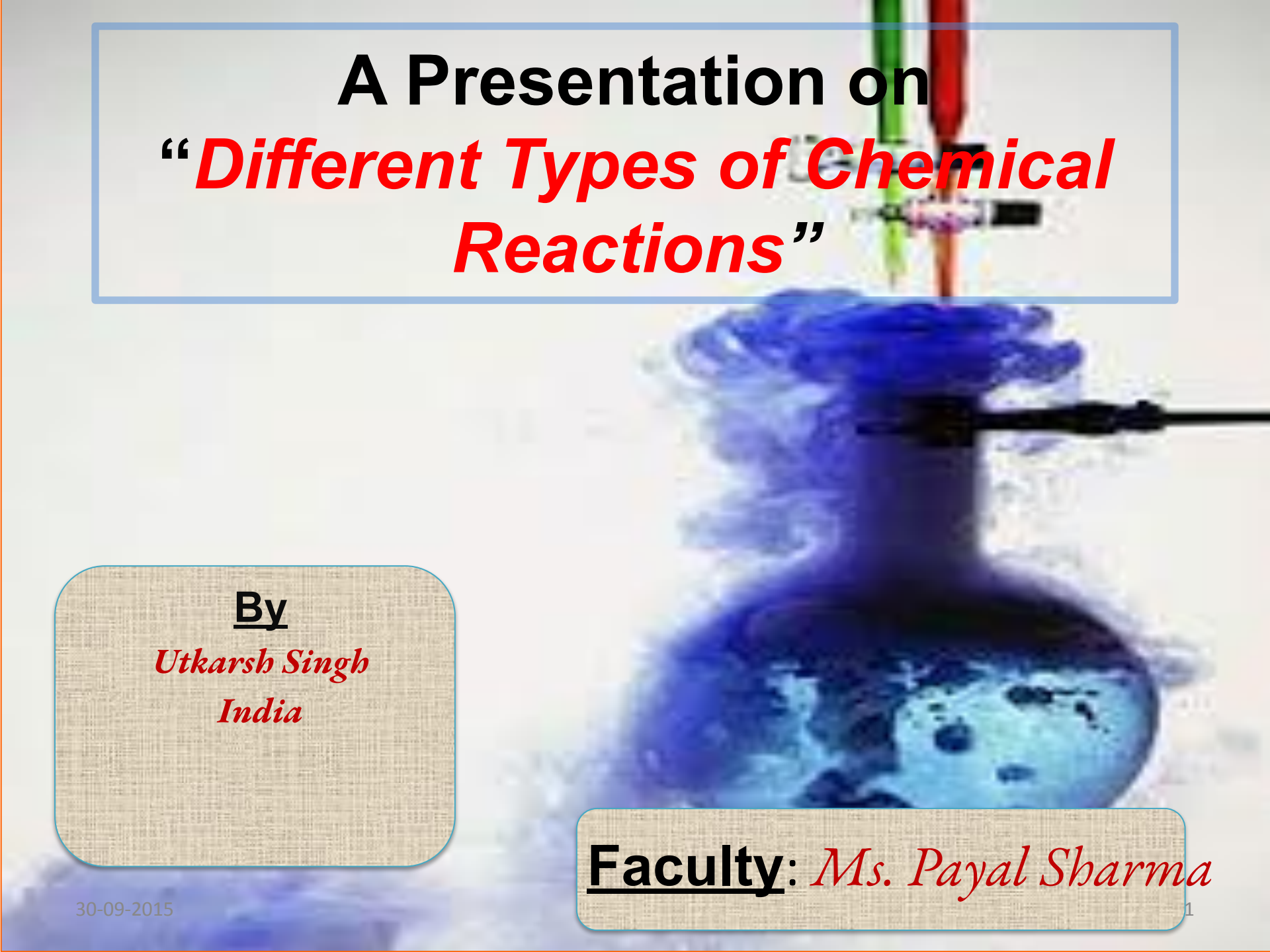
A Presentation on

"*Different Types of Chemical Reactions*"



