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9702/31

October/November 2008

2 hours

Additional Materials: As listed in the Confidential Instructions.

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO NOT WRITE IN ANY BARCODES.

You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them. The working of the answers is to be handed in.

You are reminded of the need for good English and clear presentation in your answers.

All questions in this paper carry equal marks.

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- 1** In this experiment you will observe the motion of two simple pendulums, and measure the interval between successive times at which the pendulums are moving together. You will investigate how this time interval is affected when the length of one of the pendulums is changed.

- (a)** Set up two simple pendulums side by side as shown in Fig. 1.1, with each string clamped between two wooden blocks.

Set the length of pendulum A to about 0.65 m.

Pendulum A should be left at its set length throughout the experiment.

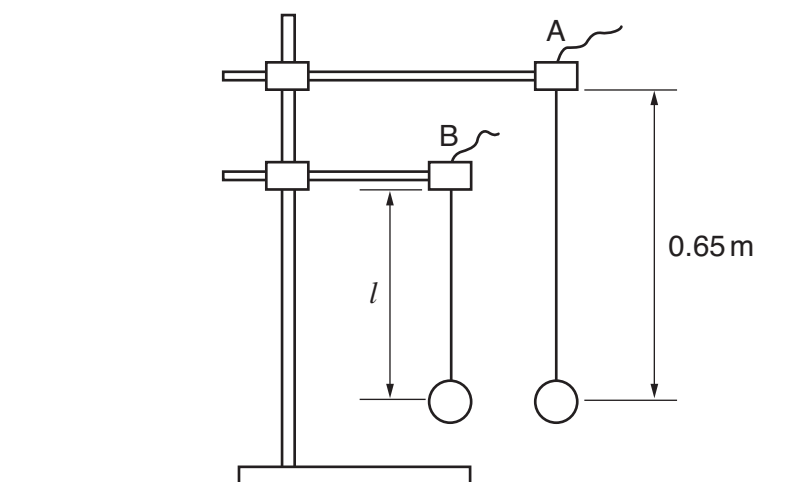


Fig. 1.1

- (b)** Adjust pendulum B so that its length l is about 0.5 m.

Measure and record the value of l .

$l = \dots\dots\dots\text{m}$

- (c) Set both pendulums into motion with small oscillations.

Start the stopwatch when the two pendulums are lined up as shown in Fig. 1.2 **and** are moving in the same direction.

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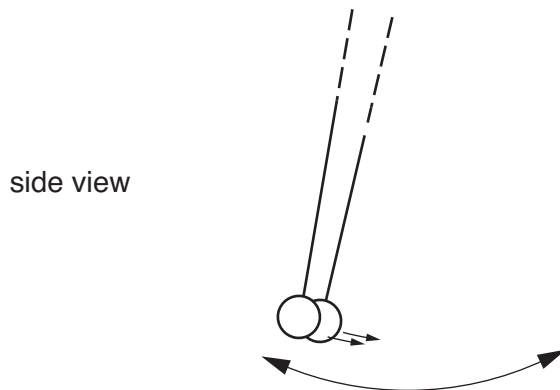


Fig. 1.2

Determine the time t that elapses before the next occasion when the two pendulums are lined up **and** moving in the same direction.

$t = \dots\dots\dots$ s

- (d) Change l and repeat (c) until you have six sets of values for l and t .

l should be from about 0.3m to about 0.6m. Include values of $\frac{1}{t}$ and $\frac{1}{\sqrt{l}}$ in your table of results.

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- (e) Plot a graph of $\frac{1}{t}$ on the y -axis against $\frac{1}{\sqrt{l}}$ on the x -axis and draw the line of best fit.
- (f) Determine the gradient and y -intercept of this line.

gradient = ...

y -intercept = ...

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(g) The equation relating t and l is

$$\frac{1}{t} = \frac{p}{\sqrt{l}} - \frac{p}{q}$$

where p and q are constants.

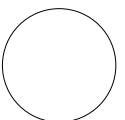
Use your answer from (f) to determine a value for p .

$$p = \dots\dots\dots \text{m}^{1/2}\text{s}^{-1}$$

(h) Use your answers from (f) and (g) to determine a value for q .

$$q = \dots\dots\dots \text{m}^{1/2}$$

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2 In this experiment you will investigate the resistance of a wire coil.

