

Question 1

You are provided with the following:

- Micrometer screw gauge (may be shared)
- Centre zero galvanometer
- Resistor labelled **R**
- Jockey
- Resistor wire labelled **N** mounted on a half meter rule
- Resistor wire labelled **Q** mounted on a half meter rule
- Resistor wire labelled **Y** mounted on a meter rule with ends marked **A** and **B**
- Switch
- Connecting wires
- A cell in a cell holder

Proceed as follows:

(a) Using the micrometer screw gauge, measure and record the diameter of the wire labelled **Q**

$d = \dots\dots\dots$ mm

$d = \dots\dots\dots$ m

(1 mark)

(b) Set up the circuit as shown in **Figure 1**

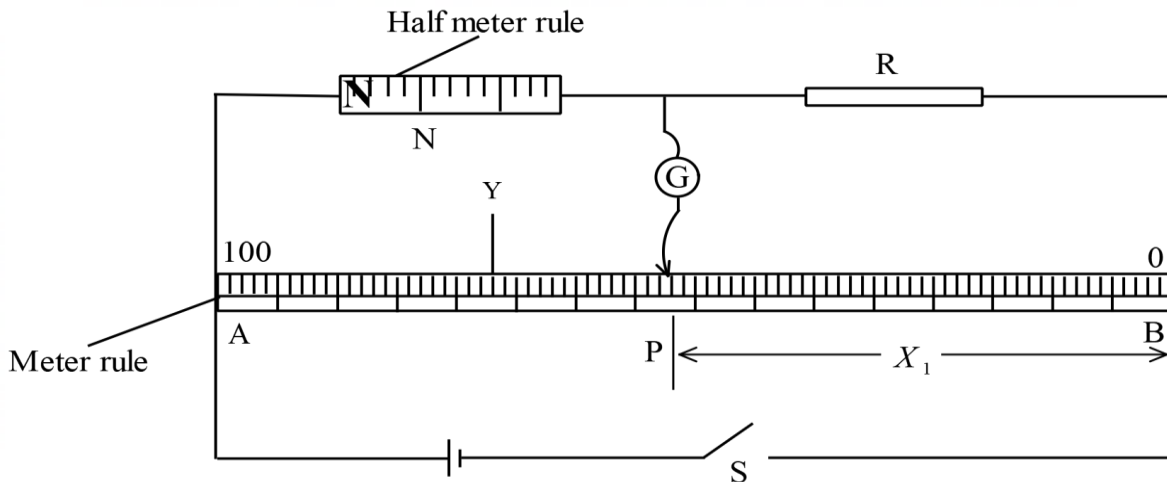


Figure 1

- (i) Close the switch. Using the jockey tap at various points on the wire **Y** to obtain a balance point **P** at which the galvanometer shows zero deflection.

Measure and record the balance length **PB = X₁**

X₁ = cm (1 mark)

- (ii) Determine the resistance **N** given that: $\frac{10}{X_1} = \frac{N}{100 - X_1}$ (1 mark)

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- (c) (i) Open the switch and interchange **R** and **N**. Close the switch and obtain the new balance length **X₂**

X₂ = cm (1 mark)

- (ii) Determine a second value of **N** given: $\frac{N}{X_2} = \frac{10}{100 - X_1}$ (1 marks)

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- (d) Determine the average value of \bar{N} (1 mark)

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- (e) Without disconnecting the whole circuit, replace the resistor **R** with the wire labelled **Q** and adjust the length of **N** to $l = 25$ cm as shown in the **Figure 2**.

