

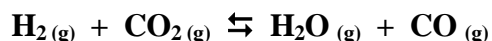
**Equilibrium Worksheet #5**  
From the Internet October, 2003 (Revised 2010)

1. Suppose 1.000 mole CO and 3.000 moles H<sub>2</sub> are put into a 10.00 L vessel at 1200 Kelvin. If the equilibrium constant for the reaction shown below is 3.92, calculate the final composition of the mixture at equilibrium.

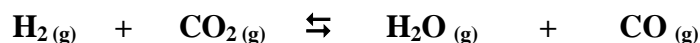


$$\begin{aligned}[\text{CO}] &= 0.0613 \text{ M} \\[\text{H}_2] &= 0.1839 \text{ M} \\[\text{CH}_4] &= 0.0387 \text{ M} \\[\text{H}_2\text{O}] &= 0.0387 \text{ M}\end{aligned}$$

2. For the reaction represented by the equation:

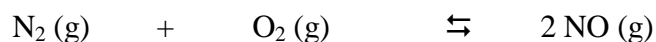


the value of K is 0.771 at 750°C. If 0.0100 mole of H<sub>2(g)</sub> and 0.0100 mole of CO<sub>2(g)</sub> are mixed inside a 2.00 L vessel at 750°C, what are the concentrations of all substances at equilibrium?



$$\begin{aligned}[\text{H}_2] &= 0.00266 \text{ M} \\[\text{CO}_2] &= 0.00266 \text{ M} \\[\text{H}_2\text{O}] &= 0.00234 \text{ M} \\[\text{CO}] &= 0.00234 \text{ M}\end{aligned}$$

3. Nitrogen monoxide is formed in automobile exhaust by the reaction of the N<sub>2</sub> and O<sub>2</sub> in the air. At 2127°C, K=0.0125. Initially, a mixture contains 0.850 moles of N<sub>2</sub> and 0.850 moles of O<sub>2</sub> in a 15.0-Liter vessel. Calculate the concentration of all species when equilibrium is established at 2127°C.



$$\begin{aligned}[\text{N}_2] &= 0.0537 \text{ M} \\[\text{O}_2] &= 0.0537 \text{ M} \\[\text{NO}] &= 0.00600 \text{ M}\end{aligned}$$

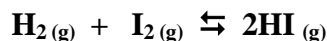
4. The equilibrium constant  $K$  is 115 at  $60^\circ\text{C}$  for the reaction shown below. A 1.500 L flask contains 3.000 mole of each substance.



- A. Is the system at equilibrium? (Show work here)
- B. If not, in which direction will the equilibrium shift?
- C. What are the equilibrium concentrations for each substance?

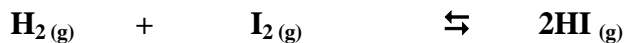
$$\begin{aligned}[\text{H}_2] &= 0.472 \text{ M} \\[\text{F}_2] &= 0.472 \text{ M} \\[\text{HF}] &= 5.056 \text{ M}\end{aligned}$$

5. The value of  $K$  for the HI equilibrium at  $425^\circ\text{C}$  is 54.8.



A quantity of  $\text{HI}(\text{g})$  is placed in a 1.00 L container and allowed to come to equilibrium at  $425^\circ\text{C}$ . At equilibrium, the concentration of  $\text{HI}(\text{g})$  is found to be 0.50 M.

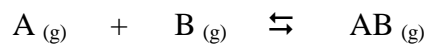
- (a) What are the concentrations of  $\text{H}_2(\text{g})$  and  $\text{I}_2(\text{g})$  at equilibrium?
- (b) What was the initial concentration of  $\text{HI}(\text{g})$ ?



$$\begin{aligned}[\text{H}_2] &= 0.068 \text{ M} \\[\text{I}_2] &= 0.068 \text{ M} \\[\text{HI}] &= 0.64 \text{ M}\end{aligned}$$

6. Consider the system  $A_{(g)} + B_{(g)} \rightleftharpoons AB_{(g)}$  at equilibrium where  $K_c = 500$ .

At equilibrium, the concentrations of A, B, and AB are found to be 0.0300 M, 0.0100 M, and 0.150 M, respectively, in a 5.00 L container. An additional 0.0400 moles of B are added. What are the final equilibrium concentrations of A, B, and AB?



$$\begin{aligned} [A] &= 0.0246 \text{ M} \\ [B] &= 0.0126 \text{ M} \\ [AB] &= 0.1554 \text{ M} \end{aligned}$$

7. A 2.50-mole quantity of NOCl was initially in a 1.50-L reaction chamber at 400°C where the following chemical reaction occurred.



After equilibrium was established, it was found that 28.0% of the NOCl had decomposed. Calculate the equilibrium constant  $K_c$  for this reaction.

$$K = 0.0353$$