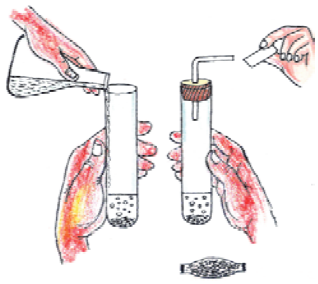
CHAPTER 2

ACIDS, BASES AND SALTS



You have learnt about acids, bases and salts as well as some of their properties in previous classes. Have you ever wondered why when a red ant or a wasp stings us, we are advised to rub soap over the sting? You must have observed that of *haldi* (turmeric) stains on our clothes changes in colour when we rub soap over it.A person suffering from acidity eats baking soda for relief. Lemon juice or tamarind is used to clean tarnished copper vessels. Think: Where can we see the effects of acids and bases in our daily lives?

Do you recall reading about indicators? Indicators help us classify substances into acidic, basic or neutral groups. For example, litmus is an indicator that changes colour in the presence of acids and alkalis. You also know that the reaction between an acid and a base produces a salt and water.

2.1 Acids and Bases are everywhere around us

Let us try to find out which acids and bases are present in the many substances we use in our daily life.

Table-1: Acids and Bases from Natural Sources

S.No.	Natural Source	Acid	S.No.	Natural Source	Base
1.	Tamarind	Tartaric acid	5.	Lime	Calcium hydroxide
2.	Apple	Maleic acid	6.	Baking Soda	Sodium hydrogencarbonate
3.	Vinegar	Acetic acid	7.	Antacid	Magnesium hydroxide
4.	Tomato	Oxalic acid	8.	Washing soda	Sodium carbonate

In addition to the acids given in Table-1, we also have mineral/non-carbonic acids such as nitric acid (HNO_3), sulphuric acid (H_2SO_4) and hydrochloric acid (HCl). Similarly, there are many other alkalis such as ammonium hydroxide (NH_4OH), sodium hydroxide (NaOH), potassium hydroxide (KOH) etc.

Alkalis and Bases

Not all bases are soluble in water. Those bases that can be dissolved in water are called alkalis.

2.2 How to identify acids and bases?

You know that acids turn blue litmus red and alkalis turn red litmus blue. Similarly, any substance which can be used to test the nature of a solution is called an indicator. Indicators change their colour (or there is a change in some other property such as odour) in acidic or basic media and in this way they help us identify acids and bases. Hibiscus flower petals, purple cabbage leaves, turmeric can also be used to identify acids and bases; they all are natural indicators. Can you find more indicators which will help us distinguish between acids and bases?

We can also use synthetic indicators such as methyl red, methyl orange, phenolphthalein to test for acids and bases. Let us do an activity to understand how.

Activity-1

- Take three glass slides.
- With the help of a dropper place three drops of phenolphthalein on three different spots on the first slide (Figure-1).
- In the same manner, add three drops of methyl orange and three drops of juice of hibiscus or rose flowers to slide 2 and slide 3, respectively. Make sure that the drops are in three different spots and don't mix with each other.

  (If the indicators mentioned in the activity are not available, use any other indicator which is available)
- With the help of a dropper add one drop of dilute hydrochloric acid to the first drop on each slide. Use a second dropper to add dilute sodium hydroxide solution to second drop on each slide. Note the change in colour of drops in Table-2.

  (**Note:-** for accurate results, use distilled water for making the solutions)
- The third drop on each slide shows the actual colour of the indicator. This drop is used as a reference to identify changes in colour on addition of acid or base.

