Assignment XI, HONS 158 (Honors Physics II)
Spring 2016
Due 4/20/16 at start of class

As always, please put your answers on separate paper.

1. Two 85 kW radio stations broadcast at different frequencies. Station A broadcasts at a frequency of 892 kHz, and station B broadcasts at a frequency of 1410 kHz.
   a) Which station emits more photons per second? (Explain/justify your answer).
   b) Which station emits photons of higher energy?
2. What is the wavelength of a photon that has the same momentum as an electron moving with a speed of 1200 m/s? (Ignore relativistic effects).
3. The work function of Molybdenum is 4.22 eV.
   a) What is the smallest frequency that will emit a Photoelectron from Molybdenum?
   b) Will yellow light of wavelength 560 nm cause ejection of photoelectrons from Molybdenum? (Justify your answer with a calculation).
   c) What would the stopping potential be for Molybdenum illuminated with UV light of wavelength 150 nm?
4. A photoelectric experiment with Cesium yields stopping potentials for $\lambda = 435.8$ nm and $\lambda = 546.1$ nm to be 0.95 V and 0.38 V, respectively. Using these data only, find an experimental value for h and use it to find the threshold frequency and work function for Cesium.
5. I have a ping-pong ball in my office. It has a diameter of 40 mm (regulation size because that's how I roll). Let's pretend that I painted it black and it is, for our purposes, a perfect blackbody.
   a) Assume my office is kept at a constant temperature of 293K. How much energy does the ball emit in a year? (You may assume that the ball stays in thermal equilibrium at all times).
   b) What is the peak wavelength of the blackbody emission from the ping-pong ball?
6. Calculate the de Broglie wavelengths of the following:
   a) An electron with kinetic energy 13.6 eV. (Convert this to Joules!)
   b) The Earth. (Assume that the sun is stationary. You may have to google some stuff).
   c) An average Sodium atom in an ideal gas at 500 pK. (The average speed of a molecule in an ideal gas can be computed via $v_{\text{avg}} = \left(\frac{8kT}{\pi m}\right)^{1/2}$ with k the Boltzmann constant 1.38×10^{-23} J/K. A picoKelvin is 1×10^{-12} K). Sodium has an atomic mass of 22.990, which means that the mass of a Sodium atom is about $0.02299 \text{ kg}/6.022 \times 10^{23} \approx 3.82 \times 10^{-26}$ kg.