PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 18

Total Marks : 30

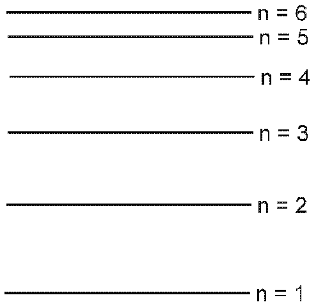
Max. Time : 33 min.

Topic : Atomic Structure

Type of Questions		**M.M., Min.**
Single choice Objective ('–1'negative marking) Q.1 to Q.4,7,8	(3 marks, 3 min.)	[18, 18]
Subjective Questions ('–1' negative marking) Q.5 to Q.6,9	(4 marks, 5 min.)	[12, 15]

1. In a mixture of sample of H-atoms and He^+ ions, electrons in all the H-atoms and He^+ ions are present in n = 4^{th} state. Then, find total number of spectral lines obtained when all the electrons make transition from n = 4 upto ground state :
(A) 12 (B) 6 (C) 11 (D) 16

2. What would be the maximum number of emission lines for atomic hydrogen that you would expect to see with the naked eye, if the only electronic energy levels involved are those shown in the Figure :



(A) 4 (B) 6 (C) 5 (D) 15

3. A sample of H–like ion is in a particular excited state n_2. The electron in it makes back transition upto a lower excited state n_1 producing a maximum of 10 different spectral lines. The change in angular momentum of electron corresponding to maximum frequency line is expressed as y $\frac{h}{4\pi}$ J-s. Then, the value of y is :
(A) 2 (B) 4 (C) 8 (D) 6

4. In a sample of H–atom, electron makes transition from lower state n_1 to higher state n_2 by absorbing photons emitted by another sample of Li^{2+} ions from 12 $\rightarrow$ 3 transition. The electron in H–atom then makes back transition from state n_2 to ground state by emitting all posible photons. Then, the number of lines in infrared region in emission spectrum of H–atom sample is :
(A) 3 (B) 2 (C) 1 (D) 0

5. In a sample containing a finite number of H- like atoms, electrons make transition from n = 6 upto ground state producing a total of 10 different spectral lines. Find the minimum number of atoms that must have been present in the sample.

6. An ion (atomic number Z), isoelectronic with Hydrogen, is in n^{th} excited state. This ion emits two photons of energies 10.2 eV and 17eV successively to return to first exited state. It can also emit two photons of energies 4.25 and 5.95 eV successively to return to second excited state. What is value of n and Z ?

7. Determine the de-Broglie wavelength associated with an electron in the 3^{rd} Bohr's orbit of He^+ ion :
(A) 10 Å (B) 2 Å (C) 5 Å (D) 1 Å

8. If the radius of first Bohr's orbit of H-atom is x, which of the following is the INCORRECT conclusion :
(A) The de-Broglie wavelength of electron in the third Bohr orbit of H-atom = 6 πx.
(B) The fourth Bohr's radius of He^+ ion = 8x.
(C) The de-Broglie wavelength of electron in third Bohr's orbit of Li^{2+} = 2πx.
(D) The second Bohr's radius of Be^{2+} = x

9. An electron is present in n^{th} orbit of Be^{3+} ion such that its de-Broglie wavelength is same as associated with the electron in 3^{rd} orbit of C^{5+} ion. Find the distance between two adjacent crests of wave associated with motion of an electron in n^{th} orbit of Be^{3+} ion.

Answer Key

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1.	(A)	**2.**	(D)	**3.**	(D)	**4.**	(D)	**5.**	(A, B)
6.	(C)	**7.**	(D)	**8.**	(B)				

9. [A $\rightarrow$ r, s] ; [B $\rightarrow$ p, s] ; [C $\rightarrow$ q, r, s] ; [D $\rightarrow$ p, q, s]. **10.** (D)

Hints & Solutions

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1. Total spectral lines obtained from H-atom = 6
Total spectral lines obtained from He^+-ion = 6
One line is common between them so total number of lines are 11.

2. Balmer series lines lies in visible region.

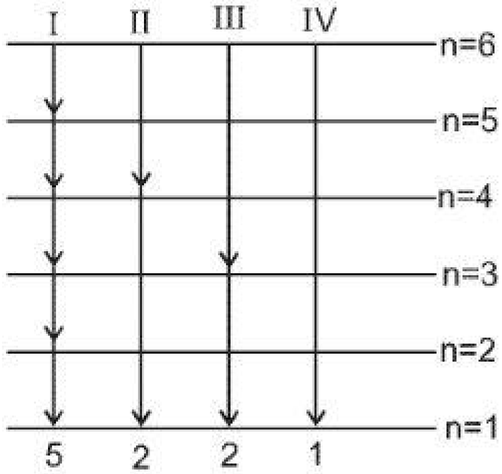
3. $n_2 \rightarrow n_1$, max different spectral lines = 10
$\therefore \Delta n = n_2 - n_1 = 4$

$\therefore$ change in angular momentum = $(\Delta n)\dfrac{h}{2\pi} = 4\left(\dfrac{h}{2\pi}\right) = 8\left(\dfrac{h}{4\pi}\right)$

$\therefore$ y = 8

4. $(Li^{2+})_{12 \rightarrow 3} = (H)_{4 \rightarrow 1}$
$\therefore$ No. of lines in infrared region = 1 (4 $\rightarrow$ 3) paschen series

5.



$\therefore$ Minimum number of atoms required = 4

6. Let excited state be n.

Case - I : There is a transition to first exited state i.e. 2nd level from n^{th} level.

$$10.20 + 17.00 = 13.6\, Z^2 \left[\frac{1}{2^2} - \frac{1}{n^2}\right] \qquad ..... (1)$$

Case - II : There is a transition to second excited state i.e. 3rd levle from n^{th} level.

$$4.25 + 5.95 = 13.6\, Z^2 \left[\frac{1}{3^2} - \frac{1}{n^2}\right] \qquad ..... (2)$$

on dividing (1) to (2), we have n^{th} level is **= 6.**

So, excited state is 5^{th}.

So, **n = 5.**

7. $n\lambda = 2\pi r \quad \Rightarrow \quad$ so $\quad \lambda = \frac{2\pi r}{3} = \frac{2\pi}{3} \times (53\text{ pm}) \times \frac{9}{2} \simeq 5\text{Å}$

8. Use formula $2\pi r_n = n\,\lambda$

We can't apply Bohr radius formula for Be^{2+}

$2\pi r_n = n\,\lambda$ सूत्र का उपयोग करें

9. $\frac{4}{n} = \frac{6}{3} \Rightarrow n = 2$ electron is present in 2^{nd} orbit of Be^{3+}. (Be^{3+} के द्वितीय कक्ष में उपस्थित इलेक्ट्रॉन)

$2\pi r = 2\lambda \quad \Rightarrow \quad \lambda = \pi r \quad \Rightarrow \quad r = 0.529 \times 10^{-10} \times \frac{2^2}{4} = 0.529 \times 10^{-10} = 0.529\text{Å}.$