

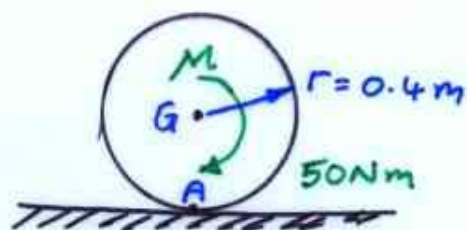
EXAMPLE

Wheel, $W = 250 \text{ N}$

R. of gyr. $k_G = 0.2 \text{ m}$

50 Nm torque applied,

find a_G if $\mu_s = 0.3$ $\mu_k = 0.25$
(friction coeffs)



A is point of contact.

from dirxn of $M \Rightarrow \alpha$ clockwise $\Rightarrow a_G$ to right
 $I_G = mk_G^2 = \left(\frac{250}{9.81}\right)(0.2)^2 = \underline{1.019 \text{ kg m}^2}$

UNKNOWN

N_A, F_A, a_G, α

EQNS of MOTION...

$$\sum F_x = ma_{Gx}$$

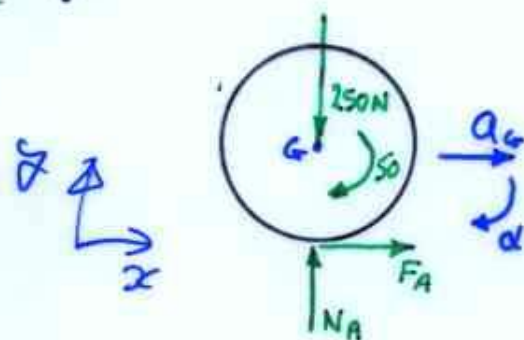
$$\Rightarrow F_A = ma_G$$

$$\sum F_y = ma_{Gy} = 0$$

$$\Rightarrow N_A = 250 \text{ N in dirxn shown } \uparrow$$

$$\sum M_G = I_G \alpha$$

$$\Rightarrow -50 \text{ Nm} + 0.4 F_A = -I_G \alpha \quad \text{negative because of dirxn of } \alpha$$



Kinematics $\rightarrow$ Assume NO SLIP

$$\Rightarrow a_G = 0.4 \alpha$$

SOLVE SIMULTANEOUS EQNS

$$\Rightarrow N_A = 250 \text{ N} \quad F_A = 100 \text{ N} \quad \alpha = 9.81 \text{ rad s}^{-2} \quad a_G = 3.92 \text{ m s}^{-2}$$

Q) IS THIS VALID?

A) NO

i.e. is $F_A \leq \mu_s N_A$?

$$100 \leq (0.3)(250)?$$

[UNTRUE] $100 \leq 75? \Rightarrow$ [NO] $\Rightarrow$ false assumption $\Rightarrow$ there IS SLIP