

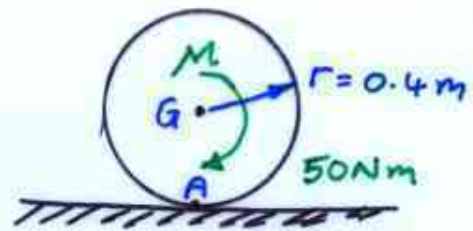
## EXAMPLE

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

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

$50 \text{ Nm}$  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

$N_A$ ,  $F_A$ ,  $a_G$ ,  $\alpha$

EQNS of MOTION...

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

$$\Rightarrow F_A = ma_G$$

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

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

$$\underline{\sum M_G = I_G \alpha}$$

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

Kinematics  $\rightarrow$  Assume NO SLIP

$$\Rightarrow \underline{a_G = 0.4 \alpha}$$

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