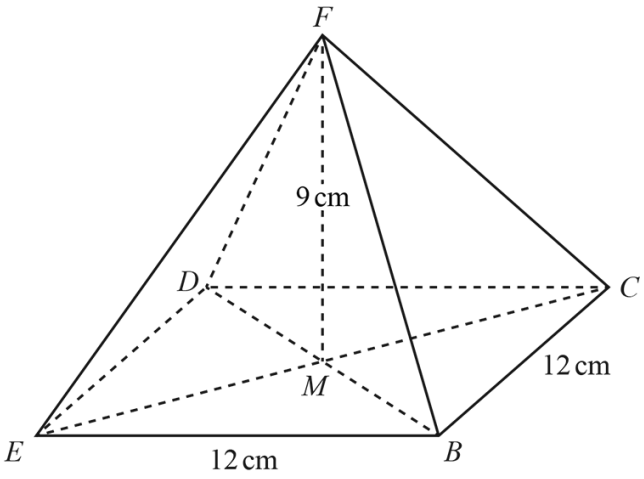
Chapter 5

Mensuration

01. 0580_m24_qp_42 Q: 4

(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.

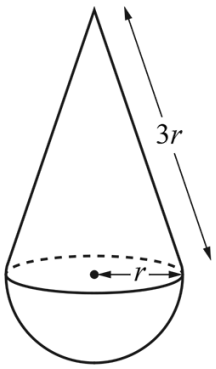
[The volume, V, of a pyramid with base area A and height h is $V = \frac{1}{3}Ah$.]

..... cm^3 [2]

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

..... cm^2 [5]

(b)



NOT TO SCALE

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 $304\,\text{cm}^2$.

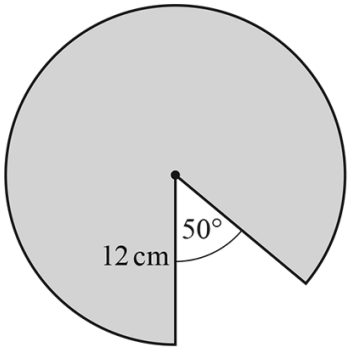
Calculate the value of r.

[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi rl$.]
[The curved surface area, A, of a sphere with radius r is $A = 4\pi r^2$.]

$r =$ ..... [4]

02. 0580_m24_qp_42 Q: 12

(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]

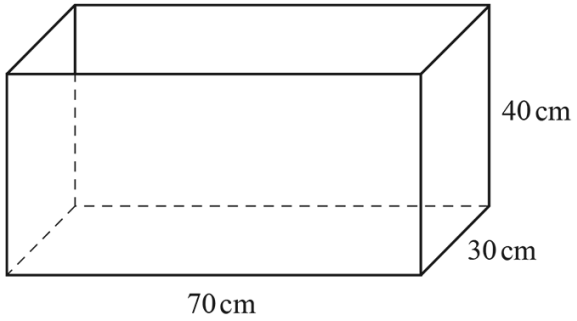
(b) The diagram in **part(a)** shows the top of a cylindrical cake with a slice removed.
The volume of cake that remains is 3510 cm^3.

Calculate the height of the cake.

..... cm [3]

03. 0580_s24_qp_41 Q: 7

(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 ÷ volume]

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

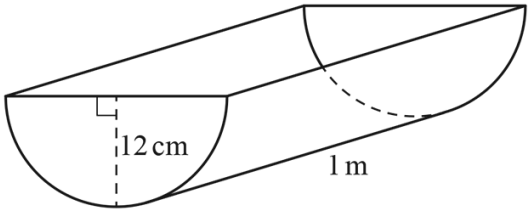
[4]

(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 $A = \pi rl$.]

..... cm^2 [5]

04. 0580_s24_qp_42 Q: 4

(a)



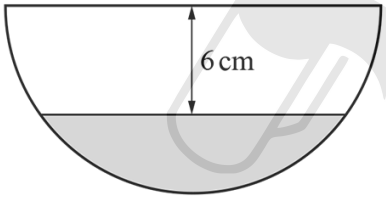
NOT TO SCALE

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)



NOT TO SCALE

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.

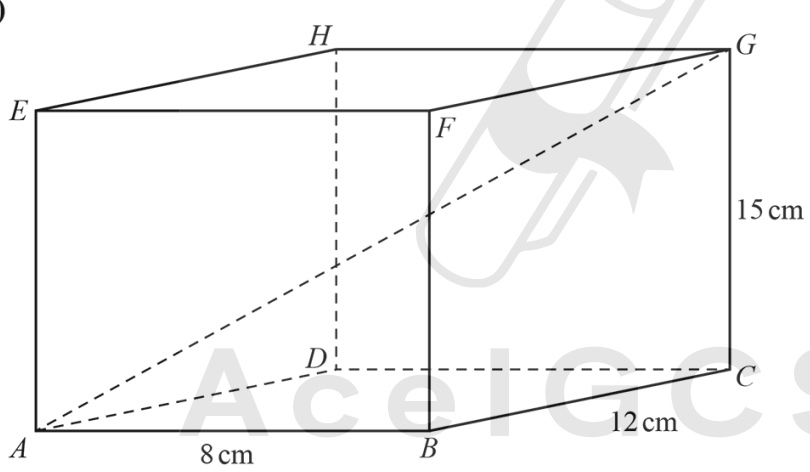
..... cm^3 [5]

(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 ÷ volume]

..... 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]

05. 0580_s24_qp_42 Q: 5

(a) Simplify $\left(25x^6\right)^{\frac{3}{2}}$.

..... [2]

(b) These are the first five terms of a sequence.

$$\frac{1}{6} \qquad 1 \qquad 6 \qquad 36 \qquad 216$$

Find the nth term of the sequence.

..... [2]

(c) Expand and simplify.

$$(x+4)(x-3)(3x-1)$$

..... [3]

(d) **(i)** Show that $(3x+5)+\frac{7}{x-2}=x$ simplifies to $2x^2+x-3=0$.

[4]

(ii) Solve by factorisation $2x^2+x-3=0$.

$x =$ ..... or $x =$ ..... [3]

(e) 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 $5y$.

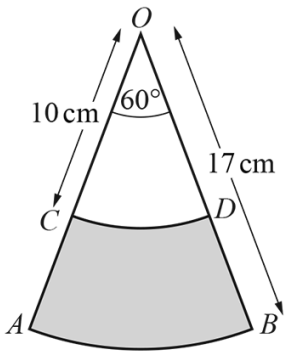
Show that $x^2=\frac{75y^2}{8}$.

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

[4]

06. 0580_s24_qp_42 Q: 9

(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 $AOB = 60°$.

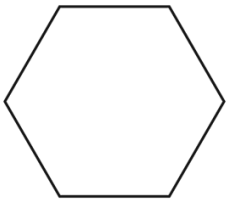
The perimeter of the shaded shape *ABDC* can be written in the form $(a\pi + b)$ cm.

Find the value of *a* and the value of *b*.

$a =$ .....

$b =$ ..... [3]

(b)



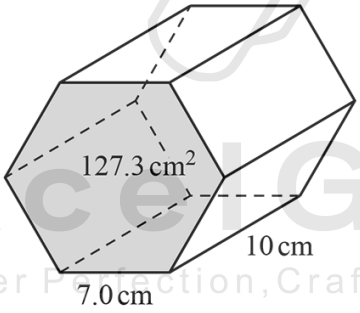
NOT TO SCALE

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.

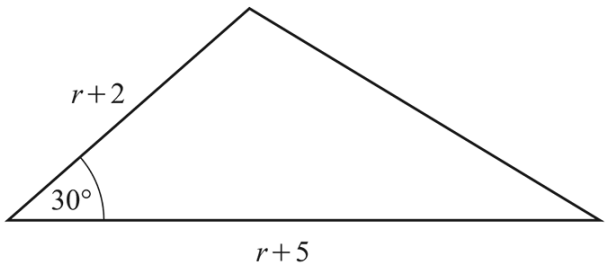
..... cm^3 [1]

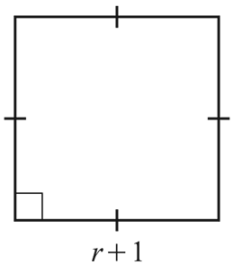
(b) Calculate the surface area of the prism.

..... cm^2 [2]

07. 0580_s24_qp_43 Q: 4

In this question all the measurements are in centimetres.





NOT TO SCALE

The area of the triangle is equal to the area of the square.

(a) Show that $3r^2 + r - 6 = 0$.

[4]

(b) Solve the equation $3r^2 + r - 6 = 0$.
Give your answer to 2 decimal places.
You must show all your working.

r = ... or r = ... [3]

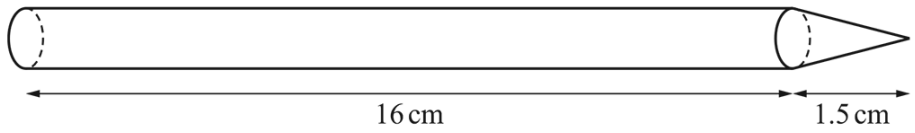
(c) Find the perimeter of the square.

..... cm [2]

---

08. 0580_s24_qp_43 Q: 8

(a)



NOT TO SCALE

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.

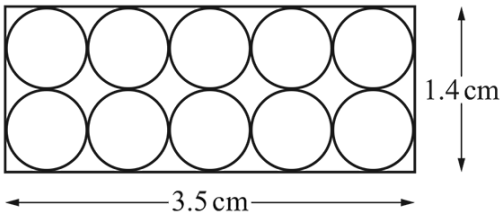
(i) Calculate the total surface area of the solid.
[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi rl$.]

..... cm^2 [5]

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

..... cm^3 [3]

(iii)



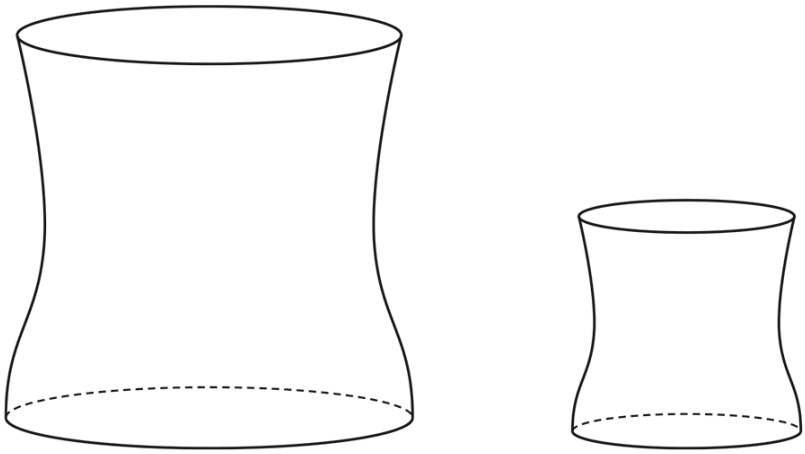
NOT TO SCALE

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.

..... cm^3 [3]

(b)

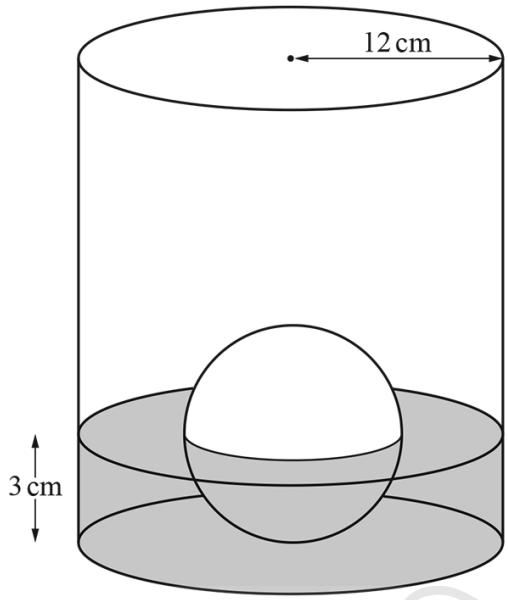


NOT TO SCALE

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

Calculate the volume of the smaller solid.

..... cm^3 [3]



NOT TO SCALE

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.

$R =$ ..... [3]

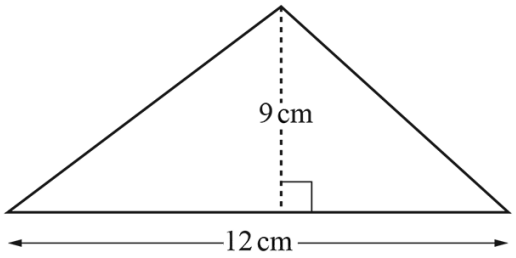
(c) The sphere is melted down and some of the metal is used to make 30 cubes with edge length 1.5 cm.

Calculate the percentage of metal **not** used.
[The volume, V, of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... % [3]

10. 0580_m23_qp_42 Q: 8

(a)

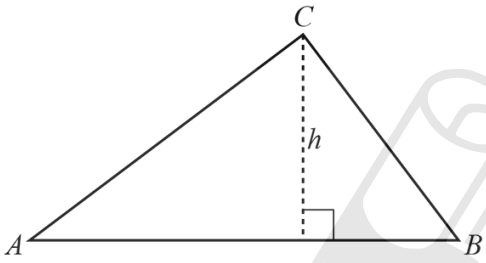


NOT TO SCALE

Calculate the area of the triangle.

..... cm^2 [2]

(b)



NOT TO SCALE

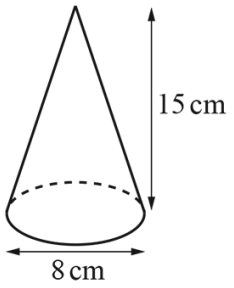
$AB = (2x+3)$ cm and $h = (x+5)$ cm.
The area of triangle $ABC = 50\,cm^2$.

Find the value of x, giving your answer correct to 2 decimal places.
You must show all your working.

$x =$ ..... [6]

11. 0580_s23_qp_42 Q: 5

(a)



NOT TO SCALE

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

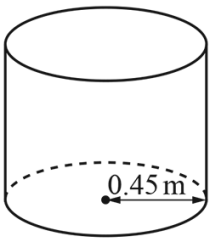
..... cm^3 [2]

(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

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]

12. 0580_s23_qp_43 Q: 8

(a) A shop sells shirts for $\$x$ and jackets for $\$(x + 27)$.
The shop sells 4 shirts and 3 jackets for a total of \$194.75 .

Write down and solve an equation to find the cost of one shirt.

\$ ..... [3]

(b) Solve the simultaneous equations.
You must show all your working.

$$x^2 + 4y = 37$$
$$5x + y = -8$$

$x =$ ..... , $y =$ .....

$x =$ ..... , $y =$ ..... [5]

(c) A solid cylinder has radius x and height $6x$.
A sphere of radius r has the same surface area as the total surface area of the cylinder.

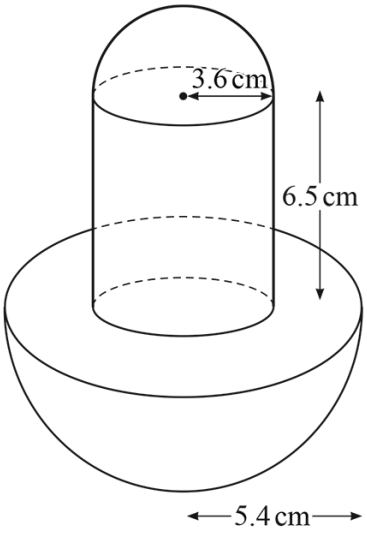
Show that $r^2 = \frac{7}{2}x^2$.

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

[4]

13. 0580_w23_qp_41 Q: 8

(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 $V = \frac{4}{3}\pi r^3$.]

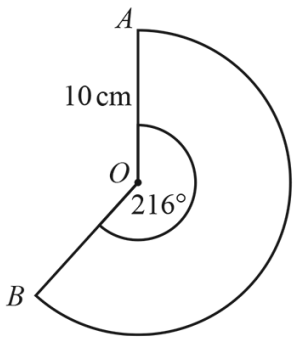
[4]

(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.

