Revision Notes for Class 10 Science

Chapter 2 – Acid, Bases and Salts

Acids:

- **Concentrated & Dilute acids -** A concentrated acid has the least quantity of water in it. By diluting a concentrated acid with water, a dilute acid is created.
- **Dissolving Acids or Bases in Water -** Dissolving an acid or a base in water is a very exothermic process. Because this reaction generates a lot of heat, caution should be exercised when mixing strong acids with water, particularly nitric or sulphuric acid. Always put acid in water, never the other way around! The acid must be slowly added to the water while swirling constantly.
- When water is added to a concentrated acid, the heat generated causes the mixture to splash out, resulting in burns. Excessive local heating may potentially cause the glass container to break and cause harm! Dilution occurs when an acid or base is mixed with water. It reduces the concentration of ions $\left(H_3O^+/OH^-\right)$
- per unit volume, allowing the heat effect to be easily dissipated.

Bases:

- Metal oxides and hydroxides are known as bases. Sodium hydroxide, magnesium oxide, calcium oxide, copper oxide, potassium hydroxide, magnesium hydroxide, and other bases are examples. Some bases are water-soluble, forming hydroxyl ions $\left(OH^-\right)$
- when they dissolve in water. An alkali is a base that is soluble in water. When sodium hydroxide is dissolved in water, for example, it readily dissociates into a large number of hydroxide ions.

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

All alkalis are bases that dissociate in water to produce the lone negative ion, the hydroxyl ion. The most prevalent alkalis are sodium hydroxide, potassium hydroxide, calcium hydroxide, and ammonium hydroxide.

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

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

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

$$NH_4OH(aq) \rightarrow NH^{4+}(aq) + OH^{-}(aq)$$

- **Strong Base/Alkali -** When a base is dissolved in water, the concentration of hydroxyl ions determines its strength. A strong base dissociates completely or nearly completely in water to produce a large concentration of hydroxyl ions. The base's strength is proportional to the number of hydroxyl ions it produces. Strong alkalis are represented by the letter NaOH, KOH, & LiOH

  Example:

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

- **Weak Base / Alkali -** A weak base is one that only partially dissociates in water, leaving a low concentration of hydroxyl ions. Weak alkalis include calcium hydroxide and ammonium hydroxide.

  Example:

  $$NH_4OH(aq) \rightarrow NH^{+}{}_4(aq) + OH^{-}(aq)$$

- **Reactions of Bases/alkalis:**

  Neutralization Reaction – Already done

The action of Alkalis/Base with Ammonium Salts

Alkalis combine with ammonium salts to liberate ammonia.

$$Ca(OH)_2(aq) + 2NH_4Cl(s) \rightarrow CaCl_2(s) + 2H_2O(l) + 2NH_3(g)$$

Calcium hydroxide	Ammonium chloride	Calcium chloride	Water	Ammonia

$$2NaOH(aq) + (NH_4)_2SO_4aq \rightarrow Na_2SO_4(aq) + 2H_2O + 2NH_3(g)$$

Sodium hydroxide	Ammonium sulphate	Sodium sulphite	Water	Ammonia

- The negative logarithm of hydrogen ion concentration in moles per litre is used to calculate the

pH of a solution.

$$\text{pH} = -\log\left[\text{H}+(\text{aq})\right]$$

The pH scale is a continuous scale and the value of pH varies between 0 to 14

.The pH of pure or neutral water is 7 .

Solutions having pH less than 7 are acidic and the solutions with pH more than 7 are basic.

General properties of Acids:

- Tastes sour
- Reacts with metals such as zinc, magnesium etc. liberating hydrogen gas.
- Changes the colour of litmus from blue to red.

- Conducts electricity.

General properties of Bases:

- Have a soapy feel,
- It may also burn the skin
- Common examples are soaps & detergents.
- Commonly found bases in laboratories and in our daily life are: Caustic soda, $NaOH$; Caustic potash, KOH; Milk of magnesia, $Mg(OH)_2$; Liquor ammonia, NH_3; Washing powder, Toothpaste.

