ULTIMATE KCET

CRASH COURSE 2026

Chemistry | Lecture - 01

Solution

By – Arunkumar Sir

Topics to be covered

1. Theory + PYQ
2. [redacted]
3. [redacted]
4. [redacted]

Solution :-

* it is a Homogeneous mixture of Solute & Solvent is Called Solution

* Solution = Solute + Solvent

* $M_{Soln} = M_{solute} + M_{Solvent}$

* The state of the Solution depends on State of the Solvent

Solute	Solvent	Solution	Example
Solid	Solid	Solid	Cu in Gold.
liquid	Solid	Solid	Sodium Amalgum
gas	Solid	Solid	H_2 gas with Pd.
Solid	liquid	liquid	$NaCl + H_2O$
liquid	liquid	liquid	Ethanol + H_2O
gas	liquid	liquid	$CO_2 + H_2O$
Solid	gas	gas	Camphor + N_2 gas.
liquid	gas	gas	H_2O + Air
gas.	gas	gas	$O_2 + N_2$

Solubility:-

* The maximum Amount of Solute dissolved in a given amount of Solvent is Called Solubility

  * Solubility of Solid in liquid
  * Solubility of gas in liquid
  * Solubility of liquid in liquid

* Solubility of Solid in liquid :-

* factors :-

* Solute & Solvent must be Same { like dissolves like }

* Temprature :- * if disolution process is Exothermic Solubility decreases with increase in Temp

* if disolution process is Endothermic Solubility Increases with increase in Temp

* Solubility of gas in liquid :-

* factor :-

* Nature of Solute & Solvent

* Temprature :- Solubility increases with decrease in Temp bcoz disolution of gas in liquid is Exothermic process

* Pressure :- The Solubility of a gas increases with increase in pressure

Henry's law:-

* partial pressure above the liquid by gas is directly proportional to mole fraction of a gas in liquid at Constant Temp

$P_{gas} \propto x_{gas}$

$P_{gas} = K_H \, x_{gas}$

Unit K_H = atm/bar/mmHg

$K_H \propto \frac{1}{x_{gas}}$ → the gas with high K_H value has less solubility.

$K_H \propto Temp$

* Applications of Henry's law :-

01. in Sealing of Soft drinks

02. To Avoid Bund disease

03. Anoxia disease { Mountain Climbers / High Altitude staying people }.

*Raoult's law:- The vapour pressure of a liquid is directly proportional to the Amount of volatile liquid present in the Container

$$P_{solvent} \propto X_{solvent}$$

$$P_{solvent} = P^{0}_{solvent} X_{solvent}$$

* When two volatile liquids are mixed :-

the vapour pressure of liquid A $\Rightarrow P_A = P_A^\circ \chi_A$

The vapour pressure of liquid B $\Rightarrow P_B = P_B^\circ \chi_B$

$$P_{soln} = P_A + P_B = P_A^\circ \chi_A + P_B^\circ \chi_B$$

$$P_{soln} = P_A^\circ \chi_A + P_B^\circ (1 - \chi_A)$$

$$= P_A^\circ \chi_A + P_B^\circ - P_B^\circ \chi_A$$

$$P_{soln} = P_B^\circ + \chi_A (P_A^\circ - P_B^\circ)$$

$$P_A = y_A \cdot P_{Total}$$

$$P_B = y_B \cdot P_{Total}$$

Ideal soln & non-Ideal soln :-

Ideal soln :- the soln which obey's Raoult's law at all conc^{n}

* The force of attraction b/w A-A & B-B is equal to A-B
* $\Delta V_{mix} = 0$
* $\Delta H_{mix} = 0$

eg :- Benzene & Toluene
Ethyl bromid & Ethyl chloride
hexane & heptane ... etc

* **non-Ideal Soln:-** The soln which doesnot obey's Raoult's at all Conc^{n} is called non-Ideal soln.

