6 ACIDS, BASES AND SALTS

In This Chapter You Will Learn :

- *acids : their properties and uses*
- *bases : their properties and uses*
- *salts : their properties and uses*
- *indicators*
- *Soil treatment*
- *Disposal of factory wastes*

SULPHURIC ACID IS USED IN BATTERIES, WHILE VINEGAR, USED IN THE KITCHEN, CONTAINS ACETIC ACID

INTRODUCTION

Compounds are pure substances. The smallest particle exhibiting all the properties of a compound is a ***molecule***. There are very large number of compounds which contain different types of molecules. Therefore they all are different in their properties.

On the basis of their properties, chemical compounds are mainly divided into three classes.

- Acids (*e.g.* : Hydrochloric acid, acetic acid, *etc*.)
- Bases (*e.g.* : Sodium hydroxide, calcium hydroxide, *etc*.)
- Salts (*e.g.* : Common salt (NaCl), copper sulphate, *etc*.)

6.1 ACIDS

The word 'acid' is derived from the Latin word *acidus*, meaning *sour*. Many fruits and vegetables are sour in taste because they contain acids. *Examples* : Oranges, lemons, grapes, *etc*. Different foods contain different acids. Some of them are listed in table 6.1 ahead.

6.2 DEFINITION OF AN ACID

All acids essentially contain hydrogen atom(s) in their molecule which can be released in water. Therefore, an acid is a compound, which furnishes hydrogen ions (H^+) as the only positively charged ions when dissolved in water.

Example :

$$\underset{\text{(hydrochloric acid)}}{HCl} \xrightleftharpoons{H_2O} \underset{\text{(hydrogen ion)}}{H^+} + \underset{\text{(chloride ion)}}{Cl^-}$$

$$\underset{\text{(sulphuric acid)}}{H_2SO_4} \xrightleftharpoons{H_2O} \underset{\text{(hydrogen ion)}}{2H^+} + \underset{\text{(sulphate ion)}}{SO_4^{2-}}$$

$$\underset{\text{(nitric acid)}}{HNO_3} \xrightleftharpoons{H_2O} \underset{\text{(hydrogen ion)}}{H^+} + \underset{\text{(nitrate ion)}}{NO_3^-}$$

The H^+ ions so furnished cannot exist freely. Therefore, they combine with water molecules to give positively charged hydronium ions.

$$H_2O \quad + \quad H^+ \quad \rightleftharpoons \quad H_3O^+$$
(hydronium ion)

6.3 CLASSIFICATION OF ACIDS

Acids can be classified in different ways.

A. *On the basis of their sources*

1. Naturally occurring (organic) acids
2. Mineral (inorganic) acids

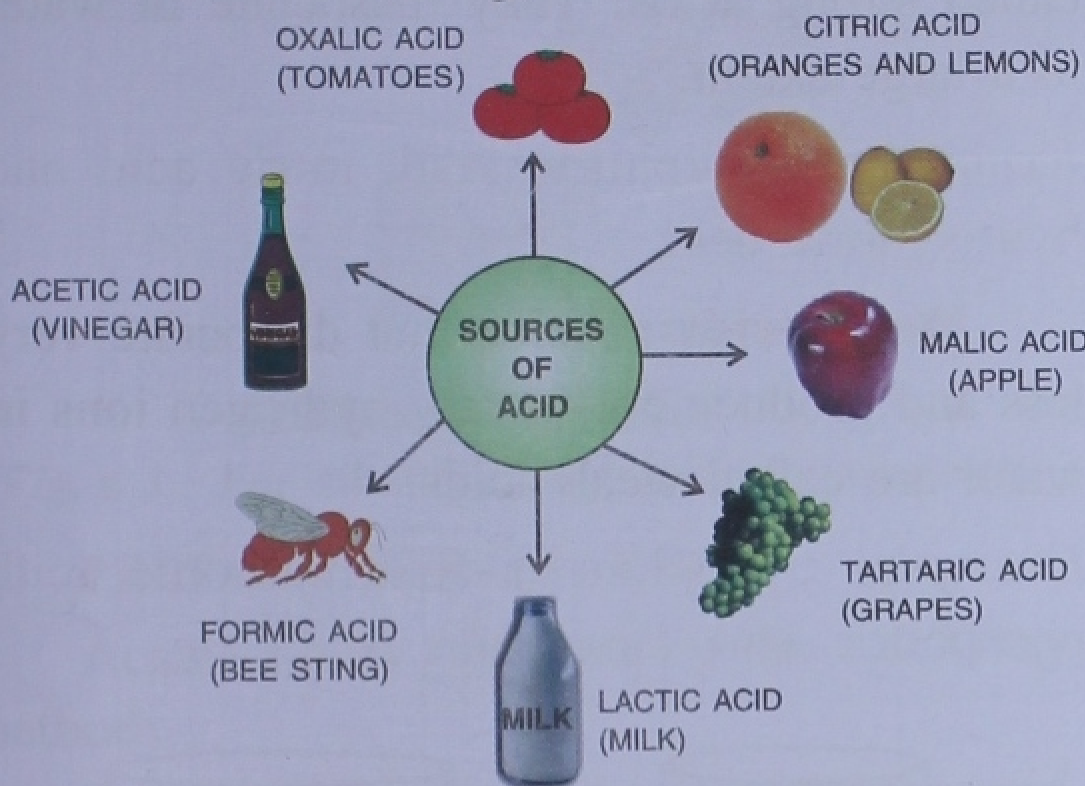


Fig. 6.1 : Some acids and their sources.

6.3.1 Naturally occurring acids

These acids are mostly derived from plants, therefore, they are called *organic acids*. Acetic acid, citric acid, tartaric acid, *etc*. They are present in our food. They can also be prepared artificially.

Table 6.1 Sources of some naturally occurring acids

Acids	*Sources*
1. Citric acid	Oranges, lemons
2. Malic acid	Apples
3. Tartaric acid	Tamarind and grapes
4. Acetic acid	Vinegar
5. Oxalic acid	Tomatoes, spinach
6. Lactic acid	Sour milk and yoghurt
7. Ascorbic acid (vitamin C)	Fruits and vegetables (Amla, citrus fruits)
8. Tannic acid	Tea
9. Hydrochloric acid	Gastric juice (present in the stomach)
10. Folic acid	Lettuce leaves
11. Stearic acid	Mustard oil, rape seed
12. Formic acid	Sting of ants and bees

6.3.2 Mineral acids

These acids are prepared from minerals present in the earth's crust. They are also called *inorganic acids*. They are important laboratory reagents. The three most important inorganic acids are hydrochloric acid, sulphuric acid and nitric acid. Hydrochloric acid is also produced in our stomach. It helps in digestion.

Besides these, *boric acid* is present in our tears, and *carbonic acid* in aerated drinks.

Table 6.2 Important inorganic acids and their chemical formulae

Names	*Chemical formulae*
1. Sulphuric acid	H_2SO_4
2. Hydrochloric acid	HCl
3. Nitric acid	HNO_3
4. Phosphoric acid	H_3PO_4
5. Chromic acid	H_2CrO_4

B. *On the basis of molecular composition :*

1. ***Oxy acids :*** These acids contain oxygen atoms in their molecule. *e.g.* : sulphuric acid (H_2SO_4), nitric acid (HNO_3), *etc*.
2. ***Hydracids :*** These acids do not contain oxygen atoms in their molecules. *e.g.* : hydrochloric acid (HCl), hydrobromic acid (HBr).

Do You Know ?

The atmosphere of venus is made up of thick white and yellowish clouds of sulphuric acid.

6.4 BASICITY OF AN ACID

The basicity of an acid is the number of hydrogen ions (H^+) *produced by one molecule of that acid when dissolved in water.*

Acids can be *monobasic, dibasic, tribasic,* or more, depending upon the number of hydrogen ions furnished per molecule.

Monobasic acids : Acids that furnish only one hydrogen ion (H^+) per molecule in water, are called monobasic acids.

$$HCl \xrightleftharpoons{H_2O} H^+ + Cl^-$$

Examples **:** Hydrochloric acid, nitric acid, acetic acid, *etc.*

$$HCl + H_2O \rightleftharpoons H_3O^+ + Cl^- \text{ (chloride ion)}$$

Dibasic acids **:** Acids that furnish two hydrogen ions (H^+) per molecule in water, are called dibasic acids.

$$\underset{\text{(sulphuric acid)}}{H_2SO_4} \xrightleftharpoons{H_2O} \underset{\text{(hydrogen ion)}}{2H^+} + \underset{\text{(bisulphate ion containing one replaceable } H^+)}{SO_4^{2-}}$$

Examples **:** Sulphuric acid, carbonic acid, sulphurous acid, oxalic acid, *etc.*

Tribasic acids : Acids that furnish three hydrogen ions per molecule in water are called tribasic acids.

