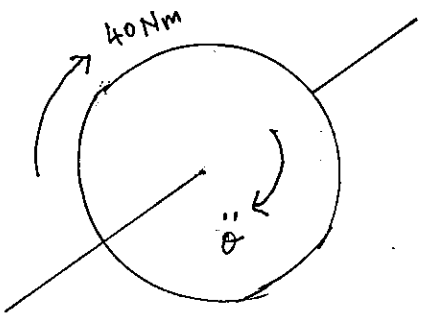
Lesson 2

Flywheel Problems

1. The MI of a flywheel about its axis is 20 kgm². When it is stationary, a constant torque of 40 Nm is applied to the flywheel. Find its kinetic energy after three seconds assuming the flywheel has smooth bearings. (A flywheel is either a circular disc or a circular rim which can rotate through its centre perpendicular to the flywheel)

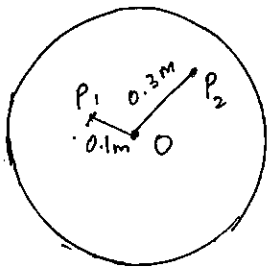
$\omega = \omega_0 + \alpha t$
$= 2(3)$
$= 6$



$T = I\alpha$
$40 = 20\alpha$
$\alpha = 2$

$KE = \frac{1}{2} I\omega^2$
$= \frac{1}{2}(20)(6)^2$
$= 360J$

2. A uniform circular disc has mass 1 kg and radius 0.5m. Particles P_1 and P_2 of mass 0.2 kg and 0.5kg respectively are attached to the disc at distances 0.1m and 0.3m respectively from the centre O of the disc. The disc is rotating in a horizontal plane about a smooth vertical axis through its centre O. Calculate the kinetic energy of the system when the disc is rotating at 5 rads⁻¹.



MI disc $= \frac{1}{2}(1)(0.5)^2 = 0.125$
$M_1 = (0.2)(0.1)^2 = 0.002$
$M_2 = (0.5)(0.3)^2 = 0.045$
Total MI $= 0.172$
$KE = \frac{1}{2}(0.172)(5)^2 = 2.15J$

3. A flywheel can rotate about a smooth horizontal axis passing through its centre of mass, and its MI about this axis is 25 kgm². The flywheel is rotating with a constant angular speed of 3 rads⁻¹ when a constant torque of magnitude 5 Nm is applied to it so that it comes to rest. Find the time taken to stop and the total angle the flywheel turns through in that time.

$5 = 25\alpha \quad \alpha = \frac{1}{5}$

$0 = 3 + \left(-\frac{1}{5}\right)t \quad t = 15s$

$\theta = (3)(15) + \frac{1}{2}\left(-\frac{1}{5}\right)(15)^2$
$= 22.5 rad$