1. Consider the reaction that occurs during the Haber process:

   $N_{2\,(g)} + 3\ H_{2\,(g)} \rightleftharpoons 2\ NH_{3\,(g)}$

   The equilibrium constant is 3.9×10^{5} at 300.0 K and 1.2×10^{-1} at 500.0 K. Calculate $\Delta_{rxn}H°$ and $\Delta_{rxn}S°$ for this reaction.

2. At 154.3°C the following reaction has a thermodynamic equilibrium constant of 1.4×10^{4}

   $A_{(g)} + 2\ B_{(aq)} \leftrightharpoons C_{(s)}$

   What is the ***free energy change*** when the partial pressure of A is 635.4 mmHg and the concentration of B is 2.357 M?

3. Calculate the entropy change when 1.00 mol of water boils at its normal boiling point.

   What is the free energy change for this process? Explain or show calculations.

4. You have the following reaction at 250 °C.

   $2\ NO_{(g)} + O_{2\,(g)} \rightleftharpoons 2\ NO_{2\,(g)}$

   a. Determine if the reaction is spontaneous at this temperature.

   b. If the reaction is not spontaneous at this temperature, calculate the temperature at which it becomes spontaneous.

   c. Calculate the equilibrium constant for this reaction at 250 °C.

5. An ideal solution forms between hexane and octane. Calculate the mole fraction of hexane in the vapor above the solution when 100.0 g of hexane and 154.3 g of octane are mixed. The vapor pressure of pure hexane is 17.60 kPa and the vapor pressure of pure octane is 1.47 kPa.

6. 6.5973 g of myoglobin is dissolved into enough water to make 100.00 mL of solution. The osmotic pressure of the solution is determined to be 9.696 kPa at 26.5 °C. What is the molar mass of myoglobin?