Chapters 17 and 8.7
Electrochemistry: The Quest for Clean Energy
Learning Objectives

1-6-2023

To satisfy the minimum requirements for this course, you should be able to:

Chapter 8, Section 8.7 - Oxidation-Reduction Reactions: Electron Transfer

1. Assign oxidation numbers to atoms in a formula.

2. Recognize oxidation reduction (redox) reactions and be able to:
   - identify the substances being oxidized and reduced.
   - identify the oxidizing agent and reducing agent.
   - determine the number of electrons transferred.

Chapter 17 – Electrochemistry: The Quest for Clean Energy

3. Diagram simple voltaic and electrolytic cells and be able to:
   - label the anode, cathode, and directions of ion and electron movement.
   - write half reaction equations for the anode and cathode.

4. Given an appropriate Standard Reduction Potentials table (found in Table A6.1, Appendix 6, pp. APP-30 – APP32),
   - be able to construct a balanced chemical equation using half-cell reactions.
   - calculate the cell voltage generated by a voltaic cell (standard cell potential, E^o_{cell}).
   - determine the relative strengths of oxidizing or reducing agents.
   - use standard reduction potentials to predict whether a given reaction will be spontaneous when all of the reactants and products are present in standard state conditions.

5. Understand the relationship between E^o_{cell}, $\Delta G°_{rxn}$, and K for oxidation-reduction reactions and be able to:
   - calculate $\Delta G°_{rxn}$ from E^o_{cell} and perform the reverse operation.
   - calculate K from E^o_{cell} and perform the reverse operation.

6. Use the Nernst equation to calculate the cell potential or the concentration of a substance under nonstandard conditions.

7. Discuss how a spontaneous redox reaction can be used to create a battery and:
   - recognize the connection between the components of the cell and the properties of the battery.
   - recognize the chemical reaction used in a lead-acid storage battery and lithium ion battery.
   - describe the basic components and processes in the H_2/O_2 fuel cell.

8. Discuss the difference between galvanic and electrolytic cells and calculate the time, current, and the amount of substance produced/consumed in an electrolysis reaction.

9. NavApp: Corrosion and Oxygen Production On Board Submarines. Be able to:
   - describe general corrosion in terms of electrochemistry and the corrosion triangle.
   - describe chemical corrosion and recognize the primary oxidation and reduction reactions.
   - describe atmospheric corrosion and recognize the primary oxidation and reduction reactions.
   - describe methods for minimizing corrosion on Naval vessels and other equipment: sacrificial anodes, impressed voltage, phosphating, coating with less active metal (*e.g.*, tin can), coating with more active metal (*e.g.*, galvanized iron).
   - identify electrolysis of water as the primary source of oxygen generation.
   - describe how oxygen is produced on submarines with an electrochemical oxygen generator.
   - describe how oxygen is produced on submarines with an oxygen candle furnace.