

Parvatibai Chowgule College of Arts and Science

Autonomous

B.Sc. Semester End Examination, February 2022

Semester: III

Subject: Chemistry

Course Title: Surface Chemistry and Catalysis (Elective)

Duration: 2 Hours

Maximum Marks: 45

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- Instructions:** 1. All Questions Are Compulsory.
2. Figures To The Right Indicate Full Marks.
3. Use Of Calculators Is Allowed.
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Q. 1 Answer ANY THREE from the following:

- i) State the effect of temperature and time on sintering process. **3**
- ii) Explain the effect of surface heterogeneity on surface energy of a crystal. **3**
- iii) Write a note on zeolites. **3**
- iv) What is a Wulff plot? State its limitations. **3**

Q. 2 Answer ANY TWO from the following:

- A. i)** Using the B. E. T. equation, how one can determine the volume of a unimolecular layer of gas adsorbed on a solid. **3**
- ii) Explain the role of 'rate of dissolution method' to determine the surface area of a solid. **3**
- B. i)** Using the Freundlich Adsorption Isotherm equation, evaluate the constant terms K and n involved. **3**
- ii) Explain: Types of adsorptions from solution. **3**
- C. i)** Using Langmuir's Adsorption Isotherm equation, evaluate the constant terms a and b involved. **3**
- ii) Describe: Classification of adsorbent pores based on the width. **3**

Q. 3 Answer ANY TWO from the following:

- A.** For a bimolecular surface reaction involving gaseous reactants A and B, depict the elementary processes leading to formation of product(s) and give only expression for rate of reaction. (Derivation not needed)
Based on rate expression, predict the mechanistic behaviour for the following cases:
x. Both A and B are very slightly adsorbed.

- y. A is relatively strongly adsorbed than B.
- z. A is very strongly adsorbed. 6
- B.** Explain the Michaelis-Menten kinetics of an enzyme catalysed reaction. 6
- C. i)** Explain the mechanism for the acid base catalyzed transformation of alpha glucose to beta glucose. 3
- ii)** For the kinetics of acid base catalysis, prove that, rate of reaction = $K'[H^+][S]$. 3
- Q. 4 Answer ANY ONE from the following:**
- A. i)** Predict the rate determining steps apart from surface area for the following dissolution processes:
- x. Dissolution of a soluble solid
- y. Dissolution involving chemical reaction
- z. Dissolution involving chemical attack 3
- ii)** Depict the various ways to reduce surface energy for a given surface with a fixed surface area. 3
- iii)** The volume of nitrogen gas at 1.0 atmosphere and 273 K required to cover 1.0 g of the silica gel is 0.129 L. Calculate the surface area of the gel, if each nitrogen molecule occupies an area of $16.2 \times 10^{-20} \text{ m}^2$. [$N_A = 6.02 \times 10^{23} \text{ mole}^{-1}$] 3
- iv)** Antibiotics are prescribed by medical practitioners for a patient suffering from bacterial infection. Justify and depict the phenomena graphically. 3
- B. i)** Justify why sintering of catalysts is not desired and suggest ways to counter its effect. 3
- ii)** Unlike liquids, surface tension may not be same as surface stress in case of solids. Justify. 3
- iii)** Explain the general calculation involved in the determination of the radius of adsorbed gas molecule and hence the total surface area covered by gas molecules to form mono molecular layer. 3
- iv)** For the rate constant of a reaction catalyzed by H^+ , prove that the graph of $\log K$ against pH is a straight line with slope = -1, 3
