"The Banana Watch"!

ELECTROCHEMISTRY

Electrochemical Cells…Redox in Action!

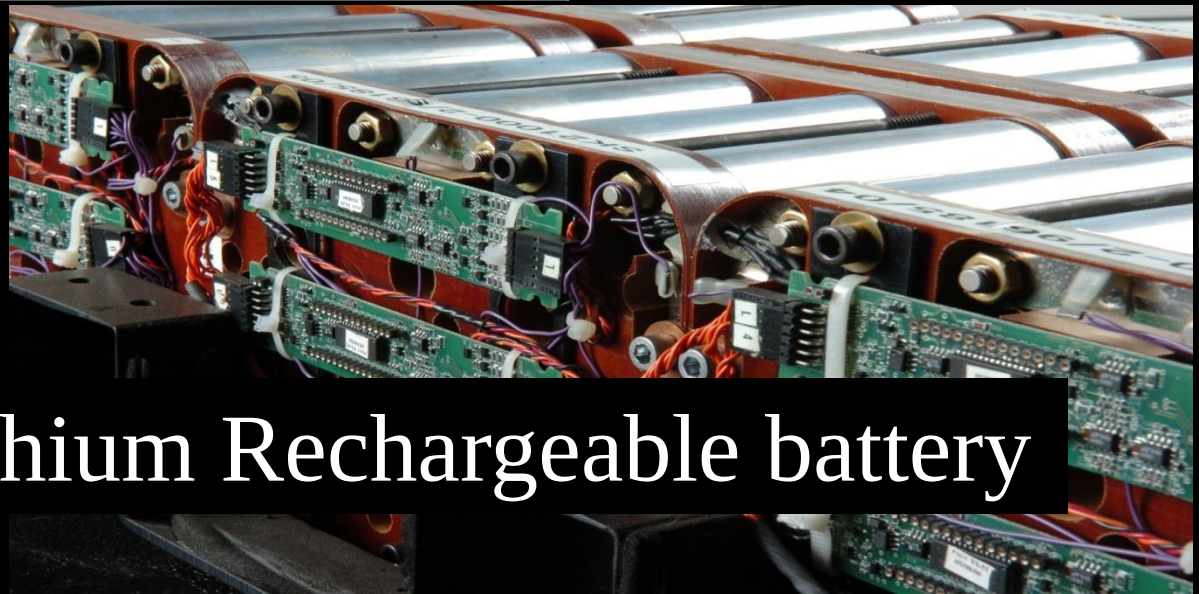
Electrochemical cells are Batteries

Alkaline Batteries

Car Batteries

Electric Car

Hybrid Electric Car



Powered by a Lithium Rechargeable battery

Cell Phone batteries

Lithium Coin Cell

Space Ship Batteries

Metal Hydride

Notes on Electrochemical Cells

An **electrochemical cell** – a system of **electrodes**, **electrolytes**, and **salt bridge** that allow **oxidation** and **reduction** reactions to occur and **electrons** to **flow** through an external circuit.

1. **Spontaneous** redox reaction
2. **Produces electricity** from chemicals
3. Is commonly called a **battery**

The **salt bridge** allows **ions to migrate** from one half-cell to the other without allowing the solutions to mix.

Analyzing Electrochemical Cells

The reaction that is **higher** on the **reduction chart** is the **reduction** and the **lower** is **oxidation** and is **written in reverse**.

For any cell

Oxidation always occurs at the **anode (LEOA)** and **reduction** at the **cathode (GERC)**

Electrons flow through the **wire** and go from **anode** to **cathode (ALPHABETIC)**

Anions (- ions) migrate to the **anode (an→an)** and **cations** (+ions) migrate towards the **cathode (cat→cat)** usually through the **salt bridge**

