ACIDS, BASES, AND SALTS

ACIDS

The word "acid" comes from the Latin word "acidus" which means sour.
According to Arrhenius theory an acid is a substance which ionizes and gives hydrogen ions when dissolved in water
Example: Hydrochloric acid in water releases H^+ ions.
$HCl + H_2O \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$

A hydrogen ion cannot exist on its own, so it combines with a water molecule to form a hydronium ion.
Example: Hydrochloric acid when dissolved in water liberates a hydrogen ion and a chloride ion. The hydrogen ion combines with water to form a hydronium ion.
$HCl + H_2O \rightarrow H_3O^+_{(aq)} + Cl^-_{(aq)}$

Classification of acids

Classification of acids based on source
Based on the source the acids were classified into two types. They are organic acids and in-organic acids.

Organic acids

Acids obtained from food like curd, lemons, grapes, raw mango, citrus fruits and gooseberry are called organic acids.

In-organic acids

Acids which are synthesised in the laboratory are called as in-organic acids or mineral acids
Following table is the list of some acids which are used in the laboratory.

Name of the acid	Chemical formula
Sulphuric acid	H_2SO_4
Nitric acid	HNO_3
Hydrochloric acid	HCl
Acetic acid	CH_3COOH

Classification of acids based on concentration

The word concentration indicates the quantity of acid in relative to the quantity of water in the aqueous solution of that acid.
Highly concentrated acid contains high percentage of acid in comparison with water in that solution.
Low concentrated acid contains low percentage of acid in comparison with water in that solution.

Dilution of acid

Mixing an acid with water reduces the concentration of hydronium ions of the acid per unit volume. This is called dilution of acid. The action of acids with water is exothermic as heat is generated on dilution.

Classification of acids based on strength

Based on ionisation, the acids were classified into strong acids and weak acids.
Strong acids: Acids which ionises completely into its ions are called strong acids.
Example: HCl, H_2SO_4, HNO_3...etc.
Weak acids: Acids which ionises partially into its ions are called weak

acids.
Example: CH_3COOH, H_2CO_3...etc

Classification of acids based on basicity of acids

Based on basicity acids were classified into different types. They are
Mono-basic acids
Di-basic acids
Tri-basic acids

Mono-basic acids:

Acids which on ionisation produces on hydronium ion in water are termed as mono-basic acids.
Example: HCl

Di-basic acids:

Acids which on ionisation produces two hydronium ions are called as di-basic acids.
Example: H_2SO_4, H_2CO_3..etc

Tri-basic acids:

Acids which on ionisation produces three hydronium ions are called astri-basic acids.
Example: H_3PO_4, H_3PO_3..etc

Properties of acids

Acids have corrosive action on skin.
Acids are good conductors of electricity.
Acids neutralizes bases to form salt and water.

Chemical properties of acids

Reaction of acids with active metals:
Acids reacts with metals to form metal salts. In this reaction, hydrogen gas is liberated.
Example: In the reaction of hydrochloric acid reacts with zinc produces hydrogen gas and zinc chloride.
$2HCl + Zn \rightarrow ZnCl_2 + H_2$

Reaction of acids with metal carbonates:

Acids reacts with metal carbonates to form corresponding salts, carbon dioxide and water.
Example: Hydrochloric acid on reaction with sodium carbonate forms sodium chloride, carbon dioxide and water.
$2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$

Reaction of acids with metal hydrogen carbonates:

Acids reacts with metal hydrogen carbonates and form corresponding salts, carbon dioxide and water.
Example: Hydrochloric acid on reaction with sodium bicarbonate forms sodium chloride, carbon dioxide and water.
$HCl + NaHCO_3 \rightarrow NaCl + CO_2 + H_2O$

Reaction of acids with metal oxides:

Acids reacts with metal oxide to form salt and water.
Example: Sulphuric acid on reaction with cupric oxide forms copper sulphate and water.
$CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$

Indicators:

An acid base indicator is a substance which exhibits different colour in acids and bases.

