



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

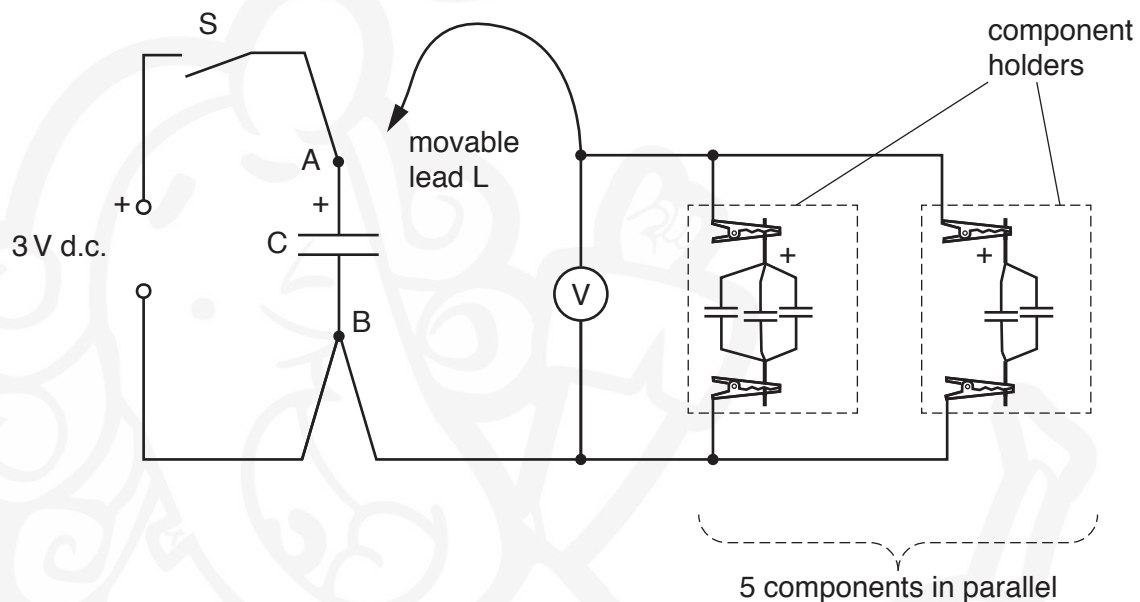
- 1** In this experiment, you will investigate an electrical circuit.

You are provided with groups of components connected in parallel. The circuit symbol for each of these components is shown in Fig. 1.1.



**Fig. 1.1**

- (a)** • Assemble the circuit shown in Fig. 1.2.



**Fig. 1.2**

- Check that the positive terminals of the power supply, component C and the groups of components are connected as shown in Fig. 1.2.
- Connect the movable lead L to terminal A.
- Close the switch S.
- Record the voltage  $V_S$  shown on the voltmeter.

$V_S = \dots\dots\dots$

- Open switch S.

[1]

- (b) • Record the total number  $n$  of components in parallel in the component holders.

$n =$  .....

- Move the movable lead L and connect it to terminal B.
- Close switch S.
- Open switch S after approximately 5 s.
- Move the movable lead L and connect it to terminal A. **Immediately** record the voltage  $V$  shown on the voltmeter.

$V =$  .....[2]

- (c) Change  $n$  and repeat (b) until you have six sets of values of  $n$  and  $V$ . One of the component holders may be left empty if required.

Record your results in a table. Include your values from (b). Also include values of  $\frac{1}{V}$  in your table.

- (d) (i) Plot a graph of  $\frac{1}{V}$  on the  $y$ -axis against  $n$  on the  $x$ -axis. [9]

