Due: Wednesday, 18-April-2007 by the beginning of class. Remember, this is to be your own work!!

1) An aqueous solution of an unknown salt of vanadium is electrolyzed by a current of 2.75 amps for 2.15 hours. The electroplating is carried out with an efficiency of 95.0%, resulting in a deposit of 3.558 g of vanadium.
   a) How many faradays are required to deposit the vanadium?
   b) What is the charge on vanadium (based on your calculations)?

2a) Calculate the $\Delta G^\circ$ for the following cell reaction:

   \[ \text{Rb}^+ | \text{Rb}^{(aq)} || \text{Pb}^{2+} | \text{Pb} \]

   The $\Delta G^\circ$ for $\text{Rb}^+$ = -282.2 kJ/mol

   b) From this calculated $\Delta G^\circ$, calculate the standard emf for the cell reaction. Using this standard emf, calculate the standard half-cell potential for $\text{Rb}^{+} (\text{aq}) + \text{e}^- \rightarrow \text{Rb} (\text{s})$

3) Under standard conditions for all concentrations, the following reaction is spontaneous at 25°C.

   \[ \text{O}_3 (\text{g}) + 2\text{H}^+ (\text{aq}) + 2\text{Co}^{2+} \rightarrow \text{O}_2 (\text{g}) + \text{H}_2\text{O} (\text{l}) + 2\text{Co}^{3+} (\text{aq}) \]

If [H$^+$] is adjusted by a buffer of 0.10 M NaClO and 0.15 M HClO ($K_a = 3.5 \times 10^{-8}$) what value will $E_{\text{cell}}$ have, and will the reaction be spontaneous at this [H$^+$]?

4) An electrode is prepared from liquid mercury in contact with a saturated solution of mercury(I) chloride, $\text{Hg}_2\text{Cl}_2$, containing 1.00 M Cl$^-$. The emf of the voltaic cell constructed by connecting this electrode as the cathode to the standard hydrogen half-cell as the anode is 0.268 V. What is the solubility product of mercury(I) chloride?

5) Look up the reduction potential for $\text{Fe}^{3+}$ to $\text{Fe}^{2+}$. Look up the reduction potential for $\text{Fe}^{2+}$ to Fe. Now look up the reduction potential for $\text{Fe}^{3+}$ to Fe. You should notice that adding the reduction potentials for the first two does not give you the reduction potential for the third. Why not? Show how could you use the first two potential to get the potential for the third.