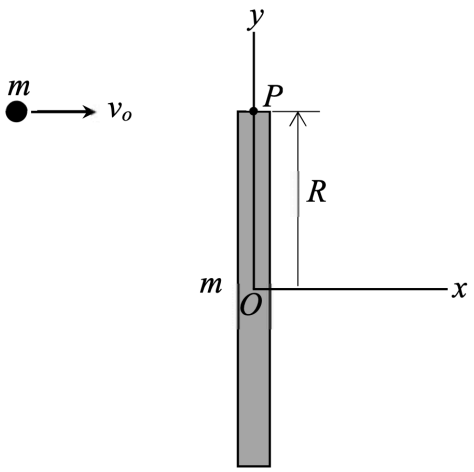
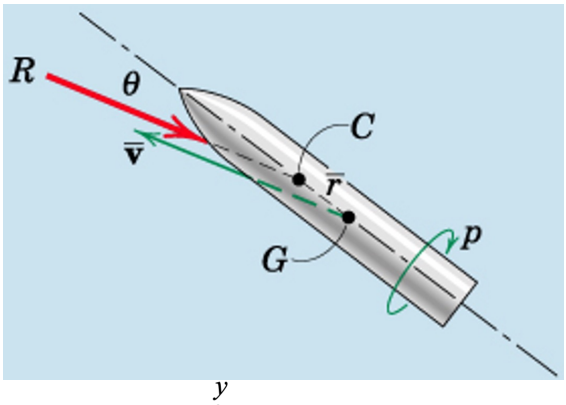
ESO209A: Dynamics: **Tutorial 12**
(Week: 27 Oct. - 2 Nov. Based on L15-L20)

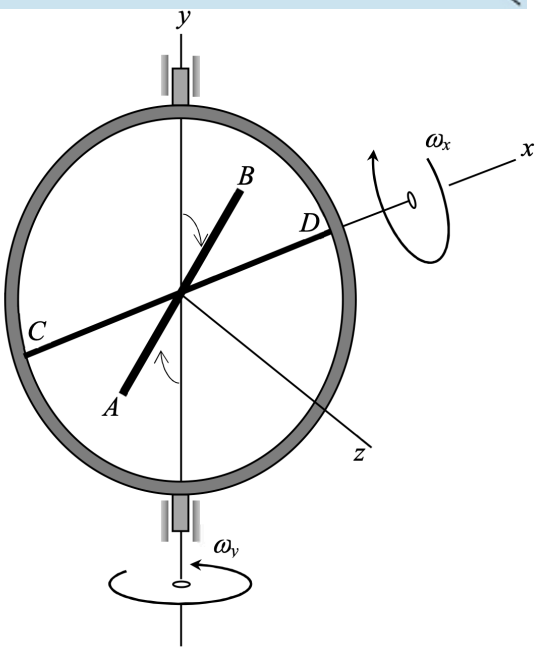
(1) A thin uniform circular disc-type satellite of mass m and radius R is spinning at a constant angular rate of ω_0 in space about its body-fixed x-axis, as shown. A space debris of equal mass but of a point size hits the satellite normal to its plane with the velocity v_0 as shown. Subsequently, the debris gets embedded into it at point P. Find the angular velocity vector immediately after the collision. What impact model is being used here? The figure shows the side view of the satellite.



(2) The velocity vector v of a rocket, moving through the earth's atmosphere, makes an angle θ with respect to its symmetry axis as shown. The net aerodynamic drag acts parallel to v but in opposite direction such that its line of action cuts the symmetry axis at C, slightly away from G, as shown. The moment of inertia of the rocket about its symmetry axis is I and that through G and perpendicular to the plane of the paper is I_0. How much spin p about the symmetry axis should bė provided to stabilize the rocket such that $\dot{\theta} = 0$?



(3) A thin uniform rod AB of mass m and length l is rotating about the shaft CD at a constant angular velocity ω_x as shown. Note that the rod AB is normal to the shaft CD. The shaft CD is attached to a circular gimbal which rotates about the fixed y-axis at a constant angular rate of ω_y, as shown. Find the components of the moments acting on the rod AB



(4) The sketch shows the velocity of a small disk of mass m at the instant before its collision with a rigid body consisting of the same disks connected by a rigid massless bar. Determine the rebound velocity of each disk in terms of the coefficient of restitution ε.