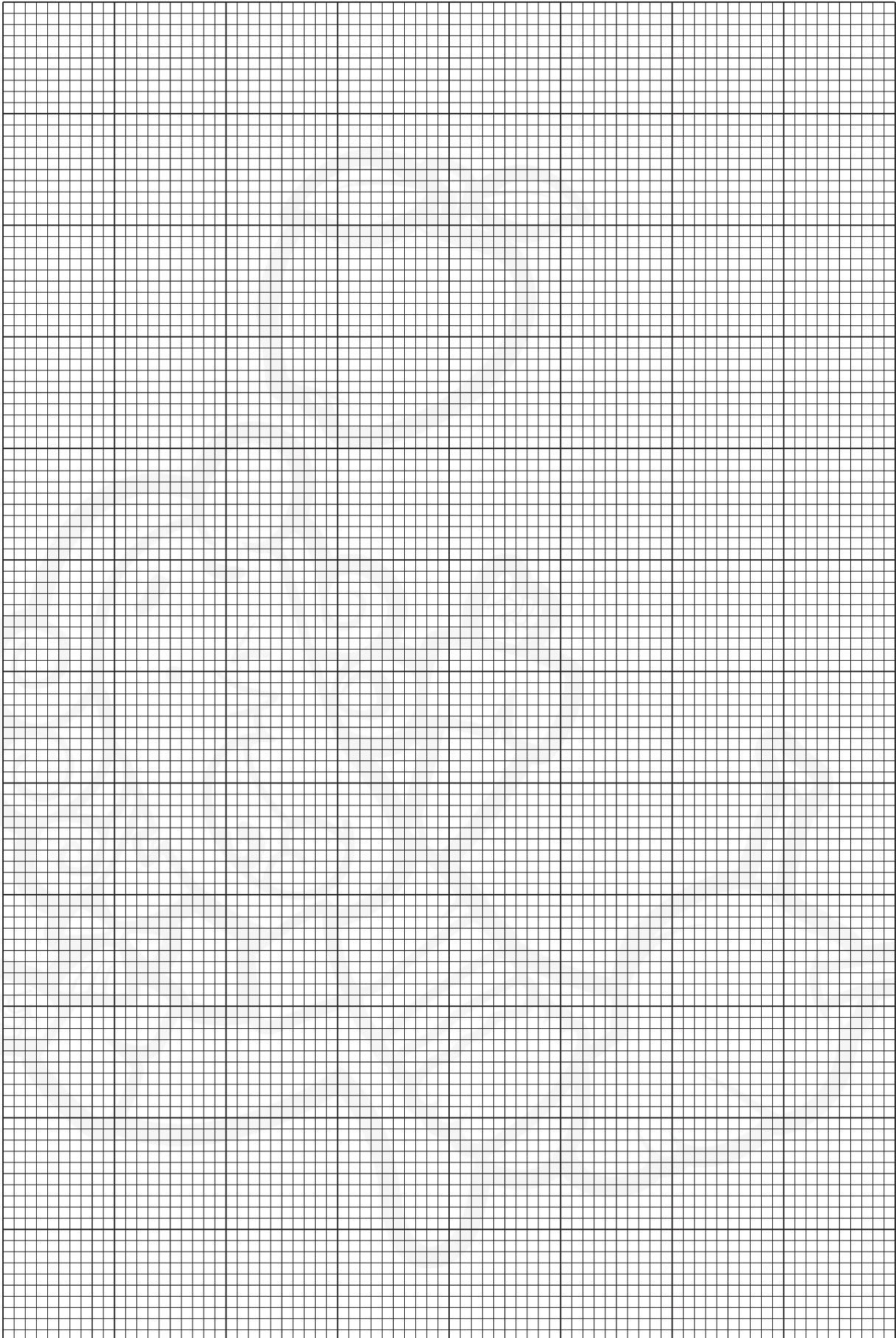
- (ii) Draw the straight line of best fit. [3]

- (iii) Determine the gradient and  $y$ -intercept of this line. [1]

gradient = .....

$y$ -intercept = .....

[2]



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

$$\frac{1}{V} = an + b$$

where  $a$  and  $b$  are constants.

Use your answers in (d)(iii) to determine the values of  $a$  and  $b$ .  
Give appropriate units.

$a =$  .....

$b =$  .....