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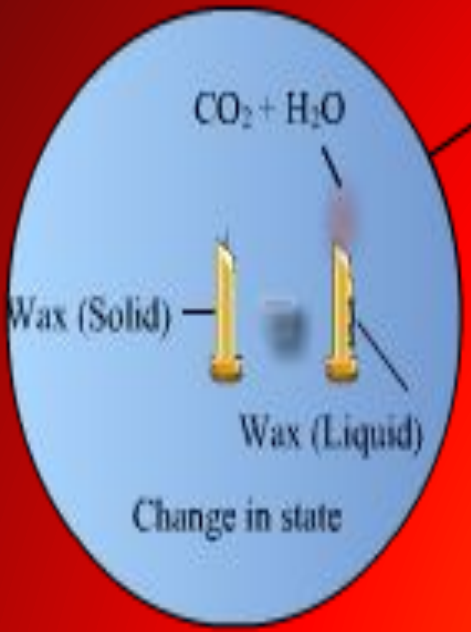
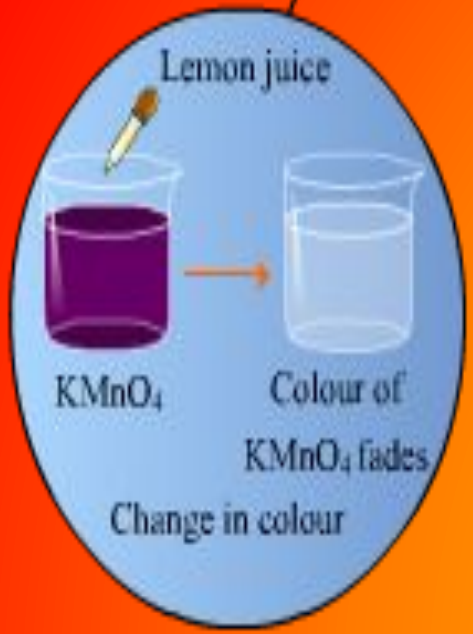
Chemical changes

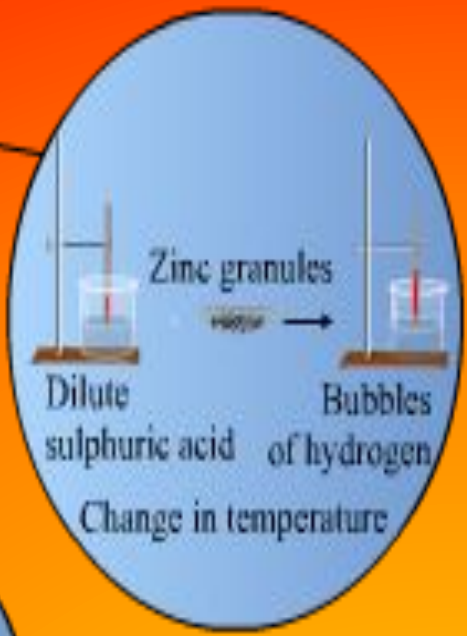
The formation of new substances takes place with different chemical properties is called chemical changes. A chemical change can be confirmed by any or all of the following observations:

- change in state
- change in color
- change in temperature
- evolution of gas

Characteristics of chemical reaction







Examples of Chemical Change

What is Chemical Reaction?

- The change of one or more substances into other substances having different composition and properties is called a chemical reaction.

Example:

$$C(s) + O_2(g) \longrightarrow CO_2(g)$$

$$2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)$$

- **In a chemical reaction, the substances which react together are called reactants whereas the new substances formed are called products.**

