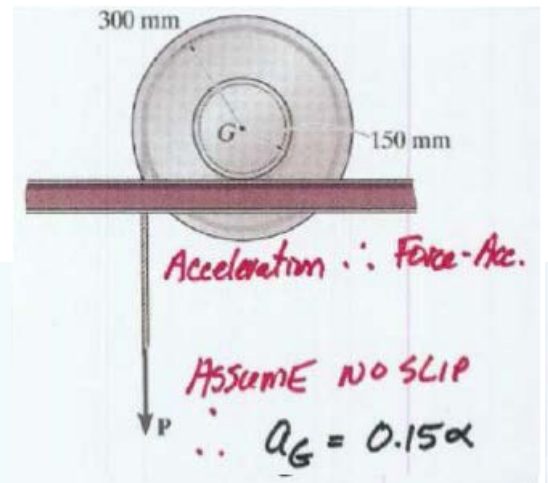


## EGM 3420C - Engineering Mechanics Dynamics Review Problems

**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.



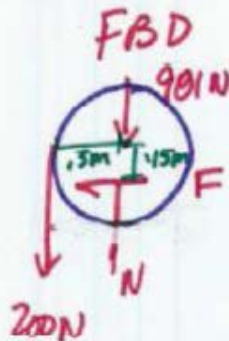
CLASSIFY MOTION

WHEEL - GPM

PROPERTIES

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

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



$$\sum X \rightarrow$$

$$-F$$

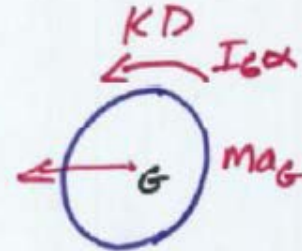
$$\sum Y \uparrow$$

$$N - 981 - 200$$

$$\sum \curvearrowright$$

$$200(.3) - F(.15)$$

$$=$$



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

$$= 0 \quad N = 1181 \text{ N}$$

$$= 4 \alpha \quad (2)$$

SOLVE (1) + (2)

$$F - 15 \alpha = 0$$

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

$$F = 144 \text{ N}$$

$$\alpha = 9.6 \text{ rad/s}^2$$

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

CHECK ASSUMPTION

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

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