Density

Question Paper 1

Level	IGCSE
Subject	Physics
Exam Board	CIE
Topic	General Physics
Sub-Topic	Density
Paper Type	Alternative to Practical
Booklet	Question Paper 1

Time Allowed: **44 minutes**

Score: **/36**

Percentage: **/100**

1   The class is carrying out an experiment to determine the density of glass.
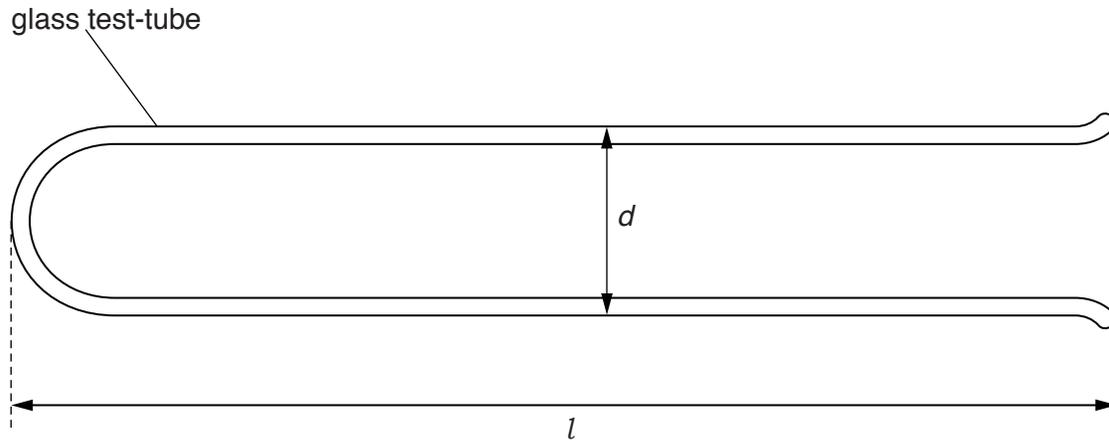
Each student has a test-tube, as shown in Fig. 2.1.

glass test-tube

d

l

Fig. 2.1

(a) (i) • Measure the length l of the test-tube shown in Fig. 2.1.

$l = $ .... cm

• Measure the external diameter d of the test-tube.

$d = $ .... cm
[1]

(ii) A student uses two wooden blocks to help him to measure the diameter d of the test-tube.

Describe his method. You may draw a diagram. Include one precaution which could be taken to ensure that the value of d is as reliable as possible.

....

....

....[2]

(iii) Assuming that the test-tube is an approximate cylinder, calculate a value for its external volume V_1 using the equation $V_1 = \dfrac{\pi d^2 l}{4}$.

$V_1 =$ .... cm^3 [1]

(b) The test-tube is completely filled with water and then the water from the test-tube is poured into a measuring cylinder.

(i) Read and record the volume V_2 of the water as shown in Fig. 2.2.
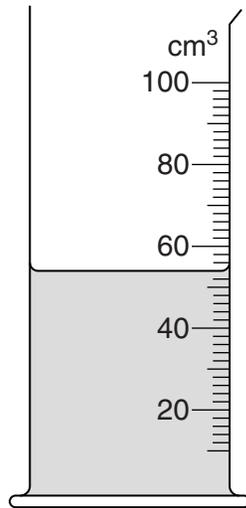

Fig. 2.2

$V_2 =$ .... cm^3 [1]

(ii) Describe briefly how you would read the measuring cylinder to obtain a reliable value for the volume of water. You may add to Fig. 2.2 to illustrate your explanation.

....

....

....[1]

(iii) Calculate the volume V_3 of the glass, using the equation $V_3 = V_1 - V_2$.

