Homework Solution
Chapter 4

Pb # 8.

$$\frac{1}{2} m v^2 = eV \quad (\Delta U = \Delta K.E)$$

$$\frac{m^2 v^2}{2m} = eV \quad \text{or} \quad \frac{p^2}{2m} = eV$$

The de Broglie wavelength of the electron is related to its momentum through

$$\lambda = \frac{h}{p} \quad \text{where } h \text{ is Planck's Constant}$$

$$\Rightarrow \frac{p^2}{2m} = \frac{h^2}{2m\lambda^2} = eV \Rightarrow \lambda = \sqrt{\frac{h^2}{2me\,V}}$$

$$\lambda = \sqrt{\frac{(6.63\times10^{-34})^2}{2(9.1\times10^{-31})(1.6\times10^{-19})V}} = \frac{1.229\times10^{-9}}{\sqrt{V}}\ (m)$$

or $\boxed{\lambda = \frac{1.229}{\sqrt{V}}}$ (nm) where V is in volts.

Pb # 11.

Since $\lambda = 10^{-14}$ m, then the momentum of the electron is

$$p = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{1\times10^{-14}} = 6.63\times10^{-20}\ Kg\cdot\frac{m}{s}$$

$$K = E - m_0 c^2 \quad (\text{relativistic kinetic energy})$$

$$E = \sqrt{p^2c^2 + m_0^2 c^4}$$