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Dataset2

EXPERIMENT: No. 2 Sonometer

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- AIM: To study the vibrational modes of a stretched string/wire using sonometer.

- APPARATUS REQUIRED: Sonometer, a non-magnetic wire (eg:- stainless steel wire), an electromagnetic coil, an AC source of known frequency (6-8V, 1A), a set of weights.

- FORMULA:

$$f = \frac{n}{2L}\sqrt{\frac{T}{\mu}}$$

where, → n=1 corresponds to fundamental mode of vibration while n=2, 3, 4..... correspond to respective harmonics.
→ T is the tension in the wire
→ μ is mass per unit length or linear density of the wire.
→ L is the length of the wire.

- RESULT:

Value of frequency of AC source is 50.224 Hz (According to the formula).

OBSERVATION TABLE :

Mass per unit length of the wire, $\mu = 1.9 \times 10^{-3}$ kg/m

Sr. No.	Load (M) (kg)	Tension (T) $T=Mg$ (N)	Resonance Length (L) (I)	(II)	Mean (cm)	Mean (L) (m)	Frequency (f) $f=\frac{1}{4L}\sqrt{\frac{T}{\mu}}$ (Hz)
1.	0.1	0.98	15	13.5	14.25	0.1425	39.84
2.	0.2	1.96	16.5	16	16.25	0.1625	49.41
3.	0.3	2.94	19	19.5	19.25	0.1925	51.08
4.	0.4	3.92	20	20	20	0.2	56.77
5.	0.5	4.9	23.5	23.5	23.5	0.235	54.02
						Mean Frequency	50.224

- GRAPH :

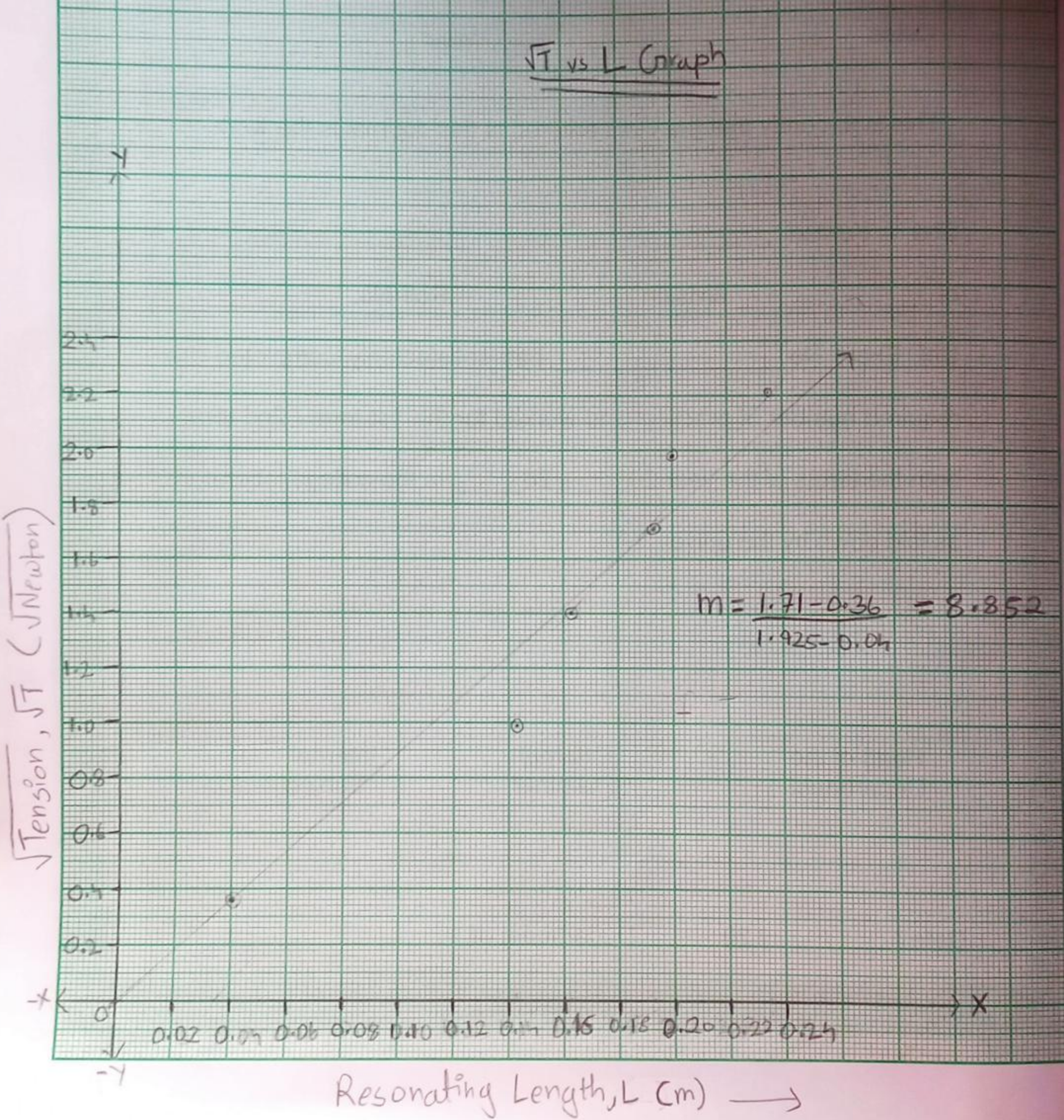
	y	x
	$\sqrt{T}$	L
0.99 =	$\sqrt{0.98}$	0.1425
1.4 =	$\sqrt{1.96}$	0.1625
1.71 =	$\sqrt{2.94}$	0.1925
1.98 =	$\sqrt{3.92}$	0.2
2.21 =	$\sqrt{4.9}$	0.235

