Intro. Astrophysics II NAME:
HW #4
Due Wed. Feb 25
FOR ALL PROBLEMS, SHOW YOUR WORK

1. Calculate the equilibrium temperature for a spherical blackbody grain located 1 AU from the Sun. What is the temperature of the same grain at 100 AU from the Sun? *(3 points)*

Water ice in a vacuum will sublimate when $T > 150K$. How many AU from the Sun would this be? Assume that $Q_{abs} = Q_{em} = 1$ (this is probably not far from the truth – the reflectivity of comet nuclei is about 4%, due to the contamination by organics). Compare this distance to the orbits of the terrestrial and gas giant planets. *(1 poins)*

2. Suppose we were dealing with just the outermost layers of a star, so that we could use the following approximations:

$M_r = M$

$L_r = L$

If energy transport were due to radiation, such that $\kappa = \kappa_0 \rho T^{-3.5}$ (i.e. a "Kramers Opacity), could you solve for $P_r, \rho_r, and\ T_r$? *(4 points)*

The equations that include $P, \rho, and\ T$ are HE, Radiative Transport, and the ideal gas law.

3. Using the SSM table posted on the class web page, plot X(^{12}C), X(^{14}N) and X(^{16}O) versus M_r/M_Θ. Describe what you see in your plot, and explain the reasons why the mass fractions behave the way that they do for $M(r)/M < 0.9$ in terms of the pre-MS and early post-MS evolution of the Sun. What physically is going on at $M(r)/M \sim 0.95$? *(4 points)*

4. Look at Figures 7.1-7.5 in your textbook. Based on the graphical information in these figures and the rest of Ch. 7, approximately what would be the smallest mass a star could have in order to have any significant CNO processing as a MS or post-MS star? To have He-burning? *(2 points)*