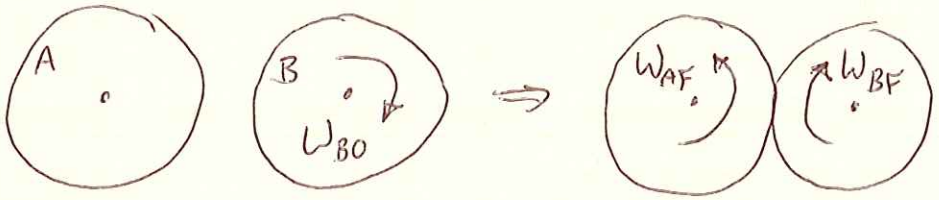
PROB. 16-40

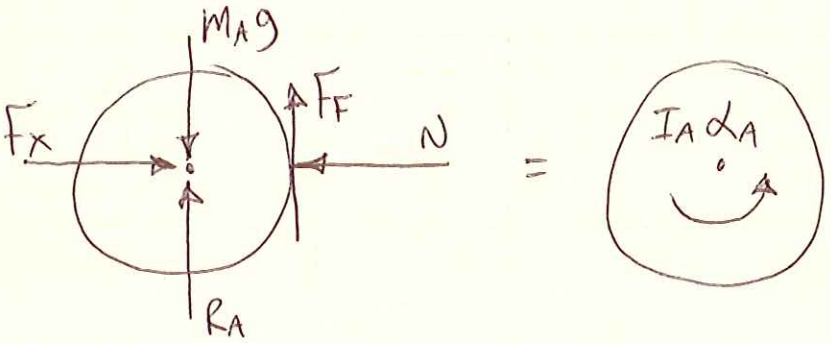
$m_A = 6^{kg}$, $\omega_{AO} = 0$, $m_B = 3^{kg}$, $\omega_{BO} = 360^{RPM} = 37.7 \frac{RAD}{s}$ ↻

$F_x = 20^N$, $\mu_K = 0.15$, $r_A = 0.08^m$, $r_B = 0.06^m$,

FIND α_A, α_B, ω_{AF}, ω_{BF}



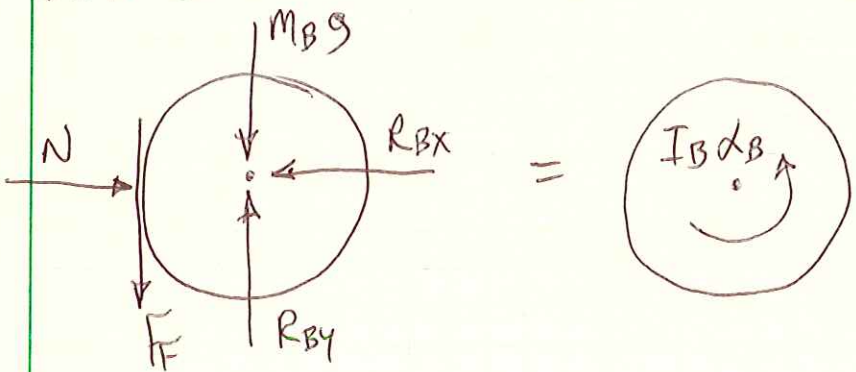
DISK A:



$\Sigma \vec{M}_G = \Sigma (\vec{M}_G)_{EFF}$ +↻: $r_A F_F = I_A \alpha_A$

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

DISK B:



PROB. 16-40 CONT.

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

$$\alpha_B = \frac{r_B(\mu F_x)}{\frac{1}{2} m_B r_B^2} = \frac{2\mu F_x}{m_B r_B} = \frac{2(0.15)(20^N)}{(3^{kg})(0.06^m)} = 33.33 \frac{RAD}{s^2} \circlearrowleft$$

DISKS STOP SLIPPING WHEN $v_{tA} = v_{tB}$

$r_A \omega_{AF} = -r_B \omega_{BF}$ (NEGATIVE SIGN BECAUSE $\omega_{BF} < 0$)

$\omega_F = \omega_0 + \alpha t$, $\omega_{AF} = \omega_{A0}^{\,0} + \alpha_A t = \alpha_A t$

$\omega_{BF} = \omega_{B0} + \alpha_B t$

$r_A \alpha_A t = -r_B(\omega_{B0} + \alpha_B t)$

$$t = \frac{-r_B \omega_{B0}}{(r_A \alpha_A + r_B \alpha_B)} = \frac{-(0.06^m)(-37.7 \frac{RAD}{s})}{(0.08^m)(12.5 \frac{RAD}{s^2}) + (0.06^m)(33.33 \frac{RAD}{s^2})}$$

$t = 0.754^s$

$\omega_{AF} = (12.5 \frac{RAD}{s^2})(0.754^s) = (9.425 \frac{RAD}{s})(\frac{60}{2\pi}) = 90\ RPM \circlearrowleft$

$\omega_{BF} = (-37.7 \frac{RAD}{s}) + (33.33 \frac{RAD}{s^2})(0.754^s)$

$\omega_{BF} = (-12.56 \frac{RAD}{s})(\frac{60}{2\pi}) = -120\ RPM \circlearrowright$