Angular Momentum Problems
Challenge Problems

Problem 1: A spaceship is sent to investigate a planet of mass m_p and radius r_p. While hanging motionless in space at a distance $5r_p$ from the center of the planet, the ship fires an instrument package with speed v_0. The package has mass m_i which is much smaller than the mass of the spacecraft. The package is launched at an angle θ with respect to a radial line between the center of the planet and the spacecraft. For what angle θ will the package just graze the surface of the planet?

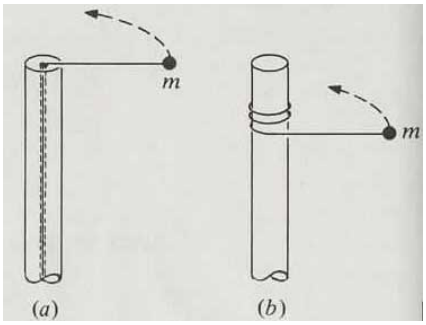
Problem 2: Conservation Laws

a) Show that if the total linear momentum of a system of particles is zero, the angular momentum of the system is the same about all origins. Explain how you may apply this result involving an elastic collision of two rigid bodies.

b) Show that if the total force on a system of particles is zero, the torque on the system is the same about all origins. Explain how you can use this result for static equilibrium problems.

Problem 3: Conservation Laws Post

A body of particle of mass m (treat it as a point like particle) is attached to a post of radius R by a string. Initially it is a distance r_0 from the center of the post and it is moving tangentially with a speed v_0. In case (a) the string passes through a hole in the center of the post at the top. The string is gradually shortened by drawing it through the hole. In case (b) the string wraps around the outside of the post. What quantities remain constant in each case? Find the final speed of the body when it hits the post for each case.



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