Acids :- acids are substances which dissociate in aqueous solution to give hydrogen ions E.g,

HCL, HNO_3, CH_3 COOH and H_2 So_4 are acids because they give hydrogen ions when dissolved in water.

$$HCL \xrightarrow{H_2O} H^+ + Cl^-$$

$$HNO_3 \xrightarrow{H_2O} H^+ + No^-_3$$

Acids are sour in taste and turn blue litmus solution red.

Bases :- Bases are substances which dissociate in aqueous solution to give hydroxide ions. E.g, substances such as NaoH, KoH, Ca $(oH)_2$ etc are bases because they give hydroxide ions when dissolved in water.

$$NaoH\ (aq) \xrightarrow{H_2O} Na^+\ (aq) + OH^-\ (aq)$$

$$Ca\ (oH)_2\ (S) \xrightarrow{H_2O} Ca^{2+}\ (aq) + oH^-\ (aq)$$

Bases have bitter taste and soapy touch and turn red litmus solution blue.

Strong Acids :- the acids which are completely ionised in water are called strong acids.for example, hydrochloric acid (HCl), nitric acid (HNO_3), sulphuric acid (H_2SO_4) are strong acids because they are fully ionized in aqueous solutions. For example,

$$HCl\ (aq) + H_2O(l) \longrightarrow H^+\ (aq) + Cl^-(aq)$$

Weak Acids :- the acids which inonise to only a very small extent in water are called weak acids. For example, acetic acid (CH_3COOH), hydrocyanic acid (HCN), carbonic acid (H_2CO_3), phosphoric acid (H_3PO_4)are weak acids because they are only partially ionized in aqueous solutions. For example,

$$CH_3\ COOH\ (aq) + H_2O(l) \rightleftharpoons H^+\ (aq) + CH_3COO^-(aq).$$

Strong Bases :- the bases which completely ionize to give hydroxide ions (OH^-)are called strong bases. For example, sodium hydroxides (NaOH), potassium hydroxide (KOH), completely dissociate in aqueous solution and therefore, these are strong bases, water soluble bases are also called alkalies. For example,

$$NaOH\ (aq) \xrightarrow{water} Na+\ (aq) + OH-(aq).$$

Weak bases :- the bases which ionize to only small extent in sater to give hydroxide ions (OH^-)are called weak bases. For example, ammonium hydroxide (NH_4 OH), calcium hydroxide ($Ca(OH_2)$) are weak bases because they only partially ionize in water. For example,

$$NH_4OH(aq) \overset{water}{\rightleftharpoons} NH^+_4\ (aq) + OH^-(aq).$$

Classification of Acids :- the acids are classified on the basis of number of hydrogen (H^+)or hydronium (H_3O^+) ions produced by the ionization of one molecule of the acid in aqueous solution. On the basis of bascitiy, acids are classified as :

1. **Monobadic acids.** Acids which when dissolved in water produce one hydronium ion per molecule of the eacid are called monobasic acids. Thus, the basicity of monobasic acids is one. For example, HCl. It dissociates in one step only as :

$$HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-\ (aq)$$

Since they have only one replaceable hydrogen atom, they form only one type of salts.

2. **Dibasic acids.** Acids which when dissolved in water produce two hydronium ions per molecule of the acid are called dibasic acids. Thus the basicity of a dibasic acid is 2. For example, sulphuric acid (H_2SO_4) is a dibasic acid. It dissociates in two steps as :

$$H_2SO_4 + H_2O \rightleftharpoons H_3O^+ + HSO^-_4.$$

$$H\ SO^-_4 + H_2O \rightleftharpoons H_3O^+ + SO^{2-}_4$$

Since they have two replaceable hydrogen atoms, they form two types of salts.

3. **Tribasic acids.** Acids which when dissolved in water produce three hydronium ions per molecule of the acid are called tribasic acids. Thus, their basicity is 3. For example, phosphoric acid, H_3PO_4 is a tribasic aicd. It dissociates in three steps in aqueous solution as.

$$H_3PO_4 + H_2O \rightleftharpoons H_3O^+ + H\ PO_4^-$$

$$H_2PO_4^- + H_2O \rightleftharpoons H_3O^+ + HPO_4^{2-}$$

$$HPO_4^{2-} + H_2O \rightleftharpoons H_3O^+ + PO_4^{3-}$$

Since they have three replaceable hydrogen atoms, they form three series of salt.

