24MCHEH101

Reg No : .....

**CHOICE BASED CREDIT SYSTEM**

**M.Sc. CHEMISTRY FIRST SEMESTER DEGREE EXAMINATION NOVEMBER 2025**

**Inorganic Chemistry -I**

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

## PART - A

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

a) Draw the neat diagram of Unit cell of ZnS (blende).

b) Calculate the bond order of $N_2$.

c) Mention the type of hybridisation in $ClF_3$

d) List any four factors affecting the strength of hydracids.

e) Trichloroacetic acid is stronger than acetic acid. Why?

f) What is the use of molten salt in metallurgy? Give one example.

g) Define titration curve.

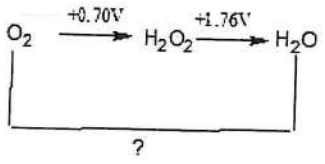
h) What is complexometric titration? Give an example.

i) Differentiate between accuracy and precision.

j) Only at high temperatures carbon can reduce metal oxides to metals: Justify.

k) Write the Latimer diagram for the disproportionation reaction of $H_2O_2$ with SRP values +0.70V and +1.76V.

l) From the Latimer diagram of oxygen given below, calculate skip potential.




## PART - B

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

### UNIT - I

2. a) Draw the molecular orbital diagram of CO.

b) Indicate the different states of hybridisation and deduce the geometry of the following isolated molecules : i) $XeF_4$ ii) $SF_6$ (5+5)

3. a) Differentiate amorphous and crystalline ionic compounds with respect to their properties.

   b) Explain the Geometry of $BF_3$

   c) Draw the unit cell of CsCl. Give the coordination number and number of $Cs^+$ and $Cl^-$ ions in a unit cell. (4+3+3)

**UNIT - II**

4. a) What is meant by the levelling effect? Explain this effect based on the solvent-system concept of acids and bases.

   b) Explain the HSAB principle. Discuss its applications. (5+5)

5. a) Explain briefly the reactions which take place in $CH_3COOH$.

   b) Write a note on amphoteric behaviour of substances with suitable examples.

   c) Discuss the following reactions in liq HF.

   i) Metathetical reaction ii) Solvolysis reaction iii) Neutralisation reaction (4+3+3)

**UNIT - III**

6. a) Write a note on: i) Mohr's method ii) Fajan's method

   b) List the characteristics and limitations of the precipitation titration method. (5+5)

7. a) Describe the applications of Gravimetric analysis.

   b) Write a note on the mechanism of precipitate formation and types of precipitating reagents. (5+5)

**UNIT - IV**

8. a) Explain any three methods of synthesis of Nano particles.

   b) Define the terms:

   i) Gangue ii) flux iii) Calcination iv) Roasting (6+4)

9. a) Construct Frost diagram for $O_2$ from the Latimer diagram constructed from $O_2$, $H_2O_2$ & $H_2O$. The SRP for the stepwise conversion are 0.70 and 1.76 respectively.

   b) Explain Comproportionation and disproportionation reactions with examples. ( 5+5)

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24MCHEH102 Reg No : .....

**CHOICE BASED CREDIT SYSTEM**

**M.Sc. CHEMISTRY FIRST SEMESTER DEGREE EXAMINATION NOVEMBER 2025**

**Organic Chemistry - I**

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

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## PART - A

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

a) What are inclusion compounds? Give an example.

b) Draw the resonance form of the following compounds:
i) p-nitrophenol ii) p-methoxybenzoic acid
iii) nitrobenzene iv) Benzyl carbocation

c) Formic acid is strongest among monocarboxylic aliphatic acids. Why?

d) Arrange the following into increasing order of their stability.

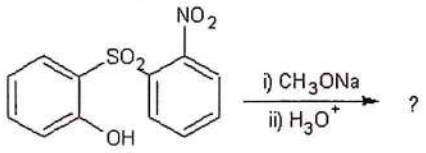
e) Discuss the stability of benzyl carbocation and benzyl carbanion.

f) Give the insertion reaction of nitrenes.

g) What is $S_Ei$ reaction? Give an example.

h) What is Von-Richter rearrangement?

i) Predict the product in the following:




j) What is Prelog's rule? Give an example.

k) Trans-decalin is optically inactive. Give reason.

l) Write the structures of all the possible geometrical isomers of 2,4-hexadiene.

