

Electrochemistry

Terminology

- You may have noticed oxygen never gets oxidized, it normally gets reduced.
- The reason for this is because oxygen is an **oxidizing agent**.
- An oxidizing agent is something that causes something else to be oxidized.
- An oxidizing agent readily accepts (or takes) electrons from something else.
- In the process, the oxidizing agent gets reduced.
- A **reducing agent** is something that causes something else to be reduced.

Electrochemistry

- ~The study interactions of chemical and electrical energy.
- Electrochemistry deals with 2 types of processes
 1. The production of an electric current from an oxidation reduction reaction
 2. The use of an electric current to produce a chemical reaction.

Production of Current

- Oxidation Reactions involve a transfer of electrons.
- Electric current is a movement of electrons.
- In order to produce a usable current, the electrons must be forced across a set path (circuit).
- In order to accomplish this, an oxidizing agent and something to oxidize must be separated from a reducing agent with something to reduce.

Pictures

■ An Oxidation Reduction reaction in the same container will have electrons transferring, but we can't harness them.

■ Separating the oxidation from the reduction, but connecting them by a wire would allow only electrons to flow.

■ The solid metal bars in the diagram are called **terminals**.

Closer look

■ On the left, the solution would contain X^+ , the terminal would be $X(s)$, the same is true for Y on the right

■ We now have **excess electrons** being formed in the oxidizing reaction and a **need for electrons** in the reducing reaction with a **path** for them to flow through.

■ However, if electrons did flow through the wire it would cause a negative and positive solution to form.

That's not possible

- Or at least it would require a lot of energy.
- A negative solution would theoretically be formed by adding electrons, and a positive one by removing electrons.
- The negative solution would then repel the electrons and stop them from flowing in, and a positive solution would attract the electrons pulling them back where they came from.
- Making it so the charged solutions wouldn't form.
- In order for this to work, I would need a way for ions to flow back and forth but keeping the solutions mostly separated.

Salt Bridge

- Salt Bridge- a connector for two solutions previously discussed that allows ions to pass back and forth.
- This can be accomplished by a tube filled with an electrolyte (positive and negative ions) or a porous disc connecting the two solutions.

Closer look

■ Now electrons can flow across the wire from the oxidation reaction to the reduction reaction.

■ As the oxidation reaction becomes positive, it removes negative ions and adds positive ions to the salt bridge.

■ The reduction reaction does the reverse.

Zinc will need to be flipped to an oxidation to make the cell positive

- $\text{Zn} \rightarrow \text{Zn}^{2+} + 2 \text{e}^-$ $E = .76 \text{ V}$
- $\text{Cu}^{2+} + 2 \text{e}^- \rightarrow \text{Cu}$ $E = \underline{.34 \text{ V}}$
- $E_{\text{cell}} = 1.10 \text{ V}$

- The overall reaction of the cell is
- $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Cu} + \text{Zn}^{2+}$

Write the equation for and figure out the electric potential of a cell based on...

- $\text{Sn}^{4+}/\text{Sn}^{2+}$ & Pb^{2+}/Pb
- Zn^{2+}/Zn & Cr^{3+}/Cr
- $\text{Fe}^{3+}/\text{Fe}^{2+}$ & $\text{Co}^{3+}/\text{Co}^{2+}$

Write the equation for and figure out the electric potential of a cell based on...

- $\text{Sn}^{4+}/\text{Sn}^{2+}$ & Pb^{2+}/Pb
- $\text{Sn}^{4+} + \text{Pb} \rightarrow \text{Sn}^{2+} + \text{Pb}^{2+}$
- $E_{\text{cell}} = .15 + (.13) = .28 \text{ V}$
- Zn^{2+}/Zn & Cr^{3+}/Cr
- $2 \text{Cr}^{3+} + 3 \text{Zn} \rightarrow 3 \text{Zn}^{2+} + 2 \text{Cr}$
- $E_{\text{cell}} = .76 + (-.74) = .02 \text{ V}$ (coefficients don't change this value)
- $\text{Fe}^{3+}/\text{Fe}^{2+}$ & $\text{Co}^{3+}/\text{Co}^{2+}$
- $\text{Fe}^{2+} + \text{Co}^{3+} \rightarrow \text{Co}^{2+} + \text{Fe}^{3+}$
- $E_{\text{cell}} = 1.82 + (-.77) = 1.05 \text{ V}$