Physical Chemistry (Chem 132A)

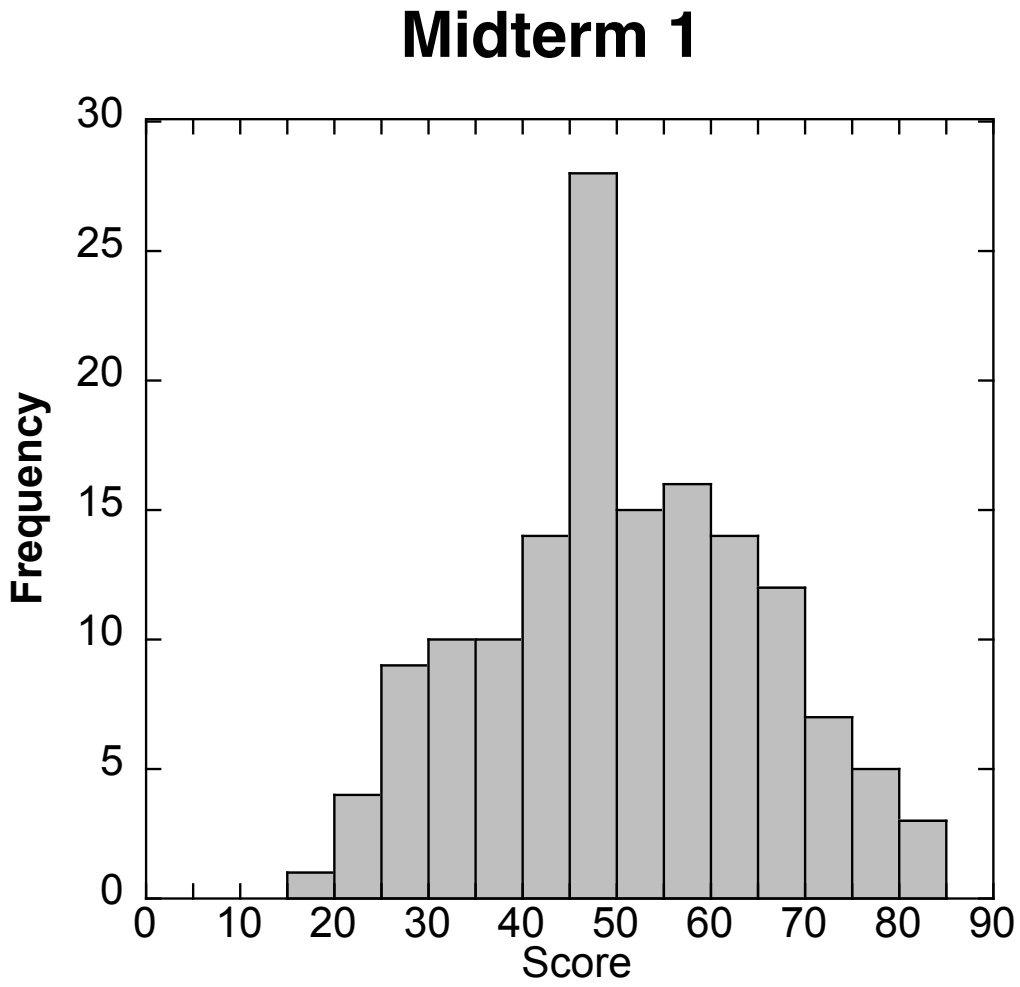
Lecture 13
Monday, October 30

Homework #5 will be due November 4

Additional Problems you should look at in the text, from Topic 5C. (not for credit but important for midterm 2 and final.

