

Lesson 20: Gaseous Equilibrium

text: 280-297

what to know:

- concept of equilibrium and equilibrium constants, §7-1
- how to calculate equilibrium constants, §7-2
- reaction quotients are and how they are used, §7-3
- how to use equilibrium constants to predict results of chemical reactions, §7-4

questions:

1. Write equilibrium constant expressions (K_p) for the reaction, $P_4H_{10}(g) + 6PCl_5(g) \rightleftharpoons 10POCl_3(g)$
2. Consider the following reaction: $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ $K_p = 11$ at $100^\circ C$. & endothermic
 - a. Write the equilibrium constant expression, K_p .
 - b. What is the value for the K_p of the reverse reaction?
 - c. If the partial pressures of N_2O_4 and NO_2 in a 4.0 L container are 2.0 atm and 4.0 atm respectively, which direction will the reaction go?
3. Given the equation: $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$, $K_p = 1.30$
 - a. What is the K_p for the reaction, $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
 - b. What is the K_p for the reaction, $4SO_3(g) \rightleftharpoons 4SO_2(g) + 2O_2(g)$?
4. Consider the reaction, $2A_2B_3(g) \rightleftharpoons 4A(g) + 3B_2(g)$. 12.0 atm of A_2B_3 is placed into a 10.0 L container and allowed to dissociate at constant T. Upon achieving equilibrium, it was found that 33.0% of the A_2B_3 was dissociated. Calculate the equilibrium constant, K_p , for the reaction.
5. Consider the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ with a K_p of 62.5 at 800 K. The initial partial pressure of H_2 was 0.20 atm I_2 was 0.20 atm and HI was 2.00 atm.
 - a. Determine which direction the reaction will go.
 - b. Calculate the equilibrium partial pressures of all three species under these conditions.
6. Consider the reaction, $Cl_2(g) \rightleftharpoons 2Cl(g)$. $K_p = 1.4 \times 10^{-4}$ at $1100^\circ C$.
 - a. If one starts with 0.5 atm Cl_2 at $1100^\circ C$, will the equilibrium system contain mostly Cl_2 , mostly Cl or appreciable amounts of both species?
 - b. At another temperature the K_p for the reaction is 3.6×10^{-1} . At this temperature will the equilibrium system contain mostly Cl_2 , mostly Cl or appreciable amounts of both species?
7. At $650^\circ C$, the reaction, $H_2(g) + CO_2(g) \rightleftharpoons CO(g) + H_2O(g)$ has a K_p value of 0.771. If hydrogen and carbon dioxide, each at a partial pressure of 0.500 atm, are placed in a 4.00 L container and allowed to react, what will be the partial pressures of all four gases at equilibrium?
8. Carbonyl bromide, $COBr_2$, can be formed by reacting carbon monoxide with bromine gas
{ $CO(g) + Br_2(g) \rightleftharpoons COBr_2(g)$ }.
A mixture of carbon monoxide, bromine and carbonyl bromide with partial pressures of 0.0800 atm, 0.0600 atm and 0.0400 atm, respectively, is sealed in a flask. Assuming the K_p to be 5.26 at this temperature, calculate the equilibrium pressures for all gases.