

Question 1 **PDF Compressor Free Version**

You are provided with the following:

- two cells in a cell holder;
- a switch;
- a micrometer screw gauge;
- a nichrome wire mounted on a millimetre scale;
- a voltmeter;
- an ammeter;
- a jockey;
- connecting wires with crocodile clips.

Proceed as follows:

- (a) Using the micrometer screw gauge, measure and record the diameter d of the wire.

$d = 0.29 \pm 0.02$ mm. *2 d.p. a must* $0.27 \leftrightarrow 0.31$

$d = 2.9 \times 10^{-4}$ m. *Conversion of student's value correctly*
Accept std form to whatever no. of d.p.

(1 mark)

- (b) Set up the apparatus as shown in **Figure 1**.

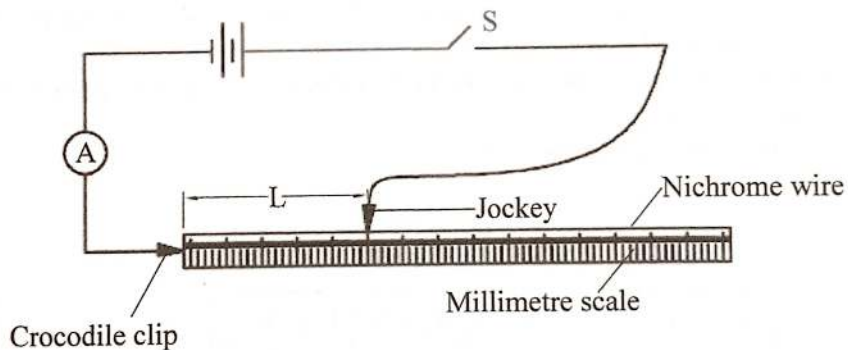


Figure 1

- (c) Using the voltmeter, measure the potential difference E across the battery before closing the switch.

$E = 3.1 \pm 0.1$ volts. *1 d.p. a must*

(1 mark)

- (d) Add the length L of the wire (10 cm). Close the switch, read and record the value of the current I in **Table 1**.
- (e) Repeat (d) for the other values of L given in **Table 1**. Complete the table. (6 marks)

Table 1

Length L (m)	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Current I (A) ± 0.10	0.72	0.53	0.44	0.38	0.33	0.29	0.27
$\frac{1}{I} A^{-1}$	- Correct reciprocals exact or to 4 s.f. - All correctly done toward 1 mark						

- 2 dp or must
 - Trend - decreasing
 from the 1st correct
 value

- (f) On the grid provided; plot the graph of $\frac{1}{I}$ (y axis) against L . (5 marks)

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- Axes ✓ - 1 mark
- Labelled with quantity & correct units or correct unit alone ($\frac{1}{A}$ or A^{-1}); (m). Accept correct unit stated in the scale or at the title.
- Scale ✓ - 1 mark
- Simple, uniform and accommodative
- Plotting - 2 marks
- All points correctly plotted within one small square.
 - Award $\frac{1}{2}$ mark for @ correctly plotted points to a maximum of four.
 - ~~Do not~~ Subtract 1 mark for misplaced power (leading to ^{WRONG} inverse plotting)
- Line - 1 mark
- Should pass through at least 3 correctly plotted points
 - Should have a positive slope

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From the graph, determine the:

(3 marks)

(i) gradient S;

- 1 - $\frac{\Delta \frac{1}{I}}{\Delta L}$ ✓
 ✓ Extracting correctly ✓
 ✓ Correct interval and size
- 1 - Accept
 ✓ Correct interval and size (with grid or if
 ✓ It can be deduced from the graph.
- 1 - Correct evaluation exact or to 4 s.f. award 1 mark $(A^{-1} M^{-1})$ or (M^{-1})
 - Deny evaluating mk if the unit is wrong; Deny $\frac{1}{2}$ mk for missing unit. or $(\frac{1}{A})$
- (ii) intercept C on the $\frac{1}{I}$ axis. (1 mark)

