



CHAPTER

3

ACIDS, BASES AND SALT

You know the tastes of various fruits and vegetables. Some fruits and vegetables such as lemon, tamarind, green mango, oxalis, Indian goose berry (amla), unripe grapes, curd are sour to taste. Do you know the taste of sodium bicarbonate ? It is bitter in taste. Add some sodium bicarbonate on a half-cut lemon. What do you see ? There will be gas bubbles escaping from the lemon surface.

Those substances which have sour taste are said to contain acids. Different types of acids are present in different kinds of food materials. Acids present in food materials are generally called **organic acids**. Oxalic acid, lactic acid, tartaric acid, citric acid are some common organic acids found in food materials. Other types of acids are hydrochloric acid, sulphuric acid, nitric acid, phosphoric acid etc. which are called **mineral acids**. They are generally prepared from minerals. The liquid present in lead storage battery is dilute sulphuric acid. It is sour to taste.

Substances like potassium hydroxide, sodium hydroxide, calcium hydroxide etc. which are bitter to taste, are called **bases**. Sodium carbonate and sodium bicarbonate also shows basic character in their solutions. Bases react with acids to form compounds called **salts**. You know the salty taste of common salt.

Acids change the blue colour of litmus to red. Bases turn the colour of red litmus to blue. The colour of litmus generally remains unaffected in salt solutions. You must have seen the change of curry stain (turmeric stain) in soap solution. Turmeric and litmus are examples of natural indicators. They are called so because they differentiate acidic and basic solutions by changing their colours. Here we will discuss the reaction of acids and bases. We will also study how acids and bases interact with each other in reactions known as **neutralisation reactions**.

Litmus solution is a water soluble purple dye extracted from Lichen. Lichen is a plant belonging to Thallophyta family. Acid turns the purple color of litmus red while base turns it into blue. There are many natural substances like turmeric, red cabbage leaves, colour petals of Petunia, Geranium, Hydrangea etc. which can indicate the presence of acid or base in a solution. They are generally called acid-base indicators or simply indicators .

The teacher can ask the students to identify the solutions by using red and blue litmus papers.

3.1. Chemical Properties of Acids and Bases

3.1.1. Acids and Bases in the Laboratory

Activity 3.1

- ☞ Find the following solution samples from your laboratory : sulphuric acid (H_2SO_4) hydrochloric acid (HCl), acetic acid (CH_3COOH), oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$), sodium hydroxide (NaOH), sodium carbonate (Na_2CO_3), ammonium hydroxide (NH_4OH).
- ☞ With the help of a dropper or glass tube, take out a few drops of each sample solution on a watch glass or a small test tube. Add a drop of the following indicators as given in the Table 3.1.
- ☞ Observe the change in the colour of each solution taken and note them in the Table 3.1.

Table 3.1

Sample Solution	Phenolphthalein	Blue litmus	Red litmus	Methyl orange
Hydrochloric acid				
Sulphuric acid				
Acetic acid				
Oxalic acid				
Sodium hydroxide				
Sodium carbonate				
Ammonium hydroxide				

Activity 3.2

- ☞ Prepare an aqueous solution of turmeric powder and filter. Collect the filtrate.
- ☞ Collect samples of lime juice, passion fruit juice, unripe tomato juice, soap solution, detergent solution and common salt solution. Filter, if necessary.
- ☞ Take 10 drops or about 1mL of each solution in separate test tubes and add 1 or 2 drops of the indicators and mix thoroughly as shown in the Table 3.2.
- ☞ Observe the change in colour of each solution taken and note them in the table.

Table 3.2

Sample solution	Turmeric solution	Phenolphthalein
Lime juice		
Passion fruit juice		
Unripe Tomato juice		
Soap solution (Toilet Soap)		
Detergent (washing powder) solution		
Common salt (NaCl) solution		

Let us answer these

1. From the observed facts draw your conclusion comparing with the results of the activity 3.1.
2. Suggest the usefulness of turmeric powder as an indicator.
3. Is sodium chloride solution acidic or basic ?

Indicators tell us the nature of a solution – acidic or basic by a change in their colour in different solutions.

3.1.2. Reaction of acids and bases with metals**Activity 3.3**

Under the guidance of your teacher perform this activity

- ☞ Set up the apparatus as shown in Fig. 3.1
- ☞ Take 2-3 pieces of zinc granules in a double necked Woulf's bottle, fitted with a thistle funnel and a delivery tube.

- ☞ Add some dilute sulphuric acid through the funnel to cover the zinc granules. See that the end of the Thistle funnel is under the acid.
- ☞ Observe the surface of zinc granules. Do you see the bubbles formed on it?
- ☞ Allow the gas formed to pass through the soap solution.

