Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Compound solids and parts of solids

Time allowed: 1 hour

Subject code **0580**

Mathematics

Questions from Paper 1, Paper 2, Paper 3 and Paper 4

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
You may use a calculator.

Total marks

/ 48

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.
- Unless a question says otherwise, give answers that are not exact to 3 significant figures, and angles in degrees to 1 decimal place.

Information

- This paper has 9 questions worth 48 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

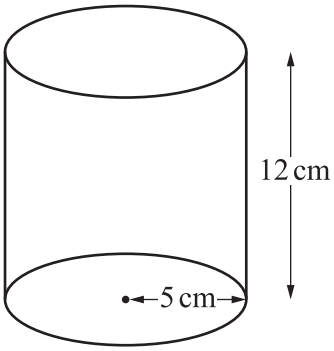
Advice

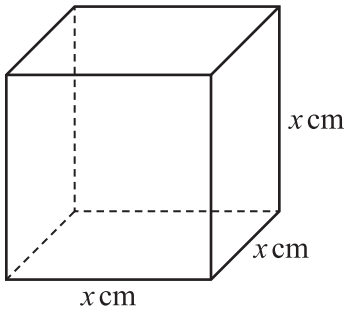
- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 The diagram shows a cylinder and a cube.





NOT TO SCALE

The cylinder has the same volume as the cube.

Find the value of x.

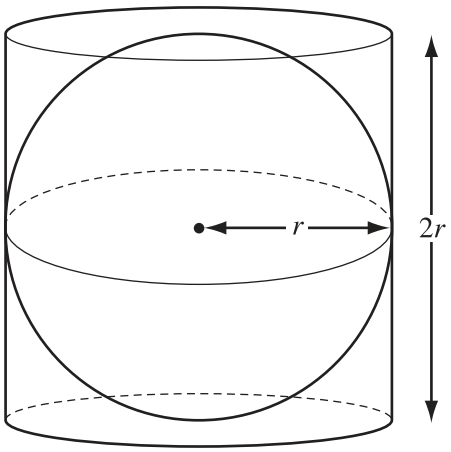
$x =$ ..... [3]

Problem solving with volumes Click for more variations

1	9.8[0] or 9.804 to 9.805	**3**	**M2** for $x^3 = \pi \times 5^2 \times 12$ oe or **M1** for $\pi \times 5^2 \times 12$ oe or for $x^3 =$ *their* 942.7

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2



NOT TO SCALE

The sphere of radius r fits exactly inside the cylinder of radius r and height $2r$.
Calculate the percentage of the cylinder occupied by the sphere.

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

Answer ..... % [3]

Problem solving with volumes Click for more variations

2	$66\frac{2}{3}$ or 66.7 www	**3**	**M2** for $\frac{\frac{4}{3}\pi r^3}{\pi r^2 (2r)}$ (× 100) or **M1** for $\pi r^2 (2r)$

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3 A sphere has radius 8 cm.
A cone has radius 8 cm and height h.
The sphere and the cone have the same volume.

Work out the height, h, of the cone.

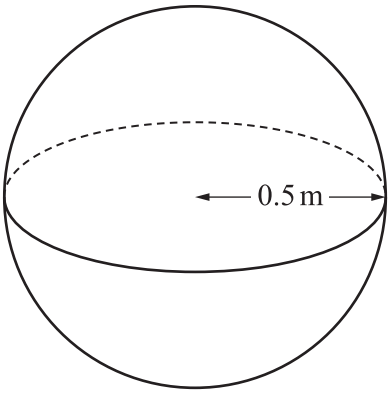
$h =$ .....cm [4]

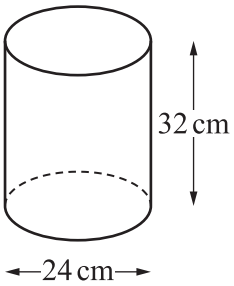
Problem solving with volumes Click for more variations

