4 Acids, Bases and Salts

We use in our daily life a large number of substances such as lemon, tamarind, common salt, sugar and vinegar. Do they have the same taste? Let us recall tastes of some edible substances listed in Table 4.1. If you have not tasted any of these substances taste it now and enter the result in Table 4.1.

CAUTION
1. Do not taste anything unless asked to do so. 2. Do not touch anything unless asked to do so.

Table 4.1

Substance	Taste (sour/bitter/ any other)
Lemon juice	
Orange juice	
Vinegar	
Curd	
Tamarind (*imli*)	
Sugar	
Common salt	
Amla	
Baking soda	
Grapes	
Unripe mango	
Cucumber	

You find that some of these substances taste sour, some taste bitter, some taste sweet and some taste salty.

4.1 Acids and Bases

Curd, lemon juice, orange juice and vinegar taste sour. These substances taste sour because they contain **acids**. The chemical nature of such substances is **acidic**. The word acid comes from the Latin word *acere* which means sour. The acids in these substances are natural acids.

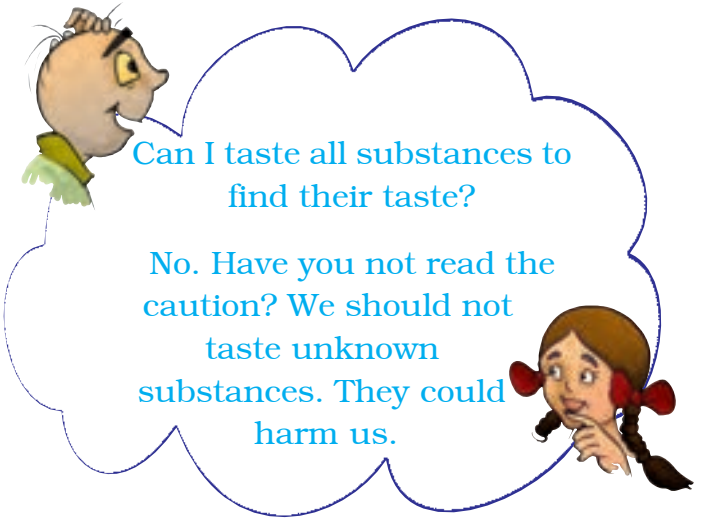
What about baking soda? Does it also taste sour? If not, what is its taste? Since, it does not taste sour it means, that it has no acids in it. It is bitter in taste. If you rub its solution between fingers, it feels soapy. Generally, substances like these which are bitter in taste and feel soapy on touching are known as **bases**. The nature of such substances is said to be **basic**.

If we cannot taste every substance, how do we find its nature?

Special type of substances are used to test whether a substance is acidic or basic. These substances are known as **indicators**. The indicators change their colour when added to a solution containing an acidic or a basic substance. Turmeric, litmus, China rose petals (*Gudhal*), etc., are some of the naturally occurring indicators.

Do you know?

Name of acid	Found in
Acetic acid	Vinegar
Formic acid	Ant's sting
Citric acid	Citrus fruits such as oranges, lemons, etc.
Lactic acid	Curd
Oxalic acid	Spinach
Ascorbic acid (Vitamin C)	*Amla*, Citrus fruits
Tartaric acid	Tamarind, grapes, unripe mangoes, etc.
All the acids mentioned above occur in nature	
Name of base	**Found in**
Calcium hydroxide	Lime water
Ammonium hydroxide	Window cleaner
Sodium hydroxide/ Potassium hydroxide	Soap
Magnesium hydroxide	Milk of magnesia



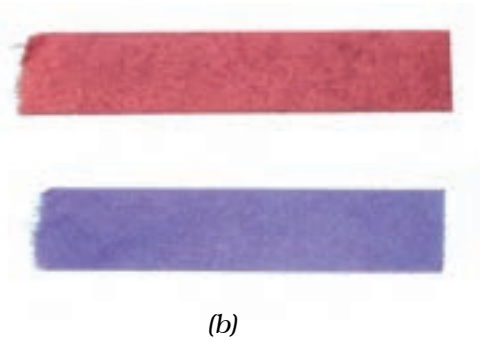
4.2 Natural Indicators around Us

Litmus: A natural dye

The most commonly used natural indicator is litmus. It is extracted from **lichens** (Fig. 4.1a). It has a mauve (purple) colour in distilled water. When added to an acidic solution, it turns red and when added to a basic solution, it turns blue. It is available in the form of a solution, or in the form of strips of paper, known as litmus paper. Generally, it is **available as red and blue litmus paper** (Fig. 4.1b).