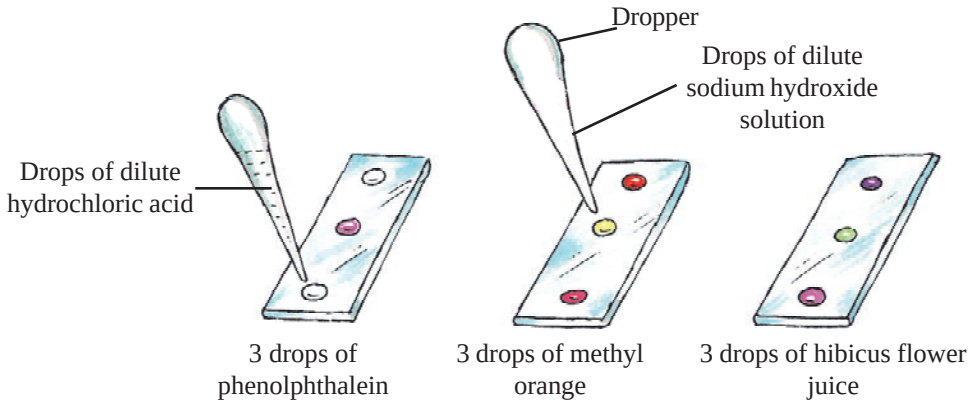


Figure-1: Changes of colour of different indicators in acidic or basic medium

Table-2: Change of colour of indicator in the presence of acids and bases

Indicator	Original colour of indicator	Colour in dilute hydrochloric acid	Colour in dilute sodium hydroxide
Phenolphthalein	_____	_____	_____
Methyl orange	_____	_____	_____
Juice of red rose/ hibiscus flower	_____	_____	_____

- Can you tell what will be the colour of methyl organe in dilute sulphuric acid?

Indicators react with acids and bases to form new substances and this causes change in colour. Do you know that there are some substances that change their odour in acidic or basic media? These substances are called olfactory indicators. Let us carry out an activity with an olfactory indicator.

Activity-2

- Cut an onion and rub it on a piece of white paper. Cut this paper into three smaller pieces.
- On the first piece, put a drop of dilute hydrochloric acid. On the second piece of paper put a drop of dilute sodium hydroxide solution.
- Compare the odour of the first and second paper with the third paper.
- Did you notice any change in the odour of the first and second pieces of paper?

Onion is one example of an olfactory indicator. Vanilla and clove oil are also olfactory indicators. Only dilute solutions of vanilla or clove oil should be used to test for acids and bases. Vanilla does not change its odour in the presence of dilute hydrochloric acid but its odour disappears in the presence of dilute sodium hydroxide. Carry out activity-2 using clove oil and note your observations.

Make your own indicator

Rub any one of the following - Jamuns, oleander (Kaner) flowers, turmeric, kachnaar flowers etc.- on a piece of white paper and use this paper as an indicator to distinguish between acids and bases.

Questions

1. Why are copper and aluminium containers not used to store pickles?
2. While eating midday meal, some sabzi fell on Kusum's clothes. She went home and rubbed some soap on the spot which turned red. Can you give the reason for the change in colour?
3. Suresh is a visually disabled student. Which indicators can he use to identify acids and bases? Give two examples.

2.3 Chemical Properties of acids and bases

We looked at the how acids and bases behave with different indicators. Let us now study some of the chemical properties of acids and bases.

2.3.1 How do acids and bases react with metals?

We know that generally metals react with acids to form a salt with the displacement of hydrogen gas. We can depict the reaction between an acid and a metal as follows:

$$\text{Acid} + \text{Metal} \longrightarrow \text{Salt} + \text{Hydrogen}$$

When hydrochloric acid reacts with zinc metal, the salt zinc chloride is formed along with the evolution of hydrogen gas.

$$2HCl(aq) + Zn(s) \longrightarrow ZnCl_2(aq) + H_2\uparrow$$

Hydrochloric acid *Zinc* *zinc chloride* *hydrogen*

Write down the chemical equations of reactions between hydrochloric acid and some metals that you already know.

Let us do an activity to understand how alkalis react with metals.

Activity-3

- Place a few pieces of granulated zinc in a test tube.
- Add 2 mL of dilute sodium hydroxide solution to the test tube (Figure-2).
- Do you observe any changes on the surface of granulated zinc? What are the changes?
- How will you test the gas which evolves during the reaction?

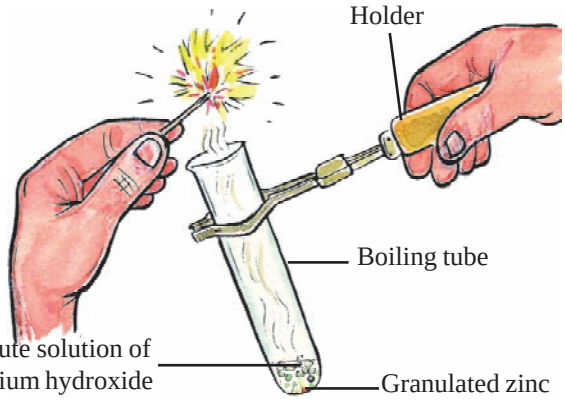


Figure-2 : Reaction of granulated zinc with dilute sodium hydroxide and test of H_2 gas

The reaction that takes place can be written as follows:

$$2NaOH(aq) + Zn(s) \xrightarrow{\text{warm}} Na_2ZnO_2(aq) + H_2\uparrow$$

Sodium hydroxide *zinc* *sodium zincate* *hydrogen*

Some metals react with alkalis to form a salt with the evolution of hydrogen gas.

