Chapter 1: Chemical Reactions and Equations

1. Chemical Reaction

A chemical reaction is a process in which one or more substances called reactants change into new substances called products with different physical and chemical properties.

Examples from daily life:

- Milk turning into curd
- Rusting of iron
- Fermentation of grapes
- Cooking of food
- Digestion of food in our body

2. Types of Changes in Matter

Physical Change

A physical change is a change in which only the physical properties such as shape, size, or state change and no new substance is formed.

Example: Ice → Water → Water Vapour (Chemical composition remains H_2O).

Chemical Change

A chemical change is a change in which one or more substances react to form new substances with different properties.

- Rusting of iron
- Burning of wood
- Curdling of milk
- Digestion of food

Activity 1.1 – Burning of Magnesium Ribbon

Procedure:

1. Clean a magnesium ribbon using sandpaper.
2. Hold the ribbon with tongs.
3. Burn it in a flame.
4. Collect the ash in a watch glass.

Observation:

- Magnesium burns with a dazzling white flame.
- A white powder is formed.

Result: The white powder formed is Magnesium Oxide (MgO).

Equation: $2Mg + O_2 \rightarrow 2MgO$

Activity 1.2 – Reaction of Lead Nitrate and Potassium Iodide

Procedure:

5. Take lead nitrate solution in a test tube.
6. Add potassium iodide solution.

Observation: A yellow precipitate is formed.

Result: The yellow solid formed is Lead Iodide (PbI_2).

Equation: $Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$

Activity 1.3 – Reaction of Zinc with Acid

Procedure:

7. Take zinc granules in a conical flask.
8. Add dilute hydrochloric acid or sulphuric acid.
9. Touch the flask carefully.

Observation:

- Bubbles of gas are produced.
- The flask becomes warm.

Result: Hydrogen gas is released and heat is produced.

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

Indicators of a Chemical Reaction

- Change in state
- Change in colour
- Evolution of gas
- Formation of precipitate
- Change in temperature

Chemical Reactions in Everyday Life

- Burning of wood – Wood burns and produces ash.
- Rusting of iron – Iron reacts with oxygen and moisture to form rust.
- Curdling of milk – Milk changes into curd due to bacterial action.
- Digestion of food – Food breaks into simpler substances producing energy.

Chapter 1: Chemical Reactions and Equations

1. Chemical Reaction

A chemical reaction is a process in which one or more substances undergo chemical change to form new substances with different properties.

Example:

Hydrogen reacts with oxygen to form water.

Balanced Equation:

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

Reactants → Hydrogen, Oxygen

Product → Water

2. Chemical Equation

A chemical equation is the symbolic representation of a chemical reaction using chemical formulas.

General form:

Reactants → Products

Example:

$Mg + O_2 \rightarrow MgO$

3. Writing Chemical Formula

Chemical formulas are written using valency of ions.

Examples:

$Na^+ + Cl^- \rightarrow NaCl$

$Al^{3+} + Cl^- \rightarrow AlCl_3$

$Fe^{2+} + SO_4{}^{2-} \rightarrow FeSO_4$

$Pb^{2+} + NO_3{}^- \rightarrow Pb(NO_3)_2$

4. Balanced Chemical Equation

A balanced chemical equation is one in which the number of atoms of each element on both sides is equal.

Example:

$A_2 + B_2 \rightarrow 2AB$

Why do we balance equations?

Because of the Law of Conservation of Mass.

Mass can neither be created nor destroyed.

Total mass of reactants = Total mass of products.

5. Steps to Balance Chemical Equation (Hit and Trial Method)

Example:

$Fe + H_2O \rightarrow Fe_3O_4 + H_2$

Step 1: Write skeletal equation

Step 2: Count atoms

Fe: 1 → 3

H: 2 → 2

O: 1 → 4

Step 3: Balance O

$Fe + 4H_2O \rightarrow Fe_3O_4 + H_2$

Step 4: Balance H

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

Step 5: Balance Fe

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

Final Balanced Equation:

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

6. Writing Physical States

(s) solid

(l) liquid

(g) gas

(aq) aqueous solution

Example:

$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$

7. Characteristics of Chemical Reaction (FECTS Rule)

F → Formation of precipitate

E → Evolution of gas

C → Colour change

T → Temperature change

S → Change in state

Example:

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

NCERT Questions

Q1. Why should a magnesium ribbon be cleaned before burning in air?

Answer:

Magnesium ribbon is cleaned with sandpaper to remove magnesium oxide layer present on its surface. This oxide layer prevents magnesium from burning easily.

Q2. Write the balanced equation for the following reactions.

(i) Hydrogen + Chlorine → Hydrogen chloride

$H_2 + Cl_2 \rightarrow 2HCl$

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

$3BaCl_2 + Al_2(SO_4)_3 \rightarrow 3BaSO_4 + 2AlCl_3$

(iii) Sodium + Water → Sodium hydroxide + Hydrogen

$2Na + 2H_2O \rightarrow 2NaOH + H_2$

Practice Questions

1. $Zn + H_3PO_4 \rightarrow Zn_3(PO_4)_2 + H_2$

Answer: $3Zn + 2H_3PO_4 \rightarrow Zn_3(PO_4)_2 + 3H_2$

2. $MnO_2 + HCl \rightarrow MnCl_2 + H_2O + Cl_2$

Answer: $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

Quick Revision

Chemical reaction → formation of new substances

Chemical equation → symbolic representation

Balanced equation → equal atoms on both sides

Law used → Conservation of mass

Indicators → FECTS