Engineering Chemistry

Part 1

Revision on Solutions

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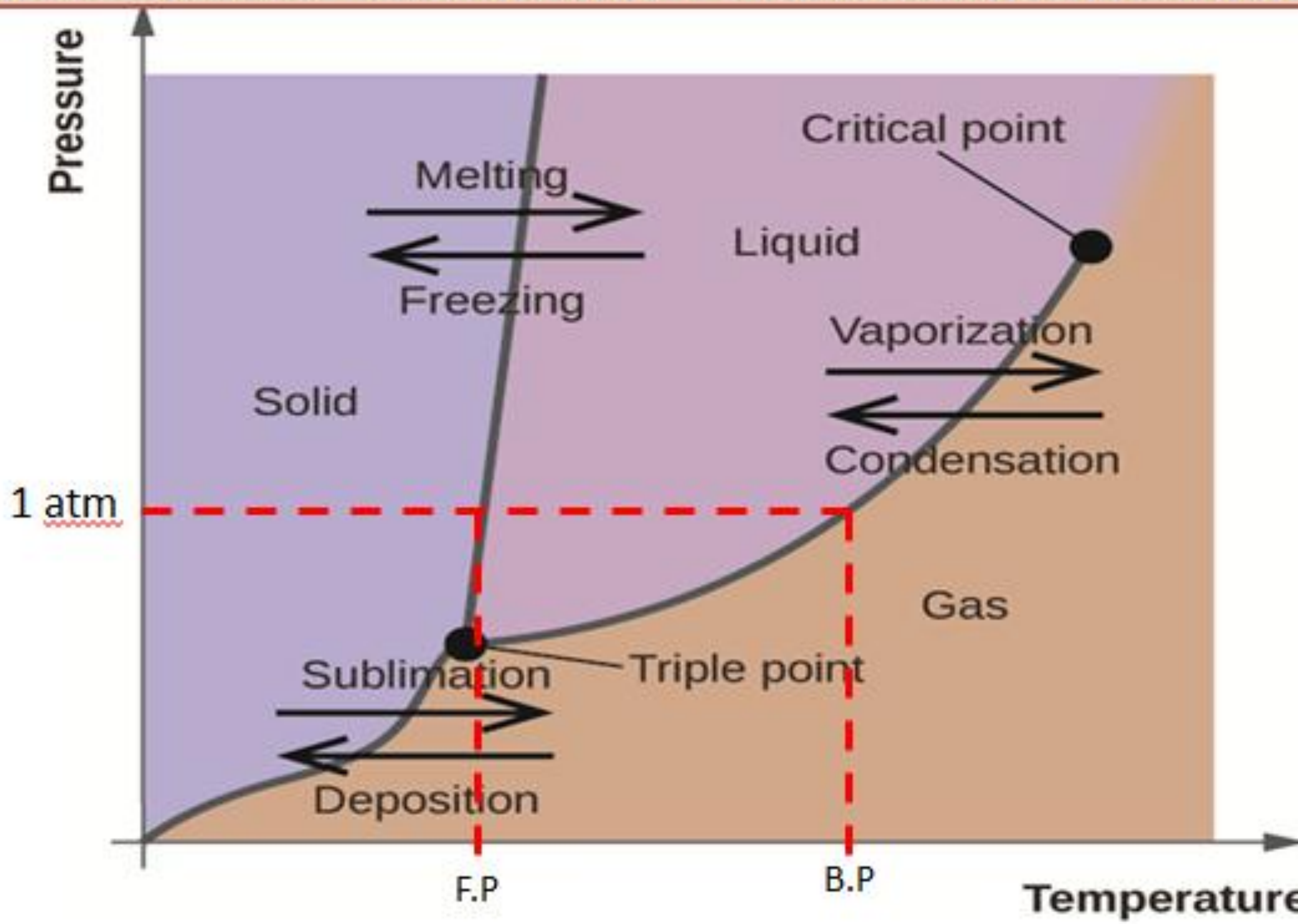
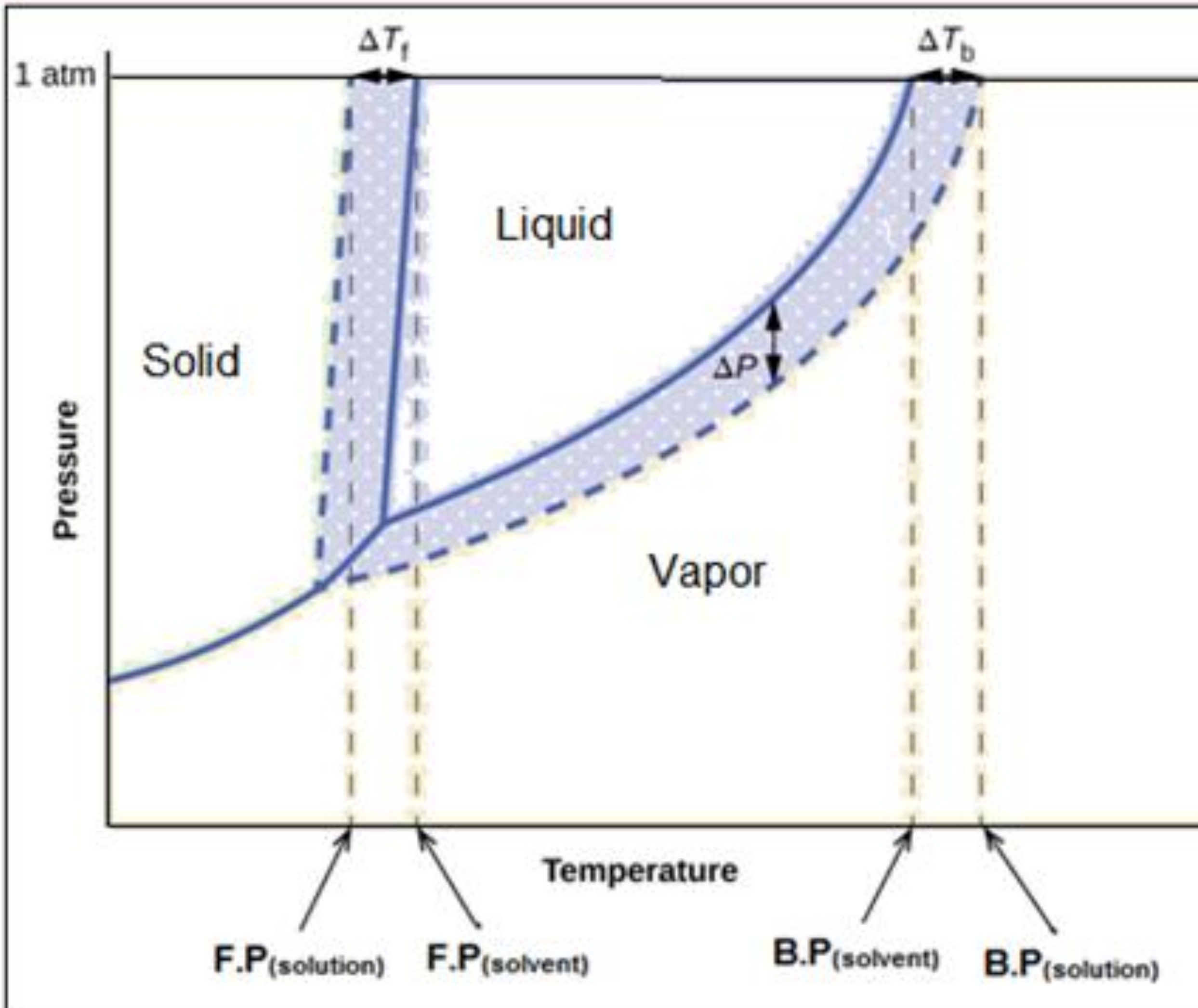
Chapter 1: Solutions

