Physics 200 Problem Set 6

Problem 1

Estimate how many photons enter your eye per second if you are looking in the direction of the sun on a clear day. (Hint: it may be helpful to look up the flux of energy from the sun at the surface of the Earth).

Problem 2

Color-Blind Cathy carries a metal bar around with her to help distinguish electromagnetic radiation of different wavelengths. She heads down to "The Monochrome," a trendy bubble-tea joint with various rooms illuminated by light of a single wavelength. She goes in the 650nm room, and notices electrons being emitted from her metal bar. Later, she moves to the 600nm room, where electrons are emitted with a maximum kinetic energy that is twice as much as in the first room. Finally, she moves to a third room, where her bar emits electrons whose maximum kinetic energy is three times the energy of the speediest electrons in the first room. What is the wavelength of the light in the third room?

Problem 3

An experimenter finds that a cold gas of atomic helium starts to ionize (i.e. electrons are freed from the atoms) when it is illuminated with a low-intensity beam of light whose wavelength is less than 50.4nm. Using this information, determine the mass of a He^+ ion in terms of the mass M_{He}, of a Helium atom, the mass m_e of an electron, and some energy expressed in electron volts (e.g. $M_{He^+} = m_e + M_{He} + 10000eV/c^2$ (not the right answer)).

Problem 4

a) The photoelectric effect simulation that I'll do in class may be found on the "Resources" section of the course website. In the simulation, select the sample labeled ????? in the pull-down menu in the box labeled Target (at the upper right). Using the simulation, determine the work function of this metal. Explain how you obtain your result.

b) Make a rough graph of how the current of the electrons behaves as you increase the wavelength from 100nm up to the wavelength where the electrons stop being emitted (keep the voltage at zero and the intensity fixed). Give a possible explanation for the shape of the curve you find.