Examples **:** Phosphoric acid, phosphorus acid, *etc.*

$$\underset{\text{(phosphoric acid)}}{H_3PO_4} \xrightleftharpoons{H_2O} \underset{\text{(hydrogen ion)}}{3H^+} + \underset{\text{(phosphate ion)}}{PO_4^{3-}}$$

Table 6.3 Acids and their basicity

Name of acid	*Basicity*
1. Hydrochloric acid	1
2. Nitric acid	1
3. Acetic acid	1
4. Sulphuric acid	2
5. Sulphurous acid	2
6. Oxalic acid	2
7. Phosphoric acid	3

6.5 ON THE BASIS OF THE STRENGTH OF ACIDS

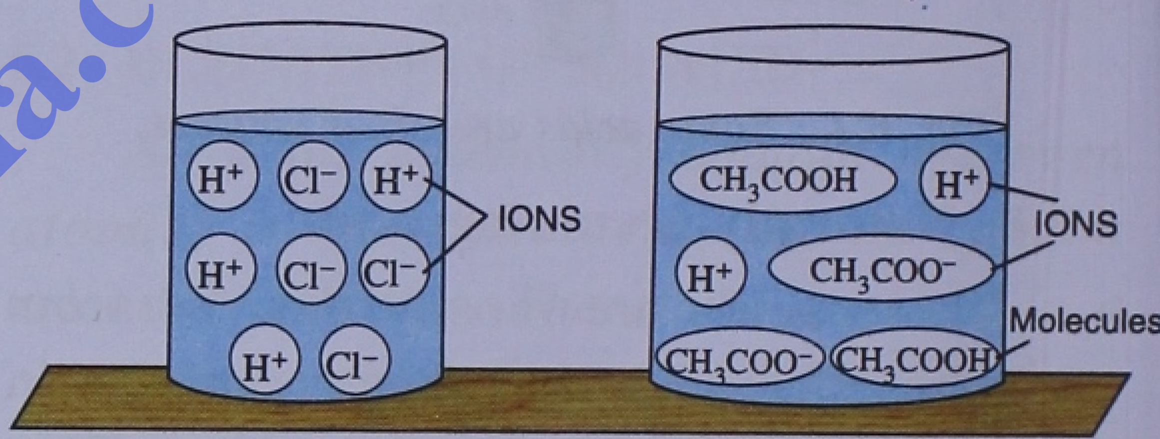
Acids can be divided into *two* types, depending upon the amount of hydrogen ions furnished in water.

Strong acids : Acids that produce large amount of hydrogen ions in water are called strong acids. They dissociate in water to a large extent.

Examples **:** Sulphuric acid, nitric acid and hydrochloric acid.

Weak acids : Acids that dissociate very less and produce only a few hydrogen ions in water are called weak acids.

Examples **:** Sulphurous acid, carbonic acid, phosphoric acid, all organic acids, *etc.*



(A) ***A solution of a strong acid containing only ions.***

(B) ***A solution of a weak acid containing both ions and molecules.***

Fig. 6.2

6.6 ON THE BASIS OF CONCENTRATION

An acid can be concentrated or dilute.

Concentration of acids means amount of acid in a definite amount of water.

A concentrated acid is that in which amount of acid is more and the amount of water is less.

A dilute acid is that which contains less amount of acid and more water.

DILUTION OF AN ACID :

Acids are diluted by adding them to water. This produces a large amount of heat energy (an exothermic reaction). Therefore, while diluting, only a small amount of acid should be added to water at a time, with constant stirring. Never pour water into an acid. Always pour an acid into water.

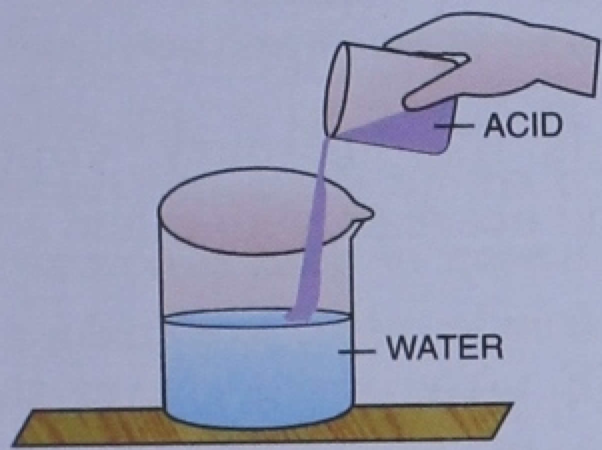


Fig. 6.3 : For dilution acid is poured into water.

6.7 PREPARATION OF ACIDS

Acids can be prepared by the following methods :

(i) *By direct combination of hydrogen and non-metals* : Hydra-acids are prepared by this method. Non-metals like chlorine, bromine, iodine, *etc*., combine directly with hydrogen to produce respective acids.

$$\underset{\text{(hydrogen)}}{H_2} + \underset{\text{(chlorine)}}{Cl_2} \xrightarrow[\text{sunlight}]{\text{diffused}} \underset{\text{(hydrogen chloride)}}{2HCl} \xrightarrow{\text{dissolved in water}} \text{Hydrochloric acid}$$

$$H_2 + \underset{\text{(bromine)}}{Br_2} \xrightarrow{\text{sunlight}} \underset{\text{(hydrogen bromide)}}{2HBr} \xrightarrow{\text{dissolved in water}} \text{Hydrobromic acid}$$

(ii) *By the action of water on non-metallic oxides:* Acids can be prepared by dissolving non-metallic oxides, like nitrogen dioxide, carbon dioxide, sulphur dioxide, *etc*., in water.

> The non-metallic oxides that form acids when dissolved in water, are called acidic oxides.
>
> Acidic oxide + Water → Acid

Activity 1

To prepare carbonic acid by burning charcoal

Heat a piece of charcoal in a deflagrating spoon until it is red hot. Then lower the spoon into a jar containing oxygen. Cover it with a lid. Hot carbon combines with oxygen to form carbon dioxide. Now take out the spoon from the jar and pour some water into the jar. Cover

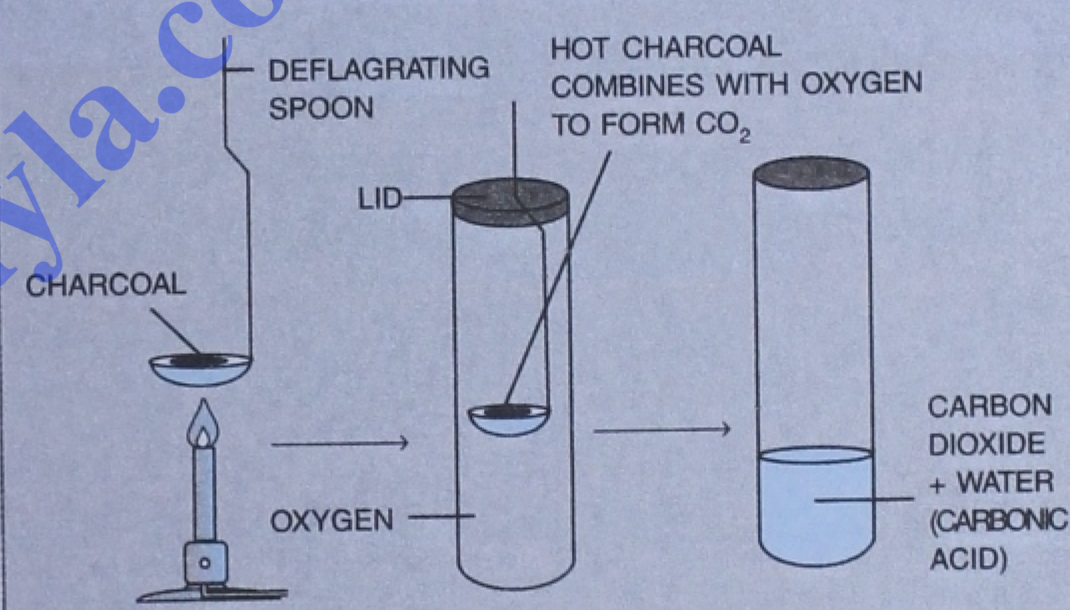


Fig. 6.4

Table 6.4 Preparation of acids from non-metallic oxides

Non-metallic oxides	*Chemical reaction with water*	*Acid formed*
1. Carbon dioxide (CO_2)	$CO_2 + H_2O \rightarrow H_2CO_3$	Carbonic acid
2. Sulphur dioxide (SO_2)	$SO_2 + H_2O \rightarrow H_2SO_3$	Sulphurous acid
3. Sulphur trioxide (SO_3)	$SO_3 + H_2O \rightarrow H_2SO_4$	Sulphuric acid
4. Nitrogen dioxide (NO_2)	$2NO_2 + H_2O \rightarrow HNO_2 + HNO_3$	Nitrous acid (HNO_2) and nitric acid (HNO_3)
5. Phosphorus pentoxide (P_2O_5)	$P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$	Phosphoric acid

the jar and shake it properly. Carbon dioxide dissolves in water to form carbonic acid, which can be tested by dipping a blue litmus paper in it. The litmus paper turns red.

Carbon	+	Oxygen	$\rightarrow$	Carbon dioxide
C	+	O_2	$\rightarrow$	CO_2
Carbon dioxide	+	Water	$\rightarrow$	Carbonic acid
CO_2	+	H_2O	$\rightarrow$	H_2CO_3

6.8 GENERAL PROPERTIES OF ACIDS

1. ***Taste :*** Acids have a sour taste. Therefore, all substances containing acids have a sour taste, *viz.* lemons, oranges, *etc*.
2. ***Nature :*** Acids are corrosive by nature. They destroy organic materials like clothes, paper, wood, human skin, *etc*., very quickly.

Do You Know ?

- Why the pages in new books look white while those in older books turn yellow ?

This is because paper contains tiny amounts of an acid. This acid slowly breaks down the cellulose fibres in the paper which changes the colour of paper from white to yellow. The reaction speeds up in sunlight and the paper may turn brown and become brittle.

3. ***Solubility :*** Acids are soluble in water in all proportions. Depending upon the amount of water present, they form either concentrated or dilute solutions.
4. ***Action on indicators :*** Acids change the colour of indicators. Blue litmus turns red and methyl orange turn pink when treated with acidic solutions. Phenolphthalein remains colourless.
5. ***Action of acid on metals :*** Normally, dilute acids react with metals to produce hydrogen gas and a salt.