- Candidates value of C taking into account candidate error transcribe
 either positive or negative with correct units award 1 mark
- Deny $\frac{1}{2}$ mark if or missing unit
- C-value should be within the grid.
- Wrong units correct evaluation - $\frac{1}{2}$ mark

(h) Given that:

(i) $\frac{4K_1}{\pi d^2 E} = S$ determine the value of K_1 . (2 marks)

- ✓ Correct substitution S, d and E - Award 1mk (any)
- ✓ Correct evaluation exact or to 4 s.f. - Award 1mk
- ✓ Ignore units

(ii) $\frac{K_2}{E} = C$ determine the value of K_2 . (1 mark)

- ✓ Correct substitution of C and E award 1mk
- ✓ Correct evaluation exact or 4 s.f. award $\frac{1}{2}$ mk.
- ✓ Ignore unit.

Question 2 **PDF Compressor Free Version**

You are provided with the following:

- a metre rule;
- a biconvex lens;
- a source of light (bulb in a bulb holder, cells in a cell holder and a switch);
- a stand boss and clamp;
- a lens holder;
- a screen;
- a half metre rule;
- three pieces of plastic pipes A, B and C;
- a vernier callipers (to be shared);
- a stopwatch;
- some plasticine.

Proceed as follows

PART A

- (a) Clamp the bulb holder onto the stand. Arrange the bulb, the lens and the screen along the metre rule as shown in **Figure 2**.

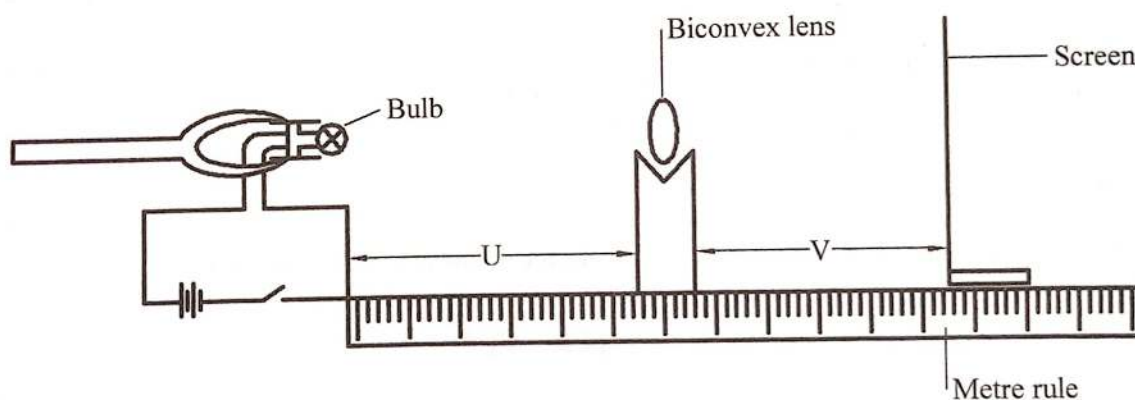


Figure 2

- (b) Adjust the distance of the bulb from the lens to $U = 25$ cm. Put on the switch and adjust the position of the screen from the lens so that a sharp image of the bulb is observed. Record the distance V between the screen and the lens in **Table 2**.
- (c) Repeat part (b) for the other values of U shown in **Table 2**. Complete the table. 5
(7 marks)

Table 2

U cm	25	30	35
V cm	45.0	35.0	30.0
$M = \frac{V}{U}$	- Each value correctly evaluated - All correct award 1mk.		
$F = \frac{V}{M+1}$	- Correct evaluation exact or to 4 s.f. - All correct award 1mk.		

± 10 cm @ 1mk; values with decreasing trend - Exact or to 4 s.f

- (d) Determine the average value of F . (2 marks)

- Statement of principle of averaging students value award 1mk.
- Correct evaluation exact or to 4 s.f - award 1mk.
- Ignore units.

$$\left(\frac{F_1 + F_2 + F_3}{3} \right) \Rightarrow \text{Principle of averaging shown.}$$

PART B

- (e) Using the vernier callipers measure and record the diameters of the three pipes.

d_A, d_B and d_C ^{2dp} ✓ 1 Correct conversion $\frac{1}{2}$

$d_A = 3.00 - 3.70$ ✓ 1 cm m (1 mark)

$d_B = 3.60 - 4.90$ ✓ 1 cm m (1 mark)

$d_C = 5.10 - 5.80$ ✓ 1 cm m (1 mark)

- (f) Measure and record the thickness X of the half metre rule.

