



You may not need to use all of the materials provided.

1 In this experiment, you will investigate an electrical circuit.

(a) (i) You have been provided with two metre rules. One is labelled P and the other is labelled Q.

- Set up the circuit shown in Fig. 1.1.

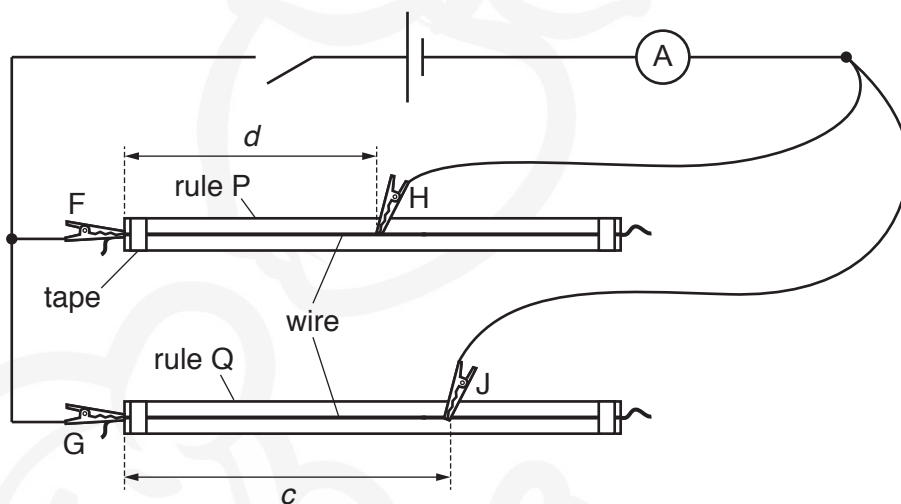


Fig. 1.1

- F, G, H and J are crocodile clips.  
Place H approximately half-way along the wire on rule P.
- The distance between F and H is  $d$ , as shown in Fig. 1.1.  
Record  $d$ .

$d =$  .....

- Place J on the wire on rule Q so that the distance between G and J is approximately 60 cm. The distance between G and J is  $c$ , as shown in Fig. 1.1.
- Record  $c$ .

$c =$  .....

- Calculate  $n$ , where  $n = \frac{c-d}{d}$ .

$n =$  .....

[1]

- (ii) • Close the switch.
- Record the ammeter reading  $I$ .

$I =$  .....

- Open the switch.

[1]



- (b) **Keeping  $d$  constant**, vary  $c$  until you have six sets of readings of  $c$  and  $I$ . Do **not** use values of  $c$  less than  $d$ .

Record your results in a table. Include values of  $n$  and  $\frac{(n+2)}{(n+1)}$  in your table.

[9]

- (c) (i) Plot a graph of  $I$  on the  $y$ -axis against  $\frac{(n+2)}{(n+1)}$  on the  $x$ -axis.

[3]

- (ii) Draw the straight line of best fit.

