Outcomes for Exam 2

Equations of State

- Adapt our approach to mixtures
  - Write the van der Waals mixing rules and explain their functionality in terms of molecular interactions
  - Write the mixing rules for the virial coefficients and for pseudo-critical properties using Kay’s rule
  - Using mixing rules to solve for P, v, and T of mixtures
- Write the exact differential of one property in terms of two other properties
- Use departure functions to calculate property data for real fluids (and use them to solve engineering problems)
  - Calculate departure functions from Lee-Kesler charts
  - Use equations of state to calculate departure functions

Phase Equilibrium: Conditions for Equilibrium

- Write down the conditions for equilibrium for: a pure single phase system, a pure multi-phase system, and a multi-phase mixture
- Explain how energetic and entropic effects balance at equilibrium
- Use the Clapeyron equation and/or the Clausius-Clapeyron equation to relate T and P for pure species phase equilibrium
- Use the Antoine equation to relate T and P for pure species phase equilibrium
- Explain the relationship between the Clausius-Clapeyron equation and the Antoine equation
- Write exact differentials for extensive properties in terms of m+2 independent variables for mixtures of m species
- Define and explain the difference between the terms: pure species property, total solution property, and partial molar property
- Calculate total solution properties from partial molar properties
- Calculate partial molar properties
  - using graphical methods
  - using equations of state
  - using the Gibbs-Duhem equation
- Explain the origin of enthalpy, entropy, and volume changes due to mixing
- Calculate the enthalpy of solution from the enthalpy of mixing and vice versa
- Explain why the chemical potential is the relevant property for determining solution equilibrium

Phase Equilibrium: Fugacity and Equilibrium Calculations

- Relate the fugacity and the chemical potential (or the partial molar Gibbs free energy)
- Use the fugacity coefficient to calculate the vapor phase fugacity
- Use the activity coefficient to calculate the liquid (or solid) phase fugacity
- Identify conditions when a liquid or solid mixture would form an ideal solution
- Explain when Lewis-Randall versus Henry ideal solution reference states are appropriate
Use the Gibbs-Duhem equation to relate activity coefficients in a mixture
Perform bubble-point and dew point calculations
  ◦ using Raoult's Law
  ◦ using complete fugacity relations (assuming known fugacity coefficients and activity coefficients)
Draw and read Txy and Pxy diagrams for VLE
Use Henry's Law to calculate VLE for gases dissolved in liquids