar.

- (a) The areas of the frames are 350 cm^2 and 1134 cm^2 .
The width of the smaller frame is 17.5 cm.

Calculate the width of the larger frame.

..... cm [3]

- (b) A picture in the smaller frame has length 15 cm and width 10.5 cm, both correct to the nearest 5 mm.

Calculate the upper bound for the area of this picture.

..... cm^2 [2]

- (c) In a sale, the price of a large frame is reduced by 18%.
Parthi pays \$166.05 for 5 large frames in the sale.

Calculate the original price of one large frame.

\$ [2]

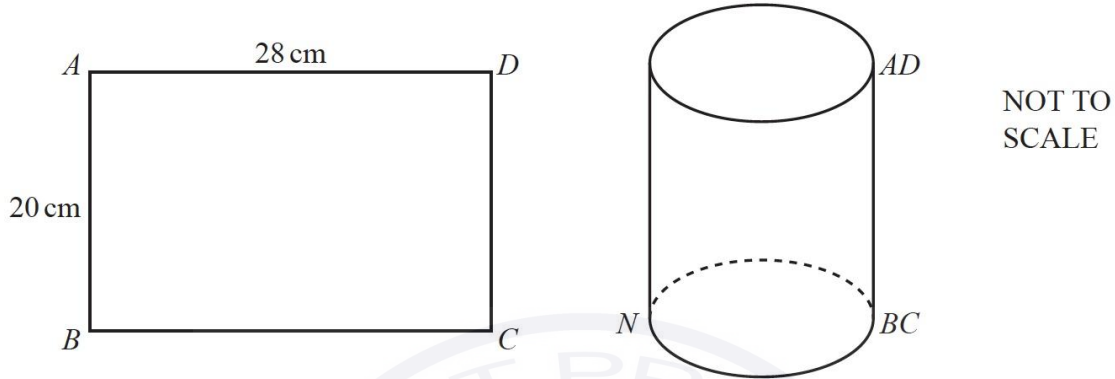
- (d) Parthi advertises a large frame for a price of \$57 or 48.20 euros.
The exchange rate is $\$1 = 0.88$ euros.

Calculate the difference between these prices, in dollars and cents, correct to the nearest cent.

\$ [3]

Question 56

(a)



A rectangular sheet of paper $ABCD$ is made into an open cylinder with the edge AB meeting the edge DC .

$AD = 28$ cm and $AB = 20$ cm.

(i) Show that the radius of the cylinder is 4.46 cm, correct to 3 significant figures.

[2]

(ii) Calculate the volume of the cylinder.

..... cm³ [2]

(iii) N is a point on the base of the cylinder, such that BN is a diameter.

Calculate the angle between AN and the base of the cylinder.

..... [3]

(b) The volume of a solid cone is 310 cm³.
The height of the cone is twice the radius of its base.

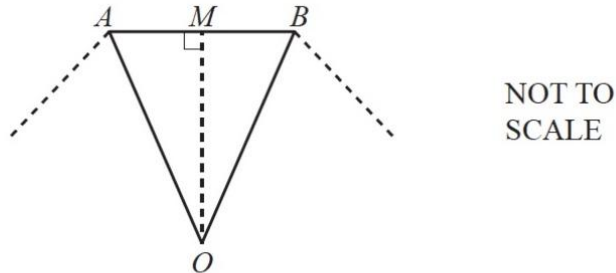
Calculate the slant height of the cone.

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

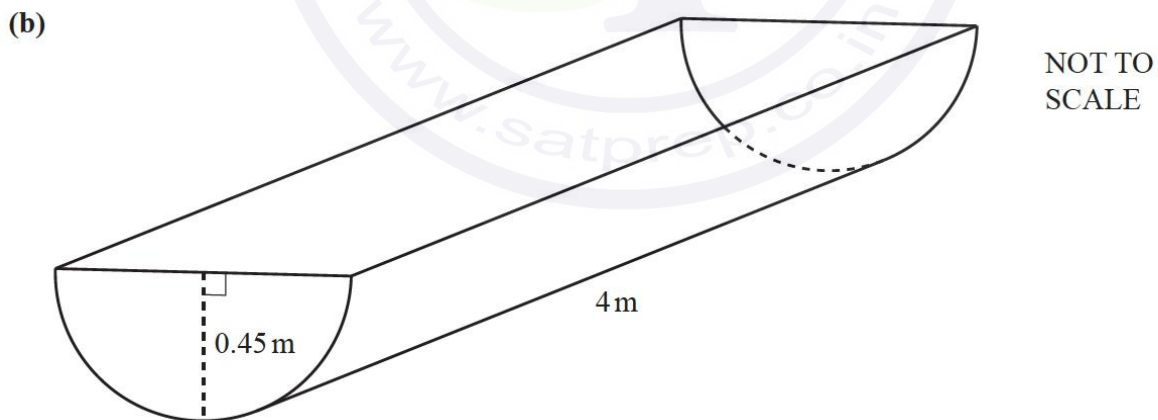
..... cm [5]

Question 57

- (a) $ABCDEFGH$ is a regular octagon with sides of length 6 cm.
The diagram shows part of the octagon.
 O is the centre of the octagon and M is the midpoint of AB .



- (i) (a) Show that angle OAM is 67.5° . [2]
- (b) Calculate the area of the octagon. cm^2 [4]
- (ii) Find the area of the circle that passes through the vertices of the octagon. cm^2 [3]

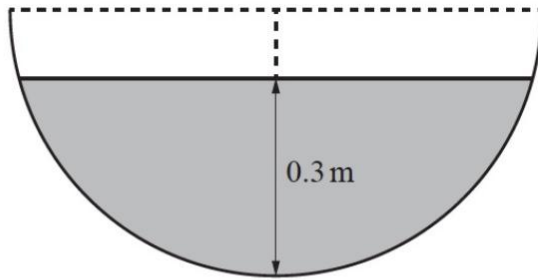


The diagram shows a horizontal container for water with a uniform cross-section.
The cross-section is a semicircle.
The radius of the semicircle is 0.45 m and the length of the container is 4 m.

