



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

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

(a) Set up the circuit shown in Fig. 1.1.

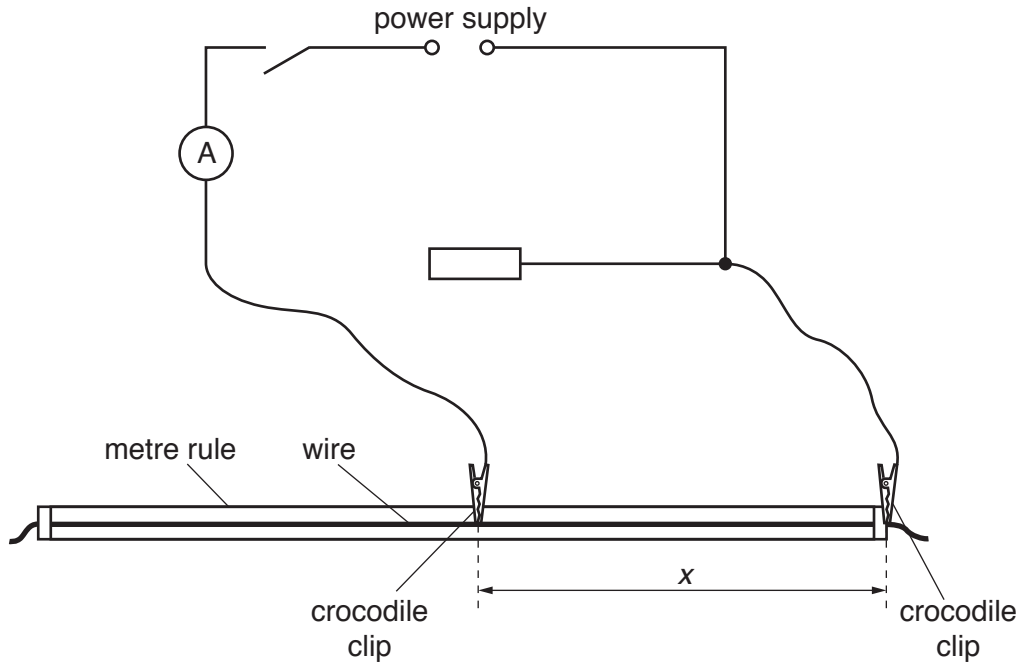


Fig. 1.1

The distance  $x$  between the crocodile clips should be approximately 40 cm.

(b) (i) Measure and record  $x$ .

$x = \dots\dots\dots$

(ii) Close the switch.

(iii) Record the ammeter reading  $I_1$ .

$I_1 = \dots\dots\dots[1]$

(iv) Open the switch.

- (c) (i) Connect an additional lead L to the circuit as shown in Fig. 1.2.

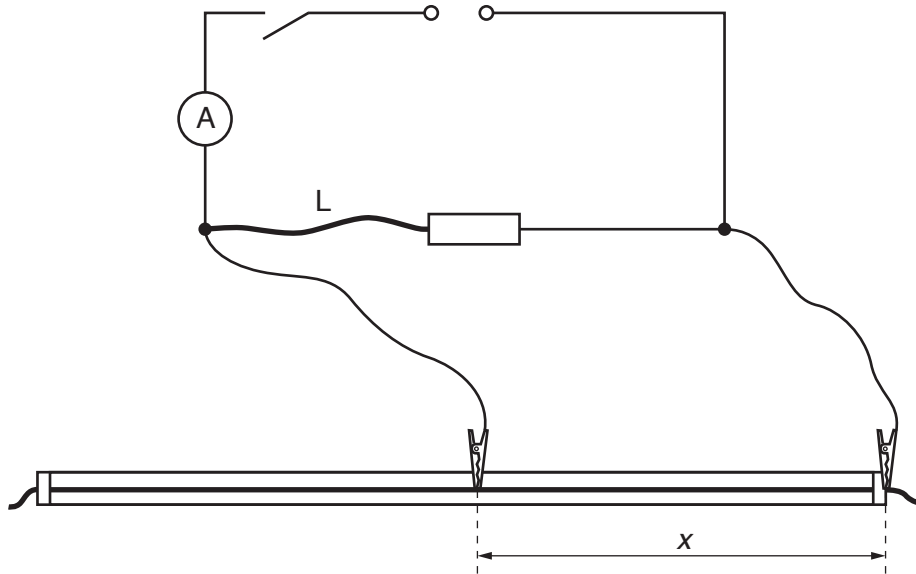


Fig. 1.2

- (ii) Close the switch.  
 (iii) Record the ammeter reading  $I_2$ .

