

CHAPTER

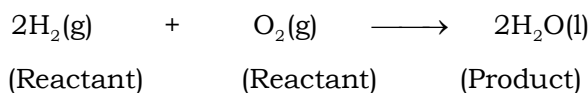
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CHEMICAL REACTIONS AND EQUATIONS

- **Chemical Reactions** : The process in which a substance or substances undergo change, to produce new substances with new properties, is known as Chemical Reaction. During a chemical reaction, there is breaking of bonds between atoms of the reacting molecules to give products.
- **Physical Change** : If a change involves change in colour or state but no new substance is formed, then it is a Physical Change.
- **Chemical Change** : If a change involves formation of new substances, it is a Chemical Change.
- A chemical reaction can be observed with the help of any of the following observations :

- | | |
|--------------------------------|---------------------------|
| (a) Evolution of a gas | (b) Change in temperature |
| (c) Formation of a precipitate | (d) Change in colour |
| (e) Change of state | |

- **Chemical Equation** : The symbolic representation of a chemical reaction is called a Chemical Equation.
- **Reactants** : The substances which take part in a chemical reaction are called Reactants.
- **Products** : The new substances formed as a result of chemical reaction are called Products.

For example

- **Skeletal Chemical Equation** : A chemical equation which simply represents the symbols and formulae of reactants and products taking part in the reaction is known as Skeletal Chemical Equation for reaction.
- **Balanced Chemical Equations** : Chemical equations in which the number of atoms of different elements are same on both side are called balanced chemical equations. These equations follow law of conservation of mass.
- **Law of Conservation of Mass** : It states that the total mass of the elements present in the products of a chemical reaction has to be equal to the total mass of the elements present in the reactants.

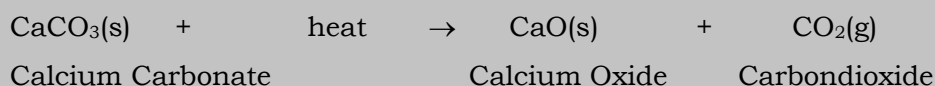
- **Types of Chemical Reactions** :

Combination reactions,
Decomposition reactions,
Displacement reactions,
Double displacement reactions,
Precipitation reactions,
Redox reactions.

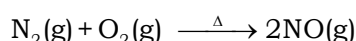
- **Combination Reactions** : In these type of reactions two or more substances combine to form another substance. These reactions are exothermic reactions.
- **Exothermic Reactions** : If heat is evolved during a reaction, then such a reaction is known as **Exothermic Reaction**.
- **Decomposition Reactions** : Reactions in which a compound breaks up into simple substances are decomposition reactions.
 - (i) Thermolysis or thermal decomposition reactions (decomposition by heat).
 - (ii) Electrolysis or electrolytic decomposition reactions (decomposition by electricity)
 - (iii) Photolysis or photodecomposition reactions (decomposition by light).

- **Endothermic Reaction** : In an Endothermic Reaction heat is taken from the surrounding and as a result the temperature decrease.

- An endothermic reaction is indicated by writing “+ heat” or “+ heat energy” or “+ energy” on the reactants side of an equation as shown below.




- Heat absorbed in a chemical reaction can also be represented by the symbol delta (Δ) as follows:



- **Displacement Reactions** : Reaction in which an atom or group of atoms in a molecule is replaced by another atom or group of atoms are displacement reactions.
 - The elements involved may be metals or non-metals. In displacement reactions more reactive metal may displace a less reactive metal or a more reactive non-metal may displace a less reactive non-metal from its compound.
 - From the following series the metals lying above the hydrogen are more reactive than the metals lying below the hydrogen. Thus any metal can displace the metals lying below it from its solution.