Red cabbage is a visual indicator used to detect acids.
Onions are called olfactory indicators. They change their odour with change in the nature of solution.
Litmus is a natural indicator and is extracted from lichens.
Apart from natural indicators there are a few synthetic indicators, such as methyl orange and phenolphthalein.

Following table gives colours of these indicators in presence of acids and bases.

Indicator	Acid	Base
Methyl orange	Red	Yellow
Phenolphthalein	Colourless	Pink
Blue litmus paper	Red colour	No Change
Red litmus paper	No change	Blue colour

Universal indicator is a mixture of different number of indicators which shows different colours in different solutions.

BASES

According Arrhenius theory any substance that can produce hydroxide ions when dissolved in water is called as a base.

Substance + Water → Metal ion + OH^-

Example:

$NaOH\ (aq) \rightarrow Na^+_{(aq)} + OH^-\ (aq)$

A base is said to be an alkali if it is soluble in water. In general hydroxides of alkali metals and alkaline earth metals are considered as alkalis.

Example:

$KOH\ (aq) \rightarrow K^+(aq) + OH^-\ (aq)$

$Ca(OH)_2(aq) \rightarrow Ca^{+2}(aq) + OH^{-}(aq)$

It is not a necessary that a base should contain hydroxide ion.
There are some bases even they does not contain hydroxide ion, can be considered as bases.
Example: Ammonia (NH_3)
Ammonia when dissolved in water forms ammonium hydroxide which is a weak base.
$NH_3 + H_2O \rightarrow NH_4OH$ (aq)

Oxides of alkali metals and alkaline earth metals are also considered as basic in nature.
Example: CaO, MgO, Na_2O, K_2O...etc.

Classification of bases:

Classification based on the strength:

Based on the extent of ionisation bases are classified into strong bases and weak bases.

Strong bases:

The bases which undergoes complete ionisation in aqueous solution are called as strong bases.
Example: NaOH, KOH...etc

Weak bases:

The bases which undergoes partial ionisation in aqueous solution are called weak bases.
Example: NH_4OH, NH_3...etc

Classification based on acidity:

Based on acidity bases can be classified into different types. They are:
Mono acidic base
Di acidic base
Tri acidic base

Mono acidic bases
:
Bases which produces only one hydroxide (OH^-) ion in aqueous solutions are called mono acidic bases.
Example: NaOH, KOH,,,etc

Di acidic bases:

Bases which produces two hydroxide ions in aqueous solutions are called di acidic bases.
Example: $Ca(OH)_2$, $Mg(OH)_2$...etc

Tri acidic bases:

Bases which produces three hydroxide ions in aqueous solutions are called tri acidic bases.
Example: $Al(OH)_3$, $Fe(OH)_3$...etc

Physical properties of bases:

- Bases are bitter to taste, soapy to touch.
- Bases are good conductors of electricity in aqueous solution. In aqueous solution, they release ions, which conduct electricity.
- Bases liberates heat on dilution.

Indicators in presence of bases:

Bases turns red litmus to blue.
Phenolphthalein turns pink in presence of bases.
Methyl orange turns to yellow in presence of bases.

Chemical properties:

Reaction with active metals:

Bases react with metals to liberate hydrogen gas
Example: Sodium hydroxide react with zinc and liberate hydrogen and sodium zincate.

$$NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$$

Reaction with non-metal oxides:

Bases react with non-metallic oxides to form salt and water. This is similar to a neutralization reaction between an acid and a base.
Example: Calcium hydroxide reacts with carbon dioxide to form calcium carbonate and water

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

From this reaction, it can be concluded that non-metallic oxides are acidic in nature.

