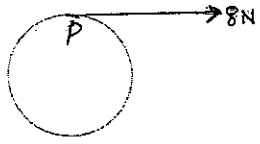
Exercise 2

1. A flywheel of radius 0.5 m is free to rotate smoothly about an axis through its centre. The moment of inertia of the flywheel about this axis is 2.4 kg m^2. A light rope is attached at one end to a point P on the rim of the wheel and the rope is wrapped once round the flywheel so that the free end lies along the tangent to the flywheel at P. If the free end is pulled with a constant force of 8 N so as to unwrap the string, find the angular speed of the wheel when it has rotated through one half of a revolution.



[3.24 rad s^{-1}]

2. A uniform circular disc of radius 0.2 m and mass 0.5 kg is free to rotate in a horizontal plane about a smooth, fixed, vertical axis through its centre. A horizontal force of constant magnitude is applied at a point on the rim of the disc in the direction of a tangent to the disc. The disc rotates with angular acceleration 5 rad s^{-2}. Calculate the magnitude of the force. [0.25 N]

3. An electric motor drives a flywheel by exerting a torque of 80 N m. As a result the angular velocity of the flywheel is reduced from 9 rad s^{-1} to 3 rad s^{-1} in 12 seconds Assuming that there is no resistance to motion, find the moment of inertia of the flywheel. [160 kg m^2]

4. A uniform rod of length $2a$ and mass m is free to rotate in a horizontal plane about a fixed vertical axis through one end. A horizontal force of constant magnitude 5mg is applied to its free end at right angles to the rod. Find the magnitude of the resulting angular acceleration. $[\frac{15g}{2a}]$

5. A uniform cylinder of mass 2 kg and radius 5 cm can rotate about its axis. A thread is wound round the cylinder and pulled with a force of 2 newtons tangentially to the cylinder at right angles to the axis. The motion is opposed by a frictional couple of moment 4 N cm. Find the angular acceleration of the cylinder. [24 rad s^{-2}]

6. A uniform, square lamina, of mass 0.5 kg and side length 60 cm, is mounted with its plane horizontal on a vertical axis. The lamina is rotating at a rate of 4rad s^{-1} when a torque of magnitude 6Nm is applied for 2s in the same sense as the lamina's rotation. Find the angular speed of the lamina at the end of this time. [404 rad s^{-1}]

7. A uniform cylinder, of radius 0.5 m and mass 20 kg, is rotating about its geometrical axis at a rate of 8rads^{-1}. Find the magnitude of the constant torque needed to double the kinetic energy of the cylinder in 5 s. $[4(\sqrt{2}-1)\text{Nm}]$

8. A uniform flywheel, of radius 0.4 m and mass 60 kg, is rotating at a rate of 300 rev min^{-1}. A brake pad is pressed against the rim of the wheel and its speed is halved in 10 s. If the coefficient of friction between the wheel and the brake pad is 0.8, find the normal force with which the pad is pressed onto the wheel. [7.5 π N]