2.3.2 How do acids react with metal carbonates and metal hydrogencarbonates?

Let us first do an activity.

Activity-4

- Take about 0.5 g sodium carbonate in a test tube.
- Using a thistle funnel, add 2 mL dilute hydrochloric acid to the test tube (Figure-3).
- Do you notice any change?
- How will you test that the gas being produced is carbon dioxide?
- Repeat the activity by replacing sodium carbonate with sodium hydrogencarbonate.

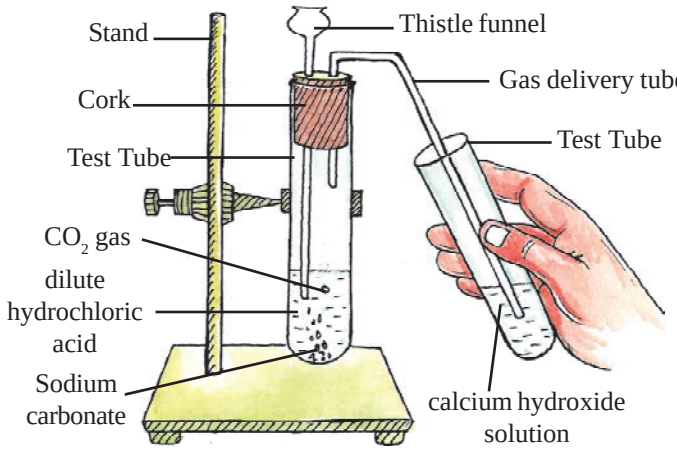


Figure-3 : Reaction of acid with metal carbonate and metal hydrogencarbonate

The chemical equations of the reactions taking place in activity-4 are as follows:

$$Na_2CO_3(s) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + CO_2\uparrow$$

$$NaHCO_3(s) + HCl(aq) \longrightarrow NaCl\,(aq) + H_2O(l) + CO_2\uparrow$$

Sodium hydrogencarbonate

All metal carbonates and hydrogencarbonates react with acids to form the corresponding salt, carbon dioxide and water. We can summarize the reaction as follows:

Metal carbonate/ metal hydrogencarbonate + acid ⟶ salt + carbon dioxide + water

2.3.3 How do bases react with non-metal oxides?

Non-metals such as carbon and sulphur react with oxygen to form carbon dioxide and sulphur dioxide respectively. Bases react with these non-metal oxides to form corresponding salts and water.

Non-metal oxide + base ⟶ salt + water

Sulphur dioxide reacts with sodium hydroxide to form sodium sulphite and water.

$$SO_2(g) + 2NaOH(aq) \longrightarrow Na_2SO_3(aq) + H_2O(l)$$

Sodium sulphite

2.3.4 How do acids and bases react with each other?

We know that an acids and a base react to form a salt and water.

Acid + bases ⟶ salt + water

Let us understand this more through an activity:

Activity-5

- Take 20 drops of dilute hydrochloric in a test tube and add 1-2 drops of phenolphthalein to it.
- With the help of a dropper, add dilute sodium hydroxide solution, drop by drop, to the above solution while continuously shaking the test tube. Keep adding sodium hydroxide till the colour of solution in the test tube become light pink.
- What is the reason for the change in colour of the solution?

We can write the equation for the above reaction as follows:

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

When a drop of alkali is added to acid, it reacts with some acid molecules to form salt and water. This is called neutralization. As we keep adding the alkali, it keeps on reacting with acid molecules. When all the acid molecules have reacted with the alkali molecules then the solution is neutral. As soon as we add another drop of alkali to the solution it becomes pink. Can you tell what will be the nature of this solution?

Questions

1. Explain the reaction between metals and dilute hydrochloric acids with the help of an example.
2. Write the balanced chemical equation of the reaction between calcium hydrogencarbonate and hydrochloric acid.
3. Give an example to show that non-metal oxides are acidic in nature.

2.3.5 Do acids and alkalis conduct electricity?

Let us do an activity to answer this question.

