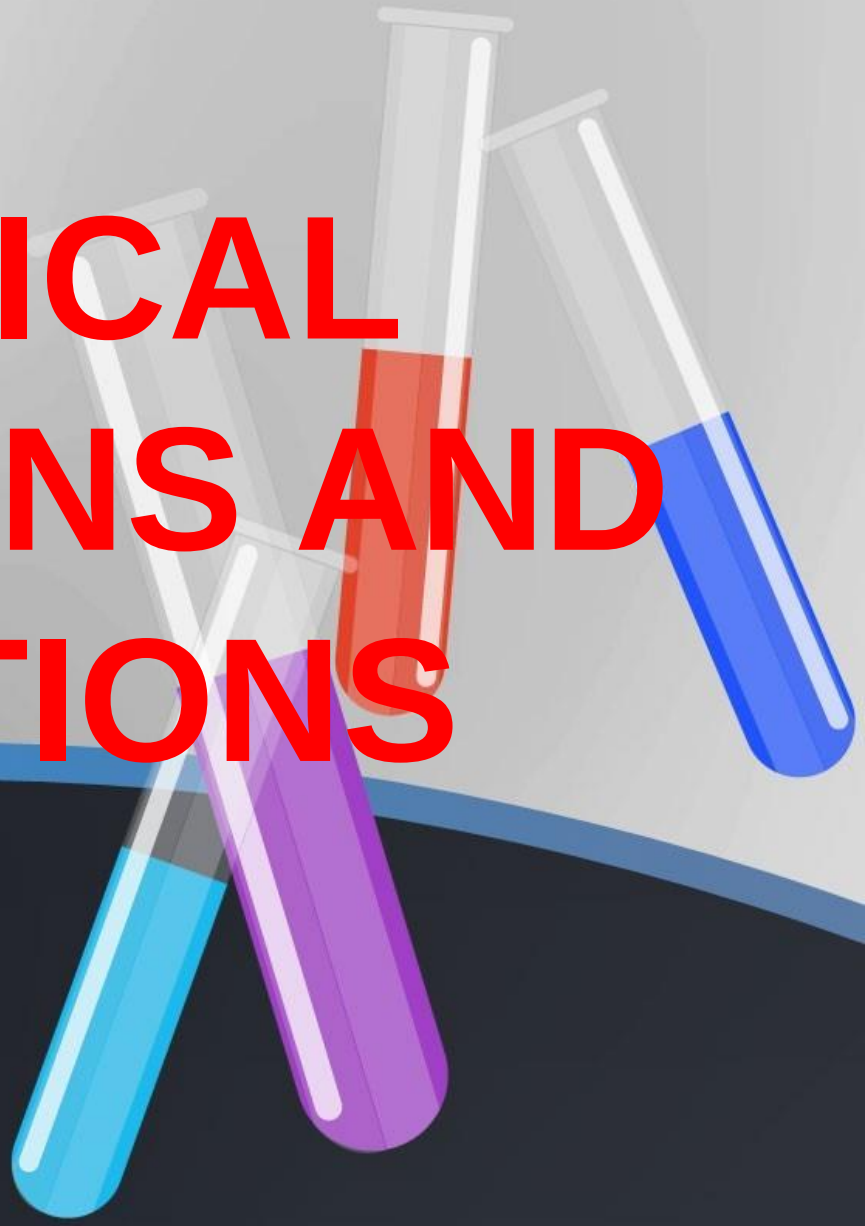
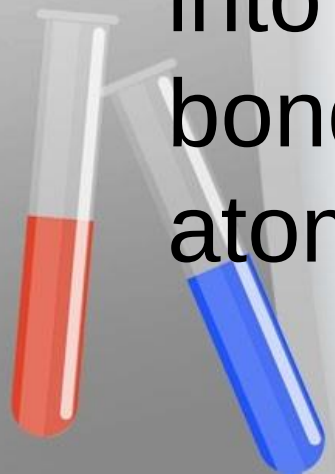
CHEMICAL REACTIONS AND EQUATIONS



CHEMICAL REACTIONS

- A **chemical reaction** is a process that leads to the transformation of one set of chemical substances to another.
- Chemical reactions are chemical changes in which reactants transform into products by making or breaking of bonds(or both) between different atoms.



