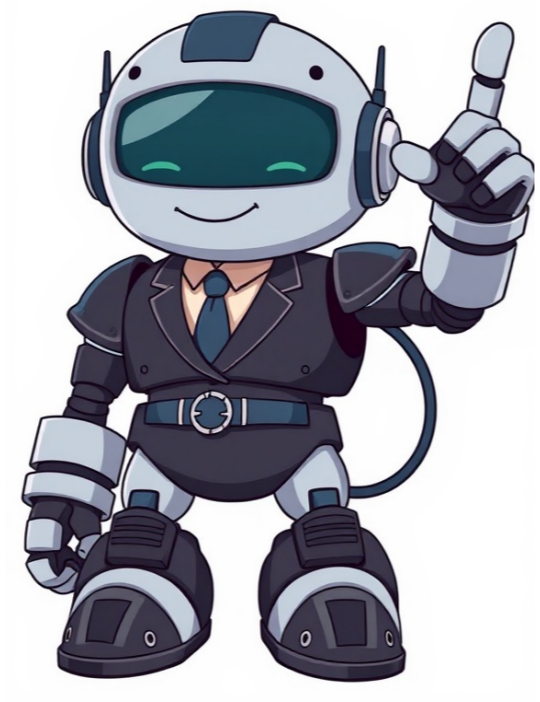


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Acids are intriguing substances that play a significant role in chemistry and our daily lives. They're present in various aspects of life, from the food we consume to the batteries powering our devices. In essence, acids are substances that have a sour taste and can turn blue litmus paper red, indicating their acidic nature. They're renowned for their ability to react with bases to form water and salts, a fundamental reaction in chemistry. Understanding acids is not just vital in chemistry; it also offers insights into the chemical reactions occurring around us every day. Acids are a group of substances with distinct properties that make them essential to numerous chemical reactions and processes. At their core, acids are compounds that release hydrogen ions (H<sup>+</sup>) when dissolved in water. This release of hydrogen ions confers acidic characteristics, such as the sour taste observed in lemon juice and vinegar. Furthermore, acids have the ability to alter indicators' colors, like turning blue litmus paper red, demonstrating their acidic nature. They play a pivotal role in both nature and industry, from aiding digestion in our bodies to manufacturing a wide array of products. These are the key players in the acid world. Acids play a pivotal role in various aspects of our lives, from medicine and agriculture to industry and education. Derived from salicylic acid, aspirin is one common medication used to alleviate pain and reduce inflammation. The agricultural sector benefits greatly from acids such as sulfuric and phosphoric acid, which are fundamental in manufacturing fertilizers. These acids provide essential nutrients to plants, enhancing growth and agricultural productivity. Acids like hydrochloric acid, vinegar, and nitric acid serve diverse purposes in households and industries. Hydrochloric acid is a potent cleaning agent found in many household products, while vinegar contains acetic acid, making it an eco-friendly cleaning solution for homes. Sulfuric acid serves as the electrolyte in lead-acid batteries, powering vehicles and electrical systems. In educational settings, acids are essential tools for demonstrating chemical reactions and principles, inspiring future scientists. Acetic Acid (CH<sub>3</sub>COOH) is widely recognized for its sour taste and has applications in food preservation, culinary arts, and organic chemistry. Citric Acid (C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>), found abundantly in citrus fruits, is a natural preservative that adds a refreshing tartness to beverages and candies. Carbonic Acid (H<sub>2</sub>CO<sub>3</sub>) plays a crucial role in regulating pH in blood and forming rainwater and soda water. Hydrofluoric Acid (HF) is used in glass etching, semiconductor manufacturing, and chemical synthesis. Despite its strength, HF is considered a weak acid due to its incomplete ionization. Phosphoric Acid (H<sub>3</sub>PO<sub>4</sub>) provides a tangy or sour taste in soft drinks, detergents, and fertilizers. Hydrochloric Acid (HCl) is found naturally in gastric acid and is used industrially for metal cleaning and processing, pH regulation, and as a household cleaning agent. Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>), known as the "king of chemicals," is crucial in manufacturing fertilizers, refining petroleum, and processing metals. Nitric Acid (HNO<sub>3</sub>) is vital in making fertilizers, explosives, and plastics, showcasing its significant industrial utility. The strength of an acid is measured by its ability to donate protons in an aqueous solution. Fluoroantimonic Acid (HSbF<sub>6</sub>), a super acid, has an acidity greater than that of 100% sulfuric acid due to its extreme reactivity. Its applications are specialized and handled with care, primarily within scientific research environments. Acid definition categorised into three main theories: Arrhenius, Brønsted-Lowry and Lewis definitions. Acid strength is not fully captured by pH measurements, as this parameter does not account for the extent of dissociation in an aqueous solution. Instead, the dissociation constant offers