Chapter 4

ACIDS, BASES AND SALTS

While eating if some food spills on our clothes then it leaves a stain of turmeric. You might have tried to remove these stains with soap. Have you noticed the colour of the stain changing? What could be the reason for this? This happens due to a special property of soap. Let us try to understand it.

Activity - 1

Materials required :- A piece of white cloth, Turmeric, Washing soap, Lemon, Water, Bowl.

Make a thick paste of turmeric in water. Put some drops of this paste on a white cloth. Apply soap on this cloth. What change in colour do you see? Now, put a few drops of lemon juice on this red colour. You will see that the colour changes back to yellow. This shows that lemon juice has a property that neutralizes the effect of the soap.

Many substances used by us in daily life have this neutralizing property. This nature of substances can be identified with a litmus paper.

Activity - 2

Materials required :- Red and Blue Litmus paper, Lemon juice, Washing soda, Tamarind (imli) juice, Baking soda, Salt, Sugar, Some beakers or Bowls, a Dropper and a Spoon.

To do the experiment make a solution of each substance. For this put less than half a tea-spoon of the substance in a bowl and fill one-third of it with water. Now stir it with a spoon till the substance dissolves fully. With the help of a dropper put a drop of the solution on a leaf of red and blue litmus paper. Note the change in the colour of both the litmus papers. Similarly make solutions of all the other substances one by one and test on both the litmus papers. Remember to wash the dropper with water after each test. Record your observations in table 4.1.

Table - 4.1

S.No.	Substance	Effect on blue limtus Colour becomes red/ no change	Effect on red litmus Colour becomes blue/ no change
1.	Lemon juice	Colour becomes red	No change
2.	Washing soda	.....	.....
3.	Tamarind juice	.....	.....
4.	Baking soda	.....	.....
5.	Sugar Solution	.....	.....
6.	Salt Solution	.....	.....

On the basis of change in colour we can divide the substances given in table 4.1 into three groups. First group would be of those substances that change the colour of blue litmus to red. All these are acids. Second group would be of those that change the colour of red litmus to blue. All these are bases. There are some substances that do not cause any change in colour of either litmus papers. These are neutral substances.

Table - 4.2

S.No.	Acidic substances	Basic substances	Neutral substances
1. 2. 3.			

Write the names of substances from table 4.1 in appropriate columns in table 4.2 as acids, bases or neutral. substances.

4.1. Indicators

Substances that change colour to indicate an acidic or basic medium are called indicators. Methyl orange and phenolphthalein are also used as acid-base indicators apart from litmus. Methyl orange gives red colour with acids and yellow colour with bases. Phenolphthalein remains colourless in acidic solution while it turns pink in basic solution. We have identified acids and bases using indicators but they have other characteristics that can help to identify them.

4.1.1 Let us find out, if there can be some other indicators? Petals of flowers can also act as indicators. Let's do an activity.

Activity - 3

Materials required: China rose petals (Gudhal) breaker, test tube, warm water, dropper, some acidic, alkaline and neutral substances.

Collect some China rose (Gudhal) petals and place them in a beaker. Add some warm water. Keep the mixture for some time till water becomes coloured. Use the coloured water as an indicator. Add five drops of the indicator to each of the solution given in table 4.3. Now note the change in colour before and after adding the China rose indicator (fig 4.1).