$$f = \frac{1}{4L}\sqrt{\frac{T}{\mu}}$$

$\Rightarrow \sqrt{T} = 4f\sqrt{\mu}\, L$
$(y = mx)$

$\Rightarrow$ Slope, $m = 4f\sqrt{\mu} = 8.852$ (from graph)

$\Rightarrow f = \frac{m}{4\sqrt{\mu}} = 50.772$ Hz



√T vs L Graph
m = 1.71-0.36 / 1.925-0.04 = 8.852
√Tension, √T (√Newton)
Resonating Length, L (m)
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
0
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
X
-X
Y
-Y

- CALCULATIONS:

$u = 0.0019 \ kg/m$, $f = \frac{1}{4L}\sqrt{\frac{T}{\mu}}$

1) $L_1 = 0.1425 m$
$T_1 = 0.98 N$
$\Rightarrow f_1 = \frac{1}{4(0.1425)}\sqrt{\frac{0.98}{0.0019}}$
$\Rightarrow f_1 = 39.8438 \ Hz$

2) $L_2 = 0.1625 \ m$
$T_2 = 1.96 \ N$
$\Rightarrow f_2 = \frac{1}{4(0.1625)}\sqrt{\frac{1.96}{0.0019}}$
$\Rightarrow f_2 = 49.4126 \ Hz$

3) $L_3 = 0.1925 \ m$
$T_3 = 2.94 N$
$\Rightarrow f_3 = \frac{1}{4(0.1925)}\sqrt{\frac{2.94}{0.0019}}$
$\Rightarrow f_3 = 51.0865 \ Hz$

4) $L_4 = 0.2 \ m$
$T_4 = 3.92 N$
$\Rightarrow f_4 = \frac{1}{4(0.2)}\sqrt{\frac{3.92}{0.0019}}$
$\Rightarrow f_4 = 56.7774 \ Hz$

5) $L_5 = 0.235 \ m$
$T_5 = 4.9 N$
$\Rightarrow f_5 = \frac{1}{4(0.235)}\sqrt{\frac{4.9}{0.0019}}$
$\Rightarrow f_5 = 54.0248 \ Hz$

$\Rightarrow f = \frac{f_1 + f_2 + f_3 + f_4 + f_5}{5}$

$\Rightarrow f = \frac{39.84 + 49.41 + 51.08 + 56.77 + 54.02}{5}$

$\Rightarrow f = \frac{251.12}{5}$

$\therefore \boxed{f = 50.224} \ Hz$