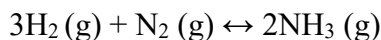


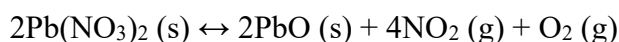
Chemistry Module 15 Homework

Assignment #1

1. What is chemical equilibrium?
2. Write the equilibrium constant formula for the formation of ammonia from hydrogen and nitrogen gas.



3. Use the formula you wrote in the previous problem to calculate the value of the equilibrium constant for this reaction. The concentrations at equilibrium are: $[\text{NH}_3] = 2.4 \text{ M}$, $[\text{N}_2] = 1.45 \text{ M}$, and $[\text{H}_2] = 1.6 \text{ M}$.
4. A chemist is determining the equilibrium constant for the following reaction. He starts out with 10.0 g of $\text{Pb}(\text{NO}_3)_2$ and ends up with 2.02 g of PbO at equilibrium. The concentrations of NO_2 and O_2 at equilibrium are 0.18 M and 0.045, respectively. What is the value of the equilibrium constant?



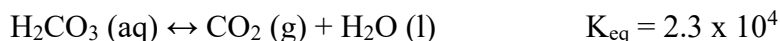
5. A chemist has determined the equilibrium constants for several reactions. In which of these reactions are the products favored over the reactants?

- a. $K_{\text{eq}} = 1 \times 10^2$
- b. $K_{\text{eq}} = 0.003$
- c. $K_{\text{eq}} = 3.5$
- d. $K_{\text{eq}} = 6 \times 10^{-4}$

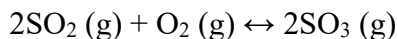
6. Three chemical equilibria are written below, along with their equilibrium constants. Which way should the arrow point (to the right, to the left, both ways)?

- a. $2\text{NOCl}(\text{g}) + \text{O}_2(\text{g}) \leftrightarrow 2\text{NO}_2(\text{g}) + \text{Cl}_2(\text{g})$ $K_{\text{eq}} = 2.2 \times 10^{-5}$
- b. $2\text{SO}_3(\text{g}) \leftrightarrow 2\text{SO}_2(\text{g}) + \text{O}_2(\text{g})$ $K_{\text{eq}} = 1.6 \text{ M}$
- c. $2\text{NO}_2 \leftrightarrow \text{N}_2\text{O}_4$ $K_{\text{eq}} = 9.3 \times 10^4 \text{ 1/M}$

7. A chemist is studying the following reaction. She measures the concentrations of H_2CO_3 and CO_2 when there is $1.23 \times 10^3 \text{ kg}$ of water present.

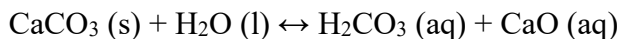


- a. If their concentrations are 2.3 M and 3.5 M, respectively, is the reaction at equilibrium?
 - b. If the reaction is not at equilibrium, which way must the reaction shift to reach equilibrium?
8. The following reaction has an equilibrium constant of 4.4 1/M.



- a. If the following concentrations are present: $[\text{SO}_2] = 0.340 \text{ M}$, $[\text{O}_2] = 0.154 \text{ M}$, $[\text{SO}_3] = 0.280 \text{ M}$, is the reaction at equilibrium?
 - b. If not, which way must it shift to reach equilibrium?
9. State Le Chatelier's principle in your own words.
 10. Why do we ignore solids and liquids in the equilibrium constant and when using Le Chatelier's principle?

11. What effect do the following changes have on this reaction that has reached equilibrium? Explain what happens to the amount (not concentration) of the other reactants and products after the change has been made (do they increase or decrease?).



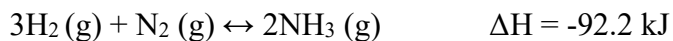
- Extra CaO is added
- H₂CO₃ is removed

12. What effect do the following changes have on this reaction that has reached equilibrium? Explain what happens to the concentrations of the other reactants and products after the change has been made (do they increase or decrease)?



- The temperature is raised.
- The temperature is lowered.

13. What effect do the following changes have on this reaction that has reached equilibrium? Explain what happens to the concentrations of the other reactants and products after the change has been made (do they increase or decrease)?



- The temperature is raised.
- The pressure is raised.
- The pressure is lowered.

Chemistry Module 15 Homework

Assignment #2

1. What does the acid ionization constant tell you about the acid?
2. What is the maximum possible value for pH? What is the minimum possible value for pH?
3. Given the pH of the solutions below, indicate whether the solution is a strong acid, weak acid, neutral, weak base or strong base.
 - a. Solution A = 9.4
 - b. Solution B = 1.25
 - c. Solution C = 6.3
 - d. Solution D = 7.00
 - e. Solution E = 8.04
4. Three acids are listed below. Which acid has the lowest ionization constant?
Acid A – pH = 4
Acid B – pH = 6
Acid C – pH = 1
5. Write the expression for K_a for each of these acids.
 - a. HCN
 - b. HI
 - c. HNO_3
6. Write the expression for K_b for each of these bases.
 - a. CH_5N
 - b. PH_3
 - c. SO_4^{-2}
7. Honors – A 0.200M solution of a weak acid has a $[\text{H}^+]$ of 9.86×10^{-4} M.
 - a. Calculate the value of K_a for this acid.
 - b. Calculate the pH of the solution.
8. Honors – Calculate the pH of a 0.20 M solution of HCN. Its $K_a = 4.9 \times 10^{-10}$.

$$\text{pH} = -\log [\text{H}^+]$$