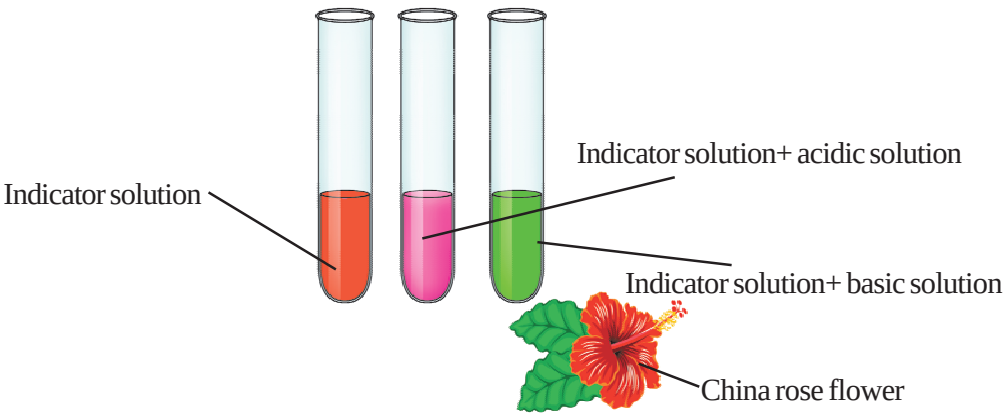

Fig 4.1 China rose flower and indicator prepared from it.

Table - 4.3

S.No.	Test Solution	Initial Colour	Final Colour
1.	Baking Soda Solution	……..	……..
2.	Lemon Juice	……..	……..
3.	Soda Water	……..	……..
4.	Sugar Solution	……..	……..
5.	Tamarind Juice	……..	……..
6.	Washing Soda Solution	……..	……..
7.	Salt Solution	……..	……..
8	Milk	……..	……..
9.	……..	……..	……..
10.	……..	……..	……..

What is the effect of the indicator on acidic, basic and neutral solutions? China rose indicator tums acidic solutions to dark pink (magenta) and alkaline solutions to green. Repeat this activity with some other flower extracts.

4.2 Acids

The word 'acid' is derived from latin word *acidus* which means sour.

Lemon, orange, amla, tamarind, raw mango etc. are all sour due to the presence of acids. You may have experienced a burning sensation when bitten by an ant. This sensation is due to the presence of formic acid that the ant releases at the place of the bite. Acids present in animals, and plant vegetation/ flora are called natural acids. Names of some natural acids and their origins are given in table 4.3.

Table - 4.4

S. No.	Source	Acid	S. No.	Source	Acid
1.	Orange, lemon	Citric acid	5.	Vinegar	Acetic acid
2.	Apple	Malic acid	6.	Tea	Tannic acid
3.	Ant and honeybee	Formic acid	7.	Tamarind	Tartaric acid
4.	Spoilt milk/ sour milk, curd	Lactic acid	8.	Tomato	Oxalic acid

We can also make acids from the minerals obtained from the soil like hydrochloric acid (HCl), sulphuric acid **(H_2SO_4)**, nitric acid **(HNO_3)** etc. These are called mineral acids. Mineral acids also taste sour. Do not touch or taste these chemicals without instructions from your teacher. They can be harmful. If the amount of water added to pure acid is more, then it is a dilute acid. If the amount of water in an acid is less then it is called concentrated acid.

When a sour substance is kept in a brass or bronze container for a long time then a blue-green layer is formed on the inner walls of the container. The copper present in brass or bronze reacts with the acid to form this blue-green compound. To avoid this reaction, the brass containers are coated with tin. This coating protects the containers from reacting with acids and avoids corrosion of the metal of the container. You must have noticed that articles made of iron and silver get tarnished on exposure to air and moisture, this is known as corrosion. Let us take up the process of corrosion (rusting) in iron.

Rusting is a change that affects iron articles and slowly destroys them. The process of rusting can be represented by the following equation:

Iron (Fe) +Oxygen (O_2, from air) + Water (H_2O) $\longrightarrow$ Rust (Iron Oxide Fe_2O_3)

For rusting, the presence of both oxygen and water (or water vapour) is essential. So, to prevent iron from rusting we have to prevent iron articles from coming in contact with oxygen, or water or both.

One simple way is to apply a coat of paint or grease. Another way is to deposit a layer of a metal like chromium or zinc on iron. This process of depositing a layer of zinc on iron is called galvanization. Thus, corrosion can be prevented by protecting iron articles from exposure to air and moisture.