* The force of attraction b/w A-A & B-B is not equal to A-B.
* $\Delta H_{mix} \neq 0$
* $\Delta V_{mix} \neq 0$

Eg:- $HCl + H_2O$

$C_2H_5OH + H_2O$ - etc

* non-Ideal soln with +ve deviation :-

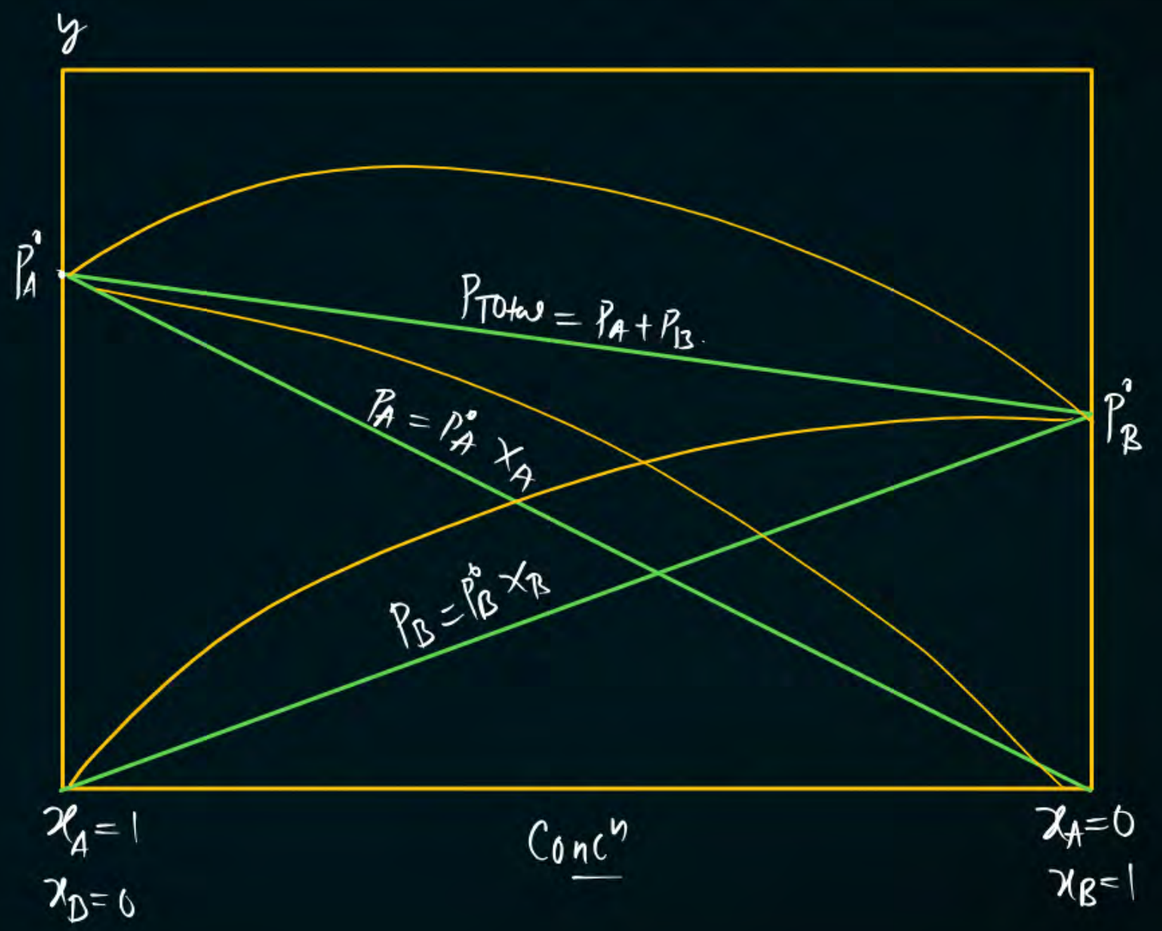
* The force of Attraction b/w A–A & B–B is greater than A–B.

