Answer on Question #63281 - Chemistry - General Chemistry

Question: At a particular temperature, K_p= 70.9 for the following reaction: $N_2O_4(g) \leftrightarrow 2NO_2(g)$. A certain pressure of N_2O_4 is initially added to an otherwise evacuated. At equilibrium, 25.8% of N_2O_4 remains. What is the partial pressure of NO_2 at equilibrium?

Solution

The task does not define the units of pressure (kPa's, bars, etc.), so they are not defined in the solution, but it is right for any units.

1) Derive the expression for the pressure constant of equilibrium for the reaction

$$N_2O_4(g) \leftrightarrow 2NO_2(g)$$

$$K_p = \frac{p(NO_2)^2}{p(N_2O_4)} = 70.9$$

Assume that the initial pressure of N_2O_4 is x, then if 25.8% of it remains at equilibrium (74.2% is conversed), its pressure at equilibrium is 0.258*x, and due to the fact that one molecule of N_2O_4 generates two molecules of NO_2, the pressure of NO_2 at equilibrium is 2*0.742*x = 1.484*x.

2) Set the derived expressions for N_2O_4 and NO_2 pressures into the expression for K_p:

$$70.9 = \frac{(1.484x)^2}{0.258x} = 8.5359x; x = \frac{70.9}{8.5359} = 8.3061$$

So, the initial pressure of N_2O_4 is 8.3061, then its partial pressure at equilibrium is 8.3061*0.258 = 2.1430, and the partial pressure of NO_2 is 1.484*8.3061 = 12.3263.

Answer: the partial pressure of NO_2 at equilibrium is equal to 12.3263.