Examples : Metals like zinc, magnesium and calcium react with dilute acids to produce hydrogen.

	Metal	+	*Acid*	$\rightarrow$	*Salt*	+	*Hydrogen*
(i)	Mg	+	H_2SO_4	$\rightarrow$	$MgSO_4$	+	$H_2\,(g)$
(ii)	Ca	+	2HCl	$\rightarrow$	$CaCl_2$	+	$H_2\,(g)$
(iii)	Zn	+	2HCl	$\rightarrow$	$ZnCl_2$	+	$H_2\,(g)$

Metals like mercury, copper, silver and gold do not react with dilute acids to form hydrogen.

NOTE : You should never store vinegar in a metal bottle because it can react with metal and create a slight fizzing of hydrogen gas.

All acids produce hydrogen gas when they combine with a reactive metal that is why acids are never kept in metal containers.

Intext Question

1. Why curd and sour substances should not be kept in brass and copper vessels ?
2. Which gas is liberated when an acid reacts with a metal? Illustrate with an example.

6. ***Action of acids on metal carbonates and bicarbonates :*** Acids react with metal carbonates and bicarbonates to produce carbon dioxide gas, which is indicated by its strong effervescence. The other products are salt and water.

(a) *metal carbonate* + *dilute acid* $\rightarrow$ *salt* + *water* + *carbon dioxide*

(i) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

(ii) $MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$

(b) *metal bicarbonate* + *dilute acid* $\rightarrow$ *salt* + *water* + *carbon dioxide*

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

Effervescence : Formation of a large number of air bubbles in a solution, with hissing sound, indicating the evolution of a gas is called *effervescence*.

Activity 2

Add vinegar to sodium bicarbonate in a bottle, a fizzy reaction takes place producing carbon dioxide gas. A large amount of gas is produced which almost fills up the bottle.

This reaction is used in cookery. Baking powder is a mixture of cream of tartar (a form of tartaric acid) and baking soda ($NaHCO_3$). When water is added to it carbon dioxide gas is produced in a large amount, which makes the cakes to rise.

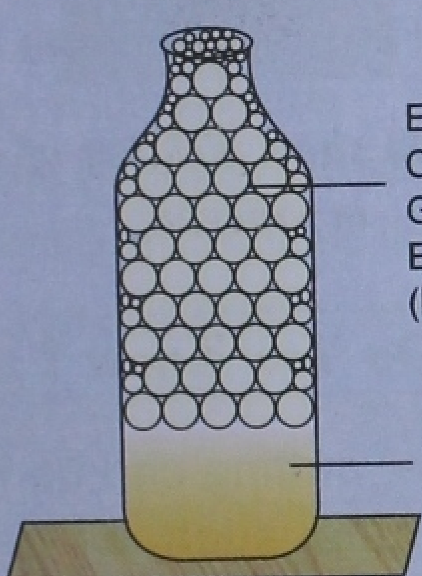


Fig. 6.5

7. ***Action of acids on bases (Neutralization):*** Acids react with bases (metallic oxides and hydroxides) to produce salt and water only. This reaction is known as **neutralization** reaction because acid and base react with each other to produce water which is neutral and does not change the colour of indicators.

$$\text{Acid} + \text{Base} \rightarrow \text{Salt} + \text{Water}$$
$$H_2SO_4 + CaO \rightarrow CaSO_4 + H_2O$$
$$HCl + NaOH \rightarrow NaCl + H_2O$$

6.9 USES OF ACIDS

Acids and the compounds derived from them, are used extensively in industries and in agriculture.

Sulphuric acid (H_2SO_4) : It is the most extensively used acid in various industries. Therefore it is known as "*King of chemicals*".

As it is dense and oily liquid it is also known as *oil of vitriol*.

1. Sulphuric acid is used to make detergents, paints, fertilizers and salts.
2. Motor batteries and fire extinguishers contain sulphuric acid.
3. It is an important laboratory reagent. It is used as a dehydrating agent in chemical reactions.
4. It is also used in the petroleum refining industry.

Do You Know ?

- Why paper turns black when sulphuric acid is poured on it ?

Concentrated sulphuric acid reacts with paper and removes its water content that is why paper turns black and looks burnt.

Nitric acid (HNO_3) : It is one of the most important mineral acid. It was earlier known as *aquafortis* meaning strong water. It reacts with almost all the metals.

1. Nitric acid is used to make many useful compounds, like silver nitrate, sodium nitrate, *etc*.
2. It is used to make fertilizers like ammonium nitrate, calcium-ammonium nitrate, *etc*.

3. It is used to manufacture explosives like T.N.T. (trinitrotoluene), nitro-glycerine, etc.
4. It is also used in the purification of precious metals like gold and silver.

Hydrochloric acid (HCl) : It is also known as muriatic acid.

1. Hydrochloric acid is used to make dyes, glues and medicines. It is also used to prepare glucose from starch.
2. It is used as a cleansing agent in galvanization mixtures and for preparing some bathroom cleansing agent.
3. It is used for the purification of common salt.
4. It is used as a bleaching agent in the textile industry.
5. It is used as a source of chlorine and bleaching powder.
6. Our stomach contains dilute hydrochloric acid which provides an acidic medium for digestion of food in the stomach. But an excess of HCl in the stomach causes acidity and indigestion.

Other acids

1. *Aquaregia:* It is a mixture of concentrated nitric acid and concentrated hydrochloric acid in the ratio 1 : 3. It is used to dissolve noble metals like gold and platinum.
2. *Acetic acid* is used to make vinegar and various preservatives.
3. *Citric acid* is used in soft drinks and also as a preservative.
4. *Tartaric acid* is used in the manufacture of baking powder and as a preservative.
5. *Carbonic acid* is used in aerated drinks.
6. *Boric acid* is used to prepare eye drops.
7. *Phosphoric acid is used for making fertilizers.*

Pickling : Since acids are dangerous to living things, they can be used as preservatives to kill bacteria. Many food substances are preserved by soaking them in vinegar. This process is called **pickling**. It protects the food from becoming stale.

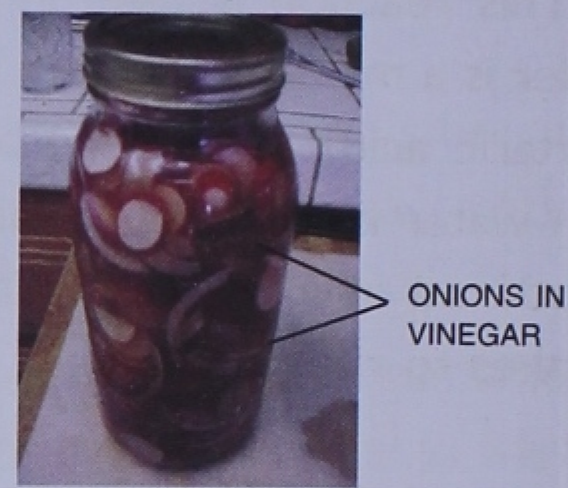


Fig. 6.6 : To show pickling of onions in vinegar.

Do You Know ?

- **How fruits after cutting can be kept fresh?**

Freshly cut fruits such as apples and bananas soon become brown when they are exposed to air because of the reaction between chemicals in the fruit and oxygen. The browning reaction can be slowed down by applying an acid, such as citric acid (lemon juice), to the freshly cut fruit.

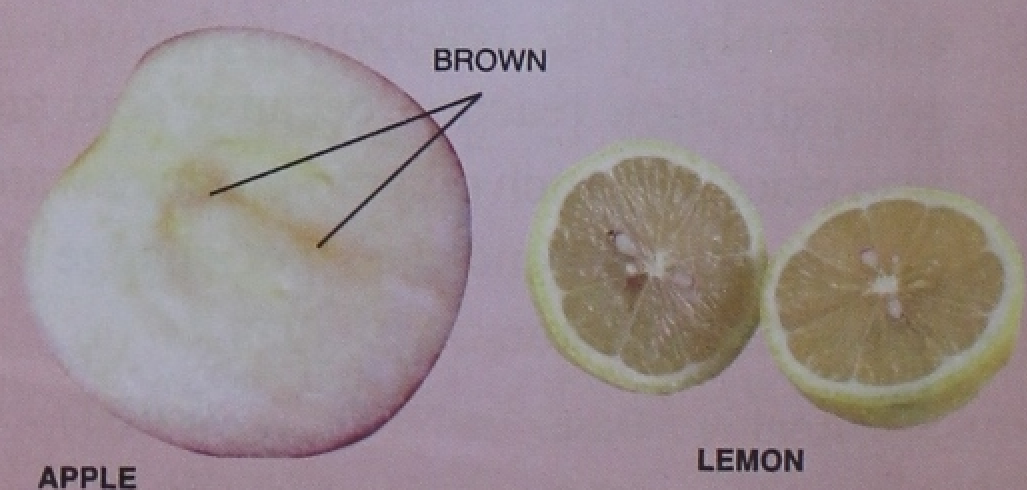


Fig. 6.7 : A piece of apple turning brown.