Reaction with acids:

Bases reacts with acids to form salts and water.
Example:
Potassium hydroxide reacts with hydrochloric acid to form potassium chloride and water.

$$KOH + HCl \rightarrow KCl + H_2O$$

Uses of Bases:

- Mild bases neutralise the acidity in the stomach.
- Sodium hydroxide is used in the manufacture of soaps, paper and synthetic fibres like rayon.
- Calcium hydroxide is used in the manufacture of bleaching powder. Bleaching powder is used as a disinfectant.
- Magnesium hydroxide is used as an antacid to neutralize the

acid in the stomach.

• Ammonium hydroxide is used in the preparation of fertilizers like ammonium phosphate and ammonium sulphate.

USES OF ACIDS AND BASES

Uses of acids:

H_2SO_4 (Sulphuric acid):

Sulphuric acid, because of its wide applications, is referred as the king of chemicals.

It is used in the manufacture of:

Fertilisers like ammonium sulphate and superphosphate.

Dyes, pigments and paints.

Explosives such as T NT.

It is used in the refining of petroleum.

As a pickling agent.

As a laboratory agent, and a dehydrating and oxidising agent.

HNO_3 (Nitric acid):

Nitric acid is widely used in the manufacture of dyes and drugs, as well as explosives such as trinitrotoluene, or TNT, nitro-glycerine and picric acid.

The salts of nitric acid, such as ammonium nitrate and calcium nitrate, are used as important fertilisers.

It is used in the purification of silver and gold.

It is used in the laboratory as an oxidising and a nitrating reagent.

It finds a major use in the pickling of stainless steel, etching of metals and as an oxidiser in rocket fuels.

HCl (Hydrochloric acid):

It is used in the manufacture of chlorine, and chlorides like ammonium chloride.
It used in the manufacture of glucose from corn starch.
It is used as a laboratory reagent and in medicines.
A saturated solution of zinc chloride in dilute hydrochloric acid is used to remove the impurities on a metal surface before soldering or electroplating.

CH_3COOH (Acetic acid):

It is useful in cooking. In general it is useful under the name of vinegar.
Manufacture of artificial fibres
Ethanoic acid is used for coagulating latex to prepare rubber from it.
It is used as a reagent in the laboratory.
It is used in the preparation of perfumes.

H_2CO_3 (Carbonic acid):

It is useful in the form of carbonated drinks.
It is also useful in the preparation of medicine.

C_6H_5COOH (Benzoic acid):

It is useful in the preservation of food.
It is useful in the synthesis of medicines (one of the important pharmaceutical compound) and also in making of perfumes.

Boric acid(H_3BO_3):

It is useful as an antiseptic and insecticide.
It is useful as a flame retardant.

Uses of Bases:

NaOH (Sodium hydroxide):
It is used in the manufacture of soaps, paper.
It is also used in the manufacture of synthetic fibres like rayon.
It is important constituent in drain cleaners.

$Ca(OH)_2$ (Calcium hydroxide):

It is used in the manufacture of bleaching powder. Bleaching powder is used as a disinfectant.

$Mg(OH)_2$ (Magnesium hydroxide):

It is used as an antacid to neutralize the acidity in the stomach.

NH_4OH (Ammonium hydroxide):

It is used in the preparation of fertilizers like ammonium phosphate and ammonium sulphate.
It is useful in removing stains of grease from cloths.

$Al(OH)_3$ (Aluminium hydroxide):

It is useful in fire extinguishers as a foaming agent.

THEORIES OF ACIDS AND BASES

There are different theories that try to explain the behaviour of an acid and a base. Some of them are given below.

