CHAPTER – 1

CHEMICAL REACTIONS AND EQUATIONS

CHEMICAL REACTIONS

Any change can be classified as physical change and chemical change. Physical changes can be easily reversed but, it is not easy to reverse a chemical change.
In chemical changes, new substances are formed and it is difficult to regenerate the original substances. Chemical changes are more permanent than physical changes.
Chemical reaction involves chemical changes.
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.

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.

Magnesium (As ribbon)	+	Oxygen (From air)	$\xrightarrow{\text{Heat}}$	Magnesium Oxide (White powder)

The burning of magnesium in air to form magnesium oxide is an example of chemical reaction.

REACTANTS AND PRODUCTS

The substances which take part in a chemical reaction are called reactants.
The new substances produced as a result of chemical reaction are called products.
In the above chemical reaction, there are two reactants : Magnesium and Oxygen but only one product : Magnesium oxide.

CHARACTERISTICS OF CHEMICAL REACTIONS

In a chemical reaction, reactants are transformed into products.
The important characteristics of chemical reaction are:

- ❖ Evolution of a gas
- ❖ Formation of a precipitate
- ❖ Change in colour
- ❖ Change in temperature and
- ❖ Change in state.

Any one of these characteristics can tell us whether a chemical reaction has taken place or not.

CHEMICAL EQUATIONS

The method of representing a chemical reaction with the help of symbols and formulas of the substances involved in it is known as chemical equation.

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.

Example: $A + B \rightarrow C + D$

In this equation, A and B are called reactants and C and D are called the products. Arrow shows the direction of chemical reaction. Condition, if any, is written generally above the arrow.

When hydrogen reacts with oxygen, it gives water. This reaction can be represented by following chemical equation:

$$\text{Hydrogen} + \text{Oxygen} \Rightarrow \text{Water}$$

$$H_2 + O_2 \rightarrow H_2O$$

In first equation words are used and in second symbols of substances are used to write the chemical equation. For convenience, symbol of substance is used to represent chemical equations. Chemical Equation is a way to represent the chemical reaction in concise and informative way.

Chemical equation can be divided into two types – Balanced Chemical Equation and Unbalanced Chemical Equation.

Balanced Chemical Equation: A balanced chemical equation has number of atoms of each element equal on both sides.

Example: $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

In this equation, numbers of zinc, hydrogen and sulphate are equal on both sides, so it is a balanced chemical equation.

Unbalanced Chemical Equation: If the number of atoms of each element in reactants is not equal to the number of atoms of each element present in product, then the chemical equation is called unbalanced chemical equation.

Example: $Fe + H_2O \rightarrow Fe_3O_4 + H_2$

In this example number atoms of elements are not equal on two sides of the reaction. For example, on the left hand side only one iron atom is present, while three iron atoms are present on the right hand side. Therefore, it is an unbalanced chemical equation.

BALANCING A CHEMICAL EQUATION:

To balance the given or any chemical equation, follow these steps:

$$Fe + H_2O \rightarrow Fe_3O_4 + H_2$$

Write the number of atoms of elements present in reactants and in products in a table; as shown here.

Name of atom	No. of atoms in reactant	No. of atoms in product
Iron	1	3
Hydrogen	2	2
Oxygen	1	4

Balance the atom which is the maximum in number; on either side of chemical equation.
In this equation, the number of oxygen atom is the maximum on the RHS.
To balance the oxygen one needs to multiply the oxygen on the LHS by 4; so that the number of oxygen atoms becomes equal on both sides.

$$Fe + 4 \times H_2O \rightarrow Fe_3O_4 + H_2$$

Now, the number of hydrogen atoms becomes 8 on the LHS; which is more than that on the RHS. To balance it, one needs to multiply the hydrogen on the RHS by 4.

$$Fe + 4 \times H_2O \rightarrow Fe_3O_4 + 4 \times H_2$$

After that number of oxygen and hydrogen atoms becomes equal on both sides. The number of iron is one on the LHS, while it is three on the RHS. To balance it, multiply the iron on the LHS by 3.

$$3 \times Fe + 4 \times H_2O \rightarrow Fe_3O_4 + 4 \times H_2$$

Now the number of atoms of each element becomes equal on both sides. Thus, this equation becomes a balanced equation.

