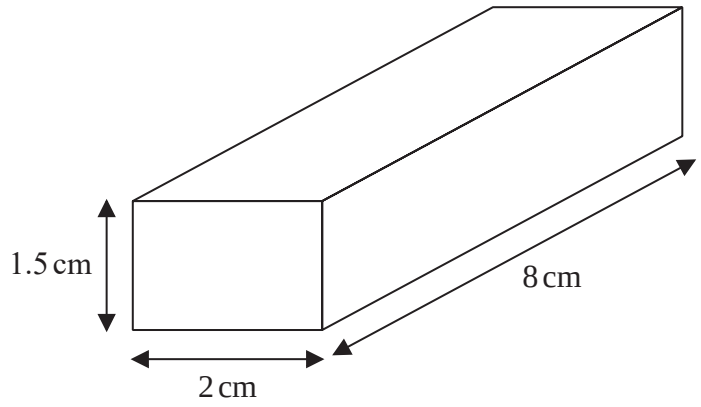
1 Pablo made a solid gold statue.

He melted down some gold blocks and used the gold to make the statue.
Each block of gold was a cuboid, as shown below.

Diagram **NOT** accurately drawn



The mass of the statue is 5.73 kg.
The density of gold is 19.32 g/cm^3

Work out the least number of gold blocks Pablo melted down in order to make the statue.
Show your working clearly.

Volume of gold blocks : $2 \times 1.5 \times 8 = 24\ cm^3$ (1)

Mass of gold = density x volume

$= 19.32 \times 24$

$= 463.68\ g$ (2)

Convert to kg = $0.46368\ kg$

Number of gold blocks needed = $\frac{5.73}{0.46368}$

$= 12.35\ \ldots$ (1)

↖ round up the value

≈ 13

13 (1)

(Total for Question 1 is 5 marks)

2 The diagram shows a box in the shape of a cuboid.

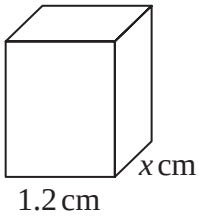


Diagram **NOT** accurately drawn

The box is put on a table.
The face of the box in contact with the table has length 1.2 metres and width x metres.

The force exerted by the box on the table is 27 newtons.
The pressure on the table due to the box is 30 newtons/m^2

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the value of x.

Area of the base of the box :

$1.2x$ m^2

$30 \text{ N/m}^2 = \dfrac{27 \text{ N}}{1.2x \text{ m}^2}$ (1)

$1.2x = \dfrac{27}{30}$

$1.2x = 0.9$

$x = \dfrac{0.9}{1.2}$ (1)

$= 0.75$ (1)

$x =$ 0.75

(Total for Question 2 is 3 marks)

3 The diagram shows a solid cube.
The cube is placed on a table so that the whole of one face of the cube is in contact with the table.

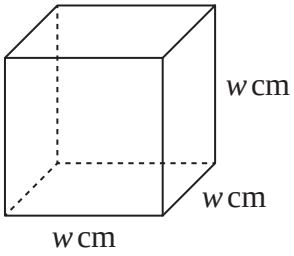


Diagram **NOT** accurately drawn

The cube exerts a force of 56 newtons on the table.
The pressure on the table due to the cube is 0.14 newtons/cm^2

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the volume of the cube.

$0.14\ N/cm^2 = \frac{56\ N}{w^2}$ (1)

$w^2 = \frac{56}{0.14}$

$w^2 = 400$

$w = \sqrt{400}$

$= 20\ cm$ (1)

Volume of cube $= 20\ cm \times 20\ cm \times 20\ cm$ (1)

$= 8000\ cm^3$ (1)

8000 ..... cm^3

(Total for Question 3 is 4 marks)

4 The density of gold is 19.3 g/cm^3
A gold bar has volume 150 cm^3

density = $\frac{\text{mass}}{\text{volume}}$

Work out the mass of the gold bar.

