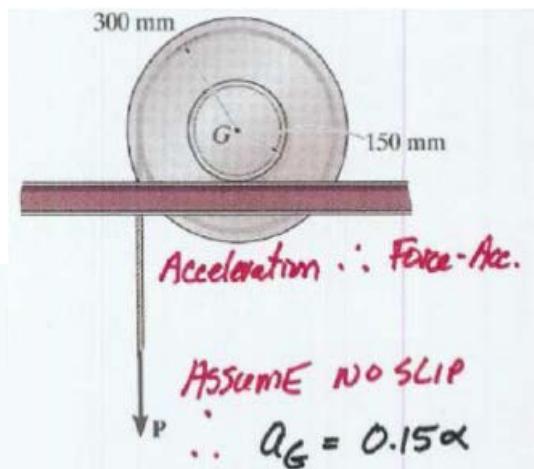


EGM 3420C - Engineering Mechanics

Dynamics Review Problems

Problem 13. The spool has a mass of 100 kg and a radius of gyration $k_G = 200$ mm about its center of mass G . If a vertical force $P = 200$ N is applied to the cable, determine the acceleration of G and the angular acceleration of the spool. The coefficients of static and kinetic friction between the rail and the spool are $\mu_s = 0.3$ and $\mu_k = 0.25$, respectively. If you assume a No-slip wheel, you must verify your assumption.



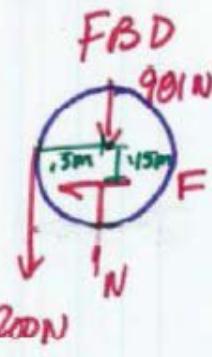
CLASSIFY MOTION

WHEEL - GPM

PROPERTIES

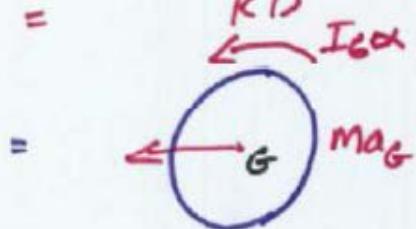
$$W_{GK} = 100(9.81) = 981 \text{ N}$$

$$I_G = mK^2 = 100(.2)^2 = 4 \text{ kg}\cdot\text{m}^2$$



$$\sum X \rightarrow$$

$$-F$$



$$= -100a_G = -15\alpha \quad (1)$$

$$\sum Y \uparrow$$

$$N - 981 - 200 = 0$$

$$N = 1181 \text{ N}$$

$$\sum \text{G} \uparrow$$

$$200(.3) - F(.15) = 4\alpha \quad (2)$$

SOLVE (1) + (2)

$$\begin{aligned} F - 15\alpha &= 0 \\ .15F + 4\alpha &= 60 \end{aligned} \Rightarrow \begin{bmatrix} 1 & -15 \\ .15 & 4 \end{bmatrix} \begin{Bmatrix} F \\ \alpha \end{Bmatrix} = \begin{Bmatrix} 0 \\ 60 \end{Bmatrix}$$

$$\begin{aligned} F &= 144 \text{ N} \\ \alpha &= 9.6 \text{ rad/s}^2 \uparrow \end{aligned}$$

$$a_G = \alpha r = 9.6 (.15) = 1.44 \text{ m/s}^2 \leftarrow$$

CHECK ASSUMPTION

$$F_{max} = M_s N = 0.3(1181) = 354 \text{ N} > F = 144 \text{ N} \therefore \text{NO SLIP!}$$

Answer: $a_G = 1.440 \text{ m/s}^2 \leftarrow$