Chemistry 3.7
Redox Chemistry

Electrochemistry

Electropotential

- **Electropotential** (also known as electromotive force, emf) is the **ability** of a chemical to
  - **lose electron** (oxidation)
  - **accept electron** (reduction)
- Since each redox reaction involves a reduction ½ and an oxidation ½
- This mean each redox reaction will involves two electropotentials
  - The "push of electron" from the reductant (oxidation)
  - The "pull of electron" from the oxidant (reduction)

Voltages

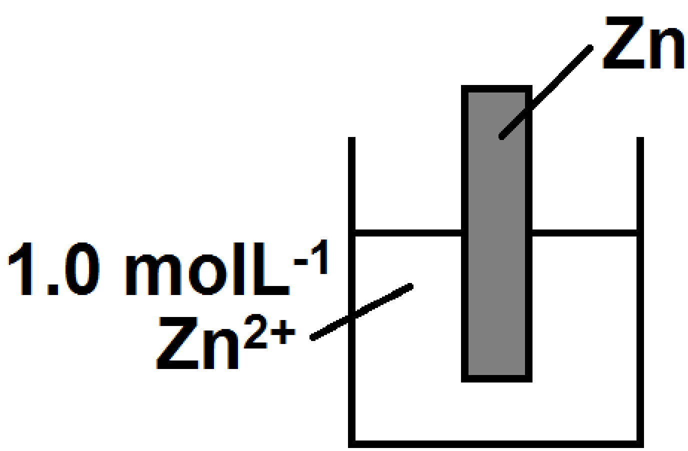
- The push and pull of electrons results in a "movement of electron" (electrical current)
- The energy of this movement (in the electron) is measured in Voltage (V)
- Chemists decided to standardise each chemical species that undergo oxidation or reduction by reacting them under a set of conditions

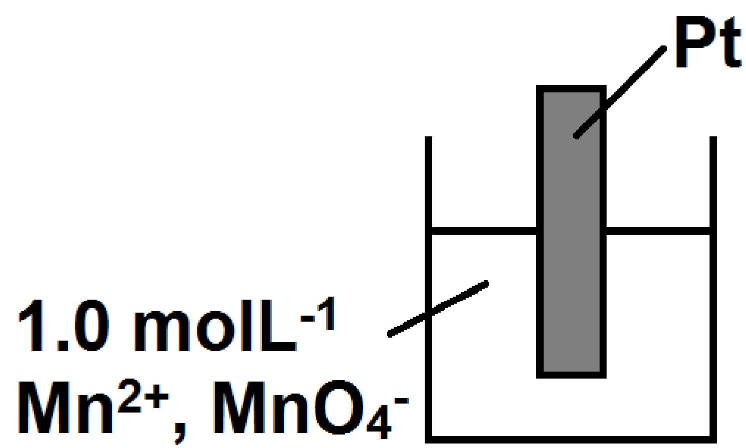
Standard condition

- In electrochemistry, chemists decided to set a parameter and called them the standard condition, the followings are the requirements
  - All elements are in pure form
  - Temperature $25^{o}C$ (or 298K)
  - All concentration 1.00 $molL^{-1}$
  - Pressure of gases 1.0 atm (or 1.3 kPa)
  - In cases where no solid reagent involve, platinum or graphite is used as electrode

Half cell

- A half cell represent a half reaction
- It contains BOTH reaction and product of a half reaction
- Below are two examples of standard ½ cell



