Equilibrium II: A Couple More Equilibrium Problems

1. A solution of 0.1 M acetic acid is about 1.4% ionized in water as measured by solution's electrical conductivity. What is K_c for

$$CH_3COOH(aq) \rightleftarrows CH_3COO^-(aq) + H^+(aq)$$

$$\frac{[OAc^-]}{C_{HOAc}} = 0.014 \quad \text{so...} \quad [OAc^-] = 0.1\ \text{M} \times 0.014 = 0.0014\ \text{M}$$

$$[H_3O^+] = [OAc^-] = 0.0014 \quad \text{and} \quad [HOAc] = 0.1\ \text{M} - 0.0014\ \text{M} = 0.0986\ \text{M}$$

$$K_a = \frac{(0.0014)^2}{0.0986} = 1.99 \times 10^{-5}$$

2. A quantity of 0.050 mol of SO_2 gas and 0.025 mol of Cl_2 gas are introduced into an evacuated 1.75 L flask and the following equilibrium is established at 303 K:

$$SO_2Cl_2(g) \rightleftarrows SO_2(g) + Cl_2(g) \qquad K_c = 1.2 \times 10^{-3}$$

What the final concentrations of each gas?

$$C_{SO_2} = \frac{0.050\ \text{mol}}{1.75\ \text{L}} = 0.0286\ \text{M} \qquad C_{Cl_2} = \frac{0.025\ \text{mol}}{1.75\ \text{L}} = 0.0143\ \text{M}$$

No SO_2Cl_2 is present so the reaction proceeds left:

	SO_2Cl_2	$\rightleftarrows$	SO_2	+	Cl_2
at equilibrium	x		$0.0286 - x$		$0.0143 - x$

$$1.2 \times 10^{-3} = \frac{(0.0286 - x)(0.0143 - x)}{x}$$

$$x = [SO_2Cl_2] = 0.013\ \text{M}$$

$$[SO_2] = 0.0286\ \text{M} - 0.013\ \text{M} = 0.016\ \text{M}$$

$$[Cl_2] = 0.0143\ \text{M} - 0.013\ \text{M} = 0.001\ \text{M}$$