Density

Question Paper 2

Level	IGCSE
Subject	Physics
Exam Board	CIE
Topic	General Physics
Sub-Topic	Density
Paper Type	Alternative to Practical
Booklet	Question Paper 2

Time Allowed: **57 minutes**

Score: **/47**

Percentage: **/100**

1 The IGSCE class is determining the density of modelling clay by two methods.

(a) Method 1

A student moulds a piece of modelling clay into a cube shape as shown in Fig. 5.1.

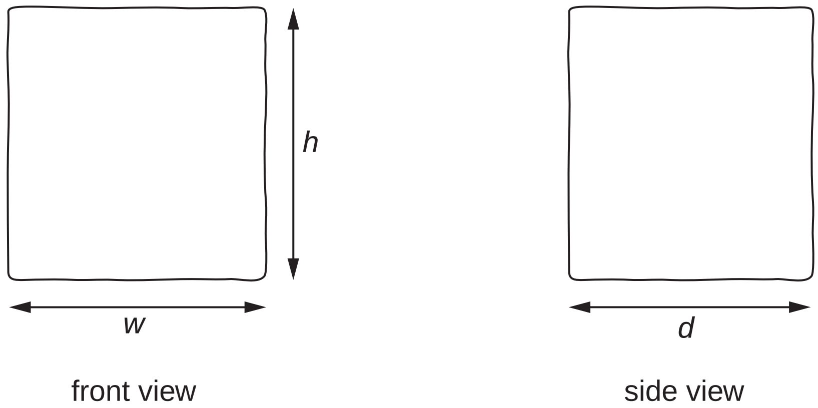

Fig. 5.1

(i) On Fig 5.1, measure the height *h*, width *w* and depth *d* of the cube-shaped piece of modelling clay.

h = ... cm

w = ... cm

d = ... cm

(ii) Calculate the volume V of the modelling clay using the equation $V = hwd$.

V = ...

(iii) Calculate the density ρ of the modelling clay using the equation $\rho = \frac{m}{V}$, where the mass of the modelling clay $m = 103\,g$.

ρ = ... [3]

(b) Method 2

The student cuts the piece of modelling clay into two pieces. One piece is approximately twice the size of the other piece. The mass m_s of the smaller piece is 34.5 g.

Fig. 5.2a shows a measuring cylinder containing water. Fig. 5.2b shows the same measuring cylinder after the smaller piece of modelling clay has been lowered into it.

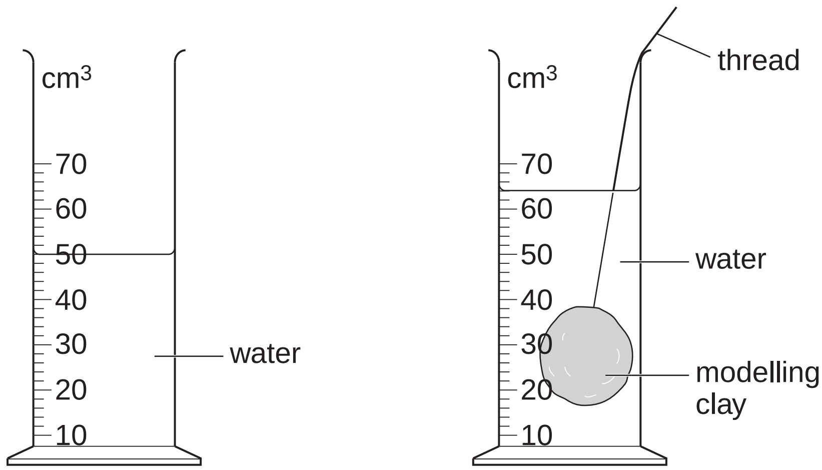

Fig. 5.2a **Fig. 5.2b**

(i) Record the volume of water V_1 in the measuring cylinder, as shown in Fig. 5.2a.

V_1 = ... [1]

(ii) Record the new volume V_2 in the measuring cylinder, as shown in Fig. 5.2b.

V_2 = ... [1]

(iii) Describe briefly one precaution you would take to read the measuring cylinder correctly.

