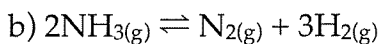


1) For each of the following write the equilibrium expression and calculate the value of K.



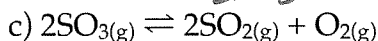
$[\text{CH}_4] = 0.50\text{M}$ ,  $[\text{Cl}_2] = 0.50\text{M}$ ,  $[\text{CH}_3\text{Cl}] = 1.5\text{M}$ ,  $[\text{HCl}] = 1.5\text{M}$

$$K = \frac{[\text{CH}_3\text{Cl}][\text{HCl}]}{[\text{CH}_4][\text{Cl}_2]} = \frac{(1.5)(1.5)}{(0.5)(0.5)} = 9.0$$



$[\text{NH}_3] = 0.00250\text{M}$ ,  $[\text{N}_2] = 0.100\text{M}$ ,  $[\text{H}_2] = 0.300\text{M}$

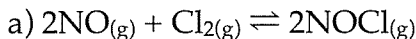
$$K = \frac{[\text{N}_2][\text{H}_2]^3}{[\text{NH}_3]^2} = \frac{(0.1)(0.3)^3}{(0.0025)^2} = 432$$



$[\text{SO}_3] = 3.45 \times 10^{-3}$ ,  $[\text{SO}_2] = 6.70 \times 10^{-4}$ ,  $[\text{O}_2] = 3.35 \times 10^{-4}$

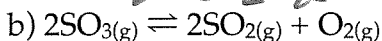
$$K = \frac{[\text{SO}_2]^2[\text{O}_2]}{[\text{SO}_3]^2} = \frac{(6.7 \times 10^{-4})^2(3.35 \times 10^{-4})}{(3.45 \times 10^{-3})^2} = 1.26 \times 10^{-5}$$

2) For each of the following write the equilibrium expression and determine if the system is at equilibrium or not.



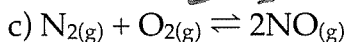
$K_c = 4.6 \times 10^4$ ;  $[\text{NO}] = 1.00\text{M}$ ,  $[\text{Cl}_2] = 1.00\text{M}$ ,  $[\text{NOCl}] = 0\text{M}$

$$K = \frac{[\text{NOCl}]^2}{[\text{NO}]^2[\text{Cl}_2]} \quad Q = \frac{(0)^2}{(1.0)^2(1.0)} = 0 \quad Q \neq K \text{ not at Equilibrium}$$



$K_c = 0.230$ ;  $[\text{SO}_3] = 2.00\text{M}$ ,  $[\text{SO}_2] = 2.00\text{M}$ ,  $[\text{O}_2] = 2.00\text{M}$

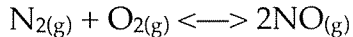
$$K = \frac{[\text{SO}_2]^2[\text{O}_2]}{[\text{SO}_3]^2} \quad Q = \frac{(2.0)^2(2.0)}{(2.0)^2} = 2.0 \quad Q \neq K \text{ not at Equilibrium}$$



$K_c = 0.50$ ;  $[\text{N}_2] = 0.100\text{M}$ ,  $[\text{O}_2] = 0.200\text{M}$ ,  $[\text{NO}] = 0.1200\text{M}$

$$K = \frac{[\text{NO}]^2}{[\text{N}_2][\text{O}_2]} \quad Q = \frac{(0.1200)^2}{(0.100)(0.200)} = 0.72 \quad Q \neq K \text{ not at Equilibrium}$$

2) Nitrogen monoxide,  $\text{NO}_{(g)}$ , can be formed during lightning strikes by the direct reaction of nitrogen gas,  $\text{N}_{2(g)}$ , with oxygen gas,  $\text{O}_{2(g)}$ , as shown below:



A researcher conducts an experiment by filling a 2.50L reaction vessel to a pressure of 0.750 atm with  $\text{NO}_{(g)}$  at a temperature of 300.K. Over time the pressure of the  $\text{NO}_{(g)}$  in the reaction vessel was measured and after 15 minutes the pressure of  $\text{NO}_{(g)}$  was found to be 0.450 atm.

A) Calculate the equilibrium molarity of  $\text{NO}_{(g)}$ .

$$\frac{n}{V} = \frac{P}{RT} = \frac{0.450 \text{ atm}}{0.08206 \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}} \cdot 300\text{K}} = \boxed{0.0183 \text{ M NO}}$$

B) Calculate the equilibrium molarity of  $\text{N}_{2(g)}$  and  $\text{O}_{2(g)}$ .

$$\frac{n}{V} = \frac{P}{RT} = \frac{0.750 \text{ atm}}{0.08206 \cdot 300} = 0.0305 \text{ start}$$

$$\frac{1 \text{ N}_2}{2 \text{ NO}} = 6.09 \cdot 10^{-3} \text{ M N}_2$$

$$\frac{1 \text{ O}_2}{2 \text{ NO}} = 6.09 \cdot 10^{-3} \text{ M O}_2$$

- 0.0183 end

0.0122 M used up

C) Write the equilibrium expression for the formation of  $\text{NO}_{(g)}$ .

$$K = \frac{[\text{NO}]^2}{[\text{N}_2][\text{O}_2]}$$

D) Calculate the value of the equilibrium constant K for the reaction at 300.K.

$$K = \frac{(0.0183)^2}{(6.09 \cdot 10^{-3})(6.09 \cdot 10^{-3})} = 9.03$$

E) Based on the value of the equilibrium constant are the reactants or products favored in this reaction?

Since K is greater than 1 the products are favored.