3	32	**4**	**M3** for $[h =] \dfrac{\frac{4}{3}\times\pi\times8^3}{\frac{1}{3}\times\pi\times8^2}$ oe or **M2** for $\frac{4}{3}\times\pi\times8^3=\frac{1}{3}\times\pi\times8^2\times h$ oe or **M1** for $\frac{4}{3}\times\pi\times8^3$ oe or $\frac{1}{3}\times\pi\times8^2\times h$ oe

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4





NOT TO SCALE

The diagram shows a spherical tank with radius 0.5 m and a cylindrical jug with diameter 24 cm and height 32 cm.
The tank is full of water.

Calculate how many times the jug can be completely filled with water from the tank.
[The volume, V, of a sphere with radius r is $\frac{4}{3}\pi r^3$.]

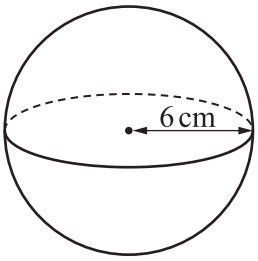
..... [5]

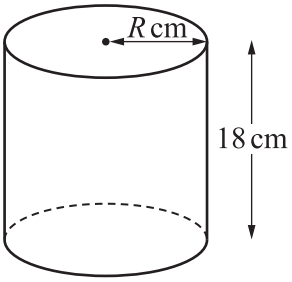
Problem solving with volumes Click for more variations

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4	36	**5**	**B4** for 36.16 to 36.17 or 36.2 or **B1** for 50 or 0.12 and 0.32 **M1** for $\frac{4}{3}\times\pi\times(their50)^3$ or $\frac{4}{3}\times\pi\times 0.5^3$ **M1** for $\pi\times12^2\times32$ or $\pi\times their\ 0.12^2\times their\ 0.32$ **M1** for *their* 523 598 ÷ *their* 14 476 or *their* 0.523 598 ÷ *their* 0.014 476 dep on M1 M1and correct formulae used If **1**,**2**or **3** scored award **SC1** for *their* decimal answer correctly rounded down to the nearest integer

5





NOT TO SCALE

The diagram shows a sphere of radius 6 cm and a cylinder of height 18 cm and radius R cm.
The volume of the sphere is equal to the volume of the cylinder.

Calculate the curved surface area of the cylinder.
Give your answer in terms of π.
[The volume, V, of a sphere with radius r is $V=\frac{4}{3}\pi r^3$]

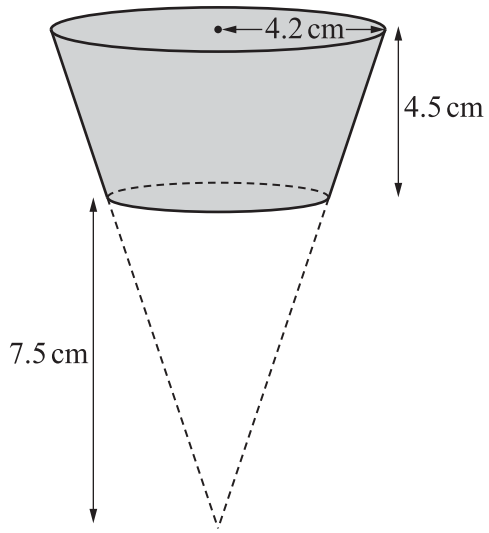
..... cm^2 [4]

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Surface area Click for more variations

5	144π cao	**4**	**M2** for $[R^2 =] \dfrac{\frac{4}{3}\times\pi\times6^3}{18\times\pi}$ oe or **M1** for $\frac{4}{3}\times\pi\times6^3 = \pi\times R^2\times18$ oe **M1** for $2\times\pi\times theirR\times18$ oe

6



NOT TO SCALE

The diagram shows a frustum made by removing a small cone from a large cone.
The height of the small cone is 7.5 cm.
The height of the frustum is 4.5 cm.
The radius of the large cone is 4.2 cm.