Reactants ⟶ Product

Different types of chemical reaction

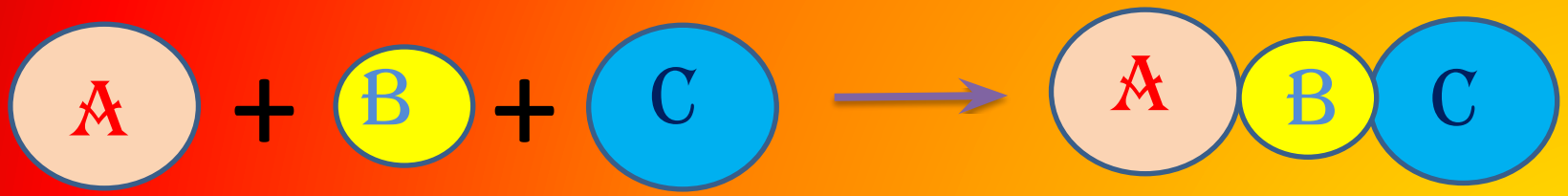
- Combination reactions
- Decomposition reactions
- Displacement reactions
- Double-displacement reactions
- Oxidation-reduction reactions
- Precipitation reactions
- Exothermic and endothermic reactions

Combination Reaction

- What is combination reaction?

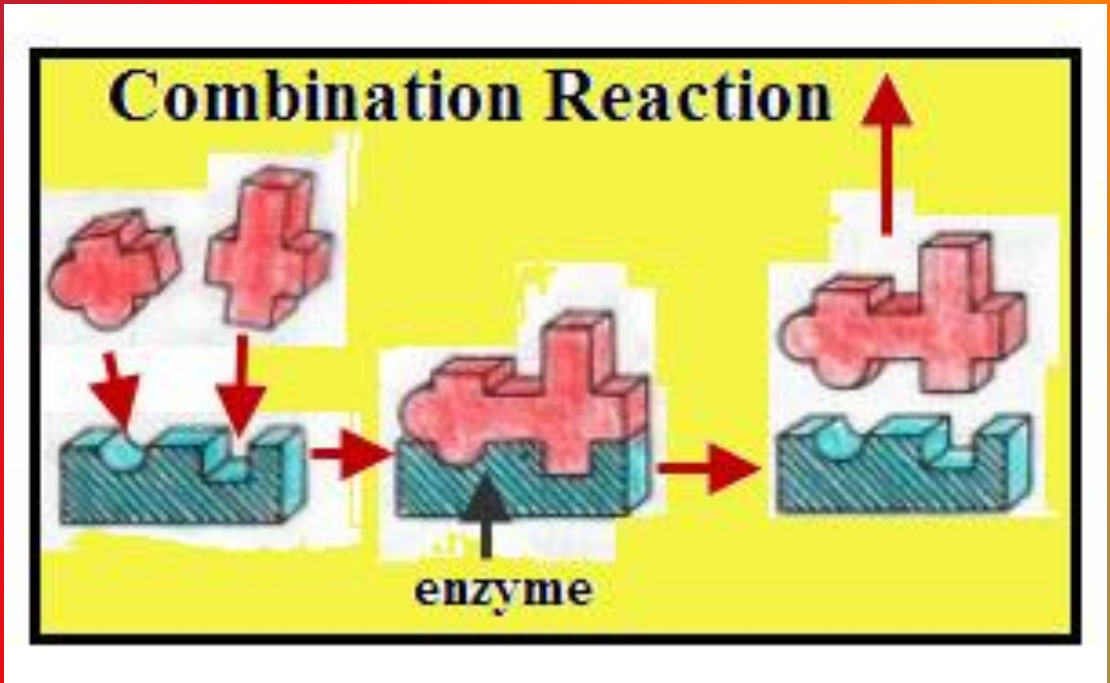
- A reaction in which two or more substances (elements or compounds) combine together to form a new substance is called a combination reaction.

- Many combustion reaction are also examples of combination reaction.



where A,B,C and ABC represent elements or compounds

- Examples:
  - $H_2(g) + Cl_2(g) \longrightarrow 2HCl(l)$
  - $Mg(s) + Cl_2(g) \longrightarrow MgCl_2(s)$
  - $Fe(s) + S(s) \longrightarrow FeS\ (s)$
  - $MgO(s) + H_2O(l) \longrightarrow Mg(OH)_2\ (aq)$

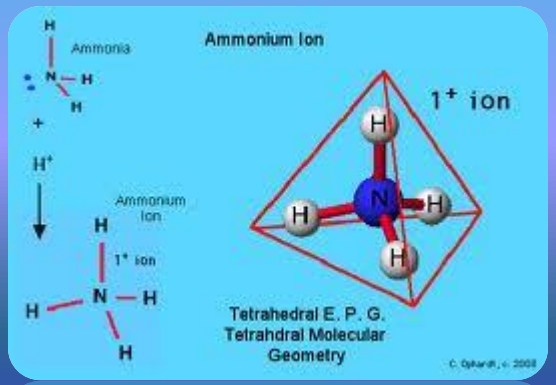


- Synthesis Reaction:
  - » The combination reaction in which a compound is formed from its constituent elements is called "*synthesis reaction*".

