Miscellaneous Exercise Question Bank

1.(B) K.E = P.E

$$5 \times 10^6 \text{ev} = \frac{9 \times 10^9 \times 29 \times 2 \times 1.6 \times 10^{-19}}{r}$$

$$r = 1.67 \times 10^{-14} \text{m}$$

2.(C) Radial node occurs where probability of finding e^- is zero.

$\therefore \; \Psi^2 = 0$ or $\Psi = 0 \;\; \therefore \; 6 - 6\sigma + \sigma^2 = 0; \quad \sigma = 3 \pm \sqrt{3}$

For max. distance $r = \frac{3}{2} \frac{(3+\sqrt{3})a_0}{Z}$

3.(D) $\frac{n(n-1)}{2} = 6; \; n = 4$

$n = 4 \qquad E_4 = -0.85 \text{ eV}$

$n = 1 \qquad E_1 = -13.6 \text{ eV}$

$\therefore \qquad \Delta E = 12.75 \text{ eV}$

$$12.75 \text{ eV} = \frac{1240 \text{ eV} - \text{nm}}{\lambda}$$

$\lambda = 97.25$ nm

4.(D) For II to I transition

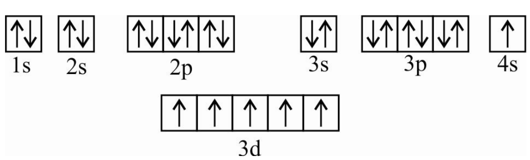
$$\Delta E = \frac{4E}{3} - E = \frac{hc}{\lambda_{II \to I}}; \quad \frac{E}{3} = \frac{hc}{\lambda_{II-I}}$$

For III to I transition

$$\Delta E = 2E - E = \frac{hc}{\lambda} \text{ or } E = \frac{hc}{\lambda}$$

$$\therefore \qquad \frac{hc}{3 \times \lambda} = \frac{hc}{\lambda_{II-I}}, \; \lambda_{II-I} = 3\lambda$$

5.(D)



Out of 6 electrons in 2p and 3p must have one electron with m = + 1 and $s = -\frac{1}{2}$ but in 3d-subshell an orbital having m = + 1 may have spin quantum no. $-\frac{1}{2}$ or $+\frac{1}{2}$.

Therefore, minimum and maximum possible values are 2 and 3 respectively.

6.(A) energy absorbed $13.6 \times 1.5 = 20.4$ eV out of this 6.8 eV is converted to K.E.

$6.8 \text{ eV} \qquad \Rightarrow \quad 6.8 \times 1.6 \times 10^{-19}$ J;

$$6.8 \times 1.6 \times 10^{-19} = \text{K.E.} \Rightarrow \left(\frac{1}{2}\right) mv^2$$

$$v = \sqrt{\frac{2KE}{m}} = \sqrt{\frac{2 \times 1.088 \times 10^{-18}}{9.1 \times 10^{-31}}} = 1.54 \times 10^6 \text{ m/s}$$

7.(D) Fe^{2+}: d-orbitals have $6e^-$s.

Na:	$1s^2\ 2s^2\ 2p^6\ 3s^1$	:	5 s-orbital e^-s
Li:	$1s^2\ 2s^1$	:	3 s-orbital e^-s
N:	$1s^2\ 2s^2\ 2p^3$	:	4 s-orbital e^-s
P:	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$	:	6 s-orbital e^-s

8.(D) Hund's rule is related to the degenerate orbitals.

9.(C) 6s will be closest. {Aufbau $(n + \ell)$ rule}

10.(B)

$$\left.\begin{aligned} h\nu_1 &= W_0 + K.E_1 \\ \text{and } h\nu_2 &= W_0 + K.E_2 \end{aligned}\right\} \Rightarrow \left.\begin{aligned} hx &= W_0 + y \\ \text{and } h(2x) &= W_0 + 3y \end{aligned}\right\}$$

Solve for $W_0 = h\nu_0 = \dfrac{hx}{2} \Rightarrow \nu_0 = \dfrac{x}{2}$

11.(A) $B.E_n = 0.85 \text{ eV} \Rightarrow E_n = -B.E_n = -0.85 \text{ eV} = -13.6 \times \dfrac{Z^2}{n^2} \text{eV} \Rightarrow n = 4$

Check yourself that excitation energy, i.e., energy required for an electron to jump to next higher energy shell, is 10.2 eV for n=1 in H atom (means $\Delta E_{n=1 \to n=2} = 10.2 \text{ eV}$)

