DI Physics Hons.

Paper-I:

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Determination of modulus of rigidity (Dynamical Method):

The apparatus consists of a long thin specimen wire, whose one end is attached to a rigid support. To the other free end of the wire, a

heavy disc is fixed in the centre. The disc is turned in the horizontal plane and then released, it executes torsional vibrations, whose time period is given by

$$T = 2\pi\sqrt{\frac{I}{C}} = 2\pi\sqrt{\frac{I \cdot 2l}{n\pi r^4}},$$

where n is the modulus of rigidity of the material of the wire, r its radius and l its length.

If R is the radius of disc and M its mass, then the moment of inertia I of the disc about the wire as axis is $I = MR^2/2$.

Thus, $$T = 2\pi\sqrt{\frac{MR^2}{2} \cdot \frac{2l}{n\pi r^4}}$$

$$\therefore \quad n = \frac{4\pi l M R^2}{T^2 r^4}.$$

The time period T is measured with the help of a stop-watch. The radius r of wire occurs in fourth power in the formula; hence it is measured accurately by a screw gauge.

at several places of the wire in two perpendicular directions and mean value of $\underline{\underline{n}}$ is calculated. The length of the wire is measured by a metre scale. Thus, by substituting the values of various quantities in the above formula, $\underline{\underline{n}}$ for the material of the wire can be calculated.

Torsional pendulum suffers with two defects:

(i) In deriving the expression for $\underline{\underline{n}}$, it has been already used that the restoring couple per unit twist, C, due to torsional reaction of the wire remains constant, which is not perfectly true, because with a change of load at the end of wire, the radius of the wire alters.

(ii) The moment of inertia of the body is calculated from its geometrical dimensions on the assumption of the uniform density of its material throughout, but it is not so in practice.