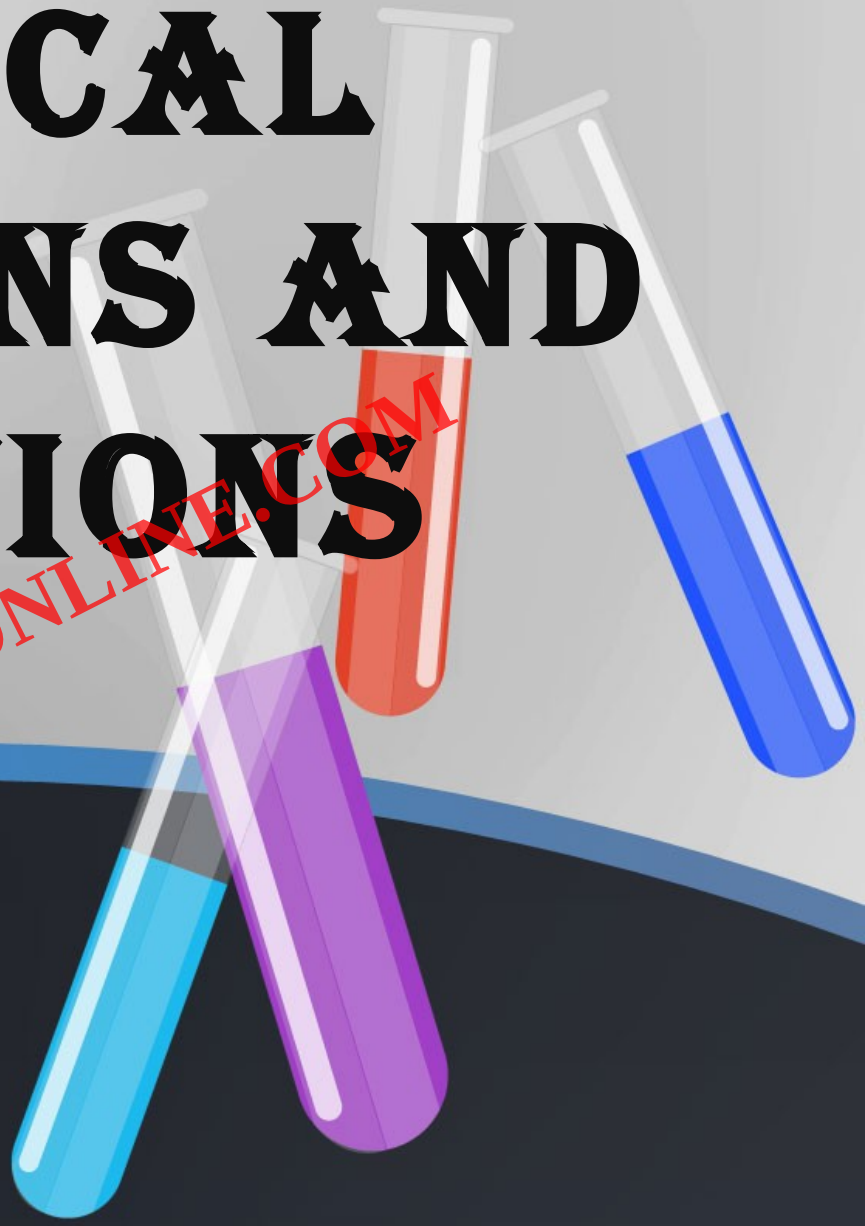
CHEMICAL REACTIONS AND EQUATIONS



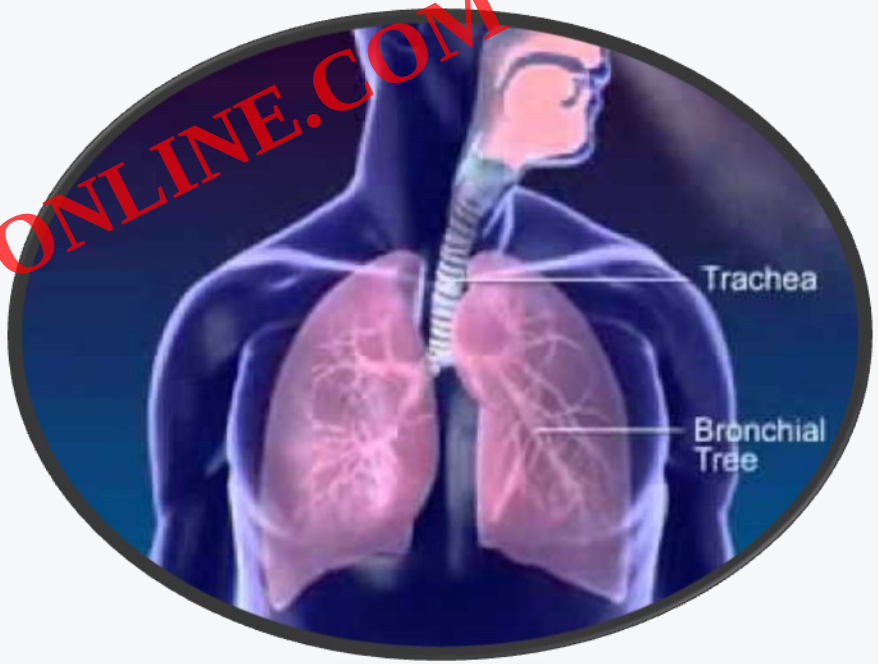
CHEMICAL REACTIONS

- A **chemical reaction** is a process that leads to the transformation of one set of chemical substances to another.
- Classically, chemical reactions encompass changes that only involve the positions of electrons in the forming and breaking of chemical bonds between atoms, with no change to the nuclei, and can often be described by a chemical equation.

