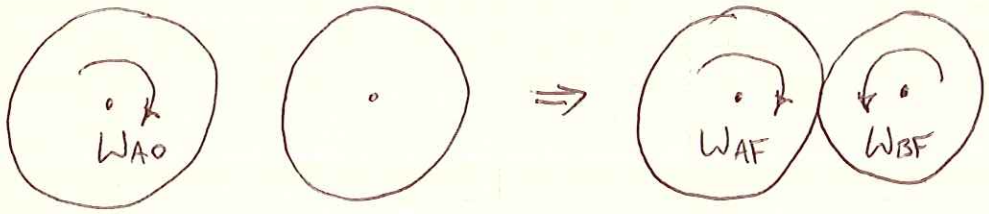
PROB. 16-39

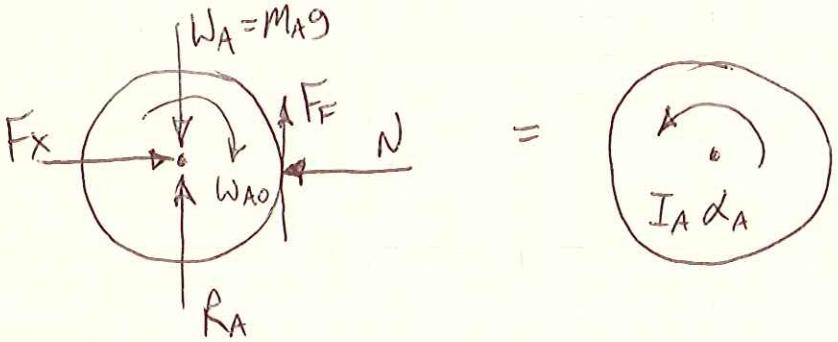
$m_A = 6^{kg}$, $v_{A,0} = \left(360 \frac{REV}{MIN}\right)\left(\frac{MIN}{60\,s}\right)\left(\frac{2\pi}{REV}\right) = 37.7 \frac{RAD}{s}$ ↻

$m_B = 3^{kg}$, $v_{B,0} = 0$, $F_x = 20^N$, $\mu_K = 0.15$,

$r_A = 0.08^m$, $r_B = 0.06^m$, FIND α_A, α_B, W_{AF}, W_{BF}



DISK A:

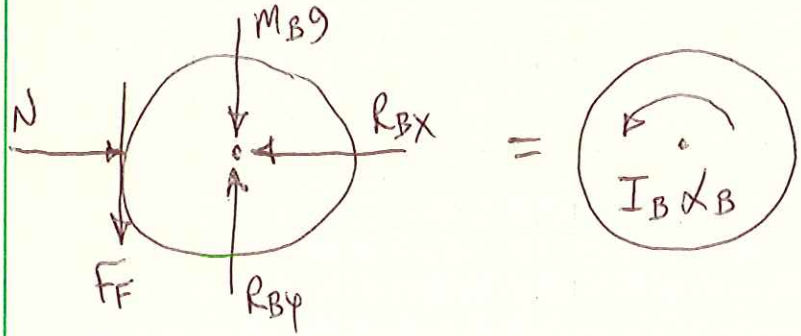


$\Sigma \vec{M}_G = \Sigma (\vec{M}_G)_{EFF} : +\circlearrowleft \quad r_A F_F = I_A \alpha_A \Rightarrow \alpha_A = \frac{r_A F_F}{I_A}$

$F_F = \mu N = \mu F_x$, $I_A = \frac{1}{2} m_A r_A^2$

$$\alpha_A = \frac{r_A(\mu F_x)}{\frac{1}{2} m_A r_A^2} = \frac{2\mu F_x}{m_A r_A} = \frac{2(0.15)(20^N)}{(6^{kg})(0.08^m)} = 12.5 \frac{RAD}{s^2} \circlearrowleft$$

DISK B:



PROB. 16-39 CONT.

$\Sigma \vec{M}_G = \Sigma (\vec{M}_G)_{EFF}$ $+\circlearrowleft$: $r_B F_F = I_B \alpha_B$ ~~$\alpha_B = r_B F_F$~~

$F_F = \mu N = \mu F_X$, $I_B = \frac{1}{2} m_B r_B^2$

$$\alpha_B = \frac{r_B F_F}{I_B} = \frac{r_B (\mu F_X)}{\frac{1}{2} m_B r_B^2} = \frac{2 \mu F_X}{m_B r_B} = \frac{2(0.15)(20^N)}{(3^{kg})(0.06^m)}$$

$\boxed{\alpha_B = 33.33 \frac{RAD}{s^2} \circlearrowright}$

FIND W_{AF}, W_{BF}:

WHEELS STOP SLIPPING WHEN $v_{At} = v_{Bt}$

$-r_A W_{AF} = r_B W_{BF}$ (NEGATIVE SIGN SINCE $W_{AF} < 0$)

$W_F = W_0 + \alpha t$, $W_{AF} = W_{A0} + \alpha_A t$, $W_{BF} = \cancel{W_{B0}}^{\,0} + \alpha_B t$

$-r_A (W_{A0} + \alpha_A t) = r_B \alpha_B t$

$-r_A W_{A0} - r_A \alpha_A t = r_B \alpha_B t$

$t (r_B \alpha_B + r_A \alpha_A) = -r_A W_{A0}$

$$t = \frac{-r_A W_{A0}}{(r_B \alpha_B + r_A \alpha_A)} = \frac{-(0.08^m)(-37.7 \frac{RAD}{s})}{(0.06^m)(33.33 \frac{RAD}{s^2}) + (0.08^m)(12.5 \frac{RAD}{s^2})}$$

$\boxed{t = 1.005^s}$

$W_{AF} = (-37.7 \frac{RAD}{s}) + (12.5 \frac{RAD}{s^2})(1.005^s) = -25.13 \frac{RAD}{s} \circlearrowleft$

PROB. 16-39 CONT.

$$\omega_{AF} = \left(-25.13 \frac{RAD}{s}\right)\left(\frac{60^s}{MIN}\right)\left(\frac{REV}{2\pi RAD}\right) = -240 \text{ RPM} \circlearrowleft$$

$$\omega_{BF} = \alpha_B t = \left(33.33 \frac{RAD}{s^2}\right)(1.005^s) = 33.5 \frac{RAD}{s} \circlearrowright$$

$$\omega_{BF} = \left(33.5 \frac{RAD}{s}\right)\left(\frac{60}{2\pi}\right) = 320 \text{ RPM} \circlearrowright$$