Chemical Properties of Acids:

1. **Reaction with Metals**:
   - Acids react with metals like zinc, magnesium, or iron to produce hydrogen gas.
   - Example: $Zn + HCl \rightarrow ZnCl_2 + H_2$
2. **Reaction with Metal Carbonates and Bicarbonates**:
   - Acids react with metal carbonates and bicarbonates to produce carbon dioxide, water, and salt.
   - Example: $Na_2CO_3 + HCl \rightarrow NaCl + H_2O + CO_2 \uparrow$
3. **Reaction with Bases (Neutralization)**:
   - Acids react with bases to form water and salt. This is called a neutralization reaction.
   - Example: $HCl + NaOH \rightarrow NaCl + H_2O$

4. **Effect on Indicators**:
    - Acids turn blue litmus paper red.
    - They also turn methyl orange-red and phenolphthalein colourless.

Chemical Properties of Bases:

1. **Reaction with Acids (Neutralization)**:
    - Bases react with acids to form water and salt.
    - Example: $NaOH + HCl \rightarrow NaCl + H_2O$
2. **Reaction with Metals**:
    - Bases like sodium hydroxide react with some metals (e.g., aluminium) to produce hydrogen gas.
    - Example: $2Al + 2NaOH + 6H_2O \rightarrow 2NaAl(OH)_4 + 3H_2 \uparrow$
3. **Reaction with Non-metal Oxides**:
    - Bases react with non-metal oxides to form salt and water.
    - Example: $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$
4. **Effect on Indicators**:
    - Bases turn red litmus paper blue.
    - They turn phenolphthalein pink and methyl orange yellow.

The Reaction of Acids with Metals:

a. In the metal reactivity series, all metals above hydrogen react with dilute acids to generate their respective salts and liberate hydrogen.

$$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2 + H_2(g)$$

b. Magnesium Dil. Hydrochloric Magnesium Hydrogen

acid chloride

$$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$$

Zinc Dil. Hydrochloric Zinc Hydrogen

Acid chloride

$$Fe(s) + H_2SO_4(aq) \longrightarrow Fe_2SO_4(aq) + H_2(g)$$

Iron Dil. Sulphuric Iron(II) Hydrogen

acid Sulphate

b. Very active metals like potassium, sodium and calcium also react similarly but tend to explode when combined with acids.

$$2Na(s) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2(g)$$

Sodium Dil. Hydrochloric Sodium Hydrogen

acid chloride

c. Nitric acid (at varied doses) usually has an oxidising rather than an acidic quality. To liberate hydrogen, metals like magnesium react with extremely dilute $(1\,\%)$ nitric acid.

d. How do Acids React with Metal Carbonates and Metal Hydrogen Carbonates? Acids generate salt, water, and carbon dioxide when they react with carbonates and hydrogen carbonates (bicarbonates).

$$Na_2CO_3(aq)+2HCl(aq)\rightarrow 2NaCl(aq)+H_2O(l)+CO_2(g)$$

Sodium Carbonate	Hydrochloric acid	Sodium chloride	Water	Carbon dioxide

$$ZnCO_3(aq) + H_2SO_4(aq)\rightarrow ZnSO_4(aq) + H_2O(l)+CO_2(g)$$

Zinc Carbonate	Sulphuric acid	Zinc Sulphate	Water	Carbon dioxide

$$2NaHCO_3(s) + H_2SO_4(aq)\rightarrow Na_2SO_4(aq)+2H_2O(l)+2CO_2(g)$$

Sodium Hydrogen Carbonate	Sulphuric acid	Sodium sulphate	Water	Carbon dioxide

How do Metal Carbonates and Metal Hydrogencarbonates React with Acids?

When metal carbonates and metal hydrogen carbonates react with acids, they undergo a chemical reaction that produces salt, carbon dioxide (CO_2), and water (H_2O). This reaction is common and significant in various chemical processes.

Reaction with Metal Carbonates:

1. **General Reaction**:
   - Metal Carbonate + Acid → Salt + Carbon Dioxide + Water
2. **Example**:
   - Consider the reaction between calcium carbonate ($CaCO_3$) and hydrochloric acid (HCl): $\mathrm{CaCO_3+2HCl\rightarrow CaCl_2+CO_2\uparrow+H_2O}$
   - In this reaction:
     - Calcium carbonate reacts with hydrochloric acid.

