Reaction Quotient examples:

ex1> For the synthesis of ammonia (NH_3) from its elements at 500 °C, the equilibrium constant is 6.0×10^{-2}. Predict the direction in which the system will shift to reach equilibrium in each of the following cases:

(a) $[NH_3]_0 = 1.0 \times 10^{-3}$ M, $[N_2]_0 = 1.0 \times 10^{-5}$ M, $[H_2]_0 = 2.0 \times 10^{-3}$ M

(b) $[NH_3]_0 = 2.00 \times 10^{-4}$ M, $[N_2]_0 = 1.50 \times 10^{-5}$ M, $[H_2]_0 = 3.54 \times 10^{-1}$ M

(c) $[NH_3]_0 = 1.0 \times 10^{-4}$ M, $[N_2]_0 = 5.0$ M, $[H_2]_0 = 1.0 \times 10^{-2}$ M

Calculating Equilibrium Pressures examples:

ex1> Dinitrogen tetroxide in its liquid state was used as one of the fuels on the lunar lander for the NASA Apollo missions. In the gas phase, it decomposes to gaseous nitrogen dioxide.

Consider an experiment in which gaseous dinitrogen tetroxide was placed in a flask and allowed to reach equilibrium at a temperature where $K_p = 0.133$. At equilibrium, the pressure of N_2O_4 was found to be 2.71 atm. Calculate the equilibrium pressure of nitrogen dioxide.

[0.600 atm]

ex2> Gaseous phosphorus pentachloride decomposes into phosphorus trichloride and chlorine gas. At a certain temperature, a 1.00-L flask initially contained 0.298 mol of PCl_3 (g) and 8.70 x 10^{-3} mol PCl_5 (g). After the system had reached equilibrium, 2.00 x 10^{-3} moles of chlorine gas were found in the flask. Calculate the equilibrium constant and the equilibrium concentrations of all the chemicals.

[K_{eq} = 8.96 x 10^{-2}, $[PCl_5]_{eq}$ = 6.70 x 10^{-3} M, $[PCl_3]_{eq}$ = 0.300 M]

Calculating Equilibrium Concentrations from Initial Values examples:

ex1> Carbon monoxide reacts with steam to produce carbon dioxide gas and hydrogen gas. At 700 K, the equilibrium constant is 5.10. Calculate the equilibrium concentrations of all species if 1.000 mol of each reactant and product are mixed in a 1.000 L flask.

[$[CO]_{eq}$ = $[H_2O]_{eq}$ = 0.613 M, $[CO_2]_{eq}$ = $[H_2]_{eq}$ = 1.387 M] ex2> Assume that the reaction for the formation of gaseous hydrogen fluoride from hydrogen and fluorine gases has an equilibrium constant of 1.15×10^2 at a certain temperature. In a particular experiment, 3.000 mol of each reactant and product were added to a 1.500 L flask. Calculate the equilibrium concentrations of all species.

[$[H_2]_{eq} = [F_2]_{eq} = 0.472$ M, $[HF]_{eq} = 5.056$ M]

ex3> For the same reaction and temperature as in Example 2 above, 3.00 mol of hydrogen gas and 6.000 moles of fluorine gas were mixed in a 3.000 L flask. Re-calculate the equilibrium concentrations of all species.

[$[H_2]_{eq} = 3.2 \times 10^{-2}$ M, $[F_2]_{eq} =1.032$ M, $[HF]_{eq} = 1.936$ M] ex4> Assume that gaseous hydrogen iodide is synthesized from hydrogen gas and iodine vapor at a temperature where the K_p is 1.00×10^2. Suppose HI at 5.000×10^{-1} atm, H_2 at 1.000×10^{-2} atm, and I_2 at 5.000×10^{-3} atm are mixed in a 5.000 L flask. Calculate the equilibrium pressures of all species.

[$P_{HI} = 4.29 \times 10^{-1}$ atm, $P_{H2} = 4.55 \times 10^{-2}$ atm, $P_{I2} = 4.05 \times 10^{-2}$ atm]