(a) You have been provided with a coil as shown in Fig. 2.1.

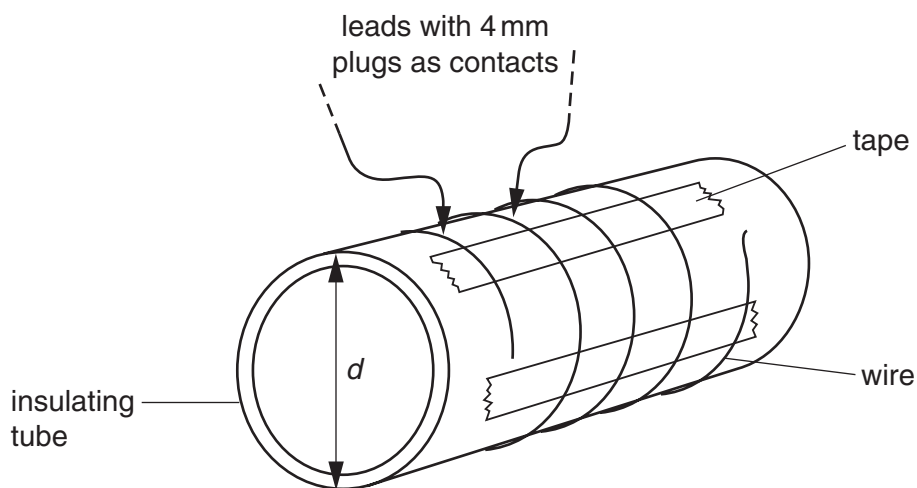


Fig. 2.1

(i) Measure and record the diameter d of the insulating tube.

$d = \dots\dots\dots\text{m}$

(ii) Estimate the percentage uncertainty in your value for d .

percentage uncertainty = $\dots\dots\dots$

(iii) Use your value from **(i)** to estimate the length x of wire in a single turn.

$x = \dots\dots\dots\text{m}$

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- (b) Set up the circuit as shown in Fig. 2.2, and hold the contacts against two positions on the coil.

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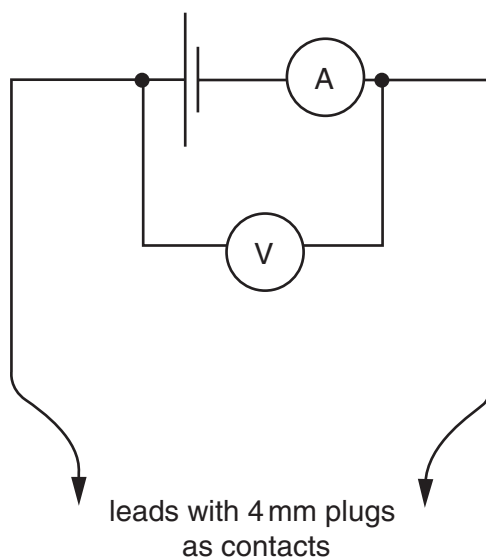


Fig. 2.2

- (c) (i) Measure and record the number n of turns between the contacts, voltage V and current I .

$n =$

$V =$

$I =$

- (ii) Determine the resistance R between the contacts.

$R =$

- (iii) The resistance per metre μ of the wire is given by

$$\mu = \frac{R}{x n}$$

Use your results to determine a value for μ .

$\mu =$

(d) Repeat (c) for a different value of n .

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$n =$

$V =$

$I =$

$R =$

$\mu =$

(e) Explain whether your results support the idea that R is proportional to n .

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- (f) (i) State four sources of error or limitations of the procedure in this experiment.

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- (ii) Suggest four improvements that could be made to the experiment. You may suggest the use of other apparatus or different procedures.

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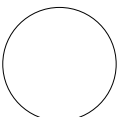
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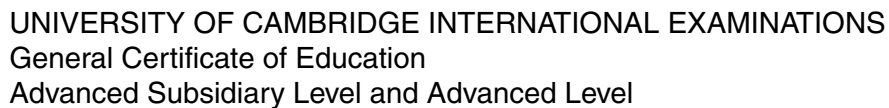
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- 1** In this experiment you will investigate the equilibrium position of a pivoted wooden strip as the turning load on it is varied.

(a) The equipment is set up as shown in Fig. 1.1.

