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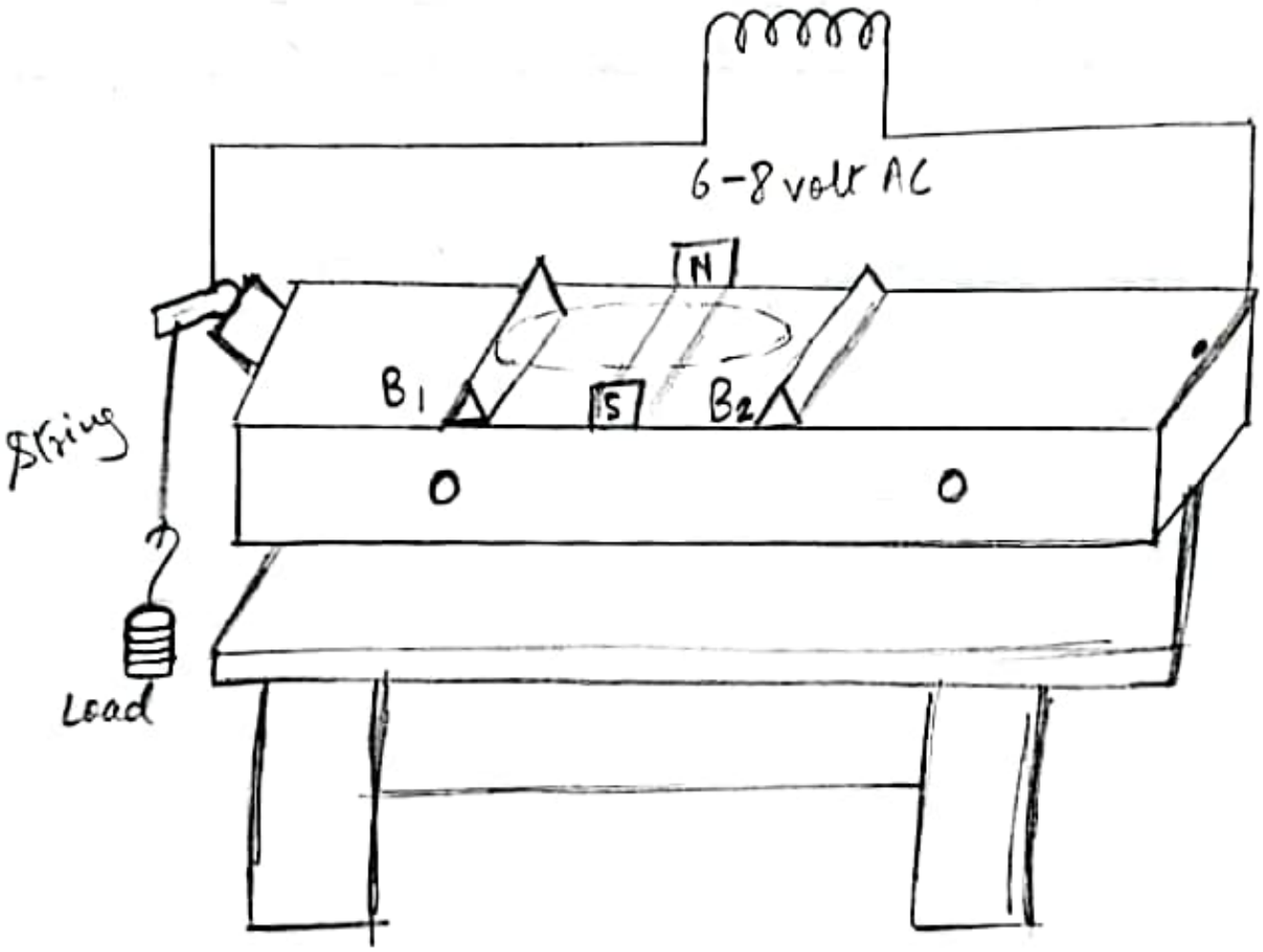
SONOMETER Experiment-8

- Aim ⇒ To determine the frequency of alternating current.
- Apparatus ⇒ Sonometer, step down transformer, horse shoe magnet, weight hanger, paperider, bridges, set of slotted weights.
- Theory ⇒ A Sonometer is an apparatus used to study tranverse vibrations of streched strings. It is used to determine the frequency of alternating current. A step down transformer is used for the determination of frequency of AC. Because the voltage of the Ac is 220V.

