

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

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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.

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3. Diagram simple voltaic and electrolytic cells and be able to:
  - label the anode, cathode, and directions of ion and electron movement.
  - write half reactions for the anode and cathode.
4. Given an appropriate Standard Reduction Potentials table (found in Table A6.1, Appendix 6, pp. APP-30 – APP30),
  - be able to construct a balanced chemical equation using half-cell reactions
  - calculate the cell voltage generated by a voltaic cell (standard cell potential,  $E^\circ_{\text{cell}}$ )
  - 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  $E^\circ_{\text{cell}}$ ,  $\Delta G^\circ_{\text{rxn}}$ , and K for oxidation-reduction reactions and be able to:
  - calculate  $\Delta G^\circ_{\text{rxn}}$  from  $E^\circ_{\text{cell}}$  and perform the reverse operation
  - calculate K from  $E^\circ_{\text{cell}}$  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  $\text{H}_2/\text{O}_2$  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
  - 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