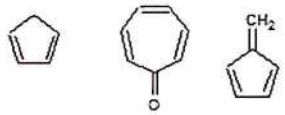
## PART - B

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

### UNIT - I

2. a) Expalin the effect of hydrogen bonding on the boiling points of amines and alcohols.
b) Compute the resonance energy of ebnzene from heat of hydrogenation. (6+4)

3. a) Classify the following into aromatic, antiaromatic and non aromatic compounds with suitable reasons.




b) Write a note on: i) non-benzenoid compounds ii) crown ethers (6+4)

## UNIT - II

4. a) Account on the structure, stability and reactions of carbocations.
b) Discuss the methods of determination of the mechanism by crossover experments. (6+4)

5. a) Explain the impotance of kinetic methods and product analysis in determining reaction mechanism.
b) Discuss the structure and stability of carbenes. (6+4)

## UNIT - III

6. a) With suitable examples, discuss the Sommelet-Hauser rearrangement. What are the evidences which support this mechanism?
b) What is $S_N2$ reaction? Explain with examples the stereochemistry of the reaction. (5+5)

7. a) Discuss the aryne mechanism in aromatic nucleophilic substitution reaction taking suitable examples.
b) Explain the neighbouring group participation in the conversion of 2-Bromopropanoic acid to lactic acid. (6+4)

## UNIT - IV

8. a) Discuss the conformational analysis and stability of cyclohexane.
b) Wtite the Sawhorse and Newmamm projection formula of meso-2,3-dihydroxybutane. (6+4)

9. a) What is racemization? Explain various methods of producing racemic mixtures.
b) Write a note on determination of configuration of geometrical isomers. (6+4)

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24MCHEH103 Reg No : .....

**CHOICE BASED CREDIT SYSTEM**

**M.Sc. CHEMISTRY FIRST SEMESTER DEGREE EXAMINATION NOVEMBER 2025**

**Physical Chemistry-I**

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

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## PART - A

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

a) Give any two methods of determination of fugacity.

b) Write the Maxwell relations obtained from dE=TdS-PdV and dH= TdS+VdP.

c) Vapour pressures of water at 95°C and 100°C are 634 and 760nm respectively. Calculate the molar heat of vapourisation of water between 95°C and 100°C.

d State the two conditions for an ensemble to be in statistical equilibrium.

e) Differentiate between bosons and fermions with suitable examples.

f) Calculate the translational partition function of an oxygen molecule at 298K confined to a 200$cm^3$ vessel. (Mass of oxygen = 16x3.348x$10^{-27}$ kg, k = 1.381x$10^{-23}$ J $K^{-1}$)

g) Give reasons for inadequacy of conventional methods to study fast reactions.

h) State the assumptions of Lindemann theory of unimolecular mechanisms.

i) The rate of a first order reaction is 6.0 x $10^{-5}$ $s^{-1}$ at 298K and 10.5 x $10^{-4}$ $s^{-1}$ at 318K. Calculate activation energy of the reaction.

j) Differentiate between the equilibrium and steady-state approximations in catalytic reactions.

k) Explain photofragmentation in gas phase.

l) How does the Frank-Condon principle affect the shape of absorption spectra?

## PART - B

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

### UNIT - I

2. a) Derive the expression for entropy production in a chemical reaction.
   b) List the various transport processes and write their phenomenological equations. (5+5)

3. a) Explain the effect of concentration, temperature and pressure on the chemical equilibrium using suitable examples.
   b) In the formation of ammonia gas by Haber's process, what would happen if the volume of the container is decreased? Explain. (6+4)

## UNIT - II

4. a) Discuss the Einstein theory of heat capacity of solids.
   b) Give the derivation for the expressions of enthalpy and entropy in terms of partition function. (5+5)

5. a) Derive the expression for internal energy and entropy in terms of partition function.
   b) Define heat capacity. State and explain Dulong-Petit's law and mention its drawbacks. (6+4)

