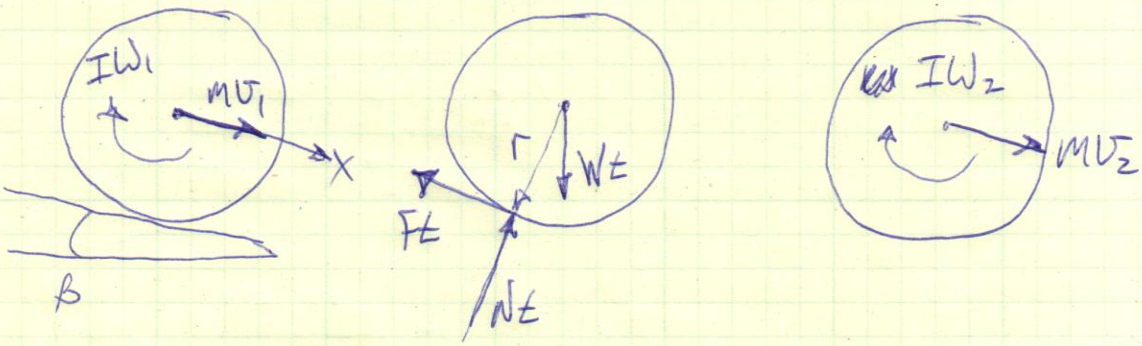
$\omega_1 = 0$, FIND $v(t)$, μ_s



X-DIR. LIN. MOM:

$$\cancel{mv_1}^{\,0} - Ft + Wt\sin\beta = mv_2$$

$$\boxed{Ft = Wt\sin\beta - mv_2} \quad ①$$

ANG. MOM.: ↻:

$$-\cancel{I\omega_1}^{\,0} - Ft\cdot r = -I\omega_2$$

$$\boxed{Ft = \frac{I\omega_2}{r}} \quad ②$$

SET ① = ②:

$$Wt\sin\beta - mv_2 = \frac{I\omega_2}{r}$$

FOR NO SLIPPING, $v = r\omega$, $\omega_2 = \frac{v_2}{r}$

$$mgt\sin\beta - mv_2 = \left(\frac{mk^2}{r}\right)\left(\frac{v_2}{r}\right)$$

$$v_2\left[1 + \left(\frac{k}{r}\right)^2\right] = gt\sin\beta$$

$$\boxed{v_2 = \frac{gt \sin\beta}{\left[1 + \left(\frac{k}{r}\right)^2\right]}}$$

$$F = \mu_s N, \quad \mu_s = \frac{F}{N}$$

$$N = W\cos\beta$$

$$\mu_s = \frac{F}{W\cos\beta}$$

$$Ft = \frac{I\omega_2}{r}$$

$$F = \frac{(mk^2)\left(\frac{v_2}{r}\right)}{rt}$$

$$F = \left(\frac{Wv_2}{gt}\right)\left(\frac{k}{r}\right)^2$$

$$\mu_s = \frac{\left(\frac{Wv_2}{gt}\right)\left(\frac{k}{r}\right)^2}{W\cos\beta}$$

$$\mu_s = \left(\frac{v_2}{gt\cos\beta}\right)\left(\frac{k}{r}\right)^2$$

$$\boxed{\mu_s} = \left[\frac{\frac{gt\sin\beta}{\left[1+\left(\frac{k}{r}\right)^2\right]}}{gt\cos\beta}\right]\cdot\left(\frac{k}{r}\right)^2 = \boxed{\frac{\tan\beta}{\left[1+\left(\frac{k}{r}\right)^2\right]}\cdot\left(\frac{k}{r}\right)^2}$$