An old angular collision problem from the files.



1. A thin uniform rod of mass M_r and length L is initially at rest on a frictionless horizontal surface. The moment of inertia of the rod about its center of mass (Pt. C) is $(^1/_{12})M_rL^2$. As shown above, the rod is struck (at Pt. P) by a ball with mass, m_b , whose initial velocity **v** is perpendicular to the rod. After the collision, the ball has a velocity -v/2. Answer the following questions in terms of the symbols given.

a. Using linear momentum, determine the velocity \mathbf{v}_{r} of the center of mass of the rod after the collision.

b. Using angular momentum, determine the angular velocity ω of the rod about its center of mass after the collision.

c. Write (and simplify) a relationship for the kinetic energy of the system after the collision. (Note: this may be somewhat "ugly" but can be simplified to a reasonable degree.)