9.6 Corrosion

- Corrosion: an electrochemical process in which a metal reacts with substance in the environment, returning the metal to an ore-like state.
- In general, any metal appearing below the oxygen half-reaction in a redox table will oxidize in our environment.
- Based on the above statement, why doesn't Al oxidize rapidly. It is due to the nature of the oxide. Aluminum oxide forms a tightly bonded transparent coating on the elemental aluminum and prevents oxygen from reaching it and oxidizing it further. Iron on the other hand flakes off and exposes more elemental iron for oxidation.

Rusting of Iron

- Water and oxygen are need for iron to corrode.
- First step iron is oxidized: $Fe_{(s)} \rightarrow Fe^{2+}_{(aq)} + 2e^-$
- Second step: electrons flow through the iron which is an electrical conductor.
- Third step: oxygen dissolved in the water is reduced: $\frac{1}{2} O_{2(g)} + H_2O_{(l)} + 2e^- \rightarrow 2OH^-_{(aq)}$
- Fourth step: the iron ion and hydroxide react in the presence of the dissolved oxygen and forms hydrated iron (III) oxide and iron (III) hydroxide.
- See figure 2 on page 711.
- The rusting of iron requires the presence of oxygen and water and is accelerated by the presence of acidic solutions, electrolytes, mechanical stresses, and contact with less active metals.

Corrosion Prevention

- 2 types: barrier methods and cathodic protection
- Paint, tin, and zinc are used to create a barrier protecting the iron underneath. It prevents water and oxygen from reacting with the iron.

Cathodic Protection

- By forcing iron to become the cathode, electrons will flow into the iron and prevent it from corrosion.
- Method 1: apply a constant current to keep the iron from corrosion.
- Method 2: sacrificial anode, by using a metal more easily oxidized than iron the electrons will flow into the iron to prevent corrosion. However, the anode will eventually be consumed and will need to be replaced. Common metals used are zinc and magnesium.