CHEM101 (MAJOR/MINOR)

Student's Copy

2023

(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 (\checkmark) the correct answer in the brackets provided :

- Which principle explains the arrangement of electrons in an atom's orbitals?
 - (a) Aufbau principle ()
 - (b) Hund's rule ()
 - (c) Pauli's exclusion principle ()
 - (d) Heisenberg's uncertainty principle ()
- 2. What is the significance of quantum numbers in atomic theory?
 - (a) They indicate the size of an atom ()
 - (b) They describe the shape of an atom's nucleus ()
 - (c) They specify the energy levels of electrons ()
 - (d) They determine the atomic mass of an element ()

 $1 \times 10 = 10$

- 3. What is the trend in atomic radii as you move from left to right across a period in the periodic table? (a) Atomic radii increase () (b) Atomic radii decrease 1 (c) Atomic radii remain constant () (d) Atomic radii fluctuate randomly ſ) 4. The shielding effect in atoms is primarily caused by (a) an increase in the number of protons) (b) a decrease in the number of neutrons () (c) inner electrons repelling outer electrons () (d) outer electrons shielding inner electrons () 5. Which type of bond involves the sharing of electrons between atoms? (a) Ionic bond l) (b) Covalent bond () (c) Metallic bond () (d) Hydrogen bond - () 6. Which factor determines the extent of polarization in a chemical bond? (a) Electronegativity difference () (b) Atomic radius () (c) Ionization energy ()(d) Electron affinity () 7. What is the oxidation number of S in $Na_2S_2O_3$? (a) +1() (b) +4 Ĺ)
 - (c) +3 ()
 - (d) +2 ()

- 8. In Ellingham diagrams, a negative slope indicates the metal oxide
 - (a) can be reduced using carbon ()
 - (b) is thermally unstable ()
 - (c) cannot be reduced ()
 - (d) is chemically inert ()
- 9. Which property of an element indicates its tendency to attract electrons in a chemical bond?

(a)	Ionization energy	()
(b)	Electron affinity	()
(c)	Electronegativity	()
(d)	Atomic radius	⁰ ()	

10. Which term refers to the potential of a half-cell compared to the standard hydrogen electrode?

(a)	Electrode potential	()
(b)	Reduction potential	()
(c)	Oxidation potential	()
	(

(d) Electrolytic potential ()

(SECTION : B-SHORT ANSWERS)

(Marks: 15)

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

3×5=15

Unit—I

- 1. Explain the concept of dual character of matter as proposed by de Broglie.
- Describe Pauli exclusion principle and its significance in atomic structure.

Unit—II

- 3. Explain how effective nuclear charge affects the periodic trends.
- 4. Explain the periodic variations of electronegativity in a period.

UNIT-III

- Discuss the significance of Fajan's rules in predicting the polarity of chemical bonds.
- 6. How is the concept of bond moment related to the ionic character of covalent compounds?

UNIT-IV

- Discuss the significance of standard electrode potential in predicting the spontaneity of redox reactions.
- 8. Discuss the process of hydrometallurgy in extracting metals.

(SECTION : C-DESCRIPTIVE)

(Marks : 50)

Answer five questions, taking at least one from each Unit : 10×5=50

Unit—I

- 1. (a) Compare and contrast the shapes of s, p and d orbitals. Provide diagrams to support your explanation.
 - (b) Discuss the limitations of Bohr's theory of atomic structure.
- **2.** (a) Explain the concept of exchange energy and how it relates to the stability of electronic configurations.
 - (b) Write the Schrödinger wave equation and explain the terms involved in it. Which quantum number cannot be derived with Schrödinger wave equation? 4+1=5

UNIT-II

- 3. (a) Define effective nuclear charge and shielding effect. Calculate the effective nuclear charge experienced by the outermost electron of nitrogen atom (atomic number = 7).
 2+3=5
 - (b) Define electron affinity. How does electron affinity change across the periodic table? Explain why the electron affinity of nitrogen is smaller than oxygen. 1+2+2=5

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- Analyze and explain the variation in atomic radii within a group and 4. (a) across a period in the periodic table.
 - Define ionization energy and explain the periodic variations in a group. (b) Give reasons why the ionization energy of Ga is higher than Al and that of Tl is higher than In. 1+2+2=5

Unit—III

- 5. (a) Describe the concept of hybridization in chemical bonding. Discuss the hybridization of NH₃ and SF₆. 2+3=5
 - (b) Explain the concept of covalent character in ionic compounds. Provide an example.
- 6. (a) Explain the Valence Shell Electron Pair Repulsion (VSEPR) theory and predict the shapes of SF_4 , H_3O^+ and ClF_3 . 2+3=5
 - (b) Compare and contrast ionic and covalent bonds, highlighting their differences in terms of electron sharing and electronegativity. 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 :

$$K_2Cr_2O_7 + H_2SO_4 + FeSO_4 \rightarrow Cr_2(SO_4)_3 + Fe_2(SO_4)_3$$

- (b) Discuss the concepts of the following :
 - (i) Zone refining process
 - (ii) Electrolytic reduction
- 8. (a) Explain the Ellingham diagram and how it helps in predicting the feasibility of metal reduction using different reducing agents. Provide examples to support your explanation.
 - (b) What do you understand by equivalent weight of oxidizing agent? Calculate the equivalent weight of KMnO4 in acidic medium 1+4=5

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 $2\frac{1}{2} \times 2 = 5$

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	(a)	Atomic radii increase ()
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[Contd.

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UNIT-IV

- **7.** Discuss the significance of standard electrode potential in predicting the spontaneity of redox reactions.
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(SECTION : C-DESCRIPTIVE)

(Marks : 50)

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[Contd.

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- 8. (a) Explain the Ellingham diagram and how it helps in predicting the feasibility of metal reduction using different reducing agents. Provide examples to support your explanation.
 - (b) What do you understand by equivalent weight of oxidizing agent? Calculate the equivalent weight of KMnO₄ in acidic medium (mol. wt. = 158). 1+4=5

21/2×2=5

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