Acid & Bases

ACIDS

Acids come from the Latin work 'acere' meaning sour.

Acids are substances which are sour to taste….e.g. lemons and oranges are sour to taste..as they have citric acid. Similarly Vinegar is also sour in taste as it has an acid called Acetic Acid in it.

They are of 2 types of Acids: - **Mineral Acids & Organic Acids**

TYPES OF ACIDS

MINERAL ACIDS	ORGANIC ACIDS
1) Acids that can be prepared from naturally occurring compounds/ minerals are called Mineral Acids	1) Acids that occur naturally in plant & animal materials are called Organic Acids
2) Hydrochloric, Sulphuric & Nitric Acids. Sulphuric & Nitric acid are strong acids	2) Carbonic Acid, lactic acid & Acetic acid. These acids found in fruits & vegetables are generally weak.
3) These acids should be handled with great care as they can burn our skin or clothes.	e.g. Amla (gooseberry) has Ascorbic Acid Lemon, Grape fruit & Orange – Contain Citric Acid.
e.g. Sulphuric, Nitric , Hydrochloric Acids, Boric Acid, Carbonic Acid (made out CO_2)	e.g Lactic Acid, Acetic Acid, Formic Acid. Citric Acid, Oxalic Acid, Uric acid.

FOOD & ACIDS THEY CONTAIN

FOODS	ACIDS
Tomato	Malic, Citric, Ascorbic acid
Grapefruit, Orange, Lemon	Citric acid
Curd, Milk	Lactic Acid
Mango, Banana, Tamarind, Grape	Tartaric Acid
Tea	Tannic acid
Amla	Ascorbic acid
Coca cola	Carbonic acid
Apple	Malic Acid
Proteins	Amino acid
Vinegar	Acetic acid
Ant's Sting	Formic acid
Spinach	Oxalic acid

BASES/ALKALI

- Bases are substances that are bitter to taste and soapy and slippery to touch.
- For example, bleaches, soaps, toothpastes and cleaning agents contain bases.

PRODUCT	BASE
Soap	Caustic soda (NaOH)
Limewater	[$Ca(OH)_2$]
Window Cleaners	Ammonium Hydroxide or (NH_4OH) or Ammonia water
cooking and baking.	Baking Soda- Sodium Bicarbonate [$NaHCO_3$]
Antacid tablets to control acidity. E.g. Digene	Aluminium Hydroxide

PROPERTIES OF ACIDS

1. Acids are **sour in taste**
2. **Corrosive in nature** - Acids corrode metals & even cut their surface.
3. **Acids are soluble in water** – When dissolved in water, they become diluted & release hydrogen ions (H+). (sometimes give out heat also).
4. **Reaction with Metals** - When certain acids react with metals, Hydrogen gas is released.
5. **Conduct Electric Current-** The aqueous (water) solution of acids conducts electric current (i.e. the solution acts like electrolytes)
6. **Reaction with bases** - They react with bases to form salt and water.
7. **Reaction with Carbonates** - Acids react with carbonates to form carbon dioxide water & salt.

USES OF ACIDS

1. **Essential For Humans-** Acids present in fruits and vegetables provide us with essential acids needed by our body.
2. **For Digestion-** Hydrochloric acid is a part of the gastric acid in humans and animals that helps in digestion.
3. **As Preservatives** - Acids eg. Acetic acid is added to pickles in order to give it a sour taste and for preservation.
4. **Removing Rust** - Acids are used to remove rust. E.g. Steel used in the construction of buildings is treated with acid before painting.
5. **Removing Scales** - HCl is used to remove scales (deposits) on boilers.
6. **In Agriculture**- Sulphuric Acid (H_2SO_4) & Nitric Acid (HNO_3) are used for manufacturing fertilizers for agriculture.
7. **Cleaning Agents** - Acids are used in homes for cleaning sanitary ware, windows & floors.
8. **In Painting & Dying Industry-** Acids are used in the manufacture of **Paints & Dyes.**
9. **Metal Purification-** Nitric Acid is used to purify metals such as silver and gold.
10. **In Explosives -** Nitric Acid is also used for preparation of explosives like Dynamite and TNT.