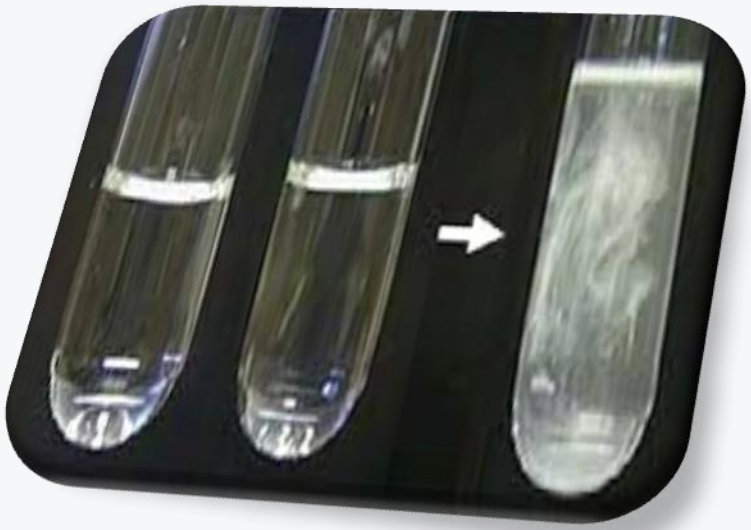
Indications of a Chemical Reaction

- 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 is a chemical reaction expressed in words rather than chemical formulas. It helps identify the reactants and products in a chemical reaction.

  Sodium + Chlorine → Sodium chloride

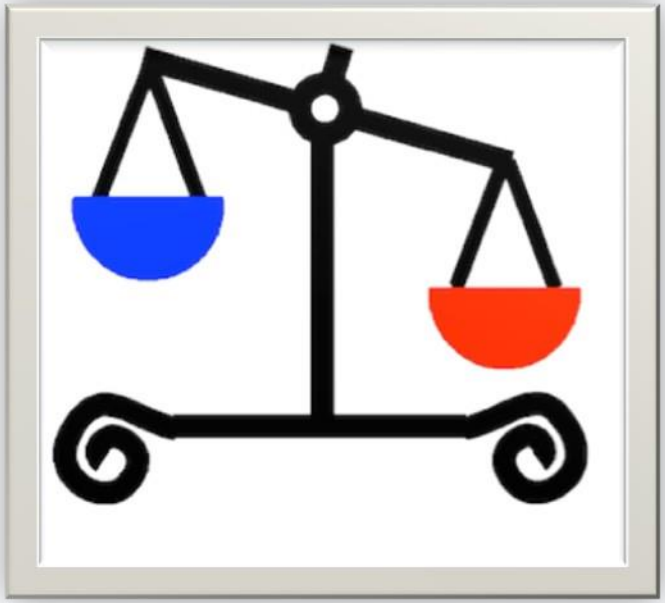
- The reactants are written on the left hand side (LHS) with a plus sign between them.
- Similarly , products are written on the right hand side (RHS) with a plus sign between them.
- The arrowhead points towards the products, and shows the direction of the reactions.

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.

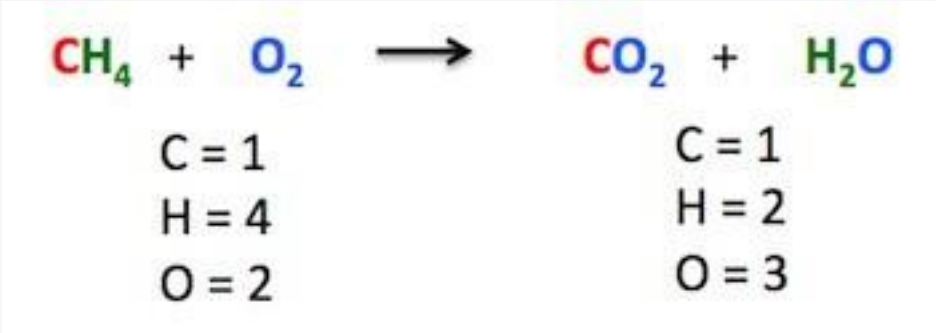
BALANCED EQUATION

- The chemical equation needs to be balanced so that it follows the law of conservation of mass.
- The chemical equation in which the number of atoms of each element in the reactants side is equal to that of the products side is called a balanced chemical equation.Example

