

**M.Sc. (Part-I) Semester-I (C.B.C.S. Scheme) Examination**  
**CHEMISTRY (NEW)**  
**(Inorganic Chemistry-I)**  
**Paper-I**

Time : Three Hours]

[Maximum Marks : 80

**Note :—** (1) All questions are compulsory and carry equal marks.

(2) Use of scientific calculator is allowed.

1. (a) On the basis of VSEPR theory, explain the shapes of following species :  
(i)  $\text{PF}_5$  (ii)  $\text{NH}_4^+$  (iii)  $\text{ICl}_4^-$  6  
(b) State Bent rule. Explain with suitable examples. 5  
(c) Draw M.O. diagram of  $\text{O}_3$  (Ozone) molecule and explain its bond order. 5

**OR**

- (p) Write an illustrative account on various stereochemical rules of VSEPR theory. Explain why  $\text{Li}_2\text{O}$  is not bent like  $\text{H}_2\text{O}$ . 6  
(q) Explain the energetics of  $\text{O}_2 p^3 d^2$  hybridization with suitable example. 5  
(r) Draw molecular orbital diagram of  $\text{CO}_2$  molecule and explain its magnetism and bond order. 5  
2. (a) Explain the formation of  $\sigma$  bonds in an octahedral complex in terms of MOT. 5  
(b) How heat of hydration varies for divalent metal ions across first row transition elements ? Explain its correlation with CFSE. 5  
(c) Give the evidences in support of metal-ligand orbital overlaps in the metal complexes. 6

**OR**

- (p) State and explain Jahn-Teller theorem. Explain why  $[\text{Cu}(\text{en})_2(\text{H}_2\text{O})_2]^{2+}$  is more stable than  $[\text{Cu}(\text{en})_3]^{2+}$ . 5  
(q) Draw M.O. diagram of  $[\text{CO}(\text{NH}_3)_6]^{3+}$  and explain its magnetism. 6  
(r) Give the comparison of CFT and MOT. 5  
3. (a) Discuss the structure and bonding in diborane on the basis of M.O. diagram. 6  
(b) What are heteropoly acids ? Highlight the structure of heteropoly molybdate. 5  
(c) What are metalloboranes and metallocarboranes ? Explain with suitable examples. 5

**OR**

- (p) Explain the structure and bonding in binuclear and trinuclear metal clusters with one example of each. 6  
(q) Discuss the chemistry of isopolyacids of molybdenum. 5  
(r) What is meant by styx numbers in boranes ? Sketch the possible topological structures in terms of styx number for the following :  
(i)  $\text{B}_4\text{H}_{10}$  (ii)  $\text{B}_6\text{H}_{10}$  5

4. (a) Why liquid  $N_2O_4$  is considered more suitable solvent for organic compounds ? Give the following reactions in liquid  $N_2O_4$  :  
 (i) Acid-base reaction (ii) Solvolysis reaction 6  
 (b) Explain with suitable example why the successive stability constant decreases from  $K_1$  to  $K_n$ . 5  
 (c) How do we understand the Chelate effect by means of thermodynamic relationship ? Discuss.  
 $-RT \ln \beta = \Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$  [ $\Delta H^\circ$  is negative] 5

**OR**

- (p) Give autoionization of Sulphuric acid. What is its liquid range ? Write any two reactions in anhydrous Sulphuric acid. 5  
 (q) Describe Job's method of continuous variation for the determination of composition of complex. 6  
 (r) Explain the importance of thermodynamic parameters in complex formation. 5  
 5. (a) Define the following terms :  
 (i) Symmetry operations  
 (ii) Identity  
 (iii) Reflection plane. 6  
 (b) Derive the character table for  $C_{3v}$  point group. 5  
 (c) What are proper and improper axis of symmetry ? Give example on each. 5

**OR**

- (p) Explain the rules that are to be followed for a set of operations to form a group. 6  
 (q) What are point groups ? Identify the symmetry point groups in the following :  
 (i)  $PCl_3$   
 (ii)  $HCl$   
 (iii)  $[PtCl_4]$  5  
 (r) Give important rules for irreducible representations. 5