State of matter - Phase transition - Phase Diagram of a matter



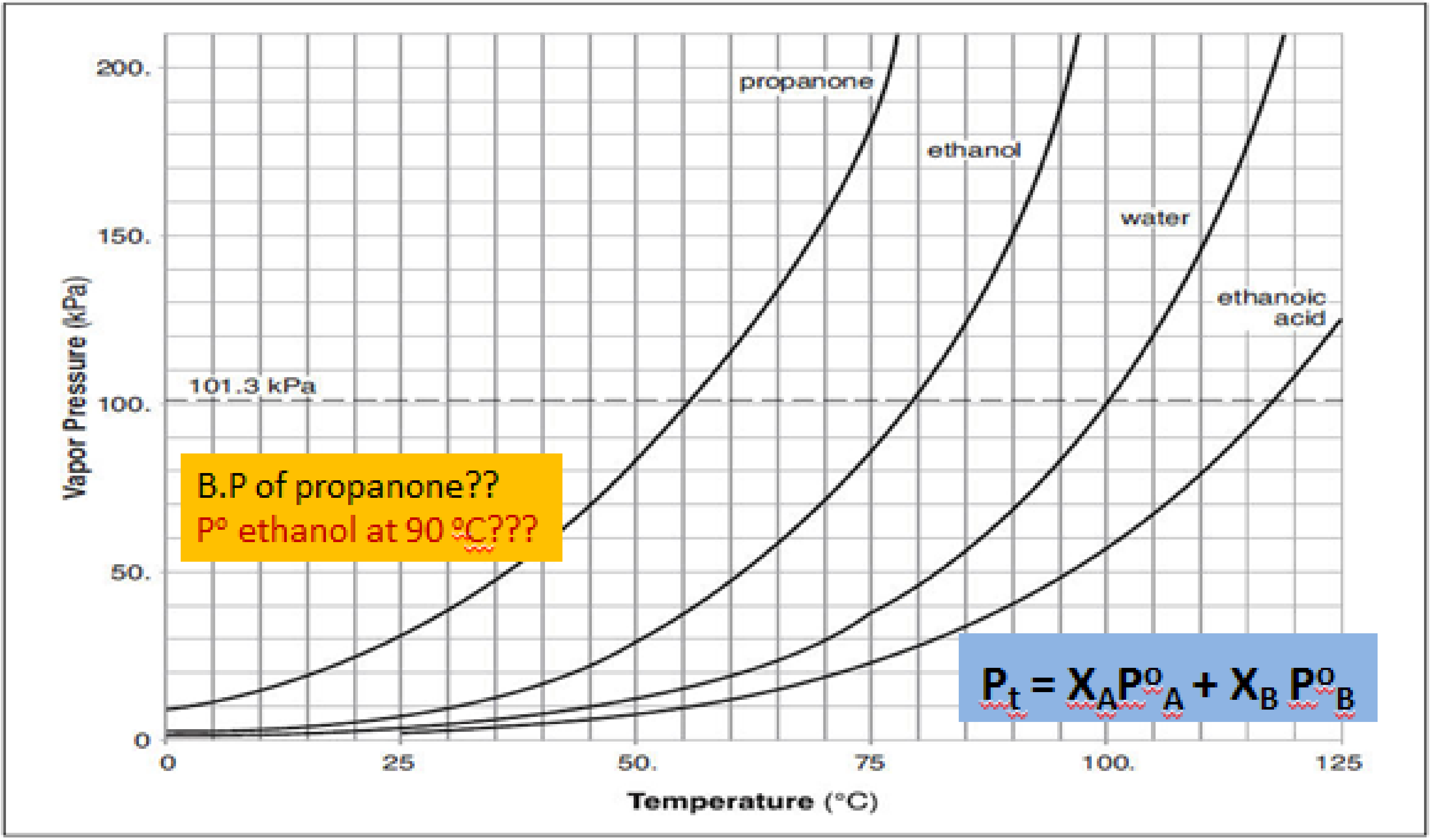
Phase diagram of a soln containing volatile solvent and non-volatile solute



Vapor pressure of a volatile liquid

* Temperature ↑ V.P. ↑

** Molecular force ↓ volatility ↑ V.P. ↑ B.P. ↓



B.P of propanone??

P° ethanol at 90 °C???

$P_t = X_A P^o_A + X_B P^o_B$

Mixtures

Solubility Factors

Homogeneous (solutions)

heterogeneous

gas in liquid

- ✓ Nature of gas & liquid
- ✓ **Temperature**
- ✓ **Pressure:**

Hennery's law: m = k P

$m_1/m_2 = P_1/P_2$

Limitations of the law

liquid in liquid

- ✓Completely immiscible
- ✓Partially miscible
- ✓**Completely miscible:**

Raoult's law (ideal solution)

$P_A = X_A P^o_A$, $P_B = X_B P^o_B$

$P_{soln} = P_t = X_A P^o_A + X_B P^o_B$

solid in liquid

- ✓Solute-solvent interaction
- ✓Temperature

❖ **Colligative properties:**

- •Lowering in P° of solvent
- •Elevation in B.P of solvent
- •Depression in F.P of solvent
- •Osmotic pressure

