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Engineering Physics

Tutorial - 5

1) $\lambda = \frac{hc}{\sqrt{2 \times 0.65 \times 10^3 \times 1.6 \times 10^{-19} \times 80 \times 1.6 \times 10^{-19}}} = 1.22 \text{ Å}$

$V_g = \frac{h}{m\lambda} = \frac{6.63 \times 10^{-34} \times c^2}{0.65 \times 1.6 \times 10^{-19} \times 10^3 \times 1.22 \times 10^{-10}} = 4.7 \times 10^6 \text{ m/s}$

2) $\Delta x = 8.5 \times 10^{-14} \text{ m}$

$\Delta x \cdot \Delta P \geq \frac{h}{4\pi}$

$\Delta P = \frac{h}{4\pi \times \Delta x}$

$= \frac{6.6 \times 10^{-34}}{4\pi \times 8.5 \times 10^{-14}}$

$= 0.061 \times 10^{-20} \text{ kgm/s}$

8) $V = 400 \text{ m/s}$, accuracy $= 0.01\%$

$\Delta V = \frac{0.01}{100} \times 400 = 0.04$

$\Delta P = m\Delta V = 0.04 \times 9.1 \times 10^{-31} = 3.64 \times 10^{-32}$

$\Delta x \cdot \Delta P \geq \frac{h}{4\pi}$

$\Delta x = \frac{h}{4\pi \times 3.64 \times 10^{-32}} = \frac{6.63 \times 10^{-34}}{4\pi \times 3.64 \times 10^{-32}}$

$\therefore \Delta x = 1.45 \text{ mm}$

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3) V = 10 kV,
$d = 5.5 \times 10^{-11}$ m

$$\lambda = \frac{h}{\sqrt{2meV}} = \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 9.1 \times 10^{-34} \times 1.6 \times 10^{-19} \times 10 \times 10^{3}}} \quad \therefore \lambda = 12.27 \text{ A}$$

∴ By Bragg's law,

$$2d\sin\theta = n\lambda$$

$$\theta = \frac{12.27}{2 \times 55}$$

$$\theta = 6.31^{\circ}$$

5) $d = 4\text{A}^{\circ} = 4 \times 10^{-10}$ m

$$d = \frac{h}{p}$$

$$\therefore p = \frac{h}{d} = \frac{6.63 \times 10^{-34}}{4 \times 10^{-10}} = 1.65 \times 10^{-24}$$

7) $d = 1.65\ \text{A}^{\circ}$

$$d = \frac{h}{\sqrt{2eV_m}}$$

$$1.65 \times 10^{-10} = \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 1.6 \times 10^{-19} \times V \times 9.1 \times 10^{-31}}}$$

$$\therefore V = 55.05\ \text{V}$$

∴ Potential difference = 55.05 V

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4) $\lambda = \frac{h}{\sqrt{2mK}} = \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 1836 m^2 c^2}}$

$\therefore \lambda = 4 \times 10^{-14} m = 0.0004 A^{\circ}$