ACIDS, BASES AND SALTS

10

In previous classes you have often grouped things into sets, like magnetic and non-magnetic; soluble and insoluble; starch, protein, and fats; hard and soft water and so on. In this chapter we will study one other property of things, and we will use it as a basis for making groups of substance.

In class seven you did some tests for oxygen, carbon dioxide and ammonia gases. You may remember that in one of the tests a wet piece of red or blue litmus paper was inserted in a test tube filled with gas. In different gases this paper either:

- changed from blue to red, or
- changed from red to blue, or
- showed no change in colour.

You did other test for gases using a phenolphthalein solution. When a gas flowed through it, it would either:

- change from pink to colourless,
- change from colourless to pink, or
- show no change in colour.

In this chapter we will study the effects of different solutions on litmus paper and phenolphthalein solution. On the basis of this, we shall learn of a new property of substances.

Teacher's preparation for the experiments

Solutions of various substances will be needed for the following experiments. It will be convenient if you make adequate quantities of these solutions before hand and store them for future use. If you have 7 or 8 groups of students in your class you should make about100 ml of each solution. For classes with more groups, make that much more of each solution in the beginning. Mix each solution

well and store it in a bottle with a cap. Carefully label all the solutions.

The method for making about 100 ml of each solution is given below:

CAUSTIC SODA (Sodium hydroxide) - Make a solution which is twice as dilute as that given in the kit. Take 50 ml solution from the kit using a measuring cylinder and add water to make the total volume 100 ml.

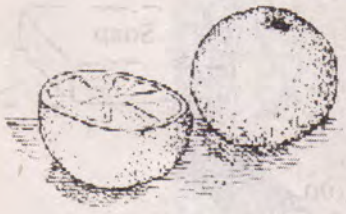
SULPHURIC ACID AND HYDROCHLORIC ACID - Make a solution which is 20 times more dilute than the solution given in the kit. Take about 50 ml of water in a clean measuring cylinder. Add 5 ml acid solution from the kit and stir it. Add water to make the total volume 100 ml.

Salt, sugar, washing soda (Sodium Carbonate), sal ammoniac (Ammonium Chloride), Calcium Sulphate, and Calcium Chloride - Add one small spoonful of each of the above mentioned chemicals to 100 ml of water separately and dissolve.

***Lime water** - Prepare lime water according to the method given in the chapter on "Gases" in class 7.

Tamarind (*Imli*) Solution - Make a thick solution of tamarind and strain it through a thin cloth. Mix enough water in this solution so that it becomes transparent.

Lemon juice - Squeeze 10 ml of lemon juice in a measuring cylinder. Add enough water to make the total volume 100 ml.



*** Colourless phenolphthalein indicator solution** - Take 5 ml of solution given in the kit and add enough water to make a total volume of 100 ml. This will give you the colourless indicator solution. If no phenolphthalein solution is available in the kit, you can buy some purgative pills containing phenolphthalein from a chemist's shop - for example, 'Vaculax', 'Julabin', 'Pargolax' etc. Knowing the amount of phenolphthalein in these pills, prepare a 0.1% solution in water. Filter this solution with filter paper. This solution can now be used instead the one supplied in the kit.

Bougainvillea

*** Pink phenolphthalein indicator solution** - Take 10 ml solution from the kit and make it up to 200 ml. Add about 1 ml of lime water to it. This makes it a pink indicator solution.

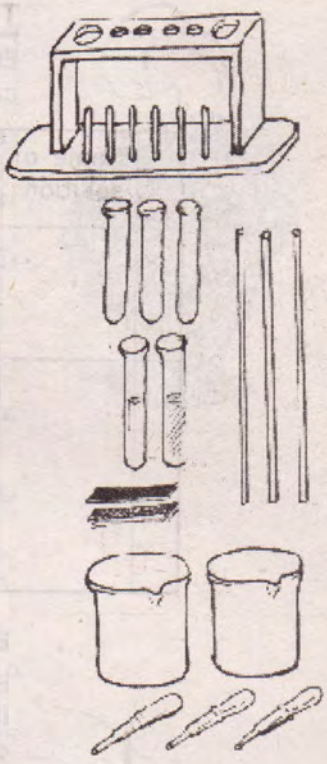
* Use distilled water to make solutions marked with asterisks. If these solutions are made with normal water, then you may get wrong results in the following experiments.

