Physics 1214, Homework #10 (due 12/5)

M1 Light falling on a metal surface causes electrons to be emitted from the metal by the photoelectric effect. As we increase the frequency of the light, but do not vary anything else (there may be more than one correct answer),

    A. The number of electrons emitted from the metal increases.

    B. The maximum speed of the emitted electrons increases.

    C. The maximum speed of the emitted electrons does not change.

    D. The work function of the metal increases.

M2 A photon of wavelength λ has energy E. If its wavelength were doubled, its energy would be

    A. $4E$.

    B. $2E$.

    C. $E/2$.

    D. $E/4$.

M3 If the Bohr radius of the $n = 2$ state of a hydrogen atom is R, then the radius of the ground state is

    A. $4R$.

    B. $2R$.

    C. $R/2$.

    D. $R/4$.

M4 Electron A has a de Broglie wavelength λ. If electron B has twice the kinetic energy (but a speed much less than that of light) of electron A, the de Broglie wavelength of electron B is

    A. 2λ.

    B. $\lambda\sqrt{2}$.

    C. $\lambda/\sqrt{2}$.

    D. $\lambda/2$.

Problems

P1 A telescope with angular magnification -200 is adjusted for a relaxed eye when the two lenses are 67 cm apart. What are the focal lengths of the objective and the eyepiece?

P2 Find the wavelengths of a photon and an electron that have the same energy of 50 eV. (The energy of the electron is its kinetic energy.)

P3 A sample of hydrogen atoms is excited in such a way that all electrons in atoms are positioned in the $n = 4$ level. Then the sample is left to itself, and electrons eventually transit to the ground level. How many lines will be observed in the emission spectrum? What are their wavelengths? Hint: the transition to the ground level may occur either directly $(4 \rightarrow 1)$ or in more than one step (e.g. $4 \rightarrow 3 \rightarrow 1$).

P4 For $n = 5$, $l = 3$, what are the possible values of m_l and m_s? How many electrons can be in the $n = 5$, $l = 3$ subshell?