

18-5.

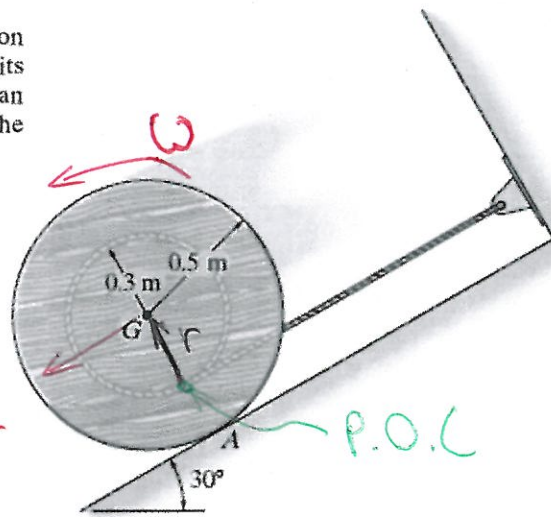
The spool has a mass of 60 kg and a radius of gyration $k_G = 0.3$ m. If it is released from rest, determine how far its center descends down the smooth plane before it attains an angular velocity of $\omega = 6$ rad/s. Neglect friction and the mass of the cord which is wound around the central core.

Properties

$$M = 60 \text{ kg} \quad W = 588.6 \text{ N}$$

$$I_G = 5.4 \text{ kgm}^2$$

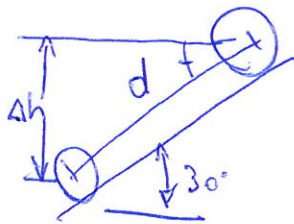
V_G



What Works?

$$\Delta h: \quad U_{12} = W \Delta h = 588.6(d \sin(30^\circ))$$

$$U_{12} = 294.3(d)$$



Work Energy

$$T_1 \rightarrow 0$$

$$+ U_{1 \rightarrow 2} = T_2$$

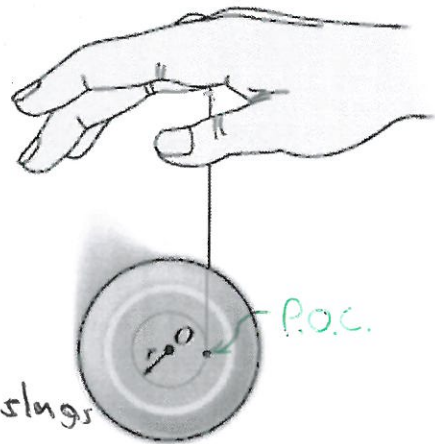
$$294.3(d) = \frac{1}{2}(\overset{M}{60})(\overset{V_G}{6 \times 0.3})^2 + \frac{1}{2}(\overset{I_G}{5.4})(\overset{\omega}{6})^2$$

$$d = \frac{(97.2 + 97.2)}{294.3} = 0.6605 \text{ m}$$

$$\underline{\underline{d = 0.661 \text{ m}}}$$

18-21.

A yo-yo has a weight of 0.3 lb and a radius of gyration $k_O = 0.06$ ft. If it is released from rest, determine how far it must descend in order to attain an angular velocity $\omega = 70$ rad/s. Neglect the mass of the string and assume that the string is wound around the central peg such that the mean radius at which it unravels is $r = 0.02$ ft.



Properties

$$W = 0.3 \text{ lb} \quad m = \frac{0.3}{32.2} = 9.317 \times 10^{-3} \text{ slugs}$$

$$I_G = 9.317 \times 10^{-3} (0.06)^2 = 3.354 \times 10^{-5} \text{ slug} \cdot \text{ft}^2$$

What Works?

$$\Delta h: \quad U_{1-2} = W \Delta h = 0.3 (\Delta h)$$

Work Energy

$$T_1 + \sum U_{1 \rightarrow 2} = T_2$$

$$T_2 = \frac{1}{2} m V_2^2 + \frac{1}{2} I_G \omega_2^2$$

$$\omega_2 = 70 \frac{\text{rad}}{\text{s}}$$

$$V_2 = \omega r = 70(0.02)$$

$$0.3 (\Delta h) = \frac{1}{2} (9.317 \times 10^{-3}) (1.4)^2 + \frac{1}{2} (3.354 \times 10^{-5}) (70^2) \quad V_2 = 1.4 \text{ ft/s}$$

$$\Delta h = \frac{0.00913 + 0.0821}{0.3}$$

$$\underline{\underline{\Delta h = 0.304 \text{ ft}}}$$