	Element	Symbol	
Metals More Reactive than Hydrogen	Potassium	K	← Most Reactive
	Sodium	Na	
	Barium	Ba	
	Calcium	Ca	
	Magnesium	Mg	
	Aluminium	Al	
	Zinc	Zn	
	Iron	Fe	
	Nickel	Ni	
	Tin	Sn	
Lead	Pb		
	Hydrogen	H	
Metals less Reactive than Hydrogen	Copper	Cu	
	Mercury	Hg	
	Silver	Ag	
	Gold	Au	
	Platinum	Pt	← Least Reactive



Activity series of metals

- **Double Displacement Reactions** : Reactions in which two compounds react to form two other compounds by mutual exchange of their ions are Double Displacement Reactions.
- **Precipitation Reactions** : The reaction that produces a precipitate can be called as Precipitation Reaction.
- **Oxidation** : Oxidation is a process which involves addition of oxygen or removal of hydrogen. According to electronic concept, oxidation is a process which involves loss of electrons.
- **Reduction** : Reduction is a process which involves addition of hydrogen or removal of oxygen. According to electronic concept, reduction is a process which involves gain of electrons.
- **Oxidizing Agent** : A substance which gives oxygen or removes hydrogen and causes oxidation of other substances. It is itself reduced in the process.
- **Reducing Agent** : A substance which gives hydrogen or removes oxygen and causes reduction of other substance. It is itself oxidized in the process.
- **Corrosion** : The slow process of eating up of metals due to attack of atmospheric gases such as oxygen, carbon dioxide, hydrogen sulphide, water vapour etc. on the surface of the metals so as to convert the metal into oxide, carbonate, sulphide etc. is known as Corrosion.
- **Rusting** : Rusting involves unwanted oxidation of iron metal which occurs in nature on its own.
- **Rancidity** : When fats and oils in food are oxidized, their smell and taste changes and they become *rancid*. This phenomenon is called *rancidity*.



SOLVED EXAMPLE**Example 1:**

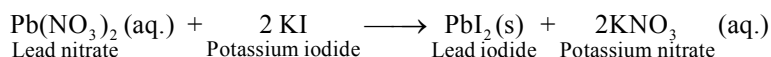
Why should a magnesium ribbon be cleaned before burning in air?

Solution:

A magnesium ribbon is cleaned by rubbing with a paper to remove the protective layer basic magnesium carbonate so that it readily combines with air.

Example 2:

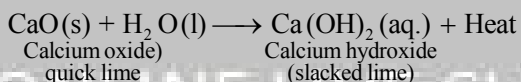
Write a balanced chemical equation of the reaction between lead nitrates and potassium iodide.

Solution.**Example 3:**

Name the substance 'A' used for white wash. What happens when 'A' is mixed with water. Give chemical equations. What is the action of air on freshly white washed wall? Give chemical equation.

Solution.

The substance 'A' used for white wash is calcium oxide also known as quick lime (CaO). When it reacts with water it forms slacked lime or calcium hydroxide.



Slacked lime is coated on the walls during white washing. It reacts with CO₂ of the air over the next 2-3 days and forms a shiny covering of calcium carbonate.

**Example 4:**

Balance the equation, $\text{Mg} + \text{H}_2\text{O} \longrightarrow \text{Mg(OH)}_2 + \text{H}_2$

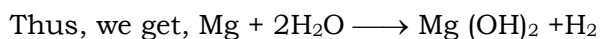
Solution.

(i) Count each type of atom.

Element	Left side	Right side
Mg	1	1
O	1	2
H	2	4

H and O are unbalanced.

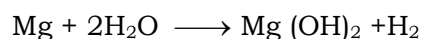
(ii) Let us start with Mg (OH)₂. In order to balance O, 2 is set just before H₂O.



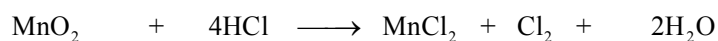
(iii) Let us now check if the numbers of atoms on both sides are equal.

Element	Left side	Right side
Mg	1	1
O	2	2
H	4	4

The equation is now balanced, as we can see the balanced equation is

**Example 5:**

Give an example of redox reaction. Mention the substance oxidized, substance reduced, oxidizing agent and reducing agent.

Solution.

Substance Oxidized - Hydrochloric acid

Substance Reduced - Manganese oxide

Oxidizing Agent - Manganese oxide

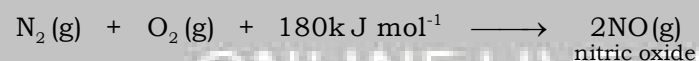
Reducing Agent - Hydrochloric acid

Example 6:

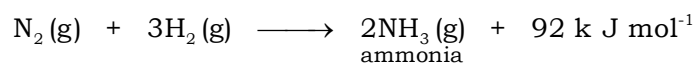
What are Endothermic and Exothermic reactions. Give one example of each.

