

Chem 402—Physical Chemistry
Homework Problem Set—Chapter 7, con't.

1. Calculate the activity coefficient of Ba^{2+} and of Cl^- and the mean ionic activity coefficient of a BaCl_2 in a 0.0050 M aqueous solution at 25 °C using the Debye-Huckel limiting law.
2. Write the cell reaction for the following electrochemical cells:
 - (a) $\text{Cd} | \text{Cd}^{2+} | | \text{KCl} | \text{Hg}_2\text{Cl}_2 | \text{Hg}$
 - (b) $\text{Pt} | \text{Ti}^+, \text{Ti}^{3+} | | \text{Cu}^{2+} | \text{Cu}$
 - (c) $\text{Pb} | \text{PbSO}_4(\text{s}) | \text{SO}_4^{2-} | | \text{Cu}^{2+} | \text{Cu}$
3. For each of the cells given in Prob. 2, calculate the standard free energy change, $\Delta_r G^\circ$. Use information from Table 7.2 (p. 1005) to do these problems.
4. The emf of the lead storage cell depends on the temperature and on the sulfuric acid content of the solution. At 25°C the emf is 1.90 V when the solution is 7.4% sulfuric acid, 2.00 V when the solution is 21.4% H_2SO_4 , and 2.14 V when the solution is 39.2% H_2SO_4 . With the help of these data, what can you deduce about the activity or the activity coefficient of the sulfuric acid?
5. The emf of the cell $\text{Ag}(\text{s}) | \text{AgCl}(\text{satd.}), \text{KCl}(0.05 \text{ M}) | \text{AgNO}_3(0.1 \text{ M}) | \text{Ag}(\text{s})$ is 0.4312 V at 25 °C. The mean ionic activity coefficients of KCl and AgNO_3 at these concentrations are estimated to be 0.817 and 0.723, respectively. What is the solubility of AgCl?
6. At 25 °C the emf, E , and the derivative, $(\partial E/\partial T)_P$ of the cell $\text{Pb} | \text{PbCl}_2(\text{s}), \text{KCl}, \text{AgCl}(\text{s}) | \text{Ag}$ are 0.4902 V and $-0.000186 \text{ V K}^{-1}$, respectively. The silver electrode is the cathode. Calculate ΔG and ΔH for the reaction
$$\text{Pb}(\text{s}) + 2 \text{AgCl}(\text{s}) \rightarrow \text{PbCl}_2(\text{s}) + 2 \text{Ag}(\text{s})$$
Compare your result with the value obtained from data in Table 2.7 (p. 995)