Due: Tuesday, 26-April-2005 by the beginning of class. Remember, this is to be your own work!!

1) An aqueous solution of an oxide of osmium 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 4.98 g of osmium.
   a) How many faradays are required to deposit the osmium?
   b) What is the charge on osmium (based on your calculations)?
   c) What is the formula of the oxide?

2a) Calculate the $\Delta G^\circ$ for the following cell reaction:
   \[ \text{Ce}|\text{Ce}^{3+}\text{ (aq)}||\text{Ni}^{2+}\text{ (aq)}|\text{Ni} \]
   \[ \Delta G^\circ_f \text{ for Ce}^{3+} = -671.95 \text{ kJ/mol} \]

   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 $\text{Ce}^{3+}\text{(aq)} + 3e^- \rightarrow \text{Ce(s)}$

3) Automobile manufacturers are currently developing cars that will use hydrogen as fuel. In Iceland, Sweden, and other parts of Scandinavia, where hydroelectric plants produce relatively inexpensive electric power, the hydrogen may be made industrially by the electrolysis of water.
   a) How many coulombs are needed to produce $2.5 \times 10^6$ L of H$_2$ gas at 10.0 atm pressure, and 25.0°C? (Assume that the ideal gas law applies at this pressure.)
   b) If the coulombs are supplied at 1.24 V, how many joules are produced?
   c) If the combustion of oil yields $4.0 \times 10^4$ kJ/kg, what mass of oil would have had to be burned to yield the number of joules in part (b)?

4) An electrode is prepared from liquid mercury in contact with a saturated solution of mercury(I) chloride, Hg$_2$Cl$_2$, containing 1.00 $M \text{Cl}^{-}$. 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) Checking Appendix I in the text, we see that standard electrode potentials range from about -3 volts to +3 volts. Therefore, it seems logical that, by using a half-cell from each end of this range, it would be possible to construct a cell with a voltage of approximately 6 V. Yet, most commercial aqueous voltaic cells have $E^\circ$ values of 1.5 to 2 V. Why are there no aqueous cells with significantly higher voltages?