IIT Foundation Plus

Class: IX

Postulates of Bohr's Theory

Teaching Task

Q1) Ans:- B

Solution:- Last line of Lymen series

$$n_1 = 1, \quad n_2 = \infty$$

$$\frac{1}{\lambda_1} = R\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right]$$

$$\frac{1}{\lambda_1} = R.$$

2nd line of Balmer series

$$n_1 = 2, \quad n_2 = 4.$$

$$\frac{1}{\lambda_2} = R\left[\frac{1}{4} - \frac{1}{16}\right]$$

$$\frac{1}{\lambda_2} = R\left[\frac{4-1}{16}\right] = \frac{3R}{16}$$

$$\frac{16}{3\lambda_2} = R.$$

$$\frac{16}{3\lambda_2} = \frac{1}{\lambda_1} \Rightarrow \boxed{\frac{16}{\lambda_2} = \frac{3}{\lambda_1}}$$

Q2) Ans:- A, B, C.

Solution:- $\frac{1}{\lambda} = \bar{\nu} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

For H, last line $\bar{\nu} = V_1 = R\left[\frac{1}{1^2} - 0\right] = R.$

For He^+, last line of lymen $V_2 = R(4)\left[\frac{1}{1^2}\right] = 4R.$

For He^+, last line of Balmer $V_3 = R(4)\left[\frac{1}{2^2}\right] = 4R \cdot \frac{1}{4} = R$

$$V_1 = V_3, \quad 4V_1 = V_2, \quad 4V_3 = V_2$$

$$2(V_1 + V_2) = 2(R+R) = 4R = V_2$$

Q3) Ans:- A

Solution:-

Lymen series last line. $u_1 = R\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right] = R.$

First line of lymen $u_2 = R\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \left[\frac{4-1}{4}\right]R = \frac{3R}{4}$

Balmer last line $u_3 = R\left[\frac{1}{2^2} - \frac{1}{\infty^2}\right] = \frac{R}{4}.$

A) $u_1 - u_2 = u_3 \Rightarrow R - \frac{3R}{4} = \frac{4R-3R}{4} = \frac{R}{4} = u_3.$ ✓

B) $u_2 - u_1 = \frac{3R}{4} - R = \frac{3R-4R}{4} = -\frac{R}{4} = -u_3$

C) $u_3 \neq \frac{1}{2}(u_1 - u_2) = \frac{1}{2}\left(R - \frac{3R}{4}\right) = \frac{1}{2} \cdot \frac{R}{4} = \frac{R}{8} = \frac{u_3}{2}$

D) $u_1 + u_2 = R + \frac{3R}{4} = \frac{4R+3R}{4} = \frac{7R}{4}.$

Q4) Ans:- C

Solution:- $V = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ For Li^{+2}, $Z=3$

$n_1 + n_2 = 4, \quad n_2 - n_1 = 2.$

$n_1 = 1, n_2 = 3.$

$V = RZ^2\left[\frac{1}{1^2} - \frac{1}{3^2}\right] = R(3^2)\left[\frac{9-1}{9}\right] = 9R\left[\frac{8}{9}\right] = 8R.$

Q5) Ans:- A

Solution:- For nth excited state $n = (n^{th} + 1)$

$n^{th} = 3^{rd} = 3+1$

$n = 4.$

For the 1st H-atom the possible no. of photons emitted

$4 \rightarrow 3, 3 \rightarrow 2, 2 \rightarrow 1$

2nd H-atom, $4 \rightarrow 2, 2 \rightarrow 1$ (Repeated).

Maximum no. of photons emitted $= 4.$

Q6) Ans:- B, C, D.

Solution:- For an electronic transisition from n_2 to n_1 state, the no. of lines in the spectrum $= \frac{(n_2-n_1)(n_2-n_1+1)}{2}$

$n_2 = 5$ & $n_1 = 2$.

$$\frac{(5-2)(5-2+1)}{2} = \frac{3(\cancel{4}^{2})}{\cancel{2}} = 6.$$

6 Different spectral lines are observed.

Balmer series:- 3.

$5 \to 2$, $4 \to 2$, $3 \to 2$

Paschen series:- 2

$5 \to 3$, $4 \to 3$

Q7) Ans:- C

Solution:- Shortest wavelength of Lymen

$n_1 = 1$, $n_2 = \infty$

$$\lambda_S = R_h\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right] = R_h = x.$$

Longest wave length in Balmer He^+.