Name of atom	No. of atoms in reactant	No. of atoms in product
Iron	3	3
Hydrogen	8	8
Oxygen	4	4

After balancing, the above equation can be written as follows.

$$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$$

Writing the symbols of Physical States of substances in Chemical equation:

By writing the physical states of substances a chemical equation becomes more informative.

- Gaseous state is represented by symbol 'g'
- Liquid state is represented by symbol 'l'
- Solid state is written by symbol 's'
- Aqueous solution is written by symbol 'aq'

Writing the condition in which reaction takes place: The condition is generally written above and/or below the arrow of a chemical equation.

Thus, by writing the symbols of physical state of substances and condition under which reaction takes place, a chemical equation can be made more informative.

INTEXT QUESTIONS PAGE NO. 6

Q1: Why should a magnesium ribbon be cleaned before it is burnt in air?

Answer : Magnesium is an extremely reactive metal. When stored, it reacts with oxygen to form a layer of magnesium oxide on its surface. This layer of magnesium oxide is quite stable and prevents further reaction of magnesium with oxygen. The magnesium ribbon is cleaned by sand paper for removing this layer so that the underlying metal can be exposed to air.

Question 2: Write the balanced equation for the following chemical reactions.

(i) Hydrogen + Chlorine → Hydrogen chloride

(ii) Barium chloride + Aluminium sulphate → Barium sulphate + Aluminium chloride

(iii) Sodium + Water → Sodium hydroxide + Hydrogen

Answer :

$$H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$$

$$3BaCl_{2(s)} + Al_2(SO_4)_{3(s)} \longrightarrow 3BaSO_{4(s)} + 2AlCl_{3(s)}$$

$$2Na_{(s)} + 2H_2O_{(l)} \longrightarrow 2NaOH_{(aq)} + H_{2(g)}$$

Question 3: Write a balanced chemical equation with state symbols for the following reactions.

(i) Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate and the solution of sodium chloride.

(ii) Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.

Answer :

$$BaCl_{2(aq)} + Na_2SO_{4(aq)} \longrightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$$

$$NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$$

TYPES OF CHEMICAL REACTION

Chemical reactions can be classified in following types:

- Combination Reaction
- Decomposition Reaction
- Displacement Reaction
- Double Displacement Reaction
- Oxidation and Reduction Reaction

COMBINATION REACTION

Reactions in which two or more reactants combine to form one product are called COMBINATION REACTION.
A general combination reaction can be represented by the chemical equation given here.

Example: When magnesium is burnt in air (oxygen), magnesium oxide is formed. In this reaction, magnesium is combined with oxygen.

$$Mg + O_2 \rightarrow 2MgO$$

Magnesium + Oxygen ⇨ Magnesium oxide

When carbon is burnt in oxygen (air), carbon dioxide is formed. In this reaction, carbon is combined with oxygen.

$$C + O_2 \rightarrow CO_2$$

Carbon + Oxygen ⇨ Carbon dioxide

When hydrogen reacts with chlorine, hydrogen chloride is formed.

$$H_2 + Cl_2 \rightarrow 2HCl$$

Hydrogen + Chlorine ⇨ Hydrogen chloride

When calcium oxide reacts with water, calcium hydroxide is formed

$$CaO + H_2O \rightarrow Ca(OH)_2$$

Calcium oxide + Water → Calcium hydroxide

When carbon monoxide reacts with oxygen, carbon dioxide is formed.

$$2CO + O_2 \rightarrow 2CO_2$$

Carbon monoxide + Oxygen → Carbon dioxide

DECOMPOSITION REACTION

Reactions in which one compound decomposes in two or more compounds or element are known as DECOMPOSITION REACTION. Decomposition reaction is just opposite of combination reaction.
A general decomposition reaction can be represented as follows:

Example: When calcium carbonate is heated, it decomposes into calcium oxide and carbon dioxide

$$CaCO_3 \rightarrow CaO + CO_2$$

Calcium carbonate → Calcium oxide + Carbon dioxide

When ferric hydroxide is heated, it decomposes into ferric oxide and water

$$2Fe(OH)_3 \rightarrow Fe_2O_3 + 3H_2O$$

Ferric hydroxide → Ferric oxide + Water

When lead nitrate is heated, it decomposes into lead oxide, nitrogen dioxide and oxygen.

$$2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$$

Lead nitrate ⇨ Lead oxide + Nitrogen oxide + Oxygen

In above examples, compound is decomposed because of heating, so, these reactions are called THERMAL DECOMPOSITION REACTION.