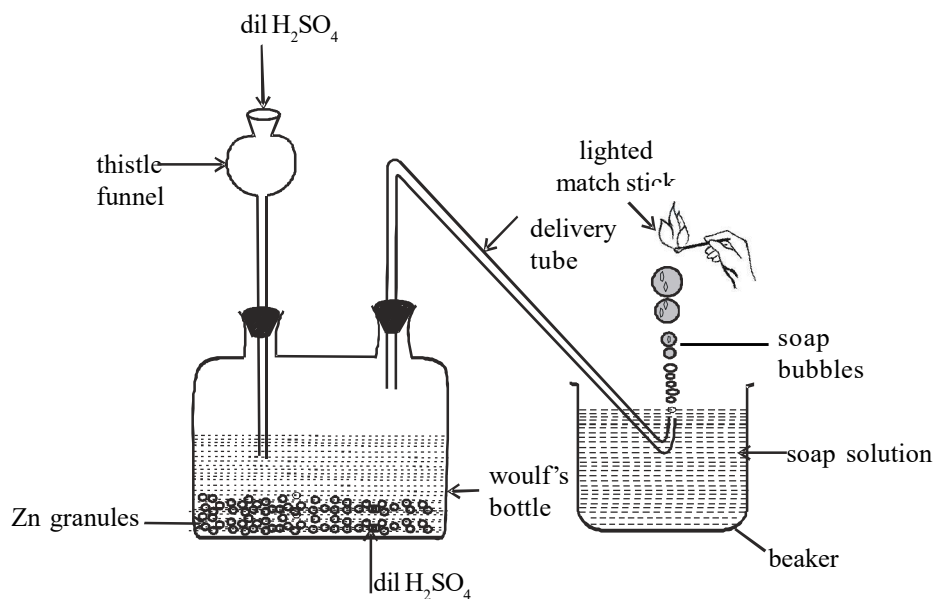


Fig 3.1. Zinc granules react with dilute sulphuric acid to give hydrogen gas. Hydrogen burns in air with a pop sound.

Let us answer these observations:

- ⇒ Why are soap bubbles formed?
- ⇒ Why do the bubbles go up in the air ?
Compare with the hydrogen balloons you have seen in the market place.
Did the balloons go up in the air when released ? Why ?
- ⇒ Take a lighted match stick near the rising soap bubbles.
What do you observe ?
- ⇒ Repeat this activity using acetic acid solution in place of dilute sulphuric acid solution.
- ⇒ Are there any differences in your observations ?

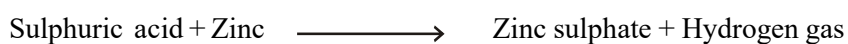
Note carefully the composition of acids—sulphuric acid (H_2SO_4), hydrochloric acid (HCl), nitric acid (HNO_3), phosphoric acid (H_3PO_4), acetic

acid (CH_3COOH) etc. All of them contain hydrogen and another part e.g., Cl^- and SO_4^{2-} in HCl and H_2SO_4 respectively.

In the above activity, the hydrogen (H) of the acid is replaced by the metal releasing hydrogen gas (H_2). Then the metal combines with the other part of the acid to form a compound which is called salt. In short, we can write



For example,



Can you write the equation for the reaction between zinc and acetic acid ?

Activity 3.4.

Repeat the activity 3.3 using pieces of copper metal instead of zinc granules

- ☞ Do you see any gas formed on the metal surface ?
- ☞ Can you draw a conclusion from this observation ?
- ☞ Does this verify the general statement that
 $\text{Acid} + \text{Metal} \longrightarrow \text{Salt} + \text{Hydrogen gas} ?$
- ☞ Are there exceptions to the above statement ?

Activity 3.5.

Repeat the activity 3.3 using dil sodium hydroxide (NaOH) in place of dilute sulphuric acid.

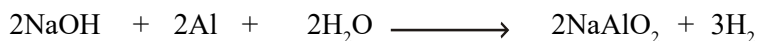
- ☞ You can repeat the activity using fine pieces of aluminium metal with dilute sodium hydroxide.
- ☞ Can you draw a conclusion from these observations ?
- ☞ Repeat all the steps in activity 3.3 and record all your observations.

Here, the metal zinc reacts with the alkali sodium hydroxide to release hydrogen gas and forms a salt. The reaction can be written as



Aluminium can also release hydrogen in a similar way. Thus,

Sodium hydroxide + Aluminium + Water $\longrightarrow$ Sodium meta aluminate + Hydrogen gas



Alluminium powder and NaOH solution is used to prepare hydrogen for gas balloon sold in the market. Here, you find that hydrogen gas is formed in the reaction. However, such reactions do not occur with all metals. Besides zinc and aluminium, other elements which react with sodium hydroxide to liberate hydrogen are tin and silicon.