EXERCISE – I

1. Define :
   (a) acid (b) basicity
   (c) pickling
2. Name the following :
   (a) three naturally occurring acid and their sources.
   (b) three strong acids.
   (c) two oxy acid.
   (d) two dibasic acids.
   (e) one tribasic acid.
3. Name the products formed when an acid reacts with
   (a) an active metal
   (b) a metal carbonate
   (c) a base
4. What do you observe when
   (a) a few drops of methyl orange is added to an acidic solution.
   (b) vinegar is added to baking soda ($NaHCO_3$)
   (c) dilute hydrochloric acid is added to zinc.
   (d) concentrated sulphuric acid is poured on a piece of paper.
5. Name the acid present in the following :
   (a) ant sting (b) oranges
   (c) apple (d) milk
6. Give two important uses of each of the following acids
   (a) Sulphuric acid (b) Nitric acid
   (c) Hydrochloric acid (d) Acetic acid
7. Which acid is produced in the human digestive system? What happens when the body produces too much of this acid?
8. Complete and balance the following chemical equations:
   (a) $CO_2 + H_2O \longrightarrow$
   (b) $SO_3 + H_2O \longrightarrow$
   (c) $H_2 + Cl_2 \longrightarrow$
   (d) $Zn + H_2SO_4 \longrightarrow$
   (e) $NaHCO_3 + H_2SO_4 \longrightarrow$

6.10 BASES

The chemical substances which are bitter in taste and soapy to touch are called bases

Bases and the substances in which they are found.

Sl. No.	Name base	Substances in which it is found
1.	Sodium hydroxide	Soap
2.	Ammonium hydroxide	Window cleaning solution
3.	Calcium hydroxide	Lime water
4.	Potassium hydroxide	Soap
5.	Magnesium hydroxide	Milk of Magnesia

A base is a compound that reacts with an acid to give salt and water.

All the oxides and hydroxides of metals are bases. *Exception* : Ammonium hydroxide is a base, but it is not a metallic hydroxide.

Table 6.5 Some common bases with their formulae

	Base	Formula
1.	Sodium oxide	Na_2O
2.	Copper oxide	CuO
3.	Zinc oxide	ZnO
4.	Potassium hydroxide	KOH
5.	Aluminium hydroxide	$Al(OH)_3$
6.	Iron (II) hydroxide	$Fe(OH)_2$
7.	Calcium hydroxide	$Ca(OH)_2$

Bases are either soluble or insoluble in water.

Do You Know ?

Sodium hydroxide is also known as caustic soda.

6.10.1 Alkali

A base, which is soluble in water, is called an *alkali*. The word alkali is Arabic which means "ashes of a plant". Earlier alkalis were made by burning wood and other plants. All alkalis are bases but all bases are not alkalis.

Table 6.6 Common alkalis with their formulae

Alkali	Formula
1. Potassium hydroxide	KOH
2. Sodium hydroxide	NaOH
3. Calcium hydroxide	$Ca(OH)_2$
4. Magnesium hydroxide	$Mg(OH)_2$
5. Ammonium hydroxide	NH_4OH

6.11 DEFINITION OF ALKALI

An alkali is a compound which furnishes hydroxyl ions (OH^-) as the only negatively charged ions, when dissolved in water.

e.g. (i) $$\underset{\text{(sodium hydroxide)}}{NaOH} \xrightleftharpoons{H_2O} \underset{\text{(sodium ion)}}{Na^+} + \underset{\text{(hydroxyl ion)}}{OH^-}$$

(ii) $$\underset{\text{(ammonium hydroxide)}}{NH_4OH} \xrightleftharpoons{H_2O} \underset{\text{(ammonium ion)}}{NH_4^+} + \underset{\text{(hydroxyl ion)}}{OH^-}$$

Bases and alkalis are all around us, as in saliva, baking powder, chalk, indigestion tablets, polish, oven cleaners *etc.*

6.12 THE ACIDITY OF A BASE

The acidity of a base is the number of hydroxyl ions (OH^-) produced by one molecule of that base, when dissolved in water.

Bases can be :

(i) ***Monoacidic :*** They furnish only one hydroxyl ion per molecule.
Examples – sodium hydroxide (NaOH), ammonium hydroxide (NH_4OH), *etc.*

$$NH_4OH \xrightleftharpoons{H_2O} \underset{\text{(ammonium ion)}}{NH_4^+} + OH^-$$

(ii) ***Diacidic :*** They furnish two hydroxyl ions per molecule.
Examples – calcium hydroxide [$Ca(OH)_2$], copper (II) hydroxide [$Cu(OH)_2$], *etc.*

$$Ca(OH)_2 \xrightleftharpoons{H_2O} Ca^{2+} + 2OH^-$$

(iii) ***Triacidic :*** They furnish three hydroxyl ions per molecule.
Examples – aluminium hydroxide [$Al(OH)_3$], ferric hydroxide [$Fe(OH)_3$], *etc.*

$$Al(OH)_3 \xrightleftharpoons{H_2O} Al^{3+} + 3OH^-$$

Caution

Laboratory acids and bases are corrosive in nature. They are harmful to the skin and should be handled with care.

6.13 THE STRENGTH OF BASES

Strong bases : *Bases which produce a high concentration of hydroxyl ions in water, are called strong bases.*

Examples : Sodium hydroxide (NaOH) and potassium hydroxide (KOH) respectively known as caustic soda and caustic potash (caustic means *burning*).

Weak bases : *Bases, which dissociate in water only slightly and thus produce a low* *concentration of hydroxyl ions, are called weak bases.*

Examples : Calcium hydroxide [$Ca(OH)_2$], ammonium hydroxide [NH_4OH], etc.

6.14 PREPARATION OF BASES

1. ***By direct combination of metals and oxygen :*** Metals, when heated in the presence of oxygen form metallic oxides, which are basic in nature.

$$\text{Metal} + \text{Oxygen} \xrightarrow{\text{heat}} \text{Metal oxide}$$

Metallic oxides are also called *basic oxides*, because they react with acids to produce salt and water.

Table 6.7 Formation of basic oxides

Metal	*Chemical reaction with oxygen*	*Name of basic oxide*
1. Sodium	$4Na + O_2 \rightarrow 2Na_2O$	Sodium oxide
2. Magnesium	$2Mg + O_2 \rightarrow 2MgO$	Magnesium oxide
3. Calcium	$2Ca + O_2 \rightarrow 2CaO$	Calcium oxide
4. Potassium	$4K + O_2 \rightarrow 2K_2O$	Potassium oxide

2. ***By dissolving basic oxides in water :*** Basic oxides dissolve in water to produce soluble bases known as alkalis.

$$\text{Basic oxide} + \text{water} \longrightarrow \text{Soluble base (Alkali)}$$

Table 6.8 Formation of soluble bases

Basic oxide	*Reaction of basic oxide with water*	*Soluble base (alkali)*
1. Sodium oxide (Na_2O)	$Na_2O + H_2O \rightarrow 2NaOH$	Sodium hydroxide
2. Potassium oxide (K_2O)	$K_2O + H_2O \rightarrow 2KOH$	Potassium hydroxide
3. Calcium oxide (CaO)	$CaO + H_2O \rightarrow Ca(OH)_2$	Calcium hydroxide

Ammonium hydroxide (NH_4OH) is also a weak alkali but it idoes not contain any metal.

Activity 3

To prepare a basic hydroxide by burning calcium and then dissolving it in water

Take a few pieces of calcium in a deflagrating spoon and heat it until it starts burning with a brick red flame. White solid calcium oxide is left behind in the spoon.

Transfer the solid to a test tube containing water. Calcium oxide dissolves in water to form a solution. Dip a red litmus paper into the solution. It turns blue, thereby showing its basic nature.

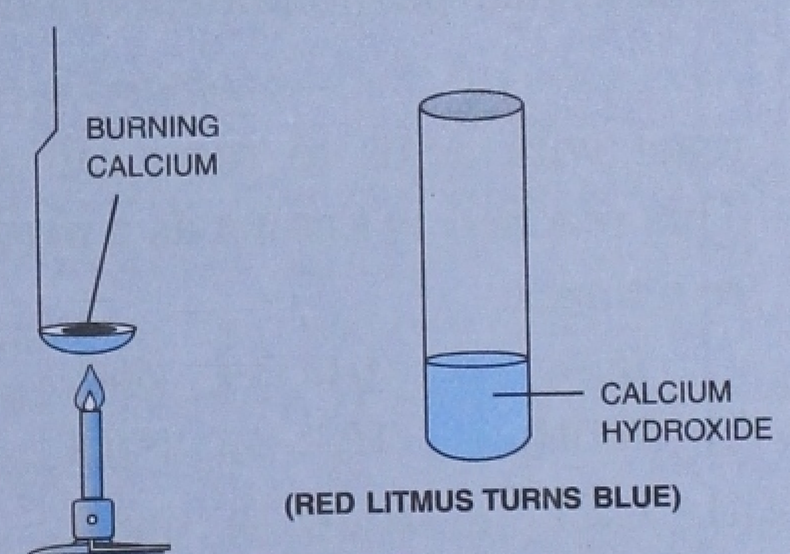


Fig. 6.8

$$\text{Calcium} + \text{Oxygen} \xrightarrow{\text{heat}} \text{Calcium oxide}$$
$$2Ca + O_2 \longrightarrow 2CaO$$
$$\text{Calcium oxide} + \text{Water} \xrightarrow{\text{heat}} \text{Calcium hydroxide}$$
$$CaO + H_2O \longrightarrow Ca(OH)_2$$

The basic solution of calcium hydroxide is known as lime water. This can be prepared by dissolving some lime (CaO) in water.

6.15 PROPERTIES OF BASES

1. ***Taste :*** Bases have a bitter taste.
2. ***Nature :*** All bases are corrosive. When they come into contact with our skin, they produce painful blisters some of them are very dangerous and cause burns on the skin.

Do You Know ?

- Why are alkalis soapy to touch ?

This is because they react with the oils in our skin and make soap.

Soaps are made on this principle by boiling animal fats and vegetable oils with a strong alkali like sodium hydroxide.

