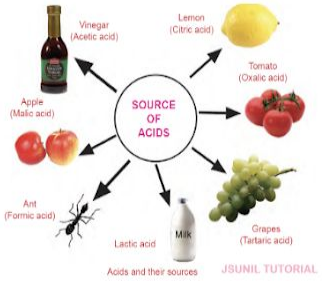
Acid



Inorganic compounds can broadly be classified into three main classes namely acids, bases and salt. This classification is based primarily on the fact that each class has own characteristics properties.

An acid is a substance which dissociates in water to give positively charged hydrogen (H^+). H^+ is called hydrogen ion. Acids have the sour taste and turn blue litmus paper into red, react with carbonates to give carbon dioxide and with metallic oxides to give salts and water.

The dissociation of Hydrochloric acid is given as:

$HCl \rightarrow H^+ + Cl^-$

The dissociation of acetic acid in aqueous solution is represented as:

$CH_3COOH \rightarrow H^+ + CH_3COO^-$

Some strong acids are commonly used in the laboratory. They are:

S.N.	Name	Formula
1.	Hydrochloric acid	HCl
2.	Sulfuric acid	H_2SO_4
3.	Nitric acid	HNO3

Acids in nature

Generally acid denotes a substance which tastes sour but in chemistry, its meaning is not limited up to this concept only. Most substances that contain acid taste sour due to the presence of H^+ ion. Example of some acids that we can gain through fruits and vegetables are:

S.N	Acids	Sources
1.	Citric acid	Lemons, tomatoes
2.	Acetic acid	Vinegar
3.	Carbonic acid	Soda water
4.	Hydrochloric acid	Stomach
5.	Tartaric acid	Fruits
6.	Ascorbic acid	Citrus fruits
7.	Formic acid	Ants(produced by ant bite)

Characteristics of acid

Physical properties

1. They all contain hydrogen.
2. They possess sour taste.
3. Many acids are corrosive.
4. They turn blue litmus red.
5. They turn methyl orange into yellow color.

Chemical properties

1. Dilute acids react with some metals like zinc, magnesium etc. to form the salt and release hydrogen gas. The metals replace the hydrogen of acids to form a salt.

$Mg + 2HCl \rightarrow MgCl_2 + H_2$.

Hydrochloric acid Magnesium chloride

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

Zinc + Sulphuric acid → Zinc sulphate + Hydrogen

2. Dilute acids decompose bicarbonate and carbonates and liberate carbon dioxide.

$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$

Sodium bicarbonate + Hydrochloric acid → Salt + Water + Carbondioxide

3. They neutralize alkali-forming salt and water.

$NaOH + HCl \rightarrow NaCl + H_2O$

(Alkali) (Acid) (Salt) (Water)

4. They react with metallic oxides to give salt and water.

$Na_2O + 2HNO_3 \rightarrow 2NaNO_3 + H_2O$

Sodium Oxide + Nitric Acid → Sodium nitrate + Water

5. They dissolve in water to produce hydrogen ions (H^+).

Uses of acid

a. Tannic acid is used to tan leather.

b. Sulfuric acid is used in the manufacture of ammonium sulphate.

c. Sodium bicarbonate is used to make baking powder.

d. Hydrochloric acid, sulphuric acid, and nitric acid are used in the laboratory.

Differences between acids and bases:

S.N	Acids	Bases
1.	Turn blue litmus into the red.	Turn red litmus into blue.
2.	React with metals to give a salt and hydrogen gas.	Normally do not react with metals. Only some metals like zinc, aluminum and tin react to give hydrogen.
3.	Are corrosive to skin.	Are slippery to touch.
4.	Are sour in taste.	Are bitter in taste.
5.	React with bases to give salts and water.	React with acids to give salt and water.
6.	Aqueous solutions of acids contain replaceable hydrogen ions.	Aqueous solution of the base contains replicable hydroxyl ions.
7.	Give no color with phenolphthalein.	Give red color with phenolphthalein.

Base

A base is defined as any substance which releases hydroxyl ions (OH^-) when dissolved in water. Sodium hydroxide and ammonia are bases because they give hydroxyl ions in water.

$NaOH \rightarrow Na^+ + OH^-$

Sodium hydroxide

$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$

Ammonia (Ammonium ion)

Bases which are soluble in water are called alkalies. Some bases are not soluble in water. They are not alkalies. Thus, **all alkalies are bases but all bases are not alkalies**. Sodium oxide is called soda and potassium hydroxide is called caustic potash.

Some are given below:

S.N	Bases	Formula
1.	Sodium hydroxide	NaOH
2.	Potassium hydroxide	KOH
3.	Aluminum hydroxide	$Al(OH)_3$
4.	Ammonium hydroxide	NH_4OH
5.	Sodium oxide	Na_2O
6.	Potassium oxide	K_2O
7.	Magnesium oxide	MgO

Properties of bases

Physical properties:

1. They are soapy in touch.
2. They have a bitter test.
3. They turn red litmus paper into blue.
4. They turn turmeric paper brown.
5. They turn methyl orange yellow and phenolphthalein pink.

