

1 In this experiment, you will investigate the oscillation of masses on springs.

You have been provided with masses and springs.

Set up the apparatus as shown in Fig. 1.1.

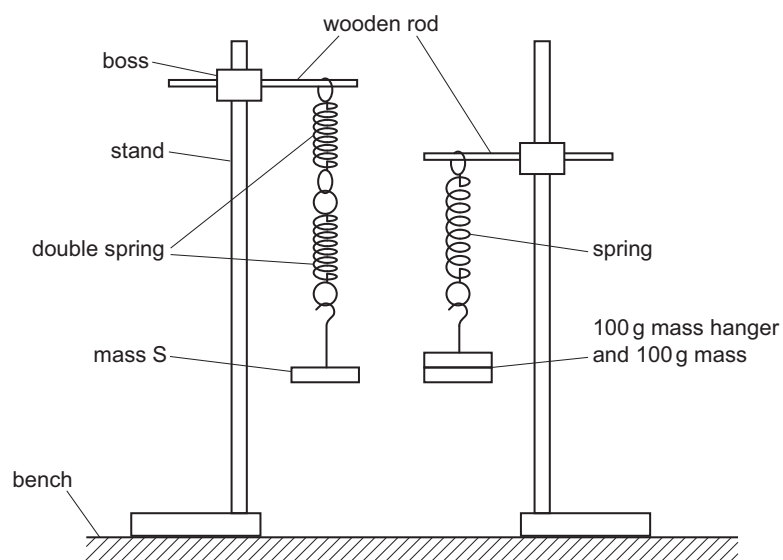


Fig. 1.1

- (a)
- Ensure the bottoms of both masses are at the same level.
 - Pull both masses down through a short distance and release them at the same time.
 - Watch the oscillations of the masses. The masses initially oscillate in phase, then out of phase and then back in phase.
 - The number of oscillations of mass S from release until the masses are back in phase for the first time is n_0 .

Determine and record n_0 .

$n_0 =$ [2]

- (b) (i)
- Add a mass of 30 g to mass S. The added mass is M .

- Record M .

$M =$

- Repeat (a). The number of oscillations of mass S from release until the masses are back in phase for the first time is n .
- Determine and record n .

$n =$ [1]

- (ii) Calculate N , where

$$N = n_0 - n.$$

$N =$ [1]

- (c) Vary M by changing the number of 10 g masses added to mass S and determine n . Do **not** use $M = 0$.

Repeat until you have five sets of values of M and n .

Record your results in a table. Include values of N . Also include values of N^3 to three significant figures.

[8]

- (d) (i) Plot a graph of N^3 on the y -axis against M on the x -axis.

[3]

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

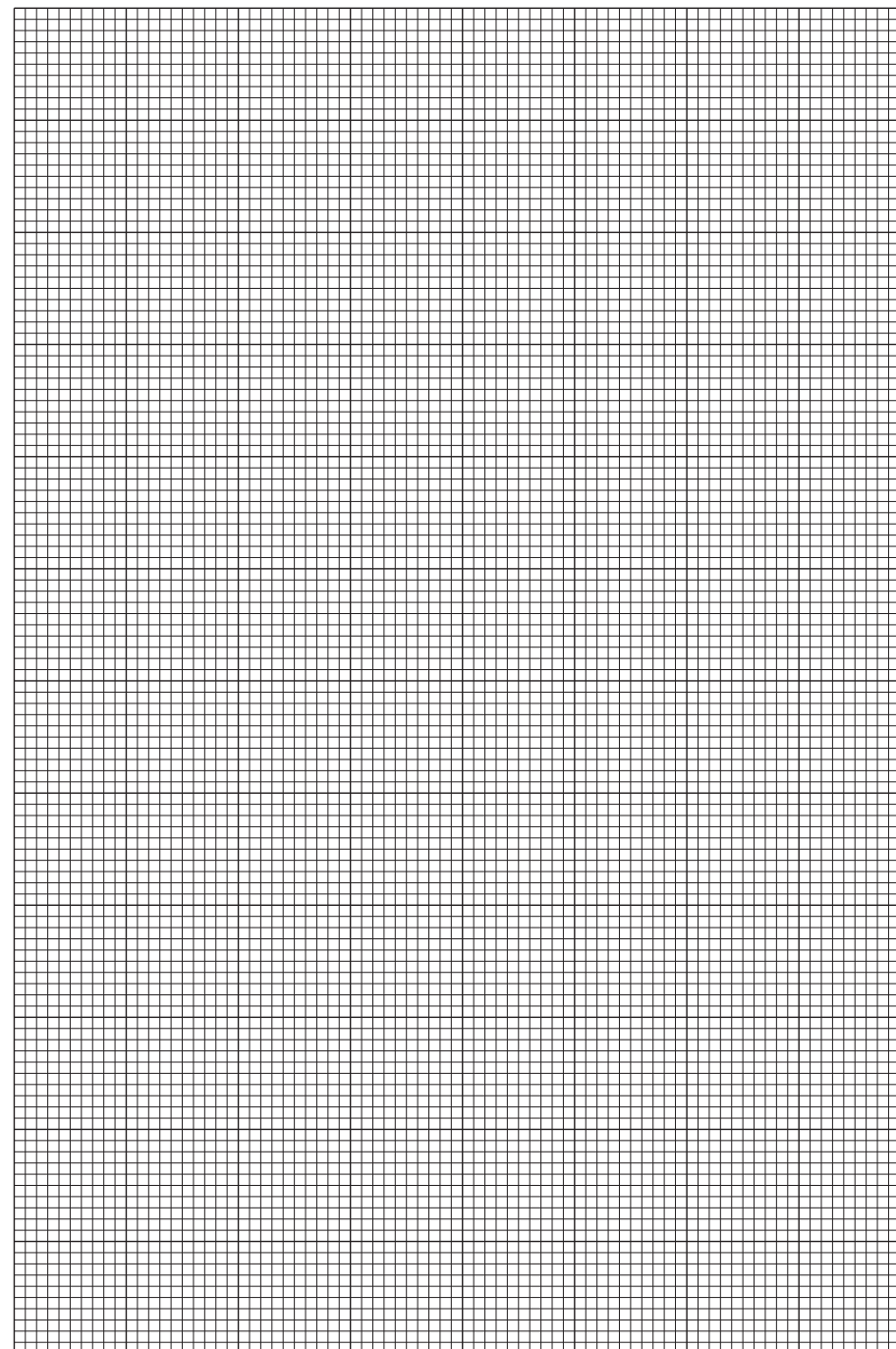
[1]

