3 SEM TDC CHMH (CBCS) C 7

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(Held in April–May, 2021)

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. Select the correct answer from the following :

$1 \times 5 = 5$

(a) For a reaction $\frac{1}{2}A \rightarrow 2B$, rate of disappearance of A is related to the rate of appearance of B by the expression

(i) $\frac{d[A]}{dt} = \frac{1}{2}\frac{d[B]}{dt}$

(ii) $\frac{d[A]}{dt} = \frac{1}{4}\frac{d[B]}{dt}$

(*Turn Over*)

(2)

(iii) $\frac{d[A]}{dt} = \frac{d[B]}{dt}$

(iv) $\frac{d[A]}{dt} = 4\frac{d[B]}{dt}$

(b) The unit of rate constant of a reaction is $mol\, l^{-1}\, s^{-1}$. The order of the reaction is

(i) 0

(ii) 1

(iii) 2

(iv) 0·5

(c) The number of components, phases and degrees of freedom in silver and lead system at the eutectic point is

(i) 2, 2, 1

(ii) 1, 2, 2

(iii) 2, 1, 2

(iv) 2, 3, 0

(d) The adsorption theory explains

(i) homogeneous catalysis

(ii) acid-base catalysis

(iii) heterogeneous catalysis

(iv) enzyme catalysis

(*Continued*)

(3)

(e) During adsorption, the entropy of the system

  (i) increases

  (ii) decreases

  (iii) remains same

  (iv) first decreases and then increases

2. Answer the following questions :   2×5=10

(a) Discuss the efficiency of metal nano-particles as catalyst.

(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) Explain the terms 'components' and 'degrees of freedom'.

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

(e) Show that for a first-order reaction, time required for 99% completion is twice that for the time required for 90% completion of the reaction.

     (Turn Over)

(4)

UNIT—I

3. Answer any *two* questions from the following :   7½×2=15

(a) (i) Write down the number of components, number of phases and degrees of freedom for the following equilibria :   1½

$$NH_4Cl(s) \rightleftharpoons NH_3(g) \quad HCl(g),$$
$$P_{NH_3} \quad P_{HCl}$$
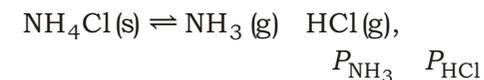
  (ii) Distinguish between the triple point and the freezing point of a pure substance.   2

  (iii) Draw and explain the phase diagram of a one-component system which contains more than one solid phase.   4

(b) (i) Draw the phase diagram of a simple eutectic system and label each zone and line. Describe the effect of cooling of liquid mixture of different compositions.   5½

  (ii) Explain congruent and incongruent melting points.   2

     (Continued)

(c) *(i)* What are azeotropes? Can we separate an azeotropic mixture by fractional distillation? Why is it not considered as a compound?

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

(ii) What is critical solution temperature? Describe different types of partially miscible liquids.

$1+3=4$

UNIT—II

4. Answer any *two* questions from the following : $5\times2=10$

(a) Discuss the collision theory of reaction rates. Write down its limitations. $4+1=5$

(b) For the thermal decomposition of O_3, the following mechanism has been suggested :

$$O_3 \xrightleftharpoons[k_{-1}]{k_1} O_2 + O$$

$$O_3 + O \xrightarrow{k_2} 2O_2$$
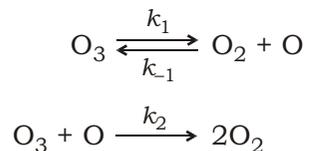
Assuming that $k_{-1}[O_2] \gg k_2[O_3]$, derive a rate expression for the reaction. How will you show that oxygen retards the rate of the reaction? $4+1=5$

(c) *(i)* Derive the integrated rate expression for the second-order reaction of the type $2A \longrightarrow$ products. $2\frac{1}{2}$

(ii) Deduce the expression for half-life period of such a reaction. $1\frac{1}{2}$

(iii) Give an example of such type of reaction. 1

UNIT—III

5. Answer any *two* questions from the following : $3\frac{1}{2}\times2=7$

(a) Deduce Michaelis-Menten equation for enzyme catalytic reaction. Define Michaelis constant. $2\frac{1}{2}+1=3\frac{1}{2}$

(b) What are homogeneous and heterogeneous catalyses? Give one example of each type of these catalyses. What are catalytic promoters?

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

(c) *(i)* What is autocatalysis? Give one example. $\frac{1}{2}+1=1\frac{1}{2}$

(ii) Briefly discuss acid-base catalysis. 2

UNIT—IV

6. *(a)* What are adsorption isotherms? Deduce Freundlich adsorption isotherm and present it graphically. $1+2+1=4$

(b) Write the differences between chemisorption and physisorption. 2

Or

Write the postulates of Langmuir adsorption isotherm.

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