6 SEM TDC CHMH (CBCS) C 13

2025

(May)

CHEMISTRY

(Core)

Paper : C–13

[Inorganic Chemistry
(Organometallic Chemistry)]

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following : 1×7=7

(a) The total electron count for the complex $[Fe_4N(CO)_{12}]^-$ is

(i) 60

(ii) 62

(iii) 72

(iv) 59

(b) EAN for $[CoNO(CN)_5]^{3-}$ is

(i) 35

(ii) 36

(iii) 37

(iv) 38

(c) Which of the following has minimum *trans*-effect?

(i) H_2O

(ii) NH_3

(iii) Py

(iv) Cl^-

(d) Which of the following complexes obeys 18 e^- rule?

(i) $(\eta^5\text{–}C_5H_5)Mn(CO)_3$

(ii) $Cr(\eta^5\text{–}C_5H_5)_2$

(iii) $Co_2(CO)_8$

(iv) $Fe(CO)_3(\eta^5\text{–}C_5H_5)$

(Continued)

(e) Cataions of which of the following groups are precipitated in alkaline medium?

(i) Group I

(ii) Group II

(iii) Group IV

(iv) None of the above

(f) Which of the following combinations of basic radicals belongs to group III?

(i) Fe, Al, Cr

(ii) Fe, Mg, Ba

(iii) Mg, Ba, Ca

(iv) Mg, Ba, Fe

(g) Find the hapticity of C_5H_5 ligand in $Fe(C_5H_5)_2$ complex.

(i) Monohapto ligand

(ii) Trihapto ligand

(iii) Pentahapto ligand

(iv) Dihapto ligand

(Turn Over)

2. Answer any *five* questions from the following : 2×5=10

(a) Why is H_2S passed in alkaline medium for the precipitation of group IV basic radicals? 2

(b) Define solubility product and ionic product of a solution. 2

(c) What is the importance of Zeise's salt in organometallic chemistry? How was it prepared? 1+1=2

(d) Give an example of reaction in which $HCO(CO)_4$ is used as a catalyst. 2

(e) What is Wilkinson's catalyst? Mention one use of this catalyst. 2

(f) How is 18 e^- rule helpful in determining the number of metal-metal bonds in metal carbonyl compounds? 2

UNIT—I

3. Answer any *two* from the following questions : 3×2=6

(a) How will you detect the presence of phosphate as interfering radical in a salt mixture? How does phosphate interfere in the detection of basic radicals? 1+2=3

(b) What is common ion effect? Explain why during the precipitation of group III radicals, NH_4OH is added in presence of NH_4Cl. 1+2=3

(c) What is the group reagent for group V? Write the chemical form of the precipitate of group V. How will you confirm the presence of Ba^{2+} ion in a salt mixture? 1+1+1=3

UNIT—II

4. Answer any *four* from the following questions : 3×4=12

(a) The CO molecule has JR stretching frequency of 2143 cm^{-1}, but it shifts to different regions in metal carbonyls. Explain. 3

(b) What is Ziegler-Natta catalyst? Discuss its use in the polymerization of ethane. 1+2=3

(c) What is synergic effect in metal carbonyls? Draw the molecular orbital energy-level diagram of CO molecule. 1+2=3

(d) What is ferrocene? Write its preparation. Write the Friedel-Crafts acylation reaction of ferrocene. 1+1+1=3

(e) Give one method of preparation for each of the following : 1+1+1=3

(i) Metal carbonyl

(ii) Zeise's salt

(iii) Binuclear carbonyl

UNIT—III

5. Answer any *four* from the following questions : 3×4=12

(a) Write a note on acid hydrolysis of cobalt (III) compounds with suitable example. 3

(b) Draw the structures of the intermediates that are formed in S_N1 and S_N2 mechanisms of $[MA_3X]^{n+}$. Compare their stability. 2+1=3

(c) What is *trans*-effect? Outline the synthesis of *cis*- and *trans*-dichloro-diammineplatinum (o). How will you distinguish between them? 3

(d) Explain the mechanism of the following : 3

$$[L_5MX] \xrightarrow{\text{slow}} X + [L_5M] \xrightarrow[\text{fast}]{+Y} [L_5MY]$$

(e) Explain the S_N1 CB mechanism for the following reaction : 3

$$[Co(NH_3)_5Cl]^{2+} + OH^- \rightarrow [Co(NH_3)_5(OH)]^{2+} + Cl^-$$

(Continued)

UNIT—IV

6. Answer any *two* from the following questions : 3×2=6

(a) Discuss Wilkinson's catalyst's role in hydrogenation of alkyne. 3

(b) Discuss the method of synthesis of gas by metal carbonyl complexes. 3

(c) Write a note on synthetic gasolin. 3

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Total No. of Printed Pages—7

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CHEMISTRY

(Core)

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(Organic Chemistry)

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Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following : 1×5=5

(a) Natural rubber is a polymer of

(i) 2-methyl-1, 3-butadiene

(ii) 2-chloro-1, 3-butadiene

(iii) 2-methyl but-2-ene

(iv) 1, 3-butadiene

(b) The different types of energies associated with a molecule are

(i) electronic energy

(ii) vibrational energy

(iii) rotational energy

(iv) All of the above

(c) Among the following the NMR active nucleus is

(i) ^{12}C

(ii) ^{19}F

(iii) ^{2}H

(iv) ^{16}O

(d) Which of the following is a basic dye?

