

DECEMBER, 2025

(Acid-Bases, Principle of Metallurgy, Chemistry of s & p-block elements and Inorganic Polymer)

Full Mark: 100

Duration: 3 Hours

(The figures in the right-hand margin indicate marks)

(Part I)

1. All questions are Compulsory.

[10x1=10]

- (a) What is the role of a flux in metallurgy?
- (b) What is the general electronic configuration of Neon?
- (c) Define the term Metalloid?
- (d) Arrange the following in order of Basicity: NF_3 , NMe_3 and NH_3
- (e) What is the magnetic nature of Interhalogen compounds?
- (f) The repeating unit in Silicone polymer is _____.
- (g) The type of hybridisation of boron in Diborane is _____.
- (h) Which type of Silicates are obtained when two oxygen atoms per $[\text{SiO}_4]^{2-}$ tetrahedra are shared?
- (i) What is the shape of XeF_4 molecule?
- (j) What is Hydrometallurgy?

(Part II)

2. All questions are Compulsory.

[9x2=18]

- (a) How is Orthoboric acid is prepared from borax.
- (b) Why HClO_4 is stronger acid than HClO_3 ?
- (c) What is an inorganic polymer? Specify one example.
- (d) What are Pseudohalogens? Give one example.
- (e) What happens when Xe reacts with O_2F_2 ?
- (f) Give the significance of Zone refining in metallurgical processes.
- (g) What are Zeolites? Give one example.
- (h) What is the difference between Ore and Mineral?
- (i) What are Clathrates? Give two examples.

(Part III)

3. Answer any three of the following questions.

[8x5=40]

- (a) Differentiate between Calcination and Roasting.
- (b) What are Conjugate acids and bases? Show that a strong acid has a weaker conjugate base and *vice-versa*.

- (c) Discuss Bronsted-Lowry concept of acids and bases.
- (d) Derive Handerson-Hasselblach equation and explain its significance in Buffer solution.
- (e) Differentiate between Inorganic polymer and Organic polymer.
- (f) Describe the chemistry of Orthosilicates and Pyrosilicates with one example in each case,
- (g) Explain the uses of Ellingham diagram by using carbon as reductant.
- (h) How metal can be purified by Mond's process?
- (i) Calculate the pH of 0.1 M HCl.
- (j) What are Interhalogen compounds? Describe the preparation, structure and characteristics of IF_7 and ClF_3 .

(Part IV)

4. Answer any four of the following questions. [4x8=32]

- (a) Briefly discuss about Lewis concept of acids and bases. How does it differ from Bronsted-Lowry concept of acids and bases? Explain it with suitable examples.

Or

Discuss HSAB Principle and its applications in predicting the stability of complexes. Explain the factors that influence the hardness or softness of acids and bases?

- (b) Describe the chemistry of Carbon and its compounds.

Or

Describe the chemistry of Boron and its compound.

- (c) Discuss the chemistry of Xenon and its compounds.

Or

Describe the general characteristics, electronic configuration, physical properties and chemical inertness of Noble gases. Explain why they are unreactive.

- (d) Discuss the structure, bonding and preparation of Boron nitride.

Or

Discuss the structure, bonding and preparation of Chlorite ion.

- (e) What are Silicones? Describe two methods of synthesis and properties of linear Silicones. Write two uses of Silicone polymers,

Or

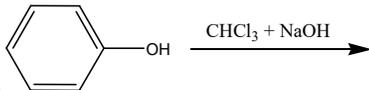
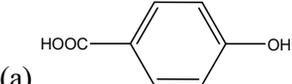
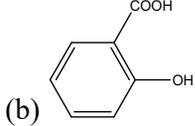
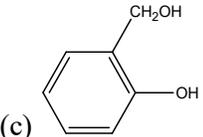
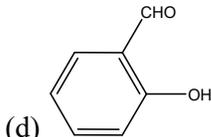
Discuss the structure, synthesis and applications of Phosphazenes.

