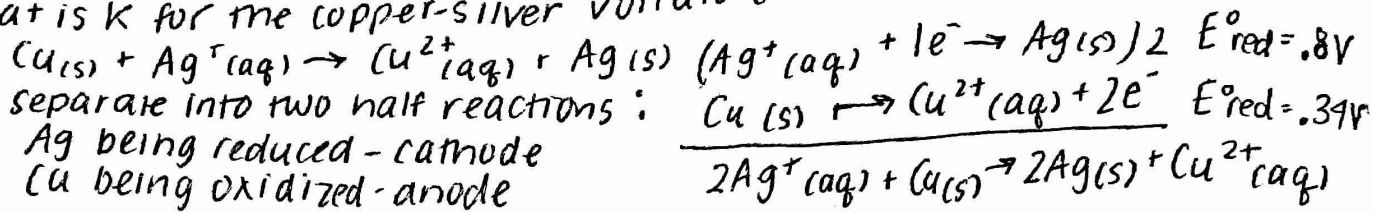


concentration cell: same material, diff. conc. - flows from side with lower concentration to higher concentration
 $\Delta G = -nFE^\circ_{\text{cell}} = -2 \text{ mol} (96,485 \text{ J/V}\cdot\text{mol}) (1.10 \text{ V})$
 $\Delta G = -nFE^\circ = -RT \ln K$

What is K for the copper-silver voltaic cell reaction?



$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = 0.8 \text{ V} - 0.34 \text{ V} = 0.46 \text{ V}$$

$$E^\circ = \frac{RT}{nF} \ln K \quad \text{so} \quad \ln K = \frac{nFE^\circ}{RT} = \frac{(2 \text{ mol})(96,485 \text{ J/V}\cdot\text{mol})(0.46)}{RT}$$

$$K = 4.3 \times 10^{15} \leftarrow \text{very favorable}$$

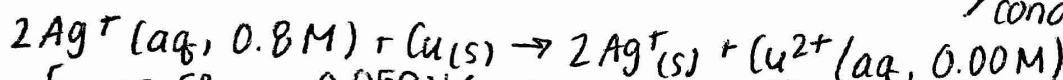
Nernst Equations: accounting for non-standard conditions

$$\Delta G = \Delta G^\circ + RT \ln Q$$

Substituting ΔG terms: $-nFE = -nFE^\circ + RT \ln Q$ - divide both sides by $-nF$

$$E = E^\circ - \frac{0.0592 \text{ V} \log Q}{n}$$

nonstandard conditions bc not 1M

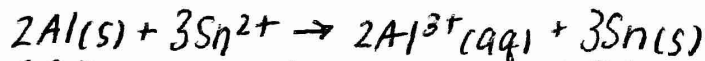
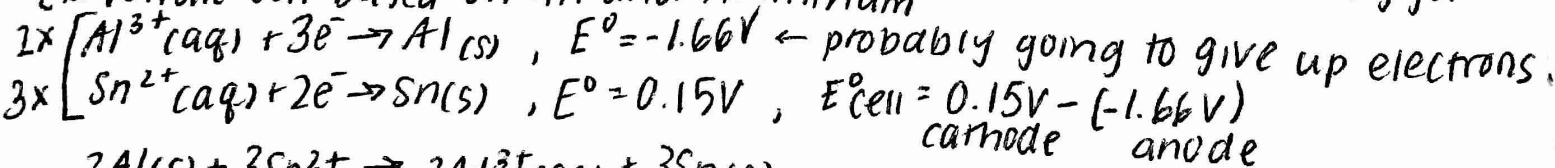


$$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.0592 \text{ V}}{n} \log Q, \quad Q = \frac{[\text{Cu}^{2+}]}{[\text{Ag}^+]^2} = \frac{0.00}{0.8^2}$$

Using standard temperature, the constants R and F, and converting to log gives an alternative form

$$0.46 \text{ V} - \frac{0.0592 \text{ V}}{2 \text{ mol}} \log Q = 0.54 \text{ V} \leftarrow \text{more favorable than under standard conditions bc positive which means that it is bigger}$$

Ex. voltaic cell based on Tin and Aluminum



$$\Delta G^\circ_{\text{rxn}} = nFE^\circ = 6 \text{ mol} \cdot F \cdot 1.81 \text{ V} = -1050 \text{ kJ} \leftarrow \text{a lot of energy - good battery!}$$

product reactant

Case 1. $[\text{Al}^{3+}] = 3.0 \text{ M}, [\text{Sn}^{2+}] = 0.75 \text{ M}$: products > reactants
 Case 2. $[\text{Al}^{3+}] = 0.75 \text{ M}, [\text{Sn}^{2+}] = 3.0 \text{ M}$: $\log Q > 0$, subtracting a positive #, which is less favorable
 'More reactant, shift right, more favorable'

No difference in energy between half cells of equal M (see ppt slide 14)
 Slide 15: flow from anode to cathode - by convention.

Anode is on the left and cathode is on the right