

2025

(NEP—2020)

(2nd Semester)

CHEMISTRY (MAJOR/MINOR)

(Physical Chemistry—I)

Full Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

Use of simple calculator is allowed

(SECTION : A—OBJECTIVE)

(Marks : 10)

Tick (✓) the correct answer in the brackets provided :

1×10=10

1. Boyle's temperature is defined as the temperature at which

(a) a real gas behaves ideally over a range of pressures ()

(b) the volume of a gas becomes zero ()

(c) the intermolecular forces in a gas are at their maximum ()

(d) the gas liquefies completely ()

2. For an ideal gas, compressibility factor (Z) is

(a) 0 ()

(b) 1 ()

(c) greater than 1 ()

(d) less than 1 ()

3. A liquid rises in a capillary tube due to

(a) surface tension ()

(b) viscosity ()

(c) effusion ()

(d) molar refraction ()

4. Surface tension arises due to

(a) cohesive forces between liquid molecules ()

(b) adhesive forces between the liquid and container ()

(c) the weight of the liquid ()

(d) the movement of free electrons ()

5. The charge on As_2S_3 sol is due to

- (a) absorption of H^+ ions ()
- (b) adsorption of H^+ ions ()
- (c) adsorption of S^{2-} ions ()
- (d) absorption of S^{2-} ions ()

6. A lower gold number indicates

- (a) lower protective power of the colloid ()
- (b) higher protective power of the colloid ()
- (c) higher molecular weight of the colloid ()
- (d) less stability of the gold sol ()

7. The unit of rate constant for a first-order reaction is

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

8. The rate of a chemical reaction generally increases with

- (a) decreasing reactant concentration ()
- (b) increasing reactant concentration ()
- (c) decreasing temperature ()
- (d) increasing activation energy ()

9. The activation energy (E_a) is

- (a) the energy required to break all bonds in reactants ()
- (b) the energy released in an exothermic reaction ()
- (c) the minimum energy required for a reaction to occur ()
- (d) the total energy of reactants and products ()

10. The Gibbs' adsorption isotherm applies to adsorption at which type of interface?

- (a) Solid-liquid interfaces ()
- (b) Liquid-gas interfaces ()
- (c) Solid-gas interfaces ()
- (d) Liquid-solid interfaces ()

(SECTION : B—SHORT ANSWERS)

(Marks : 15)

Answer *five* questions, taking at least *one* from each Unit :

3×5=15

UNIT—I

1. What are the causes of deviation of real gas from ideal gas behaviour?
2. What is the significance of van der Waals' constants *a* and *b*?

UNIT—II

3. How does temperature affect the surface tension of the liquid?
4. What is meant by free volume in a liquid?

UNIT—III

5. Write a note on Tyndall effect.
6. Differentiate between physisorption and chemisorption.

UNIT—IV

7. Write a note on the effect of temperature on reaction rate.
8. Differentiate between order and molecularity of reaction.

(SECTION : C—DESCRIPTIVE)

(Marks : 50)

Answer *five* questions, taking at least *one* from each Unit :

10×5=50

UNIT—I

1. (a) What are the postulates of the kinetic molecular theory of gases? 5
(b) Derive van der Waals' equation for real gases. 5
2. (a) What do you mean by compressibility factor Z of a gas? Show graphically the variation of Z with pressure of a real gas at a constant temperature. 5
(b) Explain the behaviour of real gases by van der Waals' equation at low pressure and at high pressure. 3
(c) Calculate the critical temperature of van der Waals' gas for which $P_c = 100 \text{ atm}$ and $b = 50 \text{ cm}^3 \text{ mol}^{-1}$. 2

UNIT—II

3. (a) Explain the free volume in liquid with suitable diagram. 5
(b) Explain the structure and types of liquid crystals. 5
4. (a) Define the terms 'specific refraction' and 'molar refraction'. 2
(b) Give a brief account of the molecular arrangements which exist in various states of liquid crystals. 3
(c) Explain the effects of temperature on the viscosity of a liquid. 5

UNIT—III

5. (a) What are protective colloids? How do they help in stabilizing colloidal solutions? 5
(b) Explain the origin of charge on colloidal particles. 5

6. (a) Explain the process of peptization for the preparation of colloidal solutions. 3
(b) Derive Langmuir adsorption isotherm. 5
(c) Define gold number. Give one example. 2

UNIT—IV

7. (a) For a certain first-order reaction, half-life ($t_{1/2}$) is 100 seconds. How long will it take for the reaction to be completed 75%? 3
(b) State and explain pseudo-unimolecular reaction with example. 3
(c) What are the important characteristics of a catalyst? 4
8. (a) Explain the collision theory of reaction rates. 5
(b) Derive the Michaelis-Menten equation. 5
