Chapter 17 Electrochemistry

Nearing the end.

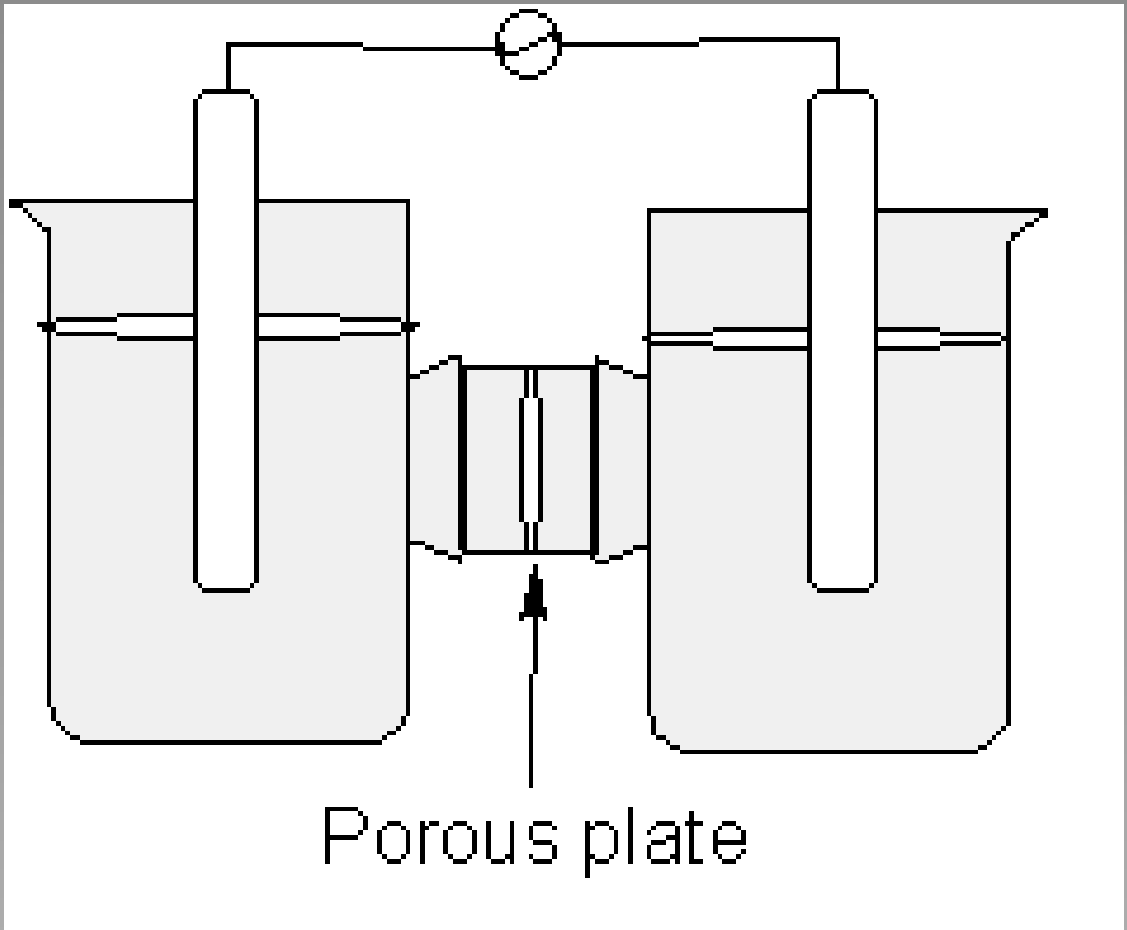
Chapter 17 Electrochemistry

- What is it?
- Why should we care?

Galvanic (voltaic) cells

- Controlled redox reactions that generate current.
- *A device that converts chemical potential energy into electrical energy*
- Separate the oxidizing and reducing chemicals and make the electrons flow through a battery.