Activity - 4

Materials required :- Dilute hydrochloric acid, zinc granules, matchbox, test tube

Fill a test tube upto approximately ¼ part with dilute hydrochloric acid. Add some zinc granules. There would be a reaction that would produce a gas. Bring a burning matchstick near the mouth of the test tube in the path of the emerging gas. What happens? You will see that the gas burns with a blue flame and produces a pop sound. The gas produced is hydrogen (figure 4.2)

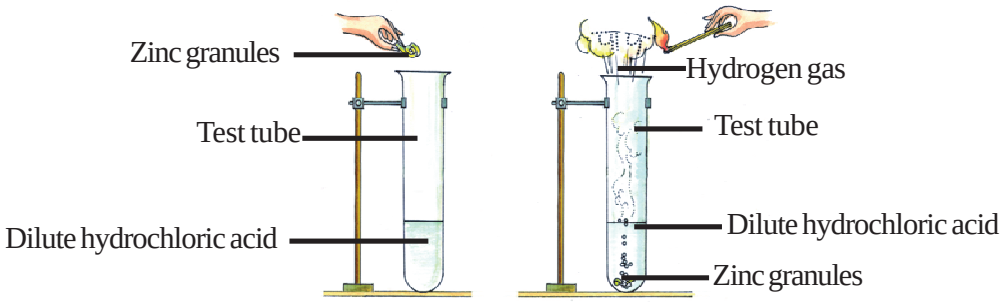

Fig. 4.2 Reaction of zinc granules with dilute hydrochloric acid

$$Zn + 2HCl = ZnCl_2 + H_2$$

Zinc + Hydrochloric acid = Zinc chloride + Hydrogen

Acids react with some metals to release hydrogen gas.

Activity - 5

Materials required :- Marble chips, Dilute hydrochloric acid, Test tube

Take some marble chips in a test tube and add some dilute hydrochloric acid to them. What do you see? A gas comes out of the test tube with effervescence. As the marble chips are made of calcium carbonate they react with dilute hydrochloric acid to form carbon dioxide. Acids react with carbonates and bicarbonates to produce carbon dioxide gas. This property of acids is used in fire extinguishers.

$$CaCO_3 + 2\,HCl = CaCl_2 + H_2O + CO_2$$

Calcium carbonate + Hydrochloric acid = Calcium chloride + Water + Carbon dioxide

4.2.1 Uses of acids

1. Sulphuric acid is used in making fertilizers like ammonium sulphate, and super phosphate, in car batteries as battery acid and in fire extinguishers etc.
2. Hydrochloric acid is used in the purification of salt, to clean ceramic utensils and tiles.
3. Nitric acid is used in making fertilizers like ammonium nitrate etc. and in cleansing silver and gold ornaments.

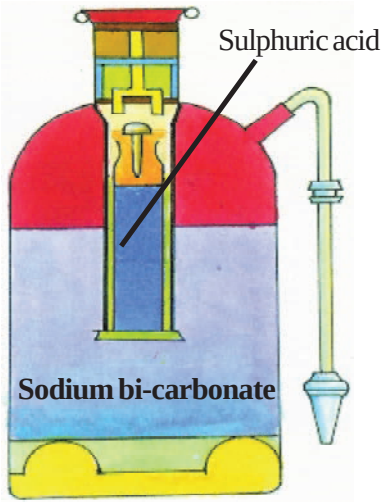

Fig. 4.3 Fire Extinguisher

4.2.2 Fire Extinguisher

This comprises of a metal cylinder filled with sodium bicarbonate. A glass bottle filled with dilute sulphuric acid is kept inside the cylinder. Bottle has a knob going inside it. In case of fire the knob is hit on a hard surface. This breaks the glass bottle enabling the sulphuric acid in the bottle to come in contact with sodium bicarbonate. They react to produce carbon dioxide. This carbon dioxide and the effervescence help to extinguish fire (figure 4.2).

$$2\,NaHCO_3 + H_2SO_4 = Na_2SO_4 + 2H_2O + 2CO_2$$

Sodium bi-carbonate + Sulphuric acid = Sodium Sulphate + Water + Carbon dioxide

Answer these

1. Name three natural and three mineral acids.
2. What do the terms dilute and concentrated acids mean?
3. Why are acids not stored in a metal container?
4. Acidic, basic and neutral solutions are given in three test tubes. If you are given a strip of red litmus how will you identify the three solutions?