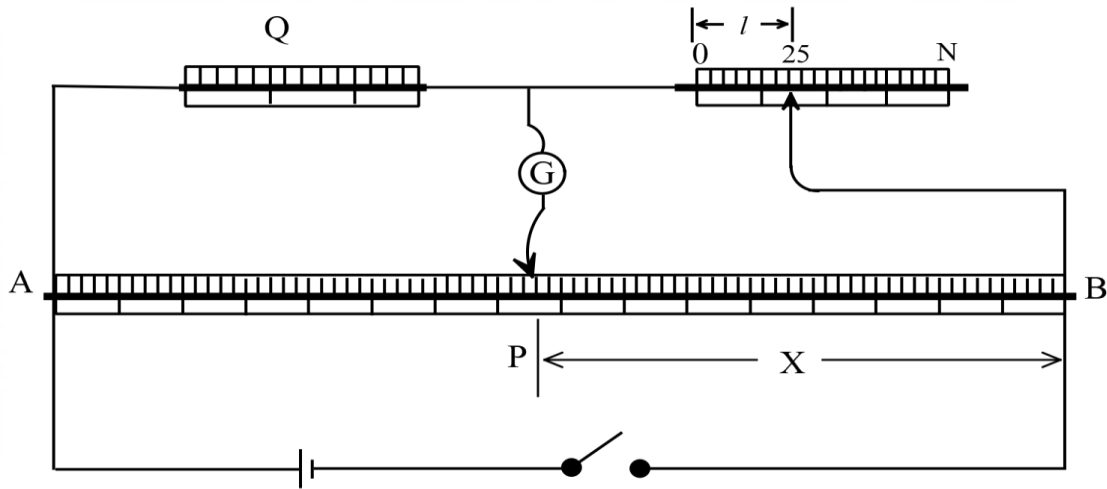


Figure 2

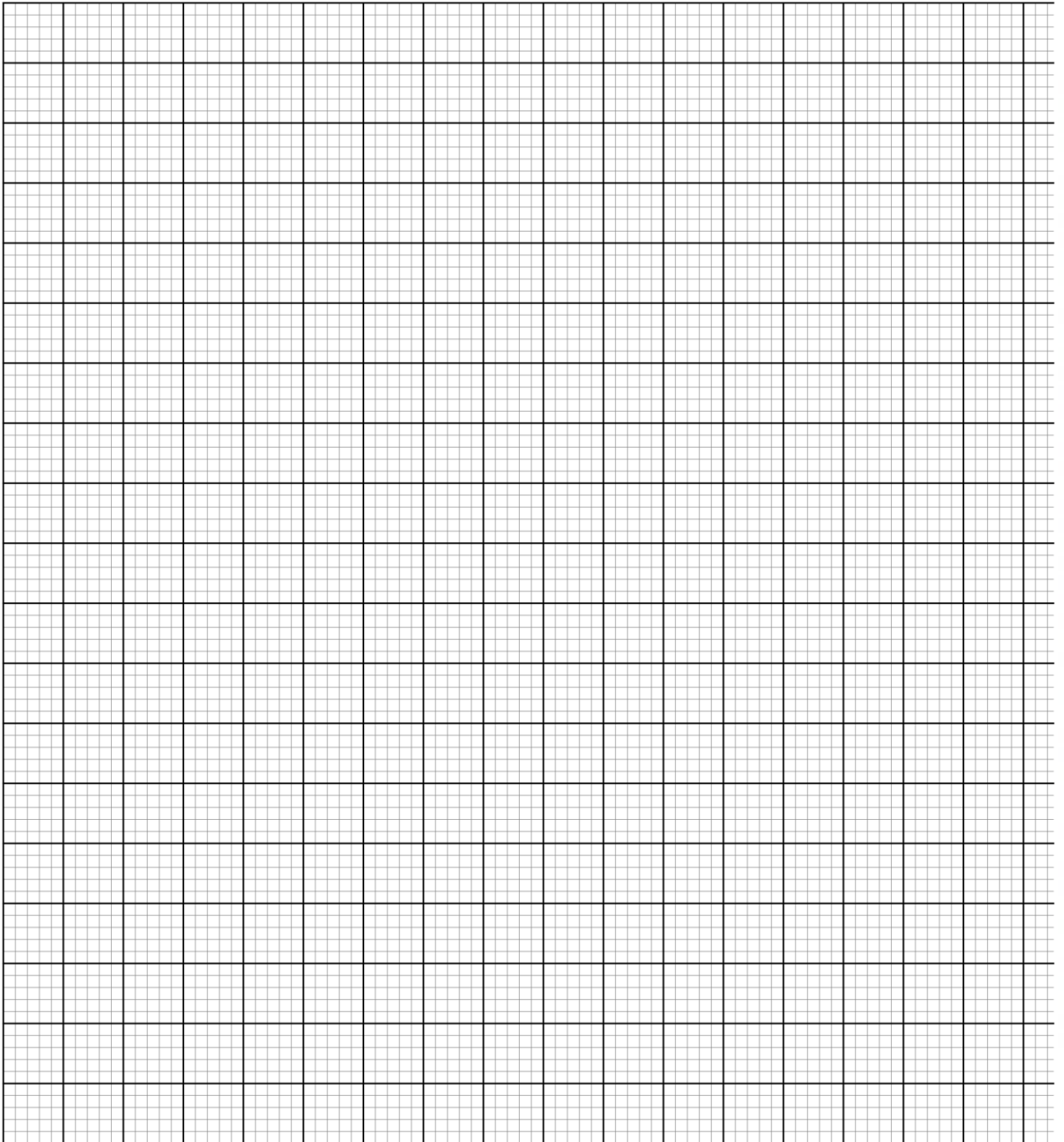
- (i) Determine the balance length **X** and record it in **Table 1**.
 (ii) Repeat part e (i) for other values of length l of wire **N** shown in **Table 1** and complete **Table 1**