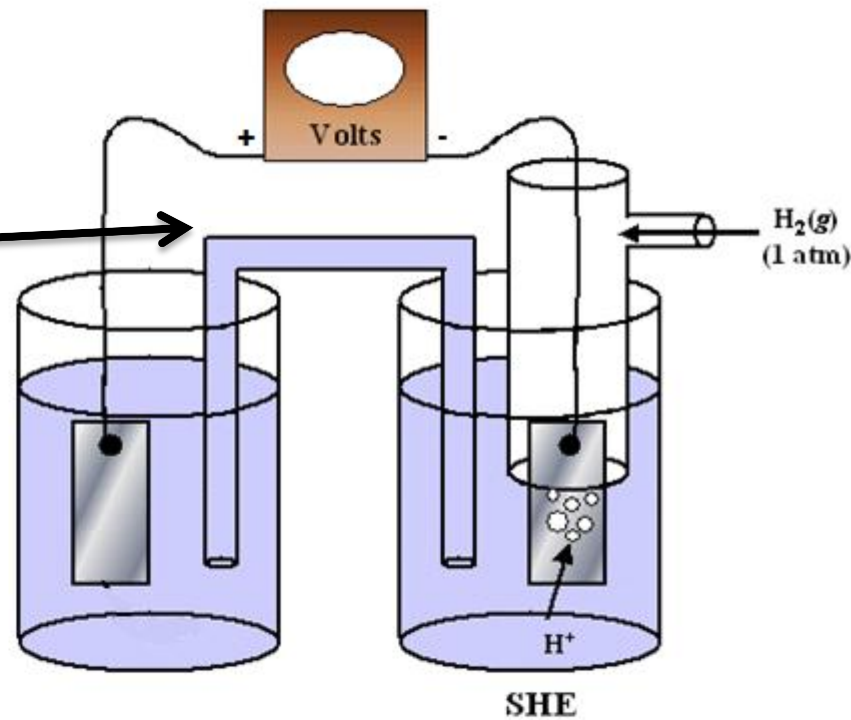


Standard Electrode Cell

- Each standard half cell is then connected to standard hydrogen electrode, SHE (the standard ½ cell of H_2/H^+) by:
  - A wire (with voltmeter)

  And

  - A salt bridge



- The SHE is always treated as negative electrode (undergoing oxidation)

Salt bridge

- The purpose of **salt bridge** is to **balance the charge** of each half cell
- It contains **inert salt solution** such as KNO_3
- As reaction occur, the **anode side** (oxidation) will **loses electrons** and become more positive. To balance the charge, the **anions** in the salt bridge will **travel to** the **anode beaker**
- Similar for **cathode side** (reduction) the **cations** will travel to the **cathode beaker** as it gains in electrons

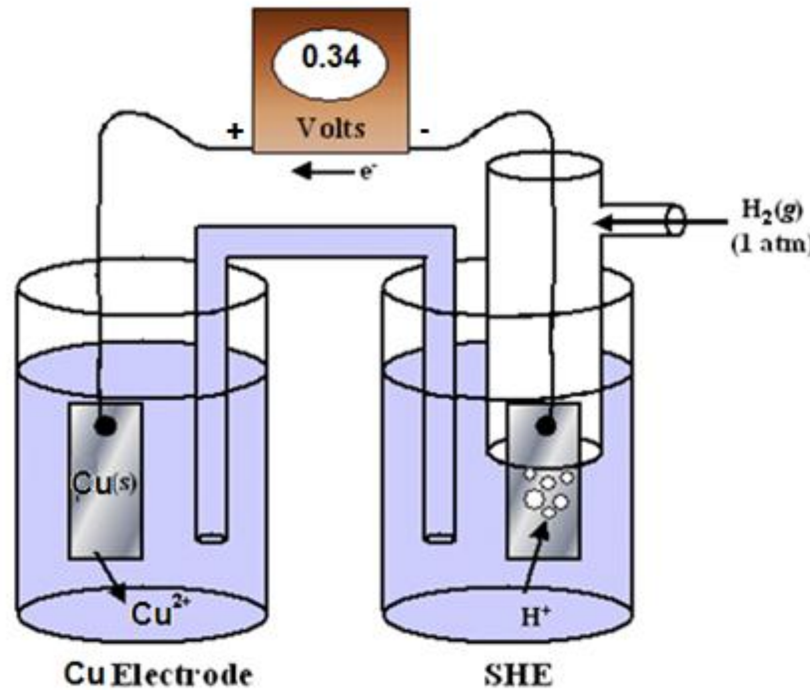
Standard Reduction Potential (E°)

- However if the other ½ cell (Cu in this case) undergo reduction, a **positive voltage** will be produce

