PHYS 1070 3.0 W08/09 Astronomy/Astrophysics I
Assignment #3
Deadline: May 19, 2009.

The solutions must be typed or a penalty will be incurred.

1. Compare the atmospheres of Venus , Earth and Mars. Write a ~¾-page essay with single-line spacing.

2. A hypothetical spherical asteroid with a diameter of 2 km composed of rock with an average density of 2500 kg m^{-3} strikes Earth with a speed of 25 km s^{-1}.
   a) What is the kinetic energy of the asteroid at the moment of impact?
   b) How does that energy compare with the energy of $8.4 \bullet 10^{13}$ J released by a 20-kiloton nuclear bomb, like the bomb that destroyed Hiroshima?

3. Assuming a value for Venus' radius of 6050 km, an albedo of Venus of 0.59, and Venus' distance from the Sun of 0.72 AU, then:
   a) Determine the power , $P_{sq.m}$, of the radiation from the Sun flowing through and area of 1 m^2 facing the Sun with the area located at a distance of Venus of 0.72 AU.
   b) What power , P_{abs}, is absorbed by Venus?
   c) What would Venus' surface temperature, T, be assuming that Venus radiated into space an amount , P_{em} , that is equal to the power it absorbed?
   d) How much warmer is it actually on Venus than what is suggested in c) and what is the reason for the higher temperature?

4. In the late 19th century, Percival Lowell claimed he could see canals on the surface of Mars; long, dark, narrow features. This question looks at the reasonableness of his claim.
   a) What is Mars's angular diameter (in arcseconds) when it is at opposition (i.e., closest approach to Earth)? Be sure to declare your opposition distance.
   b) The smallest angle that Lowell's telescope could resolve (meaning the smallest angle an observer could make out) was 1 arcsecond. This means that Lowell's canals would have had to be at least this wide to have been detected. What is the narrowest width (km) Lowell's putative canals could be, and would these be anything like canals on Earth?

5. A spherical asteroid has an average temperature of 200K, an albedo of 0.2 and a circular orbit around the Sun. Based on your considerations under 3), what is the asteroid's orbital period, P?

6. Using the data on Saturn's moon Titan (e.g. Appendix 3 of *Universe*) determine the mass of Saturn by using the Newtonian version of Kepler's Third Law.