(a)



(b)

Fig. 4.1 *(a) Lichens, and (b) Red and blue litmus paper*

Activity 4.1

- Mix some water with lemon juice in a plastic cup/tumbler/test tube.
- Put a drop of the above solution on a strip of the red litmus paper with the help of a dropper.
  Is there any change in colour?
- Repeat the same exercise with the blue litmus paper.

Note down if there is any change in colour.

Perform the same activity with the following substances:

Tap water, detergent solution, aerated drink, soap solution, shampoo, common salt solution, sugar solution, vinegar, baking soda solution, milk of magnesia, washing soda solution, lime water. If possible make solutions in distilled water.

Record your observations as in Table. 4.2.

In your Table, are there any substances on which litmus had no effect? Name those substances.

The solutions which do not change the colour of either red or blue litmus are known as **neutral** solutions. These substances are neither acidic nor basic.

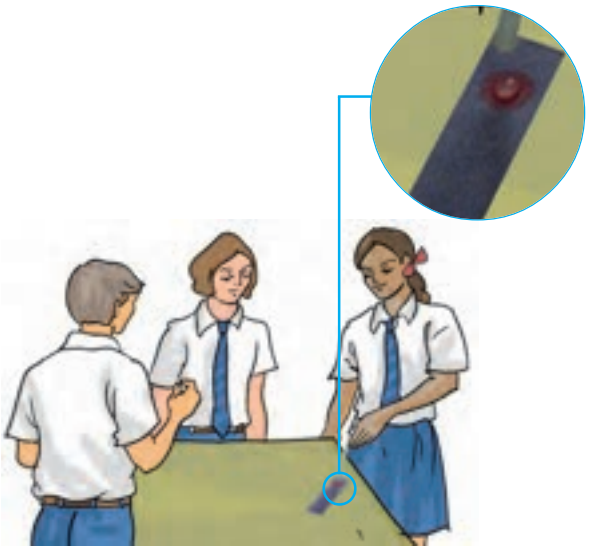


Fig. 4.2 Children performing litmus test

Turmeric is another natural indicator

Activity 4.2

- Take a tablespoonful of turmeric powder. Add a little water and make a paste.
- Make turmeric paper by depositing turmeric paste on blotting paper/filter paper and drying it. Cut thin strips of the yellow paper obtained.
- Put a drop of soap solution on the strip of turmeric paper.
  What do you observe?

To prepare limewater, take some water in a tumbler and add some lime (*chuna*) into it. Stir the solution and keep it for some time. Pour a little from the top. This is lime water.

Table 4.2

S. No.	Test solution	Effect on red litmus paper	Effect on blue litmus paper	Inference

You can prepare a greeting card for your mother on her birthday. Apply turmeric paste on a sheet of plane white paper and dry it. Draw a beautiful flower with soap solution with the help of a cotton bud. You will get a beautiful greeting card.





Now I understand why a turmeric stain on my white shirt is turned to red when it is washed with soap. It is because the soap solution is basic.

Similarly test the solutions listed in Table 4.3 and note down your observations. You may try solutions of other substances also.

