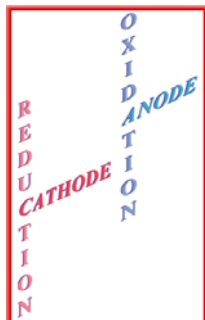


17.1 Electrolysis: Chemistry from Electricity

An **electrical current** is the flow of charged particles such as electrons in a particular direction.

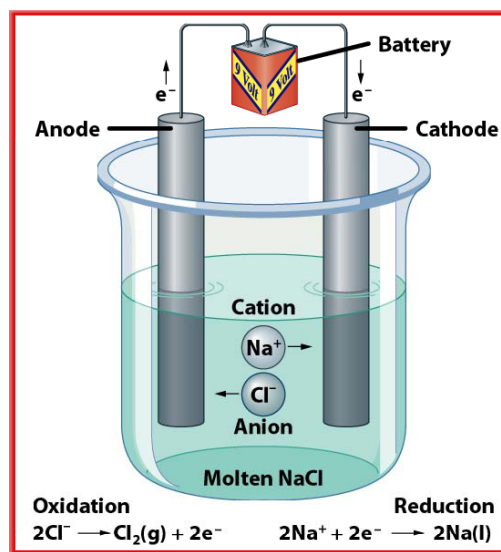
You can use **redox** reactions to produce an electrical current. This is what occurs in a battery, one form of electrochemical cell, in which chemical energy is converted into electrical energy.



An **electrolytic cell** is a chemical system that uses an electric current to drive a non-spontaneous redox reaction. **Electrolysis** is the process that takes place in such a cell.

Reduction takes place at the **cathode** in an electrolytic cell.

Oxidation takes place at the **anode** in an electrolytic cell.

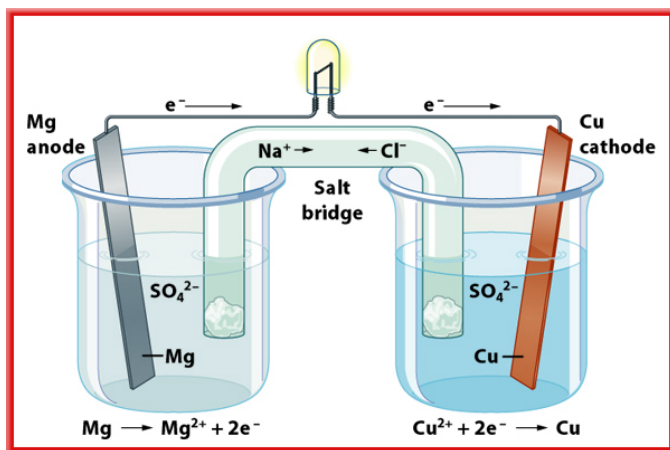


Electrolysis can be used to produce compounds; separate metals from ores, clean metal objects, and electroplate metal coatings onto objects. For more details see worksheets (and textbook).

17.2 Galvanic Cells: Electricity from Chemistry

A **potential difference** between two substances is a measure of the tendency of electrons to flow from one to the other.

A **galvanic cell** is a chemical system that produces an electric current through a spontaneous redox reaction. Batteries contain one or more galvanic cells.