..... 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]

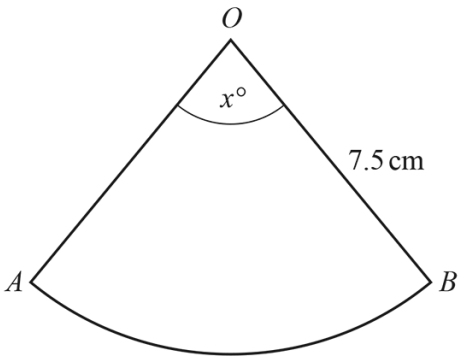
(ii) A cone is made from this sector by joining OA to OB.

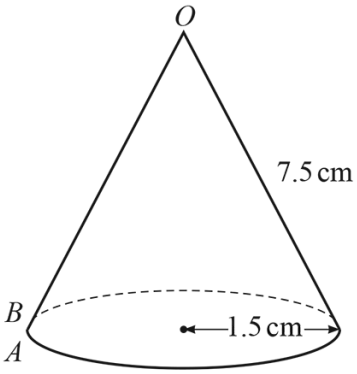
Calculate the volume of the cone.
[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

..... cm^3 [4]

14. 0580_w23_qp_42 Q: 4

(a)





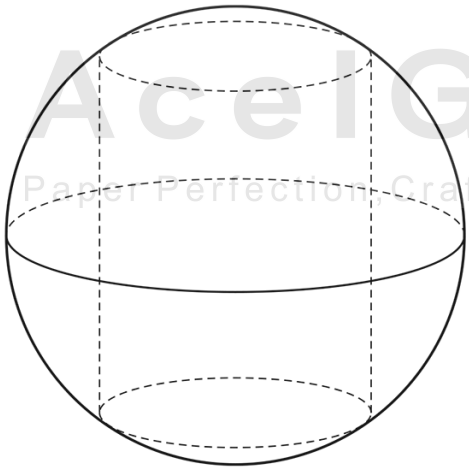
NOT TO SCALE

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.

$x =$ ..... [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.

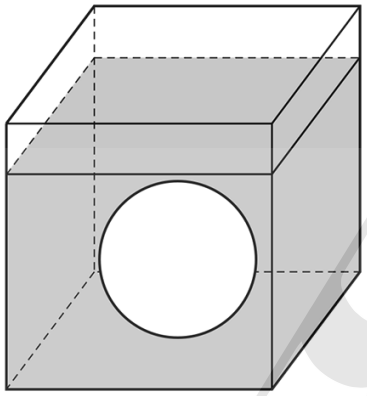
[2]

(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 $V = \frac{4}{3}\pi r^3$.]

..... % [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.

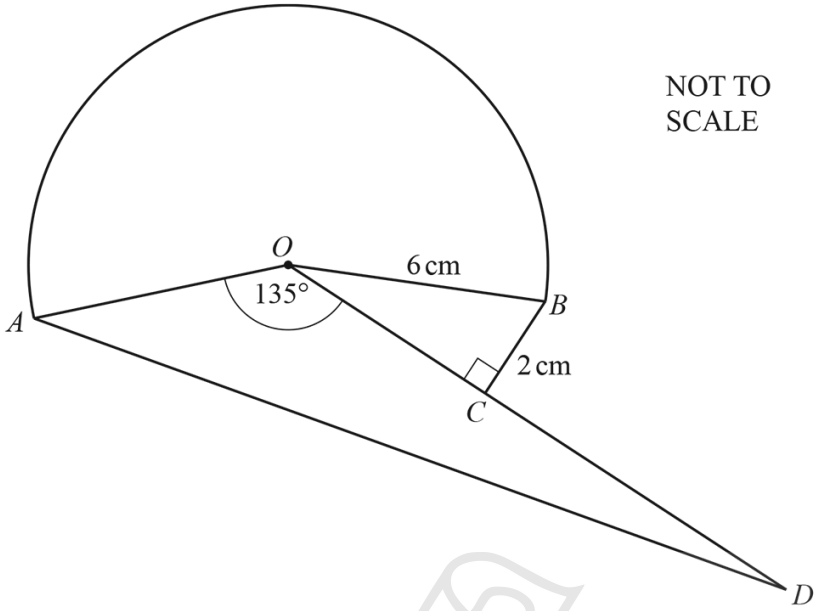
Calculate the new depth of water in the cube.

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

..... cm [3]

15. 0580_w23_qp_43 Q: 8

(a)



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 $AOC = 135°$ and angle $BCO = 90°$.

(i) Show that angle $BOC = 19.5°$, 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]

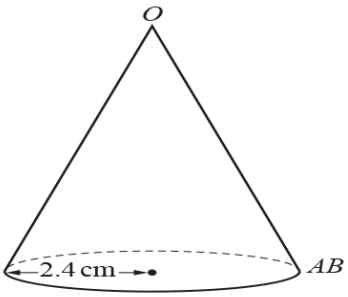
(b) A sector of a circle has radius 8 cm and area 160 cm^2.
A mathematically similar sector has radius 20 cm.

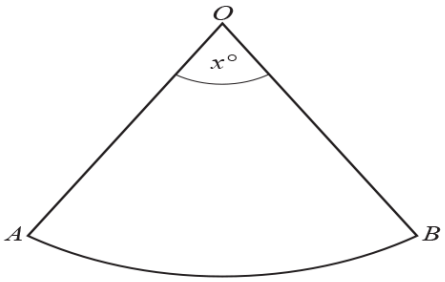
Calculate the area of the larger sector.

..... cm^2 [3]

16. 0580_m22_qp_42 Q: 9

(a)





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]

17. 0580_w22_qp_41 Q: 1

(a) Calculate the volume of

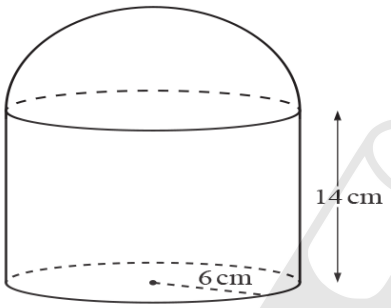
(i) a solid cylinder with radius 6 cm and height 14 cm,

..... 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]

(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]

(c) 2000 cm^3 of iron is melted down and some of it is used to make 50 spheres with radius 2 cm.

(i) Calculate the percentage of iron that is left over.
[The volume, V, of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... % [3]

(ii) The iron left over is then made into a cube.

Calculate the length of an edge of the cube.

..... cm [1]

(d) A solid cone has radius $3R$ cm and slant height $9R$ cm.
A solid cylinder has radius x cm and height $7x$ cm.
The **total** surface area of the cone is equal to the **total** surface area of the cylinder.

Given that $R = kx$, find the value of k.
[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi rl$.]

$k =$ ..... [4]

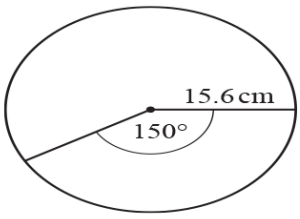
18. 0580_w22_qp_42 Q: 10

(a) The lengths of the sides of a triangle are 11.4 cm, 14.8 cm and 15.7 cm, all correct to 1 decimal place.

Calculate the upper bound of the perimeter of the triangle.

..... cm [2]

(b)

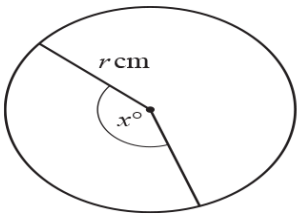


The diagram shows a circle, radius 15.6 cm.
The angle of the minor sector is 150°.

Calculate the area of the minor sector.

..... cm^2 [2]

(c)

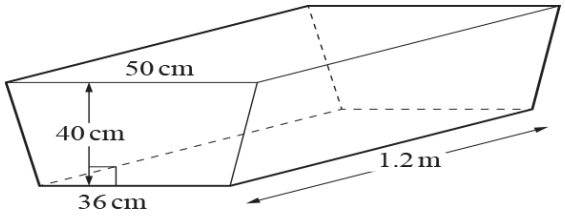


The diagram shows a circle, radius r cm and minor sector angle $x°$.
The **perimeter** of the major sector is three times the **perimeter** of the minor sector.

Show that $x = \frac{90(\pi - 2)}{\pi}$.

[4]

19. 0580_w22_qp_43 Q: 5



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.

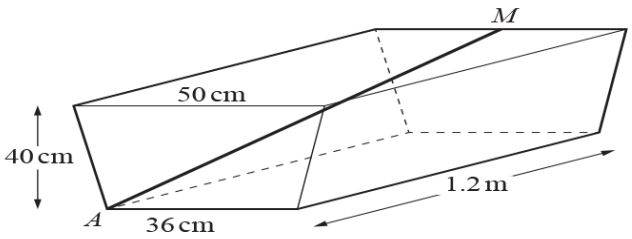
..... cm [3]

(ii) The tank is 60% full.

Calculate the height of the tank.

..... cm [2]

(d)



NOT TO SCALE

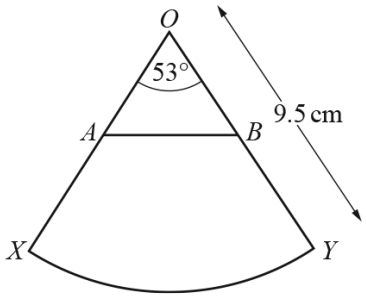
A steel rod AM is placed inside the empty water trough as shown in the diagram.
A is a vertex at the base of the isosceles trapezium and M is the midpoint of the top edge on the opposite face.

Calculate the length of the steel rod, AM.

$AM =$ ..... cm [4]

20. 0580_m21_qp_42 Q: 8

(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.

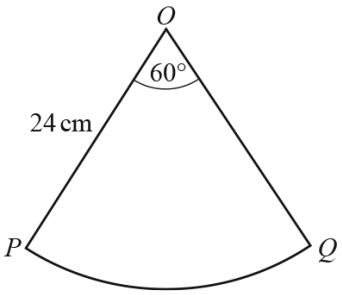
[2]

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

Calculate OA.

$OA =$ ..... cm [4]

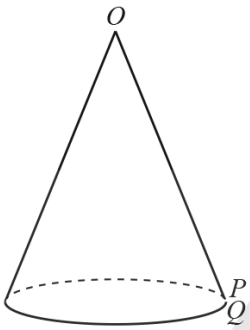
(b)



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

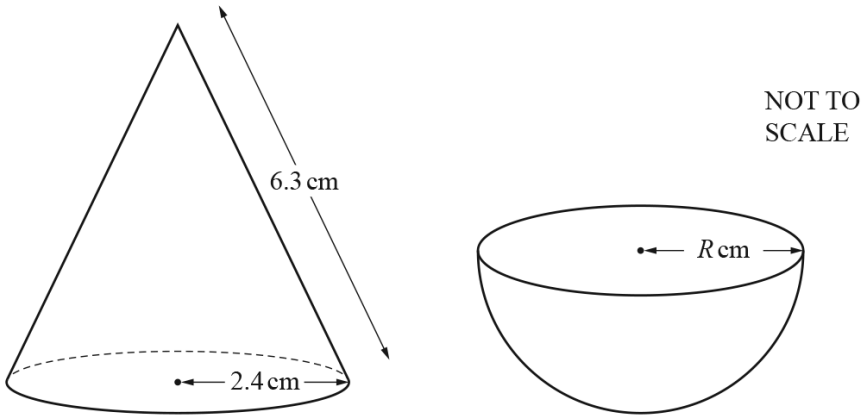
Calculate the volume of the cone.

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

..... cm^3 [6]

21. 0580_s21_qp_41 Q: 3

(a)



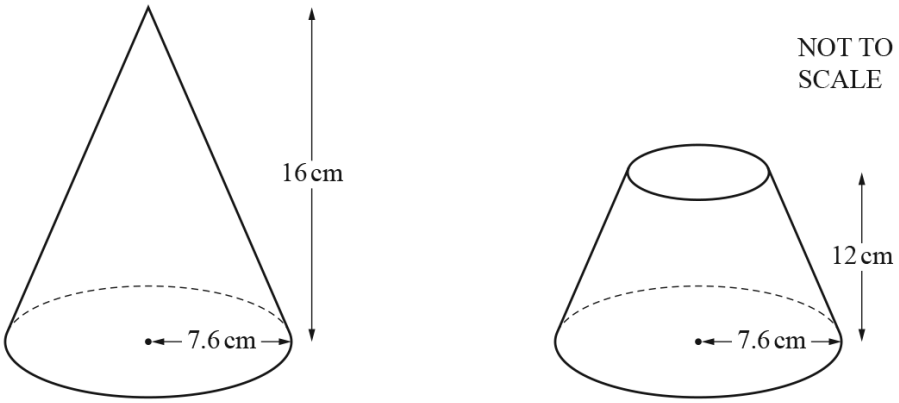
The diagram shows a solid cone and a solid hemisphere.
The cone has radius 2.4 cm and slant height 6.3 cm.
The hemisphere has radius R cm.
The **total** surface area of the cone is equal to the **total** surface area of the hemisphere.

Calculate the value of R.

[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi rl$.]
[The curved surface area, A, of a sphere with radius r is $A = 4\pi r^2$.]

$R =$ ..... [4]

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

..... cm^3 [4]

22. 0580_s21_qp_43 Q: 8

(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 $1 cm^2$ of the cuboid.
Give your answer in cents.

..... cents [1]

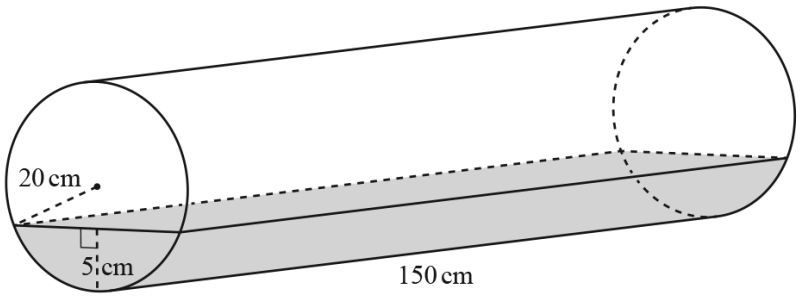
(b) A solid metal cylinder with radius x and height $\frac{9x}{2}$ is melted.
All the metal is used to make a sphere with radius r.

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]

(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]

23. 0580_m20_qp_42 Q: 3

(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]

24. 0580_m20_qp_42 Q: 4

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 $A = \pi rl$.]

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

..... cm^3 [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]

25. 0580_p20_qp_40 Q: 5

(a)

NOT TO SCALE

The perimeter of the rectangle is 80 cm.
The area of the rectangle is A cm^2.

(i) Show that $x^2 - 40x + A = 0$.

[3]

(ii) When $A = 300$, solve the equation $x^2 - 40x + A = 0$ by factorising.

$x =$ ..... or $x =$ ..... [3]

(iii) When $A = 200$, solve the equation $x^2 - 40x + A = 0$ using the quadratic formula.
Show all your working and give your answers correct to 2 decimal places.

$x =$ ..... or $x =$ ..... [4]

(b) A car completes a 200 km journey at an average speed of x km/h.
The car completes **the return journey** of 200 km at an average speed of $(x + 10)$ km/h.

(i) Show that the difference between the time taken for each of the two journeys is $\frac{2000}{x(x+10)}$ hours.

[3]

(ii) Find the difference between the time taken for each of the two journeys when $x = 80$.
Give your answer in **minutes** and **seconds**.

..... min ..... s [3]

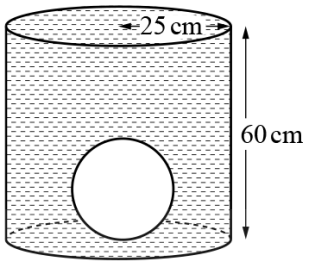
26. 0580_p20_qp_40 Q: 10

(a) Show that the volume of a metal sphere of radius 15 cm is 14 140 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.

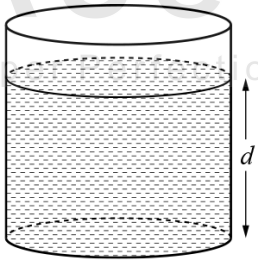


NOT TO SCALE

Calculate the volume of water needed to fill the tank.

