Length & Time

Question Paper 2

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

Time Allowed: **60 minutes**

Score: **/50**

Percentage: **/100**

1 The IGCSE class is investigating the current in copper wires.

Each student has a selection of wires and a range of apparatus that could be used, listed below.

30 cm ruler
ammeter
electrical leads
electromagnet
electronic balance
lamp
metre rule
12 V fixed-voltage power supply
switch
tape measure
variable resistor (rheostat)
voltmeter

(a) From the list, choose the most suitable device to measure the length of approximately 20 m of copper wire.

.... [1]

(b) **(i)** Draw a circuit diagram to show the circuit that you would set up to measure the current in a sample of copper wire. The current is to be measured for a range of potential differences that must also be measured. Draw the symbol for a resistor to represent the sample of copper wire.

[3]

(ii) A student replaces the copper wire with a lamp. She switches on the circuit but the lamp does not glow.

Suggest how she can check that the lamp filament is not broken by using the circuit, and without removing the lamp.

....

....[1]

(iii) State whether a 0 – 300 V voltmeter is suitable for measuring a potential difference in the circuit you have drawn in part **(b)(i)**. Give a reason for your answer.

statement ....

reason ....

....

....
[1]

[Total: 6]

2 A student carries out an experiment using a simple pendulum.

Fig. 4.1 shows the apparatus.

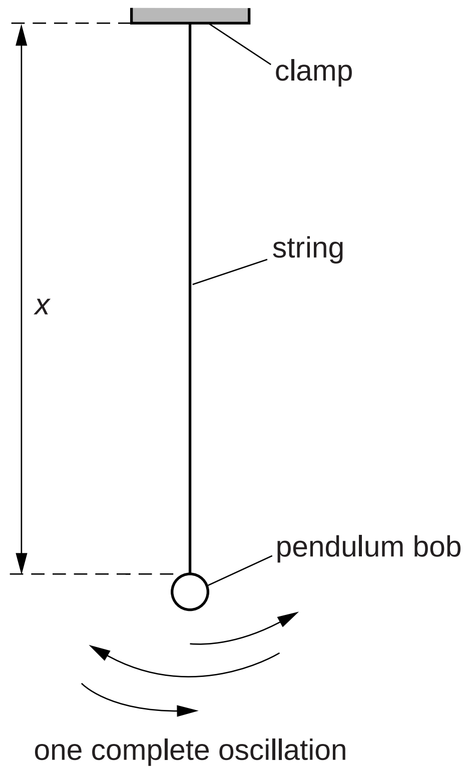


Fig. 4.1

The student records the time t taken for 20 complete oscillations of the pendulum for a range of different lengths x of the string. The readings are shown in Table 4.1.

Table 4.1

x/cm	t/s	T/s
90.0	38.5	
80.0	36.0	
70.0	33.4	
60.0	31.4	
50.0	28.2	
40.0	25.5	

(a) The period T of the pendulum is the time taken for one complete oscillation.

For each set of readings in the table, calculate the period T and enter the results in the table. [2]

(b) Suggest a reason for measuring the time for twenty oscillations rather than just one.

....

....

....[1]

(c) In this experiment, the length x of the string is measured with a metre rule.

Suggest one precaution that you would take when measuring the length in order to obtain an accurate reading.

....

....[1]

(d) The student decides that a more useful result is possible if the length is measured to the centre of mass of the pendulum bob.

The pendulum bob is a small metal ball. The student has a 30 cm ruler and two rectangular blocks of wood that are about 10 cm long.

Suggest how the student can use this equipment to measure accurately the diameter of the pendulum bob. You may draw a diagram.

....

....

....[2]

[Total: 6]

3 The IGCSE class is investigating the oscillation of a pendulum.

The apparatus is set up as shown in Fig. 2.1.

