2024

(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

(SECTION : A—OBJECTIVE)

(*Marks* : 10)

Tick (✓) the correct answer in the brackets provided : 1×10=10

1. For an ideal gas under all conditions of temperature and pressure, the compressibility factor Z is equal to

   (a) less than one ( )

   (b) greater than one ( )

   (c) unity ( )

   (d) None of the above ( )

2. For 1 mole of a gas, the kinetic energy is given by

(a) $E = 5 / 2\ RT$ ( )

(b) $E = 3 / 2\ RT$ ( )

(c) $E = 1 / 2\ RT$ ( )

(d) $E = 7 / 2\ RT$ ( )

3. A drop of liquid appears spherical in shape due to

(a) surface tension ( )

(b) evaporation ( )

(c) condensation ( )

(d) None of the above ( )

4. The refractive index of a liquid depends upon

(a) temperature ( )

(b) density of the liquid ( )

(c) wavelength of the light used ( )

(d) All of the above ( )

5. The charge on As_2S_3 sols is due to

(a) the adsorption of S^{2-} ions ( )

(b) the adsorption of O^{2-} ions ( )

(c) the absorption of S^{2-} ions ( )

(d) the adsorption of As^{3+} ions ( )

6. Which method is preferred for the preparation of gold sol?

(a) Oxidation ( )

(b) Double decomposition ( )

(c) Reduction ( )

(d) Hydrolysis ( )

7. Freundlich adsorption isotherm is applicable only at

(a) room temperature ( )

(b) 273 K ( )

(c) high pressure ( )

(d) low pressure ( )

8. In a chemical reaction, how does the concentration of reactant change with time?

(a) Decreases ( )

(b) Increases ( )

(c) Remains unchanged ( )

(d) Increases and then decreases ( )

9. The unit of rate constant for a second-order reaction is

(a) s^{-1} ( )

(b) $mol^{-1}\ s^{-1}$ ( )

(c) $mol^{-1}\ L\ s^{-1}$ ( )

(d) $L\ s^{-1}$ ( )

10. On increasing the substrate concentration, the reaction rate of an enzyme-catalyzed reaction changes from

(a) zero-order to first-order ( )

(b) second-order to first-order ( )

(c) first-order to zero-order ( )

(d) first-order to second-order ( )

(SECTION : B—SHORT ANSWERS)

(*Marks* : 15)

Answer *five* questions, taking at least *one* from each Unit : 3×5=15

UNIT—I

1. How does the compressibility factor vary with pressure?

2. State and explain the law of corresponding states.

UNIT—II

3. What do you mean by free volume in liquid?

4. Explain the terms *(a)* refractive index and *(b)* specific refraction.

UNIT—III

5. Differentiate between lyophilic colloid and lyophobic colloid.

6. Explain Freundlich adsorption isotherm.

UNIT—IV

7. What do you mean by order and molecularity of a reaction?

8. Write an equation for half-life period of a first-order reaction. Why is it independent of initial concentration?

(SECTION : C—DESCRIPTIVE)

(*Marks* : 50)

Answer *five* questions, taking at least *one* from each Unit : 10×5=50

UNIT—I

1. *(a)* Starting from the basic postulates, derive the kinetic gas equation. 5

(b) Calculate the pressure exerted by 88 g of CO_2 in an 8-litre vessel at 27 °C by using—

(i) the ideal gas equation;

(ii) van der Waals' equation.

(Given : $a = 3 \cdot 6$ atm.litre mol^{-2}, $b = 0 \cdot 024$ litre mol^{-1} and $R = 0 \cdot 082$ litre atm K^{-1} mol^{-1}) 5

2. *(a)* What is excluded volume? Show that it is four times the actual volume of the gas molecules.

(b) Evaluate the critical constants from van der Waals' equation. 5

UNIT—II

3. *(a)* Describe the vacancy theory of liquids. 5

(b) Define surface tension. What are the effects of temperature on the surface tension of a liquid? 1+4=5

4. *(a)* Define liquid crystal. Differentiate clearly between smectic and nematic liquid crystals. 1+4=5

(b) Explain the effects of temperature on the viscosity of a liquid.

UNIT—III

5. *(a)* Write short notes on the following : 2+2=4

(i) Tyndall effect

(ii) Origin of charge on colloidal particle.

(b) What are colloids? How are they classified based on *(i)* affinity for dispersion medium and *(ii)* their sizes? 2+(2+2)=6

6. *(a)* What are protective colloids? Explain how a lyophilic colloid protects lyophobic colloids. 1+3=4

(b) What is adsorption isotherm? Derive Langmuir adsorption isotherm. 1+5=6

UNIT—IV

7. *(a)* Define zero-order reaction. Derive an expression for the rate constant and half-life period of a zero-order reaction. 1+4=5

(b) Explain activation energy. How is activation energy determined with the help of Arrhenius equation? 2+3=5

8. *(a)* What are pseudo-unimolecular reactions? Determine the units of rate constant, k for—

(i) zero-order reaction;

(ii) first-order reaction;

(iii) second-order reaction;

(iv) third-order reaction. 1+(1×4)=5

(b) Write the characteristics of catalysis. Explain enzyme catalysis. 2+3=5

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