$I_2 = \dots\dots\dots$ [1]

- (iv) Open the switch.  
 (v) Remove L. The circuit is now as shown in Fig. 1.1.

(d) **Increase**  $x$  and repeat (b) and (c) until you have six sets of readings of  $x$ ,  $I_1$  and  $I_2$ .

Record your values in a table. Include values of  $\frac{I_2}{I_1}$  in your table.


[10]

(e) (i) Plot a graph of  $\frac{I_2}{I_1}$  on the  $y$ -axis against  $x$  on the  $x$ -axis.

[3]

(ii) Draw the straight line of best fit.

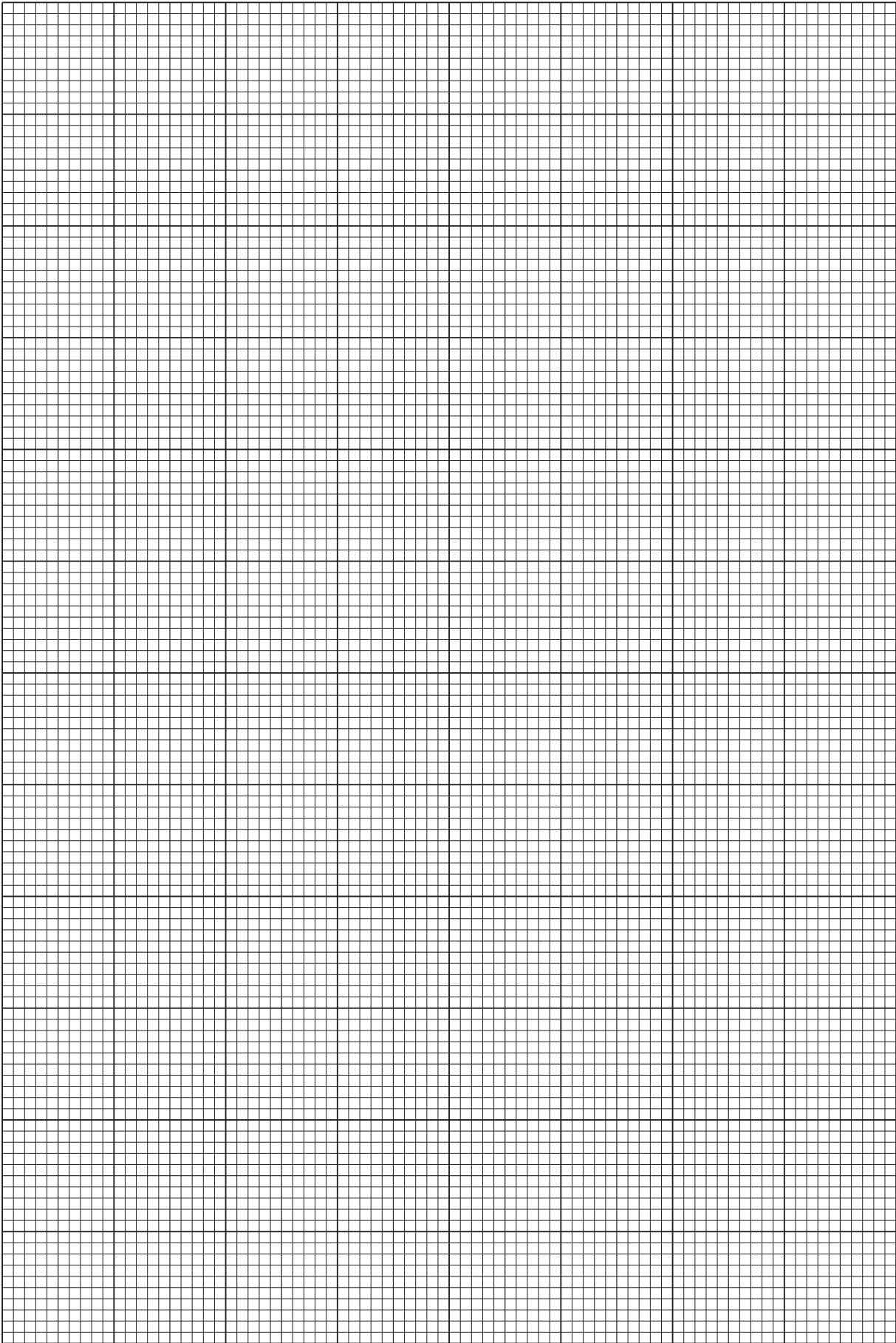
[1]

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

gradient = .....