Table 1

(5 marks)

l (cm)	25	30	35	40	45	50
X (cm)						
$\frac{1}{l} \text{ cm}^{-1}$						
$\frac{1}{x} (\text{cm}^{-1})$						

- (f) On the grid provided, plot a graph of $\frac{1}{x}$ (y – axis) against $\frac{1}{l}$. (4 marks)



(g) Determine the slope **S** of the graph.

(2 marks)

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(h) Given that $\frac{1}{X} = \frac{Q}{2N} \frac{1}{l} + \frac{1}{100}$, determine the:

(i) value of **Q**

(2marks)

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(ii) Constant ρ given that: $Q = \frac{2\rho}{\pi d^2}$

(1 marks)

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Question 2

You are provided with the following:

- Micrometer screw gauge (may be shared)
- Weighing balance (may be shared)
- Match box (may be shared)
- Piece of candle
- Water in a measuring cylinder labelled **W**
- Piece of white sewing thread
- Some tissue paper
- Liquid **L** in a measuring cylinder
- Stop watch
- Half meter rule
- Seven (7) steel balls placed in a beaker
- Plastic drinking straw

Proceed as follows:

- (a) (i) Wrap five of the steel balls with a small piece of tissue and place them on the weighing balance to measure the mass of the five balls and determine the mass m of one ball.

$$m = \dots\dots\dots \text{ kg} \quad (1 \text{ mark})$$

- (ii) Using the micrometer screw gauge, measure and record the diameter d of one steel ball.

$$d = \dots\dots\dots \quad (1 \text{ mark})$$

$$d = \dots\dots\dots$$

- (b) Determine the:

- (i) volume v of the steel ball given that $v = \frac{\pi d^3}{6}$ (1 mark)

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- (ii) density ρ of the steel ball. (2 marks)

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- (c) Wind the thread provided around the straw as shown in Figure 3 to make 10 closely packed turns. Mark with a pen the start and end of the 10 turns.

