

R4473

Sub. Code

25MCH2C1

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Chemistry

INORGANIC CHEMISTRY – II

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. The coordination number of phosphorus in $[\text{PMo}_{12}\text{O}_{40}]$ is
(CO1, K2)
(a) 2 (b) 4
(c) 5 (d) 6
2. Water glass is (CO1, K2)
(a) Calcium silicates
(b) Sodium silicate
(c) Sod.calcium silicates
(d) Magnesium silicate
3. The number of $3\text{C} - 2\text{e} - \text{BHB}$ bonds present in B_4H_{10}
(CO2, K1)
(a) 2 (b) 3
(c) 4 (d) 5

4. $C_2B_{10}H_{12}$ is isoelectronic with (CO2, K1)
- (a) $B_{12}H_{22}^-$ (b) $B_{12}H_{12}$
(c) $B_{12}H_{12}^+$ (d) $B_{12}H_{12}^{2+}$
5. The base hydrolysis of $[CoCl(NH_3)_5]^{2+}$ proceeds is (CO3, K2)
- (a) SN^1 (b) SN^2
(c) SN^1CB (d) SE^2
6. Reaction of $[CoCl(H_2O)_5]^{2+}$ by Cr^{2+} (aq) leads to the formation of $[CrCl(H_2O)_5]^{2+}$. This is an example of (CO3, K2)
- (a) Outer sphere redox reaction
(b) Inner sphere redox reaction
(c) Acid-hydrolysis reaction
(d) Base-hydrolysis reaction
7. The complex which obey 18 e-rules is (CO4, K1)
- (a) $[Fe(CO)_4]$ (b) $[Ni(CO)_3PPh_3]$
(c) $[Cr(CO)_5]$ (d) $[Cr(C_2H_5)_2]$
8. A compound which has four metal-metal-bonds is (CO4, K1)
- (a) $[Fe(CO)_9]$ (b) $[Co_2(CO)_8]$
(c) $[ReCl_8]^{2-}$ (d) $[Ru_3(CO)_{12}]$

9. The number of α and β particles emitted in nuclear reaction ${}_{90}\text{Th}^{228}$ _____ ${}_{83}\text{Bi}^{212}$ are (CO5, K2)
- (a) 4α and 1β (b) 3α and 7β
(c) 8α and 1β (d) 4α and 7β
10. Which of the following is used as neutron absorber in the nuclear reactor? (CO5, K2)
- (a) Water (b) Deuterium
(c) Copper (d) Cadmium

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Discuss details the structure of Borazine and phosphazine. (CO1, K3)

Or

- (b) Give the structure of polymeric boron nitride compound with suitable examples. (CO1, K3)
12. (a) Define STYX number rule. Calculate STYX number of B_4H_{10} , $\text{B}_{12}\text{H}_{12}$ and $\text{C}_2\text{B}_{10}\text{H}_{12}$. (CO2, K4)

Or

- (b) What are carboranes? How are boranes and carboranes classified? (CO2, K4)

13. (a) Explain the ligand substitution reactions of Pt(II) square planar complexes. (CO3, K5)

Or

- (b) Demonstrate suitable examples of factors affecting the rate of substitution reaction. (CO3, K5)
14. (a) Define 18 electron rule and calculate 18 electron in oxidation method of the following complexes
- (i) $[(\text{CH}_3\text{CO})\text{Rh}(\text{CO})\text{I}_3]$
- (ii) $[\text{Fe}_2(\text{CO})_9]$. (CO4, K4)

Or

- (b) Write a note on structure and bonding $\text{Co}_2(\text{CO})_8$ and $\text{Fe}_3(\text{CO})_{12}$. (CO4, K4)
15. (a) What is nuclear fission? Explain the nuclear fission reaction by the liquid drop model. (CO5, K5)

Or

- (b) Discuss the stability of nucleus under neutron-proton ratio. (CO5, K5)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Describe briefly heteropoly acid with example of 12 and 6 heteropoly acids of molybdenum. (CO1, K4)

Or

- (b) Explain the structure and bonding of sulphur-nitrogen compounds with examples. (CO1, K4)

17. (a) Explain the metal organic framework with suitable examples and its application. (CO2, K5)

Or

- (b) Classification of boranes and its structures based on wades' rule with examples. (CO2, K5)

18. (a) Discuss inner sphere mechanism of electron transfer reaction with example. (CO3, K6)

Or

- (b) Compare S_N1 and S_N2 mechanism of octahedral complexes with examples. (CO3, K6)

19. (a) Explain the briefly the mode of vibrations found in metal carbonyls and metal nitrosyl poly-nuclear complexes with suitable examples. (CO4, K4)