CHEMICAL REACTIONS ARE EVERY WHERE

COOKING

RESPIRATION



CHEMICAL REACTIONS ARE EVERY WHERE

RUSTING

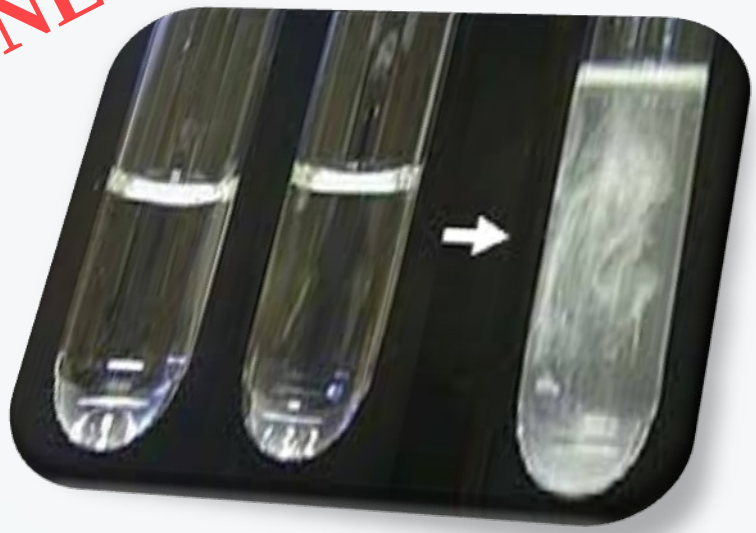
FORMATION OF CURD

Indications of a Chemical Reaction

- CHANGE IN COLOUR
- EVOLUTION OF GAS

- CHANGE IN TEMPERATURE

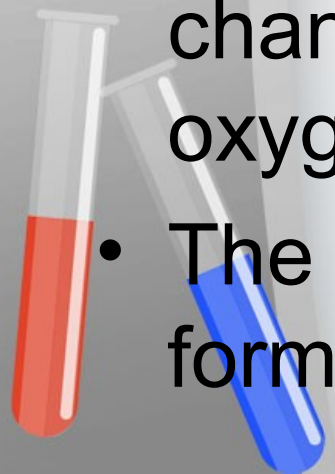
- FORMATION OF PRECIPITATION



CHEMICAL EQUATION

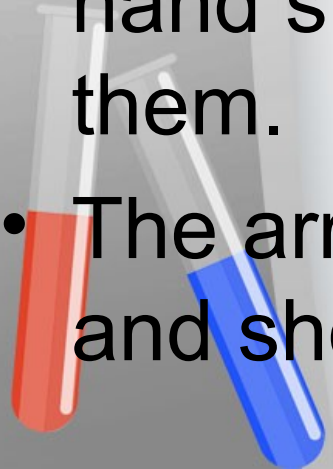
- A **chemical equation** is the symbolic representation of a chemical reaction in the form of symbols and formulae.
- ex:-

  magnesium + oxygen = magnesium oxide
- The substances that undergo chemical change in the reaction (magnesium and oxygen) are the reactants.
- The new substances (magnesium oxide) formed during the reactions is the product.



WORD EQUATION

- A word – equation shows change of reactants to products through an arrow placed between them.
- The reactants are written on the left - hand side (LHS) with a plus sign between them.
- Similarly , products are written on the right hand side (RHS) with a plus sign between them.
- The arrowhead points towards the products, and shows the direction of the reactions.



SKELETAL EQUATION

- Skeletal equation are those equation which shows the reactant and product so formed without balancing them.
- Example :-

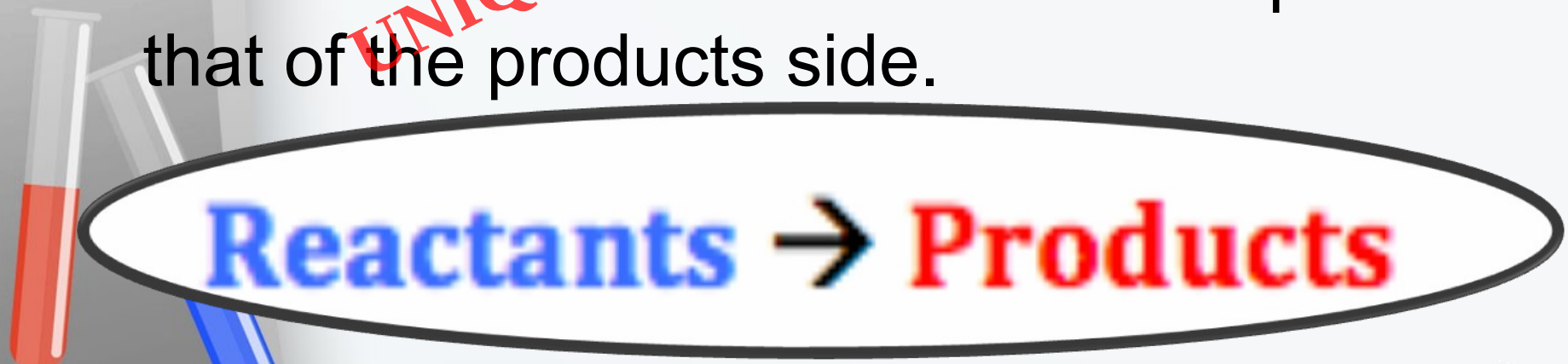
$Mg + O_2 \longrightarrow MgO$

$H + O \longrightarrow H_2O$

- It is also known as unbalanced equation.