DECEMBER, 2025
CHEMISTRY OF HALOGEN, OXYGEN AND SULPHUR
CONTAINING ORGANIC COMPOUNDS

Marks: 100

Time: 3 hr

Answer as per instructions. The figures in the right-hand margin indicate marks

1. Answer all questions. **[10x1=10]**
- (i) Write the reagent for the following reaction.
- 
- (a) NaF (b) KF (c) HBF₄ (d) CuF
- (ii) The reaction of alkyl halide with Na metal in the ether medium is known as _____.
- (a) Hunsdieker reaction (b) Sandmeyer's reaction
(c) Fridel-Craft's reaction (d) Wurtz reaction
- (iii) The order reactivity 1^o, 2^o and 3^o alcohol with Lucas reagent is _____.
- (a) 1^o > 2^o > 3^o (b) 1^o < 2^o > 3^o (c) 1^o > 2^o < 3^o (d) 1^o < 2^o < 3^o
- (iv) Which of the following is most acidic.
- (a) *m*-nitrophenol (b) *o*-nitrophenol (c) *p*-nitrophenol (d) *o*-aminophenol
- (v) Which of the following does not undergo aldol condensation reaction.
- (a) Acetaldehyde (b) Acetone (c) Propionaldehyde (d) Formaldehyde
- (vi) Hunsdieker reaction is given by _____.
- (a) Alcohol (b) Aldehyde (c) Ketones (d) Carboxylic acid
- (vii) In Friedel-Craft's reaction _____ is used.
- (a) AlCl₃ (b) Na (c) PPh₃ (d) OsO₄
- (viii) 
- Write the product of the reaction.
- (a) 
- (b) 
- (c) 
- (d) 
- (ix) Which of the is the appropriate reagent for the conversion of propyl iodide to propene.
- (a) Aqueous KOH (b) Alcoholic KOH (c) H⁺/H₂O (d) dil. H₂SO₄
- (x) The presence of the CH₃CO group can be detected by _____ reagent.
- (a) Benedict's solution (b) Fehling's reagent
(c) Tollen's reagent (d) I₂/NaOH

2. Answer all questions.

[9x2=18]

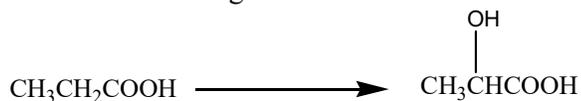
- (i) What is Wurtz-Fittig reaction?
- (ii) What is Grignard's reagent? Give one method of preparation of Grignard's reagent.

- (iii) What is DDT? Write the application DDT.
- (iv) Why phenol is acidic but methanol is not?
- (v) What is Fries rearrangement?
- (vi) What is Reformatsky reaction?
- (vii) Which is more acidic between thiols and alcohol? Explain why?
- (viii) State and explain the mechanism of the acid catalysed ester hydrolysis.
- (ix) What is Rosenmund reduction?

3. Answer any eight of the questions.

[8x5=40]

- (i) State and explain anti-Markonikoff's rule with a suitable example.
- (ii) What is S_Ni mechanism? Write the action of thionyl chloride on alcohols in presence of pyridine.
- (iii) State and explain Riemer-Tiemann reaction with mechanism.
- (iv) How can you distinguish between primary, secondary and tertiary alcohol by Lucas test. Explain with mechanism.
- (v) Briefly discuss Cannizarro's and cross-Cannizarro's reaction.
- (v) Write a note on Meerwin-Pondrorf-Verley reduction.
- (vi) Illustrate the electrophilic substitution of benzoic acid. How the carboxy group acts as a deactivating group.
- (vii) Write the conversion of benzamide to aniline with mechanism.
- (viii) Write the method of the preparation of alcohol using Grignard's reagent.
- (ix) Write notes on haloform reaction.
- (x) Write the following conversion.



4. Answer any four of the questions.

[4x8=32]

- (i) State and explain characteristics of S_N1 reaction. What are the factors affecting S_N1 mechanism? Discuss the stereochemistry of the substrate in S_N1 reaction.
- (ii) Discuss the pinacol-pinacolone rearrangement with mechanism. Explain the migratory aptitude in the reaction.
- (iii) Write one method of preparation of acetoacetic ester. Write two synthetic applications of acetoacetic ester.
- (iv) Discuss the mechanism of the following reaction.
 - (i) Wittig reaction (ii) Michel addition
- (v) What is benzyne intermediate? Explain the evidence of benzyne in aromatic nucleophilic reaction.

