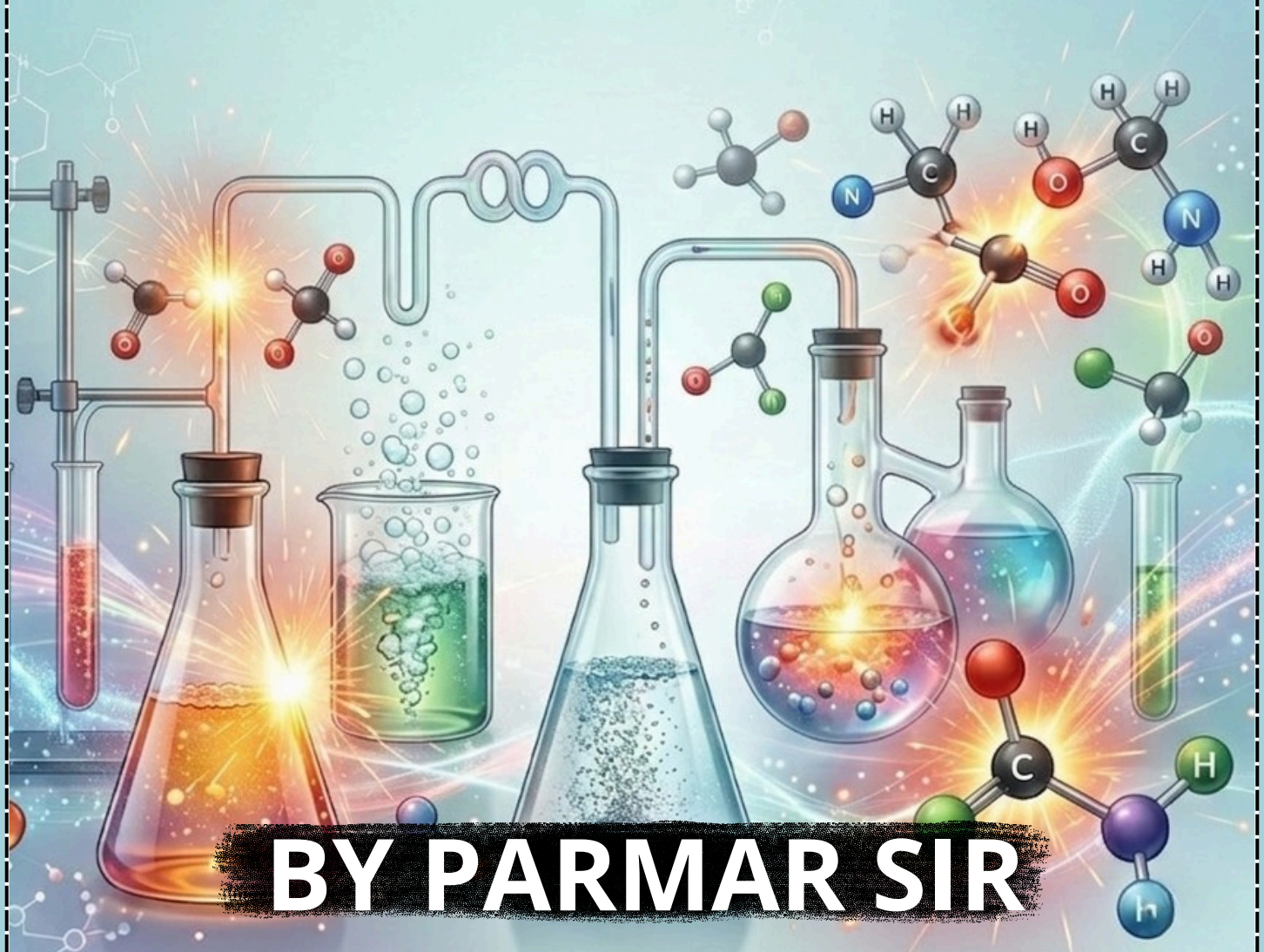
PARMAR SSC

CHEMICAL REACTIONS

Lecture - 5



BY PARMAR SIR

CHEMICAL REACTIONS

- Chemical reactions are processes where substances (reactants) transform into new substances (products) through the breaking and forming of chemical bonds.
- **They can be classified as:** Exothermic and Endothermic Reactions.

Exothermic Reactions	Endothermic Reactions
A reaction that releases energy from the system in the form of heat	A reaction in which the system absorbs energy from its surrounding in the form of heat
Exo means "out"	Endo means "in"

Types of Chemical Reaction

1. Combination Reaction

(a). Combination Reaction (most combination reactions are exothermic):

- It is a chemical reaction where a single product is formed from two or more reactants.

$$CaO + H_2O \rightarrow Ca(OH)_2\ (aq) + Heat$$

Quick Lime *Slaked Lime* *(It is an exothermic reaction)*

Neutralisation is an exothermic reaction.
Eg. mixing acid and alkali.