Balanced Equation

- The chemical equation needs to be balanced so that it follows the law of conservation of mass.
- A balanced chemical equation occurs when the number of the different atoms of elements in the reactants side is equal to that of the products side.

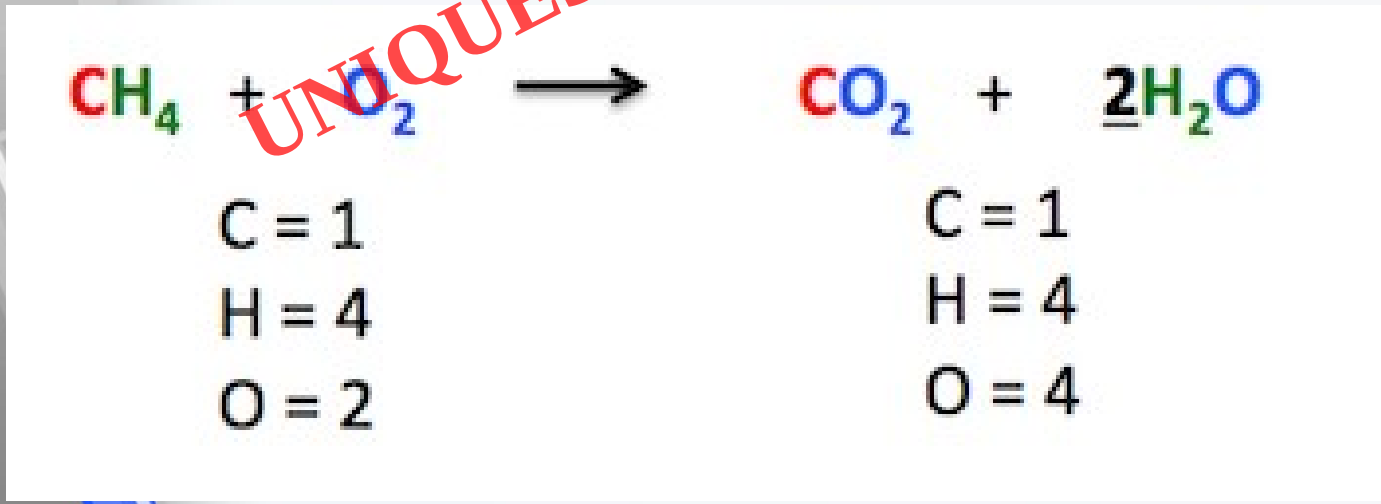


How to balance a equation

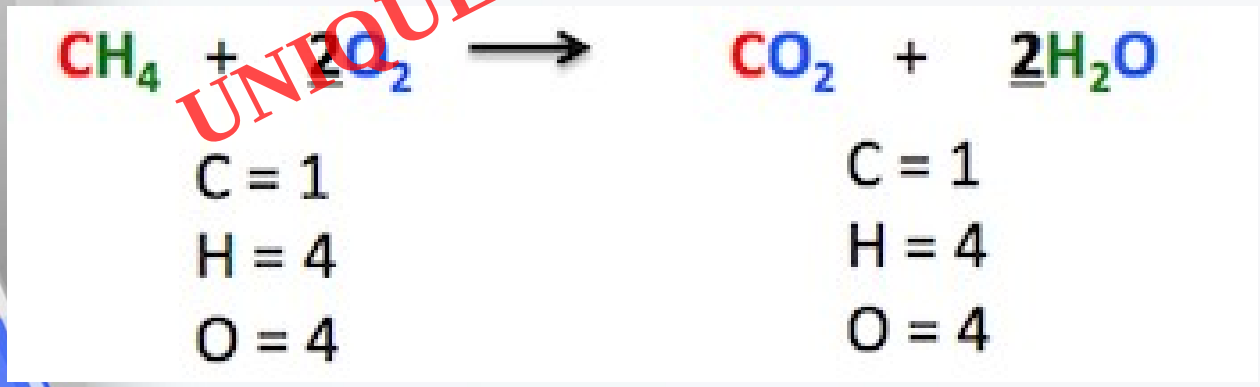
- This is a reaction between methane (CH4) and oxygen (O2), producing carbon dioxide (CO2) and water (H2O)

- The reaction shown is a combustion reaction: a compound reacts with oxygen and produces carbon dioxide and water. The technique is to balance the carbon (C) atoms first, then the hydrogen (H) atoms, and then the oxygen (O) atoms.

- In this case, the carbon (C) atoms are already balanced. So now we look at the hydrogen (H) atoms. There are 4 hydrogen (H) atoms on the reactants side and 2 hydrogen (H) atoms on the products side. To balance them, we put a coefficient of 2 in front of H_2O.