China Rose as Indicator

Activity 4.3

Collect some China rose (*Gudhal*) petals and place them in a beaker. Add some

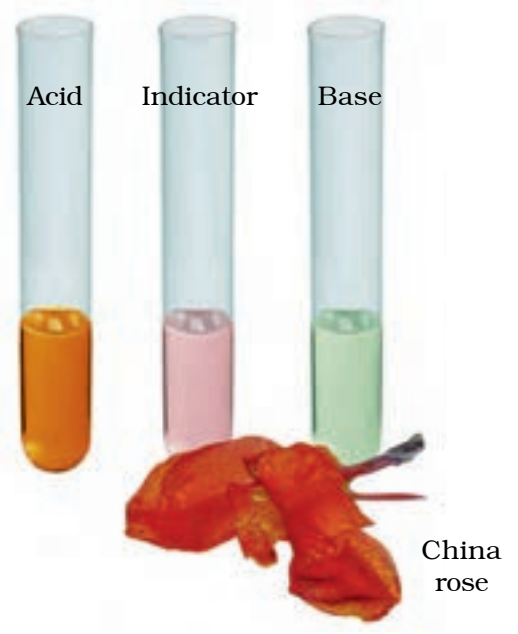


Fig. 4.3 *China rose flower and indicator prepared from it*

Table 4.3

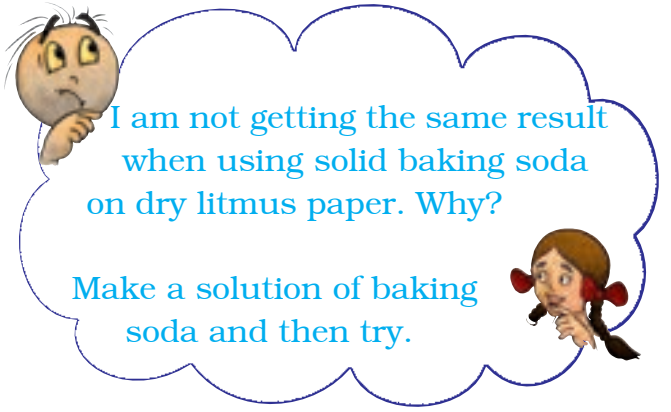
S. No.	Test solution	Effect on turmeric solution	Remarks
1.	Lemon juice		
2.	Orange juice		
3.	Vinegar		
4.	Milk of magnesia		
5.	Baking soda		
6.	Lime water		
7.	Sugar		
8.	Common salt		

Table 4.4

S. No.	Test solution	Initial colour	Final colour
1.	Shampoo (dilute solution)		
2.	Lemon juice		
3.	Soda water		
4.	Sodium hydrogencarbonate solution		
5.	Vinegar		
6.	Sugar solution		
7.	Common salt solution		

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 solutions given in Table 4.4.

What is the effect of the indicator on acidic, basic and neutral solutions? China rose indicator (Fig. 4.3) turns acidic solutions to dark pink (magenta) and basic solutions to green.



Paheli brought the following paheli (riddle) for you.

Coffee is brown
And bitter in taste.
Is it an acid?
Or a base?
Don't give the answer
Without any test,
You are in the dark
With its taste.

Activity 4.4

The teacher is requested to get the dilute solution of the following chemicals from his/her school laboratory or from a nearby school: hydrochloric acid, sulphuric acid, nitric acid, acetic acid, sodium hydroxide, ammonium hydroxide, calcium hydroxide (lime water).

Table 4.5

S. No.	Name of acid	Effect on litmus paper	Effect on turmeric paper	Effect on China rose solution
1.	Dilute hydrochloric acid			
2.				
3.				

Are you familiar with the term acid rain? Have you ever heard about damaging effect of acid rain? As the name indicates the rain containing excess of acids is called an acid rain. Where do these acids come from? The rain becomes acidic because carbon dioxide, sulphur dioxide and nitrogen dioxide (which are released into the air as pollutants) dissolve in rain drops to form carbonic acid, sulphuric acid and nitric acid respectively. Acid rain can cause damage to buildings, historical monuments, plants and animals.

CAUTION

Great care should be taken while handling laboratory acids and bases because these are corrosive in nature, irritating and harmful to skin.

Demonstrate the effect of the three indicators on each of these solutions. Record your observations in Table 4.5.

4.3 Neutralisation

We have learnt that acids turn blue litmus red and bases turn red litmus blue. Let us see what happens when an acid is mixed with a base.

We are going to use an indicator you have not used so far. It is called **phenolphthalein**.

Activity 4.5

To be demonstrated by the teacher in the class

Fill one fourth of a test tube with dilute hydrochloric acid. Note down its colour. Note down the colour of phenolphthalein solution also. Add 2–3 drops of the indicator to the acid. Now shake the test tube gently. Do you observe any change in colour of the acid?

Add to the acidic solution a drop of sodium hydroxide solution by a dropper. Stir the tube gently. Is there any change in the colour of the solution? Continue adding the sodium hydroxide solution drop by drop while stirring till the pink colour just appears.

Now add one more drop of dilute hydrochloric acid. What do you observe? The solution again becomes colourless. Again add one drop of sodium hydroxide solution. Is there any change in colour? The solution again becomes pink in colour.

It is evident that when the solution is basic, phenolphthalein gives a pink colour. On the other hand, when the solution is acidic, it remains colourless.



Fig. 4.4 Process of neutralisation

When an acidic solution is mixed with a basic solution, both the solutions neutralise the effect of each other. When an acid solution and a base solution are mixed in suitable amounts, both the acidic nature of the acid and the basic nature of the base are destroyed. The resulting solution is neither acidic nor basic. Touch the test tube immediately after neutralisation. What do you observe? In neutralisation reaction, heat is always produced, or evolved. The evolved heat raises the temperature of the reaction mixture.

In neutralisation reaction a new substance is formed. This is called **salt**. Salt may be acidic, basic or neutral in nature. Thus, neutralisation can be defined as follows:

The reaction between an acid and a base is known as neutralisation. Salt and water are produced in this process with the evolution of heat.

Acid+Base → Salt+Water
(Heat is evolved)

The following reaction is an example:

Hydrochloric acid (HCl) + Sodium hydroxide (NaOH) →

Sodium chloride (NaCl) + Water (H_2O)

Boojho added dilute sulphuric acid to lime water. Will the reaction mixture become hot or cool?