Chemical properties:

1. They produce hydroxyl ions (OH^-) in aqueous solution.
2. They neutralize acids to form salt and water.
   $KOH + HCl \rightarrow KCl + H_2O$
   Potassium hydroxide + Hydrochloric acid → Potassium chloride + Water
3. Bases react with carbon dioxide to form carbonate
   $K_2O + CO_2 \rightarrow K_2CO_3$
4. They react with metals of the type zinc and aluminum and produce hydrogen.
   $Zn + 2NaOH \rightarrow NaZnO_2 + H_2$
5. When a base is heated with an ammonium salt, ammonia gas is given off. It can recognized by its extremely pungent smell.
   $NaOH + NH_4Cl \rightarrow NaCl + H_2O + NH_3$
   Sodium hydroxide + Ammonium chloride → Sodium chloride + Water + Ammonia

Some bases which are commonly used in daily life are:

S.N	Bases	Uses
1.	Sodium hydroxide	In the manufacture of soap.
2.	Potassium hydroxide	Firewood ash-filtered wood ash is used for washing clothes in rural areas.
3.	Aluminum hydroxide	As medicine (antacid) for gastric patients.

Differences between acids and bases:

S.N	Acids	Bases
1.	Turn blue litmus into red.	Turn red litmus into blue.
2.	React with metals to give the salt and hydrogen gas.	Normally do not react with metals. Only some metals like zinc, aluminum and tin react to give hydrogen.
3.	Are corrosive to skin.	Are slipper to touch.
4.	Are sour in taste.	Are bitter in taste.
5.	React with bases to give salts and water.	React with acids to give salt and water.
6.	An aqueous solutions of acids contain replaceable hydrogen ions.	An aqueous solution of the base contains replicable hydroxyl ions.
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Salt

A salt is a compound formed by the partial or complete neutralization of an acid by a base. Some salt are salty while most of them taste bitter. Sodium chloride, Potassium chloride, calcium chloride, calcium sulphate, etc. are some examples of salts.

Properties of salts

1. Some salts are salty in taste, but most of the salts are bitter in taste.
2. Salts normally do not cause any change in the color of indicators like litmus paper, methyl orange, and phenolphthalein.
3. Some salts are white while some salts are colored.
4. Most of them are soluble in water.

Preparation of salts

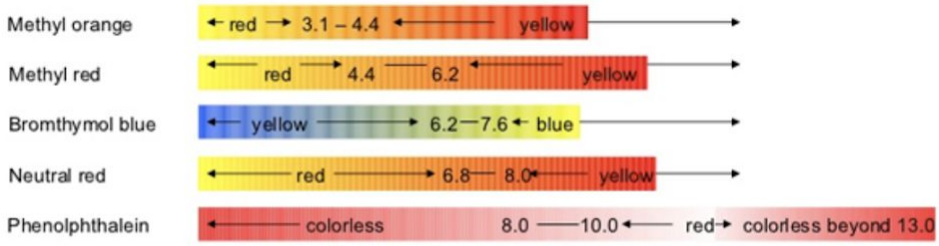
Salts can be prepared in many ways. Some methods of preparing salts are given below:

1. The reaction between an acid and a base: Common salt (NaCl) can be prepared by the reaction of sodium hydroxide with hydrochloric acid.
   $NaOH + HCl \rightarrow NaCl + H_2O$
2. The reaction between an acid and a metal: A metal displaces hydrogen from an acid to form a salt.
   $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
   $Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$
3. Reaction between a metal oxide or another salt with and acid
   $ZnO + H_2SO_4 \rightarrow ZnSO_4 + H_2O$
4. By a direct combination of metals and non-metals
   $2Na + Cl_2 \rightarrow 2NaCl$

Some salts and their uses are given below:

S.N	Salts	Uses
1.	Sodium chloride	As edible salts (table salt, rock salt)
2.	Copper sulphate	As insecticides
3.	Magnesium sulphate	Used in constipation
4.	Calcium sulphate	Plastering fractured bones, in the manufacture of chalk.

Indicator



An indicator is a substance which changes color in the presence of acids or alkalis. In the laboratory, we use three indicators. These are litmus, phenolphthalein, and methyl orange.

Indicator	Acid	Base
Red litmus	No change in color	Blue in color
Blue litmus	Red in color	No change in color
Phenolphthalein	Colorless	Rose color
Methyl orange	Red in color	Yellow in color

Turmeric powder mixed with water is a bright orange-yellow which turns a brick red in the presence of alkali. Indicator can be prepared by boiling, mashing and straining a finely chopped beetroot. Many red or blue colored flowers contain natural dyes which can be used as indicators.

pH Scale

The pH scale is a standard scale, which is used for measuring the approximate strength of an acid or an alkali solution.

The pH scale has ranged from 1 to 14. Acidic solutions have a pH value less than 7 while alkaline solutions have a pH value greater than 7. Distilled water has pH value 7 and is called neutral substance. Strong acids have pH value 1 or 2 while strong alkali's have pH value 13 or 14.

From the pH scale, we can say that higher the hydrogen ion concentration, lower is the pH value and vice versa.