- (i)** Add sand to the plastic container until the angle θ is between 5° and 10° .

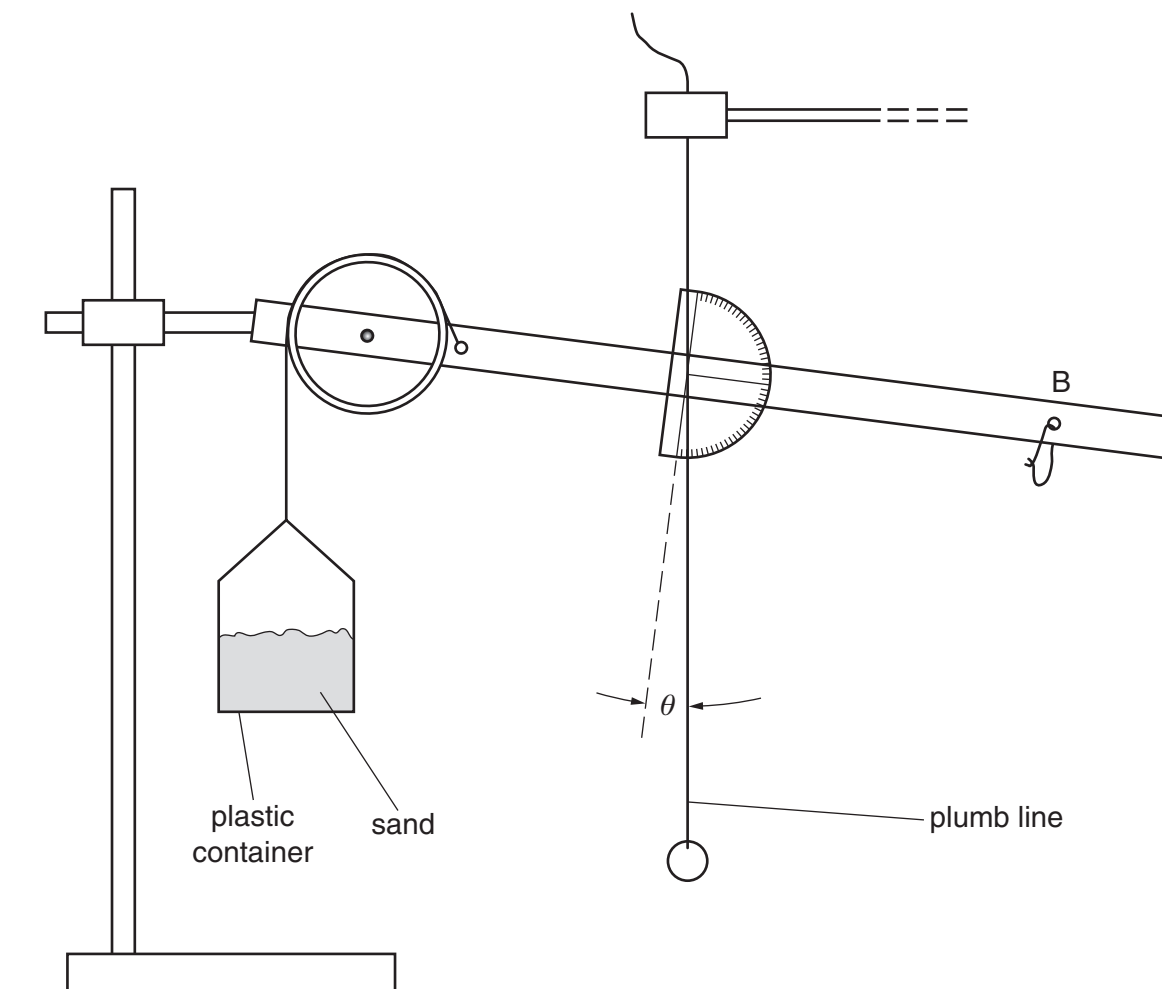


Fig. 1.1

- (ii)** Measure and record the value of θ .

$\theta = \dots\dots\dots^\circ$

- (b) Add n paper clips to the string loop at B and repeat (a)(ii) until you have six sets of values of n and θ , with θ in the range 5° to 60° . You may bend the paper clips if you wish.

Include values of $\frac{1}{\cos\theta}$ in your table of results.