$n_1 = 2$, $n_2 = 3$, $Z = 2$.

$$\lambda_L = R_h(4)\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \cancel{4}R_h\left[\frac{9-4}{\cancel{36}_{9}}\right] = R_h\left[\frac{5}{9}\right]$$

$$\boxed{\lambda_L = \frac{5x}{9}}$$

Q8) Ans:- C.

Solution:- Transition we have, $5 \to 2$

$$\Delta L = \frac{\Delta n h}{2\pi} = \frac{3h}{2\pi}$$

Q9) Ans:- A.

Solution:- $n = 4$ because only 2 Balmer lines are obtained.

i.e, $4 \to 2$, $3 \to 2$

$$K.E = 13 - \frac{13.6}{4^2} = 12.15\,eV.$$

Q10) Ans:- A

Solution:- $\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$n_1 = 1,\ n_2 = \infty$

$R = 1.097 \times 10^7\ m^{-1}.$

$\frac{1}{\lambda} = 1.097 \times 10^7 \left[\frac{1}{1^2} - \frac{1}{\infty^2}\right] = 1.097 \times 10^7$

$\lambda = 9.1 \times 10^{-8}\ m = 91nm.$

Q11) Ans:- A

Solution:- Frequency of He^+, $n=4$ to $n=2$

$$V = R(2)^2\left[\frac{1}{2^2} - \frac{1}{4^2}\right] = 4R\left[\frac{4-1}{16}\right] = \cancel{4}R\left[\frac{3}{\cancel{16}_4}\right] = \frac{3R}{4}.$$

For H, $Z = 1$.

A) $n=2$ to $n=1$.

$$V = R\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = R\left[\frac{4-1}{4}\right] = \frac{3R}{4}.$$ ✓

B) $n=3$ to $n=2$

$$V = R\left[\frac{1}{4} - \frac{1}{9}\right] = \cancel{4}\left[\frac{9-4}{\cancel{36}_9}\right]R = \frac{5R}{9}$$ ✗.

c) $n=4$ to $n=3$

$$V = R\left[\frac{1}{9} - \frac{1}{16}\right] = R\left[\frac{16-9}{16\times9}\right] = \frac{7R}{144}$$ ✗

D) $n=3$ to $n=1$

$$V = R\left[\frac{1}{1^2} - \frac{1}{3^2}\right] = R\left[\frac{9-1}{9}\right] = \frac{8R}{9}$$ ✗.

JEE Advanced Level

Q1) Ans:- A, B, D

Solution:- A) Marginal line of Balmer, $n_1 = 2, n_2 = \infty$

$$\frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{\infty^2}\right] = \frac{R}{4}$$

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

B) Last line of Lymen series from $\infty \rightarrow 1$

C) Marginal line of paschen series

$$\frac{1}{\lambda} = R_H\left[\frac{1}{3^2} - \frac{1}{\infty^2}\right] = \frac{R}{9}$$

$$\lambda = \frac{9}{R}$$

D) Humphry series $\frac{1}{\lambda} = R_H\left[\frac{1}{6^2} - \frac{1}{n_2^2}\right]$, $n_2 > 6$

Q2) Ans:- B.

Solution:-

A) The lines of balmer series line in visible range

B) First line of lymen $2 \rightarrow 1$.

C) 1st line of balmer $= R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = R\left[\frac{9-4}{36}\right] = \frac{5R}{36}$

D) For lyman series $[10.2eV \leq (\Delta E)_{Lyman} \leq 13.6eV]$

Q3) Ans:- C

Solution:- $\bar{\nu} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$. Thus $\bar{\nu}$ does not depend on the electron's speed, but rather just on the orbits (n_1 and n_2) between which the transition occurs.

Q4) Ans:- E

Solution:- In this case both Assertion & reason are false. Both $2P_x$ and $2P_y$ orbitals have equal energy (2P orbitals are degenerate), there is no possibility of electron transition and hence, no energy is released & thus, no spectral line will be observed.

Q5) Ans:- C

Solution:-

a) For H atom, Balmer series lines are in visible range.

but He^+ ion $\frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{n^2}\right]z^2$ (True).

$\frac{1}{\lambda} \propto z^2 \Rightarrow \lambda \propto \frac{1}{z^2}$

For He^+ ion, $z = 2$

λ ration by $\frac{1}{4}$ times as compared to H atom

visible range 380nm. to 760nm for 'H' atom

In case of He^+, divide with '4'.