....

....

....[1]

(iv) Calculate the volume V_s of the modelling clay using the equation $V_s = (V_2 - V_1)$.

V_s = ...

(v) Calculate the density ρ of the modelling clay using the equation $\rho = \frac{m_s}{V_s}$, where m_s = 34.5 g.

ρ = ... [1]

(c) (i) Assuming that the experiment has been carried out with care, suggest two reasons why the two values obtained for the density of the modelling clay in **(a)** and **(b)** may not be the same.

1. ....

....

2. ....

....[2]

(ii) State which of the two methods for determining density (method 1 or method 2) you judge to be less accurate. Give a reason for your judgement.

method ....

reason ....

....[1]

[Total: 10]

2 An IGCSE student is measuring the capacity of a drinks cup by three methods.

The capacity of a cup is the maximum volume of liquid that it will hold in normal use. This maximum level is marked on the cup, as shown in Fig. 1.1.

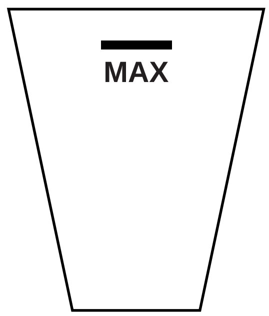

Fig. 1.1

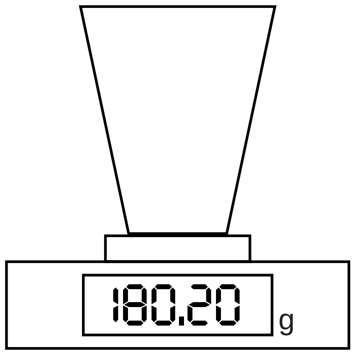

Fig. 1.2

(a) **Method 1**
In Method 1, the capacity V_1 is determined from the mass of water in the cup.

(i) The cup is filled to the marked level with water. It is then placed on the balance, as shown in Fig. 1.2.

Read and record its mass *m*.

m = ... [1]

(ii) Calculate a value for the capacity V_1, using your reading from **(a)(i)** and the equation $V_1 = \frac{m}{\rho}$, where $\rho = 1.00\,\text{g/cm}^3$.

V_1 = ... [2]

(b) Method 2

In Method 2, the capacity V_2 is measured directly from the volume of water in the cup.

The cup is filled to the marked level and the water is tipped into a measuring cylinder, as shown in Fig. 1.3.

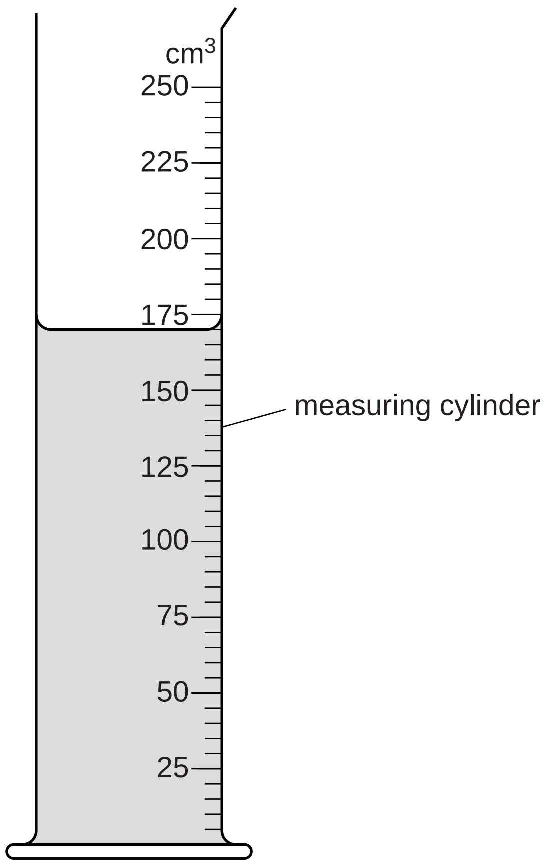

Fig. 1.3

Read and record the volume V_2 of water in the measuring cylinder.

