h2+cl2-> 2HCl if you start with .250 of H2 and Cl2 determine equilibrium concentrations if keq=2.51 x 1 x 10 -4 what is the answer

Solution:

From the equation of reaction at starting point the concentrations of H_2 and Cl_2 were 0.250 M and concentration of HCl was 0. The *x* moles of H_2 and Cl_2 have been reacted at equilibrium point and *2x* M of HCl has been found. So, the equilibrium concentrations of H_2 and Cl_2 are (*0.25-x)* M and HCl is 2x M.

The equilibrium constant of this reaction is:

$$K_c = \frac{[HCl]_{eq}^2}{[H_2]_{eq} \cdot [Cl_2]_{eq}} = \frac{[2x]^2}{[0.25-x] \cdot [0.25-x]} = 2.51 \cdot 10^{-4}$$

$$2.51 \cdot 10^{-4} \cdot (0.0625 - 0.5x + x^2) = 4x^2$$

$$3.999749x^2 + 1.255 \cdot 10^{-4} x - 1.56 \cdot 10^{-5} = 0$$

We calculate the x: $x_{1,2} = \frac{-1.255 \cdot 10^{-4} \pm \sqrt{1.255 \cdot 10^{-4} - 4 \cdot 3.999749 \cdot (-1.56 \cdot 10^{-5})}}{2 \cdot 3.999749}$

$x_1 = 7.84 \cdot 10^{-6}$, $x_2 = -3.92 \cdot 10^{-5}$(the second gives negative concentrations so is wrong).

The equilibrium concentrations of H_2 and Cl_2 are: $0.25 - 7.84 \cdot 10^{-6} = 0.249992$ M.

The equilibrium concentration of HCl is: $2 \cdot 7.84 \cdot 10^{-6} = 1.568 \cdot 10^{-5}$ M.

Answer:

The equilibrium concentrations of H_2 and Cl_2 are 0.249992 M and the equilibrium concentration of HCl is $1.568 \cdot 10^{-5}$.