4.4 Neutralisation in Everyday Life

Indigestion

Our stomach contains hydrochloric acid. It helps us to digest food, as you have learnt in Chapter 2. But too much of acid in the stomach causes indigestion. Sometimes indigestion is painful. To relieve indigestion, we take an antacid such as milk of magnesia, which contains magnesium hydroxide. It neutralises the effect of excessive acid.

Ant bite

When an ant bites, it injects the acidic liquid (formic acid) into the skin. The effect of the acid can be neutralised by rubbing moist baking soda (sodium hydrogencarbonate) or calamine solution, which contains zinc carbonate.

Soil treatment

Excessive use of chemical fertilisers makes the soil acidic. Plants do not grow well when the soil is either too **acidic** or too **basic**. When the soil is too acidic, it is treated with bases like quick lime (calcium oxide) or slaked lime (calcium hydroxide). If the soil is basic, organic matter (compost) is added to it. Organic matter releases acids which neutralises the basic nature of the soil.

Factory wastes

The wastes of many factories contain acids. If they are allowed to flow into the water bodies, the acids will kill fish and other organisms. The factory wastes are, therefore, neutralised by adding basic substances.

Keywords

Acid	Basic	Neutralisation
Acidic	Indicator	Salt
Base	Neutral	

What you have learnt

- Acids are sour in taste. Generally, bases are bitter in taste and soapy to touch.
- Acid turns blue litmus red. Bases turn red litmus blue.
- Substances which are neither acidic nor basic are called neutral.
- Solutions of substances that show different colour in acidic, basic and neutral solutions are called indicators.
- An acid and a base neutralise each other and form a salt. A salt may be acidic, basic or neutral in nature.

Exercises

1. State differences between acids and bases.
2. Ammonia is found in many household products, such as window cleaners. It turns red litmus blue. What is its nature?
3. Name the source from which litmus solution is obtained. What is the use of this solution?
4. Is the distilled water acidic/basic/neutral? How would you verify it?
5. Describe the process of neutralisation with the help of an example.
6. Mark 'T' if the statement is true and 'F' if it is false:
   (i) Nitric acid turn red litmus blue. (T/F)
   (ii) Sodium hydroxide turns blue litmus red. (T/F)
   (iii) Sodium hydroxide and hydrochloric acid neutralise each other and form salt and water. (T/F)
   (iv) Indicator is a substance which shows different colours in acidic and basic solutions. (T/F)
   (v) Tooth decay is caused by the presence of a base. (T/F)
7. Dorji has a few bottles of soft drink in his restaurant. But, unfortunately, these are not labelled. He has to serve the drinks on the demand of customers. One customer wants acidic drink, another wants basic and third one wants neutral drink. How will Dorji decide which drink is to be served to whom?
8. Explain why:
   (a) An antacid tablet is taken when you suffer from acidity.

(b) Calamine solution is applied on the skin when an ant bites.

(c) Factory waste is neutralised before disposing it into the water bodies.

9. Three liquids are given to you. One is hydrochloric acid, another is sodium hydroxide and third is a sugar solution. How will you identify them? You have only turmeric indicator.

10. Blue litmus paper is dipped in a solution. It remains blue. What is the nature of the solution? Explain.

11. Consider the following statements:

(a) Both acids and bases change colour of all indicators.

(b) If an indicator gives a colour change with an acid, it does not give a change with a base.

(c) If an indicator changes colour with a base, it does not change colour with an acid.

(d) Change of colour in an acid and a base depends on the type of the indicator.

Which of these statements are correct?

(i) All four (ii) a and d (iii) b, c and d (iv) only d

Extended Learning — Activities and Projects

1. Using the knowledge of acids and bases, write a secret message with the help of baking soda and beet root. Explain how it works.

   (**Hint:** Prepare baking soda solution in water. Use this solution to write the message on a sheet of white paper with a cotton bud. Rub a slice of fresh beet root over the message.)

2. Prepare red cabbage juice by boiling a piece of red cabbage in water. Use it as an indicator and test the acidic and basic solutions with it. Present your observations in the form of a table.

3. Bring the soil sample of your area, find out if it is acidic, basic or neutral. Discuss with farmers if they treat the soil in any manner.

4. Visit a doctor. Find out the medicines, he prescribes to treat acidity. Ask him how acidity can be prevented.

Did you know?

Each cell in our body contains an acid, the **deoxyribonucleic acid** or **DNA**. It controls every feature of the body such as our looks, colour of our eyes, our height etc. Proteins that build part of our cells are also made of **amino acids**. The fats in our body contain **fatty acids**.