ASTR 311 STELLAR ASTROPHYSICS
Problem Set #4
(due 30 Sep 11)

Problem #1 Blackbody Radiation

Here's what you "know" about blackbody radiation: brightness as a function of frequency always follows the same functional form, the scaling is a function only of temperature, a higher temperature blackbody (of the same size) emits more radiation at every frequency than one of lower temperature, the frequency of the peak in the brightness distribution is a monotonic function of temperature (Wien's law), the integrated flux is a function of temperature to the 4^{th} power (Stephan's Law). You now know that the thermal equilibrium distribution of radiative intensity is given by the "planckian distribution".

Starting with the functional form of the planckian:

a) derive (for both frequency and wavelength), the Wien displacement rule
b) derive Stephan's law
c) evaluate the Stephan-Boltzman constant (i.e. calculate its numerical value)
d) Show that the brightness of a blackbody at a given temperature is higher at all frequencies than that for a body at a lower temperature.

Carry out your derivations analytically as far as possible. It might be necessary in the last step to solve an equation numerically. Feel free to use Mathematica, trial and error, or any other method for the numerical solution (but not for deriving the basic functional form).