Daily Tutorial Sheet 1	JEE Main (Archive)

1.(AB) Nucleus is composed of neutrons and protons.

2.(C) According to Heisenberg uncertainty principle,

$$\Delta x \cdot m\Delta v = \frac{h}{4\pi}$$

$$\Delta v = \frac{6.6\times10^{-34}\times1000}{4\times3.14\times25\times10^{-5}}$$

$$\therefore \qquad \Delta v = 2.1\times10^{-28}\,m\,s^{-1}$$

3.(A) 2nd excited state will be the 3rd energy level.

$$E_n = \frac{13.6}{n^2}eV \text{ or } E = \frac{13.6}{9} = 1.51\,eV$$

4.(A) $\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}\times1000}{60\times10}m$

$= 11.05\times10^{-34}m = 1.105\times10^{-33}$ metres.

5.(B) The electron has minimum energy in the first orbit and its energy increases as n increases. Here n represents number of orbit, i.e. 1st, 2nd, 3rd.... The third line from the red end corresponds to yellow region i.e., 5. In order to obtain less energy electron tends to come in 1st or 2nd orbita. So jump involved may be either $5\rightarrow1$ or $5\rightarrow2$.

6.(B) $_{24}Cr \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

We know for p, l = 1 and for d, l = 2.

For l = 1, total number of electrons = 12 $[2p^6 \text{ and } 3p^6]$

For l = 2, total number of electrons $= 5[3d^5]$

7.(C) According to Heisenberg's uncertainty principle,

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

$$\Delta x \cdot (m \cdot \Delta v) = \frac{h}{4\pi} \Rightarrow \Delta x = \frac{h}{4\pi m \cdot \Delta v}$$

Here $\Delta v = \frac{0.001}{100}\times300 = 3\times10^{-3}\,m\,s^{-1}$

$$\therefore \qquad \Delta x = \frac{6.63\times10^{-34}}{4\times3.14\times9.1\times10^{-31}\times3\times10^{-3}} = 1.92\times10^{-2}m$$

8.(C) $n = 3, l = 0$ represents 3s orbital

$n = 3, l = 1$ represents 3p orbital

$n = 3, l = 2$ represents 3d orbital

$n = 4, l = 0$ represents 4s orbital

The order of increasing energy of the orbitals is

$3s < 3p < 4s < 3d$.

9.(C) Given, velocity of $e^-, v = 600\,m\,s^{-1}$

Accuracy of velocity = 0.005%

$\therefore \qquad \Delta v = \dfrac{600 \times 0.005}{100} = 0.03$

According to Heisenberg's uncertainty principle,

$\Delta x \cdot m\Delta v \geq \dfrac{h}{4\pi}$

$\Rightarrow \qquad \Delta x = \dfrac{6.6 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 0.03} = 1.92 \times 10^{-3}\ m$

10.(B) According to de-Broglie's equation, $\lambda = \dfrac{h}{mv}$

Given, $v = 1.0 \times 10^3\ m\,s^{-1}$

$\therefore \qquad \lambda = \dfrac{6.63 \times 10^{-34}}{1.67 \times 10^{-27} \times 1.0 \times 10^3} = 3.9 \times 10^{-10}\ m$

or $\qquad \lambda \approx 0.4\ nm$

11.(C) Ionisation energy of $He^+ = 19.6 \times 10^{-18}\ J\ \ atom^{-1}$.

= Energy of first stationary state of He^+

$= -19.6 \times 10^{-18}\ J\,atom^{-1}$.

$E_{n(He^+)} = \dfrac{-2\pi^2 Z_{He}^2 me^4}{n^2h^2}; E_{n(Li^+)} = \dfrac{-2\pi^2 Z_{Li}^2 me^4}{n^2h^2}$

$\dfrac{E_{n(Li^{2+})}}{E_n(He^+)} = \dfrac{Z_{Li}^2}{Z_{He}^{2+}} = \dfrac{3^2}{2^2}$

or, $\qquad E_1(Li^{2+}) = \dfrac{3^2}{2^2} E_{1(He^+)} = \dfrac{9}{4}(-19.6 \times 10^{-18})$

$= -4.41 \times 10^{-17}\ J\,atom^{-1}$

12.(C) We know that, $E = hv = hc/\lambda$

$E = E_1 + E_2$ or $\dfrac{hc}{\lambda} = \dfrac{hc}{\lambda_1} + \dfrac{hc}{\lambda_2}$

$\Rightarrow \qquad \dfrac{1}{\lambda} = \dfrac{1}{\lambda_1} + \dfrac{1}{\lambda_2} \Rightarrow \dfrac{1}{355} = \dfrac{1}{680} + \dfrac{1}{\lambda_2}$

$\therefore \qquad \lambda_2 = \dfrac{355 \times 680}{680 - 355} = 742.769 nm \approx 743\ nm$

13.(A) Higher is the value of $(n + l)$ more is the energy level of orbital. If $(n + l)$ is same lower value of n decides lower energy level.

14.(A) Electronic configuration of Rb (atomic no 37)

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^1$

$n = 5, l = 0, m = 0\ \&\ s = \pm\dfrac{1}{2}$

15.(A) $\dfrac{1}{\lambda} = R_H Z^2 \left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right)$

$Z = 1, n_1 = 1\ \&\ n_2 = 2, R_H = 109677\ cm^{-1}$

$\lambda = 1.2 \times 10^{-7} m$