Q. Why are pickles / curd/ acids not stored in metal containers?

Ans. As they contain acids which are corrosive in nature. They react with metals & may even cut through the metal surface. Hence, they are stored in glass containers.

Q. An Antacid tab is taking during acidity. Why?

Ans. Our stomach contains Hydrochloric acid that helps to digest food. Too much of the acid in our stomach causes indigestion, to treat this we take an antacid such as milk of magnesia which neutralizes the effect of excessive acid.

PROPERTIES OF BASES/ALKALIS

1. **Bitter Taste**
2. **Slippery to touch**
3. **All Bases are not soluble in water –** Bases that are soluble in water are called alkalis. They produce Hydroxide ions (OH^-) in water.
4. **Reaction with Acids to form Salts -** Bases react with acids to form salt and water.
5. **Corrosive -** Strong bases like Caustic soda & caustic potash are corrosive & dangerous to skin and eyes.

USES OF BASES

1. **Strong Household Cleaners** – Bases are often used as household cleaners as they help to remove stains and tarnish by reacting with oils & fats. eg. Ammonium Hydroxide (Window Cleaner) is a base which dissolves grease.
2. **Drain Cleaners** - Sodium Hydroxide & Ammonia are used in making Drain cleaners that also have a choking smell.
3. **To reduce Acidity in Body** – Milk of Magnesia (Magnesium hydroxide) is used as an Antacid which works to reduce acidity in stomach.
4. **In Soap, Rayon & paper Industry** - Sodium hydroxide (A Base) is used for making soap, rayon & paper.
5. **Bleaching Agent-** For making bleaching powder.
6. **For white washing of buildings.-** When Lime or calcium oxide is dissolved in a large amount of water It forms a white solid called Calcium Hydroxide or slaked lime (कास्टिक चूना) which is applied on walls and specially roof as a substitute for cement in low cost construction.
7. **For neutralizing the acidity of soil when it becomes acidic** due to excessive use of chemical fertilizers.

DIFFERENT TYPES OF SOLUTIONS

1. **Acidic Solutions :** Acids when dissolved in water give acidic solutions.
2. **Basic Solutions :** Bases when dissolved in water give basic solutions.
3. **Neutral substances / Solutions :** The substances which are neither acid nor basic are called neutral substances e.g. Pure water is neutral.

CHEMICAL REACTION

- When two or more substances react with one another to produce some other substances. It is known as a **Chemical Reaction**.
- Substances that react among themselves are called **Reactants**.
- Substances that are formed are called **Products.**
- No atoms are lost or gained in a chemical change and hence the no. of atoms on the reactant side should always be same as those on the product side. This then would make the equation a **Balanced Equation.**

DIFFERENTIATING BETWEEN ACIDS AND BASES

We can use different things to determine whether a substance is an Acid or Base:

A. Indicators

a. Natural b. Synthetic

B. Determining the PH value of the substances **C. Using Hydrangea Flower**

A. INDICATORS :

- Special substances that help us in identifying whether a substance is acidic or basic are called Indicators.
- They change their colour when added to an acidic or basic solution.
- There are different types of Indicators

a). **NATURAL INDICATORS**

i) Turmeric - This is a natural indicator .This is because turmeric contains an ingredient called Curcumin which acts as an indicator.

It remains yellow in acidic (vinegar) or neutral solutions and turns red in basic solutions (soap solution).

