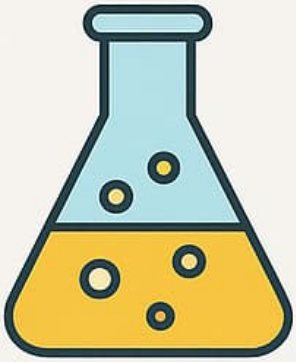
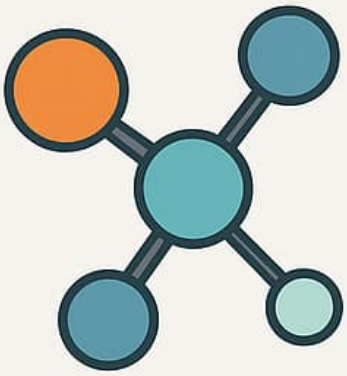
CHEMISTRY

CLASS 10 NOTES

Based on NCERT 2025-26

- Comprehensive notes
- Easy to understand language





JAGDISH BHAKAT

M.Sc. (Physics), B.Ed.

CONTENTS

Ch 01 – CHEMICAL REACTIONS & EQUATIONS

⇒ **Chemical Reaction**: A chemical reaction is a process in which one or more substances (reactants) are converted into one or more new substances (products) with different properties.

⇒ **Indicators of a Chemical Reaction**

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

⇒ **Chemical Equation**: A chemical equation is a symbolic representation of a chemical reaction, where the **reactants** (substances that undergo the reaction) are written on the left side, and the **products** (new substances formed) are written on the right side, connected by an arrow (→) that shows the direction of the reaction.

$$H_2 + O_2 \rightarrow H_2O$$

- **Skeletal Chemical Equation**: An unbalanced equation that shows only the reactants and products.
  - Example: $H_2 + O_2 \rightarrow H_2O$
- **Balanced Chemical Equation**: A chemical equation in which the number of atoms of each element is equal on both sides.
  - Example: $2H_2 + O_2 \rightarrow 2H_2O$

⇒ **Balancing a Chemical Equation**

- Why Balance Equations?
  According to the Law of Conservation of Mass, matter cannot be created or destroyed. So, in a chemical reaction, the number of atoms of each element must be equal on both sides of the equation.
- Steps to Balance a Chemical Equation
  - **Step 1**: Write the Skeletal Equation
    - Write the correct chemical formulas for all reactants and products.

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

  - **Step 2**: Count the Number of Atoms of Each Element

Element	Reactant Side	Product Side
Fe	1	3
H	2	2
O	1	4

  - **Step 3**: Balance One Element at a Time
    - Start with Fe (iron):
      - On left: 1 Fe
      - On right: 3 Fe
      - → Multiply Fe on left by 3:

$$\mathbf{3}Fe + H_2O \rightarrow Fe_3O_4 + H_2$$

- Now balance O (oxygen):
  - On right: 4 O
  - On left: 1 O (in 1 H_2O)
  - → Multiply H_2O by 4:

$$3Fe + \mathbf{4}\boldsymbol{H_2O} \rightarrow Fe_3O_4 + H_2$$

- Now balance H (hydrogen):
  - On left: 4 × 2 = 8 H
  - On right: H_2 → only 2 H
  - → Multiply H_2 on right by 4:

$$3Fe + 4H_2O \rightarrow Fe_3O_4 + \mathbf{4}\boldsymbol{H_2}$$

- **Step 4**: Double-Check All Elements

Element	Reactant Side	Product Side
Fe	3	3
H	8	8
O	4	4

Number of atoms on both sides of equation are equal, hence the equation is balanced. The balanced chemical equation is:

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

- Tips for Balancing Equations:
  - Balance metals first.
  - Balance non-metals next.
  - Balance oxygen and hydrogen last, especially if they appear in multiple compounds.
  - Use lowest whole number coefficients.
- To make chemical equations more informative, we write the physical states of the reactants and products using symbols in brackets next to each substance.

Symbol	Meaning	Example
(s)	Solid	Zn(s), Fe(s)
(l)	Liquid	H_2O(l), Br_2(l)
(g)	Gas	H_2(g), CO_2(g)
(aq)	Aqueous (dissolved in water)	NaCl(aq), HCl(aq)

- Sometimes the reaction conditions, such as temperature, pressure, catalyst, etc., for the reaction are indicated above and/or below the arrow in the equation. For example –

$$6CO_2(aq) + 12H_2O(l) \xrightarrow{sunlight\ \&\ chlorophyll} C_6H_{12}O_6(aq) + 6O_2(aq) + 6H_2O(l)$$

This is the chemical reaction of photosynthesis by plants.

