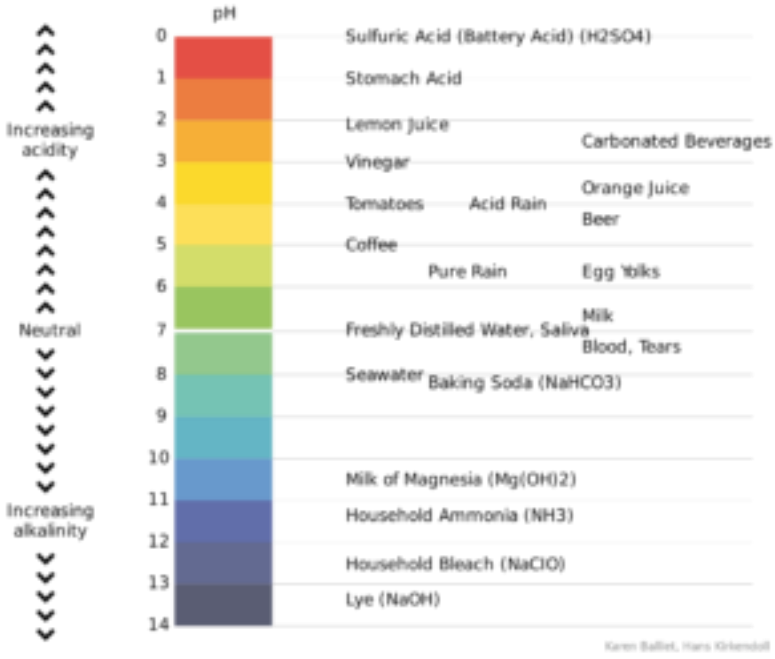
Class 10
Subject: Science

Acids and Bases

You probably think of acid as a dangerous substance. But did you know that you consume acid every day? Most of the food that you eat is acidic in nature. For example, lemon is acidic in nature. However, there are a few food items that are basic in nature. How do you determine if a substance is acidic or basic? How do you use litmus paper? What is it?. Let's find out more about acids and bases.

Introduction to Acids



The word “acid” is derived from the Latin word “acidus” which means tart or sour. Acids are molecules or other species that can donate a proton or accept an electron pair in reactions. All acids change the color of blue litmus paper to red. Acids lose their acidity when combined with alkalis. Generally, the pH value of acids ranges from zero to six.

Some common examples of acids are citrus fruits such as lemon and oranges which contain citric acid. Lemon also has ascorbic acid. Tamarind contains tartaric acid. Vinegar has Acetic acid. Apple consists of Malic acid. Lactic acid is found in milk and other dairy products. Insects like bees, ants, etc have formic acid in their stings. Mustard Oil has stearic acid.

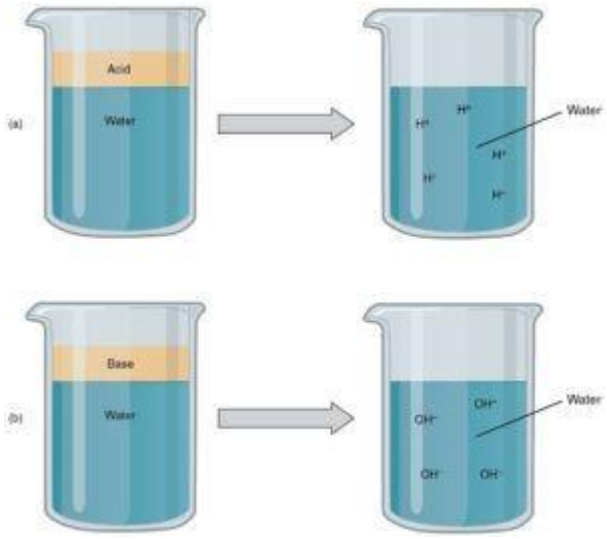
Properties of Acids

The following are the properties of acids :

- Acids turn the color of blue litmus paper to red.
- All acids taste sour or tart.
- Their pH range is from 0 to 6.

- Acids lose their acidity when combines with bases.
- They change the color of Methyl to Orange/Yellow to Pink.
- Acidic substances convert Phenolphthalein from deep pink to colorless.
- Acids reduce the basicity of bases.
- Most acids are corrosive, they tend to corrode or rust metals.
- They produce positive hydrogen ions (H+) when mixed with water.
- Acids react with metals and form hydrogen gas.
- Acids produce carbon dioxide when reacted with carbonates.

