

2020

(Held in 2021)

CHEMISTRY

(Major)

Paper : 5.4

(Inorganic Chemistry)

Full Marks : 42

Time : 2 hours

The figures in the margin indicate full marks
for the questions

GROUP—A

(Marks : 21)

1. Answer/Choose the correct answer : 1×2=2

(a) Find the hapticity of nitrosyl in $[\text{Mo}(\text{}^1\text{-allyl})_3(\text{}^3\text{-allyl})_2\text{NO}]$.(b) Zn in carbonic anhydrase is coordinated by three histidine and one water molecule. The reaction of CO_2 with the enzyme is an example of

(i) electrophilic addition

(ii) electron transfer

(iii) nucleophilic addition

(iv) electrophilic substitution

2. Answer the following : 2×2=4

(a) Why does SF_4 have C_{2v} symmetry rather than C_{4v} ?(b) $\text{K}_2[\text{NiF}_6]$ is diamagnetic while $\text{K}_3[\text{CoF}_6]$ is paramagnetic. Both have same d -configuration. Explain on the basis of CFT.

3. Answer any three of the following : 5×3=15

(a) Draw the crystal-field splitting patterns of d -orbitals for the following crystal symmetries (qualitative data only) : 5 C_{4v} and D_{5h}

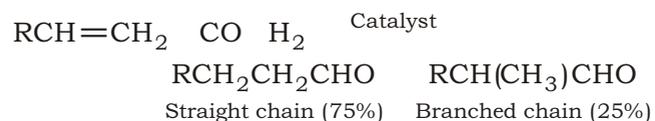
(b) Determine the symmetry elements of the following orbitals assuming that their shapes are similar to that of their boundary surfaces :

 d_{xy} and d_z^2 Which *chloro*-substituted benzene of formula $\text{C}_6\text{H}_n\text{Cl}_{6-n}$ has exactly four planes of symmetry? 3+2=5

(3)

(c) Explain with the help of a diagram the mechanism of sodium-potassium pump in human body. What is the source of energy for the function of this pump? 5

(d) The following organic transformation can be achieved by using a Co-based catalyst and the products obtained are straight chain as well as branched chain aldehydes with a selectivity of 75% and 25% respectively. It is highly desirable that the straight chain isomer should be formed exclusively because of its biodegradable nature. Write the mechanism of the reaction discussing each step of the catalytic cycle. Also suggest a mechanism for increasing selectivity of the straight chain aldehyde : 4+1=5



(e) Discuss the bonding and structure of ferrocene. Write two important applications of ferrocene. 3+2=5

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(Turn Over)

(4)

GROUP—B

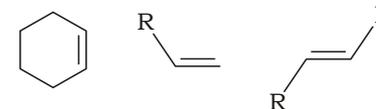
(Marks : 21)

4. Answer any *three* of the following : 7×3=21

(a) Both H⁻ and PPh₃ are ligands of similar field strength, high in the spectrochemical series. Recalling that phosphines act as π -acceptors, is π -acceptor character required for strong-field behaviour? What orbital factors account for the strength of each ligand? 3+4=7

(b) Explain the structural and bonding features of halide clusters with quadruple, triple and double bonds. 7

(c) Arrange the following alkenes in the increasing order of rate of hydrogenation by Wilkinson's catalyst. Comment on the observed rates for each of the alkenes with a plausible mechanism : 7



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(Continued)

(5)

(d) Explain why heme group cannot function as biological oxygen carrier in the absence of the globin chain. What serves as trigger in the Perutz mechanism for oxygenation and deoxygenation of hemoglobin? 4+3=7

(e) Write the methods of preparation of $(C_2H_5)_3SnCl$. Suggest the products when $(C_2H_5)_3SnCl$ reacts with the following reagents : 2+5=7

(i) Na

(ii) $Na[C_5H_5]$

(iii) Na_2S

(iv) H_2O
