2021/TDC/CBCS/ODD/
CHMHCC–303T/290

TDC (CBCS) Odd Semester Exam., 2021
held in March, 2022

CHEMISTRY

(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 any *ten* from the following : $2 \times 10 = 20$

1. What is reduced phase rule? When is it applied? $1+1=2$

2. Calculate the number of components and degree of freedom of the following equilibrium :

$$NH_4Cl\,(s) \rightleftharpoons NH_3\,(g) + HCl\,(g)$$

(Turn Over)

(2)

3. Explain with the help of Clapeyron-Clausius equation the effect of pressure on the boiling point of water.

4. Derive a statement of Raoult's law with the help of Gibbs-Duhem-Margules equation for ideal binary solution.

5. State and explain lever rule.

6. What are the differences between ideal solution and non-ideal solution?

7. Explain how temperature and use of catalyst affect the reaction rate. 1+1=2

8. A first-order reaction is half complete in half-an-hour. How much will it be complete in one hour?

9. Calculate the activation energy of a reaction whose rate constant is triple by 10° rise in temperature in the vicinity of 27 °C.

10. What is the difference between auto-catalyst and promoters? Give example to each.

(3)

11. Why is heterogeneous catalysis preferred over homogeneous catalysis? Explain.

12. What are the properties of enzymes that make them a biocatalyst? Give example of an enzyme catalyzed reaction. 1+1=2

13. What are the factors that affect adsorption of gas on solid surface?

14. Physisorption is reversible while chemi-sorption is irreversible. Why?

15. What is adsorption isotherm? How are they useful in study of adsorption?

SECTION—B

Answer any *five* from the following : 6×5=30

16. (a) Derive Gibbs' phase rule thermo-dynamically. 3

    (b) Define incongruent melting point and explain it with the help of Zn-Mg system. 1+2=3

17. (a) Discuss the phase diagram of Pb-Ag system. 3

(4)

(b) For liquid-vapour equilibrium, show that

$$\ln\frac{P_2}{P_1} = \frac{\Delta H_v}{R}\frac{[T_2 - T_1]}{[T_1 T_2]}$$

Symbols have their usual meanings. 3

18. (a) What are the different types of binary solutions? Derive Gibbs-Duhem-Margules equation for binary liquids. 1+2=3

(b) Explain Raoult's law by using vapour-pressure composition plot of ideal solution. 3

19. (a) Define minimum and maximum boiling azeotropes. Give example of each. 3

(b) Discuss upper critical solution temperature (UCST) with the help of phenol-water system. 3

20. (a) Discuss activated complex theory of bi-molecular reaction. 3

(b) The rate constant of a second-order reaction is $5 \cdot 70 \times 10^{-5}$ dm^3 mol^{-1} s^{-1} at 25 °C and $1 \cdot 64 \times 10^{-4}$ dm^3 mol^{-1} s^{-1} at 40 °C. Calculate the activation energy and the Arrhenius pre-exponential factor. 3

(5)

21. (a) Discuss the kinetics of reversible reaction. 3

(b) Write short notes on the following : 1½×2=3

(i) Steady-state approximation

(ii) Chain reaction

22. (a) Describe the mechanism of heterogeneous catalyzed reaction at solid surface. 3

(b) Discuss the kinetics of enzyme-catalyzed reaction. 3

23. (a) Enzymes are selective in nature. Explain with an example. 2

(b) What will be the effect of pH and substrate concentration on enzyme catalysis? 1+1=2

(c) Write a short note on acid-base catalysis. 2

24. (a) Explain how surface area and temperature affect the adsorption of gas on solid. 1½+1½=3

(b) State three applications of adsorption process. 3

25. *(a)* Derive an expression for Langmuir adsorption isotherm. 3

(b) Why is Freundlich adsorption isotherm applicable only for low pressure of gas? What will happen if the pressure rises?

$1\frac{1}{2}+1\frac{1}{2}=3$

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