AP CHEMISTRY

TOPIC 6: EQUILIBRIUM, PART B

Day 65:

- Equilibrium (pressures)

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1) Consider the reaction:

$$2\ NOCl_{(g)} \rightleftharpoons 2\ NO_{(g)} + Cl_{2\ (g)}$$

At 25 ^{0}C, a particular experiment had the following equilibrium pressures:

$$P_{NOCl} = 1.20\ atm,\ P_{NO} = 0.00125\ atm,\ P_{Cl_2} = 0.300\ atm$$

Calculate the value of K_p for the reaction at 25 ^{0}C.

$$K_p = \frac{\left(P_{NO}\right)^2\left(P_{Cl_2}\right)}{\left(P_{NOCl}\right)^2} = \left[\frac{\left(0.00125\ atm\right)^2\left(0.300\ atm\right)}{\left(1.20\ atm\right)^2}\right] = 3.3\times10^{-7}\ atm$$

2) Consider the reaction:

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

At 25 ^{0}C, a particular experiment had the following equilibrium pressures:

$$P_{NH_3} = 0.0031\ atm,\ P_{N_2} = 0.85\ atm,\ P_{H_2} = 0.00031\ atm$$

Calculate the value of K_p for the reaction at 25 ^{0}C.

$$K_p = \frac{\left(P_{NH_3}{}^2\right)}{\left(P_{N_2}\right)\left(P_{H_2}{}^3\right)} = \frac{\left(0.0031\ atm\right)^2}{\left(0.85\ atm\right)\left(0.00031\ atm\right)^3} = 3.8\times10^5\ atm^{-2} \quad or \quad \frac{1}{atm^2}$$

3) For the reaction:

$$CaCO_{3\ (s)} \rightleftharpoons CaO_{(s)} + CO_{2\ (g)}$$

It is found that at equilibrium, [CO_2] = 2.1 x 10 $^{-3}$ *M* at a particular temperature. Calculate the K_C for the reaction at this temperature. (Note: solids are NEVER considered (calculated) in the equilibrium constant)

Answers:

Solids and Liquids do not appear in the equilibrium expression (only gases and aqueous solutions appear in the equilibrium expression). The equilibrium expression would be written as:

$$K_c = \left[CO_2\right]$$

Therefore:

$$K_c = \left[CO_2\right] = \frac{2.1\times10^{-3}\ mol}{L} = 2.1\times10^{-3}\ mol\ L^{-1}$$