Lime and lime water are also bases. A suspension of lime (CaO) in water is called milk of lime but the clear supernatant liquid is called lime water. Chemically, it is calcium hydroxide $\text{Ca}(\text{OH})_2$. Lime water readily absorbs carbon dioxide forming calcium carbonate which is insoluble in water.

Lime is used in the treatment of acidic soil. The acids in soil are released by the decay of organic matter. Lime neutralises these acids. Nitrifying bacteria (those bacteria which can increase the nitrogen content of the soil) which cannot function in acid soils become active again when the soil is treated with lime.

3.1.3. Reactions of acids with metal carbonates and metal hydrogen carbonates.

Activity 3.6

- ☞ Take about 0.5g of a metal carbonate like zinc carbonate, magnesium carbonate, sodium carbonate etc. in a test tube as shown in the Fig 3.2.
- ☞ Add about 3ml of dilute hydrochloric acid into the test tube.
- ☞ Note the evolution of a colourless gas.
- ☞ Pass the gas into a test tube containing clear lime water as in the figure.
- ☞ Record the changes you have seen.

Now repeat the above steps, taking sodium bicarbonate or baking soda in place of metal carbonate and record your observations.

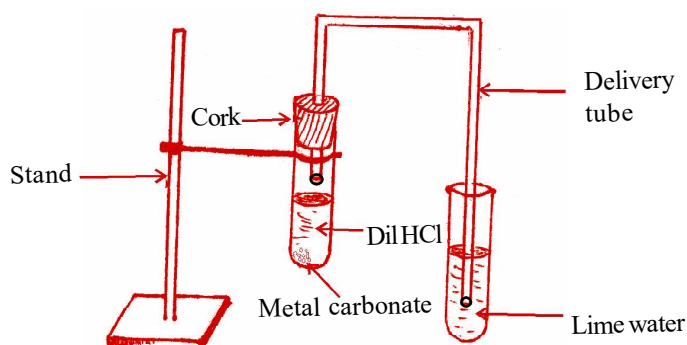
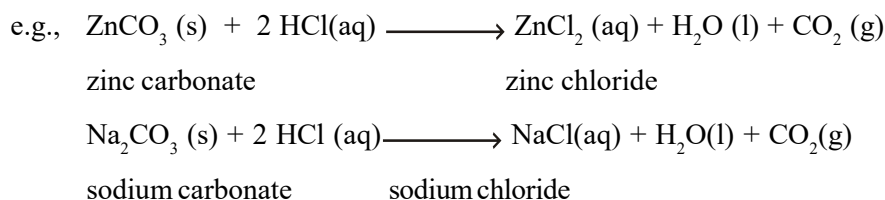


Fig. 3.2. Action of acids on metal carbonates and bicarbonates.

The reaction taking place in the above can be written as

Metal carbonate + Hydrochloric acid $\longrightarrow$ Metal chloride + Water + Carbon
(salt) dioxide

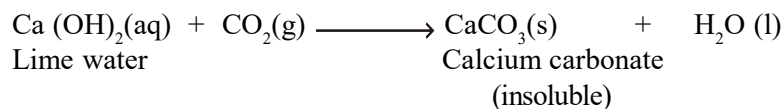


With sodium bicarbonate (sodium hydrogen carbonate) the reaction is

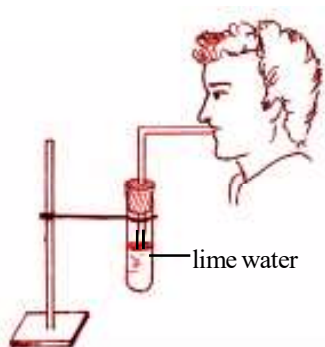


Sodium hydrogen carbonate

When the evolved carbon dioxide is passed into lime water, the clear solution becomes milky due to the formation of insoluble calcium carbonate. The reaction is



When carbon dioxide is passed into lime water for a longer period, the milkyiness of the solution will start disappearing. The solution will again become clear. This is due to the conversion of insoluble calcium carbonate into soluble calcium hydrogen carbonate. The reaction is



Activity 3.7.

- ### 3.1.4. Neutralisation Reactions

How do Acids and Bases React with each other ?

Different acids and different bases have different strengths. Generally dilute solutions of these substances are prepared by dissolving them in water. Such solutions generally have similar strengths. They are usually available in the laboratory. If different strengths are required for a specific purpose, they are further diluted with fixed amounts of water.

In acid-base reactions, solutions with similar strengths are usually taken. For example, samples of dilute HCl and dil NaOH solutions in the laboratory have nearly the same strength.

