



**Class 10<sup>th</sup>**

**Chapter 1<sup>st</sup>**

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**CHEMICAL**

**REACTIONS**

**AND**

**EQUATIONS**

**Chemical reactions are the processes in which new substances with new properties are formed.**

**During a chemical reaction, atoms of one element do not change into those of another element. Only a rearrangement of atoms takes place in a chemical reaction.**

- (i) The substances which take part in a chemical reaction are called reactants.**
- (ii) The new substances produced as a result of chemical reaction are called products.**

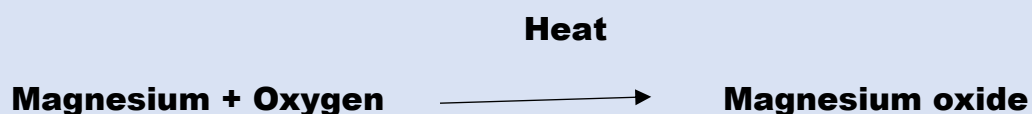
### **Example**

**Clean a magnesium ribbon about 3-4 cm long by rubbing it with sandpaper.**

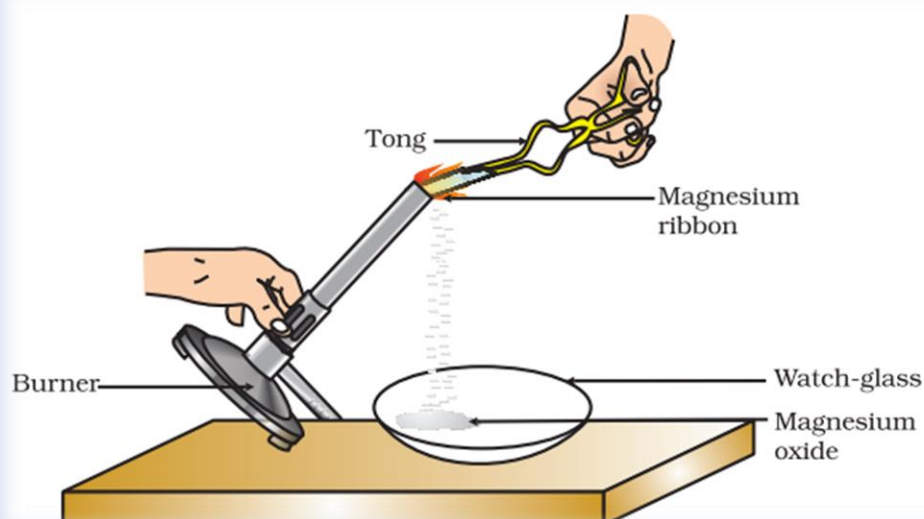
**Hold it with a pair of tongs. Burn it using a spirit lamp or burner and collect the ash so formed in a watch-glass.**

**Burn the magnesium ribbon keeping it away as far as possible from your eyes.**

**observed that magnesium ribbon burns with a dazzling white flame and changes into a white powder. This powder is magnesium oxide. It is formed due to the reaction between magnesium and oxygen present in the air.**



**In this chemical reaction there are two reactants 'magnesium and oxygen' but only one product 'magnesium oxide'.**

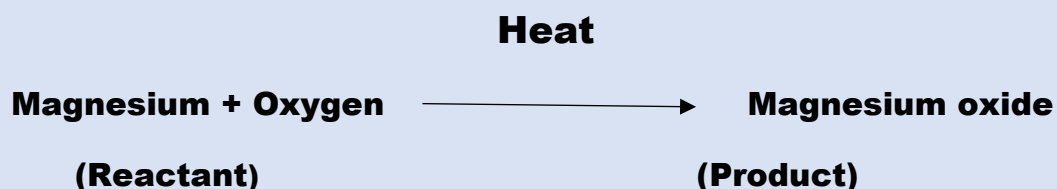


## Characteristics of Chemical Reactions

The important characteristics of chemical reactions are :

- (i) Evolution of a gas,
- (ii) Formation of a precipitate,
- (iii) Change in colour,
- (iv) Change in temperature,
- (v) Change in state

## CHEMICAL EQUATIONS



A word-equation shows change of reactants to products through an arrow placed between them.

The reactants are written on the left-hand side (LHS) with a plus sign (+) between them.

