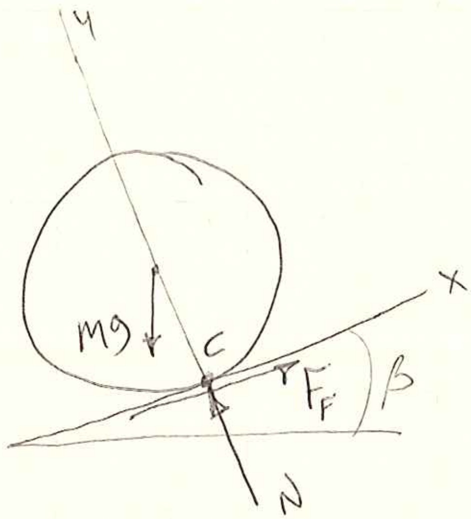
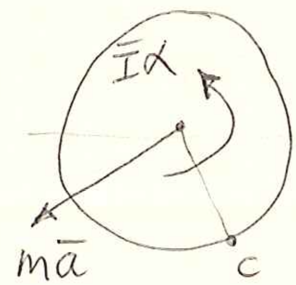
PROB. 16-96

FIND β FOR NO SLIPPING





$\Sigma F_x = ma_x$: $F_F - mg\sin\beta = -m\bar{a}_x$

$\bar{a}_x = r\alpha$, FOR NO SLIPPING, $F_{F,MAX} = \mu_s N$

$\Sigma F_y = ma_y$: $N - mg\cos\beta = 0 \Rightarrow \boxed{N = mg\cos\beta}$

$\mu_s mg\cos\beta - mg\sin\beta = -mr\alpha$

$\boxed{\mu_s g\cos\beta - g\sin\beta = -r\alpha}$

$\Sigma M_c = \Sigma(M_c)_{EFF}$ $+\circlearrowleft$: $r\cdot mg\sin\beta = r\cdot m\bar{a}_x + \bar{I}\alpha$

$\bar{I} = mK_o^2$, $\bar{a}_x = r\alpha$

$rmg\sin\beta = rm\cdot r\alpha + mK_o^2\alpha$

$\sin\beta = \dfrac{r^2\alpha + K_o^2\alpha}{rg} = \dfrac{(r^2+K_o^2)\alpha}{rg}$

$\alpha = \left[\dfrac{rg}{(r^2+K_o^2)}\right]\cdot\sin\beta$

PROB. 16-96 CONT.

$$\mu_s g \cos\beta - g \sin\beta = -r\left[\frac{rg}{(r^2+k_o^2)}\right]\cdot \sin\beta$$

$$\mu_s \cos\beta = \left[1 - \frac{r^2}{(r^2+k_o^2)}\right]\cdot \sin\beta$$

$$\mu_s \cos\beta = \left[\frac{r^2+k_o^2-r^2}{(r^2+k_o^2)}\right]\cdot \sin\beta$$

$$\tan\beta = \mu_s\left(\frac{r^2+k_o^2}{k_o^2}\right)$$

$$\boxed{\beta = \tan^{-1}\left\{\mu_s\left[\left(\frac{r}{k_o}\right)^2+1\right]\right\}}$$