AST 207 Homework 6 Due 26 October 2011 at 3:10.
No late papers will be accepted.

Table 1 The 8 stages in the life of the sun. The size is relative to its size at present. Abbreviations: M for million (10^6) and B for billion (10^9).

		Lifetime	*Temperature*		*Radius*
			Center	*Surface*	
1	Interstellar Cloud	0.1Myr	10K	10K	10^8
2	Protostar	10Myr	1MK	4000K	6
3	Main-sequence Star	10Byr	15MK	5600K	1
4	Red Giant	1.3Byr	50MK	3000–5000K	3–100
5	Helium Burning Star	100Myr	200MK	5000K	10
6	Double Shell-burning Red Giant	20Myr	250MK	3000–5000K	3–500
7	Planetary Nebula	0.1Myr		3000K	1000
	Star in center		300MK	100,000K	0.01
8	White Dwarf (newly formed)		200MK	50,000K	0.01

1. The solar system including the sun is 4.6 billion year old. Consider a carbon nucleus that eventually became part of my hand. That nucleus existed before the sun formed.
    a. (3 pts.) Describe a possible environment of that carbon nucleus 1 billion years ago.
    b. (3 pts.) Describe a possible environment of that carbon nucleus 5 billion years ago.
    c. (3 pts.) Describe a possible environment of that carbon nucleus 8 billion years from now when the sun is dead.
2. The Life of the Sun.
    a. (2 pts.) Why is no lifetime given for the white dwarf stage?
    b. (2 pts.) Why is the central temperature of stages 4, 5, and 6 hotter than that of the present sun?
    c. (not graded) For which of stages 3-7 will the earth be inside the sun? (The earth is 100 solar radii from the sun.) The answer changes over the course of some stages.
    d. (not graded) Scale the lifetimes of Stages 1-7 by a factor of 10^{-10}. For example, the lifetime as a main-sequence star is $10\text{Byr} \times 10^{-10} = 1\text{yr}$. Express your answers in terms of years, months, days, hours, minutes, seconds, whichever yields a small integer. (1 month=0.03yr. 1day=0.0003yr. 1hr=0.0001yr. 1min=2e-6yr. 1s=3e-8yr) Use a scale where 10 Byr is 1 year. (1 pt.) In the scaled time, how old is the sun? (1 pt.) In terms of the scaled time, how long does the shortest stage(s) last?
    e. (not graded) For stages 2-7, how is the sun producing energy?
    f. (4 pts.) Simplicio reasons, "For stage 8, the sun has run out of fuel to burn. Therefore it will not produce any light." Correct Simplicio's misconception, and explain to him why he is wrong.
    g. (not graded) Why is the sun in stage 8 so much smaller than it is now?