Experiment No. ………….. Date: …. /…. / 20….

TO DETERMINE THE ACCELERATION DUE TO GRAVITY IN THE LABORATORY BY USING A SIMPLE PENDULUM AND HENCE DETERMINE THE LENGTH OF SECOND PENDULUM BY THE HELP OF GRAPH BETWEEN $T\ Vs\ L$ AS WELL AS $T^2\ Vs\ L$.

APPARATUS REQUIRED:

1. A pendulum bob
2. A thread (about $1.5m$)
3. A vernier calliper
4. A stop watch
5. A stand with clamp
6. A meter scale

THEORY:

A simple pendulum consists of a small metal ball (called bob or mass) suspended from a fixed point by a long thread such that the bob is free to swing back and forth in a vertical plane under the influence of gravity.

The oscillation of simple pendulum is simple harmonic for small angular displacement ($\theta < 6^o$).

Effective length of simple pendulum:
The distance between the point of suspension and center of gravity (CG) of the bob is called as effective length of simple pendulum.

Expression for time period of simple pendulum:

The restoring force acting on the pendulum at point B is:

$$F = -mg\ sin\theta$$

or, $ma = -mg\ \theta$ $[\because for\ small\ \theta,\ \ sin\theta \approx \theta]$

or, $a = -g\ \theta$

or, $a = -g\ \frac{y}{L}$ $[\because \theta = \frac{Arc\ AC}{L} \approx \frac{y}{L}]$

or, $a = -\frac{g}{L}\ y$ …. …. …. (1)

or, $a \propto -y$

This shows that the motion of simple pendulum under small displacement is simple harmonic.

For a simple harmonic oscillator,

$$a = -\omega^2\ y \dots \dots \dots (2)$$

On comparing equations (1) and (2), we get

$$\omega^2 = \frac{g}{L}$$

or, $\omega = \sqrt{\frac{g}{L}}$

or, $\frac{2\pi}{T} = \sqrt{\frac{g}{L}}$

or, $T = 2\pi\sqrt{\frac{L}{g}}$

This is the expression for time period of oscillation of simple pendulum.

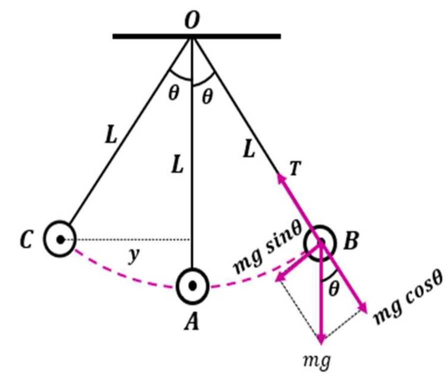

Figure*: *Oscillation of simple pendulum

Note:

$$T = 2\pi\sqrt{\frac{L}{g}}$$

➢ $L = effective\ length\ of\ simple\ pendulum$

➢ $g = effective\ acceleration\ due\ to\ gravity$

$$\therefore T = 2\,\pi\sqrt{\frac{L_{eff}}{g_{eff}}}$$

Example:

✓ For a lift under free fall, $g_{eff} = 0$.

✓ For a satellite, $g_{eff} = 0$.

Hence, time period of oscillation of simple pendulum in above cases **is infinite**.

(The pendulum does not swing at all).

❖ The time period of simple pendulum is **independent of**:

1. Mass of the pendulum.
2. Amplitude of oscillation.