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(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

Simple calculator may be permitted.

(SECTION : A—OBJECTIVE)

(Marks : 10)

Tick (✓) the correct answer in the brackets provided :

1×10=10

1. de Broglie's equation relates wavelength to

(a) mass and energy ()

(b) velocity and energy ()

(c) momentum ()

(d) mass and its speed ()

2. What is the mathematical expression of the Heisenberg uncertainty principle?

(a) $\Delta x \Delta p = h/4$ ()

(b) $\Delta x \Delta p = h/4$ ()

(c) $\Delta x \Delta p = h/4$ ()

(d) $\Delta x \Delta p = h/2$ ()

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

(a) $2p$ ()

(b) $3p$ ()

(c) $3d$ ()

(d) $3s$ ()

4. Modern periodic law states that the physical and chemical properties of elements are periodic functions of their

(a) atomic weight ()

(b) mass number ()

(c) electronic configurations ()

(d) atomic number ()

5. Which one of the following has the highest electron affinity value?

(a) F ()

(b) Cl ()

(c) O ()

(d) H ()

6. According to Allred-Rochow definition, the electronegativity of an element is

(a) directly proportional to the radius of an atom ()

(b) the average of ionization energy and electron affinity ()

(c) directly proportional to the effective nuclear charge ()

(d) inversely proportional to the effective nuclear charge ()

7. The number of lone pairs and bond pairs present on oxygen atom in water molecule are respectively

(a) 1 and 2 ()

(b) 2 and 1 ()

(c) 3 and 2 ()

(d) 2 and 2 ()

8. Which one of the following ions will be having the highest polarizing power?

(a) Cu^{2+} ()

(b) Co^{2+} ()

(c) Fe^{2+} ()

(d) Ni^{2+} ()

9. Select the reducing agent in the following redox reaction :



(a) Fe^{2+} ()

(b) Fe^{3+} ()

(c) Sn^{2+} ()

(d) Sn^{4+} ()

10. Mond's process is used for the purification of

(a) Mo ()

(b) Ni ()

(c) Al ()

(d) Fe ()

(SECTION : B—SHORT ANSWERS)

(Marks : 15)

Answer *five* questions, taking at least *one* from each Unit :

3×5=15

UNIT—I

1. Write the limitations of Bohr's theory of atomic structure.
2. Write a brief note on Pauli's exclusion principle.

UNIT—II

3. What do you mean by diagonal relationship in the periodic table?
4. Define electronegativity. Explain its variation in a period of the periodic table.

UNIT—III

5. Differentiate between covalent bond and coordinate bond.
6. What is an ionic bond? What are the factors affecting the formation of an ionic bond?

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 applications of electrochemical series to check feasibility of the chemical reactions.

(SECTION : C—DESCRIPTIVE)

(Marks : 50)

Answer *five* questions, taking at least *one* from each Unit :

10×5=50

UNIT—I

1. (a) What is meant by radial probability distribution curves? Write the probability distribution curves for 1s, 2s and 2p orbitals. 2+3=5
- (b) State and explain Aufbau principle. Write its limitations. 3+2=5
2. (a) Explain briefly the significances of principal quantum number and magnetic quantum number. 2½+2½=5
- (b) Comment on the stability of half-filled and fully-filled orbitals. Write the electronic configurations of chromium (Z = 24) and copper (Z = 29). 3+2=5

UNIT—II

3. (a) Define effective nuclear charge and shielding effect. Calculate the effective nuclear charge experienced by the outermost electron of boron and nitrogen atoms. 2+3=5
- (b) Define electron affinity. Explain by giving reasons how it varies along a period and down the group. 1+4=5
4. (a) Explain the general trend of atomic radius across a period in the periodic table. Why is the atomic radius of noble gas atom bigger than that of the preceding halogen atom in the periodic table? 3+2=5
- (b) Define ionization energy and state its trend in a group of the periodic table. Give reasons why the ionization energy of Ga is higher than Al. 1+2+2=5

UNIT—III

5. (a) What is meant by polarization of ions? Write a brief note on Fajans' rules. 2+3=5
- (b) Explain the valence shell electron pair repulsion (VSEPR) theory and predict the shapes of PCl_5 and SF_6 . 2+3=5
6. (a) What are meant by bond moment and dipole moment? Compare the dipole moment of NH_3 and NF_3 molecules. 2+3=5
- (b) Write the salient features of hybridization. Explain the sp^3 hybridization by taking NH_3 as an example. 2+3=5

UNIT—IV

7. (a) Provide a step-by-step explanation of balancing a redox reaction using the ion-electron method for the following reaction : 5
- $$\text{MnO}_4^- + \text{H}^+ + \text{Fe}^{2+} \rightarrow \text{Mn}^{2+} + \text{Fe}^{3+}$$
- (b) Discuss the concepts of the following : 2½×2=5
- (i) Zone refining
- (ii) Hydrometallurgy
8. (a) What is Ellingham diagram? Explain the significance of Ellingham diagrams for reduction of metal oxides using carbon or carbon monoxide as reducing agent. 1+4=5
- (b) What is meant by equivalent weight of an oxidizing agent? Calculate the equivalent weight of $\text{K}_2\text{Cr}_2\text{O}_7$ in acidic medium. (Given : Mass of $\text{K}_2\text{Cr}_2\text{O}_7$ = 294; Equation : $\text{Cr}_2\text{O}_7^{2-} + \text{H}^+ \rightarrow \text{Cr}^{3+}$) 2+3=5
