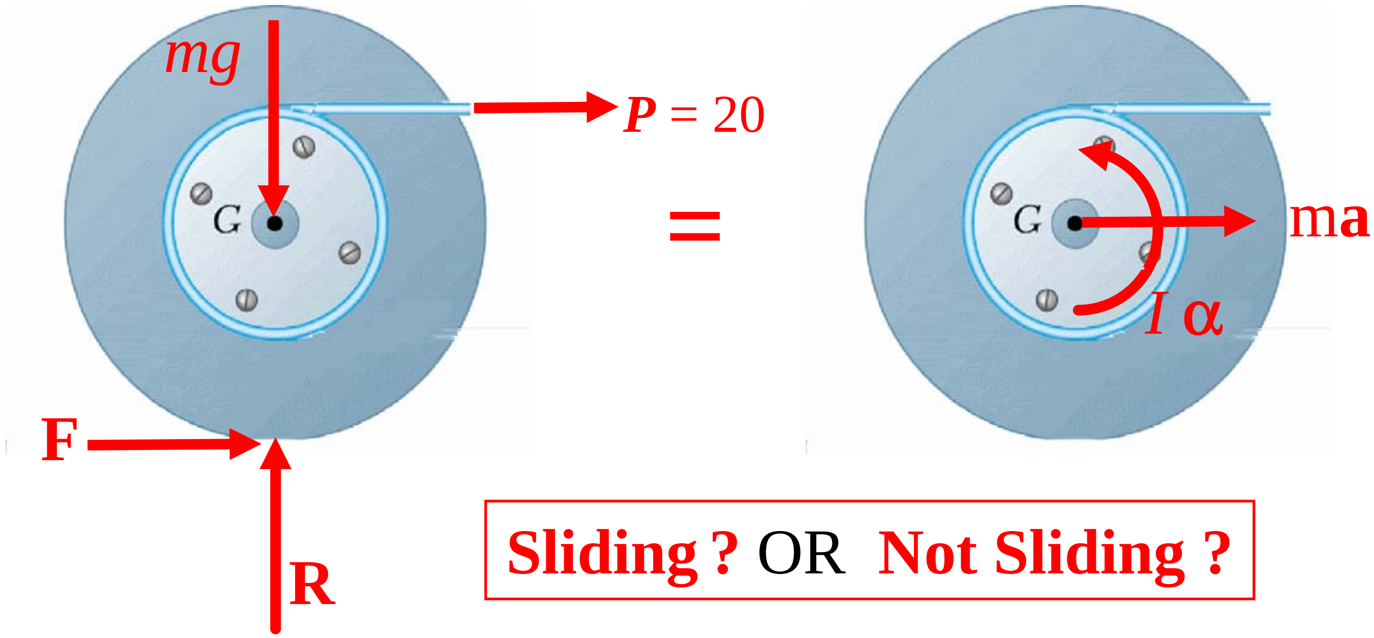
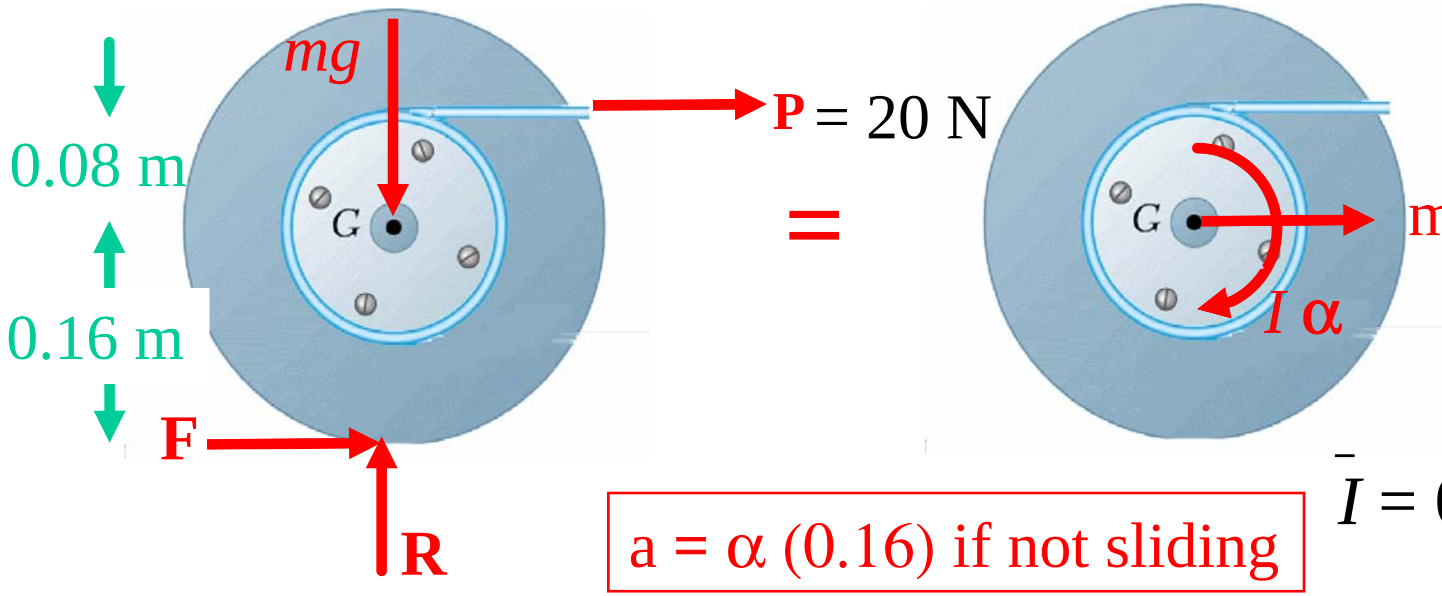


