

CLASS X

SUBJECT CHEMISTRY

CHAPTER 1—CHEMICAL REACTIONS AND EQUATIONS

➤ **Physical Change: Change in physical properties.**

- Melting
- Boiling
- Condensation
- [Note- No change occurs in the identity of the substance].

➤ **Chemical Change:**

- Atoms in the reactants are rearranged to form one or more different substances.
- Old bonds are broken, new bonds are formed.
- Reactants lose their properties to form product of different properties.

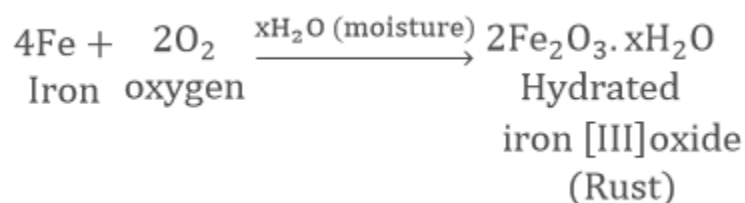
$4 \text{Fe(s)} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$ (rust). Iron Oxygen Ferric oxide

Chemical Reactions and Equations

Any process that involves the rearrangement of structure of the substance or conversion of reactants into products is defined as **Chemical Reaction**.

For a Chemical Reaction to occur, the change can be observed in the form of -

- **Change in State:** Melting of ice into water.
- **Change in Colour:** Iron rusting which has colour change from silver to reddish brown.



- **Change in Temperature:** There are two types of reaction i.e Exothermic and Endothermic Reaction.

Exothermic Reactions: Those reactions in which energy is released in the form of heat are called **Exothermic Reactions**.

Examples -

(1) All combustion reactions e.g.



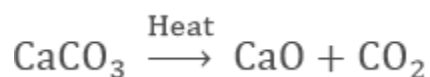
(2) Thermite reactions e.g.



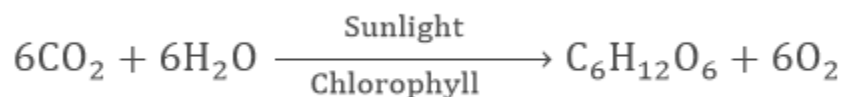
Combinations are generally exothermic in nature. The decomposition of organic matters into compost is an example of exothermic reaction.

Endothermic Reactions: Those reactions in which energy is absorbed are called **Endothermic Reactions**.

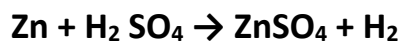
Examples -



also, the reaction of photosynthesis -



- **Evolution of any gas: When Zinc reacts with sulphuric acid it gives hydrogen gas.**



Formation of Precipitate: When a soluble carbonate reacts with Barium, Barium Carbonate precipitate can be observed.

Change in State

Some chemical reactions are characterized by a change in state.

- When wax is burned (in the form of wax candle,) then water and carbon dioxide are formed.

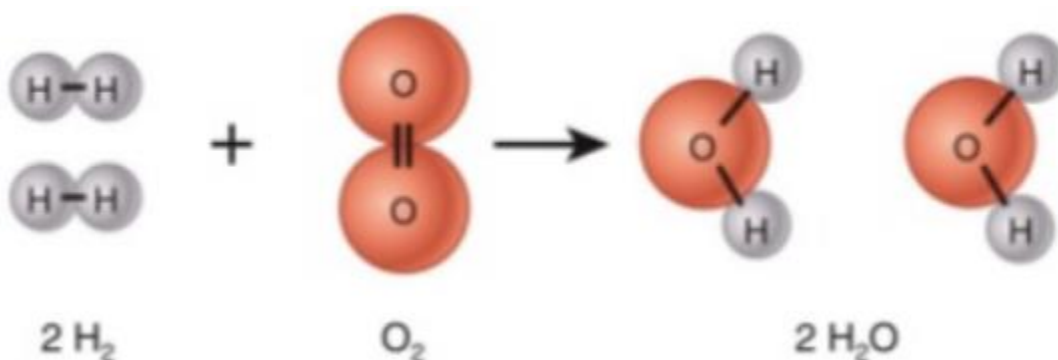
- Now, wax is a liquid whereas carbon dioxide is a gas. This means that during the combustion reaction of wax, the physical state changes from solid to liquid and gas.

Physical Change

- In this change identity of the substance remains same.
- For Example, Melting, Boiling etc.

Chemical Change

- The identity of the substances change
- Reactants are converted into substance due to formation or broken down of older bonds



Characteristics of Chemical reaction

1) Evolution of gas

Some chemical reactions are characterized by the evolution of gas.