Similarly, products are written on the right-hand side (RHS) with a plus sign (+) between them.

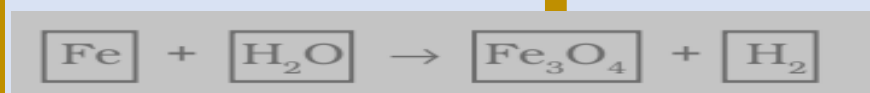
The arrowhead points towards the products, and shows the direction of the reaction

### **Balanced Chemical Equations**

The process of making the number of different types of atoms equal on both the sides of an equation is called balancing of equation.

#### **Step I:**

To balance a chemical equation, first draw boxes around each formula. Do not change anything inside the boxes while balancing the equation.



#### **Step II:**

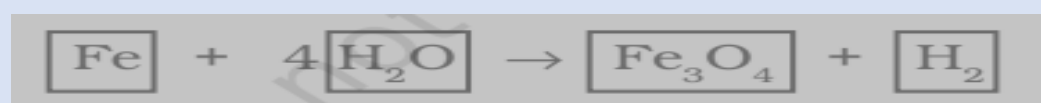
List the number of atoms of different elements present in the unbalanced equation

Element	Number of atoms in reactants (LHS)	Number of atoms in products (RHS)
Fe	1	3
H	2	2
O	1	4

#### **Step III:**

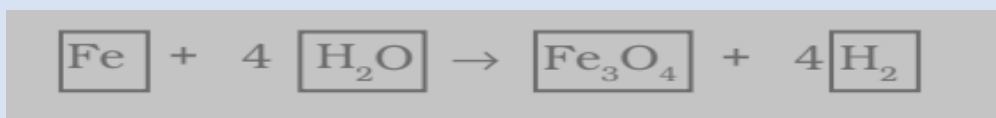
select the element which has the maximum number of atoms.

Using these criteria, we select Fe<sub>3</sub>O<sub>4</sub> and the element oxygen in it. There are four oxygen atoms on the RHS and only one on the LHS.



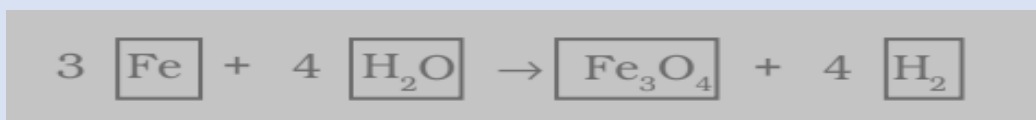
#### Step IV:

**Fe and H atoms are still not balanced. To equalise the number of H atoms, make the number of molecules of hydrogen as four on the RHS.**



#### Step V:

**To equalise Fe, we take three atoms of Fe on the LHS.**



#### Step VI:

**Finally, to check the correctness of the balanced equation, we count atoms of each element on both sides of the equation.**

### To Make Equations More Informative

**The chemical equations can be made more informative in three ways:**

- 1. By indicating the “physical states” of the reactants and products.**
- 2. By indicating the “heat changes” taking place in the reaction.**
- 3. By indicating the “conditions” under which the reaction takes place.**

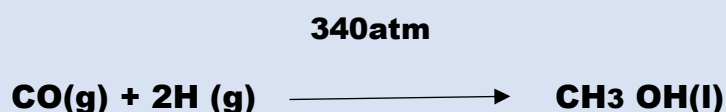
**Solid state is indicated by the symbol (s)**

**Liquid state is indicated by the symbol (l)**

**Aqueous solution (solution made in water) is indicated by the symbol (aq)**

**Gaseous state is indicated by the symbol (g)**

Sometimes the reaction conditions, such as temperature, pressure, catalyst, etc., for the reaction are indicated above and/or below the arrow in the equation. For example



## TYPES OF CHEMICAL REACTIONS

1. Combination reactions,
2. Decomposition reactions
3. Displacement reactions,
4. Double displacement reactions
5. Oxidation and Reduction reactions

### COMBINATION REACTIONS

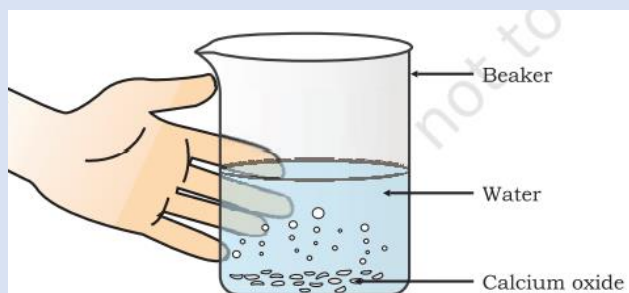
Those reactions in which two or more substances combine to form a single substance, are called combination reactions.

