

## Ay 20: Basic Astronomy and the Galaxy Fall Term 2010

### Problem Set 2

Due on: 20 Oct 2010 by 5pm

*Carroll & Ostlie, An Introduction to Modern Astrophysics*, 2<sup>nd</sup> ed., Addison-Wesley will be referred to as C&O hereafter. I hope everyone can find a copy in the library.

PROBLEM 1: C&O Problem 3.9

PROBLEM 2: C&O Problem 5.1

PROBLEM 3: C&O Problem 8.5

PROBLEM 4: C&O Problem 8.9

PROBLEM 5:

(a) Suppose a stellar photosphere is composed of pure neutral hydrogen. At what temperature is the density of atoms in the  $n=2$  excited state equal to that in the  $n=1$  ground state? (Note: for hydrogen, the statistical weight  $g_n = 2n^2$ ).

(b) Assume our photosphere has a constant electron pressure of  $P_e = 200 \text{ dyne cm}^{-2}$ . At what temperature are the ionized and neutral fractions equal? (Note: the partition functions for HII (ionized hydrogen) and HI (neutral hydrogen) are 1 and 2 respectively.)

PROBLEM 6:

You will soon be preparing an observing proposal for the Palomar 60-inch telescope (P60). Let us get to know the telescope a little better through this problem. Lookup necessary details at the website <http://www.astro.caltech.edu/palomar/60inch.html> to calculate the following quantities:

(a) theoretical diffraction limit in U,B,V wavelength filters (consider only the central wavelength for each of these filters). Note that 60 inches is the diameter of the primary mirror of the telescope.

(b) focal length

(c) plate scale (express your answer in arc-minutes per millimeter)

(d) if the detector can accommodate a maximum image size of 24mm, what is the maximum angular extent of an astronomical object in the sky that can be observed as whole with P60? This is called the field-of-view.

(d) a star of spectral type A0 is to be observed with P60. Calculate the luminosity of this star using Stefan-Boltzmann equation and compare it with the observed value (use data from Appendix G of C&O)

(e) calculate the flux from the star received at earth considering that it lies at a distance 500 pc. This is, of course, the bolometric flux.

(f) how much energy is collected from this star per second by the primary mirror of P60? Assume (falsely) that there is no atmospheric attenuation.

(g) given that its apparent magnitude in V band is 9, what is its absolute V magnitude?