current in Electrolytic Cells

Amps, sec

current & time → charge → mol e^- → mol of X → gram X

Ex: How many hrs is required to plate 25 g Cu from 1 M $CuSO_4$ by using current of 3 A?

96485 C = 1 mole e^-

① $2e^- + Cu^{2+} \rightarrow Cu$

25 g Cu	1 mol Cu	2 mole e^-	96485 C	1 s
	65.5 g	1 mol Cu	1 mole-	3 C

= 7 hrs

Lecture 4-22-14

- current × time = charge
- ** How many hrs. is required to plate 35 g Cu from 0.5M $CuSO_4$ by using a current of 3A

35 g	1 mol Cu	2 mol e^-	96485 C	1 s
	63.55 g	1 mol Cu	1 mole-	3 C

15	1 min	1 hr
3C	60s	60 min

= 9.8 hrs

$Cu^{2+} + 2e^- \rightarrow Cu$

- ACTIVTY : EXTRACTING WORK FROM CHEM CHANGE

① $Al + Cu^{2+} \rightarrow Al^{3+} + Cu$

$(Al \rightarrow Al^{3+} + 3e^-)\,2 \quad 2Al \rightarrow 2Al^{3+} + 6e^-$

$(Cu^{2+} + 2e^- \rightarrow Cu)\,3 \quad 3Cu^{2+} + 6e^- \rightarrow 3Cu$

$2Al + 3Cu^{2+} \rightarrow 2Al^{3+} + 3Cu$

$\Delta G = [2(-481.2) + 3(0)] - [2(0) + 3(65.5)] =$

$-962.4 - 196.5 =$ -1158.9 kJ/mol

(a) spontaneous

(b) $\Delta G = -RT \ln K$

~~$\Delta G = -(8.314)(298)\ln K$~~

~~[illegible]~~ [illegible]

$K_{eq} = e^{-\Delta G/RT}$ ↑ converts to J

This rxn favors the product since ΔG is very large and negative, favoring the products makes K very very **large**

- spontaneous rxn that favors products gives large, positive voltage for standard potential

$w = -QV$ (work = charge × voltage)
(neg. sign shows that work done by the system)

ΔG_{rxn} = − (charge × voltage)
- voltage is E, potential of the cell
- total charge = # e^-/mole rxn, n, times F

$\Delta G = -nFE$

- electrical potential is different way of measuring the free energy
- when ΔG is neg, the voltage is positive

- standard conditions → everything 1M
  is this @ equilibrium? if not, predict direction of rxn based on standard conc. (Q vs K)?

$$2Al_{(s)} + 3Cu^{2+} \longrightarrow 2Al^{3+} + Cu_{(s)}$$

solids drop out → $Q = \dfrac{[Al^{3+}]^2}{[Cu^{2+}]^3}$ @ standard, Q = 1

@ standard, K = really big. $Q \ll K$.
favors products.

As it goes to product, conc. of Cu^{2+} dec.
and Al^{3+} inc.

So when gets to eq, free energy diff is gone ($G = 0$). This is standard ΔG.

~~$\Delta G = -nFE$~~

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

$-nFE = -nFE^\circ + RT \ln Q$

↑ potential on cell now.

↑ now

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

@ standard $Q = 1$.

$$E = E^\circ - \frac{0.059V}{n} \log Q$$

calc. potential:

$Al_{(s)} | Al^{3+}(aq, 0.001M) || Cu^{2+}(aq, 0.01M) | Cu_{(s)}$

$$Q = \frac{[Al^{3+}]^2}{[Cu^{2+}]^3} = \frac{(.001\,M)^2}{(.01\,M)^3} = 1$$

① write out balanced eq

$= 2V$

what happens to V as I change Q?
Inc. conc. of prod, dec.
conc. of react, voltage dec.