

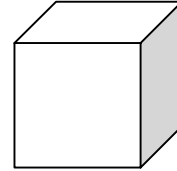
PHYS 101

Homework # 9

DUE DATE: November 17, 2009

Try to use the problem solving techniques discussed in the class, for the following questions (when needed). Each of them should contain an *analysis of the problem*, a *well-constructed solution*, and the *checks* of the problems.

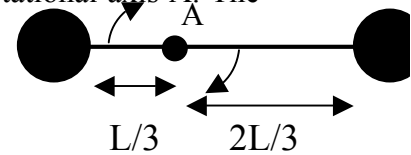
- 1) Find the moment of inertia of a cube (of mass M , side length L) around an axis going through one of the edges.



- 2) Three cylindrical cans are identical. One is empty, one is uniformly filled, the last one has most of its mass concentrated at the center. Each of these cans starts from rest and rolls down the same inclined plane. Which of these cans arrive at the bottom of the plane first. Explain why? Use a mathematical explanation.

- 3) If the melting of the polar ice caps were to raise the water level on the Earth by 10 m, by how much would the day be lengthened? Assume that the moment of inertia of the ice in the polar ice caps is negligible (they are very near the axis), and assume that the extra water spreads out uniformly over the entire surface of the Earth (that is neglect the area of the continents compared with the area of oceans). Assume that the earth is a sphere with uniform density.

- 4) A dumbbell is made of a rod length L and M , and 2 spheres of radius r and mass m (see figure). The rod is attached at a distance $L/3$ from the left end to a rotational axis A . The dumbbell is let go under gravity and makes a rotational motion under gravity around the rotational axis A .



(Known: g , M , m , L , r)

- Make a detailed analysis of the problem
- Find the distance between the center of mass of the system and the rotational axis A .
- Find the moment of inertia (I) of the system about A .
- What is the maximum angular velocity achieved by the system?
- What are the maximum speed of each of the spheres?
- Make the checks of your results.

- 5) A disk of radius R_1 is carved out of a disk of radius R_2 . The surface mass density (kg/m^2) of the structure is ρ . a) Find the location of center of mass b) Find the moment of inertia I_x , I_y , and I_z c) If the structure in the figure is hung on a wall using a pin going through the center, what is the net gravitational torque about an axis going through the center? Which direction it will rotate? d) If the structure rotates about the center point, which point will reach the maximum linear velocity during this motion? Calculate this maximum velocity.