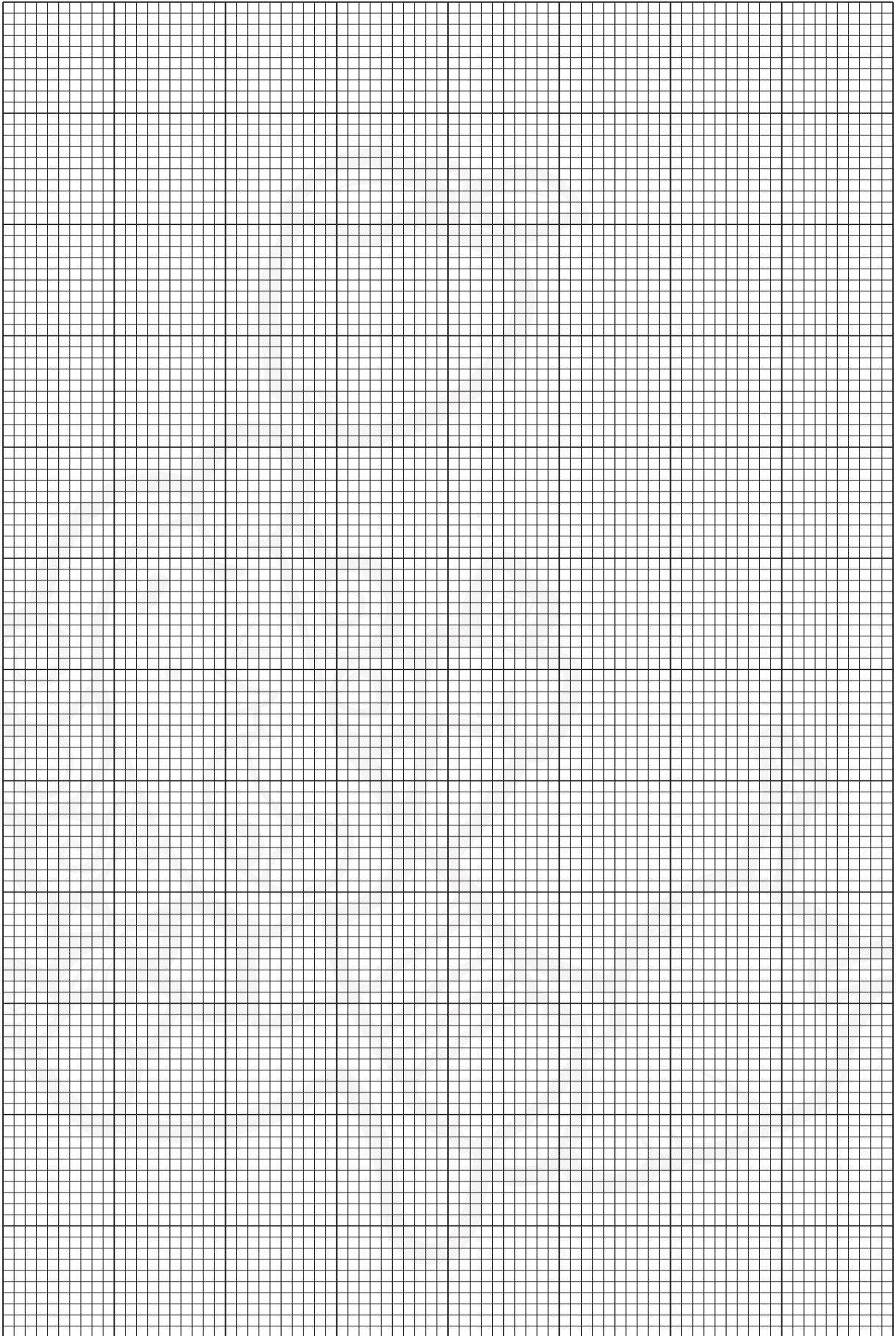
[1]

- (iii) Determine the gradient and  $y$ -intercept of this line.

gradient = .....

$y$ -intercept = .....

[2]



- (d) It is suggested that the quantities  $I$  and  $n$  are related by the equation

$$I = S \frac{(n+2)}{(n+1)} + T$$

where  $S$  and  $T$  are constants.

Using your answers in (c)(iii), determine values for  $S$  and  $T$ .  
Give appropriate units.

$S =$  .....

$T =$  .....

[2]

- (e) Theory suggests that  $S$  is inversely proportional to  $d$  and that  $T$  is independent of  $d$ .  
The experiment is repeated using the same equipment but a larger value of  $d$ .

For this experiment, draw a second line on the graph to show the expected results.  
Label this line W.

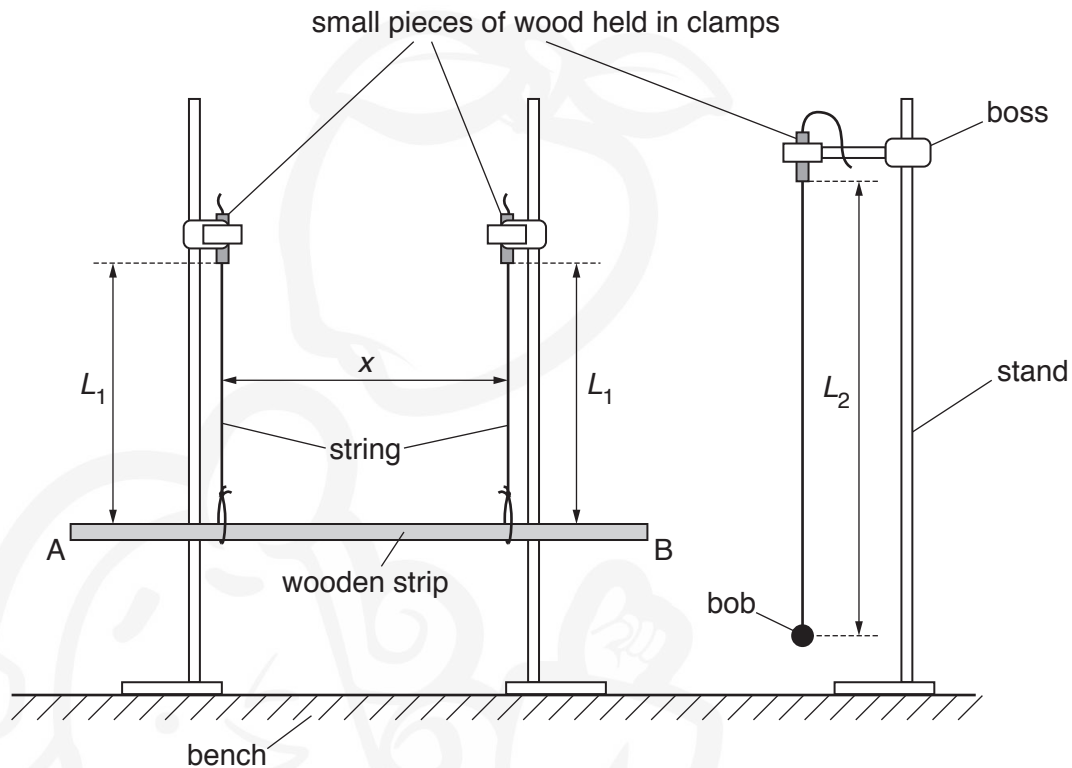
[1]