$V_3 =$ .... cm^3 [1]

(c) One student uses a balance to measure the mass *m* of the test-tube, as shown in Fig. 2.3.

test-tube

32.17 g
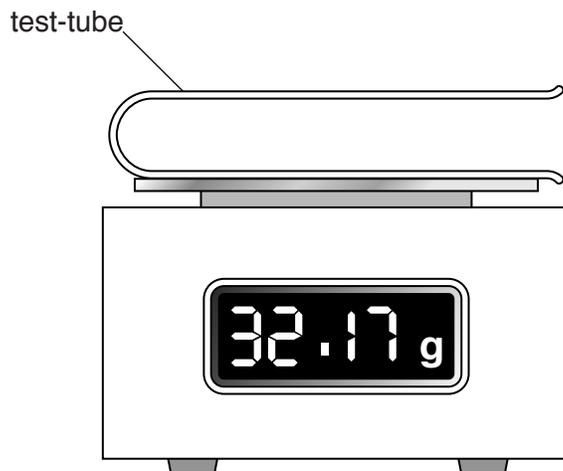
Fig. 2.3

(i) Calculate the density ρ of the glass, using the equation $\rho = \dfrac{m}{V_3}$.

$\rho =$ .... [2]

(ii) Other students are using a balance which only measures to the nearest gram.

Record the mass *m* of the test-tube to the nearest gram.

m = ... g [1]

(d) The precision of the balance does not affect the accuracy of this experiment.

State one possible source of inaccuracy in the experiment. Explain what effect this inaccuracy would have on the value obtained for ρ.

....

....

....

....

....[2]

[Total: 12]

2 The IGCSE students are carrying out measurements in order to determine the density of water using two methods.

(a) Method 1

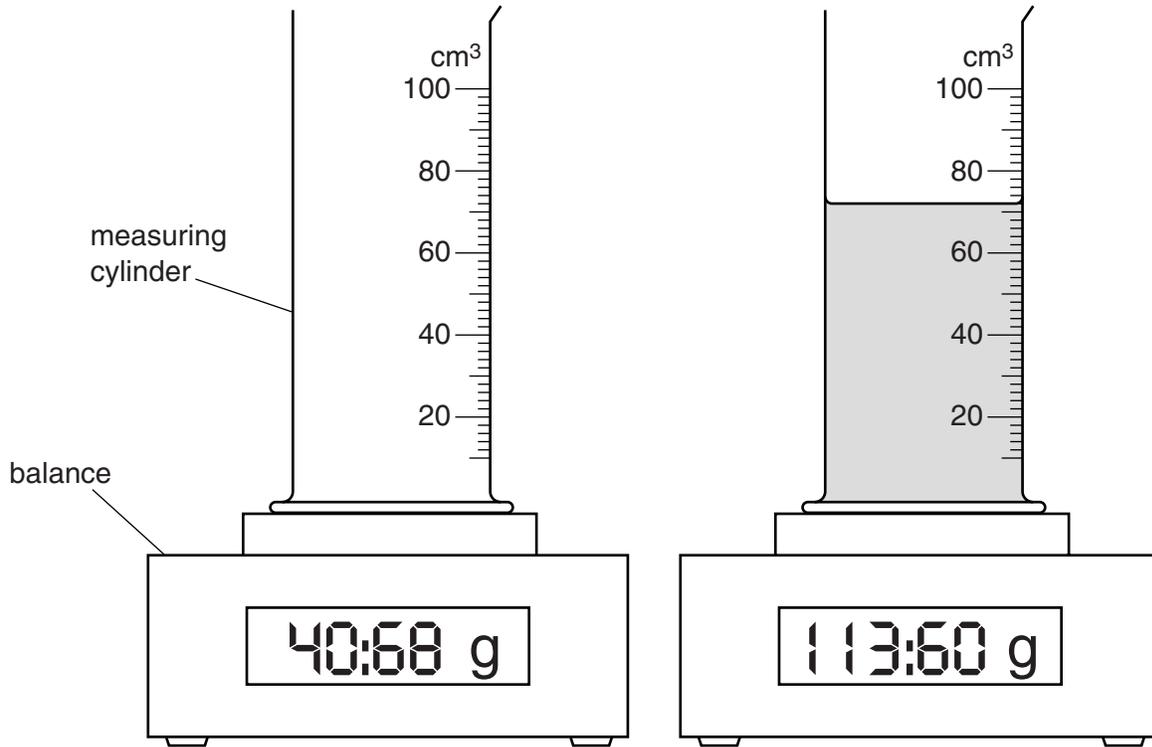Fig. 1.1 shows an empty measuring cylinder on a balance and Fig. 1.2 shows the measuring cylinder containing water.