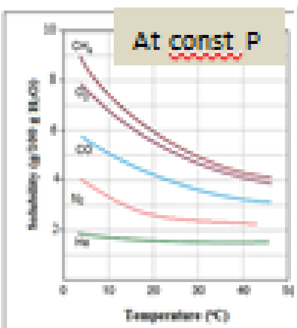
$P_{soln} = X_A . P^o_A$ $\pi = M . R . T$

$\Delta P = X_B . P^o_A$

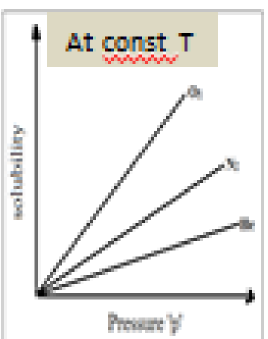
$\Delta T_b = K_b\ m\ i$ $\Delta T_f = K_f\ m\ i$

T (solution) = T (solvent) + ΔT

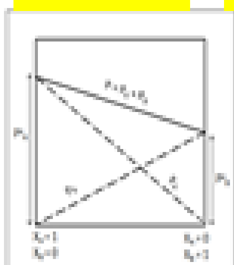
At const P



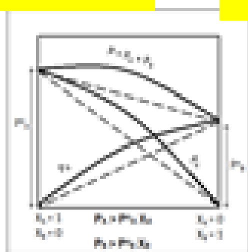
At const T



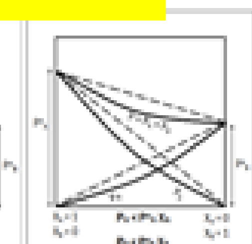
$P = X P^0$



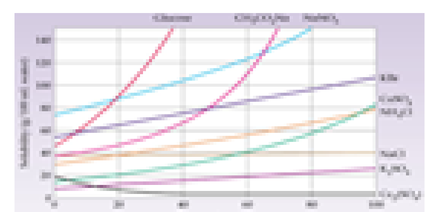
$P > X P^0$

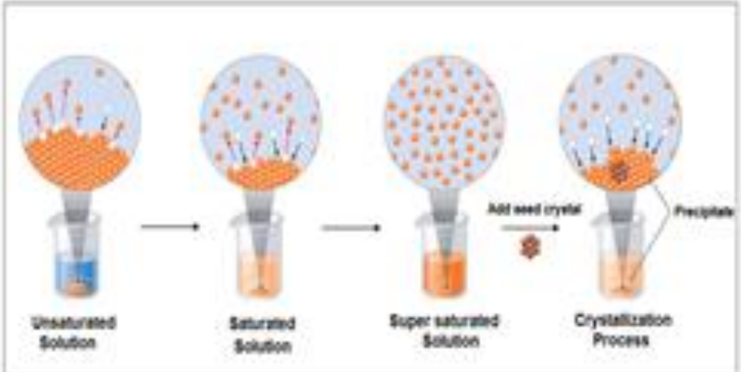


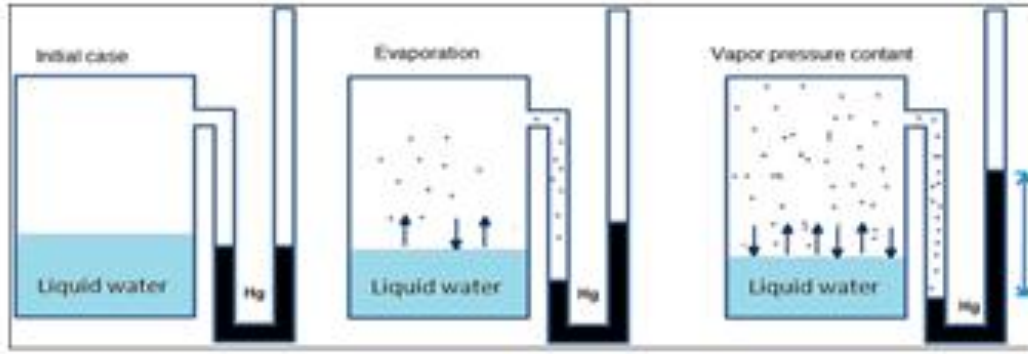
$P < X P^0$

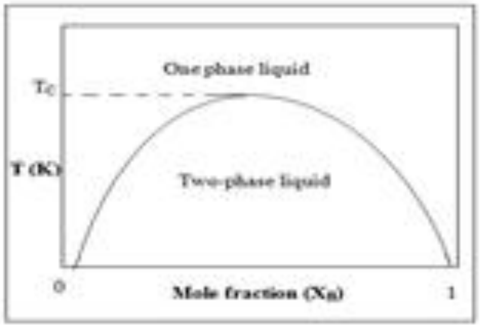


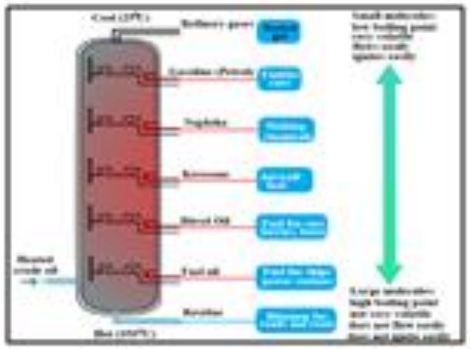
Two examples of each– Characteristics:
A-B attraction forces, ΔH_{mix} , ΔV_{mix}

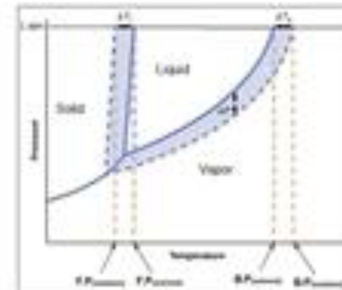