$y$ -intercept = .....

[2]


- (f) It is suggested that the quantities  $I_1$ ,  $I_2$  and  $x$  are related by the equation

$$\frac{I_2}{I_1} = Px + Q$$

where  $P$  and  $Q$  are constants.

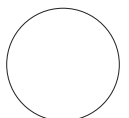
Using your answers in (e)(iii), determine values for  $P$  and  $Q$ .  
Give appropriate units.

$P =$  .....

$Q =$  .....

[2]

[Total: 20]

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

2 In this experiment, you will investigate the motion of oscillating table tennis balls.

(a) Tape each ball to a length of string. Ensure the total length of the string and ball is 35.0 cm, as shown in Fig. 2.1.

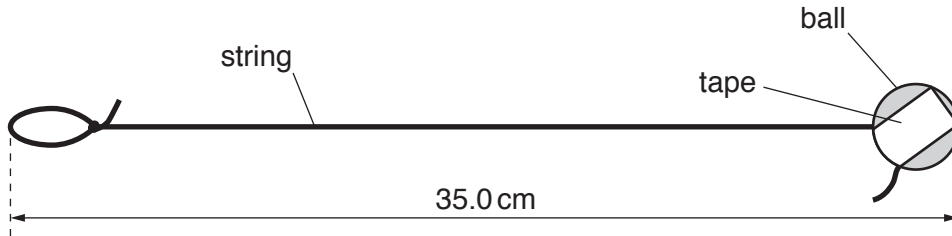


Fig. 2.1

(b) (i) Set up the apparatus as shown in Fig. 2.2.

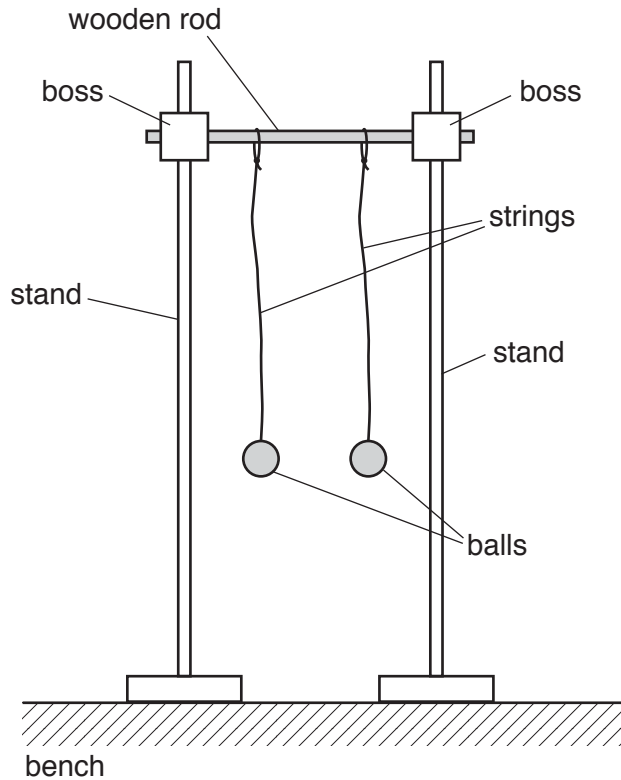


Fig. 2.2

- (ii) Pull **one** of the balls towards you through a short distance.

Release the ball and determine the time for **five** complete oscillations.

time = ..... s

Repeat for the other ball.

time = ..... s  
[1]

- (iii) Remove the balls and strings from the wooden rod.

- (c) (i) Tape the **shorter** wooden block to one of the balls as shown in Fig. 2.3.  
Tape should be used on opposite sides of the block and the ball.

