SET A

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

[USE OMR SHEET FOR OBJECTIVE PART]

Duration: 3 hrs. **Full Marks: 70**

(Objective)

Time: 30 min. **Marks: 20**

Choose the correct answer from the following: ***1X20=20***

1. Which of the following catalyst is used in Haber's process?
   a. Cu b. Ag
   c. Au d. Fe

2. When [S] << K_M, the rate, r of the enzyme catalyzed reaction is given by
   a. V_{max} b. $\frac{V_{max}}{2}$
   c. $\frac{V_{max}[S]}{K_M}$ d. None of the above

3. Which of the following catalyst is used in Contact's process?
   a. Fe_2O_3 b. Cr_2O_3
   c. V_2O_5 d. ZnO

4. When a catalyst is used in a reaction, which of the following changes?
   a. Heat of reaction b. Product of reaction
   c. Equilibrium constant d. Activation energy

5. Substances that decrease the activity of a catalyst are known as
   a. Controllers b. Promoters
   c. Poisons d. Initiators

6. The "adsorption isobar" is defined as dependence of
   a. Surface coverage on the temperature at fixed pressure
   b. Surface coverage on the pressure at fixed temperature
   c. Surface coverage at constant pressure and temperature
   d. None of the above

7. Which of the following is not the characteristics of Physical Adsorption
   a. It is a multilayer phenomena b. It is reversible in nature
   c. The particles of the adsorbate are held to the surface of the adsorbent by the by Chemical forces d. None of the above

8. Increase in ---------- of the adsorbent increases the total amount of the gas adsorbed.
   a. Density b. Volume
   c. Surface area d. Surface tension

9. The term 'sorption' stands for _____.
   a. Absorption
   b. adsorption
   c. Both absorption and adsorption
   d. desorption

10. Which is not correct regarding the adsorption of a gas on surface of solid?
   a. On increasing temperature adsorption increases continuously
   b. Enthalpy and entropy change is negative
   c. Adsorption is more for some specific substance
   d. Reversible

11. For the reaction 2A + B → 3C + D. Which of the following does not express the reaction rate?
   a. – d[C]/3dt
   b. – d[B]/dt
   c. d[D]/dt
   d. – d[A]/2dt

12. $3A \longrightarrow B+C$ It would be a zero order reaction, when
   a. the rate of reaction is proportional to square of concentration of *A*
   b. the rate of reaction remains same atany concentration of *A*
   c. the rate remains unchanged at any concentration of *B* and *C*
   d. the rate of reaction doubles ifconcentration of *B* is increased todouble

13. Consider the Arrhenius equation given below and mark the correct option $k = A.\ e^{-Ea/RT}$
   a. Rate constant increases exponentially with increasing activation energy and decreasing temperature.
   b. Rate constant decreases exponentially with increasing activation energy and decreasing temperature
   c. Rate constant increases exponentially with decreasing activation energy and decreasing temperature
   d. Rate constant increases exponentially with decreasing activation energy and increasing temperature.

14. Which of the following statements are applicable to a balanced chemical equation of an elementary reaction?
   a. Molecularity can never be zero.
   b. Order is less than the molecularity
   c. Order is greater than the molecularity.
   d. None of the above

15. Freundlich adsorption isotherm is given by the expression $x/m = kp^{1/n}$, which of the following conclusions can be drawn from this expression
   a. When $1/n = 0$, the adsorption is independent of pressure
   b. When $1/n = 0$, the adsorption is directly proportional to pressure
   c. When $n = 0$, plot of x/m vs p is a curve
   d. None of the above.

16. The temperature at which a compound melts into a liquid of the same composition as the solid is called the:
   a. Congruent melting point
   b. Incongruent melting point
   c. Peritectic point
   d. Eutectic point

17. How is the distribution among two or more phases at equilibrium determined by?
    a. Application of entropy
    b. Application of Newton's laws of motion
    c. Application of Gibbs free energy
    d. Application of force

18. The number of components for the system $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$
    a. 0
    b. 3
    c. 1
    d. 2

19. It is not possible to liquify CO_2 by cooling below_____atm pressure.
    a. 3.5
    b. 2.6
    c. 5.2
    d. 1

20. In terms of number of phases (P), components (C), and degrees of freedom (F), the phase rule is expressed as:
    a. P+C=F+2
    b. F=P+C-2
    c. P+F=C+2
    d. P-F=C+2

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PART-B : Descriptive

Time : 2 hrs. 30 min. **Marks : 50**

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

1. **a.** What do you mean by catalyst promoter and catalyst poison?Give example of each of them. **3+4+3 =10**

   b. Describe Freundlich adsorption isotherm? What are the limitations of this isotherm? Write the relation between extent of adsorption with pressure at a constant temperature?

   c. Define phase and component and degree of freedom.

2. **a.** What are the advantages on using nanoparticles as catalyst? What are the merits and demerits of nanoparticles in heterogeneous catalysis? **4+3+3 =10**

   b. Describe the phase diagram of lead-silver system.

3. **a.** What are the different steps involve in Langmuir-Hinshelwood mechanism of heterogeneous catalysis? Give two examples of each of the acid-catalyzed and base-catalyzed reaction. **3+2+2+3 =10**

   b. What is meant by turn over number of an enzyme? The rate of an enzyme catalyzed reaction is 35 μmol/min at [S] = 10^{-4} M, (K_M = 2×10^{-5}. Calculate the velocity at [S] = 2×10^{-6} M.

4. **a.** Why the adsorption occurs? Explain. **2+2+2+2 +2= 10**

   b. Write the difference between physical adsorption and chemical adsorption.

   c. What is the role of adsorption in heterogeneous catalysis?

   d. What is an adsorption isotherm and isobar?

   e. The adsorption of a gas is described by Langmuir adsorption isotherm with the equilibrium constant k = 0.9 $K.Pa^{-1}$ at 25 °C. Calculate the pressure in K.Pa at which fractional surface coverage is 0.95.

5. **a.** Write the postulates of Langmuir Adsorption isotherm. **3+2+2+3 =10**

b. If the rate of a reaction is equal tothe rate constant, Find the order of the reaction.

c. Write the Arrhenius equation and explain its importance.

d. Write the collision theory of reaction rates? Write the equation of rate constants in terms of collision theory.

6. **a.** Write the difference between order and molecularity of a reaction. **2+3+3+2 =10**

b. Derive the integrated rate expression for a second order reaction of type $2A \rightarrow P$.

c. The rate constant for a first order reaction is $k = 1\ s^{-1}$, calculate the time (t) required for the completion of 99% of the reaction.

d. Write the units of the rate constants for a 3/2 order and 1st order reaction.

7. **a.** What is steady state approximation? Explain its applications. **3+2+5 =10**

b. The plot of concentration of the reactant versustime for a reaction is a straight line with a negative slope. Find the order of the reaction.

c. State the lever rule. Describe the phase diagram of a 3-component system.

8. **a.** Give the expressions for the following: **2+2+6 =10**

   i. Clausius-Clapeyron equation

   ii. Gibbs-Duhem-Marghules equation

b. What is Critical Solution Temperature? Give an example.

c. Determine the number of components, the number of phases, and the degrees of freedom in the following equilibria:

i. $NH_4Cl\ (s) \rightleftharpoons NH_3\ (g) + HCl\ (g)$ when $p_{NH_3} = p_{HCl}$

ii. $NH_4Cl\ (s) \rightleftharpoons NH_3\ (g) + HCl\ (g)$ when $p_{NH_3} \neq p_{HCl}$

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