A cord is wrapped around the inner drum and pulled horizontally with a force P = 20 N. The wheel has a mass of 5 kg and a radius of gyration of 0.12 m. The geometric radius of the wheel is 0.16 m. The radius of the drum is 0.08 m. Knowing that the coefficients of kinetic and static frictions and between the disk and the belt are 0.15 and 0.2 respectively, determine the acceleration of G and the angular acceleration of the wheel.



$m = 5$ kg

$\bar{I} = 0.072$ kg-m ^{2}

a = α (0.16) if not sliding

$\xrightarrow{} +$ $\quad \Sigma F_x = m\,a_x : \quad F + 20 = m\,a$

$\uparrow +$ $\quad \Sigma F_y = m\,a_y : \quad R - 5g = 0$

$\curvearrowright +$ $\quad \Sigma M_P = I\alpha : \quad 20\,(0.08+0.16) = 5a\,(0.16) + I\alpha$

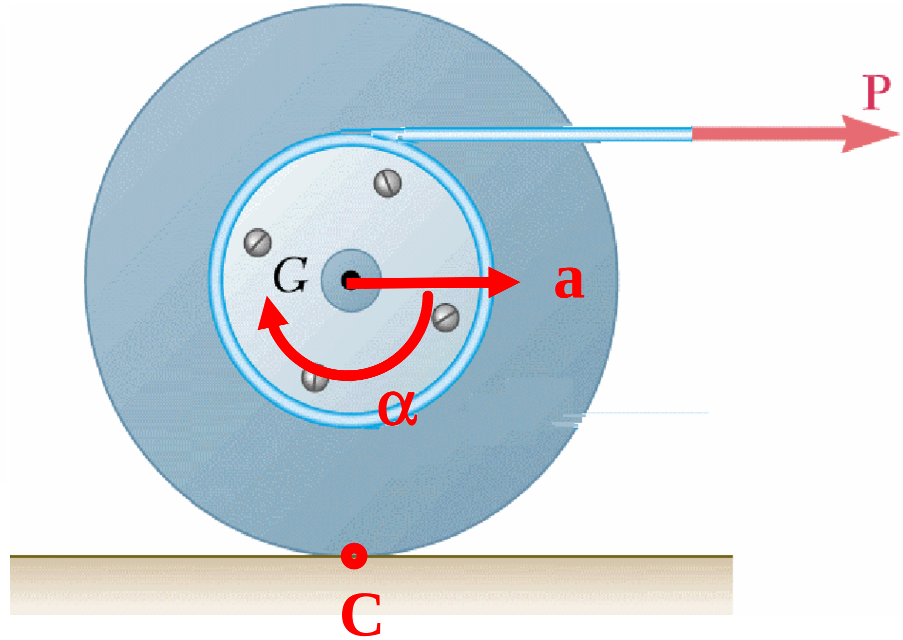
$\alpha = 24$ rad/s^2, $a = 3.84$ m/s^2, $F = -0.8$ N

