# Free Energies and Equilibria

At the end of this chapter you should be able to...

- Describe processes using Gibb's and Helmholtz Free Energies.
- Determine Natural Variables of Various Thermodynamic State Functions (U, S, H, A, and G) and Use Maxwell Relations to Derive Various Thermodynamic Relationships.
- Describe the direction of spontaneous processes and equilibrium using S, G, and A.
- Calculate Gibb's Free Energies of Gases at Non-standard Pressures.
- Describe Criterion for Equilibrium for Chemical Mixtures and Phase Changes.
- Calculate Gibb's Free Energy Changes for Chemical Reactions under Standard and Non-Standard Conditions.
- Solve Problems involving Chemical Equilibrium by using $\Delta G$, $K_p$, and $Q_p$.
- Determine Equilibrium Shifts due to Perturbations (Le Chatelier's Principle) by using Q and K for chemical reactions.
- Determine the temperature dependence of G and K in terms of H and S.
- Express the Equilibrium Constant in Terms of Partial Pressures, Concentrations (Molarity), or Mole Fraction and interrelate all of these equilibrium constants.