(c) The hydrolysis of the of the complex $[Co(NH_3)_4(CO_3)]+$ is much faster in acid than neutral solution. 3

(d) Explain oxygen-17 NMR line broadening experiment technique for determination of rate constant of paramagnetic ions. 3

10. (a) Predict whether these complexes would be labile or inert and explain your choices. The magnetic moment is given in Bohr magnetons (μB) after each complex. 2x2=4

Potassium hexaiodomanganate (IV)————————3.82

Hexaammineiron (II) chloride————————5.45

(b) Base hydrolysis of trans-$[Co(tren)(NH_3)Cl]^{2+}$ is 10^{14} times faster than cis-$[Co(tren)(NH_3)Cl]^{2+}$. Explain. 5

(c) The reduction of $[Co(NH_3)_5Cl]^{2+}$ is about 10^{10} times faster than $[Co(NH_3)_6]^{3+}$. Explain in the light of electron transfer mechanism. 5

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PG ODD SEMESTER EXAMINATION, 2022

CHEMISTRY

1st Semester

Course No. : CHMCC - 501

(Inorganic Chemistry- I)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

(Answer any five questions, taking one from each unit)

UNIT - I

1. (a) Work out the symmetry point group of the following species (any 3). 3x2=6

(i) SbF_5 (ii) OHD (iii) CO_3^{2-} (iv) N_3^-

(b) Show figuratively the occurrence of S_4 in CH_4 molecule. 4

(c) Taking (x_1, y_1, z_1) as co-ordinate point, work out the matrix representation of the symmetry operation, centre of inversion (*i*) and show that it is its own inverse. 4

2. (a) Show how the symmetry point group of NH_3 changes upon substitution of H by (i) one *Cl* (ii) two *Cl* atoms. Explain if the symmetry of NH_3 matches with that of SO_3. 3+2=5

(b) Suggest species for the following symmetry point groups with justification. 3x2=6

(i) C_s (ii) $D_{\infty h}$ (iii) I_h

(c) Using matrix representation for a C_{2v} point group, show that $C_2^2 = E$. 3

UNIT - II

3. (a) Predict the geometry of the following molecules based on VSEPR model. Comment on thehybridization. 1×4=4

(i) $SbF_4]$- (ii) $BH_4]^-$ (iii) XeF_4 (iv) IOF_3

(b) What is meant by absolute hardness? Describe the absolute hardness in halogen groups (F, Cl. Br and I) using their HOMO and LUMO. 1+2=3

(c) Define spectroscopic electronegativity? How it differs from Mulliken electronegativity? 2

(d) Draw and explain the MO diagram of SF_6 molecule. Comment on the magnetism. 3

(e) Draw and explain the VSEPR model-based structure of $PCl_3F_2$and PCl_3H_2. Comment on their polarity. 2

4. (a) Using VSEPR model, predict the shape of glycine (NH_2CH_2COOH) molecule. Give the hybridization of interior atoms. 3

(d) Write a brief note on the structure and complex stability of spherands. 3

8. (a) Discuss the biological role and toxicity of two essential elements (any two from Zn, Fe, Cu, Ca). 2+2=4

(b) Write the sources and speciation of mercury (Hg). Give biochemical effects and antidotes of mercury. 3

(c) Draw the structure of cyclam and cyclohexyl-18-Crown-6 and comment on Na^+ metal binding. Write the criteria that enhances the stability of metal crown ether complexes. 2+2= 4

(d) What are ionophores? Write a brief account on cyclic natural ionophores. 1+2=3

UNIT - V

9. (a) Write a rate law for a dissociative reaction 4

$$ML_5X \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ML_5 + X$$

$$ML_5 + Y \xrightarrow{k_2} ML_5X$$

(b) Octahedral complexes of metal centres with high oxidation numbers or of d metals of second and third series are less labile than those of the low oxidation numbers and d metals of the first series of the block. Account for this observation on the basis of dissociative rate determining step. 4

(b) 'The equatorial < F-S-F bond angles for SOF_4, SF_4 and $S(CH_2)F_4$ are found to be 112.3°, 101.6° and 97.5° respectively'. Justify the observation. 2

(c) Write a brief account on clathrates properties of H_2O. 2

(d) Describe Walsh diagram to predict the molecular shape of BeH_2. 4

(e) Sketch and explain the band structure for metal, semiconductor and insulator. 3

UNIT - III

5. (a) Write down the equations of balance for Lipscomb topological diagram of boron hydrides. Using the equations, find out the styx numbers of B_4H_{10}. Draw the most symmetric Lipscomb topological diagram of B_4H_{10} and calculate the orbitals and electrons available for the boron framework. 1+2+2+2=7

(b) Using Wade's rule, calculate the number of skeletal electrons of the following cluster compounds and nomenclate the polyhedron to which the cluster belongs. 3

(i) $Co_4(CO)_{12}$

(ii) $[Co(\eta^5\text{-}C_5H_5)(B_4H_8)]$

(c) Write the products formed in the following reactions: 2

(i) Nido-$B_{10}H_{14}$ + C_2Me_2 + Et_2S →

(ii) B_2H_6 + NMe_3 →

(d) B_6H_{10} can acts as an acid as well as base. Explain by taking suitable examples. 2

6. (a) What are amphiboles? Draw their unit structure. Give example. 2

(b) Talcom powder is slippery whereas Mica is hard-Explain 3

(c) Discuss the Dewar model for π-bonding in cyclophosphazene $(NPCl_2)_3$. 3

(d) Complete the following reactions and draw the structure of the main product. 3

(i) $6\ SCl_2 + 16\ NH_3 \rightarrow A$

(ii) $S_4N_4 + 8\ Ag \rightarrow B \rightarrow C$

(e) Write down the product form in the following reaction and discuss about its structure.

$HPO_4^{2-} + MoO_4^{2-} + H^+ \rightarrow\ ?$ 3

UNIT - IV

7. (a) Define passive transport with a suitable example. Describe the ion transport mechanism in Na^+-K^+ Pump. 1+3=4

(b) Describe the biochemical effects of Arsenic (As). With suitable example comment on the function of antidotes. 4+1=5

(c) Draw and explain a Dose-Response curve for toxicity of (i) essential and (ii) quintessential elements. 2