

Chapter 10 Problem 18 †

Given

$$\alpha = 0.52 \text{ rad/s}^2$$

Solution

a) Find the time to reach 3600 *rpm* from rest.

Convert the angular velocity into *rad/s*.

$$\omega = \frac{3600 \text{ rev}}{\text{min}} \left(\frac{1 \text{ min}}{60 \text{ s}} \right) \left(\frac{2\pi \text{ rad}}{1 \text{ rev}} \right) = 377 \text{ rad/s}$$

Now calculate the time for startup.

$$\bar{\alpha} = \frac{\Delta\omega}{\Delta t}$$

Solving for t gives

$$\Delta t = \frac{\Delta\omega}{\alpha} = \frac{(377 \text{ rad/s} - 0)}{0.52 \text{ rad/s}^2} = 725 \text{ s}$$

$$\Delta t = 12.1 \text{ min}$$

b) Find the number of revolutions during startup.

Since the initial angular velocity is zero,

$$\Delta\theta = \frac{1}{2}\alpha t^2 = \frac{1}{2}(0.52 \text{ rad/s}^2)(725 \text{ s})^2$$

$$\Delta\theta = 1.37 \times 10^5 \text{ rad}$$

Converting to revolutions gives

$$\Delta\theta = (1.37 \times 10^5 \text{ rad}) \left(\frac{1 \text{ rev}}{2\pi \text{ rad}} \right) = 2.18 \times 10^4 \text{ rev}$$

†Problem from Essential University Physics, Wolfson