## UNIT - III

6. a) Explain the effect of ionic strength for reactions between ions.
   b) Derive an expression for elementary reactions in solutions given by CTST. (5+5)

7. a) Discuss the kinetics and mechanism of photochemical reaction between $H_2$ and $Br_2$.
   b) Explain steady state treatment with an example. (6+4)

## UNIT - IV

8. a) Describe the photochemical kinetics of unimolecular reactions.
   b) Explain the Stern-Volmer equation and its use in understanding quenching in solutions. (5+5)

9. a) Discuss the prototropic mechanism for an acid catalysed reaction.
   b) Describe how catalysis is used in industrial processes, providing relevant examples. (5+5)

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24MCHES104 Reg No : .....

**CHOICE BASED CREDIT SYSTEM**

**M.Sc. CHEMISTRY FIRST SEMESTER DEGREE EXAMINATION NOVEMBER 2025**

**Spectroscopy I**

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

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## PART - A

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

a) Justify: Separate lamps are required for determination of each element in AAS.

b) Give the limitations of flame photometry.

c) Explain what is meant by line reversal.

d) Distinguish between Rayleigh's line, stokes lines and anti-stokes lines in Raman spectra.

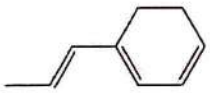
e) What type of molecules give rotational spectra? Which molecules show rotational spectra among HCl, CO, $H_2$ and $O_2$?

f) Write the working mechanism of the microwave oven.

g) What is Hooke's law?

h) o-Nitroacetanilide is deep yellow but p-nitroacetanilide is yellow. Why is the colour of the o-isomer deeper? Explain using UV visible spectroscopy.

i) What is the predicted $\lambda_{max}$ for the compound drawn below?



## PART - B

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

**(14×4 = 56)**

### UNIT - I

2) a) Explain in detail the types of emission spectra.
b) Define line width and explain the possible reasons for line broadening.
c) Describe the determination of Ca, Mg, Na and K in Blood Serum using AAS.

(5+5+4)

3) a) List the strengths and weaknesses of ICP-AES.
b) Describe the determination of lead in petrol by AAS.
c) Explain use of FES in water analysis. (5+5+4)

## UNIT - II

4) a) Discuss the Morse equation for the energy of anharmonic oscillators.
   b) Write a note on a diatomic molecule as an anharmonic oscillator.
   c) Illustrate the selection rules for vibrational transitions in a simple harmonic oscillator and anharmonic oscillator. (5+5+4)

5) a) Write a note on Raman Polarization. Mention any two advantages of the Raman spectroscopic technique.
   b) Write a note on surface-enhanced Raman spectroscopy and resonance Raman spectroscopy.
   c) Outline the conditions to obtain the Raman spectrum. (5+5+4)

## UNIT - III

6) a) Give an account on the given C-O stretching details:

| Complex | CO stretching frequency ($cm^{-1}$) |
|---|---|
| Free CO | 2143 |
| $[Ag(CO)]^+$ | 2204 |
| $[Ni(CO)_4]$ | 2060 |
| $[Co(CO)_4]^-$ | 1890 |
| $[Mn(CO)_6]^-$ | 2090 |
| $[Cr(CO)_6]$ | 2000 |
| $[V(CO)_6]^-$ | 1860 |

   b) Match the following complexes with their C-O stretching frequency and justify your answer.

| Complex | CO stretching frequency ($cm^{-1}$) |
|---|---|
| (a) $Mo(PF_3)_3(CO)_3$ | (i) 1835, 1934 |
| (b) $Mo(P(OMe)_3)_3(CO)_3$ | (i) 1888, 1977 |
| (c) $Mo(PPh_3)_3(CO)_3$ | (iii) 2055, 2090 |
| (d) $Mo(pyridine)_3(CO)_3$ | (iv) 1746,1888 |

   c) Discuss the various types of electronic transitions and explain the effect of the polarity of the solvent on each type of transition. (5+5+4)

7) a) How do you distinguish the two types of hydrogen bonding by IR spectroscopy?
   b) Explain the Fieser-Kuhn rule for polyenes.
   c) How is IR spectroscopy helpful in the study of Keto-enol tautomerism? (5+5+4)

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