- The hydrogen (H) atoms are now balanced. Due to the coefficient 2 in front of H2O, there are a total of 4 oxygen (O) atoms on the products side. To balance the oxygen atoms on both sides, we put a coefficient of 2 in front of O2. The chemical equation is now balanced.



Writing Symbols of Physical States

- The physical states of the reactants and products are mentioned along with their chemical formulae.
- The gaseous, liquid, aqueous, and solid states of reactants and products are represented by the notations (g), (l), (aq), and (s), respectively.
- Sometimes the reaction conditions , such as temperature, pressure, catalyst etc are indicated above or below the arrow in the equation

EXAMPLES

$$C_2H_4(g) + H_2(g) \xrightarrow[250^0C - 300^0C]{Ni} C_2H_6(g)$$

Ethylene + Hydrogen → Ethane

$$N_2(g) + O_2(g) \xrightarrow{At\ 3000^0C} NO(g)$$

Nitrogen + Oxygen → Nitric Oxide

$$CO_2(g) + H_2O(l) \xrightarrow[Sunlight]{Chlorophyll} C_6H_{12}O_6(s) + O_2(g)$$

Carbon dioxide + Water → Glucose + Oxygen

$$NH_4NO_3(s) \xrightarrow{\Delta\ 170^0C - 240^0C} N_2O(g) + 2H_2O(l)$$

Ammonium Nitrate → Nitrous Oxide + Water


TYPES OF CHEMICAL REACTION
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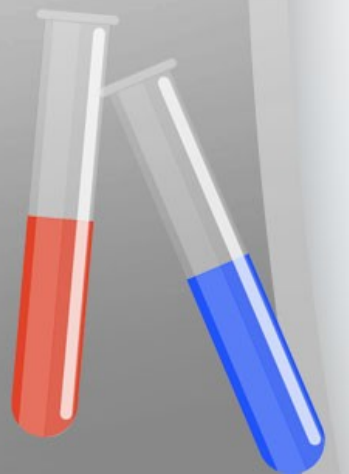
TYPES OF CHEMICAL REACTION

- COMBINATION REACTION
- DECOMPOSTION REACTION
- DISPLACEMENT REACTION
- DOUBLE DISPLACEMENT REACTION
- OXIDATION AND REDUCTION/REOX REACTION

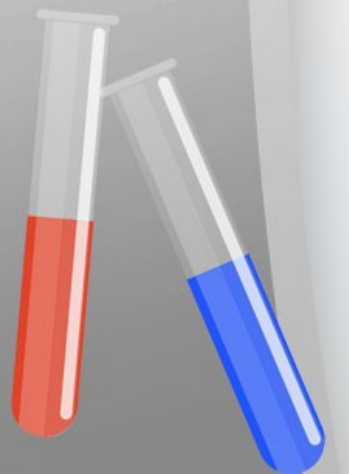
COMBINATION REACTION

- In combination reaction , two or more substances combine to form a new substance
- For example –
- $C(s) + O_2(g) \longrightarrow CO_2(g)$
- $2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)$



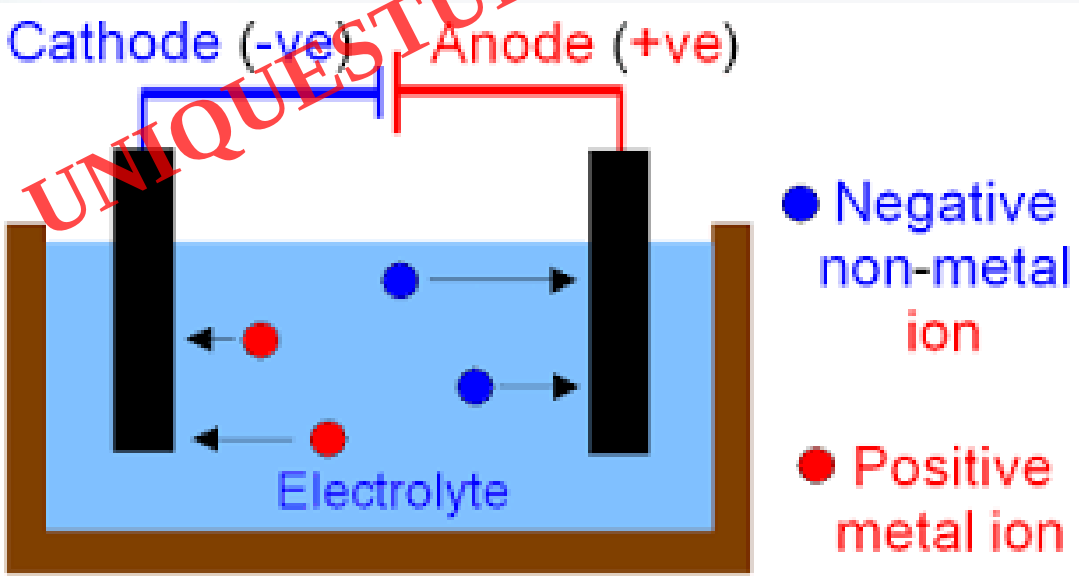
DECOMPOSITION REACTION

- In a decomposition reaction , a single compound breaks down to produce two or more similar substences.
- The decomposition reactions take place when energy is supplied in the form of heat , electricity or light.