* $\Delta V_{mix} > 0$

* $\Delta H_{mix} > 0$

Eg:- CCl_4 + benzene
CCl_4 + chloroform
Acetone + CS_2
Acetone + alcohol
alcohol + water

↑ V.P



* non-Ideal soln with -ve deviation :-

* The force of attraction b/w A-A & B-B is smaller than A-B

* $\Delta V_{mix} < 0$

* $\Delta H_{mix} < 0$

eg:- Chlorform + Acetone

phenol + Aniline

$HNO_3 + H_2O$

Chloroform + benzene ... etc

Boiling point :- the Temperature at which the vapour pressure of liquid becomes atmospheric pressure is called Boiling point.

Azeotropic mixture:- the mixture which has equal composition in both vapour phase & liquid phase is called Azeotropic mixture

* **Maximum boiling Azeotropes:-** the Soln shows Negative deviation from Raoult's law eg:- 68% HNO_3 + 32% H_2O

* **Minimum boiling Azeotropes:-** the Soln show the deviation from raoult's law eg:- 95% C_2H_5OH + 5% H_2O

Colligative property: The property of soln which depend on Amount of Solute added but not on Nature of solute.

* Relative lowering of vapour pressure (RLVP)
* Elevation in Boiling Point (ΔT_b)
* depression in freezing point (ΔT_f)
* Osmotic pressure (π)

01. RLVP :- $\frac{P^0 - P}{P^0} = \chi_{solute} = i\chi_{solute}$

02. $\Delta T_b = K_b \times m = \frac{K_b \times W_B \times 1000}{M_B \times W_A}$ $\{B = Solute, A = Solvent\}$

$= i \times K_b \times m$

03. $\Delta T_f = K_f \times m = \frac{K_f \times W_B \times 1000}{M_B \times W_A}$

$= i \times K_f \times m$

04. $\pi = CRT = i \times C \times R \times T$

$C = Conc^n$

$R = gas\ Constant$

$T = Temp.$

Osmosis:- The movement of Solvent from H.C to L.C Soln through S.P.M is called osmosis

* The pressure which is applied to stop osmosis is called Osmotic pressure (π)

* $\pi_1 = \pi_2 \Rightarrow$ isotonic soln { RBC & 0.9% NaCl }
* $\pi_1 > \pi_2 \Rightarrow$ Hypertonic soln { RBC kept in soln > 0.9% }
  ↳ H.S
  ↳ Shrink.
* $\pi_1 < \pi_2 \Rightarrow$ Hypotonic soln { RBC kept in soln < 0.9% }
  ↳ Hypotonic
  ↳ Swell

Vanthoff's factor :- (i) :-

$$i = \frac{\text{no. of molecule After dissociation / Association}}{\text{no. of molecule before dissociation / Association}}$$

$i = 1$ No dissociation / Association.

$i < 1$ dissociation.

$i > 1$ Association.

* for weak Electrolyte ($\alpha > 1$)

* dissociation:-

$$\alpha = \frac{i-1}{n-1}$$

* Association -

$$\alpha = \frac{1-i}{1-\frac{1}{n}}$$

Question

Among the following 0.1 m aqueous solutions, which one will exhibit the lowest boiling point elevation, assuming complete ionization of the compound in solution? (KCET 2025)

