

1-2 A flywheel with a moment of inertia of $4 \text{ kg}\cdot\text{m}^2$ is initially at rest. If a torque of $5 \text{ N}\cdot\text{m}$ (counterclockwise) is suddenly applied to the flywheel, what will be the speed of the flywheel after 5 s ? Express that speed in both radians per second and revolutions per minute.

➤ First, find the angular acceleration.

Given: $J = 4 \text{ kg}\cdot\text{m}^2$ & $\tau = 5 \text{ N}\cdot\text{m}$.

$$\text{Per (1-8), } \tau = J\alpha \Rightarrow \alpha = \tau / J = 5/4 \Rightarrow \underline{\alpha = 1.25 \text{ rad/s}^2}.$$

$$\text{From (1-5), } \alpha = \frac{d\omega}{dt} \Rightarrow \omega = \int_0^t \alpha dt = \alpha t \Rightarrow \omega = 1.25(5) \Rightarrow \underline{\omega = 6.25 \text{ rad/s}}.$$

$$n_m = \omega (1 \text{ rev}/2\pi \text{ rad}) (60 \text{ s}/1 \text{ min}) = 6.25 \text{ rad/s} (1 \text{ rev}/2\pi \text{ rad}) (60 \text{ s}/1 \text{ min}) \\ \Rightarrow \underline{n_m = 59.683 \text{ r/min} = 59.683 \text{ rpm}}.$$