Exam 2 Review Sheet

Chemical Engineering 273

1. **Single-Phase Systems**
   a. Liquid densities of mixtures
   b. Ideal gas
      i. Most common equation of state
      ii. Range of applicability (check $\hat{V}_{ideal}$)
      iii. Mixtures (partial pressure, volume fraction, mole fraction)
   c. Standard temperature and pressure (SCF, SLPM, etc.)
   d. Non-ideal equations of state
      i. Van der Waals
      ii. SRK
      iii. Corresponding States ($P_r = P/P_c$, $T_r = T/T_c$) and compressibility factor (z)
      iv. Kay's rule for mixtures ($P_c' = \sum y_i P_{c,i}$, $T_c' = \sum y_i T_{c,i}$)
2. **Multiphase Systems**
   a. Single-component phase behavior
   b. Tables for Saturated Steam (B.3, B.5, B.6)
   c. Vapor pressure estimation (P_i*) – Antoine, DIPPR, Fig. 6.1-4
   d. Gibbs phase rule
   e. Gas-liquid systems with one condensable component
      i. Raoult's Law ($y_i P_{tot} = x_i P_i^*$, but $x_i = 1$)
      ii. Humidity and drying (relative humidity, absolute humidity, degrees superheat)
   f. Multicomponent Systems
      i. Raoult's Law ($y_i P_{tot} = x_i P_i^*$)
         1. Assumptions
            a. Ideal systems
            b. Real systems where x_A is close to 1
         2. Dew point and bubble point
         3. 2 phase separation (Flash calculations)
         4. Non-condensable gas above liquid mixture (like air or N_2)
      ii. Henry's Law ($y_i P_{tot} = x_i H_i$, used for small x_i) (will not be on exam)
      iii. Diagrams
         1. Vapor-liquid diagrams (T-xy and P-xy)
         2. Solid-Liquid phase diagram
         3. Liquid-Liquid ternary diagram
         4. Tie lines and lever rule
      iv. Material balances using phase equilibrium data/calculations

Learning Outcomes Covered on Exam 2

Student Expectations
Students will understand process variables (e.g., P, T, flow rate, conc.) including procedures and equipment for their measurement.
Students will be able to apply solution thermodynamics fundamentals to solve phase equilibrium problems including bubble point, dew point and flash calculations.
Students will be able to read and understand phase diagrams and use these to determine physical phenomena.
Students will understand pure-component, PVT phase behavior including vapor pressure, critical point, freezing line, triple point, etc.
Students will understand how molecular interactions to the behavior of material gives rise to macroscopic properties.