**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 = …….. mm

d = …….. m (1 mark)

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

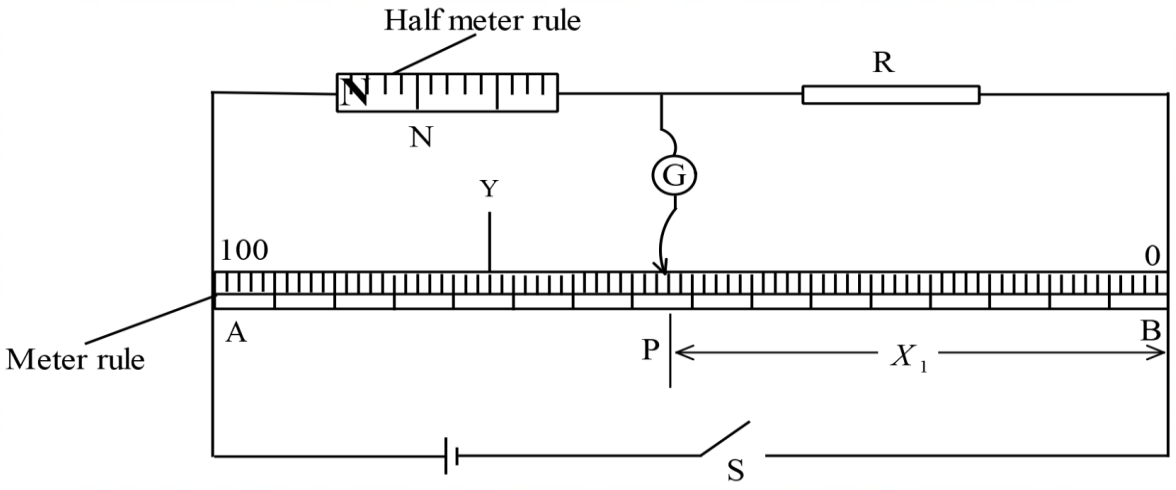


**Figure 1**

(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 = $X_1$**

**$X_1$** = …….. 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 **$X_2$**

**$X_2$** = …… 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 $\overline{N}$ (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.**