Example:

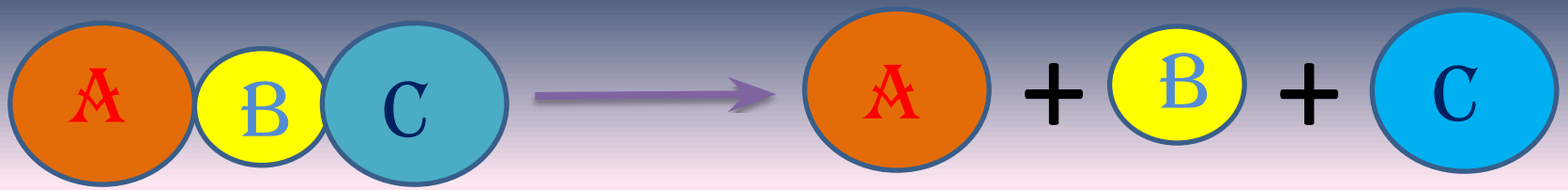
- ***Synthesis of ammonia (NH_3)***

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$



Decomposition Reaction

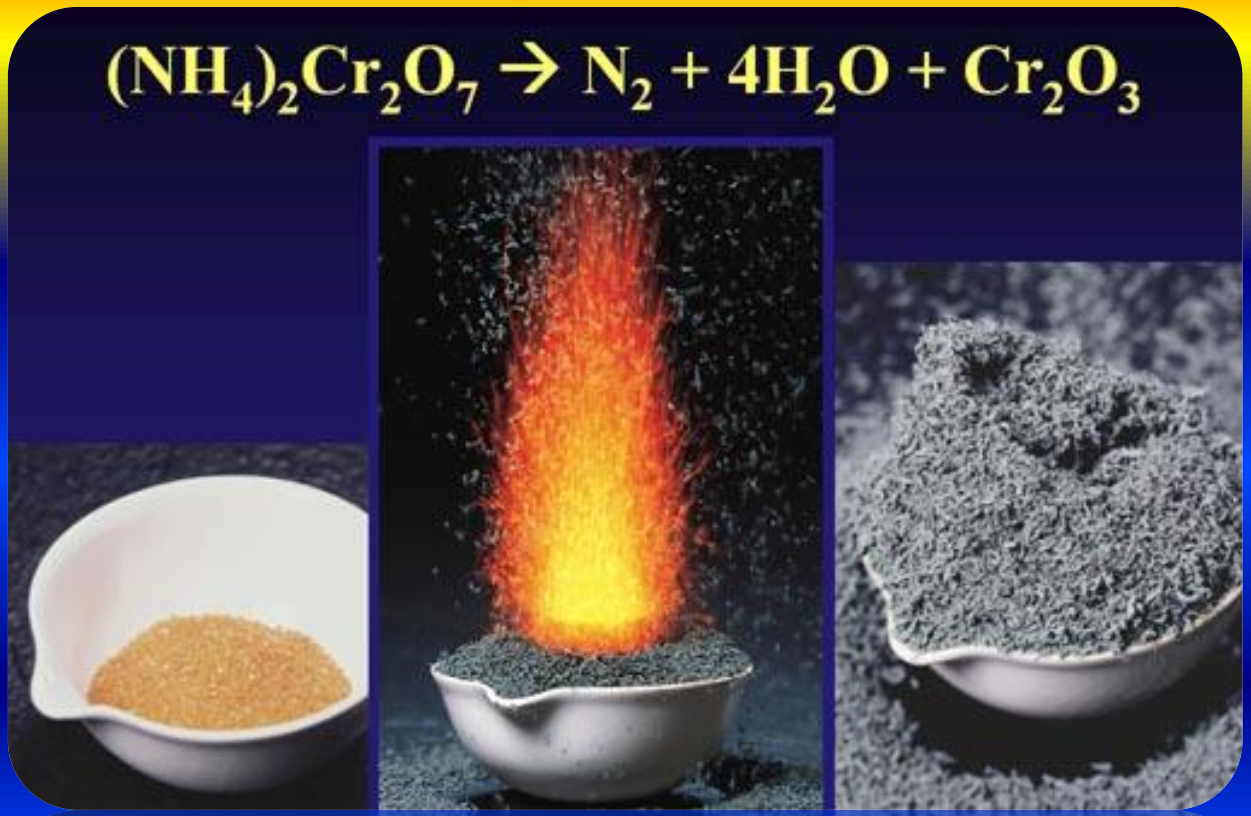
- What is decomposition reaction?
  - A reaction in which a substance is broken down into two or more simpler substances is known as decomposition reaction.
  - A decomposition reaction is opposite of combination. A decomposition reaction takes place only when some energy in form of heat, light or electricity is supplied to the reactant.