Work out the volume of the frustum.

..... cm^3 [4]

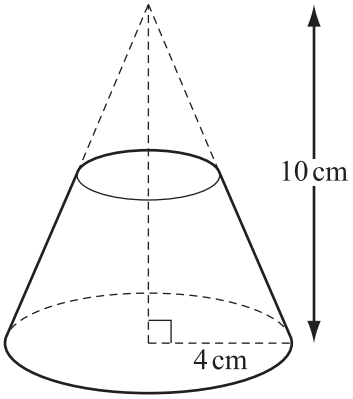
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Problem solving with volumes Click for more variations

6	168 or 167.5 to 167.6	**4**	**M3** for $\frac{\pi}{3}\times\left[4.2^2\times(4.5+7.5)-\left(4.2\times\frac{7.5}{4.5+7.5}\right)^2\times 7.5\right]$ oe or **M2** for $\left(\frac{7.5}{7.5+4.5}\right)^3\times\frac{1}{3}\times\pi\times4.2^2\times(4.5+7.5)$ or for $\frac{1}{3}\times\pi\times\left(4.2\times\frac{7.5}{4.5+7.5}\right)^2\times7.5$ or **M1** for $\frac{1}{3}\times\pi\times4.2^2\times(4.5+7.5)$ OR **M1** for $\frac{1}{3}\times\pi\times4.2^2\times(4.5+7.5)$ **M1** for $\frac{4.2}{4.5+7.5}=\frac{radius}{7.5}$ oe or better **M1** for $\frac{1}{3}\times\pi\times(their\ 2.625)^2\times7.5$

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7



NOT TO SCALE

A **solid** cone has base radius 4 cm and height 10 cm.
A mathematically similar cone is removed from the top as shown in the diagram.
The volume of the cone that is removed is $\frac{1}{8}$ of the volume of the original cone.

(a) Explain why the cone that is removed has radius 2 cm and height 5 cm.

Answer(a)

[2]

(b) Calculate the volume of the remaining solid.

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

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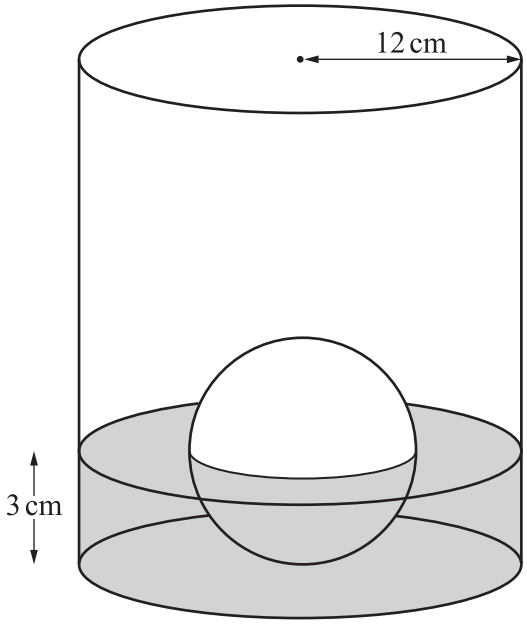
Answer(b) ..... cm^3 [4]

(a) Similar areas and volumes (b) Problem solving with volumes Click for more variations

7 (a)	correct working	**2**	**B2** for $\sqrt[3]{\frac{1}{8}} = \frac{1}{2}$ or $\sqrt[3]{8} = 2$ AND $\frac{10}{2} = 5$ oe and $\frac{4}{2} = 2$ oe or **B1** for $\sqrt[3]{\frac{1}{8}}$ or $\sqrt[3]{8}$ or $8 = 2^3$ or $\frac{1}{8} = (\frac{1}{2})^3$
(b)	147 or 146.5 to 146.6…	**4**	**M3** for $\frac{7}{8} \times \frac{1}{3} \times \pi \times 4^2 \times 10$ or **M1** for $\frac{1}{3} \times \pi \times 4^2 \times 10$ and **M1** for $\frac{1}{3} \times \pi \times 2^2 \times 5$ and **M1** for subtracting *their* volumes

