

**CHOICE BASED THIRD SEMESTER M.Sc. CHEMISTRY DEGREE EXAMINATION
FEBRUARY 2021**

Inorganic Chemistry Theory III

Duration: 3 Hours

Max Marks: 70

PART - A

1. Answer any TEN of the following :

(10×2= 20 Marks)

- a). List the applications of group theory
- b). List symmetry elements and identify point group of CHCl_3
- c). What is a group and what are its properties?
- d). Arrange the energies of d-orbitals of the square planar complexes in their increasing energy
- e). Arrange the Lattice energy of bivalent transition metal cations surrounded by six ligands in their decreasing order
- f). How does the charge of the metal ions influence the stability of complexes
- g). Calculate the number of microstates in d^9 system
- h). In $[\text{Co}(\text{NH}_3)_5\text{I}]^{2+}$, the charge transfer bands largely obscure the d-d bands. Explain
- i). Differentiate para and ferromagnetic substances.
- j). Differentiate between complimentary and non-complimentary reactions
- k). Justify: Acid hydrolysis in the octahedral complexes having pi acceptor inert ligand occurs through $\text{S}_{\text{N}}2$ mechanism
- l). Give evidence to suggest that substitution in square planar complexes occurs through $\text{S}_{\text{N}}2$ mechanism.

PART - B

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

UNIT - I

2. a) Derive the matrix representation for rotation axis
b) Using matrix multiplication method, find the products for :
i) $\sigma_{\text{yz}} \times \text{S}_{4\text{x}}$ ii) $\text{C}_{2\text{y}} \times \text{C}_{2\text{x}}$ (5+5)
3. a) Sketch and describe all symmetry operations of $[\text{Ni}(\text{CN})_4]^{2-}$.
b) Define plane of symmetry. Explain different types using examples. (5+5)

UNIT - II

4. a) Octahedral field splitting energy, Δ_o is always higher than tetrahedral field splitting energy
b) Among Fe_3O_4 and Mn_3O_4 which is normal spinel? Justify using CFT
c) In the crystal of CuF_2 , all Cu-F bond distances are not equal: Justify (4+3+3)
5. a) Describe the bonding in $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Fe}(\text{CN})_6]^{3-}$ in terms of valence bond theory.
b) Magnetic moment value of $[\text{Mn}(\text{CN})_6]^{3-}$ ion is 2.8 B.M. Predict the hybridisation & geometry of the ion.

c) Draw the VB diagram and indicate the type of hybridisation for $\text{Cr}(\text{NH}_3)_6^{3+}$ & $[\text{Ni}(\text{CN})_4]^{2-}$. (4+3+3)

UNIT - III

6. a) Explain the concept quenching of orbital contribution with examples
b) Among the following, predict the complex with highest magnetic moment (spin only)
 $[\text{Ni}(\text{EDTA})]^{2-}$, $[\text{CrF}_6]^{3-}$, $[\text{VCl}_6]^{4-}$ and $\text{Co}[\text{NO}_2]_6^{3-}$ (6+4)
7. a) In the spectra of $[\text{CrF}_6]^{3-}$ three peaks are obtained at 16800cm^{-1} , 24400cm^{-1} and 36200cm^{-1} , Interpret the spectra. If the Racah parameter for free gaseous Cr^{+3} ion is 785cm^{-1} , comment on the nature of metal ligand bond in the complex
b) Among $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{CoCl}_4]^{2-}$, which has higher molar absorptivity? Give reason (6+4)

UNIT - IV

8. a) Explain the applications of Trans effect series
b) Arrange the following ligands in an increasing order of trans effect and explain the Pi Bonding theory: Cl^- , Br^- , F^- , I^- (5+5)
9. a) Explain the formation of different types of intermediates in $\text{S}_{\text{N}}1$ mechanism
b) Explain on the basis of valence bond theory, the cause of lability and inertness of octahedral complexes (5+5)

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Techniques & Applications of Spectroscopy

Duration: 3 Hours

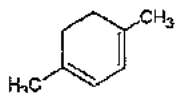
Max Marks: 70

PART - A

1. Answer any TEN of the following :

(10×2= 20 Marks)