$$Cu^{2+} + 2e^{-} \rightarrow Cu$$

$$H_2 \rightarrow 2H^{+} + 2e^{-}$$

- The voltage measured is called the **standard reduction potential (E°)**



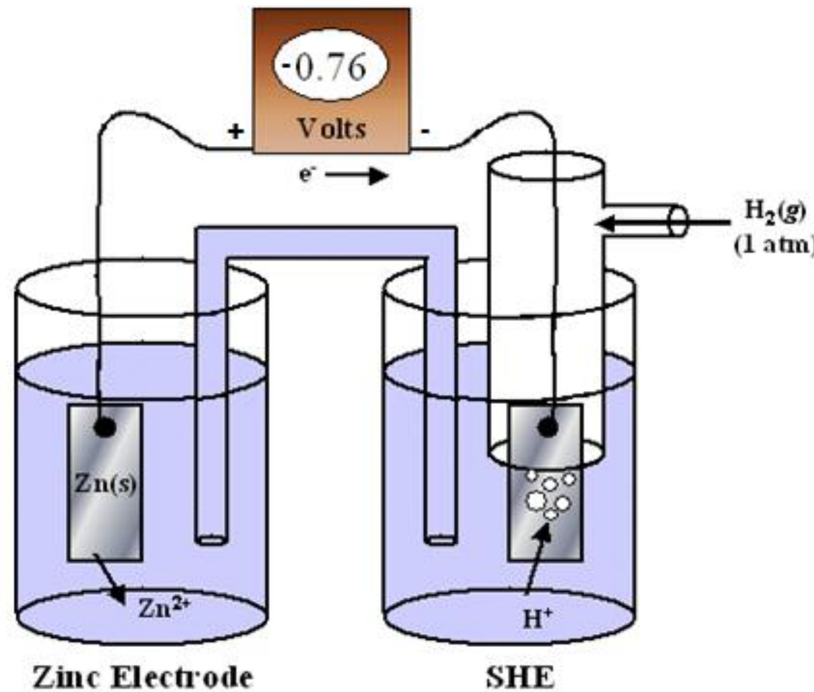
Negative E°

- If the other ½ cell (Zn in this case) undergo oxidation, a **negative voltage** will be produce

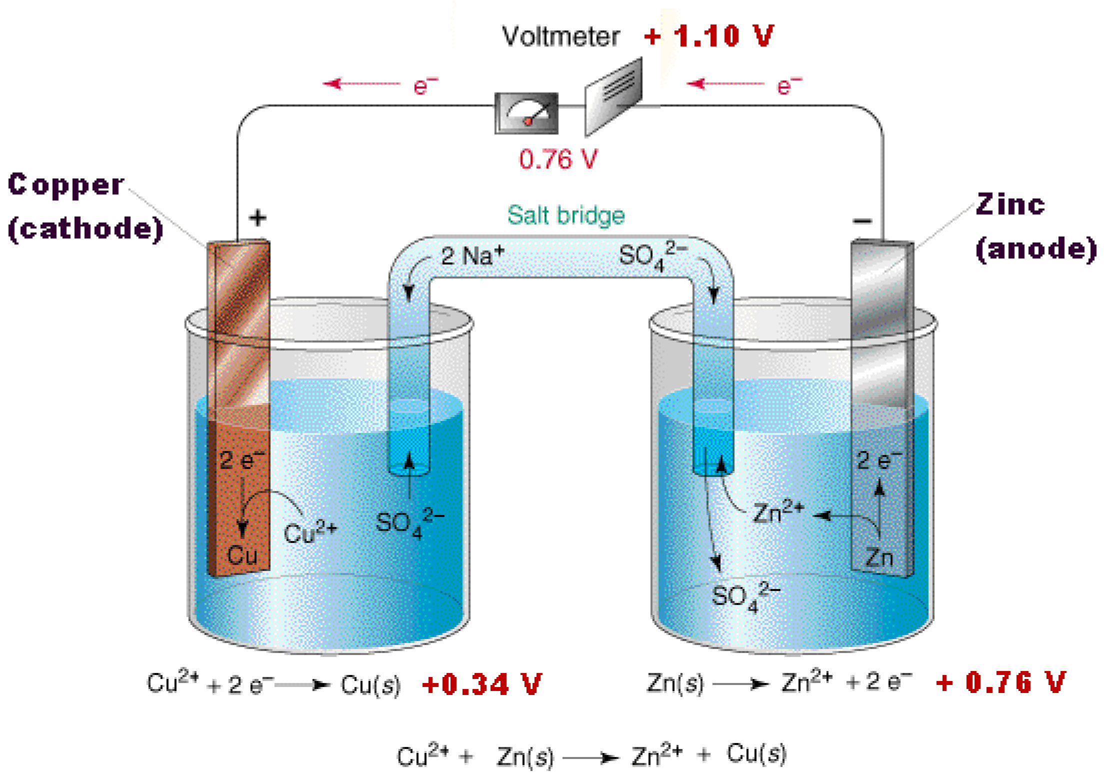
$Zn \rightarrow Zn^{2+} + 2e^-$ (oxidation)

$2H^+ + 2e^- \rightarrow H_2$ (reduction)

- Negative voltage because now the SHE is under going reduction instead



Example



Voltmeter
+ 1.10 V
e⁻
e⁻
0.76 V
Copper
(cathode)
Zinc
(anode)
+
−
Salt bridge
2 Na⁺
SO₄²⁻
2 e⁻
Cu²⁺
Cu
SO₄²⁻
Zn²⁺
2 e⁻
Zn
SO₄²⁻
Cu²⁺ + 2 e⁻ → Cu(s) +0.34 V
Zn(s) → Zn²⁺ + 2 e⁻ + 0.76 V
Cu²⁺ + Zn(s) → Zn²⁺ + Cu(s)