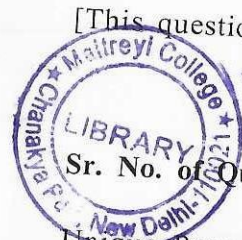


- (b) Equivalent and Non-equivalent hybrid orbitals.
- (c) Different scales of electronegativity.
- (ii) Which of the following combinations are allowed in LCAO (considering Z axis as molecular axis) and sketch the shapes of molecular orbitals formed by their addition and subtraction
- (a) s and p_z
- (b) p_x and p_x
- (iii) List the limitations of:
- (a) Bohr's Theory of atomic structure.
- (b) Radius ratio rule. (5,5,5)

(1000)

[This question paper contains 8 printed pages.]

28.12.2023(M)
Your Roll No.....

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Sr. No. of Question Paper : 1545

Unique Paper Code : 2172011101

Name of the Paper : DSC: Atomic Structure &
Chemical Bonding
(Inorganic Chemistry I)

Name of the Course : B.Sc. (H) Chemistry

Semester : I

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt six questions.
3. Question no. 1 is compulsory.
4. All questions carry equal marks.

P.T.O.

1. Attempt **any five** of the following

- (i) What is meant by Dipole moment? Can its magnitude give an idea about the structure of molecules? Explain.
- (ii) Why NaCl is soluble in water but AgCl is not?
- (iii) The first electron ionization enthalpy of boron (B) is smaller than that of carbon (C) whereas the second electron ionization enthalpy of carbon is smaller than boron.
- (iv) Orbitals of 1p, 2d, 4g not possible.
- (v) The electron gain enthalpy of chlorine (Cl) is greater than fluorine (F).
- (vi) Calculate the effective nuclear charge of 4s and 3d electron in Scandium using Slater's rule.

(5×3)

(iii) Draw the MO diagram of CO with sp mixing. On the basis of it, explain it is an electron pair donor.

(5,5,5)

7. (i) What is resonance? Draw the resonating structure of NO_2 , CO and O_3 .

(ii) Write the conditions for a wave function ψ acceptable to the Schrodinger wave equation. What is the physical significance of ψ and ψ^2 .

(iii) How will you convert the Cartesian co-ordinates (x, y, z) into polar co-ordinates (r, θ , ϕ)

(5,5,5)

8. (i) Write short notes (**any two**)

(a) Heisenberg Uncertainty Principle

P.T.O.

- (ii) The bond distance between H and F in HF molecule is 91.7 pm and the experimentally observed dipole moment of this molecule is 6.6×10^{-30} Cm. Find out the percent ionic character.
- (iii) Write the Born Lande equation and the Kapustinskii equation for lattice energy and define the terms involved. What is the advantage of Kapustinskii over Born Lande equation? (5,5,5)
6. (i) Calculate the electronegativity of F from the following data, electronegativity of hydrogen is 2.1, E_{F-F} bond dissociation energies = 36.6 kcal/mol, E_{H-H} = 104.2 kcal/mol, E_{H-F} = 136.6 kcal/mol.
- (ii) Draw the radial distribution curve of 1s, 2s, 2p, 3p, and 3d.

2. (i) Write the time independent Schrödinger wave equation for hydrogen atom and explain the terms used in it.
- (ii) Why half filled and fully filled configurations are more stable than the other configurations.
- (iii) Draw Born Haber Cycle and calculate the enthalpy of formation (ΔH_f) for MgF_2 using following data,
- Sublimation Enthalpy of Mg = 146. 4 kJ/mol
- Ionization Enthalpy of Mg to Mg^{2+} = 2184 kJ/mol
- Dissociation Energy of F_2 = 158.9 kJ/mol
- Electron gain enthalpy of $F(g)$ = -334.7 kJ/mol

Lattice Energy of $\text{MgF}_2 = -2922.5 \text{ kJ/mol}$

- (iv) Calculate the limiting radius ratio (r^+/r^-) of an ionic lattice having the octahedral geometry with co-ordination number 6 around cation.

(2.5×2,5,5)

3. (i) What is normalized and orthogonal wave function? Write the mathematical expression for normalization and orthogonality of wave function.

- (ii) The bond angle in CH_2F_2 , $\text{HCH} = 112.3^\circ$ and $\text{FCF} = 108.3^\circ$. Calculate the s character used by carbon atom in the orbital directed to the hydrogen and fluorine. Discuss the result in terms of Bent rule.

- (iii) Draw the shape of the following molecules using VSEPR theory.

ClF_3 , BrF_2^+ , PCl_3 , SnCl_2 , OF_2

(5,5,5)

4. (i) Calculate ionic radii for Na^+ & K^+ ions if the internuclear distance in NaF is 231 pm.

- (ii) The so-called Lyman series of lines in the emission spectrum of hydrogen corresponds to transitions from various excited states to the $n = 1$ orbit. Calculate the wavelength of the lowest-energy line in the Lyman series. In what region of the electromagnetic spectrum does it occur?

- (iii) Draw the molecular orbital diagram of N_2 and O_2 molecules and explain their magnetic behavior.

(5,5,5)

5. (i) Based on their positions in the periodic table, arrange these ions in order of increasing radius: Cl^- , K^+ , S^{2-} , and Se^{2-} .

P.T.O.