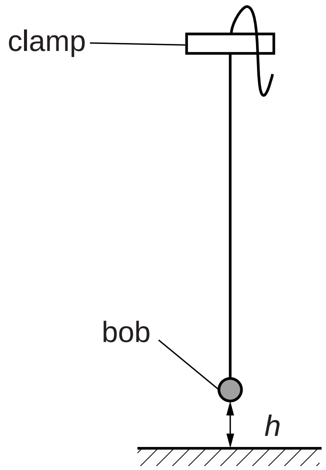


Fig. 2.1

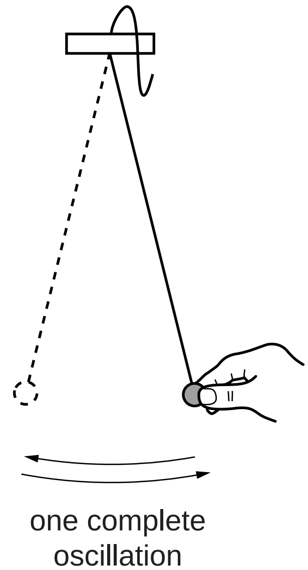


Fig. 2.2

The height *h* of the pendulum bob above the bench is measured and recorded.

This is repeated, to obtain a total of five different values of *h*, by shortening the string of the pendulum but without changing the height of the clamp.

For each value of *h*, the pendulum bob is pulled to one side by a small distance, as shown in Fig. 2.2.

The pendulum is then released and the time *t* for 10 complete oscillations is measured and recorded.

(a) Describe a precaution which the IGCSE students might have taken in order to measure *h* as accurately as possible. You may draw a diagram.

....

....

....[1]

(b) Figs. 2.3 to 2.7 are scale diagrams showing the height *h* of the pendulum bob above the bench for each of the five experiments.

