

**3 SEM TDC CHMH (CBCS) C 7**

**2023**

( Nov/Dec )

**CHEMISTRY**

( Core )

Paper : C-7

( **Physical Chemistry** )

*Full Marks : 53*

*Pass Marks : 21*

*Time : 3 hours*

*The figures in the margin indicate full marks  
for the questions*

1. Choose the correct answer from the following : 1×5=5

(a) For a reaction  $A + B \rightarrow C + D$ , doubling the concentration of both the reactants increases the reaction rate by 8 times and doubling the concentration of only  $B$  simply doubles the reaction rate. The rate law is given as

(i)  $r = k[A]^{\frac{1}{2}}[B]^{\frac{1}{2}}$

(ii)  $r = k[A][B]^2$

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(iii)  $r = k[A]^2[B]$

(iv)  $r = k[A][B]$

(b) Sulphur can exist as sulphur rhombic, sulphur monoclinic, liquid sulphur (l) and sulphur vapour (g). The maximum number of phases which can coexist in equilibrium can be

(i) 3

(ii) 4

(iii) 1

(iv) 2

(c) A solute undergoes complete association in solvent 2 out of the two solvents 1 and 2. The distribution law equation that will be applicable is

(i)  $\frac{c_1}{c_2} = \text{constant}$

(ii)  $\frac{c_1}{\sqrt[n]{c_2}} = \text{constant}$

(iii) Depends upon the temperature

(iv)  $\frac{c_2}{\sqrt[n]{c_1}} = \text{constant}$

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(d) A plot of  $\log \frac{x}{m}$  versus  $\log p$  for the adsorption of a gas on a solid gives a straight line with slope equal to

(i)  $n$

(ii)  $\frac{1}{n}$

(iii)  $\log x$

(iv)  $-\log k$

(e) The  $E_a$  for the forward reaction is  $40 \text{ kJ mol}^{-1}$  and that for the reverse reaction is  $60 \text{ kJ mol}^{-1}$ . The reaction is

(i) exothermic

(ii) endothermic

(iii) chain reaction

(iv) spontaneous

2. Answer any five questions from the following : 2×5=10

(a) Show that the half-life period of a first-order reaction is independent of the initial concentration of the reactant.

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( Turn Over )

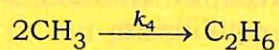
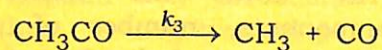
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- (b) Explain why the fusion curve of ice has a negative slope whereas the sublimation curve has a positive slope in the phase diagram of water.
- (c) A eutectic mixture has a definite composition and a sharp melting point, yet it is not a component. Give reason.
- (d) Distinguish between physical adsorption and chemical adsorption.
- (e) What are pseudounimolecular reactions? Give one example.
- (f) Explain the term 'autocatalysis' giving one example.
3. Answer any *two* questions from the following :  $6 \times 2 = 12$
- (a) (i) Draw and explain the phase diagram of water system. 4
- (ii) What is triple point? Distinguish between the triple point and the freezing point of a pure substance.  $1 + 1 = 2$
- (b) (i) Explain the terms 'phase', 'component' and 'degrees of freedom' with one example of each.  $3 + 1\frac{1}{2} = 4\frac{1}{2}$

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- (ii) Write down the number of components, number of phases and degrees of freedom for the following equilibrium :  $1\frac{1}{2}$
- $$\text{NH}_4\text{Cl(s)} \rightleftharpoons \text{NH}_3\text{(g)} + \text{HCl(g)}, P_{\text{NH}_3} \neq P_{\text{HCl}}$$
- (c) (i) Derive Gibbs-Duhem-Margules equation. 3
- (ii) What is CST? What happens to critical solution temperature on adding NaCl to phenol-water system? Write the effect of increasing pressure on a system having UCST as well as LCST.  $1 + 1 + 1 = 3$
4. Answer any *two* questions from the following :  $6 \times 2 = 12$
- (a) Deduce the integrated rate expression for the following second-order reaction :
- $$A + B \rightarrow \text{Product}$$
- Prove that when either A or B is taken in excess, then this second-order reaction shows first-order kinetics.  $4 + 2 = 6$
- (b) (i) For the pyrolysis of acetaldehyde
- $$\text{CH}_3\text{CHO} \xrightarrow{\Delta} \text{CH}_4 + \text{CO}, \quad \text{the}$$
- following mechanism is suggested :
- $$\text{CH}_3\text{CHO} \xrightarrow{k_1} \text{CH}_3 + \text{CHO}$$
- $$\text{CH}_3 + \text{CH}_3\text{CHO} \xrightarrow{k_2} \text{CH}_4 + \text{CH}_3\text{CO}$$

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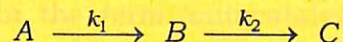


Show that the overall rate equation

is given by rate =  $k[\text{CH}_3\text{CHO}]^{\frac{3}{2}}$ . 4

(ii) Describe the half-life period method for determining the order of a reaction. 2

(c) Give one example of consecutive reaction. Discuss the kinetics of first-order consecutive reaction



Depict graphically the concentrations of A, B and C with time. 1+4+1=6

5. Answer any *two* questions from the following : 4½×2=9

(a) Discuss the mechanism of enzyme catalysis with the help of Michaelis-Menten equation. Define Michaelis constant. 3½+1=4½

(b) What is acid-base catalysis? Explain the theories of acid-base catalysis with suitable examples. 1+3½=4½

(c) (i) Explain the action of catalytic promoter with one example. 2

(ii) Write a brief note on nano-catalyst. 2½

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6. Answer any *one* question from the following : 5

(a) What are adsorption isotherms? Derive Freundlich adsorption isotherm equation and graphically represent the equation. Discuss the limitations of Freundlich adsorption isotherm. 1+2+2=5

(b) (i) Write the main assumptions of Langmuir adsorption isotherm. 2

(ii) Discuss the effect of pressure and temperature on the adsorption of gases on solids. 1½+1½=3

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