22d $MnO_4^- + Cl^- \rightarrow Mn^{+2} + Cl_2$ (g) Acidic

$\times 2$ $5e^- + 8H^+ + MnO_4^- \rightarrow Mn^{+2} + 4H_2O$

$\times 5$ $2Cl^- \rightarrow Cl_2 + 2e^-$

$16H^+ + 2MnO_4^- + 10Cl^- \rightarrow 2Mn^{+2} + 8H_2O + 5Cl_2$

+16 −2 −10 +4 ✓

+4 ✓

e GER LEO $NO_2^- + Al_{(s)} \rightarrow NH_4^+ + AlO_2^-$ BASIC

$6e^- + 8H^+ + NO_2^- \rightarrow NH_4^+ + 2H_2O$

$2 \times (2H_2O + Al \rightarrow AlO_2^- + 4H^+ + 3e^-)$

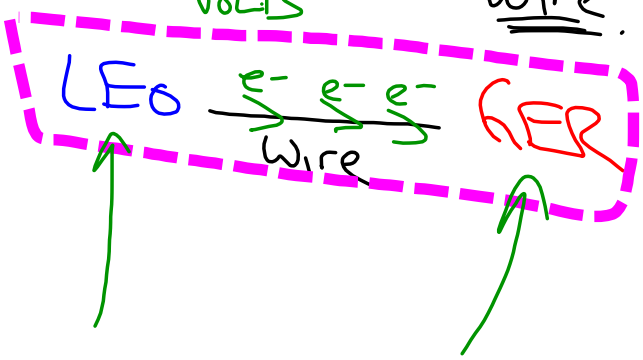
$NO_2^- + 2H_2O + 2Al \rightarrow NH_4^+ + 2AlO_2^-$ ✓

Electrochemistry (electricity)

Produce an electric current from a chemical reaction

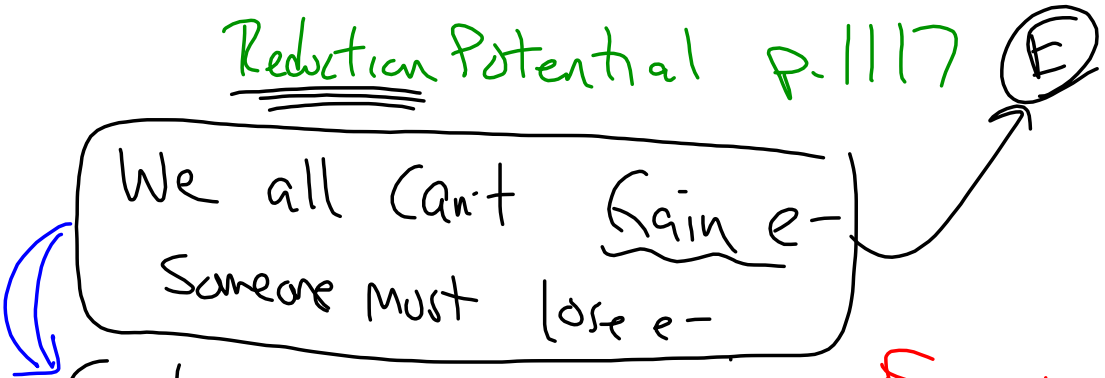
SPONTANEOUS

flow of e⁻ in a wire.



Voltage Potential (v)

Reduction Potential p. 1117



Greater E°_{red} → stays as GER

Reduction potential (v)

ox agent

Forces the other 1/2 rxn to flip an undergo LEO

Copper + Zinc

$Cu^0_{(s)}$ in $Cu(NO_3)_{2\,(aq)}$ ← BLUE.

$Zn^0_{(s)}$ in $Zn(NO_3)_{2\,(aq)}$ ← clear

$Cu^{+2} + 2e^- \rightarrow Cu^0$ $E^\circ_{red} = +0.34_V$ (+0.337) (E)

$Zn^{+2} + 2e^- \rightarrow Zn^0$ $E^\circ_{rev} = -0.76_V$ (-0.763V) (E)