<u>Classification of Bases</u> : - on the basses of acidity, the base may be classified as :

1. **Monoacidic bases.** Bases which when dissolved in water produce one hydroxide ion per molecule of the base are called monoacidic bases. For example, sodium hydroxide, Na OH is monoacidic base and its acidity is 1.

$$NaOH\ (aq) \xrightarrow{water} Na+\ (aq) + OH-(aq).$$

2. **Diacidic bases.** Bases which when dissolved in water produce two hydroxide ions per molecule of the base are called diacidic bases. For example, calcium hydroxide, Ca $(OH)_2$ is diacidic base and its acidity is 2.

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

3. **Triacidic bases.** Bases which when dissolved in water produce three hydroxide ions per molecule of the base are called triacidic bases. For example, aluminium hydroxide, $Al(OH)_3$ is triacidic base and its acidity is 3.

$$Al(OH)_3\ (aq) \xrightarrow{water} Al^{3+}(aq) + 3OH^-.$$

<u>Chemical Properties of Acids And Bases</u> :- acids and bases show the following chemical properties :

1. **Reaction of acids and bases with metals** :- acids react with metals to liberate hydrogen gas. For example, reactive metals such as zinc and magnesium displace hydrogen from acids in the form of hydrogen gas. The metal combines with the remaining part of the acids and forms a compound called salt. Thus, the reaction of a metal with an acid may be written as :

$$\text{Metal + Acid} \longrightarrow \text{Salt + Hydrogen gas}$$

For example, the reaction of zinc with dilute hydrochloric acid is represented as :

$$\underset{\text{Zinc}}{Zn} + \underset{\text{Hydrochloric acid}}{2HCl} \longrightarrow \underset{\text{zinc chloride}}{znCl_2} + \underset{\text{Hydrogen gas}}{H_2}$$

Zinc metal also reacts with dilute sulphuric acid as :

$$\underset{\text{Zinc}}{Zn} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4} + \underset{\text{Hydrgen gas}}{H_2}$$

Reaction with Bases. Some metals also react with bases to form hydrogen gas. For example, zinc reacts with sodium hydroxide and hydrogen gas is evolved. The reaction may be written as :

$$\underset{\text{Sodium Hydroxide}}{2NaOH} + \underset{\text{Zinc}}{Zn} \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + \underset{\text{Hydrogen gas}}{H_2}$$

Reaction of acids with metal carbonates and metal hydrogen carbonates :-

Acids react with metal carbonates and metal hydrogen carbonates (also called bicarbonates) to form the respective salts, water, and carbon dioxide. Carbon dioxide gas is evolved with brisk effervescence.

Metal Carbonate + Acid ⟶ metal salt + water + carbon dioxide

$$\underset{\text{Sodium Carbonate}}{Na_2CO_3(s)} + \underset{\text{Hydrochloride acid}}{2HCl(aq)} \longrightarrow \underset{\text{sodium chloride}}{2NaCl(aq)} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2(g)}$$

$$\underset{\text{Calcium Carbonate}}{CaCO_3} + \underset{\text{Hydrochloric acid}}{HCl(aq)} \longrightarrow \underset{\text{calcium chloride}}{CaCl_2(aq)} + \underset{\text{water}}{H_2O} + \underset{\text{Carbon dioxide}}{CO_2(g)}$$

Similarly, metal hydrogen carbonates (or bicarbonates) give carbon dioxide.

Metal hydrogen Carbonate + Acid ⟶ Metal salt + Water + Carbon dioxide

$$\underset{\text{Sodium hydrogen Carbonate}}{NaHCO_3(aq)} + \underset{\text{Hydrochloric acid}}{2HCl(aq)} \longrightarrow \underset{\text{Sodium Chloride}}{NaCl(aq)} + \underset{\text{Water}}{H_2O(l)} + \underset{\text{Carbon dioxide}}{CO_2(g)}$$

<u>Reaction of acids and bases with each other</u> :

Acids and bases react with each other to give salt and water. In all acid-base reactions both acids and bases lose their character. In other words, their acidity and basicity is destroyed and therefore, such reactions are called neutralization reactions. In general, a neutralization reaction may be represented as :

Acid + Base ⟶ Salt + Water

For example, the reaction between hydrochloric acid and sodium hydroxide may be written as :

$$HCl\ (aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

<u>Reaction of metallic oxides with acids</u> :

