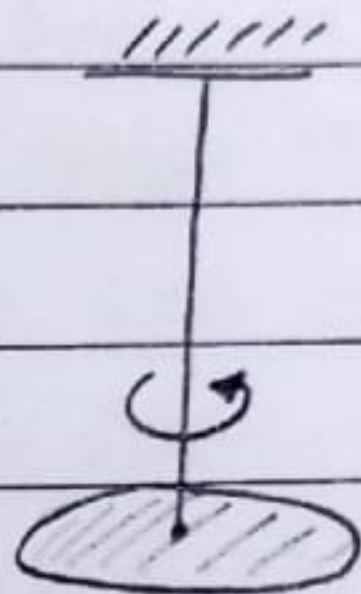


**53.** A uniform disc of mass  $m$  and radius  $r$  is suspended through a wire attached to its centre. If the time period of the torsional oscillations be  $T$ , what is the torsional constant of the wire?

SOLUTION:

\* Torsion: Wire is rotated/  
torsioned

\* Remember:



Torque in this case is

always  $\propto$  angle wire is rotated

i.e.  $\tau = k\theta$  where  $k \equiv$  torsional constant

so,

$$\tau = -I\alpha_{\text{restoring}} \Rightarrow k\theta = -I\alpha$$

$$\Rightarrow \alpha = -\left(\frac{k}{I}\right)\theta$$

where

$$I = \frac{m r^2}{2}$$

(Disc)

$$\text{so, we get } \omega^2 = \frac{k}{I} \Rightarrow \omega^2 = \frac{2k}{m r^2}$$

$$\text{so, } T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{m r^2}{2k}}$$

$$\text{so, } T^2 = \frac{4\pi^2 m r^2}{2k} \Rightarrow \boxed{k = \frac{2\pi^2 m r^2}{T^2}}$$