Activity-6

- Take 50 mL dilute hydrochloric acid in a 100 mL beaker.
- Fix 2 awl pins on a cork and place it in the beaker (Figure-4).
- Connect the awl pins to the two terminals of a 9 volt battery through a bulb and a switch as shown in the figure.
- Did the bulb light up and glow?
- Do the same activity using sodium hydroxide solution instead of hydrochloric solution.
- Did the bulb glow when you used sodium hydroxide solution?

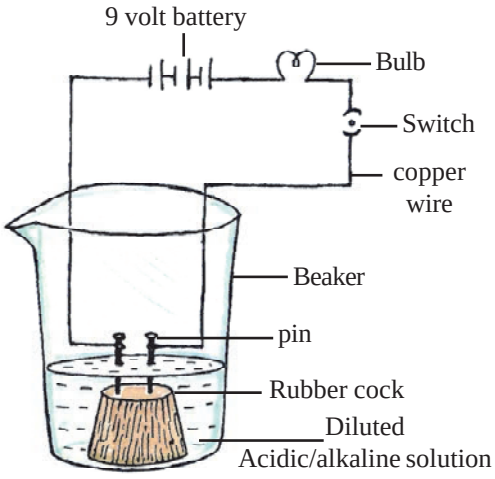


Figure-4: Electrical conductivity in acidic/alkaline solution

In class 9th we had performed a similar activity and seen that when electric current is passed through aqueous solution of an ionic compound, the bulb glows. We can conclude that ionic compounds dissociate into their ions in water which conduct electricity. Similarly, we can conclude from activity 6 that since solutions of acids and bases conduct electricity it shows that acids and bases also undergo ionization in water.

2.4 Ionization

From time to time, many scientists attempted to understand the behaviour of acids and alkalis in water. In 1884, the Swedish scientist Arrhenius used his observations to explain the special characteristics of acids and alkalis. According to Arrhenius, in aqueous solutions an acid molecule will dissociate into a positively charged hydrogen ion (H^+) and a negative ion. Similarly, in aqueous solutions an alkali molecule will dissociate into a negatively charged hydroxide ion (OH^-) and a positive ion. These ions are responsible for the flow of electric current.

Svante August Arrhenius (1859-1927)

He was a Swedish scientist who worked on the electrical conductivity of aqueous solutions of ionic compounds. He suggested that ionic compounds when dissolved in water dissociate into their ions which conduct electricity.

He explained the properties of acids and alkalis on the basis of formation of H^+ and OH^- ions respectively. He was awarded the Nobel Prize in 1903.

$$H_2SO_4 \longrightarrow 2H^+ + SO_4^{2-}$$

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

Ionization mostly depends on the amount of a substance in solution (concentration) and its ability to dissociate into ions.

2.4.1 Are all hydrogen containing compounds acidic?

Activity-7

- Take 50 mL of glucose solution in a 100 mL beaker. Set up the apparatus in the same way as done in activity-6.
- Did the bulb glow?

In activity 6, when hydrochloric acid solution was taken, the glowing of bulb indicated that HCl molecules form H^+ ions on ionization. But glucose does not give H^+ ions. Therefore, not all hydrogen containing compounds are acidic.

2.4.2 Do acids produce ions only in aqueous solutions?

Activity-8

- Take about 1 g of sodium chloride in a clean and dry test tube.
- Add 1-2 mL of concentrated sulphuric acid to the salt along the sides of the test tube.

- Did you notice any gas coming out of the test tube?
- Place a dry blue litmus paper near the mouth of the test tube to test the gas.
- Did the blue litmus paper change its colour?
- Now, take a moist blue litmus paper near the mouth of the test tube.
- Did the moist blue litmus paper change its colour?

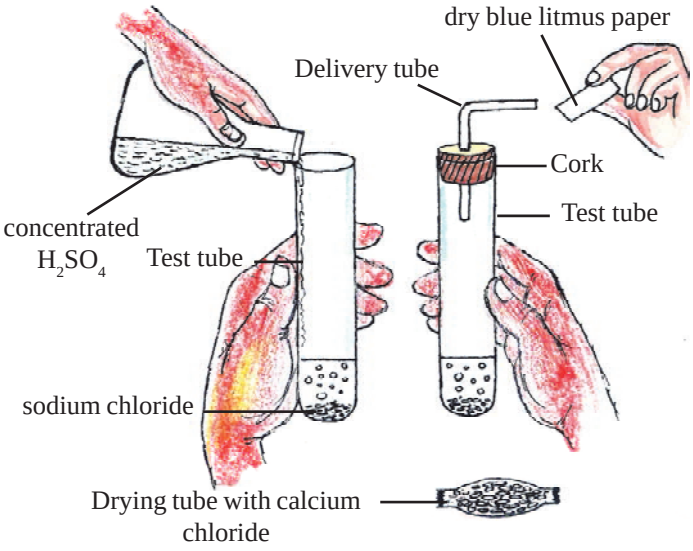


Figure- 5 : Test for HCl

Note for teachers:- If the climate is very humid, pass the gas produced through a drying tube containing calcium chloride to dry the gas.