⇒ **Types of Chemical Reactions**

1. Combination Reaction
2. Decomposition Reaction
3. Displacement Reaction
4. Double Displacement Reaction
5. Oxidation and Reduction (Redox Reaction)

⇒ **Combination Reaction**: A combination reaction (also called a synthesis reaction) is a chemical reaction in which two or more substances combine to form a single product.

$$A+B \rightarrow AB$$

Examples:

$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$ *Formation of calcium hydroxide*

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ *Burning of hydrogen*

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ *Formation of ammonia*

Key Characteristics:

- One product is formed.
- Often exothermic (releases heat).
- Common in reactions involving elements or simple compounds.

⇒ **Decomposition Reaction**: A decomposition reaction is a chemical reaction in which a single compound breaks down into two or more simpler substances (elements or compounds).

$$AB \rightarrow A+B$$

Examples:

$CaCO_3(s) \xrightarrow{\Delta} CaO\ (s) + CO_2(g)$ *Decomposition of calcium carbonate*

$2H_2O\ (l) \xrightarrow{\text{Electricity}} 2H_2(g) + O_2(g)$ *Electrolysis of water*

$2Pb(NO_3)_2(s) \xrightarrow{\Delta} 2PbO\ (s) + 4NO_2(g) + O_2(g)$ *Decomposition of lead nitrate*

Key Characteristics:

- One reactant, multiple products.
- Requires energy input: heat, light, or electricity.
- Opposite of combination reactions.

⇒ **Displacement Reaction**: A displacement reaction (also called a single replacement reaction) is a chemical reaction in which a more reactive element displaces a less reactive element from its compound.

$$A+BC \rightarrow AC+B$$

Examples:

$Zn\ (s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu\ (s)$ *Zinc displaces copper from copper sulfate*

$Fe\ (s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu\ (s)$ *Iron displaces copper from copper sulfate*

$Cl_2(g) + 2NaBr(aq) \rightarrow 2NaCl(aq) + Br_2(l)$ *Chlorine displaces bromine from sodium bromide*

Key Characteristics:

- Involves reactivity series (more reactive element replaces less reactive).
- Usually occurs between metals or halogens.
- Often occurs in aqueous solutions.

⇒ **Double Displacement Reaction**: A double displacement reaction (also called double replacement or metathesis reaction) is a chemical reaction in which two compounds exchange ions to form two new compounds.

$$AB+CD \rightarrow AD+CB$$

⇒ **Examples:**

$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s)\downarrow + 2NaCl(aq)$ *Reaction between sodium sulfate and barium chloride, ($BaSO_4$ forms a white precipitate)*

$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s)\downarrow + 2KNO_3(aq)$ *Reaction between lead(II) nitrate and potassium iodide, (PbI_2 forms a yellow precipitate)*

Key Characteristics:

- Involves exchange of ions between two ionic compounds.
- Often results in:
  - Precipitate formation
  - Gas evolution
  - Or neutralization (acid + base)

⇒ **Oxidation and Reduction (Redox Reaction)**: A Redox Reaction is a chemical reaction in which oxidation and reduction occur simultaneously.

- Oxidation: The loss of electrons, or the addition of oxygen, or removal of hydrogen.
- Reduction: The gain of electrons, or the removal of oxygen, or addition of hydrogen.

Example:

$$CuO\ (s) + H_2(g) \rightarrow Cu\ (s) + H_2O\ (l)$$

$CuO \rightarrow Cu \rightarrow$ Oxygen is removed $\rightarrow$ Reduction (CuO is reduced.)

$H_2 \rightarrow H_2O \rightarrow$ Oxygen is added $\rightarrow$ Oxidation (H_2 is oxidized.)

Oxidizing Agent & Reducing Agent:

Oxidizing Agent: Causes oxidation, itself gets reduced (e.g., CuO)

Reducing Agent: Causes reduction, itself gets oxidized (e.g., H_2)

Key Points:

- Always involves electron transfer
- Used in metal extraction, combustion, cell reactions, etc.

Some Other Important Reactions/Terms

⇒ **Exothermic Reaction**: An exothermic reaction is a chemical reaction that releases heat energy to the surroundings.

Examples:

- Combustion of fuels ($CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + heat$)
- Respiration ($C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + energy$)
- Neutralization of acid and base

⇒ **Endothermic Reaction**: An endothermic reaction is a chemical reaction that absorbs heat energy from the surroundings.