where A,B,C and ABC represent an element or compound .

- Various types of decomposition reactions
  1. Thermal decomposition reaction
     - Decomposition caused by heating
  2. Electrolytic decomposition (electrolysis) reaction
     - Decomposition reaction caused by electricity
  3. Photodecomposition reaction
     - Decomposition reaction caused by light

- Examples:
  - $ZnCO_3(g) \xrightarrow{\Delta} ZnO(s) + CO_2(g)$
  - $2H_2O(l) \xrightarrow{\text{electrolysis}} 2H_2(g) + O_2(g)$
  - $CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2(g)$
  - $2H_2O_2(l) \xrightarrow{UV} 2H_2O(l) + O_2(g)$



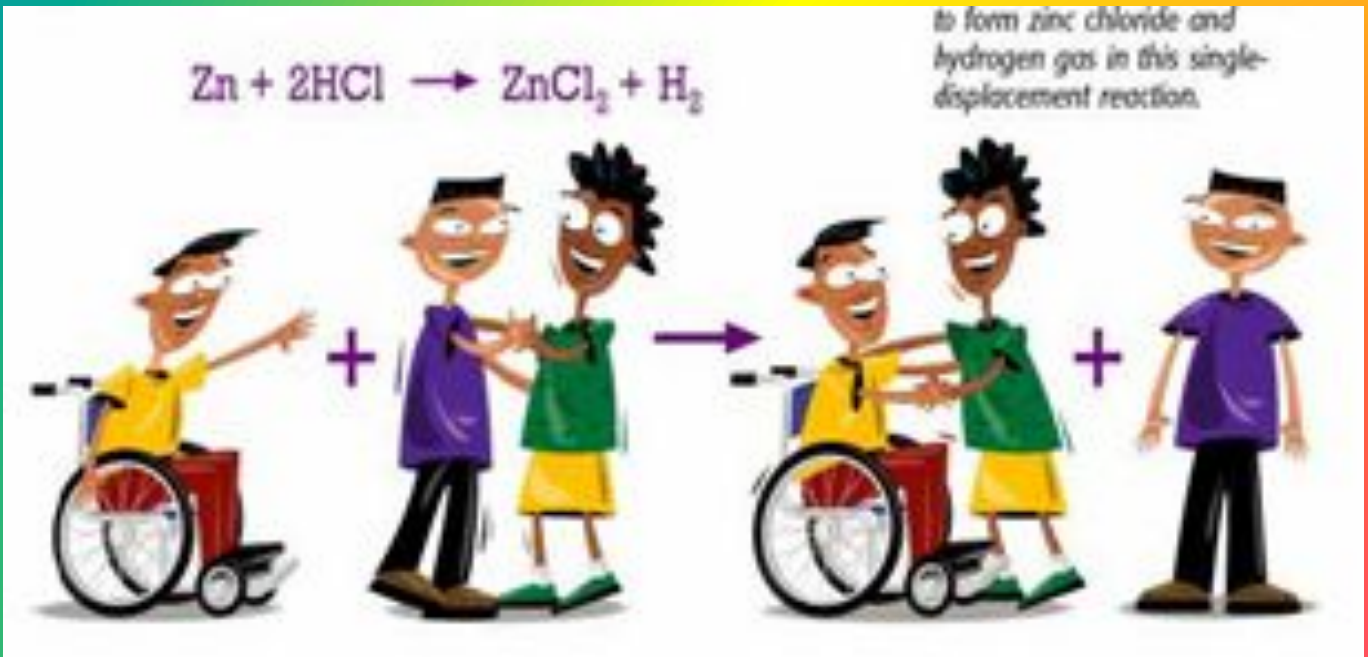
Displacement Reaction

❖ What is displacement reaction?