$\Rightarrow$ Energy released when an electron jumps from n = 4 to n = 2 is given by :

$\Delta E_{n=4 \to n=2} = -0.85 \text{ eV} - (-3.4 \text{ eV}) = 2.55 \text{ eV}$ $\quad [\because E_2 = -3.4 \text{ eV}]$

12.(A) Frequency of revolution means number of revolution per sec $\left[= \dfrac{1}{\text{Time period per revolution}}\right]$

$\Rightarrow$ Frequency in nth orbit $= \dfrac{v_n}{2\pi r_n} \propto \dfrac{Z/n}{n^2/Z} = \dfrac{Z^2}{n^3}$ $\quad \left[\because v_n \propto \dfrac{Z}{n} \text{ and } r \propto \dfrac{n^2}{Z}\right]$

$$\Rightarrow \frac{\left(\text{Freq. of revolution of } e^- \text{ in } He^+(Z=2)\right)_{n=3}}{\left(\text{Freq. of revolution of } e^- \text{ in } H(Z=1)\right)_{n=2}} = \frac{2^2/3^3}{1^2/2^3} = \frac{32}{27}$$ [2nd Excited state means n = 3]

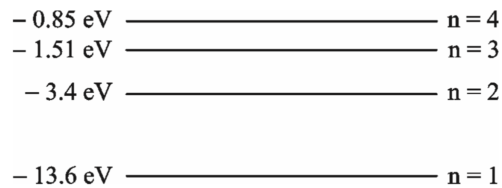
13.(C) First line in Lyman series corresponds to transition $2 \to 1 \Rightarrow \dfrac{1}{\lambda} = R \times 1^2 \times \left(\dfrac{1}{1^2} - \dfrac{1}{2^2}\right) = \dfrac{3}{4} \times R$ and 2nd line in Balmer series corresponds to transition

$4 \to 2 \Rightarrow \dfrac{1}{\lambda} = R \times Z^2 \times \left(\dfrac{1}{2^2} - \dfrac{1}{4^2}\right) = \dfrac{3}{16} \times RZ^2$

$\Rightarrow \dfrac{3}{4}R = \dfrac{3}{16} R \times Z^2 \Rightarrow Z = 2$

Thus, $E_2 = -13.6 \dfrac{Z^2}{n^2} \text{eV} = -13.6 \times \dfrac{2^2}{2^2} \text{ eV} = -13.6 \text{ eV}$

14.(C) Ground state e^- in H atom can only be excited by energy greater than 10.2 eV. Thus, 15 eV photon energy will ionize the atom and 8.4 eV photon will not be able to excite the electron at all.
Only 11.09 eV excite the to higher states.



Now, Thus, will be excited to n = 3.

During de-excitation, corresponding to three transitions, wavelength will be emitted.

$$\begin{Bmatrix} n_3 \to n_1 \\ n_3 \to n_2 \\ n_2 \to n_1 \end{Bmatrix}$$

15.(D) $Mg^{2+}(Z = 12) : 1s^2\ 2s^2 2p^6$: No unpaired

$Ti^{3+}(Z = 22) : 1s^2\ 2s^2 2p^6 3s^2 3p^6 3d^1$: 1 unpaired

$V^{3+}(Z = 33) : 1s^2\ 2s^2 2p^6 3s^2 3p^6 3d^2$: 2 unpaired

$Fe^{2+}(Z = 26) : 1s^2\ 2s^2 2p^6 2s^2 3p^6 3d^6$: 4 unpaired

16.(A) Radial nodes = n – ℓ – 1

For 3s : 3-0-1 = 2 radial nodes ; $4d_{z^2}$: 4 – 2 – 1 = 1 radial node;

$4d_{xy}$: 4 – 2 – 1 = 1 radial node ; $2p_x$: 2 – 1 – 1 = 0 radial node

17.(A) P = 200W = 200J/s $\Rightarrow$ Energy released in one second $= n\left(\frac{hc}{\lambda}\right)$

Where : n = 4 × 10^{20} photons emitted per second.

$$\therefore \quad n\left(\frac{hc}{\lambda}\right) = 200$$

$$(4 \times 10^{20})\left(\frac{6.626 \times 10^{-34} \times 3 \times 10^8}{\lambda}\right) = 200 \Rightarrow \lambda = 400\text{nm}$$

18.(D) 10.2eV, 1.9eV photons belong to 1 or two atoms. Hence number of atoms are either two or three.

