ASTRONOMY 1100. INTRODUCTION TO ASTROPHYSICS

Assignment 2. **Due Date: February 26, 2014.**

1. Suppose that you discover an alien planetary system in which a planet circles the parent star of the system once every 4 years at an average distance from the star of 3 A.U. Calculate the mass of the star relative to the mass of our Sun. [Hint: It is safe to assume that the planet's mass is negligibly small in comparison to the mass of the star.]

2. The bright star Altair in the constellation of Aquila (the Eagle) has a surface temperature of 7400 K. By comparison, the surface temperature of the Sun is 5779 K. Relative to the Sun, how much *more* energy is emitted per second from each square metre of Altair's surface? Show how you reached your answer.

3. During the 1970s and 1980s, balloon-borne instruments detected 511 keV photons coming from the direction of the centre of our Galaxy. (k means *kilo*, or thousand, so 1 keV = 10^3 eV.) What is the wavelength of such photons? In what part of the electromagnetic spectrum do they originate?

4. You are given a traffic ticket for going through a red light (λ = 6500 Å). You tell the judge that because you were approaching the light, the Doppler effect caused a blue shift that made the light appear green (λ = 5000 Å). How fast would you have had to be moving for that to be true? Would the judge be justified in giving you a speeding ticket? Explain.

5. Suppose your Newtonian reflecting telescope has an objective mirror 25 cm in diameter with a focal length of 2 m. What magnification do you get with eyepieces having focal lengths of: (a) 9 mm, (b) 20 mm, and (c) 55 mm? Show how you arrived at your answers. What is the telescope's angular resolution?

6. How large in diameter is the image of the Sun (angular diameter = 30.6 arcminutes) at the focus of a telescope that has an objective with a focal length of 4.5 metres? How large would the image appear (*i.e.* What would be its magnification?) if it were viewed with an eyepiece having a focal length of 12.5 mm? Remember that there are 206265 arcseconds per radian.

7. Suppose that there is a planet in the solar system with a semi-major axis of a = 77.2 A.U., as predicted by the Titius-Bode relation. Calculate how long would it take such a planet to orbit the Sun. Suppose that the planet is an icy object with an albedo A = 0.50, and calculate its corresponding surface temperature. Would such a planet be expected to have an atmosphere? Why or why not?