Solution.

Endothermic reactions are those in which heat is absorbed by the reactants to form the products



Exothermic reactions are those in which heat is liberated when the reactants form the products.



EXERCISE**LEVEL-I**

1. Why do we paint iron articles ?
2. What are antioxidants? Give one example.
3. Write the chemical equation and name the reaction when a solution of sodium chloride is mixed with silver nitrate and white ppt. of silver chloride is formed.
4. Explain why respiration is considered as an Exothermic Reaction ?
5. What does the arrow pointing downwards (\downarrow) along with a product represents and the arrow pointing upwards (\uparrow) represent ?
6. What is the solution of a substance in water called and what is the symbol used to represent it ?
7. Name the gas which burns with a pop sound.
8. Why are bags of fat and oil containing food items (like chips) flushed with nitrogen?
9. Can silver nitrate (AgNO_3) solution be stored in an iron container? Explain your answer.
10. Why does the colour of copper sulphate solution fade when an iron nail is dipped in it? Explain with the help of an equation.
11. What do you mean by a precipitation reaction? Explain by giving example.
12. What do you mean by Exothermic and Endothermic reaction? Give examples:
13. Write the four changes which help us to determine whether a chemical reaction has taken place.
14. What happens when calcium oxide reacts with water? Write the chemical equation of reaction involved.
15. Write the balanced equation for silver chloride kept in sunlight.

LEVEL-II

1. Balance the following chemical equations:
 - (i) $\text{HNO}_3 + \text{Ca}(\text{OH})_2 \longrightarrow \text{Ca}(\text{NO}_3)_2 + \text{H}_2\text{O}$
 - (ii) $\text{NaOH} + \text{H}_2\text{SO}_4 \longrightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$
 - (iii) $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \longrightarrow \text{BaSO}_4 + \text{HCl}$
2. Write the balanced chemical equation of the following and identify the type of reaction in each case:

- (i) Potassium bromide (aq) + Barium iodide (aq) → Potassium iodide(aq) + Barium bromide(s)
- (ii) Zinc carbonate (s) → Zinc oxide (s) + Carbon dioxide (g)
- (iii) Magnesium (s) + Hydrochloric acid (aq) → Magnesium chloride (aq) + Hydrogen(g)
- 3.** Give an example each for the following type of double displacement reactions :
- when a precipitate is formed
 - when a change in colour is observed
 - when a gas is formed
- 4.** Water is added slowly to the calcium oxide or quick lime. Answer the following :
- Is there any change in temperature?
 - Identify the type of reaction involved in it and also write the chemical equation.
- 5.** Identify the type of chemical reaction taking place when the following substances are made to react. Also write the balanced chemical equation for the reaction involved.
- Calcium oxide is made to react with water.
 - Solution of barium chloride and sodium sulphate are mixed together.
 - Lead nitrate is heated strongly in a dry test tube.
- 6.** When a green iron salt is heated strongly, its colour finally changes to brown and odour of burning sulphur is given out. Answer the following :
- Name the iron salt and write its formula.
 - Name the brown substance obtained and write its formula.
 - Which product gives the odour of burning sulphur? Write its formula.
 - Write the chemical equation of the reaction involved.
 - Name the type of chemical reaction which takes place during the heating of iron salt.
- 7.(a)** What are Redox reaction ? Give its two examples.
- (b)** Make chemical equations and then balance the following :
- Hydrogen sulphide gas burns in air to give water and sulphur dioxide.
 - Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.
- 8.(a)** Write the balanced equation for the following chemical reactions:
- Hydrogen + Chlorine → Hydrogen Chloride

- (ii) Barium chloride + Aluminium sulphate \longrightarrow Barium sulphate + Aluminium chloride
- (iii) Sodium + Water \longrightarrow Sodium hydroxide + Hydrogen gas
- (b) A solution of a substance X is used for white-washing. Answer the following :
- (i) Name the substance X and write its formula.
- (ii) Write the reaction of the substance 'X' named in (i) above with water.
9. Make chemical equations and balance them :
- (i) Sodium chloride reacts with silver nitrate to give sodium nitrate and a precipitate of silver chloride.
- (ii) Hydrogen gas combines with nitrogen to form ammonia.
- (iii) Zinc carbonate decomposes to give zinc oxide and carbon dioxide.
- (iv) Ammonia gas reacts with water to give ammonium hydroxide.
- (v) Copper (II) oxide on heating with hydrogen gas gives copper and water
10. Hydrogen peroxide decomposes into water and oxygen in the presence of light. Name the reaction? Give balanced chemical equation for the process.