Our observations show that HCl behaves like an acid only when it is in the presence of water because it can ionize to give H^+ ions when it comes in contact with water. Some compounds generate OH^- in water, they are called alkalis. For example, NH_4OH, NaOH are alkalis.

The extent of ionization of any base or acid decides whether it is strong or weak. The molecules of strong acids and bases ionize completely in water. On the other hand, the molecules of weak acids or bases ionize partially, that is, only a few of the molecules dissociate in water and most remain unionized.

Questions

1. Identify acids from the given compounds - HNO_3, Na_2CO_3, $Ca(OH)_2$, HCl
2. Sulphric acid is a strong acid while ammonium hydroxide is a weak base. Explain.
3. When some pellets of sodium hydroxide are place on red litmus paper then initially nothing happens but after some time the red litmus starts turning blue. Explain why.
4. The aqueous solutions of glucose and starch do not show acidic properties but that of sulphuric acid and acetic acid do. Why?

2.5 The strength of solutions of acids and alkalis

We know that presence of H^+ and OH^- ions decides whether a solution is an acid or an alkali. Can we count the number of ions present in a given solution? Can we judge how strong an acid or an alkali is?

What is pH scale?

In 1909, Danish scientist Sorensen developed pH scale to distinguish between the strength of acids and bases. Here, ´p´ stands for potenz (the German word for power). pH tells us the concentration of H^+ ions in a given solution. On the pH scale we can measure pH from 0 (very acidic) to 14 (very alkaline). We can think of pH as a number which indicates the acidic or basic nature of a dilute solution.

We use universal indicator, which is a mixture of several indicators, to find and compare the pH of different solutions. It tells us the strength of an acidic or basic solution. Universal indicator shows different colours at different concentrations of hydrogen ions in a solution.

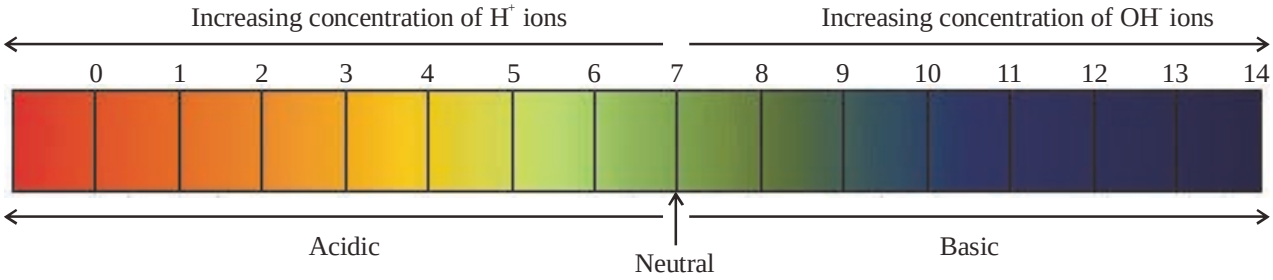


Figure-6: pH scale (colours are only a rough guide)

Activity-9

Test the solutions given in table-3 using red and blue litmus paper and universal indicator. Observe the colour changes and on this basis note down the pH and nature of solution in the table.

Table-3: Nature of solutions and pH value

S.No.	Solutions	Nature of solution as determined by litmus paper	pH value as determined by universal indicator
1.	Lemon juice		
2.	Milk		
3.	Tomato juice		
4.	Baking soda		
5.	Dilute hydrochloric acid		
6.	Dilute sodium hydroxide		
7.	water		
8.	solution of soap in water		
9.	copper sulphate		
10.	bleaching powder		
11.	ammonium acetate		
12.	common salt		

You know that pH is a measure of hydrogen ion concentration. In activity-9 we observed that even basic substances have a pH value. What does the hydrogen ion concentration in a basic solution imply? Let us understand.

