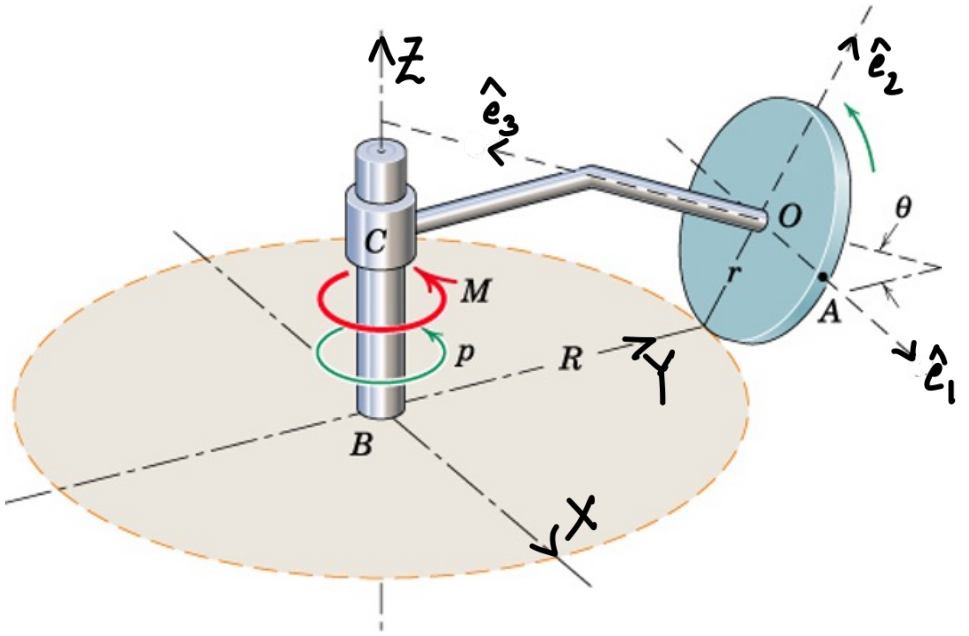
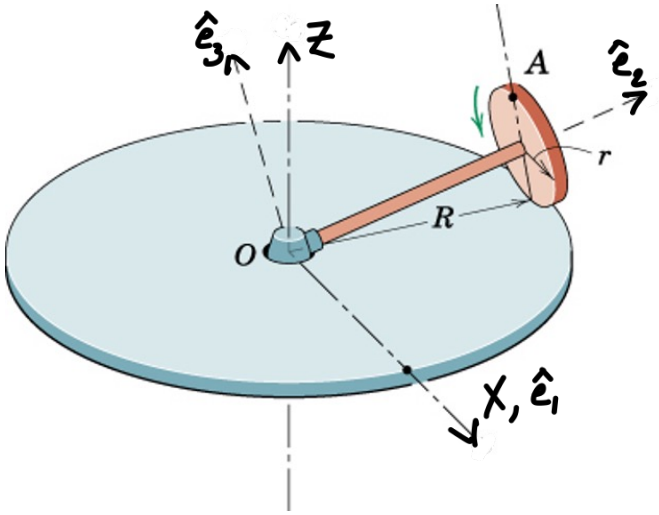
ESO209A: Dynamics: **Tutorial 8**
(Week: 23 - 29 Sep. Based on L12-L14)

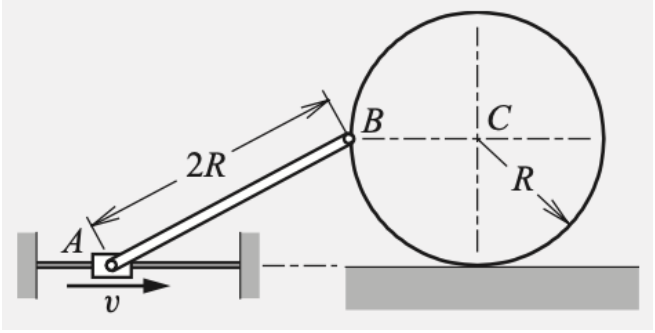
(1) A wheel of radius r, connected to a bent shaft OC, rolls without slipping as shown. The shaft about the vertical shaft BC at a constant angular rate p rad/sec. Determine the following kinematic quantities:
   a. Angular velocity of the wheel in the ground-fixed frame B-XYZ
   b. Angular acceleration of the wheel in the ground-fixed frame B-XYZ