- (i) Calculate the volume of the container. m^3 [2]

Continue on the next page...

(ii)

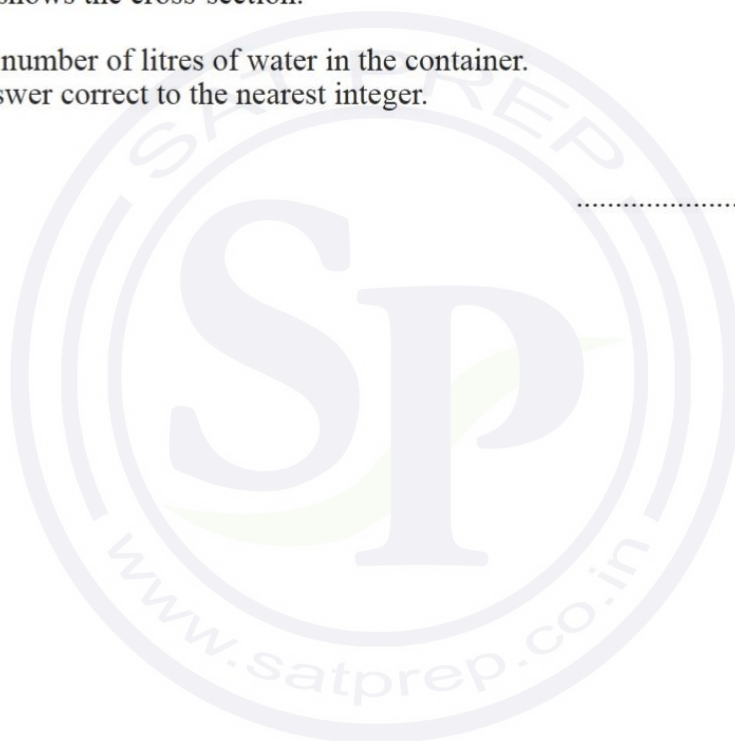


NOT TO
SCALE

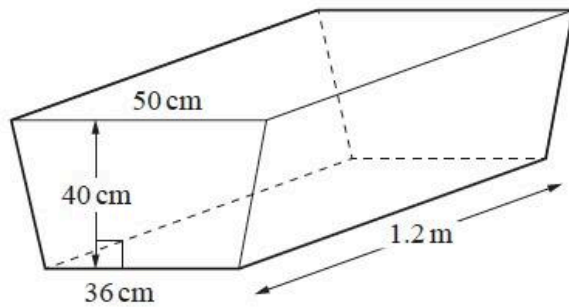
The greatest depth of the water in the container is 0.3 m.
The diagram shows the cross-section.

Calculate the number of litres of water in the container.
Give your answer correct to the nearest integer.

..... litres [6]



Question 58



NOT TO SCALE

The diagram shows a water trough in the shape of a prism.
The prism has a cross-section in the shape of an isosceles trapezium.
The trough is completely filled with water.

- (a) Show that the volume of water in the trough is 206.4 litres.

[3]

- (b) The water from the trough is emptied at a rate of 600 ml per second.

Calculate the time taken, in minutes and seconds, for the trough to be emptied.

..... minutes seconds [3]

- (c) All the water from the trough is emptied into a vertical cylindrical tank.
The depth of the water in the tank is 84 cm.



- (i) Calculate the radius of the tank.

..... cm [3]

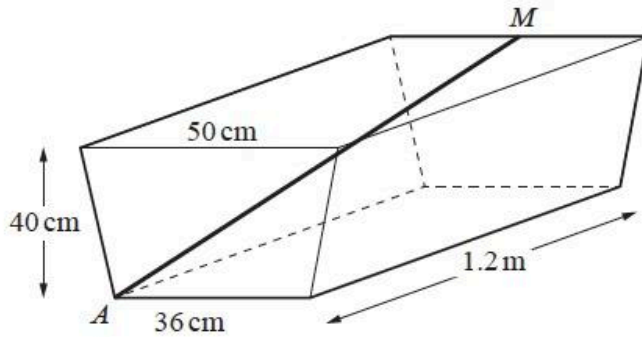
- (ii) The tank is 60% full.

Calculate the height of the tank.

Continue on the next page...

..... cm [2]

(d)



NOT TO
SCALE

A steel rod AM is placed inside the empty water trough as shown in the diagram. A is a vertex at the base of the isosceles trapezium and M is the midpoint of the top edge on the opposite face.

Calculate the length of the steel rod, AM .

$AM =$ cm [4]

Question 59

(a) Calculate the volume of

(i) a solid cylinder with radius 6 cm and height 14 cm,

..... cm^3 [2]

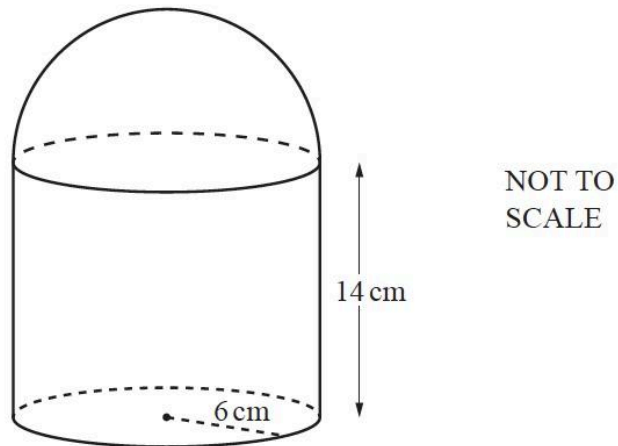
(ii) a solid hemisphere with radius 6 cm.

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

..... cm^3 [2]

Continue on the next page...

(b)



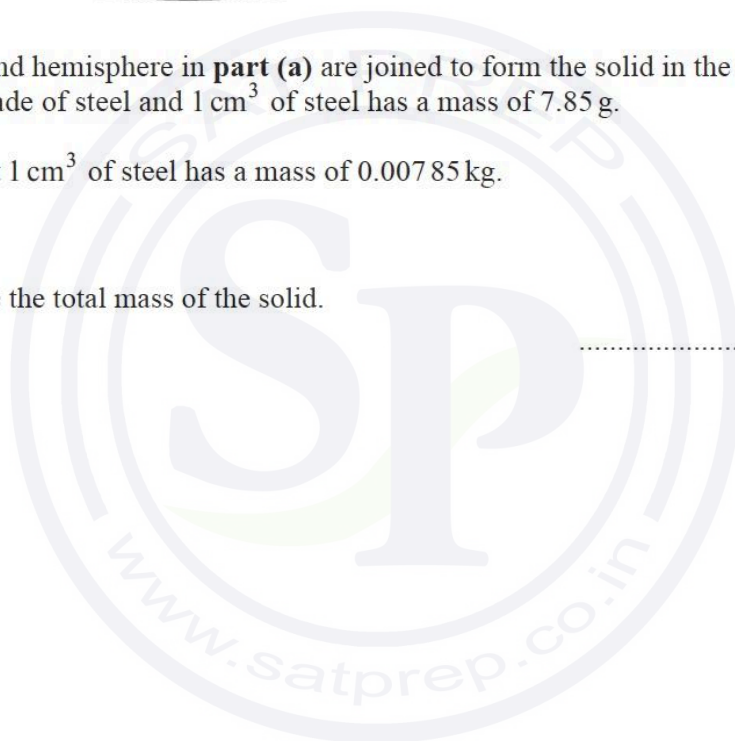
The cylinder and hemisphere in **part (a)** are joined to form the solid in the diagram. The solid is made of steel and 1 cm^3 of steel has a mass of 7.85 g.

(i) Show that 1 cm^3 of steel has a mass of 0.007 85 kg.

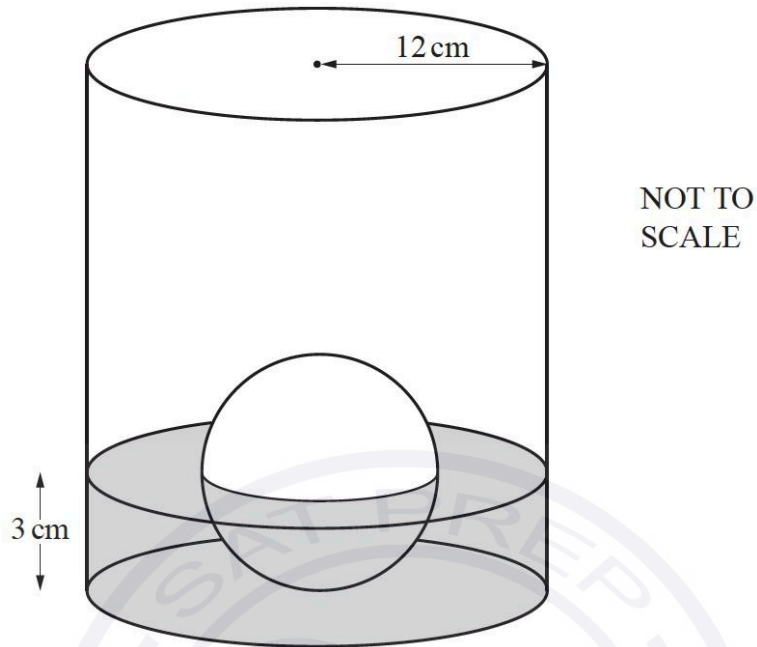
[1]

(ii) Calculate the total mass of the solid.

..... kg [2]



Question 60



The diagram shows a cylinder containing water.
 There is a solid metal sphere touching the base of the cylinder.
 Half of the sphere is in the water.
 The radius of the cylinder is 12 cm and the radius of the sphere is 3 cm.

- (a) The sphere is removed from the cylinder and the level of the water decreases by h cm.
 Show that $h = 0.125$.

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

[3]

- (b) The water in the cylinder is poured into another cylinder of radius R cm.
 The depth of the water in this cylinder is 18 cm.

Calculate the value of R .

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

- (c) The sphere is melted down and some of the metal is used to make 30 cubes with edge length 1.5 cm.

Calculate the percentage of metal **not** used.

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

$\dots\dots\dots$ % [3]

Question 61

A bronze statue is 4.5 m high and has a mass of 195 200 kg.

The density of bronze is 8000 kg/m^3 .

The volume of a mathematically similar model of the statue is 0.385 m^3 .

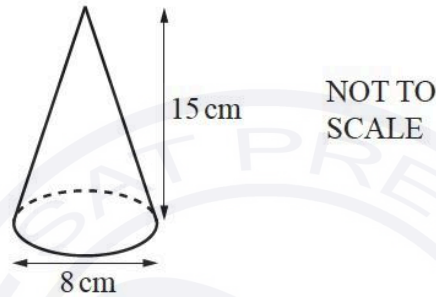
Calculate the height of the model.

