January 2023
B.Sc.- I SEMESTER
Inorganic Chemistry- I (BCH-101)

Time: 3 Hours

Max. Marks:75

Instructions:
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
2. Answer any four questions from Part -B in detail.
3. Different sub-parts of a question are to be attempted adjacent to each other.
4. Use of Non programable calculator is allowed

PART -A

Q1 (a) What is the significance of ψ and ψ^2. (1.5)

(b) What is the increasing order of Melting point and covalent character among (1.5) $NaCl$, $MgCl_2$, $AlCl_3$ and $SiCl_4$. Give reason

(c) What will be the C.N. of each ion in KCl if ionic radius of K+ and Cl- are 1.33Å (1.5) and 1.81Å respectively. Predict the crystal structure.

(d) Why the bond angles in CH_4, NH_3 and H_2O molecule decreases from 109.5^0 to (1.5) 107.3^0 to 104.5^0.

(e) Comment on the dipole moment and hybridization of NH_3 and NF_3. (1.5)

(f) On the basis of Hanny Smith's equation calculate the percentage of ionic (1.5) character in HI molecule. $\aleph_H = 2$ and $\aleph_I = 2.7$.

(g) Name the effects involved behind the reason that bond angle in PH_3 and OF_2 is (1.5) smaller as compared to that in NH_3 and OCl_2 respectively.

(h) What do you mean by saying that energy of the electron is quantized. Write (1.5) down equation for quantization of angular momentum.

(i) How Bohr's theory explain the existence of various lines in H-spectrum. Name (1.5) the limitations of Bohr's theory that could not explain the splitting of spectral line into fine lines under electric and magnetic effect.

(j) Write down the orthonormality of wavefunction. Write the Schrodinger (1.5) equation.

PART -B

Q2 (a) Draw an expression for the lattice energy of 1 mol of NaI crystal using born (10) haber cycle. Calculate the Lattice Energy of NaI with the following data as
$\Delta H_{formation} = -287.6$ KJ/mol,
$\Delta H_{sublimation} = 108.7$ KJ/mol,
$\Delta H_{IE} = 493.8$ KJ/mol,
$\Delta H_{DE} = 106.6$ KJ/mol,
$\Delta H_{EA} = 305.9$ KJ/mol.

(b) What will be the shape, hybridisation and geometry of the following molecules (5) on the basis of VSEPR model ClF_3, XeF_6, SF_6, $BrCl_6^{2-}$ and I_3^-

Q3 (a) Calculate the electronegativity of Carbon from the data using pauling's scale (5)
E_{H-H}= 104.2 KCal/mol,
E_{C-C} = 83.1 KCal/mol,
E_{C-H} = 98.8 KCal/mol and $\aleph_H$ =2.1

(b) Explain the Heitler-London theory and list down the limitation of VBT by (10) explaining the bonding in H_2 molecule as ψ_{VB} = $\psi_{covalent}$ + $\lambda\psi_{ionic}$

Q4 (a) Draw molecular orbital diagram of N_2 and F_2 molecules. What is the reason (10) behind the difference in their molecular orbital diagram? Also comment on their magnetic behavior.

(b) Define shielding effect and effective nuclear charge. Calculate Z_{eff} for 4s (5) electron in Zn, 3p electron in P and 3d electron in Mn.

Q5 (a) Draw the plot of $R_{n,l}$ and $4\pi^2 r R^2_{n,l}$ against r for 2s,2p and 3d orbital. What was (10) the limitation of radial plot. How many total numbers of nodes, radial node and angular node do 3s, 3d and 5f orbital exibits. What is the value of principle quantum number in R = K $(Z/a_0)^{3/2}$ $(2-Zr/a_0)e^{-Zr/2a0}$

(b) Comment on the hybridization, geometry and structure of CrO_8^{3-} and IF_8^- (5) differentiate between these two on the basis of different orbital involved in hybridization.

Q6 (a) What is LCAO approximation. Draw the bonding and anti-bonding molecular (8) orbital formed by 1s orbital. Mention the MONP, gerade or ungerade in the formed MO. Arrange O_2, O_2^+, O_2^- and O_2^{2-} in increasing order of their bond order and bond length.

(b) What is Allred and Rochow's scale of electronegativity. Calculate the (7) electronegativity of fluorine atom given that ionization of fluorine atom is 17.41eV and electron affinity of fluorine atom is 3.45eV.

Q7 Derive the expression of Born lande equation by giving its assumptions. Also (15) comment on the cases where lattice type and Madelung constant is not given.

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