

Chapter Summary: Electrochemistry

Oxidation-Reduction: Oxidation is loss of electrons and reduction is gain of electrons.

Half Reactions: Show oxidation and reduction in individual reactions. These are balanced independently to determine the number of electrons transferred during redox reactions.

Redox reactions: These occur in acidic or basic solutions.

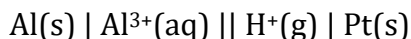
Oxidizing agent: An element causing another to oxidize, to lose electrons. Mostly nonmetals.

Reducing agent: An element causing another to reduce, to gain electrons. Mostly metals.

Galvanic/Voltaic Cells: A cell with spontaneous redox reaction. The terminology of a cell is:

- **Electrode** – a metal piece at which the electrochemical reaction takes place.
- **Anode:** where oxidation (loss of e^-) occurs.
- **Cathode:** where reduction (gain of e^-) occurs.
- **Half-cell:** the reduction or the oxidation part of the cell.
- **Volt (V):** one joule per coulomb; the chemical energy measured.
- **Voltmeter:** measures volts.
- **Cell potential (E_{cell}):** electro-potential difference that moves the electrons from the anode to cathode.

Voltaic Cell Notation: Anode on the left side and cathode on the right. Single line (|) to separate electrode and solution and double line (||) to separate half cells.



Standard Hydrogen Electrode Potential (SHE): The potential when a 1M solution of H^+ is reduced to H_2 gas at one atmosphere on Platinum electrode. At this point the electro-potential $E^\circ = 0 \text{ V}$. Equilibrium is established between H^+ and H_2 gas.

Standard Electrode Potential – The tendency for reduction to occur at an electrode under the conditions of SHE.

$$\begin{aligned}\text{Standard Cell Potential: } E^\circ_{\text{cell}} &= E^\circ (\text{cathode}) - E^\circ (\text{anode}) \\ E^\circ_{\text{cell}} &= E^\circ (\text{right electrode}) - E^\circ (\text{left electrode})\end{aligned}$$

Activity Series and E°_{cell} values: The element with most negative reduction potential is the most powerful reducing agent (i.e. causes other elements to gain electrons).

Applications: (read on your own if not covered in class)

1. Batteries: dry cells, lithium batteries, lead-acid batteries, fuel cells.
2. Corrosion chemistry: e.g. of iron.
3. Electrolysis: non-spontaneous voltaic cell.
4. Electroplating: application of electrolysis, helps to protect certain metals against corrosion.

Key Words

Oxidation, Reduction	Redox reactions	Oxidizing and Reducing agent
Electrochemical cells	Galvanic cells	Electrode
Cathode and Anode	Salt bridge	Voltaic cell notation
Standard reduction potential	E_{cell}	Activity series