[Density = Mass \div Volume]

[5]

Question 62

(a)



A cone has base diameter 8 cm and perpendicular height 15 cm.

(i) Calculate the volume of the cone.

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

..... cm^3 [2]

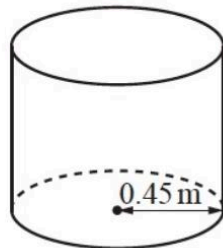
(ii) A label completely covers the curved surface area of the cone.

Calculate the area of the label as a percentage of the **total** surface area of the cone.

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

..... % [5]

(b)



NOT TO
SCALE

Continue on the next page...

An empty cylindrical container has radius 0.45 m.
 300 litres of water is poured into the container at a rate of 375 ml per second.

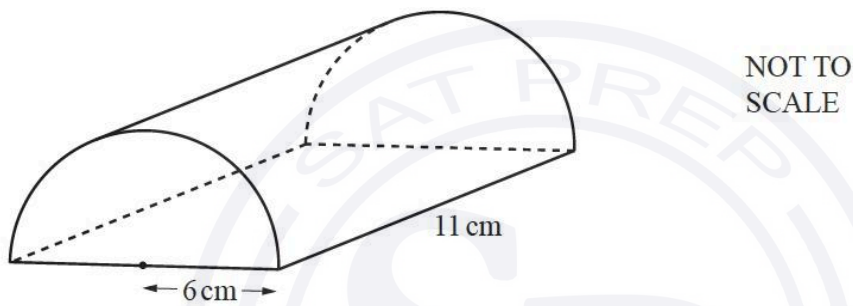
(i) Find the time taken, in minutes and seconds, for all the water to be poured into the container.

..... min s [3]

(ii) Calculate the height of the water in the container.

..... m [3]

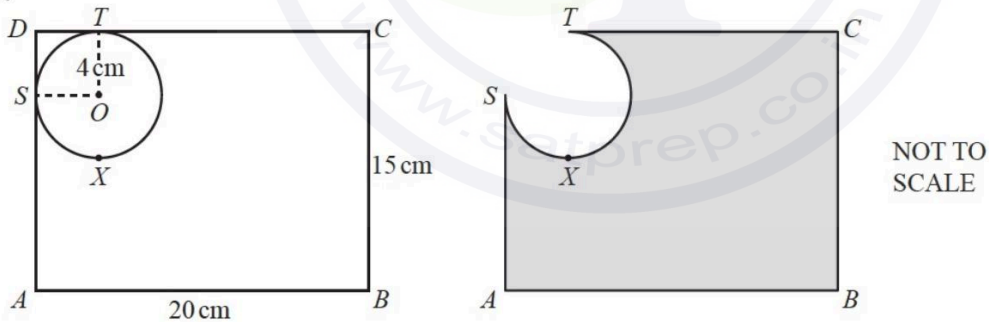
Question 63



The diagram shows a half-cylinder of radius 6 cm and length 11 cm.
 Calculate the volume of the half-cylinder.

..... cm³ [2]

(c)



(i) ABCD is a rectangle with AB = 20 cm and BC = 15 cm.

S, X and T are points on a circle centre O, such that DSA and DTC are tangents to the circle.

The radius of the circle is 4 cm and TX is a diameter of the circle.

The shape DSXT is removed from the corner of the rectangle, leaving the shaded shape shown in the second diagram.

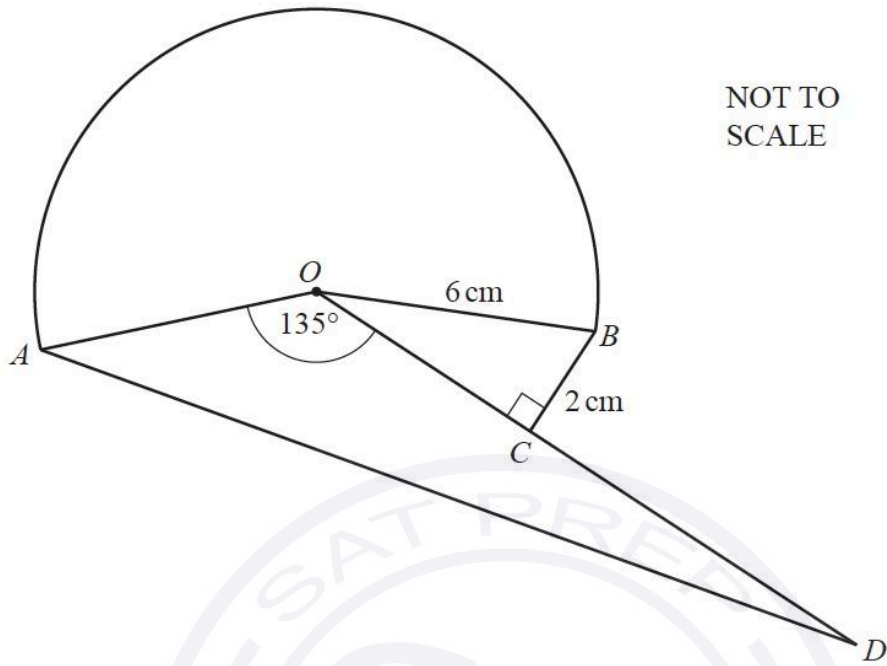
Calculate the area of the shaded shape.

..... cm² [5]

(ii) Calculate the perimeter of the shaded shape.

..... cm [3]

Question 64



The diagram shows a shape made from a major sector AOB and triangles OBC and AOD .
 $OB = 6\text{ cm}$, $BC = 2\text{ cm}$, obtuse angle $AOC = 135^\circ$ and angle $BCO = 90^\circ$.