Pure water ionizes partially, producing H^+ and OH^- ions:-

$$H_2O \rightleftharpoons H^+ + OH^-$$

Due to this partial ionization, all aqueous solutions have some H^+ and OH^- ions and therefore even acidic solutions have some OH^- ions and basic solutions have some H^+ ions.The number of H^+ and OH^- ions is inversely related. This means that if the number of H^+ ions in a solution is more, the number of OH^- ions will be less. Conversely, if the concentration of OH^- ions is more, that of H^+ ions will be less.

As shown in table-4, pH depicts the relative values of H^+ and OH^- ions.

At 25°C, equal amounts of H^+ and OH^- ions are present in pure water. In table-4, we can see that at pH 7, the concentration of H^+ and OH^- ions is equal (10^{-7}mol/L).In this way, pH 7 stands for neutral solutions. A pH value of less than 7 shows acidic nature and more than 7 shows that the solution is basic.

Table-4: Concentration of H^+ and OH^- ions and pH value

	← Increasing acidic nature								Increasing basic nature →						
pH value	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
H^+ mol/L	10^{0}	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}	10^{-11}	10^{-12}	10^{-13}	10^{-14}
OH^- mol/L	10^{-14}	10^{-13}	10^{-12}	10^{-11}	10^{-10}	10^{-9}	10^{-8}	10^{-7}	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	10^{0}

2.6 Importance of pH in our daily lives

pH value of a substance helps us in understanding its acidity or basicity. There are many fluids in our body with a very specific, fixed pH and the bio-chemical processes in our body are also pH dependent. pH of soil and water also play an important role in our life. Let us understand through some examples:

1. pH and the process of digestion: Our stomach secretes dilute hydrochloric acid but the acid does not harm the stomach. In fact, it helps in digestion of food. When too much acid is produced in the stomach it causes indigestion and the sufferer feels acidity and pain. Antacids such as weak bases are used to neutralize excess acid in the stomach.

2. pH of blood and life-processes: The pH of our blood is in the range 6.8 to 7.8. This pH is optimum for life processes because proper equilibrium of chemicals present in blood plasma and serum is maintained within this range. For example, in acidic pH the shape of hemoglobin molecules changes and they are not able to take in oxygen properly; so the pH of blood should not fall below this limit, that is, it should not become acidic.

3. pH of saliva: Our teeth enamel is made of calcium phosphate, a hard substance that does not dissolve in water. But when the pH of the saliva in our mouth falls below 5.5, then our teeth start decaying. To prevent this, we should brush our teeth daily with a basic toothpaste.

4. Self defense of animals and plants and pH: Some plants such as the nettle plant have thin, stinging hair or fur. When humans or other animals come in contact with these stings, the stinging hair inject formic acid that causes pain and a burning sensation. So, animals leave the plants alone and they are not eaten. Bees and wasps also secrete an acid when they sting us, causing pain and burning. This is how animals and plants protect themselves.

5. pH of soil and crop production: Ideal soil for cultivation of paddy should have pH between 5 and 8. When the pH is above or below this level farmers add fertilizers or lime or ash to it so that crop production is not affected.

The colour of the flower of the hydrangea plant depends on the pH of the soil in which it is cultivated. When the soil is acidic, the flowers are blue and when it is slightly alkaline they are pink.

Questions

1. Are H^+ ions present in basic solutions? If yes, then why is the solution basic?
2. You have two solution "A" and "B" in water. The pH value of solution "A" is 6 and that of "B" is 8. Which solution will have a higher concentration of hydrogen ions? Which one of the solutions is acidic and which is basic?
3. When Julie tested solutions "A", "B", "C", "D" and "E" using a universal indicator, she got pH values of 9,7,1,13, and 6 respectively. On this basis can you tell which solution-

   (a) Is a weak acid (b) Is a weak base (c) Is a strong acid

   (d) Is a strong base (e) Is neutral
4. On the basis of the numbers given in question 3, arrange the solutions in increasing order of hydrogen ion concentration.

2.7 Salts

We know that acids produce H^+ ions and alkalis produce OH^- in the presence of water. When acids and bases react with each other, these H^+ and OH^- ions together give water molecules along with the production of a salt. Salts are ionic compounds in which one part is positively charged and

the second part is negatively charged. The number of positive ions is equal to the number of negative ions and as a result salts are electrically neutral. Salts can be prepared by many methods. Neutralization reaction between an acid and a base is one of the most popular ways of preparing salts.

