REV-01
MSC/32/37

2025/11

SET A

M.Sc. CHEMISTRY
THIRD SEMESTER
INORGANIC CHEMISTRY III
MSC – 303

[USE OMR FOR OBJECTIVE PART]

Duration: 1:30 hrs. **Full Marks: 35**

Objective

Time: 15 min **Marks: 10**

Choose the correct answer from the following: ***1×10=10***

1. According to the Irving–Williams Series, which of the following metal ions form the most stable complex with a given ligand?
   a. Mn^{2+} b. Fe^{2+}
   c. Ni^{2+} d. Cu^{2+}

2. Which one of the following factors increases kinetic lability?
   a. High oxidation state of the metal ion b. Low CFSE
   c. Low spin configuration d. Large CFSE

3. Coordinated unsaturated hydrocarbons are particularly susceptible to
   a. nucleophilic attack b. electrophilic attack
   c. elimination reaction d. free radical reactions

4. Reactivity of Ferrocene is similar to that of
   a. benzene b. naphthalene
   c. thiophene and phenol d. anthracene

5. The associatively activated substitution even with 18-electrons with NO ligand is feasible because
   a. angular NO switches to linear NO b. linear NO switches to angular NO
   c. it becomes 22 electron system d. it becomes 16 electron system

6. 1,2 Insertion reaction
   a. takes place with reduction in the oxidation number of the metal b. is reverse of β-hydride elimination
   c. is migratory elimination d. is simple elimination

7. The stronger M-C bond
   a. Increases the tendency of CO ligand to leave the metal ion b. Decreases the tendency of CO ligand to leave the metal ion
   c. Neither increases nor decreases the tendency of CO ligand to leave metal ion. d. becomes weaker in course of time

8. Which of the following ligand is π-acceptor ligand

a. NH_3 b. CO

c. Cl^- d. ethylene diamine

9. In the context of electron-transfer reactions between coordination complexes of transition metals, an outer-sphere mechanism is characterized by which of the following features

a. No ligand substitution or new bond formation occurs

b. A ligand of one complex bridges to the other complex and forms a covalent bond prior to electron transfer

c. The two metal centers must form a μ-ligand (bridging ligand) intermediately before the electron can move

d. One complex must first lose a ligand before electron transfer can take place

10. Which of the following orders of ligands is correct according to the spectrochemical series (from weaker field → stronger field)?

a. $NH_3 < H_2O < Cl^- < Br^- < I^- < CN^-$ b. $CN^- < NH_3 < H_2O < Cl^- < Br^- < I^-$

c. $I^- < Br^- < Cl^- < H_2O < NH_3 < CN^-$ d. $Cl^- < Br^- < I^- < H_2O < NH_3 < CN^-$

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Descriptive

Time : 1 hr. 15 mins. **Marks : 25**

[Answer question no.1 & any two (2) from the rest]

1. a. Explain why Ferrocene loses an electron rather reluctantly; whereas Cobaltocene is readily oxidized to very stable Cobaltocenium ion. **2+1+2 =5**

   b. What do you mean by kinetically labile and inert complexes?

   c. Write two characteristics of sigma donor ligands.

2. a. What do you mean by thermodynamic stability of metal complexes? Derive overall stability constant from stepwise stability constants. **5+5=10**

   b. Discuss the factors which contribute to the thermodynamic stability of metal complexes.

3. a. Explain why coordinated unsaturated hydrocarbons are particularly susceptible to nucleophillic attack, whereas as a free organic molecules they tend to resist such reactions. **3+3+2+2 =10**

   b. What is Second Generation Grubbs' Catalyst? Discus it's superiority over other such reagents.

   c. What is 1,2 Insertion reaction? Explain with suitable example.

   d. Discuss the significance of "Trans effect".

4. a. Write down the acid hydrolysis mechanism of the following coordinated complexes and make the order of the rate of acid hydrolysis among them: (i) $[Co(NH_3)_4Cl_2]^+$ and (ii) $[Co(NH_3)_4(H_2O)\,Cl]^{2+}$. **3+5+2 =10**

   b. Define the term "Inner sphere mechanism" with an example by following the key steps involved.

   c. Define "anation reaction" with one example.

5. **a.** Discuss the role of solvent like Tetrahydrofuran in the replacement of CO group from $[Cr(CO)_6]$ by other ligands. **3+2+2+3 =10**

b. Explain with suitable examples why Oxidative addition reactions normally require unsaturated metal centers and are particularly common to 16- electron square planar complexes?

c. Explain why $[Cu(H_2O)_6]^{2+}$ complex is thermodynamically stable but kinetically labile.

d. What are the key differences between SN^1CB and SN^2 pathways of base hydrolysis in octahedral complexes?

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