2021

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*** and ***any eight*** questions from the rest.

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

(a) Name the basic radicals with their charges which are separated in qualitative analysis of mixtures with H_2S as the group reagent in alkaline medium in presence of ammonium chloride.

(b) What is the formal oxidation state of iron in $Na_2[Fe(CN)_5NO]$?

(c) State the metal ion present in carboxypeptidase A.

(d) Which antidote is used to reduce the toxicity due to excess Pb?

(e) Indicate the possible hapticity of the following ligands:
Ethylene, Cyclopentadienyl

(f) What is the actual catalytic species in the cobalt carbonyl based hydroformylation process?

(g) Which of the following obeys the 18-electron rule?
$RhCl(PPh_3)_3$, $[Rh(bipy)_2Cl]^+$

(h) Show the possible bonding modes of CO in organometallic complexes.

(i) Why does Wilkinson's catalyst act in a selective manner?

(j) At what pH is phosphate separation carried out by $FeCl_3$?

(k) State the origin of red colour of oxyhaemoglobin.

(l) Name a metal ion other than iron which is involved in the dioxygen transport in biological system.

2. (a) Cite the role of Fe^{3+}/Fe^{2+} in the basic chemical reactions of the biological systems.

(b) What is to be done in the detection of cations by group separation if copper phosphate and zinc phosphate are present in a salt mixture? Give reasons. 3+2

3. (a) Draw the mechanistic steps for the generation of butanal from propene. Indicate the catalyst species and the 18e/16e intermediates formed.

(b) Draw the structure of the products for the reaction of Ferrocene with RCOCI and $AlCl_3$. 3+2

4. (a) Draw the active site structure of Myoglobin and Hemerythrin and comment on the oxygen binding modes for each.

(b) How is ferrocene converted to $(\eta^5 - C_5H_5)Fe(\eta^5 - C_5H_4NH_2)$? 3+2

5. (a) In the IR spectrum of free MeCH = CH_2, $\nu_{C=C}$ comes at 1652 cm^{-1}, but in the complex $K[PtCl_3(MeCH=CH_2)]$, the corresponding absorption is at 1504 cm^{-1}. Comment on the experimental result.

(b) What is the toxic effect of the presence of arsenic in drinking water? 3+2

6. (a) What is the group reagent for the precipitation of Gr.III-A cations? Why is NaOH not used as a reagent for the above separation?

(b) Name two metal dependant diseases. 3+2

7. (a) What is the function of Na-K ion pump?

(b) What is synergic effect and how does it relate to metal-carbonyl bonding? 3+2

8. (a) Explain the mechanism of action of carbonic anhydrase and how it helps in the transport of CO_2 by Haemoglobin.

(b) Show by examples oxidative addition and insertion reactions in organometallic complexes. 3+2

9. (a) Explain the role of Glu-270 in the hydrolytic mechanism of Carboxypeptidase A.

(b) Draw the microenvironment of the active site of Hemocyanin. 3+2

10. (a) Show the role of $[PdCl_4]^{2-}$ in the transformation of ethylene to acetaldehyde using mechanistic steps.

(b) What prevents simple iron-porphyrins from functioning as O_2 carriers like Haemoglobin? 3+2

11. (a) Illustrate by an example using its qualitative molecular orbital diagram the reason for the stability of 18e organometallic complexes.

(b) Give examples of a bulk and an ultra-trace element and identify them as essential or beneficial element of life. 3+2

12. (a) Discuss the structure and bonding of the Zeise's salt.

(b) On the basis of 18e rule, find 'z' and 'M' in the following:

(i) $[Ni(NO)_3(SiMe_3)]^z$

(ii) $[\eta^3 - C_3H_3)(\eta^5 - C_5H_5)M(CH_3)(NO)]$

NO has linear coordination in both cases. 3+2

13. (a) Show the catalytic cycle for the polymerisation of propene using an organometallic catalyst.

(b) Why does Pb^{2+} appear both in Gr. 1 and Gr. IIA during qualitative analysis of inorganic salts? 3+2