- Arrhenius theory
- Bronsted-Lowry theory
- Lewis theory

Arrhenius theory

In the year 1884 Arrhenius proposed theory about electrolytes. According to his theory an acid is a substance that contains hydrogen and ionises in an aqueous solution to give hydrogen ions.
Example:
Strong acids like HCl, HNO_3 and H_2SO_4 contains hydrogen and ionises in water to release H^+ and Cl^-, NO_3^-, SO_4^{-2} ions.
$HCl(aq) \rightarrow H^+(aq) + Cl\text{-}(aq)$
$HNO_3\ (aq) \rightarrow H^+\ (aq) + NO_3^-(aq)$
$H_2SO_4\ (aq) \rightarrow 2H^+(aq) + SO_4^{-2}\ (aq)$

Weak acids like acetic acid will ionise to release H^+ ions and acetate ions but not 100%. There exists equilibrium between unionised and ionised species in the solution.
$CH_3COOH \leftrightarrow H^+ + CH_3COO^-$
A base is a substance that contains the hydroxyl group and ionises in an aqueous solution to give hydroxide ions.
Example: Strong bases like NaOH, KOH contains a hydroxyl group and ionises in water to Na^+, K^+ and OH^- ions.
$NaOH(aq) \rightarrow Na^+(aq) + OH^-(aq)$
$KOH\ (aq) \rightarrow K^+\ (aq) + OH^-(aq)$

Weak bases will not ionise 100% so, there exits equilibrium between unionised and ionised species in the solution.
$NH_4OH \leftrightarrow OH^- + NH_4^+$

Limitations

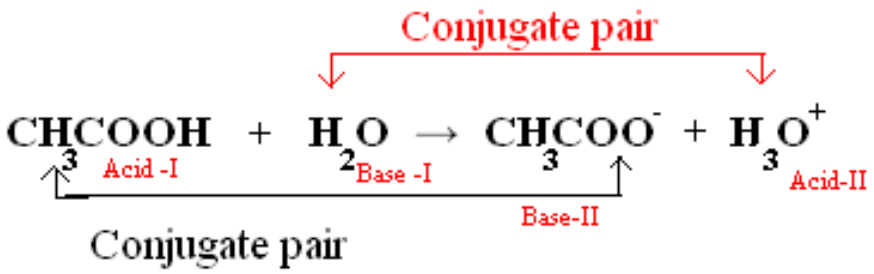
- It is limited to aqueous solutions only. As there exists some acids and bases which can show their acidic and basic character in other solvents (liquid ammonia, alcohol...etc) than water.
- Some substances exhibit the properties of a base though they do not contain hydroxide ions.
- Example: Liquid ammonia.
- According to this theory acids gives H^+ ions in solution but, H^+ is very reactive and cannot exist independently in aqueous solutions. Instead, it bonds to an oxygen atom of the water molecule and forms H_3O^+, the hydronium ion.

  $HCl(aq) \rightarrow H_3O^+(aq) + Cl^-(aq)$

Bronsted-Lowry theory

According to this theory, 'an acid is a substance that exhibits a tendency to donate proton and a base is a substance that exhibits a tendency to gain proton'.
Proton donors are acids and proton acceptors are bases.
Consider a general equation
$HA(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + A^-(aq)$
In the forward reaction, HA donates proton to water, and thus, acts as a Bronsted-Lowry acid, while water accepts the proton, and acts as a Bronsted-Lowry base.
A related pair of an acid and a base which differ by a single proton is called a conjugate acid-base pair.

HA	+	H_2O	$\rightleftharpoons$	H_3O^+	+	A^-
acid		base		conjugate acid		conjugate base



Limitations

- The theory fails to explain some reactions that do not involve a proton transfer.
- It fails to explain the acidic behaviour of electron-deficient molecules like $AlCl_3$ and BCl_3.

Lewis theory

According to this theory, an acid is any molecule or ion that can accept an electron pair to form a coordinate covalent bond with the donor.
Examples: H^+, BF_3, $AlCl_3$ and $SnCl_4$
According to this theory a base is any molecule or ion that can donate a pair of electrons to form a coordinate covalent bond with the acceptor.
Examples: NH_3, H_2O and OH^-

Lewis acids and lewis bases reacts to form salts.