Activity 3.8

- ☞ Take about 5ml of dilute NaOH solution in a test tube and add two drops of phenolphthalein indicator.
(Note that volume of a test tube is about 20 mL).
- ☞ Note the colour of the solution
- ☞ Add dilute HCl into the above solution drop by drop and mix well.
- ☞ Do you see any change in the colour of the mixture ?

- ☞ Continue to add dil HCl in the above manner till the solution becomes almost colourless.
- ☞ Now add a few drops of dilute NaOH to the above colourless solution.
- ☞ What is the colour of this solution ?
- ☞ Why is this happened ?

The effect of a base can be annulled by an acid. Similarly, we can find out that the effect of an acid can also be annulled by a base. (For this, repeat the steps of **activity 3.8** taking 5 mL of dilute HCl in the test tube first and adding dilute NaOH dropwise to it after adding two drops of phenolphthalein).

The reaction between the acid and the base is



Such a reaction between an acid and a base producing salt and water is known as **neutralisation reaction**.

The neutralisation reaction between dilute sulphuric acid and sodium carbonate solution can be studied using methyl orange indicator also. For this follow the similar steps in activity 3.8.

Consider again the reaction between dilute HCl and dilute NaOH solutions to form sodium chloride solution and water.



Here, 1 mole of HCl react with 1 mole of NaOH to form 1 mole of NaCl and 1 mole of water.

$$\text{Molecular mass of HCl} = 1 + 35.5 = 36.5$$

$$\text{Molecular mass of NaOH} = 23 + 16 + 1 = 40$$

$$\text{Molecular mass of NaCl} = 23 + 35.5 = 58.5$$

$$\text{Molecular mass of H}_2\text{O} = 1 \times 2 + 16 = 18$$

Therefore,



36.5 g of HCl reacts with 40 g of NaOH to produce 58.5 g of NaCl and 18 g of H₂O.

Let us answer these.

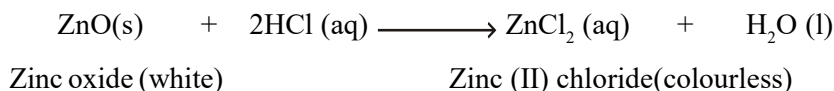
1. Dissolve a small amount of NaHCO_3 in water. Add 1 drop of methyl orange into it. What is the colour of the mixture ?
Add lime juice in the above solution till the evolution of the gas stops. What is the colour of the mixture now ?
2. How many grams of sulphuric acid (H_2SO_4) will be needed to react completely with a solution containing 10.6g of sodium carbonate (Na_2CO_3)?

3.1.4. Reaction of Acids with metal Oxides

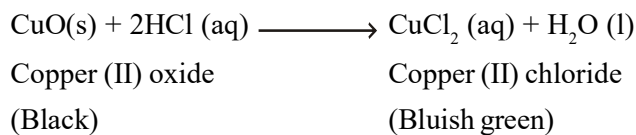
Activity 3.9

- ☞ Collect samples of zinc oxide, magnesium oxide, copper oxide, manganese dioxide, ferric oxide etc. and note their colours.
- ☞ Take a small amount of an oxide in a test tube.
- ☞ Add dilute hydrochloric acid into it and warm on a spirit lamp.
- ☞ What happens to the oxide ?
- ☞ Note the colour of the solution.

In the case of colourless oxides, like that of zinc and magnesium, you will get a colourless solution when hydrochloric acid dissolves the oxides. The reaction in case of zinc oxide is



If you take the black copper oxide you will get a bluish green solution. The reaction is

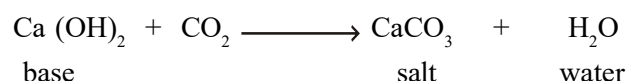


Thus the general reaction between a metal oxide and an acid can be written as



Let us answer these.

1. What is the nature of metal oxides – acidic or basic ?
2. Two metallic compounds A and B react separately with acid to form salt and water. The compound A also produces an effervescence. What could be A and B ?
3. When milk becomes curd lactic acid is produced as one of the products. Give reason why is it not advisable to keep curd in copper and brass vessels?
4. Carbon dioxide reacts with lime water, Ca(OH)_2 to form salt, CaCO_3 and water as



Indicate the nature of CO_2 . What will be the general nature of non-metallic oxides?

5. Write the reaction between sodium hydroxide and sulphur dioxide (SO_2).
6. What will happen when CO_2 gas is passed into water ? Write the chemical equation.
7. Write the reaction that takes place between water and sulphur dioxide.
8. Give definition of base.
9. Define acids.
10. Give definition of acidic oxides.