$$\Delta T_b = i \times k_b \times m$$

A Aluminium chloride $(AlCl_3) \Rightarrow 4$

B Aluminium sulphate $(Al_2(SO_4)_3) = 5$

C Potassium sulphate $(K_2SO_4) = 3$

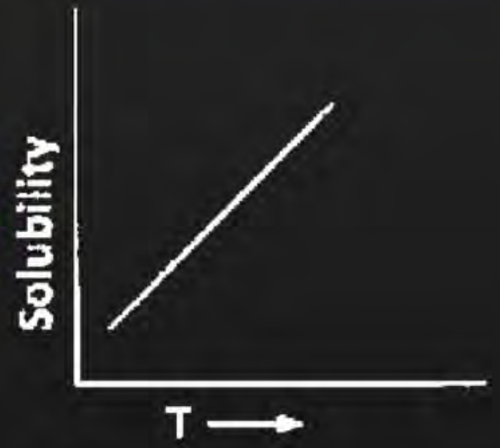
D Sodium chloride $(NaCl) = 2$

Question

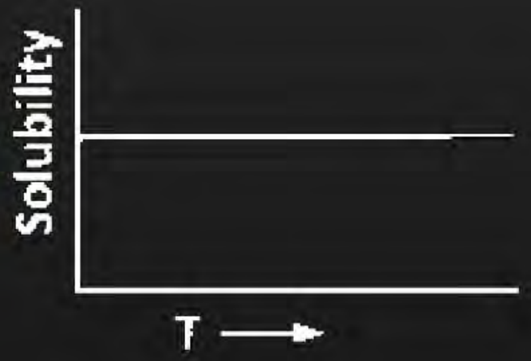
Variation of solubility with temperature t for a gas in liquid is shown by the following graphs. The correct representation is

(KCET 2025)

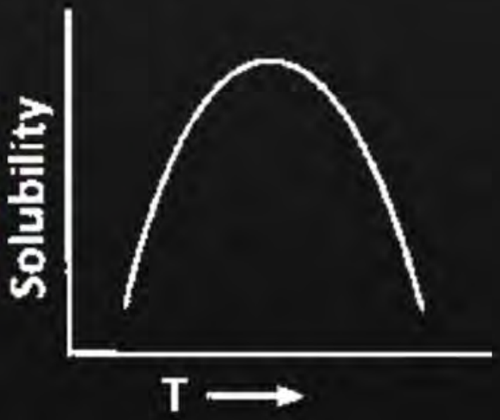
A



B



C



D

Question

180 g of glucose, $C_6H_{12}O_6$, is dissolved in **1 kg** of water in a vessel. The temperature at which water boils at **1.013** bar is _____.
(given, K_b for water is 052 K kg mol^{-1}. Boiling point for pure water is 373.15 K)

(KCET 2025)

A 373.67 K

B 373015 K

C 373.0 K

D 373.202 K

$M_B = 180$ W_B W_A

$$\Delta T_b = \frac{i \times K_b \times W_B \times 1000}{M_B \times W_A} = \frac{1 \times 052 \times 180 \times 1000}{180 \times 1000}$$

$\Delta T_b = 0.52$

$= 0.52\ K$

$T_b = 373.15 + 0.52$

$T_b = 373.67\ K$

Question

$1L = 1kg \quad n_{H_2O} = \frac{1000}{18} = 55.5 \quad n_{N_2} = ?$

If N_2 gas is bubbled through water at 293 K, how many moles of N_2 gas would dissolve in 1 litre of water? Assume that N_2 exerts a partial pressure of 0.987 bar. [Given K_H for N_2 at 293 K is 76.48 K bar]

(KCET 2025)

$P = K_H X_{N_2}$

$X_{N_2} = \frac{P}{K_H} = \frac{0.987}{76.48 \times 10^3} = 0.0129 \times 10^{-3}$

$= 1.29 \times 10^{-5}$

$X_{N_2} = \frac{n_{N_2}}{n_{H_2O} + n_{N_2}} \simeq n_{H_2O} >> n_{N_2}$

$1.29 \times 10^{-5} = \frac{n_{N_2}}{55.5}$

$n_{N_2} = 7.16 \times 10^{-4}$

A. $0.716 \times 10^{-3} = 7.16 \times 10^{-4}$

B. 7.16×10^{-5}

C. 7.16×10^{-4}

D. 7.16×10^{-3}

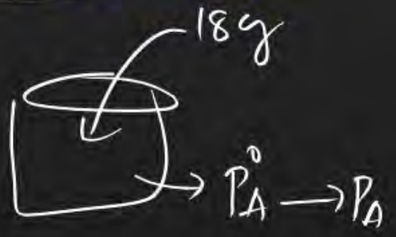
Question

$$X_A = \frac{n_A}{n_A + n_B} = \frac{9.9}{9.9 + 0.1} = \frac{9.9}{10} = 0.99.$$

$B = 0.1$

(A) $\frac{178.2}{18} = 9.9$

Vapour pressure of a solution containing 18g of glucose and 178.2g of water at 100°C is (Vapour pressure of pure water at 100° C = 760 torr) (KCET 2024)



