

Chemical Reactions and Equations

→ Chemical Reaction

It's a process where substances combine to create a new substance with unique properties.

- These are the following changes to determine that the chemical reaction has taken place :

(i) Change in state

(iii) Evolution of gas

(ii) Change in colour

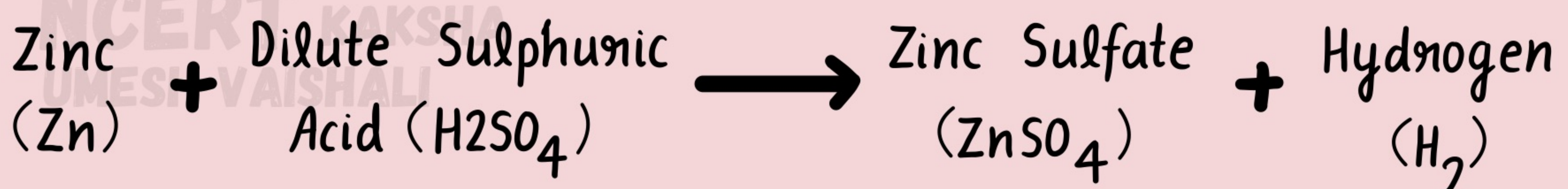
(iv) Change in temperature

→ **Reactant** :- Substances which take part in a chemical reaction are called reactants. Ex :- Mg and O_2

→ **Product** :- New substance formed after a chemical reaction is called a product. Ex :- MgO

→ Chemical Equation

A chemical equation symbolically represents a chemical reaction, using formulas of reactants and products. For instance :



→ **Balanced Chemical Reaction**

A reaction where the number of atoms of each element is equal on both sides of the equation.

Example :

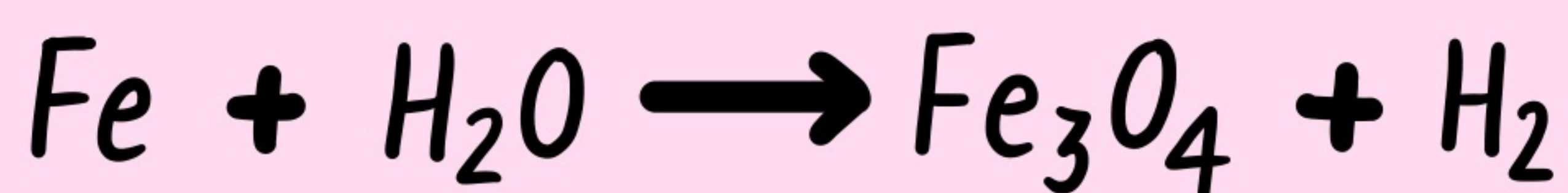


represents the balanced combustion of hydrogen gas with oxygen to form water vapor.

→ **Unbalanced chemical Equation**

If the number of atoms of each element in reactants is not equal to the numbers of atoms of each element present in the product, then the chemical equation is called **Unbalanced Chemical Equation**.

