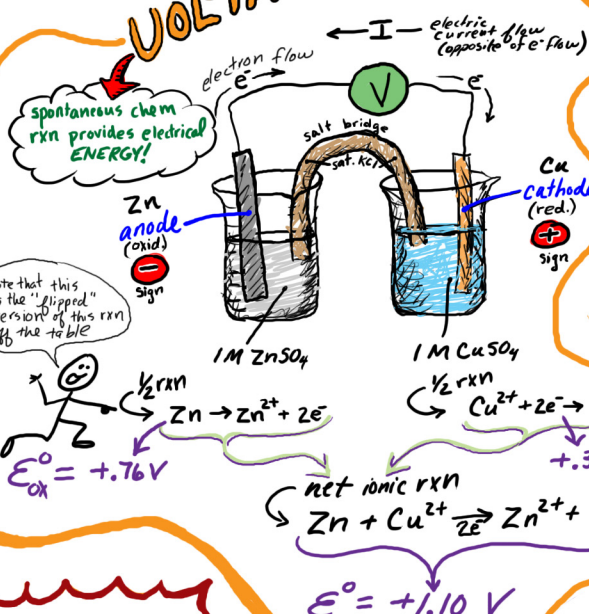
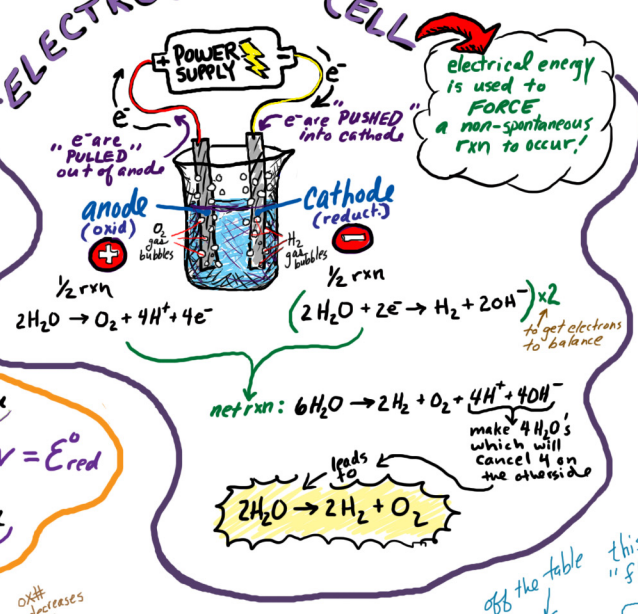


# ELECTROCHEMISTRY

## VOLTAIC CELL



## ELECTROLYTIC CELL



## NERNST

$$E = E^0 - \frac{RT}{nF} \ln Q$$

$$E = E^0 - \frac{0.0257}{n} \ln Q$$

$$E = E^0 - \frac{0.05916}{n} \log Q$$

for calculating potentials @ NON-std conditions!

S.H.E. standard hydrogen electrode  
 2H<sup>+</sup> + 2e<sup>-</sup> ⇌ H<sub>2</sub>(g)  
 assigned 0.000000... Volts\* by IUPAC agreement \*at all temperatures

Reduction: the GAIN of e<sup>-</sup>  
 Oxidation: the LOSS of e<sup>-</sup>

LEO says GER

$$E_{cell}^0 = E_{red}^0 + E_{ox}^0$$

opposite sign as that on table

Counting coulombs... you need the Faraday constant

$$F = 96485 \text{ C/mol e}^-$$

this is our unit factor to get from "electricity world" which is full of volts, amps, & time and into "chemistry world" which is moles of stuff

$$\frac{I \cdot t}{nF} = \text{mol of stuff}$$

I: current in amps  
 t: time in seconds  
 n: number of e<sup>-</sup> transferred

this formula works for any ½ rxn + the "mol of stuff" is whatever you are after in the ½ rxn - great for electrodepositions!

ΔG

ε

K

$$\Delta G^0 = -RT \ln K$$

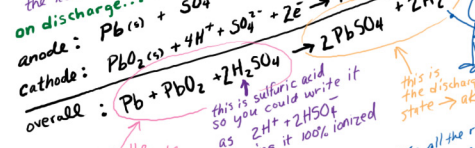
$$\Delta G^0 = -nFE^0$$

$$E^0 = \frac{RT}{nF} \ln K$$

## BATTERIES

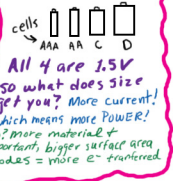
- ★ PRIMARY: rxn is not reversible NOT rechargeable → ALKALINES, Lithium, "Heavy" Duty
- ★ Secondary: rxn is reversible RECHARGEABLE! → NiCads, NiMH, Li-ion, Pb-storage
- ★ Fuel Cells: you REFILL with reactants (not recharged) → H<sub>2</sub>/O<sub>2</sub>, Zn-air

CAR BATTERY (Pb-acid)  
 the lead is in 3 different oxidation states in this battery

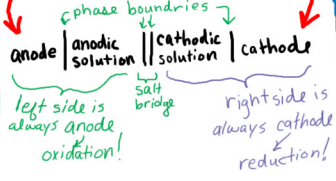


NOTE: the sulfuric acid is consumed during discharge & more water is made!

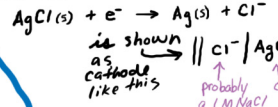
### SIZE MATTERS



### Shorthand cell notation



★ If there are SOLIDS (salts) as part of the ½ rxn then the solid must be in contact (coating) with the electrode. Gases must be bubbled over the electrode



IF the ½ rxn has no conductor (metal) in it, use an INERT electrode like platinum (Pt), gold (Au), or graphite (C)

for S.H.E. you use a Pt electrode in 1M H<sup>+</sup> with 1atm H<sub>2</sub>(g) bubbling over the surface

shorthand → Pt | H<sub>2</sub> | H<sup>+</sup> || ← shown as anode (on the left)