$3CaCO_3+2H_3PO_4 \rightarrow Ca_3(PO_4)_2+3H_2CO_3$

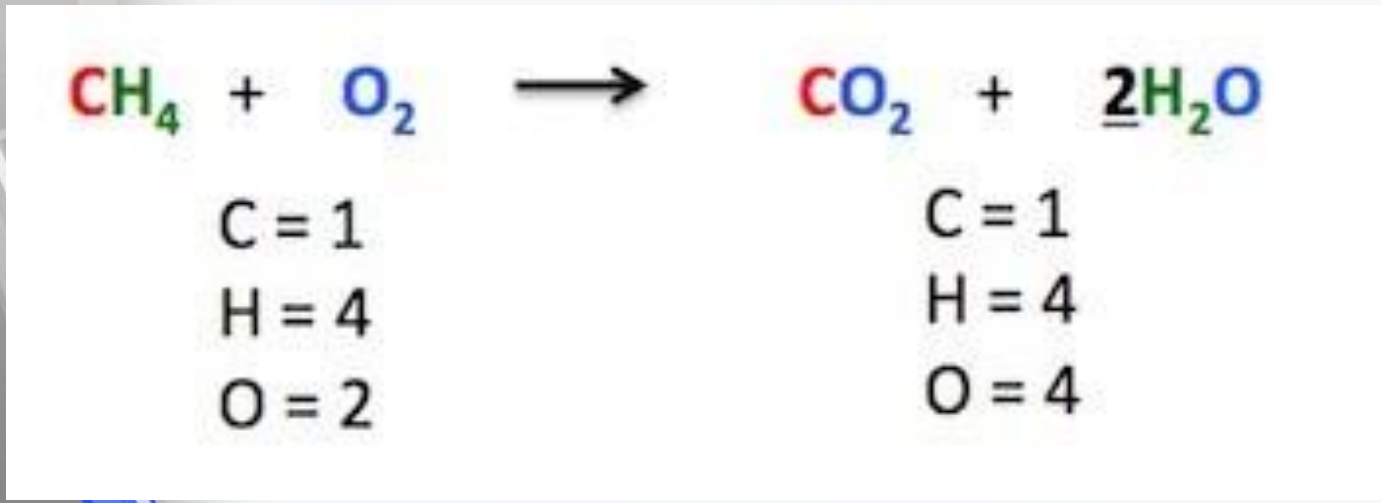
How to balance a equation

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

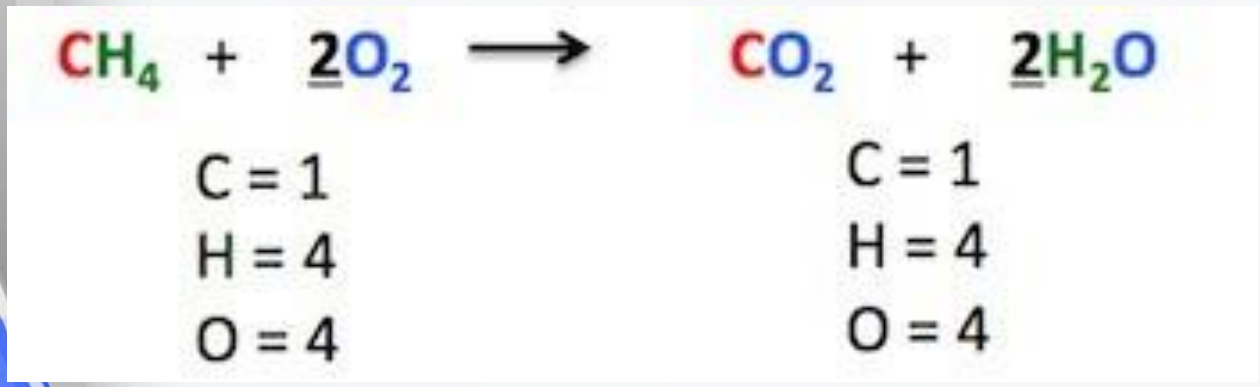


In the reaction a compound reacts with oxygen and produces carbon dioxide and water. It is often convenient to start balancing with the compound that contains the maximum number of atoms. It may be a reactant or a product.