Example :-



In this example,

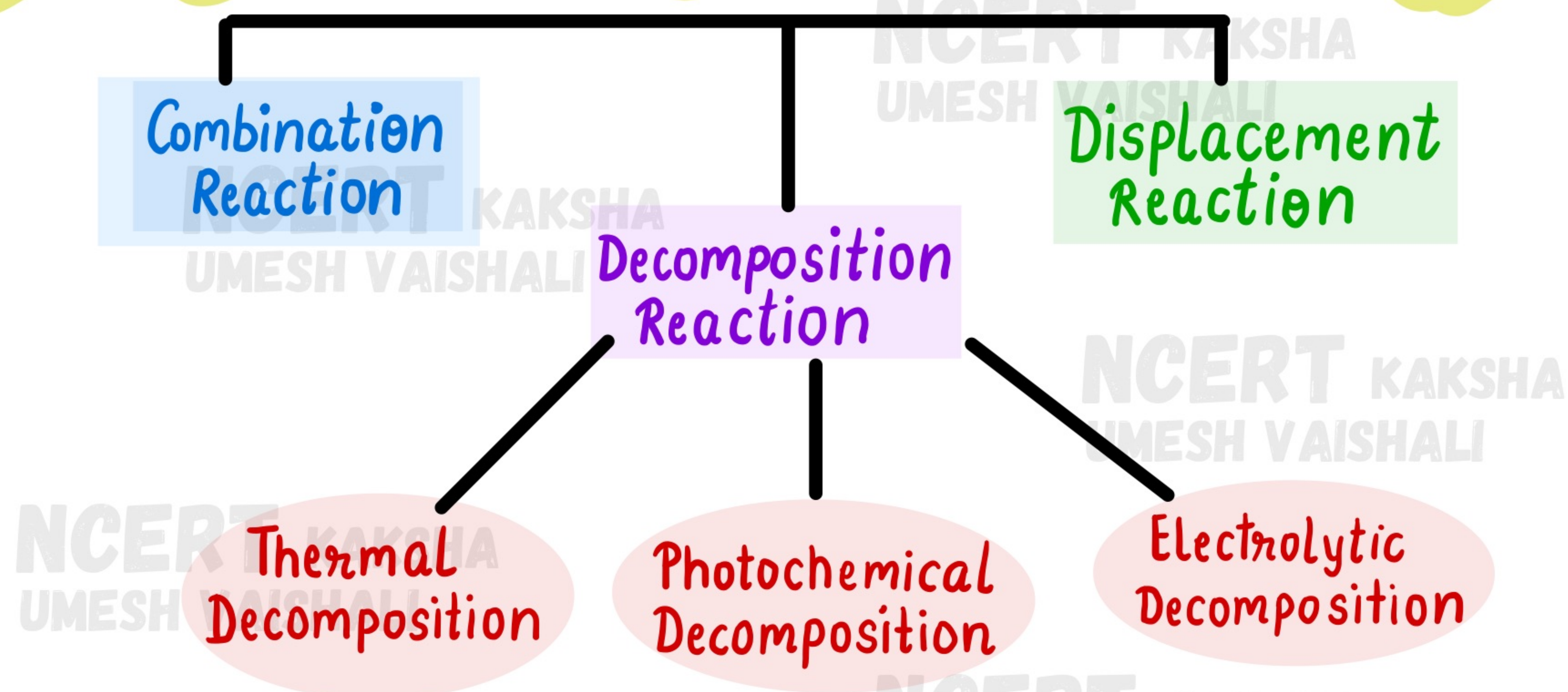
a number of atoms of elements are not equal on two sides of the reaction.

For example; on the left-hand side only one iron atom is present, while three iron atoms are present on the right-hand side. Therefore, it is an unbalanced chemical equation.

NOTE

A Solid substance that has been separated from a liquid in a chemical process. { Denoted as (↓) in reactions }

TYPES OF CHEMICAL REACTIONS



To Make Equations More Informative

Writing the symbols of physical states of substances in a chemical equation :

By writing the physical states of substances , a chemical equation becomes more informative .

- Gaseous state is represented by symbol (g) .
- Liquid state is represented by symbol (l) .
- Solid state is written by symbol (s) .
- Aqueous solution is written by symbol (aq) .
- Writing the condition in which reaction takes place . The condition is generally written above and/or below the arrow of a chemical equation .

→ Combination Reaction

A combination reaction, also called a synthesis or addition reaction, occurs when two or more reactants combine to produce a single product.

General Form: $A + B \rightarrow AB$

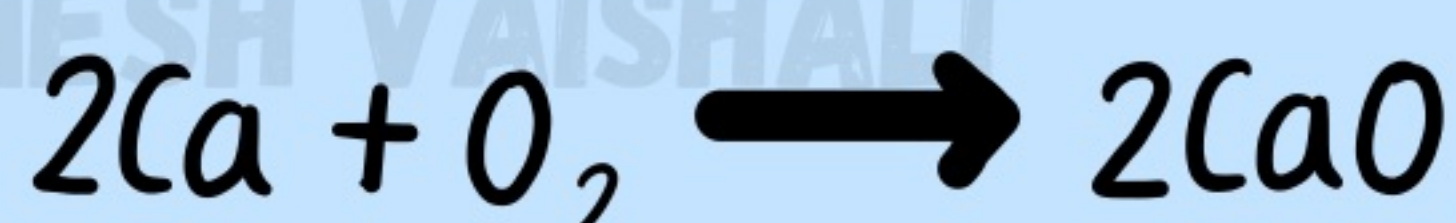
Examples

1. Formation of Water (Hydrogen and Oxygen):



In this reaction, hydrogen gas (H_2) combines with oxygen gas (O_2) to form water (H_2O).

