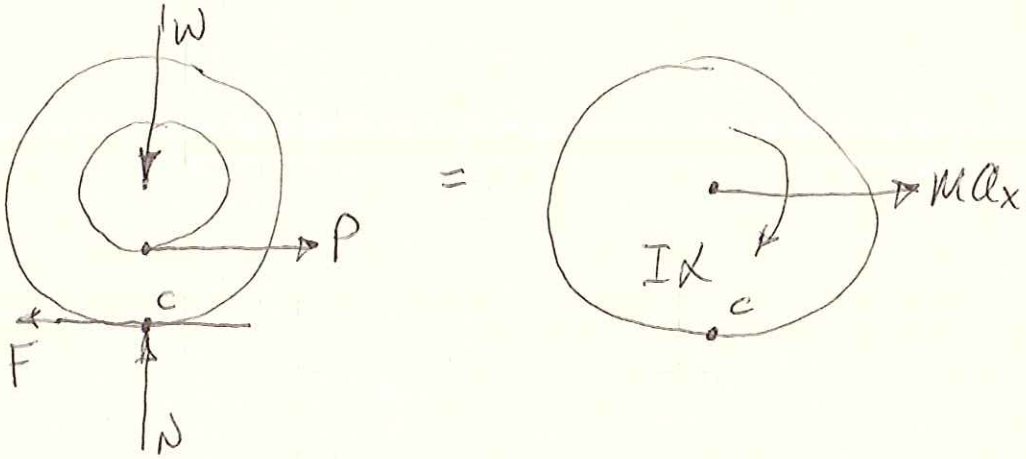
PROB. 16-100

$r_1 = \frac{1}{3}$ ft, $r_2 = \frac{2}{3}$ ft, $W = 10^{LB}$, $K = \frac{1}{2}$ ft, $P = 5^{LB}$,

$\mu_s = 0.25$, $\mu_k = 0.2$

DETERMINE IF DISK SLIDES, α, a_x



FOR NO SLIPPING,

$\Sigma F_x = ma_x$: $P - F = ma_x$, $F = P - \left(\frac{W}{g}\right) r_2 \alpha$

$\Sigma M_C = \Sigma (M_C)_{EFF}$ $+\circlearrowleft$: $-(r_2 - r_1) P = -r_2 \cdot ma_x - I\alpha$

$(r_2 - r_1) P = r_2 \left(\frac{W}{g}\right) \cdot r_2 \alpha + \left(\frac{W}{g}\right) K^2 \alpha$

$$\alpha = \frac{gP(r_2 - r_1)}{W(r_2^2 + K^2)} = \frac{\left(32.2 \frac{ft}{s^2}\right)(5^{LB})\left[\frac{2}{3} - \frac{1}{3}\,ft\right]}{(10^{LB})\left[\left(\frac{2}{3}\,ft\right)^2 + \left(\frac{1}{2}\,ft\right)^2\right]}$$

$$\boxed{\alpha = 7.728 \frac{RAD}{s^2} \curvearrowright}$$

$$F = (5^{LB}) - \left(\frac{10^{LB}}{32.2 \frac{ft}{s^2}}\right)\left(\frac{2}{3}\,ft\right)\left(7.728 \frac{RAD}{s^2}\right) \boxed{= 3.4^{LB}}$$

PROB. 16-100 CONT.

FOR NO SLIPPING, THE MAXIMUM FRICTION IS

$$F_{max} = \mu_s N = \mu_s W = (0.25)(10^{LB}) = 2.5^{LB}$$

SINCE $F > F_{MAX}$, DISK SLIDES

SINCE DISK SLIDES, $F = \mu_K N = \mu_K W = (0.2)(10^{LB}) = 2^{LB}$

$$\Sigma F_x = ma_x: \quad P - F = ma_x, \quad a_x = \left(\frac{g}{W}\right)(P - F)$$

$$a_x = \frac{\left(32.2 \frac{ft}{s^2}\right)}{(10^{LB})} \cdot (5 - 2^{LB}) = 9.66 \frac{ft}{s^2} \rightarrow$$

$$\Sigma M_C = \Sigma (M_C)_{EFF}: \quad +\circlearrowleft \quad -(r_2 - r_1)P = -r_2 \cdot ma_x - I\alpha$$

$$\alpha = \frac{1}{I}\left[(r_2 - r_1)P - r_2 ma_x\right] = \frac{1}{mk^2} \cdot \left[(r_2 - r_1)P - r_2 ma_x\right]$$

$$\alpha = \left(\frac{g}{Wk^2}\right) \cdot \left[(r_2 - r_1)P - r_2\left(\frac{W}{g}\right)a_x\right]$$

$$\alpha = \frac{\left(32.2 \frac{ft}{s^2}\right)}{(10^{LB})\left(\frac{1}{2} ft\right)^2} \cdot \left[\left(\frac{2}{3} - \frac{1}{3} ft\right)(5^{LB}) - \left(\frac{2}{3} ft\right)\left(\frac{10^{LB}}{32.2 \frac{ft}{s^2}}\right)\left(9.66 \frac{ft}{s^2}\right)\right]$$

$$\alpha = -4.293 \frac{RAD}{s^2} \circlearrowleft$$