

**B.Sc. CHEMISTRY
THIRD SEMESTER
PHYSICAL CHEMISTRY- II
BSC – 931 IDM.J
[USE OMR FOR OBJECTIVE PART]**

**SET
A**

Duration: 3 hrs.

Full Marks: 70

Time: 30 min.

Marks: 20

(Objective)

Choose the correct answer from the following:

1×20=20

- A process is said to be spontaneous if
 - $\Delta G > 0$
 - $\Delta G < 0$
 - $\Delta G = 0$
 - None of the above
- The relation between Gibb's free energy and Helmholtz free energy is
 - $\Delta G = \Delta A + P\Delta V$
 - $\Delta A = \Delta U - T\Delta S$
 - $\Delta A = \Delta G + P\Delta V$
 - $\Delta G = \Delta H - T\Delta S$
- Standard enthalpy of a reaction is determined at
 - 298 K and 1 atm pressure
 - 25 K and 1 atm pressure
 - 25° C and 1 bar pressure
 - 25 K and 1 bar pressure
- The correct option representing a Freundlich adsorption isotherm is
 - $\frac{x}{m} = k p^{-0.3}$
 - $\frac{x}{m} = k p^{2.5}$
 - $\frac{x}{m} = k p^{0.5}$
 - $\frac{x}{m} = k p^{-1}$
- Freundlich adsorption isotherm is given by the expression $x/m = kp^{1/n}$, which of the following conclusions can be drawn from this expression
 - When $1/n = 1$, the adsorption is directly proportional to pressure
 - When $1/n = 1$, the adsorption is independent of pressure
 - When $n = 0$, plot of x/m vs p is a curve
 - None of the above
- Choose the incorrect answer
 - BET is multilayer adsorption
 - Langmuir isotherm is applicable for unilayer adsorption
 - Freundlich isotherm is applicable for multilayer adsorption
 - Physical adsorption is multilayer adsorption process
- At 273 K and 10 bar, the Langmuir adsorption of a gas on a solid surface gave the fraction of the surface coverage as 0.01. The Langmuir adsorption isotherm constant is
 - 0.001 bar^{-1}
 - 1 bar
 - 0.001
 - 0.1 bar^{-1}
- Thermochemistry deals with
 - Heat changes in chemical reactions
 - Study of spontaneous processes

- c. Measurement of entropy
- d. Heat transfer without chemical change
9. The term 'sorption' stands for _____
- a. Absorption
- b. adsorption
- c. Both absorption and adsorption
- d. desorption
10. The Langmuir adsorption isotherm is deduced by using the assumption that
- a. The adsorption takes place in multilayers
- b. The adsorption sites are equivalent in their ability to adsorb the particles
- c. The heat of adsorption varies with coverage
- d. The adsorbed molecules interact with each other
11. The pOH of a solution having $[H^+] = 1 \times 10^{-6} \text{ M}$ is
- a. 5
- b. 7
- c. 6
- d. 8
12. For the equilibrium
- $$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$
- What happens if pressure is increased?
- a. The equilibrium shifts to the right
- b. The equilibrium shifts to the left
- c. No change
- d. Reaction stops
13. If 50 mL of 0.1 M NaOH is added to 50 mL of 0.1 M HCl, the resulting pH is:
- a. 7
- b. 0
- c. 14
- d. 12
14. Which of the following salts will give an acidic solution on hydrolysis?
- a. NaCl
- b. CH_3COONa
- c. Na_2CO_3
- d. NH_4Cl
15. When sodium acetate is added to acetic acid solution, the ionization of acetic acid:
- a. Becomes zero
- b. Remains the same
- c. Decreases
- d. Increases
16. If a non-volatile solute is added to a solvent, vapour pressure
- a. Increases
- b. Decreases
- c. Remains same
- d. Becomes zero
17. Molality is independent of
- a. Temperature
- b. Solvent mass
- c. Solute moles
- d. Pressure
18. Boiling point of solution compared to pure solvent is:
- a. Lower
- b. Higher
- c. Same
- d. Variable
19. Which of the following does NOT affect the colligative properties of a solution?
- a. Nature of solute
- b. Temperature
- c. Pressure
- d. Volume

20. Which of the following is a colligative property applicable to non-volatile solutes
- Boiling point elevation
 - Freezing point depression
 - Osmotic pressure
 - Vapor pressure lowering

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(Descriptive)

Time : 2 hrs. 30 min.