ELECTROLYSIS

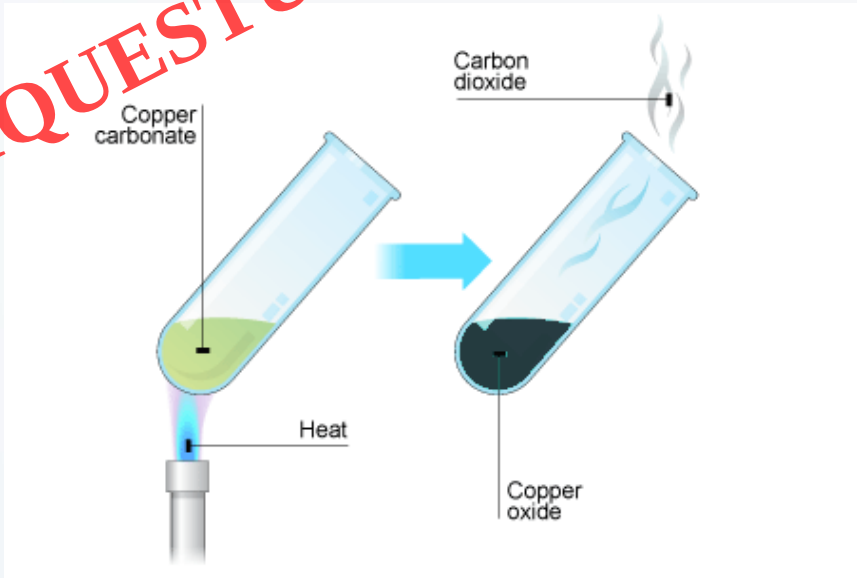
- When a substance is decomposed by passing electric current, the process is called electrolysis.
- $2H_2O(l) \longrightarrow 2H_2(g) + O_2(g)$



THERMAL DECOMPOSITION

- When a substance decomposes on heating it is called thermal decomposition.

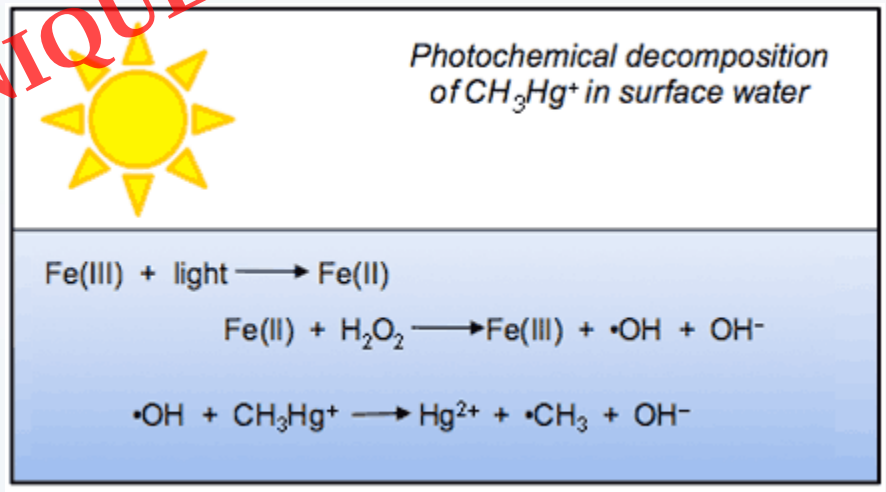
- $CaCO_3(S) \longrightarrow CaO(S) + CO_2(g)$



PHOTOCHEMICAL DECOMPOSITION

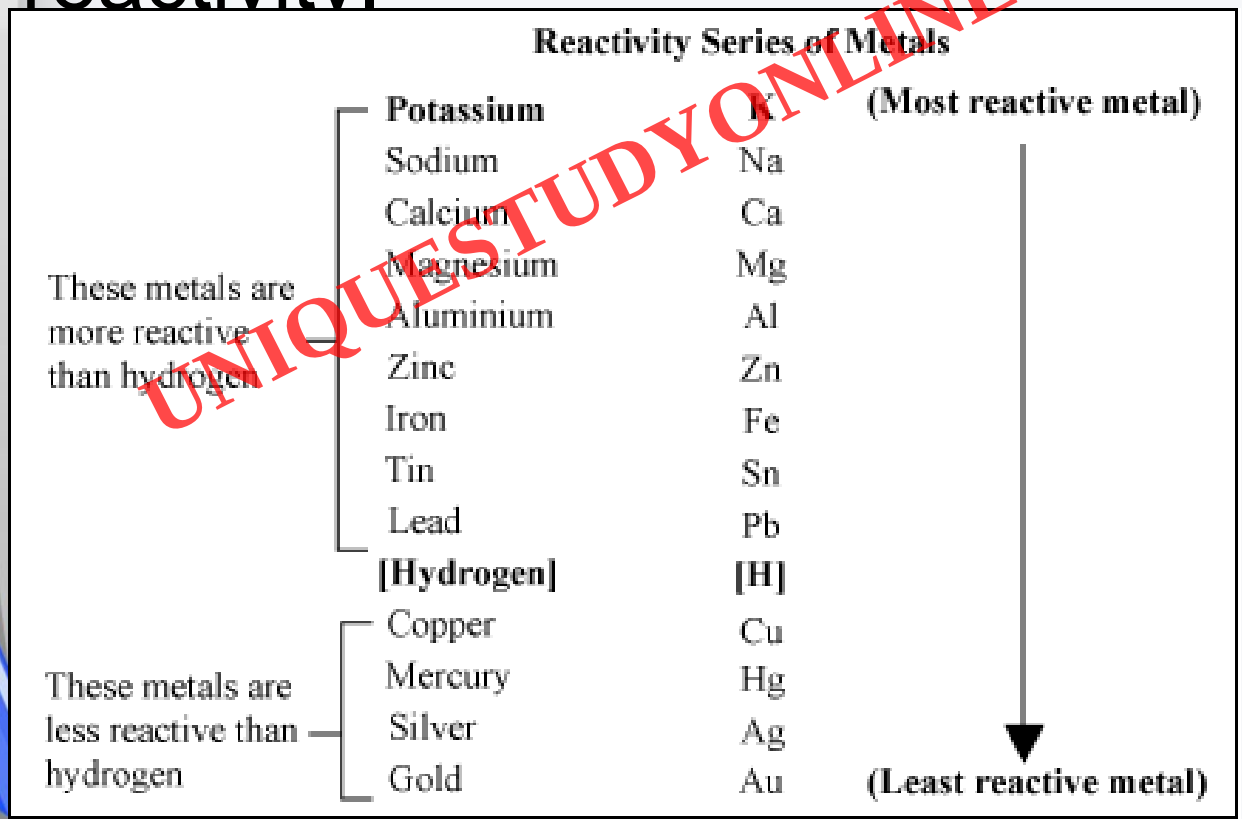
- When a substance is decomposed in presence of sunlight, it is called a photochemical decomposition.