$P_A = P_A^\circ \times X_A$

$= 760 \times 0.99$

$=$

A. 76.0 torr

B. 752.0 torr

C. 7.6 torr

D. 3207.6 torr

Question

A mixture of phenol and aniline shows negative deviation from Raoult's law. This is due to the formation of

(KCET 2024)

A. polar covalent bond

B. non-polar covalent bond

C. intermolecular hydrogen bond

D. intramolecular hydrogen bond

Question

Which one of the following pairs will show positive deviation from Raoult's law?

(KCET 2024)

A Water – HCl (-ve)

B Benzene – Methanol

C Water – HNO_3 (-ve)

D Acetone – Chloroform (-ve)

Question

For which one of the following mixtures is composition uniform throughout? (KCET 2024)

A. Sand and water

B. Grains and pulses with stone

C. Mixture of oil and water

D. Dilute aqueous solution of sugar

Question

The swelling in feet and ankles of an aged person due to sitting continuously for long hours during travel, is reduced by soaking the feet in warm salt water. This is because of

(KCET 2023)

A Reverse osmosis

B Osmosis

C Edema

D Diffusion

Question

5.85 g AB in 100 g H_2O

$AB \longrightarrow A^+ + B^-$

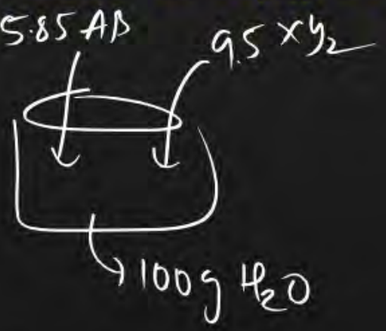
1	0	0
1 − 0.8	0.8	0.8

A sample of water is found to contain 5.85% $\left(\frac{w}{w}\right)$ of AB (molecular mass 58.5) and 9.50% $\left(\frac{w}{w}\right)$ XY_2 (molecular mass 95). Assuming 80% ionisation of AB and 60% ionisation of XY_2, the freezing point of water sample is [Given, K_f for water 1.86 K kg mol^{-1}, Freezing point of pure water is 273 K and A, B and Y are monovalent ions.] (KCET 2023)

9.5 g, $\alpha = 0.8$, $\alpha = 0.6$

$m_A = \frac{w_B \times 1000}{M_B \times w_A}$

=



$i = \frac{1 - 0.8 + 0.8 + 0.8}{1}$

$i = 1.8$

$\Delta T_f = K_f \{ i \times m_{AB} + i\, m_{XY_2} \}$

A. 264.25 K

B. 265.56 K

C. 280.44 K

D. 281.75 K

Question

Solubility of a gas in a liquid increases with

(KCET 2022)

A decrease of p and increase of T

B increase of p and decrease of T

C decrease of p and decrease of T

D increase of p and increase of T

Question

The rise in boiling point of a solution containing 1.8g of glucose in 100g of solvent is 0.1°C. The molal elevation constant of the liquid is (KCET 2022)

K_b

$$\Delta T_b = \frac{k_b \times w_B \times 1000}{M_B \times w_A}$$

$$0.1 = \frac{x \times 1.8 \times 1000}{180 \times 100}$$

$$x = \frac{0.1 \times 180}{18}$$

$$x = 1$$

A. 1 K kg/mol

B. 2 K kg/mol

C. 10 K kg/mol

D. 0.1 K kg/mol

Question

If 3g of glucose (molar mass = 180 g) is dissolved in 60g of water at 15°C, the osmotic pressure of the solution will be (KCET 2022)

$$M = \frac{3 \times 1000}{180 \times 60} = \frac{10}{36}$$

(A) 0.65 atm

(B) 6.57 atm

(C) 5.57 atm

(D) 0.34 atm

$$\pi = \frac{10}{36} \times 0.082 \times 288$$

$$\pi = 6.57 \text{ atm}$$

Question

Which of the following colligative properties can provide molar mass of proteins, polymers and colloids with greater precision? (KCET 2022)