ELECTROCHEMICAL CELL ANIMATION

1. Draw and completely analyze a $Cu/Cu^{2+}//Zn^{2+}/Zn$ electrochemical cell.

SOA = GERC

Highest

Strongest Oxidizing Agent

Reduction

Cathode

$Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$

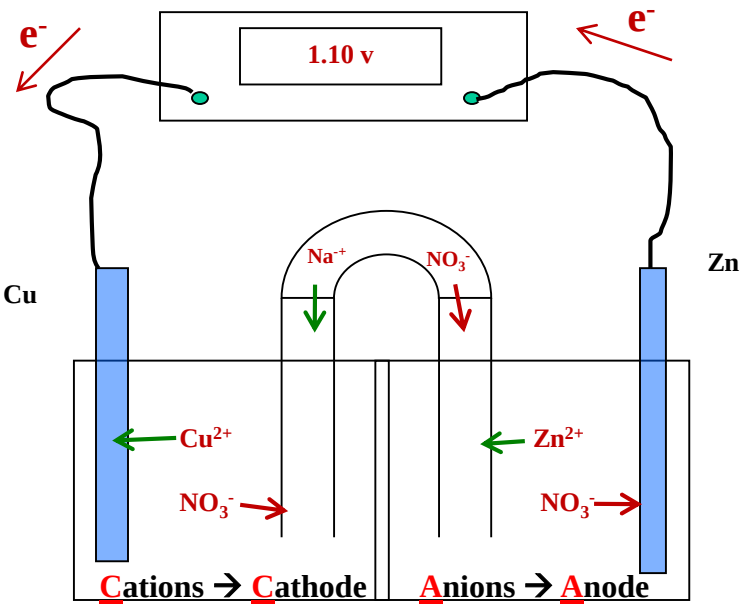
$E^o = +0.34$ v

Gains mass

+

electrons A → C

voltmeter



SRA = LEOA

Lowest

Strongest Reducing Agent

Oxidation

Anode

$Zn_{(s)} \rightarrow Zn^{2+} + 2e^-$

$E^o = +0.76$ v (switch sign)

Loses mass

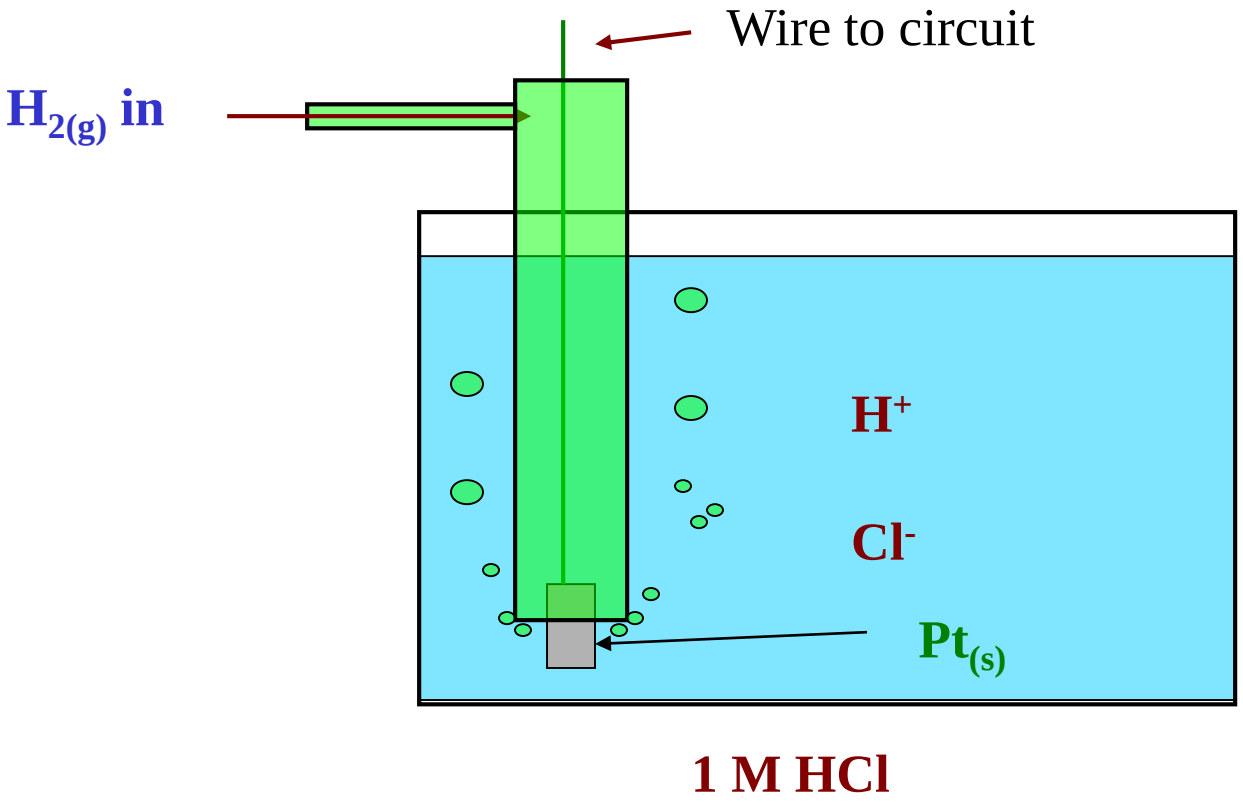
-

GERC: $Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$ $E^o = +0.34$ v

LEOA: $Zn_{(s)} \rightarrow Zn^{2+} + 2e^-$ $E^o = +0.76$ v

NET: $Cu^{2+} + Zn \rightarrow Zn^{2+} + Cu_{(s)}$ $E^o_{net} = +1.10$ v

The **Hydrogen half cell** involves a **gas** and requires an inert or nonreactive **Pt** electrode.



