

HOMEWORK ASSIGNMENT # 1

Due: Tuesday, 15 January

1. a) Determine the average orbital speed of the earth during its revolution around the sun in units of  $\text{km s}^{-1}$ .  
b) The solar system is currently orbiting the center of the galaxy at a speed of  $250 \text{ km s}^{-1}$ . How long will it take to make one revolution?
2. Determine the mass of the sun from the period and radius of the orbit of the earth. Hint: look up the Newtonian form of Kepler's Third Law and remember that the mass of the sun is much greater than that of the earth.
3. Determine the standard parallax formula:  $r(\text{pc}) = 1/\rho(\text{arc sec})$ . This expression is derived for a baseline of 2 AU. Suppose parallax is measured with a smaller baseline consisting of the diameter of the earth. Obtain an equivalent formula. Is there any use for such a formula?
4. Determine the luminosity of the sun if the energy reaching the earth from the sun is  $1400 \text{ W/m}^2$ .
5. What is the absolute magnitude of a main sequence star with distance  $r = 0.1 \text{ Mpc}$  and  $m = +25$ ? What are its luminosity, peak wavelength, and spectral class?
6. Calculate the distance to a main sequence star with  $m = +15$  and spectral class A0.
7. What is the radius (in terms of solar radii) of an A0 main sequence star assuming its surface temperature to be  $10,000 \text{ K}$ ? What is the radius of a white dwarf of the same surface temperature if its luminosity is  $10^{-4}$  that of the sun?
8. Show that the extinction in terms of  $A$  is equal to the optical depth  $\tau$  multiplied by 1.086. Hint: start with the formula  $m_1 - m_2 = A = 2.5 \log_{10} \frac{I_0}{I}$
9. Calculate the wavelength (nm) of the so-called Lyman limit ( $n = \infty \rightarrow n = 1$ ) of atomic hydrogen. This wavelength is the shortest wavelength that stars can emit. What happens if radiation of shorter wavelengths attempts to leave the star?
10. Explain why astronomers can detect the H I 21-cm line from diffuse interstellar material through the whole galaxy while visible spectroscopy of diffuse clouds is confined to nearby clouds.