5.60/BE.110: Thermodynamics and Kinetics (r08)
Recitation Handout for 10/03/2006

Quick summary of today's topics:

Fundamental equations for multicomponent systems:

- $U = U(S, V, n_i)$: $dU = TdS - PdV + \sum_i \mu_i dn_i$
- $H = H(S, P, n_i)$: $dH = TdS + VdP + \sum_i \mu_i dn_i$
- $A = A(T, V, n_i)$: $dA = -SdT - PdV + \sum_i \mu_i dn_i$
- $G = G(T, P, n_i)$: $dG = -SdT - VdP + \sum_i \mu_i dn_i$

Equilibrium:

- $\Delta G = \Delta G^\circ + RT \ln(Q_p)$
- $K = e^{(-\Delta G^\circ / RT)}$

Main Course:

Consider the equilibrium: $2\mathrm{NO}(g) + Cl_2 = 2\mathrm{NOCl}(g)$

At 25°C, for NOCl(g): $\Delta^\circ G_f = 66.07\, kJ/mol$
for NO(g): $\Delta^\circ G_f = 86.57\, kJ/mol$

If NO and Cl_2 are mixed in the molar ratio 2:1 with no initial NOCl, express $y_{NOCl}, y_{NO}, y_{Cl2}$ as a function of the total pressure p and the quotient of pressures, Q_p . Note how each one of these quantities depends on pressure; is this consistent with LeChatelier's principle? Evaluate y_{NO} at 1bar and 10bar.