AVIRAL CLASSES
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CHEMISTRY
CRASH COURSE

LECTURE-02

TOPICS : Atomic Structure

1. The nucleus of an atom is located at x = y = z = 0. If the probability of finding an s-orbital electron in a tiny volume around x = a, y = z = 0 is 1×10^{-5}, what is the probability of finding the electron in the same sized volume around x = z = 0, y = a ?
   (a) 1×10^{-5}
   (b) $1 \times 10^{-5} \times a$
   (c) $1 \times 10^{-5} \times a^2$
   (d) $1 \times 10^{-5} \times a^{-1}$
2. The limiting line in Balmer series will have a frequency of
   (a) $6.22 \times 10^{15}\ s^{-1}$
   (b) $7.22 \times 10^{14}\ s^{-1}$
   (c) $8.22 \times 10^{14}\ s^{-1}$
   (d) $9.22 \times 10^{14}\ s^{-1}$
3. If the electron falls from n = 5 to n = 4 in the H-atom, then emitted energy is
   (a) 0.306 eV (b) 12.09 eV
   (c) 1.89 eV (d) 0.65 eV
4. Which of the following statements is not correct ?
   (a) The shape of an atomic orbital depends on the azimuthal quantum number
   (b) The orientation of an atomic orbital depends on the magnetic quantum number
   (c) The energy of an electron in an atomic orbital of multi-electron atom depends on principal quantum number
   (d) The number of degenerate atomic orbitals of one type depends on the values of azimuthal and magnetic quantum numbers.
5. The total number of orbitals in a shell with principal quantum number n is
   (a) 2n (b) $2n^2$
   (c) n^2 (d) n + 1
6. Effective nuclear charge (Z_{eff} e) for a nucleus of an atom is defined as
   (a) shielding of the outermost shell electrons from the nucleus by the innermost shell electrons
   (b) the net positive charge experienced by electron from the nucleus
   (c) the attractive force experienced by the nucleus from electron
   (d) screening of positive charge on nucleus by innermost shell electrons.
7. The number of radial nodes and angular nodes for d-obrital can be represented as
   (a) (n– 2) radial nodes + 1 angular node = (n – 1) total nodes
   (b) (n– 1) radial nodes + 1 angular node = (n – 1) total nodes
   (c) (n– 3) radial nodes + 2 angular node = (n – l – 1) total nodes
   (d) (n– 3) radial nodes + 2 angular node = (n – 1) total nodes
8. The correct set of quantum numbers for the outermost electron of Rubidium (37) is
   (a) $5,0,0,+\frac{1}{2}$ (b) $4,3,2,-\frac{1}{2}$
   (c) $5,1,0,-\frac{1}{2}$ (d) $5,1,1,+\frac{1}{2}$
9. In any subshell, the maximum number of electrons having same value of spin quantum number is
   (a) $\sqrt{l(1+1)}$
   (b) $l + 2$
   (c) $2l + 1$
   (d) $4l + 2$
10. Energy of H-atom in the ground state is – 13.6 eV, hence energy in the second excited state is
    (a) – 6.8 eV (b) – 3.4 eV
    (c) – 1.51 eV (d) – 4.53 eV

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TOPICS : Atomic Structure SOLUTION

1. **(a) :** Since the distance from the nucleus is same, and the *s*-orbital is spherically symmetrical, hence probability is identical.

2. **(c) :** The limiting line of Balmer series refers to the transition of electron from ∞ to 2^{nd} orbit $\upsilon = c.\bar{\upsilon}$

$$= 3\times10^{10}\times109677\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right) = 3.29\times10^{15}\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)\ \text{sec}^{-1}$$

$= 8.22 \times 10^{14}\ \text{sec}^{-1}$ $(n_1 = 2,\ n_2 = \infty)$

3. **(a) :** $E_n = -\frac{13.6}{n^2}\ \text{eV}$

$$E_5 - E_4 = 13.6\left(\frac{1}{4^2}-\frac{1}{5^2}\right)\text{eV} = 13.6\left(\frac{1}{16}-\frac{1}{25}\right) = 0.306\ \text{eV}$$

4. **(c) :** The energy level of an orbital in multi-electron system depends upon *l*.

5. **(c) :** Number of orbitals in a shell = n^2.

6. **(b):** Effective nuclear charge is the net positive charge experienced by the electrons from the nucleus. Due to presence of electrons in the innermost shells the electrons in the outermost shell do not experience the full positive charge from the nucleus. This is known as shielding of the outermost shell electrons from the nucleus by the innermost shell electrons.

7. **(d) :** Total number of nodes = $n - 1$
For *d*-orbital, radial nodes = $n - 3$ and there are 2 angular nodes.
The number of angular nodes is given by *l*. *i.e.*, for *p*, 1 angular node, for ***d*** , **2** angular nodes and so on.

8. **(a) :** Outermost electron of Rb (At. no. 37) is 5s. Hence, its quantum numbers are 5, 0, 0, $\pm 1/2$.

9. **(c) :** Maximum number of electrons with same spin is equal to the maximum number of orbitals *i.e.*, $(2l + 1)$.

10. **(c) :** $E_n = -\frac{13.6}{n^2}\text{eV}$

Second excited state means $n = 3$

Thus, $E_3 = -\frac{13.6}{3^2} = -\frac{13.6}{9} = -1.51\ \text{eV}$