

# 4

## CHEMICAL REACTIONS WHEN AND WHAT TYPE

### 4.1

We see many changes all around us, as melting of ice, rusting of iron, wearing of the cycle tube, spoiling of the food, breaking of the clay pitcher etc. You can add some more examples to this list. Let us find out about these changes.



#### Activity -1 (Demonstration by the teacher)

**Materials required:** Two beakers, concentrated sulphuric acid, quicklime, water and glass rod.

Take about 50mL of water in a beaker and 1-2 mL of concentrated sulphuric acid. Carefully stir with the help of the glass rod. Touch and feel the beaker. Is the prepared solution hot?

Now in another beaker take quicklime and add water. You will find that a sizzling sound is produced. Touch and feel this beaker. Does this also feel hot?

You will find that in both the cases due to the liberation of heat the beaker gets heated. So in this case, can we say that both the changes are same. To understand this better, let us do another activity.



#### Activity 2

**Materials required:** Test tube, test tube holder, red and blue litmus paper, heating apparatus, soda water and baking soda

Open the soda water bottle. What changes do you find? Place red and blue litmus paper, one by one near the gas coming out of the bottle. Also, put both of the litmus paper inside the solution of soda water and note the changes in the colour of litmus paper.

Take the baking soda in a spoon and test it with wet litmus paper (blue and red) for its acidic/basic nature.

Now heat baking soda in a boiling test tube. Bring the blue and red litmus paper near the gas liberated, and note the changes in the colour of litmus. Draw table no. 4.1 in your copy and note the nature acidic/basic according to the colour change in the litmus paper.

**Table 4.1**

S.No.	Substance/Compound	Test with litmus paper	Acidic/basic nature
1.	soda water	(a) Liberated gas	.....
		(b) In soda water	.....
2.	Baking soda	(a) In baking soda	.....
		(b) Liberated gas	.....

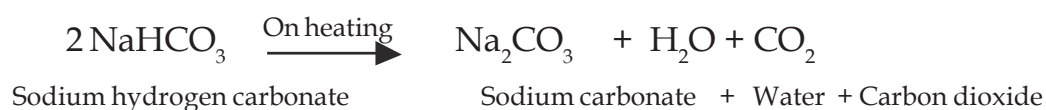
What differences did you see in both the cases? Can you say in which case a new substance was formed?

If you carefully note the results of the experiment -1, you will find that when we add sulphuric acid to water, it produces heat due to which the beaker gets hot. This is a physical change. However, when quicklime was added to water the heat produced was due to a chemical change. In both the cases heat was produced and on this basis we cannot define the type of change occurred.

Therefore, it is not necessary that the changes, which seems to be of the same type. To identify a chemical change we have to observe if any new compound is formed or not after the process.

In activity-2 the gas coming out from soda water, and the baking soda, both are of acidic nature. Whereas baking soda, which has an alkaline nature, and which when heated, liberates a gas of acidic nature. Based on the formation of the new substance and recognizing it we can say that a chemical reaction has taken place.

On opening the soda bottle, the carbon dioxide dissolved in it is liberated. Here no chemical reaction takes place. However, when we heat the baking soda the following reaction takes place.



In this reaction, on heating baking soda (sodium hydrogen carbonate) we get sodium carbonate, water and carbon dioxide, which is very different from initially

taken substance. Did you notice the water drops formed in the experiment? Such a process where a new compound is formed is called chemical reaction. The compounds, which take part in a reaction, are called reactants and the compounds formed in the reaction are called products. In this way in any chemical reaction, reactants are changed into products.

## 4.2 PROPERTIES OF A CHEMICAL REACTION

Come let us know about the properties of chemical reaction.

