

Q15: A pulley of radius 2 m is rotated about its axis by a force $F = 20t - 5t^2$ newton (where t is measured in seconds) applied tangentially. If the moment of inertia of the pulley about its axis of rotation is 10 kgm^2 , the number of rotations made by the pulley before its direction of motion it reversed, is

- (a) more than 6 but less than 9
- (b) more than 9
- (c) less than 3
- (d) more than 3 but less than 6

Solution

Torque is given by $\tau = FR$

Or $\alpha = FR/I$

Given $F = 20t - 5t^2$

$R = 2\text{m}$,

$I = 10 \text{ kgm}^2$

$\alpha = [(20t - 5t^2) \times 2]/10$

$\alpha = 4t - t^2$

$\omega = \int_0^t \alpha dt = 2t^2 - t^3/3$

at $\omega = 0 \Rightarrow 2t^2 - t^3/3 = 0$

$t^3 = 6t^2$

$t = 6$

$\theta = \int_0^6 \omega dt = \int_0^6 (2t^2 - t^3/3) dt$

$\theta = 36/2\pi < 6$

Answers: (d) more than 3 but less than 6