PROJECT 11

AIM

To study conservation of energy with a 0.2 pendulum.

APPARATUS AND MATERIAL REQUIRED

A heavy spherical, bob with a hook, thread, metre scale, a peg (a pencil or a 15 cm scale), a rigid support and a stand with a clamp.

PRINCIPLE

A simple pendulum of length l, mass m oscillates due to the restoring force expressed as $F = -mg \sin\theta$ for small displacement (less than 15°)

$$\sin\theta = \theta = \frac{x}{l}$$

The force constant k can be written as $k = \frac{mg}{l}$

and maximum kinetic energy $KE = \frac{1}{2}kx^2$

DESCRIPTION

When the oscillation of a simple pendulum is restricted into two parts using a peg P at any point on its string, it becomes a two-length pendulum. During one half of the journey, the bob of mass m, has length l_1 and dispalcement x_1 at position A and for other half it has a length l_2 and displacement x_2. At position B, the bob of mass m has the same kinetic energy. Therefore, energy conservation demands that

$$\frac{1}{2}k_1x_1^2 = \frac{1}{2}k_2x_2^2 \qquad \text{(P 11.1)}$$

or $$\frac{l_1}{l_2} = \frac{x_1^2}{x_2^2}$$

This relationship (Eq. P 11.1) can be verified for different positions of peg P.

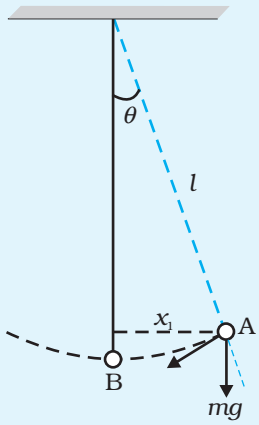

Fig. P 11.1: *A simple pendulum*

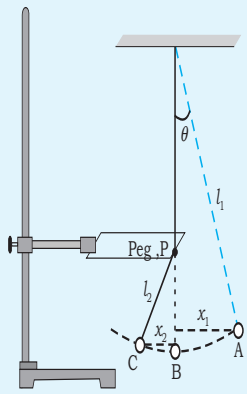

Fig. P 11.2: *A two-length pendulum*

PROCEDURE

1. Setup a simple pendulum using a heavy bob. Release the bob gently from position A and measure the maximum displacement x_1, using a metre scale (Fig. P 11.1).

2. Fix a peg P (a pencil or a scale will do) horizontally to a clamp stand and bring it in contact with the string of the oscillating pendulum. The peg should obstract the motion of the pendulum when its sting is vertical, that is, along its mean position (Fig. P 11.2).

3. The effective length of the pendulum would get reduced for a part of its oscillation after it is held by the peg (Fig. P 11.2).

4. Measure the maximum displacement x_2 using metre scale, when the bob reaches at position C.

5. Repeat the Steps 2 to 4 for different positions of peg P.

6. Record these observations in a table and calculate $\frac{l_1}{l_2}$ and $\frac{x_1^2}{x_2^2}$ for each case.

7. Establish the equality, $\frac{l_1}{l_2} = \frac{x_1^2}{x_2^2}$.

OBSERVATIONS AND CALCULATIONS

Length of a simple pendulum, l = ... cm

S. No.	Displacement of bob		Length of the pendulum		$\frac{l_1}{l_2}$	$\frac{x_1^2}{x_2^2}$
	In position A x_1 (cm)	In position B x_2(cm)	In position A l_1(cm)	In position B l_2(cm)		
1						
2						
3						
4						

RESULT

Relationship $\frac{l}{l} = \frac{x}{x}$, based on the conservation of energy is verified.