Class Worksheet 16

1. Using standard reduction potentials, calculate the standard EMF for each of the following reactions:
   (a) $H_2(g) + I_2(s) \rightarrow 2H^+(aq) + 2I^-(aq)$
   (b) $Ni(s) + 2Ce^{4+}(aq) \rightarrow Ni^{2+}(aq) + 2Ce^{3+}(aq)$
   (c) $Cr(s) + 2Cr^{3+}(aq) \rightarrow 3Cr^{3+}(aq)$
   (d) $2Al^{3+}(aq) + 3Cd(s) \rightarrow 2Al(s) + 3Cd^{2+}(aq)$

2. A 1M solution of copper (II) nitrate is places in a beaker with a strip of copper. A 1M solution of tin (II) sulfate is placed in a second beaker with a strip of tin metal. The two beakers are connected by a salt bridge, and the two metal electrodes are linked by wires to a voltmeter.
   (a) Which electrode serves as the anode, and which is the cathode?
   (b) Which electrode gains mass and which loses mass as the cell reaction proceeds?
   (c) Write the equation for the overall cell reaction.
   (d) What is the emf generated by the cell under standard conditions?

3. (a) For a strong reductant, you expect $E°_{red}$ to be positive or negative?
   (b) Are reducing agents found on the left or right side of reduction half-reactions?

4. From each of the following pairs of substances, use reduction tables to choose which is the stronger oxidizing agent:
   (a) $Cl_2(g)$ or $Br_2(l)$
   (b) $Ni^{2+}(aq)$ or $Cd^{2+}(aq)$
   (c) $BrO_3^-(aq)$ or $IO_3^-(aq)$
   (d) $H_2O_2(aq)$ or $O_3(g)$

5. For each of the following reactions, write a balanced equation, calculate the emf, and calculate $\Delta G°$ at 298K.
   (a) Aqueous iodide ion is oxidized to $I_2(s)$ by $Hg_2^{2+}(aq)$
   (b) In acidic solution Copper (I) ion is oxidized to copper (II) ion by nitrate ion
   (c) In basic solution $Cr(OH)_3(s)$ is oxidized to $CrO_4^{2-}(aq)$ by $ClO^-(aq)$

6. (a) Under what circumstances is the Nernst equation applicable?

   (b) What is the value of the reaction quotient, Q, under standard conditions?

   (c) What happens to the EMF of a cell if the concentrations of the reactants are increased?

7. A voltaic cell is constructed that uses the following reaction and operates at 298K:

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

   (a) What is the EMF of this cell under standard conditions?

   (b) What is the EMF of this cell when $[Cd^{2+}] = 1.50M$ and $[Zn^{2+}] = 0.150M$?

   (c) What is the EMF of the cell when $[Cd^{2+}] = 0.075M$ and $[Zn^{2+}] = 0.950M$?

8. A voltaic cell uses the following reaction and operates at 298K:

   $4Fe^{3+}(aq) + O_2(g) + 4H^{+}(aq) \rightarrow 4Fe^{3+}(aq) + 2H_2O(l)$

   (a) What is the EMF of this cell under standard conditions

   (b) What is the EMF of this cell when $[Fe^{2+}] = 2.0M$, $[Fe^{3+}] = 0.0010M$, $P_{O_2} = 0.50$ atm, and the pH of the solution in the cathode is 3.00.

9. A cell exhibits a standard emf of +0.217V at 298K. What is the value of the equilibrium constant for the cell reaction

   (a) If n = 1?

   (b) If n = 2?

   (c) If n = 3?