

Bs/CHEM.M4(T)

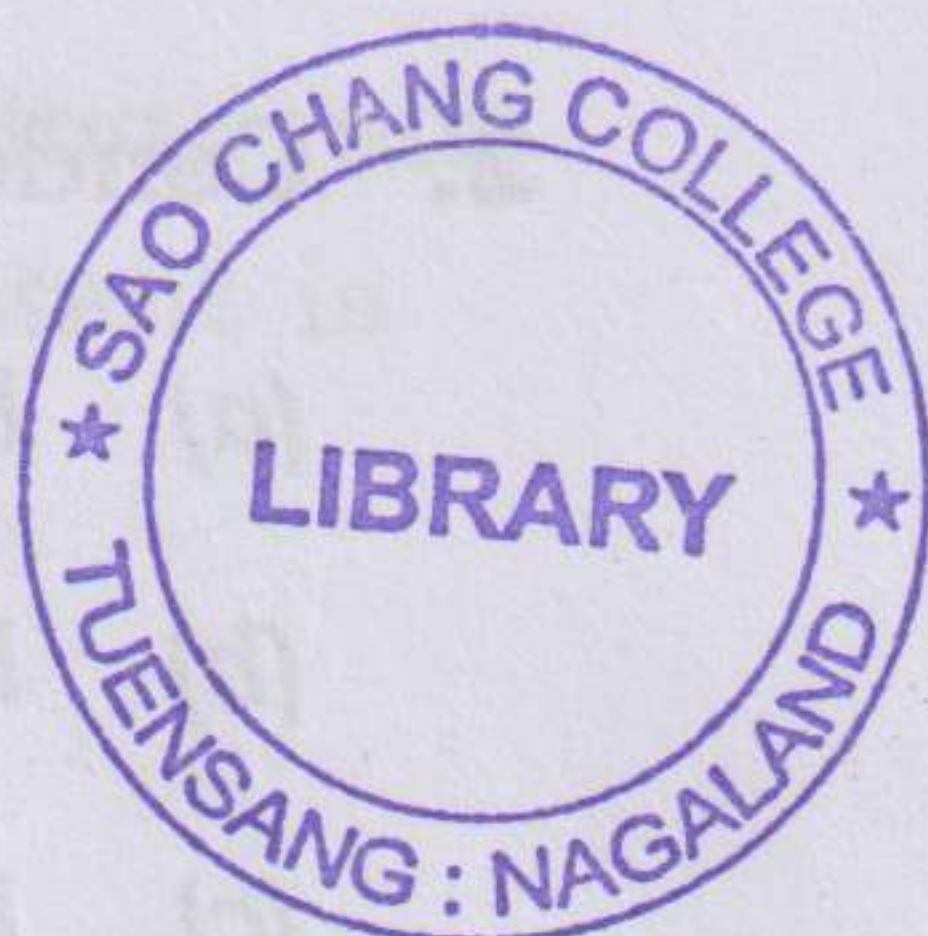
2026

(FYUGP)

(4th Semester)

CHEMISTRY

(MINOR)



Paper : CHEM.M4(T)

**(Physical Chemistry-III : Phase Equilibria
and Chemical Kinetics)**

Full Marks : 75

Pass Marks : 40%

Time : 3 hours

*The figures in the margin indicate full marks
for the questions.*

(PART : A—OBJECTIVE)

(Marks : 25)

SECTION—I

(Marks : 15)

Choose the correct option :

1×15=15

- 1.** In sulphur, the maximum number of phases
which can coexist in equilibrium can be

(a) 3

(b) 4

(c) 1

(d) 2

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(Turn Over)

