Length & Time

Question Paper 3

Level	IGCSE
Subject	Physics
Exam Board	CIE
Topic	General Physics
Sub-Topic	Length & Time
Paper Type	Alternative to Practical
Booklet	Question Paper 3

Time Allowed: **72 minutes**

Score: **/60**

Percentage: **/100**

1 A student is measuring some small glass spheres.

(a) The student has a 30 cm rule and two rectangular blocks of wood.

In the space below, draw a diagram to show clearly how you would arrange the apparatus to measure the diameter of **one** of the spheres.

[2]

(b) The student then determines the average volume of a glass sphere by a displacement method. She pours some cold water into a measuring cylinder and records the volume V of the water, as shown in Fig. 4.1.

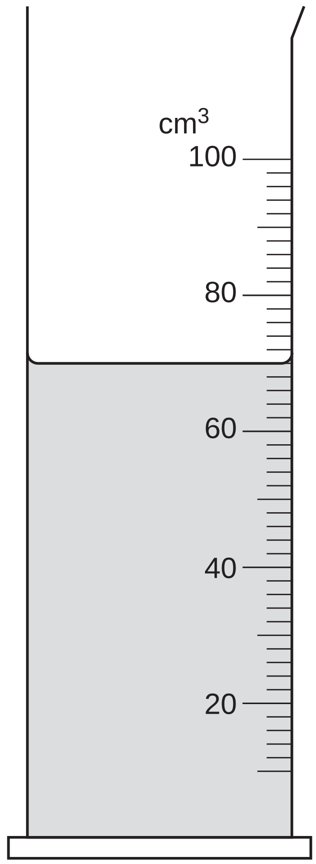


Fig. 4.1

(i) On Fig. 4.1, show clearly the line of sight that you would use to obtain an accurate volume reading. [2]

(ii) Using Fig. 4.1, record the volume V of water in the measuring cylinder.

V = ... [1]

(iii) The student carefully puts 15 of the glass spheres into the measuring cylinder. The new water level reading is 78 cm^3.

Calculate the volume V_1 of **one** sphere.

V_1 = ... [1]

[Total: 6]

2 **(a)** The IGCSE class has a range of apparatus available. Here is a list of some of the apparatus.

ammeter

barometer

beaker

electronic balance

manometer

measuring cylinder

metre rule

newtonmeter (spring balance)

stopwatch

tape measure

thermometer

voltmeter

Complete Table 5.1 by inserting the name of one piece of apparatus from the list that is the most suitable for measuring each quantity described.

Table 5.1

quantity to be measured	most suitable apparatus
volume of water	
a distance of about 50 m	
the force required to lift a laboratory stool	
the mass of a coin	
the pressure of the laboratory gas supply	

[5]

(b) The IGCSE class is carrying out a lens experiment. This involves using an illuminated object, a screen and a lens.

Firstly, the distance between the illuminated object and the lens is measured with a metre rule. Next, a clearly focused image is obtained on the screen.

(i) Explain briefly how you would avoid a parallax (line-of-sight) error when using the metre rule.

....

....

....[1]

(ii) State a precaution that you would take to ensure that the image is well focused.

....

....

....[1]

[Total: 7]

3 The IGCSE class is investigating a pendulum.

The apparatus is shown in Fig. 5.1.