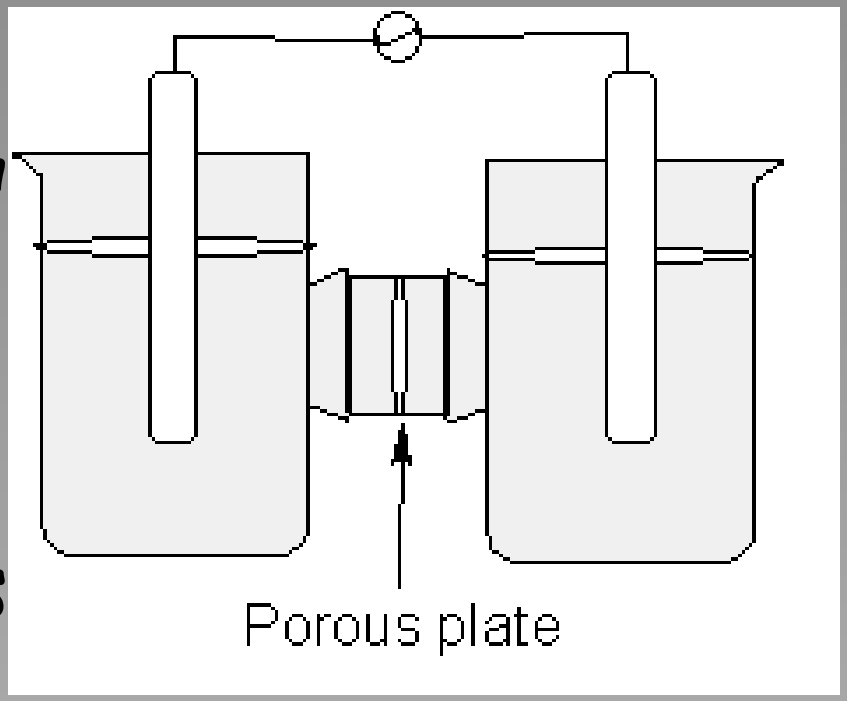
Schematic cell



Parts of a cell

- Electrodes
- Anode: oxidation reactions
- (*Anode and oxidize both begin with vowels)*
- Cathode: reduction reactions
- Porous plate: allows ion exchange w/o much mixing

LEO says GER



Cell Potential (voltage) ε^o

- Standard Reduction Potentials
- Write a reducing reaction for the cathode **(reaction higher on reduction potential list)**
- Write an oxidizing reaction for the anode **(reaction lower on reduction potential list)**
  - Standard hydrogen electrode
    - $2\ H^+ + 2e^- \rightarrow H_2$ is set equal to 0.00V
    - All other oxidizing and reducing agents are compared to this standard.