Exercises: 5c.3a, 5c.3b, 5c.4a, 5c.7a
Problems: 5c.5, 5c.7

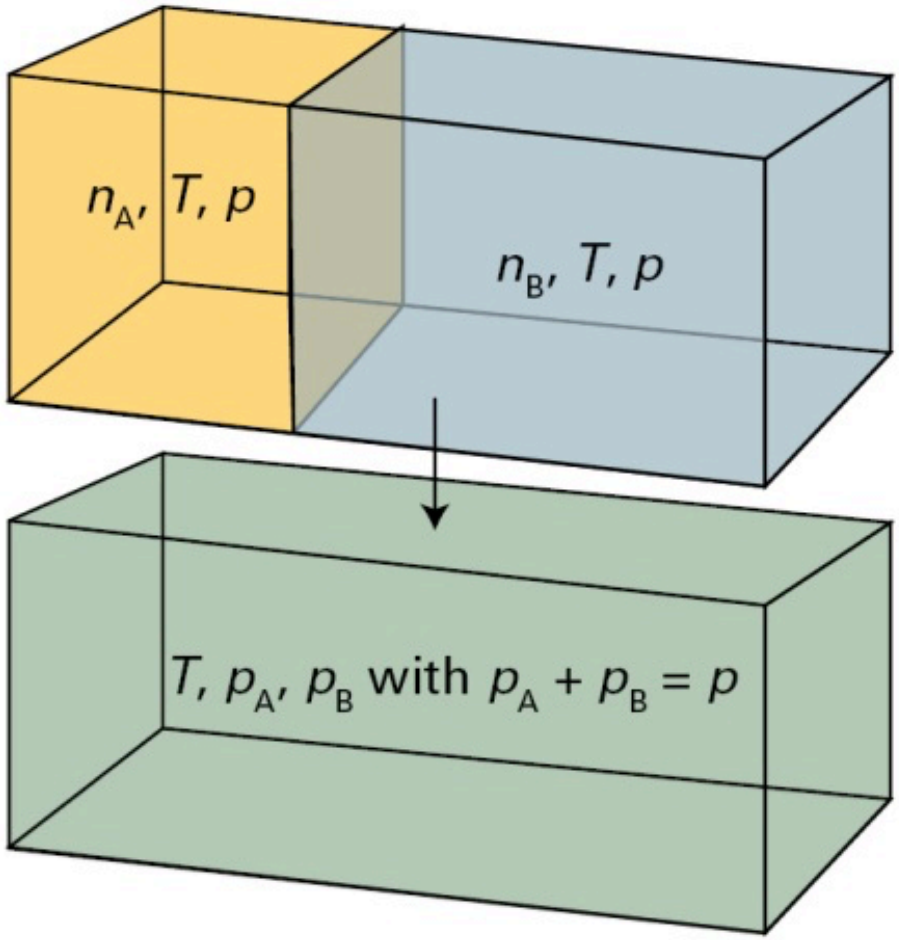
Midterm Exam #1



Average = 50.1

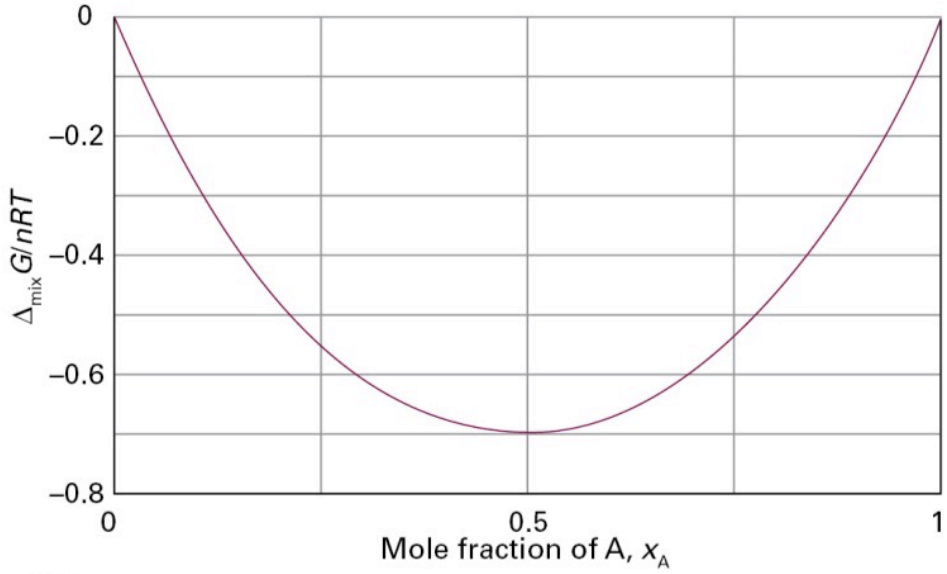
Standard deviation = 12

MIXING

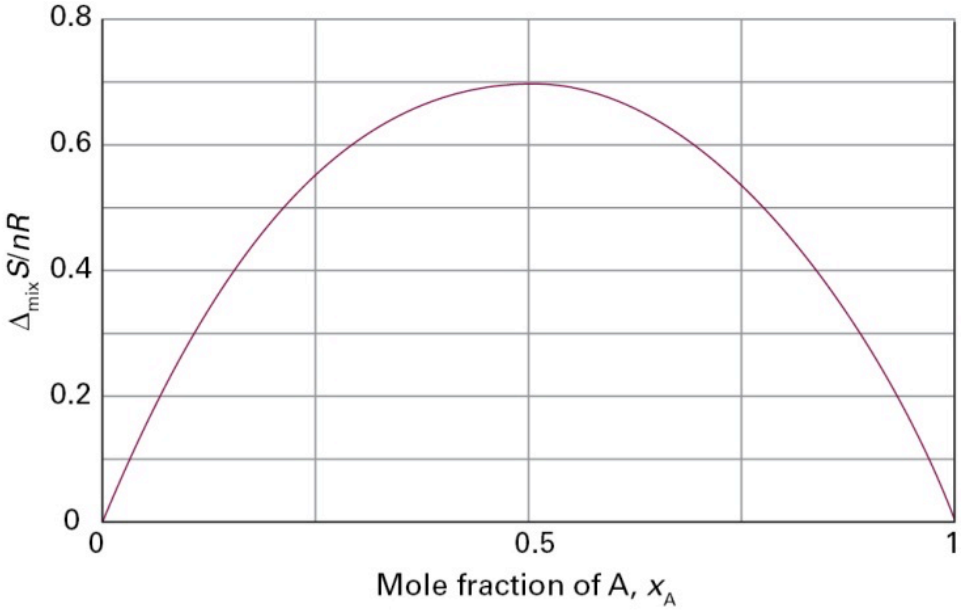


WHAT HAPPENS TO G AND S?