$HNO_3(aq)$	+	$KOH(aq)$	⟶	$KNO_3(aq)$	+	$H_2O(l)$
Nitric acid		*potassium hydroxide*		*potassium nitrate*		*water*
$H_2SO_4(aq)$	+	$Cu(OH)_2(aq)$	⟶	$CuSO_4(aq)$	+	$2H_2O(l)$
Sulphuric acid		*copper hydroxide*		*copper sulphate*		*water*
$CH_3COOH(aq)$	+	$NaOH(aq)$	⟶	$CH_3COONa(aq)$	+	$H_2O(l)$
Acetic acid		*sodium hydroxide*		*sodium acetate*		*water*
$CH_3COOH(aq)$	+	$NH_4OH(aq)$	⟶	$CH_3COONH_4(aq)$	+	$H_2O(l)$
Acetic acid		*ammonium hydroxide*		*ammonium acetate*		*water*

In the reactions given above, we can see that the positively charged part of the salt, comes from the base and is called basic radical and the negatively charged part comes from the acid and is known as acidic radical. For example, in potassium nitrate (KNO_3), K^+ is the basic radical and NO_3^- is the acidic radical.

2.7.1 Are all salts neutral?

In activity-9, we found pH values of salts such as common salt, ammonium acetate, baking soda and copper sulphate. How many of them had pH value equal to 7?

If all salts are formed by neutralization reaction between acids and bases, then why do different salts have different pH values? To answer this, we will need to understand the nature of the acidic radical and basic radical in each salt. In common salt, the basic radical (Na^+) is from strong base sodium hydroxide (NaOH) and the acidic radical (Cl^-) is from strong acid hydrochloric acid (HCl). The salts formed by the neutralization reaction between a strong acid and a strong base are neutral in nature. See table-5 to understand the nature of other salts.

Table-5: Nature of salts

Formula of salt	Source of basic radical		Source of acidic radical		Nature of salt
	Formula of source	Nature of source	Formula of source	Nature of source	
$CuSO_4$	$Cu(OH)_2$	weak	H_2SO_4	strong	acidic
$NaHCO_3$	NaOH	strong	H_2CO_3	weak	basic
CH_3COONH_4	NH_4OH	weak	CH_3COOH	weak	neutral
NH_4Cl	?	?	?	?	?
KNO_3	KOH	strong	HNO_3	strong	?

We find that the nature of salt formed between a strong base and a weak acid is basic and that formed by reaction between strong acid and weak base is acidic. The nature of salt formed by neutralization reaction of weak acid and weak base is also neutral.

2.8 Acid Rain

Usually, the pH of rain water is 7. But when different gases present in the atmosphere dissolve in it, the pH of rain water becomes less than 7. When pH of rain water is less than 5.6, it is called acid rain. Carbon dioxide, sulphur dioxide (SO_2) and the oxides of nitrogen produced during fuel combustion are the main cause of acid rain. The gases produced during decomposition of vegetation and volcanic explosions are another factor. These gases dissolve in water to produce carbonic acid, sulphuric acid and nitric acid.

$$CO_2 + H_2O \longrightarrow H_2CO_3$$
$$2SO_2 + O_2 \longrightarrow 2SO_3$$
$$SO_3 + H_2O \longrightarrow H_2SO_4$$
$$3NO_2 + H_2O \longrightarrow 2HNO_3 + NO$$

Acid rainfall damages plants, animals and buildings.

Questions

1. Identify the acidic and basic radicals in each of the given salts:

   NH_4Cl, KNO_3, $(NH_4)_2CO_3$, $CuSO_4$

2. What will be the nature of an aqueous solution of potassium chloride? Explain.
3. How does excess of carbon dioxide, sulphur dioxide and oxides of nitrogen in the atmosphere effect life?

What we have learnt

- Indicators react with acids and bases to form new substances which are responsible for change in colour of indicator.
- Blue litmus becomes red in the presence of acid and red litmus becomes blue in the presence of a base.
- We can use different flowers and leaves - such as hibiscus flower, rose, red cabbage, turmeric, kachnaar flower - found in nature as indicators.
- There are some substances that change their odour in the presence of an acid or a base. These are known as olfactory indicators, for example, clove oil, onion juice, vanilla etc.