$|F|_{max} = \mu_s R = 0.2(5g) = 9.81$ N

Transverse acceleration — Centripetal acceleration

$$\mathbf{a}_G = \mathbf{a}_C + \boldsymbol{\alpha} \times \mathbf{r}_{G/C} + \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \mathbf{r}_{G/C})$$

$$(a_{G/C})_t = \alpha r_{G/C}, \qquad (a_{G/C})_n = \omega^2 r_{G/C}$$



Kinematics:

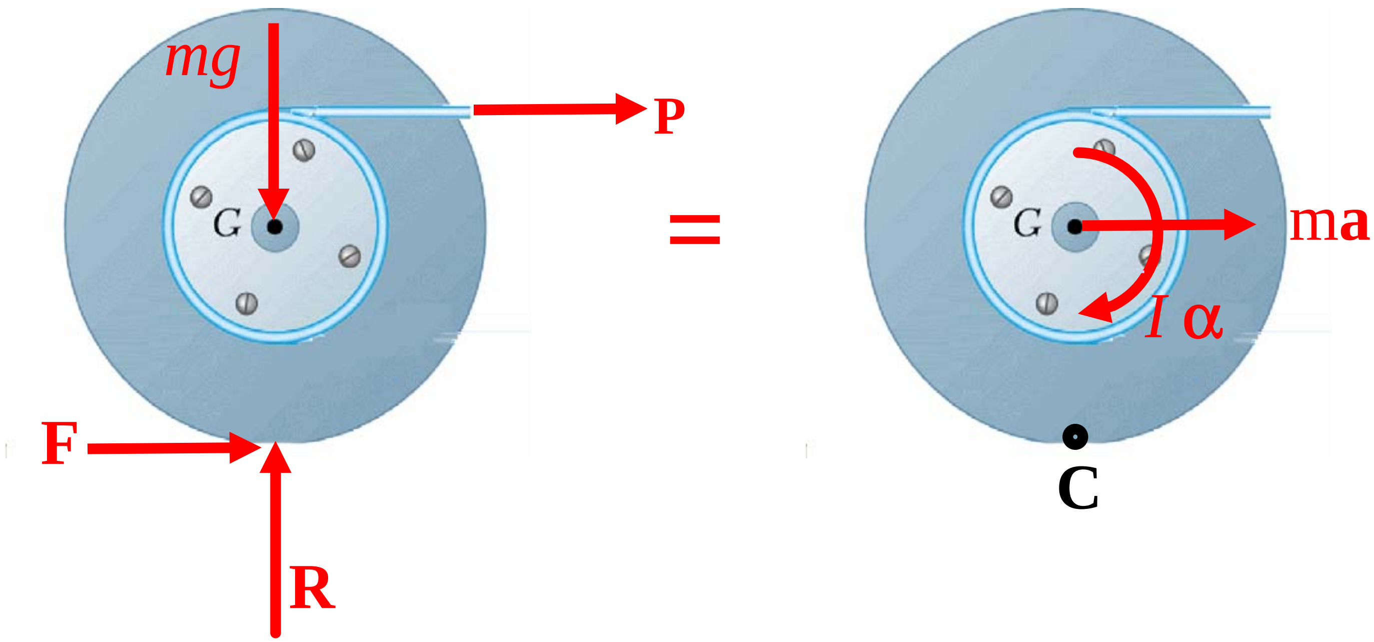
G: a_G has only the horizontal component.

C: without sliding, the tangential component of a_C is zero. The normal component of a_C is not generally zero.

$$a_x \mathbf{i} = a_C \mathbf{j} - \alpha \mathbf{k} \times r \mathbf{j}$$

$$a_x \mathbf{i} = a_C \mathbf{j} + \alpha r \mathbf{i}$$

i-component: $a_x = \alpha r$



$a_G = \alpha$ (0.16) **if Not Sliding)**

F = 0.2 ***R*** **if Sliding**

- a_C has only a horizontal component
- $a_{G/C}$ is transverse initially when $\omega = 0$.
- Therefore, $a_G = \alpha\, r_{G/C}$