AST 301 Homework #6 Due Friday Oct. 17

1. Sketch an HR diagram.

Label the axes with a few numbers and the names of the quantities plotted. Note the location of the Sun on your diagram, the main sequence, the red giants and the white dwarfs.

Draw arrows showing how the location of the Sun on your diagram would change if:

a) its luminosity stayed constant while its temperature increased by a factor of 2

b) its radius stayed constant while its temperature increased by a factor of 2

c) its temperature stayed constant while its radius increased by a factor of 2

The heads of your arrows should show where the Sun will be on the diagram after the luminosity, radius, or temperature changed.

2. Look up the diameter of the Sun and the size of the Astronomical Unit (AU) in your book. When the Sun becomes a red giant, in about 5 billion years, its diameter will increase to about 1 AU.

a) By what factor will the diameter of the Sun change?

(How many times larger will it be?)

b) By what factor will the radius of the Sun change?

c) By what factor will the surface area of the Sun change?

d) If the temperature of the Sun didn't change while becoming a red giant, it would become more luminous simply because it would have a larger surface to radiate light. If the temperature of the Sun didn't change while it diameter increased to 1 AU, by what factor would its luminosity change?

e) In fact, the surface of the Sun will cool from about 6000 K to about 3000 K when it becomes a red giant. By what factor will the power radiated by each square meter of its surface change

f) Now, combine your answers to parts d and e to calculate what the luminosity of the Sun will be when it becomes a red giant. Give your answer in solar luminosities and in Watts.