22/10/25

TM2538896H

Reg. No :.....

Name :.....

MASTER'S DEGREE (C.S.S) EXAMINATION, OCTOBER 2025

2024 ADMISSIONS REGULAR

SEMESTER III - CORE COURSE

CH3C11TM20 - Chemical Kinetics, Surface Chemistry and Photophysics

Time : 3 Hours

Maximum Weight : 30

Part A

I. Answer any Eight questions. Each question carries 1 weight (8x1=8)

1. Explain the concept of branching chain reactions and how they differ from non-branched chain reactions.
2. Define steric factor. Explain its relation with entropy of activation.
3. Explain the characteristics of enzyme catalyzed reaction.
4. Define potential energy surface. How does it relate to chemical reactions?
5. Presence of H_2S is essential in As_2S_3 sol, though H_2S ionizes. Explain.
6. Record the disadvantages of SPM.
7. Show that BET isotherm reduces to Langmuir adsorption isotherm under limiting conditions.
8. Explain the principle laws of photochemistry
9. Discuss the main causes of ozone layer depletion. Outline the protective measures.
10. Discuss quenching of fluorescence at molecular level.

Part B

II. Answer any Six questions. Each question carries 2 weight (6x2=12)

11. In the temperature range of 250-450K, the pre- exponential factor, A for the reaction $Cl_{(g)} + H_{2(g)} \rightarrow HCl_{(g)} + H_{(g)}$ is found to be equal to 1.20×10^{10} dm^3 $mol^{-1}S^{-1}$. Given molecular masses (Cl = 35.453gmol^{-1}, H_2 = 2.016gmol^{-1}), collision diameters (Cl = 200 pm, H_2 = 150pm) Determine the steric factor, P.
12. Discuss the mechanism of specific acid and specific base catalysis.
13. Discuss the effect of dielectric constant on reactions in solutions.
14. Derive the microcanonical rate constant of unimolecular reactions using RRKM theory.
15. A monolayer of N_2 molecule (effective area 0.162nm^2) is adsorbed on the surface of 1 g of an Fe/Al_2O_3 catalyst at 77 K, the boiling point of liquid nitrogen occupies 2.86 cm^{-3} at 0^{o}C and 1 atm pressure. Compute the surface area of the catalyst.
16. Observe the important applications of Zeta potential.
17. Explain the principle and theory of lasers in photochemical kinetics.
18. Discuss fluorescence. Structural variations in molecules influence the property of fluorescence. Explain.

Part C

III. Answer any Two questions. Each question carries 5 weight (2x5=10)

19. (a) Discuss the salient features of RRKM theory and explain how these features enhance our understanding of unimolecular reactions. (b) Discuss the effect of pH on enzyme catalyzed reaction.
20. (a) Explain the lower and upper explosion limits in $H_2 - O_2$ reaction. (b) Describe flash photolysis method for studying fast reactions.

21. Explain the following about AFM a) AFM probe b) imaging modes c) applications d) advantages and disadvantages.
22. (a) Explain fluorescence quenching, including concentration, static and collisional quenching mechanisms. (b) Derive Stern-Volmer equation.