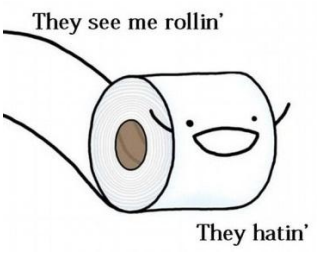
ROLLING MOTION (FREE WHEELS)

● So far we have seen Point Masses in a circular path OR Shapes/Rigid Bodies around themselves → "FIXED WHEEL"

- In some problems, Shapes/Rigid Bodies are BOTH Rotating **(___)** AND MOVING **(___)** → "FREE WHEEL"



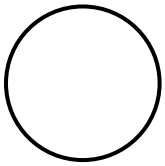
- Cylinder rotating around FIXED axis:

w _____ 0 BUT $v_{,CM}$ _____ 0

- Cylinder rotating around FREE axis:

w _____ 0 AND $v_{,CM}$ _____ 0

- If FREE Axis, the *total velocity* (linear) at the center of mass (usually middle), top, and bottom of the ***wheel*** are:



EXAMPLE 1**:** A wheel of radius 0.30 cm rolls without slipping along a flat surface with 10 m/s. Calculate **(a)** the angular speed of the wheel**;** and **(b)** the speed of a point at the bottom of the wheel, relative to the floor**.**

EXAMPLE 2**:** When a car accelerates from rest for 10 s, its tires experience 8 rad/s². The tires are 0.40 m in radius. Calculate**: (a)** the angular speed of the tires after 10 s**; (b)** the speeds of points at the top, center, and bottom of the tire**.**

PRACTICE: ROLLING MOTION

PRACTICE**:** A long, light rope is wrapped around a cylinder of radius 40 cm, which is at rest on a flat surface, free to move. You pull horizontally on the rope, so it unwinds at the top of the cylinder, causing it to begin to roll without slipping. You keep pulling until the cylinder reaches 10 RPM. Calculate the speed of the rope at the instant the cylinder reaches 10 RPM**.**