(i) Show that angle $BOC = 19.5^\circ$, correct to 1 decimal place. [2]

(ii) Calculate the area of the major sector AOB .
 cm^2 [3]

(iii) C is the midpoint of OD .
 Calculate AD .
 cm [5]

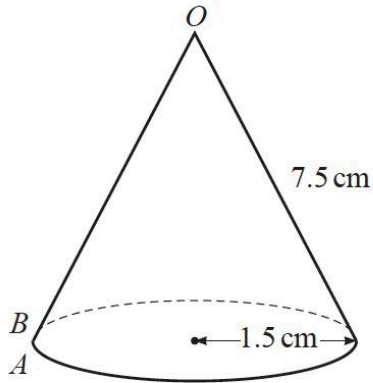
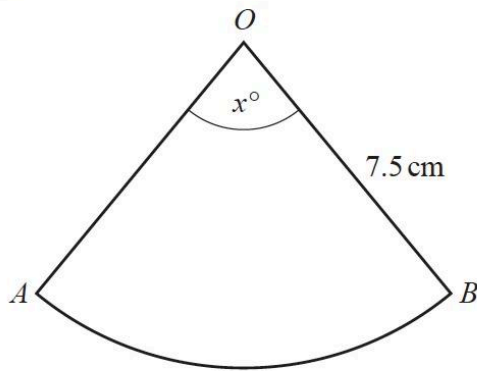
(iv) Calculate the total area of the shape.
 cm^2 [4]

(b) A sector of a circle has radius 8 cm and area 160 cm^2 .
 A mathematically similar sector has radius 20 cm .

Calculate the area of the larger sector.

Question 65

(a)



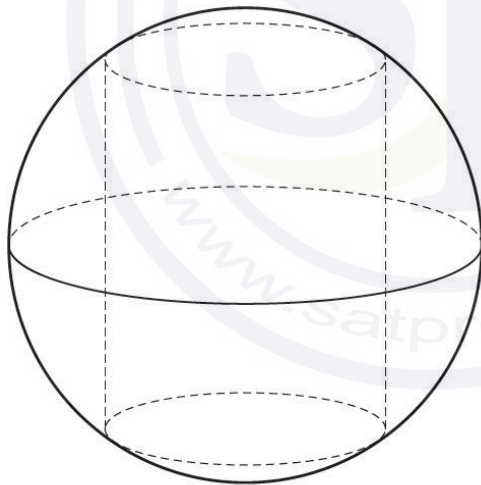
NOT TO SCALE

The diagram shows a sector of a circle that is made into a cone by joining OA to OB . The sector angle is x° and the radius of the sector is 7.5 cm. The base radius of the cone is 1.5 cm.

Calculate the value of x .

$x = \dots\dots\dots$ [3]

(b)



NOT TO SCALE

The diagram shows a cylinder with radius 8 cm inside a sphere with radius 17 cm. Both ends of the cylinder touch the curved surface of the sphere.

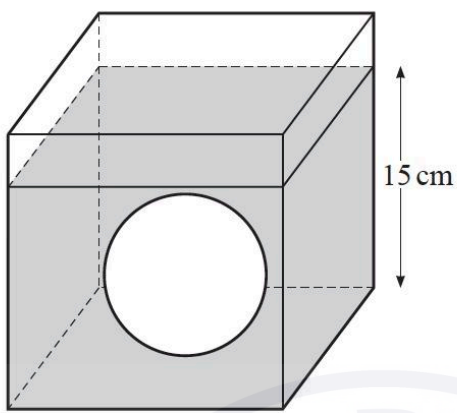
- (i) Show that the height of the cylinder is 30 cm.
- (ii) Calculate the volume of the cylinder as a percentage of the volume of the sphere.

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

Continue on the next page...

..... % [4]

(c)



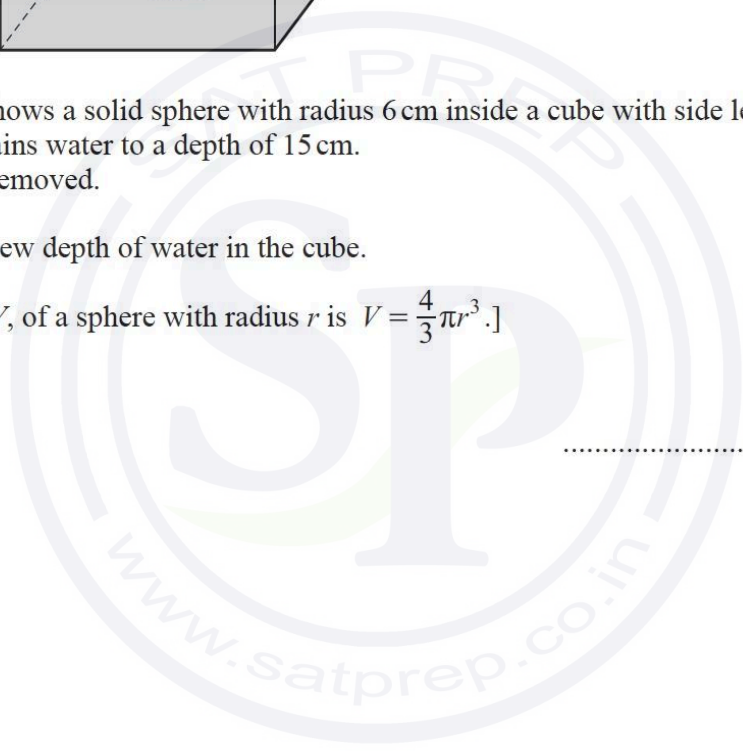
NOT TO SCALE

The diagram shows a solid sphere with radius 6 cm inside a cube with side length 20 cm.
The cube contains water to a depth of 15 cm.
The sphere is removed.

