Total number of printed pages–7

63(FY) SEM–4/MAJ/CHMMAJ2054

2025

CHEMISTRY

(Major)

Paper : CHMMAJ2054

(Physical Chemistry–II)

Full Marks : 50

Pass Marks : 20

Time : Two hours

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

1. Choose the correct answer : 1×5=5

(a) Select the correct relation :

(i) $\Delta G = RT \ln K_p$

(ii) $K_p = e^{-\Delta G^o / RT}$

(iii) $K_p = e^{\Delta H^o / RT}$

(iv) $K_p = \Delta G^o / RT$

(b) Which one is the SI unit of molar conductivity ?

(i) Scm^2mol^{-1}

(ii) $Sm^2(equiv)^{-1}$

(iii) $Sm^2\,mol^{-1}$

(iv) Sm^{-1}

(c) For an ideal solution obeying Raoult's law

(i) $P_A/P^oA = X_A$

(ii) $P_AX_A = P^o{}_A$

(iii) $P_A = X_A/P^o{}_A$

(iv) $P_A = P_A{}^o(1-X_A)$

(d) Which one is reduced phaserule ?

(i) $F = C - P + 1$

(ii) $F = C - P + 2$

(iii) $F + P = C + 2$

(iv) $F = C + P - 1$

(e) An increase in equivalent conductance of a strong electrolyte with dilution is due to

(i) increase in ionic mobility of ions

(ii) 100% ionisation of electrolyte at normal dilution

(iii) increase in both the number of ions and ionic mobility of ions

(iv) increase in number of ions

2. Answer the following questions : ***(any five)*** 2×5=10

(a) What do you mean by advancement of a reaction ? Express the reaction rate in terms of advancement.

(b) Explain how will you determine the equivalent conductivity of CH_3COOH at infinite dilution by Kohlerausch's law.

(c) How does molar conductivity of strong electrolyte vary with concentration ? Explain with diagram.

(d) Why H^+ ion has exceptionally high ionic mobility ?

(e) Define 'Components' and 'Degrees of freedom'.

(f) What is the triple point of water ? Why is it different from the normal melting point of ice ? 1+1=2

(g) State and explain lever rule.

3. Answer the following questions : ***(any five)*** 5×5=25

(a) What is meant by standard free energy change of a reaction ? Obtain expression for Gibb's free energy of mixing (ΔG_{mix}) of ideal gas. 1+4=5

(b) (i) Establish the relationship between K_p and K_c. Under what conditions $K_p = K_c$? 3

(ii) Calculate the number of moles of Cl_2 produced in the reaction ?

$$PCl_{5(g)} \rightleftarrows PCl_{3(g)} + Cl_{2(g)},$$

when 1·00mole of PCl_5 is heated at 250°C in a 10·0dm^3 vessel. ($K = 0{\cdot}041$) 2

(c) Write short notes on :

(i) Debye-Huckel theory of strong electrolytes 3

(ii) Ionic molality 2

(d) Deduce Clausius-Clapeyron Equation. Give its application for liquid-vapour equilibrium. 3+2=5

(e) (i) The electrical resistance of a column of 0·05*M* *NaOH* solution of diameter 1*cm* and length 50*cm* is $5{\cdot}55 \times 10^3 Ohm$. Calculate its resistivity, conductivity and molar conductivity. 3

(ii) Sketch the conductometric—titration curves of *HCl vs NaOH*. Give an explanation of variation of conductance from the curves. 2

(f) Find the no. of components and degrees of freedom for the following systems : 1×5=5

(i) $N_{2(g)} + O_{2(g)} \rightleftarrows 2NO_{(g)}$

(ii) An aqueous solution of CH_3COOH

(iii) $Na_2SO_4 \cdot 10H_2O_{(s)} \rightleftarrows Na_2SO_{4(s)} + 10H_2O_{(g)}$

(iv) $NH_4Cl_{(s)} \rightleftarrows NH_{3(g)} + HCl_{(g)}$

(v) A binary azeotrope

(g) Draw the phase diagram of lead-silver system. How can you explain pattinson's process for the desilverisation of lead from argentiferrous lead with the help of the diagram ? 2+3=5

(h) (i) Define chemical potential. How does it vary with temperature and pressure ? 3

(ii) State Nernst distribution law. Under what conditions is the law valid ? 2

4. Answer the following questions : ***(any one)*** 10×1=10

(a) (i) Discuss the phase diagram of sulphur. Justify the diagram with proper explanation. 4+3=7

(ii) Write short note on steam distillation. 3

(b) (i) What is transport number ? Describe the Hittorf's method employed in determining the transport number of an ion. 2+5=7

(ii) How can you determine the solubility product of a salt by conductance measurements ?

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