Chem 116 Lecture 22 (12/2/08)
JL

Practice using SOHe⁻ method

1. $Cu\ (s) + NO_3^-(aq) \rightarrow Cu^{2+}\ (aq) + NO_2\ (g)$ in acid

Oxidation Number Cu=0 N=+5 Cu=+2 N=+4

Element whose oxidation #s are changing.
Cu: 0 to +2 oxidation.
N: +5 to +4. reduction.

<u>Species on reactant side</u>
Cu(s) is getting oxidized
NO_3^- is getting reduced.

<u>Species on the product side</u>.
Cu^{2+} (aq)
NO_2(g)

Oxidation half rxn: Cu → Cu^{2+} + $2e^-$
We added 2 electrons to the product side to make the charge on the reactant side = charge on the product side.

Reduction half-rxn: NO_3^- + $2H^+$ → NO_2 + H_2O …water added
NO_3^- + $2H^+$ → NO_2 + H_2O …add - charge
NO_3- + 2H+ + 1e- → NO_2 + H_2O

Oxid: Cu → Cu^{2+} + $2e^-$
Red: (NO_3^- + $2H^+$ + $1e^-$ → NO_2 + H_2O) × 2 …× 2 to cancel e- out
Cu + $2NO_3$- + $4H^+$ → $2NO_2$ + $2H_2O$ + Cu^{2+}

2. $Cd\ (s) + NiO_2\ (s) + H_2O\ (l) \rightarrow Cd(OH)_2\ (s) + Ni(OH)_2\ (s)$ in acid

Species on reactant side
Cd(s) is getting oxidized => reducing agent
NiO_2(s) is getting reduced => oxidizing agent.

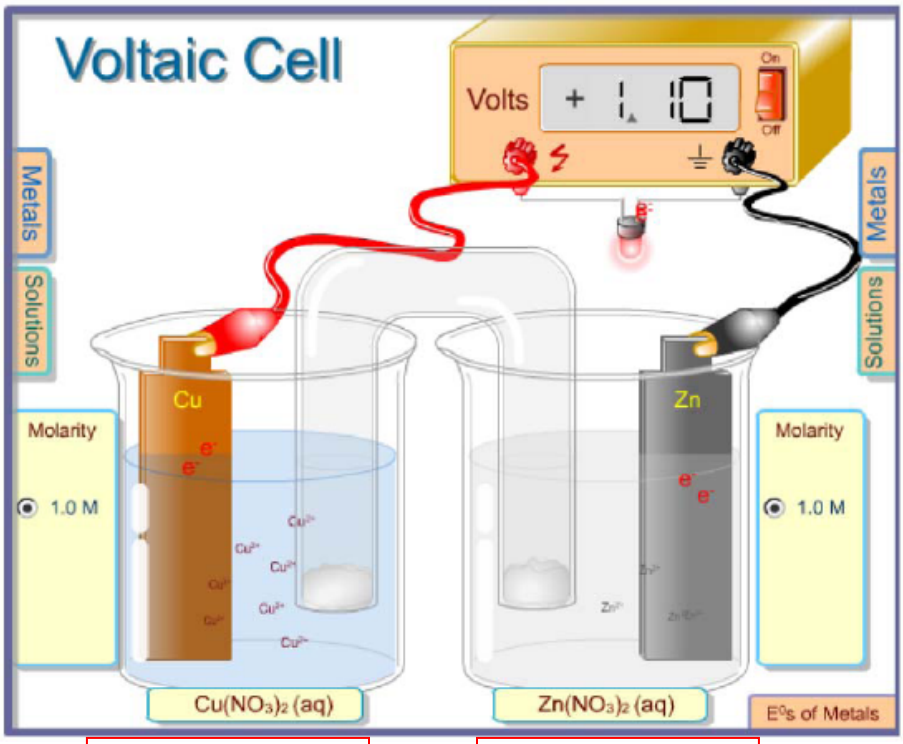
Oxid.half-rxn.
Cd(s) → $Cd(OH)_2$(s)
Cd(s) + $2H_2O$ → $Cd(OH)_2$(s) + $2H^+$
Cd(s) + $2H_2O$ → $Cd(OH)_2$(s) + $2H^+$ + $2e^-$

Reduction half-rxn:
NiO_2(s) → $Ni(OH)_2$(s)
NiO_2(s) + $2H^+$ → $Ni(OH)_2$(s)
NiO_2(s) + $2H^+$ + $2e^-$ → $Ni(OH)_2$(s)

Cd(s) + $2H_2O$ + NiO_2(s) → $Cd(OH)_2$ + $Ni(OH)_2$

Animation shown in class

Note: This corresponds to Fig 20.5 (on p. 857) in your text book



In the Cu cell			In the Zn cell			
Cu	→	Cu^{2+}	Zn^{2+}	→	Zn	possibility #1
Cu^{2+}	→	Cu	Zn	→	Zn^{2+}	possibility #2
(one of these two things must be happening)			(one of these two things must be happening)			

…use the reduction potentials to figure out which one of these cells is the oxidation (anode) and which is the reduction (cathode)

Standard Reduction Potentials are:

$Cu^{2+} + 2e^- \rightarrow Cu \quad E^o = +0.332$ v

$Zn^{2+} + 2e^- \rightarrow Zn \quad E^o = -0.763$ v

…two possibilities.

1. Oxid. $Cu \rightarrow Cu^{2+} + 2e^- \quad E^o = -0.337$ v

   Red. $Zn^{2+} + e^- \rightarrow Zn. \quad E^o = -0.763$ v

   $Cu + Zn^{2+} \rightarrow Cu^{2+} + Zn \quad E^o = -1.10$

2. Oxid. $Zn \rightarrow Zn^{2+} + 2e^- \quad E^o = +0.763$ v

   Red. $Cu^{2+} + 2e^- \rightarrow Cu \quad E^o = +0.337$ v

   $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu \quad E^o = +1.10$ v

possibility #2 is the reaction that occurs spontaneously since E^o is +.