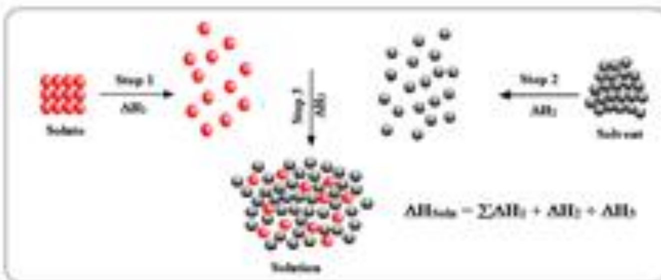

Unsaturated Solution
Saturated Solution
Super saturated Solution
Add seed crystal
Precipitate
Crystallization Process

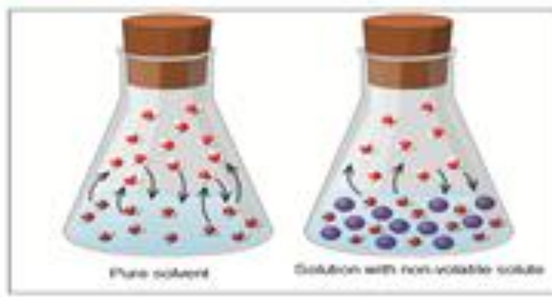

Initial case
Evaporation
Vapor pressure contant
Liquid water
Liquid water
Liquid water
Hg
Hg
Hg

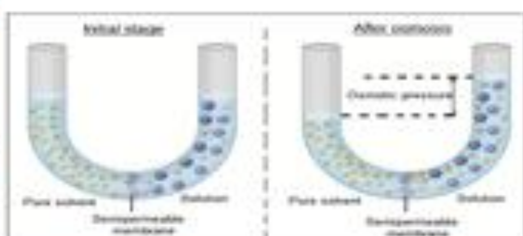

One phase liquid
T_C
T (K)
Two-phase liquid
0
Mole fraction (X_B)
1

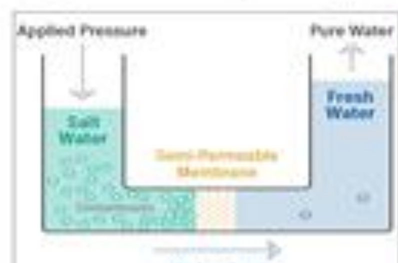



Liquid
Solid
Vapor


Step 1
Step 2
Step 3
Solute
Solvent
Solution


Pure solvent
Solution with non-volatile solute


Initial stage
After osmosis
Osmotic pressure
Pure solvent
Solution
Semipermeable membrane


Applied Pressure
Pure Water
Salt Water
Fresh Water
Semi-Permeable Membrane
Water Flow