Acids react with merallic oxides to form their respective salts and water. The general reaction between metal oxide and acid can be written as :

Metal oxide + Acid Salt + Water

$$\underset{\text{Copper oxide (black)}}{CuO(s)} + \underset{\text{Hydrochloric acid}}{2HCl\ (aq)} \longrightarrow \underset{\text{Copper(II)chloride (blue green)}}{CuCl_2} + 2H_2O(l)$$

Similarly,

$Na_2O(s)$ + $2HCl(aq)$ ⟶ $2NaCl(aq)$ + $H_2O(l)$

Reaction of non-metallic oxides with bases :

Bases react with non-metallic oxides such as carbon dioxide to give salt and water. For example, sodium hydroxide reacts with carbon dioxide to form sodium carbonate and water as :

$2NaOH(s)$ (Soduim Hydroxide) + $CO_2(g)$ (Carbonate dioxide) ⟶ $Na_2CO_3(aq)$ (Sodium carbonate) + $H_2O(l)$

Calcium hydroxide solution is basic and it reacts with carbon dioxide to give salt and water.

$Ca(OH)_2$ (Calcium hydroxide) + CO_2 ⟶ $CaCO_3(s)$ (Calcium carbonate) + $H_2O(l)$ (Water)

Reaction with sulphites and bisulphites (hydrogen sulphites) :

Dilute acids react with sulphites and hydrogen sulphites (bisulphites) to give sulphur dioxide as :

Sulphite + Acid ⟶ Salt + Water + Sulphur dioxide

Some of the reactions are ;

$Ca\ SO_3(s)$ (Calcium Sulphite) + $2HCl(aq)$ (Hydrochloric acid) ⟶ $CaCl_2(aq)$ (Calcium chloride) + $H_2O(l)$ + $SO_2(g)$ (Sulphur dioxide dioxide)

$NaHSO_3(s)$ (Sodium bisulphite) + $H_2SO_4(aq)$ (Sulphuric acid) ⟶ $Na_2SO_4(aq)$ (Sodium sulphate) + $H_2O(l)$ + $SO_2(g)$ (Sulphur dioxide)

Reaction of acid with metal sulphides :

Acids react with metal sulphides to liberate hydrogen sulphide gas.

Metal sulphide + Acid ⟶ Salt + Hydrogen sulphide

Hydrogen sulphide has the smell of rotten eggs. For exsample,

$FeS(s)$ (Ferrous Sulphide) + $H_2\ SO_4(aq)$ (Sulphuric acid) ⟶ $Fe\ SO_4$ (Ferrous Sulphate) + $H_2S(g)$ (Hydrogen sulphide)

$ZnS(s)$ (Zinc Sulphide) + $H_2SO_4(aq)$ (Sulphuric acid) ⟶ $ZnSO_4(aq)$ (Zinc sulphate) + $H_2S(g)$ (Hydrogen sulphide)

pH SCALE

The strength of an acid is a measure of its hydrogen ion $[H^+]$ concentration In 1909; Sorensen suggested a new term for expressing the hydrogen ion concentration known as pH or pH scale, which in Danish language stands for Protenz and hydrogen (means Power of 1^{++} ion).

pH may be defined as a number by which negative power of 10 has to be raised in order to express the concentration of hydrogen ion of the solution in moles per litre.

$$[H^+] = -\ pH$$

Where the concentration of H^+ ions is expressed as moles/litre and is written as $[H^+]$.

pH may also be defined as :

Negative logarithm (base 10) of the hydrogen ion concentration in moles per litre.

Mathematically, it may be expressed as :

$$pH = -\log_{10}[H^+]$$

Since H^+ ions are always associated with water molecules, we may also write H_3O^+ for H^+ and hence pH may be expressed as :

$$pH = -\log[H_3O^+]$$

On the pH scale, we may measure pH from 0 (very acidic) to 14 (very basic). The pH may simply be thought as a number which indicates the acidic or basic nature of the solution.

pH of solutions :

pH of a solution gives ingformation regarding acidic, basic ar neutral character of the solution.