- 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

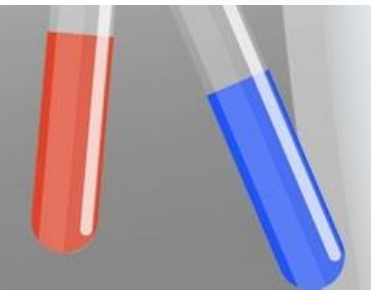
EXAMPLES

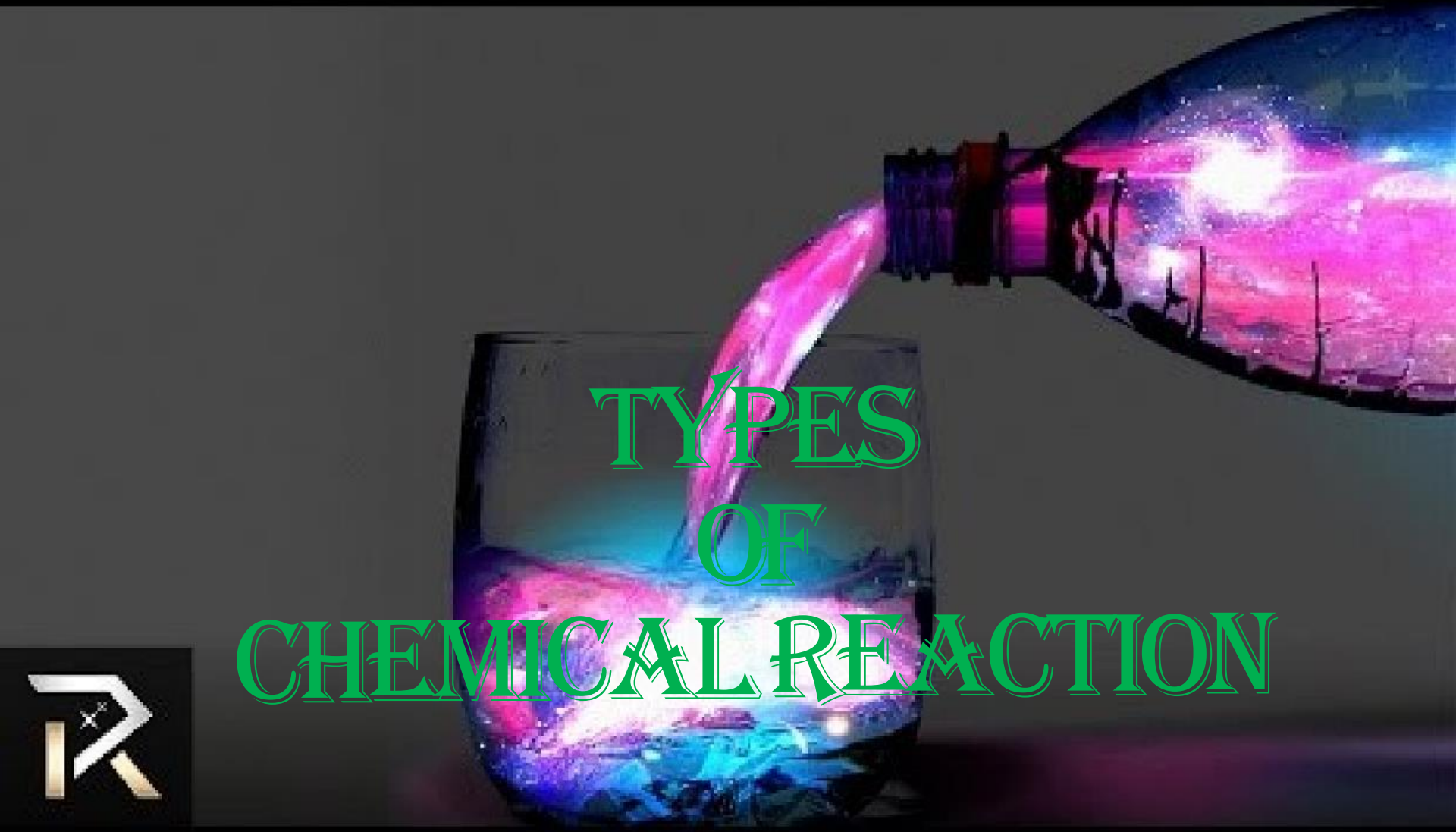
$$\underset{\text{Ethylene}}{C_2H_4(g)} + \underset{\text{Hydrogen}}{H_2(g)} \xrightarrow[250^0C - 300^0C]{Ni} \underset{\text{Ethane}}{C_2H_6(g)}$$

$$\underset{\text{Nitrogen}}{N_2(g)} + \underset{\text{Oxygen}}{O_2(g)} \xrightarrow{At\ 3000^0C} \underset{\text{Nitric Oxide}}{NO(g)}$$

$$\underset{\text{Carbon dioxide}}{CO_2(g)} + \underset{\text{Water}}{H_2O(l)} \xrightarrow[\text{Sunlight}]{Chlorophyll} \underset{\text{Glucose}}{C_6H_{12}O_6(s)} + \underset{\text{Oxygen}}{O_2(g)}$$

$$\underset{\text{Ammonium Nitrate}}{NH_4NO_3(s)} \xrightarrow{\Delta\ 170^0C - 240^0C} \underset{\text{Nitrous Oxide}}{N_2O(g)} + \underset{\text{Water}}{2H_2O(l)}$$




TYPES
OF
CHEMICAL REACTION

TYPES OF CHEMICAL REACTION

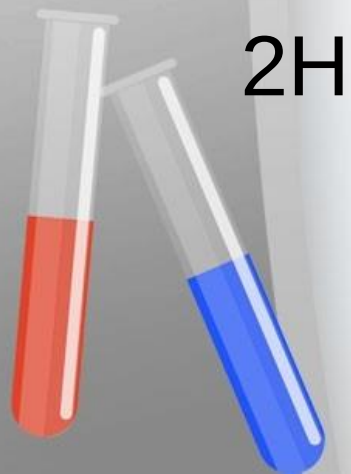
- *COMBINATION REACTION*
- *DECOMPOSTION REACTION*
- *DISPLACEMENT REACTION*
- *DOUBLE DISPLACEMENT REACTION*
- *OXIDATION AND REDUCTION /REDOX REACTION*