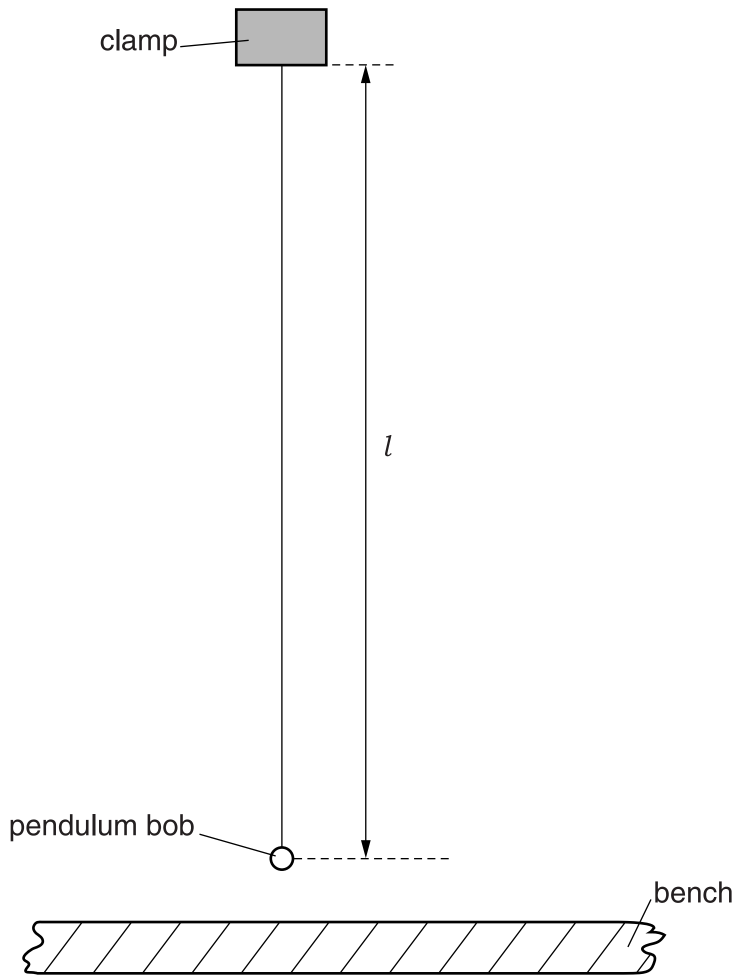


Fig. 5.1

(a) On Fig. 5.1, measure the length l of the pendulum.

l = ... [1]

(b) The diagram is drawn 1/5th actual size.

Calculate the actual length L of the pendulum.

L = ... [2]

(c) A student places a metre rule on the bench so that the 50.0 cm mark is vertically below the centre of the pendulum bob. Describe how you would judge that the 50.0 cm mark is vertically below the centre of the pendulum bob. You may draw a diagram.

....

....[1]

(d) The student pulls the pendulum bob to one side until it is vertically above the 52.0 cm mark on the rule. He has moved the pendulum bob a horizontal distance d = 2.0 cm.

He releases the pendulum bob, then measures the time t taken for 12 complete swings of the pendulum. He repeats the procedure using a range of d values. The values of d and t are shown in Table 5.1.

Table 5.1

d/	t/	T/
2.0	17.4	
3.0	17.6	
4.0	17.2	
5.0	17.3	
6.0	17.5	

(i) Calculate the period T of the pendulum for each value of d. Enter the values in the table. The period T is the time taken for one complete swing of the pendulum. [2]

(ii) Complete the column headings in the table. [1]

(e) Using the evidence in the table, describe the effect on the period T of increasing the distance d. Justify your answer by reference to your results.

description ....

....

justification ....

....

....

[2]

(f) Suggest why the student measures the time taken for twelve swings of the pendulum rather than for one swing.

....

....

....[1]

[Total: 10

4 Table 5.1 shows some measurements taken by three IGCSE students. The second column shows the values recorded by the three students. For each quantity, underline the value most likely to be correct.

The first one is done for you.

Table 5.1

quantity measured	recorded values
the mass of a wooden metre rule	<u>0.112 kg</u> 1.12 kg 11.2 kg
the diameter of a test tube	0.15 cm 1.5 cm 15 cm
the volume of a coffee cup	10 cm^3 100 cm^3 1000 cm^3
the area of a computer keyboard	0.07 m^2 0.70 m^2 7.0 m^2
the current in a 1.5 V torch lamp at normal brightness	0.12 A 12 A 120 A
the circumference of a 250 cm^3 beaker	2.3 cm 23 cm 230 cm

[5]

[Total: 5]

5 The IGCSE class is investigating the swing of a loaded metre rule.

The arrangement of the apparatus is shown in Fig. 5.1.