1. **pH of neutral solutions :**

Pure wateer is neutral. It has equal concentration of H_3O^+ and OH^- ions. It has been calculated that the conceentration of both H_3O^+ and OH^- ions in a neutral solution or pure water are :

$$[H_3O^+]= 10^{-7} \text{ mol } L^{-1} \text{ and } [OH^-] = 10^{-7} \text{ mol } L^{-1} \text{ at } 298 \text{ K}$$

Therefore, pH of water or nuetral solution may be written as :

$$pH = -\log[H_3O^+]$$
$$= \log[\quad]$$
$$= 7$$

Thus, pH of all nuetral solutions or pure water is 7. For example, a sodium chloride soltion or a sugar sollution are neutral, each having pH of 7.

2. **pH of basic solutions :**

All basic solution have pH more than 7. In other words, whenever a solution has pH more than 7, it will be basic (or alkaline) in nature and it will turn red litmus blue. As the pH increases from 7 to 14, the basic character increases.

3. **pH of acidic solutions :**

An acid solution having low pH value will be stronger acid than another solution having higher pH value solutions, having pH between 0 to 2 are strongly acidic while those having pH between 5 to 7 are weakly acidic. The soluutions having pH between 2 to 5 are moderatley acidic.

Salts :

A salt is a compound formed by complete neutralization of a base by an acid or an acid by a base.

Acid + Base $\longrightarrow$ Salt + Water

For example,

$$HCl(aq) + NaOH(aq) \rightleftharpoons NaCl(aq) + H_2O$$

A salt is an ionic compound which contains apositive ion (cation) other than hydrogen ion and a negative ion (anion) other than hydroxyl ion.

Classific ation of salts :

The salts may be classified in the following ways :

1. **Normal salts.** A normal salt is oner which does not contain any ionisable or replacieable hydrogen atoms in its molecule. These salts are generally formed by complete replacement of all the replaceable hydrogen atoms of an acid by a metallic or electropositive radical such as ammonium ion.

For example, a normal salt sodium shloride (NaCl) is formed by replacement of hydrogen from hydrochloric acid by sodium metal.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

Similarly, a normal salt soduim sulphate is formed by the replacemen of both the hydrgen atoms of H_2SO_4 by sodium atoms.

$$\mathbf{2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O}$$

2. **Acidic salts.** These salts formed by partial replacement of replaceable hydrgen ion are called acidic salts. These contain repaleeable hydrgen ions.

For example,

$$H_2SO_4 + NaOH \longrightarrow NaHSO_4 + H_2O$$

In this case, the metal sodium replaces only one hydrogen ion from sulphuric acid. Therefore, acid salt ionises inaqueous solution giving hydronium ion (H_3O^+) and hence gives all the properties of acids.

For example,

$$NaHSO_4 + H_2O \qquad Na^+ + H_3O^+ + SO^2{}_4^- \text{ (aq)}$$

Acid salts further react with bases to form normal salts. Since these salts contain hydrogen ion.

3. **Basic salts.** The salts formed by the partial neutralization of a base by an acid are called basic salts.

For example,

$$\underset{\text{Copper Hydroxide Base}}{Cu\,(OH)_2} + \underset{\text{hydrochloric acid}}{HCl} \qquad \underset{\text{Basic copper chloride}}{Cu(OH)Cl} + H_2O$$

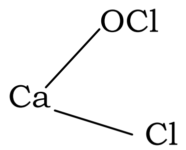
Basic salts further react with acids to form normal salts.

$$\underset{\text{Basic copper Chloride salt}}{Cu\,(OH)\,Cl} + \underset{\text{hydrochloric acid}}{HCl} \longrightarrow \underset{\text{copper (II) chloride normal salt}}{CuCl_2} + H_2O$$

Some other examples of basic salts are :

$Cu\,(OH)\,NO_3$, $Pb\,(OH)NO_3$, $Pb\,(OH)Cl$

4. **Mixed Salts.** The sals containing mote than onev cation or an-ion other than H^+ or H^- ions are called mixedd salts. For example, bleaching powder, $CaOCl_2$ which contains two anions Cl^- and Ocl^-.



Bleaching Powder

Some other example are : $NaKCO_3$, $NaNH_4HPO_4$ (microcosmic salt).

5. **Double salts.** These salts are formed from two simpe salts in their equimolar proprtions, when they are slowly crystallized out from a mixture of their saturated salt solutions. For example, potash alum, K_2SO_4, $Al_2\,(So_4)_3$. $24H_2O$ is obtained by mixing K_2SO_4, and $Al_2\,(So_4)_3$ in molar ratioin water solution followed by crystallisation.