3.2. What Is Common In All Acids ?

You have seen that most metals react with acids to liberate hydrogen gas (Activity 3.3). You have also come across that metals replace all or some of the hydrogen (H) atoms present in acids and these replaced hydrogens came out as hydrogen (H_2) gas. Let us see the chemical formulas of some common acids :

Hydrochloric acid	HCl
Sulphuric acid	H_2SO_4
Sulphurous acid	H_2SO_3
Nitric acid	HNO_3
Nitrous acid	HNO_2
Phosphoric acid	H_3PO_4

Boric acid H_3BO_3

Hydrofluoric acid HF

Hydrobromic acid HBr

All these acids known as **inorganic acids** (mineral acids), contain at least one or more hydrogen atoms which can be replaced by metals.

Let us see some of the acids found naturally in plants, fruits and insects which have acidic properties.

Plants and animal sources	Name of the acid present	Chemical formula
Lemon and oranges etc (citrus fruits)	Citric acid	$\text{C}_3\text{H}_4(\text{OH})(\text{COOH})_3$
Apple, Peach etc	Malic acid	$\text{C}_2\text{H}_3(\text{OH})_2(\text{COOH})_2$
Tamarind and grapes	Tartaric acid	$\text{C}_2\text{H}_2(\text{OH})_2(\text{COOH})_2$
Oxalis	Oxalic acid	$(\text{COOH})_2$
Sour Milk (Curd)	Lactic acid	$\text{C}_2\text{H}_4(\text{OH})\text{COOH}$
Vinegar	Acetic acid	CH_3COOH
Ants, Bees, Wasp	Formic acid	HCOOH
Cabbage, green leafy vegetables etc	Ascorbic acid (vitamin C)	$\text{C}_5\text{H}_5(\text{OH})_4\text{COOH}$

If you observe the chemical formulas of these natural acids carefully it can be easily noted that all them are made up of carbon, hydrogen and oxygen elements. Some of the hydrogens are present as $-\text{OH}$, $-\text{COOH}$ and some of the hydrogens are attached to carbon. In other words, there are different hydrogens in these acids. These acids are known as **organic acids**. Those hydrogen atoms (H) present only in the form $-\text{COOH}$ can be replaced. For example, acetic acid reacts with sodium metal to form sodium acetate liberating hydrogen gas. The reaction is



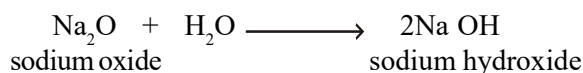
Organic acids contain hydrogen atoms which are not acidic i.e., which are not replaceable by metals. In the case of CH_3COOH , the three hydrogen atoms attached to carbon as $-\text{CH}_3$ are not replaced by metals i.e., these three hydrogens are not acidic.

3.2.1. What Constitute Bases ?

From the activities 3.5, 3.6 and 3.8 you have learnt that bases may be metal hydroxide, metal oxides. Metal carbonates and metal hydrogen carbonates also show basic character. All of them combine with acid forming a salt and water. For example, sodium hydroxide, NaOH, sodium oxide, Na₂O and calcium hydroxide, Ca(OH)₂, are bases. Sodium carbonate, Na₂CO₃ and Sodium hydrogen Carbonate, NaHCO₃ also have basic properties.

Water soluble hydroxide and metal oxide, which dissolve in water to form metal hydroxides are known as alkalis. However, the alkali NH₄OH is not a metal hydroxide.

Thus, sodium hydroxide is an alkali,



There are metal hydroxides (bases) like aluminium hydroxide Al(OH)₃, ferric hydroxide Fe(OH)₃, etc. which are not soluble in water. Such hydroxides are not alkalis.

3.2.2. What happens to an acid when dissolved in water ? Will dry HCl show the acidic reactions ?

Activity 3.10

- ☞ Take a clean dry hard test tube and set up the apparatus as shown in the Fig. 3.4.
- ☞ Add about 1g of NaCl into it.
- ☞ Add about 5 mL of conc. H₂SO₄ into the test tube.
- ☞ Quickly cover the test tube with the cork fitted with delivery tube protected by a calcium chloride guard tube.
- ☞ Test the issuing gas with a dry blue litmus paper.
- ☞ Is there any change in the colour of litmus paper ?
- ☞ Now dip the blue litmus paper in water and test the gas with it as before ?
- ☞ Do you see any change in the colour of litmus paper ?

Dry litmus paper is unaffected by the dry HCl.

