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4 SEM PG CHM (CBCS) IC-IV 401

2026

(June)

CHEMISTRY

Paper : Core-401

(Inorganic Chemistry-IV)

Full Marks : 60

Time : Three hours

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

UNIT-I

Marks : 28

1. Answer ***any four*** questions from the following : 5×4=20

(a) Name the type of electron transfer reaction in which the reductant and oxidant share a ligand in the precursor and successor complex. Taking a suitable example, explain the mechanism of such a reaction. Mention the rate-determining step in the mechanism. 1+3+1=5

- (b) Mention *two* factors in which the rate of racemization depends. Explain the mechanism of racemization of $[Cr(en)_3]^{3+}$ via a non-dissociative pathway. 2+3=5
- (c) Discuss with a suitable example the template effect in coordination chemistry. Explain from a thermodynamic point of view why complexes with macrocyclic ligands are more stable than the conventional chelated or monodentate ligands. 3+2=5
- (d) What is the oscillating reaction? Discuss its mechanism with a suitable example. 2+3=5
- (e) Write a short note on molecular rearrangement in a six-coordinated complex.
- (f) What are complementary and non-complementary reaction? Give *two* examples of each type of reactions.

2. Answer **any one** question from the following: 4×1=4

- (a) What are the basic categories of photochemical reactions? Mention the laws of photochemistry. 2+2=4
- (b) A sample of gaseous *HI* was irradiated by the light of wavelength 253.7nm , when 307J of energy was found to decompose 1.30×10^{-3} mole of *HI*. Calculate the quantum yield (ϕ) for the dissociation of *HI*. 4

3. Write short notes on: (**any one**) 4

- (a) Photosubstitution reaction
- (b) Photoredox reaction

Unit-II

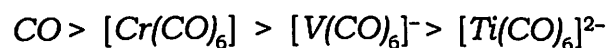
(Marks :16)

4. Answer **any two** questions from the following: 2×2=4

- (a) Give the valence Electron Counts (VEC) for $[(\eta^5-C_5H_5)_2Ru_2(CO)_4]$ and $[Mn(CO)_5CH_3]$. 1+1=2

(b) When nitrosyl acts as a *one*-electron donor (1e-donor), it becomes bent at the N-atom, giving reason. 2

(c) Explain the order of carbonyl stretching frequency (ν_{C-O}) in the light of synergistic bonding in the following compounds :



5. Answer **any three** questions from the following : 4×3=12

(a) d^8 -square planar complexes are stable, although they do not obey the 18-electron rule. Explain.

(b) Write down a method of preparation and the structure of Zeise's salt. Which will undergo electrophilic substitution reaction more readily, $[Cr(\eta^6-C_6H_6)_2]$ or $[Cr(\eta^6-C_6H_6)(CO)_3]$ and why ? 3+1=4

(c) Give *one* method of preparation of transition metal allyl complex. Discuss the bonding of transition metal allyl complex. 1+3=4

(d) Cyclobutane is a very unstable molecule at room temperature, but on complexation with transition metal fragments, it attains very high stability. Explain.

(e) What are transition metal carbene complexes? What are Fischer and Schrock carbene complexes? Distinguish between them clearly. 1+1+2=4

(f) What do you mean by stereochemical non-rigidity? Discuss the fluxionality in η^3 -allyl complexes. 1+3=4

Unit-III

(Marks :16)

6. Answer **any four** questions from the following :

4×4=16

(a) Why do transition metals and their compounds display catalytic properties? Mention *three* major advantages of homogeneous catalysts over their heterogeneous counterpart. 1+3=4

(b) What are oxidative addition and migratory insertion reactions? Mention *two* factors that influence each of the oxidative addition and migratory insertion reactions. 2+2=4

(c) Discuss the mechanism of alkene hydrogenation using Wilkinson's catalyst. Explain why ethylene is not a suitable substrate for alkene hydrogenation with the Wilkinson catalyst. 3+1=4

(d) What is Sonogashira cross-coupling reaction? In what way is this reaction different from the Suzuki-Miyaura cross-coupling reaction? Give a mechanistic outline of either the Suzuki or Sonogashira reaction. 1+1+2=4

(e) What is Cativa Process? Discuss the mechanism of carbonylation of methanol to acetic acid using Cativa Catalyst. Mention *one* major difference between Monsanto and Cativa catalyst. 1+2+1=4

(f) What is β -hydride elimination reaction? Write *two* reactions that proceed via β -hydride elimination step. Write *two* factors that influence β -hydride elimination steps in a catalytic reaction. 1+2+1=4
