## Chapter 11 Problem 14 †

### Given

$\omega_0 = 45\hat{j}\frac{rev}{min}\left(\frac{2\pi\ rad}{1\ rev}\right)\left(\frac{1\ min}{60\ s}\right) = 4.71\hat{j}\ rad/s$
$\omega_f = 60\hat{j}\frac{rev}{min}\left(\frac{2\pi\ rad}{1\ rev}\right)\left(\frac{1\ min}{60\ s}\right) = 6.28\hat{i}\ rad/s$
$t = 15\ s$

### Solution

a) Find the magnitude of the average angular acceleration.

The average angular acceleration is

$$\vec{\bar{\alpha}} = \frac{\Delta\vec{\omega}}{\Delta t} = \frac{\vec{\omega}_f - \vec{\omega}_0}{\Delta t} = \frac{6.28\hat{i} - 4.71\hat{j}}{15}\ rad/s^2$$

$$\vec{\bar{\alpha}} = \{0.419\ \hat{i} - 0.314\hat{j}\}\ rad/s^2$$

The magnitude of this angular acceleration is

$$\alpha = \sqrt{\alpha_x^2 + \alpha_y^2} = \sqrt{(0.419\ rad/s^2)^2 + (-0.314\ rad/s^2)^2}$$

$$\alpha = 0.524\ rad/s^2$$

b) Find the angle of this angular acceleration with respect to horizontal.

The two components of the angular acceleration give an angle of

$$\theta = tan^{-1}\left(\frac{\alpha_y}{\alpha_x}\right) = tan^{-1}\left(\frac{-0.314}{0.419}\right) = -36.8^\circ$$

†Problem from Essential University Physics, Wolfson