



B.Sc./6th Sem (H)/CEM/25(CBCS)

2025

6th Semester Examination

CHEMISTRY (Honours)

Paper : C 13-T

[Inorganic Chemistry-V]

[CBCS]

Full Marks : 40

Time : Two Hours

*The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.*

Group - A

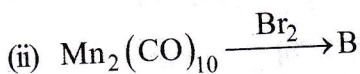
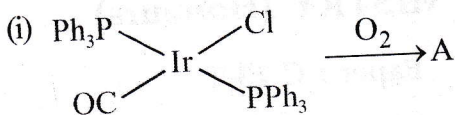
Answer any **five** questions : $2 \times 5 = 10$

1. Highly reduced carboxylates like $[\text{Mn}(\text{CO})_5]^{-3}$ and $[\text{V}(\text{CO})_5]^{-3}$ are found to be unstable although carbonyl prefers to stabilize lower oxidation state in metal complexes. Explain.
2. How does rubredoxin can be distinguished from ferredoxin?
3. The d^{10} systems are expected to be labile in terms of both VBT and CFT. Explain.
4. Write the role of Mg^{2+} and Cu^{2+} in the biological systems.

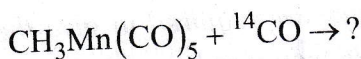
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(2)

5. The formation of ' $\text{Zn}^{11} - \text{OH}$ ' at physiological pH is the key step in explaining the buffering activity of carbonic anhydrase. Justify the statement with proper explanation.
6. Write down the major product of the following reactions :



7. Identify the product of the given reaction with probable mechanism :



8. Evaluate metal-metal bond per metal atom in $\text{Os}_4(\text{CO})_{16}$ and $\text{Mn}_2(\text{CO})_{10}$ complexes.

Group - B

Answer any **four** questions :

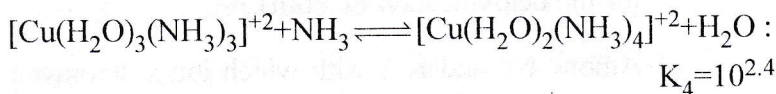
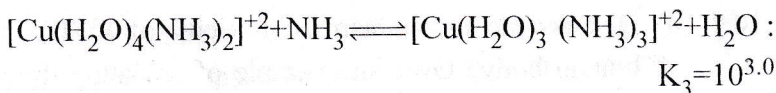
5×4=20

9. What is cooperative interaction? Using cooperative interaction, explain the exact order of stepwise binding constants (K_1 , K_2 , K_3 , K_4) for the consecutive oxygenation steps in tetrameric haemoglobin. Why the order of binding constants are found to be reversed with respect to normal trends in transition metal-complexes?

1+2+2

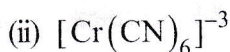
10. (a) Discuss the mechanism of toxicity of Pb(II) in human body? Give an example of chelating drug for the detoxification of Pb(II).
- (b) Among Na^+ and K^+ , with which ion valinomycin binds more tightly and why? 3+2
11. (a) Heating a sample of $[(\eta^5\text{-C}_5\text{H}_5)\text{Mo}(\text{CO})_3]_2$ results in the formation of $[(\eta^5\text{-C}_5\text{H}_5)\text{Mo}(\text{CO})_2]_2$ with the elimination of two equivalent of CO. Calculate the change of metal-metal bond order from reactant to product.
- (b) The complex $[\text{M}(\eta^6\text{-C}_6\text{H}_6)(\text{CO})_2]_2$ obey the 18-electron rule and has only one metal-metal bond having bond order one. Predict 'M' (if it is a first-row transition metal element) and sketch the probable structure of the complex. $2\frac{1}{2}+2\frac{1}{2}$
12. (a) Using appropriate relation between stepwise stability constant ($K_1, K_2, K_3 \dots K_n$, etc.) and overall stability constant (β_n). Calculate the value of the overall stability constant as a form of $\log \beta_n$ for the following stepwise complexation reactions :
- $[\text{Cu}(\text{H}_2\text{O})_6]^{+2} + \text{NH}_3 \rightleftharpoons [\text{Cu}(\text{H}_2\text{O})_5(\text{NH}_3)]^{+2} + \text{H}_2\text{O} : K_1 = 10^{4.2}$
- $[\text{Cu}(\text{H}_2\text{O})_5(\text{NH}_3)]^{+2} + \text{NH}_3 \rightleftharpoons [\text{Cu}(\text{H}_2\text{O})_4(\text{NH}_3)_2]^{+2} + \text{H}_2\text{O} : K_2 = 10^{3.6}$