ELECTROLYTIC DECOMPOSITION

Reactions in which compounds decompose into simpler compounds because of passing of electricity, are known as ELECTROLYTIC DECOMPOSITION. This is also known as ELECTROLYSIS.

Example: When electricity is passed in water, it decomposes into hydrogen and oxygen.

$$2H_2O \rightarrow 2H_2 + O_2$$

PHOTOLYSIS OR PHOTO DECOMPOSITION REACTION

Reactions in which a compound decomposes because of sunlight are known as PHOTOLYSIS or PHOTO DECOMPOSITION REACTION.

Example: When silver chloride is put in sunlight, it decomposes into silver metal and chlorine gas.

$$2AgCl \rightarrow 2Ag + Cl_2$$

Similarly, when silver bromide is put under sunlight, it decomposes into silver metal and bromine gas.

$$2AgBr \rightarrow 2Ag + Br_2$$

Photographic paper has coat of silver chloride, which turns into grey when exposed to sunlight. It happens because silver chloride is colourless while silver is a grey metal.

INTEXT QUESTIONS PAGE NO. 10

Question 1: A solution of a substance 'X' is used for white washing.
(i) Name the substance 'X' and write its formula.
(ii) Write the reaction of the substance 'X' named in (i) above with water.
Answer : (i) The substance 'X' is calcium oxide. Its chemical formula is CaO.
(ii) Calcium oxide reacts vigorously with water to form calcium hydroxide (slaked lime).

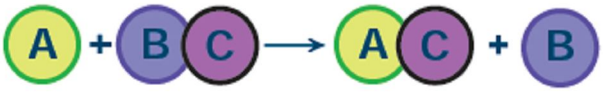
$$CaO_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_{2(aq)}$$

Calcium oxide	Water	Calcium hydroxide
(Quick lime)		(Slaked lime)

Question 2: Why is the amount of gas collected in one of the test tubes in Activity 1.7 double of the amount collected in the other? Name this gas.
Answer : Water (H_2O) contains two parts hydrogen and one part oxygen. Therefore, the amount of hydrogen and oxygen produced during electrolysis of water is in a 2:1 ratio. During electrolysis, since hydrogen goes to one test tube and oxygen goes to another, the amount of gas collected in one of the test tubes is double of the amount collected in the other.

DISPLACEMENT REACTION

Reactions in which atoms or ions move from one compound to other to form new compound are known as DISPLACEMENT REACTION. Displacement reaction is also known as Substitution Reaction or Single displacement /Replacement Reaction.
A general displacement reaction can be represented using chemical equation as follows:



Displacement reaction takes place only when 'A' is more reactive than B. If 'B' is more reactive than 'A', then 'A' will not displace 'C' from 'BC' and reaction will not be taken place.
Example: When zinc reacts with hydrochloric acid, it gives hydrogen gas and zinc chloride.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

When zinc reacts with copper sulphate, it forms zinc sulphate and copper metal.

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

When silver metal is dipped in copper nitrate, no reaction takes place because silver metal is less reactive than copper.

$$Ag + Cu(NO_3)_2 \rightarrow \text{No reaction takes place}$$

DOUBLE DISPLACEMENT REACTION

Reactions in which ions are exchanged between two reactants forming new compounds are called double displacement reactions.

Example: When solution of barium chloride reacts with the solution of sodium sulphate, white precipitate of barium sulphate is formed along with sodium chloride.

$$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$$

When sodium hydroxide (a base) reacts with hydrochloric acid, sodium chloride and water are formed.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Double displacement reaction, in which precipitate is formed, is also known as precipitation reaction. Neutralisation reactions are also examples of double displacement reaction.