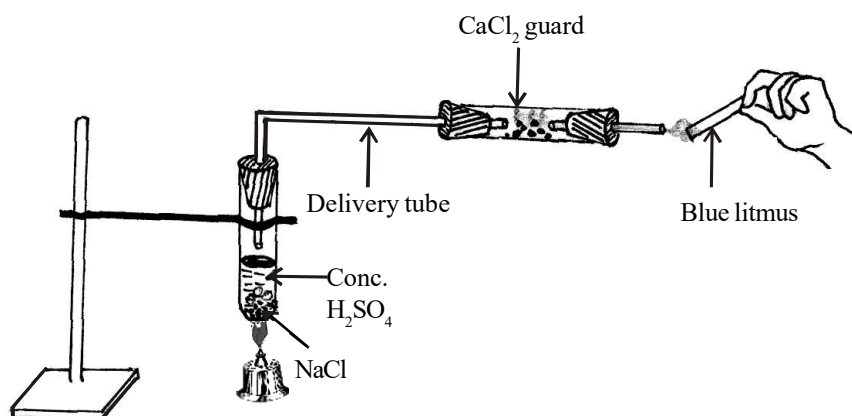
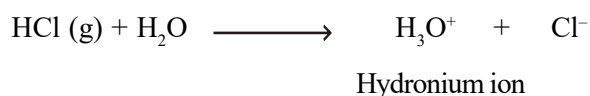


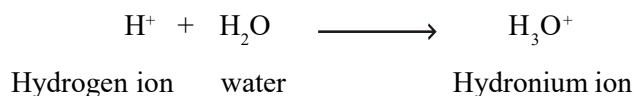
Fig. 3.4. Reaction between conc. H_2SO_4 and $NaCl$ to form HCl



However colour of the blue litmus paper becomes red when it is moistened with water. Because dry HCl reacts with water to form hydrogen ions (H^+) as



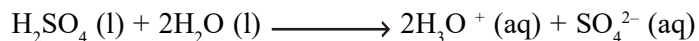
Hydrogen ions (H^+) do not exist independently but it readily combine with H_2O to form hydronium ion, (H_3O^+).



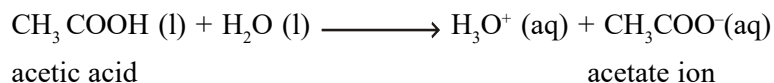
When dissolved in water HCl forms ions as



Similarly, H_2SO_4 in aqueous solution gives



Acetic acid also dissolves in water as



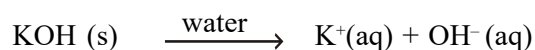
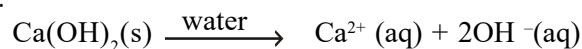
As you know, the acidic reaction of acids are due to the presence of ionisable or replaceable hydrogens in them. Actually, it is the reactions of hydronium ions (H_3O^+) in solution.

3.2.3 What happens when a base is in aqueous solution ?

When solid sodium hydroxide is dissolved in water, it is ionised to form ions ;



Similarly all soluble hydroxides of metals ionise to give hydroxide ion OH^- and the metal ion.



Aqueous solution of alkalis are soapy to touch, bitter to taste and corrosive. You should not directly touch them as it causes burn on your skin. NaOH and KOH are highly corrosive and they are also known as **caustic soda** and **caustic potash** respectively.

You have seen above that soluble metal oxides also produce hydroxides in their aqueous solution .

Does the dissolution of acids and alkalis in water involve heat change ?

Activity 3.11

- ☞ Take about 10 mL of water in a test tube
- ☞ Add about 10 drops of concentrated sulphuric acid to it slowly.
- ☞ Hold the test tube in your palm
- ☞ What do you feel – hot or cold ?
Draw your conclusion from the observations you made.
- ☞ Now take about 3–4 pellets or flakes of NaOH in a test tube.
- ☞ Add about 5 ml of water into it and shake slowly to dissolve.
- ☞ Hold the test tube in your palm.
- ☞ What do you feel again– hot or cold ?

Now let us answer the following.

1. Is the dilution of acid with water exothermic or endothermic ?
2. 'NaOH dissolves in water with the absorption of heat'.
Is it correct or not ? If not, give the correct statement.
3. Why does an aqueous solution of an acid conduct electricity ?
4. What is the effect of dilution on the concentration of H_3O^+ ion of an acid ?
5. What will happen to the concentration of H_3O^+ in a given volume of an acid if it is mixed with a same amount of NaOH solution ?

3.3. Do all acids have the same strength ?

Do all bases have the same strength ?

We have seen that all acids produce hydronium ion H_3O^+ in their aqueous solutions. The strength of an acid depends upon the amount of H_3O^+ ion it can produce in equimolar solutions. However, all acids do not produce the same amount of H_3O^+ ions. Therefore, all acids do not have the same strength.

