

REV-01
BSC/09/14

2023/12

B.SC. CHEMISTRY
THIRD SEMESTER
PHYSICAL CHEMISTRY- II
BSC - 301
[USE OMR FOR OBJECTIVE PART]

**SET
A**

Duration : 3 hrs.

Full Marks : 70

Time : 30 min.

(PART-A: Objective)

Marks : 20

Choose the correct answer from the following:

1×20=20

- What happens to the molarity of a solution when it is diluted by adding more solvent?
 - It increases
 - It decreases
 - It remains the same
 - It becomes saturated
- What is the main factor responsible for boiling point elevation in a solution?
 - Solute-solvent interaction
 - Increased pressure
 - Decreased temperature
 - High molecular weight of solute particles
- Which of the following is a colligative property applicable to non-volatile solutes?
 - Boiling point elevation
 - Freezing point depression
 - Osmotic pressure
 - Vapor pressure lowering
- Which of the following is true for an ideal solution according to Raoult's Law?
 - Total vapor pressure is equal to the sum of partial vapor pressures
 - Total vapor pressure is greater than the sum of partial vapor pressures
 - Total vapor pressure is less than the sum of partial vapor pressures
 - Total vapor pressure is independent of the nature of solute and solvent
- What is the unit of osmotic pressure?
 - atm
 - torr
 - mmHg
 - All of the above
- The degree of dissociation, α for weak electrolyte is-
 - Less than 1
 - More than 1
 - Very very less than 1
 - None of the above
- Which of the following is an example of weak electrolyte?
 - NaOH
 - HCl
 - CH₃COOH
 - None of the above
- Haber's process is an example of-
 - Reversible process
 - Irreversible process
 - Concurrent process
 - Photochemical process
- At equilibrium point of a reaction, rate of forward and backward reaction is-
 - Same
 - Cannot predict
 - Forward is greater than backward
 - Backward is greater than forward

10. Ionic product of water at 298K is-
- 10^{-14}
 - 10^{-15}
 - 10^{-13}
 - 10^{-12}
11. What is the concentration of H_3O^+ ion in pure water at 298K?
- $10^{-14} \text{ molL}^{-1}$
 - $10^{-11} \text{ molL}^{-1}$
 - $10^{-7} \text{ molL}^{-1}$
 - $10^{-12} \text{ molL}^{-1}$
12. For acid base titration, the resultant graph is-
- Sigmoid type
 - Straight type
 - Exponential type
 - None of the above
13. The correct statement about chemisorption is
- Chemisorption results in multi molecular layer adsorption
 - Chemisorption is reversible in nature.
 - Chemisorption has lower specificity than physisorption
 - Chemisorption occurs due to formation of chemical bonds.
14. A gas is known to satisfy Langmuir isotherm when adsorbed on a certain metal surface. If the fractional coverage of the gas is 0.5 when the gas pressure is 1.0 Pa, the fractional coverage at 3.0 Pa would be closest to
- 0.67
 - 0.75
 - 0.80
 - 1.0
15. The correct option representing a Freundlich adsorption isotherm is
- $\frac{x}{m} = k p^{0.5}$
 - $\frac{x}{m} = k p^{2.5}$
 - $\frac{x}{m} = k p^{-0.5}$
 - $\frac{x}{m} = k p^{-1}$
16. Which is not correct regarding the adsorption of a gas on surface of solid?
- On increasing temperature adsorption increases continuously
 - Enthalpy and entropy change is negative
 - Adsorption is more for some specific substance
 - Reversible
17. When a catalyst is used in a reaction, which of the following changes?
- Heat of reaction
 - Product of reaction
 - Equilibrium constant
 - Activation energy
18. Substances that decrease the activity of a catalyst are known as
- Controllers
 - Promoters
 - Poisons
 - Initiators
19. The Langmuir adsorption isotherm is deduced by using the assumption that
- the adsorption takes place in multilayers
 - the adsorption sites are equivalent in their ability to adsorb the particles
 - the heat of adsorption varies with coverage
 - the adsorbed molecules interact with each other

20. Which one of the following statements is incorrect about enzyme catalysis?
- | | |
|--|---|
| a Enzymes are mostly proteinous in nature | b Enzyme action is specific |
| c Enzymes are denaturated by UV-rays and at high temperature | d Enzymes are least reactive at optimum temperature |

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(Descriptive)

Time : 2 hrs. 30 min.