#### Example

Take a small amount of calcium oxide or quick lime in a beaker. Slowly add water to this.

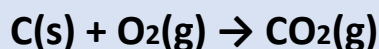
Touch the beaker.

Calcium oxide reacts vigorously with water to produce slaked lime (calcium hydroxide) releasing a large amount of heat.

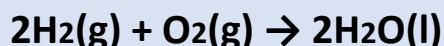


**In this reaction, calcium oxide and water combine to form a single product, calcium hydroxide.**

**(i) Burning of coal**

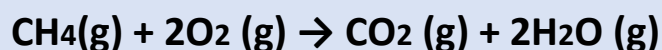


**(ii) Formation of water from H<sub>2</sub>(g) and O<sub>2</sub>(g)**



**A large amount of heat is evolved. This makes the reaction mixture warm. Reactions in which heat is released along with the formation of products are called exothermic chemical reactions.**

**(i) Burning of natural gas**



**(ii) respiration is an exothermic process**



## **DECOMPOSITION REACTIONS**

**Those reactions in which a compound splits up into two or more simpler substances are known as decomposition reactions.**

### **Example**

**Take about 2 g ferrous sulphate crystals in a dry boiling tube.**

**Note the colour of the ferrous sulphate crystals.**

**Heat the boiling tube over the flame of a burner or spirit lamp**

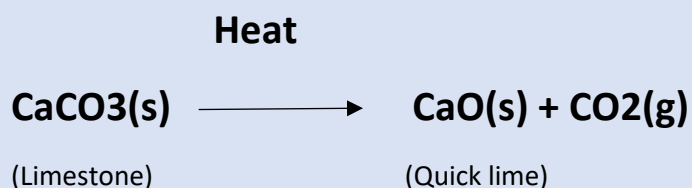
**Ferrous sulphate crystals (FeSO<sub>4</sub>, 7H<sub>2</sub>O) lose water when heated and the colour of the crystal's changes. It then decomposes to ferric oxide (Fe<sub>2</sub>O<sub>3</sub>), sulphur dioxide (SO<sub>2</sub>) and sulphur trioxide (SO<sub>3</sub>). Ferric oxide is a solid, while SO<sub>2</sub> and SO<sub>3</sub> are gases.**



(Ferrous sulphate)

(Ferric oxide)

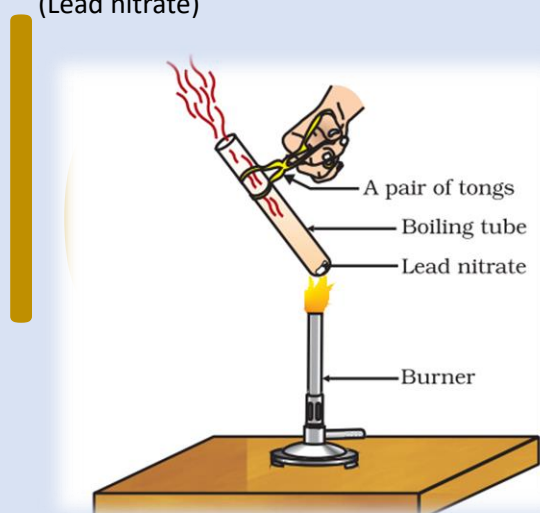
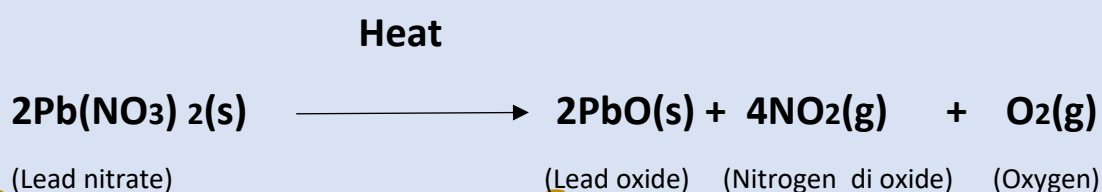
**When a decomposition reaction is carried out by heating, it is called thermal decomposition.**