19.(D) As we move away from the nucleus, the energy gap between any two adjacent shells becomes narrower. And maximum energy will correspond to minimum wavelength.

20. (A) $$\frac{\Delta E}{E_{4th}} = \frac{24}{E_{4th}} = \frac{\left[\frac{1}{1} - \frac{1}{4}\right]}{\left[\frac{1}{16}\right]} = \frac{3/14}{1/16} \quad \Rightarrow \quad E_{4th} = 2 \text{ eV}$$

21.(A) H_β in lyman series $\Rightarrow$ $h\upsilon = 2.18 \times 10^{-18} \times 1^2 \times \left(\frac{1}{1^2} - \frac{1}{3^2}\right)$ $\Rightarrow$ $\upsilon = 2.90 \times 10^{15}$Hz

22. (C) Value of $\ell <$ 'n' $\quad -\ell \le m \le +\ell,\ m_s = \pm\frac{1}{2}$

23.(C) $2.5\hbar$ cannot be correct value of angular momentum.

24.(B) $$\Delta E = \frac{hc}{\lambda} = \frac{(6.63 \times 10^{-34}\ J-s)(3.00 \times 10^8\ m/s)}{3.055 \times 10^8\ m/s} = 6.52 \times 10^{-18}\ J$$

$$\Delta E_H = \frac{3}{4}(2.176 \times 10^{-18}\ J) = 1.63 \times 10^{-18}\ J; \quad \Delta E = \Delta E_H(Z^2)$$

$$Z^2 = \frac{\Delta E}{\Delta E_H} = \frac{(6.52 \times 10^{-18})}{(1.63 \times 10^{-18})} = 4; \qquad Z = 2 \text{ (helium)}$$

25.(A) $E_1 = -13.6$ eV; Excited states $\Rightarrow$ $n \geq 2$

$E_2 = -13.6 \times \frac{1^2}{2^2} eV = -3.4\, eV$; $E_3 = -13.6 \times \frac{1^2}{3^3} eV = -1.51$ eV and so on

26.(C) $P.E. = \frac{1}{4\pi\varepsilon_0}\frac{(+Ze)(-e)}{r} = \frac{1}{4\pi\varepsilon_0}\frac{(+2e)(-e)}{r} = -\frac{e^2}{2\pi\varepsilon_0 r}$

27.(C) Ionization energy :

$-217.6 = -13.6 \times \frac{Z^2}{1^2}$; $Z = 4$

So, it is ${}_4^9Be^{3+}$; no. of neutrons $9 - 4 = 5$.

28.(B) $B_5 \to 1s^2, 2s^2 2p^1$

Electron in p-subshell will revolve in elliptical path.

29.(D) $\Delta E_1 = (2E - E) = E = \frac{hc}{\lambda_1}$ ....(1)

$\Delta E_2 = \left(\frac{4}{3}E - E\right) = \frac{E}{3} = \frac{hc}{\lambda_2}$ ....(2)

From Eqns. (1) and (2)

$$\frac{hc}{3\lambda_1} = \frac{hc}{\lambda_2}$$

$\lambda_2 = 3\lambda_1 = 3\lambda$ $(\lambda_1 = \lambda, \text{given})$

30.(A) $\frac{1}{2}mv^2 = \frac{k(q_1)q_2}{r} \Rightarrow \frac{q_2}{m} = \frac{r.v^2}{2k.q_1.Z}$

$\frac{q_2}{m} = \frac{2.5 \times 10^{-14} \times (2.1 \times 10^7)^2}{2 \times 9 \times 10^9 \times 79 \times 1.6 \times 10^{-19}}$

$\Rightarrow$ 4.84×10^7 coulomb/kg

31.(B) $2\pi r_n = n\lambda \Rightarrow 2\pi \times 0.53\frac{n^2}{z} = n\lambda$

$\lambda = 2\pi \times 0.53 \times \frac{n}{z}$ ...(1)

$E_{sep} = 3.4 = 13.6\frac{z^2}{n^2} \Rightarrow \frac{n}{z} = 2$

$\lambda = 2\pi \times 0.53 \times 2 = 6.66\,\text{Å}$

32.(B) $r_n \propto \frac{n^2}{Z}$; for H, $r_4 - r_3 = 0.529(16 - 9)$

$\Rightarrow 0.529 \times 7\,\overset{o}{A}$

$r_4 - r_3$ for $Li^{2+} \Rightarrow 0.529\left(\frac{16}{3} - \frac{9}{3}\right)$ $\Rightarrow 0.529 \times \frac{7}{3}$ so ratio $\frac{7}{7/3} = 3:1$

