SIMPLE PENDULUM

Objective:

- To plot a l -T^2 graph using a simple pendulum.
- To find the effective length of the Seconds pendulum using the graph.
- To calculate the acceleration due to gravity at a place.

Theory :

An ideal simple pendulum consists of a heavy point mass (called bob) tied to one end of a perfectly inextensible, flexible and weightless string. In practice, we make it by tying a metallic spherical bob to a fine cotton stitching thread.

Length of a Simple Pendulum

The distance between the point of suspension of the pendulum and its Centre of Gravity (C.G.), which is the C.G. of the bob, is called the length of the simple pendulum. It is represented using the alphabet (L).

Time Period of a Simple Pendulum

Time period is the time taken by the bob of the simple pendulum to make one complete oscillation. It is represented by the letter T.

Finding the acceleration due to gravity

The time period of a simple pendulum depends on the length of the pendulum (L) and the acceleration due to gravity (g), which is expressed by the relation,

$$T = 2\pi\sqrt{\frac{L}{g}} \quad \text{------------------------------(1)}$$

(for small amplitude of oscillations)

$$g = 4\pi^2 (L / T^2) \quad \text{--------------------------(2)}$$

ie;

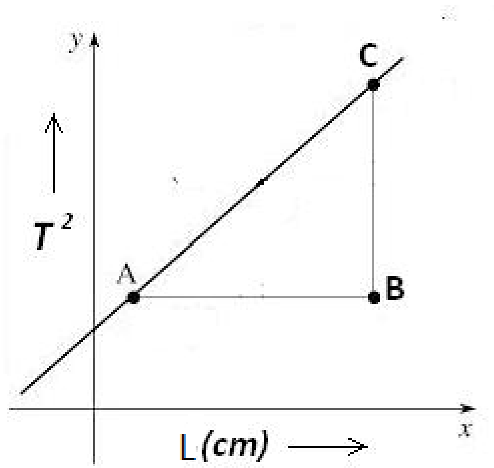
If we know the value of L and T, we can calculate the acceleration due to gravity, g at that place.

The L- T graph

We can plot a graph between L and T by taking L along the X axis and T along the Y axis. The graph is parabolic in nature.

The L- T^2 graph

We can plot a graph between L and T^2 by taking L along the X axis and T^2 along the Y axis. The graph is a straight line.



From the graph,

$$\frac{L}{T^2} = \frac{AB}{BC}$$

$$g = 4\pi^2 \left(\frac{AB}{BC} \right)$$

Procedure:

1. Find the radius of bob with the help of a Vernier callipers. Measure the length of string add radius of bob in it, this will give effective length of pendulum.
2. By changing the length of its string, you can change its period of oscillation, T. Period, T is defined as the time of one full oscillation. Rightmost position of bob can be used as a reference point or state for counting the number of oscillations. The time elapsed between every **two consecutive states** is the period, T. To measure T, measure the time for 25 oscillations (swings) and then divide that time by 25 .
3. Select a length of l = 115cm or 100 cm(say). Hold the hanging tiny mass and move it and release the mass, swinging starts, turn on the timer simultaneously.
4. Calculate the time of one oscillation or the period (T) by dividing the total time by the number of oscillations you counted.
5. Use your calculated (T) along with the exact length of the pendulum (L) in the above formula to find "g." This is your measured value for "g."
6. Repeat the above procedure for 3 more cases. Choose 3 other values for L and record them in the Table.
7. Record your measured time and the corresponding ‘T’ of oscillations and calculate "g" in each case. In each case you should get "g" close to its accepted value of 9.81 m/s^2.
8. Calculate the mean value of "g" and record it in the space provided. This is your measured value for "g."
9. Find a %error on "g" knowing that the accepted value is 9.81 m/s^2
10. Draw *L*- T graph and The *L*- T^2 graph

11. From The *L*- T^2 graph calculate the value of for Second's pendulum by seeing the value of 'L' corresponding to T= 4.0. (A **second's pendulum** is a **pendulum** whose **period** is precisely two **seconds)**

s. no.	Length (*l*) in cm	Effective length L=(*l*+r) (cm)	Time of 25 oscillations (sec)	Average time of 25 oscillations (sec)	Time Period (T) (sec)	$g = 4\pi^2 (L/T^2)$	Average 'g'
1							
2							
3							
4							

Calculations:

The acceleration due to gravity 'g' is :

$$g = 4\pi^2 (L/T^2)$$

Percentage Error: $$\frac{\Delta g}{g} \times 100 = \frac{\Delta L}{L} \times 100 + 2 \times \frac{\Delta T}{T} \times 100$$

Results:

1. The effective length of the Seconds pendulum using the graph is found to be ……….cm.
2. The acceleration due to gravity 'g' is found to be …… m/sec^2.