- A reaction in which one part (an atom or a group of atoms) of a molecule is replaced by another is called a displacement reaction.

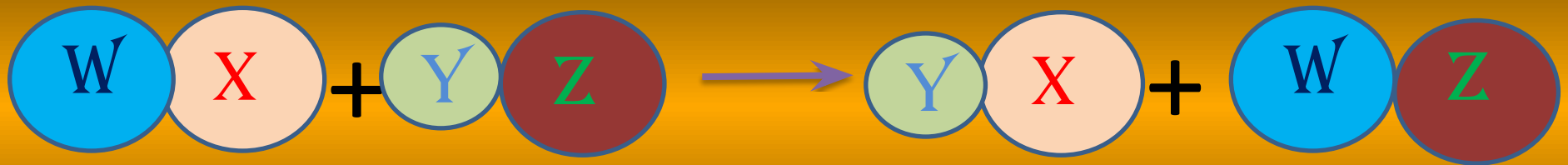
where X,Y,Z represent an element or compound .

- Examples:
  - $Zn(s) + 2HCl(dil) \longrightarrow ZnCl_2(aq) + H_2(g)$
  - $2KBr(aq) + Cl_2(aq) \longrightarrow 2KCl(aq) + Br_2(aq)$
  - $CuSO_4(aq) + Zn(s) \longrightarrow Cu(s) + ZnSO_4(aq)$
  - $Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$



Double-displacement Reaction

- What is double-displacement reaction?
  - A reaction in which the two reacting ionic compounds exchange their corresponding ions is called a double-displacement reaction.

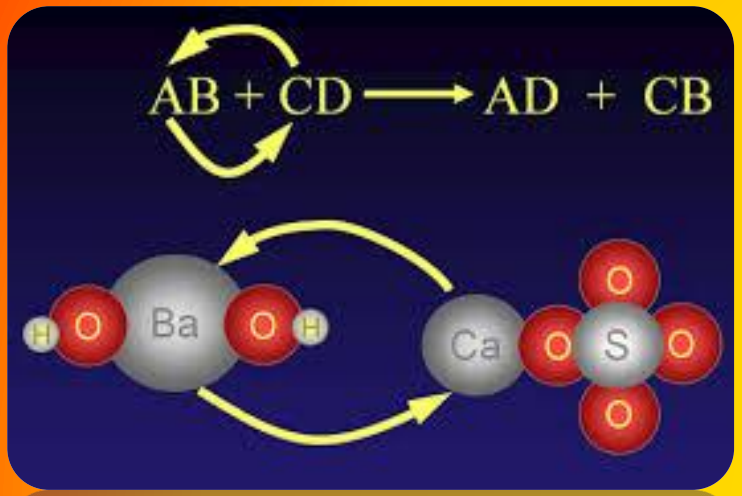


where W,X,Y,Z represent an element or compound .

