Chemical Thermodynamics
Chemical Potential: gas

- Need chemical potential at arbitrary temperature and pressure.

- For an ideal gas:
Chemical Potential: liquid

- Liquids are a little more complicated.
- Start by looking at a mixture of two different liquids.

- Molar volumes:
Gibbs-Duhem equation

- Total Gibbs energy

- Two different expressions for $dG$.

- Results in Gibbs-Duhem equation
Partial molar quantities

- We will consider many different partial molar quantities.
- Total quantity

- Partial molar quantity

- Sums of partial molar quantities
Partial molar volume

- Partial molar volume can be determined experimentally.

- Fitting a polynomial to a curve of total volume versus molality.
Partial molar volume

- Given a binary liquid mixture knowing the partial molar volume of one component gives the other.
For a pure substance in equilibrium liquid and gas chemical potentials are equivalent.
Chemical potential

- Back to a liquid mixture.

- The chemical potentials for a given component in solution and gas phase are equal.
Chemical potential

- Chemical potentials of the two components are related.
Vapor pressure diagram

- For an ideal solution of two volatile liquids

- P-X diagram of an ideal binary solution.