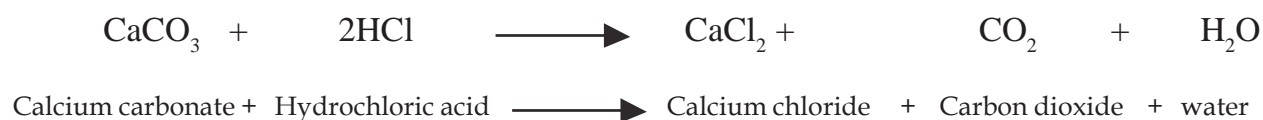


### Activity 3

**Materials required:** Test tubes, calcium carbonate, dilute hydrochloric acid.

Take some Calcium carbonate in a test tube and add dilute hydrochloric acid in it. What changes take place on adding acid? Which gas is liberated during this reaction?

Here we find that calcium carbonate is an insoluble solid, which reacts with hydrochloric acid to give out carbon dioxide gas and calcium chloride. Calcium chloride is, formed which is soluble in water.



Liberation of gas and changes in the state of reactants are properties of a reaction.

We have seen that there was a reaction when two compounds combined with each other. Can you give some other such examples? Rusting, food spoiling etc are some examples of such reaction.



### Activity 4

**Materials required:** Sugar, heating apparatus, test tube holder, boiling test tube.

Take a boiling test tube. Take some sugar in it and heat it. (fig 4.1). Observe the changes on heating. On heating at first sugar melts, then on further heating it turns black and we can see water droplets on the inside walls of the test tube.

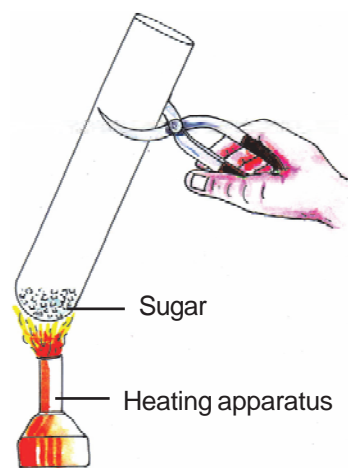


Fig 4.1 Charring of Sugar

This is called charring of sugar. Is the compound taken for the experiment same as that which is produced after the experiment?

Here we find that the production of the new compound is due to the heating. Therefore, we can say that chemical reaction happens when something is burned. Such reactions absorb heat. These reactions are called Endothermic reactions.

In the activity 1, you have seen that on adding water to quicklime heat was produced. Therefore, in some reactions heat is evolved. These reactions are called Exothermic reactions.



### Activity 5

**Materials required:** Test tube, milk, lemon juice, heating apparatus.

Fill half the test tube with milk. Heat this and add some drops of lemon juice. Observe the changes happening due to the chemical changes.

Here you get some white residue. Formation of a residue is also a property of chemical reaction.



### Activity 6 (Demonstration by the teacher)

**Materials required :** Test tube, copper turnings, concentrated nitric acid.

Take about 1 g of copper turnings in a test tube and add 2-3 drops of concentrated nitric acid in it. You will find that a brown coloured gas is liberated during the chemical reaction. Changes in the colour of the reactants are also a property of a chemical reaction.

In this way, we have seen that a chemical reaction can be recognized by liberation of gas, colour change, residue formation, heat changes and changes in states of matter. Some reactions show more than one property.



### NOW ANSWER THESE

- 1) What do you understand by chemical reaction?
- 2) Burning of candle is a chemical reaction. Give the properties connected with this.

3) What are reactants and products? Explain with examples.

### 4.3 TYPES OF CHEMICAL REACTION

After finding out the properties of the chemical reaction; come, we will see the different types of chemical reactions.

#### 1. Combination reaction



#### Activity 7

**Materials required:-** Magnesium piece, forceps, heating apparatus.

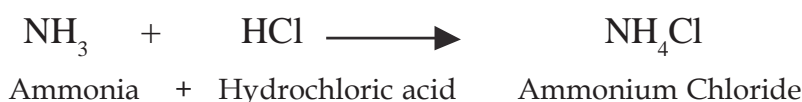
Heat the magnesium piece, holding it with a forceps. During of burning, heat and light is produced and a white product is formed. What is this white product? On this basis, can you say that there is a chemical reaction going on between magnesium and oxygen?