The only Thing we do to any E° half reaction is change the Sign

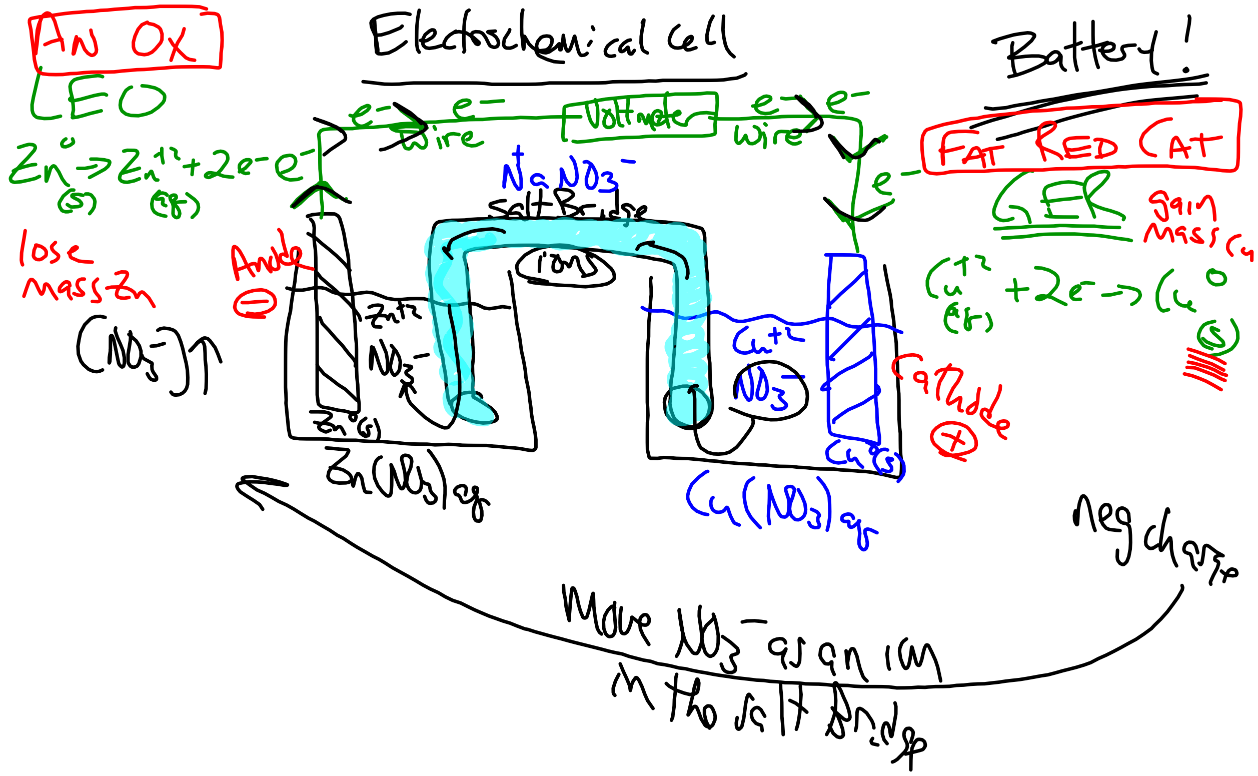
GER $Cu^{+2}_{(aq)} + 2e^- \rightarrow Cu^0_{(s)}$ $+0.337_V\ E^\circ_{red}$ (n=2) $\Delta G = -nFE^\circ$

LEO $Zn^0_{(s)} \rightarrow Zn^{+2}_{(aq)} + 2e^-$ $+0.763V\ E^\circ_{ox}$

$Cu^{+2}_{(aq)} + Zn^0_{(s)} \rightarrow Cu^0_{(s)} + Zn^{+2}_{(aq)}$ $+1.10_{Volts}$ E°_{rxn}

Electrochemical cell
Voltaic cell
Galvanic cell
Daniell cell

E° ← Std conditions 1 atm, 298K, 1M



E° = Electro Motive Force (EMF)

⊕ E° = Spontaneous

Energy

Volts

Faraday Constant

$\frac{96\,500\ \text{Cal}}{\text{Mole}\cdot e^-}$

$$\Delta G^{\circ} = -nFE^{\circ}$$

Gibbs free energy (KJ) (J)

Watch Units!

moles of e- once e- gained = e- lost

LCM

EMF Voltage (rxn) Volts.

$$1\ \text{Volt} = \frac{\text{Joule}}{\text{coulomb}}$$

Cu/Zn

spont. ⊖ $\Delta G^\circ = -nFE^\circ$ ⊕

$= (-2)(96500)(1.1)$

$= \left(\frac{\text{mole}^-}{1}\right)\left(\frac{\text{coul}}{\text{mole}^-}\right)\left(\frac{\text{J}}{\text{coul}}\right)$

$\Delta G^\circ_{\text{spont}} = -212300\ \text{J} = -212.3\ \text{kJ}$

HW

20 / 36 atc, 40, 52

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

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

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