..... cm^3 [3]

(ii) The sphere is removed from the tank.

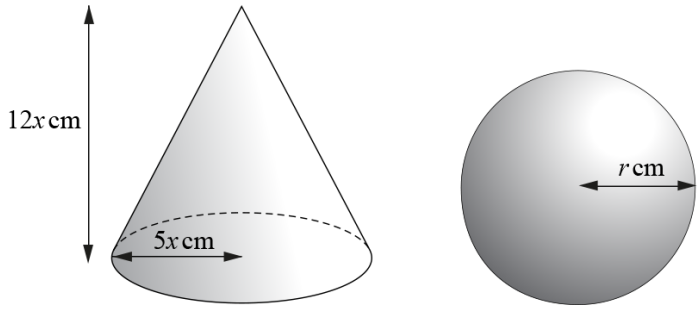


NOT TO SCALE

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

d = ... cm [2]

(c) The diagram below shows a solid circular cone and a solid sphere.



NOT TO SCALE

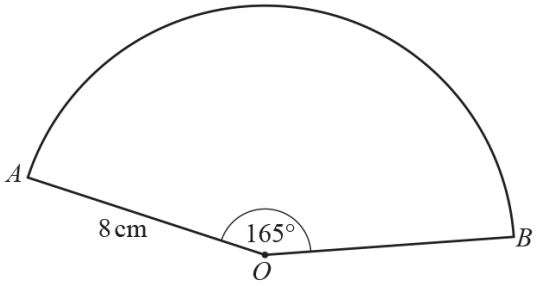
The cone has radius $5x$ cm and height $12x$ cm.
The sphere has radius r cm.
The cone has the same **total** surface area as the sphere.

Show that $r^2 = \frac{45}{2}x^2$.

[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi rl$.]
[The surface area, A, of a sphere with radius r is $A = 4\pi r^2$.]

[5]

27. 0580_s20_qp_41 Q: 9



NOT TO SCALE

The diagram shows a sector of a circle with centre O, radius 8 cm and sector angle 165°.

(a) Calculate the total perimeter of the sector.

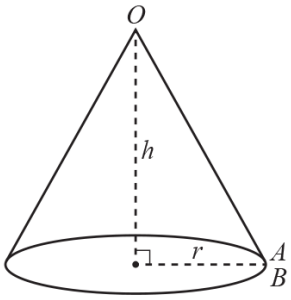
..... cm [3]

(b) The surface area of a sphere is the same as the area of the sector.

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

..... cm [4]

(c)



NOT TO SCALE

A cone is made from the sector by joining OA to OB.

(i) Calculate the radius, r, of the cone.

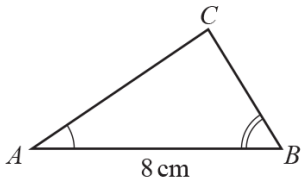
$r =$ ..... cm [2]

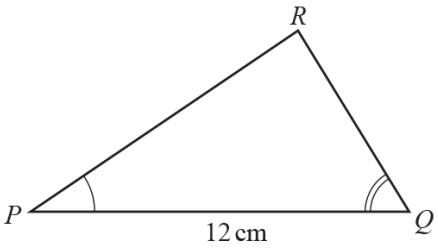
(ii) Calculate the volume of the cone.
[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

..... cm^3 [4]

28. 0580_s20_qp_42 Q: 8

(a)





NOT TO SCALE

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 $V = \frac{4}{3}\pi r^3$.]

$h =$ ..... [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 $V = \frac{4}{3}\pi r^3$.]

$r =$ ..... [3]

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

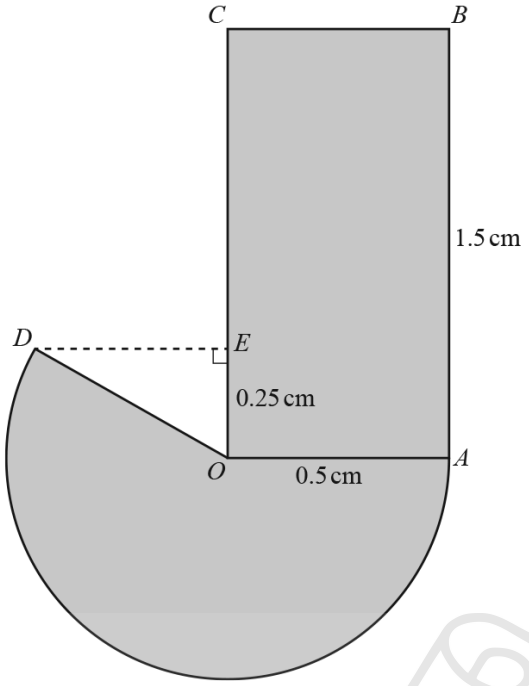
The surface area of a sphere with radius R cm is equal to the total surface area of the cylinder.

Find an expression for R in terms of x.

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

$R =$ ..... [3]

29. 0580_m19_qp_42 Q: 6



The diagram shows a company logo made from a rectangle and a major sector of a circle.
The circle has centre O and radius OA.
$OA = OD = 0.5$ cm and $AB = 1.5$ cm.
E is a point on OC such that $OE = 0.25$ cm and angle $OED = 90°$.

(a) Calculate the perimeter of the logo.

..... cm [5]

(b) Calculate the area of the logo.

..... cm^2 [3]

(c) A mathematically similar logo is drawn.
The area of this logo is $77.44\,cm^2$.

(i) Calculate the radius of the major sector in this logo.

..... cm [3]

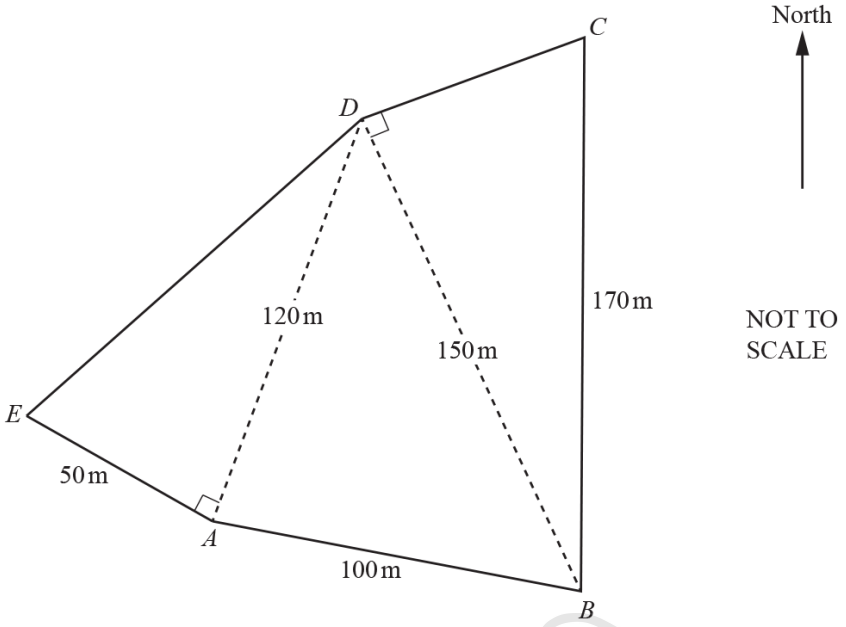
(ii) A gold model is made.
This model is a prism with a cross-section of area $77.44\,cm^2$.

This gold model is 15 mm thick.
One cubic centimetre of gold has a mass of 19 grams.

Calculate the mass of the gold model in kilograms.

..... kg [3]

30. 0580_s19_qp_41 Q: 3



The diagram shows a field *ABCDE*.

(a) Calculate the perimeter of the field *ABCDE*.

..... m [4]

(b) Calculate angle *ABD*.

Angle *ABD* = ... [4]

(c) **(i)** Calculate angle *CBD*.

Angle *CBD* = ... [2]

(ii) The point *C* is due north of the point *B*.

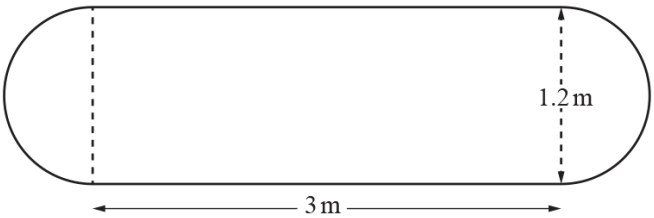
Find the bearing of *D* from *B*.

..... [2]

(d) Calculate the area of the field *ABCDE*.
Give your answer in hectares.
[1 hectare = 10 000 m^2]

..... hectares [4]

31. 0580_s19_qp_41 Q: 5



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.

..... m^2 [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]

32. 0580_s19_qp_41 Q: 10

The volume of each of the following solids is $1000\,\text{cm}^3$.

Calculate the value of x for each solid.

(a) A cube with side length x cm.

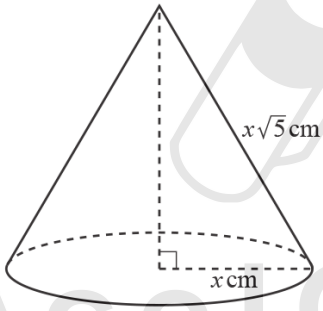
$x =$ ..... [1]

(b) A sphere with radius x cm.

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

$x =$ ..... [3]

(c)

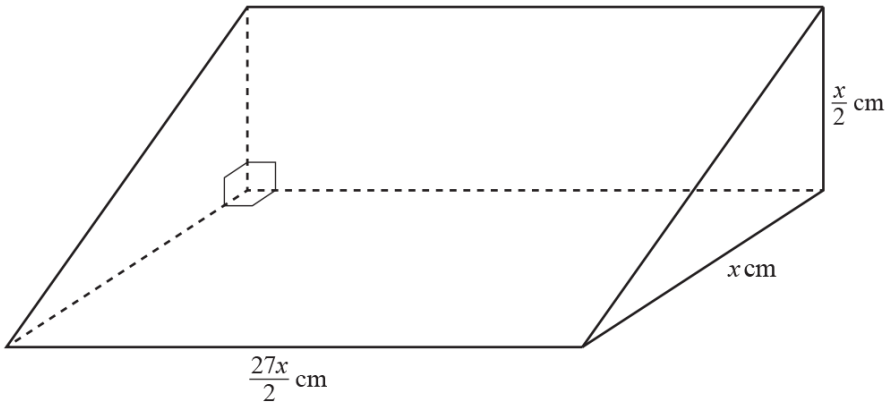


NOT TO SCALE

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

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

$x =$ ..... [4]



NOT TO SCALE

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

$x =$ ..... [4]

33. 0580_s19_qp_42 Q: 10

(a) The volume of a solid metal sphere is 24 430 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.

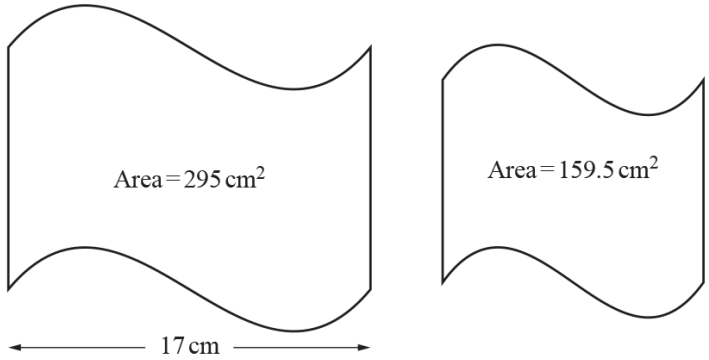
..... litres [3]

(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)



NOT TO SCALE

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]

34. 0580_s19_qp_43 Q: 4

(a)

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 $V = \frac{4}{3}\pi r^3$.]

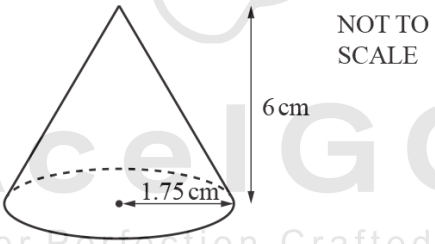
[2]

(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)

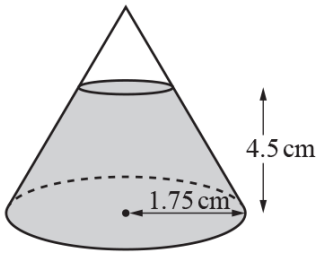


The diagram shows a cone with radius 1.75 cm and height 6 cm.

(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 $A = \pi rl$.]

..... cm^2 [5]

(ii)



NOT TO SCALE

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 cm^3, 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]

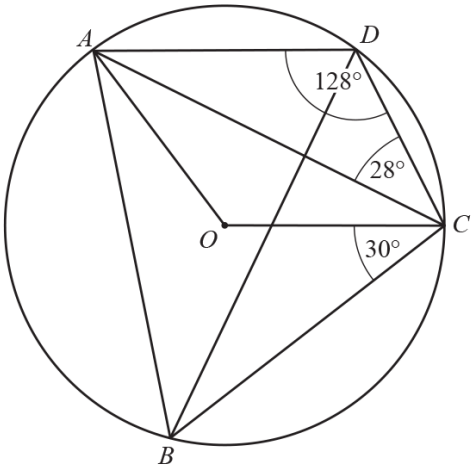
(b) The salt is removed from the cone at a constant rate of 200 mm^3 per second.

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

..... s [3]

35. 0580_w19_qp_43 Q: 6

(a)



NOT TO SCALE

In the diagram, A, B, C and D lie on the circle, centre O.
Angle $ADC = 128°$, angle $ACD = 28°$ and angle $BCO = 30°$.

(i) Show that obtuse angle $AOC = 104°$.
Give a reason for each step of your working.

[3]

(ii) Find angle BAO.

Angle BAO = ... [2]

(iii) Find angle ABD.

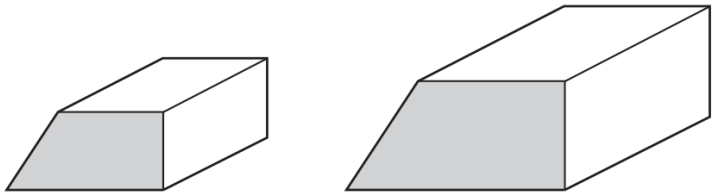
Angle ABD = ... [1]

(iv) The radius, OC, of the circle is 9.6 cm.

Calculate the total perimeter of the sector $OADC$.

..... cm [3]

(b)



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]

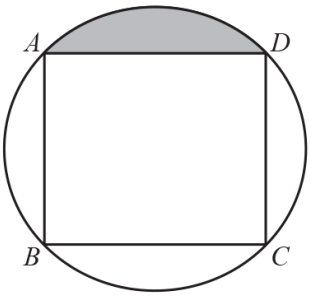
(ii) The larger prism is melted down into a sphere.

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]

36. 0580_m18_qp_42 Q: 2



NOT TO SCALE

The vertices of a square *ABCD* lie on the circumference of a circle, radius 8 cm.

(a) Calculate the area of the square.

..... cm^2 [2]

(b) **(i)** Calculate the area of the shaded segment.

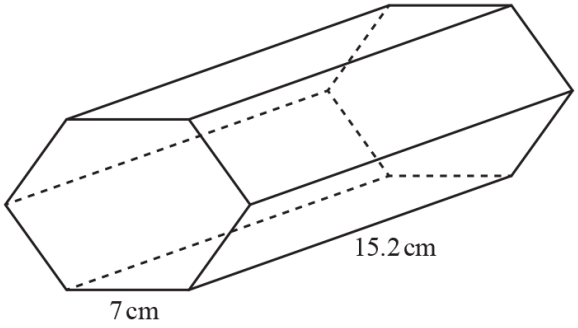
..... cm^2 [3]

(ii) Calculate the perimeter of the shaded segment.

..... cm [4]

37. 0580_m18_qp_42 Q: 5

(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.

