VC210 Recitation Class 6

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Contents

Vapour Pressure

- Determinants: Intermolecular force&temperature.

  - Low intermolecular forces

  → High vapor pressure

  → Prefer gas phase

  → Low boiling point / More volatile

  - Clausius – Clapeyron Equation:

$$\ln\frac{P_2}{P_1} = \frac{\Delta H°_{vap}}{R}\cdot\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$$

$$\ln\frac{P}{P°} = -\frac{\Delta H°_{vap}}{RT} + \frac{\Delta S°_{vap}}{R}$$

$P° = 1$ bar

Boiling

- Normal boiling point (T_b): the temperature when a liquid boils with the external pressure at 1 atm.
- Boiling occurs when the vapor pressure of a liquid is equal to the external pressure.

Vapour Pressure in Multi-component System

- If the liquid is not pure…(i.e. Solute would influence the vapor pressure of the solvent)
- Raoult's Law
  - The vapor pressure of a solvent is proportional to its mole fraction in a solution.

$$\boxed{P = X_{solvent} \cdot P_{pure}}$$

- It is also valid when liquid is solved in liquid:

$$\left.\begin{aligned} P_A &= X_{A,liquid} \cdot P_{A,pure} \\ P_B &= X_{B,liquid} \cdot P_{B,pure} \\ &\dots \end{aligned}\right\}$$

Recall Dalton's Law:

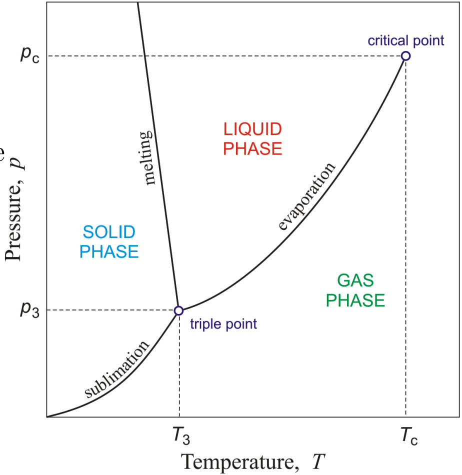
$$P_{total} = P_A + P_B + \cdots$$

P_{total} = the vapor pressure of the solution

Phase Diagram

Information we can know from the diagram:

- Phase boundary
- Triple point
- Critical point



Solubility

- General rule: like dissolves like
  - More specifically: polar solvent dissolves polar solute; non-polar solvent dissolves non-polar solute
- Pressure influences gas's solubility
  - Henry's Law:

$$\boxed{Solubility = k_H \cdot P \text{ (}k_H\text{: Henry's constant)}}$$

*k_H varies with gas, solvent, and the temperature

- High temperature makes dissolution faster, but doesn't necessarily increase the solubility.

Solubility

- Enthalpy of solution

$$\Delta H_{sol} = \Delta H_{LA} + \Delta H_{hydration}$$

High charge + small ionic radius

→High lattice enthalpy & low hydration enthalpy

→It's hard to predict the sign of ΔH_{sol}

- Entropy of solution
  - The "disorder" increases → $\Delta S > 0$
- Gibbs free energy of solution

$$\Delta G = \Delta H - T\Delta S$$

Molarity V.S. Molality

Pay attention to the words!!

$$molality = \frac{n_{solute}}{\underline{m_{solvent}}} \; [\frac{mol}{kg}]$$

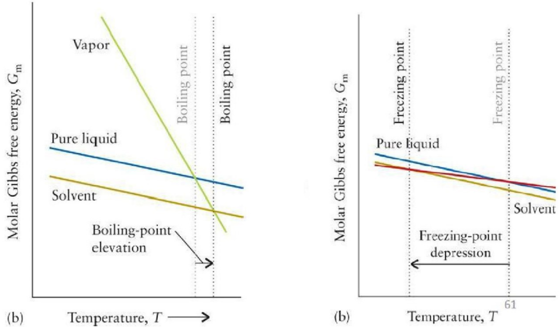
$$Molarity = \frac{n_{solute}}{\underline{V_{solution}}} \; [\frac{mol}{L}]$$

When we use ”M”: molarity.

Boiling Point&Freezing Point Change

- Freezing-point depression = $i \cdot k_f \times molality$
- Boiling-point elevation = $i \cdot k_b \times molality$

i: van't Hoff factor (e.g. $i_{HCl} = 2$, $i_{CaCl_2} = 3$)



Osmosis

- Osmosis is the flow of solvent through a membrane into a more concentrated solution
- Osmotic pressure: the pressure needed to stop the flow of solvent

$$\boxed{\Pi = iRTM}$$

Π: Osmotic pressure

i: van't Hoff factor

M: Molarity

End

Q&A