- The products are calcium chloride (a salt), carbon dioxide gas (which bubbles out), and water.

Reaction with Metal Hydrogencarbonates (Bicarbonates):

1. **General Reaction**:
   - Metal Hydrogencarbonate + Acid → Salt + Carbon Dioxide + Water

2. **Example**:
   - Consider the reaction between sodium bicarbonate ($NaHCO_3$) and hydrochloric acid (HCl): $NaHCO_3 + HCl \rightarrow NaCl + CO_2 \uparrow + H_2O$
   - In this reaction:
     - Sodium bicarbonate reacts with hydrochloric acid.
     - The products are sodium chloride (a salt), carbon dioxide gas, and water.

How do Acids and Bases React with each other?

When acids and bases react with each other, they undergo a chemical reaction known as **neutralization**. In this process, the acid and the base neutralize each other's properties, resulting in the formation of water and salt. Here's how this reaction occurs:

Neutralization Reaction:

1. **Reaction Process**:
   - An acid, which typically contains hydrogen ions (H^+), reacts with a base, which contains hydroxide ions (OH^-).
   - The hydrogen ions from the acid combine with the hydroxide ions from the base to form water (H_2O).
   - The remaining ions from the acid and the base form a salt.

2. **General Equation**:
   $\text{Acid} + \text{Base} \rightarrow \text{Salt} + \text{Water}$

3. **Example**:

   - Consider the reaction between hydrochloric acid (HCl) and sodium hydroxide (NaOH): $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

   - In this reaction, HCl (acid) provides H^+ ions, and NaOH (base) provides OH^- ions. They combine to form water (H_2O) and sodium chloride (NaCl), which is a salt.

4. **Properties of the Products**:

   - The resulting solution typically has a pH close to 7, indicating that it is neutral.

   - The salt formed in the reaction depends on the specific acid and base used. For example:

     - $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl}$ (sodium chloride)

     - $H_2 ? SO_4$ + KOH $\rightarrow$ K_2SO_4 (potassium sulfate)

Neutralization:

Neutralization is the reaction between the hydrogen ions of an acid and the hydroxyl ions of a base. A neutralisation reaction can be written as follows:

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

Examples:

1.

$$\text{NaOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NaCl}(\text{aq}) + \text{H}_2\text{0}(\text{l})$$

Sodium Hydrochloric Sodium Water

hydroxide acid chloride

2.

$$3NH_4 0H(aq) + H_3PO_4(aq) \rightarrow (NH_4)_3 PO_4(aq) + 3H_2 0(l)$$

Ammonium Phosphoric Ammonium Water

hydroxide acid phosphate

Importance of Neutralization:

- **In Everyday Life**: Neutralization reactions are common in everyday life, such as in the use of antacids to neutralize stomach acid or in agriculture to adjust soil pH.
- **In Industry**: Neutralization is used in chemical manufacturing, wastewater treatment, and other industrial processes to control acidity or alkalinity.

This neutralization process is fundamental to understanding how acids and bases interact and how their effects can be managed in various chemical and biological systems.

Acid Reactions of Metallic Oxides:

Basic Oxides in Action

Basic oxides are oxides that react with an acid to generate salt and water. When these oxides react with acids, they get neutralised.

1.

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

Sodium Hydrochloric Sodium Water

Oxide acid chloride

2.

$$PbO(s) + 2HNO_3(aq) \rightarrow Pb(NO_3)_2(aq) + H_2O(l)$$

Lead oxide   Nitric acid   Lead nitrate   Water

3.

$$CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$$

Copper   Sulphuric   Copper   Water

Oxide   acid   sulphate

Reaction of a Non-metallic Oxide with Base

When a non-metallic oxide reacts with a base, it forms salt and water. This reaction is similar to acid-base neutralization, as non-metallic oxides are generally acidic.

Example:

- **Reaction**: Carbon dioxide (CO_2) reacts with calcium hydroxide ($Ca(OH)_2$) to form calcium carbonate ($CaCO_3$) and water. $CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$
- **Observation**: The formation of calcium carbonate, a white precipitate, indicates the reaction.

