	INDIAN SCHOOL AL WADI AL KABIR	
Class: X	**DEPARTMENT OF SCIENCE -2022-23** **SUBJECT : CHEMISTRY**	DATE OF COMPLETION: 05.06.2022
NOTES	**CHAPTER- ACIDS, BASES AND SALTS**	
CLASS & SEC:	**NAME OF THE STUDENT:**	**ROLL NO.**

ACIDS, BASES AND SALTS

On the basis of chemical properties, all compounds can be classified into three groups.

- Acids
- Bases
- Salts

ACIDS-Turns blue litmus red. Acidic nature is due to the formation of H+ ions in solution.

BASES-Turns red litmus blue. Basic nature is due to the formation of OH- ions in solution.

INDICATORS:-Substances that are used to check whether a substance is acidic or basic. Indicators have different colours in acidic and basic medium.

Eg: - Turmeric, Litmus-(Blue, Red), Phenolphthalein, Methyl orange.

Indicators	Colour in acids	Colour in bases
Turmeric(yellow)	Yellow	Reddish brown
Litmus(blue, red)	Blue → red	Red → blue
Methyl orange(orange)	Red	Yellow
Phenolphthalein(colourless)	Colourless	Pink

Olfactory indicators:-Those substances whose smell changes in acidic or basic solutions are called olfactory indicators.

Eg:-Onion and vanilla extract.

CHEMICAL REACTIONS OF ACIDS AND BASES

1. REACTION OF ACIDS AND BASES WITH METALS:-

- Acids react with metals to form hydrogen gas and salt.

Acid + metal → Salt + hydrogen gas

Eg:-$H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2$

- Bases react with some metals to form hydrogen gas.

Eg:- $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$

Sodium zincate

- The presence of hydrogen gas can be tested by bringing a burning candle near the mouth of the test tube. Hydrogen gas burns with a pop sound. (The candle flame will go off.)

2. REACTION OF ACIDS WITH METAL CARBONATES AND METAL HYDROGENCARBONATES:-

Acid + metal carbonate/metal hydrogencarbonate→ Salt + water + Carbon dioxide gas

Eg:- $2HCl + Na_2CO_3 \rightarrow 2NaCl + H_2O + CO_2$

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

The presence of carbon dioxide gas can be tested by passing the gas through lime water. The lime water turns milky. (due to the formation of white insoluble $CaCO_3$)

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

White insoluble

On passing excess amount of CO_2, the solution becomes clear. (due to the formation of soluble $Ca(HCO_3)_2$)

$CO_2 + CaCO_3 + H_2O \rightarrow Ca(HCO_3)_2 + H_2O$

Soluble

3. REACTION OF ACIDS WITH BASES:-

Acid + Base → Salt + water

Eg:- $HCl + NaOH \rightarrow NaCl + H_2O$

A chemical reaction in which an acid reacts with a base to form salt and water is known as Neutralisation reaction.

4. REACTION OF ACIDS WITH METAL OXIDES:-

Acid + metal oxide → Salt + water

Eg:- $2HCl + CuO \rightarrow CuCl_2 + H_2O$

black blue-green

- Metal oxides are basic in nature

5. REACTION OF NON-METAL OXIDES WITH BASES:-

Non-metal oxide + Base → Salt + water

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

- Non-metal oxides are acidic in nature.

WHAT DO ACIDS AND BASES HAVE IN COMMON

- All acids have similar chemical properties.
- Acids generate hydrogen gas on reacting with metals.

All the compounds containing hydrogen are not acids

- Solution of an acid conducts electricity due to the presence of charged particles called ions in it.
- Acids produce hydrogen ions (H^+) in solution. These H+ ions are responsible for their acidic properties. These H+ ions can carry electric current.
- It is the presence of hydrogen ions which gives an acid solution its acidic properties.
- Hydrogen containing compounds like glucose and alcohol do not produce hydrogen ions in solution. So, solutions of glucose and alcohol do not show acidic character.
- When a base is dissolved in water, it always produces hydroxide ions (OH^-) and due to the presence of OH^- ions, basic solutions conduct electricity.

- **ACID**:- An acid is a substance which dissolves in water to produce hydrogen ions (H^+ions) in solution.
- **BASE:-** A base is a substance which dissolves in water to produce hydroxide ions (OH^- ions) in solution.

Acids and bases in water solution.