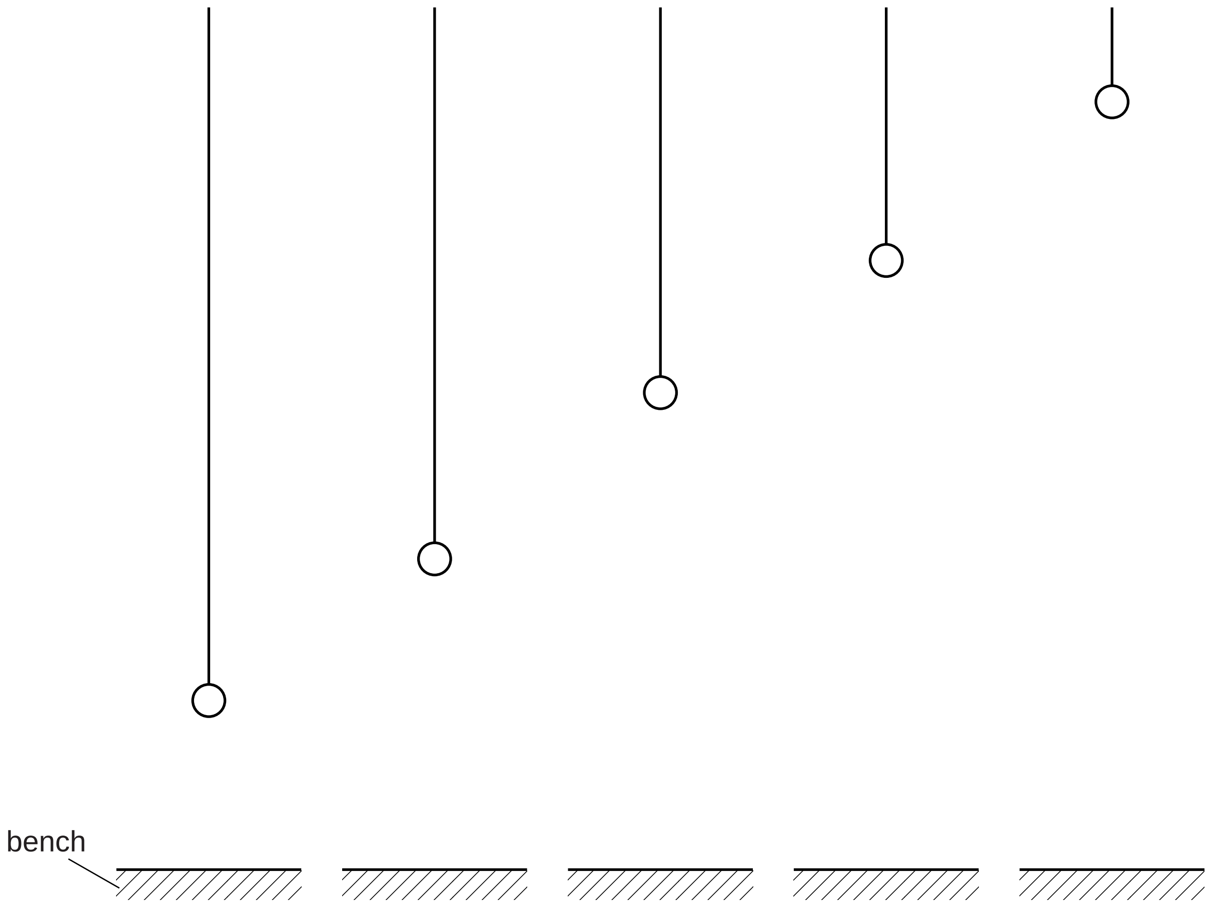


Fig. 2.3 **Fig. 2.4** **Fig. 2.5** **Fig. 2.6** **Fig. 2.7**

(i) Measure, and record in Table 2.1, the height *h* in each experiment.

(ii) The diagrams are drawn to 1/5 scale.

Calculate, and record in Table 2.1, the actual heights *H* of the pendulum bob above the bench. [2]

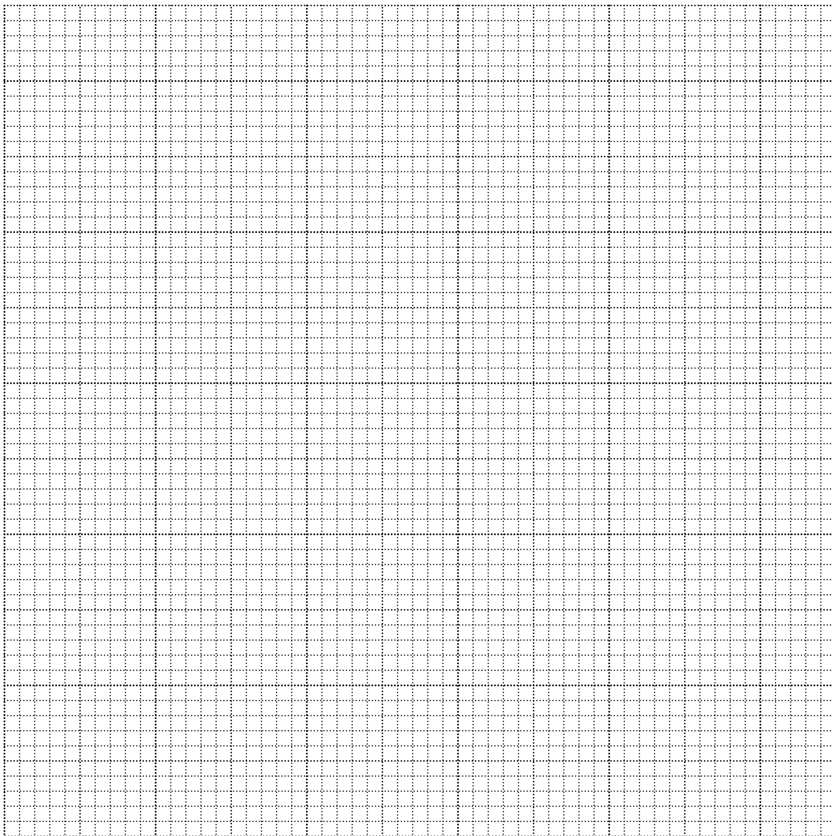
Table 2.1

	h/cm	H/cm	t/s	T/s	T^2/s^2
Fig. 2.3			14.01		
Fig. 2.4			12.39		
Fig. 2.5			10.85		
Fig. 2.6			8.93		
Fig. 2.7			6.30		

(c) **(i)** For each value of height h, calculate the time T for one complete oscillation, using the equation $T = \dfrac{t}{10}$. Record these values in Table 2.1.

(ii) Calculate the values of T^2 and record these in the table. [1]

(d) Plot a graph of T^2/s^2 (y-axis) against H/cm (x-axis).



[4]

(e) Determine the gradient G of the graph.