V_2 = ... [1]

(c) **Method 3**
In Method 3, the capacity V_3 is calculated by considering the cup as a cylinder, using the average diameter of the cup and an approximate equation.

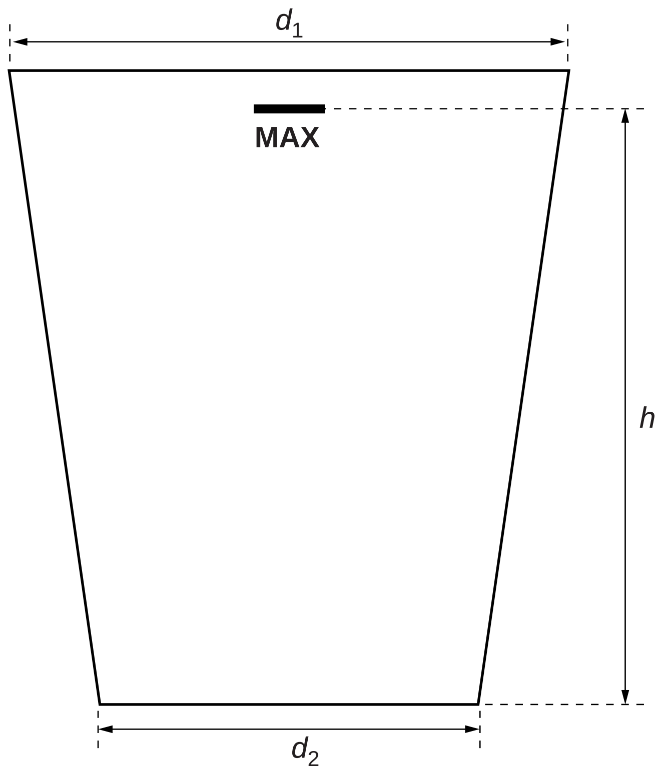

Fig. 1.4

(i) On Fig. 1.4, measure and record the diameter d_1 of the top of the cup.

d_1 = ... cm

(ii) On Fig. 1.4, measure and record the diameter d_2 of the base of the cup.

d_2 = ... cm

(iii) On Fig. 1.4, measure and record the height h from the base to the marked level **MAX**.

h = ... cm
[1]

(iv) Calculate the average diameter D using your readings from **(c)(i)** and **(c)(ii)**, and the equation $D = \frac{(d_1 + d_2)}{2}$.

D = ...

(v) Calculate a value for the capacity V_3, using your results from **(c)(iii)** and **(c)(iv)** and the equation $V_3 = \frac{\pi D^2 h}{4}$.

V_3 = ...
[2]

(d) State a possible practical source of inaccuracy in **Method 2** and a possible practical source of inaccuracy in **Method 3**.

Method 2 ....

....

Method 3 ....

....
[2]

(e) State an additional measurement which could be taken to give a more accurate result in **Method 1**.

....

.... [1]

[Total: 10]

3 An IGCSE student is determining the density of the material of a metre rule.

Fig. 1.1 shows the balancing experiment used to determine the mass of the rule.

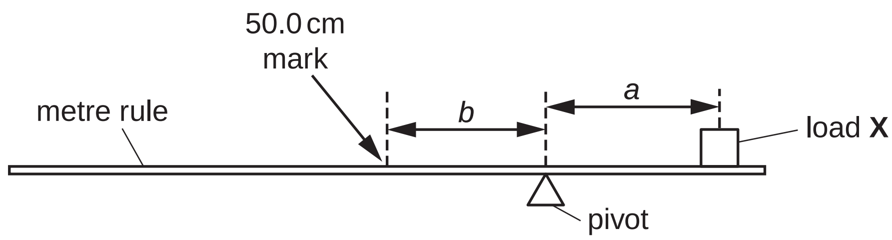

Fig. 1.1

(a) **(i)** On Fig. 1.1, measure the distance *a* from the centre of the load **X** to the pivot.

a = ... cm

(ii) On Fig. 1.1, measure the distance *b* from the pivot to the 50.0 cm mark on the rule.

b = ... cm
[1]

(b) The diagram is drawn one tenth of actual size.

