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(November)

CHEMISTRY

(Major)

Course : 501

(Physical Chemistry—II)

(New Course)

Full Marks : 48
Pass Marks : 14

Time : 2 hours

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

1. Select the correct answer : 1×5=5

   (a) The equation for rate constant, is

   $$k = Ae^{-E_a/RT}$$

   The chemical reaction will proceed more rapidly, if there is a decrease in

   (i) k

   (ii) A

   (iii) T

   (iv) E_a

(Turn Over)

(b) The vapour pressure of a dilute aqueous solution of glucose is 740 mm of mercury at 373 K. The mole fraction of the solute is

(i) $\dfrac{1}{20}$

(ii) $\dfrac{1}{38}$

(iii) $\dfrac{1}{76}$

(iv) $\dfrac{1}{740}$

(c) The function of alum used for the purification of water is to

(i) coagulate the sol particles

(ii) disperse the sol particles

(iii) emulsify the sol particles

(iv) absorb the sol particles

(d) In gas masks, the poisonous gases are adsorbed by activated charcoal. The activated charcoal acts as

(i) adsorbate

(ii) adsorbent

(iii) catalyst

(iv) All of the above

(e) 0·01 M solution each of urea, common salt and sodium sulphate are taken, the ratio of depressions in freezing point of these solutions is

(i) 1 : 1 : 1

(ii) 1 : 2 : 1

(iii) 1 : 2 : 3

(iv) 2 : 2 : 3

2. Answer any *five* questions : 2×5=10

(a) Describe one method for determining the order of a reaction.

(b) When a gas is adsorbed by a solid sample, then both the enthalpy and entropy of the system decrease. Explain.

(c) State and explain Nernst distribution law.

(d) The rate constant for a reaction of zero order with respect to reactant A is 0·0030 mol l^{-1} s^{-1}. How long will it take for the initial concentration of A to fall from 0·10 M to 0·075 M?

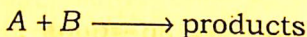(e) Explain what is observed when an electrolyte NaCl is added to hydrated ferric oxide sol.

(f) Describe the cleansing action of soaps on the basis of micelle formation.

(g) What is chemical potential? Mention its significance.

UNIT—I

3. Answer any *two* questions : 6×2=12

(a) Deduce the integrated rate expression of the following second-order reaction :

$$A + B \longrightarrow \text{products}$$

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) Describe Lindemann's theory of unimolecular gas phase reaction. 5

(ii) Give one example of zero-order reaction. 1

(c) (i) What is steady-state approximation? 1

(ii) For the reaction $2NO + Cl_2 = 2NOCl$, following mechanism has been proposed

$$NO + Cl_2 \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} NOCl_2$$

$$NO + NOCl_2 \overset{k_2}{\longrightarrow} 2NOCl$$
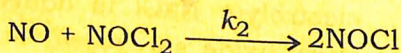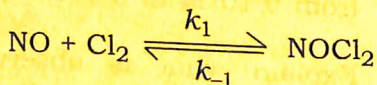
Show that the overall rate of the reaction is given by $k\,[NO]^2\,[Cl_2]$ assuming $k_2\,[NO] \ll k_{-1}$. 5

UNIT—II

4. Answer any *one* question : 5

(a) What is solvent extraction? Show that multistep extraction is more economical than single-step extraction. 1+4=5

(b) (i) Discuss how the elevation of boiling point of a solution of non-volatile, non-electrolyte solute is related to the molecular mass of the solute. 3

(ii) Determine the number of mol of $CaCl_2$ $(i = 2 \cdot 47)$ dissolved in $2 \cdot 5$ litre of water such that its osmotic pressure is $0 \cdot 75$ atm at 27 °C. 2

UNIT—III

5. Answer any *two* questions : 3½×2=7
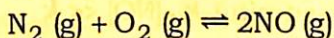
(a) State and explain Le Chatelier's principle. 3½

(b) Derive Duhem-Margules equation. 3½

(c) (i) What is fugacity? Write its physical significance. 1+1½=2½

(*Turn Over*)

(ii) Write the effect of pressure on the following equilibrium : 1

$$N_2 \text{ (g)} + O_2 \text{ (g)} \rightleftharpoons 2NO \text{ (g)}$$

UNIT—IV

6. Answer any *one* question : 4

(a) Write the postulates of Langmuir adsorption isotherm. Also write four important applications of adsorption.

