22MCHEH301 Reg No : .....

CHOICE BASED CREDIT SYSTEM

M.Sc. CHEMISTRY THIRD SEMESTER DEGREE EXAMINATION DECEMBER 2023

Inorganic Chemistry - III

Duration:3 Hours **Max Marks:70**

PART - A

1. Answer any TEN of the following : **(10×2= 20 Marks)**

a) Explain Irreducible representations and give any two of its properties.

b) How many symmetry elements does BF_3 have and what are they?

c) Mention the subgroups present in a water molecule.

d) Predict the point group of Diborane.

e) Predict the point group of N_3^-

f) Identify the point group of $CHCl_3$ & justify the answer.

g) Based on CFT, Draw the energy level diagram and write the electronic configuration of the central metal ion $[Fe(CN)_6]^{4-}$

h) On the basis of CFT, explain the following, giving appropriate reasons to your answer: Both $[Fe(CN)_6]^{3-}$ and $[Fe(H_2O)_6]^{3+}$ appear colorless in dilute solutions.

i) Give the number of unpaired electrons in a strong and weak octahedral field for Mo^{2+}

j) Differentiate between inert and labile complexes.

k) The rates of aquation of the complexes increases in the following order: $[Co(NH_3)_5Cl]^{2+} > [Co(en)(NH_3)_2Cl]^{2+} > [Co(en)_2(NH_3)Cl]^{2+} > [Co(tetraene)Cl]^{2+}$ Give reason.

l) Give evidence to suggest that the substitution in square planar complexes proceeds through S_N2 mechanism.

PART - B

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

UNIT - I

2. a) Explain all the symmetry elements of staggered and eclipsed ethane.

   b) How do the order and class of point groups differ for H_2O and NH_3 molecules?

   (5+5)

3. a) Generate the RR's of i) cis planar H_2O_2 and decompose into IRR's

	E	C_2 (z)	σ_v(xz)	σ_v(yz)	linear, rotations	quadratic
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	x, R_y	xz
B_2	1	-1	-1	1	y, R_x	yz

   b) Derive the transformation matrix for S_4 rotation in the anticlockwise direction representing a rotation of 90° about the z-axis followed by reflection along the horizontal plane and find out the character of the matrix. (5+5)

UNIT - II

4. a) Deduce the reducible representations of BF_3 by using the following character table:

	E	$2C_3$	$3C'_2$	σ_h	$2S_3$	$3\sigma_v$
A'_1	1	1	1	1	1	1
A'_2	1	1	-1	1	1	-1
E'	2	-1	0	2	-1	0
A''_1	1	1	1	-1	-1	-1
A''_2	1	1	-1	-1	-1	1
E''	2	-1	0	-2	1	0

   b) Find the vibrational and Raman active modes for m-dichlorobenzene with the help of the following Character table: (5+5)

C_{2v}	E	C_{2z}	σ_{xz}	σ_{yz}		
A_1	1	1	1	1	z	x^2, y^2,z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	x, R_y	xz
B_2	1	-1	-1	1	y, R_x	yz

5. a) List the symmetry elements and hence the point groups of the following:

   i) Methane ii) benzene

   b) Find the IR, Raman active modes of vibrations in H_2O by using the following character table: (5+5)

C_{2v}	E	C_{2z}	σ_{xz}	σ_{yz}		
A_1	1	1	1	1	z	x^2, y^2,z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	x, R_y	xz
B_2	1	-1	-1	1	y, R_x	yz

UNIT - III

6. a) What is crystal field theory? How does it differ from the valence bond theory?

   b) $[NiCl_4]^{2-}$ ion is paramagnetic tetrahedral but $[PdCl_4]^{2-}$ and $[PtCl_4]^{2-}$ ions are diamagnetic square planar: Give reason.

   c) How will you account for the non-existence of tetrahedral complexes with low spin configurations? (4+3+3)

7. a) Discuss the sigma and pi metal ligand bonding in transition metal complexes with reference to tetrahedral transition metal complexes

   b) Explain the ionic radii of divalent metal cations of the first transition series using CFT (6+4)

UNIT - IV

8. a) Explain and predict the order of the rate of electron transfer in the following:

   i) $[Cr(H_2O)_6]^{2+} + [Co(NH_3)_6]^{3+} \rightarrow [Cr(H_2O)_6]^{3+} + [Co(NH_3)_6]^{2+}$

   ii) $[Cr(H_2O)_6]^{2+} + [Co(NH_3)_5(H_2O)]^{3+} \rightarrow [Cr(H_2O)_6]^{3+} + [Co(NH_3)_5(H_2O)]^{2+}$

   b) Differentiate between complimentary and non-complimentary reactions with examples. (6+4)

9. a) Explain the applications of Trans effect series.

   b) Explain polarisation theory to explain trans effect. (5+5)

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22MCHEH302 Reg No : .....

