Lecture Notes L: Chemical Equilibrium IV

1) Partial Pressures

You have a 1.00 liter vessel at 25°C containing a 1.00 atm of a mixture that is 25% Ne and 75% Ar (by volume). What is the partial pressure of Ne and Ar?

Keeping the volume of the vessel fixed at 1.00 liter, you add 1.00 atm of Kr. What is the partial pressure of Ne?

a) 0.125 atm b) 0.25 atm c) 0.50 atm d) 1.0atm

You heat the vessel to 50°C. What is the partial pressure of Ne in the vessel?

Problem

Consider a 1 liter container filled with NO_2 gas. The following dimerization reaction occurs in this gas.

	$2\ NO_{2\ (g)} \leftrightarrow$	$N_2O_{4\ (g)}$	
ΔH^o_f (kJ/mol)	33.18	9.16	ΔH^o= -57.20 kJ/mol
S^o (J/mol K)	239.95	304.18	ΔS^o= -175.72 J/mol K
Color:	brown	colorless	

The container has a temperature of 25°C and a total pressure of 1 atm. What is the ratio of P_{NO2} to P_{N2O4} at room temperature (25°C)?

2) Le Chatelier's principle

A system in equilibrium that is subjected to a stress will react in a way that tends to counteract the stress.

Changing the concentration of a reactant or product

$$A + B \leftrightarrow C + D$$

Changing the volume (leads to a change in total pressure)

$$A_{(g)} + B_{(g)} \leftrightarrow C_{(g)}$$

Changing the temperature

$$A + B \leftrightarrow C + \text{heat} \qquad \Delta H < 0$$

$$\text{heat} + A + B \leftrightarrow C \qquad \Delta H > 0$$

$$2\ NO_{2\ (g)} \leftrightarrow N_2O_{4\ (g)}$$

The volume of the container is decreased to 0.5 liter. What happens to the ratio of P_{NO2} to P_{N2O4}?

a) It increases b) It decreases c) Nothing

Calculate the ratio of P_{NO2} to P_{N2O4} when the volume of the container is decreased to 0.5 liter

Consider the 1 liter container of NO_2 discussed above. The temperature of the container is increased to 100°C. What happens to the ratio of P_{NO2} to P_{N2O4}?

a) It increases b) It decreases c) Nothing d) Not obvious (have to do calculation)

Calculate the ratio of P_{NO2} to P_{N2O4}