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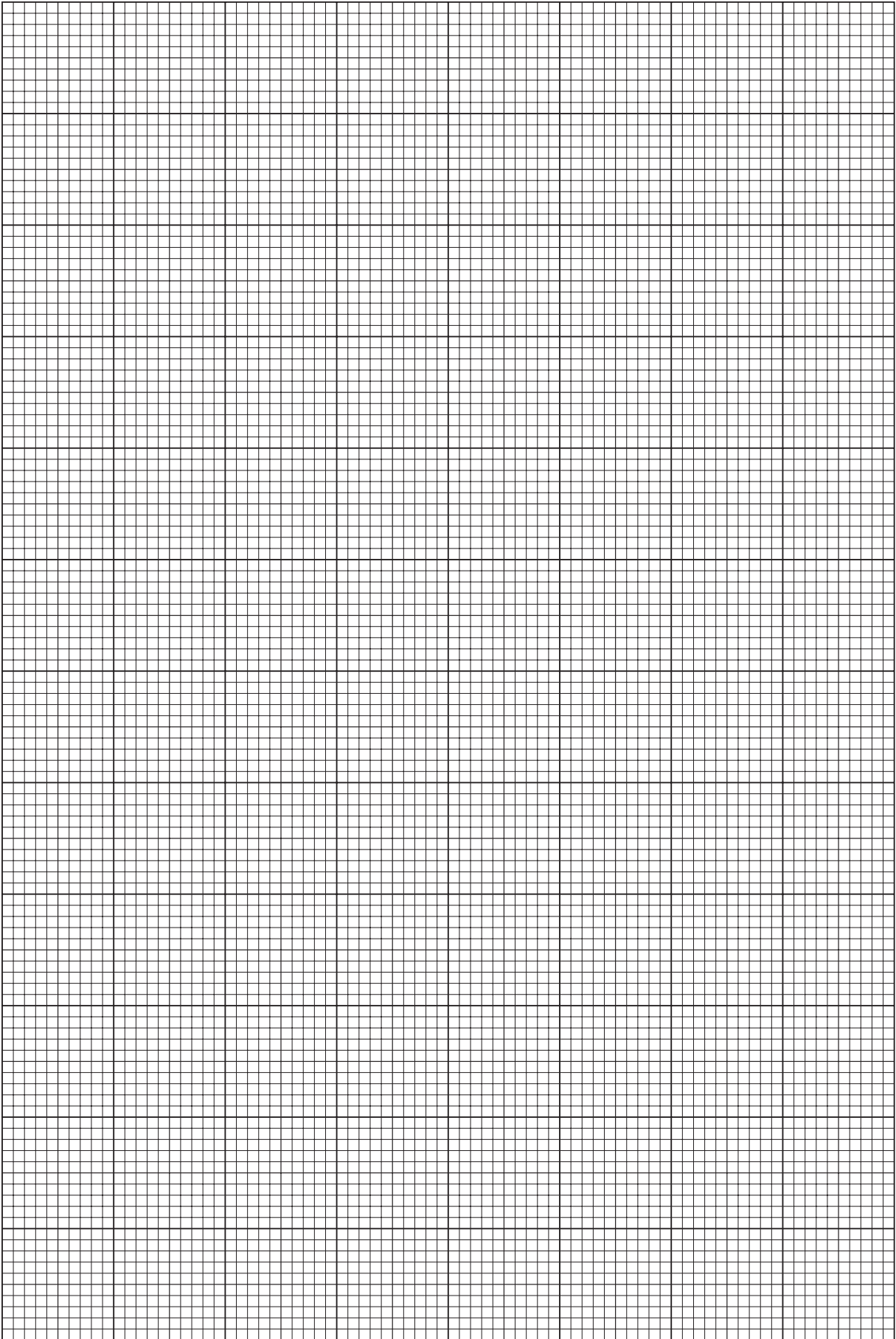
- (c) Plot a graph of $\frac{1}{\cos\theta}$ on the y -axis against n on the x -axis and draw the line of best fit.

- (d) Determine the gradient and y -intercept of the line.

gradient = ...

y -intercept = ...

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- (e) The formula that relates θ and n is

$$\frac{1}{\cos \theta} = 2kmn + kM$$

where k is a constant, m is the mass of one paperclip and M is the mass of the wooden strip and protractor.