$\Delta_{mix}G$ and $\Delta_{mix}S$??



$\Delta_{mix}G$ is negative



$\Delta_{mix}S$ is positive

Ideal solution definition:

$\mu_j = \mu_j^* + RT \ln(x_j)$

Pressure above a mixed solution

$p_a = x_a p$ note: p = total pressure

Definition of partial pressure.

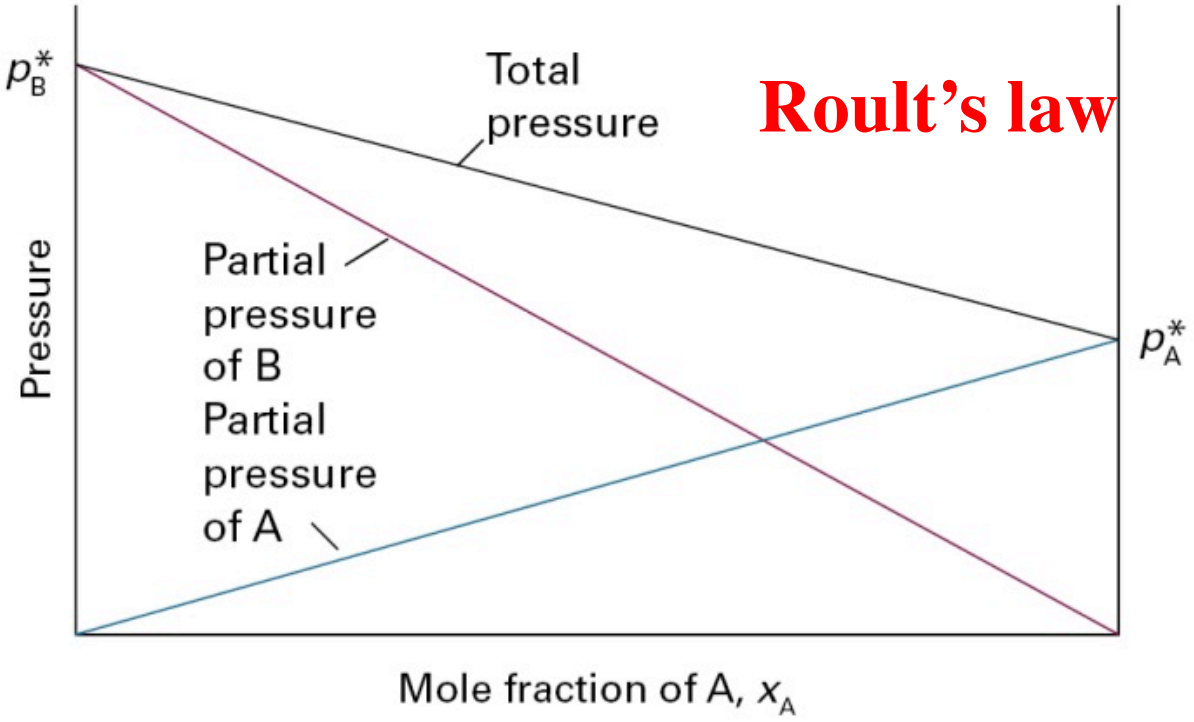
Empirically: $p_a = x_a\, p_a^*$
Where p_a^* is the vapor pressure of pure A

