Week 37 (5/26/03)

Bouncing down a plane

Consider a ball (with moment of inertia $I = (2/5)MR^2$) which bounces elastically off a surface. Assume that the ball's speed in the direction perpendicular to the surface is the same before and after a bounce. Also, assume that the ball is made of a type of rubber which allows it to not slip on the surface (which has friction) during the bounce. (This implies that the angular and linear motions may affect each other.)

The ball is projected from the surface of a plane which is inclined at angle θ. The initial velocity of the ball is perpendicular to the plane and has magnitude V. The initial angular velocity is zero. Find the component of the ball's velocity along the plane, immediately after the nth bounce.