PHYS 321 Homework Assignment #8
Due: Friday, 15 November 2002 (5 probs)

1. Calculate the principal moments of inertia for the following objects of uniform density:
   
   a) Cylinder.
   b) Cone.
   c) Long thin rod.
   d) Sphere.
   e) Spherical shell of inner radius $r$ and outer radius $R$.

   Show your computations, do not merely list the results from B&O Table 6-1.

2. Evaluate the inertia tensor of a cube, using a reasonable set of principal axes. What is the moment of inertia of the cube about an axis connecting a corner to its diagonal opposite (and passing through the center of the cube)? In fact, what is the $M$ of I about any axis passing through the center of the cube?

3. A thin uniform rigid rod of mass $m$ and length $\ell$, initially not rotating and aligned along the $y$-direction and moving at velocity $\vec{v} = v\hat{x}$ in a plane as shown below, strikes a small immovable peg, as shown. (The collision takes place at the bottom end of the rod.) If the collision is elastic (energy is conserved), describe the motion of the rod after the collision. What if the collision is completely inelastic (bottom end recoils at velocity $\vec{v}' = 0$)? Describe the motion and calculate the energy loss in the latter case.
4. A physical pendulum consists of a rod of mass $m$ and length $\ell$ to the end of which is attached a solid sphere of mass $M$ and radius $r$, constrained to swing from a pivot, in a vertical plane. (That is, the distance from the pivot to the top of the spherical bob is $\ell$.) What is the period of small oscillations?

5. Another physical pendulum consists of a cone suspended by its apex and confined to swing in the $x-z$ plane ($z$ vertical). What is its period for small displacements from equilibrium?