2+2=4

(b) Derive Gibbs' adsorption equation for the adsorption of a solute on the surface of a liquid. 4

UNIT—V

7. Answer any *one* question : 5

(a) *(i)* What is peptization? Explain with example. 2

(ii) Write the differences between lyophilic sol and lyophobic sol. 3

(b) *(i)* Describe any one method for preparing a colloidal solution. 2

(ii) What is critical micelle concentration? Mention two properties of the ionic surfactant solution which undergo abrupt change at CMC. 1+1+1=3

(Old Course)

<u>Full Marks</u> : 48

<u>Pass Marks</u> : 19

Time : 3 hours

The figures in the margin indicate full marks
for the questions

1. Select the correct answer :   1×5=5

   (a) The equation for rate constant, is
   $$k = Ae^{-E_a/RT}$$

   The chemical reaction will proceed more
   rapidly, if there is a decrease in

   (i) k

   (ii) A

   (iii) T

   (iv) E_a

   (b) An aqueous soltuion of Na_2CO_3 is

   (i) basic

   (ii) acidic

   (iii) neutral

   (iv) unpredictable

(c) The function of alum used for the purification of water is to

    (i) coagulate the sol particles

    (ii) disperse the sol particles

    (iii) emulsify the sol particles

    (iv) absorb the sol particles

(d) In gas masks, the poisonous gases are adsorbed by activated charcoal. The activated charcoal acts as

    (i) adsorbate

    (ii) adsorbent

    (iii) catalyst

    (iv) All of the above

(e) 0·01 M solution each of urea, common salt and sodium sulphate are taken, the ratio of depressions in freezing point of these solutions is

    (i) 1 : 1 : 1

    (ii) 1 : 2 : 1

   (iii) 1 : 2 : 3

    (iv) 2 : 2 : 3

2. Answer any *five* questions : 2×5=10

(a) Describe one method for determining the order of a reaction.

(b) When a gas is adsorbed by a solid sample, then both the enthalpy and entropy of the system decrease. Explain.

(c) State and explain Nernst distribution law.

(d) The rate constant for a reaction of zero order with respect to reactant A is 0.0030 mol 1^{-1} s^{-1}. How long will it take for the initial concentration of A to fall from 0.10 M to 0.075 M?

(e) Explain what is observed when an electrolyte NaCl is added to hydrated ferric oxide sol.

(f) Describe the cleansing action of soaps on the basis of micelle formation.

(g) Deduce the relatiohsip between solubility and solubility product of a sparingly soluble salt.

UNIT—I

3. Answer any *two* questions : 6×2=12

(a) Deduce the integrated rate expression of the following second-order reaction :

$$A + B \longrightarrow \text{products}$$

8P/395

(Turn Over)
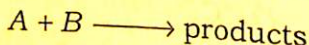
Prove that when either A or B is taken in excess, then this second-order reaction shows first-order kinetics. 4+2=6

(b) (i) Describe Lindemann's theory of unimolecular gas phase reaction. 5

(ii) Give one example of zero-order reaction. 1

(c) (i) Define order and molecularity of a reaction. Write one difference between these two. 2+1=3

(ii) Describe the effect of temperature on the rate of a reaction. 3

Unit—II

4. Answer any *one* question : 5

(a) What is solvent extraction? Show that multistep extraction is more economical than single-step extraction. 1+4=5

(b) (i) Discuss how the elevation of boiling point of a solution of non-volatile, non-electrolyte solute is related to the molecular mass of the solute. 3

(ii) Determine the no. of mol of $CaCl_2$ $(i = 2 \cdot 47)$ dissolved in $2 \cdot 5$ litre of water such that its osmotic pressure is $0 \cdot 75$ atm at 27 °C. 2

UNIT—III

5. Answer any *two* questions : $3\frac{1}{2} \times 2 = 7$

(a) Derive an expression for the pH of an aqueous solution of a salt of weak acid and strong base. $3\frac{1}{2}$

(b) (i) Distinguish solubility product from ionic product. 1

(ii) 50 ml of $6 \cdot 0 \times 10^{-3}$ M $CaCl_2$ is mixed with 30 ml of $0 \cdot 04$ M NaF. Will precipitation of CaF_2 occur? K_{sp} for CaF_2 is $4 \cdot 0 \times 10^{-11}$. $2\frac{1}{2}$

(c) (i) What are buffer solutions? Classify them giving examples. $1+1=2$

(ii) Explain why NH_4Cl should be added to the solution before adding NH_4OH solution for Gr-IIIA precipitation. $1\frac{1}{2}$

UNIT—IV

6. Answer any *one* question : 4

(a) Write the postulates of Langmuir adsorption isotherm. Also write four important applications of adsorption.

$2+2=4$

(*Turn Over*)

(b) Derive Gibbs' adsorption equation for the adsorption of a solute on the surface of a liquid. 4

UNIT—V

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(a) (i) What is peptization? Explain with example. 2

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