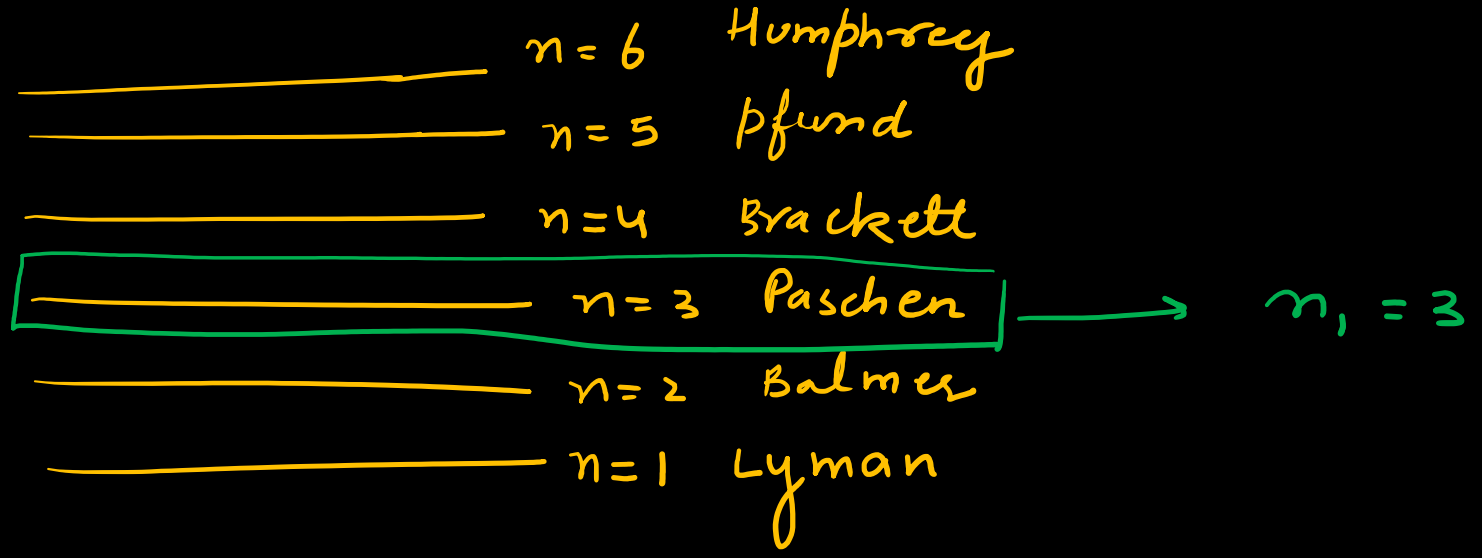
ARJUNA NEET BATCH

Atomic Structure

DPP-07

1. The value of n_1 for Paschen series of hydrogen spectrum is (n_1 = orbit number in which electron falls)
   (A) 1
   (B) 2
   (C) 3
   (D) 4



r_n → orbit no.

Z = 1

1 e⁻ → n = 1

2. Radius of Bohr's orbit of hydrogen atom is

(A) 0.24 Å ✗

(B) 0.48 Å ✗

(C) 0.53 Å ✓

(D) 1.06 Å ✗

$$r_n = 0.529 \frac{n^2}{Z} \text{ Å}$$

n → orbit number

Z → atomic "

$$= 0.529 \frac{(1)^2}{1} \text{ Å}^\circ$$

$$r_n = 0.529 \text{ Å}^\circ$$

$$\boxed{r_n = 0.53 \text{ Å}^\circ}$$

3. **Bohr theory is not applicable for**

(A) He^+
(B) Li^{2+}
(C) Be^+
(D) H

Bohr theory is only applicable to single electron system.

(A) He^+ $(Z=2)$ $\Rightarrow$ no of electrons $= 2-1 = 1$ ✓

1 +ve charge → one electron is less

(B) Li^{2+} $(Z=3)$ $\Rightarrow$ no. of electrons $= 3-2 = 1$ ✓

(C) Be^+ $(Z=4)$ $\Rightarrow$ no. of e^- $= 4-1 = 3$ ✗

(D) H $(Z=1)$ = no. of e^- = 1

4. What is the energy associated with 3rd energy shell of hydrogen atom

(A) -2.18×10^{-18} J

(B) -0.342×10^{-19} J

(C) -0.726×10^{-18} J

(D) -2.42×10^{-19} J

$n = 3$ $\quad Z = 1$

Joule.

$$E_n = -2.18 \times 10^{-18} \frac{Z^2}{n^2}$$

E_n ← orbit number.

$$= -2.18 \times 10^{-18} \times \frac{(1)^2}{(3)^2}$$

$$= -0.242 \times 10^{-18} \text{ J}$$

$$E = -2.42 \times 10^{-19} \text{ J}$$

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5. According to the Bohr Theory, which of the following transitions in the hydrogen atom will give rise to the least energetic photon ?

