2023

(CBCS)

(3rd Semester)

CHEMISTRY

THIRD PAPER

(**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. The temperature at which a real gas behaves like an ideal gas over appreciable pressure range is called

    (a) critical temperature   (   )

    (b) absolute temperature   (   )

    (c) Boyle's temperature   (   )

    (d) Charles' temperature   (   )

2. The compressibility factor Z for an ideal gas is

   (a) zero   ( )

   (b) less than one   ( )

   (c) greater than one   ( )

   (d) equal to one   ( )

3. The substance having the structure between a liquid and a crystalline solid is called

   (a) critical state   ( )

   (b) activated state   ( )

   (c) liquid crystal   ( )

   (d) corresponding substance   ( )

4. The rate of evaporation of liquid depends upon the

   (a) surface area   ( )

   (b) temperature   ( )

   (c) nature of liquid   ( )

   (d) All of the above   ( )

5. The term used to determine the protecting power of lyophilic colloids is

    (a) oxidation number   ( )

    (b) coagulation value   ( )

    (c) gold number   ( )

    (d) critical micelle concentration   ( )

6. Freundlich adsorption isotherm is not applicable at

    (a) low pressure   ( )

    (b) high pressure   ( )

    (c) room temperature   ( )

    (d) 273 K   ( )

7. For a weak acid with α as its degree of dissociation, the value of dissociation constant is given by

    (a) $K_a = C\alpha$ ( )

    (b) $K_a = C\alpha^2$ ( )

    (c) $K_a = C^2\alpha$ ( )

    (d) $K_a = C^2\alpha^2$ ( )

8. The ionic product of water will increase, if

(a) temperature is increased ( )

(b) pressure is increased ( )

(c) temperature is reduced ( )

(d) pressure is reduced ( )

9. A thermodynamically irreversible process is always accompanied by

(a) increase in the entropy ( )

(b) decrease in the entropy ( )

(c) stabilization in the entropy ( )

(d) Remains unaltered ( )

10. The fraction of heat absorbed by an engine which can be converted into work gives

(a) stability ( )

(b) deficiency ( )

(c) efficiency ( )

(d) solubility ( )

(**SECTION : B—SHORT ANSWERS**)

(*Marks* : 15)

nswer the following :   3×5=15

UNIT—I

1. "Excluded volume is four times than the actual volume of a gas molecule."
   Explain.

OR

2. Explain compressibility factor and critical compressibility factor. What do
   they signify?

UNIT—II

3. Explain smectic liquid crystal.

OR

4. Discuss the vacancy theory of liquids.

UNIT—III

5. What is molar enthalpy of adsorption?

OR

6. Differentiate between chemisorption and physisorption.

UNIT—IV

7. Write a note on pH and pH scale.

OR

8. Write a note on buffer activity of an acidic buffer.

UNIT—V

9. Explain why the second law of thermodynamics is needed.

OR

10. Explain the relationship between entropy (S) and probability (W).

(SECTION : C—DESCRIPTIVE)

(Marks : 50)

Answer the following :   10×5=50

UNIT—I

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

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

OR

2. (a) What are the causes of deviation from ideal gas behaviour?   5

   (b) The van der Waals' constant of a gas are : $a = 0 \cdot 751 \ dm^6 atm.mol^{-2}$ and $b = 0 \cdot 226 \ dm^3 \ mol^{-1}$. Calculate its critical constant.   5

UNIT—II

3. (a) Describe the effect of temperature on viscosity.   5

   (b) Explain refractive index. What are specific refraction and molar refraction?   5

OR

4. (a) What is surface tension? Why does a drop of liquid appear spherical in shape?   5

   (b) Explain the free volume in liquid with suitable diagram.   5

UNIT—III

5. (a) Explain the preparation of colloids by Bredig's arc method.   5

   (b) What is an adsorption isotherm? Explain Langmuir adsorption isotherm.   5

OR

6. (a) Discuss the origin of charge on colloidal particles.   4

   (b) Write notes on the following :   3+3=6

      (i) Protective colloids

      (ii) Tyndall effect

UNIT—IV

7. (a) Calculate the degree of hydrolysis of 0·10 M solution of sodium acetate at 25 °C. ($K_a = 1·75 \times 10^{-5}$ and $K_w = 1·008 \times 10^{-14}$) 5

(b) Derive the Henderson-Hasselbalch equation for acidic and basic buffers. 5

OR

8. (a) Deduce the hydrolysis constant for salts of weak base and strong acid. 5

(b) Discuss the ionic product of water. 3

(c) What are strong and weak electrolytes? Give examples. 2

UNIT—V

9. (a) Explain the working of Carnot's cycle and its efficiency. 5

(b) How does entropy change in an ideal gas with temperature and pressure? 5

OR

10. (a) 5 moles of an ideal gas expand reversibly from a volume of 8 dm^3 to 80 dm^3 at a temperature of 27 °C. Calculate the change in entropy. (Given, $R = 8·314$ JK^{-1} mol^{-1}) 2

(b) Distinguish between reversible and irreversible processes. 3

(c) Discuss the entropy change for irreversible isothermal expansion of an ideal gas. 5

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(*Marks : 50*)

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10×5

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