..... cm^3 [5]

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

..... cm^2 [3]

(b) Another solid metal prism with volume 500 cm^3 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]

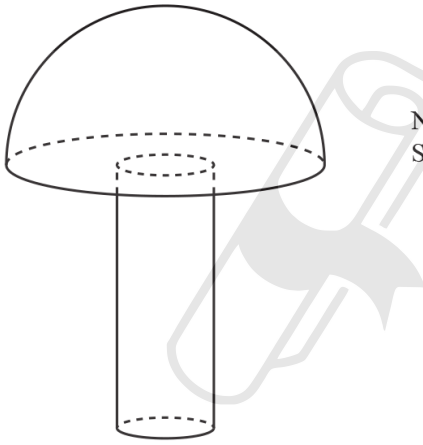
38. 0580_s18_qp_41 Q: 6
A solid hemisphere has volume 230 cm^3.

(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.



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

(i) Calculate the height of the cylinder.

..... cm [3]

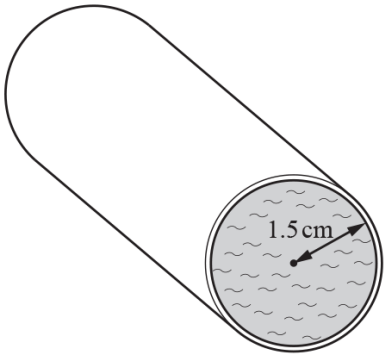
(ii) A mathematically similar toy has volume 19 200 cm^3.

Calculate the radius of the cylinder for this toy.

..... cm [3]

39. 0580_s18_qp_43 Q: 7

(a)



NOT TO SCALE

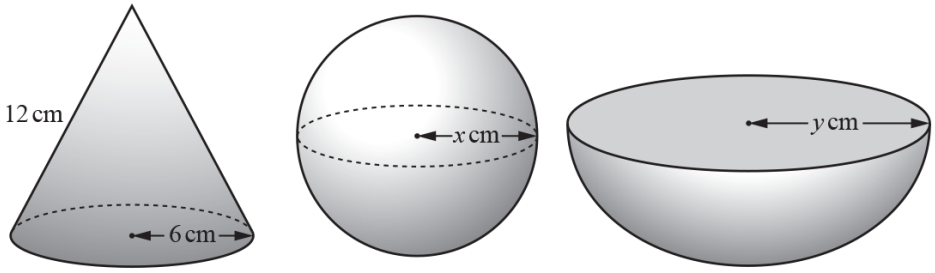
Water flows through a cylindrical pipe at a speed of 8 cm/s.
The radius of the circular cross-section is 1.5 cm and the pipe is always completely full of water.

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

..... litres [4]

(b)

NOT TO SCALE



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 $A = \pi rl$.]

[2]

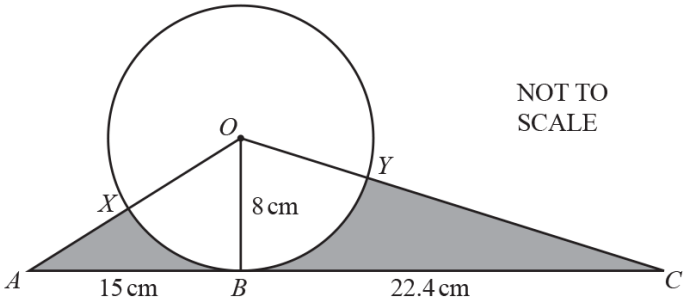
(ii) Find the value of x and the value of y.

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

x = ...

y = ... [4]

40. 0580_w18_qp_41 Q: 10



The diagram shows a circle, centre O.
The straight line ABC is a tangent to the circle at B.
$OB = 8$ cm, $AB = 15$ cm and $BC = 22.4$ cm.
AO crosses the circle at X and OC crosses the circle at Y.

(a) Calculate angle XOY.

Angle XOY = ... [5]

(b) Calculate the length of the arc XBY.

..... cm [2]

(c) Calculate the total area of the two shaded regions.

..... cm^2 [4]

41. 0580_w18_qp_42 Q: 10

(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.

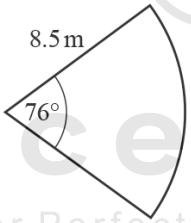
[1]

(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)



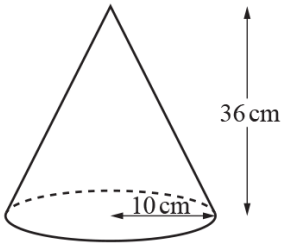
NOT TO SCALE

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]

(b)



NOT TO SCALE

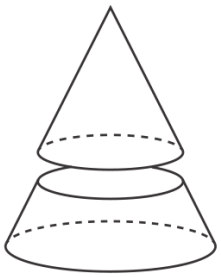
A solid metal cone has radius 10 cm and height 36 cm.

(i) Calculate the volume of this cone.

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

..... cm^3 [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.

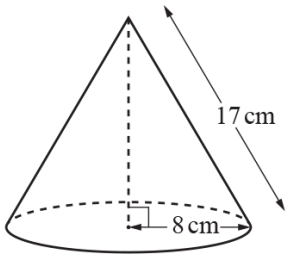
Calculate the radius of the smaller sphere.

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

..... cm [4]

42. 0580_w18_qp_43 Q: 3

(a)



NOT TO SCALE

The diagram shows a solid cone.
The radius is 8 cm and the slant height is 17 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 $A = \pi rl$.]

..... cm^2 [2]

(ii) 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]

(iii) The cone is made of wood and 1 cm^3 of the wood has a mass of 0.8 g.

Calculate the mass of the cone.

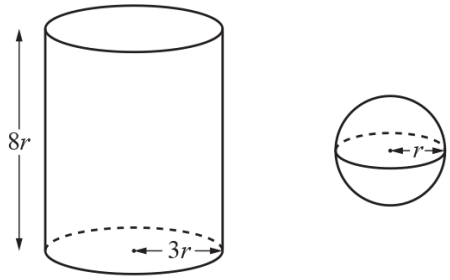
..... g [1]

(iv) The cone is placed in a box.
The total mass of the cone and the box is 1.2 kg.

Calculate the mass of the box.
Give your answer in grams.

..... g [1]

(b)



NOT TO SCALE

The diagram shows a solid cylinder and a solid sphere.
The cylinder has radius $3r$ and height $8r$.
The sphere has radius r.

(i) Find the volume of the sphere as a fraction of the volume of the cylinder.
Give your answer in its lowest terms.

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

..... [4]

(ii) The surface area of the sphere is $81\pi\,\text{cm}^2$.

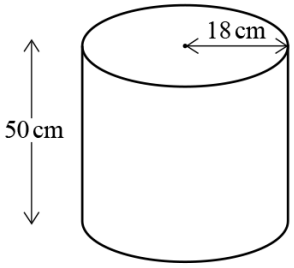
Find the **curved** surface area of the cylinder.
Give your answer in terms of π.

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

..... cm^2 [4]

43. 0580_s17_qp_41 Q: 5

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



NOT TO SCALE

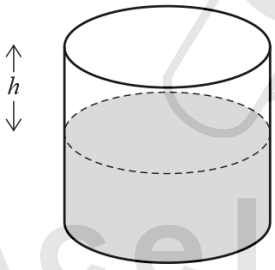
The container has a height of 50 cm and a radius of 18 cm.

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

[2]

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

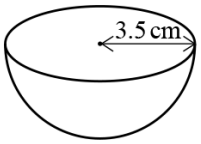
Work out the height, h, of the empty space in the container.



NOT TO SCALE

h = ... 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.



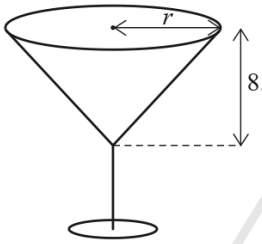
NOT TO SCALE

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

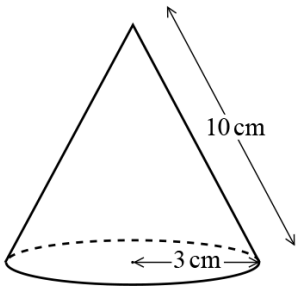
[3]

(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]

44. 0580_s17_qp_42 Q: 5



NOT TO SCALE

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 $A = \pi rl$.]

..... cm^2 [2]

(ii) Calculate the perpendicular height of the cone.

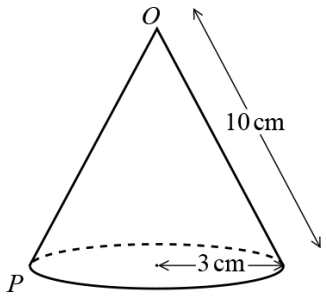
..... cm [3]

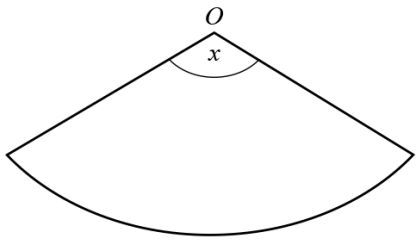
(iii) Calculate the volume of the cone.

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

..... cm^3 [2]

(b)





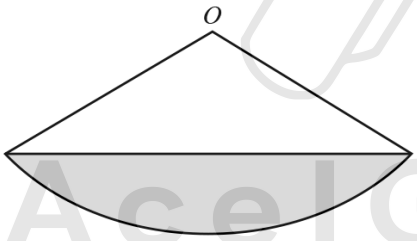
NOT TO SCALE

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.

$x =$ ..... [4]

(c)



NOT TO SCALE

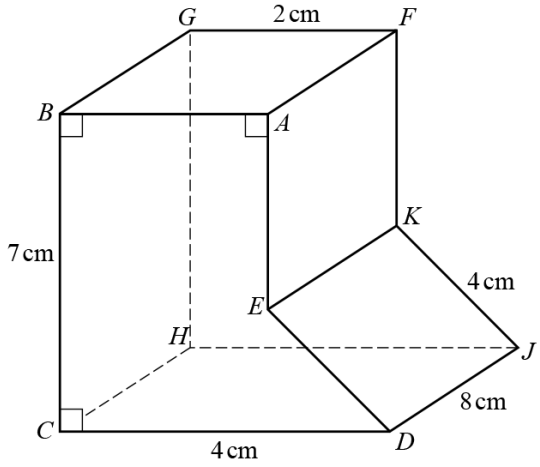
The diagram shows the same sector as in **part (b)**.

Calculate the area of the shaded segment.

..... cm^2 [4]

45. 0580_s17_qp_43 Q: 4

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



NOT TO SCALE

(i) Calculate the area of the cross section *ABCDE*.

.....cm^2 [6]

(ii) The prism is of length 8 cm.

Calculate the volume of the prism.

.....cm^3 [1]

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

(i) Calculate the radius of the cylinder.

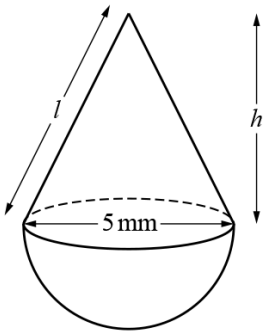
..... cm [3]

(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]

46. 0580_w17_qp_41 Q: 8



NOT TO SCALE

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 $\frac{115\pi}{4}$ mm^2.

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 $A = \pi rl$.]
[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.

h = ... 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 $V = \frac{4}{3}\pi r^3$.]

.....mm^3 [4]

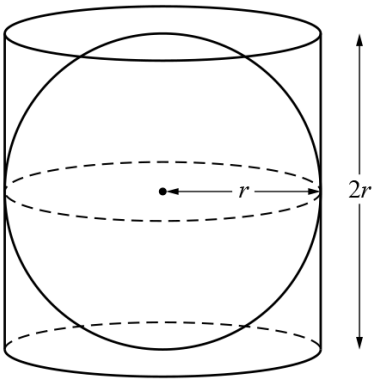
(d) The solid is made from gold.
1 **cubic centimetre** of gold has a mass of 19.3 grams.
The value of 1 gram of gold is $38.62 .

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

$..... [3]

47. 0580_w17_qp_42 Q: 2

(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 $V = \frac{4}{3}\pi r^3$.]

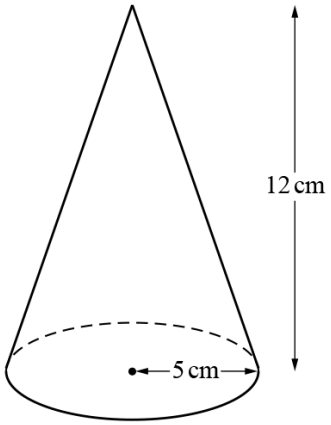
(i) When $r = 8$ cm, calculate the volume inside the cylinder which is **not** occupied by the sphere.

..... cm^3 [3]

(ii) Find r when the volume inside the cylinder **not** occupied by the sphere is $36\,cm^3$.

r = ... cm [3]

(b)



NOT TO SCALE

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 $A = \pi rl$.]

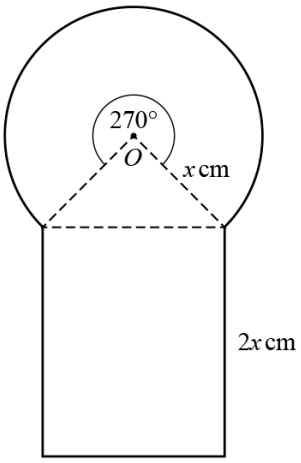
\$ ..... [4]

(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]

48. 0580_w17_qp_42 Q: 10



NOT TO SCALE

The diagram shows a sector of a circle, a triangle and a rectangle.
The sector has centre O, radius x cm and angle 270°.
The rectangle has length $2x$ cm.

The total area of the shape is kx^2 cm^2.

(a) Find the value of k.

k = ... [5]

(b) Find the value of x when the total area is 110 cm^2.

x = ... [2]

01. 0580_m24_ms_42 Q: 4

Question	Answer	Marks	Partial Marks
(a)(i)	432	**2**	**M1** for 12 × 12 × 9 ÷ 3 oe

Question	Answer	Marks	Partial Marks
(a)(ii)	404 or 403.5 to 403.7	**5**	**M4** for $12^2 + 4 \times \frac{1}{2} \times 12 \times \sqrt{6^2 + 9^2}$ oe or **M3** for $\frac{1}{2} \times 12 \times \sqrt{6^2 + 9^2}$ oe or **M2** for explicit method to find height of triangular face e.g. $\sqrt{6^2 + 9^2}$ oe or **M1** for implicit method to find height of triangular face or for $6^2 + 9^2$ oe seen or **B1** for slant height of triangle FC $\sqrt{153}$ or $3\sqrt{17}$ or 12.4 or 12.36 to 12.37 soi
(b)	4.4[0] or 4.398 to 4.399... nfww	**4**	**M3** for $\sqrt{\frac{304}{(2+3) \times \pi}}$ oe or **M2** for $\frac{4\pi r^2}{2} + \pi r \times 3r = 304$ oe or **M1** for $\frac{4\pi r^2}{2}$ oe seen or $\pi r \times 3r$ oe seen

02. 0580_m24_ms_42 Q: 12

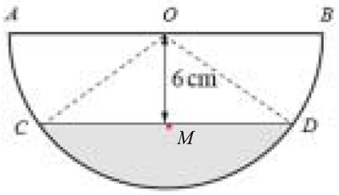
Question	Answer	Marks	Partial Marks
(a)	88.9 or 88.92 to 88.93...	4	**M3** for $2\times12+\frac{360-50}{360}\times2\times\pi\times12$ oe or **M2** for $\frac{(360-50)}{360}\times2\times\pi\times12$ oe isw or **M1** for $\frac{50}{360}\times2\times\pi\times12$ oe isw
(b)	9.01 or 9.009 to 9.010…	3	**M2** for $\frac{(360-50)}{360}\times\pi\times12^2\times h=3510$ or **M1** for $\frac{k}{360}\times\pi\times12^2\times h$ oe seen with k = 50 or 360 – 50

03. 0580_s24_ms_41 Q: 7

Question	Answer	Marks	Partial Marks
(a)(i)	10 100	3	**M2** for $30\times70+2\times30\times40+2\times40\times70$ or **M1** for 30 × 40 or 30 × 70 or 40 × 70
(a)(ii)	16	3	**M2** for 2 fit width, 2 fit height and 4 fit length soi or **M1** for 70, 30 or 40 ÷ 15 or 20
(b)(i)	$\frac{1}{3}\pi r^2\times3r$ = *their* (750 ÷ 8.9) oe	M2	**M1** for using 750 and 8.9 correctly in $v=m/d$ oe or 750 ÷ 8.9
	$r^3=\frac{\textit{their}(750\div8.9)}{\pi}$ oe	M1dep	
	r = 2.993…	A1	