So they get exempted from visible range.

B) Ultraviolet region, $n \to 1^{st}$

Balmer series $n \to 2^{nd}$ (False)

c) Energy $= -E_0 \cdot \frac{z^2}{n^2}$ z = atomic number, n = no. of orbit

$E = -13.6 \cdot \left[\frac{1}{1^2} - \frac{1}{9}\right]4.$ $z = 2$, 2nd line $3 \to 1$.

$= -13.6 \times \frac{8}{9} \times 4$

$= 48.3 eV$ (True)

Q6) Ans:- B.

Solution:- 1st line of Paschen series.

$n_1 = 3 \quad n_2 = 4.$

$$\bar{\nu} = R\left[\frac{1}{3^2} - \frac{1}{4^2}\right]$$

$$= R\left[\frac{1}{9} - \frac{1}{16}\right] = R\left[\frac{16-9}{9\times 16}\right] = \frac{7R}{144}.$$

Integer Type.

Q7) Ans:- 16.

Solution:- For, brackett series marginal line

$n_1 = 4. \quad n_2 = \infty$

$$\frac{1}{\lambda} = R_H\left[\frac{1}{4^2} - 0\right]$$

$$\frac{1}{\lambda} = \frac{R_H}{16} \Rightarrow \lambda = \frac{16}{R_H}$$

$x = 16$

Q8) Ans:- 3.

Solution:- wavelength of 1st line in Balmer series.

$$\frac{1}{\lambda_B} = Z^2 R_H\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5}{36} R_H Z^2 \Rightarrow \lambda_B = \frac{36}{5 R_H Z^2}$$

1st line in Lyman series,

$$\frac{1}{\lambda_L} = Z^2 R_B\left[\frac{1}{1^2} - \frac{1}{2^2}\right] \Rightarrow \lambda_L = \frac{4}{3 R_H Z^2}$$

$$\lambda_B - \lambda_L = 593 \times 10^{-7} = \frac{36}{5 R_H Z^2} - \frac{4}{3 R_H Z^2}$$

$$= \frac{1}{R_H Z^2}\left[\frac{36}{5} - \frac{4}{3}\right].$$

$$Z^2 = \frac{88}{593 \times 10^{-7} \times 109678 \times 15} = 9.0$$

$Z^2 = 9 \Rightarrow Z = 3$, Hydrogen like species is Li^{2+}.

Q9) Ans:- 1

Solution:- Only one line of the Balmer series of He^+ falls within the wavelength range from 120 to 165nm ! this is because the first line of the He^+ Balmer series has a wavelength of approximately 164nm, which is the only line that could fall within this specified range.

Matrix Matching.

Q10) Ans:- A) r B) s c) p D) q

Solution:-

A) Lyman series → r) 2nd line has $\bar{\nu} = \frac{8R}{9}$

B) Balmer series → s) 2nd line has wave number $\frac{3R}{16}$.

c). In a sample of H-atom for 5 upto 2 transition. → p) Maximum no. of spectral lines observed = 6.

D) In a single isolated H-atom for 3 upto 1 transition → q) Maximum no. of spectral lines observed = 2.

Learner's Task

Q1) Ans:- D.

Solution:- When an electron present in N=4 shell of H-

it can make transition to K=1 or L=2 or M=3.

N → K shell → Lymen series (UV lines)

N → L shell → Balmer series (visible)

N → M shell → Paschen series (IR)

Q2) Ans:- A.

Solution:- H_α line Balmer series means 3 → 2

$$\bar{\nu} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$= R\left[\frac{1}{2^2} - \frac{1}{3^2}\right]$$

$$= R\left[\frac{9-4}{36}\right] = \frac{5R}{36}$$

Q3) Ans:- B.

Solution:-

$$R_H = \frac{2\pi^2 z^2 m e^4 K^2}{ch^3}$$

$$R_H \propto m.$$

R_H will become half when mass 'm' will be half.

Q4) Ans:- B.

Solution:-

$$R_H = \frac{2\pi^2 z^2 m e^4 K^2}{ch^3}.$$

'z' → atomic number which is different for different elements.

∴ Rydberg constant will be different.

Q5) Ans:- D.

Solution:- In Balmer series, 1^{st} line $\rightarrow H_\alpha$

2^{nd} line $\rightarrow H_\beta$, 3^{rd} lind $\rightarrow H_\gamma$, 4^{th} line $\rightarrow H_\delta$.

