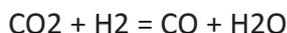


## Answer on Question#50953 – Chemistry – Inorganic Chemistry

Suppose we start with CO<sub>2</sub> and H<sub>2</sub>, both at a concentration of 0.100 M. When the system reaches equilibrium, what are the concentrations of products and reactants?

### Solution:

Reaction:



The equilibrium constant K:

$$aA + bB = cC + dD; K = \frac{[C]^c [D]^d}{[A]^a [B]^b};$$

K – the equilibrium constant; [A] – the equilibrium concentration (mol/L);

In this case we don't know the equilibrium constant (K<sub>c</sub>) and the equilibrium concentration of any reagent. Suppose that K<sub>c</sub> = 1

Initial concentration H<sub>2</sub> = initial concentration CO<sub>2</sub> = 0.1 M

$$K = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{CO}_2][\text{H}_2]};$$

C = n/V; C – molar concentration (mol/L); n – mole (mol); V – volume (L);

In this case V = const, so we can use «n» instead of «C» in this equilibrium:

$$K = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{CO}_2][\text{H}_2]};$$

The amount of reacted H<sub>2</sub> = x,

$$[\text{CO}]_{\text{eq}} = [\text{H}_2\text{O}]_{\text{eq}} = x \text{ (according to the reaction } n(\text{reactants}) : n(\text{products}) = 1 : 1);$$

$$[\text{CO}_2]_{\text{eq}} = [\text{H}_2]_{\text{eq}} = 0.1 - x;$$

$$K = \frac{[\text{CO}][\text{H}_2\text{O}]}{[\text{CO}_2][\text{H}_2]};$$

$$1 = x^2 / (0.1 - x)^2;$$

$$x = 0.05$$

The equilibrium concentration of H<sub>2</sub>O = [CO]<sub>eq</sub> = 0.05 M;

$$[\text{CO}_2]_{\text{eq}} = [\text{H}_2]_{\text{eq}} = 0.1 - x = 0.1 - 0.05 = 0.05 \text{ M}$$

**Answer:** If K<sub>c</sub> = 1,

$$[\text{CO}_2]_{\text{eq}} = [\text{H}_2]_{\text{eq}} = [\text{CO}]_{\text{eq}} = [\text{H}_2\text{O}]_{\text{eq}} = 0.05 \text{ M.}$$

(If we know the signification of K<sub>c</sub> we can calculate the concentration of products and reactants according to this example).