a more accurate assessment of an acid's potency. Strong acids, such as hydrochloric and nitric acid, exhibit complete dissociation in water, whereas weak acids, like sulphurous and phosphoric acid, only partially dissociate. The pH scale ranges from 0 to 14, with a value below 7 indicating the presence of an acid. However, this measurement has its limitations, as it does not provide information on the actual strength of an acid in solution. The dissociation constant (K<sub>a</sub>) provides a more comprehensive understanding of an acid's ability to release hydrogen ions. Acids are substances that release hydrogen ions when mixed with water, resulting in a pH lower than 7. They have a sour taste, such as the acid found in lemons, and turn litmus paper red. Acids can be found in various household items like lactic acid in milk, ascorbic acid in citrus fruits, and acetic acid in vinegar. The Arrhenius theory defines acids as neutral compounds that ionize when they dissolve in water to give H<sup>+</sup> ions and a corresponding negative ion. Compounds that contain hydrogen bound to a nonmetal are called nonmetal hydrides. Because they contain hydrogen in the +1 oxidation state, these compounds can act as a source of the H<sup>+</sup> ion in water. Metal hydrides, on the other hand, contain hydrogen bound to a metal. Because these compounds contain hydrogen in a -1 oxidation state, they dissociate in water to give the H<sup>-</sup> (or hydride) ion. The H<sup>-</sup> ion, with its pair of valence electrons, can abstract an H<sup>+</sup> ion from a water molecule. Since removing H<sup>+</sup> ions from water molecules is one way to increase the OH<sup>-</sup> ion concentration in a solution, metal hydrides are bases. A similar pattern can be found in the chemistry of the oxides formed by metals and nonmetals. Nonmetal oxides dissolve in water to form acids. CO<sub>2</sub> dissolves in water to give carbonic acid, SO<sub>3</sub> gives sulfuric acid, and P<sub>4</sub>O<sub>10</sub> reacts with water to give phosphoric acid. Metal oxides, on the other hand, are bases. Metal oxides formally contain the O<sup>2-</sup> ion, which reacts with water to give a pair of OH<sup>-</sup> ions. Metal oxides therefore fit the operational definition of a base. We see the same pattern in the chemistry of compounds that contain the OH, or hydroxide, group. Metal hydroxides, such as LiOH, NaOH, KOH, and Ca(OH)<sub>2</sub>, are bases. Nonmetal hydroxides, such as hypochlorous acid (HOCl), are acids. The table below summarizes the trends observed in these three categories of compounds. Metal hydrides, metal oxides, and metal hydroxides are bases. Nonmetal hydrides, nonmetal oxides, and nonmetal hydroxides are acids. Acids are oxyacids that contain hydrogen attached to oxygen atoms. Skeleton structures for eight oxyacids are presented in a figure, which shows that all these compounds have acidic hydrogens bonded to oxygen. The rule of thumb is that acids with oxygen have skeleton structures where the hydrogens are attached to oxygen atoms. Metal hydroxides act as bases and nonmetal hydroxides act as acids because of differences in electronegativity between metal and nonmetal atoms. In a typical metal hydroxide like sodium hydroxide, the difference in electronegativity between sodium and oxygen is very large, causing the bond to be polar. This results in NaOH dissociating into Na<sup>+</sup> and OH<sup>-</sup> ions when dissolved in water. On the other hand, for a nonmetal hydroxide such as hypochlorous acid, the difference in electronegativity between chlorine and oxygen is small, making the bond more polar. This leads to HOCl dissociating into OCl<sup>-</sup> and H<sup>+</sup> ions when dissolved in water. This thinking suggests that compounds which lie between metal and nonmetal oxides or hydroxides are called amphoteric because they can behave as both acids and bases. Alumina trihydroxide, for example, acts as an acid when reacted with a base while acting as a base when reacted with an acid. The Brønsted model of acids is based on the assumption that acids donate H<sup>+</sup> ions to another ion or molecule which acts as a base. This model proposes that reactions