2. Condensed phase rule equation is

(a) $F = C - P + 2$

(b) $F = C - P + 1$

(c) $F = C + P - 1$

(d) $F = C - P$

3. Triple point is a point where

(a) three components are in equilibrium

(b) the number of degrees of freedom in a system is three

(c) the number of degrees of freedom is zero

(d) three solids make three phases

4. For a zero-order reaction, $A \rightarrow$ products, $t_{1/2}$ is proportional to

(a) $[A]$

(b) $\frac{1}{[A]}$

(c) $[A]_0^2$

(d) $\frac{1}{[A]_0^2}$

5. For a reaction with rate law equation, rate $= k[A]^2[B]^{1/2}$, the unit of rate constant is

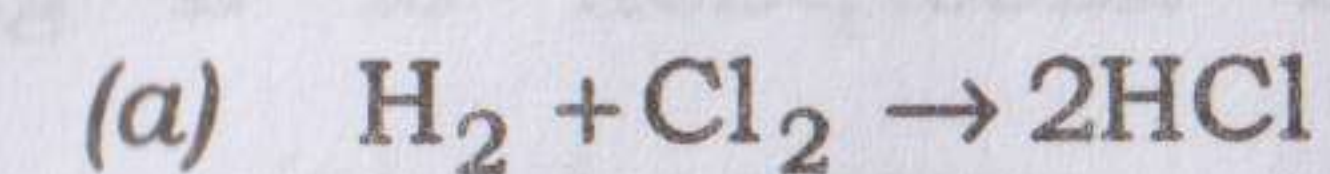
(a) s^{-1}

(b) $dm^3 mol^{-1} s^{-1}$

(c) $dm^{-9/2} mol^{3/2} s^{-1}$

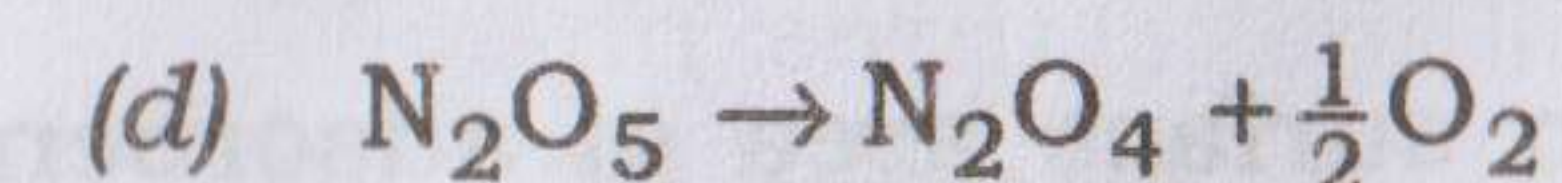
(d) $dm^{9/2} mol^{-3/2} s^{-1}$

6. Which of the following is a pseudo unimolecular reaction?



(b) Acid catalyzed hydrolysis of ester

(c) Base catalyzed hydrolysis of ester



7. Autocatalysis means catalysis of a reaction by

(a) one of its products

(b) one of its reactants

(c) the walls of the vessel

(d) the solvent

8. For heterogeneous catalysis, best results are obtained if

- (a) the solid catalyst is taken in big pieces
- (b) one of the reacting gases is strongly adsorbed
- (c) both the reacting gases are adsorbed very strongly
- (d) product molecules are adsorbed very strongly

9. Extent of physical adsorption of a gas increases with

- (a) increase in temperature
- (b) decrease in temperature
- (c) decrease in surface area of adsorbent
- (d) decrease in strength of van der Waals' forces

10. The unit of reaction rate is

- (a) mol L^{-1}
- (b) $\text{mol}^{-1} \text{L S}^{-1}$
- (c) $\text{mol L}^{-1} \text{S}^{-1}$
- (d) $\text{mol}^{-1} \text{L}^{-1} \text{S}^{-1}$

11. The minimum energy required for reactant molecules to enter into chemical reaction is known as

- (a) kinetic energy
- (b) potential energy
- (c) activation energy
- (d) Threshold energy

12. A first-order reaction is 75% completed in 32 minutes. For 50% completion, it will take

- (a) 4 minutes
- (b) 8 minutes
- (c) 16 minutes
- (d) 32 minutes

13. Enzymes are

- (a) microorganisms
- (b) proteins
- (c) inorganic compounds
- (d) moulds

(6)

14. The effect of a catalyst in a chemical reaction is to change the

- (a) activation energy
- (b) equilibrium
- (c) enthalpy
- (d) final product

15. If rate = $k[A]^2[B]^{3/2}[C]^{-1/2}$, then the order of the reaction is

- (a) $\frac{7}{2}$
- (b) $\frac{5}{2}$
- (c) 3
- (d) 1

SECTION—II

(Marks : 10)

Write on the following :

2×5=10

1. Rate constant
2. Enzyme catalysis
3. Colloids
4. Molecularity of a reaction
5. Parallel reactions

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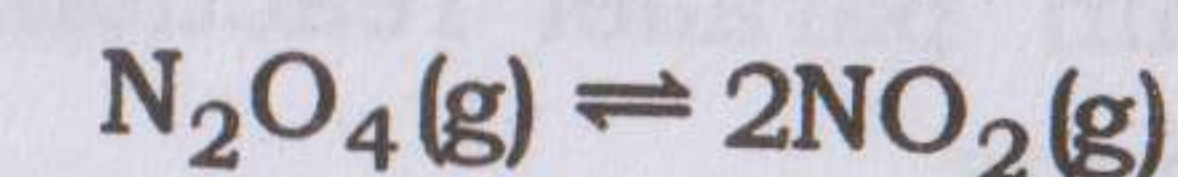
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(7)

(PART : B—DESCRIPTIVE)

(Marks : 50)

1. (a) Derive Clausius-Clapeyron equation. 4
- (b) Derive phase rule thermodynamically. 4
- (c) Write the number of components, phases and degrees of freedom in the following equilibrium : 2



Or

2. (a) Draw and discuss the phase diagram of sulphur. 4
 - (b) Discuss the phase diagram of sodium-potassium system with incongruent melting point. 4
 - (c) Phase diagram of a two-component system required three-dimensional presentation. Explain. 2
3. (a) Derive integrated rate law equation of a first-order reaction. 3
 - (b) What are the factors affecting rate of a reaction? 2

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(c) For a reaction, rate constant is $5.70 \times 10^{-5} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ at 25°C and $1.64 \times 10^{-4} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ at 40°C . Calculate the activation energy of the reaction. 3

(d) Define steady-state approximation. 2

Or

4. (a) Explain parallel reactions for complex reactions. 3

(b) Describe collision theory of reaction rates. 3

(c) Describe the Lindemann theory of unimolecular reaction. 4

5. (a) Define catalysis. Explain the mechanism of enzyme catalysis. 4

(b) Describe the mechanism of acid-base catalysis with suitable example. 4

(c) Define selectivity of a catalyst. 2

Or

6. (a) Describe Michaelis-Menten mechanism. 4

(b) Describe the particle size and efficiency of nanoparticles as catalyst. 4

(c) Define heterogeneous catalysis. 2

7. (a) Derive Langmuir adsorption isotherm. 4

(b) Write the differences between physical adsorption and chemical adsorption. 3

(c) Write the applications of adsorption. 3

Or

8. (a) Derive Freundlich adsorption isotherm. 4

(b) Define colloids. Explain its classification in detail. 1+3=4

(c) Write the differences between adsorption and absorption. 2

9. (a) Discuss the phase diagram of $\text{FeCl}_3\text{-H}_2\text{O}$ system. 4

(b) Define the following : 1×3=3

(i) Pseudo-unimolecular reaction

(ii) Specificity of a catalyst

(iii) Order of a reaction

(c) Explain chain reactions of complex reactions. 3

Or

10. (a) Discuss Gibbs' phase rule from thermodynamic consideration. 4

(b) Show that radioactive decay follows first-order kinetics. 3

(c) Define the following :

1×3=3

(i) Complex reaction

(ii) Half-life period

(iii) Phase diagram