$19.3 = \frac{\text{mass}}{150}$

mass = 19.3×150 (1)

= 2895 g (1)

2895 ..... g

(Total for Question 4 is 2 marks)

5 The diagram shows a solid cylinder made from iron.

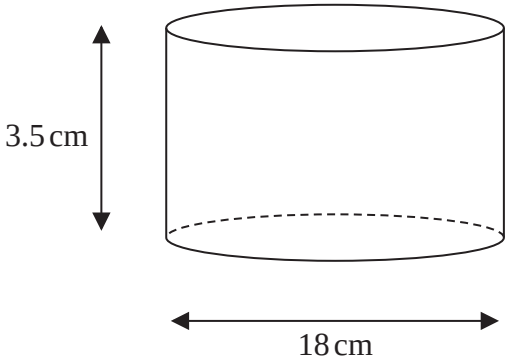
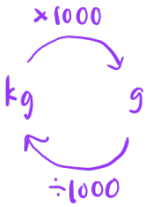


Diagram **NOT** accurately drawn

The cylinder has diameter 18 cm and height 3.5 cm
The mass of the cylinder is 7.04 kg

density = mass / volume

Work out the density of the iron.
Give your answer in g/cm^3 correct to 2 significant figures.



$\pi \times r^2 \times h$

Volume of cylinder = $\pi \times \left(\frac{18}{2}\right)^2 \times 3.5$

= 890.64.... (1)

density = $\frac{7.04 \times 1000}{890.64....}$ (1) – convert to g

= 7.9 g/cm^3 (1)

7.9 g/cm^3

(Total for Question 5 is 3 marks)

6 A cylinder is placed on the ground.

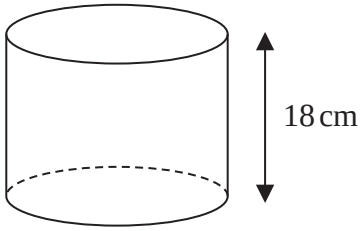


Diagram **NOT** accurately drawn

The height of the cylinder is 18 cm.

The force exerted by the cylinder on the ground is 72 newtons.
The pressure on the ground due to the cylinder is 1.4 newtons / cm^2

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the volume of the cylinder.
Give your answer correct to 3 significant figures.

area = force / pressure

= 72 / 1.4 = 51.4 (1) (1)

$51.4 = \pi \times r^2$

$r = \sqrt{\frac{51.4}{\pi}}$

= 4.046 (1)

Volume : $\pi \times (4.046)^2 \times 18$

= 926 (1)

926 ..... cm^3

(Total for Question 6 is 4 marks)

7 The diagram shows a solid made from a cylinder and a hemisphere.
The cylinder and the hemisphere are both made from the same metal.

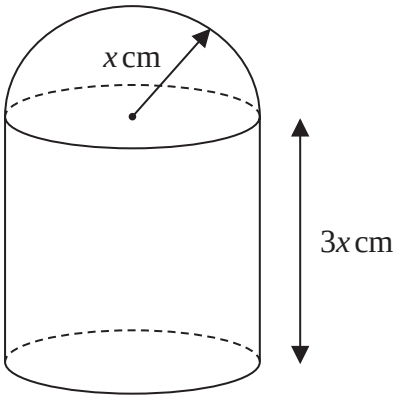


Diagram **NOT** accurately drawn

The plane face of the hemisphere coincides with the upper plane face of the cylinder.

The radius of the cylinder and the radius of the hemisphere are both x cm.
The height of the cylinder is $3x$ cm.

The total surface area of the solid is 81π cm^2
The mass of the solid is 840 grams.

The following table gives the density of each of four metals.

Metal	Density (g/cm^3)
Aluminium	2.7
Nickel	8.9
Gold	19.3
Silver	10.5

The metal used to make the solid is one of the metals in the table.

Determine the metal used to make the solid.
Show your working clearly.

$\pi x^2 + 2\pi x \times 3x + \frac{1}{2} \times 4\pi x^2 = 81\pi$ (1)

$\pi x^2 + 6\pi x^2 + 2\pi x^2 = 81\pi$

$9\pi x^2 = 81\pi$

$9x^2 = 81$

$x^2 = 9$ (1)

$x = 3$

Volume : $\pi \times 3^2 \times 3(3) + \frac{1}{2} \times \frac{4}{3} \times \pi (3)^3$ (1)

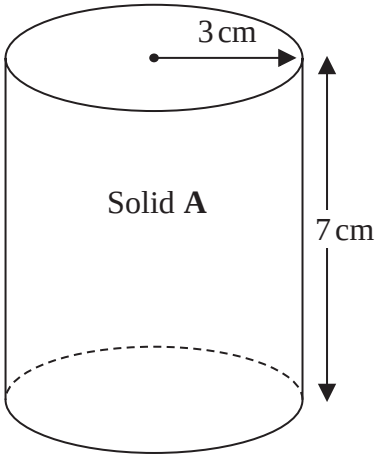
$= 81\pi + 18\pi = 99\pi$ (1)