Calculate the new depth of water in the cube.

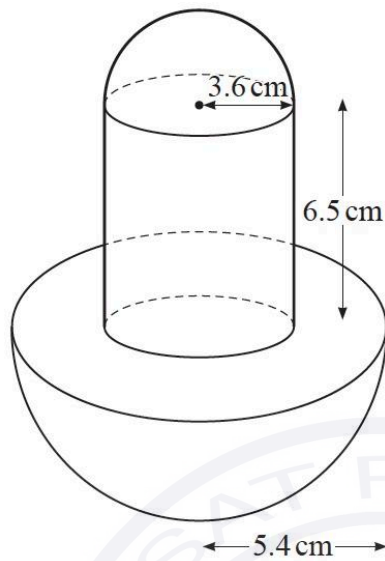
[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... cm [3]



Question 66

(a)



NOT TO
SCALE

The diagram shows a solid formed by joining two hemispheres and a cylinder.
The radius of the large hemisphere is 5.4 cm.
The radius of the small hemisphere and the radius of the cylinder are both 3.6 cm.
The height of the cylinder is 6.5 cm.

- (i) Show that the volume of the solid is 692 cm^3 , correct to the nearest cubic centimetre.

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

[4]

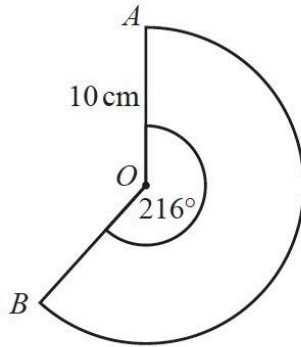
- (ii) A mathematically similar solid is made of silver.
In this solid, the cylinder has radius 0.6 cm.
 1 cm^3 of silver has a mass of 10.49 grams.

Calculate the total mass of this silver solid.

Continue on the next pages...

..... g [4]

(b)



NOT TO
SCALE

AOB is a sector of a circle, centre *O*.
AO = 10 cm and the sector angle is 216° .

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

.....cm [2]

- (ii) A cone is made from this sector by joining *OA* to *OB*.

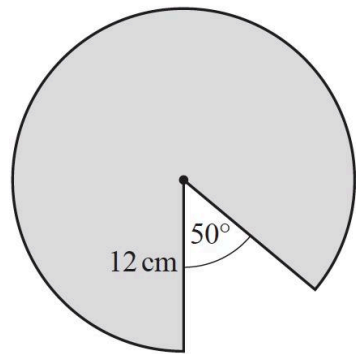
Calculate the volume of the cone.

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

..... cm^3 [4]

Question 67

(a)



NOT TO
SCALE

The diagram shows a circle of radius 12 cm, with a sector removed.

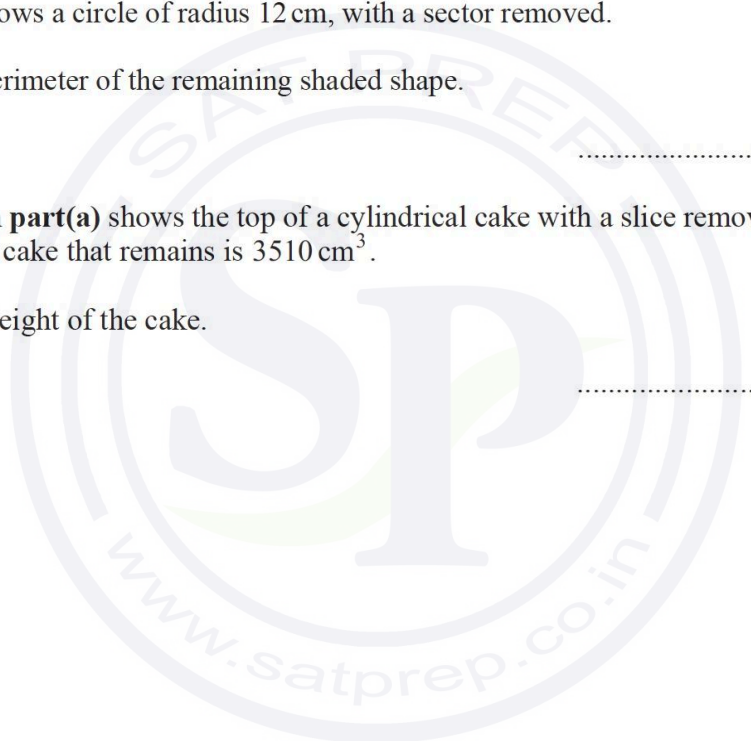
Calculate the perimeter of the remaining shaded shape.

..... cm [4]

(b) The diagram in **part(a)** shows the top of a cylindrical cake with a slice removed.
The volume of cake that remains is 3510 cm^3 .

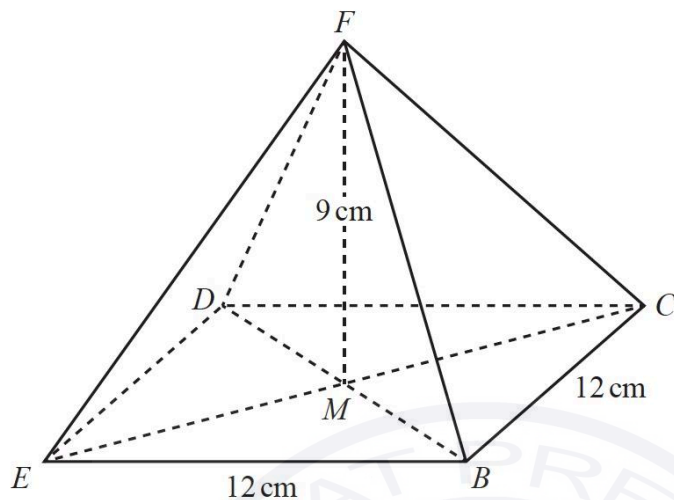
Calculate the height of the cake.