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

gradient =

y -intercept =

[2]



- (e) It is suggested that the quantities N and M are related by the equation

$$N^3 = PM + Q$$

where P and Q are constants.

Using your answers in (d)(iii), determine the values of 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 elastic properties of rubber cord.

- (a) (i) You are provided with a wire with a clip and two slotted masses attached, as shown in Fig. 2.1.

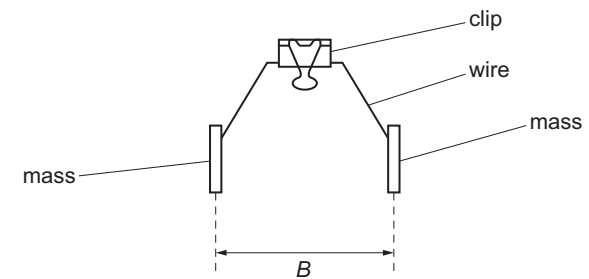


Fig. 2.1

The distance between the centres of the two slotted masses is B , as shown in Fig. 2.1.

Measure and record B .

$B =$ [1]

- (ii) Estimate the percentage uncertainty in your value of B . Show your working.

percentage uncertainty =% [1]

- (b) (i) • You are provided with two lengths of rubber cord. Select the **longer** cord.
- The diameter of the cord is d .

Measure and record d .

$d = \dots\dots\dots$ [1]

- (ii) • Suspend the clip, wire and masses using the **longer** cord secured in the two clips, as shown in Fig. 2.2.

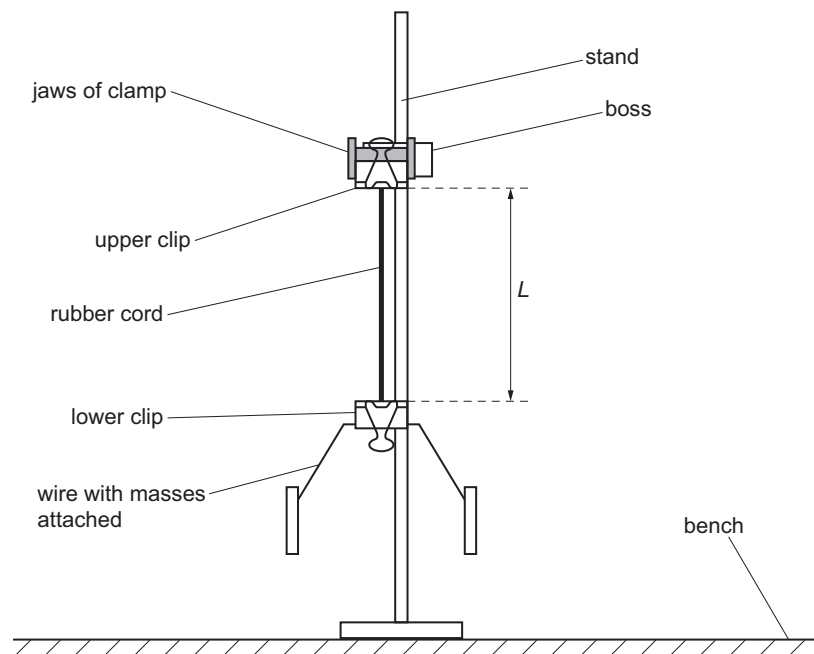


Fig. 2.2 (not to scale)

- The length of cord between the two clips is L , as shown in Fig. 2.2.
- Measure and record L .

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

- (iii) • Keeping the cord vertical, rotate the lower clip through approximately 180° and release the clip. The clip will rotate with a small number of oscillations.
- Take measurements to determine the period T of these oscillations.

$T = \dots\dots\dots$ s [2]

- (c) Using the **shorter** length of rubber cord, repeat (b).

$d = \dots\dots\dots$

$L = \dots\dots\dots$

$T = \dots\dots\dots$ s [3]

- (d) It is suggested that the relationship between T , B , L and d is

$$T^2 = \frac{B^2 L}{k d^4}$$

where k is a constant.

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

first value of k =

second value of k =

[1]

- (ii) Justify the number of significant figures that you have given for your values of k .

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

- (e) It is suggested that the percentage uncertainty in the values of k is 20%.

Using this uncertainty, explain whether your results support the relationship in (d).

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..... [1]

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

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

1

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2

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3

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4

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[4]

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

1

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2

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3

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4

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[4]

[Total: 20]