For H_β, $n_1 = 2$, $n_2 = 4$

Q6) Ans:- D

Solution:- Lymen series are in UV region.

Q7) Ans:- A.

Solution:- Balmer series of lines are observed when electron jump from any higher energy level to 2nd energy level.

Q8) Ans:- B.

Solution:- Any transition from $n \geq 3$ to $n = 2$ in the Balmer series will be associated with colored spectral lines.

$n = 4 \rightarrow n = 2$.

Q9) Ans:- A.

Solution:- Lyman series has higher energy.

Q10) Ans:- D

Solution:- $\Delta E = E_2 - E_1 = \frac{hc}{\lambda}$.

$\lambda \propto \frac{1}{\Delta E}$

wavelength is indirectly proportional to difference in energy level.

Q11) Ans:- B.

Solution:- The no. of lines in 'n' orbit for lyman series is $n-1$

Q12) Ans:- A.

Solution:- $E_n = \frac{E_0 Z^2}{n^2}$

$E_0 = -13.6$.

$E_n = \frac{-13.6 (1)^2}{5^2} = -0.54 eV$.

Q13) Ans:- A, C

Solution:- He^+, Li^{+2} & H has one electron in their outermost shell so both show the same spectrum.

Q14) Ans:- D.

Solution:- No. of spectral lines $= \frac{n(n-1)}{2}$

$= \frac{5(5-1)}{2} = \frac{5(4)}{2} = 10$

JEE Mains Level Questions

Q1) Ans:- D

Solution:- Balmer series $n_2 \rightarrow n_1 = 2$

$\hookrightarrow 3, 4, 5, 6 ----$

H $\quad \bar{\nu} = \frac{1}{\lambda} = R_H Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = R_H \cdot (1)^2 \left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

Li^{2+} $\quad \bar{\nu} = \frac{1}{\lambda} = R_H (3)^2 \cdot \left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

$= 15000 \times 3^2 = 9 \times 15000 = 135000 = 1.35 \times 10^5 cm^{-1}$.

Q2) Ans:- A.

Solution:- $n_1 = 1$, $n_2 = 2 \cdots \infty$.

For $n_1 = 1$, $n_2 = 2$.

$$\frac{1}{\lambda} = R_H\left[\frac{1}{1^2} - \frac{1}{2^2}\right]$$

$$\frac{1}{\lambda_{max}} = R_H\left[\frac{4-1}{4}\right] = \frac{3R_H}{4} \Rightarrow \lambda_{max} = \frac{4}{3R_H}$$

For minimum wave length

$$\frac{1}{\lambda_{min}} = R_H\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right]$$

$$\frac{1}{\lambda_{min}} = R_H \rightarrow \lambda_{min} = \frac{1}{R_H}$$

$$\frac{\lambda_{max}}{\lambda_{min}} = \frac{\frac{4}{3\cancel{R_H}}}{\frac{1}{\cancel{R_H}}} = \frac{4}{3}.$$

Q3) Ans:- B.

Solution:- $\bar{\nu} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

for $n_1 = 1$, $n_2 = \infty$ then

$\bar{\nu} = R$. (limiting line of lymen series)

Q4) Ans:- C

Solution:- Low energy of lymen series

$n_1 = 1$, $n_2 = 2$

$$E = R_H hc \; z^2\left[\frac{1}{1^2} - \frac{1}{2^2}\right]$$

$$= R_H hc \left(1 - \frac{1}{4}\right)$$

$$= \frac{3}{4} R_H hc.$$

Q5) Ans:- D.

Solution:- $n_1 = 2$, $n_2 = 4$ (H_β)

$$\frac{1}{\lambda} = \bar{\nu} = Rz^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$= R(1)^2\left[\frac{1}{4} - \frac{1}{16}\right]$$

$$= R\left[\frac{4-1}{16}\right] = \frac{3R}{16}$$

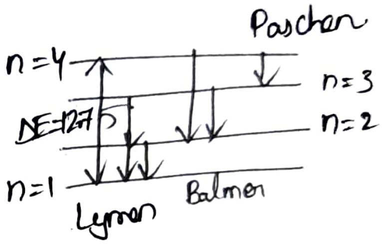
$$\lambda = \frac{16}{3R}.$$

Q6) Ans:- A

Solution:-

$$\begin{array}{cccccc} L & B & P & B & P & H. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 1 & 2 & 3 & 4 & 5 & 6. \end{array}$$

$\Delta E = 12.75$



$$\frac{1}{\lambda} = Rz^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

For lymen $\rightarrow$ 3.

