CHOICE BASED CREDIT SYSTEM

M.Sc. CHEMISTRY THIRD SEMESTER DEGREE EXAMINATION NOVEMBER 2025

Inorganic Chemistry -III

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

PART - A

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

a) Define Schonflies symbols, order and classes.

b) Write the transformation matrix of $C_2(y)$

c) Find the symmetry product of the operation $\sigma_{yz} \times C_{2z}$

d) Which symmetry element must be absent for chirality? Explain.

e) Find the point group of PPh_3

f) What is the symmetry of the stretching modes in a linear AB_2 molecule?

g) Based on CFT, draw the energy level diagram and write the electronic configuration of the central metal ion $[Co(H_2O)_6]^{2+}$.

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

i) On the basis of CFT, explain the following, giving appropriate reasons to your answer: Solution of $[Co(CN)_6]^{3-}$ ion is colorless but $[CoF_6]^{3-}$ has blue color.

j) Differentiate between complimentary and non-complimentary reactions.

k) Justify: Substitution reaction of $[NiCl(o\text{-}tolyl)(PEt_3)_2]^+$ occurs much faster than that of $[PdCl(o\text{-}tolyl)(PEt_3)_2]^+$ and $[PtCl(o\text{-}tolyl)(PEt_3)_2]^+$.

l) Give two examples of inert ligands in square planar complexes where polarisation theory can be used to explain trans effect.

PART - B

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

UNIT - I

2. a) Sketch and describe all symmetry operations of $[Ni(CN)_4]^{2-}$

b) Define plane of symmetry. Explain different types of it with examples.　　　(5+5)

3. a) Derive transformation matrix for C_n for rotation in the anticlockwise direction.

b) Decompose the reducible representation of NH_3 into Irreducible representation using the following table: (5+5)

	E	$2C_3(z)$	$3\sigma_v$
A_1	1	1	1
A_2	1	1	-1
E	2	-1	0

UNIT - II

4. a) Generate the RRs of SF_4 and decompose into IRRs using the table given below:

	E	$C_2(z)$	$\sigma_v(xz)$	$\sigma_v(yz)$
A_1	1	1	1	1
A_2	1	1	-1	-1
B_1	1	-1	1	-1
B_2	1	-1	-1	1

b) Prove that the characters of an irreducible representation are orthogonal to those of other irreducible representations across the group. Give an example from the C_{2v} group. (5+5)

5. a) Explain why totally symmetric vibrations are always Raman active.

b) Find the IR and Raman active modes of vibrations for SbH_3 with the help of the given 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 with the help of MOT why Cl^- acts as weak ligand whereas CN^- acts as a strong ligand in octahedral transition metal complexes.

b) Explain the heats of hydration of divalent metal cations of the first transition series using CFT. (6+4)

7. a) Discuss the factors affecting the stability of chelate complexes.

b) Describe the thermodynamic explanation of chelation. (6+4)

UNIT - IV

8. a) Discuss the formation of different types of intermediates in S_N1 mechanism.

   b) Explain on the basis of valence bond theory, the cause of lability and inertness of octahedral complexes. (5+5)

9. a) Describe the acid-catalysed hydrolysis reaction of octahedral complexes when the inert ligand is a π-donor.

   b) Explain in what way the acid hydrolysis of cis-$[Co(en)_2Cl(OH)]^+$ complex differs from that of trans-$[Co(en)_2Cl(NO_2)]^+$. (5+5)

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CHOICE BASED CREDIT SYSTEM

M.Sc. CHEMISTRY THIRD SEMESTER DEGREE EXAMINATION NOVEMBER 2025

Organic Chemistry -III

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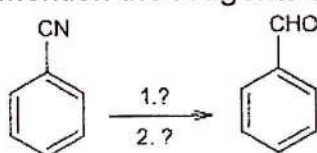