33.(C) $v_n = 2.186 \times 10^6 \dfrac{Z}{n}$

$\Rightarrow 1.093 \times 10^6 = 2.186 \times 10^6 \times \dfrac{1}{n}; n = 2 \ = \ r = 0.529 \dfrac{n^2}{Z} \Rightarrow 0.529 \times 4 \overset{o}{A}$

$\therefore$ circumference of the orbit

$\Rightarrow \quad 2 \times \dfrac{22}{7} \times 0.529 \times 4 \times 10^{-10} \quad \Rightarrow \quad 13.30 \times 10^{-10}$ m

34.(B) Angular momentum $= \dfrac{nh}{2\pi}$

$3.1652 \times 10^{-34} = \dfrac{n \times 6.626 \times 10^{-34}}{2\pi}; \qquad n = 3$

$\therefore \quad \bar{v} = R.Z^2.\left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right); \qquad \bar{v} = R.2^2.\left(\dfrac{1}{2^2} - \dfrac{1}{3^2}\right) \Rightarrow \dfrac{5R}{9}$

35.(D) Energy of photon corresponding to second line of Balmer series for Li^{2+} ion

$= (13.6) \times (3)^2 \left[\dfrac{1}{2^2} - \dfrac{1}{4^2}\right] = 13.6 \times \dfrac{27}{16}$

Energy needed to eject electron from n = 2 level in H-atom;

$= 13.6 \times 1^2 \times \left[\dfrac{1}{2^2} - \dfrac{1}{\infty^2}\right] \Rightarrow \dfrac{13.6}{4}$

K.E. of ejected electron

$= \left(13.6 \times \dfrac{27}{16}\right) - \dfrac{13.6}{4} = 19.55$ eV

36.(A) $\dfrac{1}{\lambda} = RZ^2\left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right)$, where $n_1 = n, n_2 = n+1$

$\therefore \quad \dfrac{1}{\lambda} = RZ^2\left(\dfrac{1}{n^2} - \dfrac{1}{(n+1)^2}\right) \quad \Rightarrow \quad \dfrac{1}{\lambda} = \left(\dfrac{2n+1}{n^2(n+1)^2}\right)RZ^2$

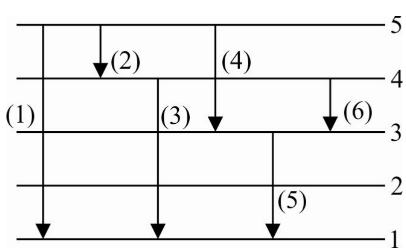
Since, $n >> 1$;

Therefore, $2n + 1 \approx 2n$

and $(n+1)^2 \approx n^2$

$\therefore \quad \dfrac{1}{\lambda} = RZ^2\left(\dfrac{2n}{n^2.n^2}\right) \quad \Rightarrow \quad \dfrac{\upsilon}{c} = \dfrac{2RZ^2}{n^3}$ or $\upsilon = \dfrac{2cRZ^2}{n^3}$

37.(D)



Total radiations are = 6.

38.(C) $\sqrt{v} = aZ - ab$

$ab = 1, \ a = \tan 45^o = 1$

$\sqrt{v} = 51 - 1 = 50$

$v = 50^2 = 2500 \ s^{-1}$

39.(C) $\frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{n^2}\right] = R\left[\frac{n^2 - 4}{4n^2}\right]$

$\lambda = \frac{4}{R} \times \frac{n^2}{n^2 - 4}$ ... (1)

Given: $\lambda = k \times \frac{n^2}{n^2 - 4}$ ...(2)

Comparing equation (1) and (2) we have

$K = \frac{4}{R}$

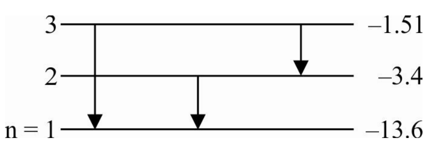
40.(C) Work function for $Li^{2+} = 9E$

$E_p = w + \frac{1}{2}mv^2; \quad E_p = 9E + \frac{1}{2}mv^2$

$v = \sqrt{\frac{2(E_p - 9E)}{m}}$

41.(A) $\Delta E = \frac{hc}{\lambda} \Rightarrow \frac{1240 \text{ eV} - \text{nm}}{1025.6 \times 10^{-1} \text{nm}}$

