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Simple Pendulum

The aim of Experiment:

To determine the acceleration due to gravity "g"

Theory:

A simple pendulum consists of a mass " m" hanging on the end of light string of length " L". When the mass is deflected from its equilibrium, it oscillates back and forth. The time for one complete oscillation is called the period time of the simple pendulum. For small angles of deflection the simple pendulum motion described by Simple harmonic motion with period time "T" given by :

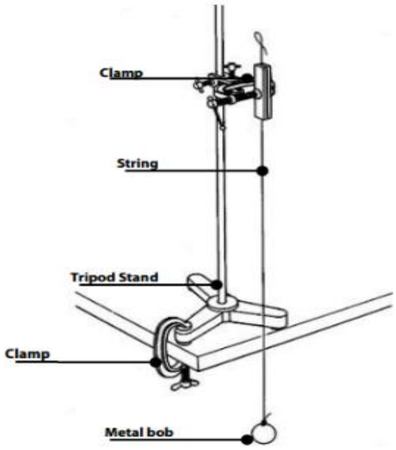


Fig 1

$$T = 2\pi\sqrt{\frac{L}{g}} \qquad \dots\dots\dots(1)$$

Where: T : the period time in second, s . L : length of pendulum= the string + radius of spherical ball in cm. g : is the acceleration due to gravity

By squaring both sides of the equation yields

$$T^2 = \frac{4\pi^2}{g}L \quad \dots\dots\dots(2)$$

In Figure 2 we see that a simple pendulum has a small-diameter bob and a string that has a very small mass but is strong enough not to stretch appreciably. The linear displacement from equilibrium is *s*, the length of the arc. Also shown are the forces on the bob, which result in a net force of ($-mg\ \sin\theta$) toward the equilibrium position—that is, a restoring force.

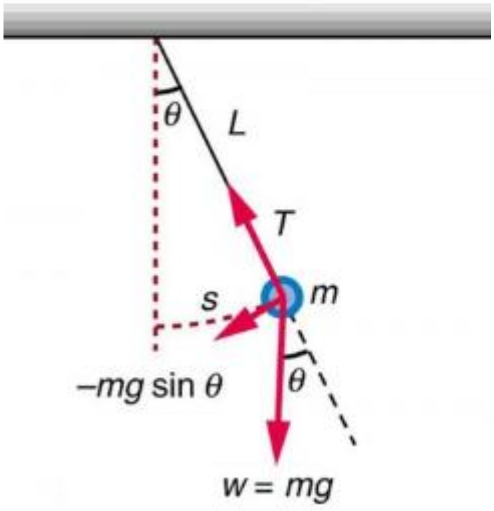


Fig. 2

Tools used:

- A clamp with stand, Cotton Thread (about 1 meters long), bob, vernier caliper, Stop watch, Meter scale. .

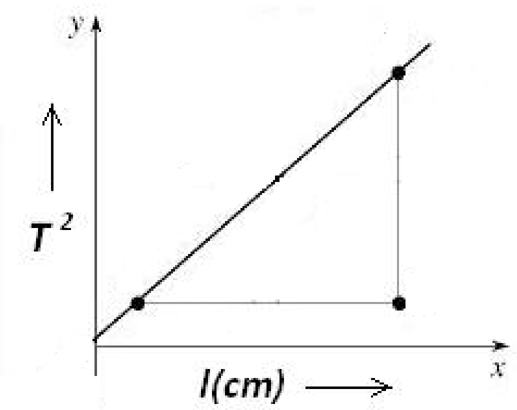
Method of working:

1. Determine the mean diameter of the simple pendulum bob using the vernier calipers.
2. Find the mean radius of the bob and represent it using ‘r’.
3. Tie a meter length of the thread to the pendulum bob and suspend the thread in the clamp .
4. Set the pendulum bob swinging through a small arc of about (10°) , with a stop-watch measure the time of 20 complete oscillations.
5. Measure the length (L) of the thread from the point of suspension to the middle of the bob .

6. Shorten the length of the pendulum by successive amounts of the time (10 cm) by pulling the thread . And for each new length take observation of the time for (20) oscillation.
7. Tabulated the reading

Length of Pendulum (L) cm	**Time for (20) oscillations (T_{20}) sec**	**Time for one oscillation T=$\frac{T_{20}}{20}$ sec**	T^2 (sec^2)

8. Plot a graph with values of (L) along X axis and (T^2) along Y axis. The graph is a straight line, as shown in the figure.



<u>Note</u>: $slope = \frac{T^2}{L} \xrightarrow{yields} g = 4\pi^2 \times \frac{1}{slope}$

Questions of the experiment:

Q1/ What is the acceleration due to gravity in a region where a simple pendulum having a length 75 cm has a period of 1.7357 s?

Q2/ A pendulum on the Earth has a period T. The acceleration due to gravity on Mars is less than that on the Earth, and the acceleration due to gravity on the Moon is even less than on Mars. Identical pendulums have the same mass and length. Where would the period of an identical pendulum be the smallest?

a. The period is smallest on the Earth.
b. The period is the same on the Earth, the Moon, and Mars.
c. The period is smallest on Mars.
d. The period is smallest on the Moon.
e. The period is smallest on both Mars and the Moon.

Q3/ How would the period of a simple pendulum be affected if it were located on the moon instead of the earth?