2023

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 : 2×5=10

1. Using 18-electron rule, find the value of 'n' in $\left(\eta^5-C_p\right)Co(CO)_n$.

2. What is the formal oxidation state of iron in $Na_2\left[Fe(CN)_5 NO\right]$?

3. Show that substitution in square planar complexes is an associative process.

4. Acetylation of ferrocene produces only one major product. Explain why.

P.T.O.

5. Between $Rh(PEt_3)Cl$ and $Rh(PPh_3)_3Cl$ which one is suitable for Wilkinson's type catalyst for hydrogenation of olefins? Explain.

6. What is synergic effect and how does it relate to metal-carbonyl bonding?

7. In the series *Ni*(II), *Pd*(II) and *Pt*(II), only *Pt*(II) shows significant trans effect. Justify.

8. What is Fischer-Tropsch process?

Group - B

Answer any ***four*** questions : 5×4=20

9. What is *trans* effect? How would you proceed to prepare *cis*- and *trans*-$[Pt(NH_3)(NO_2)Cl_2]^-$ from $[PtCl_4]^{2-}$ in two stepusing NH_3 and NO_2^-? 1+2+2

10. (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

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

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

12. (a) Draw *Bailar* twist and *Ray-Dutt* twist for the interconversion of enantiomers Δ and Λ of $M(L-L)_3$.

    (b) What is Bohr effect? Explain. 2+2+1

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

    (b) In the IR spectrum of free $MeCH=CH_2$, $\upsilon_{c=c}$ comes at 1652 cm^{-1}, but in the complex $K[PtCl_3(\eta^2-MeCH=CH_2)]$, the corresponding absorption is at 1504 cm^{-1}. Comment on the observation. 3+2

14. (a) Discuss, with examples, the differences between inner- and outer-sphere mechanisms, and state what is meant by a self-exchange reaction.

    (b) Write the advantages of using Rh-catalyst in place of Co-catalyst in hydroformylation reaction. 3+2

Group - C

Answer any ***one*** question : 10×1=10

15. (a) Explain the metal ion transport across bio-membranes with reference to the function of Na^+/K^+ pump.

P.T.O.

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

(c) Write and explain the light and dark phase reactions related to photosynthesis.

(d) Draw the structure of $4Fe\text{-}4s$ ferredoxin and mention its biological function. 3+2+4+1

16. (a) The ν_{c-o} of isoelectronic hexacarbonyls is given below. Explain their trends. ($\nu_{c-o} = 2143\ cm^{-1}$ in free *CO*).

$$\left[Ti(CO)_6\right]^{2-}\left(\nu_{c-o} = 1748\,cm^{-1}\right), \left[\nu(CO)_6\right]^{-} \left(\nu_{c-o} = 1860\,cm^{-1}\right).$$

$$\left[Cr(CO)_6\right]\left(\nu_{c-o} = 2000\,cm^{-1}\right), \left[Fe(CO)_6\right]^{2+} \left(\nu_{c-o} = 2200\,cm^{-1}\right).$$

(b) Draw the microenvironment of the active site of Hemocyanin.

(c) Illustrate by an example using its qualitative molecular orbital diagram the reason for the stability of $18e^-$ organometallic complexes.

(d) How is ferrocene converted to $\left(\eta^5 - C_5H_5\right)Fe\left(\eta^5 - C_5H_4NH_2\right)$?

(e) Applying 18-electron rule deduce the structure of $Fe_3(CO)_{12}$. Show the different modes of bonding of CO in this structure. 3+2+2+1+2
