

# EXPERIMENT → 5

## VIBRATING

## STRING

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## # OBSERVATIONS:-

1. Mass per unit length of string;

$$\mu = 0.0002875 \text{ kg/m}$$

2. Mass of the peg = 18 grams

Sl No	Total mass (m) (gm)	Length of string for normal modes			
		Length $L_1$ mode $n_1=1$	Length $L_2$ mode $n_2=2$	Length $L_3$ $n_3=3$	Length $L_4$ $n_4=4$
1.	10+18	22	42	63	85
2.	20+18	26	49	76	95
3.	30+18	29	52	82	112

# \* CALCULATIONS:-

$$1. \text{ Tension } T_1 = M_1 g = \frac{(10+18)}{1000} \times 9.8$$

$$= 0.2744 \text{ N}$$

$$= 0.27 \text{ N}$$

$$\text{Mean length for fundamental mode} = \frac{\frac{L_1}{n_1} + \frac{L_2}{n_2} + \frac{L_3}{n_3} + \frac{L_4}{n_4}}{4}$$

$$= \frac{\frac{22}{1} + \frac{42}{2} + \frac{63}{3} + \frac{85}{4}}{4} \text{ cm}$$

$$= \frac{22 + 21 + 21 + 21.25}{4} \text{ cm}$$

$$= \frac{85.25}{4} = 21.3125 \text{ cm}$$

$$= 0.213125 \text{ m}$$

$$= 0.21 \text{ m}$$

$$\text{Frequency of tuning fork } \omega_1 = \frac{1}{2L} \sqrt{\frac{T}{\mu}}$$

$$= \frac{1}{2 \times 0.213125} \times \sqrt{\frac{0.2744}{0.0002875}}$$

$$= 72.47 \text{ Hz}$$



2. Tension 2:-  $M_2 g = \frac{(20+18)}{1000} \times 9.8$   
 $= 0.3724 \text{ N}$

Mean length for fundamental mode  $L$ ;

$$= \frac{\frac{L_1}{n_1} + \frac{L_2}{n_2} + \frac{L_3}{n_3} + \frac{L_4}{n_4}}{4}$$

$$= \frac{\frac{26}{1} + \frac{49}{2} + \frac{76}{3} + \frac{95}{4}}{4}$$

$$= \frac{26 + 24.5 + 25.3 + 23.75}{4}$$

$$= 24.8875 \text{ cm}$$

$$= 0.248875 \text{ m}$$

Frequency of Tuning Fork,  $\nu_2 = \frac{1}{2L} \sqrt{\frac{T_2}{\mu}}$

$$= \frac{1}{2 \times 0.248875} \sqrt{\frac{0.3724}{0.002875}}$$

$$= 72.30 \text{ Hz}$$

$$3. \text{ Tension } 3 :- M_3 g = \frac{(30 + 12) \times 9.8}{1000} \\ = 0.4704 \text{ N}$$

Mean length of fundamental mode,  $L = \frac{L_1 + L_2 + L_3 + L_4}{n_1 + n_2 + n_3 + n_4}$

$$= \frac{29}{1} + \frac{52}{2} + \frac{82}{3} + \frac{112}{4}$$

$$= \frac{29 + 26 + 27.33 + 28}{4}$$

$$= 27.5825 \text{ cm}$$

$$= 0.275825 \text{ m}$$

$$\nu_3 = \frac{1}{2 \times 0.275825} \sqrt{\frac{0.4704}{0.0008875}}$$

$$\nu_3 = 73.32 \text{ Hz}$$

# Mean Value of Driving Frequency;

$$\bar{x} = \frac{x_1 + x_2 + x_3}{3}$$

$$= \frac{72.47 + 72.30 + 73.32}{3}$$

$$\bar{x} = 72.69 \text{ Hz}$$

Standard Deviation:-

$$= \sqrt{\frac{\sum (x_i - \bar{x})^2}{n}}$$

Sr. No.	Fundamental Frequency (Hz)	$x - \bar{x}$ (Hz)	$(x - \bar{x})^2$ (Hz <sup>2</sup> )
1	72.47	-0.22	0.04
2	72.30	-0.39	0.15
3	73.32	+0.37	0.13

$$S.D. = \sqrt{\frac{0.04 + 0.15 + 0.13}{3}}$$

$$= \sqrt{\frac{0.32}{3}}$$

$$= 0.32 \text{ Hz}$$



## # Result

The frequency of Tuning fork is:-

$$\underline{72.69 \pm 0.32 \text{ Hz}}$$