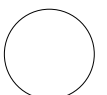
The value of m is written on a card.

Use your answers from (d) to determine values for k and M .

$$k = \dots\dots\dots \text{g}^{-1}$$

$$M = \dots\dots\dots \text{g}$$

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Please turn over for Question 2.

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- 2** In this experiment you will investigate how the period of oscillation of a metal strip varies with its length.

- (a)** You are provided with a metal strip with a mass fixed to it at one end.

Clamp the strip between the two blocks of wood, so that the length l between the blocks and the centre of the mass is about 20 cm as shown in Fig. 2.1.

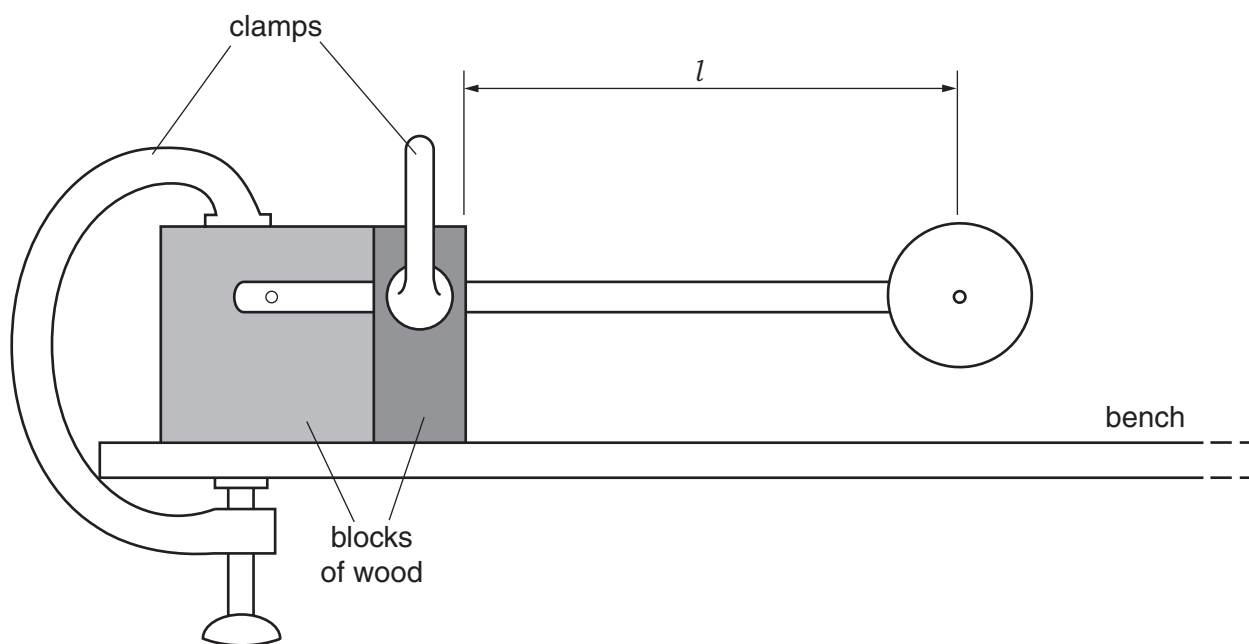


Fig. 2.1

- (b) (i)** Measure the length l .

$l = \dots\dots\dots$ cm

- (ii)** Estimate the percentage uncertainty in your value of l .

percentage uncertainty = $\dots\dots\dots\%$

- (iii)** Calculate the value of l^3 .

$l^3 = \dots\dots\dots$ cm³

- (iv)** Justify the number of significant figures you have given for l^3 .

$\dots\dots\dots$
 $\dots\dots\dots$

- (c) Pull the mass about 2 cm to one side and release it so that it oscillates.

Take measurements to determine the period of oscillation T .

$$T = \dots\dots\dots \text{ s}$$

- (d) Adjust the length l to about 15 cm.

Measure this new length l and repeat (b)(iii) and (c).

$$l = \dots\dots\dots \text{ cm}$$

$$l^3 = \dots\dots\dots \text{ cm}^3$$

$$T = \dots\dots\dots \text{ s}$$

- (e) Explain whether your results support the idea that T^2 is proportional to l^3 .

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- (f) (i) State four sources of error or limitations of the procedure in this experiment.

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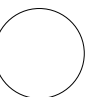
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