4.3 Alkalis

The word alkali has originated from an Arabic word that means ash. Ash has alkaline properties.

Put some lime water on your fingers, rub them against each other. Do you feel some greasiness? Repeat this activity with soap water, mashed leaves of china rose and washing soda. All of these are basic in nature. Water soluble bases are called alkalies.

Activity - 6

Materials required :- Magnesium ribbon, some source of heat like burning candle, test tube, water, tongs, red and blue litmus.

Burn a small piece of magnesium ribbon by holding it with a tongs. Collect the white ash and dissolve it in little water. Touch the solution formed and put some drops on blue and red litmus paper.

$2Mg + O_2 = 2MgO$

Magnesium Oxygen Magnesium oxide

Oxide of magnesium dissolves in water to form magnesium hydroxide. Similarly oxides of potassium and sodium dissolve in water to form potassium hydroxide (KOH) and sodium hydroxide (NaOH) respectively. All these are bases. They are soapy to touch and change the colour of red litmus to blue.

Generally oxides of metal are basic in nature. All basic substances are not soluble in water.

4.3.1 Uses of bases

1. Bases are used in the manufacture of soap, medicines, paper, bleaching powder etc.
2. Bases are used to reduce the acidity of soil and water.
3. Bases are also used in laboratories.

Answer these

1. When drops of lemon juice are put on blue litmus it turns red. What will happen if you put some drops of soap solution on it?

2. Is the solution of the white powder obtained by the combustion of magnesium in water acidic, basic or neutral?

We have seen the properties of acids and bases till now. What will happen if acid and base react with each other?

Activity - 7

Materials required :- Test tube, Sodium hydroxide, Hydrochloric acid, Phenolphthalein, Dropper.

Put about 20 drops of dilute sodium hydroxide in a test tube and add one or two drops of phenolphthalein. The colour of the solution changes to pink. Add a few drops of dilute hydrochloric acid while shaking the test tube continuously. Keep adding drops of acid till the pink colour disappears. Stop adding the acid at this stage.

Carefully add a few drops of dilute sodium hydroxide to this colourless solution and shake the mixture. Is there any change in colour? Again add a few drops of dilute hydrochloric acid. What change do you see now ?

Base solutions gives pink colour with phenolphthalein while acidic solutions remain colourless. When an acid is added to a base, the base looses its basic properties and when a base is added to an acid the acid looses its acidic properties. They neutralize the effect of each other. The reaction between a base and an acid is known as neutralization.

We see many examples of neutralization in our daily lives:-

1. The burning sensation caused by ant-bite is due to an acid. If some washing soap or baking soda is applied at the place of the bite then the person feels better due to the neutralization of the acid.
2. Neutral soil is necessary for proper growth of plants. If the soil is acidic some lime stone is added to make it neutral. If the soil is basic, organic matter is added to it. Organic matter releases acids which neutralizes the basic nature of the soil.

Often people complain of acidity in the stomach. Our stomach produces a very dilute solution of hydrochloric acid to help in the digestion of food. If the acid produced is less in quantity there is problem in digestion. However, if the quantity of acid is more than needed the persons from sour belches. To provide relief, acidity is reduced by giving milk of magnesia and other such tablets or solutions that are weak bases. Now you know why these tablets are called antacid.

4.4 Salt

The compound formed due to the neutralizing reaction between an acid and an alkali is called a salt.

Acid + Alkali = Salt + Water

For example – hydrochloric acid and sodium hydroxide react to form sodium chloride (salt) and water.

HCl + NaOH = NaCl + H_2O

Hydrochloric acid Sodium hydroxide Sodium chloride Water

Salt is a general term. It is used not only for the common salt we eat daily but for all compounds formed by the reaction of an acid with a base.

