CHEMISTRY-1

Atomic Structure

[Set-1]

SECTION-A

1. Which hydrogen atom like species will have the same radius as that of Bohr orbit of hydrogen atom?

   (i) n = 2, Li^{2+} (ii) n = 2, Be^{3+} (iii) n = 2, He^{+} (iv) n = 3, Li^{2+}

2. According to the Bohr theory, which of the following transition in the H-atom will give rise to the least energetic photon?

   (i) $n = 6 \rightarrow n = 1$ (ii) $n = 5 \rightarrow n = 4$ (iii) $n = 5 \rightarrow n = 3$ (iv) $n = 6 \rightarrow n = 5$

3. Which of the following pairs of d-orbitals will have electron density along the axes?

   (i) $d_{z^2}, d_{x^2y^2}$ (ii) d_{xy}, d_{yz} (iii) $d_{x^2-y^2}, d_{xy}$ (iv) d_{yz}, dz^2

4. Which of the following statement is incorrect about $2p_x, 2p_y$ and $2p_z$ orbitals?

   (i) These three have the same energy

   (ii) These three have the same shape

   (iii) These three have the same orientation in space

   (iv) Each orbital has only one nodal plane

5. **Match the following:**

	Column-I		**Column-II**
A:	Photon	1.	Value of n = 4 for N-shell
B:	Electron	2.	Probability density
C:	ψ^2	3.	Always positive value
D:	Principal quantum number	4.	Exhibits both momentum and wavelength

	A	B	C	D
(i)	4	4	(1,3)	(2, 3)
(ii)	2	4	2	1
(iii)	4	4	(2, 3)	(1, 3)
(iv)	4	2	3	1

Assertion-Reason type Questions:

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true and R is not the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

6. A: The f-subshell has five orbitals.

   R: The number of orbitals in a given subshell is determined by magnetic quantum number

7. A: An electron in 4p orbital will have a same value of the orbital angular momentum as the electron in the 3p orbital.

   R: The azimuthal quantum number only determines the orbital angular momentum.

Passage bases questions:

Read the following passage and answer the questions:

The electrons are distributed around the nucleus in various energy levels called shells, subshell and orbitals. A set of quantum numbers required to define the position and total energy of electron in an atom. The electrons are filled into various orbitals in order of increasing energy using Aufbau's principle, Pauli's principle and Hund's rule.

8. In which of the following set of orbitals, the second orbital is of higher energy than the first for H-atom?

   (i) 2s, 2p (ii) 2p, 3s (iii) 3s, 3p (iv) all of these

9. Which of the following set of quantum number correctly define 2pz orbital?

   (i) n = 2, l = 1 (ii) n = 2, l = 1, m = 3 (iii) n = 2, l = 0, m = 0 (iv) n = 2, l = 1, m = 0

10. Number of electron in $_{17}Cl^-$ with ($n + l$) value equal to 3 is

    (i) 4 (ii) 6 (iii) 8 (iv) 10

SECTION-B

11. Calculate the wave number of the longest wavelength transition in the Balmer series for H-atom.

OR

(i) Calculate the radius of the 2nd Bohr orbit of He^+

(ii) Potential energy of an electron in the nth Bohr orbit is equal to [?] total energy of an electron.

12. Write the electronic configuration of

    (i) $_{29}Cu^{2+}$ (ii) $_{24}Cr$

    Which one is more paramagnetic and why?

13. An electron is moving with a kinetic energy of 4.55×10^{-19} J. Calculate the wavelength of the moving electron. ($m_e = 9.1 \times 10^{-31}$ kg, $h = 6.62 \times 10^{-34}$ Js)

14. (i) State Pauli exclusion principle.

    (ii) Write the value of *n* and *l* for 3p.

    (iii) How many electrons in $n = 4$, $l = 2$ will have spin quantum number $m_s = + ½$.

    OR

    (i) State Hund's rule of maximum multiplicity

    (ii) Write the four quantum numbers for the electron with highest energy in potassium (Atomic number = 19)

15. (i) Calculate the number of radial and angular modes in 4p

    (ii) How many orbitals are present in Co (Z = 27) filled with one or more electron?

    (iii) Calculate the uncertainty in position of a tennis ball of mass 100 g moving with a speed of 50 m/s. ($h = 6.62 \times 10^{-34}$ kg $m^2 s^{-1}$)

    OR

    (i) Prove that the circumference of an orbit of radius r containing an electron is an integral multiple of wavelength λ.

    (ii) Why the exact path of an electron around the nucleus cannot be traced?

    (iii) What is the energy required when an electron in a H-atom jumps from its first excited state to third excited state? $\Delta E = 2.18 \times 10^{-18} \quad Z^2 \left(\frac{1}{n_L^2} - \frac{1}{n_H^2} \right) J$