2. Formation of Calcium Oxide (Calcium and Oxygen):



Calcium (Ca) combines with oxygen gas O_2 to form calcium oxide CaO .

→ Decomposition Reaction

A decomposition reaction is a chemical reaction in which a single reactant breaks down into two or more products.

General Form: $AB \rightarrow A + B$

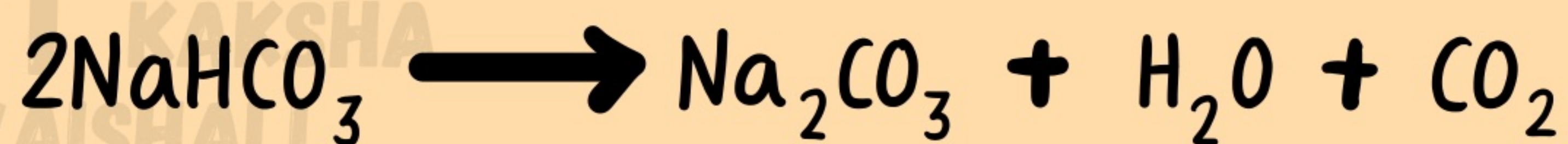
Examples

1. Decomposition of Water (Electrolysis):



In the process of electrolysis, water H_2O decomposes into hydrogen gas H_2 and oxygen gas O_2 .

2. Decomposition of Sodium Bicarbonate (Baking Soda):



Baking soda NaHCO_3 decomposes when heated to form sodium carbonate Na_2CO_3 , water H_2O and carbon dioxide gas CO_2 .

★ Thermal Decomposition

Thermal decomposition is a chemical reaction in which a substance breaks down into simpler substances when heated. The process involves the breakdown due to the absorption of heat, leading to the formation of new compounds or elements.

Example :

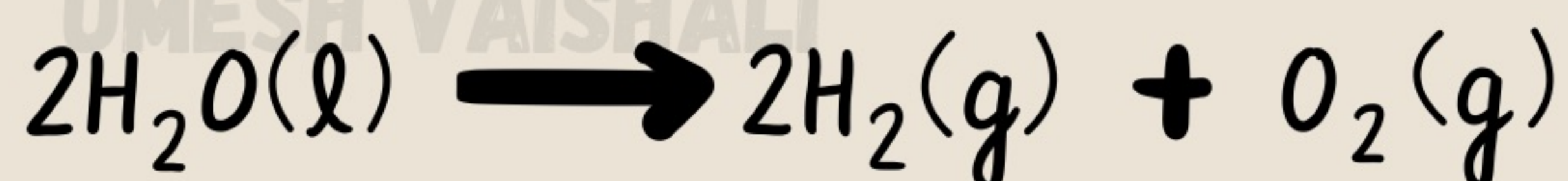


★ Electrolytic Decomposition (Electrolysis):

Electrolysis is this process where an electric current is passed through an electrolyte, causing it to decompose.

PROCESS

- Ions move towards electrodes.
- Oxidation takes place at the anode.
- Reduction occurs at the cathode.
- The electrolyte decomposes into its components.
- Example : Electrolysis of water yields hydrogen and oxygen.



Applications : Extensively utilized in industrial settings for extracting metals and manufacturing chemicals .

★ Photochemical Decomposition (Photosynthesis) :

Photosynthesis is a process in which plants use light energy to convert carbon dioxide and water into glucose and oxygen .

PROCESS

- Chlorophyll absorbs light, facilitating the conversion of CO_2 and H_2O .
- Results in the production of glucose and oxygen .