LEVEL-III

1. Can rusting of iron takes place in distilled water ?
2. A water insoluble substance 'x' on reacting with dil. H_2SO_4 released a colourless and odourless gas accompanied by brisk effervescence. When the gas is passed through water, the solution obtained turn blue litmus red. On bubbling the gas through lime water, it initially became milky and the milkiness disappeared when the gas was passed in excess. Identify the substance 'x' and write the chemical equations of the reaction involved.
3. During electrolysis of water gas collected in one test tube is double than other. Why?
4. An old cycle frame was left in open for a few days. A brown layer got slowly deposited on its surface and could not be removed when rubbed with sand paper. What actually happened?
5. When SO_3 is dissolved in water, acid rain containing sulphuric acid is formed. The acid rain attacks marble statue and damages them. Write the balanced chemical equations for these.
6. If you collect silver coins and copper coins after some days a black coating on silver coins and a green coating can be seen on copper coins. Which chemical phenomenon is responsible for these coatings. Write the chemical name of black and green coatings.

7. Nancy loves to eat chips, burgers and chocolates. Her parents always discourages her to eat junk food. Answer the following questions based on the above situation :
- Why do you think Nancy's parents do not let her eat junk food?
 - What values are they promoting?
 - How can children be persuaded to eat healthy food?
8. Daisy saw her mother preparing curd at home from milk and she was surprised to know from her mother that we cannot get back the milk from the curd.
- In your opinion why we cannot get back milk from curd?
 - What other changes in nature can be classified under the same?
9. A number of oxidation reactions are taking place within us as well as around us. Some of these are essential while others cause a lot of damage, e.g., oxidation of glucose in our body is an essential reaction as it gives us energy for day to day work whereas corrosion and rancidity are harmful and do a lot of damage. Answer the following :
- Copper vessels get a green coating which is poisonous. If all copper vessels have to be used, what should be done to make them safe for use?
 - Silver articles get tarnished. What do you think should be done to protect them from tarnishing and what should be done to regain the shine?
10. Often preservatives are added to certain food items so that they can stay consumable for a longer time but these preservatives are chemicals which may be harmful. What alternatives do you suggest/ what method of preservation of food items should be followed at home?

MULTIPLE CHOICE QUESTIONS

1. In the balanced equation: $a\text{Fe}_2\text{O}_3 + b\text{H}_2 \longrightarrow c\text{Fe} + d\text{H}_2\text{O}$
The values of a, b, c, d are respectively
- 1, 1, 2, 3
 - 1, 1, 1, 1
 - 1, 3, 2, 3
 - 1, 2, 2, 3
2. Which of the following reactions is not balanced?
- $2\text{NaHCO}_3 \longrightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$
 - $2\text{C}_4\text{H}_{10} + 12\text{O}_2 \longrightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}$
 - $2\text{Al} + 6\text{H}_2\text{O} \longrightarrow 2\text{Al}(\text{OH})_3 + 3\text{H}_2$
 - $4\text{NH}_3 + 5\text{O}_2 \longrightarrow 4\text{NO} + 6\text{H}_2\text{O}$
3. Neutralization reaction is an example of :

