PC2232: Physics for Electrical Engineers

Tutorial 5 Answers

1. (a) $\lambda_p = 62\text{nm}$
   $\lambda_e = 0.275\text{nm}$

   (b) $E_p = 4.97\text{eV}$,
   $E_e = 2.4 \times 10^{-5}\text{eV}$

   (c) Electron microscope is less damaging
   $$\lambda \approx \frac{d}{2}$$

2. (a) $\Delta p \geq 9.8 \times 10^{-25}\text{kgms}^{-1}$

   (b) $E = 3.09 \times 10^{-5}\text{eV}$

   (c) $E_T = 50.7\text{J}$

   (d) $h = 5.17\text{m}$

3. (a) $\lambda = 0.275\text{nm}$

   (b) $|\Psi(x)|^2 = 1600$ electrons per second

   (c) $|\Psi(x)|^2 = 400$ electrons per second

4. (a) $\theta_1 = 2.07^\circ$
   $\theta_2 = 4.14^\circ$

   (b) $d = 1.8\text{cm}$

5. (a) $p = \dfrac{\hbar}{a}$

   (b) $E = \dfrac{1}{2a}\left(\dfrac{\hbar}{ma} - \dfrac{e^2}{2\pi\varepsilon_0}\right)$

   (c) $a = \dfrac{4\pi\varepsilon_0\hbar^2}{me^2} = \dfrac{\varepsilon_0 h^2}{\pi me^2}$

6. (b) When $K \ll mc^2$ $\quad \lambda = \dfrac{h}{p}$

   When $K \gg mc^2$ $\quad \lambda = \dfrac{hc}{K}$

   (c) $\lambda = 1.58 \times 10^{-16}\text{m}$

   (d) $\lambda = 4.87 \times 10^{-14}\text{m}$