Balmer $\rightarrow$ 2.

Paschen $\rightarrow$ 1.

Q7) Ans:- A.

Solution:- We see red end means it is a part of the visible region and obviously only Balmer series corresponds to the visible region for the Balmer series $n_1 = 2$ and red end means low energy

$n_2 = 5$

$5 \rightarrow 2$

Q8) Ans:- A

Solution:- The emission of visible light involves transition to second orbit as it involve Balmer series from fifth to second table. Thus the exited atom in 2nd orbital, transition must be from $2 \rightarrow 1$ for a atom to its ground state.

Q9) Ans:- C

Solution:- $\frac{1}{\lambda} = R_H Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$.

$\lambda_{Li^{+2}} = \lambda_{He^+}$ ($2 \rightarrow 4$ transition)

wavelength of He^+ ($Z = 2$)

$$\frac{1}{\lambda} = R_H \cdot 4 \cdot \left(\frac{1}{4} - \frac{1}{16}\right)$$

$$\frac{1}{\lambda} = 4 R_H \left(\frac{3}{\cancel{16}4}\right)$$

wavelength of Li^{+2} ion ($Z = 3$.

$$\frac{1}{\lambda} = R_H \times 9 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{\cancel{3} \cancel{R_H}}{4} = \cancel{9}^{3} \cancel{R_H} \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{1}{12} = \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] \Rightarrow \frac{1}{3^2} - \frac{1}{6^2} = \frac{1}{n_1^2} - \frac{1}{n_2^2}$$

$n_1 = 3$, $n_2 = 6$.

Q10) Ans:- B.

Solution:- 7th excited state $n_2 = 8$.

Paschen $n_1 = 3$.

$8 \rightarrow 3$, $7 \rightarrow 3$, $6 \rightarrow 3$, $5 \rightarrow 3$, $4 \rightarrow 3$

5 lines found

Q11) Ans:- C

Solution:- Electron is in 5^{th} excited state $n=6$

Infrared region.

$n=6 \rightarrow 3$. $n=6 \rightarrow 4$ $n=6 \rightarrow 5$

$n=5 \rightarrow 3$. $n=5 \rightarrow 4$

$n=4 \rightarrow 3$

Total '6' transition lines in IR.

Q12) Ans:- D.

Solution:- The transition $3 \rightarrow 2$ will correspond to red line as it has lowest energy.

The order of high energy to low energy is

VIBGYOR

Q13) Ans:- D.

Solution:- 1st line of Balmer $n_1=2, n_2=3$. of $Li^{+2} (Z=3)$

$$\bar{\nu} = R\left[\frac{1}{2^2}-\frac{1}{3^2}\right]3^2 = R\left[\frac{9-4}{36}\right]3^2$$

$$= \frac{5R}{\cancel{36}_4} \cdot \cancel{9} = \frac{5R}{4}.$$

Last line of Paschen $n_1=3$, $n_2=\infty$.

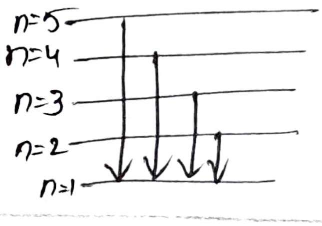
$$\bar{\nu} = R\, 3^2\left[\frac{1}{3^2}\right] = R.$$

Difference in wave number $= \frac{5R}{4} - R = \frac{5R-4R}{4} = \frac{R}{4}.$

Q14) Ans:- C

Solution:- 5th orbit $n_2=5$, For lymen $n_1=1$

4 lines observed in Lymen series.



Q15) Ans:- D

Solution:- $\frac{1}{\lambda} = R \times \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$\frac{1}{\lambda}$ is wavenumber.

$\therefore$ $\bar{\nu}$ & R have same units.

→ The lowest energy in Lymen series → UV region.

→ $L = \frac{nh}{2\pi}$, $n = 1$.

→ $r = 0.529 \times \frac{n^2}{Z}$, $n = Z = 1$.

$r = 0.529$.

Advanced Level Questions

Q1) Ans:- B.

Solution:- Longest wave length n=4 to n=3

$\frac{1}{\lambda} = 1.097 \times 10^7 \left[\frac{1}{3^2} - \frac{1}{4^2}\right]$

$\frac{1}{\lambda} = 1.097 \times 10^7 \times \frac{7}{144}$.