COMBINATION REACTION

- In a combination reaction, two elements or one element and one compound or two compounds combine to give one single product. For example –

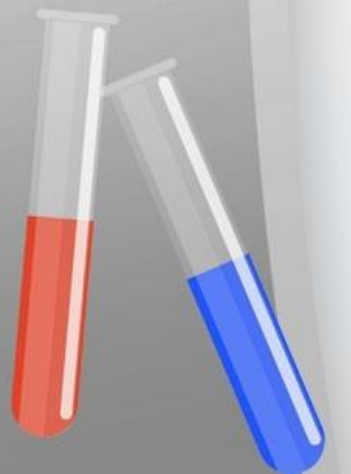
$$C(s) + O_2(g) \longrightarrow CO_2(g)$$

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



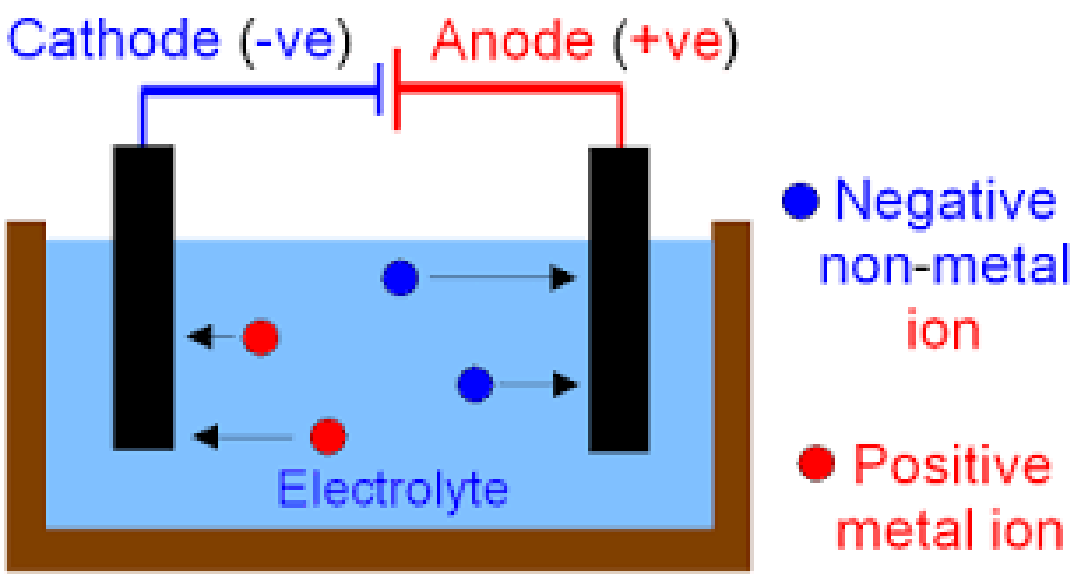
DECOMPOSITION REACTION

- 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

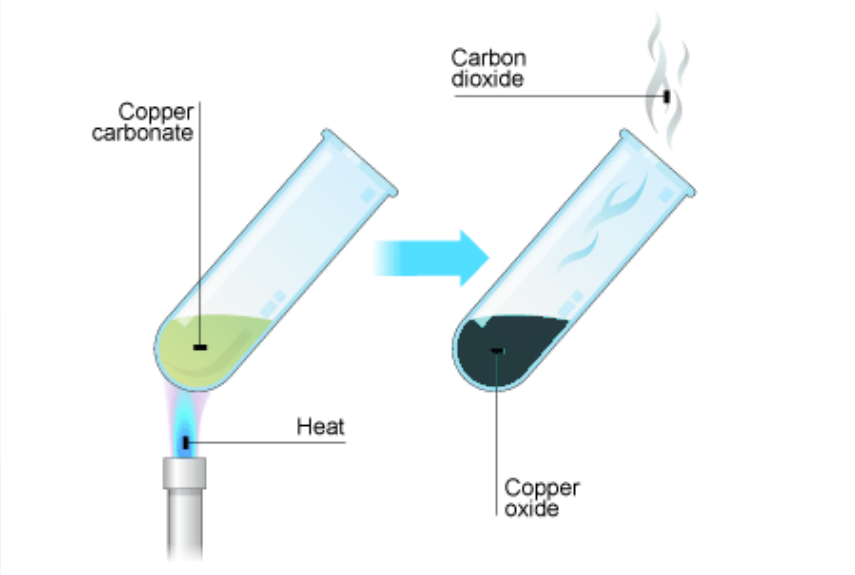
- When a substance is decomposed by passing electric current, the process is called electrolysis.
- $2H_2O(l) \longrightarrow 2H_2(g) + O_2(g)$