EXOTHERMIC AND ENDOTHERMIC REACTION

The chemical reactions which proceed with the evolution of heat energy are called exothermic reactions.

$$\mathbf{N_2 + 3H_2 \rightarrow 2NH_3 + Heat}$$

All combustion reactions are exothermic. Heat energy is liberated as the reaction proceeds.

The chemical reactions which proceed with the absorption of heat energy are called endothermic reactions.

$$\mathbf{2NH_3 + Heat \rightarrow N_2 + 3H_2}$$

Most of the combination reactions are endothermic. Most of the decomposition reactions are exothermic. Respiration is a decomposition reaction in which energy is released. When quick lime (calcium carbonate) is added to water, it decomposes and releases energy. Cooking involves chemical reactions which are endothermic as cooking is possible because of heating.

OXIDATION AND REDUCTION REACTION:

Oxidation: Addition of oxygen or non-metallic element or removal of hydrogen or metallic element from a compound is known as oxidation.
Elements or compounds in which oxygen or non-metallic element is added or hydrogen or metallic element is removed are called to be oxidized.
Oxidizing agent: Compounds which can add oxygen or a non-metallic compound or remove hydrogen or metallic element are known as oxidizing agents.

Reduction: Addition of hydrogen or metallic element or removal of oxygen or non-metallic element from a compound is called reduction. The compound or element which goes under reduction is called to be reduced.
Reducing agent: Compounds or elements which can cause reduction are called reducing agents.
In a chemical reaction oxidation and reduction both take place simultaneously and such reactions are also known as REDOX REACTIONS. In the word REDOX, 'Red' stands for reduction and 'Ox' stands for oxidation.

Example: When iron reacts with air, it forms iron oxide (rust)

$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

In this reaction, oxygen is added to iron, thus, iron is oxidized. Here oxygen is oxidizing agent.
When cupric oxide reacts with hydrogen, it gives copper and water.

$$CuO + H_2 \rightarrow Cu + H_2O$$

In this reaction, oxygen is removed from copper and oxygen is added to hydrogen. So, cupric oxide is reduced to copper and hydrogen is oxidized to water. Cupric oxide is oxidizing agent and hydrogen is reducing agent.
When sodium hydroxide reacts with hydrochloric acid, it gives sodium chloride and water.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

In this reaction, sodium hydroxide is reduced to sodium chloride since hydrogen is removed from sodium hydroxide. Hydrochloric acid is oxidized to water, since oxygen is added to hydrogen chloride and non-metallic element chloride is removed. Sodium hydroxide is oxidising agent and hydrochloric acid is reducing agent.

In this reaction oxidation and reduction both takes place simultaneously, thus it is an example of redox reaction.

SIGNIFICANCE OF OXIDATION REDUCTION IN EVERYDAY LIFE:

- Respiration is oxidation reaction in which food is oxidized to produce energy.
- Iron gets oxidized to form rust; which leads to corrosion of iron in the long run.
- Most of the metals react with atmospheric oxygen and it leads to formation of a layer on the metal article. The metal gets corroded in the long run.
- Rusting of iron can be prevented by painting the iron article. This can also be prevented by applying a layer of zinc over iron article. This process is known as galvanization.
- Fried food gets oxidized when exposed to air. This spoils the taste of the food and the food becomes unfit for consumption. The spoiling of fried food because of oxidation is called rancidity. Fried food is often packed in airtight packets to prevent rancidity.

- We are able to utilize various types of fuel because of oxidation. Oxidation of fuel helps in producing energy.

CORROSION

Corrosion is defined as the slow and steady destruction of a metal by the environment. It results in the deterioration of the metal to form metal compounds by means of chemical reactions with the environment.

Corrosion is a simple electro chemical reaction. When the surface of iron is in contact with moisture and other gases in the atmosphere an electrochemical reaction occurs. In this, impure iron surface acts as the cathode and pure iron acts as anode. H_2CO_3 formed from moisture and CO_2 from air acts as electrolyte.
The electrochemical reactions are as follows:

$$Fe \rightarrow Fe^{2+} + 2e^-$$

$$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$$

The Fe^{2+} ions are oxidised to Fe^{3+} ions.
The Fe^{3+} ions combine with OH^- ions to form $Fe(OH)_3$.This becomes rust ($Fe_2O_3.xH_2O$) which is hydrated ferric oxide.

