

Problem 1 [6 pts]

Lets go back to again look at problem 7 from assignment #3.

Explain, being as quantitative as you can:

(a) Will the distribution predicted in part (c) be in fact the distribution that actually occurs ? Why or why not ?

(b) Given the result from part (b) why aren't the Paschen series lines (those to/from the $n=3$ state) considered in our treatment of the hydrogen lines we expect to observe ?

(c) In order to calculate N_2/N_{total} needed for estimates of the Balmer series strength, we made the assumption that $N_I = N_1 + N_2$ in order to give us ratios we could easily calculate from the Boltzmann and Saha equations. Justify this assumption.

Problem 2 [5 pts]

In class we used the approximation that nearly all the H-I atoms are in the ground state so that we could estimate the partition function;

$$Z_1 \approx g_1 = 2(1)^2 = 2$$

Verify that this statement is correct for a temperature of 100,000 K by evaluating the first three terms in the partition function.

Problem 3 [5 pts]

Explain clearly why the calcium-II absorption lines in the Sun are about a factor of 400 stronger than the H-I Balmer lines when there is only one calcium atom for every 500,000 hydrogen atoms in the Sun's surface layer.

Problem 4 [6 pts]

Text, Problem 2.7

Problem 5 [3 pts]

Sirius, the brightest appearing star in the night sky, has an apparent bolometric magnitude of; $m_{bol} = -1.55$.

The distance to Sirius is 2.6 pc. Determine the absolute bolometric magnitude of Sirius and compare it with that of the Sun. What is the ratio of Sirius' intrinsic luminosity to that of the Sun ?

Problem 6 [5 pts]

Assuming that 10 eV could be released by every atom in the Sun through chemical reactions, estimate how long the Sun could shine at its current rate through chemical processes alone. For simplicity assume that the Sun is composed entirely of hydrogen. Is it possible that the Sun's energy is entirely chemical ? (You will need to look up the mass and luminosity of the Sun and the mass of a hydrogen atom – given in class and on assignment 1.)