Examples:

- Photosynthesis ($6CO_2 + 6H_2O + sunlight \rightarrow C_6H_{12}O_6 + 6O_2$)
- Dissolution of ammonium chloride in water
- Thermal decomposition of calcium carbonate

⇒ **Thermal Decomposition**: When decomposition reaction takes place with the apply of heat, then it is called Thermal Decomposition. It is an endothermic reaction, as heat is absorbed to break the chemical bonds.

$$CaCO_3(s) \xrightarrow{\Delta} CaO\ (s) + CO_2(g)$$

(Used in lime kilns to make quicklime)

⇒ **Electrolysis of Water**: Electrolysis of water is the process of breaking down water (H_2O) into hydrogen and oxygen gases by passing an electric current through it. It is a decomposition reaction and also endothermic, as it requires energy (electricity).

$$2H_2O\ (l) \xrightarrow{\text{Electricity}} 2H_2(g) + O_2(g)$$

⇒ **Process Setup of Electrolysis of Water:**
- Two electrodes (cathode and anode) are placed in acidulated water (water with a few drops of acid to improve conductivity).
- Hydrogen gas is collected at the cathode (negative electrode).
- Oxygen gas is collected at the anode (positive electrode).
- Gas ratio formed is 2:1 (Hydrogen:Oxygen).

⇒ **Precipitate**: The insoluble substance formed in a chemical reaction is known as a precipitate.

⇒ **Precipitation Reaction**: A chemical reaction that produces a precipitate can be called a precipitation reaction.

⇒ **Corrosion**: Corrosion is the gradual destruction of metals by chemical or electrochemical reaction with substances in the environment such as moisture, air, acids, or salts.

Common Example:
- Rusting of iron: $Iron\ (Fe) + O_2 + H_2O \rightarrow Fe_2O_3 \cdot xH_2O\ (Rust)$
- Silver turns black in air (forms silver sulfide)
- Copper forms a green layer of copper carbonate

Prevention of Corrosion:
- Painting
- Oiling/greasing
- Galvanization (coating iron with zinc)
- Alloying (e.g., stainless steel)

⇒ **Rancidity**: Rancidity is the process in which oils or fats get oxidized when exposed to air (oxygen) over time, leading to an unpleasant smell and taste.

Example:
- Chips or fried snacks left open for a few days smell bad due to rancidity.
- Butter turning sour when exposed to air.

Prevention of Rancidity:
- Storing in airtight containers
- Keeping in refrigerators (cool temperature slows oxidation)
- Using antioxidants (e.g., BHA, BHT added to food items)
- Flushing with nitrogen gas (e.g., in sealed chip packets)

BHA (Butylated Hydroxyanisole) and BHT (Butylated Hydroxytoluene) are synthetic antioxidants used in food preservation.

Ch 02 – ACIDS, BASES & SALTS

⇒ **Indicators**: Acid-base indicators are substances that change color depending on whether they are in an acidic or basic (alkaline) solution.

⇒ **Types of Indicators**:

1. **Natural Indicators**: Indicators obtained from natural sources like plants.
   Example:
   - Litmus: Red in acid, blue in base
   - Turmeric: Yellow in acid, reddish-brown in base
   - China rose (Hibiscus): Pink in acid, green in base
2. **Synthetic Indicators**: Man-made chemical substances that show different colors in acid and base. Example:
   - Phenolphthalein: Colorless in acid, pink in base
   - Methyl orange: Red in acid, yellow in base
3. **Olfactory Indicators**: Substances that change their smell in acidic or basic solutions.
   Example:
   - Onion extract: Smell disappears in base, stays in acid
   - Vanilla essence: Smell vanishes in base, remains in acid

⇒ **Litmus**: Litmus is a natural acid-base indicator made from lichen, a plant belonging to the division Thallophyta. It is commonly used to test whether a substance is acidic or basic.

- Acid turns **BLUE** litmus **RED**!
- Base turns **RED** litmus **BLUE**!

⇒ **Acids**:

- Acids have a sour taste.
- They can change colour of blue litmus to red.
- It ionises on dissolving in water.
- Acids present in plants and animals are organic/weak acids.
- Dilution of concentrated acid is an exothermic process.
- Acids produces H^+ ions (Hydronium ions) when dissolved in water.
- Acid solutions conduct electricity.

Chemical Properties of Acid

⇒ **Reaction of Acid with Metal**

General Reaction:

$$\text{Acid} + \text{Metal} \rightarrow \text{Salt} + \text{Hydrogen gas } (H_2)$$

Example:

$$HCl\ (\text{Hydrochloric acid}) + Zn\ (\text{Zinc}) \rightarrow ZnCl_2(\text{Zinc chloride}) + H_2(\text{Hydrogen gas})$$

$$H_2SO_4(\text{Sulfuric acid}) + Mg\ (\text{Magnesium}) \rightarrow MgSO_4(\text{Magnesium sulfate}) + H_2(\text{Hydrogen gas})$$

Observation:

- Effervescence (bubbling) is seen due to the release of hydrogen gas.
- The metal dissolves as it forms a salt.

Test for Hydrogen Gas:

- Bring a burning matchstick near the gas – it burns with a 'pop' sound, confirming hydrogen.