2024

(NEP—2020)

(1st Semester)

CHEMISTRY (MAJOR/MINOR)

(Inorganic Chemistry—I)

Full Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

(SECTION : A—OBJECTIVE)

(*Marks* : 10)

Tick (✓) the correct answer in the brackets provided : 1×10=10

1. According to de Broglie's equation, the _____ of a particle in motion is directly proportional to wavelength.

   (a) energy ( )

   (b) velocity ( )

   (c) momentum ( )

   (d) amplitude ( )

2. The p_x, p_y and p_z orbitals are called degenerate orbitals as they have

(a) same orientation in space ( )

(b) equal energy ( )

(c) same size ( )

(d) equal number of electron ( )

3. The orbital with $n = 2$, $l = 1$ refers to

(a) $2p$ ( )

(b) $2s$ ( )

(c) $1s$ ( )

(d) $3p$ ( )

4. Which one of the following is having the highest electron affinity?

(a) Fluorine ( )

(b) Chlorine ( )

(c) Oxygen ( )

(d) Hydrogen ( )

5. According to modern periodic law, the physical and chemical properties of elements are periodic functions of their

(a) atomic weights ( )

(b) mass number ( )

(c) atomic number ( )

(d) electronic configuration ( )

6. Among the given isoelectronic species, which one is having the smallest ionic radius?

(a) Mg^{2+} ( )

(b) Na^{+} ( )

(c) O^{2-} ( )

(d) N^{3-} ( )

7. Out of the following molecules, which one has trigonal planar geometry?

(a) NH_3 ( )

(b) BF_3 ( )

(c) PCl_3 ( )

(d) IF_3 ( )

8. According to VSEPR theory, the correct order of increasing electron pair repulsion is

(a) *lp-lp < bp-bp < bp-lp* ( )

(b) *bp-bp < lp-lp < bp-lp* ( )

(c) *lp-lp < bp-lp < bp-bp* ( )

(d) *bp-bp < bp-lp < lp-lp* ( )

9. The oxidation number of Cl in Cl_2O_7 is

(a) +3 ( )

(b) +5 ( )

(c) +7 ( )

(d) –7 ( )

10. Ellingham diagram represents a graph of

(a) ΔH versus T ( )

(b) ΔG versus T ( )

(c) ΔS° versus T ( )

(d) ΔG° versus P ( )

(SECTION : B—SHORT ANSWERS)

(*Marks* : 15)

Answer *five* questions, taking at least *one* from each Unit : 3×5=15

UNIT—I

1. State and explain Heisenberg's uncertainty principle.

2. Write a short note on Hund's rule of maximum multiplicity.

UNIT—II

3. Explain with reasons how the atomic radius varies in a period.

4. Define periodicity in properties of elements. What is the cause of periodicity?

UNIT—III

5. Compare the properties of ionic and covalent compounds.

6. Write the hybridization of central atom and shapes of the BeF_2 and SF_4 using VSEPR theory.

UNIT—IV

7. Define oxidation number. Find the oxidation numbers of chromium atom in $K_2Cr_2O_7$ and H_2CrO_4.

8. Explain the van Arkel-de Boer process of refining.

(SECTION : C—DESCRIPTIVE)

(*Marks* : 50)

Answer *five* questions, taking at least *one* from each Unit : 10×5=5

UNIT—I

1. *(a)* State and explain Aufbau principle. Write its limitations. 3+2=

(b) The uncertainty in the position and velocity of a particle are 10^{-10} m and $5{\cdot}27\times10^{-24}$ m sec^{-1} respectively. Calculate the mass of the particle. (Given $h = 6{\cdot}6\times10^{-34}$ kg m^2 sec^{-1})

2. *(a)* Write a note on the stability of half-filled and fully filled orbitals. Write the electronic configurations of chromium (Z = 24) and copper (Z = 29). 3+2

(b) What is radial wave function? Write the radial probability curves for 1s, 2s and 2*p* orbitals. 2+3

UNIT—II

3. *(a)* What is electron affinity? Explain why the electron affinities of halogens are very high but the electron affinities of noble gases are zero. 1+

(b) Define screening effect and effective nuclear charge. Calculate the effective nuclear charge experienced by 4s electron in potassium atom (Z = 19). 2+

4. *(a)* Explain the term 'electronegativity'. Explain the factors which affect the electron affinity. 1+

(b) What is ionization energy? Give reasons why the ionization energy of Ga is higher than Al and that of Tl is higher than In. 1+

UNIT—III

5. *(a)* What is a polar covalent bond? Write the factors that cause the polarity in a covalent bond. 2+3=5

(b) Explain the hybridization and shapes of NH_3 and ClF_3 molecules on the basis of VSEPR theory. 2½+2½=5

6. *(a)* What is meant by polarization of ions? What are the factors affecting the polarizability of an anion and polarizing power of a cation? 1+4=5

(b) What is hybridization? Discuss sp^3 and sp^3d^2 hybridization with suitable examples. 1+4=5

UNIT—IV

7. *(a)* Balance the following redox reaction by ion-electron method in acidic medium : 5

$$MnO_4^- + C_2O_4^{2-} \rightarrow Mn^{2+} + CO_2$$

(b) What do you understand by the equivalent weight of reducing agent? Calculate the equivalent weight of $Na_2S_2O_3 \cdot 5H_2O$ in acidic medium (mol. wt. = 248). 2+3=5

8. *(a)* What is meant by electrochemical series? Discuss the application of electrochemical series to check feasibility of the chemical reactions. 2+3=5

(b) Write notes on the following : 2½+2½=5

(i) Electrolytic reduction

(ii) Hydrometallurgy

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