Chemistry project: acids and bases and the ph scale essay sample

Science, Chemistry

Acids and Bases are two groups of chemical compounds that generally have opposite characteristics. They have there own unique traits, acids taste sour, turn litmus red while bases taste bitter and turn litmus blue. The term pH relates to measuring the acidity or alkalinity of a solution, such as vinegar, or even a damp substance like soul. The neutral pH is 7, which is essentially water, with lower numbers indicating acidity and higher numbers indicating alkalinity. Hydronium ions (H_3O^+) are formed when water molecules (H_2O) bond with hydrogen ions (H^+). Hydronium ions are positively charged because of their extra hydrogen ion. Hydroxide ions (OH^-) are produced when water molecules (H_2O) ionize to become hydronium ions (H_3O^+) and hydroxide ions (OH^-). Substances with a high concentration of hydroxide ions are bases. Bases have a pH rating of seven or higher. Solutions of ions conduct an electric current, similar in the way that wire does. Ions can move about in a solution and carry a charge. If they can do carry the charge they are electrolytes.

The Bronsted-Lowry theory states that an acid is a proton donor and a base a proton acceptor. Although the acid must still contain hydrogen, the Bronsted-Lowry theory does not require an aqueous medium. The Bronsted-Lowry definition of acids and bases also explains why a strong acid displaces a weak acid from its compounds and likewise for strong and weak bases. In the Lewis theory of acid-base reactions, bases donate pairs of electrons and acids accept pairs of electrons. A Lewis acid is any substance, such as the H^+ ion, that can accept a pair of nonbonding electrons. Therefore, a Lewis acid is an electron-pair acceptor. A Lewis base is any substance, such as the OH^- ion, that can donate a pair of nonbonding electrons. A Lewis base is therefore an electron-pair donor. Svante Arrhenius was a Swedish chemist who helped lay the foundation of modern day chemistry. When he was a student, he studied the conductive properties of electrolytic solutions. In his doctoral thesis he made the theory of electrolytic dissociation.

This theory implies that in electrolytic solutions, the dissolved chemical compounds in the solution are dissociated into ions, even when there is no current flowing through the solution. Initially, his theory was thought to be wrong, and his thesis was given the lowest possible passing grade. However, later on Arrhenius' theory of electrolytic dissociation became generally accepted, and eventually became one of the principles of modern chemistry. The pH scale measures the concentration of H+ and OH-. The pH scale was developed because the concentration of the solution can vary by many factors over time, and a pH scale was the easiest way to express the variation of the solution. The pH scale ranges from 0 to 14. The 0 end of the scale is where the concentration is acidic. After 7 the concentration starts to become more basic as it increases. Most biological fluids are between pH 6 and pH 8, and there are a few exceptions to this like stomach acid. Each pH unit represents a tenfold difference of the H+ and OH- concentration.

This makes the pH scale so compact. A solution of pH 2 is not twice as acidic as a solution of pH 4, but a thousand times more acidic. So when the pH of a solution changes slightly, it actually changes the concentrations of H+ and OH- in a large way. Antacids are drugs that diminish abnormal acidity in the digestive tract or in the other organs. Those that unite directly with free acid in the stomach are known as direct antacids. " Remote" antacids, such as the acetates, citrates, and tartrates of the alkalies, act by being changed into carbonates, thus increasing the alkalinity of the blood. Essentially you are lowering the acidity in your body by adding a base. The strength of acids and bases depends on their ability to donate or accept hydrogen ions. Strong acids lose hydrogen ions easily, while strong bases accept hydrogen ions easily. The strength of an acid can be measured by how a acid transfers a proton to water to produce the hydronium ion, H3O+. A convenient acid-base scale is calculated from the amount of H3O+ that is formed in water solutions of acids.

