

## CHOICE BASED CREDIT SYSTEM

M.Sc. CHEMISTRY THIRD SEMESTER DEGREE EXAMINATION NOVEMBER 2024

Inorganic Chemistry - III

Duration: 3 Hours

Max Marks: 70

## PART - A

1. Answer any TEN of the following :

(10×2= 20 Marks)

- Find the symmetry product of the operation  $\sigma_{xy} \times C_{2z}$
- What is a group and what are its properties?
- Give the character of the transformation matrix of an inversion operation.
- Find the symmetry elements in the following molecule and write their point groups:  
i) HOCl      ii) H<sub>2</sub>S
- Predict the point group of acetylene.
- Predict the point group of  $[\text{TiCl}_6]^{3-}$
- Give reason: CH<sub>3</sub>NH<sub>2</sub> forms more stable complex with Cr<sup>2+</sup> than does with CH<sub>3</sub>OH
- On the basis of CFT, Explain the given values of magnetic moment of the following complex compounds:  
 $K_3[\text{FeF}_6] = 5.9 \text{ B.M}$      $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3 = 0.0 \text{ B.M}$
- What relationship exists between  $\Delta$  (the crystal field splitting) and the pairing energy (P) in determining whether a given complex will be high spin or low spin?
- Why is S<sub>N</sub>2 mechanism not used to explain base hydrolysis in octahedral complexes?
- Justify: The transfer of electron from  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$  to  $[\text{Co}(\text{NH}_3)_6]^{3+}$  in aqueous medium is slower than the transfer from  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$  to  $[\text{Co}(\text{NH}_3)_5\text{OH}]^{2+}$
- Explain why  $[(\text{NH}_2)(\text{CH}_2)_2(\text{NH}_2)_2\text{CoCl}_2]^+$  is slower to aquate than  $[(\text{NH}_2)(\text{CH}_2)_3(\text{NH}_2)_2\text{CoCl}_2]^+$

## PART - B

Answer any Five questions selecting at least one question from each unit (5×10= 50 Marks)

### UNIT - I

2. a) Explain the improper rotation axis of symmetry by taking examples.  
b) Identify symmetry elements for pyridine and propyne and find out their order. (5+5)
3. a) Prove that in trans-dichloro ethene,  $S_2$  operation produces the same result as that of inversion operation.  
b) Depict the symmetry elements of the  $C_{4v}$ ,  $C_{6v}$ ,  $C_{3v}$ ,  $D_{6h}$ , and  $C_{\infty v}$  point groups through an example for each. (5+5)

### UNIT - II

4. a) Find the vibrational and Raman active modes for  $PH_3$  with the help of the following character table:

	E	$2C_3(z)$	$3\sigma_v$	linear, rotations	quadratic
$A_1$	1	1	1	z	$x^2+y^2, z^2$
$A_2$	1	1	-1	$R_z$	
E	2	-1	0	$(x, y) (R_x, R_y)$	$(x^2-y^2, xy) (xz, yz)$

- b) Find out the point group of  $XeO_4$  and pictorially represent all symmetry elements with respective symmetry operations. (5+5)
5. a) List the symmetry elements and hence the point groups of the following:  
i) trans-dichloroethene ii) staggered ethane  
b) Find the number of modes of vibrations in ammonia by using the following character table: (5+5)

	E	$2C_3(z)$	$3\sigma_v$	linear, rotations	quadratic
$A_1$	1	1	1	z	$x^2+y^2, z^2$
$A_2$	1	1	-1	$R_z$	
E	2	-1	0	$(x, y) (R_x, R_y)$	$(x^2-y^2, xy) (xz, yz)$

### UNIT - III

6. a) Explain the limitations of VBT.  
b) Based on VBT, explain the geometry and hybridisation of  
i)  $[\text{Ni}(\text{CO})_4]$  ii)  $[\text{Zn}(\text{NH}_3)_4]^{2+}$  (5+5)
7. Discuss carefully and concisely the splitting of d orbitals in the case of tetrahedral complexes and square planar complexes. (10)

### UNIT - IV

8. a) Explain the applications of Trans effect series.  
b) Discuss pi-bonding theory to explain trans effect (5+5)
9. a) Differentiate between labile and inert complexes. Explain on the basis of crystal field theory, the cause of lability and inertness of octahedral complexes.  
b) Explain the formation of different types of intermediates in  $\text{S}_{\text{N}}1$  mechanism. (5+5)

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## CHOICE BASED CREDIT SYSTEM

M.Sc. CHEMISTRY THIRD SEMESTER DEGREE EXAMINATION NOVEMBER 2024

## Organic Chemistry - III

Duration: 3 Hours

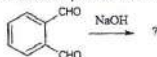
Max Marks: 70

## PART - A

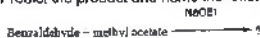
1. Answer any TEN of the following :