METHODS OF PREVENTING CORROSION

Corrosion of metals is prevented by not allowing them to come in contact with moisture,CO2 and O2.This is achieved by the following methods:

- **By coating with paints:** Paint coated metal surfaces keep out air and moisture.
- **By coating with oil and grease:** Application of oil and grease on the surface of iron tools prevents them from moisture and air.
- **By alloying with other metals:** Alloyed metal is more resistant to corrosion.
- **Example:** stainless steel.
- **By the process of galvanization:** This is a process of coating zinc on iron sheets by using electric current. In this zinc forms a protective layer of zinc carbonate on the surface of iron. This prevents corrosion.
- **Electroplating:** It is a method of coating one metal with another by passing electric current. Example: silver plating, nickel plating. This method not only lends protection but also enhances the metallic appearance.
- **Sacrificial protection:** Magnesium is more reactive than iron. When it is coated on the articles made of steel it sacrifices itself to protect the steel.

RANCIDITY

When fats and oils are oxidised, they become rancid and their smell and taste change. Rancidity is the chemical decomposition of fats, oils and other lipids.

There are three basic types of rancidity.

- ❖ Hydrolytic rancidity occurs when water splits fatty acid chains away from the glycerol backbone in glycerides.
- ❖ Oxidative rancidity occurs when the double bonds of an unsaturated fatty acid react chemically with oxygen.
- ❖ Microbial rancidity refers to a process in which microorganisms such as bacteria use their enzymes, including lipases, to break down chemical structures in the fat.

In each case, these chemical reactions result in undesirable odors and flavors. it is a condition produced by aerial oxidation of unsaturated fat present in foods and other products, marked by unpleasant odour or flavour.

When a fatty substance is exposed to air, its unsaturated components are converted into hydroperoxides, which break down into volatile aldehydes, esters, alcohols, ketones, and hydrocarbons, some of which have disagreeable odours.

Butter becomes rancid by the foregoing process and by hydrolysis, which liberates volatile and malodorous acids, particularly butyric acid. Saturated fats such as beef tallow are resistant to oxidation and seldom become rancid at ordinary temperatures.

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.

Rancidity can be avoided by:
1. Storing food in air tight containers
2. Storing food in refrigerators
3. Adding antioxidants
4. Storing food in an environment of nitrogen

INTEXT QUESTIONS PAGE NO. 13

Question 1: Why does the colour of copper sulphate solution change when an iron nail is dipped in it?

Answer : When an iron nail is placed in a copper sulphate solution, iron displaces copper from copper sulphate solution forming iron sulphate, which is green in colour.

$$Fe_{(s)} + CuSO_{4(aq)} \longrightarrow FeSO_{4(aq)} + Cu_{(s)}$$

Iron	Copper sulphate (Blue colour)	Iron sulphate (Green colour)	Copper

Therefore, the blue colour of copper sulphate solution fades and green colour appears.

Question 2: Give an example of a double displacement reaction other than the one given in Activity 1.10.

Answer : Sodium carbonate reacts with calcium chloride to form calcium carbonate and sodium chloride.

$$Na_2CO_{3(aq)} + CaCl_{2(aq)} \longrightarrow CaCO_{3(s)} + 2NaCl_{(aq)}$$

Sodium carbonate	Calcium chloride	Calcium carbonate	Sodium chloride

In this reaction, sodium carbonate and calcium chloride exchange ions to form two new compounds. Hence, it is a double displacement reaction.

Question 3: Identify the substances that are oxidised and the substances that are reduced in the following reactions.

$$4Na_{(s)} + O_{2(g)} \longrightarrow 2Na_2O_{(s)}$$

$$CuO_{(s)} + H_{2(g)} \longrightarrow Cu_{(s)} + H_2O_{(l)}$$

Answer : (i) Sodium (Na) is oxidised as it gains oxygen and oxygen gets reduced.

