PHYS-1200 PHYSICS II

HOMEWORK #20 SOLUTIONS

42. (a) Using Table 38-3 and the fact that hc = 1240 eV·nm, we obtain

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2m_e K}} = \frac{hc}{\sqrt{2m_e c^2 K}} = \frac{1240\text{eV}\cdot\text{nm}}{\sqrt{2(511000\text{eV})(1000\text{eV})}} = 0.0388\text{nm}.$$

(b) A photon's de Broglie wavelength is equal to its familiar wave-relationship value. Using the fact that hc = 1240 eV·nm,

$$\lambda = \frac{hc}{E} = \frac{1240\,\text{eV}\cdot\text{nm}}{1.00\,\text{keV}} = 1.24\,\text{nm}\ .$$

(c) The neutron mass may be found in Appendix B. Using the conversion from electronvolts to Joules, we obtain

$$\lambda = \frac{h}{\sqrt{2m_n K}} = \frac{6.63\times10^{-34}\ \text{J}\cdot\text{s}}{\sqrt{2(1.675\times10^{-27}\ \text{kg})(1.6\times10^{-16}\text{J})}} = 9.06\times10^{-13}\,\text{m}.$$

64. (a) Using the fact that $hc = 1240\text{nm}\cdot\text{eV}$, we have

$$E = \frac{hc}{\lambda} = \frac{1240\ \text{nm}\cdot\text{eV}}{10.0\times10^{-3}\ \text{nm}} = 124\ \text{keV}\ .$$

(b) The kinetic energy gained by the electron is equal to the energy decrease of the photon:

$$\Delta E = \Delta\left(\frac{hc}{\lambda}\right) = hc\left(\frac{1}{\lambda} - \frac{1}{\lambda+\Delta\lambda}\right) = \left(\frac{hc}{\lambda}\right)\left(\frac{\Delta\lambda}{\lambda+\Delta\lambda}\right) = \frac{E}{1+\frac{\lambda}{\Delta\lambda}}$$

$$= \frac{E}{1+\frac{\lambda}{\lambda_C(1-\cos\phi)}} = \frac{124\text{keV}}{1+\frac{10.0\text{pm}}{(2.43\text{pm})(1-\cos 180^\circ)}}$$

$$= 40.5\text{keV}.$$

(c) It is impossible to "view" an atomic electron with such a high-energy photon, because with the energy imparted to the electron the photon would have knocked the electron out of its orbit.

79. The uncertainty in the momentum is

$$\Delta p = m\,\Delta v = (0.50\text{ kg})(1.0\text{ m/s}) = 0.50\text{ kg·m/s},$$

where Δv is the uncertainty in the velocity. Solving the uncertainty relationship $\Delta x \Delta p \geq \hbar$ for the minimum uncertainty in the coordinate x, we obtain

$$\Delta x = \frac{\hbar}{\Delta p} = \frac{0.60\text{ J}\cdot\text{s}}{2\pi(0.50\text{ kg}\cdot\text{m/s})} = 0.19\text{ m}.$$

***Q39.02** **a. $\psi(x)=\sqrt{(1/L)}\sin((\pi/2L)x)$**

b. $\psi(x)= \sqrt{(4/L)}\sin((2\pi/L)x)$

c. $\psi(x)= \sqrt{(2/L)}\sin((\pi/L)x)$

***Q39.04** **a. 1/4**

b. By some other factor, depending on the quantum number.

***Unconfirmed answers, please comment on correctness if other solutions are found.**