Some other examples are :

$FeSo_4.\,(NH_4)_2SO_4.\,6H_2O$	Mohr's Salt
$K_2SO_4.Fe_2(SO_4)_3.24H_2O$	Ferric alum

pH of Salts :

The salts may be acidic, basic or neutral depending upon the acid or base from which they are formed. Therefore, the salts have different pH values.

In general,

- Salts of strong acids and strong bases areneutral with pH value of 7. E.g Nacl, Kno3.
- Salts of strong acids and weak bases are acidic with pH values less than 7. E.g.$Cuso_4$, $NHCL_4$.
- Salts of weak acids and strong bases are basic with pH value more than 7. E.g. Na_2Co_3.

(1) **Common Salt (or sodium chloride)**
Common salt is a compound of sodium and chlorine.
Occurrence. Common salt is obtained mainly from the sea water. At some places it is mined from salt rocks.

Formula: Common salt is an ionic compound. Its simplest formula corresponds to NaCl. In fact, it exists as an aggregate represented by the formula $(Na^+Cl^-)_n$.

Properties: (i) common salt is deliquescent i.e., it absorbs moisture from the atmosphere. This is due to the presence of small quantity of magnesium chloride ($MgCl_2$) in it. (ii) Common salt is thermally very stable

(iii) Common salt is soluble in water. Its solubility increases with a rise in temperature.

Uses: Sodium chloride although cheap, but is very important chemical compound. It is used extensively for the following purposes.

a) Common salt is used for manufacturing a large number of useful chemical compounds such as caustic soda, soda ash (Washing soda), baking soda, hydrochloride acid, chlorine gas etc.
b) Common salt forms an essential ingredient in our food.
c) Common salt is used in freezing mixtures (Mixtures containing ice and solid granular common salt)
producing low temperature.

d) Common salt is used as a preservative for meat and fish
e) Is used in yhe manufacture of soaps.
Manufacture. Common salt is generally obtained from the sea water by evaporation method and is purified further before use.

Some common examples of materails obtained from common salts are :

1. Sodium hydroxide.
2. Baking soda
3. Washing soda
4. Bleaching Powder

1. **Sodium hydroxide, NaOH :**

Sodium hydroxide is manufactured by passsing electicity through on aqueous solution of sodium chloride (called brine), which dcomposes to form sodium hydroxide. The process is called the chlor-alkali process because of the products formed chlor for chlorine and alkali for sodium hydroxide.

$$NaCl(aq) + 2H_2O(l) \xrightarrow{\text{Electricity}} 2NaOH(aq) + Cl_2(g) + H_2(g)$$

During electrolysis, chlorine gas, Cl_2 is liberated at anode while hydrgen gas, H_2 is evolved at cathode. Sodium hydroxide solution is formd near the cathode.

Properties :

i) Sodium hydroxide is a white crystalline, deliquescent solid.

ii) It iss readily soluble in water to give alkaline solution. It alsoi neutralises acids forming salt and water.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

$$2\ NaOH + H_2SO_4 \qquad Na_2SO_4 + 2H_2O$$

iii) The crystals of sodium hydroxide are deliquescent i.e., they absorb moisture from air. On prolong exposure, sodium hydroxide absorbs CO_2 resulting in the formation of white crust of solid hydrateed Na_2CO_3 at the surface.

$$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$$

iv) Its aqueous solution is soapy to touch and has a strong corrrosive action on the skin.

v) An aqueous solution of sodium hydroxide contains large concentration of hydroxyl ion (OH^-) and precipitates insoluble metal hydroxides from solutions containing metallic ions.

For example,

$$AlCl_3 + 3NaOH \longrightarrow \underset{\text{Aluminium hydroxide (White ppt)}}{Al(OH)_3} + 3\ NaCl$$

Uses of sodium hydroxide :

(I) Sodium hydroxide is used in the manufacutre of soaps and detergents, paper, artificiall silk and a number of chemicals.

(II) It is used in the petroleum refining.

(III) It is used in the purification of bauxite (ore of aluminium).

(IV) It is used in the textile industry for nurcirising cotton fabrics. i.e., Making unshrincable.

(V) It is used as cleansing agent for machines and metal sheets. It is also used for degreasing metals.

(VI) It is used for the preparation of pure fats and oils.

(VII) It is used for the preparation of artificial silk.