For Ex:1) Reaction between zinc and dilute sulphuric acid to form hydrogen gas.

2) Reaction between sodium carbonate and dilute hydrochloric acid to form carbon dioxide gas.

2) Formation of precipitate

Some chemical reactions are characterized by the formation of precipitate.

For Ex:1)Reaction between Potassium iodide and lead nitrate to form yellow precipitate of lead iodide.

2)Reaction between sulphuric acid and barium chloride to form white precipitate of barium sulphate. 3)Change in colour

Some chemical reactions are characterised by change in colour

For Ex:1)When citric acid reacts with potassium permanganate (purple) then purple colour disappears

2)When sulphur dioxide gas reacts with acidified potassium dichromate,change in colour from orange to yellow is observed.

4) Change in temperature

Those reactions in which heat is produced or evolved are called exothermic reactions.

For Ex: Reaction between zinc granules with dilute sulphuric acid.

Those reactions in which heat is absorbed are called as endothermic reactions.

Reaction between barium hydroxide and ammonium chloride to form barium chloride, ammonia and water.

5) Change of state

Some chemical reactions are characterized by change in state.

For Ex: when wax(solid) is burned ,then water(liquid) and carbon dioxide(gas) are formed.

Chemical Equation

The symbolic representation of chemical reaction using symbols and formulae is known as **Chemical Equation**. For this, reactants are written in left hand side whereas products are written on the right.

Balanced Chemical Equation

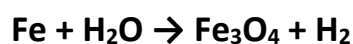
A balanced chemical equation is the one where the number of atoms involved in reactants side is equal to number of atoms on product side.



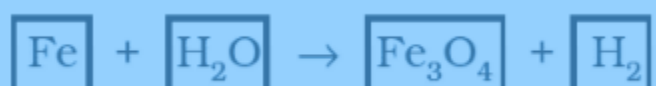
Eq.1. Example of Balanced Chemical Equation

Steps to form Balanced Equation

To show how to balance the equation, the following equation is used-



Step 1: First of all, draw the boxes around each formula as shown below-



Step 2: Find out the number of atoms of each element. **For Example**, on reactant side, 1 for Fe, 2 H, and 1 O and on product side we have, 3 for Fe, 4 for O and 2 for H.

Step 3: Start to balance the equation with the compound having maximum number of atoms. While balancing does not alter the formula of the compound.

Step 4: One by one balance each element on reactant and product side.



Step 5: After balancing number of atoms on both the side of the equation, finally check the correctness of the balanced equation.



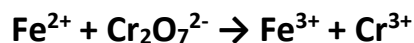
Step 6: then write the symbols of the physical state of reactants and products as shown below-



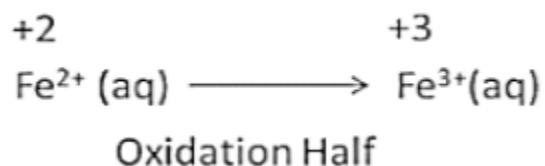
This above equation represents the balanced equation.

Balancing a Redox Reaction

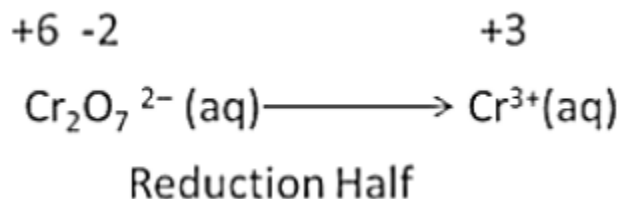
The basic ionic form of the equation is-



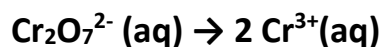
Oxidation half reaction is-



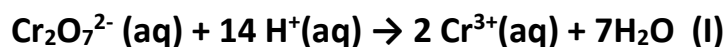
Reduction half reaction is-



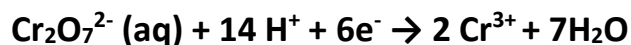
Use the reduction half method to balance the equation. Balance the atoms in each half of the reaction except H and O atoms.



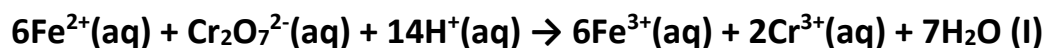
Add water molecules as the reaction is taking place in acidic solution. This is to balance the O atoms and hydrogen ions.



Then balance the charges in both half reactions.