Note for students

For this chapter, you will have to collect a few things from home and the neighbourhood :

1. Coloured flowers (for example, hibiscus, rose, bougainvillea, ipomoea (*besharam*), *kaner* etc.)

2. Turmeric (*haldi*)



Kit for each group

Before starting the experiments, each group should have the things listed below -

- one test tube stand
- three empty test tubes
- one test tube containing about 10 ml colourless phenolphthalein indicator solution.
- one test tube containing about 10 ml pink phenolphthalein indicator solution.
- a piece of red litmus paper
- three glass tubes
- two beakers or plastic glasses
- three droppers

How will you know which test tube contains what? Why not label them?

Tests with litmus paper and phenolphthalein solution

Your teacher will keep bottles of prepared solutions in a row on the table. A clean glass tube will be put in each bottle. One student from each group should take one test tube to the teacher and get 2 or 3 ml from one of the solutions. Then all students of the group should together do the experiment with that solution. Before starting an experiment make the given below table in your note book.

TAKE CARE

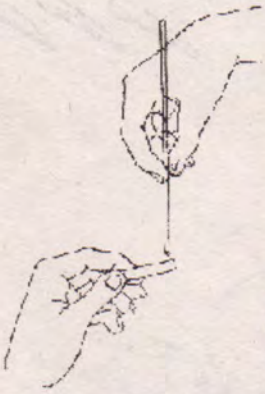
After each experiment wash the test tubes and glass tube well. Start with a clean test tube for each solution.

Table 1

Effect of various solutions on litmus paper and phenolphthalein indicator solution:

No.	Name of solution	Experiment with red litmus		Experiment with blue litmus		Experiment with colourless indicator solution		Experiment with pink litmus	
		made blue colour	made red colour	made red colour	made blue colour	made pink colour	made colourless	made colourless	made pink colour

Experiment 1



Hold the red litmus paper in your hand. Put one drop of solution on it with the help of a glass tube and observe its effect on the colour of the paper.

Record your observations in the table you have made. (1)

Experiment 2

Repeat Experiment 1 with blue litmus paper. Record your observations in the table. (2)

It is not necessary to use a new piece of litmus paper for each experiment. Tear off and discard the part of the litmus paper which gets wet and reuse the remaining part.

Experiment 3

Use a glass tube to put 1 or 2 ml of colourless phenolphthalein indicator solution into a clean test tube. Add to it one or two drops of the solution you want to test.

Does the colour of the indicator solution change or remain the same?Add your observations to the table. (3)

An important note

While testing with phenolphthalein indicator it is necessary that you shake it well after adding each drop of solution being tested.

Experiment 4

Repeat Experiment 3 with pink phenolphthalein indicator solution.

Add your observations to the table. (4)

Do experiments 1, 2, 3 and 4 one at a time with each of the solutions you have.

Make a list of those solutions which turned red litmus paper blue. (5)
Make a list of those solutions which turned blue litmus paper red. (6)
Which solutions did not have any effect on either red or blue litmus paper? (7)

Acidic, Basic, and Neutral Solutions

The solutions which turn blue litmus paper red are called **acidic solutions.**

The solutions which turn red litmus paper blue are called **basic solutions.**

The solutions which have no effect on either red or blue litmus paper are called **neutral solutions.**

Based on the above definitions, group all the solutions into acidic, basic and neutral. (8)
Did you find any solution which you cannot put in any of the three groups? If so, write down its name. (9)

Each solution should certainly fall into one or another of these three groups. If not, you must have made a mistake and you should repeat that observation.

Look for the mistake with the help of your teacher and write down how you corrected it. (10)

Now write the answers to the following questions:

What is the effect of acidic solutions on colourless and pink phenolphthalein indicators? (11)
What is the effect of basic solutions on colourless and pink phenolphthalein indicators? (12)
What is the effect of neutral solutions on colourless and pink indicators? (13)
On the basis of your observations in class 7, guess what kind of solutions - acidic, basic, or neutral - were created when carbon dioxide, oxygen and ammonia gases were passed through the indicator solution? (14)

Things that change colour - Indicators

You have first used red and blue litmus papers and colourless and pink phenolphthalein indicator solutions to test things. They are special because they show one colour with acidic things and another with basic things. Things which behave in this way are called indica-

Hibiscus

tors. Indicators have another special characteristic - they can change colour again and again. For example, if blue litmus paper turns red in an acid, it will turn blue again if it is put in a base. If you want you can quickly test this out. Many indicators are used to detect acids and bases. There are some you can find in your surroundings. Did you remember to bring some turmeric from home and some colourful flowers from the roadside? Now we shall use them to make indicators.