(10×2= 20 Marks)

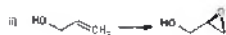
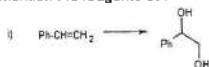
- a) Predict the product and name the following reaction:



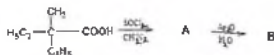
- b) Predict the product and name the following reaction:



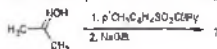
- c) Mention the reagents used for the following conversions:



- d) Give an example for the photoreduction of carbonyl compound.
- e) Triplet excited state is more stable than corresponding singlet state. Justify the statement.
- f) What is photocycloaddition reaction? Give an example.
- g) Explain FMO approach.
- h) [2+2] cycloaddition is photochemically allowed. Justify.
- i) Illustrate with the help of an example *aza-Cope* rearrangement.
- j) Predict the products A and B for the following.



- k) Predict the product and name the reaction for the following:



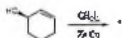
- l) What is Hofmann rearrangement? Give an example.

## PART - B


Answer any Five questions selecting at least one question from each unit (5×10= 50 Marks)

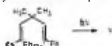
### UNIT - I

2. a) Discuss the mechanism of Mitsunobu reaction taking suitable example.  
b) Write a note on: i) Ullmann reaction ii) Stork enamine reaction (5+5)
3. a) Explain: i) Chichibabin reaction ii) Benzoin condensation  
b) Complete the following reaction. Propose a suitable mechanism: (6+4)



### UNIT - II

4. a) Complete the following reaction. Propose a suitable mechanism and explain.  
  
b) Explain the following:  
i) Norrish Type-II reaction ii) Photochemical cis-trans isomerization (6+4)
5. a) Predict the product and explain the mechanism for the following reaction:



- b) Write a note on Photo Fries rearrangement and its advantages over thermal reaction. (6+4)

### UNIT - III

6. a) Explain sigmatropic rearrangement taking the example of 1,3-shift of hydrogen atom.  
b) Draw the Molecular orbitals of pentadienyl and allyl free radical. (5+5)
7. a) Using FMO approach, predict whether the cyclisation of 1,3-butadiene is thermal or photochemical.  
b) Explain the terms taking suitable examples  
i) HOMO and LUMO ii) conrotatory and disrotatory (5+5)

### UNIT - IV

8. a) Describe the classification of rearrangement reactions with suitable examples.  
b) Write a note on Baker-Venkateswaram rearrangement. (5+5)
9. a) Write the mechanism for the following conversions.  
i) Cyclobutane carboxylic acid to Cyclobutylamine  
ii) Cyclopentanone to  $\alpha$ -Valerolactone  
iii) Camphor to  $\alpha$ -Campholide  
b) Explain the reaction mechanism for Lossen rearrangement. (6+4)

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## CHOICE BASED CREDIT SYSTEM

M.Sc. CHEMISTRY THIRD SEMESTER DEGREE EXAMINATION NOVEMBER 2024

## Spectroscopy II

Duration: 3 Hours

Max Marks: 70

## PART - A

1. Answer any SEVEN of the following :

(2×7= 14)

- a) Write the number of signals in  $^1\text{H}$  NMR for the following:
  - a)  $(\text{CH}_3)_2\text{CH}-\text{Cl}$
  - b)  $(\text{CH}_3)_2\text{C}=\text{CH}_2$
  - c) p-Xylene
  - d)  $\text{CH}_3\text{COOC}_2\text{H}_5$
- b) The proton decoupled  $^{13}\text{C}$  NMR spectrum of tribromobenzene ( $\text{C}_6\text{H}_3\text{Br}_3$ ) consists of only two signals? Which tribromobenzene is it?
- c) Give reason: Why aromatic protons come into resonance  $\delta$  1.5-2 ppm downfield from the corresponding olefinic signals?
- d) Obtain the predicted mass of a metastable ion for a molecular ion  $m/z=91$ ; daughter ion  $m/z=65$ .
- e) What is chemical ionization technique? What are its advantages?
- f) Explain fragmentation in benzaldehyde.
- g) Above the Curie point, ferromagnetic substances show paramagnetism. Justify.
- h) In  $[\text{V}(\text{H}_2\text{O})_6]^{3+}$ , is there any contribution to orbital angular momentum? Justify.
- i) Draw the Orgel diagram of  $\text{Cr}^{2+}$  in aqueous solution.

## PART - B

Answer any Four questions selecting at least one question from each unit.

