PHY305A
Exercise Set 4

1. Compute the ratio of the number of atoms in the first excited state, N_2, to the total number of neutral atoms, $N_1 + N_2$, at temperatures, 8,000K and 11,000K. Determine also the relative number in the ionized stage, that is, $N_{II}/(N_I + N_{II})$, at these temperatures. Finally, compute $N_2/(N_I + N_{II})$.

2. Using Figure 6.12 in the textbook, we deduce that for the Hyades cluster $M_V \approx V - 3$. Determine the distance to Hyades using this information. Compare with the best estimate of the distance to Hyades, which is equal to 47 pc. Furthermore, estimate the age of the cluster using

$$t = t_{Sun} \left(\frac{L_{Sun}}{L} \right)^{2.5/3.5}$$

   The lifetime of the Sun, t_{Sun}, is approximately 10^{10} years, and the absolute magnitude of a star with $B - V = 0$ is approximately 1.

3 Derive the equation for the age of a cluster given in Problem 2 by using the fact that $L = E/t$, where E is the total energy emitted by a star, and the relationship $L \propto M^{3.5}$. A star generates energy by nuclear fusion. Hence the total energy emitted is proportional to M due to the mass energy relationship, $E = Mc^2$, where c is the speed of light.