In this reaction, magnesium and oxygen combine with each other to form a new white coloured product, which is magnesium oxide.



Such chemical reaction in which two chemical substances combine to form a new substances is called a combination reaction.

You have read that iron and sulphur combine to form iron sulphide. This is also an example of combination reaction. Ammonia ( $\text{NH}_3$ ) combining with hydrochloric acid ( $\text{HCl}$ ) is also an example of combination reaction.



It is by successive combination reaction that many chemical substances are manufactured in large scale. As in the manufacture of sulphuric acid, three successive combination reactions takes place. First of all sulphur is burned, in which it reacts with oxygen to form sulphur dioxide ( $\text{SO}_2$ ).



Sulphur dioxide combines with oxygen in special conditions to form sulphur tri oxide ( $\text{SO}_3$ ).



Sulphur dioxide + Oxygen  $\longrightarrow$  Sulphur trioxide

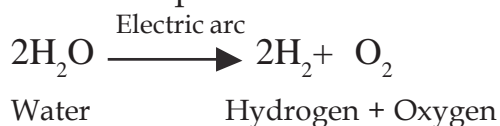
Sulphur tri oxide combines with water to form sulphuric acid.



Sulphur trioxide + Water  $\longrightarrow$  Sulphuric acid

## 2. Decomposition reaction

In activity 2, we have seen that by the decomposition of baking soda, sodium carbonate, water and carbon dioxide is formed. In such reactions where one reactant breaks into two or more components or products are called decomposition reactions. When the decomposition is due to heat then it is called thermal decomposition.



The breaking of lime stone (calcium carbonate) into lime and carbon dioxide is also an example of decomposition reaction.



## 3. Displacement reaction



### Activity 8

**Materials required-** Test tube, matches, zinc, dilute hydrochloric acid

Put some zinc pieces in the test tube. Now add the dilute hydrochloric acid into it. Is any gas liberated? Which gas is this? Bring a burning matchstick or candle near the mouth of the test tube (fig 4.2) Do you hear any type of sound?

In this reaction, zinc has displaced the hydrogen in the hydrochloric acid. Due to which zinc

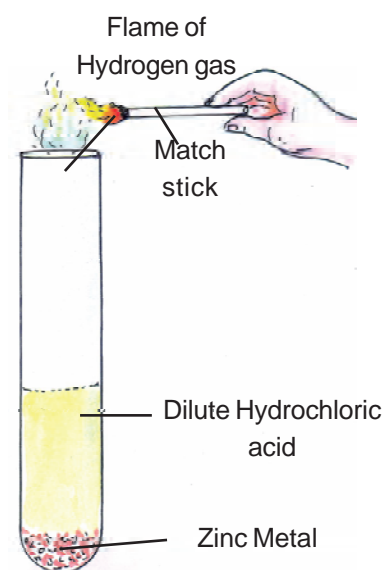
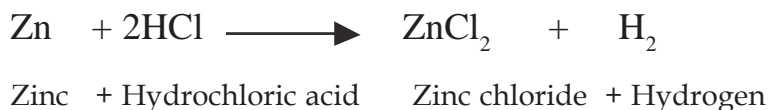


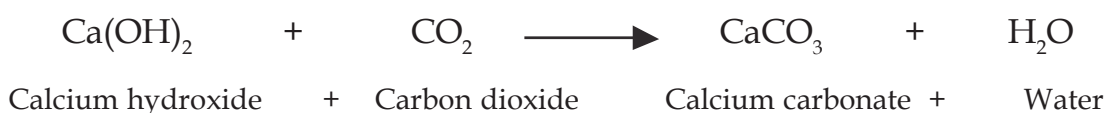
Fig 4.2 Displacement

chloride and hydrogen gas is formed. These reactions are called displacement reactions.