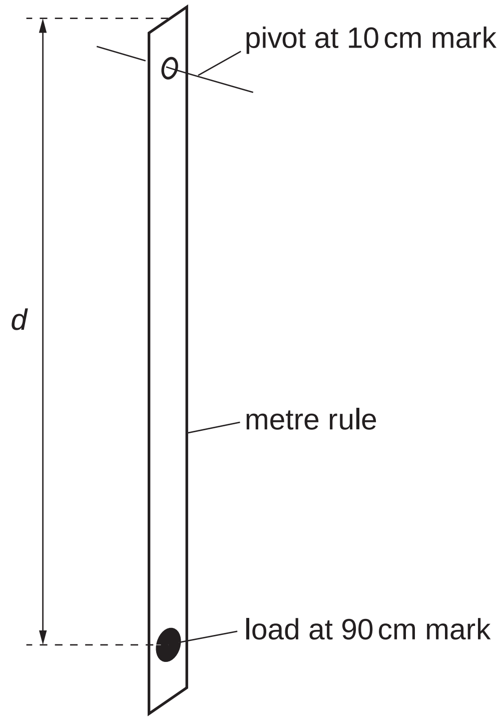


Fig. 5.1

A student displaces the rule a small distance to one side and allows it to swing. The time *t* taken for 10 complete swings is recorded. She calculates the time *T* taken for one swing. She repeats the procedure using different values of the distance *d*.

The readings are shown in the Table 5.1.

Table 5.1

0.900	18.4	1.84	
0.850	17.9	1.79	
0.800	17.5	1.75	
0.750	17.1	1.71	
0.700	16.7	1.67	

(a) Complete the column headings in the table. [3]

(b) Explain why the student takes the time for ten swings and then calculates the time for one swing, rather than just measuring the time for one swing.

....

....[1]

(c) The student tries to find a relationship between *T* and *d*. She first suggests that $T \times d$ is a constant.

(i) Calculate the values of $T \times d$ and enter the values in the final column of the table.

(ii) State whether or not the results support this suggestion and give a reason for your answer.

Statement ....

....

Reason ....

....
[2]

6 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.

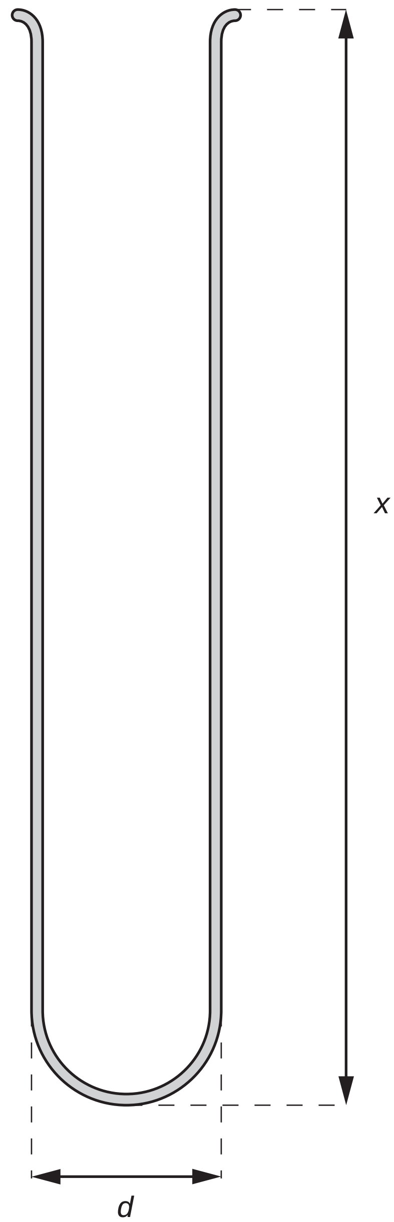


Fig. 1.1

(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.

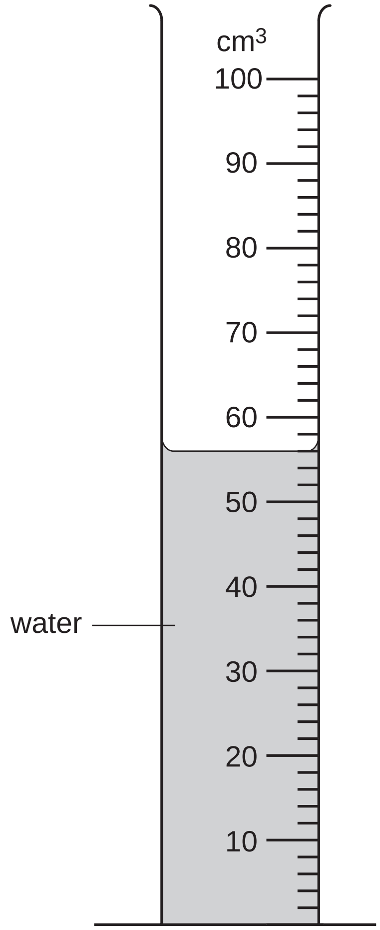


Fig. 1.2

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]

7 The IGCSE class is investigating the period of oscillation of a simple pendulum.

Fig. 1.1 shows the set-up.

