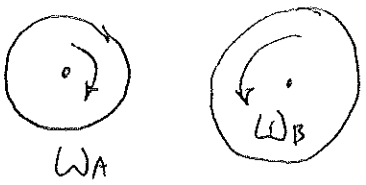
PROB. 15-33

$\omega_{A,0} = (500 \frac{REV}{MIN})(\frac{MIN}{60\,s})(\frac{2\pi}{REV}) = 52.36 \frac{RAD}{s}$



$\omega_{B,0} = 0$, $\omega_{A,F} = 0$ WHEN $t = 60^s$

$\alpha_B = 2.5 \frac{RAD}{s^2}$

a) FIND TIME FOR NO SLIPPAGE

FOR DISK A, $\omega = \omega_0 + \alpha t$

$\alpha_A = \frac{\omega_{A,F} - \omega_{A,0}}{t} = \frac{(0) - (52.36)\frac{RAD}{s}}{(60^s)} = -0.8727 \frac{RAD}{s^2}$

FOR NO SLIPPAGE, $v = r\omega = r_A \omega_{A,F} = r_B \omega_{B,F}$

$\omega_{B,F} = (\frac{r_A}{r_B})\omega_{A,F}$

$\omega_{A,F} = \omega_{A,0} + \alpha_A t$, $\omega_{B,F} = \omega_{B,0} + \alpha_B t \Rightarrow t = \frac{\omega_{B,F}}{\alpha_B}$

$\omega_{A,F} = \omega_{A,0} + \alpha_A(\frac{\omega_{B,F}}{\alpha_B}) = \omega_{A,0} + (\frac{\alpha_A}{\alpha_B})(\frac{r_A}{r_B})\omega_{A,F}$

$\omega_{A,F}\left[1 - (\frac{\alpha_A}{\alpha_B})(\frac{r_A}{r_B})\right] = \omega_{A,0}$

$\omega_{A,F} = \omega_{A,0}\left[1 - (\frac{\alpha_A}{\alpha_B})(\frac{r_A}{r_B})\right]^{-1}$

$\omega_{A,F} = (52.36 \frac{RAD}{s})\left[1 - (\frac{-0.8727}{2.5})(\frac{3}{5})\right]^{-1} = 43.29 \frac{RAD}{s}$

$t = \frac{\omega_{A,F} - \omega_{A,0}}{\alpha_A} = \frac{(43.29) - (52.36)\frac{RAD}{s}}{(-0.8727 \frac{RAD}{s^2})} = \boxed{10.39^s}$

$\omega_{B,F} = \alpha_B t = (2.5 \frac{RAD}{s^2})(10.39^s) = (25.97 \frac{RAD}{s})(\frac{60}{2\pi}) = \boxed{248.0\ RPM}$

$\omega_{A,F} = (43.29 \frac{RAD}{s})(\frac{60}{2\pi}) = \boxed{413.4\ RPM}$