(OS1-1) Simple Pendulum

Aim of experiment

Determination of the Acceleration due to gravity

Apparatus

Small Pendulum Bob of Lead or Brass Tied to a Length (L *m*) of Cotton Threaded Through a Supporting Cork or Clamped Between Two Small Metal Plates. Retort-Stand, Clamp, Meter Rule and Stop Watch.

Theory of experiment

The ideal simple pendulum consists of a point mass suspended by a weightless string. For a small angular displacement θ the restoring force acting on the point mass, *m*, is given by

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

(since θ is very small) $= mg\, x/L$

Where *x* is the displacement and L is the length of a pendulum, *figure 1.*
Hence the equation of motion is given by

$$\ddot{x} = (g/L)\, x$$

This is an equation of simple harmonic motion with periodic time

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

If one plots the relation between *L* and T^2 one obtains *g* from the slope as follows;

$$g = 4\pi^2 L/T^2 = 4\pi^2/slope$$

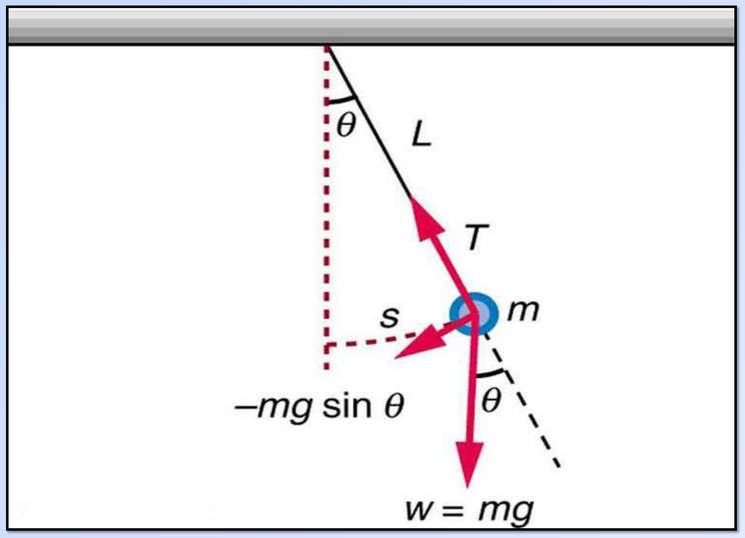

Figure 1. A schematic drawing for forces acting on the pendulum mass.

Procedures

1. Measure the length of the pendulum; this the distance from a fixed hang point to the center of the suspended bob.
2. The pendulum is given a small displacement.
3. The time of 20 swings, measured against a fixed mark on the bench, is taken, and the periodic time *(T)* found. (The reading must be rejected if the swings become elliptical.)
4. This is repeated with different lengths (*L*) of the pendulum,
5. Repeat steps 1-4 at least three times for each length, and tabulate your results.

6. A graph is drawn between T_{av}^2 and L from which an average value of slope= T^2/L= is obtained to determine *g*.

Results

L (m)	T_1 *(s)*	T_2 *(s)*	T_3 *(s)*	T_{avr} *(s)*	T^2 *(s²)*

Slope = …… s^2/m

Acceleration due to gravity

$g = 4\pi^2/ slope$ = …… m/s^2