ACID BASE & SALTS

CONTENTS

INTRODUCTION

◈ The earliest classification of inorganic compounds including the large number of organic compounds was based on their taste. On this basis of these compounds were classified into acid, bases and salt. We use many such compounds in our daily lives, which are acids, bases and salt. We use curd, pickle, amla, soap and detergents, tamarind, toothpaste etc. We must learn to classify them based on scientific tests.

◈ **Test to distinguish between acids and bases**

There are many substances, which show one colour or odour in the acidic medium and a different colour or odour in the basic medium. Such substances are called acid **base indicators.**

A. Indicators showing different colours in acidic and basic medium

a. Litmus solution as indicator is a purple coloured dye extracted from the lichen plant. It is the most commonly used indicator in the science laboratory. In the neutral solution, it has purple colour. In the acidic solution, it turns red whereas in the basic solution it turns blue. There are two types of litmus solution Blue and Red litmus solution. Red litmus solution is obtained by acidifying the purple litmus extract whereas blue litmus solution is obtained by making the purple litmus extract alkaline.

To test whether the given sample is acidic or basic, take few drops of distilled water in a test tube and two drops of blue litmus solution. Add few drops of sample substance that is to be tested. If the blue litmus solution changes into red colour, the substance is acidic. For instance, lemon juice, vinegar, orange juice, juice of unripe mangoes, tamarind all turn blue litmus solution to red. Thus, they are all acidic substances.

We may repeat the above experiment with red litmus solution. Those substances, which turn red litmus solution into blue colour, are bases. For instance, cucumber, washing soda solution, baking soda solution, bitter gourd etc. turn red litmus solution into blue. Thus, they are bases.

b. Synthetic indicators such as Phenolphthalein and Methyl orange

◈ **Methyl orange** is the compounds prepared industrially or in the laboratory. There are many such man-made substances, which can act as synthetic indicators.

◈ **Phenolphthalein** is colourless in neutral solution and in acidic solution but turns pink in basic solution.

◈ **Methyl orange** is of orange colour in neutral solution, red in acidic solution and yellow in basic solution. Ask your teacher to help you classify various substance using these indicators.

B. Indicators giving different odours in acidic and basic medium. (Olfactory indicators)

◈ **Clove oil.**

Take two test tubes. Mark them test tube 'A' and test tube 'B'. Add some hydrochloric acid in test tube 'A'

and some Sodium Hydroxide in test tube 'B'. Record the odour, of clove oil. Now add few drops of clove oil in each test tube and shake it gently. Smell the sample in test tube 'A' and 'B'. Record the odour of each test tube. You will notice that the odour of acid and base after addition of clove oil is different. Ask your teacher to help you demonstrate the experiment in the laboratory.

◈ **Vanilla essence.**

Repeat the experiment (a). Take another two test tubes and mark them 'A' and 'B'. Add some acid 'A' and sodium hydroxide in 'B'. Add some vanilla essence in each test tube (A) and (B). Vanilla retains its smell in acidic medium but looses its smell in basic medium.

C. Natural Indicators

Turmeric (Haldi), red cabbage, China rose peals are the natural indicators.

◈ **Turmeric** is yellow in colour. Turmeric leaves a yellow stain on clothes. When such stain is washed with detergents, the stain becomes brownish red. Detergents have the base called sodium hydroxide. This shows that the turmeric changes a base into brownish red colour. When the clothe is washed with lemon, it regains its yellow colour. This shows that brownish red colour of turmeric changes to yellow by acids.

◈ **China rose petals** act as a natural indicator. China rose indicator turns magenta (dark pink) in acidic solutions. It turns green in basic solutions and does not show any colour change in neural solution

Indicator	Colour in the natural solution	Acids	Bases
Methyl orange	Orange	Red	Yellow
Phenolphthalein	Colourless	Colourless	Pink
Litmus	Purple	Red	Blue
Red Cabbage leaf	Red	Red	Green
Hydrangea Flower	Blue	Blue	Pink
Turmeric (Haldi)	Yellow	Yellow	Brownish red
China rose	No change in colour	Magenta	Green (Dark Pink)

➢ ACID

An **acid** (from the Latin acidus meaning sour) is traditionally considered any chemical compound that, when dissolved in water, gives a solution with a hydrogen ion activity greater than in pure water. Chemicals or substances having the property of an acid are said to be **acidic.** Acids are sour in taste. Acids are of organic and inorganic nature. Acids found in plants and animals are organic in nature. Organic acids are weak whether inorganic acids are strong.

◈ **Organic Acids**

Sl. No.	Source	Organic Acid
1.	Vinegar	Acetic Acid
2.	Apples	Malic Acid
3.	Tomatoes	Oxalic Acid
4.	Curd	Lactic Acid
5.	Proteins	Amino Acids
6.	Tamarind	Tartaric Acid
7.	Orange and lemon	Citric Acid
8.	Tea	Tannic Acid
9.	Ant and bee sting	Formic Acid
10.	Spinach	Oxalic Acid

11.	Sour Milk	Lactic Acid
12.	Sweat or urine	Uric Acid
13.	Vitamin C	Ascorbic Acid
14.	Grapes	Tartaric Acid

- **INORGANIC ACIDS** are called **mineral acids.** They are prepared by dissolving mineral oxides in water. Sulphur dioxide dissolves in water to form sulphurous or sulphuric acid. Carbon dioxide dissolves in water to form carbonic acid. Hydrogen chloride dissolves in water to form hydrochloric acid etc.

a. Hydrochloric Acid

b. Nitric Acid

c. Phosphoric Acid

d. Sulphuric Acid.

