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M.Sc. DEGREE (C.S.S.) EXAMINATION, NOVEMBER 2019

Third Semester

Faculty of Science

Branch III—Pure Chemistry

CH3C11—CHEMICAL KINETICS, SURFACE CHEMISTRY AND PHOTOCHEMISTRY

(2012—2018 Admissions)

Time : Three Hours   Maximum Weight : 30

Part A

Answer any **ten** *questions.*
Each question carries a weight of 1.

1. What is entropy of activation $\Delta S^{\ddagger}$? What is its significance in deciding the rate of the reaction ?

2. Explain the use of ESR in the study of fast reactions.

3. What is kinetic isotopic effect ? Explain using a suitable example.

4. Give the Eyring equation. Explain the terms involved.

5. What is Cage effect ? Explain giving suitable examples.

6. What are micelles ? Explain its role in cleansing clothes.

7. What is Zeta potential ? How it is related to the stability of colloids.

8. Define :

    (a) Number average molar mass.

    (b) Mass average molar mass.

9. Give Gibbs adsorption isotherm. Explain the terms used in the equation.

10. What are surfactants ? Explain their important uses.

11. Define the term quantum yield. Explain the significance of low and high quantum yield values seen in some reactions.

12. What are excimers and exciplexs ?

13. Explain the use of lasers in studying the kinetics of photochemical reactions.

(10 × 1 = 10)

Turn over

Section B

*Answer* **five** *questions by attempting not more than 3 from each bunch.*
Each question carries a weight of 2.

BUNCH 1

14. What is Green house effect ? Explain the practical applications in agriculture.

15. Explain the use of osmotic pressure measurements in determining the molecular mass of macromolecules.

16. Derive a rate equation for the dimerisation of Anthracene.

17. Write down the derivation of BET isotherm for multilayer adsorption.

BUNCH 2

18. The energy of activation of a non-catalysed reaction at 37°C is 85 kJ mol^{-1} and the activation energy for the same reaction catalysed by enzyme is 25 kJ mol^{-1}. Calculate the ratio of the rate constants of the two reactions.

19. In the temperature range of 250K-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}. (molecular masses Cl = 35.453 g mol^{-1} , H$_2$ = 2.016 g mol^{-1} collision diameters Cl = 200 p.m., H$_2$ = 150 p.m.) Determine the steric factor, P.

20. Consider the following mechanism for an enzyme catalysed reaction.

$$E + S \underset{K^{-1}}{\overset{K_1}{\rightleftharpoons}} ES \qquad ES \overset{K_2}{\longrightarrow} EP \qquad EP \overset{K_3}{\longrightarrow} E + P$$
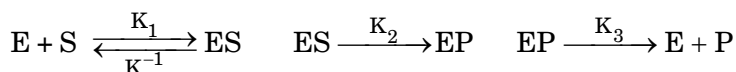
E-enzyme   S-Substrate   EP-enzyme product complex.
Using steady state approximation, show that

$$r = \frac{K_2 (E)_0 (S)}{\left(K_{-1} + K_2\right)\big/ K_1 + 1 + \dfrac{K_2}{K_3} (S)}.$$

21. At 0°C and 1 atm pressure, the volume of nitrogen gas required to cover a sample of silica gel, assuming Langmuir monolayer adsorption, is found to be 130 cm^3 g^{-1} of the gel. Calculate the surface area per gram of silica gel. Given that the area occupied by a nitrogen molecule is 0.162 (nm)^3.

$(5 \times 2 = 10)$

Section C

Answer any **two** *questions.*
Each question carries a weight of 5.

22. Discuss briefly on the following (a) Semenov-Hinshelwood mechanism of explosive reactions ; (b) Kinetics of anionic and cationic polymerisations ; (c) Skrabal diagrams.

23. Write briefly on Enzyme catalysis. Give Michelis-Menten equation. Explain the effect of pH and temperature on enzyme catalysis.

24. Write notes on (a) Surface Enhanced Raman Scattering ; (b) Donnan membrane equilibrium ; (c) Stern-Volmer equation.

25. Explain the different ways of utilisation of solar energy with special reference to solar cells and their working.

$(2 \times 5 = 10)$