- a). Calculate
- λ_{\max}
- for the following



- b). In the infrared spectrum of the polymeric complex $\text{Na}_2[(\text{CN})_5]_x$, two CN stretching frequencies occur. Explain.
- c). List out different modes of vibrations in CO_2 .
- d). How spin-spin coupling is affected by intermolecular chemical exchange.
- e). Identify the isomer of trimethyl benzene which give only three carbon signals
- f). Predict the ^1H NMR spectrum for isopropyl bromide.
- g). Determine the index of hydrogen deficiency for :
(i) $\text{C}_8\text{H}_7\text{NO}$ (ii) $\text{C}_5\text{H}_3\text{ClN}_4$ (iii) $\text{C}_3\text{H}_7\text{NO}_3$ (iv) $\text{C}_{21}\text{H}_{22}\text{N}_2\text{O}_2$
- h). Write important features of mass spectrum of phenol.
- i). How will you distinguish three isomeric butanols on the basis of mass spectrometry: 1-butanol, 2-butanol, 3-butanol?
- j). How many NQR lines are expected for ^{127}I ($I=5/2$). Assuming $\eta=0$.
- k). Which among the following are ESR active?
a) Li_2 b) B_2 c) $[\text{Co}(\text{NH}_3)_6]^{3+}$ d) $[\text{CoF}_6]^{3-}$
- l). Why Mossbauer spectrum for solid samples is recorded at low temperature?

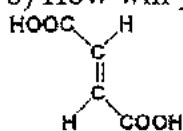
PART - B

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

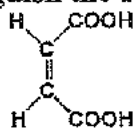
UNIT - I

2. a) Detail the chemistry of electronic spectroscopy. Give the various types of transition involved in this technique with one example in each case.
b) Describe briefly how an ultraviolet spectrum can be scanned for a pure organic compound.
c) Why are absorption bands formed instead of sharp lines in the spectrum? (4+3+3)
3. a) Describe some characteristic absorption bands with their probable region and intensity for the following functional groups: Aldehydes, Esters, Amides

b) How will you distinguish the following acids by the IR spectroscopic technique (6+4)



Fumaric Acid



Maleic Acid

UNIT - II

4. a) Write a note on: i) DEPT spectrum ii) NOE effects
b) An aromatic compound (molecular mass=135) gives the following signals in its ^1H NMR spectrum: Singlet (δ 2.09, 3H), a distorted singlet (δ 3.09, 1H), a multiplet (δ 7.24, 3H), a multiplet (δ 7.75, 2H). Predict the structure of the compound. (6+4)
5. a) Explain Karplus relationship and Karplus curve.
b) Find the ^{19}F NMR spectrum of 1-bromo-1-fluoro ethane (CH_3CHFBr). (5+5)

UNIT - III

6. a) Explain evaporative ionization techniques. Give their applications.
b) Explain MALDI technique of ionisation (6+4)
7. a) Identify the structure of the compound from the given data and interpret the data to the structure arrived at. Molecular formula: $\text{C}_9\text{H}_9\text{ClO}$, ^1H NMR (CDCl_3) δ : 7.95 (doublet, 2H, $J = 7.6$ Hz), 7.60 (triplet, 1H, $J = 7.6$ Hz), 7.50 (triplet, 2H, $J = 7.6$ Hz), 3.95 (triplet, 2H, $J = 8.0$ Hz), 3.45 (triplet, 2H, $J = 8.0$ Hz); ^{13}C NMR (CDCl_3) δ : 195, 135, 132, 130, 129, 41, 38; IR: 1686 cm^{-1} .
b) Explain the factors affecting the fragmentation pattern (5+5)

UNIT - IV

8. a) Explain Mossbauer nuclides.
b) Low and high spin complexes can be distinguished by Mossbauer spectroscopy; explain this statement.
c) Explain isomer shift in ^{57}Fe and ^{119}Sn . (4+3+3)
9. a) Explain Zero field splitting and Kramer's degeneracy.
b) Explain the instrumentation of ESR spectrometer (5+5)

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FEBRUARY 2021**

Organic Chemistry Theory - III

Duration: 3 Hours

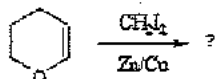
Max Marks: 70

PART - A

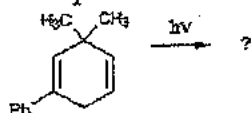
1. Answer any TEN of the following :

(10×2= 20 Marks)

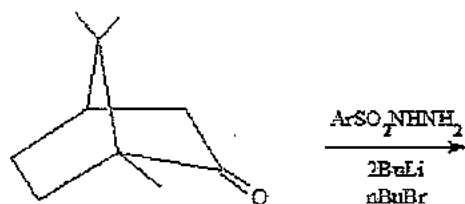
- a). How does enamines obtained? Give an example for the alkylation of enamine
 b). How will you obtain glycidic ester from aldehyde?
 c). Predict the product and name the following reaction:



- d). Give an example for the photo reduction of carbonyl compound.
 e). Complete the following reaction:



- f). Give an example for photocycloaddition reaction.
 g). How are cycloaddition reactions classified? Explain
 h). What is con-rotation? Explain with an example
 i). Comment on the stereochemistry of Pericyclic reactions with an example.
 j). Give reason: The Stevens rearrangement does not occur in a concerted manner
 k). Predict the product and name the reaction.