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8



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]

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(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]

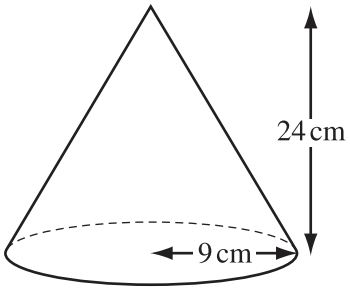
(a) Problem solving with volumes (b) Volume (c) Problem solving with volumes Click for more variations

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8(a)	$[\ h =]\ \dfrac{\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3}{\pi\times12^2}$ oe leading to 0.125 or $3 - \dfrac{\pi\times12^2\times3-\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3}{\pi\times12^2}$ 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 $\dfrac{\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3}{\pi\times12^2\times3}=\dfrac{h}{3}$ oe or **M1** for $\pi\times12^2\times h$ or $\frac{1}{2}\times\frac{4}{3}\times\pi\times3^3$ oe or $\pi\times12^2\times3$
8(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
8(c)	10.5 or 10.47 to 10.49	**3**	**M2** for $\dfrac{\frac{4}{3}\times\pi\times3^3-30\times1.5^3}{\frac{4}{3}\times\pi\times3^3}$ or $\dfrac{30\times1.5^3}{\frac{4}{3}\times\pi\times3^3}\times100$ oe or **M1** for $\frac{4}{3}\times\pi\times3^3-30\times1.5^3$ or $\dfrac{30\times1.5^3}{\frac{4}{3}\times\pi\times3^3}$ oe

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9



NOT TO SCALE

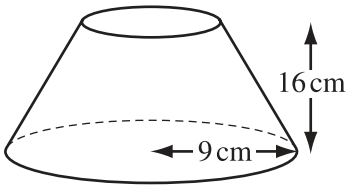
A solid metal cone has base radius 9 cm and vertical height 24 cm.

(a) Calculate the volume of the cone.

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

Answer(a) ..... cm^3 [2]

(b)



NOT TO SCALE

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

Answer (b)

[4]

(c) The 1960 cm^3 of metal in the solid in **part (b)** is melted and made into 5 identical cylinders, each of length 15 cm.
Show that the radius of each cylinder rounds to 2.9 cm, correct to 1 decimal place.

Answer (c)

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[4]

(a) Volume (b) Problem solving with volumes (c) Problem solving with volumes Click for more variations

9 (a)	2030 or 2040 or 2034 to 2036. (…)	**2**	$(V =)\frac{1}{3}\times\pi\times 9^2\times 24$ Accept 648π for 2 marks if final answer
(b)	(upper radius =) 3	**B1**	accept $9\times\frac{8}{24}$ oe
	(vol cut off =) $\frac{1}{3}\times\pi\times \textit{their}\, 3^2\times 8$	**M1**	(= 75.36 to 75.41) their *r* must be less than 9
	their (a) – *their* 75.39	**M1 dep**	[alternate method **M1** for ratio sides 1:3 **M1** ratio vols 1 : 27 **M1** *their* (a) × 26 ÷ 27] 624π implies **B1 M2** or **M3**
	1958 to 1964.(...)	**E1**	must see a figure after decimal point if 1960
(c)	$1960 = 5\times\ \pi\times r^2\times 15$ soi	**M1**	
	$r^2 = 1960\div\pi\div 15\div 5$	**M1**	implied by 8.318...
	√ *their* 8.318	**M1**	dep on **M1 M1**
	2.88 to 2.89	**E1**	**SC2** for $5\times\pi\times 2.9^2\times 15 = 1980$ to 1982

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