AS 2D06 Quiz #7 | Solutions

1. beams → same energy / sec (watts) on screen

- red photon : $E_r = \frac{hc}{\lambda_r}$
- Violet photon : $E_v = \frac{hc}{\lambda_v}$

$\left.\right\}$ $\lambda_r < \lambda_v \Rightarrow E_r > E_v$

$\therefore \quad N_v > N_r \rightarrow$ (b) is correct answer.

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2. (b) since $\Delta x \cdot \Delta p \sim \hbar$

$\Rightarrow \Delta x \sim \frac{\hbar}{\Delta p}$, but $\hbar \ll 1 \quad (\sim 10^{-34}\ J\cdot s)$

$\therefore$ Δx is negligible.

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3. $E_1 = -13.6\ eV \ , \quad E_4 = -\frac{13.6\ eV}{16} = -0.85\ eV$

$\therefore \quad E_{photon} = E_4 - E_1 = hf \quad \Rightarrow \quad f = 3.1 \times 10^{15}\ Hz$

and $\lambda = \frac{c}{f} = 9.7 \times 10^{-8}\ m$

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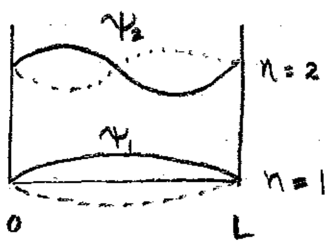
4. (a) $E_n = \frac{n^2 h^2}{8mL^2} \quad \Rightarrow \quad E_1 = \frac{h^2}{8mL^2} = 13.6\ eV \left(\frac{1.6 \times 10^{-19} J}{1\ eV} \right)$

$\therefore \ L = \sqrt{\frac{h^2}{8 \cdot m \cdot (2.2 \times 10^{-18})}} = 1.7 \times 10^{-10}\ m$

(b)



where $\psi_n = A \sin \frac{n\pi x}{L}$

Probability of electron at $x \propto |\psi_n(x)|^2$

$\therefore \ n=1$: most likely at $L/2$

$n=2$: most likely at $\frac{L}{4}$ and $\frac{3L}{4}$

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5. (a) $\frac{n^2 h^2}{8mL^2} = E_n \quad \Rightarrow \quad \frac{n^2}{(n+1)^2} = \frac{32.9}{51.4} \Rightarrow n = 0.8(n+1) \Rightarrow n = 4$ and $n+1 = 5$

(b) $\Delta E = 51.4 - 32.9\ MeV = 2.96 \times 10^{-12}\ J = \frac{hc}{\lambda}$

$\Rightarrow \lambda = 6.7 \times 10^{-14}\ m$

(c) Use $E_4 = 32.9\ MeV = \frac{16\ h^2}{8mL^2} \Rightarrow m = 1.67 \times 10^{-27}\ kg$

$\Rightarrow$ neutron or proton.