Equation : $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Light energy} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

→ Exothermic reaction

An exothermic process releases heat, and causes the temperature of the immediate surroundings to rise. The rice, potatoes and bread we eat contain carbohydrates. These carbohydrates are broken down to form glucose. This glucose combines with oxygen in the cells of our body and provides energy. The special name of this reaction is respiration is an exothermic reaction .



→ Endothermic reaction

An endothermic process absorbs heat and cools the surroundings.

The decomposition of vegetable matter into compost is also an example of an endothermic reaction.

→ Displacement Reaction

A displacement reaction is a chemical reaction in which a more reactive element displaces a less reactive element from its compound.

Examples

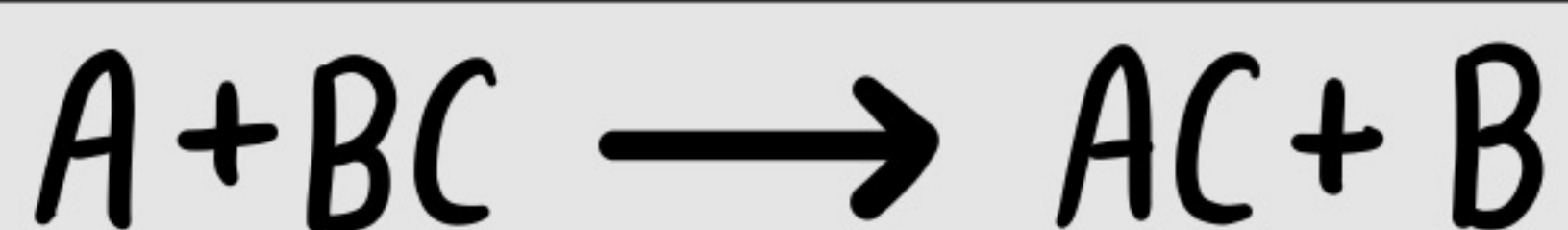


NOTE

Displacement reaction series hisab se hota hai jo reactivity Series me upar hai vo niche wale ko displace kar deta hai

1. Single Displacement:

A single displacement reaction is a chemical reaction in which an element replaces another element in a compound, resulting in the formation of a new compound and a different element.



Examples :



2. Double Displacement :

A double displacement reaction is a chemical reaction in which two compounds exchange ions to form two new compounds. This typically involves the exchange of positively charged ions (cations) or negatively charged ions (anions) between the reactants, resulting in the formation of two different compounds.



Examples :



→ Oxidation Reaction

★ Understanding Oxidation:

Oxidation is a fundamental chemical process where in a substance undergoes electron loss, an increase in its oxidation state, or a rise in the number of oxygen atoms associated with it.

★ Key Points about Oxidation:

- ★ Electron Loss: Oxidation involves the loss of electrons by a substance.
- ★ Oxidation State: The oxidation state of the substance increases during oxidation.
- ★ Combination with Oxygen: Oxidation may entail the addition of oxygen to a substance.

★ jo reduce ho jaye vo
Oxidising agent

★ jo oxidise ho jaye to
reducing agent.

★ Example of Oxidation :

An illustration of oxidation is the reaction $2\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$ where iron combines with oxygen to produce iron(III) oxide.

★ Importance of Oxidation :

Oxidation is a vital process in various chemical reactions, playing crucial roles in phenomena like combustion and corrosion.

➔ Reduction Reaction

★ Definition of Reduction :

Reduction is a chemical process wherein a substance gains electrons, reduces its oxidation state or experiences a decrease in the number of oxygen atoms.

★ Key Points about Reduction :

♦ **Electron Gain** : Reduction involves the gaining of electrons by a substance.

♦ **Oxidation State** : The oxidation state of the substance decreases during reduction.