Or

- (b) Explain structure and bonding in mono and polynuclear metal carbonyl with examples. (CO4, K4)

20. (a) What is nuclear reactor? Discuss the various components of nuclear reactor in detail. (CO5, K5)

Or

- (b) Describe briefly following nuclear transformation with examples :
- (i) Spallation reaction
 - (ii) Transmutation reaction. (CO5, K5)
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R4474

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25MCH2C2

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Chemistry

ORGANIC CHEMISTRY – II

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. The carbanion intermediate is characterized by (CO1, K1)
 - (a) sp^2 hybridization and a vacant p-orbital
 - (b) sp^3 hybridization with a lone pair on carbon
 - (c) sp hybridization without charge
 - (d) delocalized positive charge
2. The stability of an enolate ion mainly depends on (CO1, K2)
 - (a) solvent polarity
 - (b) resonance delocalization
 - (c) temperature
 - (d) steric crowding

3. Which one of the following molecules possesses a plane of symmetry? (CO2, K2)
- (a) CH_2Cl_2
 - (b) trans-1, 2 - dichloroethene
 - (c) cis-1, 2 -dichloroethene
 - (d) 2-butanol
4. The most stable conformation of cyclohexane is (CO2, K1)
- (a) boat
 - (b) twist-boat
 - (c) chair
 - (d) half-chair
5. In the Cram model, product formation depends mainly on (CO3, K2)
- (a) steric control of the largest substituent
 - (b) electronic factors
 - (c) solvent dielectric constant
 - (d) temperature
6. The Furst–Plattner rule is applied to (CO3, K1)
- (a) epoxide opening in cyclohexane systems
 - (b) $\text{S}_{\text{N}}1$ reactions
 - (c) $\text{E}1$ eliminations
 - (d) aromatic substitution
7. Nourish Type-I reaction of ketones involves (CO4, K1)
- (a) α -cleavage
 - (b) γ -hydrogen abstraction
 - (c) dimerization
 - (d) oxidation

8. Photochemical [2 + 2] cycloaddition between alkenes is known as (CO4, K2)
- (a) Paternò – Büchi reaction
 - (b) di- π -methane rearrangement
 - (c) McMurry coupling
 - (d) Sandmeyer reaction
9. The Diels–Alder reaction is thermally allowed because of (CO5, K2)
- (a) aromatic transition state stabilization
 - (b) involvement of radicals
 - (c) 6- π electron system symmetry
 - (d) photochemical activation
10. The term *cheletropic reaction* refers to (CO5, K1)
- (a) elimination of two small fragments simultaneously
 - (b) formation of two σ -bonds to a single atom
 - (c) intramolecular rearrangement
 - (d) radical coupling

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Explain the formation and stability of carbanions; illustrate their role in alkylation and acylation of enolates. (CO1, K4)

Or

- (b) Discuss the mechanism and synthetic applications of the Claisen and Dieckmann condensations. (CO1, K2)

12. (a) Explain *prochirality* and *stereotopic ligands* with suitable molecular examples. (CO2, K4)

Or

- (b) Discuss conformational analysis of six-membered rings and explain the influence of A-strain and anomeric effects. (CO2, K2)

13. (a) Explain the principle of stereoselectivity with reference to Cram–Chelate and Felkin–Ahn models. (CO3, K4)

Or

- (b) Describe the mechanism of syn- and anti-eliminations (E2) emphasizing neighbouring-group participation. (CO3, K2)

14. (a) Explain the generation of radical intermediates and discuss their addition to alkenes and alkynes. (CO4, K3)

Or

- (b) Describe Norrish Type-I and Type-II photochemical reactions of ketones with mechanisms. (CO4, K3)

15. (a) Explain the basic classification of pericyclic reactions and outline the Woodward–Hoffmann rules. (CO5, K3)

Or

- (b) Discuss the mechanism of the Diels–Alder reaction and comment on endo–exo selectivity. (CO5, K3)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Analyze the mechanisms of Michael and Stobbe condensations and justify the stability of intermediate carbanions formed. (CO1, K4)

Or

- (b) Evaluate the synthetic importance of the Wittig and Peterson olefination reactions involving ylides. (CO1, K5)

17. (a) Analyze how steric and stereoelectronic factors control conformations and reaction outcomes in cyclic systems. (CO2, K4)

Or

- (b) Design a systematic method to predict product stereochemistry using conformational and symmetry arguments. (CO2, K6)

18. (a) Examine stereoselectivity in nucleophilic additions through Zimmerman–Traxler transition states with examples. (CO3, K4)

Or

- (b) Critically evaluate the experimental methods used to establish absolute configuration in chiral molecules. (CO3, K5)

19. (a) Analyze the mechanism of di- π -methane and Paternò–Büchi photochemical reactions and discuss their synthetic relevance. (CO4, K4)

Or

- (b) Evaluate radical rearrangement and coupling reactions, such as Barton and McMurry reactions, in complex synthesis. (CO4, K5)

20. (a) Analyze electrocyclic and sigmatropic rearrangements using Frontier-Orbital theory and symmetry rules. (CO5, K4)

Or

- (b) Design a multistep synthetic route employing pericyclic reactions and justify each step on orbital-symmetry grounds. (CO5, K6)
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R4475

Sub. Code

25MCH2C3

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Chemistry

PHYSICAL CHEMISTRY – II

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective questions by choosing the correct option.