[2]

[Total: 20]

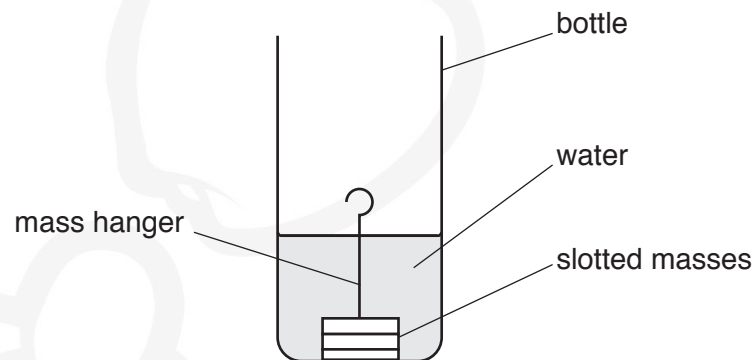
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**You may not need to use all of the materials provided.**

**2** In this experiment, you will investigate the motion of a plastic bottle floating in water.

- (a)**
- Pour  $500\text{ cm}^3$  of water from the jug into the beaker ( $1\text{ ml} = 1\text{ cm}^3$ ).
  - Pour this water into the bottle.
  - Place the 100g mass hanger with two 100g slotted masses in the bottle, as shown in Fig. 2.1.



**Fig. 2.1**

- Assume that the density of the added water is  $1.0\text{ g cm}^{-3}$  ( $1.0\text{ cm}^3$  of water has a mass of 1.0g).

Calculate the total mass  $M$  of the mass hanger, slotted masses and water in the bottle.

$M = \dots\dots\dots\text{ kg [1]}$



- (b) (i)
- Carefully place the bottle in the bucket of water so that the bottle floats vertically in the water.
  - Carefully push the bottle down, ensuring that its top remains above the level of the water in the bucket.
  - Release the bottle so that it oscillates **vertically**, as indicated in Fig. 2.2.

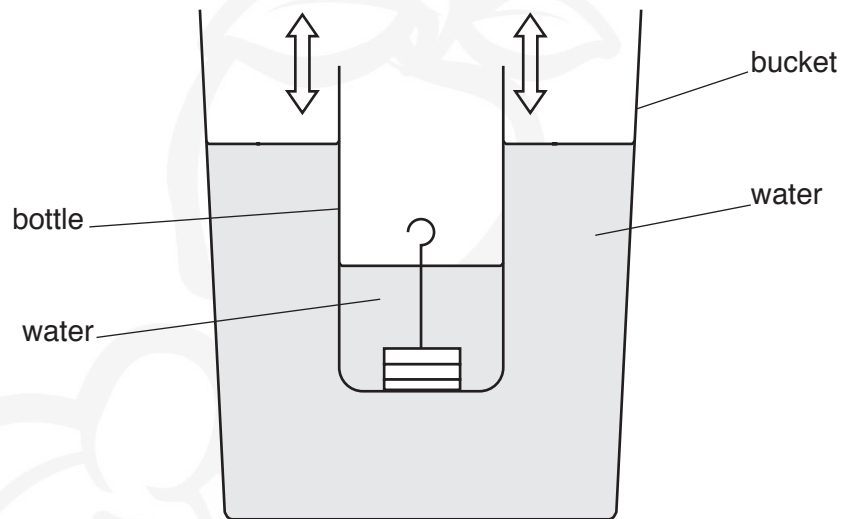


Fig. 2.2

- Take measurements to find the period  $T$  of the oscillations.

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

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

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

- (c) (i)
- Remove the bottle from the bucket and place it in the tray.
  - Add three more 100g slotted masses to the mass hanger in the bottle.
  - Calculate the new total mass  $M$ .

$M = \dots\dots\dots$  kg [1]

- (ii) Repeat (b)(i).

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

- (d) It is suggested that the relationship between  $M$  and  $T$  is

$$M = kT^2$$

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 support the suggested relationship.

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

- (e) (i) Measure and record the diameter  $D$  of the bottle.

$D = \dots\dots\dots$  m [1]

- (ii) Calculate the cross-sectional area  $A$  of the bottle using

$$A = \frac{\pi D^2}{4}.$$

$A = \dots\dots\dots$  m<sup>2</sup> [1]

- (iii) The density  $\rho$  of the water in the bucket is given by

$$\rho = \frac{4\pi^2 k}{Ag}$$

where  $g = 9.81 \text{ m s}^{-2}$ .

Using your second value of  $k$ , calculate  $\rho$ .

$\rho = \dots\dots\dots$  kg m<sup>-3</sup> [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]

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