CHOICE BASED CREDIT SYSTEM

M.Sc. CHEMISTRY THIRD SEMESTER DEGREE EXAMINATION DECEMBER 2023

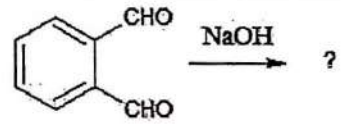
Organic Chemistry - III

Duration:3 Hours **Max Marks:70**

PART - A

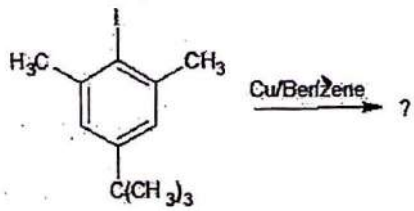
1. Answer any TEN of the following : **(10×2= 20 Marks)**

a) Predict the product and name the following reaction:



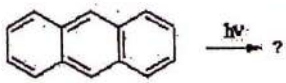
b) What is Prevost reaction? Give an example.

c) Predict the product and name the reaction:



d) How will you convert alcohol to nitroso alcohol? Name the reaction.

e) Complete the following reaction:



f) What is meant by photosensitization?

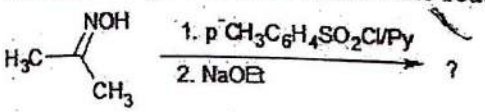
g) How are cycloaddition reactions classified? Explain with an example.

h) Comment on the stereochemistry of Pericyclic reactions with an example.

i) Illustrate with the help of an example aza-Cope rearrangement.

j) What is Baker-Venkataraman rearrangement? Give an example.

k) Predict the product and name the reaction for the following.



l) Give the reaction for the conversion of cyclobutane carboxylic acid to cyclobutylamine.

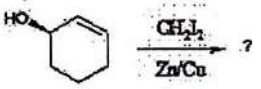
PART - B

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

UNIT - I

2. a) Discuss the mechanism and synthetic applications of Stobbe condensation.
   b) Write a note on Darzen condensation. (6+4)

3. a) Write a note on: i) Chichibabin reaction ii) Benzoin condensation
   b) Complete the following reaction. Propose a suitable mechanism: (6+4)



UNIT - II

4. a) Discuss the mechanism and applications of Paterno-Buchi reaction.
   b) Write a note on the photochemical reaction in arenes. (5+5)

5. a) Explain the various photophysical phenomenons involved in a photoexcited molecule.
   b) Discuss the Photooxidation reaction. (6+4)

UNIT - III

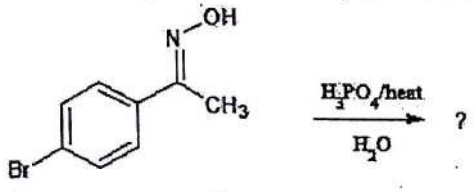
6.
   a) Explain with the help of F.M.O method of analysis, whether a suprafacial sigmatropic [1, 5] carbon shift is thermally or photochemically allowed.
   b) Draw the Molecular orbitals of pentadienyl and allyl free radical. (5+5)

7.
   a) Explain the Frontier molecular orbital theory for analysing an electrocyclic reaction by taking any one example.
   b) With the help of correlation diagram, show that the con-rotatory interconversion of hexatriene to cyclohexadiene is photochemical. (5+5)

UNIT - IV

8. a) Discuss the mechanism of Curtius and Hofmann rearrangements.

   b) Predict the product and explain the reaction mechanism for the following.



(6+4)

9. a) Explain the mechanism and synthetic application of Benzil-benzilic acid rearrangement.

   b) Describe the mechanism for conversion of neopentyl alcohol to 2- methyl- 2- butene.

   c) What is Semipinacol rearrangement? Explain with an example. (4+3+3)

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22MCHES303 Reg No : .....