- $AgBr \longrightarrow Ag + Br$



REACTIVITY SERIES OF METALS

- Reactivity series of metals is a series in which the metals arranged in the decreasing order of their reactivity.



DISPLACEMENT REACTION

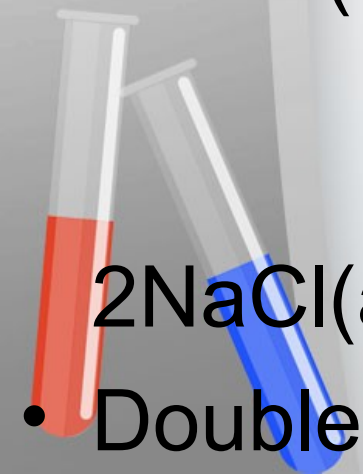
- In a displacement reaction , a more reactive metal displaces or removes another element from a compound.
- For example
- $Zn(s) + CuSO_{4(aq)} \longrightarrow ZnSO_4(s) + Cu$

  In the above reaction Zn is more reactive Cu, so Zn displaces Cu from $CuSO_4$.
- $2AgNO_3(aq) + Zn(s) \rightarrow 2Ag(s) + Zn(NO_3)_2(aq)$

  In the above reaction Zn is more reactive than Ag , so Zn displaces Ag from its solution.

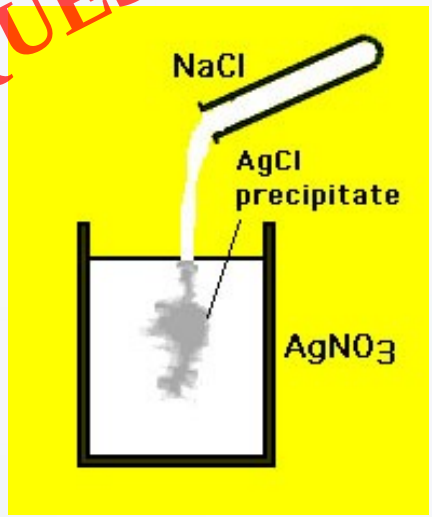
DOUBLE DISPLACEMENT REACTION

- The reaction in which two different atoms or group of atoms are displaced by other atoms or groups of atoms are double displacement reaction.
- For example
- $BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + 2NaCl(aq)$
- Double displacement reaction can be



PRECIPITATION REACTION

- Precipitation reactions occur when cations and anions in aqueous solution combine to form an insoluble ionic solid called a precipitate.
- $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