$\Delta E = 12.09$ eV



$\Delta E = 12.09 ; \quad \therefore \quad n = 3$

In three different radiations, minimum wavelength for $3 \to 1$ transition

$\lambda_{3-1} = \frac{hc}{\Delta E} \Rightarrow \frac{1240 \text{ eV} - \text{nm}}{12.09 \text{ eV}} \approx 102.6$ nm

42.(ABD) As e^- moves from higher to lower orbit : $E_n \downarrow \Rightarrow K.E._n \uparrow \left[\because K.E_n = -E_n\right]$

Similarly, $P.E._n \downarrow \left[\because P.E._n = 2E_n\right]$

Angular momentum (L) $= \frac{nh}{2\pi} \quad \Rightarrow L \downarrow$ as $n \downarrow$

$\lambda_e = \frac{h}{mv_n} \left[\because K.E_n \uparrow \Rightarrow v_n \uparrow\right] \Rightarrow \lambda_e \downarrow$

43.(AB) $B.E._4 = +13.6\frac{Z^2}{4^2} = 13.6 \Rightarrow Z = 4 \ [B.E._n = -E_n]$

E_3 (2nd excited state (n = 3)) = $-13.6 \times \frac{4^2}{3^2}$eV $= 24.18$ eV $\Rightarrow$ 25 eV photon can set this e^- free.

When electron comes to ground state from n=3, three transitions are possible : $\left.\begin{matrix} 3 \to 2 \to 1 \\ 3 \to 1 \end{matrix}\right\}$.

1st excitation energy of H-atom (n = 1 to n = 2) : 13. 6 eV

2nd line of Balmer series for Z = 4 (4 $\to$ 2) has energy difference = $13.6 \times 4^2 \times \left(\frac{1}{2^2} - \frac{1}{4^2}\right)$eV = 40.8 eV

44.(ABD) (A) correct $E = h\upsilon \Rightarrow E \times \nu$ (frequency)

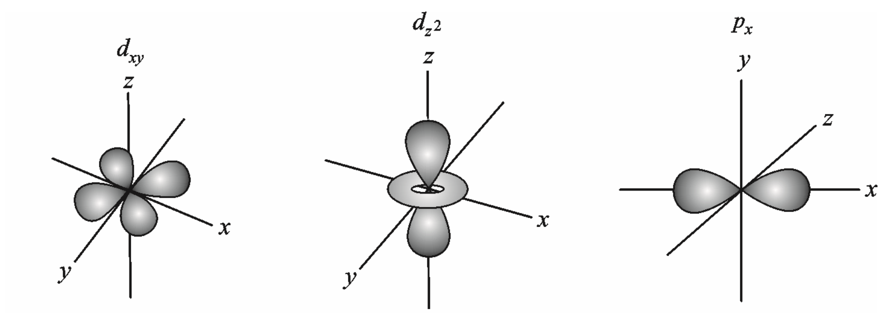
(B) correct $E = \frac{hc}{x} \Rightarrow E = hc\,\bar{v} \Rightarrow E \times \bar{v}$ (waveno.)

(C) incorrect $E = \frac{hc}{x} \Rightarrow E = \frac{1}{x}$ (wavelength)

(D) correct $E = nh\upsilon \quad E \times n$ (no. of photons)

45.(D) n = 4 $\Rightarrow$ ℓ = 0 to 3 but m = 2 so $\ell \geq 2$

46.(C)



$3d_{xy}$ & $4d_{xy}$ (2 Nodal Plane) d_{z^2} No Nodal Plane $2p_x$ (1 Nodal Plane)

47.(AB) Diffraction and interference are two phenomena that possess wave nature of light.
Photoelectric effect possesses particle nature of light.

***48.(BCD)** A $\to$ Incorrect
Thomson proposed his model for structure of atom in 1897 but Balmer and lyman series were discovered is 1906.

49.(B) **(A)** Incorrect $\to$ s-orbitals have same orientation and same shape

(C) incorrect $\to$ d-orbitals have different shapes and orientations

(D) incorrect $\to$ f-orbitals also have different shapes and orientations.

50.(BD) $\left.\begin{matrix} \text{No. of electrons} = 0 \\ \text{ionic mass} = 0 \end{matrix}\right]$ same in H^+, D^+, T^+

A, C $\to$ incorrect $\to$ $H^+ \to$ no. of neutrons = 0

$D^+ \to$ no. of neutrons = 1

$T^+ \to$ no. of neutrons = 2

51.(C) Fe^{3+} has 5 unpaired electrons and Co^{3+} has 4 unpaired electrons

$\mu_{Fe^{3+}} = \sqrt{n(n+2)} = \sqrt{5 \times 7} = \sqrt{35}$

$\mu_{Co^{3+}} = \sqrt{n(n+2)} = \sqrt{3 \times 5} = \sqrt{15}$

52.(AD) $\lambda = \dfrac{h}{mv}$

For same speed, $\lambda_A < \lambda_B$ because $m_A > m_B$.