(i) Calculate the actual distance *x* from the centre of the load **X** to the pivot.

x = ... cm

(ii) Calculate the actual distance *y* from the pivot to the 50.0 cm mark on the rule.

y = ... cm

(iii) Calculate the mass *m* of the metre rule using the equation

$$m = \frac{kx}{y}$$

where k = 100 g.

m = ...
[2]

(c) Figs. 1.2 and 1.3 show part of the metre rule drawn actual size.

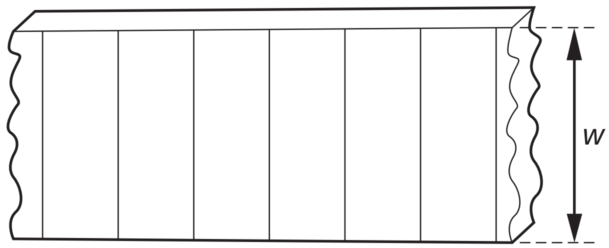

Fig. 1.2

Fig. 1.3

(i) Take and record measurements from Fig. 1.2 to determine the average width *w* of the metre rule.

w = ... cm

(ii) Take and record measurements from Fig. 1.3 to determine the average thickness *t* of the metre rule.

t = ... cm

(iii) Calculate the volume *V* of the metre rule using the equation $V = lwt$ where l is the length of the metre rule (100.0 cm).

V = ... [3]

(iv) Calculate the density ρ of the metre rule using the equation $\rho = \frac{m}{V}$.

ρ = ... [3]

(d) State the assumption that the student has made about the position of the centre of mass of the metre rule.

.... [1]

[Total: 10]

4 An IGCSE student is making measurements as accurately as possible in order to determine the density of glass.

Fig. 1.1 shows a glass test-tube drawn actual size.

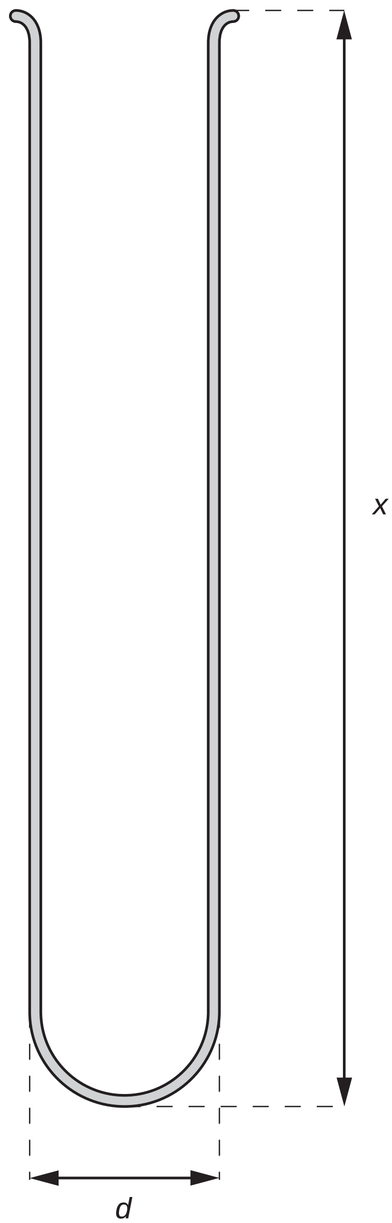

Fig. 1.1

(a) **(i)** Use your rule to measure, in cm, the external diameter *d* of the test-tube.

d = ... cm

(ii) Use your rule to measure, in cm, the length x of the test-tube.

x = ...

(iii) Draw a labelled diagram to show how you would use two rectangular blocks of wood and your rule to measure the length x of the test-tube as accurately as possible.

[4]

(b) The mass m of the test-tube is 31.2 g.

(i) Calculate the external volume V_e of the test-tube using the equation

$$V_e = \frac{\pi d^2 x}{4}.$$

V_e = ...

(ii) The student then fills the test-tube with water and pours the water into a measuring cylinder. Fig. 1.2 shows the measuring cylinder.