$X = 0.50 - 0.65$ ✓ 1 cm m (1 mark)

- (g) Place the pipe marked A on the bench and use the plasticine to stop it from rolling. (see Figure 3 (a)).

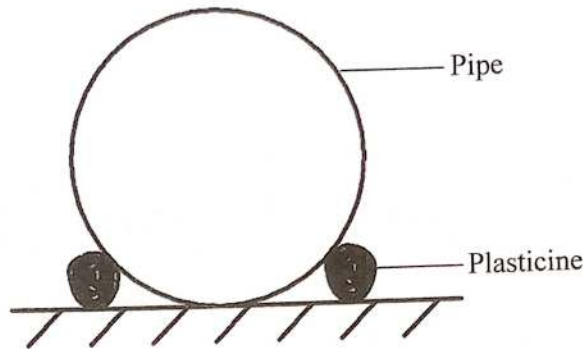


Figure 3 (a)

- (h) Place the half metre rule onto the pipe such that it balances horizontally. Ensure that the half metre rule is perpendicular to the axis of the pipe. (see Figure 3 (b)).

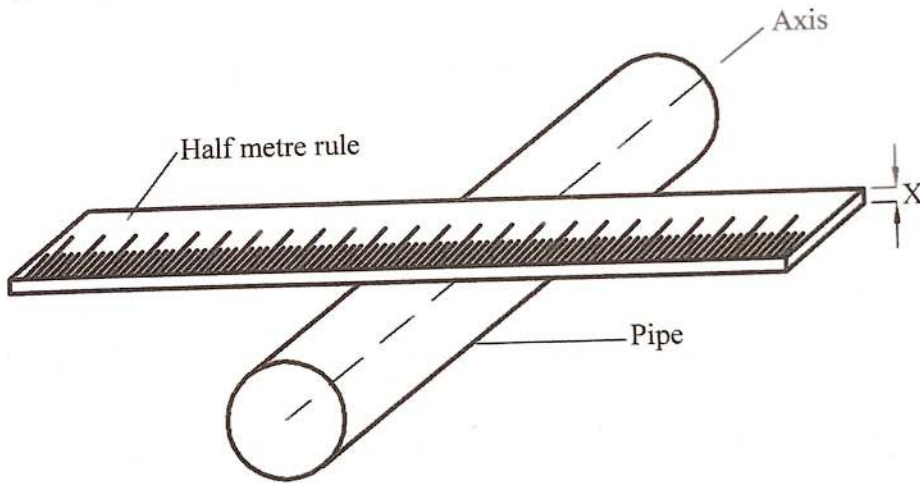


Figure 3 (b)

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- (i) Push one end of the balanced half metre rule slightly downwards and release it so that it oscillates. Measure and record in **Table 3** the time for five complete oscillations.
- (j) Repeat the procedure in (g), (h) and (i) for the other pipes B and C. Complete **Table 3**.

(5 marks)

Table 3

	Pipe A	Pipe B	Pipe C
Diameter d (m)			
Time for five oscillations	12.60	10.60	9.80
Periodic time T (s)	✓ Correct evaluation	exact or to 4 s.f	all correct 1 mark
$Z = T \sqrt{\frac{3(d-x)}{2}}$	✓ Each value correctly evaluated $\frac{1}{2}$ mark to a max of 1 mark ✓ 4 s.f or exact ✓ value of x must be in metres.		

+ 1 to 2 dt
@ 1 mark

- (k) Determine the average value of Z.

(2 marks)

- Statement of principle of averaging of student's value - 1 mark
 - Correct evaluation exact or 4 s.f (ignore unit) - 1 mark

$$\frac{Z_1 + Z_2 + Z_3}{3}$$
 (principle of averaging shown)

- If work is cancelled and replaced, mark the replaced one
- If work is cancelled and not replaced, mark the cancelled one.

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