Chem 103 Lecture 7b & c   PS 158   77-15y

Admin:
Reminder: Test #2 on Friday next week.
Review Session Monday 10-11am PS 607

Last time:
1) balancing redox reactions
2) electrochemical potential
3) electrochemical cells

Today:
1) galvanic cells
2) adding 2 half rxns to get another half rxn
3) Nernst equation

Lecture:
0) Review:
Write a possible redox reaction based on the following redox couples.

1	$Cu^{+2}(aq) + 2e^- \rightarrow Cu(s)$	+0.34V
2	$Zn^{2+}(aq)$) $+2e^- \rightarrow Zn(s)$	-0.76

(1) –(2): $Cu^{2+} + Zn \rightarrow Cu + Zn^{2+}$

$E°_{rxn} = .34+.76=1.10V$

1.10 V is the redox potential.

$E°_{Cu2+/Cu} - E°_{Zn2+/Zn} = .34+.76 = 1.10V$

1) Electrochemical Cells:

2 types:
a) Voltaic Cells or Galvanic Cells (spontaneous)

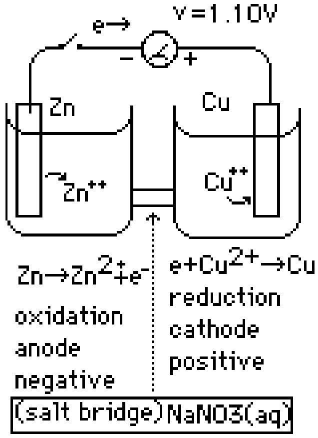
b) Electrolysis cells (nonspontaneous)

Galvanic Cells

We can utilize the above redox reaction between Zn and Cu^{2+} to do work. By using a galvanic cell.

How? Force electrons to go thru a wire!

Daniell cell:



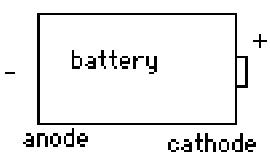
write the cell notation:

$Zn(s) \mid Zn^{2+} \| Cu^{2+} | Cu(s)$;
Anode cathode

The cell potential can be expressed as the reduction potentials of the half rxns: anode -cathode:
$E°_{cell} = E°_{cat} - E°_{an} = 0.34 - (-.76) = +1.10$ V

Or $E = E_+ - E_-$

A galvanic cell: battery



What's the work?
work can be done by a voltaic cell

w =qE= nFE

by def: E >0 for spont rxns.
E° = std conditions same as in thermo

$\Delta G° = -nFE°$

Note: that $\Delta G°$, E° and K_{eq} are related to each other!

eg for Zn+Cu rxn, E° = +1 .1 V so

$\Delta G° = -(2mol)(96500couls/mol)(1.1V) = -212kJ/mol$

$K_{eq} = \exp(-\Delta G°/RT)$

Practice balancing:
Balance $Au(s) + PbO_2(s) + SO_4^{2-}(aq)$ - - > Au^{3+} (aq) + $PbSO_4(s)$

Know how to add 2 half reactions. (both of them reductions or both are reductions)

Suppose:

	$E°_{red}$
(1) $Cu^{2+} + e^- \rightarrow Cu^+$	0.161V
(2) $Cu^+ + e^- \rightarrow Cu(s)$	0.514
(3) $Cu^{2+} + 2e^- \rightarrow Cu(s)$	?

This is sometimes represented by Latimer diagrams:

Nernst equation relates E to the concentration

Write the **Nernst equation**. Relate it to free energy.
note that

$\Delta G = \Delta G° + RT\ln Q$

=> $-nFE = -nFE° + RT\,(2.303\log Q)$

$E = E° - (2.303)\,(RT/nF)\log Q$

$= E° - (0.059V/n)\ \log Q$

==> Nernst Eqn can be written as:

$E = E° - RT/nF \ln Q$

$E = E° + RT/nF\ \ln Q$

and $\Delta G = -nFE$;