'समानो मन्त्रः समितिः समानी'

UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 6th Semester Examination, 2023

CC13-CHEMISTRY

INORGANIC CHEMISTRY

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.

1. Answer any ***five*** questions from the following: 1×5 = 5

   (a) Explain the term "hapticity" in organometallic compounds.

   (b) Write down the IUPAC name of $[Pt(NH_3)_4][Pt(CN)_4]$.

   (c) How do you distinguish PO_4^{3-} and AsO_4^{3-} in a solution following semimicro analysis?

   (d) The concept of solubility product is very important in group analysis for inorganic ions — Illustrate with an example.

   (e) Explain the electronic effect of a π-acidic ligand with a suitable example.

   (f) Tetrahedral complexes do not show *cis*- and *trans*-isomerism — Account on.

   (g) Depict the structure of Zeise salt and mention the bonding involved within it.

   (h) Write down the detection method of Aluminium ion through Alizarin Red-S dye.

2. Answer any ***three*** questions of the following: 5×3 = 15

   (a) (i) What is Wilkinson's catalyst? 1+4

   (ii) Discuss the catalytic role of Wilkinson's catalyst in the hydrogenation of olefins.

   (b) (i) How do you prepare the Ziegler-Natta catalyst? $1\frac{1}{2}+3\frac{1}{2}$

   (ii) Discuss the structure and properties of trialkylaluminium compounds.

   (c) Determine the formal oxidation states following the *d*-electron counts of the following compounds. $2\frac{1}{2}+2\frac{1}{2}$

   (i) $(\eta^6 - C_6H_6)_2Mo$ (ii) $(CO)_5(CH_3CH_2)Re$

   (d) (i) What happen when – $2\frac{1}{2}+2\frac{1}{2}$

   Ferrocene is reacted with R – COCl in presence of $AlCl_3$.

   (ii) $CuCl_2$ is treated with $AgNO_3$ in water medium followed by the addition of NH_4OH.

(e) (i) Derive the relationship between the stepwise formation constant and the overall formation constant. 2+3

(ii) How do you identify a bridging CO-group and a terminal CO-group in metal carbonyl compounds?

3. Answer any ***two*** questions of the following: 10×2 = 20

(a) (i) Discuss the structure, properties and bonding of ferrocene. 4+2+(2+2)

(ii) What do you know about hydroformylation reactions? Give examples.

(iii) What is synergistic effect? How does it relate to the bonding in metal carbonyls?

(b) (i) Draw the structure of $Co_4(CO)_{14}$. Using isolobal analogy, show which of the following fragments you would use to replace one of the Co-fragments in the above cluster? (1+6)+3

(I) CH_2 (II) CH (III) NH_2 (IV) CH_3

Write down the structures of the clusters so formed.

(ii) The observed stretching frequencies in $[V(CO)_6]^-$, $[Cr(CO)_6]$ and $[Mn(CO)_6]^+$ are 1860, 2000 and 2090 cm^{-1} respectively. Explain the trend.

(c) (i) Show the possible geometric isomers for MA_3B_3 type complex. 2+2+(3+3)
[A and B are monodentate ligands]

(ii) Typically square planar complexes are optically inactive. Give an example of its exception and draw the structure.

(iii) Write down the possible formation of isomers from the following reaction and draw the structures of the product.

(I) $[Pt(NO_2)Cl_3]^{2-} + NH_3 \longrightarrow ?$

(II) $[PtCl_2(NH_3)_2] + \text{Pyridine} \longrightarrow ?$

(d) (i) What is Schlenk equilibrium? Which type of species show the Schlenk equilibrium? 3+3+2+2

(ii) What will happen to the catalytic property if Ph_3P group is replaced by Me_3P in the Wilkinson's catalyst?

(iii) Explain in brief for the carbide mechanism of Fischer-Tropsch mechanism.

(iv) Account on the *trans*-effect for the square planar complexes in the substitution reaction.

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