Chemistry
Chapter 19 Notes: Acids and Bases

Acid: a compound that produces hydrogen ions when dissolved in water, generally in the form HX, where X is a monatomic or polyatomic anion. Acids are only technically acids when they are dissolved in water.

Review Acid Naming:

Base: a compound that produces hydroxide ions when dissolved in water.

hydroxide ion (OH^{-}) : a water molecule that loses a hydrogen atom

hydrominium atom (H_3O^{+}) : a water molecule that gains a hydrogen ion

self-ionization: reaction in which two water molecules can produce ions; occurs naturally in water. In pure water, the concentration of hydrogen ions and hydroxide ions are each 1.0×10^{-7} *M*. The concentrations of H^{+} and OH^{-} are equal in pure water. Any aqueous solution where H+ and OH- are equal is described as an **aqueous solution**. In a solution, hydroxide concentration increases as hydrominium concentration decreases, and vice-versa. In water, the product of hydroxide and hydrominium is always 1.0×10^{-14} M^2.This is called the **ion-product constant for water**, also known as K_w .

acidic solution: is one where the amount of H^{+} is greater than the amount of OH^{-}. Therefore, the H^{+} of an acidic solution is always greater than 1.0×10^{-7} *M*.

basic solution: also known as an **alkaline solution**, is one where the amount of H^{+} is less than the amount of OH^{-}, so the amount of H^{+} is less than 1.0×10^{-7} *M*.

The pH Scale:

pH of a solution: the negative logarithm of the hydrogen-ion concentration; in a neutral solution, the pH is 7. A pH of less than seven denotes acidity, while a pH of greater than seven denotes a base.

pOH of a solution: the negative logarithm of the hydroxide-ion concentration. pOH = 14 - pH, or pH = 14 - pOH. A pOH of greater than seven denotes acidity, while a pOH of less than seven denotes a base.

Calculating pH Values: Most pH numbers are not whole numbers. As a result, a table of logarithmic values or a calculator is needed to convert the pH value into the hydrogen-ion concentration.

Examples:

Measuring pH

Acid-Base Indicators: An indicator is an acid or a base that undergoes dissociation in a known pH range. Indicators are useful because they have a single color for a particular pH value, which allows tests to be done quickly and easily.

pH Meters: used to make a rapid, accurate pH measurements. It measures the voltage between two electrodes and converts this value into pH.

Definitions of acid bases:

Arrhenius Acids and Bases: Named for Swedish chemist Svante Arrhenius who explained that acids are hydrogen containing compounds that ionize to yield hydrogen ions. He also said that bases are compounds that ionize to yield hydroxide ions.
Acids that contain one ionizable hydrogen are called **monoprotic acids**. Acids that have two ionizable hydrogens are **diprotic acids.** Acids that contain three ionizable hydrogens are called **triprotic acids**.

Examples:

Bronsted-Lowry Acids and Bases: The Arrhenius definition of acids and bases was not comprehensive. It did not include many substances that had acidic or basic properties. Chemists Johanners Bronsted and Thomas Lowry independently proposed that an acid is a **hydrogen-ion donor**, while a base is a **hydrogen-ion acceptor**. A **conjugate acid** is the particle formed when a base gains a hydrogen ion. Similarly, a **conjugate base** is the particle that remains when an acid has donated a hydrogen acid. Conjugate acids and bases are always paired with a base or an acid, respectively. A **conjugate acid-base pair** consists of two substances related by the loss or gain of a single hydrogen ion. A substance, such as water,

that can act both as an acid and a base is said to be **amphoteric**.

Examples:

Lewis Acids and Bases: A third theory of acids and bases that is more general than either of the other two theories. A **Lewis acid** is a substance that can accept a pair of electrons to form a covalent bond, while a **Lewis base** is a substance that can donate a pair of electrons to form a covalent bond.

strong acid: an acid that is completely ionized in aqueous solution.

weak acid: an acid that only ionizes slightly in an aqueous solution.

Acid dissociation constant (K_a): ratio of the concentration of the dissociated (or ionized) form of an acid to the concentration of the undissociated (non-ionized) form. The value represents the fraction of an acid in the ionized form. A weak acid has a small K_a value, while a strong acid has a larger one.

Examples: