Answer on the Question #65310, Chemistry / General chemistry

If 250 mol of CO and 125 ml of H_2O gases are placed in 125 ml flask at 900 K, what is the concentration of each component at equilibrium? Kc=1.56

Solution:

Reaction between CO and H_2O at 900 K:

$$CO + H_2O \rightarrow CO_2 + H_2$$

Initial concentration of the reactants can be calculated by the following manner:

$$c_{reactant} = \frac{n_{reactant}}{V_{falsk}}$$

Results are present below:

Component	CO	H_2O	CO_2	H_2
Initial concentration, mol/l	$2 \cdot 10^3$	$1 \cdot 10^3$	0	0
Intermediate concentration, mol/l	-x	-x	+x	+x
Equilibrium concentration, mol/l	$2 \cdot 10^3$-x	$1 \cdot 10^3$-x	x	x

Equilibrium constant of the reaction is a ratio between the composition of equilibrium concentrations of products and reactants. It is equal to:

$$K_c = \frac{[CO_2] \cdot [H_2]}{[CO] \cdot [H_2O]} = \frac{x \cdot x}{(2 \cdot 10^3 - x) \cdot (1 \cdot 10^3 - x)} = 1.56$$

$$0.56x^2 - 4.7 \cdot 10^3 x + 3.1 \cdot 10^6 = 0$$

$$x_{1,2} = \frac{-b \pm \sqrt{D}}{2a}$$

$$x_1 = 0.73 \cdot 10^3$$

$$x_2 = 7.6 \cdot 10^3$$

Solution of quadratic equation gives 2 positive answers. But x_2 can't be an adequate solution, because its value much more than initial concentration of reactants.

Answer:

Component	CO	H_2O	CO_2	H_2
Equilibrium concentration, mol/l	$1.27 \cdot 10^3$	$0.27 \cdot 10^3$	$0.73 \cdot 10^3$	$0.73 \cdot 10^3$