Example: Moment of inertia of a ring is 3 kg-m^2. It is rotated for 20 sec by a torque of 6N-m. Calculate the work done. [Ans: 2400 J]

$I = 3\,kg\,m^2$, $t = 20\,sec$

$\tau = 6\,Nm$

$m \to I$
$v \to \omega$
$a \to \alpha$
$p \to L$
$F \to \tau$

$x \to \theta$, $\Delta x \to \Delta\theta$

$\Delta W = F \cdot \Delta x \longrightarrow \boxed{\Delta W_{rot} = \tau \cdot \Delta\theta}$

$dW_{rot} = \tau \cdot d\theta$

$W = \int_{x_1}^{x_2} F \cdot dx \longrightarrow \boxed{W_{rot} = \int_{\theta_1}^{\theta_2} \tau \cdot d\theta}$

Work energy Theorm

$W_{total} = K_f - K_i \longrightarrow W_{rot} = K_{f\,rot} - K_{i\,rot}$

$W = K_f - K_i$

$K = \frac{1}{2} I \omega^2$

$$\boxed{W_{rot} = \frac{1}{2} I_f \omega_f^2 - \frac{1}{2} I_i \omega_i^2}$$

Given:
$\omega_i = 0$, $\omega_f = ?$, $I = 3\,kgm^2$
$\tau = 6\,Nm$, $t = 20\,sec$, $W_{rot} = ?$

$\because \tau = I\alpha \Rightarrow \alpha = \frac{\tau}{I} \Rightarrow \alpha = \frac{6}{3} \Rightarrow \alpha = 2\,rad/s^2$