- Examples:
  - $AgNO_3(aq) + NaCl(aq) \longrightarrow AgCl(s)\downarrow + NaNO_3(aq)$

    precipitate
  - $Ni(NO_3)_2\ (aq) + 2NaOH\ (aq) \longrightarrow Ni(OH)_2(s)\downarrow + NaNO_3(aq)$

    precipitate
  - $2KBr(aq) + BaI_2\ (aq) \longrightarrow 2KI(aq) + BaBr(aq)$
  - $Pb(CH_3COOH)_2(aq) + 2HCl(aq) \longrightarrow PbCl_2(s) + CH_3COOH(aq)$



Oxidation-Reduction Reaction

- What do you mean by oxidation-reduction reaction?
  - *Oxidation* reaction: any process involving addition of oxygen, removal of hydrogen and/or loss of electron is known as oxidation reaction.
  - Example:

Addition of oxygen

- $P_4(s) + 5O_2(g) \longrightarrow 2P_2O_5(s)$ *(oxidation of P_4)*

Removal of hydrogen

- $H_2S(aq) + Br_2(aq) \longrightarrow 2HBr(aq) + S(s)$ *(oxidation of H_2S)*

Loss of electron

- $Al(s) \longrightarrow Al^{3+}(aq) + 3e^-$ *(oxidation of Al)*

- *Oxidising agent* : The substance which brings about oxidation of other substances is called an oxidising agent.
  - Example: *1. $KMnO_4$ (potassium permanganate)*

2 .H_2SO_4 (conc. sulphuric acid)

- <u>*Reduction* reaction</u>: any process involving removal of oxygen, addition of hydrogen and/or gain of electron is known as reduction reaction.
- Example:

<u>Removal of oxygen</u>

$Fe_2O_3(s) + 3CO(g) \xrightarrow{\Delta} Fe(s) + 3CO_2(g)$ *(reduction of Fe_2O_3)*

<u>Addition of hydrogen</u>

$H_2S(aq) + Cl_2(g) \longrightarrow 2HCl(aq) + S(s)$ *(reduction of Cl)*

<u>Gain of electron</u>

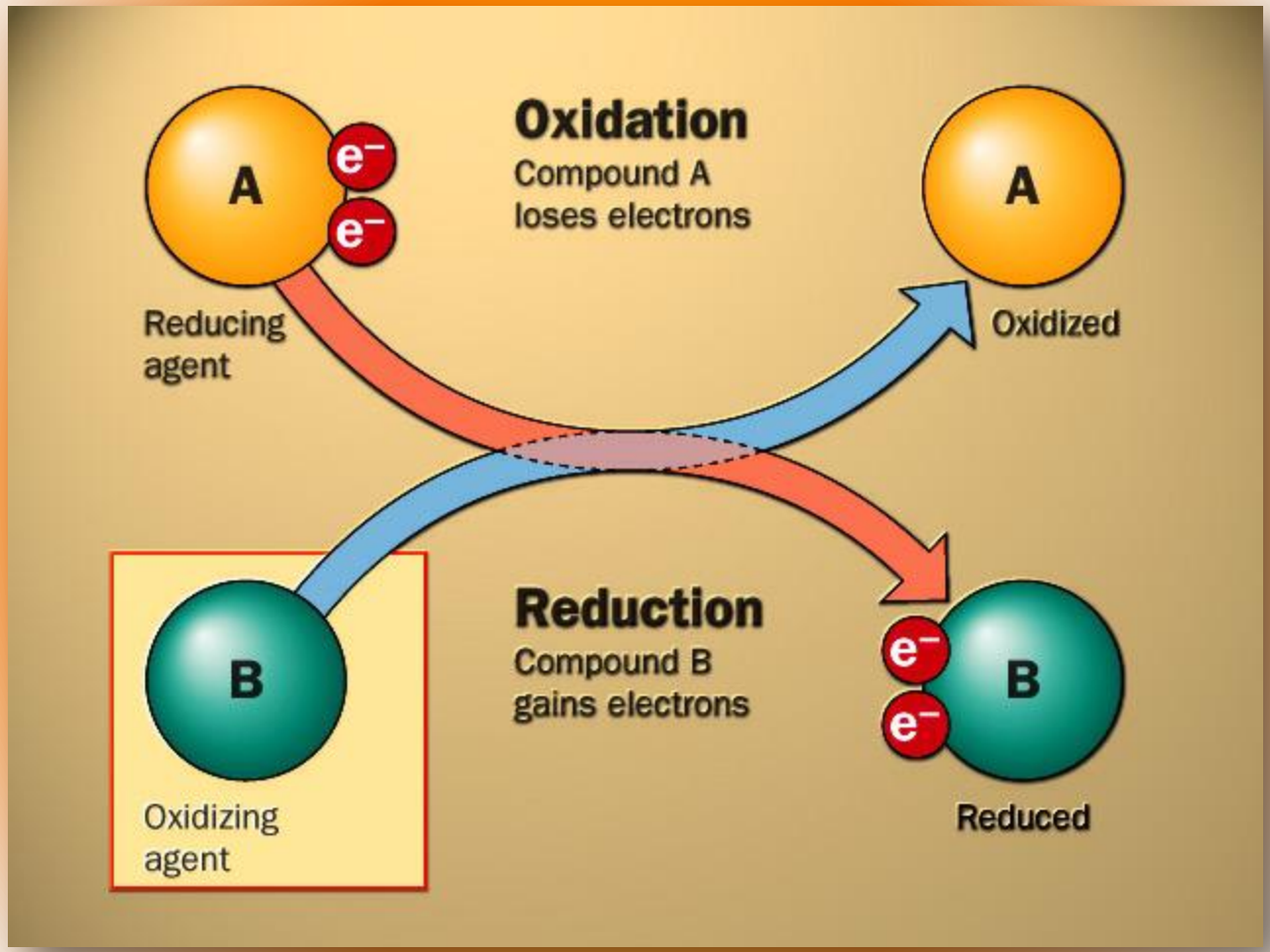
$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$ *(reduction of Cu^{2+})*

