Mathematica Homework #2

Email notebook to corbin@physics.ucla.edu
with a subject line: [Physics 105B]
Due on or about Friday, 2 Nov

- In the first cell, enter all the usual stuff: your **name**, **student ID**, **email address** and the **assignment identifier** (eg. "HW 2").
- 1) Suppose you are given a set of point-masses, m_i, each located at their respective $\vec{r}_i =< x_i, y_i, z_i >$, where i runs from 1 to **NPART**. Write the necessary code to find the rotational inertia tensor with respect to the origin, the principle axes and the principle moments of inertia. While the code should be general enough to run for any value of **NPART** (provided the values of m_i and $\vec{r}_i$ are given), you may, for the purpose of troubleshooting, set it up for a single particle of mass $m1$ at $< x_1, y_1, z_1 >$. When you run the code, do you get the expected result?
- 2) A particle of mass m_1 sits at $r_1* < \sin\theta\cos\phi, \sin\theta\sin\phi, \cos\theta >$. A particle of mass m_2 sits at $r_2* < -\sin\theta\cos\phi, -\sin\theta\sin\phi, -\cos\theta >$. Use the code you've just written to find the rotational inertia tensor with respect to the origin, the principle axes and the principle moments of inertia for the system.
- 3) Modify your code to find the rotational inertia tensor with respect to the center-of-mass of the 2-body system in the previous problem, the principle axes and the principle moments of inertia. Once you have the general answer, evaluate it at $\theta = \pi/2$, $\phi = 0$. See something cool?? Comment on it.
- 4) A uniform hemispherical bowl of inner-radius a and outer-radius b and mass M is oriented so that the circular base lies in the x, y-plane, centered on the origin. Find the rotational inertia tensor with respect to the center-of-mass of the bowl, the principle axes and the principle moments of inertia.
- 5) A cube of mass M and edge-length a is placed with one corner on the origin and one side along each of the positive x-,y-, and z-axes. The volume mass-density varies as $\rho \propto (x^2 + y^2)$. Find the rotational inertia about the center-of-mass, the principle axes and the principle moments of inertia.