- Acids and bases produce ions (H^+ or OH^-) only in aqueous solution.
- Acids and bases do not show their behavior in the absence of water.
- Dry HCl gas does not contain H+ ions (because of the absence of water). So, it does not show acidic behavior. When HCl gas dissolves in water, it forms H+ ions and shows acidic behavior.

$$HCl + H_2O \rightarrow \underset{\text{Hydronium ion (H+(aq))}}{H_3O^+} + Cl^-$$

Ionisation or dissociation of acid

When a base is dissolved in water, it gives OH^- ions.

$$NaOH_{(S)} + H_2O \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$$

Ionisation or dissociation of base.

- Bases which are soluble in water are called **alkalis.**

Concentrated acid	Dilute acid
A concentrated acid is one which contains minimum possible amount of water in it.	A dilute acid is one which contains much more of water in it.

DILUTION OF ACIDS

- The dilution of a concentrated acid should always be done by adding concentrated acid to water gradually with stirring and not by adding water to concentrated acid.
- The process of mixing concentrated acid with water is highly exothermic.
- When concentrated acid is added to water, the heat evolved is gradually and easily absorbed by the large amount of water.
- If water is added to concentrated acid, then large amount of heat is evolved. This heat changes some of the water to steam explosively which can splash acid on our face and cause acid burns.
- Dilution of an acid or base results in decrease in the concentration of ions (H+/OH-) per unit volume.

STRONG ACID	WEAK ACID
An acid which is completely ionised in water and thus produces a large amount of hydrogen ions. Eg:-Sulphuric acid, hydrochloric acid, Nitric acid etc.	An acid which is partially ionised in water and thus produces less amount of hydrogen ions. Eg: - Ethanoic acid, Carbonic acid etc.

STRONG BASE	WEAK BASE
A base which is completely ionised in water and thus produces a large amount of hydroxide ions. Eg:-Sodium hydroxide, Potassium hydroxide etc.	A base which is partially ionised in water and thus produces a small amount of hydroxide ions. Eg:- Ammonium hydroxide, Magnesium hydroxide etc.

STRENGTH OF ACIDS AND BASES – pH Scale

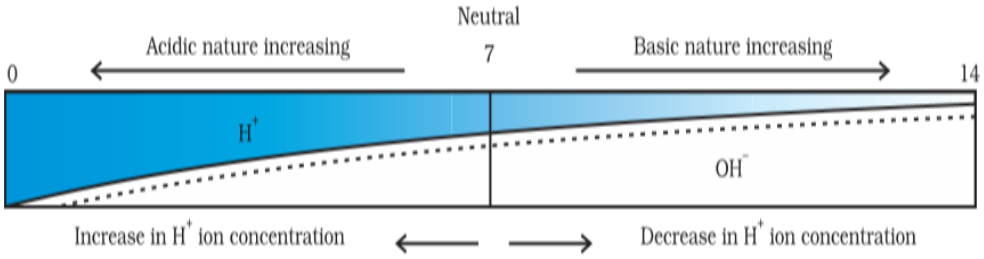
The strength of an acid or base is measured on a scale of numbers called pH scale. The pH scale has values from 0 to 14.

- Acids produce hydrogen ions in water. Acidic solutions have excess hydrogen ions.
- Bases produce hydroxide ions in water. Basic solutions have excess OH- ions.
- In pure water, concentrations of H+ and OH- ions are equal.
- pH of a solution is inversely proportional to the concentration of hydrogen ions.
- Neutral substances have a pH of exactly 7.
- Acids have a pH of less than 7 (more acidic a solution is, the lower will be its pH)
- Bases have a pH of more than 7. (higher the pH, stronger the base.)

UNIVERSAL INDICATOR

Universal indicator is a mixture of several indicators used to know the strength of acids and bases.

It gives different colours according to the strength of acids and bases.



Variation of pH *with the change in concentration of* $H^+(aq)$ *and* $OH^-(aq)$ *ions*

IMPORTANCE OF pH IN EVERYDAY LIFE

- Our body works within the pH range of 7.0 to 7.8. Living organisms can survive only in a narrow range of pH change. When pH of rain water is less than 5.6, it is called acid rain.
- Plants require a specific pH range for their healthy growth.
- pH in our digestive system:-
  During indigestion the stomach produces too much acid and this causes pain and irritation. To get rid of this pain, people use bases called antacids. These antacids neutralise the excess acid. Magnesium hydroxide (Milk of magnesia), a mild base, is often used for this purpose.

- Tooth decay starts when the pH of the mouth is lower than 5.5. Tooth enamel, made up of calcium phosphate is the hardest substance in the body. It does not dissolve in water, but is corroded when the pH in the mouth is below 5.5. Using toothpastes, which are generally basic, for cleaning the teeth can neutralise the excess acid and prevent tooth decay.