Marks : 50

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

- Establish the relation $S = -\left(\frac{\partial G}{\partial T}\right)_p$ 3+2+3+2
=10
 - What are the limitations of Freundlich Adsorption isotherm? Write the postulates of Langmuir Adsorption isotherm process.
 - The solubility product of $Mg(OH)_2$ at $25^\circ C$ is 1.4×10^{-11} . Calculate the solubility of $Mg(OH)_2$.
 - Discuss the positive deviation of Raoult's Law.
- What is thermochemistry? Write about the enthalpy of formation and enthalpy of combustion. Explain with examples. 3+3+2+2
=10
 - Derive the Kirchhoff equation for variation of enthalpy of a reaction with temperature?
 - Explain the Hess's law and its application.
 - What is enthalpy of fusion and enthalpy of sublimation?
- Why the adsorption process occurs? Explain. 2+2+2+2
+2=10
 - Write the difference between physisorption and chemisorption?
 - Explain graphically the variation of Adsorption isobar for physisorption and chemisorption.
 - Write the Freundlich Adsorption Isotherm equation? Under what condition the extent of adsorption is independent of pressure.
 - Write four applications of adsorption.

4.
 - a. What is Gibbs free energy and Helmholtz free energy? Explain 2+2+3+1
+2=10
 - b. Establish the relation $\Delta G = \Delta A + P.\Delta V$
 - c. Derive the Gibb's-Helmholtz's equation.
 - d. Write the equation for multilayer adsorption isotherm process.
 - e. What is flame and explosion temperature? Explain.

5.
 - a. A buffer solution contains 0.2 moles of NH_4OH and 0.25 moles of NH_4Cl per litre. Calculate pH of the solution. Dissociation constant of NH_4OH at room temperature is 1.81×10^{-5} . 4+3+3
=10
 - b. What do you mean by buffer solution? Discuss the two different types of buffer mixture.
 - c. A solution of 0.1M CH_3COOH is found to be dissociated to the extent of 1.33% at room temperature. Calculate the dissociation constant of the acid

6.
 - a. What do you mean by common ion effect? Explain using suitable example. 2+3+3+2
=10
 - b. What is acid-base indicator? Explain the action of Phenolphthalein.
 - c. 25 ml of 0.1M solution of HCl is titrated against 0.1M solution of NaOH . Calculate the pH of the titration solution on the addition of 5, 25, 30 ml of NaOH .
 - d. Based on Le Chatelier's principle discuss how it can be used to predict the effect of changes temperature on a system in equilibrium. Give suitable example.

7.
 - a. A 25.00 mL sample of sulfuric acid solution requires 18.00 mL of 0.200 N NaOH for complete neutralization. What is the normality of the H_2SO_4 solution? 3+2+3+2
=10
 - b. Write the Vant Hoff's Avogadro's Law for osmotic pressure with expression.
 - c. 10g of a substance is dissolved in 250 mL of H_2O . The osmotic pressure of solution is 600 mm at 15°C . Calculate the mol. wt. of the substance?
 - d. Calculate the osmotic pressure of 3% urea solution at 0°C .

8. a. Deduce the thermodynamic derivation of elevation of boiling point (ΔT_b)? 3+3+2+2
=10
- b. Deduce the relationship between Relative lowering of vapour pressure and Osmotic Pressure.
- c. 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 Na_2CO_3 = 106 g/mol).
- d. Explain the concept of ideal and non-ideal solutions in the context of dilute solutions. Give examples of each.

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