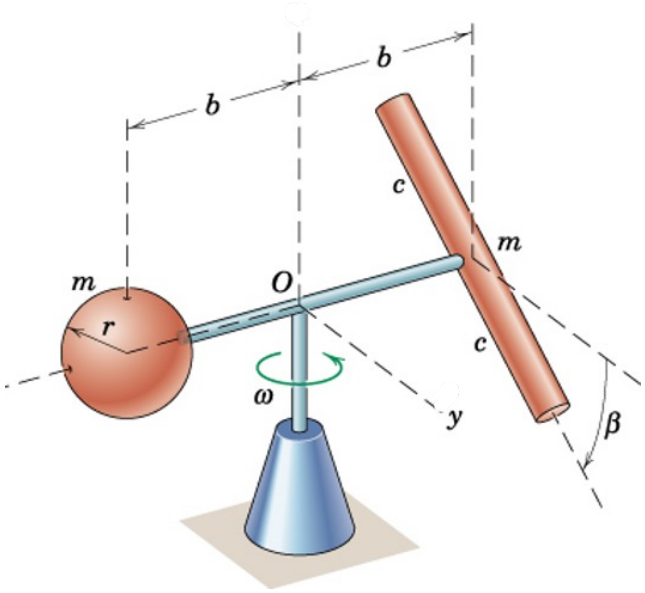
(2) The circular disk of radius r is mounted on its shaft which is pivoted at O so that it may rotate about the vertical Z axis. If the disk rolls at constant speed without slipping and makes one complete turn around the circle of radius R in time t, determine the expressions for the angular velocity and angular acceleration of the disk.



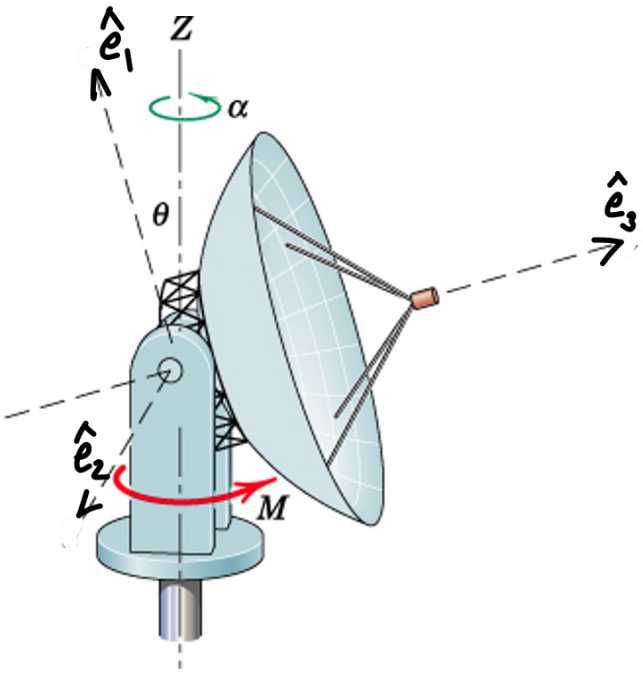
(3) Piston A has constant velocity v to the right. The wheel, which is connected to the piston by connecting rod AB, rolls without slipping over the ground. Determine the velocity and acceleration of the center of the wheel for the position shown in the sketch.



(4) The assembly, consisting of the solid spheres of mass m and the uniform rod of length $2c$ and equal mass m, revolves about the vertical axis at the angular speed ω. The rod has diameter which is small compared to its length and is perpendicular to the horizontal massless rod about which it is free to rotate. At the moment shown the angle β is changing at the rate $\dot{\beta}$. Determine the combined angular momentum of the entire system about the point O at this instant.



(5) The large satellite-tracking antenna has a moment of inertia I about its $\hat{\mathbf{e}}_3$- axis of symmetry, and a moment of inertia I_o about each of the $\hat{\mathbf{e}}_1$- and $\hat{\mathbf{e}}_2$- axes. Determine the angular acceleration α of the antenna about the vertical Z-axis caused by a torque M applied about the Z-axis by the drive mechanism for a given orientation θ.



(6) The uniform square flaps, each of mass m, are freely hinged at A and B to the square plate and attached shaft, which rotate about the vertical z -axis with a constant angular speed ω. Determine the angular velocity ω required to maintain a specified positive angle θ.