- Self-defense by animals and plants through chemical warfare:-
  Bee-sting leaves an acid which causes pain and irritation. Use of a mild base like baking soda on the stung area gives relief. Stinging hair of nettle leaves inject methanoic acid causing burning pain.

SALTS

- Salts are formed when acids react with bases.

  Acid + Base → Salt + Water
- A salt is a compound formed from an acid by the replacement of the hydrogen in the acid by a metal.
- The name of the salt consists of two parts: The first part of the name of salt is derived from the name of the base, and the second part of the name of the salt comes from the name of acid.
- Eg:- The name 'sodium chloride' comes from sodium hydroxide base and hydrochloric acid.
  - The salts of hydrochloric acid are called chlorides
  - The salts of sulphuric acid are called sulphates.
  - The salts of nitric acid are called nitrates.
  - The salts of carbonic acid are called carbonates.
  - The salts of acetic acid are called acetates.

SOME COMMON EXAMPLES OF SALTS

	SALTS		DERIVED FROM	
	NAME	FORMULA	BASE	ACID
1.	Potassium sulphate	K_2SO_4	KOH	H_2SO_4
2.	Sodium sulphate	Na_2SO_4	NaOH	H_2SO_4
3.	Magnesium sulphate	$MgSO_4$	$Mg(OH)_2$	H_2SO_4
4.	Potassium chloride	KCl	KOH	HCl
5.	Calcium nitrate	$Ca(NO_3)_2$	$CaO/Ca(OH)_2$	HNO_3

- Salts having the same positive or negative ions are said to belong to a family.
  Eg:-
- Sodium chloride(NaCl) and sodium sulphate(Na_2SO_4) belong to the same family of salts called sodium salts.(both contain same positively charged ions, sodium ions)
- Sodium chloride(NaCl) and potassium chloride(KCl) belong to the same family called chloride salts.(both contain same negatively charged ions, chloride ions.)

CLASSIFICATION OF SALTS

1. Neutral salt
2. Acidic salt
3. Basic salt

Neutral salt:-

A **neutral salt** is formed when a strong base reacts with a strong acid.

Eg:-

1. Sodium chloride(NaCl)- formed from strong acid HCl and strong base NaOH

2. Potassium sulphate(K_2SO_4)- formed from strong acid H_2SO_4 and strong base KOH

Acidic salt:-

An acidic salt is formed when a strong acid reacts with a weak base.

Eg:-

1. Ammonium chloride (NH_4Cl)- is the salt of strong acid HCl and weak base NH_4OH.

2. Ammonium sulphate, $(NH_4)_2SO_4$- is the salt of strong acid H_2SO_4 and weak base NH_4OH.

Basic salt:-

A basic salt is formed when a strong base reacts with a weak acid.

Eg:-

1. Sodium carbonate, Na_2CO_3- is the salt of strong base NaOH and weak acid H_2CO_3.

2. Sodium acetate, CH_3COONa- is the salt of strong base NaOH and weak acid CH_3COOH

pH of salts:-

- The salt of a strong acid and a strong base will be neutral in nature. pH = 7 (approx.)
- The salt of a weak acid and a strong base will be basic in nature. pH > 7.(the solution of this salt turns red litmus blue.)
- The salt of a strong acid and a weak base will be acidic in nature. pH < 7.(the solution of this salt turns blue litmus red.)

CHEMICALS FROM COMMON SALT

COMMON SALT-NaCl

- The chemical name of common salt is sodium chloride. It is a white coloured substance.

PREPARATION

- By the combination of sodium hydroxide and hydrochloric acid.
- Common salt is obtained from sea water by the process of evaporation.
- Rock salt (brown due to impurities) is mined from the underground deposits.