- $Ca(OH)_2$ reacts slowly with CO_2 in the air to form thin layer of $CaCO_3$ (Calcium carbonate gives shiny finish to walls).
- **Other names for $CaCO_3$ are:** Chalk/Marble/Limestone.

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

Lime Water

CO_2 turns lime water milky.

Other Examples of Exothermic Reactions

(b). Burning of coal (Combustion and Combination Reaction).

(c). Burning of natural gas [Primary component: CH_4 (methane)].

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Methane

(d). Burning of magnesium ribbon (Combination Reaction).

$$2Mg + O_2 \rightarrow 2MgO + Heat + Light\ (white\ dazzling\ light)$$

Magnesium *Magnesium Oxide (White ppt formed)*

- Mg is cleaned before burning in air, because it reacts with atmospheric O_2 to form MgO, which prevents further reaction with O_2.

Mg is used in fireworks because it burns very hot and bright.

(e). Respiration is also an exothermic reaction.

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + Energy$$

Glucose

2. Combustion Reaction

It is a type of chemical reaction, where a substance reacts with oxygen gas releasing energy in the form light and heat.

$$C + O_2 \rightarrow CO_2$$

Combustion reaction always takes place in presence of oxygen.

3. Decomposition Reaction

It is a type of chemical reaction, where single compound breaks down into two or more simpler products, often requiring energy in the form of heat, light, electricity.

(a) Thermal Decomposition

$$2FeSO_4 \rightarrow Fe_2O_3 + SO_2\,(g) + SO_3\,(g)\ (Endothermic)$$

Ferrous Sulphate *Ferric Oxide*

$$CaCO_3 \rightarrow CaO + CO_2$$

Calcium Carbonate

$$2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2\,(g) + O_2\,(g)$$

Lead Nitrate (White) *Lead Oxide* (Yellow) *(Brown Fumes of NO_2)*

(b) Electrolysis

- Electrolysis of water:
  - **Water used in electrolysis:** Pure water (bad conductor of electricity), acidified water, distilled water

$$2H_2O \rightarrow 2H_2 + O_2$$

At Cathode | At Anode

H_2 gas collected is double the amount of O_2.

(c) Photolysis

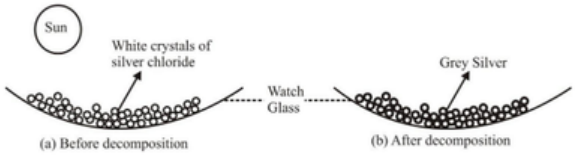
White → Grey + Yellowish Green

$$2AgCl \xrightarrow{\text{sun}} 2Ag + Cl_2$$

$$2AgBr \xrightarrow{\text{sun}} 2Ag + Br_2$$

They are kept in dark bottle

AgCl and AgBr is used in black and white photography. A photographic film is coated with the chemicals. When light falls on the surface of the film, the exposed part of the film is darkened from which photograph is developed.

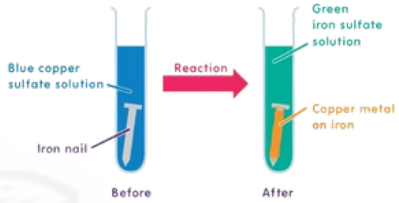


4. Displacement Reaction

It is a type of chemical reaction in which a more reactive element displaces a less reactive element from its compound. Eg. Zn and Pb are more reactive element than Cu.

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$
$$Pb + CuCl_2 \rightarrow PbCl_2 + Cu$$
$$Mg\ (s) + ZnSO_4\ (aq) \rightarrow MgSO_4\ (aq) + Zn\ (s)$$

$$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$$



- The colour of $CuSO_4$ solution changes when an iron nail is dipped in it. The iron nail becomes brownish and blue colour of $CuSO_4$ turns green.

Reactivity Series

Potassium (K)
Sodium (Na)
Calcium (Ca)
Magnesium (Mg)
Aluminium (Al)
Zinc (Zn)
Iron (Fe)
Lead (Pb)
Hydrogen (H)
Copper (Cu)
Mercury (Hg)
Silver (Ag)
Gold (Au)

Reactivity decreases ↓

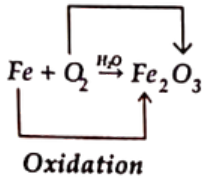
5. Double Displacement Reaction

It is a type of chemical reaction in which two compounds exchange their ions to form two new compounds. It is also sometimes called Precipitation Reaction when one of the products is an insoluble solid (precipitate).

$$Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + NaCl$$
(White ppt)
$$Pb(NO_3)_2 + KI \rightarrow PbI_2 + KNO_3$$
(Yellow ppt)
$$Ba(OH)_2 + NH_4Cl \rightarrow BaCl_2 + NH_4OH$$ *(Endothermic)*

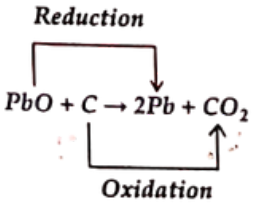
6. Oxidation Reaction

Oxidation reaction is addition of oxygen and removal of hydrogen.