**Another example of a thermal decomposition reaction is**

**Take about 2 g lead nitrate powder in a boiling tube.**

**Hold the boiling tube with a pair of tongs and heat it over a flame we observe the emission of brown fumes. These fumes are of nitrogen dioxide (NO<sub>2</sub>). The reaction that takes place is**



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## **DISPLACEMENT REACTIONS**

**Those reactions in which one element takes the place of another element in a compound, are known as displacement reactions.**

### **Examples**

**Take three iron nails and clean them by rubbing with sand paper.**

**Take two test tubes marked as (A) and (B). In each test tube, take about 10 mL copper sulphate solution.**

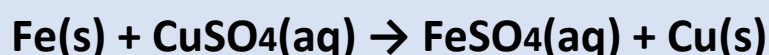


**Tie two iron nails with a thread and immerse them carefully in the copper sulphate solution in test tube B for about 20 minutes . Keep one iron nail aside for comparison.**

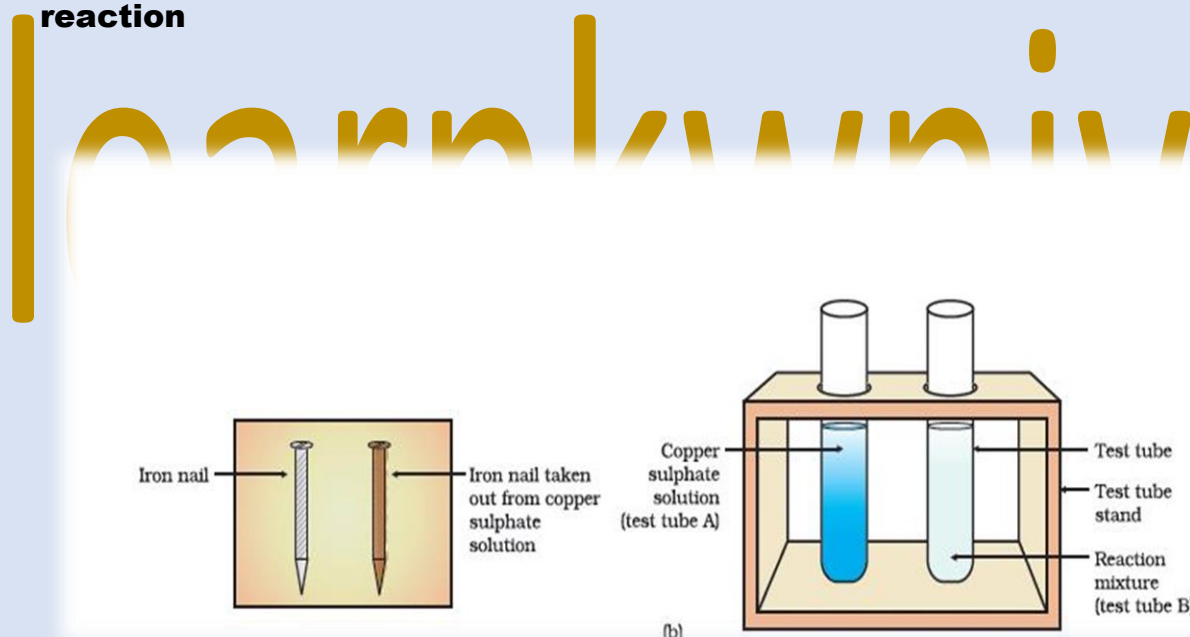
**After 20 minutes, take out the iron nails from the copper sulphate solution.**

**Compare the intensity of the blue colour of copper sulphate solutions in test tubes (A) and (B) .**

**Also, compare the colour of the iron nails dipped in the copper sulphate solution with the one kept aside.**



**iron has displaced or removed another element, copper, from copper sulphate solution. This reaction is known as displacement reaction**



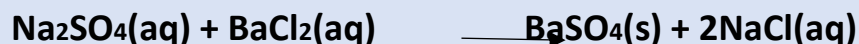
## **DOUBLE DISPLACEMENT REACTIONS**

**Those reactions in which two compounds react by an exchange of ions to form two new compounds are called double displacement reactions.**

**Example**

Take about 3 mL of sodium sulphate solution in a test tube.  
In another test tube, take about 3 mL of barium chloride solution.  
Mix the two solutions.