Roult's law

Pressure above a mixed solution: Roult's Law

$p_a = x_a p$ note: p = total pressure

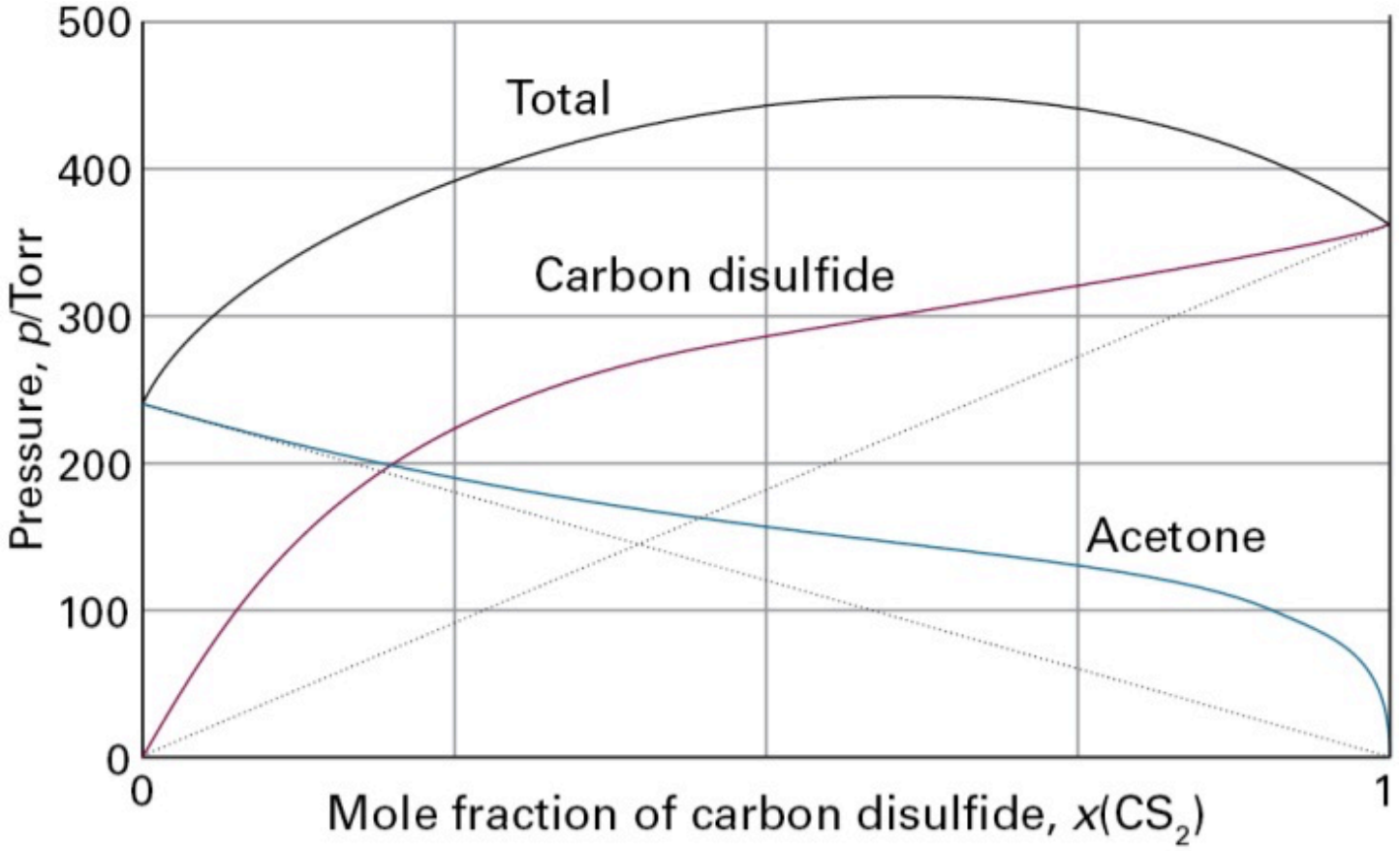
Definition of partial pressure.



Empirically: $p_a = x_a\ p_a^*$

Where p_a^* is the vapor pressure of pure A

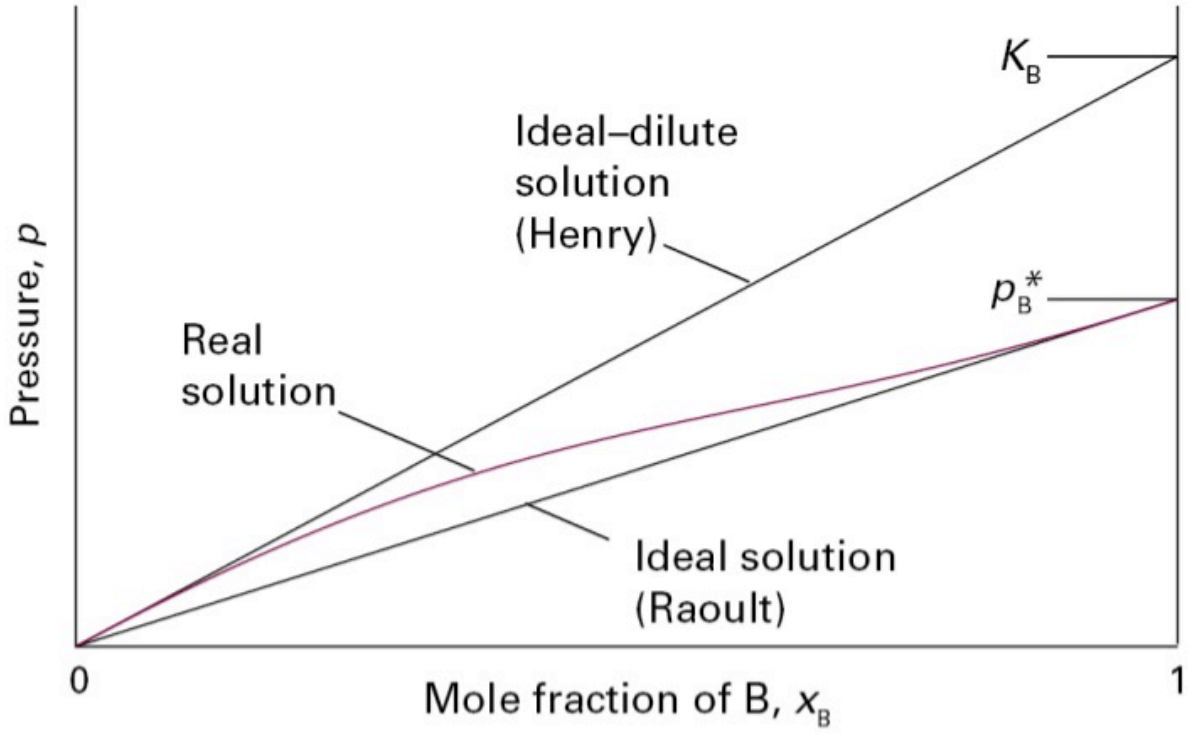
Non-Ideal Solution



Dilute Solutions that don't obey Roult's Law

$p_B = x_B K_B$ **Henry's Law---Dilute solutions**

Note: K_B is not the pure solute vapor pressure.



