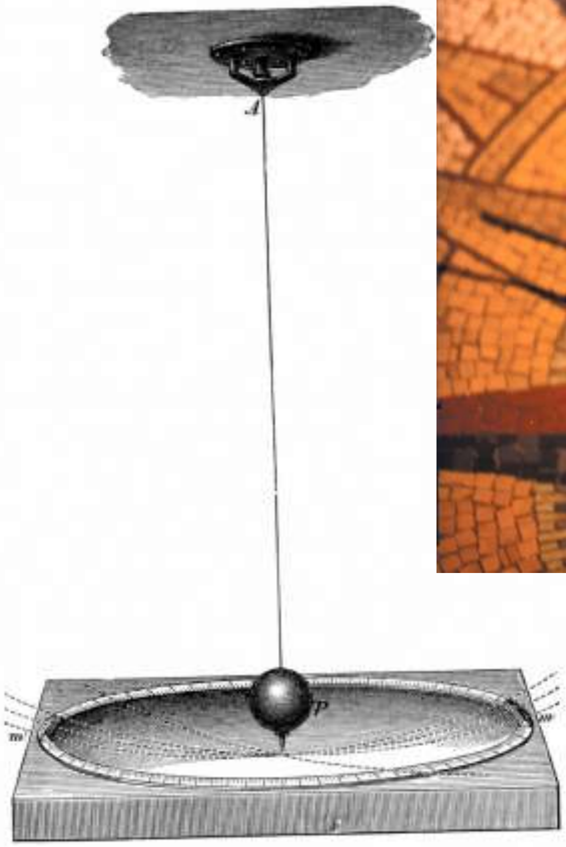


Simple Pendulum

Experimental part

Second Lecture (2)

First semester / First year

By

Assist. Lec. ASAL AHMED

Simple Pendulum

The AIM of the Experiment:

1. Determine the acceleration of free fall by means of a simple pendulum.
2. Calculate the Error and Error percentage.

Theoretical Part:

A simple pendulum consists of a mass m hanging at the end of a string of length L. The period of a pendulum or any oscillatory motion is the time required for one complete cycle, that is, the time to go back and forth once, as shown in figure 1.

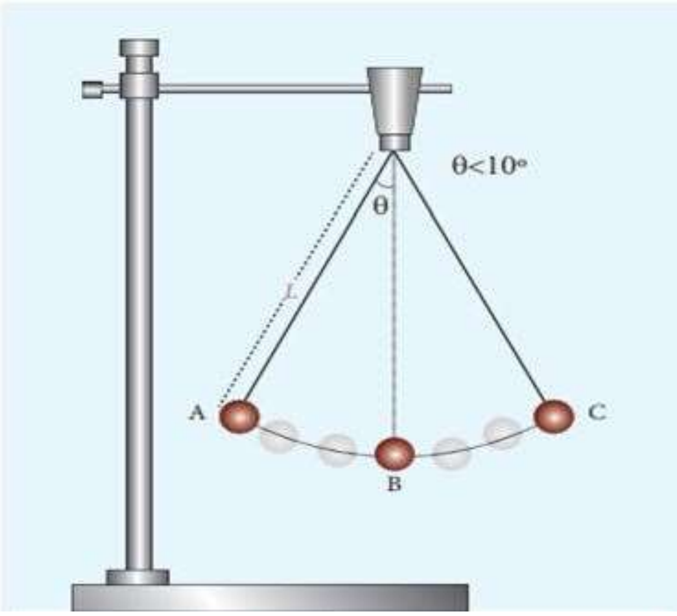


Figure (1): Shows the movement of the pendulum.

If the amplitude of motion of the swinging pendulum is small, then the pendulum behaves approximately as a simple harmonic oscillator, and the period T of the pendulum is given by approximately:

$$T = 2\,\pi\sqrt{\frac{L}{g}}$$ to find g:

$$g = \frac{4\pi^2\,L}{T^2}$$

Where:
$4\pi^2$ is equal to 39.43
g: is the acceleration of gravity
T: is the time
L: is the length of the pendulum.

This expression for T becomes exact in the limit of zero-amplitude motion and is less and less accurate as the amplitude of the motion increases. From this expression, we can use measurements of T and L to compute g (See figure 2).

