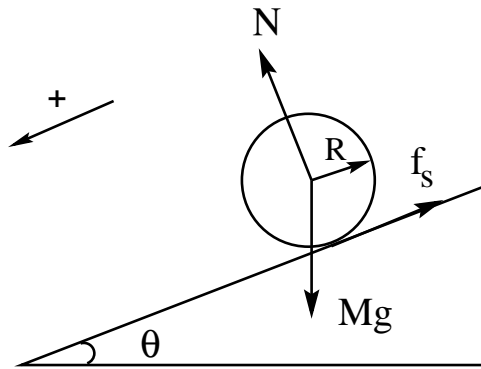


Ex : A uniform disk ($I_{cm} = MR^2/2$) rolls down a ramp of angle $\theta=30^\circ$ without slipping.



a). What is a_{cm} for the disk?

Use Newton's 2nd Laws!!

$$\text{Translation : } Mg \sin 30^\circ - f_s = Ma_{cm}$$

$$\text{Rotation : } f_s R = I_{cm} \alpha = \frac{MR^2 a_{cm}}{2R} = \frac{MR a_{cm}}{2}$$

$$\text{Therefore : } a_{cm} = \frac{2g \sin 30^\circ}{3} = 3.27 \text{ m/s}^2$$

b). What is the frictional force if $M = 1 \text{ kg}$?

$$f_s = Ma_{cm}/2 = 1.64 \text{ N} \quad (\text{up the incline})$$

c). For uniform acceleration, what is the speed of the disk at the bottom of the ramp of length $\mathbf{L = 10.0 \text{ m}}$?

$$v_f^2 = v_0^2 + 2a_{cm} \Delta x = 2a_{cm} L \quad v_f = 8.1 \text{ m/s}$$