$W_A = 8^{LB}$, $r_A = 3^{IN} = \frac{1}{4}\,ft$, $r_B = 4.5^{IN} = \frac{3}{8}\,ft$

$M = \left(20^{IN\cdot LB}\right)\left(\frac{ft}{12^{IN}}\right) = \frac{5}{3}\,ft\text{-}LB$, $\omega_1 = 0$

$\omega_2 = \left(960\,\frac{REV}{MIN}\right)\left(\frac{MIN}{60\,s}\right)\left(\frac{2\pi}{REV}\right) = 32\pi\,\frac{RAD}{s}$ FIND $t$

$m_A = \rho V_A$, $\rho = \frac{m_A}{V_A} = \frac{W_A}{g V_A}$

$V_A = \pi r_A^2 H$

$\rho = \frac{W_A}{g}\cdot\frac{1}{\pi r_A^2 H}$

$W_B = m_B g = \rho V_B g = \left(\frac{W_A}{\pi r_A^2 H g}\right)\cdot(\pi r_B^2 H)g$

$W_B = \left(\frac{r_B}{r_A}\right)^2 W_A = \left(\frac{3/8\,ft}{1/4\,ft}\right)^2\cdot(8^{LB}) = 18^{LB}$

PRINCIPLE OF IMPULSE AND MOMENTUM:


ANGULAR MOMENTUM ABOUT A ↻:

$I\omega_1^{\,0} + Mt = I\omega_2$

$$t = \frac{I\omega_2}{M}$$

$$I = I_A + I_B = \frac{1}{2} m_A r_A^2 + \frac{1}{2} m_B r_B^2 = \frac{1}{2}\left(\frac{W_A}{g}\right) r_A^2 + \frac{1}{2}\left(\frac{W_B}{g}\right) r_B^2$$

$$t = \frac{\omega_2}{M}\left[\frac{1}{2}\left(\frac{W_A}{g}\right) r_A^2 + \frac{1}{2}\left(\frac{W_B}{g}\right) r_B^2\right]$$

$$t = \frac{\omega_2}{2gM}\left(W_A r_A^2 + W_B r_B^2\right)$$

$$t = \frac{\left(32\pi \frac{RAD}{s}\right)}{2\left(32.2 \frac{ft}{s^2}\right)\left(\frac{5}{3}\ ft\text{-}lb\right)} \cdot \left[\left(8\,lb\right)\left(\frac{1}{4}\ ft\right)^2 + \left(18\,lb\right)\left(\frac{3}{8}\ ft\right)^2\right]$$

$$\boxed{t = 2.839^{s}}$$