- Acid and bases reacts with a metal to give corresponding salt with evolution of hydrogen gas.
- When an acid reacts with a metal carbonate or metal hydrogencarbonate, it gives the corresponding salt, carbon dioxide gas and water.
- Bases react with non-metal oxides to give a salt and water.
- Acids and bases react with each other to form corresponding salts and water, this reaction is known as neutralization.
- Acid and alkali solution in water conduct electricity because they ionize into their ions. An acid dissociates into H^+ and a negative ion and an alkali dissociates into OH^- and a positive ion.
- pH value is used to show the amount of hydrogen ions (H^+) in dilute solutions on a scale of 0 to 14.
- A neutral solution has a pH of 7, while an acidic solution has a pH less than 7 and a basic solution has a pH of more than 7.
- The negative part of a salt comes from a base and is known as a basic radical and the positive part comes from acid and is known as acidic radical.
- Salts can be acidic, basic or neutral in nature.

Keywords

Antacid, base, alkali, indicator, olfactory indicator, neutralization reaction, acid rain, acidic radical, basic radical.

Exercises

1. Choose the correct option

   (i) In lemon juice

   (a) H^+ ions are more, OH^- ions are less

   (b) H^+ ions are less, OH^- ions are more

   (c) H^+ ions and OH^- ions are equal

   (d) Only H^+ ions are present

   (ii) When an acid reacts with a metal carbonate then we get-

   (a) Salt and water

   (b) Salt and water and carbon dioxide

   (c) Salt and sulphur dioxide

   (d) Salt and hydrochloric acid are

(iii) Which among the following is not a strong acid

(a) HCl (b) HNO_3

(c) CH_3COOH (d) H_2SO_4

(iv) The pH of a neutral solution is

(a) 1 (b) 0

(c) 14 (d) 7

(v) Sakina has a burning sensation in her stomach due to acidity; she needs

(a) A strong acid (b) A strong base

(c) A weak base (d) A weak acid

(vi) The cause of tooth decay is pH of saliva

(a) Being less than 6.5 (b) Becoming 7

(c) Being less than 5.5 (d) Being more than 6.5

(vii) Which of the following salts is acidic in nature

(a) NaCl (b) Na_2SO_4

(c) NH_4Cl (d) KNO_3

2. Write the names of any two acids found in the food that we eat.

3. How do we distinguish between acids and bases using an olfactory indicator?

4. The pH of fresh milk is 6. What will be the pH when it sets into curd/yogurt?

5. You have been given three test tubes. One of them has distilled water and of the remaining two, one has an acid and the second has a basic solution. If you only have red litmus paper then how will how identify the nature of solutions in each of the test tubes?

6. During an experiment, Neelam and Manish added concentrated sulphuric acid to dry (anhydrous) sodium chloride. A gas evolved during the reaction. When Manish placed a dry blue litmus paper near the mouth of the test tube nothing happened but when he placed a moist blue litmus paper, it became red. Explain why.

7. Some substances and their pH values are given in the table. Analyse the data in the table and answer the following questions:

(a) Which of the substances are basic in nature?

(b) Which of the substances are acidic in nature?

(c) Which of the substances are neutral?

Substance	pH value
Solution of baking soda	8.2
Lemon juice	2.2
Vinegar	5.5
Sodium hydroxide solution	13
Water	7

8. Acids "A" and "B" were taken in two beakers. Acid "A" ionizes partially in water while acid "B" ionizes completely. On this basis, tell:
   (a) Which among "A" and "B" is strong acid and which is weak?
   (b) What is a weak acid?
   (c) What is a strong acid?
   (d) Give examples of both strong and weak acids.
9. Which gas is usually displaced during reaction between acids and a metal? How will you test this gas? Take the example of magnesium metal to explain.
10. When an egg shell is reacted with dilute hydrochloric acid, foaming is observed and an effervescent gas is produced. Once foaming subsides, a lighted *agarbatti* is extinguished on placing it inside test tube. Explain the following in the given activity:
   (a) Procedure or steps followed in the activity
   (b) Draw the picture of the experimental set-up
   (c) Write the balanced chemical equation of the reaction taking place
11. The pH of soil in Tikeshweri's field is 4.2. How can she control the pH of her soil so that she gets a good paddy crop?
12. What is neutralization reaction? Explain and give two examples.
13. Samaru added baking soda to raw milk so that its pH changed from 6 to 8. This milk will take longer to change into curd; why?
14. What is a salt? How is the nature of a salt determined? Take NH_4NO_3 and Na_2CO_3 as examples and explain.