(A) n = 6 to n = 5

(B) n = 5 to n = 3

(C) n = 6 to n = 1

(D) n = 5 to n = 4

$E = 2.18 \times 10^{-18} \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ J/atom

(constant)

$E \propto \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$n_2 > n_1$

(A) $n_1 = 5$, $n_2 = 6$

$\left(\frac{1}{25} - \frac{1}{36}\right) = \boxed{\frac{11}{900}}$ ✓

(B) $n_1 = 3$, $n_2 = 5$

$\left(\frac{1}{9} - \frac{1}{25}\right) = \boxed{\frac{16}{225}}$

(C) $n_1 = 1$, $n_2 = 6$

$\left(\frac{1}{1} - \frac{1}{36}\right) = \boxed{\frac{35}{36}}$

(D) $n_1 = 4$, $n_2 = 5$

$\frac{1}{16} - \frac{1}{25} = \boxed{\frac{9}{400}}$

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6. Calculate the radii of 2nd Bohr orbit of Li^{2+}

(A) 52.9 pm
(B) 70.53 pm
(C) 29 pm
(D) 56 pm

$n = 2$ $\quad Z = 3$

$$r_n = 0.529 \frac{n^2}{Z} \text{ Å} \Rightarrow \boxed{r_n = 52.9 \frac{n^2}{Z} \text{ pm}}$$

$$r = \frac{0.529 \times (2)^2}{3} \text{ Å} = \frac{0.529 \times 4}{3} \text{ Å}$$

$$r = 0.7053 \text{ Å} \qquad (\text{Å} = 100 \text{ pm})$$

$$\boxed{r = 70.53 \text{ pm}}$$

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7. Calculate the energy of an electron in the first Bohr orbit of He^+

(A) -8.72×10^{-18} J

(B) -4.18×10^{-18} J

(C) -2.78×10^{-18} J

(D) None of these

$n = 1$ $\quad Z = 2$

$$E = -2.18 \times 10^{-18} \frac{Z^2}{n^2} \text{ J/atom}$$

$$E = -2.18 \times 10^{-18} \times \frac{(2)^2}{(1)^2}$$

$$E = -8.72 \times 10^{-18} \text{ J}$$

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8. Calculate the energy associated with the 1st orbit of He+ atom. What is the radius of this orbit?

$n = 1 \qquad Z = 2$

$E_n = -2.18 \times 10^{-18} \left(\frac{Z^2}{n^2}\right) J/atom$

$E = -2.18 \times 10^{-18} \times 4$

$E = -8.72 \times 10^{-18} J$

$r_n = 0.529 \frac{n^2}{Z} A^\circ$

$r = \frac{0.529}{2} A^\circ$

$r = 0.264 A^\circ$

$1 A^\circ = 100 pm$

$r = 26.4 pm$

$1 A^\circ = 0.1 nm$

$r = 0.0264 nm$

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9. Calculate the ratio of the radius of 1st orbit of H atom to that of 4th orbit.

$n=1$ $\quad Z=1$ $\quad n=4$

$$r_n = \frac{0.529\, n^2}{Z}\ \text{Å}$$

$$\frac{r_1}{r_4} = \frac{\frac{0.529 \times (1)^2}{1}\ \text{Å}}{\frac{0.529 \times (4)^2}{1}\ \text{Å}}$$

$$\boxed{\frac{r_1}{r_4} = \frac{1}{16}} \Rightarrow \boxed{1:16}$$

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10. Calculate the velocity of the electron in the third orbit of hydrogen atom.

$n = 3$ $\quad Z = 1$

$$V_n = 2.19 \times 10^6 \frac{Z}{n} \text{ m/s}$$

$$V_3 = 2.19 \times 10^6 \times \frac{1}{3} \text{ m/s}$$

$$\boxed{V = 7.3 \times 10^5 \text{ m/s}}$$

Thank You