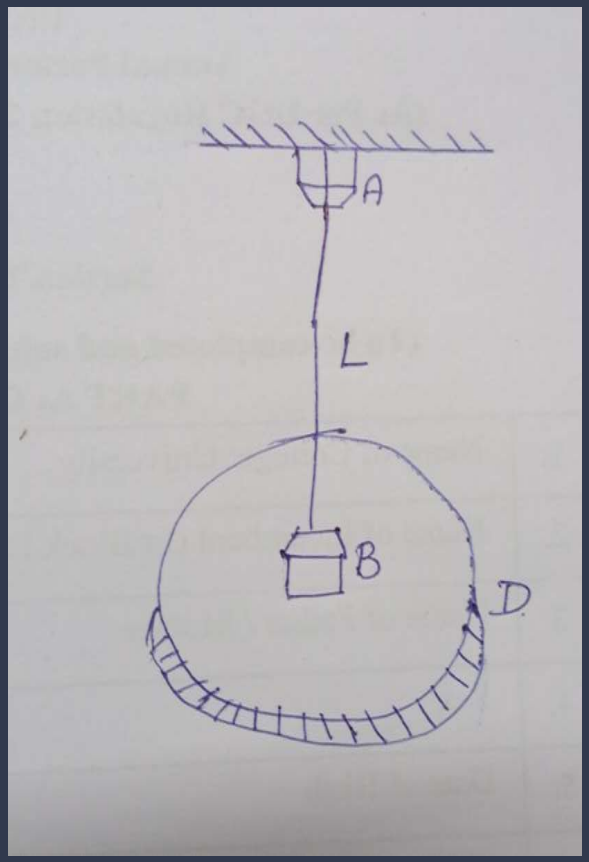
TORSION PENDULUM

Determination of Rigidity modulus of wire

LALY A.S.
ASST. PROFESSOR
DEPT. OF PHYSICS
LITTLE FLOWER COLLEGE,
GURUVAYUR

EXPERIMENTAL SETUP



A torsion pendulum consists of a rigid circular metallic disc of mass M,radius R and moment of inertia I.

The wire AB of length L and radius r is fixed at the end A and the lower end B is clamped to the centre of the disc D.

The suspended disc rotated slightly to one side,the wire gets twisted.

When the disc is released ,it starts torsional oscillations

At any instant ,the deflecting couple is equal to restoring couple.

$$I\alpha = -C\theta$$

I is the Moment of inertia and ∝is the angular acceleration,C couple per unit twist and θis the angle of twist.

The negative sign shows that the restoring couple is in the opposite direction of deflecting couple.

$$I\frac{d^2\theta}{dt^2} = -C\theta$$

$$\frac{d^2\theta}{dt^2} = -\frac{C}{I}\theta$$

$$\frac{d^2\theta}{dt^2} + \frac{C}{I}\theta = 0$$

This is the equation of a simple harmonic motion.
The general equation of a simple harmonic motion is

$$\frac{d^2\theta}{dt^2} + \omega^2\theta = 0$$

Therefore

$$\omega^2 = \frac{C}{I}, \omega = \sqrt{\frac{C}{I}}$$

$$\text{The period of oscillation } T = \frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{\frac{C}{I}}} = 2\pi\sqrt{\frac{I}{C}}$$

$$\text{We have } C = \frac{\pi n r^4}{2L}$$

$$T = 2\pi \sqrt{\frac{I}{\frac{\pi n r^4}{2L}}} = 2\pi \sqrt{\frac{2LI}{\pi n r^4}}$$

$$T^2 = 4\pi^2 \frac{2LI}{\pi n r^4} = \frac{8\pi I L}{r^4 n}$$

$$n = \frac{8\pi I}{r^4} \frac{L}{T^2}$$

$$\text{The moment of inertia of the disc, } I = \frac{MR^2}{2}$$

$$n = \frac{4\pi MR^2}{r^4} \frac{L}{T^2}$$

- The value of the wire should be measured accurately because in the equation it occurs in the fourth power of radius of the wire.

THANKYOU....