THERMAL DECOMPOSITION

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

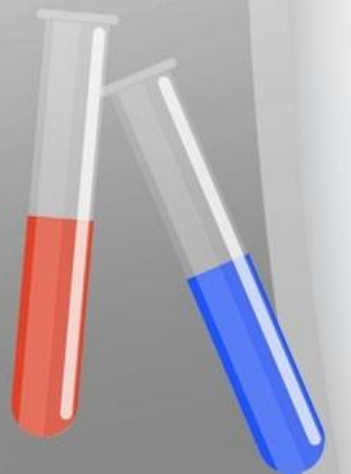
- $CaCO_3(S) \longrightarrow CaO(S) + CO_2(g)$



PHOTOCHEMICAL DECOMPOSITION

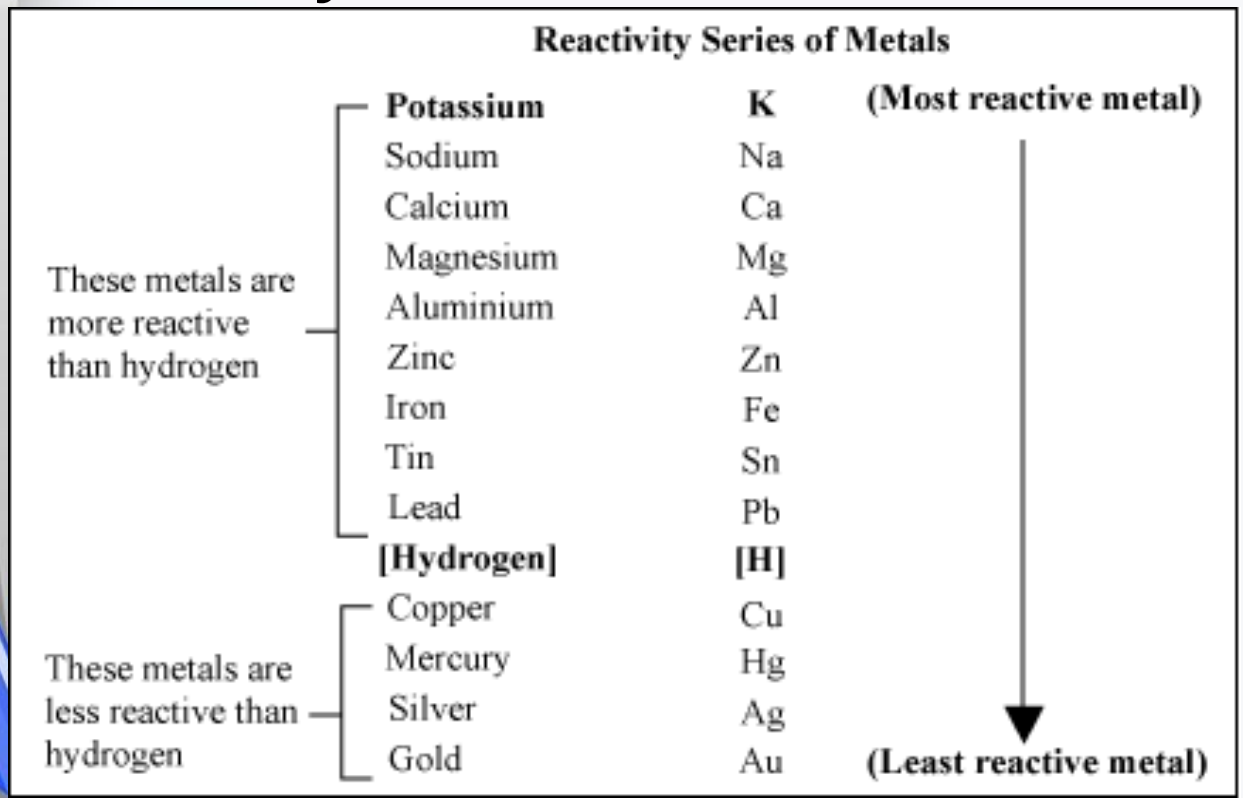
- When a substance is decomposed in presence of sunlight, it is called a photochemical decomposition.