53.(ACD) $B \rightarrow$ incorrect

The total number of electrons that can be accommodated is 3d subshell is equal to 10.

54.(ABC) $D \rightarrow$ incorrect

The five d-orbitals are energetically identical with different shapes & orientations.

55.(BCD) $\lambda_3 \neq \lambda_1 + \lambda_2$

Rather $\lambda_3 = \dfrac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$; Similarly $\left(\bar{v}_3 = \bar{v}_1 + \bar{v}_2\right)$ and $\left(v_3 = v_1 + v_2\right)$

56.(A) $\Delta x \cdot \Delta p \geq \dfrac{h}{4\pi} \Rightarrow \Delta p \geq \sqrt{\dfrac{h}{4\pi}} \left[\because \Delta x = \Delta p \text{ (given)}\right]$ $\Rightarrow$ i.e. $m\Delta v = \sqrt{\dfrac{h}{4\pi}}$

$\Rightarrow \quad \Delta v \geq \dfrac{1}{m}\sqrt{\dfrac{h}{4\pi}} = 8 \times 10^{12}\ ms^{-1} \left[\because \Delta p = m\Delta v\right]$

57.(B) $\Delta v = 2\ cms^{-1} = 2 \times 10^{-2}\ ms^{-1}$

$\Delta x \cdot m\Delta v \geq \dfrac{h}{4\pi} \Rightarrow \Delta x \geq \dfrac{h}{4\pi} \times \dfrac{1}{m\Delta v} = \dfrac{6.626 \times 10^{-34}}{4\pi \times 10^{-3} \times 2 \times 10^{-2}} = 2.64 \times 10^{-30} m$

58.(B) Ψ represents an orbital and $\Psi_{4,3,0}$ has n = 4, l = 3, i.e., 4f-orbital.

59.(A) Angular momentum in an orbital $= \sqrt{l(l+1)}.\dfrac{h}{2\pi} = \sqrt{l(l+1)}.\dfrac{h}{2\pi} = \sqrt{1(1+1)}.\dfrac{h}{2\pi} = \sqrt{2}\,\dfrac{h}{2\pi}$

60.(A) Number of radial node $= n - l - 1$

Number of angular node = l

61.(C) Sub-shells of a shell in H-atom possess same energy level, i.e., l does not specify for the energy level of an orbital in H-atom.

62.(D) $E_{2p_x} = E_{2p_y} = E_{2p_x}$

63.(D) Heisenberg principle has no significance if Δu is along x-axis and Δx along any other axis is given.

64.(D) $\Delta E = h\nu = E_m - E_n \quad \therefore \quad \nu = \dfrac{E_m - E_n}{h}$

65.(D) For II line of Balmer : $n_1 = 2, n_2 = 4$

$\dfrac{1}{\lambda_{2B}} = R_H \times \left[\dfrac{1}{2^2} - \dfrac{1}{4^2}\right] = R_H \times \dfrac{3}{16}$

For I line of Lyman; $n_1 = 1, n_2 = 2$

$\dfrac{1}{\lambda_{1L}} = R_H \times \left[\dfrac{1}{1^2} - \dfrac{1}{2^2}\right] = R_H \times \dfrac{3}{4}$

$\therefore \quad \dfrac{\lambda_{2B}}{\lambda_{1L}} = R_H \times \dfrac{3}{4} \times \dfrac{16}{3 \times R_H} = 4$

66.(A) Usually in each atom, electrons exist in ground state and thus absorption spectrum usually shows Lyman series.

67.(B) $\lambda_{\alpha B}$ for D = 656.100 nm and $\lambda_{\alpha B}$ for H = 656.279 nm, because

$$R_H \text{ for D} = \left[\frac{\left(1+\frac{m_e}{m_H}\right)}{1+\frac{m_e}{m_D}}\right] \times R_H \text{ for H}$$

R_H for D = 109708 cm^{-1} and R_H for H = 109678 cm^{-1}.

68.(D) Point (C) is a reason for the facts given in point (A) and (B).

69.(A) 1 line of Balmer possess $\lambda = \frac{hc}{\Delta E} = \frac{hc}{E_3 - E_2} = 660$ nm and thus visible light is red.