3. ***Action with indicators :*** Soluble bases turn red litmus into blue, methyl orange into yellow, and phenolphthalein into pink.
4. ***Reaction of bases with acids :*** All bases react with acids to form salt and water. This reaction is known as a *neutralization reaction.*

	Base	+	*Acid*	→	*Salt*	+	*Water*
e.g. (i)	$NaOH$	+	HCl	→	$NaCl$	+	H_2O
(ii)	CuO	+	H_2SO_4	→	$CuSO_4$	+	H_2O

5. ***Reaction of bases with salt solution :*** Soluble bases like sodium hydroxide, potassium hydroxide, *etc*., react with soluble salt like copper sulphate, lead nitrate, *etc*., to produce insoluble bases and another salt.

Base (soluble)	+	*Salt* (soluble)	→	*Base* (insoluble)	+	*Salt* (soluble)
$2NaOH$ (soluble)	+	$CuSO_4$ (copper sulphate)	→	$Cu(OH)_2$ copper hydroxide (insoluble)	+	Na_2SO_4 sodium sulphate (soluble)
$2KOH$ potassium hydroxide (soluble)	+	$Pb(NO_3)_2$ lead nitrate (soluble)	→	$Pb(OH)_2$ lead hydroxide (insoluble)	+	$2KNO_3$ potassium nitrate (soluble)

6.16 THE IMPORTANCE OF NEUTRALIZATION REACTIONS IN DAILY LIFE

Some neutralization reactions are very helpful to us. *For example* :

(i) ***Indigestion :*** When an excess of hydrochloric acid is produced in our stomach, we suffer from acidity and indigestion. We can overcome this by taking *antacids,* which contain weak bases like milk of magnesia $Mg(OH)_2$, and neutralize the excess acid in the stomach. Many toothpastes contain bases to neutralize the acids formed in the mouth.

(ii) ***Soil treatment :*** Many plants need neutral soils to grow. If the soil is acidic, it is treated with bases like quick lime, slaked lime or chalk, to make it neutral. Similarly, basic soils are neutralized by adding sulphate salts.

(iii) ***Insect sting :*** When a bee stings, it injects an acidic liquid through the skin. This painful liquid can be neutralized by applying a basic calamine solution, which contains zinc carbonate or baking soda.

But wasp stings are alkaline. They can be neutralized with vinegar.

Activity 4

To show a neutralization reaction

Pour about 25 cc of sodium hydroxide into a conical flask. Add a few drops of methyl orange to it. The solution turns yellow. Now add some drops of dilute hydrochloric acid with the help of a dropper. Shake well after adding each drop of acid. A stage comes when the solution turns pink. This shows that the basic solution has turned into an acidic solution.

This is because the base is completely neutralized by the acid, and the pink colour appears because the solution is now slightly acidic, not basic.

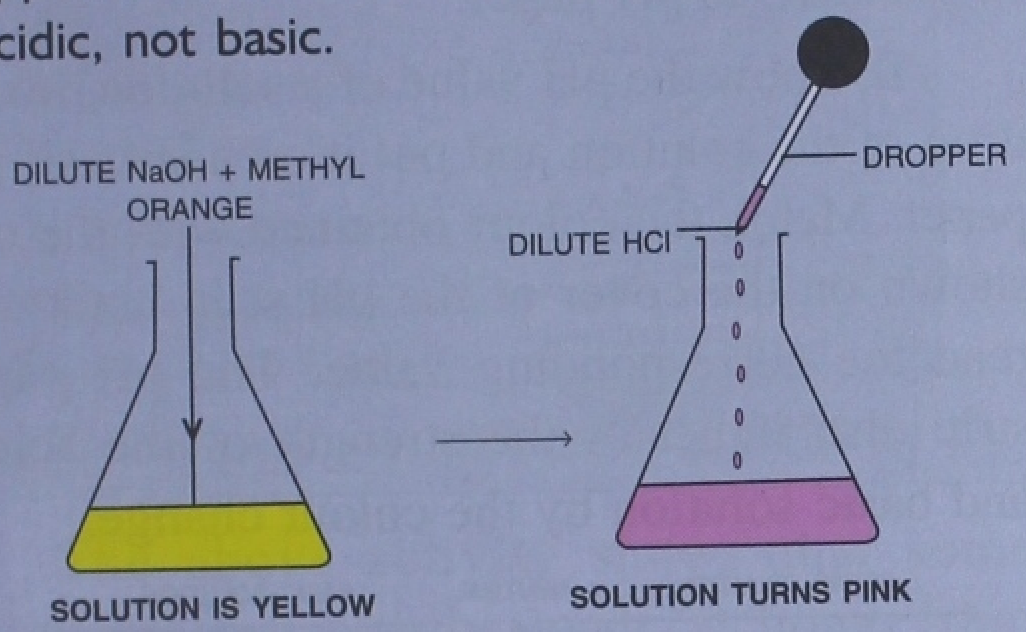


Fig. 6.9

6.17 USES OF BASES/ALKALIS

We use bases in the laboratory, industry and agriculture and at our homes.

- ***Sodium hydroxide ($NaOH$ — caustic soda) and potassium hydroxide (KOH — caustic potash).***
  - (i) They are used in the manufacture of soaps, textiles, paper, medicines and as industrial cleansing agents.
  - (ii) They are also used in the refining of petroleum.

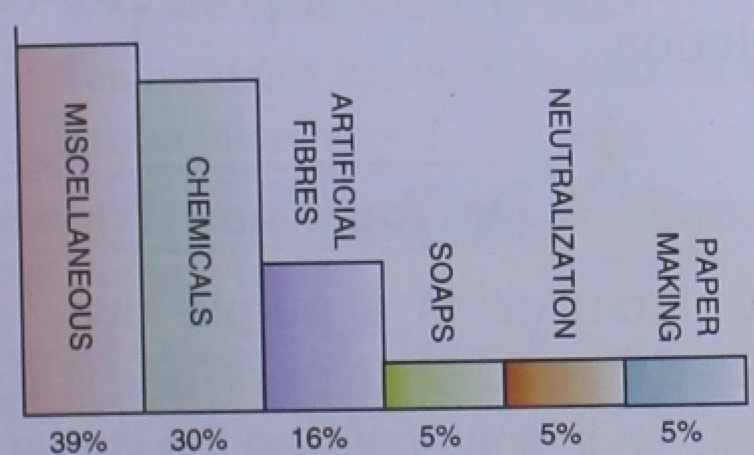


Fig. 6.10 A bar graph to show the percentage of NaOH used in different fields.

  - (iii) Potassium hydroxide is frequently used as an electrolyte (to conduct electricity).

In industry sodium hydroxide has many uses which includes drugs, dyes, oil products, bleaches, in processing foods, metals and rubber.

- ***Calcium hydroxide [$Ca(OH)_2$ — slaked lime]***
  - (i) It is used to make cement, mortar and bleaching powder. It is also used for white washing and for neutralizing acidic soils and water.
  - (ii) It is used for removing hair from animal skin.
- ***Aluminium hydroxide $Al(OH)_3$ and magnesium hydroxide $Mg(OH)_2$ (milk of magnesia)*** *are used to make antacids.*
- ***Ammonium hydroxide (NH_4OH)*** *is used to make fertilizers, nylon, plastics and dyes.* It is also used as a household cleanser.

6.18 INDICATORS

An indicator is a substance that changes its colour in acidic and basic solutions. It is used to confirm the presence of an acid, a base or a neutral solution. Indicators do not show any change in colour in neutral solutions.

The most common indicator is *litmus*. It is extracted from a certain plant *lichen*. It can be dissolved in alcohol to get a solution. **It turns red in an acid and blue in an alkali.**

The other common indicators are methyl orange and phenolphthalein.

Action of indicators with acids and alkalis

Indicators	*Colour in acids*	*Colour in alkalis*
Litmus	Red	Blue
Methyl orange	Red	Yellow
Phenolphthalein	Colourless	Pink

Activity 5

Test water, orange juice, lemon juice, salt solution, toothpaste, antacid tablets, vinegar, honey and soap solution with indicators, and record your observations.

Intext Question

1. You have been provided with three test tubes. One of them contains distilled water and the other two contain an acidic solution and a basic solution, respectively. If you are given only red litmus paper, how will you identify the contents of each test tube ?

Do You Know ?

Turmeric, litmus, china rose petals are natural indicators.

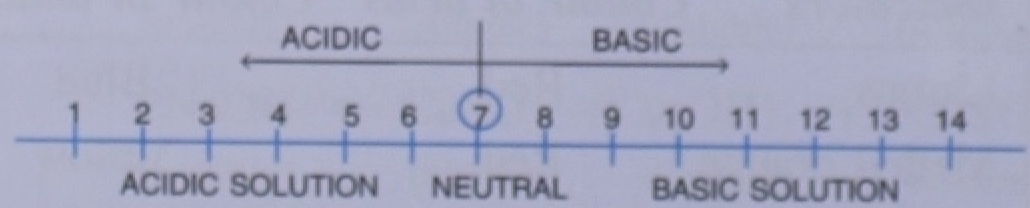
Turmeric helps to detoxify liver, balance cholesterol levels, fight allergies, stimulate digestion, boost immunity, and enhance the complexion.

Measure of acidic and basic character (pH *number*)

The strength of an acid or an alkali can be measured by the pH value of a solution.

The pH value of a solution is a measure of the amount of replaceable hydrogen ions present in it. The higher is the pH value, the lesser is the degree of hydrogen ion concentration and the lesser is the acidic nature of the solution.

