Name(s): PHY-222 (Fall 2018), 09/26/18

Homework Assignment #3

(*Due Date*: Mon, 10/08, 04:10 pm, in class; Show all your work for full/partial credit)

3.1 *Blackbody Radiation* (cf. Prob. 3.2 in textbook) *(2 pts.)*
The temperature of the human skin is about $35°C$.

(a) At what intensity and peak wavelength does a human emit blackbody radiation? What are the corresponding radiation frequency and photon energy?

(b) How much energy does a human emit during 12 hours (assume a surface area of $2m^2$)? How many photons at the peak wavelength does that correspond to?

3.2 *Sun's Radiation* *(1 pts.)*
Assuming an average wavelength of $500\,nm$ for the Sun's radiation, calculate the average photon energy (in eV) and the Sun's surface temperature (in K).

3.3 *Classical Limit of Planck's Formula* *(1 pts.)*
Show that in the limit of small frequencies Planck's formula for the spectral energy density of a blackbody recovers the classical Rayleigh-Jeans expression.

3.4 *Photoelectric Effect* (cf. Prob. 3.18 in textbook) *(3 pts.)*
Ultraviolet light of wavelength $120\,nm$ is incident on an unknown metal. The stopping voltage for the cathode current is found to be $3.98\,V$.

(a) Find the maximum energy (in eV) and speed of the emitted electrons.

(b) Identify the metal by calculating its workfunction (and check a suitable table).

(c) Calculate the cutoff wavelength (in nm) of incoming light if the voltage is (slightly) positive.

3.5 *Compton Effect* (cf. Prob. 3.36 in textbook) *(3 pts.)*
A photon Compton-scatters, bouncing off with an energy of $110\,keV$ after the collision, while the elctrons recoil with a kinetic energy of $32\,keV$. Calculate

(a) the wavelength of the incident photon (in nm).

(b) the scattering angle of the photon.

(c) the electron's recoil angle relative to the incoming photon momentum.