Colligative Properties

Boiling point elevation: $\Delta T_b = K_b b = K_b m$

Note: b subscript refers to "boiling point"

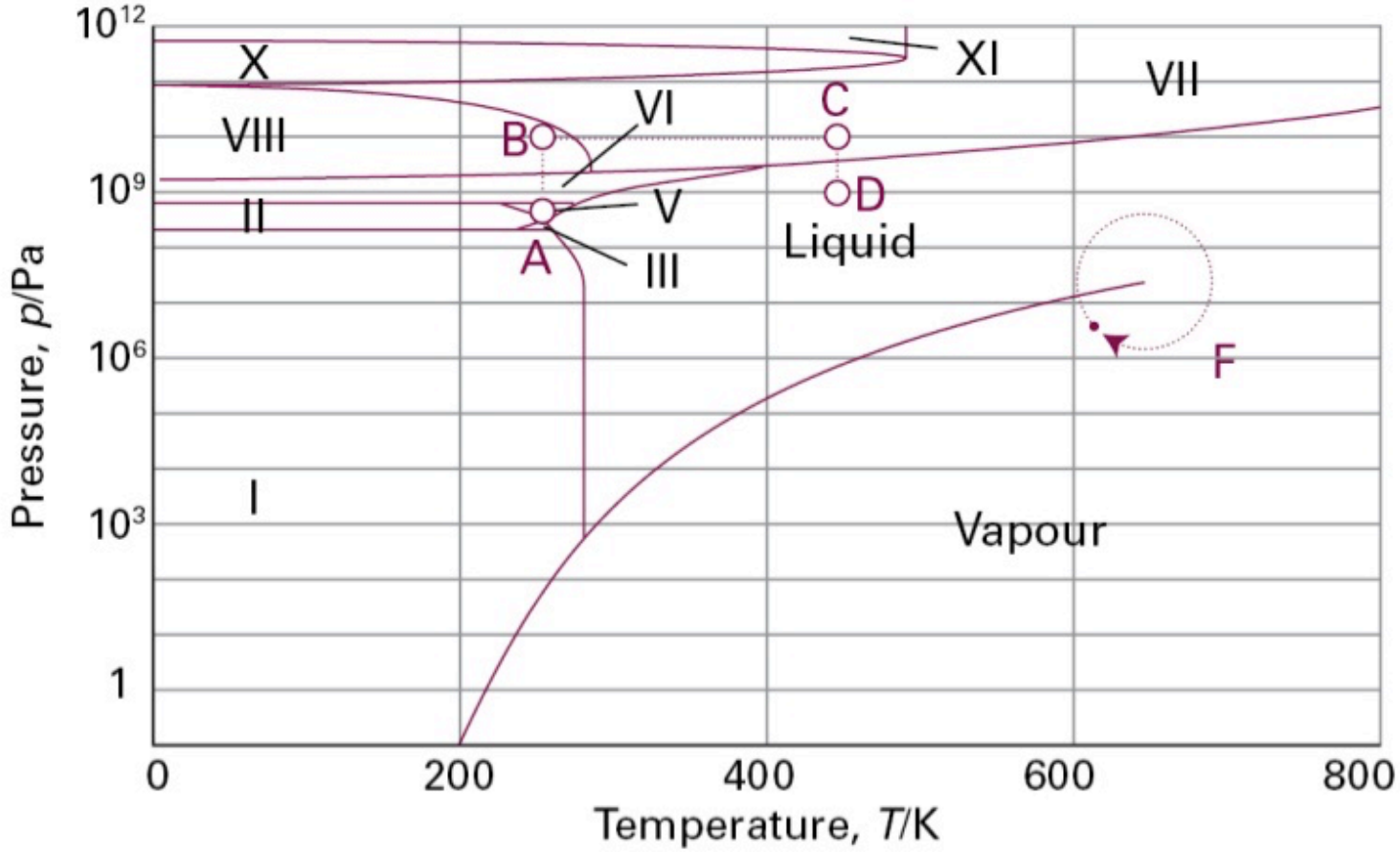
b (non-subscript) is the molality of the solution

Freezing point depression: $\Delta T_f = K_f b$

Note: These are empirical relationships valid for low concentrations.