1. The probability of finding a particle at the walls of a 1-D box is (CO1, K1)
(a) Maximum (b) Minimum
(c) Zero (d) Infinite
2. The rigid rotor model is used to explain (CO1, K1)
(a) Electronic spectra
(b) Rotational spectra
(c) Vibrational spectra
(d) Nuclear spectra

3. A vibrational mode is Raman active if it shows a change in (CO2, K1)
- (a) Dipole moment (b) Polarizability
(c) Charge (d) Energy
4. In butadiene, the number of π molecular orbitals formed is (CO2, K2)
- (a) 2 (b) 3
(c) 4 (d) 6
5. The Michaelis–Menten mechanism involves the formation of (CO3, K1)
- (a) Activated complex
(b) Enzyme–substrate complex
(c) Product–enzyme complex
(d) Free radical
6. The stopped-flow technique is mainly used for studying (CO3, K1)
- (a) Slow reactions
(b) Solid–solid reactions
(c) Fast reactions in solution
(d) Gas diffusion
7. Helmholtz free energy is defined as (CO4, K1)
- (a) $G=H-TS$ (b) $A=U-TS$
(c) $H=U+PV$ (d) $G=U+PV-TS$

8. For an ideal gas, fugacity is equal to (CO4, K1)
- (a) Mole fraction (b) Partial pressure
(c) Total pressure (d) Volume
9. Complete wetting occurs when the contact angle is. (CO5, K1)
- (a) 0° (b) 45°
(c) 90° (d) 180°
10. Surface area of solids is commonly determined by (CO5, K1)
- (a) Gibbs method
(b) BET method
(c) Freundlich method
(d) Langmuir–Hinshelwood method

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Describe the shapes of s and p orbitals using wave mechanical principles. (CO1, K3)

Or

- (b) Explain the Jahn–Teller effect and its importance in coordination chemistry. (CO1, K3)

12. (a) State and explain the mutual exclusion rule for molecules having a center of symmetry. (CO2, K2)

Or

- (b) Evaluate the importance of group theory in explaining orbital splitting in ligand fields. (CO2, K5)

13. (a) Analyze the hydrogen–bromine reaction mechanism and explain the origin of its complex rate law. (CO3, K4)

Or

- (b) Assess the importance of enzyme catalytic efficiency in biological systems. (CO3, K5)

14. (a) Apply the concept of entropy to distinguish between reversible and irreversible processes with suitable examples. (CO4, K3)

Or

- (b) Assess the applicability and limitations of the Gibbs–Duhem equation in multicomponent systems. (CO4, K5)

15. (a) Distinguish between physisorption and chemisorption based on their characteristics. (CO5, K2)

Or

- (b) Analyze the factors affecting adsorption at solid–gas interfaces. (CO5, K4)

Part C

(5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Derive the expression for the energy of a particle confined in a one-dimensional box and explain the concept of zero-point energy. (CO1, K2)

Or

- (b) Explain the rigid rotor model for a diatomic molecule and derive the expression for rotational energy levels. (CO1, K2)
17. (a) Critically evaluate the validity of the mutual exclusion rule in the interpretation of vibrational spectra. (CO2, K5)

Or

- (b) Explain the principle of Symmetry Adapted Linear Combinations (SALCs) and their role in molecular orbital information. (CO2, K2)
18. (a) Analyze the principle and working of relaxation methods (T-jump and P-jump) for studying fast reactions. (CO3, K4)

Or

- (b) Critically evaluate the assumptions and limitations of the Michaelis-Menten equation in enzyme kinetics. (CO3, K5)
19. (a) Using the Debye-Hückel limiting law, calculate and interpret mean ionic activity coefficients for dilute electrolyte solutions. (CO4, K3)

Or

- (b) Critically evaluate the assumptions and limitations of thermodynamic equations applied to open systems. (CO4, K5)

20. (a) Explain the Freundlich, Langmuir, and BET adsorption isotherms and state their assumption.
(CO5, K2)

Or

- (b) Analyze the role of surface area, pore structure, and active sites in determining catalytic efficiency.
(CO5, K4)
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R4476

