

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

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

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

1. Recognize oxidation reduction (redox) reactions and be able to:
 - identify the compounds being oxidized and reduced
 - identify the oxidizing agent and reducing agent

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2. Describe the functions of the various components of simple voltaic and electrolytic cells.
3. Diagram electrochemical cells, labeling the anode, cathode, and directions of ion and electron movement.
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°_{cell})
 - be able to predict spontaneity in a redox reaction
 - 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°_{cell} , $\Delta G^\circ_{\text{rxn}}$, and K for oxidation-reduction reactions and be able to:
 - calculate $\Delta G^\circ_{\text{rxn}}$ from E°_{cell} and perform the reverse operation
 - calculate K from E°_{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. NavApp: Corrosion
 - 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).
9. Discuss the difference between galvanic and electrolytic cells and calculate the time, current, and the amount of substance produced/consumed in an electrolysis reaction.
10. NavApp: Oxygen Production On Board Submarines
 - 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