Phsx 2220 - Homework #12

39-1. Under ideal conditions, the human eye will record a visual sensation for light whose wavelength is 550 nm if energy is transferred to the eye at a rate as low as 100 photons per second. To what power does this correspond?

39-2. The work functions for potassium and cesium are 2.25 and 2.14 eV, respectively. (a) Will the photoelectric effect occur for either of these elements with incident light of wavelength 565 nm? (b) With light of wavelength 518 nm?

39-3. Find the maximum kinetic energy of electrons emitted from a certain material if the material's work function is 2.3 eV and the frequency of the incident radiation is 3.0×10^{15} Hz.

39-4. (a) If the work function for a certain metal is 1.8 eV, what is its stopping potential for light of wavelength 400 nm? (b) What is the maximum speed of electrons emitted via the photoelectric effect as they leave the metal surface?

39-5. A certain x-ray beam has a wavelength of 35.0 pm. (a) What is the corresponding frequency? Calculate the corresponding (b) photon energy and (c) photon momentum.

39-6. Light of wavelength 2.4 pm falls on a target containing free electrons. (a) Find the wavelength of light scattered at 30^{o} from the incident direction. (b) Do the same for a scattering angle of 120^{o}.

39-7. In an ordinary television set, electrons are accelerated through a potential difference of 25.0 kV. What is the de Broglie wavelength of such electrons? (Ignore relativistic effects.)

39-8. The uncertainty in the position of an electron is given as 50 pm, which is about equal to the radius of a hydrogen atom. What is the least uncertainty in any simultaneous measurement of the momentum of the electron?

40-9. What is the ground-state energy of (a) an electron and (b) a proton if each is trapped in an infinite potential well that is 100 pm wide?

40-10. Consider an atomic nucleus to be equivalent to an infinite potential well with $L = 1.4 \times 10^{-14}$ m, a typical nuclear diameter. What would be the ground-state energy of an electron if it were trapped in such a potential well? (Note: Nuclei do not actually contain electrons.)

40-11. What are the (a) energy, (b) the magnitude of the momentum, and (c) the wavelength of a photon emitted when a hydrogen atom undergoes a transition from a state with n = 3 to a state with n = 1?

40-12. A hydrogen atom is excited from its ground state to the state with n = 4. (a) How much energy must be absorbed by the atom? (b) Calculate and display on an energy level diagram the different photon energies that may be emitted as the atom returns to the ground state.