Astronomy 475/575: Homework 1

Be sure to show your work so that a) I can verify that you solved the problem correctly and b) I can give partial credit even if you don't reach the correct answer.

1. Use the Drake Equation to compute the expected number of planets with advanced civilizations capable of interstellar communication. Do this for the following sitations:
   (a) Assume optimistic values for the various factors in the Equation (using realistic constraints where available). Compute the number of advanced civilizations in the Milky Way and in the entire Universe.
   (b) Assume pessimistic values for the various factors in the Equation (using realistic constraints where available). Compute the number of advanced civilizations in the Milky Way and in the entire Universe.
2. Kepler's Laws.
   (a) Use the Newtonian version of Kepler's Laws to compute the mass of the Sun.
   (b) Use the orbital properties of the moon to compute the total mass of the Earth-Moon system.
   (c) How would you determine the mass of the moon?
   (d) Assume the moon has 1/81 the mass of the Earth. Compute the mass of the Earth.
3. The number of impacts of > 1 km-sized bodies is $\sim 5 \times 10^{-5}$ per year for the moon. The density of large (> 1 km) craters on the moon's surface is $\sim 2 \times 10^{-3}$ km^{-2}. The diameter of the moon is ~ 3500 km.
   (a) Use the above information to estimate the age of the moon.
   (b) Do you think your answer in part (a) is over- or under-estimated? Why?
   (c) Say you wanted to use the same technique to estimate the age of the Earth. What challenges would you face?
4. Which of the following are necessary for habitability? Discuss your reasons why or why not.
   (a) Sun (or star) light.
   (b) Liquid water.

(c) Atmospheric O_2.

(d) Atmospheric ozone.

(e) Solid land.

(f) Abundance of radioactive elements.

(g) A star with a long main-sequence lifetime.