ASTR450 Homework # 6 – Two Body Problem
Due Thursday, March 26

Reading: Skim over Chapter 9 & and start reading Chapter 8. Also, test your knowledge of orbital elements with the 2D and 3D orbit viewers available from the class web page.

1. a) Orbital Elements. Find the six orbital elements $(a, e, i, \Omega, \omega, \nu)$ for an asteroid which, at time t=0, has $(X, Y, Z) = (2.5AU, 0, 0)$ and $(V_x, V_y, V_z) = (V_E/\sqrt{10}, -V_E/\sqrt{5}, 0)$. Here V_E is the speed of the Earth in its orbit, and an AU is the astronomical unit. Take the reference plane to be the XY plane and the reference direction to be $\hat{X}$. It is easiest to use dimensionless units; take $V_E = 30$km/s to be the unit of velocity, and the AU to be the unit of distance, and $GM = 1$ to define the unit of mass (so in dimensionless units, $V_E = 1, GM = 1$, and the Earth-Sun distance is one).
b) Find the pericenter distance, the apocenter distance (if it exists), and the semilatus rectum of the orbit, and use these quantities, and your orbital elements, to draw a reasonably accurate sketch of the orbit relative to the X and Y axes.

2. Danby: Page 136, Problem 1. Given that the Moon's eccentricity is 0.05, what total fraction of the Moon's surface is visible to observers on Earth over a month due to this effect?

3. Derive Equations 6.7.9 on page 163. Start with the definitions 6.7.3.

4. (Due with HW #7). In your favorite computer language, write subroutines to translate between the mean anomaly M, the eccentric anomaly E, and the true anomaly ν for elliptic orbits. Find E and ν given $M = \pi/2$, $e = 0.8$. Write down an inequality relating the three anomalies over the pericenter to apocenter half of the orbit. How does this change for the apocenter to pericenter half? Please turn in 1) a listing of your code, 2) a transcript of a rigorous series of tests that you subjected it to, and 3) a version of the code that will run on the department computers. Talk to me if you are unsure of what computer language to use.