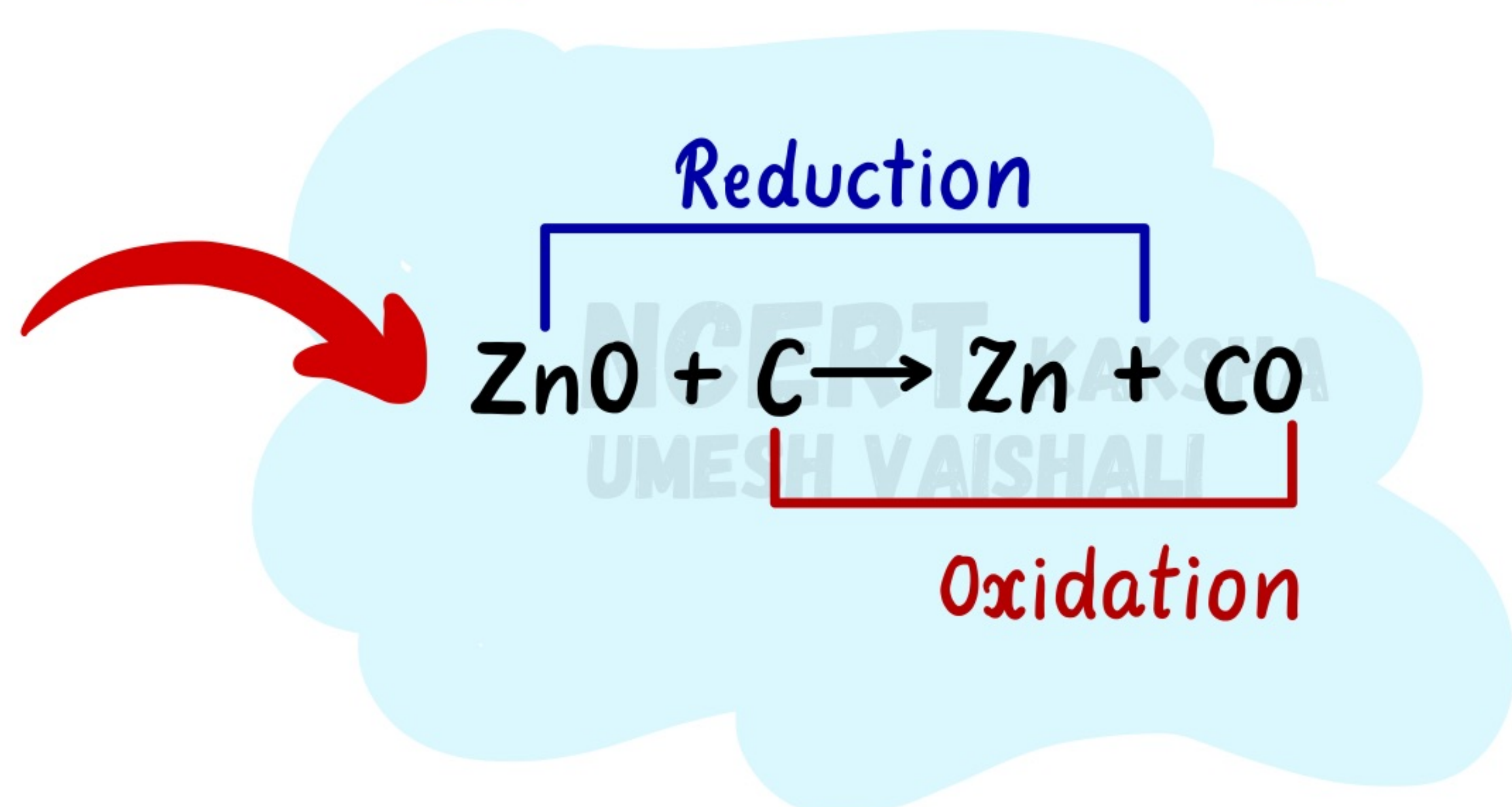
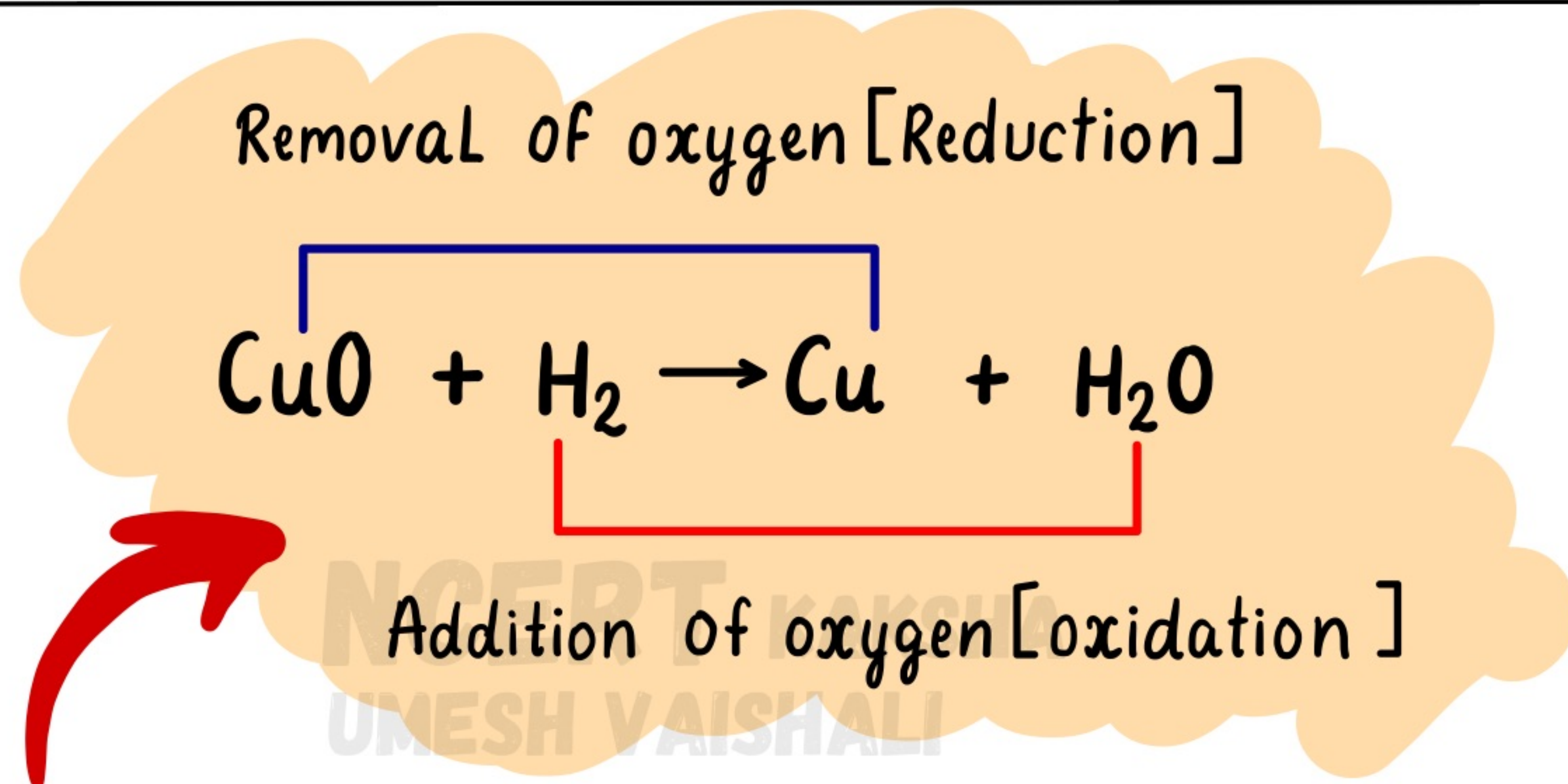
♦ **Removal of Oxygen** : Reduction can entail the removal of oxygen from a substance.