Show clearly on the graph how you obtained the necessary information.

G = ...

[1]

(f) One of the students wishes to carry out the experiment again to obtain results which are more reliable.

Describe one change she might make to the method to achieve this.

....

....

....[1]

[Total: 10]

4 The IGCSE class is investigating pendulums.

The apparatus is shown in Figs. 1.1 and 1.2.

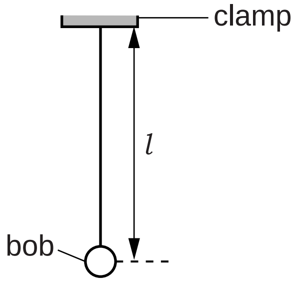


Fig. 1.1

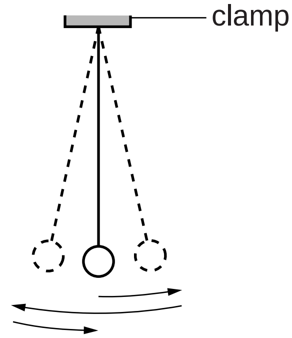


Fig. 1.2

(a) **(i)** On Fig. 1.1, measure the length l of the pendulum.

l = ... [1]

(ii) The pendulum is drawn 1/10th of actual size.

Write the actual length of the pendulum in the first row of Table 1.1.

(b) A student displaces the pendulum bob slightly and releases it so that it swings.

Fig. 1.2 shows one complete oscillation of the pendulum bob.

The student uses a stopwatch to record the time t for 20 complete oscillations of the pendulum. The reading is recorded in the table.

(i) Calculate the period T of the pendulum. The period is the time for one complete oscillation.

Record the value of T in Table 1.1.

(ii) Complete the column headings in the table.

Table 1.1

l / cm	t /	T /
	22.4	
61.9	31.6	1.58

[3]

(c) The student adjusts the length of the pendulum until its length l = 61.9 cm. He repeats the procedure in **(b)** and calculates T. The results are shown in Table 1.1.

The student suggests that doubling the length l of the pendulum should double the period T.

State whether the results support this suggestion and justify your answer by reference to the results.

statement ....

justification ....

....
[2]

(d) The student repeats the procedure in **(b)** four more times with different lengths of the pendulum.

The student plots a graph of l against T^2.

State two pieces of information from the graph that would indicate that l is directly proportional to T^2.

1. ....

2. ....
[2]

(e) The student uses another pendulum.

This pendulum has a mass that is double the mass of the first pendulum. Its length is 61.9 cm. The period T = 1.61 s.

Suggest a conclusion about the effect of doubling the mass of the pendulum.

....

....[1]

[Total: 9]

5 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.

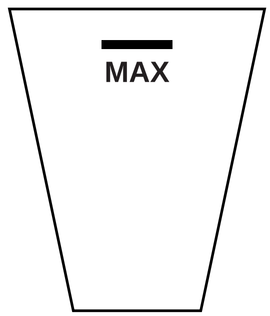


Fig. 1.1

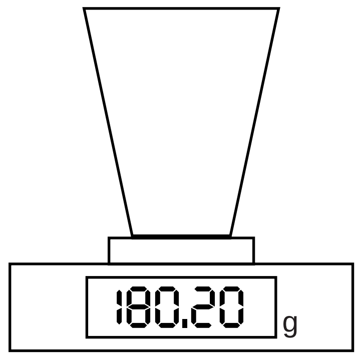


Fig. 1.2

(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 $\rho = 1.00\,g/cm^3$.

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.