Easily oxidized Not easily oxidized	Li	$\text{Li} \rightarrow \text{Li}^+ + e^-$
	K	$\text{K} \rightarrow \text{K}^+ + e^-$
	Ca	$\text{Ca} \rightarrow \text{Ca}^{2+} + 2e^-$
	Na	$\text{Na} \rightarrow \text{Na}^+ + e^-$
	Mg	$\text{Mg} \rightarrow \text{Mg}^{2+} + 2e^-$
	Al	$\text{Al} \rightarrow \text{Al}^{3+} + 3e^-$
	Mn	$\text{Mn} \rightarrow \text{Mn}^{2+} + 2e^-$
	Zn	$\text{Zn} \rightarrow \text{Zn}^{2+} + 2e^-$
	Cr	$\text{Cr} \rightarrow \text{Cr}^{3+} + 3e^-$
	Fe	$\text{Fe} \rightarrow \text{Fe}^{2+} + 2e^-$
	Ni	$\text{Ni} \rightarrow \text{Ni}^{2+} + 2e^-$
	Sn	$\text{Sn} \rightarrow \text{Sn}^{2+} + 2e^-$
	Pb	$\text{Pb} \rightarrow \text{Pb}^{2+} + 2e^-$
	Cu	$\text{Cu} \rightarrow \text{Cu}^{2+} + 2e^-$
	Ag	$\text{Ag} \rightarrow \text{Ag}^+ + e^-$
	Hg	$\text{Hg} \rightarrow \text{Hg}^{2+} + 2e^-$
	Pt	$\text{Pt} \rightarrow \text{Pt}^{2+} + 2e^-$
	Au	$\text{Au} \rightarrow \text{Au}^{3+} + 3e^-$

Of the two metals present in a typical galvanic cell, the metal higher up in the table above will be oxidized (become a cation) and the metal relatively lower will be reduced (become a metal).

Vocabulary

For each of the following terms, write a sentence that shows your understanding of its meaning.

- | | | | | |
|---------------|--------------|----------------------|--------------------|---------|
| anion | electrolysis | anode | electrolytic cell | cathode |
| galvanic cell | cation | potential difference | electrical current | voltage |

Chapter 21 Nuclear Chemistry

21.1 Types of Radioactivity

Nuclear reactions involve protons and neutrons rather than electrons, and therefore differ from chemical reactions.

Radioactivity involves the spontaneous emission of radiation by an unstable nucleus. It can be detected and measured using film and instruments, including Geiger and scintillation counters.

Unstable isotopes are called radioisotopes. Symbols for isotopes show the mass number as a superscript and the atomic number as a subscript to the left of the symbol for the element.

When nuclei decay, they usually emit one or more of the three common types of radiation: alpha particles, beta particles, and gamma rays. During alpha decay, a ${}^4_2\text{He}$ particle is emitted. During beta decay, an electron is emitted. During gamma decay, high-energy electromagnetic gamma radiation is emitted.

A nuclear decay process can be represented by an equation in which the sum of the mass numbers and the sum of the atomic numbers must each be equal on both sides of the arrow.

The half-life of a radioactive element is the time it takes for one-half of the nuclei in a sample to decay. The rate of nuclear decay can be used to date fossils and artifacts.

21.2 Nuclear Reactions and Energy

A small mass is converted into a large amount of energy during a nuclear reaction, according to Einstein's equation $E = mc^2$.

Nuclear fission is the breaking apart of a nucleus into two or more smaller nuclei that are similar in size.

Uranium-235 undergoes a fission chain reaction in a nuclear reactor, which converts some of the released energy into electricity.

Nuclear fusion is the joining together of two smaller nuclei to form a larger one. Fusion in the sun provides energy for life on Earth. Fusion reactors have the potential to provide energy more safely than fission reactors.

21.3 Nuclear Tools

Radioactive tracers are used for tracking compounds in an organism and for charting the movement of pollutants. Many different isotopes function as medical tracers for imaging organs and processes inside an organism.

Radiation therapy involves selectively killing rapidly dividing cancer cells by targeting them with radiation generated by the decay of cobalt-60.

Gamma radiation from cobalt-60 can be used to irradiate food to keep it from spoiling.

Mostly natural sources contribute to the ionizing radiation exposure that people undergo all the time. The received dose of radiation is measured in grays. The absorbed dose of radiation that results in damage done to organisms is measured in sieverts.

Vocabulary

For each of the following terms, write a sentence that shows your understanding of its meaning.

alpha particle	nuclear fission	beta particle	nuclear fusion	deuterium	nuclear reactor
gamma ray	radioactivity	gray	sievert	half-life	tritium