

Solutions & Colligative Properties

Q-1 When a mixture of H_2O & chlorobenzene (mutually immiscible) is distilled at an external pressure of 740.2 mm Hg, the mixture boiled at $90.3^\circ C$, at which temperature the vapor pressure of pure water is 530.1 mm Hg. Calculate the mass % of chlorobenzene in the distillate, molar mass $112 g mol^{-1}$.

Q-2 At $25^\circ C$ the vapor pressure of methyl alcohol is 96 torr. What is the mole fraction of methyl alcohol in a solution in which the partial vapor pressure of methyl alcohol is 23 torr at $25^\circ C$.

Q-3 Write short notes on:

(i) Steam Distillation (ii) Raoult's law

Q-4 Solutions of electrolytes do not obey Raoult's law.

Explain.

Q-5 The partition co-efficient of a solute X between chloroform & water is 0.2. Calculate the amount of solute extracted from 100 ml of aqueous solution containing 1 gm of substance using 100 ml of chloroform in two equal instalments.

Q-6 (a) State Raoult's law of ideal solution.

(b) Define "Critical Solution Temperature" & give examples of a system having upper C.S.T. & lower C.S.T. Give the effect of impurity on C.S.T.

Q-7 An aqueous solution of succinic acid at $15^\circ C$, containing 0.07g in 10ml is in equilibrium with an ethereal solution which has 0.013g in 10ml. The acid has its normal molecular weight in both the solvents. What is the concentration of the ethereal solution, which is in equilibrium with an aqueous solution containing 0.024g in 10ml?

(b) State Nernst Distribution Law. How is it used in the process of extraction of solutes?

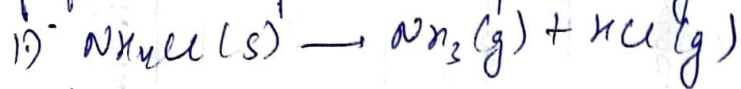
Q-8 Raoult's law is a special case of Henry's law. Explain.

(a) ~~The tie lines within a binodal curve of a~~

(b) Define CST. What is the effect of pressure on CST of partially miscible liquid pairs.

Phase Equilibria

Q-1 Calculate the number of phases, components & degree of freedom for the following systems:



Q-2 In phase diagram of water, fusion (melting point) curve is inclined towards the pressure axis. Explain.

Q-3 Define (i) Phase (ii) Component (iii) degree of freedom.

State the Gibbs Phase Rule.

Q-4 Draw the phase diagram of the one component system of water. Discuss & explain its salient features.

Q-5 State & explain the phase rule. Explain that sufficient system at any of its triple point is a non-variant system.

Q-6 The tie lines within a binodal curve of a three component system are parallel neither to the sides of triangle nor to each other.

Q-7 A substance 'S' has a low pressure form S_α , which melts at about 17°C under its own pressure of about 8 mm Hg. It also has a high pressure form S_β & the three phases S_α , S_β & liquid are in equilibrium at about 55°C under a pressure of 2000 atm. The β -form is denser than α -form but both are denser than the liquid. Draw the phase diagram.

Q-8 What is retrograde solubility? Explain with the help of phase diagram.

Q-9 The slope dP/dT of solid to liquid transformation of a one component system has very high positive (or negative) value. Why?

Q-10 Write short note on: Phase rule for non-reactive system.

Q-11 (a) What is a binodal curve in a 3 component system having one pair of partially miscible liquids?

(b) Why does the plait point lie, generally, either to the left or the right of the maximum of the binodal curve?

(c) Differentiate between congruent & incongruent melting points.

a BaBr aqueous system containing K^+ , Na^+ & Cl^- is a 3 component system whereas K^+ , Na^+ , Cl^- & Br^- is a 4 component system.

(b) Component melting point of a two component system

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Q-9 When a liquid that is immiscible with water was distilled at 95.2°C at a total pressure of 747.3 Torr , the distillate contained 1.27 g of the liquid per gram of water. Calculate the molar mass of the liquid. The vapor pressure of water is 638.6 Torr at 95.2°C .

Q-10 Under what conditions does a non-ideal solution exhibit a positive deviation from Raoult's law.

Q-11 Write short notes on:

(a.) Azeotropes (b.) Applications of Nernst Distribution law.

Q-12 (a.) For a dilute solution containing non-volatile solute, Raoult's law is obeyed by the pure solvent. Comment. Justify this, by explaining the relative lowering of vapour pressure as one important property of dilute solutions known as colligative property.

(b.) The freezing point of pure benzene is 5.40°C & that of a solution containing 2.0 g of solute per 100 g of benzene is -4.40°C . Calculate the molar mass of the solute. Molar depression constant for benzene is $5.12 \text{ K kg mol}^{-1}$.

Q-13 ~~What is a azeotrope. Give an example.~~

Q-13 What happens when small amounts of the components A, B & C (all of them are assumed to be in liquid form)?

Q-14 (a.) Describe the theory of steam distillation.

(b.) State Nernst distribution law & show that it is in agreement with the phase rule requirements.

(c.) An aq. solution contains 0.20 g aspirin in 50.0 cm^3 solution. To this, 30.0 cm^3 ether is added & the mixture is shaken & allowed to come to equilibrium at 298 K . At this temperature, the distribution coefficient is 4.7 in favour of ether.

(i.) How much aspirin remains in the aq. solution?

(ii.) What amount of aspirin would remain unextracted in the aq. phase if the extraction is carried out with 3 successive 10 cm^3 portions of ether?

Q-15 (a.) Draw & explain the vapour pressure-composition curve of an ideal solution.

(b.) What is the principle of steam distillation?

What is an ideal solution? State Raoult's law for ideal solution.

Q-17 We observe elevation in boiling point when a ~~non~~ non-volatile solute is dissolved in a volatile solvent.

Q-18 A container is divided into 4 compartments containing 1.0 mol of He, 3.0 mol of Ne, 2.0 mol of Ar & 2.5 mol of Xe at 298 K. The pressure in each compartment is 1 bar. Calculate $\Delta_{mix} G$ & $\Delta_{mix} S$, when the partitions are removed. Assume perfect behaviour.