- $2AgBr \longrightarrow 2Ag + Br_2$



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

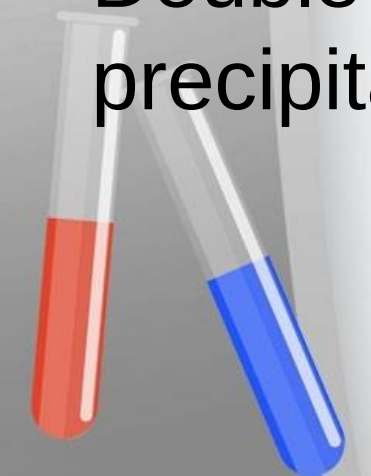
- In a displacement reaction ,more reactive element displaces a less reactive element from its compound or solution. For example
- $Zn(s) + CuSO_{4(aq)} \longrightarrow ZnSO_4(s) + Cu$

  In the above reaction Zn is more reactive than 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.

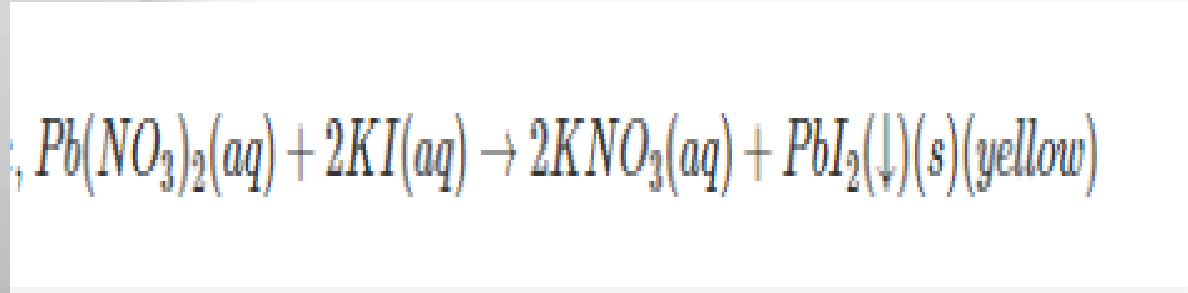
DOUBLE DISPLACEMENT REACTION

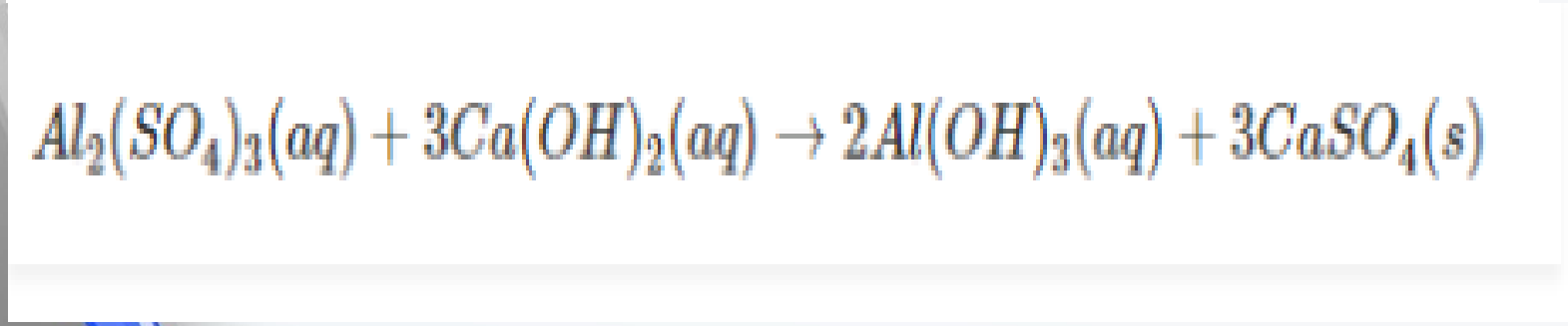
- The reaction in which an exchange of ions between the reactants takes place to give new products. For example
- $BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + 2NaCl(aq)$
- The white precipitate of $BaSO_4$ is formed
- Double displacement reaction also called precipitation reaction.



