CHAPTER OVERVIEW

4: Redox Stability and Redox Reactions

Learning Objectives

- Balance complex oxidation-reduction reactions by the ion-electron method.
- Understand periodic trends in the activity series and electrochemical series.
- Use the Nernst equation to determine half-cell and cell potentials.
- Derive the stability field of water and use this to rationalize aqueous redox chemistry.
- Construct and be proficient with Latimer diagrams, using them to determine unknown reduction potential values and to quickly identify stable and unstable species.
- Construct and be proficient with Frost diagrams, using them to identify stable and unstable species, as well as those that are strong oxidizers.
- Construct and be proficient with Pourbaix diagrams, using them to identify redox and non-redox reactions, reactions that are and are not pH-dependent, and ultimately to predict and rationalize stability, reactivity, corrosion, and passivation.

In redox reactions, one element or compound is reduced (gains electrons) and another is oxidized (loses electrons). In terms of everyday life, redox reactions occur all of the time around us. For example, the metabolism of sugars to CO_2, which stores energy in the form of ATP, is a redox reaction. Another example of redox is fire or combustion, such as in a car engine. In a car engine, hydrocarbons in the fuel are oxidized to carbon dioxide and water, while oxygen is reduced to water. Corrosion (i.e. the formation of rust on iron) is a redox reaction involving oxidation of a metal.