

2025

CHEMISTRY
(Honours Core)

Paper : CHE-HC-6016

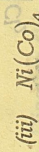
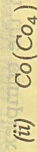
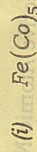
(Inorganic Chemistry-IV)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer the following questions : 1×7=7
(a) Which of the following complex is oxidizing agent ?



(Choose the correct option)

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- (b) Why is NH_4Cl added before precipitating Group III cations ?

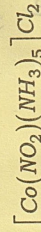
- (c) What is Schlenk equilibrium ?

- (d) In the base catalysed substitution of Cl^- by $(OH)^-$ in $[Co(NH_3)_5Cl]^{2+}$, the first step in the mechanism is -

- (i) conversion of an amine to amido group
(ii) Substitution of Cl^- by $(OH)^-$
(iii) dissociation of Cl^- to give a 5-coordinate intermediate
(iv) association of OH^- to give a 7 co-ordinate intermediate.

(Choose the correct option)

- (e) Calculate the Effective Atomic Number (EAN) of cobalt in the complex



- (f) What is the hapticity (η) of the cyclopentadienyl ligand in ferrocene ?

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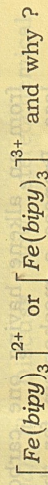
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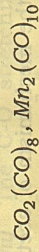
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- (g) Which metal complex undergoes faster outer-sphere electron transfer,



2. Answer the following questions : 2×4=8

- (a) Draw the structures of the following :



- (b) What do you understand by the term "labile" and "inert" ?

- (c) Rate of water exchange for $[Mo(H_2O)_6]^{3+}$ is very slow. Why ?

- (d) Why do Group I cations precipitate as chlorides while Group II cations precipitate as sulfides ?

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

- (a) Discuss the Eigen-Wilkins mechanism of ligand substitution in octahedral complexes.

(b) The complex $\text{Co}_2(\text{CO})_8$ can be used for the catalytic synthesis of aldehyde from an alkene having one carbon less. Propose a mechanism for this process taking a suitable example. What are the disadvantages of using this catalyst ?

(c) Discuss the mechanism of acetylation of ferrocene using Friedel-Crafts catalyst.

(d) Discuss in detail the transeffect and its theories in substitution reactions of square planer complexes.

(e) Explain why : $2\frac{1}{2} \times 2 = 5$

(i) Transition metal carbonyls and other organometallic compounds almost always obey 18 electron rule.

(ii) Although aromatic, ferrocene is much more reactive compared to benzene.

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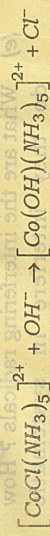
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4. Answer **any three** of the following questions: $10 \times 3 = 30$

(a) (i) Discuss how stereochemical investigation of a substitution reaction helps in predicting the shape of a reaction intermediate. 5

(ii) The C-O stretching frequencies $[\text{Ni}(\text{CO})_4]$, $[\text{Co}(\text{CO})_4]$ for and $[\text{Fe}(\text{CO})]^{2-}$ are 2060, 1890 and 1790 cm^{-1} respectively. Account for this. 5

(b) (i) Discuss the mechanism of the following reaction with proper experimental evidences. 5



(ii) Establish the relationship between stepwise and overall formation constants for a complexation reaction between $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ and ethylenediamine. 5

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(c) What is synthesis gas ? What are the reaction products derived from synthetic gas ? Discuss the mechanism of water gas shift reaction using a homogeneous catalyst. What are the advantages and disadvantages of homogeneous and heterogeneous catalyst ? $1+3+4+2=10$

(d) (i) Give the mechanism of ethene polymerization using Ziegler-Natta catalyst ? What is the role of Et_2AlCl in the process ? $3+2=5$
(ii) What is Zeise's salt ? How it is prepared from K_2PtCl_4 ? Discuss the Dewar-Chart-Duncanson bonding model in Zeises salt. $1+1+3=5$

(e) What are the interfering radicals ? How do they interfere in systematic separation of cationic radicals ? Why is it necessary to remove them before 3rd group analysis ? Why don't they interfere in 1st or 2nd group analysis ? How are borate, and phosphate removed after Group II analysis ? $1+1+1+1+6=10$

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(f) (i) Explain the synergistic bonding model in transition metal carbonyl complex clearly showing the orbital overlap diagrams. 5

(ii) Using MO theory explain the two electron-four centered (2e-4c) bonding in methyl-lithium tetramer. 5

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