Mathematica Homework #1

Email notebook to corbin@physics.ucla.edu
with a subject line: [Physics 105B]
Due on or about Friday, 19 Oct

- **Welcome back!** In the first cell, enter all the usual stuff: your **name**, **student ID**, **email address** and the **assignment identifier** (eg. "HW 1").

- 1) Let's warm our fingers up with something relatively easy. Find the normalized mass density and the center-of-mass of a non-uniform right-circular cone of height h, base-radius a and mass M for the distributions given below. Place the tip of the cone at the origin and orient the circular base parallel to the x, y-plane.
  - a) $\rho(r, \phi, z) \propto z^n$ where $n \in$ non-negative integers;
  - b) $\rho(r, \phi, z) \propto \sin \frac{\phi}{2}$

- 2) An incident particle of initial kinetic energy $T_{cm,0}$ scatters in a repulsive potential $V = \frac{k}{r^2}$. Use Mathematica to evaluate the differential cross-section (in this frame) from first principles and the total cross-section. You will probably want to comment on the result of the total cross-section.

- 3) You are sitting in the center of a large rotating platform, rotating along with it. The platform is oriented horizontally, the angular velocity of the plane is given by $\vec{\Omega} = \Omega\hat{z}$ (where $\hat{z}$ points straight up), and there are x- and y-axes painted on the plane that both pass through the point where you are sitting. At $t = 0$ you notice a puck of mass m sliding through a point $\vec{r} =< x0, y0, 0 >$ with a velocity $\vec{v} =< v0x, v0y, 0 >$. Use Mathematica to obtain the equations of motion ($\vec{r}(t)$) as well as the velocity ($\vec{v}(t)$) for the puck in the frame in which the painted axes are at rest (the rotating frame of the platform). Check your answers in the limit $\Omega \to 0$.

- 4) Suppose the puck in problem 4 had an initial upward velocity component $v0z$ as it passed through $\vec{r} =< x0, y0, 0 >$ at $t = 0$. According to the coordinates painted on the rotating platform, where will the puck land when it returns to the rotating platform?