PROPERTIES

- Acids are generally sour in taste. (For example, the sour taste of lemon juice is due to citric acid.)
- Strong or concentrated acids or their fumes often produce a stinging feeling on mucous membranes.
- Change the colour of pH indicators as follows: turn blue litmus and methyl orange red, turn phenolphthalein colourless.
- React with metals to produce a metal salt and hydrogen.
- React with metal carbonates to produce water, CO_2 and a salt.
- React with metal hydroxides and metal oxides to produce water and a salt.
- Conduct electricity, depending on the degree of dissociation in aqueous solution. Car batteries use acids in them.
- Acids can be gases, liquids, or solids. Respective examples (at 20ºC and one atm) are hydrogen chloride, sulphuric acid and citric acid. Solutions of acids in water are liquids, such as hydrochloric acid-an aqueous solution of hydrogen chloride. At 20ºC and one atm, linear carboxylic acids are liquids and solids beginning from decanoic acid (ten carbon atoms). Perfumed carboxylic acids, the simplest being benzoic acid, are solids.
- Strong acids and some concentrated weak acids are corrosive and can cause severe burns even after short contact.

BASES

Strong bases, like strong acids, attack living tissue and cause serious burns. They react differently to skin than acids do, so while strong acids are corrosive, we say that strong bases are caustic (corrosive). Bases may also be weak bases such as ammonia, which is used for cleaning. **Arrhenius** bases are water-soluble. An alkali is a special example of a base, where in an aqueous environment; hydroxide ions (also viewed as OH^-) are donated. Bases, which dissolve in water, are called **alkalis.** Bases are alkalis but not all alkalis are bases.

The notion of a base as a concept in chemistry was first introduced by the French chemist Guillaume Francois Rouelle in 1754. He noted that acids, which in those days were mostly volatile liquids (like acetic acid), turned into solid salts only when combined with specific substances. These substances form a concrete **base** for the salt and hence the name.

PROPERTIES

Some general properties of bases include:

- Slippery or soapy feel on fingers, due to specification of the lipids in human skin
- Concentrated or strong bases are caustic (corrosive) on organic matter and react violently with acidic substances
- Aqueous solutions (bases dissolved in water) or molten bases dissociate in ions and conduct electricity
- Reactions with indicators: bases turn litmus paper blue and phenolphthalein pink

In chemistry, a **base** is most commonly thought of as an aqueous substance that can accept hydrogen ions. A base is also often referred to as an **alkali** if OH^- ions (hydroxide ions) are involved. Examples of simple bases are sodium hydroxide and ammonia. Although ammonia does not directly contain an OH^- group in its, formula, it produces one in water i.e. Ammonium hydroxide. All compound containing hydroxide are bases. For example, Sodium hydroxide (NaOH), Potassium hydroxide (KOH), Magnesium hydroxide [$Mg(OH)_2$], Calcium hydroxide [$Ca(OH)_2$] etc.

Bases can be thought of as the chemical opposite of acids. A reaction between an acid and base is called **neutralization.** Bases and acids are seen as opposites because the effect on an acid is to increase the hydronium ion (H_3O^+) concentration in water, whereas bases reduce this concentration. Bases react with acids to produce water and salts (or their solutions). Acids react with bases to form salt and water.

- Hydrochloric acid reacts with sodium hydroxide to form common salt called sodium chloride and water. This reaction supports neutralization
- Farmers use slaked lime [calcium hydroxide, $Ca(OH_2)$] or quick lime [calcium oxide, CaO] to neutralise the acidic effects of soil in their farms.
- In case the soil is basic, organic matter is used to release or neutralise the bases.
- Bacterias are continuously produced in our mouth, which causes tooth decay by making acids. Basic nature of toothpaste and toothpowder prevents tooth decay by neutralizing the acidic effects.
- A small amount of hydrochloric acid available in our stomach helps digesting food and kills the germs. Its excess production in stomach causes indigestion. To neutralize the effects of acid magnesium hydroxide (milk of magnesia) tablets are used.
- Baking Soda [Sodium bicarbonate, $NaHCO_3$] is used to treat bee sting or ant sting. Their sting release formic acid on the skin is neutralized by bases.

SALT

A **salt,** in chemistry, is defined as the product formed from the neutralization reaction of acids and bases.

There are several varieties of salts. Salts that produce hydroxide ions when dissolved in water are **basic salts** and salts that produce hydronium ions in water are **acid salts. Neutral salts** are those that are neither acid nor basic salts.

When salts are dissolved in water, they are called **electrolytes,** and are able to conduct electricity, a property that is shared with molten salts. Sodium Chloride (NaCl), Magnesium Chloride ($MgCl_2$), Calcium Carbonate ($CaCO_3$), Calcium Sulphate ($CaSO_4$) etc. are some examples of salt. Not all salt are edible. Salts can be poisonous to the body as well. Not all salts are salty. Salt that we add to our food is Sodium Chloride (NaCl).