## CHEM/III/EC/05

## Student's Copy

## 2024

(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 deviation of real gases from ideal behaviour is represented in terms of

(a) temperature ( )

(b) compressibility factor ()

(c) kinetic energy ( )

(d) pressure ( )

Contd.

- 2. The unit of a, the van der Waals' constant is
  - (a)  $dm^6 atm mol^{-1}$  ( ) (b)  $dm^3 atm mol^{-1}$  ( ) (c)  $dm^6 atm mol^{-2}$  ( ) (d)  $dm^6 atm mol$  ( )
- 3. The reciprocal of viscosity is called
  - (a) surface tension ()
  - (b) refractive index ( )
  - (c) surface energy ()
  - (d) fluidity ()
- 4. The term 'mesomorphic state' refers to
  - (a) liquid crystal state ( )
  - (b) solid state ()
  - (c) gaseous state ()
  - (d) liquid state ()

[ Cont

- . The scattering of light by the dispersed phase is called
  - (a) Brownian movement ()
  - (b) Tyndall effect ( )
  - (c) adsorption ( )
  - (d) electrophoresis ( )
- 6. In a colloidal solution, the diameter of dispersed particle is in the range
  - (a) 3800 Å 4000 Å ( )
  - (b) 2010 Å 2500 Å ( )
  - (c) 2600 Å 3600 Å ( )
  - (d)  $10 \text{ \AA} 2000 \text{ \AA}$  ()
  - 7. The salt of a strong acid and a strong base
    - (a) does not hydrolyse ()
    - (b) undergoes partial hydrolysis ( )
    - (c) undergoes complete hydrolysis ( )
    - (d) will undergo precipitation ()

**8.** The pH of 0.1 M NaOH solution will be

- (a) 1 ( ) (b) 0.1 ( )
- (c) 13 ( )
- (d) 14 ()
- 9. For an irreversible process
  - (a)  $(\Delta S_{\text{syst}} + \Delta S_{\text{surr}}) = 0$  ( )
  - (b)  $(\Delta S_{\text{syst}} + \Delta S_{\text{surr}}) < 0$  ( )
  - (c)  $(\Delta S_{\text{syst}} + \Delta S_{\text{surr}}) = 1$  ( )
  - (d)  $(\Delta S_{\text{syst}} + \Delta S_{\text{surr}}) > 0$  ( )

10. The efficiency of a heat engine operating between 400 K and 300 K is

.1

 (a)
  $1 \cdot 0$  ()

 (b)
  $0 \cdot 25$  ()

 (c)
  $0 \cdot 75$  ()

 (d)
  $0 \cdot 50$  ()

/49

## ( SECTION : B-SHORT ANSWERS )

(Marks: 15)

Answer the following :

## Unit—I

1. What are the causes of deviation of real gases from ideal behaviour?

## OR

2. Write the postulates of kinetic gas theory.

## Unit—II

3. What is the effect of temperature on viscosity?

## OR

4. Write a note on free volume in liquid.

## Unit—III

5. What are colloids? How would you prepare the colloidal solution of gold?

## OR

6. Distinguish between physical adsorption and chemical adsorption.

## Unit—IV

7. Describe briefly on pH and pH scale of a solution.

## OR

8. Derive a relation between hydrolysis constant  $(K_h)$ , dissociation constant of acid  $(K_a)$  and ionic product of water  $(K_w)$ .