..... cm [3]



Question 68

(a)



NOT TO SCALE

The diagram shows a pyramid with a square base $BCDE$. The diagonals CE and BD intersect at M , and the vertex F is directly above M . $BE = 12$ cm and $FM = 9$ cm.

(i) Calculate the volume of the pyramid.

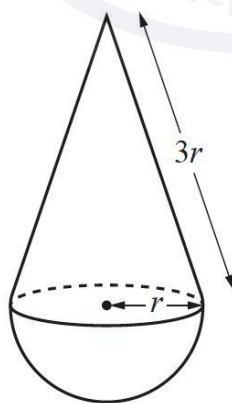
[The volume, V , of a pyramid with base area A and height h is $V = \frac{1}{3}Ah$.]

..... cm^3 [2]

(ii) Calculate the total surface area of the pyramid.

..... cm^2 [5]

(b)



NOT TO SCALE

Continue on the next page...

The diagram shows a toy made from a cone and a hemisphere.
 The base radius of the cone and the radius of the hemisphere are both r cm.
 The slant height of the cone is $3r$ cm.

The total surface area of the toy is 304 cm^2 .

Calculate the value of r .

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

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

$r = \dots\dots\dots$ [4]

Question 69

(a)



The diagram shows a solid made from a cylinder and a cone.
 The height of the cylinder is 16 cm and the height of the cone is 1.5 cm.
 The radius of the cylinder and the base radius of the cone are each 0.35 cm.

(i) Calculate the total surface area of the solid.

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

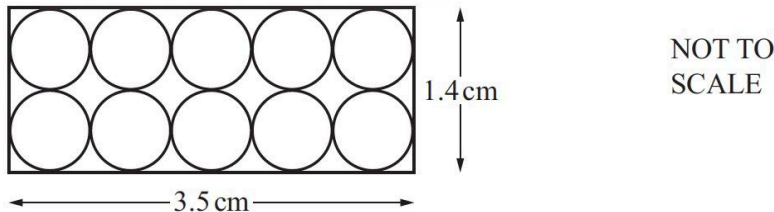
$\dots\dots\dots \text{ cm}^2$ [5]

(ii) Calculate the volume of the solid.

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

$\dots\dots\dots \text{ cm}^3$ [3]

(iii)



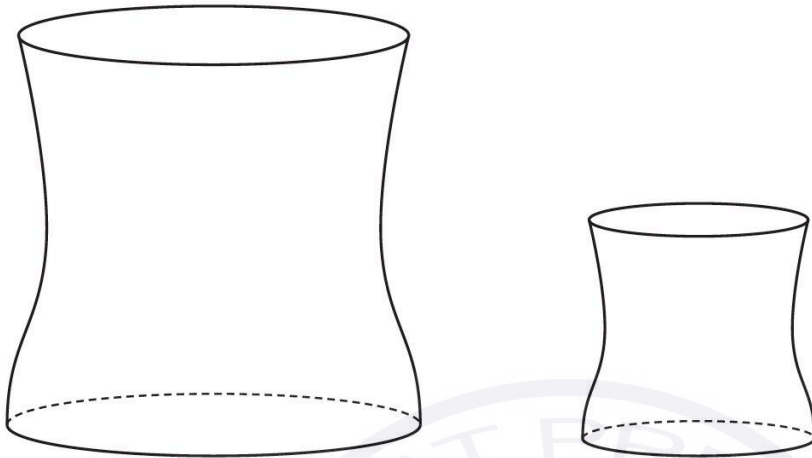
10 of the solids are placed in a box in the shape of a cuboid of length 17.5 cm.
 The diagram shows one end of the box.

Calculate the volume of the empty space in the box.

Continue on the next page...

..... cm^3 [3]

(b)



NOT TO SCALE

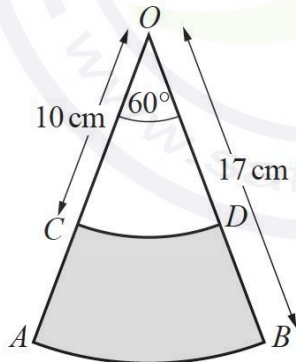
The diagram shows two mathematically similar solids.
 The surface area of the larger solid is 200 cm^2 and the surface area of the smaller solid is 98 cm^2 .
 The volume of the larger solid is 450 cm^3 .

Calculate the volume of the smaller solid.

..... cm^3 [3]

Question 70

(a)



NOT TO SCALE

OAB is a sector of a circle, centre O , radius 17 cm .
 OCD is a sector of a circle, centre O , radius 10 cm .
 OCA and ODB are straight lines and angle $AOB = 60^\circ$.

The perimeter of the shaded shape $ABDC$ can be written in the form $(a\pi + b) \text{ cm}$.

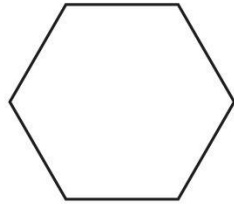
Find the value of a and the value of b .

Continue on the next page...