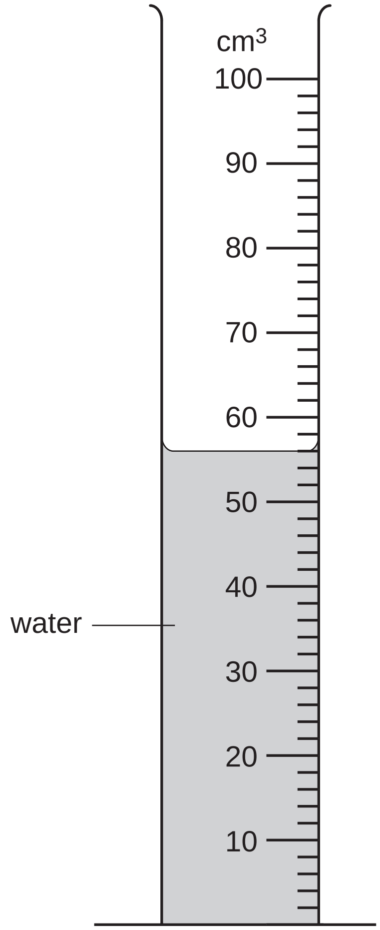

Fig. 1.2

Record the volume reading V_i from the measuring cylinder. This is the internal volume of the test-tube.

V_i = ...

(iii) Calculate the density ρ of the glass from which the test-tube is made using the equation

$$\rho = \frac{m}{(V_e - V_i)} .$$

ρ = ... [4]

[Total: 8]

5 An IGCSE student is determining the density of a solid metal cylinder using a balancing method. Fig. 1.1. shows the apparatus.

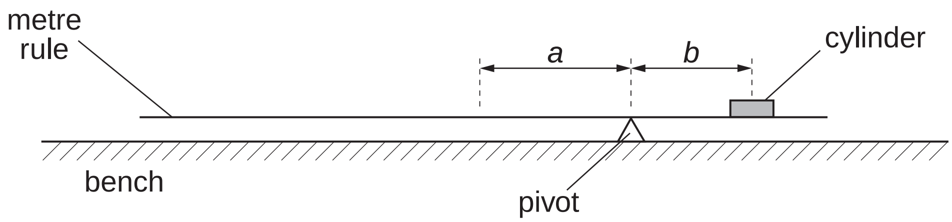

Fig. 1.1

He places the cylinder on the metre rule so that its centre is directly above the 10.0 cm mark. The rule is placed on the pivot so that the rule is as near as possible to being balanced.

He measures and records the distance *a* from the centre of the rule to the pivot and the distance *b* from the centre of the cylinder to the pivot. He repeats the experiment with the same cylinder at different positions on the rule.

The readings are shown in Table 1.1.

Table 1.1

a/	*b*/	*M*/
12.6	27.4	
11.0	24.0	
9.5	20.5	

(a) **(i)** Complete the column headings in Table 1.1.

(ii) For each set of readings, calculate the mass *M* of the cylinder using the equation

$$M = \frac{ka}{b}.$$

The value of *k* is the mass of the rule which is 108 g.

Enter the results in Table 1.1.

[3]

(b) The cylinder completely covers the marks on the metre rule. Describe, with the aid of a diagram, how you would judge that the centre of the cylinder is directly above the 10.0 cm mark.

....

....[1]

(c) Use your answers in Table 1.1 to calculate and record the average of the three values for *M*. Show your working.

average value for *M* = ...[2]

(d) Fig. 1.2 shows the cylinder placed flat on the bench and viewed from one side.

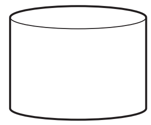

Fig. 1.2

(i) On the diagram, measure the diameter *d* and the thickness *t* of the cylinder.

d = ...

t = ...

(ii) Calculate the volume *V* of the cylinder using the equation

$$V = \frac{\pi d^2 t}{4}.$$

V = ...

(iii) Calculate the density *ρ* of the cylinder using the equation

$$\rho = \frac{M}{V}.$$

ρ = ...[3]

[Total: 9]