3×5=15

## UNIT-V

9. What are the limitations of the first law of thermodynamics? State the second law of thermodynamics.

## OR

10. Derive an expression for the entropy change in an isothermal expansion of an ideal gas.

## (SECTION : C-DESCRIPTIVE)

(Marks : 50)

Answer the following :

## UNIT-I

- 1. (a) Derive the kinetic gas equation  $PV = \frac{1}{3}mnC^2$ .
  - (b) State the law of corresponding states. Derive an expression interconnecting  $P_r$ ,  $V_r$  and  $T_r$ . 1+4=5

## OR

- 2. (a) Derive van der Waals' equation for one mole of a real gas.
  - (b) Derive the expression for the critical constants  $P_c$ ,  $V_c$  and  $T_c$  in terms of van der Waals' constants a and b. 5

## UNIT-II

| 3. | (a) | ) Define the term 'surface tension'. Discuss the effect of tempera<br>surface tension. |     | ture on     |   |
|----|-----|--|-----|-------------|---|
|    | (b) | Describe briefly on vacancy theory of liquids.   | 114 | -3<br>5     |   |
| 49 |     | 6  |     | 38 <b>_</b> | 1 |

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10×5=50

OR

- 4. (a) What are liquid crystals? Describe the main characteristics of-
  - (i) smectic liquid crystals;
  - (ii) nematic liquid crystals.
  - (b) Write notes on the following :
    - (i) Refractive index
    - (ii) Molar refraction

## Unit—III

- 5. (a) Derive Langmuir adsorption isotherm and mention its significance. 5
  - (b) How would you prepare the colloidal solution of—
    - (i) arsenious sulphide;
    - (ii) ferric hydroxide?

## OR

- 6. (a) Explain the origin of charge on the surface of colloidal particles. Give two examples.
  - (b) What is a protective colloid? How does a lyophilic colloid stabilize a lyophobic colloid? Give an account of gold number in this context.

1+2+2=5

5

21/2+21/2=5

1+2+2=5

2%+2%=5

## UNIT-IV

- 7. (a) Derive the expression for hydrolysis constant of a salt of strong acid and weak base.
  - (b) Explain the action of acidic buffer with an example.

/49

[ Contd.

5

- 8. (a) Find the pH of a buffer solution containing 0.20 moles per litre CH<sub>3</sub>COONa and 0.15 mole per litre of CH<sub>3</sub>COOH.  $K_a$  for acetic acid is  $1.8 \times 10^{-5}$ .
  - (b) Derive Henderson equation to calculate the pH of a buffer solution.

## UNIT-V

- **9.** (a) Derive an expression for entropy change of an ideal gas associated with temperature and pressure change.
  - (b) Prove that in a reversible process net entropy change for the system and the surroundings is zero.

#### OR

- 10. (a) What is cyclic process? With the help of Carnot's cycle, derive an expression for the efficiency of reversible engine working between temperatures T<sub>1</sub> and T<sub>2</sub>.
  - (b) Define entropy. What is the unit of entropy? Calculate the entropy change involved in thermodynamic expansion of 2 moles of a gas from a volume of 5 litres to a volume of 50 litres at 303 K. 1+1+3=5

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 $1 \times 10 = 10$ 

2. The unit of a, the van der Waals' constant is

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10. The efficiency of a heat engine operating between 400 K and 300 K is

2

(a) 1.0 ( ) (b) 0.25 ( ) (c) 0.75 ( ) (d) 0.50 ( )

## ( SECTION : B-SHORT ANSWERS )

(Marks: 15)

Answer the following :

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## OR

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## OR

8. Derive a relation between hydrolysis constant  $(K_h)$ , dissociation constant of acid  $(K_a)$  and ionic product of water  $(K_w)$ .

/49

3×5=15

# second law of thermodynamics.

## OR

UNIT-V

9. What are the limitations of the first law of thermodynamics? State the

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Answer the following :

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| (b)           | Describe briefly on vacancy theory of liquids.                                | 5                      |

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#### UNIT-IV

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(b) Explain the action of acidic buffer with an example.

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21/2+21/2=5

21/2+21/2=5

#### OR

- 8. (a) Find the pH of a buffer solution containing 0.20 moles per litre  $CH_3COONa$  and 0.15 mole per litre of  $CH_3COOH$ .  $K_a$  for acetic acid is  $1.8 \times 10^{-5}$ .
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