Question #57687, Chemistry, Other

Hydrogen Bromide is formed by a reaction between hydrogen gas and bromine vapor.

Here is the equation: $H_{2(g)} + Br_{2(g)} \leftrightarrow 2HBr_{(g)}$, with $K_{(eq)} = 3.5$.

Calculate the equilibrium concentration of all gases if 0.40 mol of $H_{2(g)}$ and 0.60 mol of $Br_{2(g)}$ are placed in a 4.0 L container.

Answer:

$$K_{eq} = \frac{[HBr]^2}{[H_2][Br_2]}$$

0.40 mol H_2 / 4.0 L = 0.10 M H_2

0.60 mol Br_2 / 4.0 L = 0.15 M Br_2

	$H_{2(g)}$ +	$Br_{2(g)} \leftrightarrow$	$2HBr_{(g)}$
Initial:	0.10 M	0.15 M	0
Change:	-x	-x	+2x
Equilibrium:	0.10-x	0.15-x	2x

$3.5 = [(2x)^2] / [(0.15-x)(0.10-x)]$

$3.5 = (4x^2) / (0.015-0.15x-0.10x+x^2)$

$3.5 = (4x^2) / (0.015-0.25x+x^2)$

$0.0525 - 0.875x + 3.5x^2 = (4x^2)$

$0.0525 - 0.875x - 0.5x^2 = 0$

$-0.5x^2 - 0.875x + 0.0525 = 0$

$X = 0.06$

From here:

	$H_{2(g)}$ +	$Br_{2(g)} \leftrightarrow$	$2HBr_{(g)}$
Equilibrium:	0.10-0.06=0.04	0.15-0.06=0.09	2·0.06=0.12