Fig. 1.1   **Fig. 1.2**

(i) Read and record the mass m_1 of the empty measuring cylinder.

m_1 = ... g

(ii) Read and record the mass m_2 of the measuring cylinder and water.

m_2 = ... g

(iii) Read and record the volume V_1 of water, as shown in Fig. 1.2.

V_1 = ... cm^3

(iv) Calculate a value ρ_1 for the density of water using your readings from **(a)(i)**, **(ii)** and **(iii)** and the equation $\rho_1 = \dfrac{m_2 - m_1}{V_1}$. Give an appropriate unit.
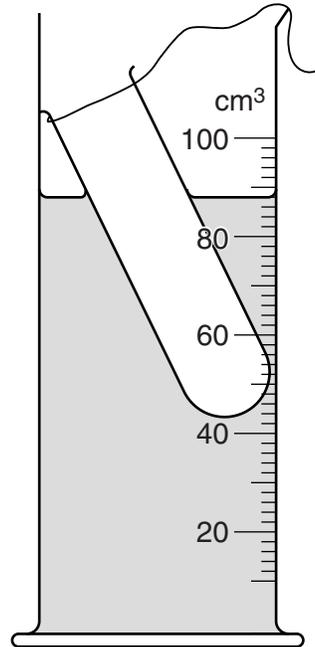
ρ_1 = ...

[3]

(b) Method 2

In this method, a test-tube is floated in the water left in the measuring cylinder from Method 1 and the change in water level is measured.
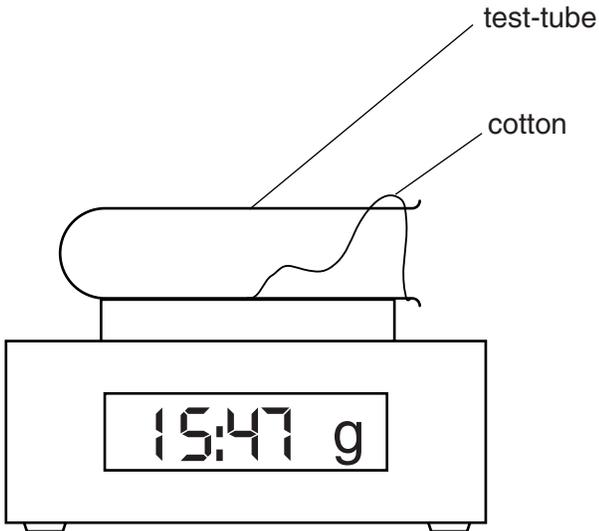
Fig. 1.3

Fig. 1.4

(i) Read and record the mass m_3 of the test-tube, as shown in Fig. 1.3.

m_3 = ...

(ii) The test-tube is carefully lowered, by means of a piece of cotton, into the measuring cylinder until it floats as shown in Fig. 1.4. Read and record the new water level V_2 in the measuring cylinder.

V_2 = ...

(iii) Using your results from **(a)(iii)** and **(b)(ii)**, calculate V_3, the change in the water level, where $V_3 = (V_2 - V_1)$.

V_3 = ...

(iv) Calculate and record a value ρ_2 for the density of water using the equation $\rho_2 = \dfrac{m_3}{V_3}$.

ρ_2 = ...

[3]

(c) Calculate an average value ρ_{AV} for the density of water using your results from **(a)(iv)** and **(b)(iv)**.

ρ_{AV} = ... [1]

(d) Suggest a precaution that should be taken in **Method 1** to ensure that the volume reading is as accurate as possible.

....

....

....[1]

(e) Suggest a possible source of experimental inaccuracy in **Method 2**, other than with the volume reading.

State and explain the effect that this would have on your value for ρ_2.

suggestion ....

....

effect and explanation ....

....