Ammonia (lewis base) reacts with hydrogen cation (lewis acid) to form ammonium ion.
$NH_3 + H^+ \rightarrow NH_4^+$

Types of lewis acids

Molecules in which central atom possess incomplete shells.
Example: $AlCl_3$, BF_3, $FeCl_3$...etc

Cations like Na^+, K^+, Ca^{+2} are electron deficient are also examples of

lewis acids.
Molecules in which central atom has multiple bonds around it are also considered to be lewis acids.
Examples: O=C=O: Carbon dioxide (CO_2).

Limitations

- This theory fails to explain the strength of acids and bases.
- All the acid-base reactions do not involve coordinate covalent bond formation
- Generally, acid-base reactions are very fast, but in certain cases, the formation of a coordinate covalent bond is very slow.

STRENGTH OF ACIDS AND BASES

Neutralization is a chemical reaction in which an acid reacts with a base to form salt and water. In this process, a hydrogen ion of the acid combines with a hydroxide ion of the base to form a water molecule. The anion of the acid combines with the cation of the base to form a salt.

For example when hydrochloric acid reacts with sodium hydroxide the chlorine of hydrochloric acid combines with sodium of sodium hydroxide to form sodium chloride. The hydrogen of hydrochloric acid combines with the hydroxyl part of the sodium hydroxide and forms water.
$HCl + NaOH \rightarrow NaCl + H_2O$

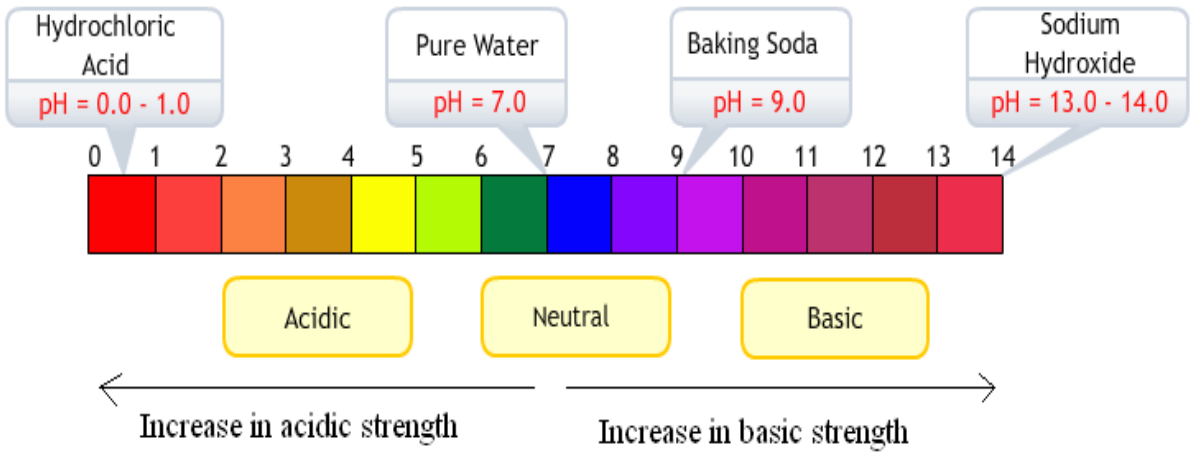
Strength of acids or bases

Based on extent of ionization acids and bases are classified into strong acids, weak acids and strong bases, weak bases.

Strong acids or strong bases ionizes completely (100%) to form ions in the aqueous solution.
Example:
Hydrochloric acid ionizes completely to form ions.
$HCl\ (aq) \rightarrow H^+(aq) + Cl^-(aq)$
Sodium hydroxide ionizes completely to form ions.
$NaOH\ (aq) \rightarrow Na^+\ (aq) + OH^-\ (aq)$

Weak acids or weak bases ionizes partially (<100%) to form ions in the aqueous solution.
Example:
Acetic acid ionizes partially in aqueous solution to form ions.
$CH_3COOH\ (aq) \Leftrightarrow H^+(aq) + CH_3COO^-{}_{(aq)}$
Ammonium hydroxide ionizes partially in aqueous solution to form ions.
$NH_4OH \Leftrightarrow NH_4^+ + OH^-\ (aq)$