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(b) How Zeise's salt is prepared? The 'C-C' bond length in $\text{K}[\text{PtCl}_3(\eta^2-\text{C}_2\text{H}_4)]$ is 1.37 Å whereas it is 1.52 Å in analogous substituted complex $[\text{Pt}\{\text{C}_2(\text{CN})_4\}(\text{PPh}_3)_2]$. Explain the observation. $2\frac{1}{2} + (1 + 1\frac{1}{2})$

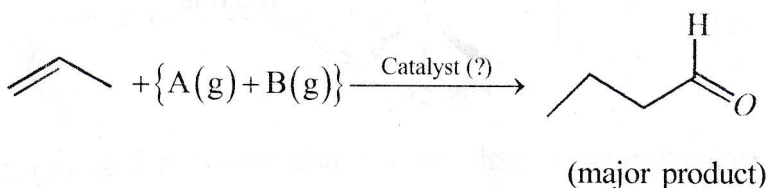
13. (a) Classify the following complexes into 'Inert' and 'Labile' with proper reasons :



(b) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ has two different geometrical isomers. One isomer gives $[\text{Pt}(\text{NH}_3)_2(\text{tu})_2]^{+2}$ on treatment with thiourea (tu); the other isomer gives $[\text{Pt}(\text{tu})_4]^{+2}$ on similar treatment. Identify the isomers with proper justification. $2+3$

14. (a) Which metal ions are used in the Wacker process? Explain the role of the metal ions used in this process.

- (b) Identify the mixture of gaseous reactants [A(g) & B(g) respectively] as well as suitable catalyst involved in the given transformation reaction and mention the name of this process :

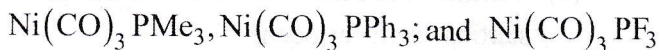


- (c) What are the active ingredients used in Ziegler-Natta catalyst? 2+2+1

Group - C

Answer any *one* question : 10×1=10

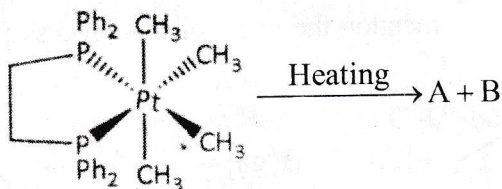
15. (a) Arrange the decreasing order of IR stretching frequency of 'C–O' bond which is trans to PMe_3 , PPh_3 and PF_3 in the following organometallic complexes with proper explanation :



- (b) What is carboxy-haemoglobin? How does distal histidine protein drastically reduces the CO affinity of Haemoglobin? Discuss with appropriate mechanism.
- (c) What is the difference between Reiske centre protein and Fe_4S_4 ferredoxin?

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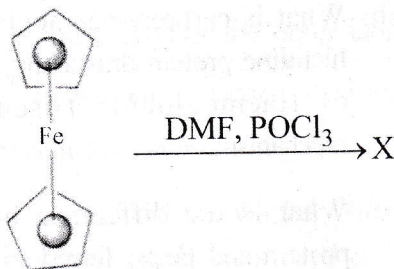
- (d) Identify the possible products (A and B) of the following reaction with suitable explanation.



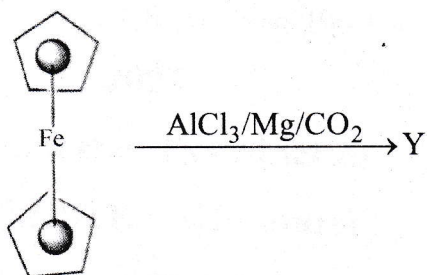
3+3+2+2

16. (a) Why $\text{Na}^+ - \text{K}^+$ ion pump is called as an 'electrogenic pump'? What do you mean by eversion in the activity of $\text{Na}^+ - \text{K}^+$ pump? Write one the major role of $\text{Mg}(\text{II})$ ion in the activity of $\text{Na}^+ - \text{K}^+$ pump.
- (b) Why the Friedel-Craft acetylation reaction in ferrocene is about 3.3×10^4 times more reactive than benzene and about 1×10^3 times more reactive than mesitylene?
- (c) Mention the main product(s) of the given reaction starting from ferrocene :

(i)



(ii)



- (d) Why the electron transport chain in the well-known Z-scheme in photosynthesis is sometimes referred to as 'red drop' process? 4+2+2+2
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