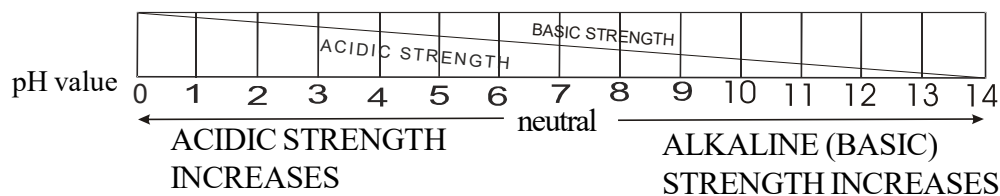
The strength of a base (alkali) depends upon the number of OH^- ions it can produce in equimolar solution. All alkalis do not give the same amount of OH^- ion in solution. Thus, all alkalis are not of the same strength.

It is important to ascertain the strength of a given acid or base. This can be done with the help of a **universal indicator** which is a mixture of indicators. Strips of paper dipped in the universal indicator and dried are available in the market. With the help of this paper the strength of a given acid or alkali solution can be determined.

The strength of acid or base is expressed in a scale called **pH scale**. The scale of pH values ranges from 0 to 14. Acidic solutions have pH value less than 7 and that of basic solutions above 7. You will learn more about pH in higher classes.

Acid solution that contains higher concentration of hydronium ions H_3O^+ is said to be stronger acid. Higher H_3O^+ ion concentration means the lesser pH value, i.e., solutions with lower pH values are stronger acids.

Solution with higher OH^- ion concentrations is more alkaline and therefore, such solution will have higher pH values. The scale of pH and the nature of the solution is given below:

*Fig. 3.5 pH scale.***Activity 3.12**

- ☞ Collect the solutions listed in the Table 3.3. Fruit juices should be collected fresh and filter if necessary.
- ☞ Test the solutions with universal indicator paper.
- ☞ Match the colour of the test papers with the chart colour given along with the paper.
- ☞ Note the pH values of the solutions in the table

Table. 3.3.

Sl. No.	Sample solutions	Colour of P ^H paper	P ^H value	Nature of the substance
1	Tap water			
2	Mineral water			
3	Black tea			
4	Orange juice			
5	Sodium bicarbonate solution			
6	Sugarcane juice			

3.4. Different Kinds of Salts

We have come across that salts are the products obtained when an acid reacts with a base. We have also seen that all acids do not have the same strength. Similarly all bases do not have the same strength. Thus, the neutralisation of an acid by a base and vice versa may have different products. Let us discuss further.

Activity 3.12.

- ☞ Take about 10 mL or $\frac{1}{2}$ test tube of dilute HCl in a conical flask.
- ☞ Add two drops of phenolphthalein indicator. (Note the colour, if any)
- ☞ Then add dil NaOH solution drop by drop, with constant swirling of the conical flask, till the colour of the mixture becomes light pink
- ☞ Why does the colour of the solution become pink ?

Here, HCl is neutralised by NaOH to form NaCl and water. The changes can be written as,



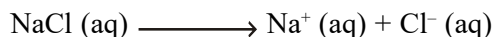
H_3O^+ ions from the acid solution combine with OH^- ions from the base solution to form unionised water.



All the above changes can be written, in short, as



NaCl (aq) will ionise in the solution

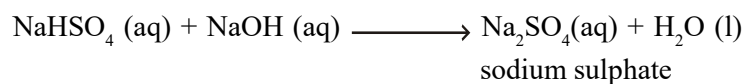
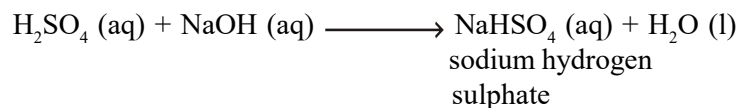


Here we get a salt sodium chloride by the complete neutralisation of HCl with NaOH. Such salts are called **normal salts**.

NaCl, Na_2SO_4 , MgCl_2 , KNO_3 , CuSO_4 etc. are examples of normal salts.