DECEMBER, 2025

Phase Equilibrium, Chemical Dynamics, Catalysis and Surface Chemistry

Full Mark: 100

Duration: 3 Hours

(The figures in the right-hand margin indicate marks)

(Part I)

1. All questions are Compulsory. **[10x1=10]**
- (a) What is the number of degree of freedom at the triple point of water?
 - (b) What is the unit of Rate constant of a Zero Order reaction?
 - (c) Define Activation energy?
 - (d) Name one inhibitor which is used as a catalyst.
 - (e) Name the adsorption isotherm used for multilayer adsorption.
 - (f) If $t_{1/2} \propto 1/a$, what is the Order of the reaction?
 - (g) Which catalyst is used in the manufacture of H_2SO_4 by Contact process?
 - (h) How many phases are represented by two miscible liquids?
 - (i) Radioactive disintegration follows _____ order reaction.
 - (j) The temperature at which a compound melts in to a liquid of the same composition as the solid is called _____.

(Part II)

2. All questions are Compulsory. **[9x2=18]**
- (a) What is Pseudo first order reaction? Give one example.
 - (b) For a reaction $A \rightarrow \text{Products}$. A graph of $[A]$ versus Time is found to be a straight line. What is the order of the reaction?
 - (c) Define Gibb's phase rule. How it is applicable to One component system?
 - (d) What do you mean by positive and negative catalysis? Give one example of each.
 - (e) Draw a labelled diagram of Pb-Ag System.
 - (f) Give one example of each from Consecutive and Opposing reaction.
 - (g) What are the conditions for the validity of Nernst Distribution law?
 - (h) Show that in a 1st Order reaction, time required for the completion of 99.9% is 10 times of half-life of the reaction.
 - (i) What are Azeotropic mixtures? Give one example.

(Part III)

3. Answer **any three** of the following questions. **[8x5=40]**
- (a) Differentiate between Order and molecularity of a reaction.
 - (b) A first order reaction has a specific rate constant $1.15 \times 10^{-3} \text{ sec}^{-1}$. How long will 20gm of the reactant take to reduce 5gm?
 - (c) State and Explain Freundlich adsorption isotherm.
 - (d) Discuss the behaviour of Freundlich and Langmuir adsorption isotherm in low and high pressure.
 - (e) Discuss the adsorption of gases by solids.
 - (f) Explain the effect of temperature on reaction rate.
 - (g) A 1st Order reaction is 40% completed in 50 minutes. Calculate Rate constant of the reaction.
 - (h) Derive Gibbs-Duhem Margules equation.
 - (i) Describe the Triangular plot for the Water-Chloroform-Acetic acid system.
 - (j) Differentiate between Physical adsorption and Chemical adsorption.

(Part IV)

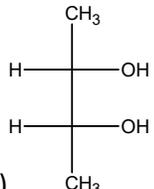
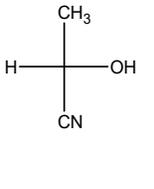
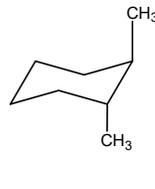
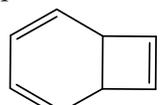
4. Answer **any four** of the following questions. **[4x8=32]**
- (a) Discuss the Sulphur system in detail with a well labelled phase diagram and describe its salient features.
- Or**
- Derive Clausius-Clapeyron equation involving liquid-vapour equilibrium.
- (b) Derive the mathematical expression for Rate constant of a 2nd Order Chemical reaction involving two different reactants with different initial concentrations.
- Or**
- What is chain reaction? Derive the Kinetics for chain reaction of H_2 and Br_2 .
- (c) Discuss Enzyme Catalysis reaction and derive the mathematical expression for Michaelis Menten equation.
- Or**
- What is Acid-base catalysis reaction? Derive the expression for acid catalyzed reaction.
- (d) Derive the Gibbs Adsorption isotherm for surface excess.
- Or**
- Define adsorption isotherm. Discuss Langmuir adsorption isotherm. What are its limitations?
- (e) Write Notes on (a) Kinetics of Opposing reaction (b) Phase diagram of Water System
- Or**
- Write Notes on (a) Chemisorption (b) Kinetics of Base catalyzed reaction.

