Medical Physics

The Simple Pendulum

Experiment Two

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Introduction

The simple pendulum offers a method of measuring the constant acceleration due to gravity very precisely.

The Aim of Experiment

Find value acceleration of gravity g.

Experiment tools

- Hard iron ball
- Thread
- Iron stand
- Ruler, Stop watch

Theory:

A simple pendulum is defined, ideally, as a particle suspended by a weightless string. Practically it consists of a small body, usually a sphere, suspended by a string whose mass is negligible in comparison with that of the sphere and whose length is very much greater than the radius of the sphere. Under these conditions, the mass of the system may be considered as concentrated at a point -namely, the center of the sphere- and the problem may be handled by considering the transitional motion of the suspended body, commonly called “bob,” along a circular arc.

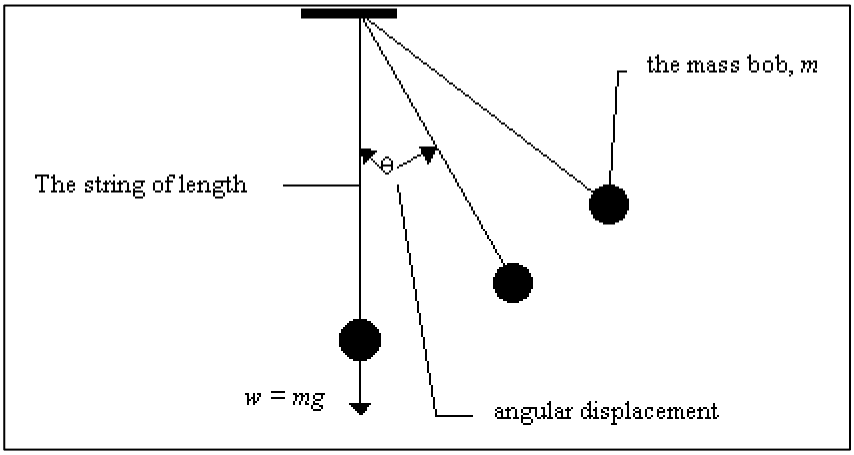

Figure 1: Diagram Analysis of the Simple Pendulum.

Consider the diagram of a simple pendulum shown in Figure 1. The displacement, arc length *x*, for small angle θ that the string makes with the vertical is given by:

$$x = A \sin \omega t \qquad (1)$$

The period of vibration is the time required for it to go through one cycle (i.e., the time for pendulum to move from any point on its path back to the same point with motion in the same direction), and is related to ω (the angular velocity) by the relation T = 2π/ω.

$$T = 2\pi\sqrt{\frac{l}{g}} \qquad (2)$$

Note finally that the constant *A* in Equation (1) is the amplitude of the motion, which measures how far the bob swings away from the vertical, the maximum value of the displacement. This is conveniently expressed as an angle in degrees.

Procedure:

The period T of a simple pendulum (measured in seconds) is given by the formula:

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

$$T = T_{ave} /10 \qquad (2)$$

Using equation (1) to solve for “g”,

L: is the length of the pendulum (measured in meters) and g: is the acceleration due to gravity (measured in meters/sec^2).

Now with a bit of algebraic rearranging, we may solve (eq. 1).

For the acceleration due to gravity g (You should derive this result on your own).

$$g = 4\,\pi^2 L/T^2 \qquad (3)$$

1. Measure the length of the pendulum to the middle of the pendulum bob. Record the length of the pendulum in the table below.

2 .With the help of a lab partner, set the pendulum in motion until it completes 10 to and fro oscillations, taking care to record this time. Then the period T for one oscillation is just the number recorded divided by 10 using (eq. 2).

3. You will make a measurement for g using four different values for the length L.

Length [m]	Time of oscillations (t_1)	Time of oscillations (t_2)	$(T_{ave}) = t_1+t_2/2$ [seconds]	$T = T_{ave}/10$ [seconds]	T^2
70	16	16.5			
60	15.4	16.3			
50	14	14.7			
40	13.1	11.7			