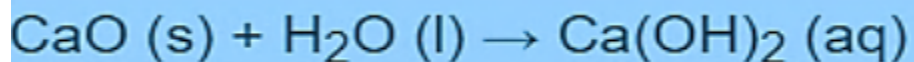


Two half of the equations are added to get the overall reaction



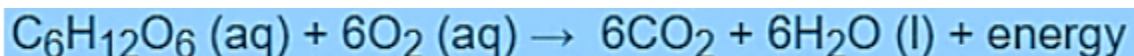
Types of Chemical Reaction

- **Combination Reaction** is reaction when single product is formed from the combination of two or more reactants. **For Example-**



Eq.2. Example of Combination Reaction

Reactions can be exothermic as well as endothermic. Exothermic reaction release heats and raises the temperature of the surroundings. **For Example**, Respiration is an example of exothermic reaction.



Eq.3. Example of Exothermic Reaction

Endothermic reaction involved the absorption of the heat and thus it cools the surrounding. The decomposition of dead organic material is an endothermic reaction.

- **Decomposition Reaction** is type of reaction which involves breakdown of single reactant into simpler products. Decomposition of silver chloride into silver and chlorine in presence of sunlight is an example of decomposition reaction.



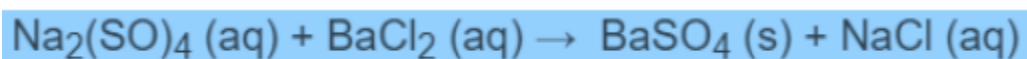
Eq.4. Example of Decomposition Reaction

- **Displacement Reaction** is a reaction in which more reactive element will displace the less reactive element.



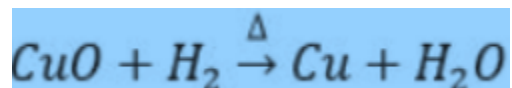
Eq. 5. Example of Displacement Reaction

- **Double Displacement Reaction** is a type of reaction in which cations and anions in the reactants switch the places to form new products.



Eq. 6. Example of Double Displacement Reaction

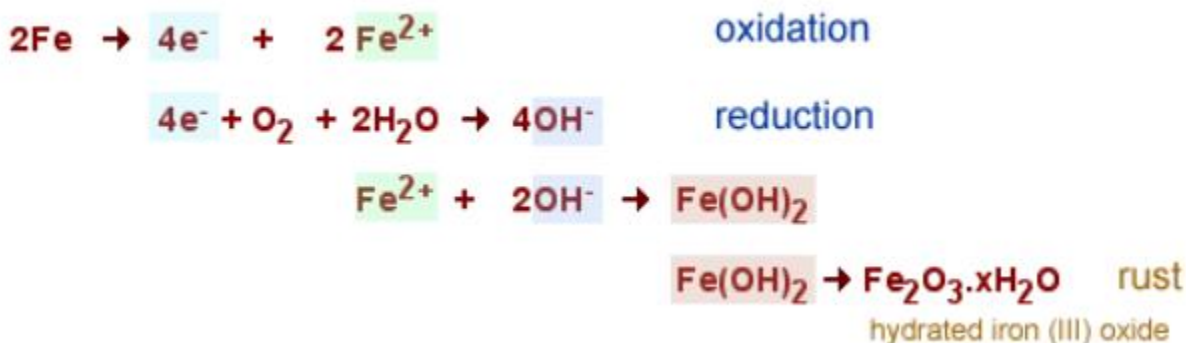
- **Redox Reaction** is also known as **Oxidation-reduction Reaction**. In this type of reaction transfer of electrons occurs between the two species. Oxidation is defined as addition of oxygen or removal of hydrogen. Reduction is defined as removal of oxygen or addition of hydrogen. Oxidizing agent is the one which gains the electrons and is reduced in a chemical reaction. Reducing agent is oxidized in a chemical reaction and it loses the electrons. Fluorine is the strongest oxidizing agent. Formic acid is a reducing agent



Eq.7. Example of Redox Reaction

Corrosion

Metals are prone to corrosion. It is a slow conversion of metals into some undesirable compounds. This occur may be due to reaction with oxygen, gases, acids etc. When irons reacts with atmospheric oxygen and moisture, a red layer is formed on the surface of the iron, this process is known as **Rusting**.



Eq. 8. Equation for Iron Rusting

Rancidity

When food containing fats and oils are exposed to the atmosphere, the oxidation of fat and oil occurs, this is known as **Rancidity**.

Methods to Prevent Rancidity

- Store cooking oils from direct sunlight.
- Food should be placed at low temperature.
- By adding antioxidants food can be protected from rancidity.
- Packing material should replace the air with nitrogen.
- Minimize the use of salt in fried foods.

