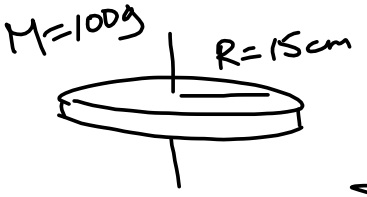
Example 1: Disk



$\tau = ?$

$\omega_i = 0$

$\omega_f = 50 \text{ rpm} = \frac{2\pi \times 50}{60} \text{ s}^{-1} = \frac{5}{3}\pi \text{ s}^{-1}$

$t = 2.50 \text{ s}$

$\Sigma\tau = I\alpha$

$I = \frac{1}{2}MR^2$

$= \frac{1}{2}(0.10\text{kg})(0.15\text{m})^2$

$= 1.125 \times 10^{-3} \text{ kg}\cdot\text{m}^2$

$= (1.125 \times 10^{-3})(\frac{2}{3}\pi)$

$= 2.4 \times 10^{-3} \text{ N}\cdot\text{m}$

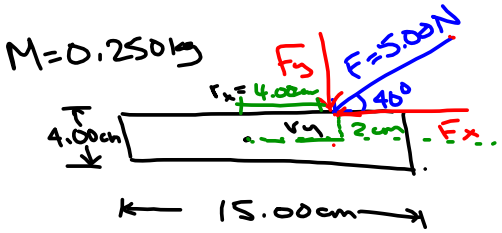
$\alpha = \frac{\omega_f - \omega_i}{t}$

$= \frac{\frac{5}{3}\pi - 0 \text{ s}^{-1}}{2.5 \text{ s}}$

$= \frac{2}{3}\pi \text{ s}^{-2}$

$\theta = \frac{l}{r} = \frac{[m]}{[m]} = [1]$

Example 2: Pushing on a block at an angle



How many revolutions after 0.300s

$$\Sigma\tau = F_y r_x - F_x r_y = (5.00\sin 40^\circ)(0.04) - (5.00\cos 40^\circ)(0.02)$$

CW rotation, CCW rotation

$$= 0.051\ \text{Nm}$$

$$\Sigma\tau = I\alpha$$

$$0.051 = (4.69\times10^{-4})\alpha$$

$$\alpha = 1.1\times10^{2}\ s^{-2}$$

(table)

$$I = \frac{1}{12}ML^2$$

$$= \frac{1}{12}(0.25)(0.15)^2$$

$$= 4.69\times10^{-4}\ \text{kg}\cdot\text{m}^2$$

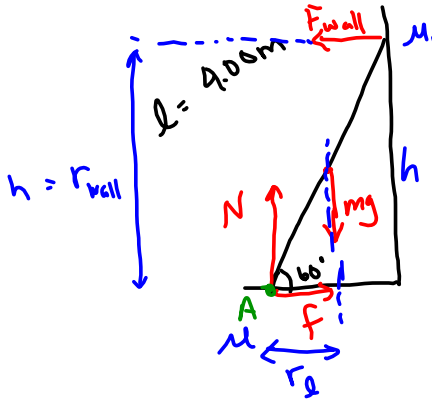
$$\theta = \omega_i t + \frac{1}{2}\alpha t^2$$

$$= \frac{1}{2}(1.1\times10^{2}\ s^{-2})(0.30s)^2$$

$$= 4.9\ \text{rad.}$$

$$= \frac{4.9}{2\pi} = 0.78\ \text{revolutions.}$$

Example 3: The ladder on the wall



$\mu = ?$ to keep it from sliding?

$\Sigma F = 0$

$N = mg = 98N$

$f = F_{wall}$

$f = \mu_{min} N$

$\Sigma \tau_A = 0$ $\quad \Sigma \tau_{cw} = \Sigma \tau_{ccw}$

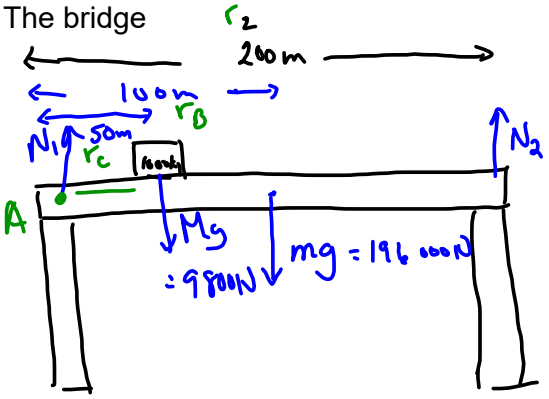
$mg \cdot r_\perp = F_{wall} \cdot r_{wall}$

$98N \cdot 2m \cos 60° = F_{wall} \cdot 4m \sin 60°$

$F_{wall} = \frac{98N}{4 \sin 60°} = 28N = f$

$\mu_{min} = \frac{f}{N} = \frac{28N}{98N} = 0.29$

Example 4: The bridge



$m = 20\,000\,kg$

$\Sigma F = \ddot\smile$

$N_1 + N_2 = mg + Mg$

$= 205\,800N$

$N_1 = 205800 - 100\,450N$

$= 105\,350N$

$\Sigma\tau = \ddot\smile$ around any and every point.

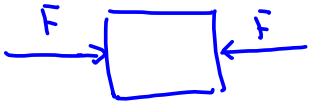
$\Sigma\tau_A = \ddot\smile$

$\Sigma\tau_{cw} = \Sigma\tau_{ccw}$

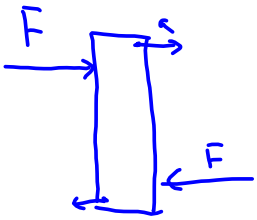
$Mg \cdot r_C + mg \cdot r_B = N_2 \cdot r_2$

$9800N \cdot 50m + 196000N \cdot 100m = N_2 \cdot 200m$

$N_2 = 100\,450N$



$\Sigma F = 0$



$v_i = 0$

$\Sigma F = 0$ ← insufficient criterion for static equilibrium

$\Sigma \tau = 0$ ← Need this too!