Solution	Colour of Turmeric Solution	Remarks
1. Vinegar	**Remains yellow**	Vinegar is Acidic
2. Baking Soda	**Turns Red**	Baking soda is Basic
3. Lemon Water (Mix lime juice in water)	**Remains yellow**	Lemon water is Acidic
4. Glucose water	**Remains yellow**	Is neutral
5. Pineapple juice	**Remains yellow**	Is acidic
6. Milk of Magnesia	**Turns red**	Is Basic

b) Red Cabbage

- Red cabbage juice is also a natural indicator.
- When the red cabbage juice is boiled it helps in identifying acids and bases.
- Natural colour or Red Cabbage is Purple.
- When we add cabbage juice, the following changes are seen:

Indicator added	To Acidic Solution	To Basic Solution	To Neutral Solution
Red Cabbage Juice	Solution Turns Red. E.g. Vinegar turns red	Solution Turns Greenish Yellow E.g. Ammonia turns greenish yellow	Solution turns Purple E.g. Water turns purple.

c) Litmus : Is also a Natural Indicator or a Natural Dye

- Is a water soluble mixture of different dyes extracted from lichens especially, Roccella tinctoria (lichens are mostly seen on bark of trees).
- Is often absorbed into filter paper to produce Red and Blue litmus paper.
- **Blue Litmus paper** (**'B'** for Blue Litmus, **'B'** in Base)
  Remains same in Base- But turns Red In Acid
- **Red litmus paper** Remains same in Acid- But turns Blue in Base
- **For neutral solutions,** neither the blue not the red litmus paper will not change into any other colour.
- But to test if a solution is neutral or not , we should use and verify using both the red and blue litmus papers
- If we dip blue and red litmus in the below mentioned solutions; this is what happens:-

BLUE LITMUS

TEST SOLUTION	Colour Change	Hence the solution is..
Vinegar	Turns Red	Acidic
Milk of Magnesia	No change	Basic
Window cleaner (Ammonia water)	No change	Basic
Lemon Juice	Turns Red	Acidic
Apple juice	Turns Red	Acidic

RED LITMUS

TEST SOLUTION	Colour Change	Hence the solution is..
Vinegar	No Change	Acidic
Milk of Magnesia	Turns blue	Basic
Window cleaner (Ammonia water)	Blue	Basic
Lemon Juice	No change	Acidic
Apple juice	No change	Acidic

d) China Rose/Hibiscus : Is also a Natural indicator. Natural colour of China Rose is Red.

China Rose or Hibiscus indicator turns the colour of acidic solutions to dark pink and Basic solutions to green.

Solution	Effect on China Rose (Indicator)	Remarks
Detergent	Green	Detergent is Basic
Vitamin C Tablet (Ascorbic Acid)	Dark pink	Acidic
Sugar	Red (No Change)	Neutral
Mouthwash	Dark Pink	Acidic

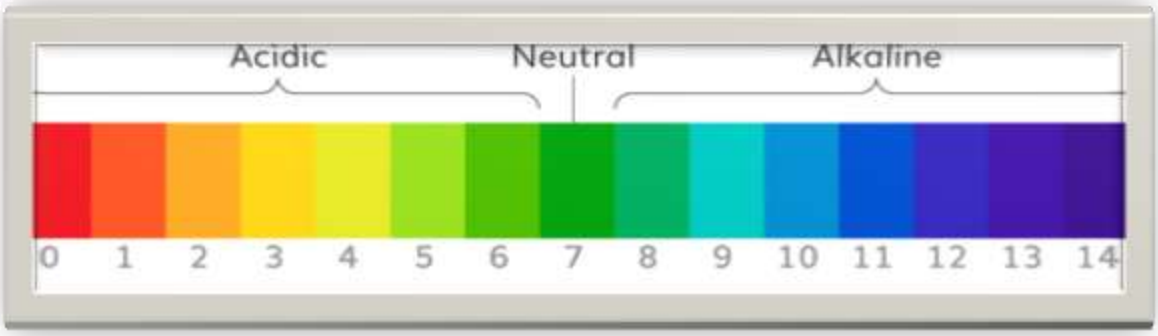
A2. **SYNTHETIC INDICATORS**

- Synthetic indicators are the indicators that are made from chemicals like Phenolphthalein, Methyl Orange & Thymol Blue. They show specific colour changes in acidic and basic solutions.
- Phenolphthalein, a colourless chemical, is the most commonly used indicator. **Phenolphthalein remains colourless in acidic & neutral solutions and turns pink in basic solutions.**

B. PH VALUE AND UNIVERSAL INDICATORS

- PH stands for Power of Hydrogen ions (H^+) concentration in a solution.
- The PH value ranges from 0 to 14.
- 1 - 3 indicates a very acidic substance 4 - 6 indicates an acidic substance 7 indicates neutral 8 - 11 indicates alkalinity 12 - 14 indicates a very high level of alkalinity.

