

Electrolytic Cells

Electrolysis

Electrolysis → The process of supplying electrical energy to force a nonspontaneous redox reaction to occur

Electrolytic Cell → A cell that consists of a combination of two electrodes, an electrolyte, and an external power source (typically a battery)

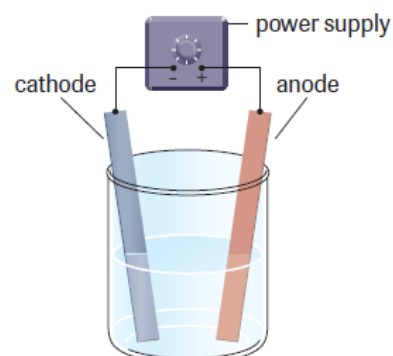


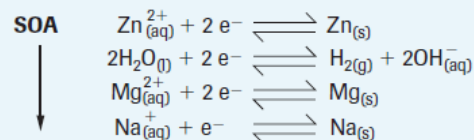
Table 11.2 Cell Comparison

Galvanic Cell	Electrolytic Cell
Spontaneous reaction	Non-spontaneous reaction
Converts chemical energy to electrical energy	Converts electrical energy to chemical energy
Anode (negative): Zinc	Anode (positive): Copper
Cathode (positive): Copper	Cathode (negative): Zinc
Oxidation (at anode): $\text{Zn}_{(s)} \rightarrow \text{Zn}^{2+}_{(aq)} + 2e^{-}$	Oxidation (at anode): $\text{Cu}_{(s)} \rightarrow \text{Cu}^{2+}_{(aq)} + 2e^{-}$
Reduction (at cathode): $\text{Cu}^{2+}_{(aq)} + 2e^{-} \rightarrow \text{Cu}_{(s)}$	Reduction (at cathode): $\text{Zn}^{2+}_{(aq)} + 2e^{-} \rightarrow \text{Zn}_{(s)}$
Cell reaction: $\text{Zn}_{(s)} + \text{Cu}^{2+}_{(aq)} \rightarrow \text{Zn}^{2+}_{(aq)} + \text{Cu}_{(s)}$	Cell reaction: $\text{Cu}_{(s)} + \text{Zn}^{2+}_{(aq)} \rightarrow \text{Cu}^{2+}_{(aq)} + \text{Zn}_{(s)}$

Galvanic Cells and Electrolytic Cells are, simply, opposites of each other. Where the GC is spontaneous, the EC requires an input of energy. Where the cell potential is positive for GC, it's negative for EC. Where the Cathode is the positive electrode and the Anode is the negative electrode for GC, it's the opposite for EC.

Production of Elements

Most elements occur naturally combined with other elements in compounds. Ionic compounds of sodium (Na), potassium (K), lithium (L), etc., are not found uncombined in nature, simply due to their oxidative potentials.

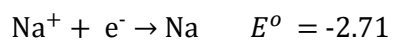


Ionic compounds can, and are, melted, yielding molten ionic compounds that are good electrical conductors and can function as the electrolyte in a cell. In the electrolysis of molten binary ionic compounds, only one oxidizing agent and one reducing agent are present. The production of active metals from their minerals typically involves the electrolysis of molten compounds of the metal.

In molten-salt electrolysis, metal cations move to the cathode and are reduced to metals, and nonmetal anions move to the anode and are oxidized to nonmetals.

Electrolysis of Molten Salts

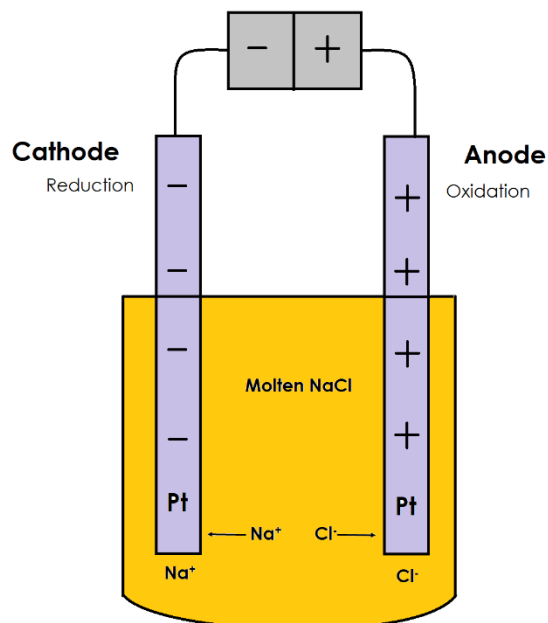
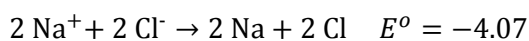
Cathode / Reduction / --'ve



Anode / Oxidation / +'ve

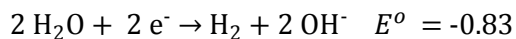


Final Equation:

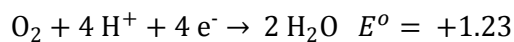


Electrolysis of Water

Cathode / Reduction / --'ve



Anode / Oxidation / +'ve



Final Equation:

