Chemistry 311   **Physical Chemistry**
                              Homework Assignment # 5
                              Due: Monday, October 18, 2004

1. A one liter vessel containing 0.233 mol of N_2 and 0.341 mol of PCl_5 is heated to 250 °C. The total pressure at equilibrium is 29.33 bar. Assuming that all gases are ideal, calculate $K°_P$ for the only reaction that occurs: $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$.

2. Find the free energy of reaction for $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$ using standard free energies of formation (Appendix D). Calculate the value of the equilibrium constant at 1000 K and the extent of reaction at equilibrium if we start with an equimolar mixture of CO and H_2O.

3. Consider the equilibrium $3C(graphite) + 2H_2O(g) \rightleftharpoons CH_4(g) + 2CO(g)$, at 1000 K. The enthalpy of reaction $\Delta_r H° = 182$ kJ mol^{-1}. Write an expression for K_P, showing the standard pressure $P°$ explicitly. Based on Le Chatelier's principle, what will be the effect of

    (a) raising the temperature at a constant pressure of 1 bar,

    (b) raising the pressure to 5 bar at constant temperature of 1000 K,

    (c) adding graphite at a constant pressure of 1 bar.