(ii) Copper oxide (CuO) is reduced to copper (Cu) while hydrogen (H_2) gets oxidised to water (H_2O).

EXERCISE QUESTIONS PAGE NO. 14, 15 and 16

Question 1: Which of the statements about the reaction below are incorrect?

$$2PbO_{(s)} + C_{(s)} \longrightarrow 2Pb_{(s)} + CO_{2(g)}$$

(a) Lead is getting reduced.
(b) Carbon dioxide is getting oxidised.
(c) Carbon is getting oxidised.
(d) Lead oxide is getting reduced.
(i) (a) and (b)
(ii) (a) and (c)
(iii) (a), (b) and (c)
(iv) all
Answer : (i)(a) and (b)

Question 2:

$$Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$$

The above reaction is an example of a
(a) combination reaction.
(b) double displacement reaction.
(c) decomposition reaction.
(d) displacement reaction.
Answer : (d) The given reaction is an example of a displacement reaction.

Question 3: What happens when dilute hydrochloric acid is added to iron filings? Tick the correct answer.
(a) Hydrogen gas and iron chloride are produced.
(b) Chlorine gas and iron hydroxide are produced.
(c) No reaction takes place.
(d) Iron salt and water are produced.
Answer : (a) Hydrogen gas and iron chloride are produced. The reaction is as follows:

$$Fe_{(s)} + 2HCl_{(aq)} \longrightarrow FeCl_{2(aq)} + H_2 \uparrow$$

Question 4: What is a balanced chemical equation? Why should chemical equations be balanced?
Answer : A reaction which has an equal number of atoms of all the elements on both sides of the chemical equation is called a balanced chemical equation.
The law of conservation of mass states that mass can neither be created nor destroyed. Hence, in a chemical reaction, the total mass of reactants should be equal to the total mass of the products. It means that the total number of atoms of each element should be equal on both sides of a chemical equation. Hence, it is for this reason that chemical equations should be balanced.

Question 5: Translate the following statements into chemical equations and then balance them.
(a) Hydrogen gas combines with nitrogen to form ammonia.
(b) Hydrogen sulphide gas burns in air to give water and sulphur dioxide.
(c) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.
(d) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

Answer :

(a) $3H_{2(g)} + N_{2(g)} \longrightarrow 2NH_{3(g)}$

(b) $2H_2S_{(g)} + 3O_{2(g)} \longrightarrow 2H_2O_{(l)} + 2SO_{2(g)}$

(c) $3BaCl_{2(aq)} + Al_2(SO_4)_{3(aq)} \longrightarrow 2AlCl_{3(aq)} + 3BaSO_{4(s)}$

(d) $2K_{(s)} + 2H_2O_{(l)} \longrightarrow 2KOH_{(aq)} + H_{2(g)}$

Question 6: Balance the following chemical equations.

(a) $HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + H_2O$

(b) $NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

(c) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(d) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + HCl$

Answer :

(a) $2HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + 2H_2O$

(b) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

(c) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(d) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$

Question 7: Write the balanced chemical equations for the following reactions.
(a) Calcium hydroxide + Carbon dioxide → Calcium carbonate + Water
(b) Zinc + Silver nitrate → Zinc nitrate + Silver
(c) Aluminium + Copper chloride → Aluminium chloride + Copper
(d) Barium chloride + Potassium sulphate → Barium sulphate + Potassium chloride
Answer :

(a) $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

(b) $Zn + 2AgNO_3 \longrightarrow Zn(NO_3)_2 + 2Ag$

(c) $2Al + 3CuCl_2 \longrightarrow 2AlCl_3 + 3Cu$

(d) $BaCl_2 + K_2SO_4 \longrightarrow BaSO_4 + 2KCl$

Question 8: Write the balanced chemical equation for the following and identify the type of reaction in each case.
(a)Potassium bromide (aq) + Barium iodide (aq) → Potassium iodide (aq) + Barium bromide(s)
(b) Zinc carbonate (s) → Zinc oxide (s) + Carbon dioxide (g)
(c) Hydrogen (g) + Chlorine (g) → Hydrogen chloride (g)
(d) Magnesium (s) + Hydrochloric acid (aq) → Magnesium chloride (aq) + Hydrogen (g)
Answer :

(a) $2KBr_{(aq)} + BaI_{2(aq)} \longrightarrow 2KI_{(aq)} + BaBr_{2(s)}$; Double displacement reaction

(b) $ZnCO_{3(s)} \longrightarrow ZnO_{(s)} + CO_{2(g)}$; Decomposition reaction

(c) $H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$; Combination reaction

(d) $Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$; Displacement reaction

Question 9: What does one mean by exothermic and endothermic reactions? Give examples.

