Physics 2D Quiz 5 Solutions #1 p.1

$\bar{e}$, accelerated through 8kV, non relativistic

(a) What is the momentum?

Conservation of energy:

$$|qV| = \tfrac{1}{2}mv^2 = \frac{p^2}{2m} \Rightarrow p = \sqrt{2m|qV|}$$

$$p = \sqrt{2 \times 9.1\times10^{-31}\,kg\,|-1.6\times10^{-19}\,C \cdot 8000V|} = \boxed{4.83\times10^{-23}\,kg\,m/s}$$

(b) $$\lambda = \frac{h}{p} = \frac{6.626\times10^{-34}\,Js}{4.83\times10^{-23}\,kgm/s} = \boxed{1.37\times10^{-11}\,m}$$

#2 p.1

mysterious jungle where $h = 50\,Js$

$\Delta x \simeq 4m$, $m = 100kg$

(a) What is the minimum uncertainty in v?

$\Delta x \Delta p \geq \hbar/2$, minimum uncertainty $\Rightarrow \Delta x \Delta p = \hbar/2$

$\Delta p = m\Delta V$ (we know the mass exactly).

Therefore, we have $\Delta V = \frac{\hbar}{2m\Delta x} = \frac{h}{4\pi m \Delta x}$

$$\Delta V = \frac{50\,Js}{4\pi(100kg)(4m)} = \boxed{9.95\times10^{-3}\,m/s}$$

(b) $\Delta x = \Delta V t = (9.95\times10^{-3}\,m/s)(10s) = \boxed{9.95\times10^{-2}\,m}$