Application:

- **Limewater Test**: This reaction is used to detect the presence of carbon dioxide by the formation of a white precipitate in limewater.

What Do All Acids And All Bases Have In Common?

When a non-metallic oxide reacts with a base, it forms salt and water. This reaction is similar to acid-base neutralization, as non-metallic oxides are generally acidic.

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Application:

- **Limewater Test**: This reaction is used to detect the presence of carbon dioxide by the formation of a white precipitate in limewater.

Common Properties of Acids:

1. **Release of Ions**: All acids release hydrogen ions (H^+) when dissolved in water. This is what gives them their acidic properties.

2. **Electrolytes**: Acids conduct electricity in an aqueous solution due to the presence of free ions.

Common Properties of Bases:

1. **Release of Ions**: All bases release hydroxide ions (OH^-) when dissolved in water, which gives them their basic properties.

2. **Electrolytes**: Bases also conduct electricity in an aqueous solution because of the presence of free ions.

Commonality:

- **Ionization in Water**: Both acids and bases ionize in water, releasing ions that are responsible for their characteristic properties. This ionization also makes both acids and bases capable of conducting electricity in solution.

What Happens to an Acid or a Base in a Water Solution?

When an acid or a base is dissolved in water, it undergoes a process called ionization, which involves the release of ions. Here's what happens to each:

What Happens to an Acid in Water:

1. **Ionization**:
   - Acids ionize in water to release hydrogen ions (H^+).
   - For example, hydrochloric acid (HCl) dissociates in water as follows: $HCl \rightarrow H^+ + Cl^-$

     Formation of Hydronium Ions:

   - The released hydrogen ions (H^+) do not exist freely in the solution. Instead, they combine with water molecules to form hydronium ions (H_3O^+).
     $H^+ + H_2O \rightarrow H_3O^+$
2. **Acidic Nature**:
   - The presence of $H_3?O^+$ ions gives the solution its acidic properties, such as a sour taste and the ability to turn blue litmus paper red.

What Happens to a Base in Water:

1. **Ionization**:
   - Bases ionize in water to release hydroxide ions (OH^-).
   - For example, sodium hydroxide (NaOH) dissociates in water as follows: $NaOH \rightarrow Na^+ + OH^-$
2. **Basic Nature**:
   - The presence of OH^- ions in the solution gives it basic properties, such as a bitter taste and the ability to turn red litmus paper blue.

Overall Effect:

- **Electrolytic Behavior**: Both acids and bases, due to the presence of free ions ($H_3?O^+$ in acids and OH^- in bases), can conduct electricity in solution.
- **pH Change**: The concentration of H^+ or OH^- ions in the solution determines its pH, with acids lowering the pH (making it acidic) and bases increasing the pH (making it basic).

How Strong Are Acid Or Base Solutions?

Strong Acid - A strong acid is an acid that dissociates completely or nearly completely in water. Only ions and water make up an aqueous solution of a strong acid.

- It is important to note that in these acids, all hydrogen ions $\left(H^+\right)$
- react with the water molecule to form hydronium ions $\left(H_3O^+\right)$
- . Strong acids include hydrochloric acid, sulphuric acid, and nitric acid, among others.

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

Hydrochloric

acid

$$HNO_3(aq) \longrightarrow H^+(aq) + NO_3^-(aq)$$

Nitric acid

$$H_2SO_4(aq) \longrightarrow 2H^+(aq) + SO_4^{2-}(aq)$$

Importance of pH in our daily life:

- Plants and pH: For healthy plant growth, the pH of the soil must be at a certain level. It shouldn't be acidic or basic in any way.

- Digestive pH: The human body produces hydrochloric acid, which assists digestion. Hyperacidity is a condition in which the stomach produces too much acid. Anti-acid tablets or suspensions can be used to treat hyperacidity.

- pH and dental decay: When the pH of the mouth falls below, tooth enamel, the toughest component in our bodies, corrodes. Toothpaste cleaning aids in the prevention of tooth decay. Toothpaste is basic, and as a result, it neutralises excess acid in the mouth, preventing tooth decay.