PHASE DIAGRAMS

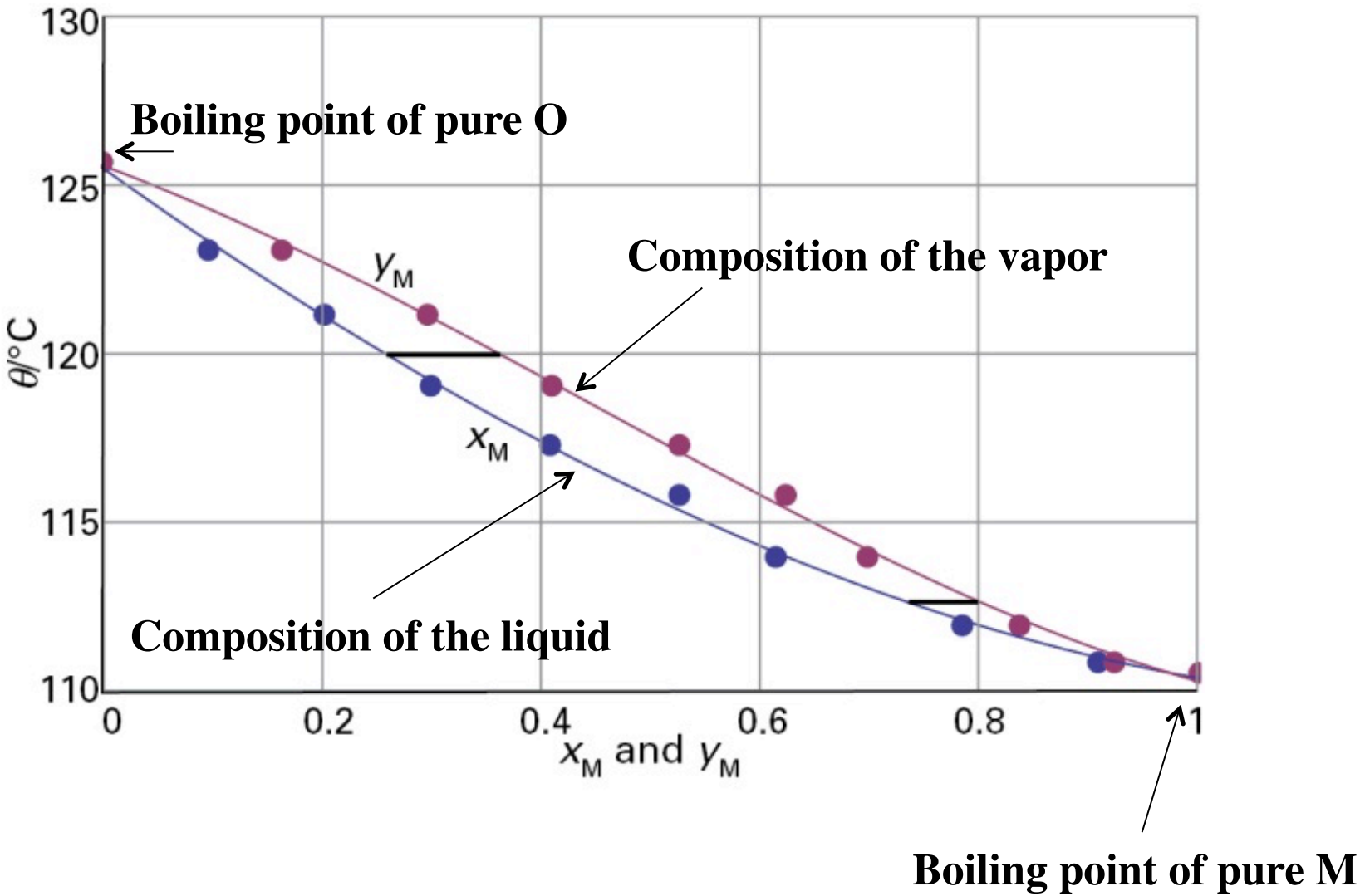
Pure substance, e.g. water



Phase Diagrams for Binary Mixtures

1. **Vapor pressure diagrams (pressure / composition)**
2. **Temperature / composition diagrams**
3. **Temperature / composition for partially miscible systems**
4. **Temperature / composition for liquid/solid systems**