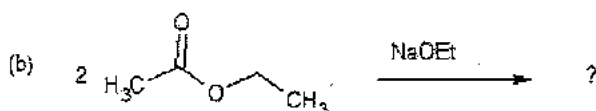
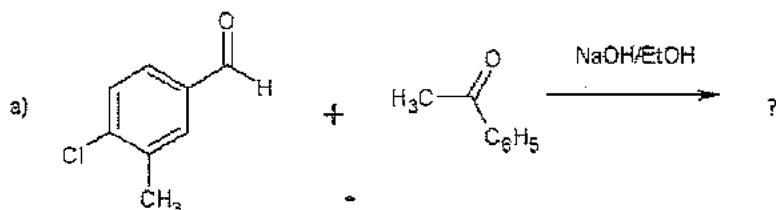
- l). Give the reaction for conversion of Cyclobutane carboxylic acid to Cyclobutylamine

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 of Suzuki coupling reaction.
b) Complete the following reactions. Propose suitable mechanism: (6+4)



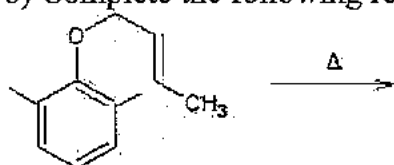
3. a) What is Sharpless epoxidation? What are its synthetic utility?
b) Discuss Wood-Prevost hydroxylation reaction for the synthesis of cis-1,2-diols. (5+5)

UNIT - II

4. a) Explain fluorescence and phosphorescence with examples.
b) Discuss the chemistry of excited molecules
c) What do you understand by quantum yield? (4+3+3)
5. a) What products can be obtained by photolysis of 2-pentanone. Give mechanisms.
b) Discuss photochemical cis-trans isomerization in stilbenes (6+4)

UNIT - III

6. a) Write explanatory notes on i) Claisen rearrangement ii) aza-cope rearrangement
b) Complete the following reaction and give its name:



(5+5)

7. 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)

UNIT - IV

8. a) Give the mechanism and applications of Wagner- Meerwein rearrangement
b) Outline the mechanism to convert Pinacol to Pinacolone (6+4)
9. a) Predict the mechanism for the conversion of Propanamide to ethyl amine
b) Explain the reaction and mechanism of Curtius rearrangement (5+5)

CHOICE BASED THIRD SEMESTER M.Sc. Chemistry DEGREE EXAMINATION
FEBRUARY 2021
P.G. CHEMISTRY
Environmental Chemistry

Duration:3 Hours

Max Marks:70

PART - A

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

- a) Write the adverse effects of acid rain.
- b) State the layers present in the atmosphere
- c) Explain pollutants and its types
- d) What is Hard Water?
- e) What do you mean by potability of water?
- f) What are pathogens?
- g) What is organic matter?
- h) Mention any two effects of soil pollution.
- i) Define Nitrogen fixation.

PART - B

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

(14×4 = 56)

UNIT - I

- 2) Give the source and effects of the following air pollutants: i) SO₂ ii) CO (14)
- 3) a) What do you mean by particulate pollutants? Explain their different types.
b) Differentiate between Classical and Photochemical Smog. Explain their adverse effects and ways to control it. (7+7)

UNIT - II

- 4) a) Explain water treatment and purification with schematic representation.
b) Explain pollution by chemical pollutants, classification and effects. (7+7)
- 5) a) Explain some of the ways through which we can reduce Water Pollution.
b) What is Waste Water Treatment? Explain. (7+7)

UNIT - III

- 6) a) Explain briefly the harmful effects of Insecticides and Herbicides as major pollutants and discuss some preventive measures to overcome their effects.
b) i) Write a note on fungicides
ii) Write a note on micro and macro nutrients present in the soil (7+7)
- 7) a) What is the importance of soil sampling? Explain the process of soil sampling and monitoring techniques.
b) Write a note on the strategies to control environmental pollution. (7+7)