Question	Answer	Marks	Partial Marks
(b)(ii)	117 or 116.9 to 117.2	**5**	**M4** for $\pi \times 2.99^2 + \pi \times 2.99 \times \sqrt{2.99^2 + (3 \times 2.99)^2}$ oe or **M3** for $\pi \times 2.99 \times \sqrt{2.99^2 + (3 \times 2.99)^2}$ or **M2** for $\sqrt{2.99^2 + (3 \times 2.99)^2}$ or **M1** for $2.99^2 + (3 \times 2.99)^2$ or for $\pi \times 2.99^2$

04. 0580_s24_ms_42 Q: 4

Question	Answer	Marks	Partial Marks
(a)(i)	22 620 cao	**3**	**B2** for 7200π or 22 608 to 22 629 or **M1** for $\frac{1}{2}\times\pi\times12^2$[×figs 1] oe
(a)(ii)	8840 or 8850 or 8836 to 8850. 	**5**	**M1** for cos $COM = \frac{6}{12}$ oe or sin $AOC = \frac{6}{12}$ oe **M1** for $\left(\frac{their\,COD}{360}\times\pi\times12^2\right)$ oe **M1** for $\left(\frac{1}{2}\times12^2\times\sin(their\,COD)\right)$ oe **M1dep** for (*their* area of sector *COD*–*their* area of triangle *COD*) ×100 **dep** on at least M1M1 oe
(b)	647 or 646.8	**3**	**M2** for $2.2 = \frac{m}{42\times35\times0.2}$ oe or **M1** for [vol of stone =] 42×35×0.2 oe If 0 scored **SC1** for answer figs 647 or figs 6468
(c)	46.1 or 46.12 to 46.14	**4**	**M3** for tan = $\frac{15}{\sqrt{8^2+12^2}}$ oe or **M2** for $8^2 + 12^2$ oe or $8^2 + 12^2 + 15^2$ oe or **M1** for identifying the angle *GAC*

05. 0580_s24_ms_42 Q: 5

Question	Answer	Marks	Partial Marks
(a)	$125x^9$ final answer	**2**	**B1** for answer $125x^k$ or mx^9 or for correct answer seen then spoilt

Question	Answer	Marks	Partial Marks
(b)	6^{n-2} oe final answer	**2**	**B1** for answer of form 6^k oe or answer of the form $\left(\frac{1}{6}\right)^{-k}$ oe or for correct answer seen
(c)	$3x^3 + 2x^2 - 37x + 12$ final answer	**3**	**B2** for correct expansion of three brackets unsimplified or for simplified four-term expression of correct form with 3 terms correct or **B1** for correct expansion of two brackets with at least 3 terms out of 4 correct
(d)(i)	eliminates the fraction correctly eg $(3x + 5)(x - 2) + 7 = x(x - 2)$	**M1**	
	$3x^2 + 5x - 6x - 10 + 7 = x^2 - 2x$ oe	**B2**	**B1** for $3x^2 + 5x - 6x - 10$ [+ 7] oe seen with at least 3 terms correct
	leading to $2x^2 + x - 3 = 0$	**A1**	**dep** on M1 B2 with no errors or omissions
(d)(ii)	$(2x+3)(x-1)$	**M2**	or **M1** for $(2x + a)(x + b)$ where $ab = -3$ or $2b + a = [+]1$ or for partial factors $2x(x - 1) + 3(x - 1)$ or $x(2x + 3) - [1](2x + 3)$
	-1.5 oe and $+1$	**B1**	
(e)	[TSA cylinder =] $2\pi x^2 + 2\pi x \times 3x$	**M1**	
	[TSA hemisphere=] $\pi(5y)^2 + \frac{4\pi(5y)^2}{2}$	**M1**	
	Leading to $2\pi x^2 + 6\pi x^2 = 50\pi y^2 + 25\pi y^2$ oe	**M1**	dep **M1M1**
	$x^2 = \frac{75y^2}{8}$	**A1**	dep on **M1M1M1**

06. 0580_s24_ms_42 Q: 9

Question	Answer	Marks	Partial Marks
(a)	[a =] 9 [b =] 14	**3**	**B2** for a =9 OR **M2** for $\frac{60}{360}\times 2\times\pi\times 17+\frac{60}{360}\times 2\times\pi\times 10+7+7$ oe or **M1** for $\frac{60}{360}\times 2\times\pi\times 17$ oe **or** $\frac{60}{360}\times 2\times\pi\times 10$ oe If 0 scored **SC1** for b =14
(b)(i)	60° at centre or interior angle = 120°	**B1**	
	[6×]$\frac{1}{2}\times d^2\times\sin 60$ oe	**M1**	
	[d^2 =]$\frac{127.3}{6\times\frac{1}{2}\times\sin 60}$	**M1**	
	6.99[9…] to 7.00[…]	**A1**	Dep on M1M1
(b)(ii)(a)	1273	**1**	
(b)(ii)(b)	675 or 674.5 to 674.6	**2**	**M1** for 2 ×127.3 oe or 6 × 7 × 10 oe

07. 0580_s24_ms_43 Q: 4

Question	Answer	Marks	Partial Marks
(a)	$\frac{1}{2}(r+5)(r+2)\sin 30=(r+1)^2$	**M2**	**M1** for $\frac{1}{2}(r+5)(r+2)\sin 30$ oe
	$r^2+5r+2r+10$ or $r^2+r+r+1$ soi	**B1**	
	Leading to $3r^2+r-6=0$ with no errors or omissions	**A1**	Dependent on both expansions seen

Question	Answer	Marks	Partial Marks
(b)	$\frac{-1\pm\sqrt{1^2-4(3)(-6)}}{2(3)}$ Or $-\frac{1}{6}\pm\sqrt{2+\left(\frac{1}{6}\right)^2}$ oe or $\frac{1}{3}\left(-\frac{1}{2}\pm\sqrt{18+\left(\frac{1}{2}\right)^2}\right)$ oe	**B2**	**B1** for $\sqrt{1^2-4(3)(-6)}$ or for $\frac{-1+\sqrt{p}}{2(3)}$ or $\frac{-1-\sqrt{p}}{2(3)}$ or $\left(r+\frac{1}{6}\right)^2$ or $\left(3r+\frac{1}{2}\right)^2$
	–1.59 and 1.26	**B1**	
(c)	9.028 to 9.040	**2**	**M1** for (*their* root (greater than –1) + 1) × 4

08. 0580_s24_ms_43 Q: 8

Question	Answer	Marks	Partial Marks
(a)(i)	37.3 or 37.26 to 37.27	**5**	**M2** for $\pi \times 0.35 \times \sqrt{0.35^2+1.5^2}$ oe or **M1** for $0.35^2+1.5^2$ or better **M1** for $\pi \times 0.35^2$ **M1** for $2 \times \pi \times 0.35 \times 16$
(a)(ii)	6.35 or 6.349 to 6.351	**3**	**M1** for $\pi \times 0.35^2 \times 16$ **M1** for $\frac{1}{3} \times \pi \times 0.35^2 \times 1.5$
(a)(iii)	22.2 or 22.3 or 22.24 to 22.26	**3**	**M2** for $17.5 \times 3.5 \times 1.4 - 10 \times$ *their* **(a)(ii)** or **M1** for $17.5 \times 3.5 \times 1.4$

Question	Answer	Marks	Partial Marks
(b)	154 or 154.3 to 154.4	**3**	**M2** for $450 \times \left(\sqrt{\frac{98}{200}}\right)^3$ oe or **M1** for $\left(\sqrt{\frac{98}{200}}\right)^3$ or $\left(\sqrt{\frac{200}{98}}\right)^3$ oe or for $\left(\frac{450}{V}\right)^2 = \left(\frac{200}{98}\right)^3$ oe

09. 0580_m23_ms_42 Q: 3

Question	Answer	Marks	Partial Marks
(a)	$[h =] \frac{\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3}{\pi\times12^2}$ oe leading to 0.125 or $3 - \frac{\pi\times12^2\times3 - \frac{1}{2}\times\frac{4}{3}\times\pi\times3^3}{\pi\times12^2}$ oe leading to 0.125	**M3**	**M2** for $\pi\times12^2\times h = \frac{1}{2}\times\frac{4}{3}\times\pi\times3^3$ oe or for $\pi\times12^2\times3 = \pi\times12^2\times x + \frac{2}{3}\times\pi\times3^3$ oe or for $\frac{\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3}{\pi\times12^2\times3} = \frac{h}{3}$ oe or **M1** for $\pi\times12^2\times h$ or $\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3$ oe or $\pi\times12^2\times3$

Question	Answer	Marks	Partial Marks
(b)	4.8[0] or 4.795 to 4.796	**3**	**M2** for $\pi\times12^2\times(3-0.125) = \pi\times R^2\times18$ oe or $\pi\times12^2\times3 - \frac{2}{3}\times\pi\times3^3 = \pi\times R^2\times18$ or **B1** for $3 - 0.125$ or for 414π oe
(c)	10.5 or 10.47 to 10.49	**3**	**M2** for $\frac{\frac{4}{3}\times\pi\times3^3 - 30\times1.5^3}{\frac{4}{3}\times\pi\times3^3}$ or $\frac{30\times1.5^3}{\frac{4}{3}\times\pi\times3^3}\times100$ oe or **M1** for $\frac{4}{3}\times\pi\times3^3 - 30\times1.5^3$ or $\frac{30\times1.5^3}{\frac{4}{3}\times\pi\times3^3}$ oe

10. 0580_m23_ms_42 Q: 8

Question	Answer	Marks	Partial Marks
(a)	54	**2**	**M1** for $\frac{1}{2}\times12\times9$

Question	Answer	Marks	Partial Marks
(b)	$2x^2+13x-85$ [= 0]	B3	**M1** for $\frac{1}{2}(2x+3)(x+5)$ [= 50] oe **B1** for $2x^2+10x+3x+15$
	$\frac{-13\pm\sqrt{13^2-4(2)(-85)}}{2(2)}$ oe or $-\frac{13}{4}\pm\sqrt{\frac{85}{2}+\left(\frac{13}{4}\right)^2}$ oe	M2	**M1** for $\sqrt{13^2-4\times2\times-85}$ oe or for $\frac{-13+\text{or}-\sqrt{p}}{2(2)}$ oe or for [2]$\left(x+\frac{13}{4}\right)^2$
	4.03 cao	B1	

11. 0580_s23_ms_42 Q: 5

Question	Answer	Marks	Partial Marks
(a)(i)	251 or 251.3 to 251.4	2	**M1** for $\frac{1}{3}\times\pi\times4^2\times15$ oe
(a)(ii)	79.5 or 79.51…	5	**M3** for $\pi\times4\times\sqrt{4^2+15^2}$ oe or **M2** for $\sqrt{15^2+4^2}$ oe or **M1** for [l^2 =] 4^2+15^2 oe or $\pi\times4\times$ *their* l **M1** for $\frac{\text{their curved surface area}}{\text{their curved surface area}+\pi\times4^2}$[×100] oe
(b)(i)	13 min 20 sec	3	**B2** for 800 or $\frac{40}{3}$ oe seen or **M1** for figs 3 ÷ figs 375 or figs 3 ÷ 22 500
(b)(ii)	0.472 or 0.4715 to 0.4716…	3	**M2** for $\pi\times0.45^2\times h=0.3$ or $\pi\times45^2\times h=300\,000$ oe or **M1** for $\pi\times\text{figs}45^2\times h=\text{figs}3$ oe

12. 0580_s23_ms_43 Q: 8

Question	Answer	Marks	Partial Marks
(a)	$4x + 3(x + 27) = 194.75$ or $4x + 3x + 81 = 194.75$	**M1**	
	16.25 cao	**B2**	**M1** for $7x = k$ where $k < 194.75$ or **B1** for answer 16.3
(b)	$x^2 - 20x - 69 [= 0]$ oe or $y^2 + 116y - 861 [= 0]$ oe	**M2**	**M1** for $x^2 + 4(-8 - 5x) = 37$ oe or for $37 - 4y = \left(\frac{-8 - y}{5}\right)^2$ oe or for $x^2 + 4y = 37$ and $20x + 4y = -32$ subtracted with no more than one error

Question	Answer	Marks	Partial Marks
	$(x + 3)(x - 23) [= 0]$ oe or $(y - 7)(y + 123) [= 0]$ oe	**M1**	correct method to solve *their* quadratic e.g. $x = \frac{-(-20) \pm \sqrt{(-20)^2 - 4 \times 1 \times (-69)}}{2 \times 1}$ or $x - 10 = \pm 13$ or $x - 10 = \pm\sqrt{169}$
	$x = -3$ $y = 7$ $x = 23$ $y = -123$ final answer	**B2**	**B1** for one correct pair or two correct x values or two correct y values
(c)	$2\pi x \times 6x + 2\pi x^2$ or $2\pi x(6x + x)$	**M2**	or **M1** for $2\pi x \times 6x$ or $2\pi x^2$
	Their $(2\pi x \times 6x + 2\pi x^2) = 4\pi r^2$	**M1**	Dep on at least on M1 earned *Their* LHS must be an area in terms of x only
	At least one further stage of working leading to $r^2 = \frac{7}{2}x^2$	**A1**	with no error seen

13. 0580_w23_ms_41 Q: 8

Question	Answer	Marks	Partial Marks
(a)(i)	$\frac{2}{3}\pi(3.6)^3 + \frac{2}{3}\pi(5.4)^3 + \pi(3.6)^2 \times 6.5$	**M3**	**M1** for either $\frac{2}{3}\pi(3.6)^3$ or $\frac{2}{3}\pi(5.4)^3$ **M1** for $\pi(3.6)^2 \times 6.5$
	692.1 to 692.2…	**A1**	
(a)(ii)	33.6 or 33.60 to 33.62	**4**	**M3** for $\left(\frac{0.6}{3.6}\right)^3 \times 692 \times 10.49$ oe or **M2** for $\left(\frac{0.6}{3.6}\right)^3 \times 692$ oe or **M1** for $\left(\frac{0.6}{3.6}\right)^3$ or $\left(\frac{3.6}{0.6}\right)^3$ oe If 0 scored, **SC1** for *their* volume × 10.49
(b)(i)	12π final answer	**2**	**M1** for $\frac{216}{360} \times 2\pi \times 10$ oe After **0** scored SC1 for final answer 8π or 12π + 20
(b)(ii)	302 or 301.5 to 301.6…	**4**	**M1** for $2\pi r =$ *their* **(b)(i)** oe or for $\frac{216}{360} \times \pi \times 10^2 = \pi \times r \times 10$ oe and **M1** for $[h =] \sqrt{10^2 - \text{their}6^2}$ oe and **M1** for $[V =] \frac{1}{3}\pi(\text{their}6)^2 \times (\text{their}8)$

14. 0580_w23_ms_42 Q: 4

Question	Answer	Marks	Partial Marks
(a)	72 or 72.0 cao nfww	3	**M2** for $\frac{x}{360}\times 2\times\pi\times 7.5=2\times\pi\times 1.5$ oe or **M1** for $\frac{x}{360}\times 2\times\pi\times 7.5$ or for $2\times\pi\times 1.5$ oe OR **M2** for $\frac{x}{360}\times\pi\times 7.5^2=\pi\times 1.5\times 7.5$ oe or **M1** for $\frac{x}{360}\times\pi\times 7.5^2$ or for $\pi\times 1.5\times 7.5$ oe
(b)(i)	$2\times\sqrt{17^2-8^2}$ or $\sqrt{34^2-16^2}$ oe	M2	**M1** for $17^2=8^2+d^2$ or $34^2 = 16^2 + k^2$
(b)(ii)	29.3 or 29.30 to 29.31	4	**M3** for $([\pi]\times 8^2\times 30)\div\frac{4}{3}\times[\pi]\times 17^3$ [$\times$ 100] oe OR **M1** for $\pi\times 8^2\times 30$ oe **M1** for $\frac{4}{3}\times\pi\times 17^3$ oe

