AU–238

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 permitted.

UNIT—I

1. (a) Explain the shapes of the following molecules on the basis of VSEPR theory :
(i) NH_3
(ii) PCl_2
(iii) PCl_5
(iv) SF_4
(v) SF_6. 5

(b) Draw M.O. diagram of CH_4 molecule and explain its bond order. 5

(c) Mention the hybridization state of central atom in the following molecules and explain their shape :
(i) BeH_2
(ii) SO_3
(iii) IF_5. 6

OR

(p) What are the characteristics of sp^3d hybridization ? Explain the formation of PCl_5 molecule on the basis of hybridization. 5

(q) Explain the formation of delocalized π-M.O. in nitrite (NO_2^-) ion. 5

(r) Give the various stereochemical rules of VSEPR theory and explain each rule with suitable example. 6

UNIT—II

2. (a) What is Jahn-Teller distortion ? Explain the distortion in following complex ions :
(i) $[Cr(H_2O)_6]Cl_2$
(ii) $NaNiO_2$(L.S.) 6

(b) Explain the variation of ionic radii of divalent metal ions of first transition series elements in Octahedral environment. 5

(c) Give various experimental evidences in support of metal ligand orbital overlap. 5

OR

(p) Explain the crystal field splitting in square planar geometry with energy level diagram. What is the relation of crystal field splitting energy for square planar and octahedral geometry ? 5

(q) Why does the t_{2g} set of orbitals in metal ions remains non-bonding in octahedral complexes of σ-donors ? Explain it on the basis of MOT. 6

(r) Explain the effect of π-bonding on the value of Δ_o in octahedral complexes. 5

UNIT—III

3. (a) What are closo and nidoboranes ? Explain the bonding in tetraborane with styx scheme. 5

(b) Explain the structure and bonding in tetranuclear and hexanuclear metal clusters with suitable example. 6

(c) Write explanatory notes on isopolyacids and heteropolyacids. 5

OR

(p) Give the templet synthesis of macrocyclic complexes with suitable example. 5

(q) Calculate total electron count and number of skeletal electron pairs in the following carbonyl clusters with Wade's rules :

(i) $Rh_6(CO)_{16}$

(ii) $Os_5(CO)_{16}$. 6

(r) What are s. t. y. x rule ? Give s. t. y. x number for :

(i) B_2H_6

(ii) B_5H_9

(iii) B_6H_{10}

(iv) B_5H_{11}. 5

UNIT—IV

4. (a) Give autoionization of Liq. N_2O_4. Explain the following reactions in it :

(i) Reaction with metals

(ii) Solvolysis. 6

(b) Arrange the following complexes in the increasing order of their stability. Give reasons :

(i) $K_3[Fe(C_2O_4)_3]$, $K_4[Fe(CN)_6]$, $K_3[Fe(CN)_6]$

(ii) $[MgOH]^+$, $[BeOH]^+$, $[CaOH]^+$. 5

(c) How will you determine the composition and stability constant of a complex by mole ratio method ? 5

OR

(p) Derive the relationship between overall stability constant (β_n) and stepwise stability constant (K_1, K_2, ... K_n). 6

(q) What is solvent system concept ? Identify the following compounds as acids or bases along with their solvents :

(i) NOCl

(ii) $NaNH_2$

(iii) $SOBr_2$. 5

(r) Both $[Cd(CH_3NH_2)_4]^{2+}$ and $[Cd(en)_2]^{2+}$ are formed from $[Cd(H_2O)_4]^{2+}$. But why the latter is far more stable than the former ? Explain, giving the reactions. 5

UNIT—V

5. (a) Explain the following terms :

(i) Identity

(ii) Centre of symmetry

(iii) Axis of symmetry. 6

(b) Identify the symmetry point groups in the following molecules :

(i) C_2H_4

(ii) NO_2^-

(iii) $[Ni(CN)_4]^{2-}$

(iv) NH_3

(v) CH_4. 5

(c) What are proper and improper axis of symmetry ? Explain, giving example on each. 5

OR

(p) Give the rules that are to be followed for a complete set of operations to form a group. 6

(q) Explain the reducible and irreducible representations. 5

(r) Derive character table for C_{3v} point group. 5