Answer : Chemical reactions that release energy in the form of heat, light, or sound are called exothermic reactions.

Example: Mixture of sodium and chlorine to yield table salt

$$Na_{(s)} + \frac{1}{2} Cl_{2(s)} \longrightarrow NaCl_{(s)} + 411 \text{ kJ of energy}$$

In other words, combination reactions are exothermic.

Reactions that absorb energy or require energy in order to proceed are called endothermic reactions.

For example: In the process of photosynthesis, plants use the energy from the sun to convert carbon dioxide and water to glucose and oxygen.

$$6CO_{2(g)} + 6H_2O_{(l)} \xrightarrow{\text{Sunlight}} \underset{\text{Glucose}}{C_6H_{12}O_{6(aq)}} + 6O_{2(g)}$$

Question 10: Why is respiration considered an exothermic reaction? Explain.

Answer : Energy is required to support life. Energy in our body is obtained from the food we eat. During digestion, large molecules of food are broken down into simpler substances such as glucose. Glucose combines with oxygen in the cells and provides energy. The special name of this combustion reaction is respiration. Since energy is released in the whole process, it is an exothermic process.

$$\underset{\text{Glucose}}{C_6H_{12}O_{6(aq)}} + \underset{\text{Oxygen}}{6O_{2(g)}} \longrightarrow \underset{\text{Carbon dioxide}}{6CO_{2(g)}} + \underset{\text{Water}}{6H_2O_{(l)}} + \text{Energy}$$

Question 11: Why are decomposition reactions called the opposite of combination reactions? Write equations for these reactions.

Answer : Decomposition reactions are those in which a compound breaks down to form two or more substances. These reactions require a source of energy to proceed. Thus, they are the exact opposite of combination reactions in which two or more substances combine to give a new substance with the release of energy.

Decomposition reaction: $AB + \text{Energy} \longrightarrow A + B$

$$2H_2O_{(l)} \xrightarrow{\text{Electrolysis}} 2H_{2(g)} + O_{2(g)}$$

Combination reaction: $A + B \longrightarrow AB + \text{Energy}$

$$2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(l)} + \text{Energy}$$

Question 12: Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.

Answer : (a) Thermal decomposition:

$$\underset{\text{Ferrous sulphate}}{2FeSO_{4(s)}} \xrightarrow{\Delta} \underset{\text{Ferric oxide}}{Fe_2O_{3(s)}} + \underset{\text{Sulphur dioxide}}{SO_{2(g)}} + \underset{\text{Sulphur trioxide}}{SO_{3(g)}}$$

(b) Decomposition by light:

$$\underset{\text{Silver chloride}}{2AgCl_{(s)}} \xrightarrow{\text{Light}} \underset{\text{Silver}}{2Ag_{(s)}} + \underset{\text{Chlorine}}{Cl_{2(g)}}$$

(c) Decomposition by electricity:

$$2Al_2O_{3(aq)} \xrightarrow{\text{Electricity}} 4Al_{(s)} + 3O_{2(g)}$$

Aluminium oxide — Aluminium — Oxygen

Question 13: What is the difference between displacement and double displacement reactions? Write equations for these reactions.