WORKSHEET 1

Fill in the blanks:-

- 1 .Addition of hydrogen in a substance in a reaction is known as _____ reaction.
- 2 .In a _____ reaction two or more substances combine to form a new single substance.
3. Unbalanced reactions are also known as _____
- 4.Reactions in which heat is given out along with the products are called _____ - reactions.
5. Reactions in which energy is absorbed are known as _____ reactions.
6. When an element displaces another element from its compound, a _____ reaction occurs.
7. Those reactions, in which two compounds react by an exchange of ions to form two new compounds, are called _____ reactions
- 8.Precipitation reactions produce _____ salts.
9. Reduction is the _____ of oxygen or gain of hydrogen.
10. The digestion of food in the body is an example of _____ reaction.
11. The addition of oxygen to a substance is called _____.
12. When calcium carbonate is heated, it decomposes to give _____ and _____.

SOLUTIONS

- 1.reduction
- 2.Combination
- 3.skeletal
- 4.Exothermic
- 5.Endothermic
- 6.Displacement
- 7.Double displacement
- 8.Insoluble
- 9.Loss
- 10.Decomposition reaction
- 11.Oxidation
- 12.CaO(s) and CO₂ (g)

True/ False:-

1. The number of atoms of each element is conserved in any chemical reaction.
- 2 .Oxidation is the loss of electrons from a substance.
3. Reduction is the gain of electrons by a substance.
- 4 .A complete chemical equation represents the reactants, products and their physical states symbolically.
- 5 .A magnesium ribbon burns with a dazzling flame in air (oxygen) and changes into a white substance, magnesium oxide.
- 6 .Rusting is a double decomposition reaction.
- 7.The reaction between nitrogen and hydrogen to give ammonia is an example of a combination reaction.
- 8.Action of heat on ferrous sulphate is an example of decomposition reaction.
- 9.The formation of Na⁺ and Cl⁻ ions from sodium and chlorine is an example of a redox reaction.

Solution

1. TRUE
2. TRUE

3. TRUE
4. TRUE
5. TRUE
6. FALSE
7. TRUE
8. TRUE
9. TRUE

Very Short Answer Questions:-

Question 1. Write a chemical equation when magnesium metal reacts with aqueous hydrochloric acid to produce a solution of magnesium chloride and hydrogen gas.

Question 2. Can a combination reaction be redox reaction?

Question 3. Why do we apply paint on iron articles?

Question 4. What are the different types of reactions?

Question 5. What is a decomposition reaction? Give example.

Question 6. Define displacement reaction.

Question 7. What happens when sodium reacts with water?

Question 8. Write the chemical equation and name the reaction when a solution of sodium chloride is mixed with a solution of silver nitrate and a white precipitate of silver chloride is formed.

Question 9. Why does the color of copper sulphate solution change, when an iron nail is dipped in it?

Question 10. Why is photosynthesis considered as an endothermic reaction?

Question 11. Potassium chlorate (KClO_3) on heating forms potassium chloride and oxygen. Write a balanced equation for this reaction.

Question 12. Give an example of a chemical reaction characterized the change in temperature.

Question 13. What type of chemical reactions take place when:

- a) Limestone is heating?
- b) A magnesium wire is burnt in air?
- c) Electricity is passed through water?
- d) Ammonia and hydrogen chloride are mixed?
- e) Silver bromide is exposed to sunlight?

Question 14. To balance a chemical equation, can we change the formula of either reactants or products?

Question 15. Why should a magnesium ribbon be cleaned before burning in air?

Question 16. If any of the following reactions occurs spontaneously, write the balanced net ionic equation. If not, write no reaction.



Question 17. Nickel (II) nitrate is prepared by heating nickel metal with liquid dinitrogen tetroxide. In addition to the nitrate, gaseous nitrogen monoxide is formed. Write the balanced equation.

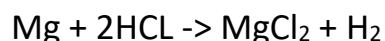
Question 18. Why is the amount of gas collected in one of the test tubes in electrolysis of water double of the amount collected in the other? Name this gas.

Question 19. Write a balanced chemical equation with state symbols for the following reactions:-

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

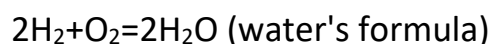
ii. Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.

Solution



2) Yes, a combination reaction can be a redox reaction.

In a combination reaction two elements are combined to make a single product.



In this reaction there is reduction of oxygen as there is transfer of electrons from hydrogen to oxygen and there is also oxidation of hydrogen as there is acceptance of electrons by oxygen from hydrogen. Oxygen is the oxidizing agent and hydrogen is the reducing agent.