The pH scale is divided into 14 parts.



pH *Scale*

Solutions with pH > 7 are alkaline

" " pH < 7 are acidic

" " pH = 7 are neutral

A very useful indicator is a mixture of dyes known as universal indicator which gives a range of colour change from red for pH 1 (very strong acid) to blue for pH 14 (very strong alkali). This is available in the form of a paper strip called as pH paper.

To know the pH value of a solution, take a drop of the solution and put it on a strip of pH paper. Match the colour obtained with the one shown on the cover of the pH strip book and read the corresponding value. The pH paper strip also indicates the strength of the acidic and basic solution by the colour change.

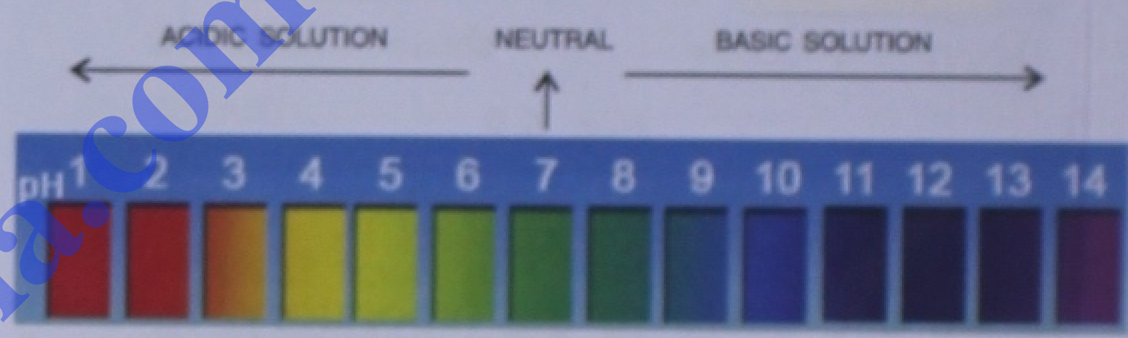


Fig. 6.11 Colour changes in the indicator paper strip for different pH value

With the help of pH paper you can also determine the pH value of various foodstuffs.

- pH of blood is 7.4.
- Substances which are neither acidic nor basic in nature are called neutral substances. ***Example :*** water, alcohol, oxygen, salt, sugar solution.

Do You Know ?

Litmus solution is a purple dye, which is extracted from lichen (a plant) and is commonly used as an indicator. When the litmus solution is neither acidic nor basic, its colour is purple.

Activity 6

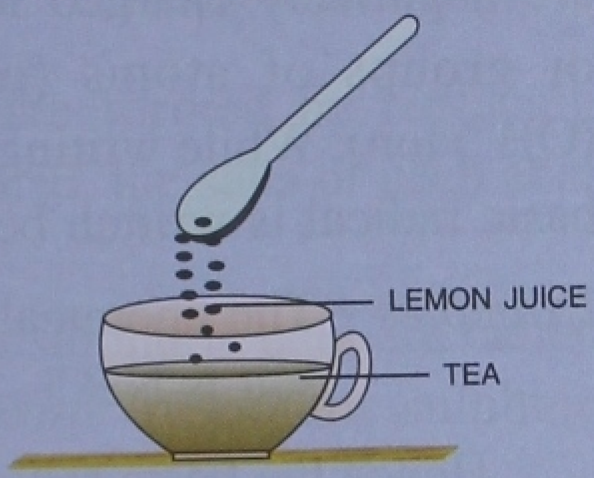
Prepare a cup of tea.

Add half spoon of lemon juice to it.

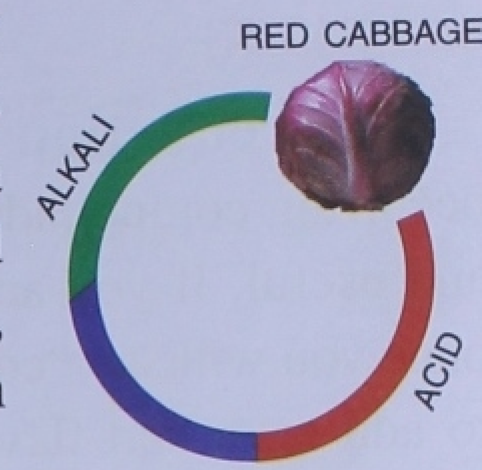
What do you observe? The colour of tea changes slightly.

This is because tea acts as an indicator for the lemon juice which is acidic in nature. When lemon juice is added to tea its acidity increases.

The colour of the tea becomes lighter on adding lemon juice.



The above activity shows that some indicators can also be made at home from various food materials. Dyes are obtained from fruits and vegetables such as beetroot, radish, pear and red cabbage which can also be used as indicators. The juice of a red cabbage turns from red in a strong acid to pink, purple, blue and green in strong alkali.



Activity 7

Take some turmeric powder and make its paste by adding water to it. Keep some paste on a filter paper. Make it dry. Now divide that filter paper in two parts. To one piece add few drops of soap solution and to another piece add few drops of lemon juice.

What do you observe ?

What conclusion can you draw ?

EXERCISE – II

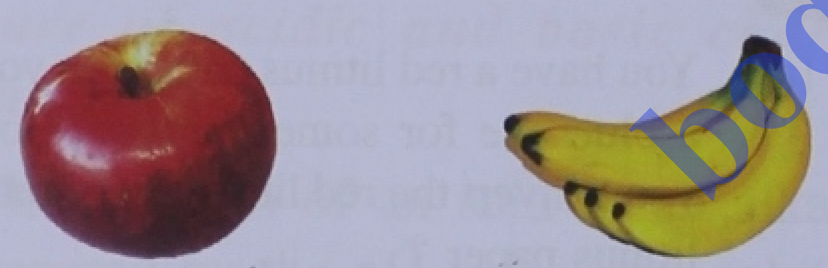
1. Define a base. Give examples.
2. What is the difference between a base and an alkali ?
3. How are strong alkali and weak alkali different? Give *two* examples for each of them.
4. What is a neutralization reaction ? Explain any *one* of its application in daily life.
5. (a) Why are bases soapy to touch ?
   (b) Tea becomes lighter in colour on adding lemon juice, why ?
6. Name some substances used in our daily life which contain bases.
7. What are indicators ? Name the three acid-base indicators known to you. Also give their colours in acidic and basic solutions.
8. (a) You have a red litmus paper but you need a blue one for some purpose. How will you convert the red litmus paper into blue litmus paper ?
   (b) The pH of a sample A is 7.4 and that of sample B is 9.0. Which one of the two samples is more basic ?
9. List one important use of :
   (a) Caustic soda
   (b) Slaked lime
   (c) Ammonium hydroxide
10. Complete and balance the following :
    (a) $NaOH + HCl \longrightarrow$ .... + ...
    (b) $Na_2O + H_2O \longrightarrow$ ....
    (c) $CaO + H_2O \longrightarrow$ ....
    (d) $Zn(OH)_2 + HCl \longrightarrow$ .... + ...

6.19 SALTS

Introduction : Salts are naturally occurring compounds which are very common and useful. If you are asked to name a salt, at once you will say "common salt" which is used to add taste and flavour to our food. But this is just one type of a salt, there are many others like chalk, gun-powder, baking soda, washing soda, fertilizers, insectides, bleaching powder, alum *etc*.

Occurrence : In nature salts are found in abundance.

- Sea water is the largest source of salts. Not only the common salt (sodium chloride) but its also contains salts of calcium, magnesium potassium *etc*.
- Earth's crust and some rocks also contain salts mostly carbonates, phosphates and silicates.
- Fruits and vegetables are rich sources of salts of iron, calcium *etc*.



AN APPLE BANANAS

Fig. 6.12 Rich sources of salts of iron

6.20 DEFINITION AND NAMING OF SALTS

A salt can be defined as a compound formed by the neutralization reaction between an acid and a base.

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

Examples :

(i) $NaOH + HCl \rightarrow NaCl + H_2O$

(ii) $Cu(OH)_2 + 2HNO_3 \rightarrow Cu(NO_3)_2 + 2H_2O$

(iii) $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$

In these reactions, hydrogen from the acid is replaced by the metal from the base.

Thus, we see that salts are made up of two radicals – basic radical, derived from a base and acidic radical, derived from an acid. Basic radicals are positively charged metal ions or ammonium ions (NH_4^+) while acid radicals are negatively charged ions of a single atom or groups of atoms (other than hydroxyl (OH^-) ion). While writing the formula of a salt, basic radical is written before the acid radical.

Examples : The chemical formula of common salt is NaCl.

Hence the basic radical is named first and then the acid radical. Therefore 'NaCl' is named as **sodium chloride**.

Activity 8

(a) Write the formulae of the salts given below. Potassium sulphate, sodium sulphate, calcium sulphate, magnesium sulphate, copper sulphate, sodium chloride, sodium nitrate, sodium carbonate and ammonium chloride.

(b) Identify the acids and bases from which the above salts may be obtained.

(c) Salts having the same positive or negative radicals are said to belong to a family. For example, NaCl and Na_2SO_4 belong to the family of sodium salts. Similarly NaCl and KCl belong to the family of chloride salts. How many families can be identify among the salts given in this activity.

CLASS ROOM DISCUSSION

Discuss the food item that produce acidity and cause discomfort in our stomach

The following table shows the chemical formula and name of some salts.

Chemical formula	Chemical name
$NaCl$	Sodium chloride
$CaCO_3$	Calcium carbonate
$NaHCO_3$	Sodium bicarbonate
$CuCO_3$	Copper carbonate
KNO_3	Potassium nitrate
NH_4Cl	Ammonium chloride

Since the salts are formed by replacing hydrogen ion of the acid, the salts of each acid has a specific name.

