


**NAVRACHANA  
UNIVERSITY**
*a UGC recognized University*

School: School of Science  
 Program: B.Sc. in Chemistry  
 Year: 3<sup>rd</sup> Semester: V  
 Examination: End Semester Examination  
 Examination year: December - 2022

Course Code: CH302

Course Name: Phase Equilibria, Chemical Kinetics &amp; Catalysis

Date: 12/12/2022

Total Marks: 40

Time: 14:30 am to 16:30 pm

Total Pages: 2

**Instructions:**

- Write each answer on a new page.  
 → Use of a calculator is not required.  
 → \* COs=Course Outcome mapping. # BTL=Bloom's Taxonomy Level mapping

Q. No.	Details	Marks	COs*	BTL#
Q.1	<b>Answer the following</b> 1) Acid catalyzed hydrolysis of methyl acetate is a pseudo first order reaction. Justify. 2) Copper (Cu) and gold (Au) can form wide range of solid solution whereas tin (Sn) and antimony (Sb) cannot. 3) Define the terms adsorption and absorption. Distinguish between chemical adsorption and physical adsorption. Discuss the various applications of adsorption in industry and in everyday life.	9	CO1, CO2, CO5	BT1, BT2, BT3, BT4, BT5
Q.2	<b>Chose the most appropriate answer from the options provided</b> A. On a two component solid-liquid phase diagram, an isopleth indicates which of the following? a) A region where the temperature is constant b) An area below which only the solid phase exists c) An area above which only the liquid phase exists d) A region where the composition of the system is constant B. A reaction involving gaseous reactants requires the presence of a strip of Rhodium in the reaction vessel. This is an example of what kind of catalysis? a. Homogeneous b. Autocatalysis c. Biocatalysis d. Heterogeneous C. The promoters added to the iron catalyst used in Haber process for synthesis of ammonia are a) K <sub>2</sub> O, Al <sub>2</sub> O <sub>3</sub> and CaO    b) K <sub>2</sub> O, Al <sub>2</sub> O <sub>3</sub> and CeO <sub>2</sub> c) SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> and CaO    d) K <sub>2</sub> O, Al <sub>2</sub> O <sub>3</sub> and BaO D. A saturated solution of sodium chloride is a a) one phase system b) two phase system c) three phase system d) none of these	4	CO1, CO2, CO3, CO4	BT1, BT2, BT3, BT4

**Q.3 Answer the following in detail (Any three)**

- A. State Gibbs Phase Rule. Define the terms involved in Gibbs Phase Rule. Draw the phase diagram of one-component system involving a vapour phase (water system) and label the regions accordingly. Discuss the phase transitions involved. State and explain applications of water phase diagram.
- B. What do you understand by a second order reaction? Cite a chemical reaction that follows second order reaction kinetics. Derive the integrated rate law expression for a second-order reaction when both the reactants are same and express the units of rate constant. Derive expression for the half life of a second-order reaction.
- C. Draw a detailed energy profile diagram for an exothermic reaction. Define activation energy on the basis of this diagram. Illustrate the reaction involving use of catalyst and its effect on activation energy.
- D. Draw neatly the phase diagram of a simple eutectic system (two component system) and label the regions. Define: Eutectic Point, Eutectic Composition and Eutectic Temperature. Explain the significance of this diagram in separation of metals from their mixture.

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CO1,  
CO2,  
CO3,  
CO4BT1,  
BT2,  
BT3,  
BT4,  
BT5**Q.4 Answer the following.**

- 1) The rate constant of a chemical reaction doubles for an increase of 10 K in absolute temperature from 298 K. Calculate  $E_a$ . Given that  $R=8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ .
- 2) 5 ml of Methyl acetate was added to a flask containing 100 ml of 0.1M HCl placed in a thermostat water bath maintained at 303 K. 5 ml of the reaction mixture was withdrawn at different time intervals and after chilling, titrated against a standard solution of sodium hydroxide. The following data were obtained:

<b>Time (minutes)</b>	<b>0</b>	<b>75</b>	<b>120</b>	<b>180</b>	<b><math>\infty</math></b>
<b>ml of NaOH used</b>	<b>9.6</b>	<b>12.1</b>	<b>13.1</b>	<b>14.8</b>	<b>21.1</b>

From the above data, prove that the hydrolysis of methyl acetate is a first-order reaction.

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CO3,  
CO4BT1,  
BT2,  
BT3,  
BT4,  
BT5