

Ex/SC/CHEM/PG/CORE/TH/III/2025

M. SC. CHEMISTRY EXAMINATION, 2025

(1st Semester)

CHEMISTRY

PAPER : PG/CORE/TH/III

(Inorganic Chemistry)

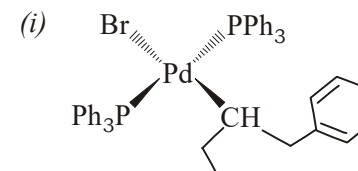
Time : Two Hours

Full Marks : 40

Use separate Answer Script for each Unit.

UNIT—1031

1. (a) Does inversion occur in ipso substitution of vinyl silanes?
Explain β -Effect in vinyl silanes. 1
- (b) Illustrate the steps involved in the reaction between trimethylsilyl hydride and ethylene catalysed by Wilkinson's catalyst, $\text{RhCl}(\text{PPh}_3)_3$ giving electron count and name of each step. 2
- (c) Calculate the Effective Atomic Number (EAN) of the following : 1

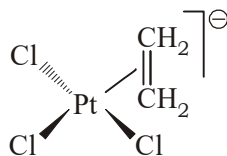


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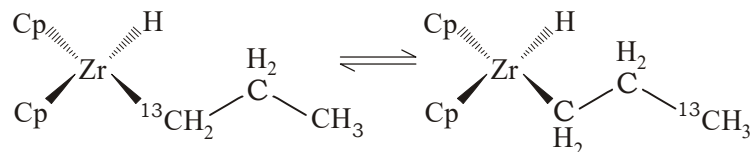
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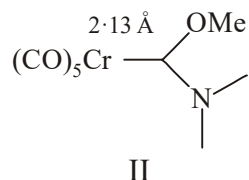
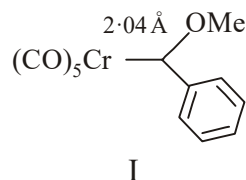
(ii)



- (d) Predict the intermediate steps with names involved in the following transformation reaction. 2



- (e) Explain why the Cr-C bond distances in I and II are different. 1



- (f) Cite an example where C-H bond activation and o-metallation occur. 1
- (g) In the reductive elimination reaction arrange the following in order of increasing rate of reaction with proper explanation (i) $ML_n(H)(H)$; (ii) $ML_n(R)(H)$ and (iii) $ML_n(R)(R)$. 2

(5)

- (b) Determine the parity and nuclear spin of ^{32}P . 2
- (c) An atom bomb of 100g ^{235}U undergoes explosion. If only one neutron starts the initial fission with reproduction factor 2.5, how much time would be required to complete the explosion? (fission time of an ^{235}U atom = $10^{-8}s$). 2
- (d) Fast neutron factor (η) of ^{235}U is 2.44 but the fast neutron factor (η) of natural U is 2.5. Explain. 2

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(3)

2. (a) The absorption spectrum of $[\text{CoF}_6]^{4-}$ exhibits three bands at 7.15, 15.2 and 19.2 kK. Assign the bands with the help of Orgel diagram. Calculate the 10 Dq and B value of the complex from the spectral data. What would be expected color of the complex? 3
- (b) With the help of pictorial representation, describe how different bonding molecular orbitals can be constructed in an octahedral complex of the type ML_6 . Also draw the relevant MO diagram of the complex taking into account both σ - and π -interactions. 3
- (c) The molar extinction coefficients of the absorptions in $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ are of the order of $1.01-0.05$. Why the intensities of the absorptions are so weak? 1
- (d) Addition of a Fe^{3+} salt into an aqueous solution of $\text{K}_4[\text{Fe}(\text{CN})_6]$ leads to the formation of a deep blue color of the resulting solution. Explain the origin of the color. 1
- (e) Taking suitable example how you will demonstrate the overlap between metal and ligand orbitals in an octahedral complex. 2

(4)

UNIT—1032 (A+B)

3. (a) What do you mean by pseudo-substitution reaction with reference to inorganic metal coordination compound? With a suitable example discuss pseudo-substitution reaction mentioning the driving force(s) of the reaction. 4
- (b) Normally Co(III) low spin complexes are more inert than Cr(III) complexes. However, $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ exchanges H_2O with H_2O^{18} rapidly. State a plausible explanation. 3
- (c) Consider the following metal ion catalysed aquation reaction :
- $$[\text{Co}(\text{NH}_3)_5\text{X}]^{2+} (\text{X} = \text{Cl, Br, I}) \longrightarrow [\text{Co}(\text{NH}_3)_5(\text{OH}_2)]^{3+} + \text{X}^-$$
- When Hg^{2+} acts as a catalyst for the aquation reaction in aqueous solvent enriched with H_2O^{18} , the product $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]^{3+}$ bears the same ratio of $^{16}\text{O}/^{18}\text{O}$ for all the three halides while Ag^+ or Tl^+ catalysis the $^{16}\text{O}/^{18}\text{O}$ content in the product is found to be a function of the leaving group X. Generalise these observations in terms of D ($\text{S}_{\text{N}}\text{I}$ limiting) or Id ($\text{S}_{\text{N}}\text{I}$). 3
4. (a) Derive the equation to calculate recoil energy of daughter nucleus based on energy of γ -photon and mass number related with Szilard-Chalmer reaction. In a $^{79}\text{Br}(\text{n},\gamma)^{80}\text{Br}$ reaction, the energy of γ -photon is 5 MeV and C—Br bond energy is 2.16 eV. Comment on the formation of ^{80}Br from $\text{C}_2\text{H}_5^{79}\text{Br}$. 2+2