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( 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  $\text{As}_2\text{S}_3$  sol is due to

(a) absorption of  $\text{H}^+$  ions ( )

(b) adsorption of  $\text{H}^+$  ions ( )

(c) adsorption of  $\text{S}^{2-}$  ions ( )

(d) absorption of  $\text{S}^{2-}$  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)  $\text{s}^{-1}$  ( )

(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  $P_c = 100$  atm and  $b = 50$  cm<sup>3</sup> mol<sup>-1</sup>. 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

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