Astronomy 45

Introduction to Astrophysics

Problem Set 10 - Due Friday April 27, 2001

1. A star has a constant core density ρ_0 out to a radius R_0. Beyond R_0 out to the stellar radius R, the density varies with radius r as $\rho_0 (R_0^2/r^2)$. Calculate the mass interior to r and obtain the stellar mass in terms of ρ_0, R_0 and R. Write down the equation of hydrostatic equilibrium and calculate the pressure $P(r)$ as a function of the radius r. (The pressure is zero at R and everywhere continuous.)

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.