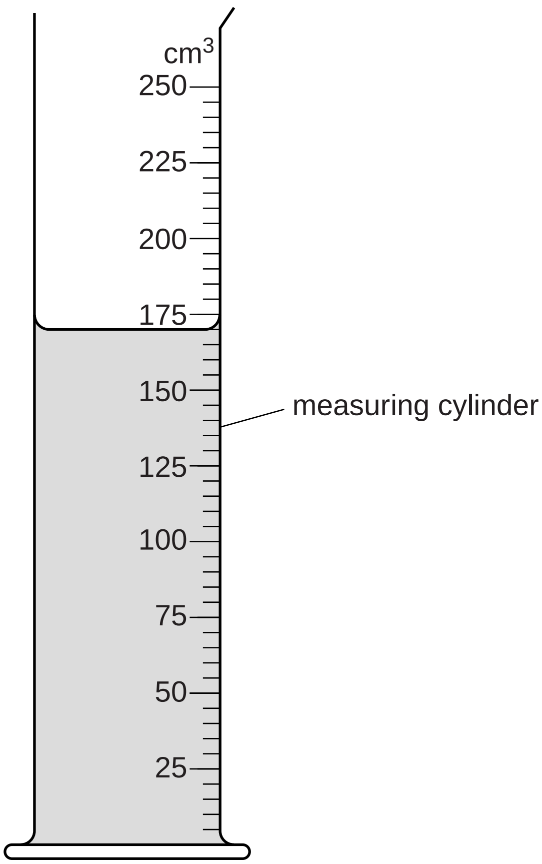


Fig. 1.3

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.

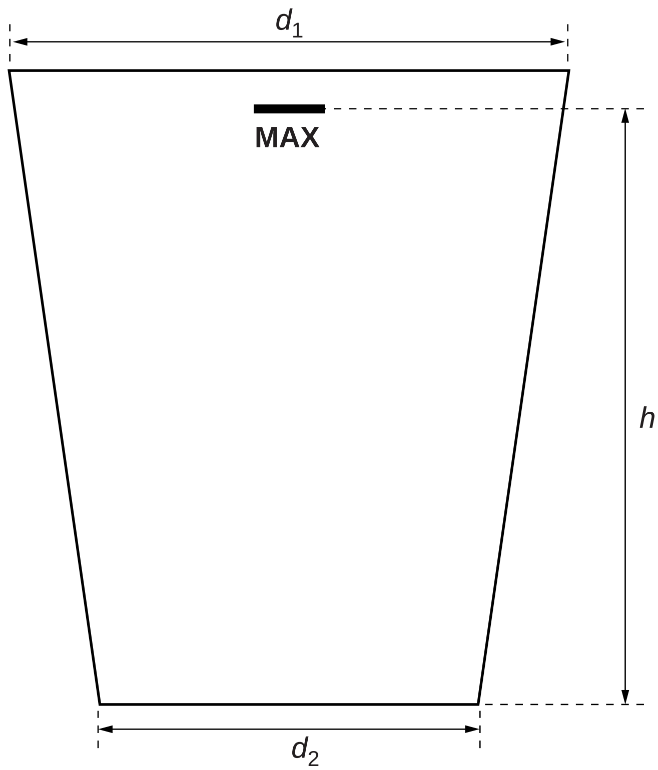


Fig. 1.4

(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]

6 The IGCSE class is determining the internal volume of a test-tube using two displacement methods.

The apparatus used is shown in Figs. 5.1, 5.2 and 5.3.