Introduction to Bases



Bases are substances that substances that are slippery to touch when in aqueous form. Usually, bases taste bitter. They also change the color of red litmus paper to blue. Bases also dissociate in the water like acids, but instead of producing H+ they produce OH- i.e. hydroxyl ion. Alkali is a base which can be dissolved in water. For example, Ammonium Hydroxide, Calcium Hydroxide, etc. Alkalis become less alkaline when mixed with an acid. The pH range of bases is from eight to fourteen.

Some examples are caustic soda or sodium hydroxide, calcium hydroxide or limewater, borax. A lot of bleaches, soaps, detergents, kinds of toothpaste, etc are bases.

Properties of Bases

The following are the properties of bases :

- Bases are slippery to touch when in aqueous form.
- Generally, bases have a bitter taste.
- Bases produce hydroxyl ions (OH-) when mixed with water.
- The pH range of bases is from 8 – 14.
- Bases turn the color of red litmus paper to blue.
- Bases lose their basicity when mixed with water.
- Acids and Bases react to form salt and water. This process is known as neutralization.

Question For You

Q. What happens when you mix acids and bases?

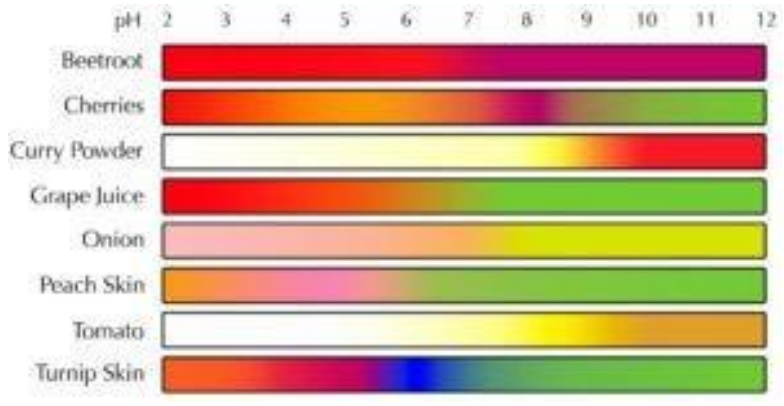
a. Neutralization
b. Endothermic reaction
c. Exothermic reaction
d. Evaporation

Sol: The correct option is ‘a’. When acids and bases are mixed, salt and water are formed. This process is known as neutralization. Learn the concept of Neutralization here in detail.

Natural Indicators Around Us

We know about Acids and Bases . But how do we determine whether a substance is acidic or basic? We have Natural Indicators around us. You probably have a natural indicator in your home right now. Let us find out more about the natural indicators around us.

What are Natural Indicators?

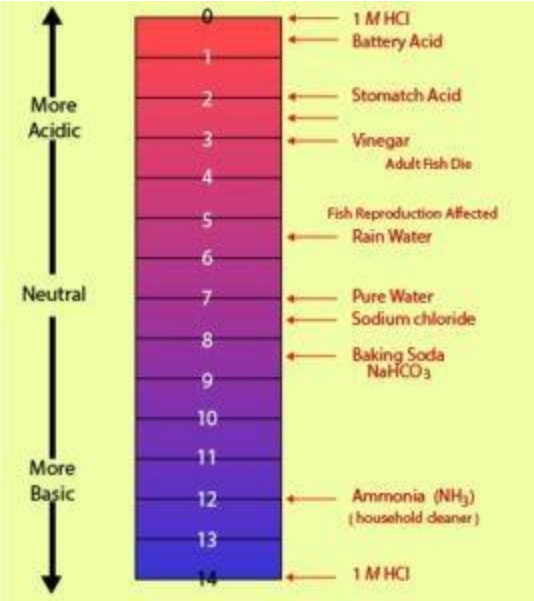


Natural Indicator is a type of indicator that can be found naturally and can determine whether the substance is an acidic substance or a basic substance. Some examples of natural indicators are red cabbage, turmeric, grape juice, turnip skin, curry powder, cherries, beetroots, onion, tomato, etc.

Some flowers like hydrangeas can determine the acidity or basicity of the soil. These flowers become blue if the soil is acidic, purple if the soil is neutral and pink if the soil is basic. The intensity of the color depends on the amount of acid or base present in the soil. Soil which is highly acidic bears deep blue flowers, whereas soil which is highly basic yields deep pink flowers.

These natural indicators are used to detect the hydrogen ions (H+) and hydroxyl ions (OH-) in a solution. Olfactory indicators can change their odor. Some examples of olfactory indicators are onion, vanilla extract, clove oil, etc.

Importance of Indicators



It is important to determine the nature of a substance because it is essential in biology, chemistry, civil engineering, water purification, agriculture, forestry, food science, environmental science, water treatment, oceanography, medicine, nutrition, agronomy, etc.

