Sanjiv Refresher

SCIENCE

CLASS X

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Contents

1

Chemical Reactions and Equations

Important Concepts

- **Chemical reaction :** Chemical changes in which one or more new substances are formed with different composition and properties. A chemical reaction shows following characteristics :
  The substances that take part in a reaction are called reactants and the substance formed are called products.

  (i) Change in state : In some reactions the physical state of reactants and products differ from each other.

  For example :

  $$\underset{\text{Hydrogen}}{2H_{2(g)}} + \underset{\text{Oxygen}}{O_{2(g)}} \xrightarrow[\text{arc}]{\text{Electric}} \underset{\text{Water}}{2H_2O_{(l)}}$$

  (ii) Change in colour : Some reactions involve change in colour during formation of products.

  For example :

  $$\underset{\substack{\text{(Red)}\\\text{Lead oxide}}}{2Pb_3O_{4(s)}} \xrightarrow{\text{Heat}} \underset{\substack{\text{(Yellow)}\\\text{Lead monoxide}\\\text{acid}}}{6PbO_{(s)}} + O_{2(g)}\uparrow$$

  (iii) Change in temperature : In some reactions either energy is absorbed or evolved. Depending upon energy change reactions are of two types :

  (a) Exothermic : Reactions in which energy is released.

  For example :

  $$\underset{\text{Coal}}{C_{(s)}} + \underset{\text{Oxygen}}{O_{2(g)}} \longrightarrow \underset{\substack{\text{Carbon}\\\text{dioxide}}}{CO_{2(g)}} + \text{Heat} + \text{Light}$$

  (b) Endothermic : Reactions in which energy is absorbed.

  For example :

  $$\underset{\substack{\text{Calcium}\\\text{carbonate}}}{CaCO_{3(s)}} + \text{Heat} \longrightarrow \underset{\substack{\text{Calcium}\\\text{oxide}}}{CaO_{(s)}} + \underset{\text{Carbon dioxide}}{CO_{2(g)}}$$

(iv) Evolution of gas : Some chemical reactions are accompanied by the evolution of gas.

For example :

$$\underset{\text{Zinc}}{Zn_{(s)}} + \underset{\text{Dilute sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4} + \underset{\text{Hydrogen}}{H_{2(g)}\uparrow}$$

- **Chemical equations :** Representation of a chemical reaction in terms of symbols and formulae of the reactants and products is known as chemical equation.
  The necessary conditions such as temperature, pressure or any catalyst should be written on arrow between reactants and products. A chemical equation can be made more informative by mentioning reaction conditions (such as temperature, pressure, catalyst), physical states of reactants and products [(*s*), (*l*), (*g*), (*aq*)], heat absorbed or evolved, concentration of reactants and products [(*conc*), (*aq*)].

- **Balanced chemical equations :** The chemical equation in which the no. of atoms of different elements is the same on both sides of the arrow is called a balanced chemical equation. All the equations should be balanced to be in accordance to law of conservation of mass. It states that "Mass can neither be created nor destroyed in a chemical reaction. So, number of elements involved in chemical reaction should remain constant at reactant and product side."

- **Types of Chemical Reactions**
  The chemical reactions can be classified into different types such as :

(a) Combination reaction : The reactions in which two or more substances combine to form a new substance are called combination reactions. These reactions are also called synthesis reactions. However, all combination reactions are not synthesis reactions, these reactions are generally exothermic in nature.

For example : $2Mg_{(s)} + O_{2(g)} \xrightarrow{\text{Burn}} 2MgO_{(s)}$

(b) Decomposition reaction : The reaction in which a single compound breaks up into two or more simpler substances are called decomposition reactions. Decomposition reactions are generally endothermic in nature. Energy may be involved in form of heat, light or electricity.

(i) If energy is involved in form of light is called **photo decomposition reaction.**

(ii) If energy is involved in form of electricity is called **electrolytic decomposition reaction.**

(iii) If energy is involved in form of heat is called **thermal decomposition reaction.**

For example :

$$2Pb(NO_3)_{2(s)} \xrightarrow{\text{Heat}} 2PbO_{(s)} + 4NO_{2(g)} + O_{2(g)} \text{ (Thermal decomposition reaction)}$$

$$\underset{\text{Acidulated water}}{2H_2O_{(l)}} \xrightarrow{\text{Electricity}} \underset{\text{Hydrogen}}{2H_{2(g)}} + \underset{\text{Oxygen}}{O_{2(g)}} \quad \text{(Electrolytic decomposition reaction)}$$

$$2AgBr \xrightleftharpoons{\text{Light}} 2Ag + Br_2 \quad \text{(Photo decomposition reaction)}$$

Electrolysis is the decomposition of a substance by passing electric current through. The decomposition of a substance on heating is known as thermal decomposition. The decomposition of a substance by absorbing light energy is called photochemical decomposition.