Question	Answer	Marks	Partial Marks
(c)	12.7 or 12.73 to 12.74	3	**B2** for 2.26 or 2.261 to 2.262…. soi or **M2** for $\left(20^2\times 15-\frac{4}{3}\times\pi\times 6^3\right)\div 20^2$ oe or for $15-\left(\frac{4}{3}\times\pi\times 6^3\div 20^2\right)$ oe or **M1** for $20^2\times 15-\frac{4}{3}\times\pi\times 6^3$ oe or $20^2\times D=\frac{4}{3}\times\pi\times 6^3$ oe If 0 scored, **SC1** for answer 11[.0] or 10.97 to 10.98

15. 0580_w23_ms_43 Q: 8

Question	Answer	Marks	Partial Marks
(a)(i)	$\sin[BOC] = \frac{2}{6}$ or better oe	**M1**	
	19.47…	**A1**	
(a)(ii)	64.6 or 64.55 to 64.58	**3**	**M2** for $\frac{360-135-19.5}{360} \times \pi \times 6^2$ oe or **M1** for $\frac{k}{360} \times \pi \times 6^2$ oe

Question	Answer	Marks	Partial Marks
(a)(iii)	16.1 or 16 10 to 16.13	**5**	**M2** for $2 \times \sqrt{6^2 - 2^2}$ oe or $2 \times 6 \cos 19.5$ oe or **M1** for $OC^2 + 2^2 = 6^2$ oe or $6 \cos 19.5$ or better AND **M2** for $\sqrt{6^2 + \textit{their } OD^2 - 2 \times 6 \times \textit{their } OD \times \cos 135}$ OR **M1** for $6^2 + \textit{their } OD^2 - 2 \times 6 \times \textit{their } OD \times \cos 135$ **A1** for 259 to 260
(a)(iv)	94.2 or 94.3 or 94.15 to 94.27… nfww	**4**	**M1** for ½ × 6 × *their OD* × sin 135 oe **M1** for ½ × 6 × 2 × sin(90 – 19.5) oe or for ½ × *their OC* × 2 **M1dep** for *their* **(a)(ii)** + *their* two triangle areas
(b)	1000 cao	**3**	**M2** for $160 \times \left(\frac{20}{8}\right)^2$ or $160 \div \left(\frac{8}{20}\right)^2$ oe or **M1** for $\left(\frac{20}{8}\right)^2$ or $\left(\frac{8}{20}\right)^2$ oe OR **M2** for $\frac{\text{sector angle}}{360} \times \pi 20^2$ or **M1** for $\frac{160}{\pi 8^2} \times 360$ oe or better OR **M2** for $\frac{\text{percentage}}{100} \times \pi 20^2$ oe or better or **M1** for $\frac{160}{\pi 8^2}$ [× 100] oe or better

16. 0580_m22_ms_42 Q: 9

Question	Answer	Marks	Partial Marks
(a)	54[.0] or 53.99 to 54.03...	6	**M2** for [h =] $95.4 \times 3 \div (\pi \times 2.4^2)$ oe or **M1** for $95.4 = \frac{1}{3} \times \pi \times 2.4^2 \times h$ **M2** for [slant ht , l =] $\sqrt{(their\ h)^2 + 2.4^2}$ or **M1** for $(their\ h)^2 + 2.4^2$ **M1** for $\frac{x}{360} \times 2 \times \pi \times their\ l = 2 \times \pi \times 2.4$ oe or $\frac{x}{360} \times \pi \times (their\ l)^2 = \pi \times 2.4 \times their\ l$

Question	Answer	Marks	Partial Marks
(b)	14500 or 14470 to 14480	4	**M3** for $200 \times 60 \times 24 \times \pi \times 4^2$ [÷1000] or $2 \times 60 \times 24 \times \pi \times 0.04^2$ [×1000] or **M2** for $200 \times \pi \times 4^2$ or for $2 \times \pi \times 0.04^2$ or **M1** for $\pi \times 4^2$ oe or $\pi \times 0.04^2$ seen oe isw or 1000 cm^3 = 1 litre soi or 1 m^3 = 1000 litres soi or for 24×60 seen oe

17. 0580_w22_ms_41 Q: 1

Question	Answer	Marks	Partial Marks
(a)(i)	1580 or 1583 to 1584	2	**M1** for $\pi \times 6^2 \times 14$
(a)(ii)	452 or 452.3 to 452.4...	2	**M1** for $\left[\frac{1}{2}\right] \times \frac{4}{3} \times \pi \times 6^3$
(b)(i)	7.85 ÷ 1000 [= 0.00785]	M1	
(b)(ii)	16[.0] or 15.95 to 15.99	2	**FT** {*their* **(a)(i)** + *their* **(a)(ii)**} × 0.00785 evaluated to 3 sig fig or better **M1** for (*their* **(a)(i)** + *their* **(a)(ii)**) × 0.00785
(c)(i)	16.2 or 16.21 to 16.23	3	**M2** for $\frac{2000 - 50 \times \frac{4}{3} \times \pi \times 2^3}{2000}$ [×100] or for $\frac{50 \times \frac{4}{3} \times \pi \times 2^3}{2000} \times 100$ or **M1** for $\frac{50 \times \frac{4}{3} \times \pi \times 2^3}{2000}$
(c)(ii)	6.87 or 6.870 to 6.872	1	FT $\sqrt[3]{2000 - their\left(50 \times \frac{4}{3} \times \pi \times 2^3\right)}$ evaluated to 3sf or better
(d)	$\frac{2}{3}$ oe	4	**M1** for $[\pi](3R)^2 + [\pi]3R \times 9R$ oe **M1** for $2[\pi]x^2 + 2[\pi]x \times 7x$ oe **M1** for *their* area of cone = *their* area of cylinder seen

18. 0580_w22_ms_42 Q: 10

Question	Answer	Marks	Partial Marks
(a)	42.05 final answer	**2**	**M1** for 11.4 + 0.05 oe or 14.8 + 0.05 oe or 15.7 + 0.05 oe
(b)	319 or 318.5 to 318.6	**2**	**M1** for $\frac{150}{360} \times \pi \times 15.6^2$ oe
(c)	$\frac{360-x}{360} \times 2\pi r + 2r = 3\left(\frac{x}{360} \times 2\pi r + 2r\right)$ oe	**M2**	**M1** for $\frac{x}{360} \times 2\pi r$ oe seen or $\frac{360-x}{360} \times 2\pi r$ oe seen
	$\frac{4x}{360} \times 2\pi[r] = 2\pi[r] - 4[r]$ oe	**M1**	i.e. M mark for isolating and collecting terms in x
	Leading to $\frac{90(\pi-2)}{\pi}$	**A1**	With no errors or omissions

19. 0580_w22_ms_43 Q: 5

Question	Answer	Marks	Partial Marks
(a)	$\left(\frac{(36+50)\times 40}{2}\right)\times 120$ oe or $\left(\frac{(0.36+0.5)\times 0.4}{2}\right)\times 1.2$ oe	**M2**	**M1** for $\frac{(36+50)\times 40}{2}$ oe or $\frac{(0.36+0.5)\times 0.4}{2}$ oe
	206400 ÷ 1000 = 206.4 or 0.2064 × 1000 = 206.4 nfww	**A1**	Must see an explicit conversion
(b)	5 [minutes] 44 seconds	**3**	**B2** for 344 [seconds] oe 5.73…[mins] or **M1** for figs206.4 ÷ figs 6 oe
(c)(i)	28[.0] or 27.96 to 27.97	**3**	**M2** for $[r^2=]\ \frac{\text{figs } 2064}{(figs84)\pi}$ or **M1** for $\pi r^2 \times figs84 = \text{figs } 2064$
(c)(ii)	140 cao	**2**	**M1** for $0.6h = 84$ oe ALT method **M1** for $\pi\times(\textit{their } \textbf{(c)(i)})^2 \times h = figs206400 \div 0.6$ oe
(d)	128 or 127.7 to 127.8	**4**	**B3** for $40^2+120^2+18^2$ oe OR **B1** for horizontal length 18 soi **M1** for any correct attempt at 2-dimensional Pythagoras' 18^2+120^2, 120^2+40^2, 18^2+40^2

20. 0580_m21_ms_42 Q: 8

	Answer	Mark	Partial Marks
(a)(i)	$\frac{53}{360}\times\pi\times9.5^2$	**M1**	
	41.74 to 41.75	**A1**	
(a)(ii)	5.9[0] or 5.899 to 5.903..	**4**	**M3** for $\left[OA^2=\right]\ \frac{\frac{1}{3}\times41.7}{\frac{1}{2}\sin53}$ oe **M2** for $\frac{1}{2}\times OA^2\times\sin53=\frac{1}{3}\times41.7$ oe **M1** for $\frac{1}{2}\times OA\times OB\times\sin53=\frac{1}{3}\times41.7$ seen or better
(b)	396 or 397 or 396.4 to 396.6	**6**	**M2** for $[r=]\left(\frac{60}{360}\times2\times\pi\times24\right)\div2\pi$ oe or better or **M1** for $2\pi r=\frac{60}{360}\times2\times\pi\times24$ oe **M2** for $\sqrt{24^2-a^2}$ or **M1** for $h^2+a^2=24^2$ **M1** for $\frac{1}{3}\pi\times$*their* $r^2\times$*their* h

21. 0580_s21_ms_41 Q: 3

	Answer	Mark	Partial Marks
(a)	2.64 or 2.638…	**4**	**M3** for $[R^2=]\frac{\pi\times2.4^2+\pi\times2.4\times6.3}{\pi+2\pi}$ oe or **M2** for $\pi\times2.4^2+\pi\times2.4\times6.3=\pi R^2+\frac{1}{2}\times4\pi R^2$ or **M1** for $[\pi\times2.4^2]+\pi\times2.4\times6.3$ oe or $[\pi R^2]+\frac{1}{2}\times4\pi R^2$ oe

	Answer	Mark	Partial Marks
(b)	953 or 952.6 to 952.8	**4**	**M3** for $\frac{1}{3}\times\pi\times7.6^2\times16\times\left(1-\left(\frac{16-12}{16}\right)^3\right)$ or $\frac{1}{3}\times\pi\times7.6^2\times16-\frac{1}{3}\times\pi\times1.9^2\times(16-12)$ OR **B1** for top radius = 1.9 or $\left(\frac{16-12}{16}\right)^3$ oe **M2** for $\frac{1}{3}\times\pi\times7.6^2\times16-\frac{1}{3}\times\pi\times(their1.9)^2\times(16-12)$ or $\frac{1}{3}\times\pi\times7.6^2\times16\times\left(1-their\left(\frac{16-12}{16}\right)^3\right)$ or **M1** for $\frac{1}{3}\times\pi\times7.6^2\times16$ or for $\frac{1}{3}\times\pi\times(their1.9)^2\times(16-12)$

22. 0580_s21_ms_43 Q: 8

	Answer	Mark	Partial Marks
(a)(i)	1200	**1**	
(a)(ii)(a)	800	**3**	**M2** for [2 ×] (20 × 12 + 20 × 5 + 12 × 5) or **M1** for 20 × 12 or 20 × 5 or 12 × 5
(a)(ii)(b)	0.19	**1**	**FT** 152 ÷ *their* 800
(b)	$\frac{3x}{2}$ or $1.5x$	**3**	**B2** for $r^3 = \frac{27x^3[\pi]}{8[\pi]}$ or better or **M1** for $\frac{4}{3}\pi r^3 = \pi x^2 \times \frac{9x}{2}$
(c)	13.6 or 13.59 to 13.61	**7**	If chord is *AB* and *O* is centre of the cross section **M2** for $2 \times \cos^{-1}\left(\frac{20-5}{20}\right)$ oe or **M1** for $\cos = \frac{20-5}{20}$ oe **M1** for $\frac{theirAOB}{360} \times \pi \times 20^2$ or $\frac{1}{2}(20)^2\left(\frac{82.8\pi}{180}\right)$ **M1** for $\frac{1}{2} \times 20^2 \times \sin(their\ AOB)$ oe **M1** for *their* area × 150 **M1** for *their* volume ÷ 1000

23. 0580_m20_ms_42 Q: 3

	Answer	Mark	Partial Marks
(a)	187	**2**	**M1** for $220 \times \left(1 - \frac{15}{100}\right)$ oe or **B1** for 33 seen
(b)	19.8	**3**	**M2** for $29.7 \times \sqrt[3]{\frac{0.4}{1.35}}$ oe or **M1** for $\sqrt[3]{\frac{0.4}{1.35}}$ or $\sqrt[3]{\frac{1.35}{0.4}}$ oe seen or for $\frac{29.7^3}{x^3} = \frac{1.35}{0.4}$ oe
(c)	12.4 or 12.44…	**3**	**M1** for $90 \times 75 \times h = 7 \times$ figs 12 **B1** for 1000 cm^3 = 1 litre soi

24. 0580_m20_ms_42 Q: 4

	Answer	Mark	Partial Marks
(a)	32.9 or 32.91 to 32.92…	**2**	**M1** for $\pi \times 1.65 \times 4.7 + \pi \times 1.65^2$
(b)	69.4 or 69.44 to 69.45	**2**	**M1** for cos = $1.65 \div 4.7$ oe
(c)(i)	12.5 or 12.54 to 12.55	**4**	**M3** for $\frac{1}{3} \times \pi \times 1.65^2 \times \sqrt{4.7^2 - 1.65^2}$ oe or **M2** for $\sqrt{4.7^2 - 1.65^2}$ oe or for $4.7 \times \sin(\textit{their}$ **(b)**$)$ oe or **M1** for $1.65^2 + h^2 = 4.7^2$ oe or for $\frac{h}{4.7} = \sin(\textit{their}$ **(b)**$)$ oe
(c)(ii)	41 nfww	**4**	**B3** for 41.7… to 41.9 or **M2** for $\frac{4}{3} \times \pi \times 5^3 \div$ *their* 12.5 or **M1** for $\frac{4}{3} \times \pi \times 5^3$ After **M2** scored, **M1** for truncating *their* decimal number of cones seen to an integer answer

25. 0580_p20_ms_40 Q: 5

	Answer	Mark	Partial Marks
(a)(i)	$[y =] \frac{1}{2}(80 - 2x)$ oe	M1	for $40 - x$ is enough
	$A =$ *their* $\frac{1}{2}(80 - 2x) \times x$ oe	M1	for $\frac{1}{2}(80 - x)$ or $40 - 2x$ for *their* $\frac{1}{2}(80 - 2x)$
	$A = 40x - x^2$ and $x^2 - 40x + A = 0$	A1	for no errors or omissions
(a)(ii)	$(x - 30)(x - 10)$	B2	**B1** for $x(x - 30) - 10(x - 30)$ [= 0] or $x(x - 10) - 30(x - 10)$ [= 0] or **SC1** for $(x + a)(x + b)$ where $ab = 300$ or $a + b = -40$
	30, 10	B1	
(a)(iii)	$\sqrt{(-40)^2 - 4(1)(200)}$ or better	B1	Or for $(x - 20)^2$
	$p = --40$ and $r = 2(1)$	B1	Must see $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$ or both or for $20 \pm \sqrt{200}$
	5.86 34.14	B2	If B0, **SC1** for 5.9 or 5.857 to 5.858 **and** 34.1 or 34.14… or 5.86 **and** 34.14 seen in working or –5.86 **and** –34.14 as final answers
(b)(i)	$\frac{200}{x} - \frac{200}{x + 10}$	M2	Or **M1** for $\frac{200}{x}$ or $\frac{200}{x + 10}$ soi
	$\frac{200(x + 10) - 200x}{x(x + 10)} = \frac{2000}{x(x + 10)}$	A1	No errors or omissions
(b)(ii)	16 (min) 40 (s)	3	**B2** for $0.2\dot{7}$ or 0.278 or 0.2777 to 0.2778 or $\frac{5}{18}$ [h] oe or $16.\dot{6}$ or 16.7 or 16.66 to 16.67 or $\frac{50}{3}$ [min] or **M1** for $2000 \div 80(80 + 10)$ or $\frac{200}{80} - \frac{200}{90}$

