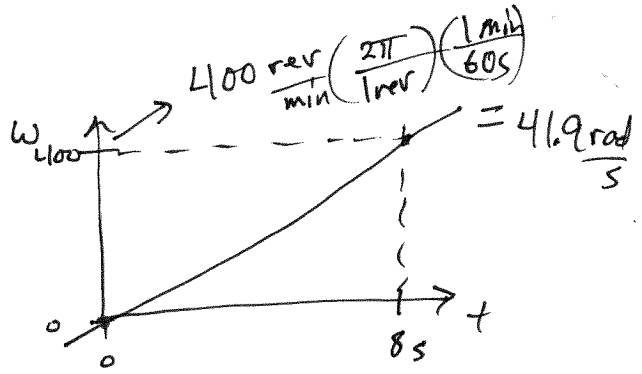
Chapter 10

Problem 44



a) What is the angle through which the blades rotate in 8 seconds?

From the graph the velocity changes linearly with time. Therefore $\omega = m \cdot t$

The slope, m, is $m = \frac{rise}{run} = \frac{400\ rev/min}{8\ s}$

$m = 50\ rev/s \cdot min$

These units are not acceptable convert everything into radians from rev and ~~min~~ seconds from min.

$$m = 50\ \frac{rev}{s \cdot min}\left(\frac{2\pi\ rad}{1\,rev}\right)\left(\frac{1\,min}{60\,s}\right) = 5.24\ rad/s^2$$

If $\omega = \left(5.24\ \frac{rad}{s^2}\right) \cdot t$

Then $\frac{d\theta}{dt} = \omega \rightarrow d\theta = \omega\, dt \rightarrow \int_0^\theta d\theta = \int_0^t \omega\, dt$

$$\theta = \int_0^t 5.24 \cdot t\, dt$$

$$= \frac{5.24\, t^2}{2}$$

If $\theta = \frac{5.24}{2} t^2 = 2.62\, t^2$

Then $\theta(8s) = 2.62(8)^2 = \boxed{168\ rad}$

b) use the Kinematic equation

$\omega_f^2 - \omega_0^2 = 2\alpha\Delta\theta$

$\alpha = m = 5.24\ rad/s^2$

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

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

$\omega_f = 41.9\ rad/s$

$$\frac{(41.9\ rad/s)^2 - (0)^2}{2(5.24\ rad/s^2)} = \boxed{168\ rad}$$