Question 71624/Chemistry/General Chemistry

At 700 K the equilibrium constant for the reaction:

$CCl_4(g) \leftrightarrow C(s)+2Cl_2(g)$

is $K_p=0.76$. A flask is charged with 1.90 atm of CCl_4, which then reaches equilibrium at 700 K. What fraction of the CCl_4 is converted into C and Cl_2?

Answer:

If the fraction of CCl_4 converted into C and Cl_2 is ϒ, then $\gamma = \frac{x}{C_0}$ and $K_p = \frac{4x^2}{C_0 - x}$. Let combine these two equations together:

$$K_p = \frac{4C_0^2\gamma^2}{C_0 - C_0\gamma} = \frac{4C_0\gamma^2}{1-\gamma}$$

Let finally express ϒ from a given equation:

$$\gamma = \frac{-K_p + \sqrt{K_p^2 + 16 \cdot C_0 \cdot K_p}}{8 \cdot C_0}$$

Now we must convert *atm* units to *mols* per *volume* of the reaction vessel units:

$$C_0 = \frac{n}{V} = \frac{P}{RT} = 0.033 mol/L$$

Thus, $\gamma = \frac{-0.76+\sqrt{0.76^2+16 \cdot 0.033 \cdot 0.76}}{8 \cdot 0.033} = 0.87 \; or \; 87\%$