Chemical Equilibrium

1. At a particular temperature, a 3.0-L flask contains 2.4 mol Cl_2, 1.0 mol NOCl, and 4.5×10^{-3} mol NO. calculate K_c at this temperature for the following reaction:

$$2NOCl(g) \leftrightharpoons 2NO(g) + Cl_2(g)$$

2. At a given temperature, $K_c = 1.3 \times 10^{-2}$ for the reaction:

$$N_2(g) + 3H_2(g) \leftrightharpoons 2NH_3(g)$$

Calculate the values of K_c for the following reaction at the same temperature.

(a) $1/2\ N_2(g) + 3/2\ H_2(g) \rightleftharpoons NH_3(g)$

(b) $2\ NH_3(g) \rightleftharpoons N_2(g) + 3\ H_2(g)$

(c) $NH_3(g) \rightleftharpoons 1/2\ N_2(g) + 3/2\ H_2(g)$

(d) $2\ N_2(g) + 6\ H_2(g) \rightleftharpoons 4\ NH_3(g)$

3. At a given temperature, $K_c = 2.4 \times 10^{3}$ for the reaction:

$$2NO(g) \leftrightharpoons N_2(g) + O_2(g)$$

For which of the following sets of conditions is the system at equilibrium? For those that are not at equilibrium, in which direction will the reaction shift?

(a) A 1.0-L flask containing 0.024 mol NO, 2.0 mol N_2, and 2.6 mol O_2.

(b) A 2.0-L flask containing 0.032 mol NO, 0.62 mol N_2, and 4.0 mol O_2.

(c) A 3.0-L flask containing 0.060 mol NO, 2.4 mol N_2, and 1.7 mol O_2.

4. A sample of $S_8(g)$ is placed in an empty rigid container at 1325 K at an initial pressure of 1.00 atm, where it decomposes to $S_2(g)$ by the reaction

$$S_8(g) \leftrightharpoons 4S_2(g)$$

At equilibrium the partial pressure of S_8 is 0.25 atm. Calculate K_P for this reaction at 1325 K.

5. At a certain temperature, 4.0 mol NH_3 is introduced into a 2.0-L container, and the NH_3 partially dissociates by the reaction:

$$2NH_3(g) \leftrightharpoons N_2(g) + 3H_2(g)$$

At equilibrium, 2.0 mol NH_3 remains. What is the value of K_c for this reaction?

6. At a certain temperature, $K_c = 3.75$ for the reaction:

$$SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$$

If all four gases had initial concentrations of 0.800 *M*, calculate the equilibrium concentrations of the gases.

7. At 2200°C, $K_P = 0.050$ for the reaction:

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

What is the partial pressure of the NO gas in equilibrium with N_2 and O_2 gases that were placed in a flask at initial pressures of 0.80 and 0.20 atm, respectively?