1. Use data in the Appendix to calculate the conventional chemical potential for NH$_3$(g) at 325 K and 2.65 bar pressure. [Use the convention that $H^\circ_{\text{m,298}}$ $\equiv$ 0.0 for elements in their standard states at 25°C.]

2. Consider the reaction, CO(g) + $\frac{1}{2}$ O$_2$(g) $\rightarrow$ CO$_2$(g). (a) Use data in the Appendix and the expression for $\Delta H^\circ$ found in Section 5.5 to obtain an expression for ln $K^\circ_T$($T$) valid from 300 to 2000 K. (b) Use this expression to calculate $K^\circ_T$ at 1500 K.

3. Many reactions involve dissociation of a starting substance into products. The simplest case is $\text{A(g)} \leftrightarrow 2 \text{B(g)}$

If we start with $n_0$ of A, we define the degree of dissociation $\alpha$ as that fraction of $n_0$ that has dissociated when equilibrium is reached. Obtain an expression for $\alpha$ as a function of $K^\circ_T$ and $P$.

Dissociation reactions are almost always endothermic. How will changes in $P$ and $T$ affect $\alpha$?

4. Do Problem 6.9, except make the temperature 500 K, and do not neglect the $T$-dependence of $\Delta H^\circ$. Also, calculate the degree of dissociation $\alpha$ under conditions where (a) the total pressure is maintained at 0.900 bar, and (b) where the pressure would be 0.900 bar if the gas remained entirely PCl$_5$, but where the volume is held constant (thus yielding increased $P$ at equilibrium). [Hint: The $T$-dependence of $\Delta H^\circ$ can be accommodated through Eq. 5.18, as discussed on p. 172. For the $\alpha$ calculations, you may need to re-express $\alpha$ for the reaction, $\text{A(g)} \leftrightarrow \text{B(g)} + \text{C(g)}$, since this form is appropriate for the PCl$_5$ dissociation.]

5. Problem 6.44 in Levine. (d) Also calculate $K^\circ_T$ for the reaction at 500 K and determine the equilibrium pressures of the three gases. (e) Then verify that these values indeed minimize $G$ for the reaction.

6. Repeat the previous problem, but now hold the volume constant, and calculate the Helmholz free energy $A$ as a function of $\xi$. For comparison with the previous results, make the initial pressure 4.00 bar (as in problem 6.44). Determine the equilibrium pressures and verify that these minimize $A$ for the reaction.