The string wire of the sonometer is a non-magnetic metallic wire like brass or copper. A horse shoe magnent is placed at the middle of the sonometer wire so that the magnetic field is applied ⊥ to the sonometer wire in a ~~logrithu~~ horizontal plane.


6-8 volt AC
N
S
B1
B2
String
Load

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When an alternating current of definite frequency passes through the wire there will be interaction between the magnetic field and current carrying conductor. So a force will act the conductor a direction perpendicular to both the field and direction of current.

When the length l of the sonometer wire vibrates with maximum amplitude, the frequency of the applied AC is equal to natural frequency of the wire.

$$\text{Frequency of } V = \frac{1}{2l} * \sqrt{T/M}$$

Where $T = mg$, the tension of the wire and m is the linear density of the wire.

$$\text{Frequency of ac } V = \frac{1}{2l} * \sqrt{Mg/M}$$

$$V = \frac{1}{2l} * \sqrt{\frac{g}{M}}$$

$\frac{M}{l^2}$ - constant

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If r is the radius of the wire, and ρ is the density of its material, $m = \pi r^2 \rho$

The graph between mass (M) of the suspended weights and square of the resonating length (l_2) by taking M along x-axis and l_2 along Y axis is drawn.

The graph should be a straight slopping line. The slope the line AB/BC gives the value of M/l^2 which is constant.

