Practice Quiz 4 #2 PHYS 1Cb

1. Ans. D

Energy in 1 second $= E = P \cdot A \cdot \Delta t = 4\times10^{-11} \times 70 \times \left(\frac{8.5\times10^{-3}}{2}\right)^2 \times 1$

$= 2.27\times10^{-15}\ (J)$ $\because E = n\cdot hf = n\cdot h\frac{c}{\lambda}$, n is the number of photons

$\therefore n = \frac{E\lambda}{hc} = \frac{2.27\times10^{-15}\times500\times10^{-9}}{6.626\times10^{-34}\times3\times10^{8}} = 5710$ photons //

2. Ans. A

$\phi = hf_{cutoff} = h\cdot\frac{c}{\lambda_{cutoff}} \Rightarrow \lambda_{cutoff} = \frac{hc}{\phi} = \frac{6.626\times10^{-34}\times3\times10^{8}}{4.2\times1.6\times10^{-19}} = 2.95\times10^{-7}\ (m)$ //

3. Ans. B

$\lambda_{electron} = 10^{-11}\ m = \frac{h}{p} = \frac{6.626\times10^{-34}}{p} \Rightarrow \therefore p = 6.626\times10^{-23}\ kg\cdot m/s$

$\Rightarrow E = \frac{p^2}{2m} = \frac{(6.626\times10^{-23})^2}{2\times9.11\times10^{-31}} = 2.41\times10^{-15}\ (J) = 1.51\times10^{3}\ eV$ //

4. Ans. A

$\Delta E = E_4 - E_1 = \frac{h^2}{8mL^2}(4^2-1^2) = 15\times\frac{(6.626\times10^{-34})^2}{8\times9.11\times10^{-31}\times(0.1\times10^{-9})^2} = 9.04\times10^{-17}\ (J)$

$\Delta E = h\cdot f = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{\Delta E} = \frac{6.626\times10^{-34}\times3\times10^{8}}{9.04\times10^{-17}} = 2.20\times10^{-9}\ (m)$ //

5. Ans. B

$\Delta E = h\cdot f = \frac{hc}{\lambda} = \frac{h^2}{8mL^2}(2^2-1^2) \Rightarrow \frac{c}{\lambda} = 3\cdot\frac{h}{8mL^2}$

$\therefore L = \sqrt{\frac{3\lambda h}{8mc}} = \sqrt{\frac{3\times694.3\times10^{-9}\times6.626\times10^{-34}}{8\times9.11\times10^{-31}\times3\times10^{8}}} = 7.95\times10^{-10}\ (m) \approx 0.8\ nm$ //

6. Ans. D

$E_6 - E_3 = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{520\times10^{-9}} = 3.82\times10^{-19}\ (J)$

$E_7 - E_3 = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{410\times10^{-9}} = 4.85\times10^{-19}\ (J)$

$\therefore E_7 - E_6 = (4.85-3.82)\times10^{-19} = \frac{6.626\times10^{-34}\times3\times10^{8}}{\lambda}$

$\Rightarrow \lambda = 1.93\times10^{-6}\ (m) = 1.93\ \mu m$ //

7. Ans. B

$E_4 = -0.85\,eV$

$E_3 = -1.51\,eV$

$E_2 = -3.4\,eV$

$E_1 = -13.6\,eV$

$E_n = -13.6\frac{1}{n^2}\ (eV)$ To ionize the atom,

$E_{input} \geq |E_n| \Rightarrow 2.28 \geq 13.6\frac{1}{n^2} \Rightarrow n \geq 2.44$

$\therefore$ The atom in the states $n \geq 3$ can be ionized //

8. Ans. D

$4d \Rightarrow n=4, \ell=2 \quad \therefore L = \sqrt{\ell(\ell+1)}\hbar = \sqrt{6}\cdot\frac{6.626\times10^{-34}}{2\pi} = 2.58\times10^{-34}$ J.s //

9. Ans. D

$\Delta E = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times 3\times10^{8}}{1090\times10^{-9}} = 1.82\times10^{-19}(J) = 1.14$ eV

$E_n = E_6 - \Delta E = -0.38 - 1.14 = -1.52$ eV $= E_3$

$\therefore$ final state is $n=3 \Rightarrow \ell = 0,1,2 \Rightarrow \ell=2$ gives maximum L

$\Rightarrow L_{max} = \sqrt{\ell(\ell+1)}\hbar = \sqrt{6}\times\frac{6.626\times10^{-34}}{2\pi} = 2.58\times10^{-34}$ (J.S) //

10. Ans. E

$n=1$ has 2 electrons. $\quad 8+2=10$ //

$n=2$ has 8 electrons $\quad 1s^2 2s^2 2p^6 \rightarrow Ne$