3) To prevent it from Corrosion

4) Combination reactions

Decomposition reaction

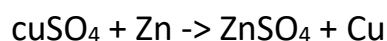
Displacement reactions

Double displacement reactions

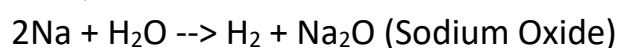
Oxidation and Reduction reactions

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

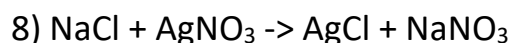
6) Those reactions, in which one element takes the place of another element in a compound, are known as displacement reactions.



7) Sodium can react with cold water as it is an extremely reactive metal; when it does,



The reaction is very vigorous and exothermic.

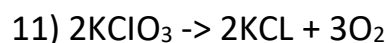


Double displacement and precipitation reaction

9) When an iron nail is dipped in the copper sulphate solution, iron displaces copper from the copper sulphate because iron is more reactive than copper.

Therefore the color of the copper sulphate solution changes.

10) Photosynthesis is considered an endothermic reaction because energy in the form of sunlight is absorbed by the green plants.



19)



WORKSHEET 2

Q1 Define: \rightarrow Reactants \rightarrow Products \rightarrow Balanced chemical equation.

Q2 Balance the following chemical equation and identify the reactants and products

- a. _____ Zn (s) + _____ AgNO₃ (aq) → _____ Zn(NO₃)₂ (aq) + _____ Ag (s)
- b. _____ N₂ (g) + _____ H₂ (g) → _____ NH₃ (g)
- c. _____ Mg(OH)₂ (aq) + _____ H₃PO₄ (aq) → _____ H₂O (l) + _____ Mg₃(PO₄)₂(aq)
- d. _____ HNO₃ (aq) + _____ Ni (s) → _____ Ni(NO₃)₂ (aq) + _____ H₂ (g) e. _____ Ba(HCO₃)₂ (s) → _____ BaCO₃ (s) + _____ H₂O (g) + _____ CO₂ (g)
- f. _____ BaCl₂ (aq) + _____ Na₂SO₄ (aq) → _____ NaCl (aq) + _____ BaSO₄ (s)
- g. _____ Al₂(CO₃)₃ (s) → _____ Al₂O₃ (s) + _____ CO₂ (g)
- h. _____ Ca (s) + _____ H₂O (l) → _____ Ca(OH)₂ (aq) + _____ H₂ (g)
- i. _____ LiHCO₃ (s) → _____ Li₂CO₃ (s) + _____ H₂O (g) + _____ CO₂ (g)
- j. _____ N₂ (g) + _____ O₂ (g) → _____ N₂O₅ (g)
- k. _____ MgBr₂ (aq) + _____ KOH (aq) → _____ KBr (aq) + _____ Mg(OH)₂ (s)
- l. _____ Mn (s) + _____ CuCl (aq) → _____ Cu (s) + _____ MnCl₂ (s)
- m. _____ Zn (s) + _____ S₈ (s) → _____ ZnS (s)
- n. _____ NaOH (aq) + _____ H₂SO₄ (aq) → _____ H₂O (l) + _____ Na₂SO₄ (aq)
- o. _____ K (s) + _____ H₂O (l) → _____ KOH (aq) + _____ H₂ (g)
- p. _____ C₅H₁₂ (l) + _____ O₂ (g) → _____ H₂O (g) + _____ CO₂ (g)
- q. _____ KOH (aq) + _____ H₂CO₃ (aq) → _____ H₂O (l) + _____ K₂CO₃ (aq)
- r. _____ C₄H₈O₂ (l) + _____ O₂ (g) → _____ H₂O (g) + _____ CO₂ (g)

Q2 Write the skeleton equation for each of the following reactions. Then balance each of the following chemical equations

- hydrogen + oxygen -----→ water
- iron(III) oxide + hydrogen----→ water + iron
- sodium + water -----→sodium hydroxide + hydrogen
- copper + Oxygen-----→ Copper(II) Oxide
- potassium iodide + chlorine ---→potassium chloride + iodine
- chromium + tin(IV) chloride ---→chromium(III) chloride + tin
- magnesium + copper(II) sulphate --→magnesium sulphate + copper
- zinc sulphate + strontium chloride --→zinc chloride + strontium sulphate
- ammonium chloride + lead(III) nitrate --→ammonium nitrate + lead(III) chloride
- iron(III) nitrate + magnesium sulphide--→ iron(III) sulphide + magnesium nitrate
- aluminum chloride + sodium carbonate-----→ aluminum carbonate + sodium chloride

12 sodium phosphate + calcium hydroxide \rightarrow sodium hydroxide + calcium phosphate