- *Reducing* agent: The substance which brings about reduction of other substance is called a reducing agent.
  - Example: *1. H_2 (hydrogen)*

2.SO_2 (sulphur dioxide)

- "Reduction is the reverse of oxidation"

- "Oxidation and reduction are mutually dependent, i.e. oxidation and reduction are reciprocal. Thus, in a reaction if a substance oxidises, another reduces."


A
e⁻
e⁻
Reducing agent
Oxidation
Compound A loses electrons
A
Oxidized
B
Oxidizing agent
Reduction
Compound B gains electrons
e⁻
e⁻
B
Reduced

Precipitation Reaction

- What is precipitation reaction?
  - The reaction in which one of the products formed is an insoluble substance and is thrown out of the solution as a solid (called precipitate) is called precipitation reaction.
  - The formed precipitate is indicated by a downward arrow(↓).

- Examples:
  - $AgNO_3(aq) + KCl(aq) \longrightarrow AgCl(s)\downarrow + KNO_3(aq)$
    precipitate
  - $Pb(NO_3)_2\ (aq) + 2KI(aq) \longrightarrow PbI_2(s)\downarrow + 2KNO_3(aq)$
    precipitate
  - $BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s)\downarrow + 2NaCl(aq)$
    precipitate
  - $LiBr(aq) + AgNO_3(aq) \longrightarrow LiNO_3(aq) + AgBr(s)\downarrow$
    precipitate

Exothermic and Endothermic Reaction

❖ What do you mean by exothermic and endothermic reaction?

- Reaction which is accompanied by evolution of heat is known as exothermic reaction whereas reaction accompanied by absorption of heat is known as endothermic reaction.

✔ Melting of ice is an endothermic reaction

✔ Freezing of water is an exothermic reaction

 Exothermic and endothermic are reverse of each other.

- Example:
  - $H_2O(s)$ + *heat* ⟶ $H_2O(l)$ *(endothermic)*
  - $C(s) + H_2O(v)$ + *heat* ⟶ $CO(g) + H_2(g)$ *(endothermic)*

  - $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ + *heat (exothermic)*
  - $H_2(g) + O_2(g)$ ⟶ $H_2O(g)$ + *heat* *(exothermic)*

Exothermic reaction

Endothermic reaction

A presentation by Utkarsh Singh