(14×4 = 56)

## UNIT - I

- 2) a) An organic compound (molecular formula  $\text{C}_8\text{H}_8\text{O}_2$ ) showed the following spectral data. Assign the structure to the compound.  
 IR ( $\text{cm}^{-1}$ ): 1685;  $^1\text{H}$  NMR (ppm): 3.9 (3H, s), 7.0 (2H, d,  $J=9\text{Hz}$ ), 7.9 (2H, d,  $J=9\text{Hz}$ ), 9.9 (1H, s).

- b) Find the  $^{19}\text{F}$  NMR spectrum of 1-bromo-1-fluoro ethane ( $\text{CH}_3\text{CHFBr}$ ) and 1-bromo-3,4,5-trifluorobenzene.
- c) Explain Karplus relationship and Karplus curve. (5+5+4)
- 3) a) Write a note on: i) DEPT spectrum ii) Anisotropy effects
- b) An aromatic compound (molecular mass=135) gives the following signals in its  $^1\text{H}$  NMR spectrum: Singlet ( $\delta$ 2.09, 3H), a distorted singlet ( $\delta$ 3.09, 1H), a multiplet ( $\delta$ 7.24, 3H), a multiplet ( $\delta$ 7.75, 2H). Predict the structure of the compound.
- c) Compare the  $^1\text{H}$  NMR and  $^{13}\text{C}$  NMR spectral feature in methyl ethyl ketone. For  $^{13}\text{C}$  NMR consider both proton decoupled and off-resonance spectrum. (5+5+4)

#### UNIT - II

- 4) a) Derive an expression to show that mass spectrometer would be unable to distinguish between a  $\text{M}^+$  and  $2\text{M}+2$  from one another.
- b) Write some characteristic features of mass spectra of aromatic aldehydes and alkyl benzene. Show fragmentation pattern.
- c) Write a note on double focused and magnetic sector analyser. (5+5+4)
- 5) a) Explain fragmentation modes of 2-hexene and 2-methyl-1-pentene.
- b) With a neat diagram, explain the instrumentation of a double focused mass spectrometer.
- c) The mass spectrum of n-butane showed some prominent peaks at  $m/z$  values 43 and 15. What are the most probable species responsible for these peaks. (5+5+4)

#### UNIT - III

- 6) a) What are the favourable conditions for LMCT and MLCT transitions? Explain with examples.
- b) In the spectra of  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  three peaks are obtained at  $8000\text{cm}^{-1}$ ,  $19600\text{cm}^{-1}$  and  $21600\text{cm}^{-1}$ . Interpret the spectra.
- c) Between  $\text{NiCO}_4$  and  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  which one shows ligand to metal charge transfer and why? (5+5+4)
- 7) a) Construct microstate table for  $[\text{V}(\text{H}_2\text{O})_6]^{3+}$  & derive free ion terms present in a complex.
- b) Derive term symbol for  $\text{Mn}^{3+}$  ion in  $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$  complex and draw the Orgel diagram of it.
- b) Calculate spin only magnetic moment of  $\text{Fe}^{3+}$  &  $\text{Cr}^{2+}$  (5+5+4)

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**CHOICE BASED CREDIT SYSTEM****M.Sc./M.A./M.COM. THIRD SEMESTER DEGREE EXAMINATION NOVEMBER 2024****Environmental Pollution and Remediation****Duration:3 Hours****Max Marks:70****PART - A****1. Answer any SEVEN of the following :****(2×7= 14)**

- a) Explain how density and pressure change with altitude in the atmosphere.
- b) Explain classical smog in short.
- c) Differentiate between hydrosphere and lithosphere.
- d) Define the alkalinity of water. How is it different from pH?
- e) What is algal bloom?
- f) What is the importance of chlorination?
- g) Name two nitrogen-fixing bacteria.
- h) What is the difference between micro and macro nutrients?
- i) Define soil pollution.

**PART - B****Answer any Four questions selecting at least one question from each unit. (14×4 = 56)****UNIT - I**

- 2) a) Explain the sources and effects of oxides of sulphur.  
b) Explain the sources and effects of oxides of carbon. (7+7)
- 3) a) Write the importance of ozone layer and the mechanism of its depletion.  
b) Explain the sources of noise pollution and ways to control it. (7+7)

**UNIT - II**

- 4) a) Describe difference between primary and secondary water treatment methods?  
b) Write short notes on water distillation and deionization? (7+7)



- 5) a) Write a note on water quality standards.  
b) What is water turbidity? Why is it important?  
c) Explain TON.

(5+5+4)

### UNIT - III

- 6) a) Write a note on the effects of pollution caused by detergents.  
b) Discuss the issues caused by agro-technology wastes.  
c) What is the impact of soil pollutants on air quality?

(5+5+4)

- 7) a) How can afforestation help to reduce soil pollution? Discuss.  
b) Write a note on Composting.

(7+7)

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