

Astronomy 3: The Solar System Homework #7

Assigned March 4, 2010
DUE THURSDAY, March 11, 2010

For problems requiring math you MUST show your work. Box your final answers and please use scientific notation.

- 1) How does the largest asteroid compare in size to the planets? How does the total mass of all asteroids compare to the mass of a terrestrial world?
- 2) How do primitive meteorites and processed meteorites differ in terms of both composition and origin?
- 3) The star 51 Pegasi has about the same mass as our Sun. A planet discovered orbiting it has an orbital period of 4.23 days. The mass of the planet is estimated to be 0.6 times the mass of Jupiter. Use Kepler's third law to find the planet's average distance (semimajor axis) from its star. (Hint: Because the mass of 51 Pegasi is about the same as the mass of our Sun, you can use Kepler's third law in its original form, $p^2 = a^3$ [Section 3.3]. Be sure to convert the period into years before using this equation.)
- 4) What is Eris? How is it related to Pluto? What evidence suggests that these objects are really just large comets of the Kuiper Belt?
- 5) How does the Doppler technique work? Explain how it can tell us a planet's orbital period, orbital distance, and orbital eccentricity.
- 6) Find the "no greenhouse" temperatures for a comet at distances from the Sun of 50,000 AU (in the Oort cloud), 3 AU, and 1 AU (see Mathematical Insight 10.1). Assume that the comet reflects 3% of the incoming sunlight. At which location will the temperature be high enough for water ice to sublime (about 150 K)?
- 7) How do the orbits of known extrasolar planets differ from those of jovian planets in our solar system? Why are these orbits surprising?
- 8) The star 51 Pegasi is approximately as bright as our Sun and has a planet that orbits at a distance of only 0.052 AU.
 - a. Suppose the planet reflects 15% of the incoming sunlight. Using Mathematical Insight 10.1, calculate its "no greenhouse" average temperature. How does this temperature compare to that of Earth?
 - b. Repeat part (a), but assume that the planet is covered in bright clouds that reflect 80% of the incoming sunlight.
 - c. Based on your answers to parts (a) and (b), do you think it is likely that the conditions on this planet are conducive to life? Explain.