Due: start of class February 7, 2008

MAS423/AST001 Solar System
Coursework #1

Please write up your solutions, explicitly stating equations, assumptions, approximations used. Also, indicate the values of physical parameters (e.g. $M_\odot$, $M_\oplus$, orbital distances,...etc). Please present your solution in a manner that a student, not quite as advanced as yourself, could easily understand what you have done.

1. (50 marks)
   (a) State Kepler's laws.
   (b) Derive Kepler's laws from Newton's laws of motion and universal gravitation.
2. (50 marks - adapted from D&L Problem 2.4I) In this problem, you will make some calculations which would be useful for planning a spacecraft mission. As a simplifying assumption you may assume the Earth travels in a circular orbit. Express your answers both in km/s and in terms of the escape velocity from the Earth's surface.
   (a) Calculate the minimum velocity relative to the Earth of a small body whose orbit intersects both the Earth's and Mercury's orbit (assume coplanar orbits). This is the so-called 'Δv' needed for a transfer orbit.
   (b) Repeat the above calculation, but for Earth and Jupiter's orbit (again assume coplanar orbits).
   (c) Repeat the above calculation, but for Earth and Mars. orbit (again assume coplanar orbits).
   (d) What is the minimum Δv needed to go into a circular orbit with inclination of $I = 90°$?

   Comment on the relative ease or difficulty of getting to Mercury. If you're curious, go to the Mercury Messenger website and examine the path taken by this spacecraft. Comment on the nature of the route to Mercury.