Astronomy 45

Introduction to Astrophysics

Problem Set 10 - Due Monday December 3, 2001

1. A star has a density which varies with radius r as $\rho_0(R^2/r^2)$ where R is the stellar radius. Calculate the pressure $P(r)$ as a function of r.

2. Assume the solar luminosity is produced by the conversion of hydrogen to helium. Given that $L_\odot = 3.83 \times 10^{33}$ ergs s^{-1} , how much mass of hydrogen is converted to helium each second?

3. Consider two non-relativistic white dwarfs *with the same central density*, one of which is made of carbon with $\mu_e = 2.00$ and the other of iron with $\mu_e = 2.15$. Which star has the smaller radius and which the smaller mass? Also calculate the ratio of the Chandrasekhar masses of the two stars.

4. The lookback time is the travel time required for light at a red shift z to reach us. Show that for a flat Einstein-De Sitter model it is given by

$$t_{lb} = \frac{2}{3H_0}\left(1 - \frac{1}{(1+z)^{3/2}}\right).$$

What is the lookback time for a quasar at $z = 4$ if one Hubble time is 20 billion years?