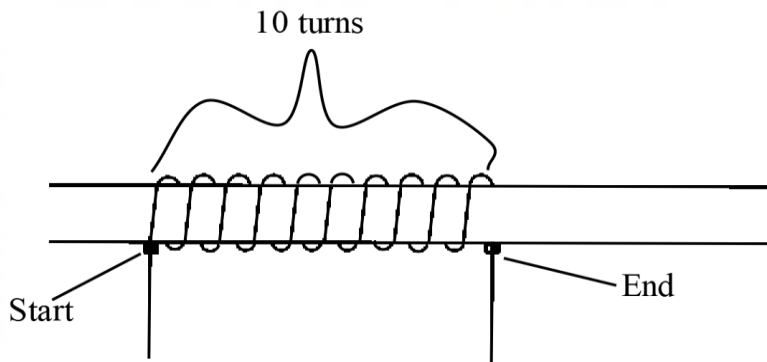


Figure 3

- (i) Unwind the thread and spread it along the half metre rule to measure the length l between the two marked points at the start and the end.

$l = \dots\dots\dots$ cm (1 mark)

- (ii) Hence determine the diameter D of the straw given that the circumference C is

given by: $C = \pi D$ (2 marks)

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- (d) (i) Light the candle and deposit 2 or 3 drops of molten wax on the bench. Seal one end of the straw by dipping it in the molten wax for a few seconds until the wax at the end of the straw solidifies.

(Ensure the seal solidifies tight)

- (ii) Put the seven steel balls provided into the straw and place it in water in the measuring cylinder so that it floats vertically. Measure the depth h_0 of the straw below the water. (See figure 4)

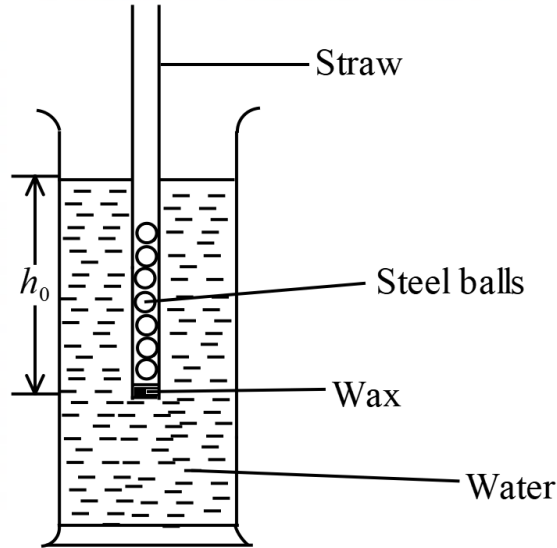


Figure 4

$h_0 = \dots\dots\dots$ cm

$h_0 = \dots\dots\dots$ m

- (iii) Given that the volume of a cylinder of radius r and height h is given by $\pi r^2 h$, determine the volume of water displaced by the straw. (2 marks)

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- (e) Remove the straw with its contents from the water and wipe it dry using a tissue paper. Place the straw with the seven steel balls into liquid L so that it floats vertically.

- (i) Measure the depth h_1 of the straw in the liquid.

$h_1 = \dots\dots\dots$ cm

$h_1 = \dots\dots\dots$ m (1 mark)

- (ii) Determine the volume of liquid L displaced by the straw. (1 mark)

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- (iii) Determine constant n given that $n = \frac{\text{volume of displaced water}}{\text{volume of displaced liquid L}} \times 1000$ (1 mark)

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- (f) Remove the straw from liquid L. Return the steel balls into the beaker. Place one steel ball at the centre of the surface of liquid L and release it so that it falls through the liquid.

- (i) Using the stop watch, measure the time t the ball takes to fall from the **200 ml** mark of the measuring cylinder to the **40 ml** mark.

- (ii) Repeat f(i) for one other ball and record in **Table 2** the time t taken (2 marks)

Table 2

Ball	Time taken
1	
2	

- (iii) Determine the average time \bar{t} taken by the steel balls to fall through the liquid. (2 marks)

$\bar{t} =$

.....

(g) (i) Measure the distance x between the 200 ml mark and the 40 ml mark.

$x = \dots\dots\dots$ cm

$x = \dots\dots\dots$ m (1 mark)

(ii) Determine the average velocity \bar{v} of the ball. (1 mark)

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(iii) Determine constant Z given that $Z = \frac{11}{20} (\rho - n) \frac{d^2}{V}$ (1 mark)

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