7. Reduction Reaction

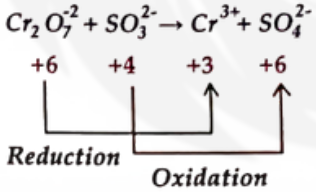
Reduction reaction is removal of oxygen and addition of hydrogen.



- **Oxidizing Agent (Oxidant):** PbO because it gives oxygen to carbon.
- **Reducing Agent (Reduction):** C because it removes oxygen from PbO.

Redox Reaction

- A redox (oxidation-reduction) reaction is a chemical process in which electrons are transferred between chemical substances.
- In redox reaction, one substance being oxidized (losing electrons) and another being reduced (gaining electrons).
- The oxidised substance is called reducing agent since it facilitates by donating electrons, while the reduced substance is the oxidising agent, as it accepts electrons.



Corrosion

- A corrosion is a process of deterioration of metal as a result of its reaction with air or water (present in environment) surrounding it.

$$4Fe + 3O_2 + xH_2O \rightarrow 2Fe_2O_3 \cdot xH_2O$$

- When iron corrodes or rust, iron molecules react with oxygen molecules to form iron oxide. Rust is a reddish brown, flaky substance that forms on the surface of the iron. Technically, a rust is Hydrated Iron (III) Oxide whose chemical formula is $Fe_2O_3 \cdot xH_2O$. Corrosion of iron is commonly known as rusting.

$$2Cu + H_2O + CO_2 + O_2 \rightarrow Cu(OH)_2 + CuCO_3$$

- Copper metal when exposed to air turns green in color due to corrosion. When the copper vessel is exposed to air in the rainy season, the metal reacts with gases, moisture and atmospheric gases to form a mixture of $CuCO_3$ and $Cu(OH)_2$. This gives a green color to the surface of Copper metal.

$$Cu + O_2 \rightarrow CuO$$
Brownish *Black*

$$Ag + S \rightarrow AgS$$
Black

Rancidity

- It is a type of oxidation reaction.
- It is the process by which fats and oils in food breakdown, resulting in unpleasant smell, taste, or texture.
- **E.g.** Nitrogen gas is used in chips packets to prevent oxidation, which may cause chips to become stale and soggy.

Calculation of Oxidation Number

Compound	Step 1 Equation	Step 2 Equation	Value of x
N_2O_5	$2x + 5(-2) = 0$	$2x - 10 = 0$	$x = 5$
CaO	$x + (-2) = 0$	—	$x = 2$
MnO_2	$x + (-2) \times 2 = 0$	—	$x = 4$
$NaAlH_4$	$1 + x + 4(-1) = 0$	$x + 1 - 4 = 0$	$x = 3$
$H_2S_2O_7$	$(-2) + 2x - 14 = 0$	$2x = 16$	$x = 8$

Balancing of Chemical Reaction

- Balancing of a chemical reaction means adjusting the coefficients of reactants and products so that the number of atoms of each element is the same on both sides of the equation.

Examples of Balanced Equation:

Unbalanced: $PbO + C \rightarrow 2Pb + CO_2$

Balanced: $2PbO + C \rightarrow 2Pb + CO_2$

Unbalanced: $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + NaCl$

Balanced: $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$

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

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



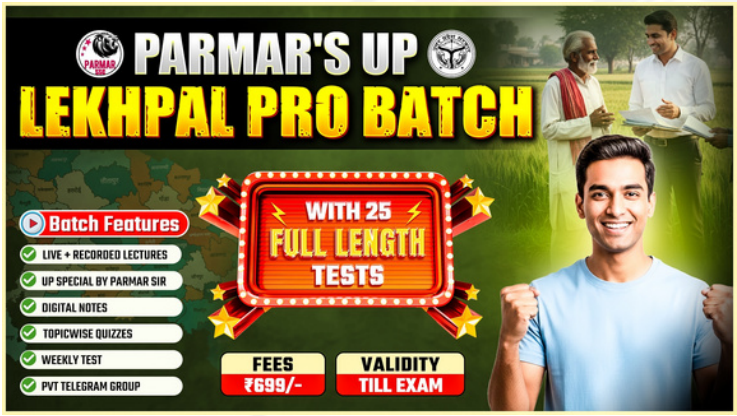


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