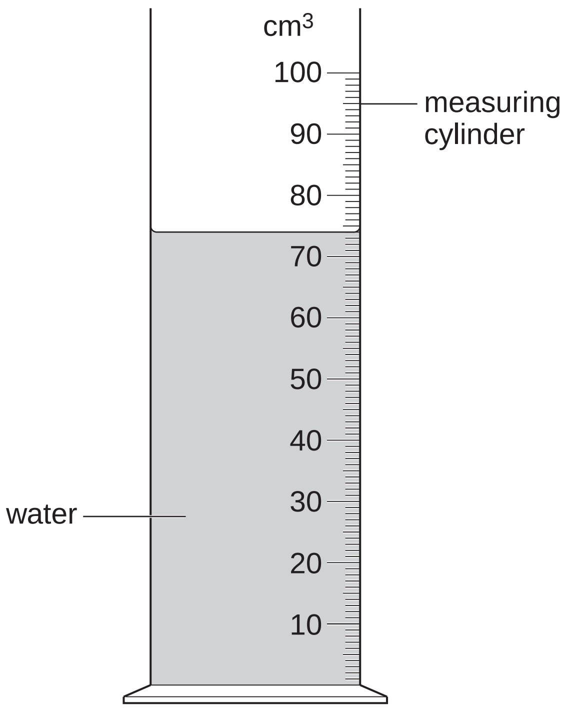


Fig. 5.1

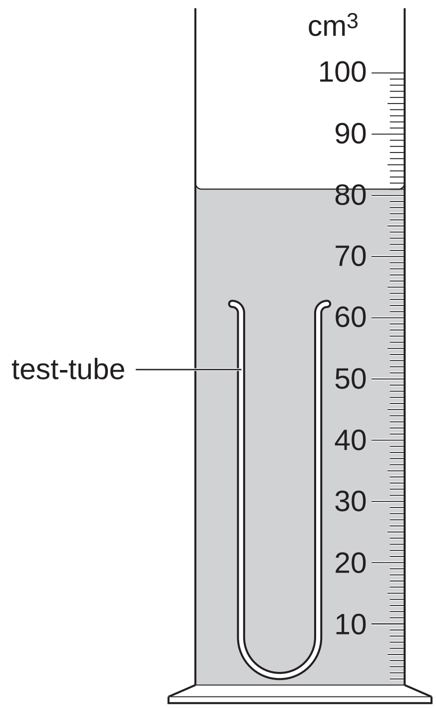


Fig. 5.2

(a) (i) Fig. 5.1 shows water in a measuring cylinder. Record the volume V_1 of the water.

V_1 = ... [1]

(ii) On Fig. 5.1, show clearly the line of sight that you would use to obtain an accurate volume reading. [2]

(b) (i) A student lowers a test-tube, closed end first, into the water in the measuring cylinder and pushes the tube down until it is filled with water. From Fig. 5.2, record the new water level V_2.

V_2 = ...

(ii) Calculate the volume V_G of the glass of the test-tube using the equation $V_G = (V_2 - V_1)$.

V_G = ...
[2]

(c) The student removes the test-tube from the measuring cylinder and empties the water back into the measuring cylinder. He then puts the test-tube, open end first, into the water in the measuring cylinder and carefully pushes it down with his finger until it is covered with water as shown in Fig. 5.3.

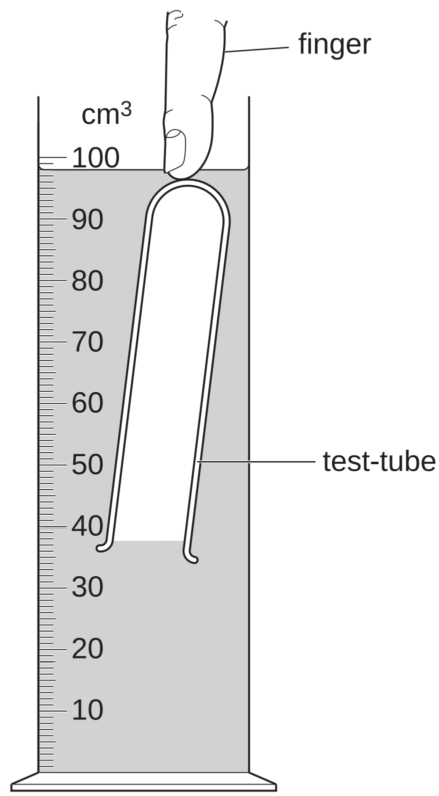


Fig. 5.3

(i) Record the new water level V_3.

V_3 = ...

(ii) Calculate the increase in water level $(V_3 – V_1)$.

$(V_3 – V_1)$ = ...

(iii) Calculate the volume V_A of air in the test-tube using the equation $V_A = (V_3 – V_1) – V_G$.

V_A = ...

[1]

(d) The student removes the test-tube from the measuring cylinder and fills the test-tube with water from a beaker. He pours the water from the test-tube into an empty measuring cylinder and records the volume V_W of water:

V_W = 18 cm^3 ....

The student has attempted to determine the internal volume of the test-tube by two methods. His two values for the internal volume are V_A and V_W.

Assuming that the experiments have been carried out correctly and carefully and that the measuring cylinder scale is accurate, suggest two reasons why the value V_A may be inaccurate and two reasons why the value V_W may be inaccurate.

V_A:

reason 1 ....

....

reason 2 ....

....

V_W:

reason 1 ....

....

reason 2 ....

....

[3]

[Total: 9]