Chapter 10 Problem 19 †

Given
$\alpha = 0.52\ rad/s^2$

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

Convert the angular velocity into rad/s.

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

Now calculate the time for startup.

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

Solving for t gives

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

$$\Delta t = 12.1\ min$$

b) Find the number of revolutions during startup.

Since the initial angular velocity is zero,

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

$$\Delta\theta = 1.37 \times 10^5\ rad$$

Converting to revolutions gives

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

†Problem from Essential University Physics, Wolfson