Salts and their pH:

Salts are made by combining an acid and a base. Positive ions, also known as 'cations,' and negative ions, sometimes known as 'anions,' make up salts. The cations are known as basic radicals and are derived primarily from metallic ions (except the ammonium ion), whereas the anions are known as acidic radicals and are derived from acids.

$$Na^{+}OH^{-}(aq) \; + \; H^{+}Cl^{-}(aq) \; \rightarrow \; NaCl(aq) \; + \; H_2O(l)$$

Sodium hydroxide   Hydrochloric acid   Sodium chloride   Water

(Base)   (acid)   (Salt)

Salt is a compound that, when dissociated in water, produces positive ions other than hydrogen and hydronium ions, as well as a negative ion other than the hydroxyl ion.

Family of salts: The following are the several types of salts:

Normal or Neutral Salts - A normal salt is generated when the replaceable hydrogen ions of an acid are completely replaced by a metal ion or an ammonium ion. Examples : NaCl, Na_2SO_4, Na_3PO_4, NH_4Cl, K_2CO_3

and so on. The neutralisation reaction produces a neutral salt. Strong acid and strong base salts combine to generate such compounds with a neutral pH of 7.

Sodium Chloride:

Common salt is sodium chloride, which is the most widely available salt. The main source of sodium chloride is seawater. The most common soluble salt in seawater is sodium chloride

$(2.7 \text{ to } 2.9\,\%)$, which makes up roughly $3.5\,\%$ of the total. Inland lakes' saline water is another good source of this salt. Rock salt is a form of sodium chloride. Evaporation of seawater is the most common method of obtaining common salt. Crude sodium chloride is made by crystallising 'brine,' which contains impurities such as sodium sulphate, calcium sulphate, calcium chloride, and magnesium chloride. By dissolving the crude salt in a small amount of water and filtering it to eliminate insoluble contaminants, pure sodium chloride can be obtained. When pure sodium chloride crystals break from the solution, it is saturated with hydrogen chloride gas. Calcium and magnesium chlorides remain in solution because they are more soluble than sodium chloride.

Properties:

- Sodium chloride is a white crystalline solid having a density of 2.17 g/ml.
- It melts at $1080\text{ K}\ (807\ ^\circ\text{C})$ and boils at $1713\text{ K}\ (1440\ ^\circ\text{C})$
- It is soluble in water and its solubility is $36\text{ g per }100\text{ g of water at }273\text{ K.}\ (0^\circ\text{C})$. The solubility in water remains constant with temperature.
- Pure sodium chloride is non-hygroscopic but behaves as hygroscopic due to the impurities of $CaCl_2$ and $MgCl_2$ in it.
- Solid Sodium chloride does not conduct electricity at room temperature but molten sodium chloride is a very good ionic conductor.

Uses:

- Table salt, is an essential constituent of our food.
- In the manufacture of Na_2CO_3, $NaOH$, Cl_2, etc.
- For salting out soap, and organic dyes.
- In freezing mixtures.
- In the tanning and textile industries.

- As a preservative for fish, meat, butter etc.

Sodium Hydroxide $(NaOH)$:

Because of its corrosive effect on animal and vegetable tissues, sodium hydroxide is usually referred to as caustic soda. The electrolytic process known as the 'Chlor-alkali process' is used to produce large amounts of sodium hydroxide. The anode emits chlorine gas, while the cathode emits hydrogen gas. Near the cathode, a sodium hydroxide solution forms.

Properties:

- Sodium hydroxide is a white deliquescent solid having melting point at $591\ K\ (318^{\circ}C)$
- It is stable towards heat.
- It is highly soluble in water and a considerable amount of heat is evolved due to the formation of a number of hydrates e.g., $NaOH.H_2O$, $NaOH.2H_2O$
- . It is also soluble in alcohol.
- Aqueous solution of sodium hydroxide is strongly alkaline due to its complete dissociation into - Na^+ and OH^-

$$NaOH + H_2O \rightarrow Na^+(aq) + OH^-(aq)$$

- When you touch a sodium hydroxide solution, it feels soapy. It has a sour taste to it. When the skin is exposed to a concentrated solution of sodium hydroxide, the skin and flesh are broken down into a pasty substance.