(i) Congo red

(ii) Aniline yellow

(iii) Alizarin

(iv) Indigo

(e) Which of the following is the general formula of carbohydrates?

(i) $(C_4H_2O)_n$

(ii) $(C_6H_2O)_n$

(iii) $(CH_2O)_n$

(iv) $(C_2H_2O)_nCOOH$

UNIT—I

2. Answer the following questions (any *five*) : 2×5=10

(a) Polar solvent shift $\pi \rightarrow \pi^*$ transition to higher wavelength. Explain.

(b) The nuclei of ^{12}C is NMR inactive but ^{13}C is NMR active. Explain.

(c) Conjugate diene has higher λ_{max} than isolated diene. Explain.

(d) Chemical shift depend upon applied magnetic field but spin spin coupling N coupling constant is independent of the applied magnetic field. Explain.

(e) How can you study H-bonding using IR spectroscopy?

(f) What do you mean by fundamental band and overtone band?

3. CH_3OH is good solvent for UV spectroscopy but bad solvent for IR spectroscopy. Explain. 3

4. Answer the following questions (any *two*) : 4×2=8

(a) The mass spectrum of an organic compound shows an abundant molecular ion peak at $\frac{m}{2} = 72$. The compound gives a characteristic band at 275 nm ($\lambda_{max} = 17$) in its UV spectrum. The IR spectrum shows prominent peak at $2940\ cm^{-1}$, $2855\ cm^{-1}$ and $1715\ cm^{-1}$, PMR spectrum of the compound is as follows :

$\delta 2{\cdot}5(q, 2H)$, $\delta 2{\cdot}12(s, 3H)$ and $\delta 1{\cdot}07(t, 3H)$

Determine the structure of the compound and explain the peaks.

(b) Three isomeric dienes *A*, *B* and *C* with molecular formula C_5H_8 shows λ_{max} 178, 211 and 215 nm. All the dienes or hydrogenation yield *n*-pentane. What are the possible structure of *A*, *B* and *C*? Given that λ_{max} of pent-1-ene is 176 nm. Justify your answer.

(c) *(i)* NMR signal of ethylenic proton is observed at higher δ value than acetylenic proton. Explain. 2

(ii) What do you mean by finger print region? 2

UNIT—II

5. Answer the following questions (any *three*) : 2×3=6

(a) How will you show that D glucose is reducing sugar?

(b) Sketch the stable conformer of the anomer of α-D-glucopyranose.

(c) How do you establish that configuration at C_3, C_4 and C_5 of D-glucose and D-mannose are same?

(d) Convert D-glucose to epimeric aldohexose.

6. Assign the structures (*A*) to (*C*) from the following reaction : 3

$$\text{Aldohexose} \xrightarrow{NH_2OH} A \xrightarrow[AcOH]{Ac_2O} B \xrightarrow{AgOH} \underset{(C)}{C_5H_{10}O_5} + AgOH + CH_3COOAg$$

Or

What product do you expect when methyl-D-(+)-glucopyranoside is subsequently subjected to periodic oxidation, Br_2—H_2O oxidation, strontium salt formation and hydrolysis with dil HCl.

UNIT—III

7. Answer the following questions (any *three*) : 2×3=6

(a) What are requisites for a compound to be true dye?

(b) Write one method for the synthesis of indigo.

(c) Discuss briefly the Witt's theory for colour and constitution.

(d) Explain the following terms with suitable example : 1+1=2

(i) Hypsochromic shift

(ii) Auxochrome

8. Write one synthesis each of the following (any *two*) : 1½×2=3

(a) Fluorescein

(b) Methyl orange

(c) Phenolphthalein

UNIT—IV

9. What is vulcanization of rubber? How does it affect the quality of the polymer? 1½+1½=3

Or

Write a short note on phenol-formaldehyde resin. 3

10. Answer the following questions : 2×3=6

(a) Write down the structure of the polymer-polyurethane and nylon-6. 1+1=2

(b) Write the difference between addition and condensation polymerization.

(c) Write a short note on biodegradable polymer.

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