3.4.1. Reaction between NaOH and H_2SO_4

The reaction between dilute NaOH and dilute H_2SO_4 may take place in the following steps:

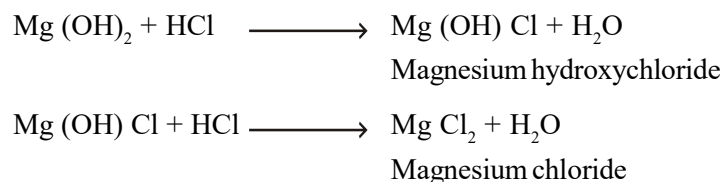


Even though sodium hydrogen sulphate, NaHSO_4 , is a salt, it can further react with more NaOH to form the normal salt, sodium sulphate, Na_2SO_4 . NaHSO_4 has got some acidic property and it can therefore, react with the base, NaOH . Salts like NaHSO_4 are called **acid salts**. They are obtained by the incomplete neutralisation of the acid by a base. Some other examples of acid salts are

Sodium bicarbonate (sodium hydrogen carbonate)	NaHCO_3
Sodium dihydrogen phosphate	NaH_2PO_4
Disodium hydrogen phosphate	Na_2HPO_4
Calcium bicarbonate	$\text{Ca}(\text{HCO}_3)_2$

3.4.2. Reaction between magnesium hydroxide $\text{Mg}(\text{OH})_2$ and HCl

The reaction between $\text{Mg}(\text{OH})_2$ and HCl can be written as



Salts like $\text{Mg}(\text{OH})\text{Cl}$ are called **basic salts**. Such salts can further react with acids to form normal salts.

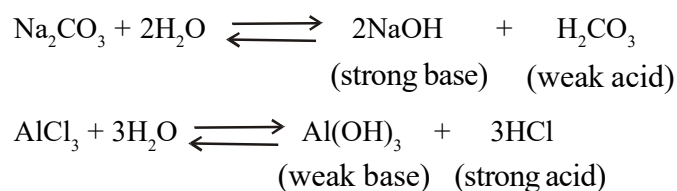
There are also some other types of salts about which you will learn in higher classes.

Hydrolysis of salts in water

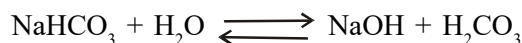
When a salt is dissolved in water, the solution obtained may be neutral, acidic or alkaline which depends upon the nature of the salt taken.

Soluble normal salts derived from strong acids and strong bases give neutral solution. Thus NaCl solution or K_2SO_4 solution is neutral to litmus.

However, the normal salts derived from weak acid and a strong base such as Na_2CO_3 and normal salts derived from strong acid and a weak base such as AlCl_3 on hydrolysis give an alkaline (basic) or an acidic solution respectively.



Soluble acid salts usually give solutions acidic to litmus. Thus, NaHSO_4 solution turns blue litmus red. But NaHCO_3 solution is slightly alkaline due to the formation of strong base NaOH . It turns red litmus blue.



Basic salts are usually insoluble in water

SUMMARY

- Acids are sour to taste. Sour fruits and vegetables contain organic acids.
- Bases are bitter to taste (Do not taste bases directly).
- Acids neutralise bases to form salt and water.
- Indicator litmus is water soluble purple dye extracted from Lichen.
- Indicators change their colour in acidic and alkaline solutions.
- Most metals react with acids to liberate hydrogen gas.
- Hydrogen is lighter than air.
- Metals like Zn, Al and Sn react with sodium hydroxide to liberate hydrogen gas.
- Acids liberate carbon dioxide from metal carbonates.
- Metal oxides dissolve in water to form alkaline solutions.
- CO_2 turns lime water milky.
- Lime water reacts with carbon dioxide to form insoluble calcium carbonate.
- Excess CO_2 dissolves CaCO_3 to produce soluble $\text{Ca}(\text{HCO}_3)_2$.
- Acids neutralise bases to form salt and water.
- All acids have replaceable or ionisable hydrogen.
- Acids have different strengths.
- Organic acids are made of C, H and O.
- Organic acids are found plenty in vegetables & fruits.
- Bases are corrosive.
- In aqueous solutions, acids produce H_3O^+ ions while alkalis produce OH^- ions.

- Dry HCl cannot produce hydrogen ions H^+ .
- pH scale is used to measure the strength of acids and alkalis. pH scale ranges from 0 to 14.
- Salts may be normal, acidic and basic salts.
- Normal salts are the products of complete neutralisation of an acid with a base.
- Acid salts can further react with more bases to form normal salts.
- Basic salts can react with more acids to form normal salts.
- Aqueous solutions of the normal salts of strong bases and strong acids are neutral.
- Aqueous solution of a normal salts of a strong bases and a weak acids is basic (alkaline).
- Aqueous solution of a normal salt of weak base and strong acid is acidic.

EXERCISES

1. Write the products obtained when Na_2SO_4 is hydrolysed. i.e., reacts with water ?
2. Write the formula of the acid and the base from which the salt Na_2CO_3 is obtained.
3. pH of samples of HCl and acetic acid are 2 and 3.5 respectively. Which one is a stronger acid?
4. $Fe(OH)_3$ is less soluble in water than $Ca(OH)_2$. Which one is a weaker base ?
5. Device an experimental set up to show that dilute hydrochloric acid is a good conductor of electricity.

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