#### 4. Precipitation reaction

In activity 2, we have seen that in the decomposition of baking soda, the gas released when passed through limewater turns it milky. In this reaction, limewater, which is known as calcium hydroxide ( $\text{Ca(OH)}_2$ ) in chemical terms, reacts with carbon dioxide to form calcium carbonate ( $\text{CaCO}_3$ ) which is insoluble in water. Such chemical reactions where the products are insoluble are called precipitation reactions. The insoluble solids are called precipitates.



##### ***How to prepare limewater***

***Materials required:*** Two glass bottles, funnel, filter paper, quicklime.

*Fill about two-third of a bottle with water. Add two teaspoons of quicklime in it and keep aside. Next day filter this into the other bottle. In this way, you can get transparent lime water.*



#### NOW ANSWER THESE

1. Explain the following reactions with two examples each.
  1. Combination
  2. Decomposition
  3. Displacement
  4. Precipitation
2. If you prepare lime water and leave it open. What changes will taken place in this solution next day and why?



## 5. Neutralization reaction



### Activity 9

**Materials required:** Test tube, sodium hydroxide, hydrochloric acid, phenolphthalein, dropper, blue and red litmus paper.

Take about twenty drops of sodium hydroxide in a test tube and add one or two drops of phenolphthalein in it. What is the colour change in the solution? By the change in the colour you can know whether the solution is acidic or alkaline.

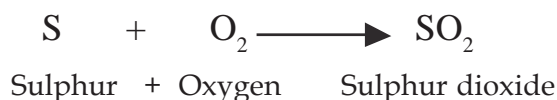
Now in this alkaline solution add few drops of hydrochloric acid, drop by drop with a dropper. A time will come when the pink colour of the solution completely vanishes or fades away. Now dip the blue and red litmus paper one by one in it. Such reaction between an acid and an alkali producing a salt and water is known as neutralization reaction.



This reaction is to be done very carefully as after the stage of neutralization, even a drop of excess acid will make the solution acidic.

## 6. Oxidation Reduction reaction

In activity 6 when we burnt the magnesium wire, then magnesium oxide was formed. This is an example of oxidation reaction. Combination of oxygen with any compound is called oxidation. Do you know that it is reaction of iron with oxygen, which forms the rust? On the other hand, rusting is an example of oxidation. When we burn sulphur, we get sulphur dioxide, here also it is oxidation of sulphur.



Opposite to this, removal of oxygen from any compounds is called reduction.

When mercuric oxide is burned, mercury and oxygen is obtained.

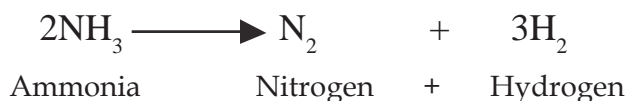


Here mercuric oxide is reduced because oxygen has been removed from it.

Oxidation and reduction can also be defined in terms of removal and addition of hydrogen respectively.



When ammonia is passed through red-hot glass tube then it is reduced to nitrogen and hydrogen.



Here hydrogen has been removed from ammonia, so ammonia has been oxidized.

Come, let us see the making of hydrochloric acid from hydrogen and chlorine.



Here chlorine has combined with hydrogen so chlorine has been reduced.

Oxidation and reduction reaction goes on simultaneously. When one reactant is oxidized, the other is reduced. Such reactions are called Redox reactions.



### Activity 10 (Performed by Teacher)

**Materials required:** A piece of coal, red lead, spirit lamp and blowpipe.

Take a piece of coal. Make a small hole in it. Put some red lead in this hole. With a blowpipe, direct the flame of the lamp towards the red lead. You will see that the colour changes from red to yellow. Continue blowing until you get a grey coloured liquid. It will solidify on cooling. This is lead. (fig 4.3)



In this reaction, oxygen was lost from lead oxide so we can say it was reduced and carbon combined with oxygen so carbon was oxidized. This is a redox reaction.

