Numericals rotational motion

Q1.	A torque of 20 N-m is applied on a wheel initially at rest. Calculate the angular momentum of the body.
	$\tau = \frac{dL}{dt}$ $= \frac{L_2 - L_1}{t}$ $20 = \frac{L_2 - 0}{3}$ $L_2 = 60kgm^2s^{-1}$
Q2.	A flywheel rotating at 420 rpm slows down at a constant rate of 2 rad.s^{-2}. In how much time will it stop?
	$\nu_1 = 420rpm = \frac{420}{60}rps = 7rps$ $\nu_2 = 0$ $\alpha = -2rad.s^{-2}$ $Now, \quad \omega_2 = \omega_1 + \alpha t$ $2\pi\nu_2 = 2\pi\nu_1 + \alpha t$ $0 = 2\times\frac{22}{7}\times 7 - 2t$ $0 = 44 - 2t$ $t = 22s$
Q3.	An energy of 484J is spent in increasing the speed of a flywheel from 60 rpm to 360 rpm. Calculate the moment of inertia of flywheel.
	$W = 484J$ $\omega_1 = 60rpm = \frac{60}{60}\times 2\pi rad.s^{-1} = 2\pi rad.s^{-1}$ $\omega_2 = 60rpm = \frac{360}{60}\times 2\pi rad.s^{-1} = 12\pi rad.s^{-1}$ $W = E_2 - E_1 = \frac{1}{2}I\omega_2^2 - \frac{1}{2}I\omega_1^2 = \frac{1}{2}I\left(\omega_2^2 - \omega_1^2\right)$ $484 = \frac{1}{2}I\left((12\pi)^2 - (2\pi)^2\right)$ $I = \frac{484\times 49}{70\times 484} = 0.7kgm^2$
Q4.	What constant torque should be applied to a disc of mass 10kg and diameter 50 cm so that it acquires an angular velocity of 2π rad.s^{-1} in 4s? The disc is initially at rest and rotates about an axis through the centre of the disc and in a plane perpendicular to the disc.

	$M = 10kg$ $R = \frac{50}{2} = 25cm = 0.25m$ $t = 4s$ $\omega_2 = 2\pi \ rad.s^{-1}, \ \ \omega_1 = 0$ $\alpha = \frac{\omega_2 - \omega_1}{t} = \frac{2\pi - 0}{4} = \frac{3.14}{2} = 1.57 \ rad.s^{-2}$ $I = \frac{1}{2}MR^2 = \frac{1}{2} \times 10 \times 0.25 \times 0.25 = 0.3125kgm^2$ $\tau = I\alpha = 0.3125 \times 1.57 = 0.49N - m$
Q5.	A disc of radius 0.5 m is rotating about an axis passing through its centre and perpendicular to its plane. A tangential force of 2000 N is applied to bring the disc to rest in 2s. Calculate its angular momentum.
	$r = 0.5m, \quad F = 2000N$ $t = 2s, \quad L_2 = 0$ $\tau = -Fr = -2000 \times 0.5 = -1000N - m$ $\tau = \frac{dL}{dt}$ $= \frac{L_2 - L_1}{t}$ $-1000 = \frac{0 - L_1}{2}$ $L_1 = 2000kgm^2s^{-1}$