8.S: Phase Equilibrium (Summary)

Learning Objectives

After mastering the material in this chapter, one will be able to

1. State the thermodynamic criterion for equilibrium in terms of chemical potential.
2. Derive and interpret the Gibbs Phase Rule.
3. Derive the Clapeyron equation from the thermodynamic criterion for equilibrium.
4. Interpret the slope of phase boundaries on a pressure-temperature phase diagram in terms of the relevant changes in entropy and molar volume for the given phase change.
5. Derive the Clausius-Clapeyron equation, stating all of the necessary approximations.
6. Use the Clausius-Clapeyron equation to calculate the vapor pressure of a substance or the enthalpy of a phase change from pressure-temperature data.
7. Interpret phase diagrams for binary mixtures, identifying the phases and components present in each region.
8. Perform calculations using Raoult's Law and Henry's Law to relate vapor pressure to composition in the liquid phase.
9. Describe the distillation process, explaining how the composition of liquid and vapor phases can differ, and how azeotrope composition place bottlenecks in the distillation process.
10. Describe how cooling curves are used to derive phase diagrams by locating phase boundaries.

Vocabulary and Concepts

- azeotrope
- Clapeyron equation
- Clausius-Clapeyron equation
- compositional degrees of freedom
- cooling curve
- distillation
- eutectic halt
- eutectic point
- Gibbs phase rule
- Henry's Law
- incongruent melting
- lever rule
- lower critical temperature
- phase diagram
- platinum resistance thermometer
- Raoult's law
- scanning calorimetry
- thermodynamic constraints
- triple point
- upper critical temperature
- volatile liquid

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