CHEMICALS FROM COMMON SALT

1. **SODIUM HYDROXIDE(caustic soda)**

   PREPARATION:-

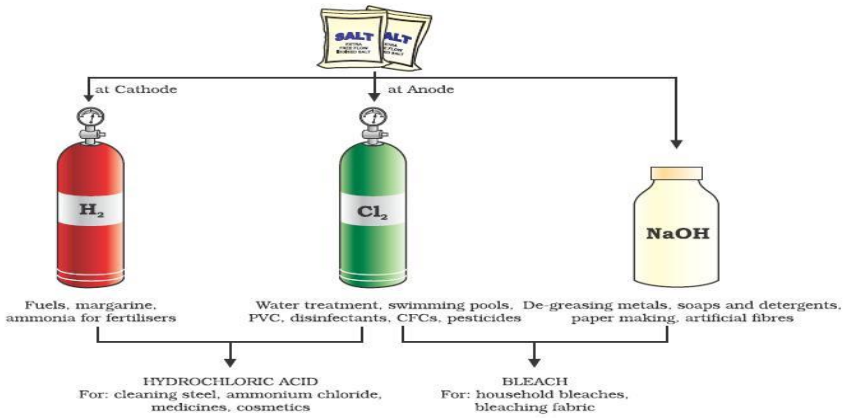
   It is produced by the electrolysis of concentrated aqueous solution of sodium chloride (brine).

   This process is called **chlor-alkali process.**

   $$2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$$

   Chlorine gas is given off at the anode and hydrogen gas at the cathode. Sodium hydroxide solution is formed near the cathode.

Important products from the chlor-alkali process



2. BLEACHING POWDER-$CaOCl_2$

Preparation:-

Bleaching powder is produced by the action of chlorine on dry slaked lime. (Chlorine gas is obtained during the electrolysis of aqueous sodium chloride ie, brine)

$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

USES OF BLEACHING POWDER

- For bleaching
  Cotton and linen in textile industry
  Wood pulp in paper factories
  Washed clothes in laundry.
- As an oxidising agent in chemical industries.
- For disinfecting drinking water.

3. BAKING SODA (Sodium hydrogencarbonate)

- It is a basic salt.

Preparation:-

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

On heating, $NaHCO_3$ decomposes to give Na_2CO_3, H_2O and CO_2

$$\underset{\text{(Sodium hydrogencarbonate)}}{2NaHCO_3} \xrightarrow{\text{Heat}} \underset{\text{(Sodium carbonate)}}{Na_2CO_3} + H_2O + CO_2$$

USES OF BAKING SODA

1. For making baking powder
(A mixture of baking soda and a mild edible acid such as tartaric acid)
   - When baking powder is heated or mixed with water, CO_2 gas is released which causes bread or cake to rise making them soft and spongy.

   $NaHCO_3 + H^+ \rightarrow CO_2 + H_2O$ + Sodium salt of acid.
2. As an ingredient in antacids.

3. Used in soda- acid fire extinguishers.

4. **WASHING SODA ($Na_2CO_3.10H_2O$)**

- It is a basic salt.

Preparation:- It is prepared by the recrystallisation of sodium carbonate.(Sodium carbonate is obtained by heating baking soda)

$$\underset{\text{(Sodium hydrogencarbonate)}}{2NaHCO_3} \xrightarrow{\text{Heat}} \underset{\text{(Sodium carbonate)}}{Na_2CO_3} + H_2O + CO_2$$

$$\underset{\text{(Sodium carbonate)}}{Na_2CO_3} + 10\,H_2O \rightarrow Na_2CO_3.10\,H_2O$$

USES OF WASHING SODA

1. Used in glass, soap and paper industries.
2. Used in the manufacture of sodium compounds such as borax.
3. Used as a cleaning agent for domestic purposes.
4. Used for removing permanent hardness of water.

WATER OF CRYSTALLISATION: HYDRATED SALTS

Water of crystallisation is the fixed number of water molecules present in one formula unit of a salt. The salts which contain water of crystallisation are called hydrated salts.

- When hydrated salts are heated strongly, they lose their water of crystallisation.
- The salts which have lost their water of crystallisation are called anhydrous salts.
- Eg:-
  On strong heating, blue copper sulphate crystals turn white.
  Anhydrous copper sulphate turns blue on adding water.

PLASTER OF PARIS

On heating Gypsum at 373K, it loses water molecules and becomes Calcium sulphate hemihydrate ($CaSO_4$. ½ H_2O). This is called Plaster of Paris.(it is a white coloured powder)

$$CaSO_4.2H_2O \xrightarrow[373\,K]{\text{Heat}} CaSO_4.\frac{1}{2}H_2O + 1\frac{1}{2}H_2O$$

On mixing with water, it changes to gypsum once again giving a hard solid mass.

$$CaSO_4.\tfrac{1}{2}H_2O + 1\tfrac{1}{2}H_2O \rightarrow CaSO_4.2H_2O$$

USES OF PLASTER OF PARIS

- It is used in hospitals for setting fractured bones in the right position to ensure correct healing.
- It is used in making toys, decorative materials, cheap ornaments, cosmetics, black-board and casts for statues.

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