EXPERIMENT

AIM

To study the relation between the length of a given wire and tension for constant frequency using a sonometer.

MATERIAL REQUIRED

Sonometer with hanger and slotted weights of $\frac{1}{2}$ kg each, a tuning fork, rubber pad metre scale and spring balance.

THEORY

The relation $v = \frac{1}{2l} \sqrt{\frac{T}{m}}$ shows that a graph between l_2 and T will be a straight line, for a wire resonating with the same frequency.

PROCEDURE

1. Place the sonometer on the table so that the hanger weight hangs without touching the table or the face. Remove wire from the pulley and make sure that it is frictionless, Oil the axle of the pulley if need be. Replace the wire on the pulley and let the hanger stretch it. Measure the value of slotted weights and hanger with the help of spring balance.

2. Check that there are no kinks in the wire and that it spreads horizontally along the sonometer. place two bridges under the wire.

3. Make a small V-shaped paper rider and place it inverted (like) over the wire just in the middle of its length between the bridges.

4. Keep the bridges at minimum separation and rider on the wire between them. Strike the given tuning fork with the pad and press the tip of its stem gently on the top of the sonometer.
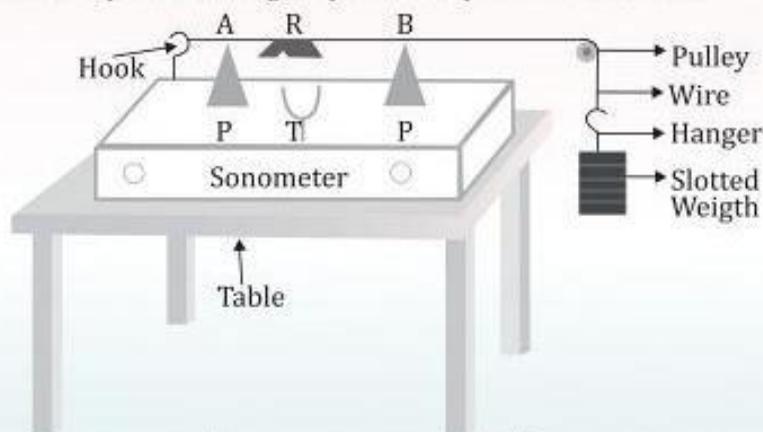
5. Increasing the separation between the bridges, repeat step-4 till we reach a stage when the rider flutters and falls. Measure the length l_1 between the bridges.

6. Place the bridges at separation a little more than and decreasing the distance repeat steps 4 and 5 and measure the length l_2. Find mean value of length $l = \frac{l_1 + l_2}{2}$, for the given tension.

7. Increase load on the hanger in steps of $\frac{1}{2}$ weight and repeat steps 4, 5 and 6 find resonating length for different values of tensions with the same tuning fork.

8. Plot a graph between l_2 and T.

OBSERVATIONS

Least count of spring balance = ... gf = ... Kg f

Weight of hanger = ... gf = ... kg f

Weight of slotted weights.