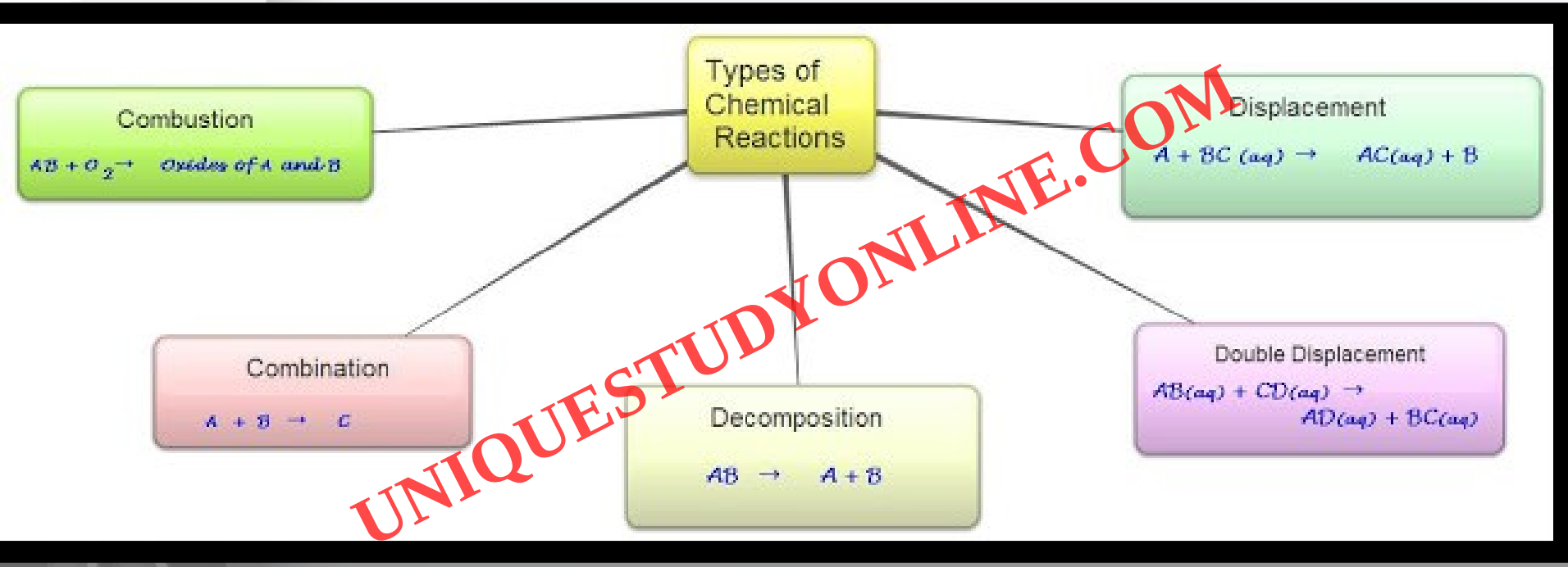


NEUTRALIZATION REACTION

- A neutralization is a type of double replacement reaction.
- In the reaction, H^+ and OH^- combine to form HOH or H_2O or water molecules.
- A salt is the product of an acid-base reaction.
- For example
- $HCl + NaOH \longrightarrow NaCl + H_2O$

In the above reaction NaCl is the salt

A QUICK RECAP



EXOTHERMIC REACTIONS

- An exothermic reaction is a chemical reaction that releases energy by light or heat. It is the opposite of an endothermic reaction.
- Expressed in a chemical equation: reactants → products + energy

For example

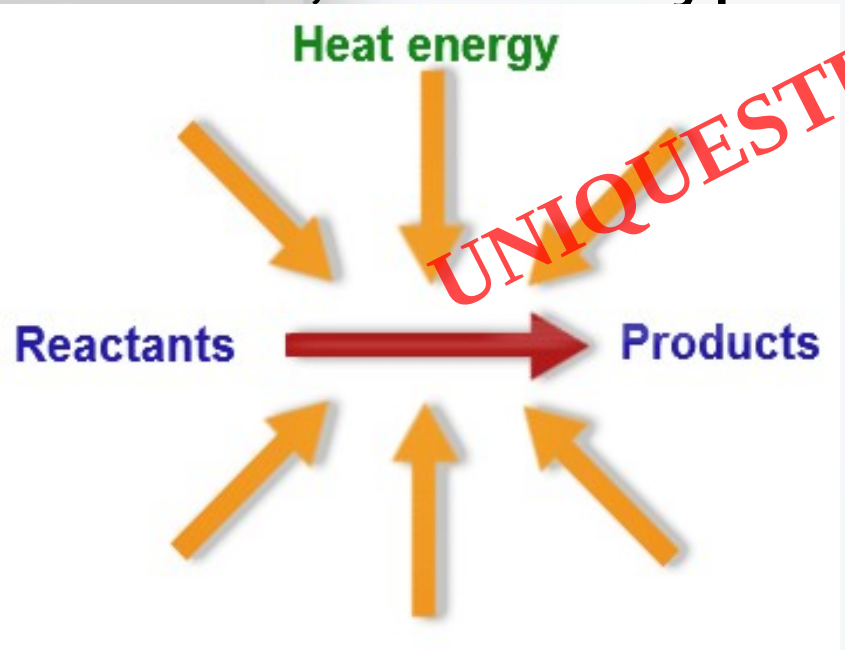
1)$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$

2)Making ice cubes

3) Mixing sodium sulfite and

ENDOTHERMIC REACTIONS

- Endothermic reaction requires or takes in energy in order for it to proceed.
- This required energy can be provided in many forms, but it is typically in the form of heat.



For example

1) **Photosynthesis**

2) **Melting ice**

3) $NH_4Cl_{(s)} + H_2O_{(l)} \rightarrow NH_4Cl_{(aq)}$ - heat

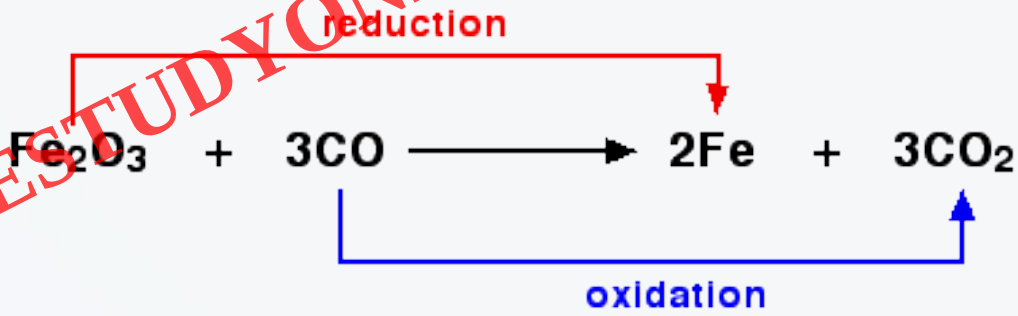
RESPIRATION IS A EXOTRHERMIC REACTIONS

- In the process of respiration , the complex substances are broken down into similar substances and then converted to glucose. In the whole process, energy (or heat) is released.
- We know that a reaction in which heat is released along with the formation of products is known as a exothermic reaction
- Thus , from the above two points we can conclude that respiration is a exothermic reaction .