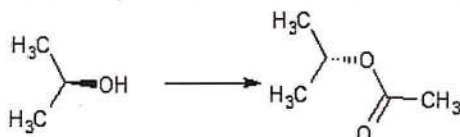## PART - A

1. Answer any TEN of the following :   **(10×2= 20 Marks)**
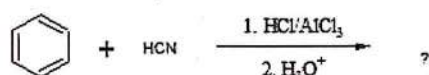
a) Mention the reagents used for the following conversions:
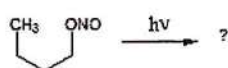

b) How do you achieve the following conversion?
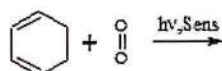

c) Predict the product and name the following reaction:

d) Predict the product and name the reaction:
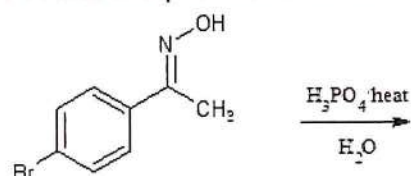

e) Predict the product in the following:

f) How will you obtain prismane intermediate from benzene?

g) With the help of a suitable example, explain Cope rearrangement.

h) Draw the molecular orbitals for allylic free radical system.

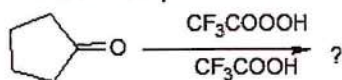i) [2+2] cycloaddition is photochemically allowed. Justify.

j) Predict the product and name the reaction:

k) What is Fries rearragement? Give an example.

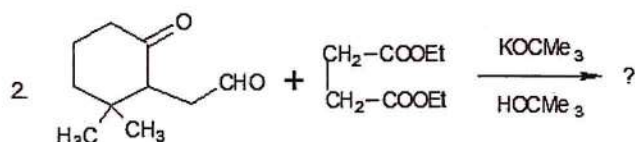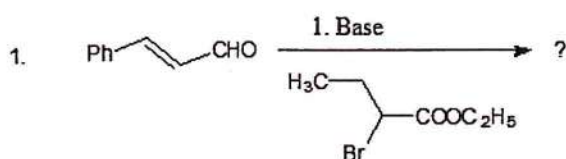l) Predict the product and name the reaction for the following:

PART - B

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

UNIT - I

2. a) Predict the products and discuss the mechanism for the following reactions :
(5+5)

3. a) Write a note on: i) Chichibabin reaction ii) Benzoin condensation

   b) Discuss the mechanism of Heck reaction.   (6+4)

UNIT - II

4. a) Write the mechanism for the following conversion:
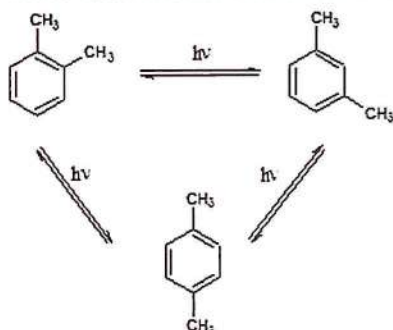
   b) Explain the photochemical reaction for the formation of oxetane.   (6+4)

5. a) Explain the photolysis of 2-pentanone and give its mechanism.

   b) Discuss the photo isomerization in cis and trans-stilbenes.   (6+4)

UNIT - III

6. a) With the help of correlation diagram, predict whether the cyclisation of 1,3-butadiene is thermal or photochemical.

   b) Explain the terms i) HOMO and LUMO ii) conrotatory and disrotatory.   (5+5)

7. a) Explain sigmatropic rearrangement taking the example of 1,5-shift of hydrogen atom.

   b) Draw the molecular orbitals of 1,3,5-hexatriene and ethene. Indicate HOMO and LUMO for ground state and excited state. (5+5)

UNIT - IV

8. a) Write a note on:

   i) Baker-Venkataraman rearrangement ii) Curtius rearrangement

   b) Explain the mechanism of Favorskii rearrangement. (6+4)

9. a) Write the mechanism for following conversions:

   i) Isoborneol to camphene ii) Pinacol to pinacolone

   b) Discuss the mechanism and migratory aptitude in Benzil- benzilic acid rearrangement. (6+4)

