TDC (CBCS) Odd Semester Exam., 2023

CHEMISTRY

(Honours)

(3rd Semester)

Course No. : CHMHCC-303T

(Phase Equilibria and Chemical Kinetics)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer *ten* questions, selecting any *two* from each Unit : 2×10=20

UNIT—I

1. Define the term 'phase' and calculate the degree of freedom for the following system : 1+1=2

$$H_2O(s) \rightleftharpoons H_2O(l) \rightleftharpoons H_2O(g)$$

2. Derive Clapeyron-Clausius equation for liquid-vapour equilibrium.

3. Define eutectic point and give example of a eutectic mixture. 1+1=2

UNIT—II

4. Show that for an ideal solution the enthalpy of mixing (ΔH_{mix}) is zero.

5. Discuss the variation of vapour pressure of completely miscible liquid pair with composition.

6. Define azeotropic mixture and give one example of it.

UNIT—III

7. Explain the graphical method to determine the rate constant of first-order reaction.

8. Rate of reaction increases two times when its temperature increases from 295 K to 305 K. Estimate activation energy.

9. What do you understand by pseudo first-order reaction? Give one example.

UNIT—IV

10. What are the general characteristics of catalyst?

11. What is autocatalyst? Explain with an example.

12. Name the catalyst and promoter for the manufacture of ammonia by Haber process. Write the reaction. 1+1=2

UNIT—V

13. What are the basic differences between absorption and adsorption processes?

14. What will be the effects of temperature and surface area of adsorbent on adsorption process?

15. What will be the limitation of Freundlich adsorption isotherm?

SECTION—B

Answer *five* questions, selecting *one* from each Unit : 6×5=30

UNIT—I

16. Explain the phase diagram of water in detail. Define triple point. 5+1=6

17. *(a)* Explain congruent melting point with the help of phase diagram of Zn-Mg system. 3

(b) Derive Gibbs' phase rule. 3

UNIT—II

18. Derive Gibbs-Duhem-Margules equation. Show that in a binary solution, if one component obeys Raoult's law then the other component also obey the same. 4+2=6

19. *(a)* State Nernst distribution law. Derive this law from thermodynamic consideration. 2+2=4

(b) Explain why it is difficult to separate azeotropic mixture by fractional distillation. 2

UNIT—III

20. *(a)* Obtain an expression of rate constant of opposing or reversible reaction. 4

(b) What will be the effect of presence of a catalyst on the activation energy of the reaction? 2

21. *(a)* Derive an expression for rate constant of a second-order reaction and show that its $t_{½}$ is inversely proportional to the initial concentration of the reactant. 2+1=3

(b) The rate constant of a second-order reaction is $5{\cdot}70\times10^{-5}\ dm^3\ mol^{-1}\ s^{-1}$ at 25 °C and $1{\cdot}64\times10^{-4}\ dm^3\ mol^{-1}s^{-1}$ at 40 °C. Calculate the activation energy and the Arrhenius pre-exponential factor. 3

UNIT—IV

22. *(a)* Differentiate between homogeneous and heterogeneous catalysis. Give one example of each. 2+2=4

(b) What is turnover number? Explain. 2

23. *(a)* Describe the mechanism of heterogeneous catalyzed reaction at solid surface. 4

(b) Explain the factors that affect enzyme catalysis. 2

UNIT—V

24. *(a)* Explain why Freundlich absorption isotherm is applicable for low pressure of gas. What will happen if the pressure rises? 2+2=4

(b) Define chemisorption. Give one application of chemisorption. 1+1=2

25. *(a)* What are the basic assumptions of Langmuir adsorption isotherm? Explain the variation of adsorption of gas on solid at different pressures of gas. 2+2=4

(b) Explain why chemisorption is irreversible and physisorption is reversible process. 2

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