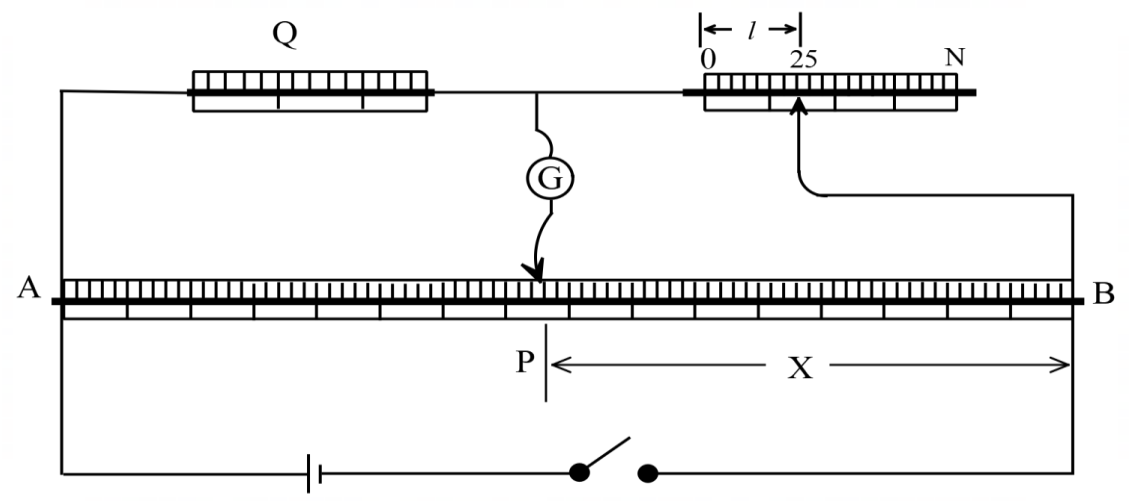



**Figure 2**

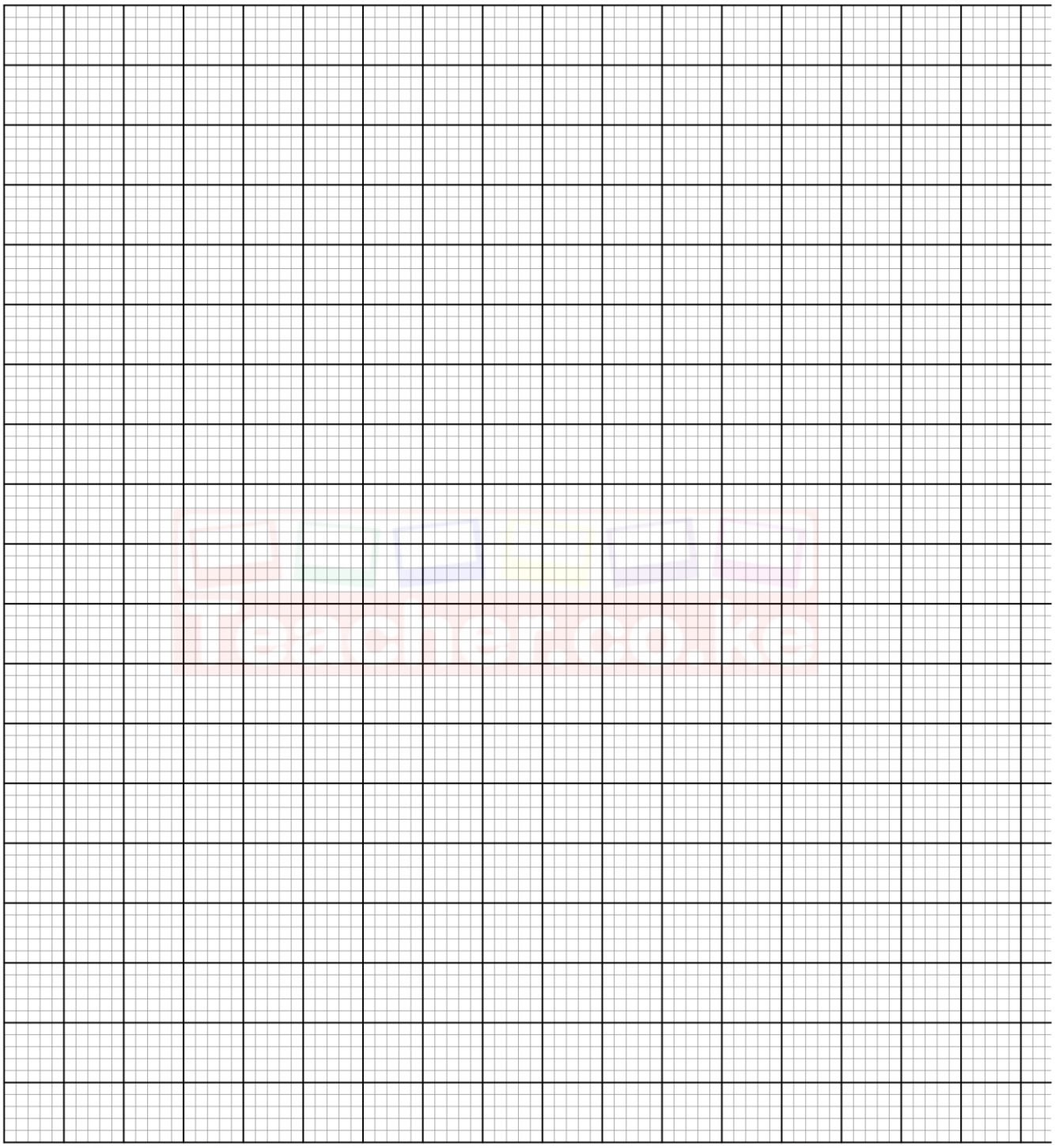
(i) Determine the balance length **X** and record it in **Table 1.**

(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) | | | | | | |
| $\frac{1}{l} cm^{-1}$ | | | | | | |
| $\frac{1}{x} (cm^{-1})$ | | | | | | |

(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 $\frac{1}{X} = \frac{Q}{2\overline{N}}\frac{1}{l} + \frac{1}{100}$, 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*** = …… kg (1 mark)

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

***d*** = …… (1 mark)

***d*** = ……

(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.

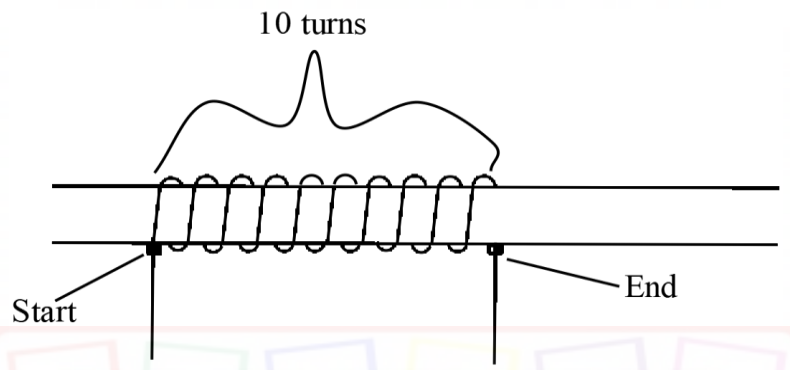


**Figure 3**

(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*** = …… 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 $\mathbf{h_0}$ of the straw below the water. **(See figure 4)**

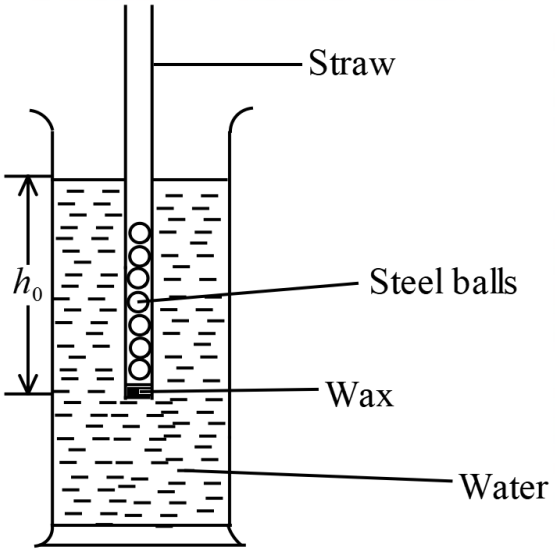


**Figure 4**

$h_0$ = ..... cm

$h_0$ = ..... 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.

$h_1$ = …….. cm

$h_1$ = …….. 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)

$\bar{t}$ =

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

$x$ = ..... cm

$x$ = ..... m (1 mark)

(ii) Determine the average velocity $\overline{V}$ of the ball. (1 mark)

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

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