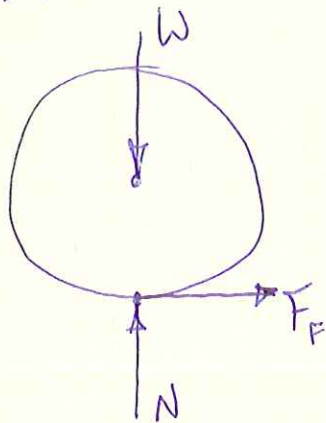FIND $\Delta\theta$ FOR $W_o = 0$ TO $W_F$

FBD:

$N = W = mg$

$F_F = \mu_k N = \mu_k mg$

WORK AND ENERGY: $T_1 + U_{1-2} = T_2$

$T_1 = 0$ SINCE $W_o = 0$

$T_2 = \frac{1}{2} I W_F^2$

$U_{1-2} = \int M d\theta = M \Delta\theta$

$M \Delta\theta = \frac{1}{2} I W_F^2$ , $\Delta\theta = \dfrac{I W_F^2}{2M}$

$M = r F_F = r \mu_k mg$, $U = r W_F$, $W_F = \dfrac{U}{r}$, $I = \frac{1}{2} m r^2$

$$\Delta\theta = \frac{\left(\frac{1}{2} m r^2\right)\left(\frac{U}{r}\right)^2}{2(r \mu_k mg)} = \left(\frac{U^2}{4 r \mu_k g}\right)^{RAD} \left(\frac{REV}{2\pi\, RAD}\right) \boxed{= \frac{U^2}{8\pi r \mu_k g} \; REV}$$