Activity - 8

Material required :- Three Test Tubes, Water, Copper Sulphate, Sodium Carbonate, Common Salt, Red and Blue litmus paper, Three Droppers.

Take copper sulphate, sodium carbonate and common salt in three different test tubes. Add a few drops of water to each to make solutions. Now pour a few drops of each solution on a red and a blue litmus paper using separate droppers. Note the changes in colour and write the observations in the given table.

Table - 4.5

S.No.	Salt	Effect on blue litmus paper	Effect on red litmus paper
1	Copper sulphate		
2	Common salt		
3	Sodium carbonate		

Salt which changes blue litmus to red is an acidic salt and the other salt which changes red litmus to blue is a basic salt. Some salts effect neither blue litmus nor red litmus. These are called neutral salts. Here copper sulphate is acidic salt, sodium carbonate is basic salt and common salt is a neutral salt.

4.4.1 Uses of salts

1. Common salt (Sodium chloride NaCl) is an essential component of our food. This makes the food tasty and helps prevent the rotting of fish, pickles etc.

2. Washing soda (Sodium carbonate Na_2CO_3) is used to wash clothes.
3. Baking soda (Sodium bicarbonate $NaHCO_3$) is used to prepare cakes, soda water, cold drinks and to reduce acidity in stomach.

Our body needs many types of salts. These salts are mainly chlorides, iodides, sulphates, bicarbonates and phosphates of calcium, magnesium, iron, sodium and potassium. We lose some salts through perspiration. This is why our sweat is salty. When we lose a lot of water due to diaorrhea or dysentery, we also lose many salts. In such condition of dehydration we should drink plenty of water with salt and sugar added so that the concentration of salts in our body is restored. This oral rehydration saves children from probable death from diaorrhea or dysentery.

Answer these

1. What is neutralization? Give an example.
2. Explain different types of salts with examples.

We have learnt

- Acids are sour in taste.
- Acids change the colour of blue litmus to red.
- Acids can be classified into natural and mineral acids.
- Bases turn red litmus to blue.
- Bases are soapy to touch.
- Acid reacts with a base to form a salt.
- Salts can be classified into acidic, basic and neutral salt.
- Coloured petals like that of China rose etc. can also act as indicators.

Questions for practice

1. Choose the correct answer:

1) The colour of phenolphthalein in an acidic medium is –

(a) pink (b) red (c) orange (d) colourless

2) Formation of salt by the reaction of an acid with a base is called –

(a) acidification (b) basification (c) dehydration (d) neutralization

3) Gas used to extinguish fire in a fire extinguisher is -

(a) oxygen (b) hydrogen (c) carbon dioxide (d) nitrogen

4) The juice of raw mango is –

(a) acidic (b) basic (c) neutral (d) none of these

2. Fill in the blanks –

1) Acids are ..... in taste.

2) Bases are .....to touch.

3) The nature of common salt solution is .....

4) Water soluble bases are called .....

3. Make appropriate connections –

Soap solution	Indicator
Sugar solution	Acidic substance
Litmus paper	Basic substance
Lemon juice	Neutral substance

4. Identify true and false statements from the following and rewrite the false statement after correcting them.

a) Lemon juice changes red litmus to blue.

b) Bases feel rough to touch.

c) The function of an antacid is to increase acidity in the stomach.

d) Coating of utensils prevents them from burning in fire.

5. What is an acid?

6. How will you differentiate between an acid and a base?

7. What are salts? Explain the reaction by which they are formed?

8. What are antacids? What is their function?

9. Write the common and chemical names of at least three salts that we use in our daily life.

Do these also

1. Make a list of a few acids, bases and salts that we use in daily lives along with their use.

S.No.	Name of the substance	Type	Use
1.	....	.....	.....
2.	....	.....	.....
3.	....	.....	.....

2. Get information from your teacher about the main acidic substances, basic substances and salts found in our body. Make a list of their names and functions.

S.No.	Name of the substance	Type	Function
1.	....	.....	.....
2.	....	.....	.....
3.	....	.....	.....