[2]

[Total: 10]

3   An IGCSE student is taking measurements of a sample of modelling clay. She has moulded the sample of modelling clay into a cube, as shown in Fig. 1.1.
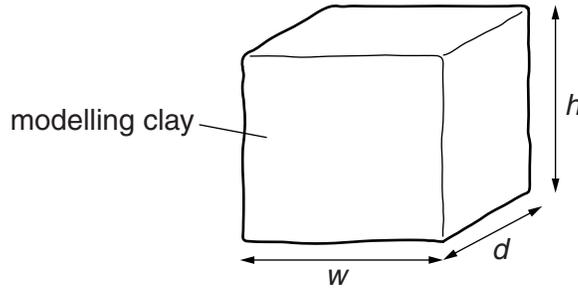

modelling clay

h

d

w

Fig. 1.1

(a) (i)   On Fig. 1.2, measure the height h and width w of the piece of modelling clay.

h

w
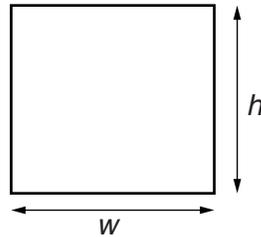
Fig. 1.2

$h =$ .... cm

$w =$ .... cm

(ii)   On Fig. 1.3, measure the depth d of the piece of modelling clay.

d
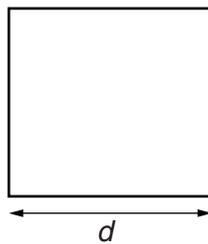
Fig. 1.3

$d =$ .... cm

(iii)   Calculate the volume V_A of the modelling clay using the equation $V_A = hwd$.

$V_A =$ .... cm^3

(iv) The mass m of the piece of modelling clay is shown in Fig. 1.4.

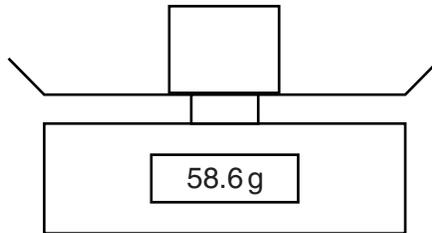Calculate the density ρ of the modelling clay using the equation $\rho = \dfrac{m}{V_A}$.

58.6 g

Fig. 1.4

ρ = ...
[3]

(b) The student moulds the piece of modelling clay into a spherical shape.

Draw a diagram to show how you would use two rectangular blocks of wood and a rule to measure the diameter of the sphere of modelling clay.

[1]

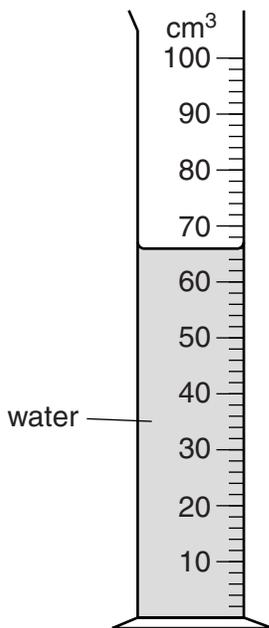**(c)** The student pours water into a measuring cylinder, as shown in Fig. 1.5.

Fig. 1.5

(i) Record the volume V_1 of water shown in Fig. 1.5.

V_1 = ...[1]

(ii) On Fig. 1.5, show clearly the line of sight required to take the reading of V_1. [1]

(d) The student uses a piece of string to lower the sample of modelling clay into the measuring cylinder until it is completely covered with water. The new volume reading V_2 is $84\,cm^3$.

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

V_B = ...[1]

(e) The student suggests that the volume of the modelling clay should not change when the shape is changed.

Assuming that the experiment has been carried out with care, suggest two reasons why the values V_A and V_B may not be the same.

1. ....

....

2. ....

.... [2]

[Total: 9]

4 The IGCSE class has been asked to determine the density of an object.

One student is finding the volume of the object using a measuring cylinder containing water in which the object is to be placed.

The measuring cylinder containing only water is shown in Fig. 4.1.