- Salts made from sulphuric acid are called sulphates. *Example* : Sodium sulphate [Na_2SO_4].
- Salts made from nitric acid are called nitrates. *Examples* : Calcium nitrate [$Ca(NO_3)_2$], copper nitrate [$Cu(NO_3)_2$].
- Salts made from hydrochloric acid are called chlorides. *Example* : Sodium chloride [$NaCl$].
- Salts made from carbonic acid are called carbonates. *Examples* : Copper carbonate [$CuCO_3$], sodium carbonate [Na_2CO_3], etc.
- Salts made from phosphoric acid are called phosphates. *Example* : Calcium phosphate [$Ca_3(PO_4)_2$].
- Salts derived from acetic acid are called acetates. *Example*: Lead acetate [$(CH_3COO)_2Pb$].

6.21 TYPES OF SALT

1. **Normal salts :** *The salt formed by the complete neutralization of an acid with a base is called a normal salt.* In such salts, all the hydrogen atoms present in an acid molecule are replaced by a metal.

$$KOH + HNO_3 \rightarrow KNO_3 + H_2O$$

Potassium hydroxide + Nitric acid → Potassium nitrate + Water

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Sodium hydroxide + Hydro-chloric acid → Sodium chloride *(Normal salt)* + Water

Examples : Potassium nitrate, calcium carbonate, sodium sulphate, etc.

2. **Acid salts :** *The salt formed by the incomplete or partial neutralization of an acid with a base is called an acid salt.* In such salts, all hydrogen atoms are not replaced from the acid.

Base + Acid → Acidic salt + Water

$$NaOH + H_2SO_4 \rightarrow NaHSO_4 + H_2O$$

$NaHSO_4$: Sodium bisulphate *(acidic salt)*

Examples : Sodium bicarbonate, potassium bisulphate, etc.

3. **Basic salts :** *The salt formed by the incomplete or partial neutrali-zation of a base with an acid is called a basic salt.*

Base + Acid → Basic salt + Water

$$Zn(OH)_2 + HCl \rightarrow Zn(OH)Cl + H_2O$$

Zinc hydroxide + HCl → Zinc hydroxy chloride + H_2O

Examples : $Cu(OH)Cl$ etc.

6.22 PREPARATION OF SALTS

Salts can be prepared by a number of methods. Such as :

1. *By direct combination of elements*

(a) *Sodium + Chlorine $\xrightarrow{heat}$ Sodium chloride*

$$2Na + Cl_2 \xrightarrow{heat} 2NaCl$$

(b) *Iron + Sulphur $\xrightarrow{heat}$ Iron sulphide*

$$Fe + S \xrightarrow{heat} FeS$$

2. *By the neutralization reaction between an acid and a base.*

Base	+	*Acid*	→	*Salt*	+	*Water*
NaOH (dil.)	+	HCl (dil.)	→	NaCl	+	H_2O

3. *By the reaction between metals and acids*

Metal	+	*Dilute acid*	→	*Salt*	+	*Hydrogen gas*
Zn	+	H_2SO_4 (dil.)	→	$ZnSO_4$	+	H_2

4. *By the reaction of metal carbonates and metal bicarbonates with acids.*

(a) *Metal carbonate* + *Acid* → *Salt* + *Water* + *Carbon dioxide*

$$Na_2CO_3 + 2HCl \text{ (dil.)} \rightarrow 2NaCl + H_2O + CO_2$$

(b) *Metal bicarbonate* + *Acid* → *Salt* + *Water* + *Carbon dioxide*

$$Ca(HCO_3)_2 + H_2SO_4 \text{ (dil.)} \rightarrow CaSO_4 + 2H_2O + 2CO_2$$

5. *By the action of acids on metallic oxides.*

Metallic oxides	+	*Acid*	→	*Salt*	+	*Water*
Na_2O	+	2HCl (dil.)	→	2NaCl	+	H_2O

6.23 PROPERTIES OF SALTS

1. Salts are solids with high melting points.
2. They may or may not be neutral to indicators, depending upon their type.
3. They are mostly soluble in water.
4. In a molten state or in a solution form, they are good conductors of electricity.
5. Two salts in solution form react with each other to produce two new salts.

Salt-I (soluble)	+	Salt-II (soluble)	→	Salt-III (insoluble)	+	Salt-IV (soluble)
AB	+	CD	→	AD	+	CB

Example :

NaCl (solution)	+	$AgNO_3$ (solution)	→	AgCl (precipitate)	+	$NaNO_3$ (soluble)

6.24 HYDRATED SALTS

There are certain salts with a fixed number of water molecules loosely attached to the molecules of salts known as hydrated salts. The water molecules attached per molecule are called *water of crystallisation*. Hydrated salts are mostly crystalline solids. Some of the important hydrated salts are given in Table 6.9.

Table 6.9 : Some hydrated salts

Chemical name	Chemical formula	Common Name	Colour of the salt
1. Copper sulphate	$CuSO_4.5H_2O$	Blue vitriol	Blue
2. Iron (II) sulphate	$FeSO_4.7H_2O$	Green vitriol	Green
3. Magnesium sulphate	$MgSO_4.7H_2O$	Epsom salt	White
4. Zinc sulphate	$ZnSO_4.7H_2O$	White vitriol	White
5. Sodium carbonate	$Na_2CO_3.10H_2O$	Washing soda	White
6. Sodium sulphate	$Na_2SO_4.10H_2O$	Glauber's salt	White
7. Calcium sulphate	$CaSO_4.2H_2O$	Gypsum	White

Examples :

(a) Copper sulphate has five molecules of water of crystallisation attached to its crystal structure [$CuSO_4.5H_2O$].

(b) Iron (II) sulphate has seven molecules of water of crystallisation [$FeSO_4.7H_2O$].

Activity 9

To show that copper sulphate crystals contain water in them (To be demonstrated by the teacher)

Copper sulphate crystals are blue in colour. Take some of these crystals in a test tube. Hold it with a test tube holder in a tilted position. Now heat the test tube on Bunsen's burner flame for some time.

What do you observe ?

The blue crystalline substance has turned into white powder and few water droplets are deposited at the upper part of the test tube.

Cool the test tube and add few drops of water to it. What do you observe now ?

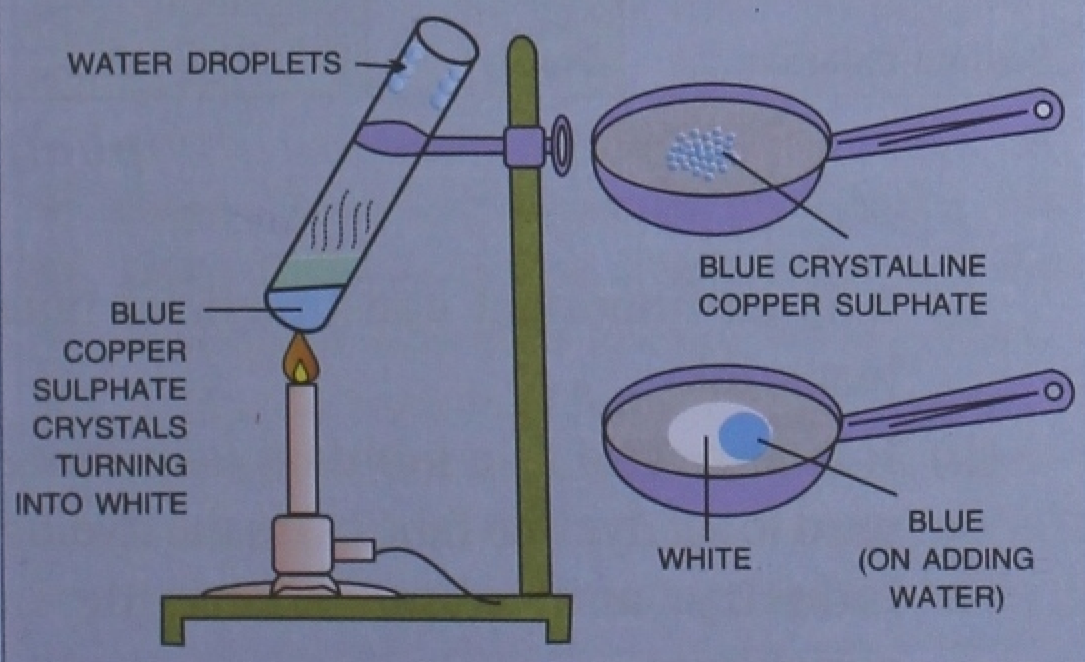
The white solid has again turned into blue.

Now answer the following questions :-

(i) Why the blue copper sulphate crystals turned into white powder ?

(ii) Why the white powder regains its blue colour on adding water ?

(iii) What conclusion would you draw from the above activity ?



6.25 USES OF SALTS

We use many kinds of salt in our daily life. The uses of some salts are mentioned below :

1. *Sodium chloride* [*common salt* NaCl]

(i) Common salt is the most important salt for us. We use it daily in cooking. It adds taste to our food and is necessary for our health.

(ii) It is used as a preservative and for curing fish and meat products.

(iii) It is mixed with ice to make a freezing mixture, which has a lower melting point.

(iv) It is used to prepare chemicals like chlorine, hydrochloric acid, sodium hydroxide, *etc*.

(v) It is also used for manufacturing soap.

Common salt helps to maintain the normal functions of the human body. People lose a lot of salt and water from their bodies when they suffer from diarrhoea. This condition is called *dehydration*. Saline solutions are given to such patients. Otherwise it may even result in death.

