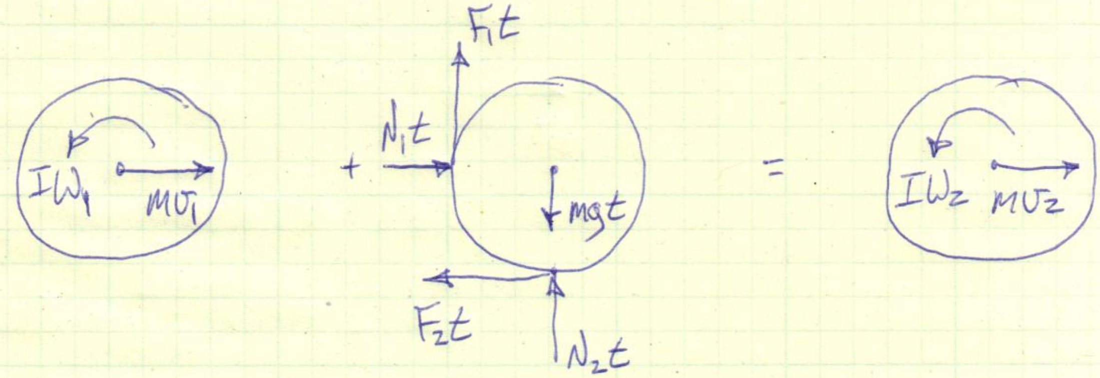
FIND t FOR $\omega_2 = 0$

PRINCIPLE OF IMPULSE AND MOMENTUM:



ANGULAR MOMENTUM ABOUT A (+↺):

$$I\omega_1 - F_1t\cdot r - F_2t\cdot r = I\omega_2 \; (\omega_2 \to 0)$$

$$\boxed{t = \frac{I\omega_1}{r(F_1 + F_2)}} \quad (1)$$

X-DIRECTION LINEAR MOMENTUM:

$$mv_1 \; (\to 0) + N_1\cdot t - F_2\cdot t = mv_2 \; (\to 0)$$

$$\boxed{N_1 = F_2} \quad (2)$$

Y-DIRECTION LINEAR MOMENTUM:

$$0 + F_1t + N_2t - mgt = 0$$

$N_2 = mg - F_1$ (3)

$F_1 = \mu N_1$ (4)

$F_2 = \mu N_2$ (5)

(4) AND (5) INTO (1), (2), (3):

$$t = \frac{I\omega_1}{r(\mu N_1 + \mu N_2)} \quad (6)$$

$N_1 = \mu N_2$ (7)

$N_2 = mg - \mu N_1$ (8)

(7) INTO (8):

$N_2 = mg - \mu(\mu N_2)$, $N_2(1+\mu^2) = mg$

$$N_2 = \frac{mg}{(1+\mu^2)}$$

$$N_1 = \frac{\mu mg}{(1+\mu^2)}$$

$$t = \frac{\frac{1}{2} m r^2 \cdot \omega_1}{\mu r \left[\left(\frac{\mu m g}{1+\mu^2} \right) + \left(\frac{m g}{1+\mu^2} \right) \right]}$$

$$\boxed{t = \left(\frac{\mu^2 + 1}{\mu^2 + \mu} \right) \cdot \left(\frac{r \omega_1}{2g} \right)}$$

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