1. Draw a $Cr/Cr^{3+}//Ag^{+}/Ag$ electrochemical cell with a KNO_3 salt bridge.

SOA = GERC

Highest

Strongest Oxidizing Agent

Reduction

Cathode

$Ag^{+} + e^{-} \rightarrow Ag_{(s)}$

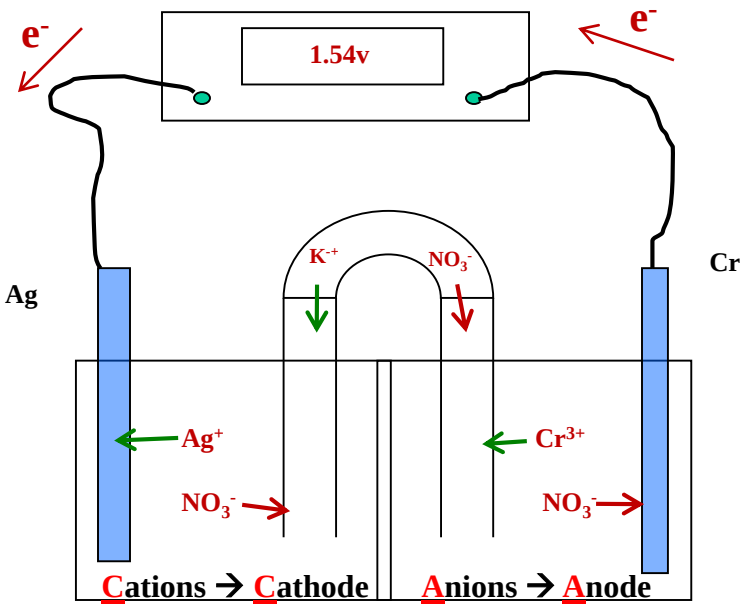
$E^{o} = +0.80$ v

Gains mass

+

electrons A → C

voltmeter



SRA = LEOA

Lowest

Strongest Reducing Agent

Oxidation

Anode

$Cr_{(s)} \rightarrow Cr^{3+} + 3e^{-}$

$E^{o} = +0.74$ v (switch sign)

Loses mass

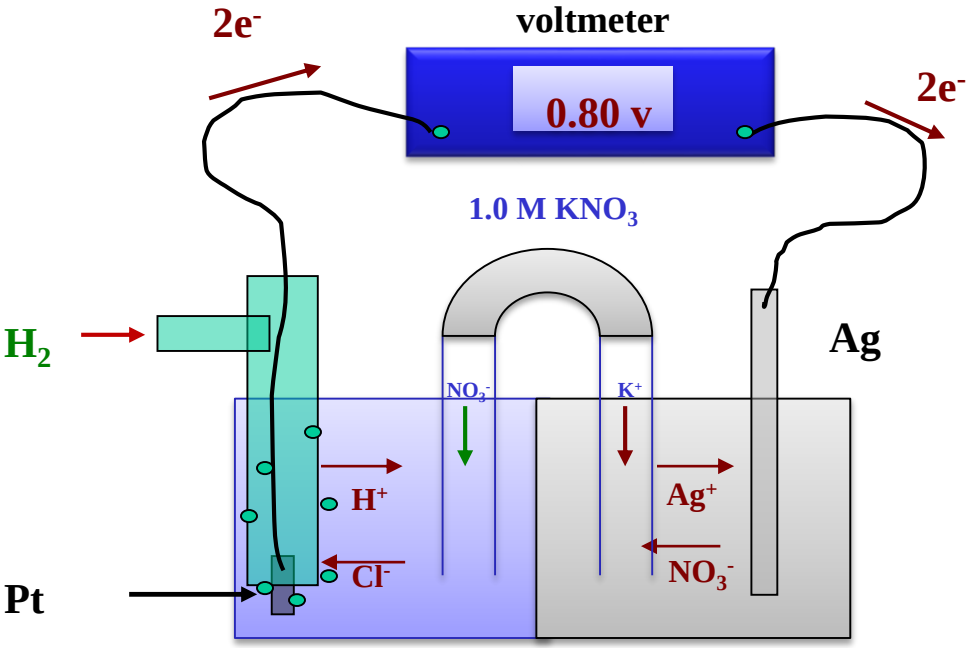
-

GERC: $(Ag^{+} + e^{-} \rightarrow Ag_{(s)}) \times 3$ $E^{o} = +0.80$ v **DON'T CHANGE!**

LEOA: $Cr_{(s)} \rightarrow Cr^{3+} + 3e^{-}$ $E^{o} = +0.74$ v

NET: $3Ag^{+} + Cr \rightarrow Cr^{3+} + 3Ag_{(s)}$ $E^{o}_{net} = +1.54$ v

Draw a H_2/Ag electrochemical cell with a KNO_3 salt bridge.



oxidation
Anode
-

$H_2 \rightarrow 2H^+ + 2e^-$
0.00 v
pH decreases

Higher
Greater electron affinity
Reduction
Cathode
+

$Ag^+ + 1e^- \rightarrow Ag_{(s)}$
+0.80 v
Gains mass

$2Ag^+ + H_2 \rightarrow 2Ag + 2H^+$ 0.80 v