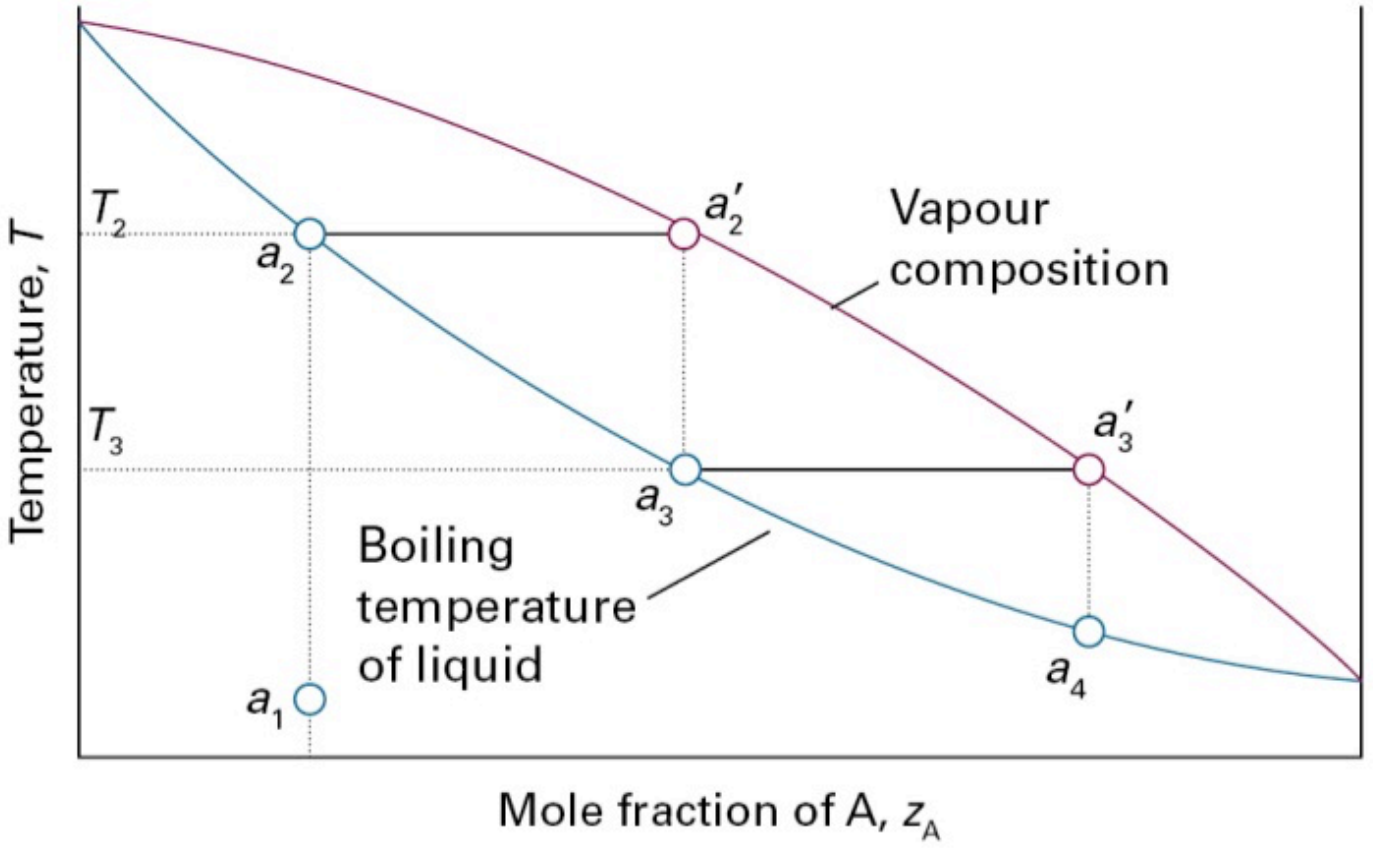
Example of a Vapor Pressure Diagram



TEMPERATURE / COMPOSITION

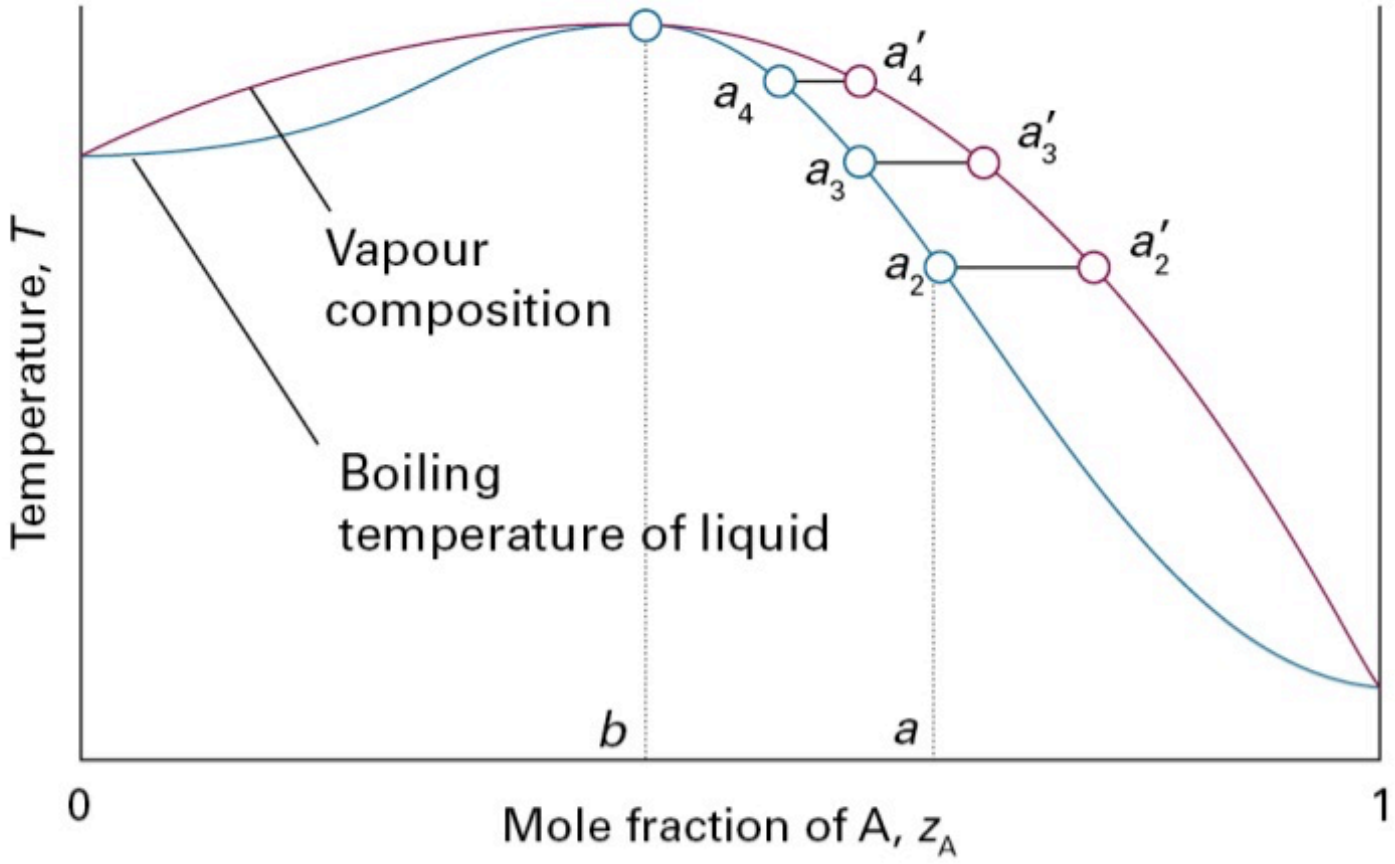
DISTILLATION

IDEAL SOLUTION

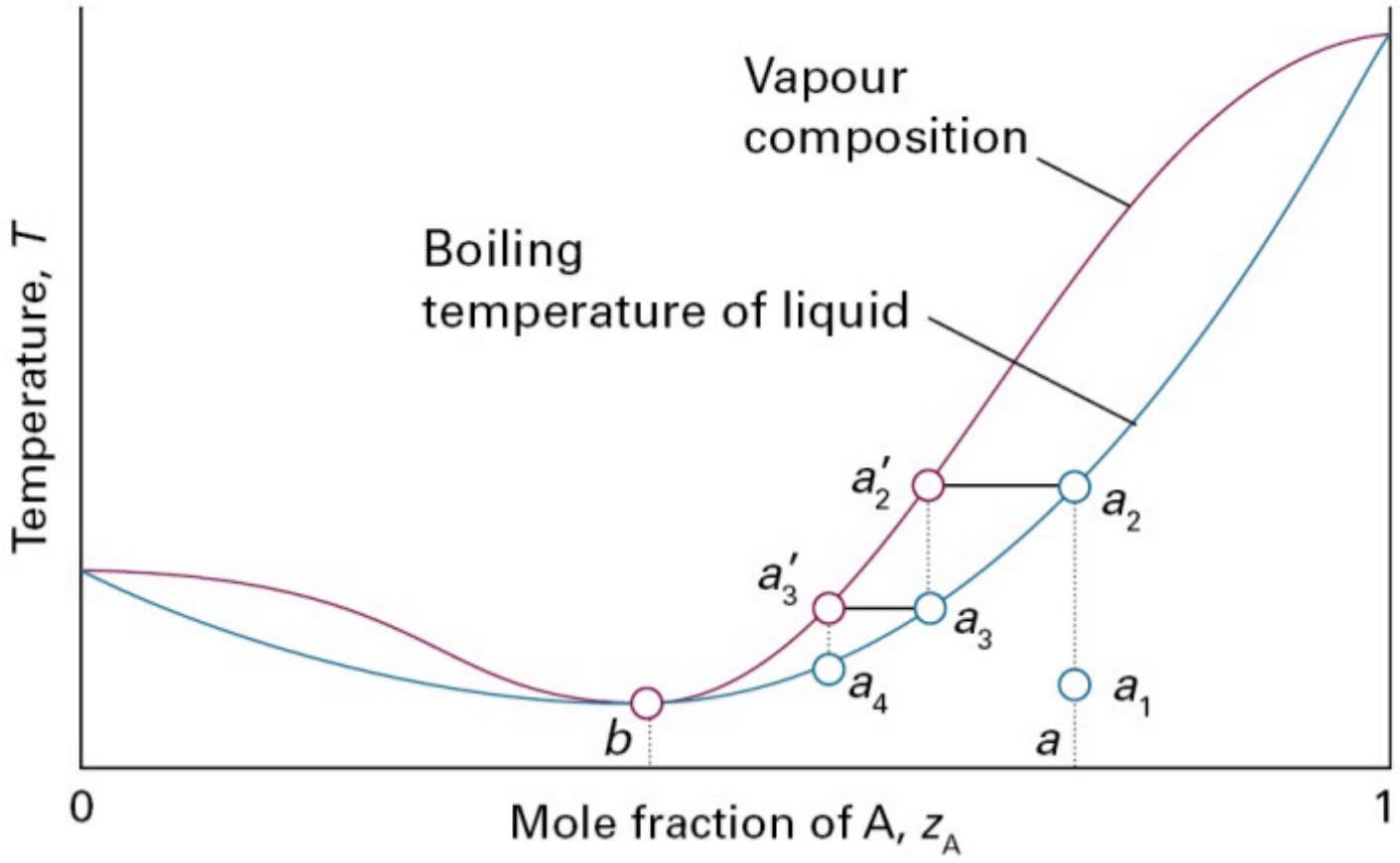


AZEOTROPE

Favorable interactions between A and B
Lead to reduced vapor pressure
compared to ideal solution behavior



Azeotrope showing unfavorable interactions between A and B



THE END

SEE YOU WEDNESDAY