Make your own indicator

Experiment 5

Take about half a spoon of powdered turmeric and mix it with enough water to make a paste. Spread a thin layer of the paste on a piece of filter paper, in the same way that you put *kattha* on betel leaf (*paan*). Dry this paper and cut it into strips, 1 cm. by 3 cm. These are your turmeric indicator papers.

Tear the petals off one kind of flower. Rub them on a strip of filter paper so that the filter papers gets the colour of the petals. You will need the petals from two to four flowers to do this. Coloured filter paper made in this way, can be used as indicators just like litmus paper. Write down in a table the names of these flowers which can be used to make indicators. Now following the same method as in experiment 1, put one drop of each solution on each indicator paper.

Besharam

Make the following table in your note book and write your observations in it. (15)

No.	Name of Solution	Effect on turmeric paper	Effect on hibiscus paper	Effect on besharam paper

Look at your table carefully and group the solutions according to their effects on turmeric paper. (16)

What is the effect of acidic solutions on turmeric paper? (17)

What is the effect of basic solutions on turmeric paper? (18)

What is the effect of neutral solutions on turmeric paper? (19)

When you wash turmeric stained clothes with soap, the stains turn red. Based on this, what can you say about soap solution? (20)

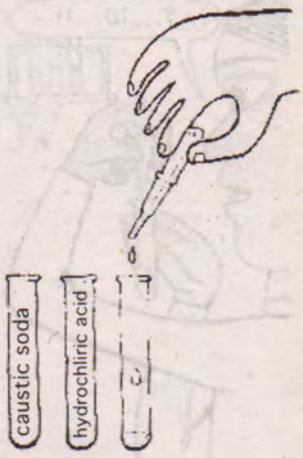
Answer questions (17), (18), and (19) with regard to each indicator made from flowers. (21)

Once the colour of an indicator paper made from a flower has changed, can it be changed back to its original colour? If so, how? (22)

Look at the table carefully. In this table neutral solutions have also got grouped together with acidic solutions.

Can you think of any method of telling the difference between neutral and acidic solutions using turmeric paper? (23)

Verify your method experimentally.



Relationship between acids and bases

You have seen that neutral solutions have no effect on indicators. You have also seen that acids and bases have opposite effects on indicators. Then is it possible that solution made by mixing an acid and a base would be a neutral solution? Let us see.

Making a neutral solution

Experiment 6

Take two clean test tubes. Stick a label that says "caustic soda" on one and "hydrochloric acid" on the other.

Ask your teacher to half fill one of the test tubes with caustic soda and the other with hydrochloric acid. Take one more clean test tube and using a clean dropper carefully put 10 drops of hydrochloric acid in it. Also add two drops of colourless indicator solution.

What is the colour of the resulting solution? (24)

Now take caustic soda solution in another dropper. Add this solution drop by drop to the test tube with acid and indicator solution. Count the number of drops as you do this. After each drop shake the test tube well and see if there is any change in colour of the solution. Keep adding the caustic soda drop by drop until the colour begins to turn pink.

Now what kind of solution does the test tube have - acidic or basic? (25)

Add one drop of hydrochloric acid and see if it changes back to its original (colourless) state. If not, then add one more drop of hydrochloric acid. Keep doing this until the solution in the test tube becomes colourless again.

Now what kind of solution is this - acidic or basic? (26)

On the basis of this experiment, can you say how would you make a basic solution from an acidic solution? (27)

And if you are given a basic solution, how can you turn it

into an acidic solution? (28)

If you are given a solution of hydrochloric acid, how can you make it into a solution which is neither acidic nor basic? (29)

If your are given a caustic soda solution how can you make it into a neutral solution? (30)

When acids and bases are mixed in definite proportions, they give a neutral solution. This process is called **neutralisation.**

Using the solutions that have been provided, find out how many drops of caustic soda solution it takes to neutralise 10 drops of hydrochloric acid? (31)

Practising neutralisation

Experiment 7

Put 25 drops of hydrochloric acid you used in experiment 6 into a clean test tube. Add 2 drops of colourless indicator solution.

