

B.SC. CHEMISTRY
THIRD SEMESTER
PHYSICAL CHEMISTRY III
BSC – 303 OLD COURSE [REPEAT]
[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:

1X20=20

- A mixture of three gases O_2 , N_2 and CO_2 is
 - 1-phase system
 - 2-phase system
 - 3-phase system
 - 4-phase system
- At a triple point
 - Both T and P are fixed
 - Only T is fixed
 - Only P is fixed
 - Sometimes P and sometime T is fixed
- The reduced phase rule equation is
 - $F=C-P+2$
 - $F=C-P+1$
 - $F=C-P$
 - $F=C-P+3$
- The completely miscible solution can be separated by
 - A separating funnel
 - evaporation
 - Fractional distillation
 - None of these
- The temperature at which two conjugate solutions merge into one another to form one layer is called the
 - Critical temperature
 - Critical solution temperature
 - Distillation temperature
 - Dalton's temperature
- For the study of distribution law the two solvents should be
 - Miscible
 - Non-miscible
 - volatile
 - Reacts with each other
- Freundlich isotherms is not applicable at
 - High p
 - Low p
 - 273 K
 - Room temperature
- Adsorption is a
 - Bulk phenomenon
 - Surface phenomenon
 - Both surface and bulk
 - None of these
- Which of the following is a zeroth order reaction
 - $k = 5.2 \times 10^{-3} \text{ mol L}^{-1} \text{ sec}^{-1}$
 - $k = 5.8 \times 10^{-3} \text{ sec}^{-1}$
 - $k = 5.6 \times 10^{-3} \text{ L mol}^{-1} \text{ sec}^{-1}$
 - $k = 4.8 \times 10^{-3} \text{ L}^2 \text{ mol}^{-2} \text{ sec}^{-1}$

10. The rate of a chemical reaction doubles for every 10°C rise of temperature. If the temperature is raised by 50°C , the rate of the reaction increased about
- 64 times
 - 10 times
 - 24 times
 - 32 times
11. The activation energy for a reaction at the temperature $T\text{ K}$ was found to be $10RT$. The ratio of the rate constant to Arrhenius factor is -----.
- e^{10}
 - $1/e^{10}$
 - e
 - $1/e$
12. For a reaction $\frac{1}{2}A \rightarrow 2B$, rate of disappearance of A is related to the rate of appearance of B by the expression
- $-\frac{d[A]}{dt} = \frac{d[B]}{dt}$
 - $-\frac{d[A]}{dt} = \frac{4d[B]}{dt}$
 - $-\frac{d[A]}{dt} = \frac{1}{2} \frac{d[B]}{dt}$
 - $-\frac{d[A]}{dt} = \frac{1}{4} \frac{d[B]}{dt}$
13. The rate of a reaction depend on concentration of
- Reactants only
 - Products only
 - Both reactants and products
 - Independent of concentration of reactants and products
14. The time period for a reversible reaction is
- $k_1 + k_2$
 - $k_1 - k_2$
 - $1 / k_1 + k_2$
 - $1 / k_1 - k_2$
15. If the rate constant for a first order reaction is 69.3 min^{-1} , then the half life of the reaction will be
- $6 \times 10^{-3}\text{ Sec}$
 - $6 \times 10^{-1}\text{ Sec}$
 - $6 \times 10^3\text{ Sec}$
 - $6 \times 10^2\text{ Sec}$
16. $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$ is an example of
- Simple reaction
 - Parallel reaction
 - Opposing reaction
 - Chain reaction
17. If liquids A and B form an ideal solution, the
- enthalpy of mixing is zero
 - entropy of mixing is zero
 - free energy of mixing is zero
 - free energy as well as the entropy of mixing are each zero.
18. The relationship between K_{eq} , K_m and V_{max} is known as
- Haldane equation
 - Michales-Menten equation
 - Gibbs-Duhem-Margules equation
 - Lineweaver-Burk equation
19. A saturated solution of a salt is a
- One phase system
 - Two phase system
 - Three phase system
 - None of these

20. The plot commonly used for determining the value of V_{\max} is
- Langmuir plot
 - Eadie plot
 - Lineweaver-Bark plot
 - Phase plot

(Descriptive)

Time : 2 hrs. 30 min.

Marks : 50

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

- Derive an expression for rate constant of 1st order reaction. 5+5=10
 - Draw phase diagram and apply phase rule to water system.
- What is order and molecularity of a reaction? Write some of the differences between them. 4+6=10

b. The following data were obtained for the reaction $A + B \rightarrow C + D$

	[A] (mol L ⁻¹)	[B] (mol L ⁻¹)	Rate (mol L ⁻¹ s ⁻¹)
1.	5×10^{-3}	2.5×10^{-3}	3×10^{-5}
2.	15×10^{-3}	2.5×10^{-3}	9×10^{-5}
3.	15×10^{-3}	10×10^{-3}	36×10^{-5}

- Calculate the order w.r.t. A and B and also the overall reaction order.
 - Write the rate law expression for the reaction.
 - Calculate the rate constant of the reaction.
 - What will be the rate of the reaction if $[A] = [B] = 8 \times 10^{-3}$ mol L⁻¹.
- Describe the Lindemann theory of unimolecular reaction. What is the order of the reaction at both low and high pressure? 6+4=10
 - Show that for a 1st order reaction, the time required for 99.9% completion of the reaction is 10 times that required for 50% completion.

4. a. What is meant by activation energy? Explain how activation energy is determined with the help of Arrhenius equation. 5+4+1
=10
- b. Derive the Clausius-Clapeyron equation for the following equilibrium Liquid \rightleftharpoons Vapour
- c. Define the term degrees of freedom.
5. a. Determine the rate constant expression for a reversible reaction. 5+5=10
- b. Discuss the effect of temperature on the composition of partially miscible liquid pairs with reference to phenol-water system.
6. a. Write the rate equation for n^{th} order reaction (Derivation not necessary). Determine half life for n^{th} order reaction. Discuss half life method for the determination of order of the reaction. 5+5=10
- b. Derive Gibbs-Duhem-Margules equation of binary solutions.
7. a. State Nernst distribution law. Deduce the formula for distribution law in the case "Association of solute in one of the phases" 5+5=10
- b. When benzoic acid was shaken with mixtures of benzene and water at constant temperature, the following results were obtained:
- | | | | |
|-----------------------------|-------|-------|-------|
| [Acid] in benzene (C_1) | 0.24 | 0.55 | 0.93 |
| [Acid] in water (C_2) | 0.015 | 0.022 | 0.029 |
- Comment whether benzoic acid exists as monomer or dimers?
8. a. What is an adsorption isotherm? Derive Langmuir's adsorption isotherm. 5+3+2
=10
- b. Derive an expression for the rate of an acid catalysed reaction.
- c. What is Nanocatalyst?

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