$$AB/BC = M/l^2 = \text{constant}$$

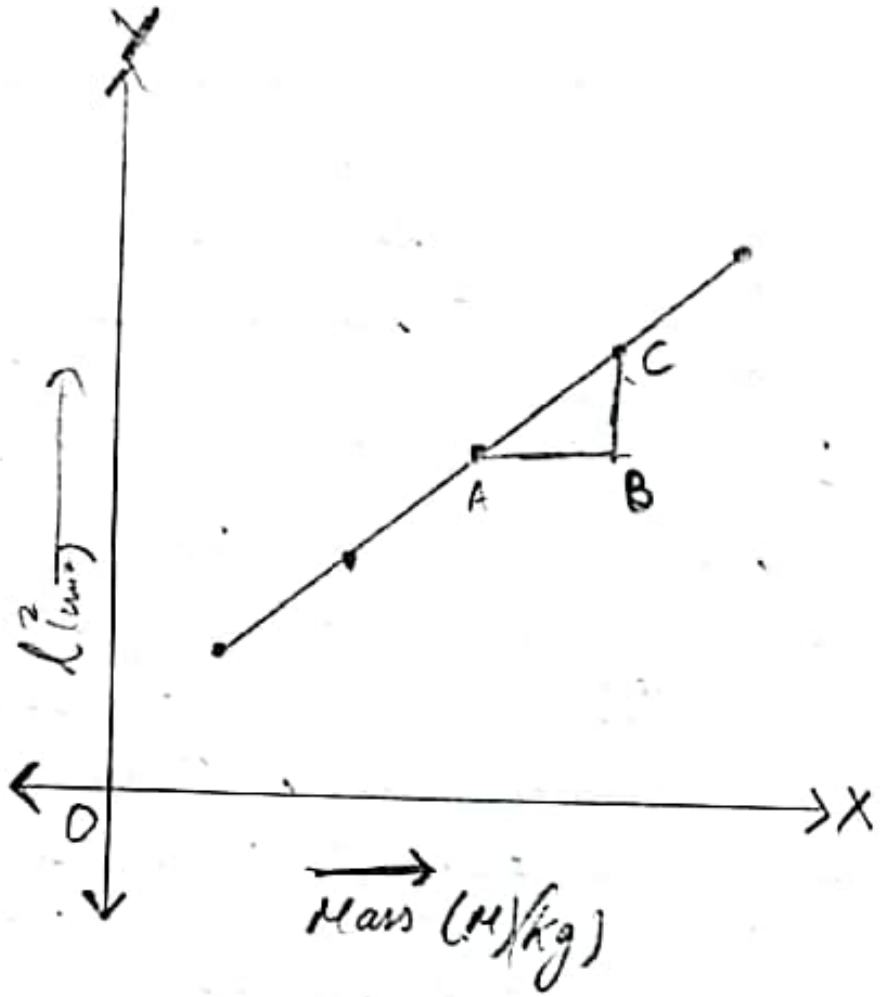
- Observation Table →

Material → Copper

Density of copper = 8940 kg/m²

Diameter of wire = 0.55mm

M-l^2 Graph



S.No	Mass	Tension	Resonating length			$\sqrt{T}/L$	M/L^2	Freq(Hz)
			Mass inc.	Mass dec.	Mean			
1)	0.05	0.49	15.2	15.2	15.2	4.605	2.5	49.96
2)	0.10	0.98	21.5	21.5	21.5	4.604	2.5	49.95
3)	0.15	1.47	26.3	26.3	26.3	4.610	2.5	50.01
4)	0.20	1.96	30.4	30.4	30.4	4.605	2.5	49.96

