NERNST EQUATION

NAME SECTION

1. During the reaction between zinc metal and copper (II) nitrate the measured cell potential changes. In the table below the measured cell potential, E_{cell} is shown as the concentration of $Zn^{2+}(aq)$ and $Cu^{2+}(aq)$ change.

Experiment	E_{cell}	E°	$[Zn^{2+}]$	$[Cu^{2+}]$
1	0.760	0.76	1	1
2	0.757	0.76	1.1	0.9
3	0.755	0.76	1.2	0.8
4	0.752	0.76	1.3	0.7
5	0.749	0.76	1.4	0.6
6	0.746	0.76	1.5	0.5
7	0.742	0.76	1.6	0.4
8	0.738	0.76	1.7	0.3
9	0.732	0.76	1.8	0.2
10	0.722	0.76	1.9	0.1
11	0.692	0.76	1.99	0.01

   a. How does the cell potential change during the reaction?

   b. When the data is plotted E_{cell} versus $\log\left(\frac{[Zn^{2+}]}{[Cu^{2+}]}\right)$ a straight line with a negative slope is obtained (try it yourself). Careful consideration of this reaction and other reactions yields the following relationship between the cell potential and concentration of reactants and products.

$$E_{cell} = E° - \frac{0.0591}{n} \log\left(\frac{[Zn^{2+}]}{[Cu^{2+}]}\right)$$

   where n is the number of electrons transferred in the balanced oxidation–reduction reaction and the concentration of products divided by reactants. You should recognize the ratio of concentration as Q for the reaction. Try one of the Experiments to see that you can calculate the E_{cell} for the reaction.

2. Complete the following problems:

   a. Calculate E° for the reaction

$$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$$

      i. Calculate E_{cell} when the ratio of these concentrations is small, that is, if $[Zn^{2+}] = 1 \times 10^{-4}$ M and $[Cu^{2+}] = 1.0$ M.

      ii. Calculate E_{cell} when the ratio of these concentrations is large, that is, if $[Cu^{2+}] = 1 \times 10^{-4}$ M and $[Zn^{2+}] = 1.0$ M.

   b. Which of the following oxidizing agents become stronger as the $[H^+]$ is increased? Which are unchanged? Which become weaker?

      i. Br_2

      ii. Fe^{3+}

      iii. MnO_4^-

      iv. H^+

      v. $Cr_2O_7^{2-}$

   c. Calculate E_{cell} for:

$$Cu(s)\|Cu^{2+}(aq)\ (3.00\ M)\|Cu^{2+}(aq)\ (0.100\ M)\|Cu(s)$$