M.Sc. Semester-I, Examination, November, 2017
Inorganic Chemistry, Paper I, Subject code: 2761

Time: 2.5 hrs] (M.Sc. Chemistry) [Marks: 70

N.B. (i) Attempt all questions
(ii) All questions carry equal marks

Q.1. Answer the following questions. 14

(a) Explain the time independent Schrödinger equation of quantum mechanics.

(b) Prove: If $\hat{B}$ is an operator which commutes with an operator $\hat{A}$ (both being Hermitian), Ψ_1 and Ψ_2 are the eigenfunctions of $\hat{A}$ and a_1 and a_2 are the corresponding eigenvalues respectively, then the integral $\int \Psi_1^* \hat{B} \Psi_2 \, d\tau = 0$.

(c) Prove that eigen values of a Hermitian operator are real.

OR

Q.1. Answer the following questions. 14

(a) Define Unitary, Laplacian and linear operators with examples.

(b) State first and second postulates of quantum mechanics.

(c) Prove that $[L_x, L_y] = i\hbar L_z$.

Q.2. Answer the following questions. 14

(a) Find out the values of Ψ and E for a particle moving in a one dimensional box.

(b) Derive the Secular determinant for a molecule having n-number of atoms.

(c) Find out the values of wave function Ψ and energy E for rigid rotator of a diatomic molecule.

OR

Q.2. Answer the following questions. 14

(a) Derive the energy for a particle moving in a three dimensional box.

(b)Applying variation principle to ethylene molecule,find out electron and charge densities and π-bond order. Given: $\psi_1 = \frac{1}{\sqrt{2}} P_1 + \frac{1}{\sqrt{2}} P_2$ & $\psi_2 = \frac{1}{\sqrt{2}} P_1 - \frac{1}{\sqrt{2}} P_2$

(c)State variation principle. Prove that $\bar{E} \geq E$.

Q.3. Answer the following questions. 14

(a) Find out the bond angle for sp hybridization.

(b) Explain molecular orbital theory for H_2 molecule.

(c) Explain ladder operators.

OR

Q.3. Answer the following questions. 14

(a) Find out the bond angle for sp^2 hybridization.

(b) Explain molecular orbital theory for H_2^+ ion.

(c) Explain Self-Consistent Field (SCF) Method.

Q.4. Answer the following: 14

(a) Give an account on polymerization of alkenes using Zeigler-Natta catalyst.

(b) Give a brief account on:

(i) Oxidative addition reaction (ii) Insertion reaction (iii) Reductive elimination reactions.

OR

Q.4. Answer the following: 14

(a) Explain Lowry-Bronsted Theory of acids and bases. Write the conjugate acids of:

(i) PH_3 (ii) ClO_4^-

(b) Define commutator operator and its application with examples.

(c) Prove that $\hat{L}_+\hat{L}_- = \hat{L}^2 - \hat{L}z^2 + \hbar\hat{L}z$.

Q.5. Answer the following: 14

(a) What is K_a? Derive a relation between ionization constant K_a and the concentration C_o and H_3O^+ of phenol in the aqueous solution.

(b) Calculate the *pH* of 0.01 M solution of CH_3COOH. Ka of CH_3COOH at 298 K is 1.8×10^{-5}.

(c) Calculate the oxidation number of underlined elements:

(i) $Na_2[\underline{Fe}(CN)_5(NO)]$ (ii) $[\underline{Cr}(CO)_6]$

(d) Give the IUPAC of the following:

(i) $Na_3[Co(CN)_6]$ (ii) $K_4[Cr(CN)_5(NO)]$

(e) Give the formula of complexes as shown below:

(i) Sodium hexanitrito cobaltate (II) **(ii)** Tris (ethylene diamine) manganese (III) chloride

OR

Q.5. Answer the following: 14

(a) What is K_b? Derive a relation between ionization constant Kb, OH^- and the concentration Co of ammonia in the aqueous solution.

(b) The ionization constant of hydrazine in aqueous solution is 1.0×10^{-6} at 25°C. At this temperature what would be pH of a solution containing 0.096 g of hydrazine in 150 ml solution. Molar mass of hydrazine is 32 g/mol.

(c) Calculate the oxidation number of underlined elements:

(i) $[\underline{Cr}(H_2O)_4\ Cl_2]\ Br$ (ii) $Na_4[\underline{Co}\ (NO_2)_6]$

(d) Give the IUPAC of the following:

(i) $[Pt(NH_3)_4(SO_3)]Br_2$ (ii) $Zn_2[Fe(CN)_6]$

(e) Give the formula of complexes as shown below:

(i) Dichloro bis (ethylene diamine) chromium (III) nitrate

(ii) Carbonato tetraammine cobalt (III) chloride.