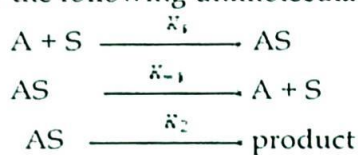
Marks : 50

[Answer question no.1 & any four (4) from the rest]

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|----|--|------------------------|
| 1. | <ul style="list-style-type: none"> a. Deduce the thermodynamic derivation of elevation of boiling point (ΔT_b). b. Show that $p_{ka} + p_{kb} = p_{kw}$ c. What is adsorption isobar? Explain graphically the variation of Adsorption isobar for physisorption and chemisorption. d. Write two applications of Adsorption process. | <p>3+3+3+1
=10</p> |
| 2. | <ul style="list-style-type: none"> a. Discuss Raoult's Law and its application in calculating the vapor pressure of solutions. b. Calculate the normality of the solution obtained by dissolving 0.321 g of the salt sodium carbonate (Na_2CO_3) in 250 mL water. (Molar Mass of $\text{Na}_2\text{CO}_3 = 106 \text{ g/mol}$). c. Explain the concept of ideal and non-ideal solutions in the context of dilute solutions. Give examples of each. d. 10g of a substance is dissolved in 250 mL of H_2O. The osmotic pressure of solution is 600 mm(Hg) at 15°C. Calculate the molecular weight. of the substance? | <p>3+2+2+3
=10</p> |
| 3. | <ul style="list-style-type: none"> a. Deduce the thermodynamic derivation of depression of freezing point (ΔT_f)? b. What is the relationship between latent heat of fusion and molal depression constant? Calculate the molal depression constant for water as solvent. | <p>4+2+2+2
=10</p> |

- c. What is flame and explosion temperature?
- d. The adsorption of a gas is described by Langmuir adsorption isotherm with the equilibrium constant $k = 0.9 \text{ K.Pa}^{-1}$ at 25°C . Calculate the pressure in K.Pa at which fractional surface coverage is 0.95.
4. a. Calculate K_c and K_x for the reaction $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$. Given $K_p = 0.157 \text{ atm}$ at 300K and 1 atm pressure. 3+3+4
=10
- b. Show that $K_p = K_x = K_c$.
- c. Derive the expression of chemical equilibrium in an ideal gas.
5. a. Derive Henderson and Hasselbalch equation for acidic buffer. 3+2+2+3
=10
- b. Define pH scale.
- c. What are the characteristics of a dynamic equilibrium?
- d. Show that α is directly proportional to \sqrt{v}
6. a. Why the adsorption process occurs? Explain. 2+2+2+2
+2=10
- b. Write the differences between physical adsorption and chemical adsorption.
- c. What is the role of adsorption in heterogeneous catalysis?
- d. Distinguish between the adsorption and absorption. Give one example of each.
- e. Explain graphically the variation of adsorption isotherm at three different temperature (T_1, T_2 and T_3 when $T_1 > T_2 > T_3$).
7. a. Write the postulates of Langmuir Adsorption isotherm. 2+1+2+2
+3=10
- b. What are the limitations of Freundlich Adsorption isotherm?
- c. At low pressure and high pressure, how the surface coverage is related to the pressure. Explain mathematically.
- d. Write the equation for multilayer adsorption isotherm process.

e. For the following unimolecular surface reactions,



Derive the equation,

$$\frac{r}{v} = \frac{r}{k_1} + \frac{k_{-1} + k_2}{k_1 k_1' + k_2'}$$

8. a. What do you mean by catalyst promoter? Write about temporary poisoning, permanent poisoning and auto-catalytic poisoning.
- b. Write about enthalpy of combustion, enthalpy of solution and enthalpy of formation.
- c. Derive the equation of variation of enthalpy of reaction with temperature.
- d. Write the Hess Law and Explain its importance.

2+3+3+2
=10

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