Chapter 10 — Problem 40

$\omega_0 = 600 \frac{rev}{min}$

$\omega_f = 400 \frac{rev}{min}$

$\Delta\theta = 40\ rev$

Convert from revolutions to radians

$1\ rev = 2\pi\ rad$
$1\ min = 60\ s$

$$\omega_0 = 600 \frac{rev}{min}\left(\frac{2\pi\ rad}{1\ rev}\right)\left(\frac{1\ min}{60\ s}\right) = 62.8 \frac{rad}{s}$$

$$\omega_f = 400 \frac{rev}{min}\left(\frac{2\pi\ rad}{1\ rev}\right)\left(\frac{1\ min}{60\ s}\right) = 41.9\ rad/s$$

$$\Delta\theta = 40\ rev\left(\frac{2\pi\ rad}{1\ rev}\right) = 251\ rad$$

a) Find the angular acceleration

Using the 4th Kinematic equation

$$\omega_f^2 - \omega_0^2 = 2\alpha\Delta\theta \longrightarrow \alpha = \frac{\omega_f^2 - \omega_0^2}{2\Delta\theta}$$

$$\alpha = \frac{(41.9\ rad/s)^2 - (62.8\ rad/s)^2}{2 \cdot 251\ rad}$$

$$\boxed{\alpha = ~~-8.72~~\ rad/s^2}$$

-4.36 rad/s^2

b) How much time elapses during the 40 revolutions?

Using the first kinematic equation gives

$$\omega_f = \omega_0 + \alpha t$$

$$t = \frac{\omega_f - \omega_0}{\alpha} = \frac{41.9\ rad/s - 62.8\ rad/s}{~~-8.72~~\ rad/s^2} \quad -4.36$$

$$\boxed{t = ~~2.40~~\ s}$$

4.80 s