70.(D) $h\nu = 2E - E$

$\frac{hc}{\lambda} = E \quad \therefore \quad \lambda = \frac{hc}{E}$

Also, $\frac{hc}{\lambda_1} = \frac{4E}{3} - E = \frac{E}{3} \quad \therefore \quad \lambda_1 = \frac{hc \times 3}{E} = 3\lambda$

71.(C) Transition occurs from 3rd to 1st orbit $\Delta E = 12.1$ eV

Spectral lines emitted $= \Sigma\, \Delta n = \Sigma(3-1) = \Sigma\, 2 = 3$

72.(C) $\Delta E = 8.4375\ R_H$, $E_{1_{Li^{2+}}} = -R_H \times 9$ and $E_{4_{Li^{2+}}} = \frac{-R_H \times 9}{16}$

$E_1 - E_4 = \frac{9R_H}{1} - \frac{9R_H}{16} = \frac{135}{16} \times R_H = 8.4375\ R_H$

Thus, de-excitation will lead from 4th to 1st shell.

i.e., number of lines $= \Sigma\, \Delta n = \Sigma(4-1) = \Sigma\, 3 = 6$

73.(A) $PE = 2 \times E_n = -\frac{2 \times 1^2 \times R_H}{2^2}$ (n = 2; Z = 1 for H-atom)

$= -\frac{R_H}{2}$

Match the Column

74. **A → P, R; B → Q, R; C → S; D → Q, R**

Neutron is a chargeless particle.

75. **A → S; B → P, R; C → P, R; D → P, Q, R**

According to Thomson Model

76. **A → S; B → Q; C → R; D → P**

(i) Rutherford scattering experiment determined the size of nucleus to be of the order of 10^{-15} m

(ii) Milliken's oil drop experiment determined the magnitude of fundamental charge i.e., 1.6×10^{-19}C

(iii) Atomic spectra could be explained by considering the quantisation of atomic energy levels and the transition of electrons between these levels.

77. $\mathbf{A \to Q; B \to S; C \to P; D \to R}$

$KE = -T.E$; $TE = \frac{1}{2} PE$

78. $\mathbf{A \to Q; B \to S; C \to R; D \to P}$

Name of Series	Region	Transition $(n_2 \to n_1)$
Lyman	UV	$n_1 = 1$; $n_2 = 2, 3, 4 ----$
Balmer	Visible	$n_1 = 2$; $n_2 = 3, 4, 5 ----$
Paschen	IR	$n_1 = 3$; $n_2 = 4, 5, 6 ----$
Brackett	IR	$n_1 = 4$; $n_2 = 5, 6, 7 ----$
Pfund	IR	$n_1 = 5$; $n_2 = 6, 7, 8 ----$
Humphrey	IR	$n_1 = 6$; $n_2 = 7, 8, 9 ----$

79. $\mathbf{A \to P, Q, R, S; B \to Q, R, S; C \to R; D \to R, S}$

Refer to spectral series for Hydrogen.

80. $\mathbf{A \to P, S; B \to P, Q, S; C \to P, Q, R, S; D \to S}$

No. of sub-shells in any n^{th} shell = n

81. $\mathbf{A \to Q; B \to R; C \to S; D \to P}$

Radial node $\Rightarrow$ $n - \ell - 1$

Angular node = ℓ

Total node = $n - 1$

82. $\mathbf{A \to P, Q; B \to Q; C \to S; D \to R}$

dz^2 has 2 conical nodes.

83. $\mathbf{A \to S; B \to R; C \to P; D \to Q}$

Learn the formulas

84. $\mathbf{A \to S; B \to P; C \to Q; D \to R}$

For $s \to \ell = 0$
$p \to \ell = 1$
$d \to \ell = 2$
$f \to \ell = 3$

85. $\mathbf{A \to S; B \to R; C \to Q; D \to P}$

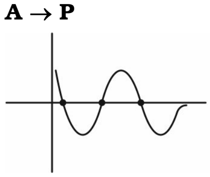
For s-orbital, $l = 0$

p-orbital, $l = 1$

d-orbital, $l = 2$

86. $\mathbf{A \to P; B \to P, Q, S; C \to Q, S; D \to Q, S}$

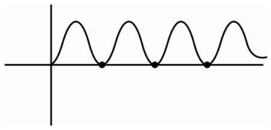
$\mathbf{A \to P}$



Total radial nodes = 3 nodes

In 4s, radial nodes $= n - \ell - 1$, $n = 4$; $\ell = 0$

B $\rightarrow$ P, Q, S;