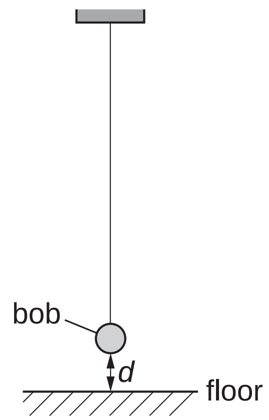


Fig. 1.1

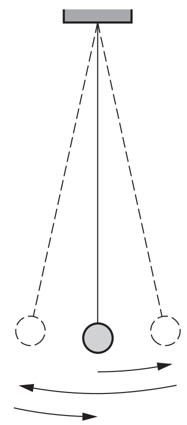


Fig. 1.2

(a) (i) On Fig. 1.1, measure the vertical distance *d* from the floor to the bottom of the pendulum bob.

d = ...

(ii) Fig. 1.1 is drawn one twentieth actual size. Calculate the actual distance *x* from the floor to the bottom of the pendulum bob. Enter this value in the top row of Table 1.1.

The students displace the pendulum bob slightly and release it so that it swings. They measure and record in Table 1.1 the time *t* for 20 complete oscillations of the pendulum (see Fig. 1.2).

Table 1.1

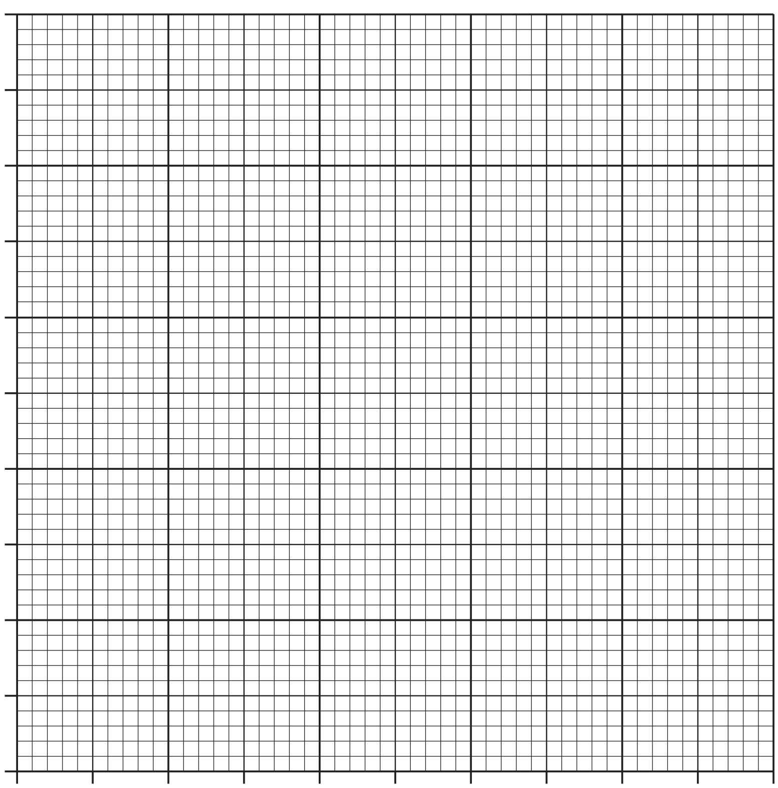
x / cm	t / s	T / s	T^2 / s^2
	20.0		
20.0	19.0		
30.0	17.9		
40.0	16.8		
50.0	15.5		

[4]

(b) **(i)** Calculate the period T of the pendulum for each set of readings. The period is the time for one complete oscillation. Enter the values in Table 1.1.

(ii) Calculate the values of T^2. Enter the T^2 values in Table 1.1.

(c) Use your values from Table 1.1 to plot a graph of T^2/s^2 (y-axis) against x/cm (x-axis). Draw the best-fit line.