$a = \dots\dots\dots$

$b = \dots\dots\dots$ [3]

(b)



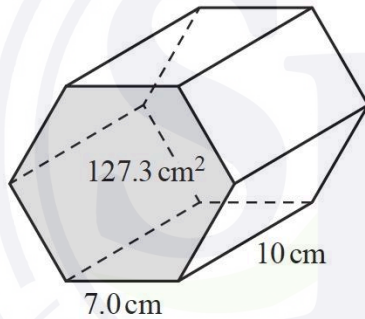
NOT TO SCALE

The diagram shows a regular hexagon.
The area of the hexagon is 127.3 cm^2 .

(i) Show that the length of one side of the hexagon is 7.0 cm, correct to 1 decimal place.

[4]

(ii) The hexagon is the cross-section of a prism of length 10 cm.



NOT TO SCALE

(a) Find the volume of the prism.

$\dots\dots\dots \text{ cm}^3$ [1]

(b) Calculate the surface area of the prism.

$\dots\dots\dots \text{ cm}^2$ [2]

Question 71

A solid cylinder has base radius x and height $3x$.

The **total** surface area of the cylinder is the same as the **total** surface area of a solid hemisphere of radius $5y$.

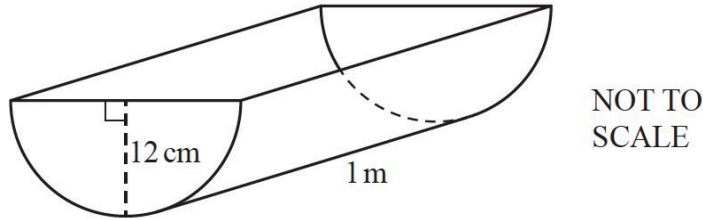
Show that $x^2 = \frac{75y^2}{8}$.

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

[4]

Question 72

(a)

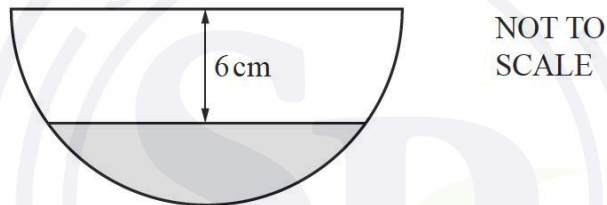


The diagram shows a tank in the shape of a half-cylinder of radius 12 cm and length 1 metre. The tank is fixed horizontally and is completely filled with water.

- (i) Calculate the volume of water in the tank.
Give your answer correct to the nearest 10 cm^3 .

..... cm^3 [3]

(ii)



Water is removed from the tank until the level of water is 6 cm below the top of the tank. The diagram shows the cross-section of the tank.

Calculate the volume of water that is now in the tank.

..... cm^3 [5]

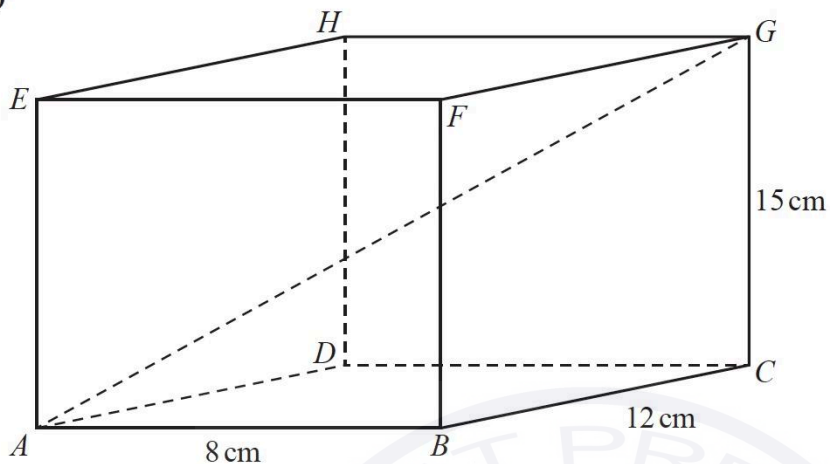
- (b) A rectangular fish tank with length 42 cm and width 35 cm is full of water. A stone lies at the bottom of the tank. When the stone is removed from the tank, the depth of the water decreases by 0.2 cm. The density of the stone is 2.2 g/cm^3 .

Calculate the mass of the stone in grams.
[Density = mass \div volume]

Continue on the next page...

..... g [3]

(c)



NOT TO SCALE

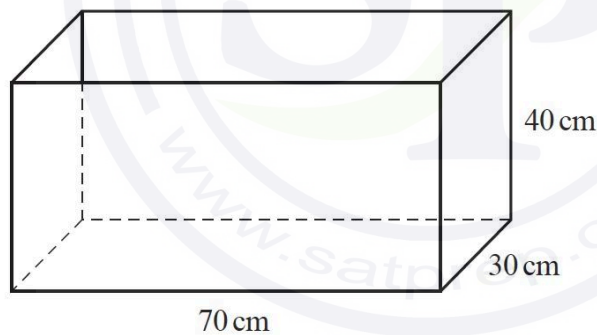
The diagram shows a cuboid, $ABCDEFGH$.

Calculate the angle that AG makes with the base of the cuboid.

..... [4]

Question 73

(a)



NOT TO SCALE

The diagram shows a box in the shape of a cuboid.
The box is open at the top.

(i) Work out the surface area of the inside of the open box.

..... cm^2 [3]

(ii) Cylinders with height 20 cm and diameter 15 cm are placed in the box.

Work out the maximum number of these cylinders that can completely fit inside the box.

..... [3]

- (b) A solid bronze cone has a mass 750 g.
The density of the bronze is 8.9 g/cm^3 .

The ratio radius of cone : height of cone = 1 : 3.

- (i) Show that the radius of the cone is 2.99 cm, correct to 3 significant figures.
[Density = mass \div volume]

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

[4]

- (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 $A = \pi r l$.]

..... cm^2 [5]

