3 (Sem–3 /CBCS) CHE HC 3

2021

(Held in 2022)

CHEMISTRY
(Honours)

Paper : CHE–HC–3036

(Physical Chemistry III)

Full Marks : 60

Time : Three hours

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

1. Answer the following as directed :   1×7 =7

   (i) A triple point is —

      (a) trivariant

      (b) bivariant

      (c) univariant

      (d) invariant

                 (Choose the correct option)

(ii) A compound with a congruent melting point melts into a liquid of —————— composition as the solid.

(Fill in the blanks with suitable word)

(iii) The minimum number of independent variables required to characterize the composition of each phase in a system is called degrees of freedom.

*(State **True or** False)*

(iv) Write the differential rate law for a zeroth order reaction.

(v) Give *one* example of a consecutive reaction.

(vi) Give *one* example of homogeneous catalysis.

(vii) What are adsorption isotherms ?

2. Answer the following questions :   2×4=8

(a) State and explain the phase rule for a non-reactive system.

(b) Distinguish between order and molecularity of a reaction.

(c) For the reaction $A + B \rightarrow C$, when the concentration of A is doubled, the rate of the reaction is doubled. But doubling the concentration of B does not change the rate of the reaction. Calculate the order of the reaction.

(d) In a reaction catalysed by metal, fine division of the metal increases the catalytic action. Explain.

3. Answer *any three* questions from the following :
      5×3=15

(a) Discuss the application of phase rule to the water system.   5

(b) (i) Explain what is meant by azeotropic mixture.   2

(ii) Explain the principle of steam distillation.   3

(c) (i) Derive an expression for rate constant of a zero-order reaction.   3

(ii) Give the characteristics of zero-order reaction.   2

(d) (i) Show that in a first order reaction the time required for completion of 99.9% of the reaction is ten times its half-life period. 3

(ii) Explain activation energy of a reaction. 2

(e) (i) What is catalysis ? 1

(ii) Depending on the role and nature of the catalyst used in a reaction, classify catalysts and give suitable examples for each of them. 4

4. Answer **any three** questions from the following : 10×3=30

(a) (i) Discuss the application of phase rule to the sulphur system. 5

(ii) Explain the term 'component'. How many components are present in the following systems ? 2+3=5

1. Water $\rightleftharpoons$ water vapour

2. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

3. $NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$

(b) (i) Define the terms congruent and incongruent melting points. 2

(ii) At 373.6 K and 372.6 K the vapour pressures of water are 1·018 atm and 0·982 atm respectively. Calculate the enthalpy of vapouration of water. 3

(iii) Define critical solution temperature (CST). Sketch and explain the curves showing upper CST and lower CST. Give suitable examples. 5

(c) (i) Derive the integrated rate law for the 2nd order reaction $A + B \rightarrow$ products.

Consider the initial concentrations of A and B be a and b $mol\,L^{-1}$ respectively. 4

(ii) Define activation energy. Give the significance of activation energy. Explain an experimental method to determine activation energy of a reaction. 1+2+3=6

(d) *(i)* Find the integrated rate law for the reaction

$$A \begin{array}{c} \xrightarrow{k_1} B \\ \xrightarrow{k_2} C \end{array}$$
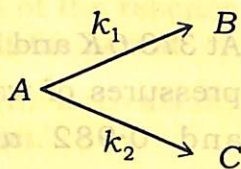
5

(ii) Explain the Lindemann mechanism of unimolecular gaseous decomposition reaction and find an expression for the rate of the reaction. 5

5. *(a)* Give the criteria of a catalyst. 4

(b) Give *one* example of heterogeneous catalysis. Describe the mechanism of the heterogeneous catalysis.

1+5=6

6. *(a)* Distinguish between physisorption and chemisorption. Give *one* example of each of the physisorption and the chemisorption. 3+2=5

(b) What is adsorption isotherm ? Write the Freundlich adsorption isotherm indicating different terms involved in it. How can the Freundlich isoterm be tested ? 1+2+2=5

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