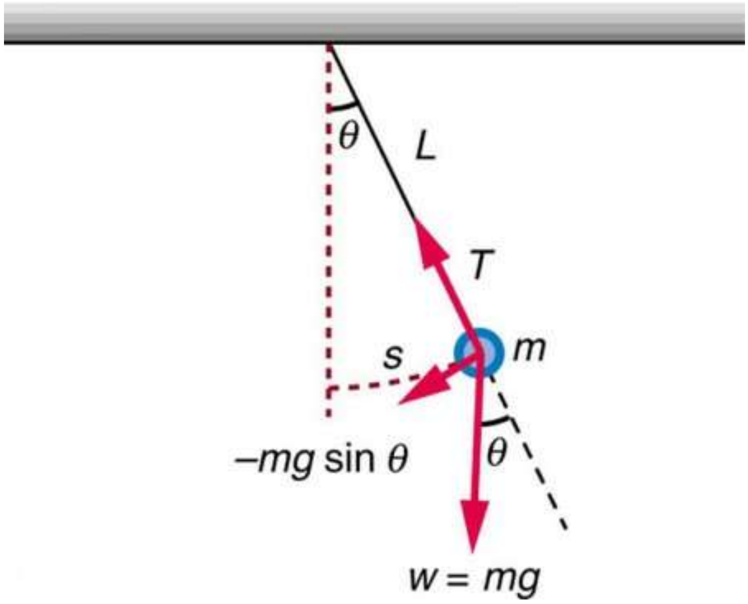


Figure (2): Shows the relationship between T and g.

Experimental Part:

Apparatus:

Pendulum bob (a metal sphere) with a hook attached or with a hole bored through its center, thread, stopwatch, meter scale, stand, and clam.

Procedure:

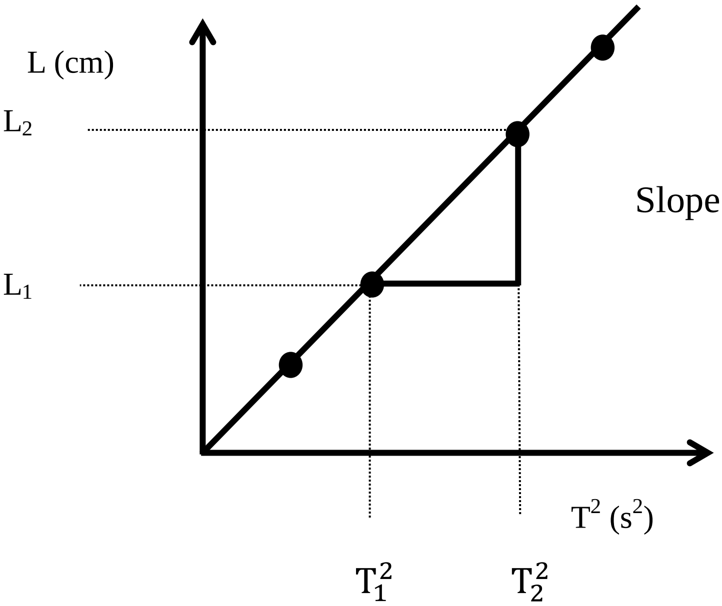
1. To get a perfect pendulum, choose a fine thread and a small-diameter ball, attach a length of string, and hang the thread between the jaws.
2. Install a piece of paper behind the pendulum and draw a vertical sign so that when the pendulum is in a stable position, it obscures the vertical signal from the viewer.
3. Measure the length of the string from the point of suspension to the center of the ball using a meter stick.
4. Displace the pendulum about 5° from its equilibrium position and let it swing back and forth.
5. Record the time of 10 complete oscillations by using the stopwatch.
6. Varying the length of the pendulum and repeating steps 3 to 5 to calculate the periodic time every time, record the result in the table as shown.

Calculations:

Record the results in the form of a table, and then plot a graph with the values of T^2 (s^2) on the X axis and the values of L (cm) on the Y axis. Use it to determine the value of g. Table (1) shows the relationship between L and T^2.

Table (1): Shows the relationship between L and T^2.

L (cm)	T	$\frac{T}{10}$	T^2 (s^2)



$$\text{Slope} = \frac{L_2 - L_1}{T_2^2 - T_1^2} = \frac{\Delta L}{\Delta T^2}$$

$$g = \frac{4\pi^2 L}{T^2} = 39.43 \times \frac{L}{T^2}$$

g = 39.43 x slope

We can calculate the experimental value of g from the graph, while the real value of g is 980, so now we can calculate the Error and Error percentage:

Error = Experimental Value - Theoretical Value

$$\textbf{Error Percentage \%} = \frac{|Error|}{Theoretical\ Value} \times 100\ \%$$

Compare the plot with theoretical calculations.

DISSCUTION

1. Is the pendulum mass affecting on the periodic time? Why? Discuss your results.

2. Is the periodic time dependent on pendulum length? Explain, depending on your result.

3. Is the acceleration dependent on the weight of the pendulum?

4. Pendulum clocks are made to run at the correct rate by adjusting the pendulum's length. Suppose you move from one city to another where the acceleration due to gravity is slightly greater, taking your pendulum clock with you. Will you have to lengthen or shorten the pendulum to keep the correct time, with other factors remaining constant? Explain your answer.