- PH VALUE	- ACIDIC/BASIC/NEUTRAL
- **0-7**	- ACIDIC
- **7**	- NEUTRAL
- **7-14**	- BASIC



Lower the PH value of a substance → Higher is its acidity.
Higher the PH value of a substance → Higher is its basicity.

HYDRANGEA FLOWERS

Hydrangea flowers are of different colours depending on whether the soil where they grow is acidic or basic.

In acidic soil they are blue while in basic soil they are red.

NEUTRALIZATION

When an acid and base are mixed, they try to neutralize each other's effect. This reaction between acids & bases which results in the formation of water and salt, along with evolution of heat energy is called Neutralization.

Acid + Base → Salt + Water.

Since, water is given out in this reaction, it is also known as water forming.

The salt that is formed can be Acidic, Basic or Neutral. This depends on the strength of the acid or base in the reaction.

E.g.

(Hydrochloric acid) (Sodium Hydroxide) (Sodium Chloride)

$HCl + NaOH \rightarrow NaCl + H_2O$

(Strong Acid) (Strong Base) (Neutral Salt)

E.g.

(Sulphuric acid) (Calcium Hydroxide) (Calcium Sulphate)

$H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + H_2O$

(Strong Acid) (Weak Base) (Acidic Salt)

E.g.

(Acitic acid, Vinegar) (Sodium Hydroxide) (Sodium Acetate)

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

(Weak Acid) (Weak Base) (Acidic Salt)

EXAMPLES OF NEUTRALIZATION

1. **SOIL TREATMENT** – Excessive Acidic or Excessive Basic soils hamper plant growth. This is when Neutralization of soil makes it suitable for plant growth.

Excessive Acidic Soil -Is treated with basic compounds like Ammonia based fertilizers before cultivating while **Excessive Basic Soil**- Is treated with Calcium Sulphate ($CaSO_4$) and Sulphur for neutralization.

2. **INDIGESTION** – Gastric juices like Hydrochloric acid help in the digestion of food and in killing harmful bacteria. However, sometimes their excess in the body leads to a burning feeling called indigestion or acidity. For this we take remedies called antacids like **Milk of Magnesia** (Magnesium Hydroxide) and **Sodium Carbonate**. These Antacids are Basic in nature & therefore react with acids in the body to neutralize them.

3. **INSECT BITE**
   When an ant or a bee stings, its **sting is acidic due** to the presence of **formic acid. Hence baking soda** is applied to the skin. Hence, neutralization takes place.
   Sting of a wasp is **basic. Hence to get relief from that vinegar** (Containing acitic acid) is applied to it to neutralize the effect & provide relief.
4. **DISPOSAL OF FACTORY WASTES** -- Acidic wastes from factories is first treated with bases so as to neutralize these wastes. This is done so that when these wastes are disposed off in rivers, the river water does to get too acidic.
5. We brush our teeth with toothpaste as they contain bases which neutralize the acids found in fruit juice and in our mouth. This helps to protect our teeth.
6. **ACID RAIN** -- Acid rain occurs when precipitation picks up pollutants like oxides of Carbon, Sulphur & Nitrogen released by industries.
   In this manner, sulphuric acid, nitric acid & other acidic substances are produced. This acidic moisture gradually damages vegetation, soil & many organisms.
   Acid rain can also damage buildings & statues made of limestone, marble & plaster.
   Such materials are made of Calcium Carbonate ($CaCO_3$) which is basic. When acid rain falls on them, the Sulphuric acid in the rain reacts with the base ($CaCO_3$) present in the building material.
   Hence such materials like $CaCO_3$ get neutralized by acid rain.