(2) **Washing Soda $Na_2CO_3.10H_2O$ (Sodium Carbonate)**

Chemically, waashing soda is sodium carbonate decahydrate The molecular formula of washing soda is $Na_2CO_3.10H_2O$, (Sodium carbonate decahydrate). Commercially, anhydrous sodium carbonate (Na_2CO_3) is called soda ash.

Manufacture :

Sodium carbonate is manufactured by solvay process (also known as ammonia soda process) as discussed below

(i) When carbon dioxide gas is passed through a brine soltion (about 28% NaCl), saturated with ammonia, it gives sodium bicarbonate.

$$NaCl + H_2O + NH_3 + CO_2 \longrightarrow NaHCO_3 + NH_4Cl$$

Sodium Chloride → Sodium bicarbonate (ppt)

The participatted sodium bicarbonate is filtered and dried. It is ignited to give sodium carbonate :

$$2NaHCO_3 \longrightarrow Na_2CO_3 + CO_2 + H_2O$$

Sodium carbonate

Properties :

1. (i) sodium carbonate is a transparent crystaline solid. It exists as a decahydrate ($Na_2CO_3.10H_2O$) containing 10 molecules of water of crystallisation.
2. It is readily soluble in water. It dissolves in water to form an alkaline solution, which turns red litmus solution blue. This shows that an aqueous solution of sodium carbonate is alkaline.
3. **Action of air :** when crystals of washing soda are left open in air they lose nine mlecules of water of crystallization and form a white powder of sodium carbonate monohydrate. This process of loss of water of crystallisation from a hydrated salt to the atmosphere, on keeping it exposed to air is called effloresecence. Thus, washing soda is efflorescent.

$$Na_2CO_3.10H_2O \longrightarrow Na_2CO_3.H_2O + 9\ H_2O$$

Sodium carbonate Decahydrate → Sodium carbonate (monohydrate)

4. Action of heart. On heating , above 373K, washing soda does not decompose but loses all its water of crystallisation to form anhydrous salt. Thus, the monohydrate becomes completely anhydrous and changes to white powder calleed soda ash.

$$Na_2CO_3.H_2O \longrightarrow Na_2CO_3 + H_2O$$

Soda ash

Or

$$Na_2CO_3.10H_2O \longrightarrow Na_2CO_3 + 10H_2O$$

Sodium carbonate (anhydrous)

Uses of Washing Soda (or sodium carbonate).

Some important uses of Washing Soda are.

1. Washing Soda is used for washing clothes (laundry purposes).
2. Washing soda is used for softening hard water.
3. Sodium carbonate (soda ash) is used for the manufacture of detergents.
4. Sodium carbonate is used for the manufacture of many important compounds such as borax.
5. Sodium carbonate is also used in paper and paint industries.

(3) **Baking soda, $NaHCO_3$ (Sodium Bicarbonate)**

The chemical name of baking soda is sodium hydrogen carbonate or sodium bicarbonate. Baking soda is represented by the formula $NaHCO_3$.

Preparation: In laboratory, sodium bicarbonate can be prepared by saturating a cold solution of sodium carbonate with carbon dioxide.

$$Na_2CO_3 + CO_2 + H_2O \longrightarrow 2NaHCO_3$$

Sodium carbonate **carbon dioxide** Sodium bicarbonate (white crystals)

Sodium bicarbonate being less soluble separates out as white crystals.

Properties :

1. Sodium bicarbonate is white crystalline solid.
2. It is soluble in water and its aqueous solution is alkaline in nature having pH grater than7. Therefore, it is used to neutralize an acid.
3. It is amild non-corrosive base.
4. Action of heat. On heating, sodium bicarbonate gets converted into sodium carbonate with the evolution of carbon dioxide gas.

$$\underset{\text{Sod.bicarbonate}}{2NaHCO_3} \xrightarrow{\text{Heat}} \underset{\text{Sodium carbonate}}{Na_2CO_3} + CO_2 + H_2O$$

Uses of sodium bicarbonate: Some typical uses of sodium bicarbonate are given below.

(i) Sodium bicarbonate is used for preparing baking powder and effervescent drinks.
(ii) Sodium bicarbonate is used as an antacid. It corrects the acidity in the stomach
(i) Sodium bicarbonate is used in old-type fire extinguishers.

What is baking powder?