Cell Potential

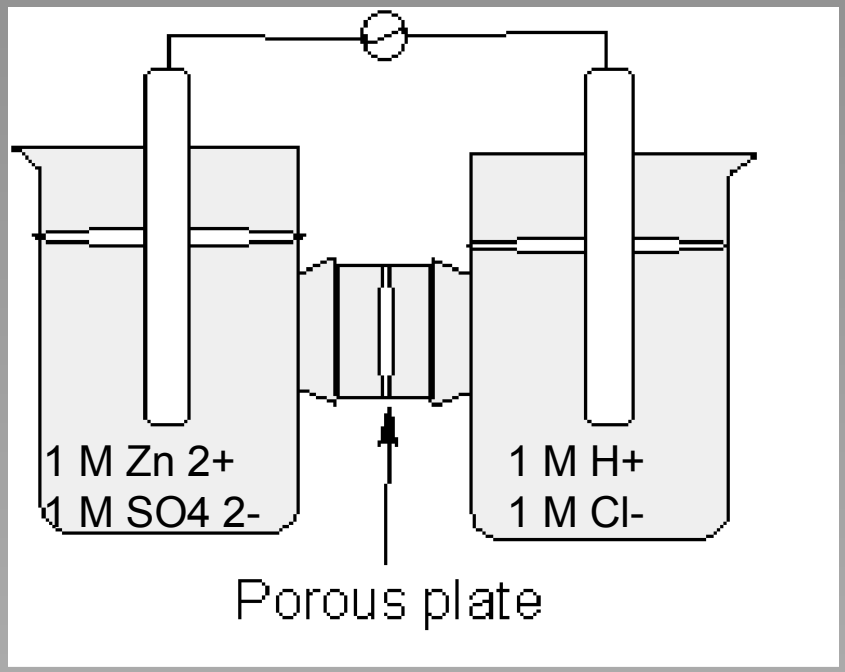
$2H^+ + 2e^- \rightarrow H_2 =$ 0.00 v

$Zn \rightarrow Zn^{2+} + 2e^- =$ 0.76 v

0.76 v

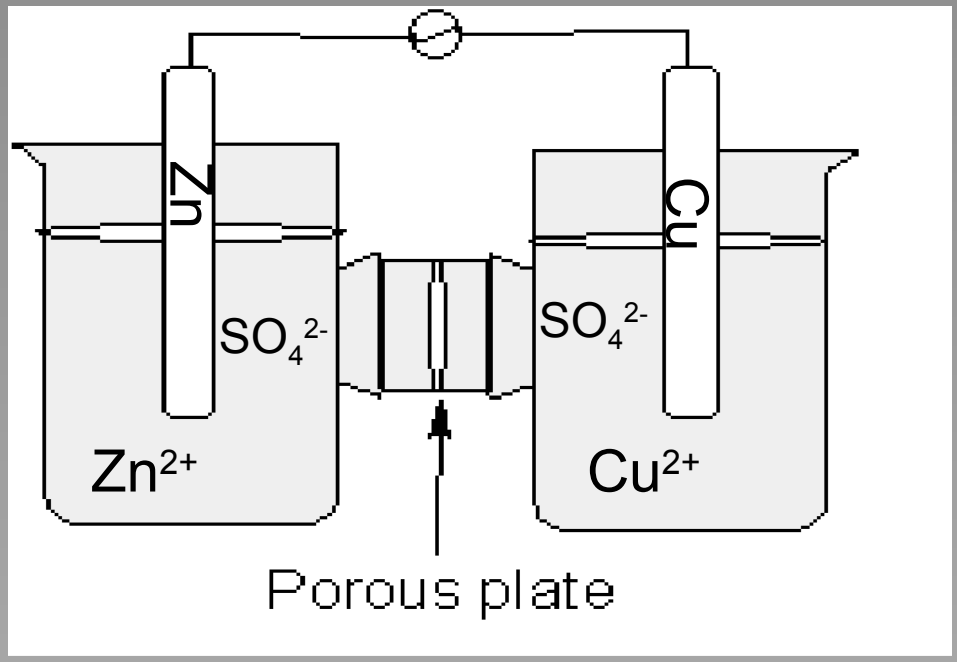
Zn 0.76 V measured H2

1 molar strength is the standard concentration



Example

- Calculate the voltage for a galvanic cell containing a Cu and a Zn electrode in a 1 M solution of $CuSO_4$ and $ZnSO_4$ respectively



Who oxidizes or reduces who

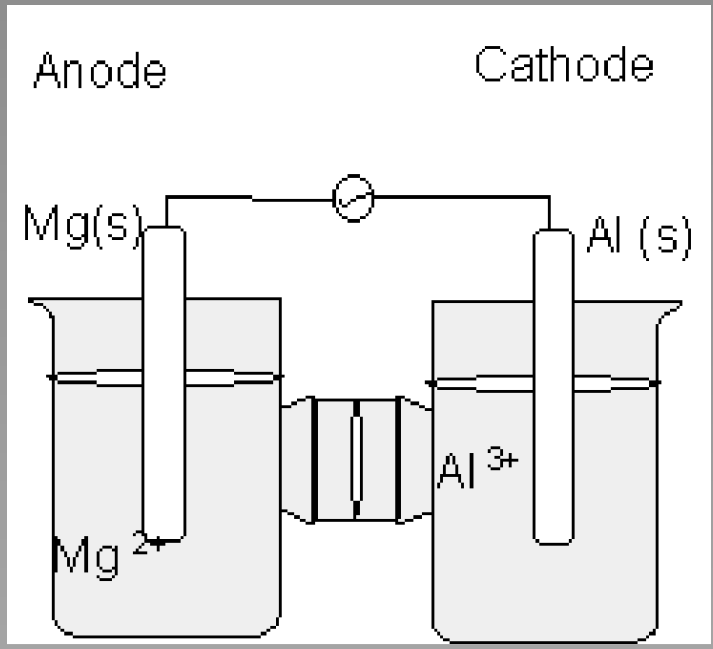
- Look on list
- Reaction on top (of list) runs as written (reduction)
- Reaction below, must be reversed so it becomes oxidation
- Remember to switch sign of voltage if reaction is flipped.

Don't be so shocking!!

- $Cu^{2+} + 2e^- \rightarrow Cu$ 0.34 V
- $Zn \rightarrow + Zn + 2e^-$ <u>0.76 V</u>
- ε^o 1.10 V

Further example

- For the following cell, write the electron flow, write the half reactions and calculate the cell voltage.



Line notation

- Short hand so you don't have to draw beakers all the time :)
- Anode Cathode
- $Mg(s) \mid Mg^{+2}(aq) \parallel Al^{+3}(aq) \mid Al(s)$
- 2.37V + -1.66V
- = 0.71 V
- Spectator ions are omitted.

Cell Potential, Work and Free Energy

- Potential = volts = electromotive force
- This is also = work/charge or
- J/C where J is joules, C is coulombs
- If a cell does work on the Universe, it is losing energy or has -E