(i) $W_1 = $ .... kg f

(ii) $W_2 = $ .... k gf

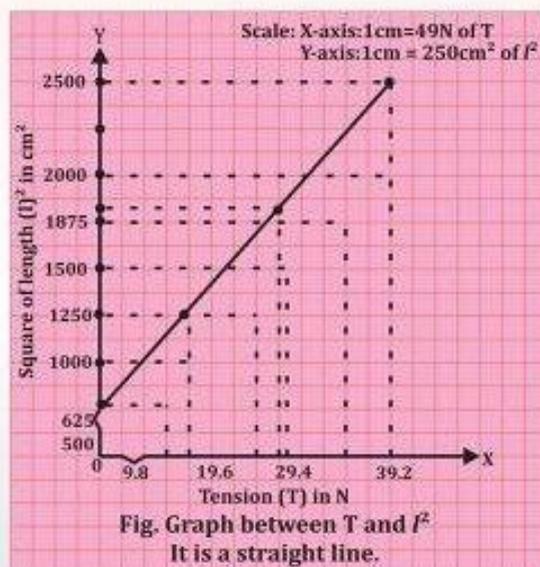(iii) $W_3 = $ .... k gf

(iv) $W_4 = $ .... k gf

(v) $W_5 = $ .... k gf

Frequency of tuning fork, n = ...H$_z$

TABLE FOR REASONING LENGTHS FOR DIFFERENT TENSIONS

S. No.	Load M (kg)	Tension T = mg (N)	Resonating length of wire			l_2 (cm²)	$\frac{T}{l_2}$ (N cm^{-2})
			Length increasing l_1 (cm)	Length decreasing l_2 (cm)	Mean length $l = \frac{l_1+l_2}{2}$ (cm)		
1.	1.0	9.8					
2.	1.5	14.7					
3.	2.0	19.6					
4.	2.5	24.5					
5.	3.0	29.4					
6.	3.5	34.3					

PLOTTING OF GRAPH

Scale: X-axis:1cm=49N of T
Y-axis:1cm = 250cm² of l^2

Fig. Graph between T and l^2
It is a straight line.

CALCULATIONS

To find mean length. And plot a graph between T and l_2, taking T along X-axis and F along Y-axis. The graph comes to be a straight line.

RESULT

1. The value of $\frac{T}{l_2}$ is a constant within limits of experimental errors.
2. The graph between l_2 and is a straight line as shown in Fig. The two results clearly indicate that $l_2 \propto T$.

PRECAUTIONS

1. Make sure that the sonometer wire is of uniform cross section and free of kinks.
2. Make the pulley frictionless by oiling and greasing before you start the experiment.
3. The load applied should not exceed $\frac{1}{3}$rd the breaking stress. For this measure the diameter of sonometer wire with the help of screw gauge and note down the value of breaking stress from the table of constant.
4. Use good quality tuning forks which vibrate for more than one minute. Take care that they are not struck with any hard surface.
5. Don't rely on the weight marked on hanger and slotted weights, verify the true weight using a spring balance.
6. Hold the tuning fork from its stem and place the tip of the stem of vibrating tuning fork gently on the top face of sonometer.
7. After completing the experiment do not forget to remove the load from the wire or else it may get permanently stretched.

SOURCES OF ERROR

1. The cross section or composition of wire may not be uniform.
2. Pulley may not be completely frictionless. Then the effective tension would be less than the applied load.
3. The knife edges over the bridges may not be sharp causing an error in measurement of length.
4. The relation $v = \sqrt{\frac{T}{m}}$ assumes that the string is perfectly elastic which really is not the case with real strings.

VIVA VOCE

Q1. What are the various ways in which the resonating length of string may change?

Ans. With the same tuning fork, the resonating length of a given wire will increase with the increase in tension in the string. Also keeping tension constant if we change the string the resonating length will decrease with increase in higher mass density of the wire.

Q2. If the tension in the string is made four times, how will the frequency of the tuning fork change?

Ans. The frequency of a tuning fork is constant. It will not change.

Q3. Define linear mass density of a wire.

Ans. Linear mass density of a wire is defined as the mass per unit length of the wire.

Q4. **All other factors remaining constant which of the two wires will have greater frequency of fundamental note-a thicker one or a thinner one.**

Ans. The thinner one.

Q5. **Why does a tuning fork have two prongs?**

Ans. So that there be two antinodes at the froe and one at the stem. This lets the fork vibrate for a long time even if you hold it at the stem.

Q6. **Why are tuning forks made of some standard frequencies?**

Ans. They are made to produce frequencies of a diatonic. musical scale.

Q7. **How do the tuning forks of different frequency differ from each other?**

Ans. The one having higher frequencies has stir and heavier prongs.

Q8. **How does the frequency of a tuning fork the if we file one of its prongs slightly?**

Ans. The frequency increases.