

SONOMETER - FREQUENCY OF A.C MAINS

Aim:

To find frequency of the A.C mains with a sonometer (and an electromagnet)

Apparatus Required:

A sonometer (with soft iron wire), $\frac{1}{2}$ kg hanger with slotted weights, an electromagnet with step down transformer, clamp, stand, metre scale.

Formula:

$$\text{Frequency of the AC mains } n = \frac{1}{2L} \sqrt{\frac{T}{\mu}} \text{ (Hz)}$$

where L = Resonant length of the wire (in cm)

T = Tension in the wire (N)

μ = linear mass density of sonometer wire =

~~Procedure:~~

→ Place the sonometer on the table as shown in the figure

Observation:

Least count of the metre scale = 0.1 cm

Tabulation:

S.No	Load in gm including the mass of hanger (g)	Length of wire (in cm) between bridges at resonances			$\frac{\sqrt{m}}{l}$	Mean $\frac{\sqrt{M}}{l}$
		on weight increasing (1) $R_1 = x_2 - x_1$	on weight decreasing (2) $R_2 = x_2 - x_1$	mean length $l = \frac{(l_1 + l_2)}{2}$		
1.	200	35.5	36.5	36	1.24	
2.	300	32.4	42.7	37.5	1.46	1.33
3.	400	48	48	48	1.31	

$$ZE = +7$$

$$ZE = -7$$

$$LC = 0.01 \text{ cm}$$

S.No	Main scale reading	Circumferential scale reading	Total uncorrected diameter (in cm) $T = MS + (CS \times LC)$	Total corrected diameter (in mm) $D = T \pm \text{error}$
1	0	43	0.043	0.036
2.	0	48	0.048	0.041
3.	0	39	0.039	0.032
4.	0	46	0.046	0.039

$$0.037 \text{ cm}$$

→ Test the pulley and make it frictionless by oiling it

→ Put suitable weight in the hanger

→ Move wooden bridges P, P outward to include maximum length of wire (AB) between them

→ Put electromagnet switch on. The electromagnet imposes its frequency on the soft iron

→ Since the long wire may have frequency less than that of electromagnet, it may not vibrate

→ Decrease the length of the wire by moving both the bridges equally inwardly

→ Keep on decreasing the length till sonometer wire starts vibrating

→ Adjust the length for maximum amplitude of vibration

→ Measure the length of the wire AB between the edges of the two bridges and record in 'length increasing' column

→ Repeat the experiment for different weights in the hanger and record the resonant length of the wire in each case

Expt. No. :

Date. :

Page No. 27

Result:

The frequency of the alternating current = 61.4 Hz

Precautions:

- The wire should be soft iron or of any other magnetic material
- Tip of the electromagnet should be very close to the wire in the middle
- The length should be noted when the amplitude of vibration is maximum

Sources of error:

- Wire may not be rigid and of uniform cross-sectional area
- Pulley may not be frictionless
- Weights may not be correct
- Knife edges may not be sharp
- ~~The mains frequency may not be stable.~~