مدونة المناهج السعودية

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الموقع التعليمي لجميع المراحل الدراسية

في المملكة العربية السعودية

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Simple Pendulum Experiment

1- Objective:

- To study the simple harmonic motions.
- To investigate the properties of a simple pendulum.
- To calculate the acceleration due to gravity at place.

2 - Theoretical Background

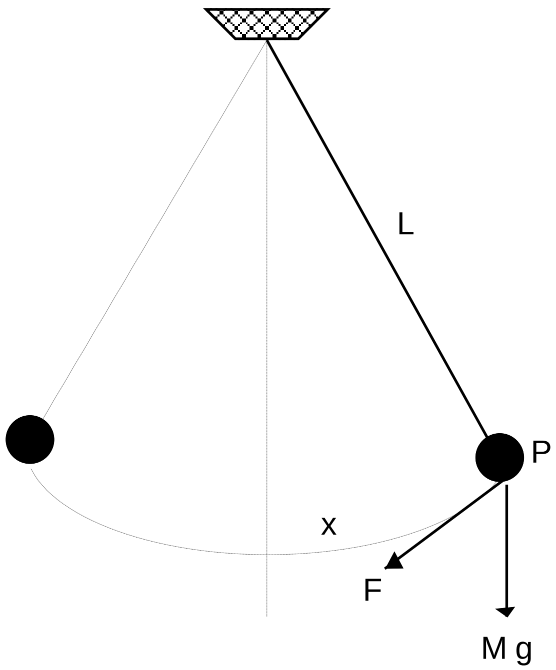


Fig. 1

For a small angular displacement θ the restoring force acting on the point mass at P along the arc (x) is

$$F = -\,M\,g\sin\theta = M\,g\,\theta \;(\text{ since } \theta \text{ is small })$$

$$= M\,g\,\frac{x}{L}$$

The equation of motion of simple Pendulum is

$$-\frac{M\,g\,x}{L} = M\,\ddot{X}$$

$$\text{or}\quad \ddot{X} + \frac{g}{L}\,x = 0$$

The motion is thus simple harmonic, and the periodic time T is

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

and

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

where

M is mass of Pendulum

F is the restoring force acting on the point mass

T is the periodic time

L is The length of the pendulum

g is the acceleration due to gravity at place

Unit of M is kilogram (Kg)

Unit of F is Newton (N)

Unit of T is Second (s)

Unit of L is Meter (m)

Unit of g is m/s^2

3 - Equipment

Small pendulum bob of lead or brass tied to a length (1 m) of cotton threaded through a supporting cork or clamped between two small metal plates. Rotate-stand and clamp, meter ruler, stop-watch.

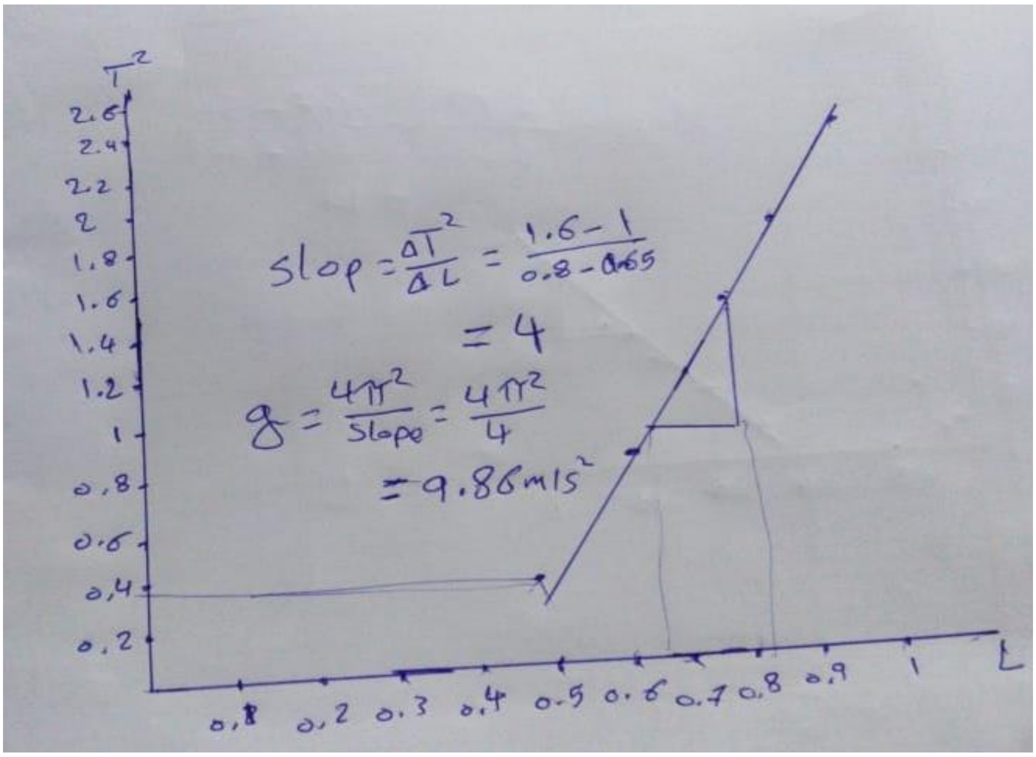
4 - Method

1. The cork is securely clamped in position with the pendulum overhanging the bench.
2. The length of the pendulum (measured from the point where the cotton emerges from the cork to the center of the bob) is adjusted by drawing the cotton through the cork.
3. The free end is secured on the clamp, and the pendulum given a small displacement.
4. The time of 10 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).
5. Repeat the previous steps with different length (L) of the pendulum.
6. Draw a graphic relation between T^2 and L from which the slope of (T^2/L) is obtained to determine g.

5- Results

L (cm)	L (m)	Time for 10 swings (S)	Time (T) (S) per swing	T^2 (S^2)
100	1	15.8	1.58	2.5
90	0.9	14.1	1.41	2
80	0.8	12.6	1.26	1.6
70	0.7	11.4	1.14	1.3
60	0.6	9.5	0.95	0.9
50	0.5	6.4	0.64	0.4

6 -Graph



7- Calculations

$$\text{Slope} = \frac{\Delta T^2}{\Delta L} = \frac{.1.6 - 1}{0.8 - 0.65} = 4$$

slope = 4

$g = \frac{4\pi^2}{\text{slope}} = 9.86\ \text{m/s}^2$

The true value (which used in your experiment), g_T =9.8 m/s^2

Errors Analysis:

$\%\,Error(\text{g}) = \frac{|\text{g}-\text{g}_T|}{\text{g}_T} \times 100\% \ = \frac{9.86-9.8}{9.8} x100 = 6\%$