between acids and bases involve the transfer of H<sup>+</sup> ions from a proton donor to a proton acceptor. The Arrhenius theory assumes that H<sup>+</sup> ions exist in aqueous solutions, whereas the Brønsted model makes more sense because H<sup>+</sup> ions are transferred from one ion or molecule to another. According to the Brønsted model, an acid is any substance that can donate an H<sup>+</sup> ion to a base while a base is any substance that can accept an H<sup>+</sup> ion from an acid. Both acids and bases can also be neutral molecules, positive ions, or negative ions. Brønsted acids include compounds with hydrogen in an oxidation state of +1 such as HCl, H<sub>2</sub>S, H<sub>2</sub>CO<sub>3</sub>, and HMnO<sub>4</sub> while Brønsted bases are identified from their Lewis structures by accepting a proton. The formation of covalent bonds with H<sup>+</sup> ions requires the base to provide both electrons needed for the bond. Compounds with nonbonding pairs of valence electrons can act as Brønsted bases, expanding the list of potential bases to include any ion or molecule containing nonbonding valence electrons. The Brønsted model includes a wide range of substances, while some do not fit due to lack of nonbonding valence electrons. Acid-base reactions involve the transfer of H<sup>+</sup> ions from acids to bases, with water acting as an intermediate. Acidic compounds donate H<sup>+</sup> ions or accept electron pairs, leading to neutralization reactions that form salts. Acids have a pH less than 7 and taste sour. The Brønsted theory explains water's role in acid-base reactions, highlighting its ability to dissociate into H<sub>3</sub>O<sup>+</sup> and OH<sup>-</sup> ions. The model can be applied to other solvents, such as liquid ammonia, where acids are defined by their ability to produce the NH<sub>4</sub><sup>+</sup> ion and bases by their ability to produce the NH<sub>2</sub><sup>-</sup> ion. There are different types of acids, including Arrhenius, Brønsted-Lowry, and Lewis acids. Each definition provides insight into the characteristics of acids, with the Brønsted-Lowry acid being the most commonly referred to term in chemistry. Amphoteric compounds can act as both acids and bases depending on the situation. Most acids will completely dissociate into their ions when mixed with water or another solvent, such as Brønsted-Lowry acids like hydrochloric acid (HCl) and nitric acid (HNO<sub>3</sub>). There are only a handful of common strong acids. On the other hand, weak acids only partially break down into their ions in solution, leaving some of the original acid molecules intact. Examples of weak acids include acetic acid (CH<sub>3</sub>COOH), nitrous acid (HNO<sub>2</sub>), and formic acid (HCOOH). There are numerous types of weak acids. Strong Acids ----- \* Hydrochloric acid: HCl \* Nitric acid: HNO<sub>3</sub> \* Sulfuric acid: H<sub>2</sub>SO<sub>4</sub> \* Hydrobromic acid: HBr \* Hydroiodic acid: HI \* Perchloric acid: HClO<sub>4</sub> \* Chloric acid: HClO<sub>3</sub> Some acids, known as monoprotic or monobasic acids, can donate only one proton per molecule. A prime example is hydrochloric acid (HCl). The chemical equation for this process is: HA (aq) + H<sub>2</sub>O (l) ⇌ H<sub>3</sub>O<sup>+</sup> (aq) + A<sup>-</sup> (aq) Other acids are polyprotic or polybasic and can release more than one proton per molecule. These include diprotic (dibasic) and triprotic (tribasic) acids. For instance, sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) is a diprotic acid that has two protons it can donate. A superacid is any acid stronger than sulfuric acid. The strongest known acid is fluoroantimonic acid (HSbF<sub>6</sub>), which donates protons about a billion times more effectively than sulfuric acid. Acids have several distinct characteristics, including: \* Most taste sour \* Most are corrosive \* They have pH values less than 7 \* Acids turn litmus paper red \* In water, Arrhenius acids act as electrolytes and conduct electricity in solution \* Arrhenius acids react with bases to form salt and water \* Arrhenius acids react with most metals to release hydrogen gas

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