**Example 7.15** A cord of negligible mass is wound round the rim of a fly wheel of mass 20 kg and radius 20 cm. A steady pull of 25 N is applied on the cord as shown in Fig. 7.35. The flywheel is mounted on a horizontal axle with frictionless bearings.

(a) Compute the angular acceleration of the wheel.

(b) Find the work done by the pull, when 2m of the cord is unwound.

(c) Find also the kinetic energy of the wheel at this point. Assume that the wheel starts from rest.

(d) Compare answers to parts (b) and (c).

***Answer***

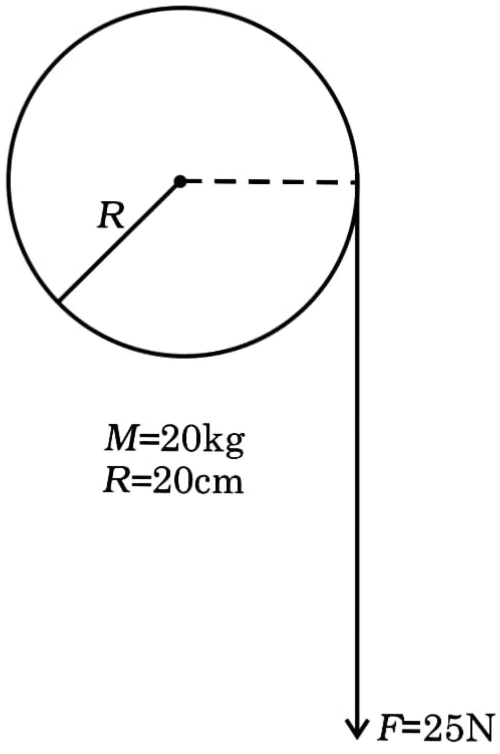


**Fig. 7.35**

(a) We use $I\alpha = \tau$

the torque $\tau = F R$

$= 25 \times 0.20$ Nm (as $R = 0.20$m)

$= 5.0$ Nm

$I$ = Moment of inertia of flywheel about its axis $= \frac{MR^2}{2}$

$$= \frac{20.0 \times (0.2)^2}{2} = 0.4 \text{ kg m}^2$$

$\alpha$ = angular acceleration

$= 5.0 \text{ N m}/0.4 \text{ kg m}^2 = 12.5 \text{ s}^{-2}$

(b) Work done by the pull unwinding 2m of the cord

$= 25 \text{ N} \times 2\text{m} = 50 \text{ J}$

(c) Let $\omega$ be the final angular velocity. The kinetic energy gained $= \frac{1}{2} I\omega^2$,

since the wheel starts from rest. Now,

$$\omega^2 = \omega_0^2 + 2\alpha\theta, \quad \omega_0 = 0$$

The angular displacement $\theta$ = length of unwound string / radius of wheel

$= 2\text{m}/0.2 \text{ m} = 10 \text{ rad}$

$$\omega^2 = 2 \times 12.5 \times 10.0 = 250 (\text{rad/s})^2$$

$$\therefore \text{ K.E. gained} = \frac{1}{2} \times 0.4 \times 250 = 50 \text{ J}$$

(d) The answers are the same, i.e. the kinetic energy gained by the wheel = work done by the force. There is no loss of energy due to friction.