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Set: 1

S. No. of Question Paper:

Unique Paper Code : 32171101\_OC  
Name of the Paper : C-I: Inorganic Chemistry –I  
(Atomic Structure and Chemical Bonding)  
Name of the Course : B.Sc. (H) Chemistry  
Semester : I  
Duration : 3 Hours  
Maximum Marks : 75

### Instructions for Candidates

1. Write your Roll no. on the top immediately on receipt of this question paper.
2. Attempt any four questions.
3. All questions carry equal marks.

1. (a) (i)  $\text{BeCl}_2$  has zero dipole moment while  $\text{H}_2\text{S}$  has some value. Justify.

(ii) Which has higher melting point  $\text{NaCl}$  or  $\text{CuCl}$ ? Explain with suitable reason.

(b) Calculate the ionic radii of  $\text{K}^+$  and  $\text{Cl}^-$  using Pauling's method if the internuclear distance between these ions is 314 pm.

(c) Write the Schrodinger wave equation for an electron in H atom and give the significance of the various terms involved. (6,6,6.75)

2. (a) Predict the shape of the following molecules/ions on the basis of VSEPR theory:

$\text{I}^-$ ,  $\text{NH}_4^+$ ,  $\text{BrF}_2$  and  $\text{PCl}_5$

(b) Explain, which one of the following pairs has higher ionization enthalpy:

(i) Be and B (ii) Cu and K

(c) Draw the MO energy level diagram of  $\text{N}_2$ . Calculate its bond order and comment on its magnetic behaviour. (6,6,6.75)

3. (a) What are degenerate orbitals? Comment upon the degeneracy of the 3s, 3p and 3d orbitals for the hydrogen atom and multi electron systems.

(b) Arrange the following in increasing order of bond angle and also explain the order.

(i)  $\text{NH}_3$  and  $\text{NF}_3$  (ii)  $\text{PH}_3$  and  $\text{PF}_3$

(c) Write the electronic configuration for Cr (Atomic No. 24) and Cu (Atomic No. 29). Explain why half-filled and fulfilled orbitals have extra stability. (6,6,6.75)

4. (a) Calculate the limiting radius ratio for Coordination number 4 (tetrahedral geometry) and 6 (Octahedral geometry).

(b) Explain why, the first electron gain enthalpy of O is exothermic, whereas second electron gain enthalpy is endothermic, still it exists as  $\text{O}^{2-}$  in oxides.

(c) Write Born-Landé's equation for calculating lattice energy explaining all terms in it. What is Madelung constant and on what factors it depends? (6,6,6.75)

5. (a) Write short note on any two of the following

(i) p-type semiconductors

(ii) Equivalent and Non-equivalent hybrid orbitals

(iii) Instantaneous-Induced dipole interactions

(b) (i) Differentiate between Bonding and Antibonding Molecular Orbitals.

(ii) On which law is Born-Haber cycle based? Set up a Born-Haber cycle for the formation of  $\text{CaCl}_2$  with complete notations.

(c) What are Eigen Values and Eigen functions?  $\psi$  has no physical significance and  $\psi^2$  has. Explain. (6,6,6.75)

6. (a) (i) Calculate the percentage ionic character in HF (Electronegativity of H is 2.1 and that of F is 4.0).

(ii) Find out the lattice energy of NaCl crystal having sum of ionic radii,  $d_0 = 281 \text{ pm}$ .

(b) Define Bent Rule? How does the bond angles in  $\text{CH}_2\text{F}_2$  vary?

(c) State the Pauli Exclusion Principle. How can this principle be used to fix the maximum capacity of the various energy levels in an atom? (6,6,6.75)



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