CHOICE BASED CREDIT SYSTEM

M.Sc. CHEMISTRY THIRD SEMESTER DEGREE EXAMINATION DECEMBER 2023

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 ^1H NMR for the following:

a) $(CH_3)_2CH-Cl$ b) $(CH_3)_2C=CH_2$ c) p-Xylene d) $CH_3COOC_2H_5$

b) How to distinguish between cis- and trans-alkenes using NMR spectroscopy?

c) Give reason: Why aromatic protons come into resonance δ 1.5-2 ppm downfield from the corresponding olefenic signals?

d) Predict the important peaks in the mass spectrum of butanal.

e) What are metastable peaks? Give example.

f) Explain fragmentation in acetophenone.

g) Why isn't orbital angular momentum is not considered while calculating the magnetic moments of 3d transition elements?

h) With a neat diagram, explain the effect of temperature on ferromagnetic substances.

i) Draw the Orgel diagram of 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) Describe the concept of decoupling techniques in ^{13}C NMR spectroscopy.

b) Proton decoupled and off resonance ^{13}C NMR data for three isomeric alcohols with molecular formula $C_4H_{10}O$ is given below:

A (δ ppm): 31 (q), 69.5 (s)

B (δ ppm): 11 (q), 22 (q), 31 (t), 69.5 (d)

C (δ ppm): 19 (q), 31 (d), 69.8 (t)

Identify alcohols, assign peaks to carbon atoms.

c) Discuss the theory of spin-spin coupling in ^1H NMR spectroscopy. (5+5+4)

3) a) What is chemical shift? Discuss the various factors affecting the chemical shift in ^1H NMR spectroscopy.

b) Explain effect of restricted rotation and chemical exchange phenomenon in ^1H NMR spectroscopy.

c) Explain relaxation processes in NMR spectroscopy. (5+5+4)

UNIT - II

4) a) Explain McLafferty's rearrangement with suitable example.

b) Predict the relative intensities of molecular ion and isotope peaks for a compound with molecular formula $C_5H_9Br_3$

c) Write a note on Index of Hydrogen Deficiency. Give its significance in mass spectrometry. Calculate IHD of Quinoline. (5+5+4)

5) a) How will you distinguish between pentane and 2-methylbutane on the basis of mass spectrometry?

b) With a neat diagram, explain the instrumentation of a double focused mass spectrometer.

c) Discuss gas phase ionization techniques used in mass spectroscopy. Write their advantages and disadvantages. (5+5+4)

UNIT - III

6) a) Discuss the different types of charge transfer spectra and explain the charge transfer spectrum of $[Co(NH_3)X]^{2+}$ when X is substituted by different halides.

b) Draw Tanabe Sugano diagram of Fe^{2+} metal ion dissolved in aqueous solution in an octahedral environment.

c) LMCT transitions in tetraoxoanions such as MnO_4^- and CrO_4^{2-} are prominent: Explain. (5+5+4)

7) a) Construct microstate table for $[V(H_2O)_6]^{3+}$ & derive free ion terms present in a complex.

b) Derive term symbol for Mn^{3+} ion in $Mn(H_2O)_6]^{2+}$ complex and draw the Orgel diagram of it.

b) Calculate spin only magnetic moment of Fe^{3+} & Cr^{2+} (5+5+4)

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22MCHEE315 Reg No : .....

CHOICE BASED CREDIT SYSTEM

M.Sc./M.A./M.COM THIRD SEMESTER DEGREE EXAMINATION DECEMBER 2023

Environmental Pollution and Remediation

Duration:3 Hours Max Marks:70

PART - A

1. Answer any SEVEN of the following : (2×7= 14)

a) Write any two major and minor components of the atmosphere.

b) Why is soil called a store house?

c) Give four examples of particulate pollutants.

d) What is soft water?

e) What makes sea water salty?

f) Define water pollution.

g) Write any two roles of inorganic material in soil.

h) Name four anthropogenic activities that lead to soil pollution.

i) Write any two effects of soil pollution by industrial pollutants.

PART - B

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

(14×4 = 56)

UNIT - I

2) What is Greenhouse effect? Explain its effects on atmosphere? (14)

3) a) Explain the sources of noise pollution and ways to control it.
b) Explain mechanisms of ozone formation and ozone depletion. (7+7)

UNIT - II

4) a) Draw a schematic diagram of water distillation unit and explain water distillation.
b) Discuss the steps in primary water treatment. (7+7)

5) a) Explain chlorination.

b) Describe the role of bleaching powder as disinfectant.

c) What is dechlorination? (5+5+4)

UNIT - III

6) a) Why is soil monitoring important? What are the important factors monitored?

b) What are the properties of good sand?

c) Explain anammox. (5+5+4)

7) a) What are the different types of composting? Explain.

b) Discuss the importance of reforestation and afforestation. (7+7)

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