Due: **Monday, 10-April-2006** by the beginning of class. Please remember that all work is to be your own.

1) $K_b$ for the dissociation of aqueous ammonia is $1.710 \times 10^{-5}$ at 20°C and $1.892 \times 10^{-5}$ at 50°C. What are the values for $\Delta H^\circ$ and $\Delta S^\circ$ for this reaction?

2) Some nonelectrolyte solute ($M_m = 142$ g/mol) was dissolved in 150 mL of a solvent (density = 0.879 g/cm$^3$). The elevated boiling point of the solution was 355.4 K. What mass of solute was dissolved in the solvent? For the solvent, the enthalpy of vaporization is 33.90 kJ/mol, the entropy of vaporization is 95.95 J/K, and the boiling-point elevation constant is 2.5 K•kg/mol.

3) If wet silver carbonate is dried in a stream of hot air, the air must have a certain concentration level of carbon dioxide to prevent silver carbonate from decomposing by the reaction:

$$\text{Ag}_2\text{CO}_3(\text{s}) \leftrightarrow \text{Ag}_2\text{O}(\text{s}) + \text{CO}_2(\text{g})$$

$\Delta H^\circ$ for this reaction is 79.14 kJ/mol in the temperature range 25 to 125°C. Given that the partial pressure of carbon dioxide in equilibrium with pure silver carbonate is $6.23 \times 10^{-3}$ torr at 25°C, calculate the partial pressure of CO$_2$ necessary to prevent decomposition of Ag$_2$CO$_3$ at 110°C. (**Hint**: think how to use equilibrium in this problem)

4) Using thermodynamic data from your textbook, calculate the $K_{sp}$ for lead (II) sulfide at 45°C. State any assumptions you made to do this problem.

5) A complex ion is formed when a ligand is bonded to a metal ion by means of a pair of electrons. Among the many complex ions of cobalt are the following two:

$$\text{Co(NH}_3)_6^{3+}(\text{aq}) + 3 \text{en(aq)} \leftrightarrow \text{Co(en)}_3^{3+}(\text{aq}) + 6 \text{NH}_3(\text{aq})$$

where $en$ stands for ethylenediamine, $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$, which bonds through the nitrogens. Since six Co-N bonds are broken, and six Co-N bonds are made, $\Delta H^\circ \approx 0$, yet $K>1$. What are the signs of $\Delta S^\circ$ and $\Delta G^\circ$? What drives the reaction?