[Total: 20]

**You may not need to use all of the materials provided.**

**2** In this experiment, you will investigate the oscillations of a pendulum.

**(a)** • Set up the apparatus as shown in Fig. 2.1.



**Fig. 2.1**

- The distance between the strings supporting the wooden strip is  $x$ .

The distances between the top of the strip and the bottom of the small pieces of wood should be equal. These distances are both  $L_1$ .

The distance between the centre of the bob and the bottom of the small pieces of wood is  $L_2$ .

Adjust the position of the strings so that  $x \approx 25$  cm,  $L_1 \approx 25$  cm and  $L_2 \approx 45$  cm.

- The strings should be vertical, the strip should be parallel to the bench and the strip should be supported centrally by the strings.

Measure and record  $x$  and  $L_1$ .

$x =$  ..... cm

$L_1 =$  ..... cm  
[2]

- (b) (i)
- Pull the bob and end B of the strip towards you through a short distance.
  - Release the bob and the strip together so that they oscillate.
  - Adjust  $L_2$  until the periods of the oscillations of the bob and of the strip are the same.
  - Measure and record  $L_2$ .

$L_2 = \dots\dots\dots$  cm [1]

- (ii) Estimate the percentage uncertainty in your value of  $L_2$ .

percentage uncertainty =  $\dots\dots\dots$  [1]

- (iii) Calculate  $\frac{L_1}{L_2}$ .

$\frac{L_1}{L_2} = \dots\dots\dots$  [1]

- (iv) Justify the number of significant figures that you have given for your value of  $\frac{L_1}{L_2}$ .

$\dots\dots\dots$   
 $\dots\dots\dots$   
 $\dots\dots\dots$  [1]



- (c) • Change  $x$  to approximately 30 cm and  $L_1$  to approximately 20 cm.
- The strings should be vertical, the strip should be parallel to the bench and the strip should be supported centrally by the strings.

Measure and record  $x$  and  $L_1$ .

$x = \dots\dots\dots$  cm

$L_1 = \dots\dots\dots$  cm

- Repeat (b)(i) and (b)(iii).

$L_2 = \dots\dots\dots$  cm

$\frac{L_1}{L_2} = \dots\dots\dots$  [3]

- (d) It is suggested that the relationship between  $L_1$ ,  $L_2$  and  $x$  is

$$\frac{L_1}{L_2} = kx^2$$

where  $k$  is a constant.

- (i) Using your data, calculate two values of  $k$ .

first value of  $k$  = .....

second value of  $k$  = .....

[1]

- (ii) Explain whether your results support the suggested relationship.

.....  
.....  
.....  
..... [1]

- (e) Theory suggests that

$$k = \frac{3}{l^2}$$

where  $l$  is the length of the strip.

Using your second value of  $k$ , calculate  $l$ .  
Give an appropriate unit.

$l$  = ..... [1]

(f) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

1. ....  
.....
2. ....  
.....
3. ....  
.....
4. ....  
.....

[4]

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

1. ....  
.....
2. ....  
.....
3. ....  
.....
4. ....  
.....

[4]

[Total: 20]

**BLANK PAGE**



Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cambridgeinternational.org](http://www.cambridgeinternational.org) after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.