In 4s, 5py and 6dxy $\longrightarrow n - \ell - 1 = 3$

C $\rightarrow$ Q, S;

(Self explanatory)

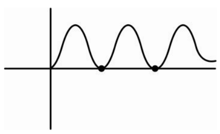
D $\rightarrow$ Q, S

In (Q) $5p_y$ angular node = $1 \geq 1$

(S) $6d_{xy}$ angular node = $2 > 1$

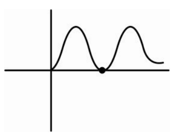
87. **A $\rightarrow$ Q; B $\rightarrow$ R; C $\rightarrow$ S; D $\rightarrow$ P**

A $\rightarrow$ Q



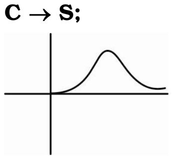
In 3s ; $n - \ell - 1 = 2$

B $\rightarrow$ R;



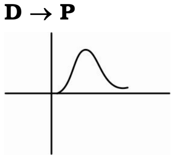
In 3p ; $n - \ell - 1 = 1$

C $\rightarrow$ S;



In 3d ; $n - \ell - 1 = 0$

D $\rightarrow$ P



In 2b ; $n - \ell - 1 = 0$

88. **(A-1, 4)** Angular momentum $(L) = \dfrac{nh}{2\pi} \Rightarrow L \uparrow$ as $n \uparrow$ and $L \downarrow$ as $n \downarrow$

(B-2) $K.E_n = -E_n \propto \dfrac{Z^2}{n^2} \Rightarrow K.E_n \uparrow$ as $Z \uparrow$; $\downarrow$ as $Z \downarrow$; $\uparrow$ as $n \downarrow$; $\downarrow$ as $n \uparrow$

(C-1, 3, 4) $P.E_n = 2E_n \propto -\dfrac{Z^2}{n^2} \Rightarrow P.E_n \downarrow$ as $Z \uparrow$; $\uparrow$ as $Z \downarrow$, as $n \downarrow$; $\uparrow$ as $n \uparrow$

(D-2) $V_n \propto K.E_n$ (Same behaviour as $K.E_n$)

Assertion Reason

89.(B) Orbital angular momentum (P) $\sqrt{\ell(\ell+1)}\dfrac{h}{2\pi}$ ($\ell = 2$ for d – orbital)

Angular momentum of e^- in orbit $= mvr = \dfrac{nh}{2\pi}$

90.(B) Angular momentum of electron in the orbit having four subshell : -

$n = 4 \;\therefore\; mvr = \dfrac{4h}{2\pi} = \dfrac{2h}{\pi}$

Statement-2 (Fact based)

91.(A) Line emission spectra or emission spectra can be used as an identifying fingerprint of an element.

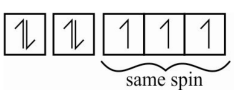
92.(A) $n_4 \longrightarrow n_2$ in H atom [Balmer series]

$\bar{v} = R_H (1)^2 \left(\dfrac{1}{4^2} - \dfrac{1}{2^2}\right)$ (Visible Region)

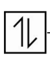
93.(A) Half filled and fully-filled degenerate orbitals are more stable due to symmetrical distribution of electrons and maximum exchange energy.

94.(A) Cr has atomic no. = 24

$\therefore$ $3d^4 4s^2$ is not stable due to unsymmetrically filled d orbital whereas $3d^5 4s^1$ is more stable due to half filled (symmetrically filled) d-orbital.

95.(A) 

(ground state)
(Aufbau principle Hund's rule)

96.(A)  $\rightarrow$ max two e^- in 1 orbital with opposite spin.

Note : if they have same spin then energy would be required to change the spin making it unstable.

97.(B) $3d_{xy}$ has two nodes in xz and yz plane

In $3d_{xy}$; radial nodes = $n - \ell - 1$

Where n = 3; $\ell = 2$

$\therefore$ $n - \ell - 1 = 0$

98.(C) $E = h\upsilon$

Intensity can't alone increase number of photo-electron ejected. The photons must have energy > work function.

99.(C) Cu^{2+} is coloured due to d-d transition and presence of unpaired electron. Generally ions present in d-orbital are coloured due to unpaired electron [d-d transition]

100.(A) $n = 3$ $\ell = n - 1$ i.e 0, 1, 2

Then $m = -2 - 1, 0, 1, 2$

Statement-2 (Fact)