$\lambda = \frac{144}{1.097 \times 10^7 \times 7}$

$\lambda \approx 1.875 \times 10^4 A^o$

Shortest wave length n=4 to n=1.

$\frac{1}{\lambda} = 1.097 \times 10^7 \left(\frac{1}{1^2} - \frac{1}{4^2}\right)$

$\lambda = 1875 A^o$

$\lambda = 1.875 \times 10^3 A^o$.

Q2) Ans: A

Solution: Limiting line of Balmer $n_1 = 2, n_2 = \infty$

$$\frac{1}{\lambda} = R\left[\frac{1}{2^2} - 0\right]$$

$$\lambda = 364\,nm$$

Q3) Ans: B

Solution: For Humphry series $n_2 = 7, 8, 9 \ldots$

and $n_1 = 6$.

Q4) Ans: A

Solution: Brackett series $n_1 = 4$, $n_2 = \infty$ (last line)

$$\frac{1}{\lambda_B} = R_H\left(\frac{1}{4^2} - \frac{1}{\infty}\right)$$

$$\frac{1}{\lambda_B} = \frac{R_H}{16} \Rightarrow \lambda_B = \frac{16}{R_H}$$

2nd line of lymen $n_1 = 1, n_2 = 3$.

$$\frac{1}{\lambda_L} = R_H\left[\frac{1}{1^2} - \frac{1}{3^2}\right]$$

$$\frac{1}{\lambda_L} = R_H\left[\frac{9-1}{9}\right] = \frac{8R}{9}$$

$$\frac{1}{\lambda_L} = \frac{8R}{9} \Rightarrow \lambda_L = \frac{9}{8R_H}$$

$$\frac{\lambda_L}{\lambda_B} = \frac{\frac{16}{\cancel{R_H}}}{\frac{9}{8\cancel{R_H}}} = \frac{16 \times 8}{9} = \frac{128}{9}$$

$$\frac{\lambda_L}{\lambda_B} = \frac{128}{9} \Rightarrow \frac{\lambda_L}{128} = \frac{\lambda_B}{9}$$

$$\frac{128}{\lambda_L} = \frac{9}{\lambda_B}.$$

Q5) Ans:- C.

Solution:- Paschen 1st line $n_1 = 3, n_2 = 4$. of Be^{3+}

$$\bar{\nu} = R(4)^2\left[\frac{1}{3^2} - \frac{1}{4^2}\right]$$

$$= R(\cancel{16})\left[\frac{16-9}{9\times\cancel{16}}\right] = \frac{7R}{9}$$

Integer Type.

Q6) Ans:- 5

Solution:- 1st line in Balmer $n_1 = 2, n_2 = 3$.

$$\bar{\nu} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right]$$

$$= R\left[\frac{9-4}{36}\right] = \frac{5R}{36}.$$

$$\bar{\nu} = \frac{xR}{36} = \frac{5R}{36}$$

$$x = 5$$

Q7) Ans:- 0

Solution:- No Balmer lines of a hydrogen atom would be present within the wavelength range of 94.5nm to 130nm.

Visible light range → 400 nm to 700nm.

Matrix Matching

Q8) Ans:- A) R B) Q C) Q D) S.

Solution:-

A) Shortest wavelength in the Lyman series → R) $\lambda_{new} = \frac{\lambda_H}{Z^2} = \frac{\lambda}{3^2} = \frac{\lambda}{9}$.

B) Longest wavelength in Lyman series → Q). $n_1 = 1,\ n_2 = 2$

$\lambda_{Long} = \frac{4}{3} \times \frac{x}{9} = \frac{4}{9}x$.

C) Shortest wavelength in Balmar serie → Q) $\lambda_{shortest\ (Balmer)} = \frac{4\lambda}{9}$

D) Longest wavelength in Balmer. → S) $n_1 = 2,\ n_2 = 3$.

$\lambda_{logest} = \frac{16}{3} \times \frac{1}{9}\lambda = \frac{4}{27}\lambda$.

Q9) Ans:- A) P,Q,R,S B) Q,R,S C) R,S D) S.

Solution:-

A) Lyman → P) $n_2 = 2$, Q) $n_2 = 3$, R) $n_2 = 4$, S) $n_2 = 5$

B) Balmer → Q, R, S) $n_2 = 3, 4, 5$ - - -

C) Paschen → R, S) $n_2 = 4, 5, 6$ - - -

D) Brackett → S) $n_2 = 5, 6, 7$ - - -