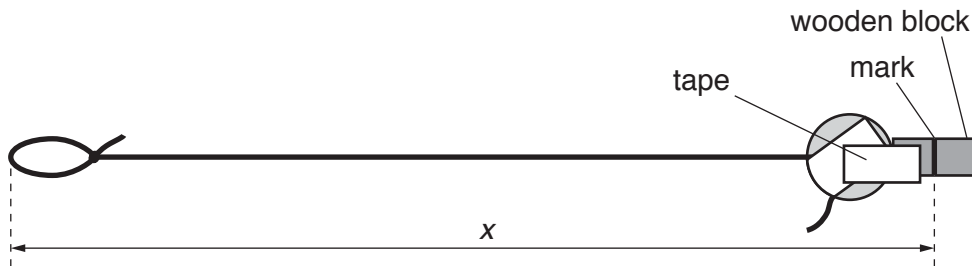


Fig. 2.3

The distance between the end of the string loop and the mark around the wooden block is  $x$ .

- (ii) Measure and record  $x$ .

$x =$  .....[1]



- (iii) Estimate the percentage uncertainty in your value of  $x$ .

percentage uncertainty = .....[1]

- (d) (i) Set up the apparatus as shown in Fig. 2.4.

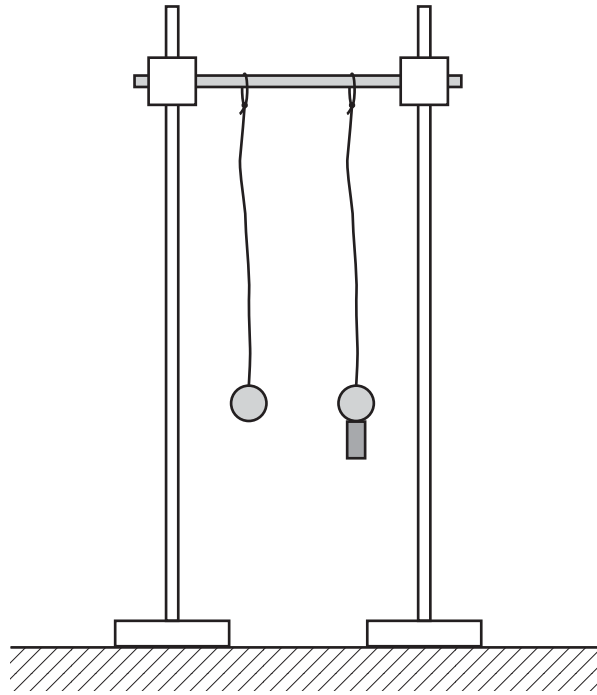


Fig. 2.4

- (ii) Pull **both** balls towards you.

Release the balls at the same time and watch the movement.  
 The two balls will move backwards and forwards becoming out of phase.  
 After a time they will be back in phase so that they move towards you together.  
 The ball with the block attached completes  $n$  oscillations in this time.

(e) (i) Repeat (d)(ii) and record  $n$ .

$n = \dots\dots\dots$ [2]


(ii) Calculate  $\frac{(n+1)^2}{n^2}$ .

$\frac{(n+1)^2}{n^2} = \dots\dots\dots$ [1]

--

(f) Using the longer wooden block, repeat (c)(i), (c)(ii), (d) and (e).

$x = \dots\dots\dots$

--

$n = \dots\dots\dots$


$\frac{(n+1)^2}{n^2} = \dots\dots\dots$   
[3]

(g) It is suggested that the relationship between  $n$  and  $x$  is

$$\frac{(n+1)^2}{n^2} = kx$$

where  $k$  is a constant.

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

first value of  $k = \dots\dots\dots$

second value of  $k = \dots\dots\dots$

[1]

(ii) Explain whether your results in (g)(i) support the suggested relationship.

.....  
 .....  
 .....  
 .....

[1]

(h) The effective length of the pendulum formed by the ball and string is  $L$ .  
 Use your second value of  $k$  to calculate  $L$  using the relationship

$$k = \frac{1}{L}$$

Give your answer to three significant figures.

$L = \dots\dots\dots$ [1]

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

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



[4]

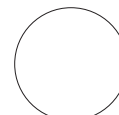
(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

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



[4]

[Total: 20]



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