2022
B.A./B.Sc.
First Semester
CORE – 1
CHEMISTRY
Course Code: CHC 1.11
(Inorganic Chemistry - I)

Total Mark: 70   *Pass Mark: 28*
Time: 3 hours

Answer <u>five</u> questions, taking <u>one</u> from each unit.

UNIT–I

1. (a) Define dual nature of electron. Derive de Broglie's equation.   1+3=4
   (b) Write the electronic configuration of Cl, Ca, P and Fe. Given atomic number of Cl =17, Ca=20, P=15 and Fe=26.   1×4=4
   (c) Give the main postulates of Bohr's model of an atom and mention its drawbacks.   4+2=6

2. (a) What is effective nuclear charge? Calculate the Z_{eff} for
      (i) 2P electron in N (atomic number 7)
      (ii) 3d electron in Ti (atomic number 22)   1+2+2=5
   (b) Explain Hund's rule of maximum multiplicity with an example.   3
   (c) Draw the shapes of 3Px and $4dx^2$–y^2 with the radial nodes present. Define probability curve and draw probability curve for 1s and 2s orbitals.   3+3=6

UNIT–II

3. (a) Define atomic radius. What happens to the radius of an atom as we move down a group and across a period?   1+3=4
   (b) Define ionisation enthalpy. Discuss the factors affecting IE.   1+4=5
   (c) Explain the Mulliken's scale of electronegativity.   5

4. (a) What is electron gain enthalpy? Discuss the factors determining the electron gain enthalpy.   1+4=5

(b) Define van der Waals radius. How is it different from covalent radii?

$2+3=5$

(c) Carbon in CH_4 is SP^3 hybridised which has 25% S-character. The electronegativity of carbon in CH_4 is 2.53. Explain. 4

UNIT–III

5. (a) Define solvation energy. What is radius ratio rule? Give its limitations.

$1+1+2=4$

(b) Write Kapustinskii equation and mention some importance of this equation. $1+3=4$

(c) Write notes on the following: $2×3=6$
   (i) Ion-dipole forces
   (ii) Dipole-dipole interactions
   (iii) Induced-dipole interactions

6. (a) Define lattice energy. Briefly explain Born-Haber cycle. Calculate the lattice energy in the formation of NaCl crystals.
   Given that EA= –85.8, IE=117.9, S=26.0, D=57.6 and
   ΔH_f = –98.3 Kcal/mole respectively. $1+3+2=6$

(b) Write the main postulates of band model theory. Define conductors and semiconductors. $3+2=5$

(c) Derive Born-Lande equation. 3

UNIT–IV

7. (a) Draw the molecular orbital energy level diagram of O_2^{2-} ion, write its molecular orbital configuration and calculate its bond order.

$3+1+1=5$

(b) Based on VSEPR theory predict the shapes of NH_3 and SF_4 molecules and mention their state of hybridization. $2+2=4$

(c) Discuss energetics of hybridization. What are the main points of Bent's rule? $2+3=5$

8. (a) What is bond order? Arrange the following ions N_2^+ ,O_2^- ,O_2^+ and O_2^{2-} in order of their increasing bond order. $2+2=4$

(b) Write the postulates of valence bond theory (Heitler-London approach). 4

(c) What are equivalent and non-equivalent hybrid orbitals? Discuss with an example each. 3+3=6

UNIT–V

9. (a) Write the Fajan's rule. What are the effects of polarisation? 3+2=5

(b) Discuss in detail any of the two factors of percent ionic character of a polar covalent bond. In HF molecule ,the inter nuclear distance is 0.95 A and the dipole moment for the ionic H^+F^- when an electron is completely transferred from hydrogen atom to fluorine atom is given by 4.8×10^{-10} esu $\times 0.92 \times 10^{-8}$ cm, i.e. 4.42 D. Calculate the percent ionic character. Given the actual dipole moment of HF molecule is 1.98 D. 4+2=6

(c) CO_2 and H_2O molecules are both triatomic but dipole moment of CO_2 zero while that of H_2O is 1.84 D. Comment. 3

10. (a) What are the uses of redox potential data? Mention any two uses. 4

(b) What is disproportionation? Explain with an example. 2+3=5

(c) Draw the Latimer diagram of chlorine in acidic medium. Write the half cell reactions. 2+3=5

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