26. 0580_p20_ms_40 Q: 10

	Answer	Mark	Partial Marks
(a)	14 137 to 14 137.2 or 14 139	2	**M1** for $\frac{4}{3} \times \pi \times 15^3$
(b)(i)	104 000 or 103 600 to 103 700	3	**M2** for $\pi \times 25^2 \times 60 - 14\,140$ or **M1** for $\pi \times 25^2 \times 60$ **FT** $\pi \times 37\,500 = 117\,809$. … allow *their* answer as long as it rounds to 14 140
(b)(ii)	52.8 or 52.75 to 52.81…	2	**M1** for *their* **(b)(i)** $\div (\pi \times 25^2)$ or $14\,140 \div (\pi \times 25^2)$ **FT** $\pi \times 25^2 = 1963$… (allow use of *their* answer as long as it rounds to 14 140) or 7.198 to 7.201…
(c)	$\sqrt{(5x)^2 + (12x)^2}$	M1	
	[slant height =] $13x$	A1	
	$\pi(5x)^2$ or $\pi(5x)(13x)$	M1	Accept $25\pi x^2$
	$\pi(5x)^2 + \pi(5x)(13x) = 4\pi r^2$	M1	
	$r^2 = \frac{90\pi}{4\pi}x^2 = \frac{45}{2}x^2$	A1	With all steps shown and no errors seen

27. 0580_s20_ms_41 Q: 9

	Answer	Mark	Partial Marks
(a)	39[.0] or 39.03 to 39.04…	**3**	**M2** for $\frac{165}{360}\times 2\times\pi\times 8+16$ or **M1** for $\frac{165}{360}\times 2\times\pi\times 8$
(b)	2.71 or 2.708…	**4**	**M3** for $\sqrt{\frac{\frac{165}{360}[\times\pi]\times 8^2}{4[\times\pi]}}$ oe or **M2** for $r^2=\frac{\frac{165}{360}[\times\pi]\times 8^2}{4[\times\pi]}$ oe or **M1** for $\frac{165}{360}\times\pi\times 8^2$ oe seen

	Answer	Mark	Partial Marks
(c)(i)	3.67 or 3.666 to 3.667	**2**	**M1** for $\frac{165}{360}\times 2[\times\pi]\times 8=2[\times\pi]\times r$ or better or for $\frac{165}{360}[\times\pi]\times 8^2=[\pi\times]r\times 8$ or better
(c)(ii)	100 or 100.0 to 100.1… final answer	**4**	**M3** for $\frac{1}{3}\pi\times their(c)(i)^2\times\sqrt{8^2-their\,\text{radius}^2}$ or **M2** for $\sqrt{8^2-their\,\text{radius}^2}$ or **M1** for $(their\ (c)(i))^2+h^2=8^2$

28. 0580_s20_ms_42 Q: 8

	Answer	Mark	Partial Marks
(a)(i)	36	**2**	**M1** for $\left(\frac{8}{12}\right)^2$ or $\left(\frac{12}{8}\right)^2$ oe
(a)(ii)	30	**3**	**M2** for $320 \div 16 \times \frac{12}{8}$ oe or **M1** for $320 \div 16$
(b)	3.375 cao	**3**	**M2** for $\frac{\frac{4}{3}\pi \times 4.5^3}{\pi \times 6^2}$ or better or **M1** for $\pi \times 6^2 \times h = \frac{4}{3} \times \pi \times 4.5^3$
(c)	3.63 or 3.627 to 3.628	**3**	**M2** for $\frac{20^3}{40 \times \frac{4}{3}\pi}$ or **M1** for $40 \times \frac{4}{3} \times \pi \times r^3 = 20^3$
(d)	$\frac{3x}{2}$ or $1.5x$ or $1\frac{1}{2}x$	**3**	**B2** for $4R^2 = 9x^2$ oe or better or **M1** for $4\pi R^2 = 2\pi x^2 + \pi \times 2x \times \frac{7x}{2}$

29. 0580_m19_ms_42 Q: 6

	Answer	Mark	Partial Marks
(a)	5.83 or 5.832 to 5.833	**5**	**B2** for sector angle = 210 soi or **M1** for [$\cos DOE =$] $\frac{0.25}{0.5}$ oe **M2** for $\frac{their\,210}{360} \times 2 \times \pi \times 0.5 + 2 \times 1.5 + 2 \times 0.5$ oe or **M1** for $\frac{their\,210}{360} \times 2 \times \pi \times 0.5$ oe isw
(b)	1.21 or 1.208…	**3**	**M2** for $\frac{their\,210}{360} \times \pi \times 0.5 \times 0.5 + 1.5 \times 0.5$ oe or **M1** for $\frac{their\,210}{360} \times \pi \times 0.5 \times 0.5$ oe isw
(c)(i)	4[.00...]	**3**	**M2** for $0.5 \times \sqrt{\frac{77.44}{their\,\mathbf{(b)}}}$ oe or **M1** for $\sqrt{\frac{77.44}{their\,\mathbf{(b)}}}$ or $\sqrt{\frac{their\,\mathbf{(b)}}{77.44}}$ or for $\frac{their\,\mathbf{(b)}}{77.44} = \frac{0.5^2}{r^2}$ oe
(c)(ii)	2.20704	**3**	**M2** for 77.44 × 1.5 × 19 ÷ 1000 oe or **M1** for figs 2207[04] or figs 221 seen or [vol =] 77.44 × 1.5

30. 0580_s19_ms_41 Q: 3

	Answer	Mark	Partial Marks
(a)	530	**4**	**B3** for $[DE] = 130$ m and $[DC] = 80$ m or **B2** for $[DE] = 130$ m or $[DC] = 80$ m or **M1** for $50^2 + 120^2$ or $170^2 - 150^2$
(b)	52.9 or 52.89…	**4**	**M2** for $\frac{100^2 + 150^2 - 120^2}{2 \times 100 \times 150}$ or **M1** for $120^2 = 100^2 + 150^2 - 2 \times 100 \times 150\cos(\ldots)$ **A1** for 0.603 or 0.6033…or $\frac{181}{300}$
(c)(i)	28.1 or 28.07…	**2**	**M1** for $\cos = \frac{15}{17}$ oe
(c)(ii)	331.9 or 331.9…	**2**	**FT** 360 – *their* **(c)(i)** **M1** for 360 – *their* **(c)(i)** oe
(d)	1.5[0] or 1.498… nfww	**4**	**M1** for $\frac{1}{2} \times 50 \times 120$ oe **M1** for $\frac{1}{2} \times 100 \times 150 \sin(\textit{their}\textbf{(b)})$ oe **M1** for $\frac{1}{2} \times 150 \times \textit{their}CD$ oe or $\frac{1}{2} \times 150 \times 170 \times \sin \textit{their}\textbf{(c)(i)}$ If 0 scored, **SC1** for dividing *their* area by 10 000

31. 0580_s19_ms_41 Q: 5

	Answer	Mark	Partial Marks
(a)	4.73 or 4.730 to 4.731...	3	**M2** for $3 \times 1.2 + \pi \times 0.6^2$ oe or **M1** for $\pi \times 0.6^2$ or $\frac{1}{2} \times \pi \times 0.6^2$ or 3×1.2
(b)	946 or 946.0 to 946.2...	3	**M2** for *their* **(a)** $\times 0.2 \times 1000$ oe or **M1** for *their* **(a)** $\times 0.2$ or 20 implied by figs 946[0] to 9462
(c)	1.28 or 1.29 or 1.284 to 1.290	3	**M2** for $\frac{(1007 - \textit{their}(\mathbf{b})) \div 1000}{\textit{their}(\mathbf{a})} \times 100$ oe or for $\frac{1007 - \textit{their}(\mathbf{b})}{\textit{their}(\mathbf{b})} \times 20$ oe or **M1** for figs $\frac{1007 - \textit{their}(\mathbf{b})}{\textit{their}(\mathbf{a})}$ or figs $\frac{1007}{\textit{their}(\mathbf{a})}$ or for $\frac{1007 - \textit{their}(\mathbf{b})}{\textit{their}(\mathbf{b})}$ or $\frac{1007}{\textit{their}(\mathbf{b})} \times 20$ oe

32. 0580_s19_ms_41 Q: 10

	Answer	Mark	Partial Marks
(a)	10	1	
(b)	6.2[0] or 6.203 to 6.204	3	**M2** for $[x^3 =]\ 1000 \div \frac{4}{3}\pi$ oe or better or **M1** for $\frac{4}{3}\pi x^3 = 1000$
(c)	7.82 or 7.815 to 7.816	4	**B3** for $[x^3 =] 1000 \div \frac{1}{3}\pi \div 2$ oe or better or **M1** for $\left(x\sqrt{5}\right)^2 - x^2$ soi by $4x^2$ or $2x$ **M1dep** for $\frac{1}{3}\pi \times x^2 \times \textit{their}h[=1000]$

	Answer	Mark	Partial Marks
(d)	$6\frac{2}{3}$ or 6.67 or 6.666 to 6.667	4	**B3** for $[x^3 =]1000 \div \frac{27}{8}$ oe or $\frac{3x}{2} = 10$ or better or **M2** for $\frac{1}{2} \times x \times \frac{x}{2} \times \frac{27x}{2} = 1000$ oe or **M1** for $\frac{1}{2} \times x \times \frac{x}{2}$ If 0 scored, **SC2** for answer 5.29 or 5.291..

33. 0580_s19_ms_42 Q: 10

	Answer	Mark	Partial Marks
(a)(i)	18[.0] or 17.99 to 18.00…	3	**M2** for $\sqrt[3]{\frac{24430 \times 3}{4\pi}}$ oe or **M1** for $\frac{4}{3}\pi r^3 = 24430$
(a)(ii)	447 or 446.8 to 446.9...	3	**M2** for $\pi \times 50^2 \times 60 - 24430$ oe or **M1** for $\pi \times 50^2 \times 60$ oe

	Answer	Mark	Partial Marks
(b)	4 [hours] 30 [mins] nfww	4	**B3** for 16200 or 4.5 or 270 or **M2** for $\frac{\text{figs } 18 \times \text{figs } 15 \times \text{figs } 12}{\text{figs } 2}$ oe or **M1** for figs 18 × figs 15 × figs 12 oe
(c)	12.5 or 12.50…	3	**M2** for $17 \times \sqrt{\frac{159.5}{295}}$ oe or **M1** for $\sqrt{\frac{159.5}{295}}$ or $\sqrt{\frac{295}{159.5}}$ seen or for $\frac{159.5}{295} = \frac{x^2}{17^2}$ oe

34. 0580_s19_ms_43 Q: 4

	Answer	Mark	Partial Marks
(a)(i)	$\frac{1}{2}\times\frac{4}{3}\times\pi\times5.6^3$	**M1**	
	367.8... to 367.9	**A1**	
(a)(ii)	3.06 or 3.060 to 3.061...	**4**	**M1** for 0.8×368 [= 294.4] **M2** for [r^2 =] $\frac{\textit{their}\ 294.4}{10\pi}$ oe or **M1** for $\pi r^2\times10=$ *their* 294.4 oe
(b)(i)	44[.0] or 43.98 to 43.99 nfww	**5**	**B2** for [slant height =] $\frac{25}{4}$ oe or **M1** for [l^2 =] $6^2+1.75^2$ oe **M2** for $\pi\times1.75\times\textit{their}\ l+\pi\times1.75^2$ or **M1** for $\pi\times1.75\times\textit{their}\ l$ or $\pi\times1.75^2$
(b)(ii)(a)	SF = $\frac{1}{4}$ oe soi	**B1**	
	$\frac{1}{3}\pi\times1.75^2\times6-\frac{1}{3}\pi\times\textit{their}\,0.4375^2\times1.5$ **OR** $\frac{1}{3}\pi\times1.75^2\times6\times\left(1-\left(\frac{1}{4}\right)^3\right)$ oe	**M2**	**M1** for $\frac{1}{3}\pi\times1.75^2\times6$ or $\frac{1}{3}\pi\times\textit{their}\,0.4375^2\times1.5$ **OR** **M1** for $1-\left(\frac{1}{4}\right)^3$ oe
	18.94 or 18.939 to18.944…	**A1**	
(b)(ii)(b)	95 final answer	**3**	**B2** for 94.5 or 94.69 to 94.722 OR **M2** for $18.9\times10^3\div200$ oe or **M1** for 18.9×10^3 or $200\div10^3$ or figs 189..÷ 200 or 18.9.. ÷ figs 2

35. 0580_w19_ms_43 Q: 6

	Answer	Mark	Partial Marks
(a)(i)	Angle ABC=52 nfww	**B1**	ALTERNATIVE [Reflex] angle AOC = 256
	Opposite angles in cyclic quad oe Angles in opposite segments	**B1**	Angle at centre=2 × angle at circumference/arc
	[Angle AOC=104] Angle at centre=2 × angle at circumference/arc nfww	**B1**	Angles around a point
(a)(ii)	22 nfww	**2**	**B1** for angle OAC = 38 or angle CAD = 24
(a)(iii)	28	**1**	
(a)(iv)	36.6 or 36.62 to 36.63 nfww	**3**	**B2** for 7.4 or 17.42 to 17.43 or **M2** for $9.6\times 2+\frac{104}{360}\times 2\times\pi\times 9.6$ or **M1** for $\frac{104}{360}\times 2\times\pi\times 9.6$
(b)(i)	81	**3**	**M2** for $\frac{A}{36}=\left(\sqrt[3]{\frac{2187}{648}}\right)$ oe or better or for $A\times\frac{648}{36}\times\sqrt[3]{\frac{2187}{648}}=2187$ oe or better or **M1** for $\frac{A^3}{36^3}=\frac{2187^2}{648^2}$ oe or $\sqrt[3]{\frac{2187}{648}}$ or $\sqrt[3]{\frac{648}{2187}}$
(b)(ii)	8.05 or 8.051 to 8.052…	**3**	**M2** for $\left[r^3=\right]\frac{2187\times 3}{4\times\pi}$ oe or **M1** for $\frac{4\pi r^3}{3}=2187$ **SC2** for $\frac{648\times 3}{4\times\pi}$ or **SC1** for $\frac{4\pi r^3}{3}=648$

36. 0580_m18_ms_42 Q: 2

	Answer	Mark	Partial Marks
(a)	128	**2**	**M1** for $4\times\frac{1}{2}\times 8\times 8$ oe
(b)(i)	18.3 or 18.26 to 18.29…	**3**	**M2** for $\frac{1}{4}(\pi\times 8^2 - \textit{their}\,128)$ oe or **M1** for $\pi\times 8^2 - \textit{their}\,128$ oe or for $\frac{1}{4}\times\pi\times 8^2$ oe OR **SC2dep** for answer 4.56 to 4.57...
(b)(ii)	23.9 or 23.87 to 23.882	**4**	**M3** for $\frac{90}{360}\times 2\times\pi\times 8+\sqrt{8^2+8^2}$ oe OR **M1** for $\frac{90}{360}\times 2\times\pi\times 8$ oe **M1** for $\sqrt{128}$ oe OR **SC3dep** for answer 11.9 or 11.93 to 11.94…

37 . 0580_m18_ms_42 Q: 5

	Answer	Mark	Partial Marks
(a)(i)	1930 or 1940 or 1933.4 to 1935.3	**5**	**B1** for interior angle 120 soi or angle at centre 60 soi or for correct use of Pythagoras' with 7 and 3.5 or with 14 and 7 **M3** for $6\times\frac{1}{2}\times 7^2\times\sin 60\times 15.2$ oe or complete other methods or **M2** for $6\times\frac{1}{2}\times 7^2\times\sin 60$ oe OR **M1** for $\frac{1}{2}\times 7^2\times\sin 60$ oe or other partial area of hexagon **M1dep** for *their* area × 15.2 evaluated

