Mini-Finale for 232 lab

Name:________________________________________________

Notice the Due Date for this Final.

Due Date: April 24th, 2007: No Exceptions by 10:00 p.m.

I. Easy Questions:

1. A certain sensor is exposed for 0.8 seconds to a 340 watt lamp that is
   about 15.2 meters away. The sensor itself has an opening that is
   22.5mm in diameter. How many photons will enter the sensor? You
   can assume that the wavelength of the emitted light is of order 442 nm.

2. Assume that light of wavelength around 480 nm strikes the surface of
   some metal that causes some of the electrons to have a stopping
   potential of 0.89 volts. What is the work function of the metal
   surface? What is the threshold frequency? What stopping potential is
   needed if the wavelength is decreased to 150nm?

3. Assume that you have a sample of radioactive material that is initially
   found to have an activity of 235 decays per minute. After 1 week the
   activity is measured to be around 42.5 decays per minute. What is the
   half-life of the material? How long will it take to reach a decay of 0.5
   decays per minute or close to a background radiation count?

II. More Challenging Questions

Problem 4:

(a) What is the wavelength of a 13 eV electron and what is the energy of a
    photon with this same wavelength?
(b) Light with a wavelength of 310 nm strikes a metal whose work function is
    2.2 eV. What is the shortest de Broglie wavelength for the electrons that are
    produced as photoelectrons?
(c) A surface is irradiated with monochromatic light whose wavelength can be
    varied. Above a wavelength of 500 nm, no photoelectrons are emitted from
    the surface. With an unknown wavelength, a stopping potential of 3V is
    necessary to eliminate the photoelectric current. What is the unknown
    wavelength?

Problem 5:

(a) Compare the intensity of a light bulb at a distance of 4 m from it to the
    intensity at 1 m from it. Repeat this comparison for laser light. Explain fully
    but briefly.
(b) Compute the electric field corresponding to a focused light intensity of \( I = 10^{12} \text{W/cm}^2 \), and compare the result with the electric field experienced by the
    electron in a Hydrogen atom.