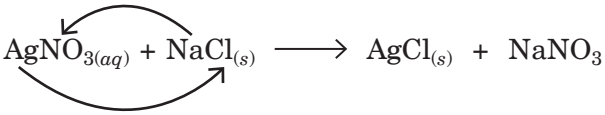
(c) Displacement reaction : The chemical reactions in which a more reactive element displaces a less reactive element from a compound are known as displacement reactions. Displacement reactions are also called substitution reactions.

For example :

$$\underset{\text{Zinc}}{Zn_{(s)}} + \underset{\text{Copper sulphate}}{CuSO_{4(aq)}} \rightarrow \underset{\text{Zinc sulphate}}{ZnSO_{4(aq)}} + \underset{\text{Copper}}{Cu_{(s)}}$$

(d) Double displacement reaction : The chemical reactions in which compounds react to form two different compounds by mutual exchange of ions are called double displacement reactions.

For example :



(e) Precipitation reaction : In this reaction, aqueous solution of two salts are mixed whereby some salts precipitate due to mutual exchange of ions between the two salts. The substance that separates out as precipitate is indicated by a downward arrow (↓).

For example :

$$\underset{\substack{\text{Aluminium}\\\text{chloride}}}{AlCl_{3(aq)}} + \underset{\substack{\text{Ammonium}\\\text{hydroxide}}}{3NH_4OH_{(aq)}} \longrightarrow \underset{\substack{\text{Aluminium}\\\text{hydroxide}}}{Al(OH)_{3(s)}\downarrow} + \underset{\substack{\text{Ammonium}\\\text{chloride}}}{3NH_4Cl_{(aq)}}$$

(f) Neutralisation reaction : The reaction in which salt and water is formed due to the combination of acid and base.

For example :

$$\underset{\substack{\text{Sodium hydroxide}\\\text{(Base)}}}{NaOH} + \underset{\substack{\text{Hydrochloric}\\\text{acid (Acid)}}}{HCl} \longrightarrow \underset{\substack{\text{Sodium chloride}\\\text{(Salt)}}}{NaCl} + \underset{\text{Water}}{H_2O}$$

(g) Redox reaction : Chemical reaction which shows both oxidation and reduction reaction.

(i) Oxidation : Reaction that involves the gain of oxygen or loss of hydrogen.

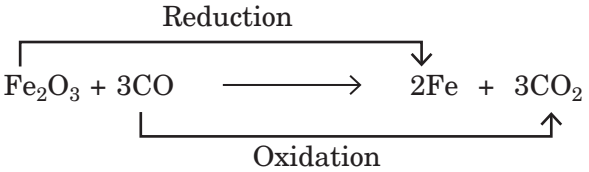
(ii) Reduction : Reaction that involves the loss of oxygen or gain of hydrogen.

Both oxidation and reduction take place simultaneously and hence called redox reaction. In redox reactions both oxidation and reduction occur simultaneously.

$$ZnO + C \rightarrow Zn + CO$$

ZnO is reduced to Zn ---- reduction

C is oxidised to CO ------ oxidation



- A substance which causes addition of oxygen or removal of hydrogen is called **oxidising agent,** whereas substance which causes addition of hydrogen or removal of oxygen is called reducing agent. For example, in the above reaction : ZnO is oxidising agent and C is reducing agent.
- **Corrosion :** The process of slow conversion of metals into their undesirable compounds due to their reaction with oxygen, water, acids, gases, etc. present in the atmosphere is called corrosion.
- **Rusting :** Iron when reacts with oxygen and moisture forms red substance called rust.

$$Fe + H_2O + O_2 \longrightarrow Fe_2O_3 \,.\, xH_2O \text{ (Rust)}$$

- **Rancidity :** The taste and odour of food materials containing fat and oil changes when they are left exposed to air for long time. This is called rancidity. It is caused due to oxidation of fat and oil present in food material. It can be prevented by using various methods such as by adding antioxidants to the food materials, storing food in air tight container and by flushing out air with nitrogen.

IN-TEXT QUESTIONS

Page 6

Q. 1. Why should a magnesium ribbon be cleaned before burning in air?

Ans. When magnesium metal left unused, its outer layer reacts with the atmospheric oxygen and forms magnesium oxide (MgO) layer which is a very stable compound, thus, preventing further reactions with oxygen. To let reaction happen, it is necessary to clean the ribbon by rubbing it with sand paper to remove the layer of MgO so that the reaction becomes feasible with the atmospheric oxygen.

Q. 2. Write balanced equations 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

Ans. (i) $H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)}$

(ii) $3BaCl_{2(aq)} + Al_2(SO_4)_{3(aq)} \rightarrow 3BaSO_{4(aq)} + 2AlCl_{3(aq)}$

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

Q. 3. Write balanced chemical equations with state symbols for the following reactions :

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