Chapter 15 - Thermodynamics

Theory:
- Standard state of elements
- Exothermic ($\Delta H < 0$) vs endothermic ($\Delta H > 0$)
- Spontaneous ($\Delta G < 0$) vs non-spont. ($\Delta G > 0$)
- $E$, $H$, $S$, $G$, $q$, $w$
- Sign conventions for $\Delta E$, $\Delta H$, $\Delta S$, $\Delta G$, $q$, $w$
- 3 laws of thermodynamics

Calorimeters:
- Bomb - measures $\Delta E$ (volume is constant)
- Coffee cup - measures $\Delta H$ (pressure constant)

\[
\Delta H = \Delta E + \Delta n_{\text{gas}} RT
\]

- Work: $w = -\Delta n_{\text{gas}} RT$ at constant $P = -P \Delta V = w$
- $\Delta E = q + w$

- Hess' Law of Heat Summation

\[
\Delta H_{\text{rxn}} = \sum \Delta H^0_{\text{product}} - \sum \Delta H^0_{\text{reactant}}
\]

(can use to find $\Delta G_{\text{rxn}}$ or $\Delta S_{\text{rxn}}$)

- Heat in reaction $\propto$ amount of substance involved
- Gibbs-Helmholtz equation + applications

\[
\Delta G = \Delta H - T \Delta S
\]

at equilibrium $\Delta G = 0 \Rightarrow T_{eq} = \frac{\Delta H (RT)}{\Delta S (J/mK)}$