$\frac{840}{99\pi}$ (1) $= 2.7\ldots$ (aluminium)

(1) aluminium

(Total for Question 7 is 6 marks)

8 The diagram shows two solids, **A** and **B**, made from two different metals.



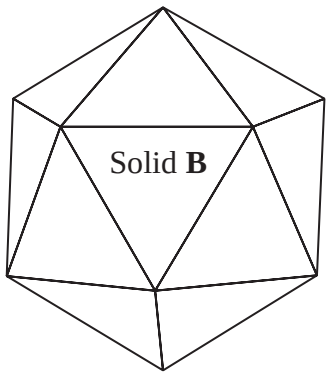


Diagram **NOT** accurately drawn

Solid **A** is in the shape of a cylinder with radius 3 cm and height 7 cm
Solid **A** has a mass of 2000 g

Solid **B** has a mass of 3375 g
Solid **B** has a volume of 450 cm^3

All of the metal from Solid **A** and Solid **B** is melted down to make a uniform Solid **C**

Given that there is no change to mass or volume during this process

work out the density of Solid **C**
Give your answer correct to one decimal place.

volume A : $\pi \times 3^2 \times 7$ = 197.9... (1)

density C : $\frac{2000 + 3375}{197.9... + 450}$ (1)

= 8.3 (1)

8.3 ..... g/cm^3

(Total for Question 8 is 3 marks)

9 The diagram shows a block of iron in the shape of a cuboid.

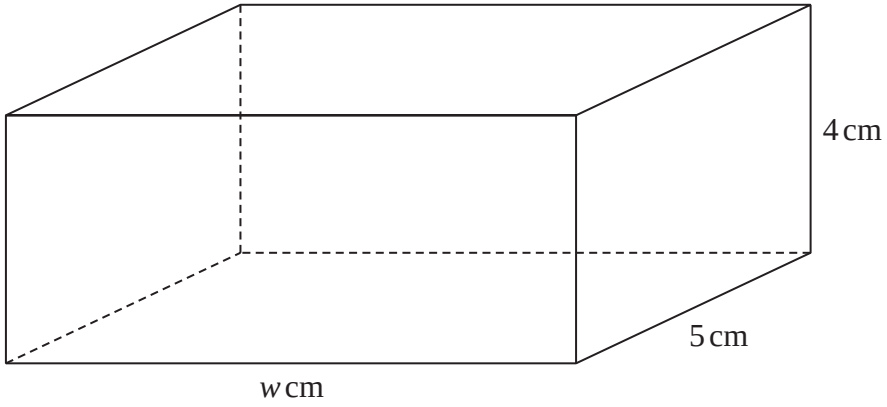


Diagram **NOT** accurately drawn

The block has length w cm, width 5 cm and height 4 cm

The density of iron is 7.8 g / cm^3
The mass of the block is 1950 g

Work out the value of w

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$\text{volume} = \frac{1950}{7.8} = 250 \text{ cm}^3 \quad (1)$$

$$250 = 5 \times 4 \times w$$

$$250 = 20w \quad (1)$$

$$w = \frac{250}{20} = 12.5 \quad (1)$$

$w =$ 12.5

(Total for Question 9 is 3 marks)

10 A solid sphere has a radius of 2.8 centimetres, correct to 1 decimal place.
The sphere has a mass of $M\pi$ grams, where $M = 260$ correct to 2 significant figures.

Work out the upper bound for the density of the sphere.
Give your answer in g/cm^3 correct to 2 decimal places.
Show your working clearly.

$M_{UB} = 265$, $M_{LB} = 255$, $r_{UB} = 2.85$, $r_{LB} = 2.75$ (1)

$$\text{density}_{UB} = \frac{\text{mass}_{UB}}{\text{Volume}_{LB}}$$

$$\text{Volume}_{LB} = \frac{4}{3} \times \pi \times 2.75^3$$

$$= \frac{1331}{48}\pi \quad (1)$$

$$\text{mass}_{UB} = 265\pi$$

$$\text{density}_{UB} = \frac{265\pi}{\frac{1331}{48}\pi} \quad (1)$$

$$= 9.56 \quad (1)$$

9.56

..... g/cm^3

(Total for Question 10 is 4 marks)