Answer : In a displacement reaction, a more reactive element replaces a less reactive element from a compound.

$$A + BX \longrightarrow AX + B;$$

where A is more reactive than B

In a double displacement reaction, two atoms or a group of atoms switch places to form new compounds.

$$AB + CD \longrightarrow AD + CB$$

For example:

Displacement reaction:

$$CuSO_{4(aq)} + Zn_{(s)} \longrightarrow ZnSO_{4(aq)} + Cu_{(s)}$$

Double displacement reaction:

$$Na_2SO_{4(aq)} + BaCl_{2(aq)} \longrightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$$

Question 14: In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

Answer :

$$2AgNO_{3(aq)} + Cu_{(s)} \longrightarrow Cu(NO_3)_{2(aq)} + 2Ag_{(s)}$$

Silver nitrate — Copper — Copper nitrate — Silver

Question 15: What do you mean by a precipitation reaction? Explain by giving examples.

Answer : A reaction in which an insoluble solid (called precipitate) is formed is called a precipitation reaction.

For example:

$$Na_2CO_{3(aq)} + CaCl_{2(aq)} \longrightarrow CaCO_{3(s)} + 2NaCl_{(aq)}$$

Sodium carbonate — Calcium chloride — Calcium carbonate — Sodium chloride

In this reaction, calcium carbonate is obtained as a precipitate. Hence, it is a precipitation reaction.

Another example of precipitation reaction is:

$$Na_2SO_{4(aq)} + BaCl_{2(aq)} \longrightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$$

Sodium sulphate — Barium chloride — Barium sulphate — Sodium chloride

In this reaction, barium sulphate is obtained as a precipitate.

Question 16: Explain the following in terms of gain or loss of oxygen with two examples each. (a) Oxidation (b) Reduction

Answer : (a) Oxidation is the gain of oxygen.

For example:

(i) $CO_2 + \underbrace{H_2}_{\text{Addition of oxgyen - oxidation}} \longrightarrow CO + H_2O$

(ii) $\underbrace{2Cu + O_2}_{\text{Gain of oxgyen - oxidation}} \longrightarrow 2CuO$

In equation (i), H_2 is oxidized to H_2O and in equation (ii), Cu is oxidised to CuO.
(b) Reduction is the loss of oxygen.
For example:

(i) $\underbrace{CO_2 + H_2 \longrightarrow CO}_{\text{Removal of oxgyen – reduction}} + H_2O$

(ii) $\underbrace{CuO + H_2 \xrightarrow{\Delta} Cu}_{\text{Loss of oxgyen – reduction}} + H_2O$

In equation (i), CO_2 is reduced to CO and in equation (ii), CuO is reduced to Cu.

Question 17: A shiny brown-coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.
Answer : 'X' is copper (Cu) and the black-coloured compound formed is copper oxide (CuO). The equation of the reaction involved on heating copper is given below.

$$\underset{\text{(Shiny brown in colour)}}{2Cu} + O_2 \xrightarrow{\text{Heat}} \underset{\text{(Black in colour)}}{2CuO}$$

Question 18: Why do we apply paint on iron articles?
Answer : Iron articles are painted because it prevents them from rusting. When painted, the contact of iron articles from moisture and air is cut off. Hence, rusting is prevented. So presence of air and moisture is essential for rusting to take place.

Question 19: Oil and fat containing food items are flushed with nitrogen. Why?
Answer : Nitrogen is an inert gas and does not easily react with these substances. On the other hand, oxygen reacts with food substances and makes them rancid. Thus, bags used in packing food items are flushed with nitrogen gas to remove oxygen inside the pack. When oxygen is not present inside the pack, rancidity of oil and fat containing food items is avoided.

Question 20: Explain the following terms with one example each.
(a) Corrosion (b) Rancidity
Answer :
(a) Corrosion:
Corrosion is defined as a process where materials, usually metals, deteriorate as a result of a chemical reaction with air, moisture, chemicals, etc.
For example, iron, in the presence of moisture, reacts with oxygen to form hydrated iron oxide.

$$4Fe + 3O_2 + nH_2O \longrightarrow \underset{\text{Hydrated iron oxide}}{2Fe_2O_3.nH_2O}$$

This hydrated iron oxide is rust.

(b) Rancidity:
The process of oxidation of fats and oils that can be easily noticed by the change in taste and smell is known as rancidity.
For example, the taste and smell of butter changes when kept for long.
Rancidity can be avoided by:
1. Storing food in air tight containers
2. Storing food in refrigerators
3. Adding antioxidants
4. Storing food in an environment of nitrogen