OXIDATION AND REDUCTION REACTION

- Oxidation is
  1) Addition of oxygen
  2) Removal of hydrogen
- Any chemical substances following any theese is said to be oxidised.
- Reduction is
  1) Removal of oxygen
  2) Addition of hydogen
- Any chemical substences following any of these rules is said to be reduced.

- Reaction involving both oxidation and reduction process , occuring simutaneously are known as redox reaction or oxidation and reduction recaction.
- Example



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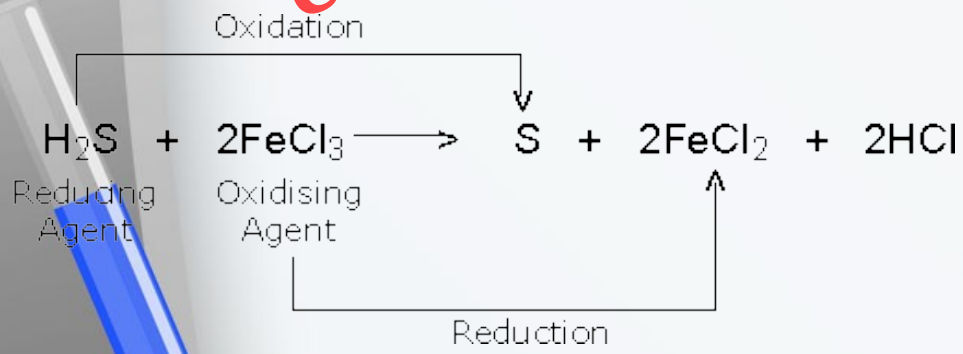

OXIDISING AND REDUCING AGENT

- An oxidising agent is substance which oxidises something else.
- A reducing agent reduces something else. In the equation, the carbon monoxide is the reducing agent.
- Oxidising agents give oxygen to another substance or remove hydrogen from it.
- Reducing agents remove oxygen from another substance or give hydrogen to it.

THE EFFECTS OF OXIDATION REACTIONS IN EVERYDAY LIFE

1) Corrosion

- Corrosion is a natural process, which converts a refined metal to a more stable form, such as its oxide, hydroxide, or sulfide.

- Corrosion engineering is the field dedicated to controlling and stopping corrosion.
- Corrosion causes damages to car bodies, bridges , iron raling, ships and to all objects made of metal , specially those of iron.
- Corrosion of iron is called rusting and it's a serious problem . Every year an enormous amount of money is spent to replace damaged iron.
- The rusting of iron can be prevented by painting , oiling , galvanizing, anodizing etc
- Galvanization is a method of protecting steel and iron from rusting by coating them with a thin layer of zinc

2) Rancidity

- The most important cause of deteriortion in fats and fatty food is oxidation.
- Rancidification, the product of which can be described as rancidity, is the process which causes a substance to become rancid, that is, having a rank, unpleasant smell or taste.
-

PREVENTION OF RANCIDITY

- Storage in coloured glass containers prevent oxidation of fats by rays of light.
- Vacuum packaging retards rancidity by excluding oxygen.
- Naturally occurring antioxidants like vitamin C, b carotene and vitamin E protect against rancidity.
- The nitrogen also serves as a cushion ta minimize breakage of the chips during transport.

SOME IMPORTANT EQUATIONS

Compound	Symbol
Calcium carbonate	$CaCO_3$
Carbon dioxide	CO_2
Copper sulphate	$CuSO_4$
Glucose	$C_6H_{12}O_6$
Hydrochloric acid	HCl
Sodium bicarbonate (baking soda)	$NaHCO_3$
Sodium chloride (table salt)	$NaCl$
Sodium hydroxide	$NaOH$
Water	H_2O

ADD TO YOUR KNOWLEDGE

	Chemical reactions		Nuclear reactions
1.	These reaction involve some loss, gain or overlap of outer orbital electrons of the reactant atoms.	1.	Nuclear reactions involve emission of alpha, beta and gamma particles from the nucleus.
2.	A chemical reaction is balanced in terms of mass only	2.	Nuclear reaction is balanced in terms of both mass and energy.
3.	The energy changes in any chemical reaction is very much less when compared with nuclear reaction.	3.	The energy changes are far exceed than the energy changes in chemical reactions.
4.	In chemical reactions, the energy is expressed in terms of kilojoules per mole.	4.	In nuclear reactions, the energy involved is expressed in MeV (Million electron volts) per individual nucleus.
5.	No new element is produced since nucleus is unaffected.	5.	New element / isotope may be produced during the nuclear reaction.