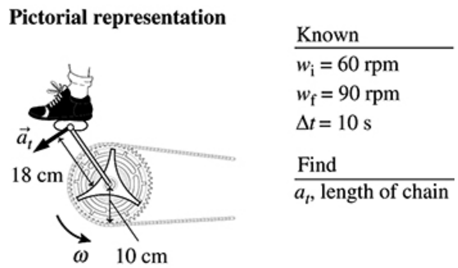
12.3. Model: Assume constant angular acceleration.

Visualize:



Solve: **(a)** Since $a_t = r\alpha$, find α first. With $90 \text{ rpm} = 9.43 \text{ rad/s}$ and $60 \text{ rpm} = 6.28 \text{ rad/s}$,

$$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{9.43 \text{ rad} - 6.28 \text{ rad/s}}{10 \text{ s}} = 0.314 \text{ rad/s}^2$$

The angular acceleration of the sprocket and pedal are the same. So

$$a_t = r\alpha = (0.18 \text{ m})(0.314 \text{ rad/s}^2) = 0.057 \text{ m/s}^2$$

(b) The length of chain that passes over the sprocket during this time is $L = r\Delta\theta$. Find $\Delta\theta$:

$$\theta_f = \theta_i + \omega_i \Delta t + \frac{1}{2}\alpha(\Delta t)^2$$

$$\theta_f - \theta_i = \Delta\theta = (6.28 \text{ rad/s})(10 \text{ s}) + \frac{1}{2}(0.314 \text{ rad/s}^2)(10 \text{ s})^2 = 78.5 \text{ rad}$$

The length of chain which has passed over the top of the sprocket is

$$L = (0.10 \text{ m})(78.5 \text{ rad}) = 7.9 \text{ m}$$