A white substance, which is insoluble in water, is formed. This insoluble substance formed is known as a precipitate. Any reaction that produces a precipitate can be called a precipitation reaction



(Sodium  
sulphate)

(Barium  
chloride)

(Barium  
sulphate)

(Sodium  
chloride)

The white precipitate of  $\text{BaSO}_4$  is formed by the reaction of  $\text{SO}_4^{2-}$  and  $\text{Ba}^{2+}$ . The other product formed is sodium chloride which remains in the solution. Such reactions in which there is an exchange of ions between the reactants are called double displacement reactions.

## OXIDATION AND REDUCTION REACTIONS

**Oxidation :** (i) The addition of oxygen to a substance is called oxidation.

(ii) The removal of hydrogen from a substance is also called oxidation

**Reduction :** (i) The addition of hydrogen to a substance is called reduction.

The removal of oxygen from a substance is also called reduction.

**Oxidising agent :** (i) The substance which gives oxygen for oxidation is called an oxidising agent.

(ii) The substance which removes hydrogen is also called an oxidising agent.

**Reducing agent :** (i) The substance which gives hydrogen for reduction is called a reducing agent.

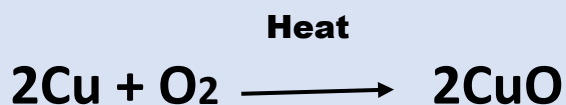
(ii) The substance which removes oxygen is also called a reducing agent.

### **Example**

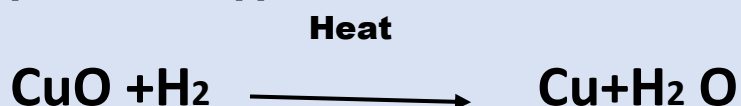
Heat a china dish containing about 1 g copper powder.

The surface of copper powder becomes coated with black copper(II) oxide.

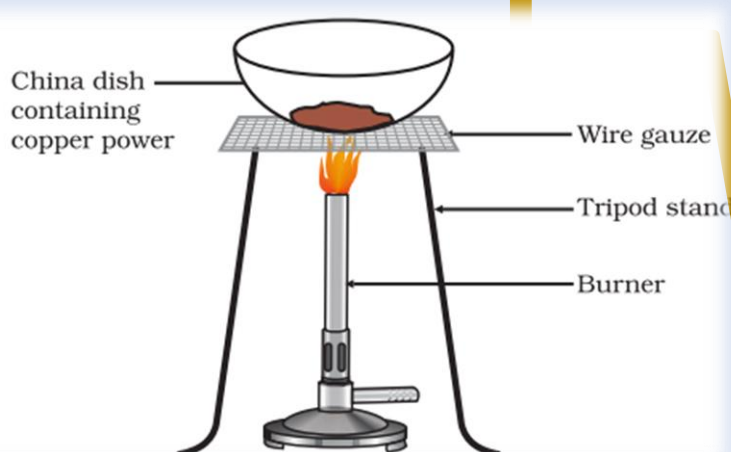
**This is because oxygen is added to copper and copper oxide is formed**



**If hydrogen gas is passed over this heated material (CuO), the black coating on the surface turns brown as the reverse reaction takes place and copper is obtained**



**During this reaction, the copper(II) oxide is losing oxygen and is being reduced. The hydrogen is gaining oxygen and is being oxidised.**



### **Corrosion**

**Corrosion is the process in which metals are eaten up gradually by the action of air, moisture or a chemical (such as an acid) on their surface.**

**The black coating on silver and the green coating on copper are other examples of corrosion. Corrosion causes damage to car bodies, bridges, iron railings, ships and to all objects made of metals, especially those of iron.**

### **Rancidity**

**The condition produced by aerial oxidation of fats and oils in foods marked by unpleasant smell and taste is called rancidity.**

**When fats and oils are oxidised, they become rancid and their smell and taste change. Usually substances which prevent oxidation (antioxidants) are added to foods containing fats and oil. Keeping food in air tight containers helps to slow down oxidation.**

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