Do You Know ?

Every time you sweat, you lose salt from your body (you can taste your sweat to know this) since salt is vital to the healthy running of the body excess sweating may lead to dehydration and collapse. That is why doctors advise people to take salt tablets when they visit hot countries.

2. *Washing soda* [*sodium carbonate* $Na_2CO_3.10H_2O$]

(i) It is used for washing clothes.

(ii) It is used in the manufacture of glass, paper and caustic soda.

(iii) It is used for refining petroleum.

(iv) It is also used to make chemicals for the food and beverage industry, and in the manufacture of textiles and dyes.

(v) It is used for removing permanent hardness of water.

(vi) It is used in the manufacture of sodium compounds such as Borax.

3. *Baking soda [sodium bicarbonate* $NaHCO_3$*] or sodium hydrogen carbonate.*

(i) It is used as baking powder in the baking industry. Baking powder contains tartaric acid also. The salt is put into the baking mixture. The released carbon dioxide gas helps in puffing the cake up while it is baked, thereby making it light and spongy.

(ii) It is used in fire extinguishers.

(iii) It is also used as a mild antiseptic and as an antacid.

(iv) The soda commonly used in the kitchen for making tasty crispy *Pakoras* is baking soda. Sometimes it is added for faster cooking.

4. *Nitre [potassium nitrate* KNO_3*]*

(i) It is an important fertilizer.

(ii) It is used to make gunpowder, fireworks and glass.

5. *Blue vitriol [copper sulphate* $CuSO_4.5H_2O$*]*

(i) It is used as a fungicide in agriculture.

(ii) It is also used for dyeing and electroplating purposes.

6. *Gypsum [calcium sulphate* $CaSO_4.2H_2O$*]*

(i) It is used for the preparation of plaster of Paris [$CaSO_4.\frac{1}{2}H_2O$], for making statues, and in the cement industry.

(ii) It is used for fabrication of walls and boards.

7. *Potash alum* [$K_2SO_4.Al_2SO_4.24H_2O$]

This is a double salt of potassium sulphate and aluminium sulphate, commonly called *phitkari.*

(i) It is used for *loading, i.e.* for quick sedimentation of suspended particles in water.

(ii) It is also used as an antiseptic and in the dyeing industry.

Table 6.10 : Common names of some acids, bases and salts

Chemical name	*Formula*	*Common name*
Sulphuric acid	H_2SO_4	Oil of vitriol
Nitric acid	HNO_3	Aqua fortis
Hydrochloric acid	HCl	Muriatic acid
Sodium hydroxide	NaOH	Caustic soda
Calcium hydroxide	$Ca(OH)_2$	Limewater/ slaked lime
Potassium hydroxide	KOH	Caustic potash
Magnesium hydroxide	$Mg(OH)_2$	Milk of magnesia
Calcium oxide	CaO	Quicklime
Calcium carbonate	$CaCO_3$	Limestone, chalk
Sodium bicarbonate	$NaHCO_3$	Baking soda
Potassium nitrate	KNO_3	Nitre, chile saltpetre
Sodium chloride	NaCl	Common salt

8. *Green vitriol [ferrous sulphate* $FeSO_4.7H_2O$*]*

(i) It is an important constituent of blue black ink.

(ii) It is also used as a mordant (substance used to set dyes on fabrics) in the dyeing industry, and as an insecticide in agriculture.

Do You Know ?

Ant and bee stings contain formic acid. When an ant or a bee bites formic acid is injected into the body which causes itching. To neutralize this effect, that portion of the body is rubbed with moist baking soda or calamine solution both these solution are basic in nature and hence reduce itching.

9. *Silver nitrate* [$AgNO_3$]

(i) It is used for the treatment of sores and infections. It is an excellent antiseptic.

(ii) It is widely used in photography.

(iii) It is an important laboratory reagent.

10. *Bleaching powder* ($CaOCl_2$)

(i) It is used for disinfecting drinking water to make it free of germs.

(ii) It is used as an oxidising agent in many chemical industries.

(iii) It is used for bleaching cotton and linen in the textile industry, for bleaching wood pulp in paper factories and for bleaching washed clothes in laundry.

Do You Know ?

Sodium and potassium ions are very important for our body because they carry messages in our bodies as electrical signals. These vital ions come from the salts you eat.

6.26 DISPOSAL OF FACTORY WASTES

The wastes of many factories are acidic in nature. If they are allowed to flow as it is into the water bodies, they cause huge damage to aquatic plants and animals.

Therefore, basic substances are added to factory wastes to neutralize their acidic nature. They are then released into the water bodies.

RECAPITULATION

- Acids are the substances that furnish hydrogen ions when dissolved in water.
- Acids are formed by dissolving acidic oxides in water.
- Acids derived from living organisms are called organic acids, and those derived from minerals are called mineral acids.
- The basicity of an acid is the number of hydrogen ions furnished by one molecule of that acid in water.
- Some acids are strong and some are weak.
- Acids have a sour taste. They turn the colour of indicators. They react with metals, metallic oxides, metallic carbonates and bases.
- Bases are metallic oxides and hydroxides. Soluble bases are called alkalis.
- Bases are bitter to taste. They also change the colour of indicators.
- Bases react with acids to form salt and water.
- A salt is a compound formed by the reaction between an acid and a base.
- Salts can be normal, acidic or basic by nature.
- Hydrated salts usually contain water of crystallisation.
- Indicators are substances that help to identify the nature of a solution by changing their colours.

EXERCISE – III

1. Define :
   (a) a salt (b) an acid salt
   (c) a hydrated salt
2. Give *two* examples of :-
   (a) two acidic salts
   (b) two basic salts
   (c) three hydrated salts
   (d) three normal salts
3. Give balanced equation for the preparation of salt by :
   (a) direct combination of elements.
   (b) the neutralization reaction between an acid and a base.
   (c) the reaction of a metal carbonate with an acid.
4. Complete and balance the following equations:
   (a) $NaOH + H_2SO_4 \longrightarrow$
   (b) $Na_2O + HCl \longrightarrow$
   (c) $NaCl + AgNO_3 \longrightarrow$
   (d) $KOH + HNO_3 \longrightarrow$
5. Give reasons :
   (a) on heating copper sulphate crystals turns from blue to white.
   (b) saline solutions are given to patients suffering from diarrhoea.
   (c) sodium and potassium ions are vital to our body.
   (d) quicklime is added to acidic soil.
6. Give the chemical name and formula for :
   (a) blue vitriol
   (b) green vitriol
   (c) white vitriol
   (d) washing soda
   (e) gypsum
7. Give two important uses of each of the following :
   (a) common salt
   (b) silver nitrate
   (c) baking soda

OBJECTIVE TYPE QUESTIONS

1. Fill in the blanks :
   (a) Acids turn the colour of methyl orange into ....
   (b) A salt containing water of crystallisation is called a .... salt.
   (c) Bases that dissolve in water are called ....
   (d) All alkalis are .... but all .... are not alkalis.
   (e) Oxides of metal dissolve in water to produce ....
   (f) A base and an acid react with each other to produce a ....
   (g) Acids react with metal carbonates to produce .... gas.
   (h) .... and .... can be used to make indicators at home.
2. Match the following :

Column A	Column B
(a) Citric acid	(i) ant and bee stings
(b) Boric acid	(ii) aerated drinks
(c) Carbonic acid	(iii) vinegar
(d) Formic acid	(iv) tears
(e) Acetic acid	(v) oranges

3. Classify the following as acids, bases or salts :
   (a) lemon juice (b) common salt
   (c) grape juice (d) sour milk

(e) milk of magnesia (f) caustic soda
(g) sodium bicarbonate (h) lime water
(i) calcium sulphate (j) zinc oxide

4. Write *'true'* or *'false'* for the following statements.
   (a) Bee stings are alkaline in nature.
   (b) Aerated drinks contain carbon-dioxide gas.
   (c) Bleaching powder is a base.
   (d) Common salt is a normal salt.
   (e) Our stomach contains nitric acid.

MULTIPLE CHOICE QUESTIONS

1. Acids have pH
   (a) less than 6 (b) more than 8
   (c) less than 7 (d) between 7 to 9
2. The wasp stings can be neutralized by
   (a) calamine solution
   (b) vinegar
   (c) water
   (d) sulphuric acid
3. The base used to make antacid is
   (a) caustic soda
   (b) milk of magnesia
   (c) slaked lime
   (d) caustic potash
4. The salt used for loading is
   (a) sodium chloride (b) green vitriol
   (c) potash alum (d) gypsum
5. Basicity of CH_3COOH (acetic acid) is
   (a) one (b) two
   (c) three (d) four
6. Oranges contain
   (a) lactic acid (b) citric acid
   (c) formic acid (d) acetic acid
7. Phenophthalein remains colourless in
   (a) an alkaline solution
   (b) an acidic solution
   (c) water
   (d) both water and acid

GROUP ACTIVITIES

Prepare your own indicator

1. Crush beet root in a morter.
2. Add sufficient water to obtain the extract.
3. Filter the extract by the procedure learn by you in earlier (class VI).
4. Collect the filtrate to taste the substances you may have tasted earlier.
5. Arrange four test tubes in a test tube stand and level than as A, B, C and D. Pour 2 mL each of lemon juice solution, soda - water vinegar and baking soda solution in them respectively.
6. Put 2-3 drops of the beetroot extract in each test tube and note the colour change if any. Write your observation in a Table.
7. you can prepare indicators by using other natural materials like extracts of red cabbage leaves, coloured petals of some flowers such as Petunia, Hydrangea and berahium.