- (a) Exothermic reaction (b) Endothermic reaction
(c) Oxidation (d) None of these
4. Which of the following statements is/are true?
(a) The total mass of the substance remains same in a chemical change.
(b) A chemical change is permanent and irreversible.
(c) A physical change is temporary and reversible.
(d) All of these.
5. When dilute hydrochloric acid is added to iron fillings
(a) hydrogen gas and ferric chloride are produced.
(b) chlorine gas and ferric hydroxide are produced.
(c) no reaction takes place.
(d) iron salt and water are produced.
6. A redox reaction is one in which
(a) both the reactants are reduced.
(b) both the reactants are oxidised.
(c) an acid is neutralised by the base.
(d) one substance is oxidised, while the other is reduced.
7. Which of the following equations represents combination of two elements?
(a) $\text{CaO} + \text{CO}_2 \longrightarrow \text{CaCO}_3$ (b) $4\text{Na} + \text{O}_2 \longrightarrow 2\text{Na}_2\text{O}$
(c) $\text{SO}_2 + \frac{1}{2}\text{O}_2 \longrightarrow \text{SO}_3$ (d) $2\text{Na} + 2\text{H}_2\text{O} \longrightarrow 2\text{NaOH} + \text{H}_2$
8. In the reaction $\text{CuO} + \text{C} \longrightarrow \text{Cu} + \text{CO}$
(a) CuO is oxidized
(b) C acts as oxidizing agent.
(c) C acts as a reducing agent.
(d) This reaction does not represent a redox reaction.
9. A brown mass of ferric chloride is formed on iron surface as a result of combination reaction between iron and chlorine, in this process
(a) Iron gets oxidized (b) Iron get reduced
(c) Iron gets oxidized as well reduced (d) It is not a redox process
10. Decomposition reaction is
(a) Mostly exothermic
(b) Mostly endothermic
(c) That reaction in which one substance get decomposed into simpler substances
(d) Both (b) and (c)



WORKSHEET-1

- Balance the following chemical equation.
 - $\text{KClO}_3 \rightarrow \text{KCl} + \text{O}_2$
 - $\text{Al} + \text{H}_2\text{SO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + \text{H}_2$
- Give the balanced chemical equations for the following reactions.
 - Calcium oxide + water \rightarrow Calcium hydroxide
 - Calcium hydroxide + carbon dioxide \rightarrow calcium carbonate + water
- Write the balanced chemical equation for the following.
 - Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.
 - Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.
- What is wrong with the following equation?
 $\text{Ca} + \text{O} \rightarrow \text{CaO}$, correct it and write in balanced form.
- Which characteristics of the chemical reaction are highlighted in the following reaction?
 - $\text{Pb}(\text{NO}_3)_2 (\text{aq}) + 2\text{KI} (\text{aq}) \longrightarrow \text{PbI}_2 (\text{s}) + 2\text{KNO}_3 (\text{aq})$
 - Citric acid + $\text{KMnO}_4 \longrightarrow$ Colourless solution
(Purple)
 - $2\text{Na} + \text{H}_2\text{O} \longrightarrow 2\text{NaOH} + \text{H}_2$
 - $\text{CaO} + \text{H}_2\text{O} \longrightarrow \text{Ca}(\text{OH})_2 + \text{Heat}$
- Write a balanced chemical equation and give symbols for the following reactions:
 - Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate.
 - Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.
- What type of reactions are represented by the following equation?
 - $\text{NH}_4\text{Cl} \rightarrow \text{NH}_3 + \text{HCl}$
 - $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
 - $\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$
 - $\text{Mg} + \text{CuSO}_4 \rightarrow \text{MgSO}_4 + \text{Cu}$

□□□□□

WORKSHEET-2

- A solution of potassium iodide is mixed with a solution of lead nitrate :
 - Name the compound precipitated.
 - What is the colour of the precipitate formed?
 - Write a balanced chemical equation for this reaction.
 - Name the type of reaction which takes place.
- What is the relationship between oxidation and oxidizing agent in a redox reaction. Explain with an equation. Write two examples of redox reactions taking place in day to day life with equations.
- Which element can displace other element from its salt solution?
 - In a solution of $\text{Pb}(\text{NO}_3)_2$, a strip of metal M was dipped. After some time lead from the solution was deposited on the strip. Which is more reactive Pb or M ?
- What happens when a strip of zinc is placed in copper sulphate solution? Write equation of the reaction involved. Name the type of chemical reaction which takes place.
- Explain the term 'rancidity' with an example. How can rancidity be prevented ?
- Write one equation each for Decomposition reactions where energy is supplied in the form of
 - heat
 - light
 - electricity
- What is meant by a double displacement reaction? Explain with the help of an example.
- What are redox reactions? Explain by giving two examples.
 - Can oxidation or reduction take place alone? Justify your answer.