Even litmus is extracted from lichens. It is a water-soluble mixture of different dyes. It is then absorbed onto filter paper to produce one of the oldest forms of pH indicator, used to test materials for acidity or basicity.

Experiment

Aim: Create a natural indicator using red cabbage.

Objective: To find out whether red cabbage is a natural indicator.
Experiment:

1. Chop some red cabbage and put it in a mixer or a blender.
2. Add water to it and mix it until a juice is prepared.
3. Strain this mixture into a glass.
4. Take different substances like lemon, milk, vinegar, ammonia, bleach etc and mix it with the red cabbage solution.
5. The color of the substance will change according to their acidity of basicity.

Observation: Acidic substances change the color of the solution from purple to red or pink. Neutral substances turn the purple solution to blue. Basic substances change the color of the purple solution to green or yellow.

Conclusion: Therefore, we can say that red cabbage is a natural indicator.

Question For You

Q1. What is the pH value of seawater? Is it acidic, basic or neutral in nature?

a. less than two, it is highly acidic
b. more than ten, it is highly basic
c. between 7 – 8.5, it is neutral or slightly basic

d. between 5.5. – 7, it is neutral or slightly acidic

Ans. The correct answer is option ‘b’. The value of seawater is between 7 to 8.4. Ideally, the sea water is neutral or slightly basic.

Q2. What is the pH level of the human body? Is it acidic, basic or neutral?

a. Less than 7, acidic
b. 7, Neutral
c. More than 7, basic
d. None of the above

Ans: The pH value of a normal body is ideally 7.4 which is on the alkaline side of neutral and human blood is usually between 7.35 to 7.45 and of human saliva is 7.5.

Neutralization

Neutralization is a chemical reaction in which acid and base react to form salt and water. Hydrogen (H+) ions and hydroxide (OH- ions) reacts with each other to form water. The strong acid and strong base neutralization have the pH value of 7. Let’s find out more about Neutralization.

What is Neutralization?

Neutralization is a process when acids and bases react to form salt and water. In a reaction to water, neutralization results in excess of hydrogen or hydroxide ions present in the solution. The pH of the neutralized solution depends on the strength of acid or base involved in it. If a strong acid is mixed with a strong base then the salt formed is neutral. If a strong acid is mixed with a weak base then the acid formed is acidic. Similarly, if a weak acid is mixed with a strong acid then the salt formed is basic Neutralization is used in many applications.

For example, Acid + Base —-> Salt + Water i. e. NaOH (Sodium Hydroxide, a base) + HCl (Hydrochloric acid, an acid) ——> NaCl (Salt) + H2O (Water)

Uses Of Neutralization

Some uses of Neutralization are as follows:

To treat wasp stings

Wasp Sting's venom is basic in nature, applying vinegar to the sting neutralizes the sting as vinegar is acidic in nature.

To treat acidity or gastric patients

Acidity or gastric problems arise due to an increase of acid in the stomach, Anti-acids or antacids are medicines containing bases such as NaCHO3 (sodium bicarbonate) Mg(OH)2 (magnesium hydroxide) neutralize excess of acid in the stomach.

To treat acidic or basic soils

Plants don't grow well if the soil is too acidic or too basic. To neutralize acidic soils, bases like ash of burnt wood, CaO, CaCO3, etc are added. Similarly, basic soils are neutralized.

To treat tooth decay or cavities

Most food particles are acidic in nature. For example, lemonade, chocolate, etc. Such foods produce acid in our mouth which reacts with enamel i.e. calcium phosphate and leads to cavities. Using toothpaste while brushing helps to neutralize the acid since toothpaste is a base.

To treat bee stings

Bee stings contain formic acid and are acidic in nature, these stings can be neutralized by applying a base like baking soda.

To prevent coagulation of latex

In the rubber industry, ammonia solution, NH_4OH, is used to prevent the coagulation of latex because ammonia solution, NH_4OH, can neutralize the acid (lactic acid) produced by bacteria in the latex.

Questions For You

Q1. Are bee stings and wasp stings the same? Justify your answer.

a. Yes, bee stings and wasp stings are the same.
b. No, bee stings and wasp stings are not the same.

Sol. The correct answer is option “b”. No, bee stings and wasp stings are not the same. Bee stings contain formic acid is and it is neutralized by adding a basic substance like baking soda. Whereas, a wasp sting venom is basic in nature, and can be neutralized by adding an acidic substance like vinegar.

Q2. What is formed in the process of neutralization?

a. Salt and water.
b. Sugar and water.
c. Oil and soap.
d. Salt and oil.

Sol. The correct answer is option “a”. Neutralization creates salt and water.