2.10 (*a*) The de Broglie wavelength of an electron is 85 Å. Determine the electron energy (eV), momentum, and velocity. (*b*) An electron is moving with a velocity of 8×10^5 cm/s. Determine the electron energy (eV), momentum, and de Broglie wavelength (in Å).

a) Per (2.2), $p = \frac{h}{\lambda} = \frac{6.62607 \times 10^{-34}}{85 \times 10^{-10}}$

$$p = 7.7954 \times 10^{-26} \text{ kg m/s}$$

$$v = \frac{p}{m_0} = \frac{7.7954 \times 10^{-26}}{9.1093837 \times 10^{-31}} \Rightarrow v = 85{,}575.2 \text{ m/s}$$

$$K.E. = T = \tfrac{1}{2} m_0 v^2 = \tfrac{1}{2}(9.1093837 \times 10^{-31}) 85{,}575.2^2$$

$$T = 3.335 \times 10^{-21} \text{ J} \left(\frac{1 \text{ eV}}{1.60218 \times 10^{-19} \text{ J}}\right)$$

$$T = 0.02082 \text{ eV} = 20.818 \text{ meV}$$

b) $v = 8 \times 10^5 \text{ cm/s} = 8000 \text{ m/s}$

$$K.E. = T = \tfrac{1}{2} m_0 v^2 = \tfrac{1}{2}(9.1093837 \times 10^{-31}) 8000^2$$

$$T = 2.915 \times 10^{-23} \text{ J} = 1.819 \times 10^{-4} \text{ eV}$$

$$p = m_0 v = 9.1093837 \times 10^{-31}(8000)$$

$$p = 7.2875 \times 10^{-27} \text{ kg m/s}$$

Per (2.3), $\lambda = \frac{h}{p} = \frac{6.62607 \times 10^{-34}}{7.2875 \times 10^{-27}}$

$$\lambda = 9.0924 \times 10^{-8} \text{ m} = 909.24 \text{ Å}$$