An acid or base is considered as strong or weak depending on the con centration of hydrogen and hydroxide ions within it.
This concentration or the power of hydrogen differs from substance to substance and can be measured using a scale, called the pH scale.
A solution that has a pH value of less than 7 is acidic and a solution with a pH value of more than 7 is basic. A neutral solution is indicated by a pH value of 7 on the scale.
Strong acids will possess pH values between 0-2 and weak acids possess pH values more than 3. Lower is the pH value stronger will be acid.
Strong bases will possess pH values between 12-14 and weak bases possess pH values less than 12. Higher is the pH value stronger will be the base.



Applications of neutralization concept in daily life

• Antacids like Milk of Magnesia are mild bases that neutralize the acids in the stomach and aid digestion.

• If the pH lowers, the acidity in the mouth increases and leads to tooth decay. Toothpastes are basic in nature and they counteract the acid in the mouth.

• Hydrangea produces pink flowers when the soil has a pH value of 6.8 or higher and blue flowers when the pH value is 6.0 or less.

• If the soil is acidic, then the applied pesticides, herbicides and fungicides will not be absorbed by the soil. In order to neutralize the soil, suitable bases are used. Generally, salts of calcium or magnesium, which are basic are used to neutralize soil acidity.

• When a bee stings, formic acid is released. That is what makes the skin burn. Baking soda, which is a base, neutralizes the formic acid and provides relief from the pain.

SALT AND THEIR PROPERTIES

The compounds formed by the reaction between an acids and a bases are known as a salts.

$$\text{Acid} + \text{Base} \rightarrow \text{Salt} + \text{Water}$$

Salts are ionic compounds which contain positively charged cations and negatively charged anions. During salt formation cation is coming from base and anion is coming from acid.
Example: In Sodium chloride (NaCl) formation cation sodium is coming from sodium hydroxide and anion chlorine is coming from hydrochloric acid.

Classification of salts

Based on nature the salts have been classified into different types. They are:
Normal salts
Acidic salts
Basic salts
Double salts
Complex salts

Normal salts

These salts are formed by the complete replacement of hydrogen in acids by other metal cations from the bases.
NaCl is normal salt formed by the reaction of HCl with NaOH.
$HCl + NaOH \rightarrow NaCl + H_2O$

Acidic salts

Salts which are formed by the partial replacement of hydrogens atoms of acids are called acidic salts.
Example:
$NaHSO_4$ is formed when partial replacement of hydrogen atoms by the sodium atoms of base.
$H_2SO_4 + NaOH \rightarrow NaHSO_4 + H_2O$
In general these salts formed when the reacted base is not sufficient for the neutralisation of acid.

Basic salts

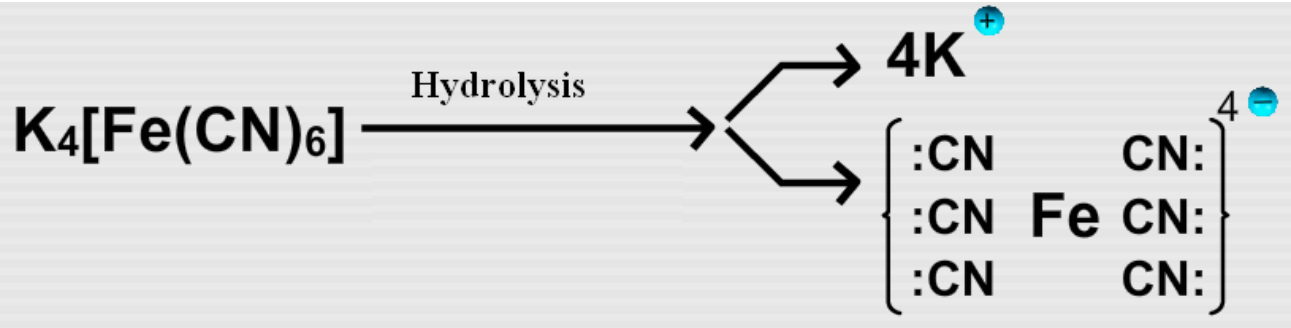
Salts which are formed by the partial replacement of hydroxyl group are called basic salts.
Example:
Ca(OH)Cl is formed by the partial replacement of hydroxide group from Ca(OH)2 by chloride ions of acid.
$Ca(OH)_2 + HCl \rightarrow Ca(OH)Cl + H_2O$
In general these salts formed when the reacted acid is not sufficient for the neutralisation of base.

