LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **CHEMISTRY**

SECOND SEMESTER – **APRIL 2022**

PCH 2602 – SURFACE CHEMISTRY AND CATALYSIS

Date: 24-06-2022 Dept. No. Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

Part – A

Answer ALL Questions. **(10 × 2 = 20)**

1. The adsorption of gas follows the Langmuir isotherm with K = 0.9 Pa^{-1} and Θ = 0.95. Calculate the pressure of the gas at 25 °C.
2. Give the Harkins-Jura equation. Mention its significances.
3. Show graphically how the physical properties of solution of surfactants change at CMC.
4. Define kraft temperature.
5. Differentiate turnover number and turnover frequency.
6. Write the Hammett acidity function for strong base.
7. Mention the criteria for a semiconductor to act as a photocatalyst.
8. Write any two applications of biocatalyst.
9. How is porosity of a substance determined?
10. What is surface plasmon resonance?

Part – B

Answer any EIGHT Questions. **(8 × 5= 40)**

11. How does chemisorption differ from physisorption?
12. Discuss the kinetics of bimolecular surface reaction occurring by Langmuir-Rideal mechanism.
13. At 0 °C and 1atm pressure the volume of N_2 gas required to form a monolayer on a sample of charcoal is 155.5 cm^3g^{-1} of charcoal. Calculate the surface area per gram of charcoal. Area of cross section of N_2 molecule is 16 x 10^{-20} m^2.
14. Compare and contrast micellar catalysis and enzyme catalysis.
15. Discuss the classification of surfactants with suitable examples.
16. Explain the thermodynamic interpretation of catalysis using the activated complex theory.
17. Derive the overall rate equation of the acid-base catalyzed reaction.
18. How is acidity function related to rate coefficient of specific acid catalysis?
19. Explain the degradation mechanism of dyes using TiO_2 photocatalyst.
20. Write the mechanism of acid-base biocatalysis with suitable examples.
21. How is the surface area of solid adsorbents determined using the BET method?
22. Discuss the role of Kelvin equation in pore size distribution measurement.

Part – C

Answer any FOUR Questions. **(4 × 10 = 40)**

23a. Derive the Langmuir adsorption isotherm equation for two substances competitively adsorbed on a surface. (5)

b. Calculate the standard free energy change for adsorption at 298 K and 1 atmosphere pressure if 50% of the total surface of silica gel covered by N_2. (5)

24a. How are surfactants selected as emulsifying agent by HLB and PIT method?

b. What are mesoporous materials? Give a detailed account of liquid crystal templating mechanism.

25. Derive the Bronsted equations from Hammett equation.

26. Discuss the mechanism of non-oxidative and oxidative ethylbenzene dehydrogenation reaction.

27a. Describe the construction and working of the Honda-Fujishima cell for the electrolysis of water. (5)

b. Discuss the mechanism of covalent biocatalysis with a suitable example.

28. Discuss the principle of XPS. How is an XPS spectrum analyzed? (5)

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