A. Elevation in boiling point

B. Depression in freezing point

C. Osmotic pressure

D. Relative lowering of vapour pressure

Question

Henry's law constant for the solubility of N_2 gas in water at 298 K is 1.0×10^5 atm. The mole fraction of N_2 in air is 0.8. The number of moles of N_2 from air dissolved in 10 moles of water at 298 K and 5 atm pressure is (KCET 2021)

A 4.0×10^{-4}

B 4.0×10^{-5}

C 5.0×10^{-4}

D 4.0×10^{-6}

Question

Choose the correct statement. (KCET 2021)

A K_H value is same for a gas in any solution

B Higher the K_H value more the solubility of gas

C K_H value increases on increasing the temperature of the solution

D Easily liquefiable gases usually has lesser K_H values

Question

The K_H value (K bar) of argon (I), carbon dioxide (II), formaldehyde (III) and methane (IV) are respectively 40.3, 167, 1.83×0^{-5} and 0.413 at 298 K. The increasing order of solubility of gas in liquid is (KCET 2021)

A. I < II < IV < III

B. III < IV < II < I

C. I < III < II < IV

D. I < IV < II < III

Question

The vapour pressure of pure liquids A and B are 450 and 700 mm of Hg at 350 K respectively. If the total vapour pressure of the mixture is 600 mm of Hg, the composition of the mixture in the solution is (KCET 2021)

$$P_{Total} = P_A^0 \chi_A + P_B^0 (1 - \chi_A)$$

A $\chi_A = 0.4, \chi_B = 0.6$

B $\chi_A = 0.6, \chi_B = 0.4$

C $\chi_A = 0.3, \chi_B = 0.7$

D $\chi_A = 0.7, \chi_B = 0.3$

Question

Which of the following pair of solutions is isotonic? (KCET 2020)

$\pi_1 = \pi_2$

$iCRT = iCRT$

$i \times C$ $\quad$ $i \times C$

A. 0.01M $BaCl_2$ and 0.015 M NaCl

B. 0.001M $Al_2(SO_4)_3$ and 0.001M $BaCl_2$

C. 0.001M $CaCl_2$ and 0.001M $Al_2(SO_4)_3$

D. 0.01M $BaCl_2$ and 0.001M $CaCl_2$

Question

Solute 'X' dimerises in water to the extent of 80%. 2.5 g of 'X' in 100g of water increases the boiling point by 0.3°C. The molar mass of '**X**' is $[K_b = 0.52 \text{ K kg mol}^{-1}]$ (KCET 2020)

A 13

B 52

C 65

D 26

Question

A non-volatile solute, 'A' tetramerises in water to the extent of 80%. 2.5g of 'A' in 100g of water, lower the freezing point by 0.3°C. The molar mass of 'A' in g is (K_f for water = 1.86 K kg mol^{-1})

(KCET 2019)

A 62

B 221

C 155

D 354

Question

Solution '*A*' contains acetone dissolved in chloroform and solution '*B*' contains acetone dissolved in carbon disulphide. The type of deviations from Raoult's law shown by solutions *A* and *B*, respectively are (KCET 2019)

A Positive and Positive

B Positive and Negative

C Negative and Negative

D Negative and Positive

Question

Relative lowering of vapour pressure of a dilute solution of glucose dissolved in 1kg of water is 0.002. The molality of the solution is (KCET 2019)

A 0.004

B 0.222

C 0.111

D 0.021

Question

Which of the following aqueous solutions should have the highest boiling point?

(KCET 2018)

A 1.0 M NaOH

B $1.0 M Na_2SO_4$

C $1.0 M NH_2NO_3$

D $1.0 M KNO_3$

Question

Isotonic solutions are solutions having the same (KCET 2018)

A. Surface tension

B. Vapour pressure

C. Osmotic pressure

D. viscosity

Summary

Theory + Pyq

Homework

Remaining Questions

Thank You