★ Example of Reduction :

In the reaction $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$, copper oxide is reduced by gaining hydrogen to form copper and undergoes water.

Example :

- * Substance Oxidised - H
- * Substance reduced - CuO
- * Oxidising agent CuO
- * Reducing agent - H
- * Substance oxidised - C
- * Substance reduce - Zn
- * Oxidising agent - ZnO
- * Reducing agent - C

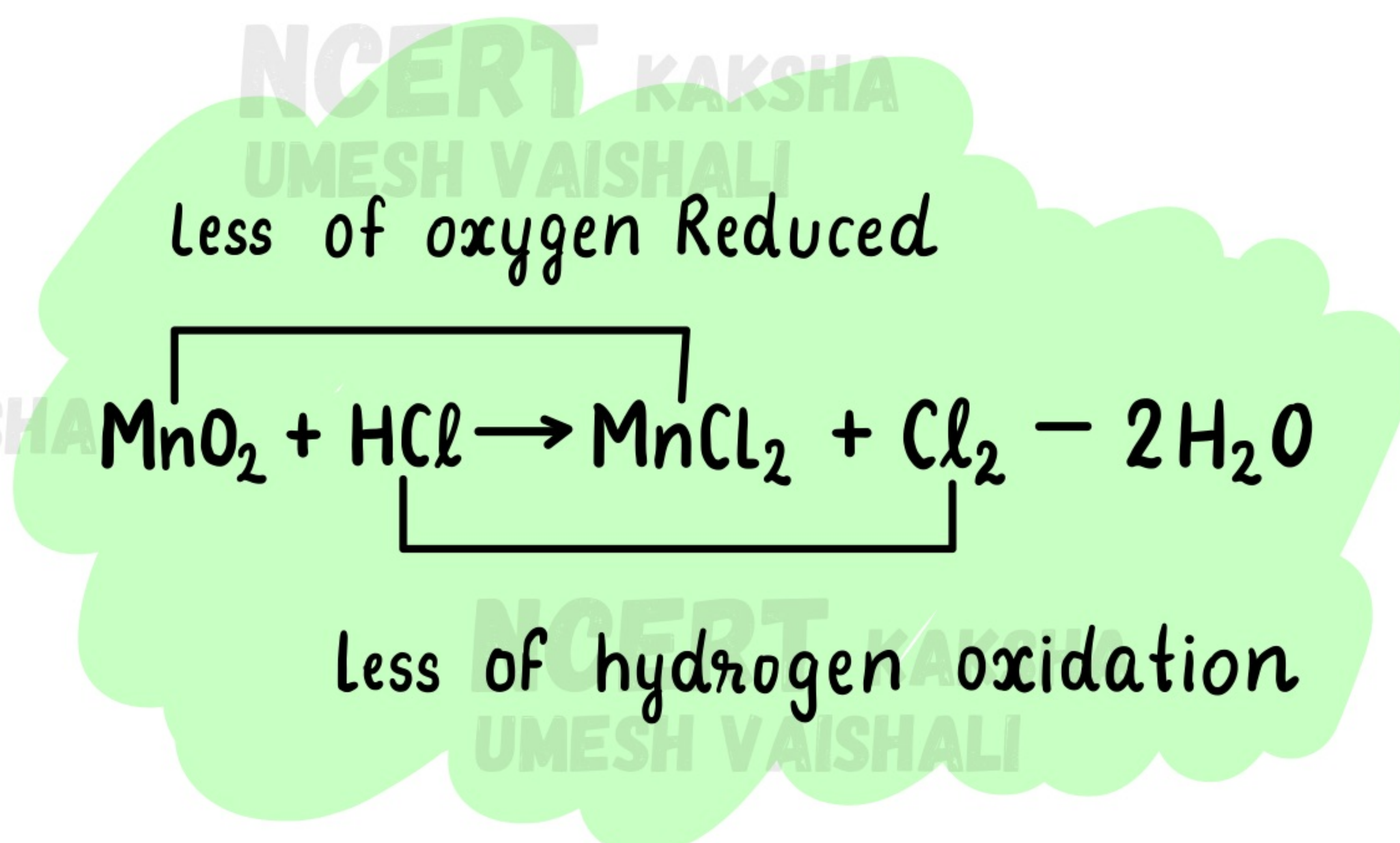


→ Redox Reaction

In a redox reaction, one substance gains electrons (reduction) while another loses electrons (oxidation). This exchange involves electron transfer between the reactants. For instance, in the reaction $\text{Zn} + \text{Cu}_2^+ \rightarrow \text{Zn}^{2+} + \text{Cu}$, zinc loses electrons (oxidation) and copper ions gain electrons (reduction).

Example :

- * Substance Oxidised - HCl
- * Substance reduced - MnO_2
- * Oxidising agent - MnO
- * Reducing agent - HCl



→ 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.

→ 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 containers and by flushing out air with nitrogen