Table below giving neutral, acidic and basic salts.

Type of Salt	**Type of Acid**	**Type of Base**	**Example**
Neutral pH = 7	Strong Acids Examples: HCl H_2SO_4	Strong Bases Examples: NaOH KOH	NaCl K_2SO_4
Acidic pH < 7	Strong Acids Examples: HCl HNO_3	Strong Bases Examples: NH_4OH $Mg(OH)_2$	NH_4Cl $Mg(NO_3)_2$
Basic pH > 7	Weak Acids Examples: H_2CO_3 CH_3COOH	Strong Bases Examples: NaOH KOH	Na_2CO_3 CH_3COOK

Double salts:

Salts that are formed by mixing of two simple salts which are obtained crystallisation.
Example:
Potash alum - $K_2SO_4\ Al_2\ (SO_4)_3\ .24H_2O$
Dolomite - $CaCO_3.MgCO_3$
Complex salts
The salts which contains different types of metal atoms which on hydrolysis produces complex ions along with simple ions are called complex salts.
Example:
$[Ag(NH_3)_2]Cl \rightleftarrows [Ag(NH_3)_2]^+ + Cl^-$



PHYSICAL AND CHEMICAL PROPERTIES OF SALT

Salts are very essential chemicals in a laboratory as they are used in several reactions and processes. They are also widely used across different industries.
Salts are ionic compounds that result from the neutralisation of an acid and a base.
Ex: Sodium carbonate, sodium bicarbonate, potassium aluminium sulphate, calcium chlorohypochlorite and ammonium chloride.
They are good conductors of electricity in their molten state or aqueous form.
Most of the salts are soluble in water. The extent of solubility varies with the temperature.
Salts consist of both cations and anions.

General properties

Water of crystallisation

The number of water molecules chemically combined in a definite molecular proportion with the salt in the crystalline state. Salts that contain a definite number of water molecules as water of crystallisation are called hydrated salts.
Example: Gypsum and washing soda.
Conversely, salts that do not contain water of crystallisation are called anhydrous salts.
Example: Anhydrous copper sulphate.

Deliquescence

The ability of some salts to absorb moisture from the atmosphere, dissolve and change into a liquid.
Deliquescence of the compounds is due to the reason that vapour pressure of the particular salt is lower than the atmospheric vapour pressure. And it can be reduced when the salt is kept under dry conditions.
Examples:
Calcium chloride, magnesium chloride, zinc chloride and potassium carbonate.

Hygroscopic substances

Some salts are hygroscopic, i.e. they have the ability absorb moisture from the atmosphere without getting dissolved. Example:
Calcium oxide, Silica gel...etc
.

Efflorescence

The loss of water of crystallisation partially or completely from a hydrated salt when exposed to atmosphere.
Efflorescent substances when lost their water of crystallisation will becomes powdery
Example:
Copper sulphate pentahydrate or bluestone and magnesium sulphate heptahydrate or Epsom salt.
$CuSO_4.5H_2O \rightarrow CuSO_4 + 5H_2O$
$MgSO_4.7H_2O \rightarrow MgSO_4 + 7H_2O$

Salts in our daily life

Sodium chloride (NaCl)

It is formed by the reaction sodium hydroxide with hydrogen chloride.
It is white crystalline solid with high melting and boiling points.
It is sparingly soluble in water/
It is used to preserve pickles, fish and meat.
It is used to melt ice formed on roads in cold countries and
It is used as a raw material for the manufacture of other compounds.
It is also used to manufacture soap.