Sub. Code

25MCH2E1

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Chemistry

Elective – NATURAL PRODUCTS AND BIOCHEMICAL ASPECTS

(CBCS – 2025 onwards)

Time : 3 Hours

Maximum : 75 Marks

Part A

(10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. Pyrrole is classified as a heterocyclic compound because it
(CO1, K1)
 - (a) contains only carbon atoms
 - (b) contains a nitrogen atom in a five-membered ring
 - (c) is saturated in nature
 - (d) contains two nitrogen atoms
2. Which heterocyclic compound exhibits aromaticity due to lone pair participation? (CO1, K2)
 - (a) Piperidine
 - (b) Pyrrole
 - (c) Tetrahydrofuran
 - (d) Imidazoline

3. The basic skeleton of steroids consists of (CO2, K1)
- (a) three fused rings
 - (b) four fused rings
 - (c) five fused rings
 - (d) six fused rings
4. Optical Rotatory Dispersion (ORD) primarily measures (CO2, K2)
- (a) absorption of UV radiation
 - (b) optical rotation as a function of wavelength
 - (c) emission of circularly polarized light
 - (d) magnetic circular dichroism
5. Quinine belongs to which class of alkaloids? (CO3, K1)
- (a) Isoquinoline alkaloid
 - (b) Indole alkaloid
 - (c) Quinoline alkaloid
 - (d) Pyridine alkaloid
6. Terpenoids are biosynthesized from which fundamental unit? (CO3, K1)
- (a) Acetate unit
 - (b) Isoprene unit
 - (c) Phenylpropane unit
 - (d) Shikimate unit

7. The β -lactam ring is a characteristic feature of (CO4, K1)
- (a) Tetracycline
 - (b) Penicillin
 - (c) Streptomycin
 - (d) Chloramphenicol
8. Vitamin K is primarily involved in (CO4, K2)
- (a) vision
 - (b) bone growth
 - (c) blood clotting
 - (d) carbohydrate metabolism
9. The monomeric unit of proteins is (CO5, K1)
- (a) nucleotide
 - (b) monosaccharide
 - (c) amino acid
 - (d) fatty acid
10. The flow of genetic information in biological systems follows (CO5, K2)
- (a) RNA \rightarrow DNA \rightarrow Protein
 - (b) DNA \rightarrow RNA \rightarrow Protein
 - (c) Protein \rightarrow DNA \rightarrow RNA
 - (d) RNA \rightarrow Protein \rightarrow DNA

Part B

(5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Explain the structure, aromatic nature, and chemical properties of pyrrole with suitable reactions. (CO1, K3)

Or

- (b) Describe the general structural features and biological importance of flavones and isoflavones. (CO1, K3)
12. (a) Discuss the structural features and biological significance of cholesterol. (CO2, K3)

Or

- (b) Explain the principle of Optical Rotatory Dispersion and its application in stereochemical analysis. (CO2, K3)
13. (a) Describe the structure and stereochemistry of the quinine molecule. (CO3, K3)

Or

- (b) Explain the classification of terpenoids based on the number of isoprene units, with examples of each type. (CO3, K3)
14. (a) Explain the structure and antibacterial action of penicillin. (CO4, K3)

Or

- (b) Describe the classification and physiological roles of the vitamins. (CO4, K3)

15. (a) Explain the structure and biological functions of glucose, fructose, and sucrose carbohydrates. (CO5, K3)

Or

- (b) Describe the primary, secondary, and tertiary structures of proteins. (CO5, K3)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Discuss the synthesis, structure, reactivity, and applications of heterocyclic compounds such as pyrrole, furan and thiophene. (CO1, K4)

Or

- (b) Elaborate on the chemistry, synthesis and biological importance of anthocyanins and flavonoids. (CO1, K5)

17. (a) Explain the biosynthesis of cholesterol and discuss their physiological importance. (CO2, K4)

Or

- (b) Compare ORD and Circular Dichroism techniques and evaluate their applications in configurational assignments. (CO2, K6)

18. (a) Describe the structural elucidation and biosynthesis of morphine. (CO3, K4)

Or

- (b) Discuss the complete structural elucidation of abietic acid and confirm with the synthesis. (CO3, K5)

19. (a) Explain the chemistry, classification, and mode of action of antibiotics with suitable examples. (CO4, K4)

Or

- (b) Discuss the structure and biological functions of Vitamin B-complex and Vitamin K. (CO4, K5)
20. (a) Explain enzyme classification, the mechanism of enzyme action, and factors influencing enzyme activity. (CO5, K4)

Or

- (b) Describe DNA structure and critically analyze the process of DNA replication and gene expression. (CO5, K6)
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