- Calculations:-

From graphical representation:-

Let $\sqrt{T} = 0.8$

then, $L = 17.3$ cm $\Rightarrow \frac{\sqrt{T}}{L} = 4.620$

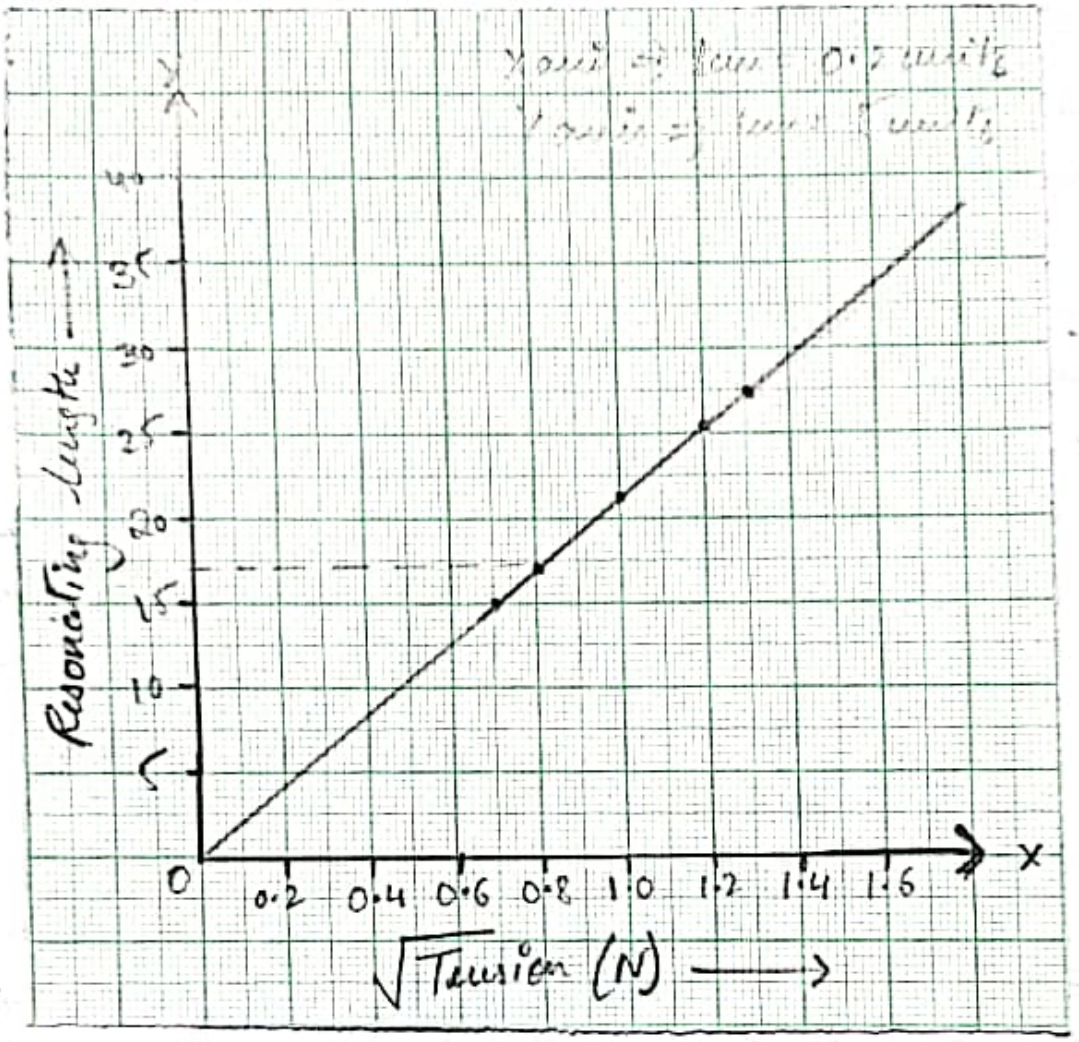
$L = 0.173$m

$$n = \frac{1}{2L}\sqrt{T/m}$$

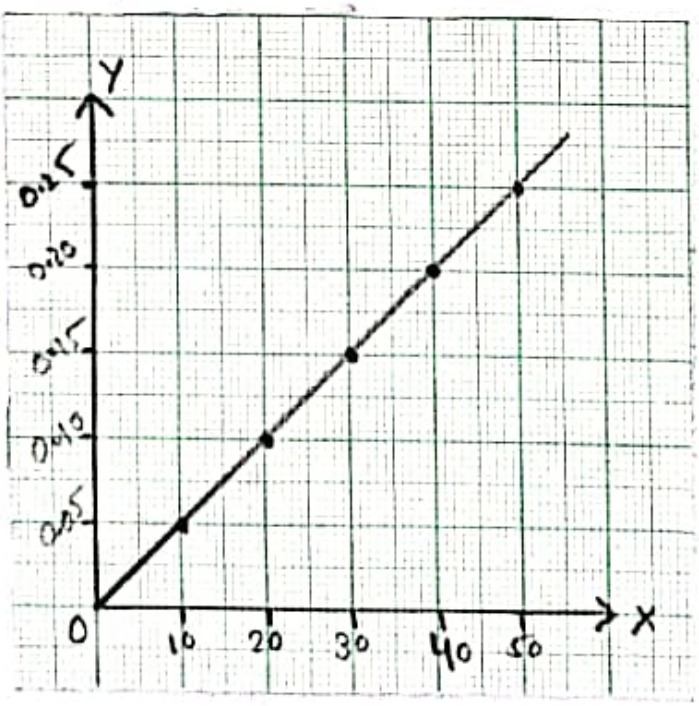
$$n = \frac{1}{2 \times 17.3} \times \frac{0.8}{m} \approx 49.97 Hz$$

$n = 49.97 Hz$ (approx)

Graph between Resonating length and $\sqrt{T}$



Graph between M and L^2



X axis ⇒ 1 cm = 10 units

Y axis ⇒ 1 cm = 0.05 units

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- **Result :-**

Tabular frequency = 49.815 Hz

Fo Graph frequency = 49.925 Hz

Std. frequency = 50 Hz

$$\therefore \text{Error \%} = \frac{50 - 49.925}{50} \times 100$$

$$\text{Error \%} = 0.0015\ \%$$

The Error is within the limits of the experimental Error.

∴, Frequency of alternating current is 24.96 Hz.

- **Precautions :-**

1) Take care to see that the wire is fixed on the sonometer.

2) The length b/w two bridges is to be taken accurately when the formed loop is stable.