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CHOICE BASED CREDIT SYSTEM

M.Sc. CHEMISTRY THIRD SEMESTER DEGREE EXAMINATION NOVEMBER 2025

Physical Chemistry II

Duration:3 Hours   Max Marks:70

PART - A

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

a)   How would the wavelength of moving objects vary with their masses?

b)   Define zero-point energy. Mention its significance.

c)   Define commutator operator and linear operator.

d)   The process of adsorption if spontaneous is exothermic. Justify the statement.

e)   State variation theorem.

f)   Which surface reaction mechanism involves only one adsorbed species reacting with a gas-phase molecule? Name the mechanism and give an example.

g)   Differentiate between pitting and galvanic corrosion.

h)   Give examples for the sacrificial anode method.

i)   Mention any four factors affecting hydrogen overvoltage.

PART - B

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

(14×4 = 56)

UNIT - I

2)   a) Solve the Schrodinger equation for a rigid rotor.

b) Derive an equation for the energy of a particle rotating in a ring by applying Schrodinger wave equation.

c) Outline the difference between classical and quantum mechanics.   (5+5+4)

3)   a) Derive time-dependent Schrodinger wave equation.

b) Deduce the Schrödinger wave equation (SWE) for a particle wave.

c) Briefly discuss the significance of the Schrodinger wave equation on wave function ψ.   (5+5+4)

UNIT - II

4) a) Explain the determination of surface area by BET and Harkins-Jura method.

b) Derive the expression for BET adsorption isotherm.

c) At $0°$ C and 1 atm pressure, the volume of nitrogen gas required to form a monolayer on a sample of charcoal is 155.5 cm^3g^{-1} of the charcoal. Calculate the surface area per gram of charcoal. Given that area of cross section of nitrogen molecule is 0.162 $(nm)^2$. (5+5+4)

5) a) Write a short note on the concept of orbitals.

b) Explain the application of the Schrödinger wave equation to the hydrogen atom.

c) What are quantum numbers? Discuss the significance of each quantum number. (5+5+4)

UNIT - III

6) a) Explain the Tafel extrapolation method of measuring corrosion rate.

b) Give an account on the kinetic theory of corrosion.

c) Write a note on DC monitoring technique of corrosion rate measurement. (5+5+4)

7) a) Explain the factors influencing the corrosion rate.

b) What is the importance of Pilling-Bedworth rule and describe Dry corrosion. (7+7)

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CHOICE BASED CREDIT SYSTEM

M.A, M.Com., M.Sc. THIRD SEMESTER DEGREE EXAMINATION NOVEMBER 2025

Environmental Pollution and Remediation

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

PART - A

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

  a)   Explain the action of ozone on human life.

  b)   Give the sources and sinks of nitrous oxide.

  c)   Write any two measures to control photochemical smog.

  d)   What are the signs of water pollutions?

  e)   Mention any four physical properties of water.

  f)   What is primary sludge?

  g)   Write effects of radioactive pollutants in aquatic life.

  h)   What is incineration?

  i)   What is the point source of soil pollution?

PART - B

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

(14×4 = 56)

UNIT - I

  2)   a) Explain the atmospheric structure.
       b) Give an account on different sources of air pollution.   **(7+7)**

  3)   a) Explain the sources and effects of oxides of carbon.
       b) Explain the sources and effects of oxides of nitrogen.   **(7+7)**

UNIT - II

  4)   a) Draw a schematic diagram of domestic water treatment steps.
       b) Write a note on disinfectants.
       c) Describe the coagulation step in domestic water treatment.   **(5+5+4)**

  5)   a) Differentiate between hard water and soft water. Give an example for each.
       b) What are the effects of permanent hardness?
       c) Discuss methods to remove water hardness.   **(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) Describe the classification of micronutrients.

b) What is Humification? How is it important to soil? Explain. (7+7)

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