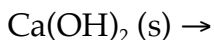


Exercise 9: Equilibrium

1. An ionic substance dissolving into its component ions in water can be written as a chemical equation.

a. Consider the dissolution of calcium hydroxide. Complete and balance the chemical equation describing this **dissolution**, and don't forget to indicate charges on ionic species:



b. Write the **equilibrium constant expression** of the equation in part a. Hint: is a pure substance supposed to be included in the expression?

c. For dissolved ionic substances, K_{eq} is written as K_{sp} and is read "the solubility product constant", but means exactly the same thing as an equilibrium constant. In any table of K_{sp} 's, the value of K_{sp} at 25°C for calcium hydroxide is 1.3×10^{-6} . For a 1.0 M solution of calcium hydroxide at 25°C, and given the equilibrium expression in part b, determine the concentration of the **calcium** ion and the **hydroxide** ion at equilibrium of this solution. Hint: these two numbers will not be the same!

d. Suppose sodium hydroxide solution were poured into the calcium hydroxide solution. The sodium hydroxide solution, of course, contains a lot of hydroxide ions. According to **LeChatelier's Principle**, what macroscopic changes would be visible in the mixture? In other words, what happens?

2. a. Write the chemical equation that shows the **dissociation** of acetic acid ($\text{HC}_2\text{H}_3\text{O}_2$) into hydrogen and acetate ions. Don't forget to indicate species charges, as appropriate, and make sure the equation is balanced.

b. Write the **equilibrium constant expression** for the dissociation of acetic acid.

c. For acids, K_{eq} is written as K_{a} and is read "the acid dissociation constant", but means exactly the same thing as an equilibrium constant. In any table listing K_{a} 's, the value of K_{a} at 25°C for acetic acid is 1.8×10^{-5} . For a 1.0 M solution of acetic acid at 25°C , and the equilibrium expression in part b, determine the **concentration of the hydrogen ion** at equilibrium of this solution. Hint: there is a significant amount of algebra, including the use of the **quadratic formula**.