[5]

(d) State whether or not your graph shows that T^2 is directly proportional to x. Justify your statement by reference to the graph.

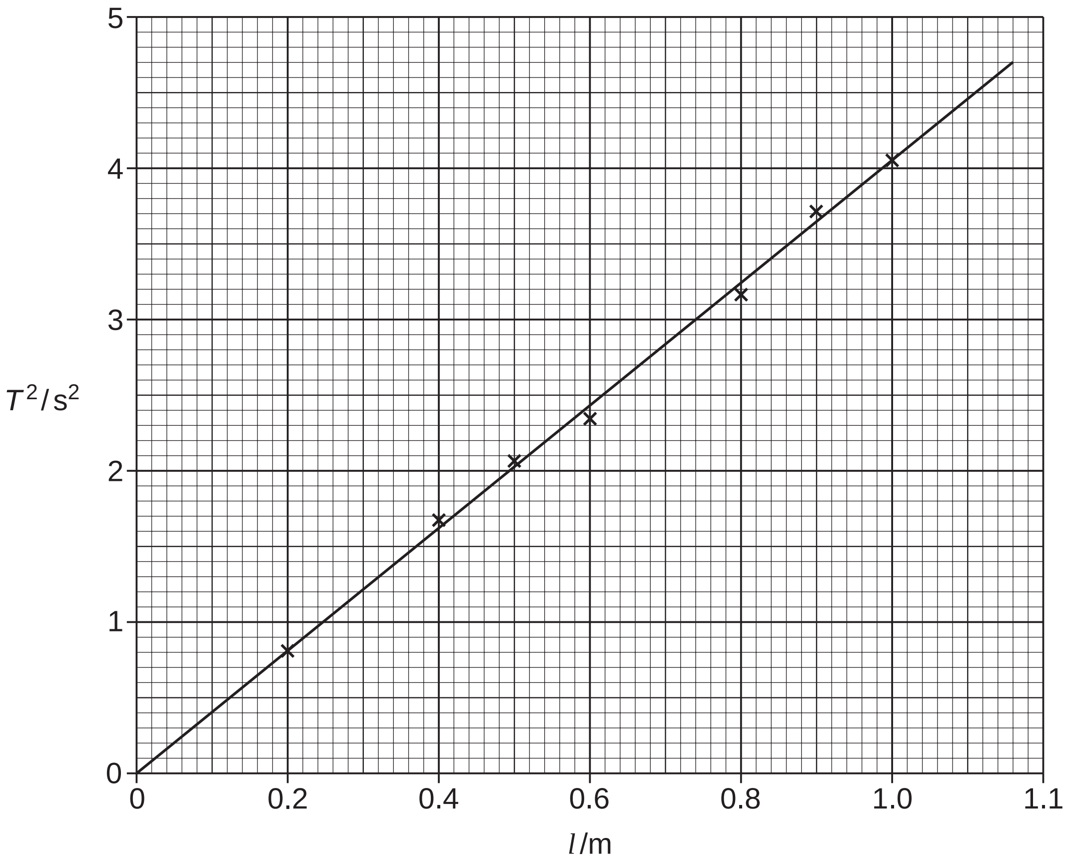
statement ....

justification ....

.... [1]

[Total: 10]

8 An IGCSE student has carried out a timing experiment using a simple pendulum. She plotted a graph of T^2/s^2 against l/m. T is the time for one swing of the pendulum and l is the length of the pendulum. The graph is shown below.



(a) **(i)** Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ...

(ii) Calculate the acceleration g of free fall using the equation

$$g = \frac{4\pi^2}{G}.$$

g = ...m/s^2

(iii) The student could have calculated the acceleration of free fall g from just one set of readings. State the purpose of taking sufficient readings to plot a graph.

....

....[5]

(b) The student next studies the relationship between the mass *m* of the pendulum and the time for one swing *T*. The readings are shown in Table 5.1.

Table 5.1

m / g	*T* / s
50	1.58
100	1.60
150	1.61
200	1.57
250	1.59

(i) Suggest two variables that must be kept constant to make the experiment a fair test.

1. ....

2. ....

(ii) Study the readings in the table and complete the following sentence.

Within the limits of experimental accuracy, the readings show that the mass *m* of

the pendulum ....[3]

[Total: 8]