The value for pH is equal to the negative logarithm of the hydronium ion concentration in an aqueous solution: pH = -log [H3O+] Pure water has a pH of 7. 0. When an acid is added, the hydronium ion concentration [H3O+] becomes larger than that in pure water, and the pH becomes less than 7, depending on the strength of the acid. A buffer is a solution containing substances that inhibit the solution’s change in pH, or hydrogen-ion concentration. Such substances consist either of the pairing of a weak acid and a related salt of the acid, or of the similar pairing of a weak base and a salt of the base. Fluids in living organisms are strongly buffered. In nature, sea water and soil substances are buffered. They serve as references in the measurement of pH. Our body pH is very important because pH controls the speed of our body’s biochemical reactions. pH is behind the body’s energy system and intracellular activity as well as the way our bodies utilize enzymes, minerals, and vitamins. It is important for the bloods pH to remain between 6. 8 and 7. 8 or else it is fatal.

The kidney adjusts the body's acid-base balance to prevent such blood disorders as acidosis and alkalosis, which impair the functioning of the central nervous system. If the blood is too acidic the kidney moves these ions to the urine through the process of tubular secretion. In the stomach, cells produce hydrochloric acid, a strong acid that helps to break down food. The acid is so concentrated that if it were placed on a piece of wood, it would go straight through it. The stomach is protected by the epithelial cells, which produce and secrete a bicarbonate-rich solution that coats the stomach lining. Bicarbonate is alkaline, a base, and neutralizes the acid secreted by the parietal cells, producing water in the process. This continuous supply of bicarbonate is the main way that the stomach protects itself from the stomach digesting itself and the overall acidic environment. Monoprotic acids have a single H+ ion, or proton, they can donate when acting as Bronsted acids. Hydrochloric acid (HCl), acetic acid (CH3CO2H), nitric acid (HNO3), and benzoic acid (C6H5CO2H) are all monoprotic acids.

Several important acids can be classified as polyprotic acids, which can lose more than one H+ ion when they act as Bronsted acids. Diprotic acids, such as sulfuric acid (H2SO4), carbonic acid (H2CO3), hydrogen sulfide (H2S), chromic acid (H2CrO4), and oxalic acid (H2C2O4) have two acidic hydrogen atoms. Triprotic acids, such as phosphoric acid (H3PO4) and citric acid (C6H8O7), have three. Experimentation: Creating a pH indicator Objective: Create a cabbage-juice pH indicator to test whether a substance is an acid or a base. Materials: * 1 red cabbage * Knife and cutting board * Large saucepan * Small beakers * Large beakers * Distilled water * Substances to test * Coffee Filter Procedure: 1. Chop red cabbage up finely. In the saucepan, boil a pint of water. 2. Add red cabbage to the boiling water and remove saucepan from heat. Let it sit and cool. 3. Strain the liquid through the coffee filter into a beaker and throw away the used cabbage. 4. Soak a new clean coffee filter in the cabbage juice and let it dry. 5.

Cut up dry filter paper into test strips for testing substances. 6. Test multiple household substances and record observations and results. Results: The pH of a solution measures the hydrogen ion concentration in that solution. A small change in pH represents a large change in hydrogen ion concentration. Acids have pH values under 7, and alkalis have pH values over 7. If a substance has a pH value of 7, it is neutral, neither acidic or alkaline. Substance Color Approx. pH Acid or Base Vinegar Light Red 3 Acid Milk Light purple 6 Acid Ammonia Dark Blue 14 Base Orange juice Light orange 4 Acid Baking Soda Blue 9 Base Soapy water Lime/Green 12 Base Toothpaste Green 10 Base Wine Light orange 4 Acid Tap water Purple 7 Neutral Coca Cola Light red 3 Acid Hydrogen Peroxide Light red 3 Acid Vinegar was tested first because it is commonly known to be acidic and therefore the pH would be low. The color could be used in comparison with the color of other test substances and would reflect their acidity or alkalinity.

After inserting a test strip into a small beaker of vinegar, the strip turned red. Ammonia would represent the other end of the pH scale and would be a good reference for the color of alkaline substances. The strip placed in Ammonia turned a dark green/blue, which indicates that it is a strong base. The other substances were tested mostly in the same manner and the pH and color varied through them. Tap water is the only neutral solution, with a pH of 7.

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