Look at your answer to question (31) and guess how many drops of caustic soda solution will be needed to make a neutral solution from these 25 drops of hydrochloric acid. (32)

Add the estimated number of drops of caustic soda solution to the test tube.

Does the solution in the test tube become neutral? (33)

If not, then is it acidic or basic? (34)

Was your guess about the number of drops of caustic soda solution needed for neutralisation too high or too low? (35)

Experiment 8

For the teacher

For this experiment we need a new hydrochloric acid solution. Pour 10 ml of the hydrochloric solution you prepared at the beginning of this chapter into a measuring cylinder. Add enough water to make a total volume of 20 ml. Mix it well and keep it in a boiling tube or a bottle. Give 10 drops of this hydrochloric acid solution to each group.

Get 10 drops of the new hydrochloric acid solution from your teacher in a clean test tube. Add caustic soda solution (the one used in experiment 6) drop by drop to this test tube to make a neutral solution. Count the number of drops.

How many drops of caustic soda solution did it take to make a neutral solution? (36)

Was the number of drops more or less than the amount needed in experiment 6? (37)

Explain why? (38)

Based on this observation can you say whether the hydrochloric acid solution used in this experiment contained more or less or the same amount of hydrochloric acid as compared to the solution used in experiment 6? Give a good reason for your answer. (39)

Compare both hydrochloric acid solutions and tell which one has more hydrochloric acid and how much more. (40)

In the above experiments you saw that you have to mix a certain amount of base with a certain amount of acid in order to get a neutral solution or, in other words, to neutralise it.

If you mix 10 grams of any acid with 10 grams of a base, will you get a neutral solution? (41)

Before answering this question, do the following experiment.

Experiment 9

In this experiment we will dissolve equal amounts of an acid and a base in equal amounts of water. Your teacher will put tartaric acid on one side of a balance and sodium carbonate (washing soda) on the other.

By doing this we will get equal amounts of acid and base.

Now take two beakers containing equal amounts of water. Dissolve tartaric acid in one and sodium carbonate in the other.

Is the amount of acid in one drop of the acid solution equal to the amount of base in one drop of the base solution? (42)

Now put 20 drops of acid solution in a test tube. Add 2 drops of pink indicator solution to it.

What is the colour of the resulting solution? (43)

How many drops of basic solution do you guess it will take to neutralise this solution? (44)

Now add the basic solution drop by drop to the test tube until the colour turns light pink. Stir the solution well after each drop.

How many drops of base did it take ? (45)

Was there any difference between your guess and what actually happened? (46)

Now try to answer question 41.

On the basis of this experiment do you think that just by knowing weights you can compare the strengths of an acid and a base? (47)

Salts

By now you have carried out neutralisation a number of times. You have seen that in this process, both the acidic and the basic qualities are destroyed. Actually when an acid and a base are mixed a **chemical reaction** occurs between them. This chemical reaction produces salts. For example, by neutralising hydrochloric acid with caustic soda (sodium hydroxide) solution, salt (sodium chloride) is produced. Other salts produced by similar reactions are:

calcium chloride, calcium sulphate, calcium carbonate, magnesium sulphate, copper sulphate, etc.

You have already used these salts.

But remember one thing. All neutral solutions are not salt solutions. For example, solution of sugar or starch is neutral, but sugar and starch are not salts. So when you see a neutral solution you can not say that it is a salt.

A thought experiment - how much water?

A teacher prepared 1 litre each of acid and base solution. Ten drops of acid solution was neutralised by ten drops of base solution.

Then some water was spilt into one of the solutions by mistake. After that it took 15 drops of base to neutralise 10 drops of acid.

Can you say in which solution the water had been spilt? (48)
Can you also say how much water had got added to it ? (49)

NEW WORDS:

acidic solution	indicator	basic solution
salt	neutral solution	neutralisation
chemical reaction