Baking powder is used to prepare porous, fluffy cakes, bread etc. Baking powder is a mixture containing sodium bicarbonate ($NaHCO_3$) and an acidic compound such as potassium hydrogen tartarate or citric acid. During the preparation of cake / bread, sodium bicarbonate reacts with the acidic compound to liberate carbon dioxide.

The CO_2 so released makes the cake/ bread porous and fluffy (light weight and soft).

4.Bleaching powder, ($CaOCl_2$)

Chemically, bleaching powder is calcium oxychloride, $CaOCl_2$ or $Ca(OCl)Cl$.

Preparation: Bleaching powder is prepared by the action of chlorine on dry slaked lime.

$$\underset{\text{slaked lime}}{Ca(OH)_2} + Cl_2 \longrightarrow \underset{\text{bleaching powder}}{CaOCl_2} + H_2O$$

Properties :

1. Bleaching powder is a yellowis white powder.
2. It gives strong smell of chlorine.
3. It is soluble in cold water giving a milky solution due to free lime present in it.
4. **Reaction with carbon dioxide :** when exposed to air, bleaching powder deteriorates giving off chlorine. This is due to the fact that it reacts with carbon dioxide present in air to produce calcium carbonate and chlorine gas.

$$\underset{\text{Calcium oxychloride}}{CaOCl_2} + \underset{\text{Carbon dioxide (from air)}}{CO_2} \longrightarrow \underset{\text{Calcium carbonate}}{CaCl_3} + \underset{\text{Chlorine}}{Cl_2}$$

5. **Reaction with dilute acids :** when bleaching powder is treated with an excess of a dilute acid (like HCl or H_2SO_4) all the chlorine persent in it is liberated. Ths chlorine bleaches the cloth, etc.

$$\underset{\text{Calcium Oxychloride}}{CaOCl_2} + 2HCl \longrightarrow \underset{\text{calium chloride}}{CaCO_2} + H_2O + Cl_2$$

$$\underset{\text{bleaching Powder}}{CaOCl_2} + H_2SO_4 \longrightarrow \underset{\text{calcium sulphate}}{CaSO_4} + H_2O + Cl_2$$

Uses: Bleaching powder is used

i. For bleaching cotton fiber/fabrics in textile industry, and wood pulp in paper industry
ii. As a disinfectant and germicide.
iii. For sterilizing water.
iv. As an oxidizing agent.

Plaster of Paris, ($CaSO_4$.1/2 H2O)

Plaster Of Paris is hemi-hydrate sulphate of calcium. Its molecular formula is $CaSO_4.\frac{1}{2} H_2O$ or $(CaSO_4)_2.H_2O$

Preparation: Plaster of Paris is obtained by heating gypsum ($CaSO_4.2H_2O$) at 120 – 125^{o}C.

$$\underset{\text{gypsum}}{2CaSO_4.2H_2O]} \xrightarrow{\Delta,\ 120^0C} \underset{\text{plaster of Paris}}{(CaSO_4)_2.H_2O} + 3H_2O$$

or $CaSO_4.2H_2O \xrightarrow{\Delta,\ 1200C}$ CaSO4. ½ H2O + $\frac{3}{2} H_2O(g)$

Properties :

1. It is a white powder.
2. It absorbs water with evolution of heat.
3. When mixed with water, it forms a paste which sets into a hard mass. This is called setting of Plaster of Paris. The setting of Plaster of Paris is due to its hydration into gypsum.

$$(CaSO_4)_2.\ H_2O + 3H_2O \longrightarrow \underset{\text{Gypsum}}{2\ CaSO_4.\ 2H_2O}$$

Uses : Plaster of Paris is used for,
i) sealing air gaps ii) making casts for statues, toys and decorative objects.
iii) Plastering the fractured bones to keep the joints in a fixed position
iv) Making black board chalks

Water of Crystallisation:

Water of crystallisation is the fixed number of water moleculees present in one formula unit of a salt. The water which combines chemically with the crystalls of a salt and becomes part of it is called water crystllisation. For example, five water molecules are present in one formula unit of copper sulphate, som the chemicasl formula of hydrated copper sulphate is CuSo+4+.5H_2O. Similarlym ten water molecules are present in one formula unit of washing sodal. The chemical formula if hydrated salt is gypsum which has two molecules of water of crystallisation, it has the formula $CaSO_4.\ 2H_2O$.