Astro 112 – Physics of Stars
Problem Set #1, Spring 2017
Due Wednesday, April 12, 2017

1) The average person has 1.5 m^2 of skin, at a skin temperature of roughly 92 °F. Consider the average person to be an ideal radiator standing in a room at a temperature of 68 °F.

a) Calculate the energy per second radiated by the average person in the form of blackbody radiation. Express your answer in Watts.
b) Determine the peak wavelength λ_{max} of the blackbody radiation emitted by the average person. In what region of the electromagnetic spectrum is the wavelength found?
c) A blackbody also absorbs energy from its environment, this case from the 68 °F room. The equation describing the absorption is the same as the equation describing the emission of blackbody radiation. Calculate the energy per second absorbed by the average person.
d) Calculate the net energy per second lost be the average person due to blackbody radiation.

2) The total flux that we receive from the Sun is known as the "Solar Constant." How close must one be to a 100 Watt light bulb to receive this same flux?

3) As written in class, the Planck function can be written in terms of

intensity/time/area/steradian/**wavelength**, B_λ, or in terms of intensity/time/area/steradian/**Hz**, B_ν.

Wien's displacement law ($\lambda_{max}T$=2.898 x 10^{-3} mK) can be derived from the B_λ Planck function.

a) Use the B_ν Planck function equation to find an expression for the frequency ν_{max} at which the Planck function B_ν attains its maximum value. This is the frequency equivalent of Wien's law. Warning—don't just simplify Wien's law ($\lambda_{max}T$=2.898 x 10^{-3}) because: ν_{max} does not equal c/λ_{max}.
b) Why does ν_{max} not equal c/λ_{max}?
c) What is the value of ν_{max} for the Sun?

4) Consider a model of a star consisting of a spherical blackbody with a surface temperature of 25,000 K and a radius of 5.0 x 10^{11} cm. This star is at 100 pc from Earth. Determine the following:

a) luminosity
b) absolute bolometric magnitude (M_{bol} for the Sun is 4.75)
c) apparent bolometric magnitude
d) flux at the star's surface
e) flux at the Earth's surface compared to that from the Sun
f) peak wavelength λ_{max}