DECEMBER, 2025
FUNDAMENTAL ORGANIC CHEMISTRY

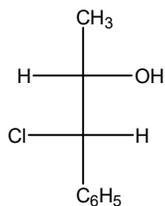
Marks: 100

Time: 3 hr

Answer as per instructions. The figures in the right-hand margin indicate marks

1. Answer all questions. **[10x1=10]**
- (i) Which of the following is a nucleophile?
(a) CH_4 (b) BH_3 (c) NO_2 (d) CN^-
- (ii) Which is permanent effect?
(a) Inductive effect (b) Hyperconjugation
(c) Resonance (d) Mesomeric effect
- (iii) Which of the following is true for free radical?
(a) is nucleophilic. (b) is stable intermediate.
(c) formed by homolytic fission. (d) is an oxidising agent.
- (iv) Which of the following exhibit geometrical isomerism.
(a) 2-butene (b) 1-butene (c) propene (d) cyclobutene
- (v) Which of the following is not optically active?
(a)  (b)  (c)  (d) None of these
- (vi) Write the correct order of stability of the following free radical.
(a) $1^\circ > 2^\circ > 3^\circ$ (b) $1^\circ < 2^\circ > 3^\circ$ (c) $1^\circ < 2^\circ < 3^\circ$ (d) $1^\circ > 2^\circ < 3^\circ$
- (vii) Which of the following is called as Lindlar's catalyst.
(a) Pt/H_2 (b) $\text{Pd}-\text{BaSO}_4/\text{quinoline}$ (c) $\text{Na}/\text{C}_2\text{H}_5\text{OH}$ (d) LiAlH_4
- (viii) Which of the following is an aromatic compound.
(a)  (b)  (c)  (d) 
- (ix) Which statement is not true for an aromatic reaction
(a) They produce sooty flame when π burn with oxygen.
(b) They have $(4n+2)$ delocalised π electrons in planar ring.
(c) They don't undergo electrophilic substitution reaction.
(d) They are highly stable compound.
- (x) Which is the strongest nucleophile among the following.
(a) H_2O (b) CH_3OH (c) CH_3O^- (d) OH^-
2. Answer all questions. **[9x2=18]**
- (i) Define inductive effect.
- (ii) What do you mean by dipole moment?
- (iii) Define nucleophile. Give two examples of nucleophile.
- (iv) What is conformational isomer?

- (v) Write the structure of D (+) glyceraldehyde and L(-) glyceraldehyde.
- (vi) What is electrophilic addition reaction?
- (vii) Explain Wurtz reaction with an example.
- (viii) Give the absolute configuration (R/S) of the following compound.



- (ix) State and explain Huckel's rule of aromaticity.

3. Answer any eight questions.

[8x5=40]

- (i) Explain the bromination of toluene with mechanism.
- (ii) Benzene undergoes electrophilic substitution reaction although it is an unsaturated compound. Explain.
- (iii) State and explain stereochemical factor effecting E₂ reaction with mechanism.
- (iv) Write the ozonolysis reaction of alkene with mechanism.
- (v) State and explain the conformations of *n*-butane with potential energy diagram.
- (vi) What are enantiomers and diastereomers?
- (vii) Write notes on carbene.
- (viii) What is hyperconjugation? Write any two applications of hyperconjugation.
- (ix) What are meso compounds. Explain the optical activity of meso compounds with an example.
- (x) State and explain Saytzeff's eliminations.

4. Answer any four questions.

[4x8=32]

- (i) Explain the generation, structure and stabilities of carbocations.
- (ii) Discuss Fridel-Craft's reaction with mechanism.
- (iii) Explain the mechanism of electrophilic addition reaction. Discuss Markownikoff's rule in electrophilic addition reaction.
- (iv) State and explain Bayer strain theory.
- (v) Discuss the S_N2 reaction mechanism. Discuss the factors influencing S_N2 mechanism.