	Answer	Mark	Partial Marks
(a)(ii)	893 or 892.8 to 893.0…	3	**M2** for $6 \times 7 \times 15.2 + 2 \times 6 \times \frac{1}{2} \times 7^2 \times \sin 60$ oe or for $6 \times 7 \times 15.2 + 2 \times$ *their* area of hexagon from **(a)** oe or **M1** for $[6 \times]\ 7 \times 15.2$ oe or $2 \times$ *their* area of hexagon from **(a)** oe
(b)	2.71 or 2.709 to 2.710	3	**M2** for $\sqrt[3]{500 \div \left(6 \times \frac{4}{3}\pi\right)}$ oe or **M1** for $500 = 6 \times \frac{4}{3}\pi r^3$ oe If 0 scored, **SC1** for answer 4.92 or 4.923 to 4.924

38. 0580_s18_ms_41 Q: 6

	Answer	Mark	Partial Marks
(a)	4.79 or 4.788 to 4.789	3	**M2** for $\sqrt[3]{\frac{230 \times 3}{2 \times \pi}}$ oe or **M1** for $230 = \frac{2}{3} \times \pi \times r^3$ oe If 0 scored **SC1** for answer 3.8[0…]
(b)(i)	8.7[0] or 8.702 to 8.704	3	**M2** for $(300 - 230) \div (1.6^2 \pi)$ or **M1** for $\pi \times 1.6^2 \times h$
(b)(ii)	6.4	3	**M2** for $1.6 \times \sqrt[3]{\frac{19200}{300}}$ oe or **M1** for sf $\sqrt[3]{\frac{19200}{300}}$ or $\sqrt[3]{\frac{300}{19200}}$ oe or for $\left(\frac{1.6}{r}\right)^3 = \frac{300}{19200}$

39. 0580_s18_ms_43 Q: 7

	Answer	Mark	Partial Marks
(a)	204 or 203.5 to 203.6… nfww	4	**M2** for $\pi \times 1.5^2 \times 8 \times 60 \times 60$ or **M1** for $\pi \times 1.5^2$ **M1** for dividing *their* volume by 1000 If 0 scored **SC1** for an answer figs 204 or figs 2035 to 2036 without working
(b)(i)	$\pi \times 6 \times 12 + \pi \times 6^2 = 108\pi$	**M2**	**M1** for $\pi \times 6 \times 12$

	Answer	Mark	Partial Marks
(b)(ii)	[x =] 5.2[0] or 5.196… [y =] 6	4	**B2** or **M1** for $4\pi x^2 = 108\pi$ seen **B2** or **M1** for $\frac{1}{2}(4\pi y^2) + \pi y^2$ or better seen

40. 0580_w18_ms_41 Q: 10

	Answer	Mark	Partial Marks
(a)	132.26 to 132.28 or 132.3	5	**B1** for angle ABO or angle $CBO = 90$ soi **M1** for $\tan [XOB] = \frac{15}{8}$ oe **M1** for $\tan [BOY] = \frac{22.4}{8}$ oe **A1** for [BOY =]70.3… or [XOB =] 61.9….
(b)	18.4 or 18.5 or 18.43 to 18.48	2	**M1** for $\frac{\textit{their}\ (\mathbf{a})}{360} \times 2 \times \pi \times 8$ oe
(c)	75.7 to 75.9	4	**M1** for $\frac{1}{2}(15 + 22.4) \times 8$ oe **M2** for $\frac{\textit{their}\ (\mathbf{a})}{360} \times \pi \times 8^2$ oe or **M1** for one sector either $\frac{inv\tan\left(\frac{15}{8}\right)}{360} \times \pi \times 8^2$ oe or $\frac{inv\tan\left(\frac{22.4}{8}\right)}{360} \times \pi \times 8^2$ oe

41. 0580_w18_ms_42 Q: 10

	Answer	Mark	Partial Marks
(a)(i)	75000 × 60 × 20 oe	**M1**	Allow × 1200 for × 60 × 20
(a)(ii)	16.4 or 16.36 …	**3**	**M2** for $\frac{9\times10^7\times100}{1000\times55\times10^4}$ oe or **B2** for answer 0.164 or 0.1636 … or **B1** for answer figs 164 or 1636 … or **M1** for figs 9 ÷ figs 55
(a)(iii)	28.3 or 28.27 to 28.28	**3**	**M2** for $\frac{76}{360}\times2\pi\times8.5+2\times8.5$ oe or **M1** for $\frac{76}{360}\times2\pi\times8.5$ oe

	Answer	Mark	Partial Marks
(b)(i)	3770 or 3769 to 3770. …	**2**	**M1** for $\frac{1}{3}\times\pi\times10^2\times36$
(b)(ii)	3.68 or 3.683 to 3.684 …	**4**	**M3** for $[r^3=]\ \frac{1}{2}\times$ *their* **(b)(i)** $\times\frac{3}{4\pi\times9}$ oe or **M2** for $\frac{4\pi r^3}{3}+\frac{4\pi(2r)^3}{3}=\frac{1}{2}\times$ *their* **(b)(i)** or for $\frac{4\pi r^3}{3}=\frac{1}{1+8}\times\frac{1}{2}\times$ *their* **(b)(i)** or **M1** for $\frac{4\pi r^3}{3}+\frac{4\pi(2r)^3}{3}$ or $\frac{1}{2}\times\frac{\pi\times10^2\times36}{3}$ or $\frac{1}{2}$ *their* **(b)(i)** seen or ratio of vols = $1:2^3$ oe seen

42. 0580_w18_ms_43 Q: 3

	Answer	Mark	Partial Marks
(a)(i)	427 or 427.2 to 427.3…	**2**	**M1** for $\pi \times 8 \times 17$
(a)(ii)	1010 or 1005….	**4**	**M2** for $\sqrt{17^2 - 8^2}$ oe or **M1** for $h^2 + 8^2 = 17^2$ oe **M1** for $\frac{1}{3} \times \pi \times 8^2 \times$ *their* h oe
(a)(iii)	804 or 804.2 to 804.4 or 808	**1**	**FT** *their* **(ii)** × 0.8
(a)(iv)	396 or 395.6 to 395.8 or 392	**1**	**FT** 1200 – *their* **(iii)**
(b)(i)	$\frac{1}{54}$	**4**	**B3** for $\frac{\frac{4}{3}\pi r^3}{72\pi r^3}$ or better or **M2** for $\frac{\frac{4}{3} \times \pi \times r^3}{\pi \times (3r)^2 \times 8r}$ or $72 \times \pi \times r^3$ or **M1** for $\pi \times (3r)^2 \times 8r$ If 0 scored, **SC2** for answer of $\frac{1}{18}$
(b)(ii)	972π final answer	**4**	**B2** for $r = \frac{9}{2}$ oe or **M1** for $4\pi r^2 = 81\pi$ or better **M1** for $2 \times \pi \times (3 \times$ *their* $r) \times (8 \times$ *their* $r)$ isw

43. 0580_s17_ms_41 Q: 5

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	50890 or 50893 to 50900.4	**2**	**M1** for $\pi \times 18^2 \times 50$

	ANSWER	MARK	PARTIAL MARKS
(a)(ii)	20.5 or 20.52 to 20.534	**3**	**B2** for answer 29.5 or 29.46 to 29.48 OR **M2** for $(50900-30000)\div(\pi\times18^2)$ oe or **M1** for (figs 50.9 –figs 30) ÷ ($\pi\times$ figs18^2) or **M1** for $(50900-30000)=(\pi\times18^2)h$ oe OR **alternative method** **M2** for $50-\frac{30000}{\pi\times18^2}$ oe **M1** for figs $30=\pi\times$ figs $18^2\times(50-h)$ oe or for $\frac{\text{figs }30}{\pi\times\text{figs}18^2}$ oe OR **alternative method** **M2** for $\frac{(50.9-30)}{50.9}\times50$ oe or **M1** for $\frac{(50.9-30)}{50.9}$ or $\frac{30}{50.9}\times50$ oe or **M1** for $\frac{(\text{figs }50.9-\text{figs }30)}{\text{figs }50.9}\times50$ oe
(a)(iii)	334 nfww	**4**	**M2** for figs $30\div\frac{2}{3}\pi\times3.5^3$ oe or **M1** for $\frac{1}{2}\times\frac{4}{3}\pi\times3.5^3$ oe and **B1** for 30 000
(b)(i)	3.28[6..] or 3.29	**3**	**M2** for [$r^2=$] $\frac{95\times3}{8.4\pi}$ oe or **M1** for $\frac{1}{3}\pi\times r^2\times8.4$ [$=95$]
(b)(ii)	93.1 to 93.6	**4**	**M3** for $\pi\times3.3\times\sqrt{3.3^2+8.4^2}$ or **M2** for $\sqrt{3.3^2+8.4^2}$ or **M1** for $3.3^2+8.4^2$

44. 0580_s17_ms_42 Q: 5

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	94.2 or 94.3 or 94.24 to 94.26	**2**	**M1** for $\pi \times 3 \times 10$
(a)(ii)	9.54 or 9.539…	**3**	**M2** for $\sqrt{10^2 - 3^2}$ or **M1** for $h^2 + 3^2 = 10^2$ oe
(a)(iii)	89.9 or 89.90 to 89.92…	**2**	**M1** for $\frac{1}{3} \times \pi \times 3^2 \times$ *their* **(a)(ii)**
(b)	108 or 107.9 to 108.1 nfww	**4**	**M3** for $\frac{\pi \times 3 \times 10}{\pi \times 10^2} \times 360$ oe or $\frac{\textit{their}\ \textbf{(a)(i)}}{\pi \times 10^2} \times 360$ oe or $\frac{2 \times \pi \times 3}{2 \times \pi \times 10} \times 360$ oe or **M2** for $\frac{x}{360} \times \pi \times 10^2 =$ *their* **(a)(i)** oe or $\frac{x}{360} \times 2 \times \pi \times 10 = 2 \times 3 \times \pi$ oe or **M1** for $\frac{x}{360} \times \pi \times 10^2$ seen or $\frac{x}{360} \times 2 \times \pi \times 10$ seen
(c)	46.6 to 46.8	**4**	**M3** for $\frac{\textit{their}\ \textbf{(b)}}{360} \times \pi \times 10^2 - \frac{1}{2} \times 10 \times 10 \times \sin(\textit{their}\ \textbf{(b)})$ oe or **M1** for $\frac{\textit{their}\ \textbf{(b)}}{360} \times \pi \times 10^2$ or *their* **(a)(i)** soi and **M1** for $\frac{1}{2} \times 10 \times 10 \times \sin(\textit{their}\ \textbf{(b)})$ soi

45. 0580_s17_ms_43 Q: 4

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	17.5 or 17.46....nfww	**6**	**B3** for triangle height 3.46[4...] or $\sqrt{12}$ oe or **M2** for $\sqrt{4^2 - 2^2}$ or **M1** for $h^2 + 2^2 = 4^2$ **and M2** for $2 \times 7 + \frac{1}{2} \times 2 \times$ *their* h oe or **M1** for $\frac{1}{2} \times 2 \times$ *their* h
(a)(ii)	140 or 139.6 to 139.7...	**1FT**	**FT** *their* **(a)** × 8
(b)(i)	2.62 or 2.618…	**3**	**M2** for $[r^2 =] \frac{280}{13\pi}$ oe or **M1** for $280 = \pi \times r^2 \times 13$
(b)(ii)	10.2 or 10.20… or $10\frac{10}{49}$	**3**	**M2** for $\frac{280}{14^3}$ [×100] oe or **B1** for 2744 or 14^3 seen

46. 0580_w17_ms_41 Q: 8

	ANSWER	MARK	PARTIAL MARKS
(a)	$\pi \times \frac{5}{2} \times l + \frac{4}{2} \times \pi \times \left(\frac{5}{2}\right)^2 = \frac{115\pi}{4}$ oe or $\frac{115\pi}{4} - \frac{4}{2} \times \pi \times \left(\frac{5}{2}\right)^2 = \pi \times \frac{5}{2} \times l$ oe	**M2**	**M1** for $\pi \times \frac{5}{2} \times l$ or $\frac{4}{2} \times \pi \times \left(\frac{5}{2}\right)^2$
	$\frac{5\pi l}{2} = \frac{65\pi}{4}$ oe or $[l =] \left(\frac{115\pi}{4} - 2 \times \pi \times 2.5^2\right) \div 2.5\pi$ oe	**B1**	nfww oe both terms must be written in terms of π nfww or correct complete method for l with decimals
	$[l =] \frac{65\pi \times 2}{4 \times 5\pi}$ or $\frac{65\pi}{10\pi}$ oe = 6.5	**A1**	Correct calculation with no errors and **B1** earned
(b)	6	**3**	**M2** for $\sqrt{6.5^2 - 2.5^2}$ or **M1** for $h^2 + 2.5^2 = 6.5^2$ If zero scored, **SC2dep** for answer 4.15[3]…

	ANSWER	MARK	PARTIAL MARKS
(c)	72[.0…] or 71.99… nfww	**4**	**M3** for $\frac{\pi}{3} \times \left(\frac{5}{2}\right)^2 \times$ *their* 6 $+ \frac{1}{2} \times \frac{4\pi}{3} \times \left(\frac{5}{2}\right)^3$ oe or **M1** for $\frac{\pi}{3} \times \left(\frac{5}{2}\right)^2 \times$ *their* 6 oe and **M1** for $\frac{1}{2} \times \frac{4\pi}{3} \times \left(\frac{5}{2}\right)^3$ oe If zero scored, **SC3dep** for $\frac{\pi}{3} \times (5)^2 \times$ *their* 4.15 $+ \frac{1}{2} \times \frac{4\pi}{3} \times (5)^3$ oe or **SC1dep** for $\frac{\pi}{3} \times (5)^2 \times$ *their* 4.15 oe **SC1dep** for $\frac{1}{2} \times \frac{4\pi}{3} \times (5)^3$ oe
(d)	53.7 or 53.65 to 53.67	**3**	**M1** for figs (*their* **(c)**) × 19.3 × 38.62 or better **M1** for ÷ 1000 soi

47. 0580_w17_ms_42 Q: 2

	ANSWER	MARK	PARTIAL MARKS
(a)(i)	1070 or 1072. ..	3	**M1** for $\pi \times 8^2 \times 2 \times 8$ **M1** for $\frac{4}{3} \times \pi \times 8^3$ or **M2** for $\frac{2}{3}\pi r^3$ or **M1** for $\pi r^2 2r - \frac{4}{3}\pi r^3$
(a)(ii)	2.58 or 2.580 to 2.581	3	**B2** for $r^3 = \frac{36 \times 3}{2\pi}$ or better or **M1** for $\pi \times r^2 \times 2 \times r - \frac{4}{3} \times \pi \times r^3 = 36$ oe
(b)(i)	4.24 or 4.241 to 4.242	4	**M3** for $(\pi \times 5^2 + \pi \times 5 \times \sqrt{5^2 + 12^2})$ or **M2** for $\pi \times 5 \times \sqrt{5^2 + 12^2}$ or **M1** for $5^2 + 12^2$ or $\pi \times 5^2$
(b)(ii)	64 cao final answer	3	**M2** for $\frac{[k\pi] \times 5^2 \times 12}{[k\pi] \times 1.25^2 \times 3}$ or **M1** for $\frac{1}{3} \times \pi \times 5^2 \times 12$ or $\frac{1}{3} \times \pi \times 1.25^2 \times 3$ OR **M2** for 4^3 or $\left(\frac{1}{4}\right)^3$ seen or **M1** for factor 4 or $\frac{1}{4}$ soi

48. 0580_w17_ms_42 Q: 10

	ANSWER	MARK	PARTIAL MARKS
(a)	5.68 or 5.684 to 5.685	5	**M2** for $2x\sqrt{x^2 + x^2}$ oe or $2 \times \sqrt{2} \times x^2$ or **M1** for $x\sqrt{2}$ or $\sqrt{x^2 + x^2}$ oe soi **M1** for $\frac{270}{360} \times \pi \times x^2$ oe **M1** for 0.5 x^2 oe
(b)	4.4[0] or 4.398 to 4.401	2	**dep** on a correct value for k in **(a)** **M1** for $[x^2] = \frac{110}{\textit{their } k}$