2023

CHEMISTRY — HONOURS

Paper : CC-13

(Inorganic Chemistry - 5)

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***question no.* 1 (Compulsory)** and ***any eight*** questions from the rest (question nos. **2** to **13**).

1. Answer ***any ten*** questions : 1×10

(a) Among Cu^{2+}, Pb^{2+}, As^{3+} and Co^{2+}, which radical will not be precipitated by passing H_2S in hydrochloric acid medium?

(b) What is the group reagent for precipitation of metal ions present in analytical group-IV?

(c) Name one biological function of Mg^{2+}.

(d) Write the formula of the precipitate obtained when disodium hydrogen phosphate is added in ammoniacal medium to Mg^{2+} solution.

(e) Name one metalloprotein which shows cooperativity effect.

(f) Name any two beneficial elements for the living bodies in biological system.

(g) What is the basic function of Carboxypeptidase-A?

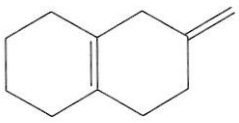
(h) What is the active species in Ziegler-Natta catalyst?

(i) Write down the IUPAC name of Zeise's salt.

(j) What is the oxidation state of molybdenum in $[\eta^7$-tropylium $Mo(CO)_3]^+$?

(k) Identify the catalyst used in the reaction given below.

$$n\mathrm{CO} + (2n+1)\mathrm{H_2} \xrightarrow{\text{catalyst}} \mathrm{C_nH_{2n+2}} + n\mathrm{H_2O}$$

(l)  $\xrightarrow[\mathrm{H_2,\ Benzene}]{\mathrm{RhCl(PPh_3)_3}}$?

2. (a) Write down the procedure for the separation of Gr. II_A and Gr. II_B basic radicals. State the relevant chemical reactions.

(b) Why is the change from deoxyhaemoglobin to the oxy-form accompanied by a decrease in the observed magnetic moment? 3+2

3. (a) Comment on the oxidation states of the metal ion in the active site of Haemoglobin and Hemerythrin with reference to oxygen transport.

   (b) Why is heating with conc. nitric acid done before precipitation of analytical group IIIA? 3+2

4. (a) Why the presence of one Zn(II) ion per mole of carboxypeptidase A is crucial for its activity? Explain.

   (b) Why is it necessary to prepare the sodium carbonate extract for the detection of acid radicals in inorganic qualitative analysis? 3+2

5. (a) What are metalloproteins and metalloenzymes? Distinguish between the terms.

   (b) How can you prepare $Fe(CO)_5$ and $Fe_2(CO)_9$? 3+2

6. (a) What is Chelation therapy? Mention its limitations.

   (b) How can you incorporate an $-NH_2$ group in ferrocene? 3+2

7. (a) Mention the role of NH_4Cl in group IV qualitative analysis. Can $(NH_4)_2SO_4$ be used instead of NH_4Cl?

   (b) Name two clinically approved drugs of platinum (II) for the treatment of cancer. 3+2

8. (a) $[Cr(CN)_5NO]^{4-}$, $\gamma(NO) = 1515\ cm^{-1}$; $[Mn(CN)_5(NO)]^{3-}$, $\gamma(NO) = 1725\ cm^{-1}$; $[Fe(CN)_5(NO)]^{2-}$, $\gamma(NO) = 1939\ cm^{-1}$: Justify.

   (b) Discuss the role of NH_4OH in Gr. III_B precipitation by H_2S. 3+2

9. (a) Draw the catalytic cycle mentioning each step for the following transformation. State the role of Cu^{2+} in the cycle. $H_2C = CH_2 + \frac{1}{2} O_2 \xrightarrow{PdCl_4^{2-}} CH_3CHO$.

   (b) 'Metal deficiency and metal excess both may exert toxic effects.' — Substantiate the statement with examples. 3+2

10. (a) Compare the acidity of the following compounds :

    $H_2Fe(CO)_4$, $HMn(CO)_5$ and $HCo(CO)_4$.

    (b) Explain, why ferrocene is unreactive toward iodine while cobaltocene rapidly decolorizes the colour of the iodine solution. 3+2

11. (a) Do you expect any rotation of ethylene molecule in Zeise's salt without hampering the stability of the complex? If possible, explain it.

    (b) What happens when boric acid is heated with methanol and the issuing gas is burnt? Write down the chemical reaction. 3+2

12. (a) Find out 'n' : (i) $Fe_4(CO)_n$ (ii) $[(\eta^5 - C_5H_5)_3Ni_3(\mu_3 - CO)_3]^n$.

    (b) Haemoglobin is not only an oxygen transporter but it also transports CO_2 and helps in the maintenance of pH of blood. Justify the statement. 2+3

13. (a) What is Wilkinson's catalyst? Mention the example of oxidative addition and reductive elimination with reference to the hydrogenation of alkene with Wilkinson's catalyst.

(b) Comment on the CO stretching frequencies of terminal CO, doubly bridging CO and triply bridging CO. 3+2