Lesson 32: Electrochemistry II

what to know:
- Gibb’s function and cell voltages, standard states, §13-1
- standard half-cell reduction potentials. §13-2, (Omit disproportionation, p-534)
- how to write balanced equations for electrode reactions, predict spontaneity of redox reactions and calculate standard cell emfs using the standard reduction potential table, p-532
- oxidizing and reducing agents, §13-3
- effect of concentrations (Nernst Equation) on cell voltages (qualitative), pH meters, §13-4
- relationship of Gibb’s free-energy, cell voltages and equilibrium constants (qualitative), §13-5

questions:
1. Consider a voltaic cell in which the half-cell reactions Mg/Mg$^{2+}$ and Ag/Ag$^{+}$ are used.
   a. What is the reducing agent?
   b. What substance is reacting at the anode?
   c. Write the overall balanced equation for the reaction occurring in the cell.
   d. Calculate the standard cell voltage for the cell.

2. Consider the cell: Al $\text{Al}^{3+}$ (aq, 1M) KCl(sat'd) NO(g) NO$_3^-$ (H$^+$) Pt(s)
   a. What is the oxidizing agent?
   b. What substance is reacting at the cathode?
   c. Write the balanced net ionic equation for the reaction.
   d. What is the $E^\circ_{\text{cell}}$ for the reaction?
   e. Would the $E^\circ_{\text{cell}}$ for the reaction be (lower than, higher than, or unchanged from) $E^\circ_{\text{cell}}$ if the aluminum ion concentration was 2 M?

3. Given the reaction, 2Au(s) + 3Ca$^{2+}$(aq) $\rightarrow$ 2Au$^{3+}$(aq) + 3Ca(s)
   a. What is the $E^\circ_{\text{cell}}$ for the reaction as written?
   b. Is this reaction spontaneous?

4. Name:
   a. a substance that will oxidize Fe$^{2+}$ but not Br$^-$.
   b. a halogen that will oxidize Cu but not Ag.$^{+}$
   c. a substance that would oxidize Fe to Fe$^{2+}$ but not to Fe$^{3+}$.

5. Which of the following:
   a. would dissolve in nitric acid but not in hydrochloric acid under standard conditions?
       Sn Hg Au Fe Mn Cu Cd Au
   b. would oxidize Br$^-$ to Br$_2$? I$_2$, I$^-$, Cl$_2$, Cl$^-$, Au$^{3+}$, Cu
   c. is the strongest reducing agent? Al$^{3+}$, H$_2$, Cl$_2$, F$^-$

6. Relate $\Delta G^\circ$, $E^\circ_{\text{cell}}$, and $K_{\text{eq}}$ for redox reactions. If $\Delta G^\circ$ is very negative, what do you know about the magnitude of $E^\circ_{\text{cell}}$ and $K_{\text{eq}}$?

7. Consider the reaction, Zn$^{2+}$ + Cu $\rightarrow$ Cu$^{2+}$ + Zn. Is this reaction spontaneous under standard conditions? Under what conditions would it be spontaneous? Explain.

8. How does a pH meter work?