Uses:

- Soap, paper, viscose rayon (fake silk), organic dyestuffs, and a variety of other compounds are made with it.
- In the petroleum and vegetable oil refining industries.
- In the purification of bauxite for aluminium extraction.

- As a cleaning agent and in the machine, metal sheet, and other laundry powders It's too corrosive to use on your clothes or your hands.
- Used to mercerize cotton.
- In the laboratory, as a reagent.
- In rubber reclamation.
- In the manufacture of soda lime.

Bleaching Powder

Bleaching powder is a chemical compound with the formula $Ca(OCl)_2$. It is commonly used for various purposes:

- **Disinfection**: Used to disinfect drinking water and sanitize swimming pools.
- **Bleaching Agent**: Employed in the bleaching of cotton and linen in the textile industry, as well as in the bleaching of wood pulp in the paper industry.
- **Oxidizing Agent**: Acts as an oxidizing agent in various chemical reactions.

Baking Soda

Baking soda, also known as sodium bicarbonate ($NaHCO_3$), has several uses:

- **Baking**: Used as a leavening agent in baking to help the dough rise.
- **Antacid**: Neutralizes stomach acid, providing relief from indigestion and heartburn.
- **Cleaning**: Used as a mild abrasive and deodorizer in household cleaning.
- **Fire Extinguisher**: Used in some fire extinguishers as it releases CO_2 when heated, helping to smother flames.

Washing Soda

Washing soda, or sodium carbonate (Na_2CO_3), is used in several applications:

- **Laundry**: Used as a water softener in laundry detergents, helping to remove stains and enhance cleaning.
- **Cleaning Agent**: Employed in household cleaning products for scrubbing and removing grease.
- **Glass Manufacturing**: Used in the manufacture of glass, where it helps to lower the melting point of silica.
- **pH Adjustment**: Used in various industrial processes to adjust the pH of solutions.

Plaster of Paris $[CaSO_4.1/2\ H_2O]$:

Plaster of Paris is calcium sulphate with half a molecule of water per molecule of salt (hemihydrate) (plaster of Paris).

- **Crystallization Water:**

When crystals of certain salts form, they do so using a specific quantity of water molecules combined chemically in a specific proportion. The number of water molecules chemically associated in a specific molecular proportion with the salt in its crystalline state is known as the water of crystallisation. The geometric shape and colour of the crystals are due to this water.

- **Remember**

A hydrous substance, also known as a hydrate, is a compound that contains water of crystallisation. This water can be ejected from the salt by heating it, and the salt is then considered to be anhydrous.

- **Preparation:**

Plaster of Paris is prepared by heating gypsum $(CaSO_4.2H_2O)$ at $120^{\circ}C$ in rotary kilns, where it gets partially dehydrated.

$$2(CaSO_4.2H_2O)\xrightarrow{120^{\circ}C}(CaSO)_4.H_2O+2H_2O$$

The temperature should be kept below $140^{\circ}C$ otherwise further dehydration will take place and the setting property of the plaster will be partially reduced.

- **Properties:**

It's a powder that's white in colour. When combined with water $(1/3 \text{ of its mass})$, it generates heat and hardens into a porous mass within $5 \text{ to } 15 \text{ minutes}$. During the setting process, the volume expands slightly $(\text{about } 1\ \%)$ so that it entirely fills the mould and leaves a clear impression. The following is how the setting procedure works:

$$CaSO_4/2H_2O \xrightarrow[setting]{H_2O} CaSO_4.2H_2O \xrightarrow[hardening]{} CaSO_4.2H_2O$$

plaster of paris	gypsum	gypsum
	orthorhombic	monoclinic
	dihydrate	dihydrate

The setting stage is the first, and the hardening stage is the second. Sodium chloride catalyses the setting of plaster of Paris, while borax or alum reduces it.

Uses:

- For manufacturing casts for sculptures, in dentistry, for surgical instruments, for toys, etc.
- In surgery for setting broken or shattered bones.
- In the creation of blackboard chalks and statues
- In the construction field.