

# Exam 2 Review Sheet

Chemical Engineering 273

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## 1. Material Balances with Reaction

- a. Species balances with generation/consumption
- b. Species balances with extent of reaction
- c. Elemental balances
- d. DOF analysis on reacting systems
  - i. Additional unknown for each reaction (extent of reaction)
  - ii. Proper use of species balances will always give correct DOF
  - iii. Elemental balances are preferred, but occasionally are not independent!!
  - iv. Use element balances for “block” with reacting systems
  - v. Always perform DOF analysis
- e. Definitions
  - i. Limiting reactant
  - ii. Yield
  - iii. Single-Pass Conversion
  - iv. Overall conversion
  - v. Selectivity
- f. Combustion Reactions
  - i. Should be able to write and balance these reactions for complete combustion, etc.
  - ii. Theoretical and excess air
  - iii. Dry basis for compositions

## 2. Single-Phase Systems

- a. Liquid densities of mixtures
- b. Ideal gas
  - i. Most common equation of state
  - ii. Range of applicability
  - iii. Mixtures (partial pressure, volume fraction, mole fraction)
- c. Standard temperature and pressure
- d. Non-ideal equations of state
  - i. Van der Waals
  - ii. SRK
  - iii. Corresponding States and compressibility factor

## 3. Multiphase Systems

- a. Single-component phase behavior
- b. Vapor pressure estimation
- c. Gibbs phase rule
- d. Gas-liquid systems with one condensable component
  - i. Raoult’s Law
  - ii. Humidity and drying
- e. Multicomponent Systems
  - i. Raoult’s Law
    1. Ideal systems
    2. Real systems where  $x_A$  is close to 1
    3. Dew point and bubble point
    4. 2 phase mixtures
  - ii. Henry’s Law
    1. Real systems where  $x_A$  is close to 0
  - iii. SLE- phase diagram and instruction from Web
  - iv. LLE- ternary diagram
  - v. Tie lines and lever rule
  - vi. Material balances using phase equilibrium data/calculations