2022

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) What masking agent can be used for the detection of Cd^{2+} in presence of Cu^{2+} ion in analytical Group II A?

(b) The chelating agent 2, 3-dimercapto-propane-1-sulfonic acid (unithiol) is used as an antidote of metal toxicity. Identify the metal.

(c) Name a dinuclear iron dioxygen transport protein in biological system.

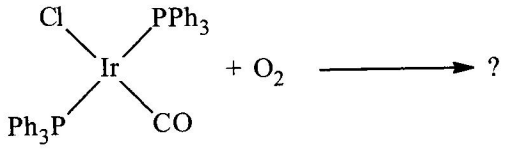
(d) Identify the first-row transition metal (M) in the following 18-electron species :

$(\eta^3 - C_5H_5)(\eta^5 - C_5H_5)M(CO)$

(e) How many ^1H NMR peaks are obtained for $Ti(\eta^1 - C_5H_5)_2(\eta^5 - C_5H_5)_2$ at $-30°C$?

(f) Name any two basic radicals with their charges present in the analytical Group II B.

(g) Draw the structure of the product of the following reaction :



(h) Which metal ion deficiency leads to pernicious anaemia?

(i) Write down the reagent(s) for the monoacetylation of ferrocene.

(j) Name two metal dependant diseases.

(k) Find out the molecular formula of the compound containing $\eta^6 - C_6H_6$, CO and Cr.

(l) Name one potential inhibitor for the activity of carbonic anhydrase (CA).

2. (a) State the roles of proximal histidine and distal histidine during the oxygenation of Haemoglobin.

(b) Compare C – C bond lengths in $[PtCl_3(C_2H_4)]^-$ and $[PtCl_3(C_2F_4)]^-$. 3+2

Please Turn Over

3. (a) What is Ziegler-Natta polymerization? Is Ziegler-Natta system homogeneous? What is the role of $Al(C_2H_5)_3$ in the catalytic process?

   (b) Discuss the difference in the active sites of carboxypeptidase A and carbonic anhydrase. 3+2

4. (a) Briefly explain the application of solubility product and common ion effect in the separation of Gr. II and Gr. III B cations.

   (b) Define reductive elimination reaction with reference to organometallic chemistry. Substantiate with an example. 3+2

5. (a) Show the valence electron count of the following :

   (i) $[(\eta^4 - C_4Ph_4)PdCl_2]_2$

   (ii) $[(\eta^5 - C_5H_5)Ir(CH_2)(PMe_3)]$

   (iii) $[Mn(SnPh_3)_2(CO)_4]^-$

   (b) Why phosphate and borate radicals are termed 'interfering'? 3+2

6. (a) Explain the principle of chelation therapy with reference to detoxification of lead, mercury and copper.

   (b) Write down the products :

   (i) $Co_2(CO)_8 + Na \rightarrow ?$

   (ii) $Mn_2(CO)_{10} + Br_2 \rightarrow ?$ 3+2

7. (a) What is the valence electron count for the blue ion $[NiCl_4]^{2-}$? Why does this tetrahedral ion not obey the 18 electron rule?

   (b) What happens when ferrocene is reacted with a hot solution of (i) sodium hydroxide and (ii) nitric acid? 3+2

8. (a) Compare the modes of binding of O_2 to the metal centres in (i) myoglobin (ii) hemerythrin (iii) hemocyanin.

   (b) Why concentrated HCl can not be used as a group reagent in place of dilute HCl for the precipitation of Group-I cations in analytical group separation? 3+2

9. (a) $Cr(CO)_5(PF_3)$ shows two C – O stretching frequencies in the range $1850 - 2125\ cm^{-1}$. Explain.

   (b) Write down the molecular formula of chromyl chloride. What happens when it reacts with NaOH solution? 3+2

10. (a) Starting from vanadium (III) chloride, how can you synthesize vanadium hexacarbonyl? Is it possible to get a dimeric carbonyl of vanadium? Justify.

   (b) Explain why EDTA or its di-sodium salt are not used in the treatment of heavy metal ion toxicity. 3+2

11. (a) What are ionophores? What are their roles in the metal ion transport across biological membrane?

(b) Give examples of one doubly bridging and one triply bridging nitrosyl compounds. 3+2

12. (a) $[V(CO)_6]$ and $[V(CO)_6]^-$ are both octahedral. Which has the shorter carbon-oxygen distance and the shorter vanadium-carbon distance?

(b) How a patient affected with Wilson's disease can be relieved by means of chelation therapy? 3+2

13. (a) Explain the biofunction of carbonate – bicarbonate buffering system.

(b) Mention one significant role in biological processes for each of the elements Cu and Ca. 3+2