The measuring cylinder after the object has been placed in the water is shown in Fig. 4.2.
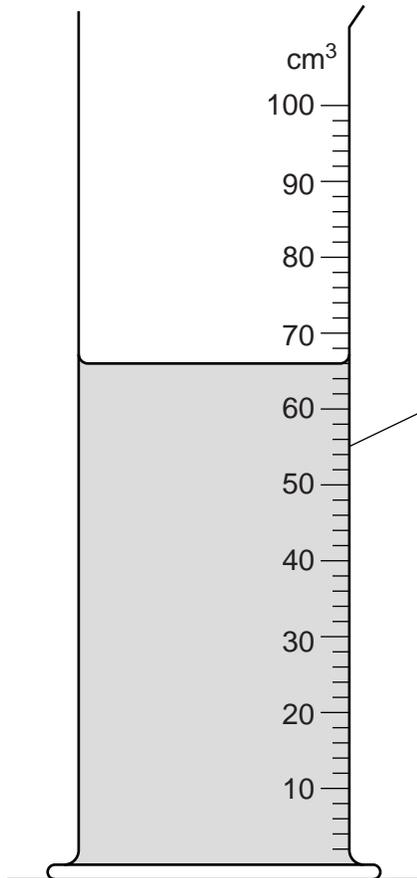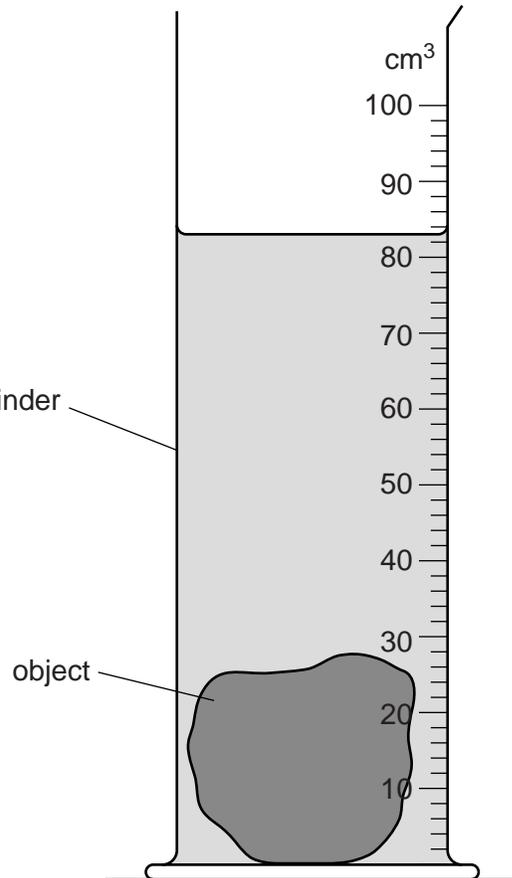

Fig. 4.1   **Fig. 4.2**

(a) (i) Read and record the volume V_1 of the water in the measuring cylinder shown in Fig. 4.1.

$$V_1 = \text{...}$$

(ii) Read and record the volume V_2 of the water in the measuring cylinder shown in Fig. 4.2.

$$V_2 = \text{...}$$
[2]

(b) The student then uses a balance to measure the mass *m* of the object, as shown in Fig. 4.3.

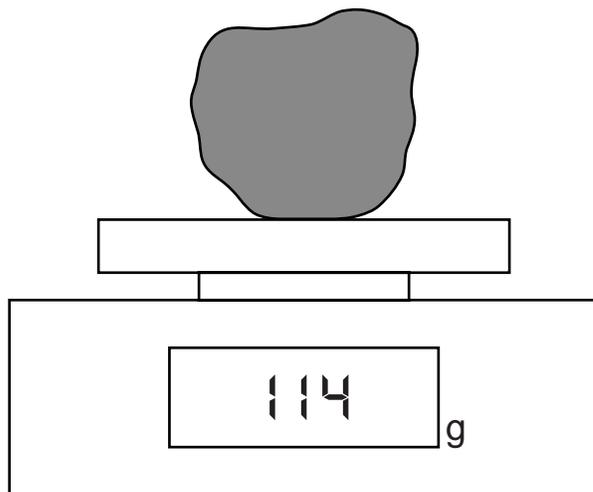**Fig. 4.3**

Calculate the density of the object using the equation

$$\text{density} = \frac{m}{(V_2 - V_1)} .$$

density = ...[2]

(c) Suggest a possible practical cause of inaccuracy in this method.

....

....

....[1]

[Total: 5]