Sodium carbonate (Na_2CO_3)

Sodium carbonate or washing soda or soda ash is the sodium salt of carbonic acid.
Adding water to sodium carbonate and this allowing this mixture to cool to forms decahydrate sodium carbonate.

$$Na_2CO_3 + 10\ H_2O \rightarrow Na_2CO_3.10H_2O$$

In crystalline state, it possesses ten molecules of water of crystallisation.
It is prepared by passing carbon dioxide gas in a concentrated solution of sodium hydroxide.

It is a white crystalline solid whose common form is decahydrate. When exposed to air, its crystals lose water, turn into a monohydrate form and appear as a white opaque powder.
It gives out a golden yellow flame when it is heated on a Bunsen burner.
On heating, sodium carbonate decahydrate acquires anhydrous form.
It dissolves in water by giving out heat. A solution of sodium carbonate is alkaline in nature.
Sodium carbonate is used to manufacture of glass, cleansing agents, soap, glass and paper, sodium compounds like borax.

Sodium hydrogen carbonate ($NaHCO_3$):

It is a white odourless, crystalline solid.
It is completely soluble in water and slightly soluble in ethanol.
It is prepared by passing carbon dioxide through a concentrated solution of sodium hydroxide or sodium carbonate.
On heating, it loses carbon dioxide and water to form sodium carbonate.
On reaction with acids, it forms salt and water and releases carbon dioxide.
Sodium hydrogen carbonate is commonly called as baking soda.
Sodium hydrogen carbonate is used in the baking industry.
It is used in preparation of soda acid.
It is also used in foam type fire extinguishers.

Potash Alum ($K_2SO_4\ Al_2\ (SO_4)_3\ .24H_2O$):

It is a colourless, odourless and crystalline substance. Its crystals are prepared by mixing concentrated solutions of potassium sulphate and aluminium sulphate.
It is soluble in water.
It melts at 92°C, and swells up as the water of crystallisation is

eliminated at 200°C.

It is prepared by mixing concentrated solutions of K_2SO_4 and $Al_2(SO_4)_3$ in equimolar proportion of weight.
$K_2SO_4 + Al_2(SO_4)_3 + 24H_2O \rightarrow K_2SO_4.Al_2(SO_4)_3\ 24H_2O$
It will decompose into its components at temperature of 200 ^{0}C.
$K_2SO_4.Al_2(SO_4)_3\ 24H_2O \rightarrow K_2SO_4 + Al_2(SO_4)_3 + 24H_2O$

Bleaching powder ($CaOCl_2$)

Bleaching powder chemically known as calcium oxy chloride.
It is prepared when chlorine reacts with dry slaked lime at 40° C.
It is a pale yellow powder with a strong smell of chlorine.
It reacts with dilute acids or carbon dioxide to release chlorine.
It is used to bleach cotton, linen textiles and wood pulp.
It is soluble in water. Where It is used to disinfect drinking water.

Ammonium chloride salt (NH_4Cl)

It is obtained by passing ammonia in hydrochloric acid.
It is a white crystalline solid soluble in water.
It is odourless, brittle, has a salty taste, and gives a cooling effect on the tongue.
At high temperature, it gets decomposed into ammonia and hydrochloric acid gas. On cooling, these gases combine to form ammonium chloride.

Plaster of paris ($CaSO_4.½H_2O$)

Plaster of paris which is chemically called calcium sulphate hemihydrate. Since it is brought to use from paris, called as "plaster of paris".
It is prepared by heating of gypsum at 373K.

$$CaSO_4.2H_2O \xrightarrow{373\ K} CaSO_4\ \tfrac{1}{2}H_2O + 1\tfrac{1}{2}H_2O$$

Gypsum → Plaster of Paris + Water