### **Bio chemical reactions**

*Some micro organisms also take part in some chemical reactions. Milk changing to curd, fermentation of batter for dosa, decaying of food, internal activities like digestion in man and other organisms are examples of bio chemical reactions.*

Chemical reactions are an important part of our life. Many chemical reactions are continuously going on in our body and in other living organisms and plants. In factories, also it is by chemical reactions that many necessary things are manufactured as medicines, fertilizers, insecticides, paint, polish, soaps, cosmetics, etc.



## NOW ANSWER THESE

- 1) What is neutralization reaction? Give one example.
- 2) What is precipitate? Write a reaction in which a precipitate is formed.
- 3) Explain oxidation, reduction and redox reactions.



## WE HAVE LEARNT

- That reaction in which a new substance is formed is called chemical reactions. The substances taking part in a reaction are known as reactants and the substances formed in a chemical reaction are called products.
- Chemical reactions can be recognized by liberation of gas, colour changes, formation of precipitates, heat changes and state changes.
- There are different types of chemical reactions. They are categorized as combination, decomposition, displacement, precipitation, neutralization, oxidation-reduction reactions.
- Those reactions in which microorganisms also take part in the chemical reaction are called bio-chemical reactions.
- These reactions are used to obtain many chemicals.



## QUESTIONS FOR PRACTICE

1. Choose the correct answer
  1.  $\text{NaOH} + \text{HCl} \longrightarrow \text{NaCl} + \text{H}_2\text{O}$  this is a:-
    - (a) Decomposition reaction
    - (b) Combination reaction
    - (c) Neutralization reaction
    - (d) Precipitation reaction
2. On ignition when a substance combines with oxygen, the process is called :-
  - (a) reduction
  - (b) oxidation
  - (c) decomposition
  - (d) displacement
3. Which of these is not a characteristic of chemical reaction?
  - (a) production of heat
  - (b) change in colour
  - (c) liberation of gas
  - (d) formation of no new substance
4.  $2\text{KClO}_3 \longrightarrow 2\text{KCl} + 3\text{O}_2$  is a reactions :-
  - (a) combination
  - (b) decomposition
  - (c) displacement
  - (d) neutralization

**2. Write the type of chemical reaction**

1.  $\text{NH}_3 + \text{HCl} \longrightarrow \text{NH}_4\text{Cl}$
2.  $\text{NaOH} + \text{HCl} \longrightarrow \text{NaCl} + \text{H}_2\text{O}$
3.  $2\text{NH}_3 \longrightarrow \text{N}_2 + 3\text{H}_2$
4.  $\text{CuSO}_4 + \text{Zn} \longrightarrow \text{ZnSO}_4 + \text{Cu}$

**3. Answer the following questions :-**

1. When calcium carbonate is heated we get calcium oxide and carbon dioxide.



What type of reaction is this? What are the reactants and products? Write it.

2. Give two examples for each of the following reactions in which -

1. Precipitate is formed
2. Heat is liberated
3. Colour is changed.

**4. Some reactions are given below. Identify the chemical reaction and write the reasons.**

1. Melting of ice.
2. Dissolution of sugar in water.
3. Burning of wood.
4. Blackening of pieces of potatoes, brinjals and apples.
5. Melting of wax.
6. Blackening of silver ornaments.
7. Souring of Milk
8. Synthesis of food by green plants in presence of sunlight.

**5. Point out the difference between-**

1. Oxidation and reduction
  2. Combination and decomposition
6. Write the characteristics of a chemical reaction.
  7. Give an example of a reaction which shows more than one of these characteristics.
  8. Enlist various chemical changes that you come across in your daily life and also classify or categorize them.
  9. When Seema tasted glucose, she felt cold in tongue. Why did she feel so? What is this reaction called ?