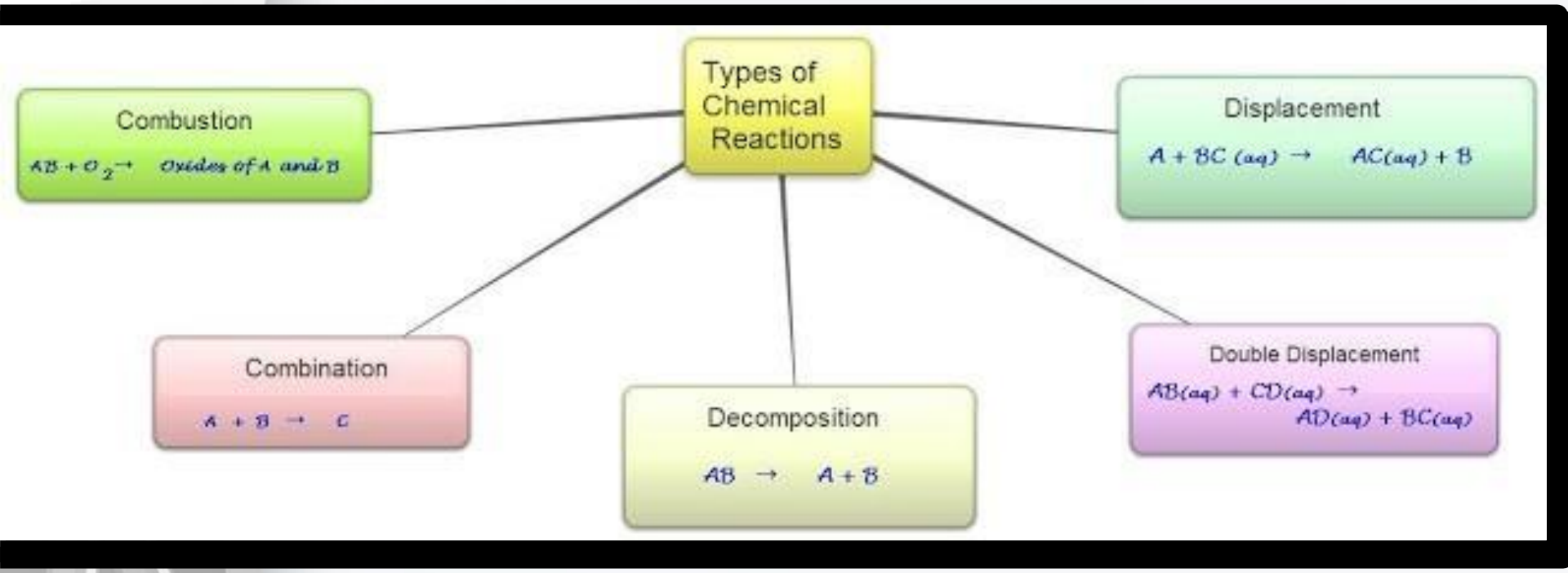
PRECIPITATION REACTION

The reaction in which precipitate is formed is called a precipitation reaction.



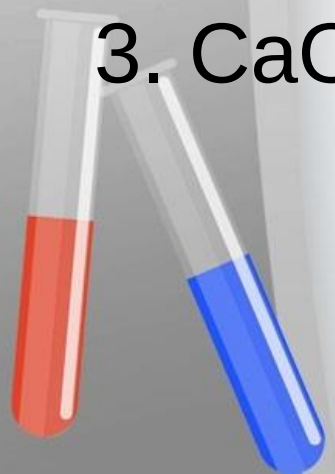


A QUICK RECAP



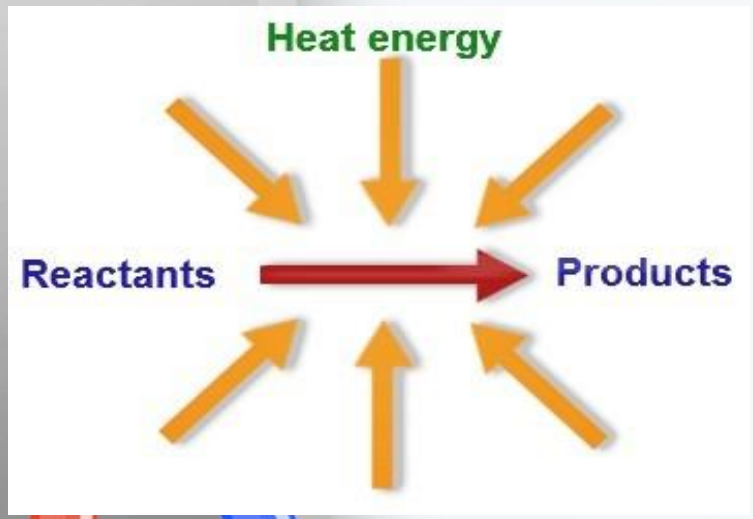
EXOTHERMIC REACTIONS

- An exothermic reaction is a chemical reaction that releases energy by light or heat. Most of the combination reactions are exothermic. For example
  1. $Al+Fe_2O_3 \rightarrow Al_2O_3+Fe+heat$
  2. $CH_4+2O_2 \rightarrow CO_2+2H_2O+heat$
  3. CaO(s) + H2O(l) → Ca(OH)2(aq)+ heat



ENDOTHERMIC REACTIONS

- Endothermic reaction requires or takes energy in order for it to proceed.
- Most of the decomposition reactions are endothermic.



For example

1) Melting of ice
2) $6CO_2+6H_2O+Sunlight \rightarrow C_6H_{12}O_6+6O_2$

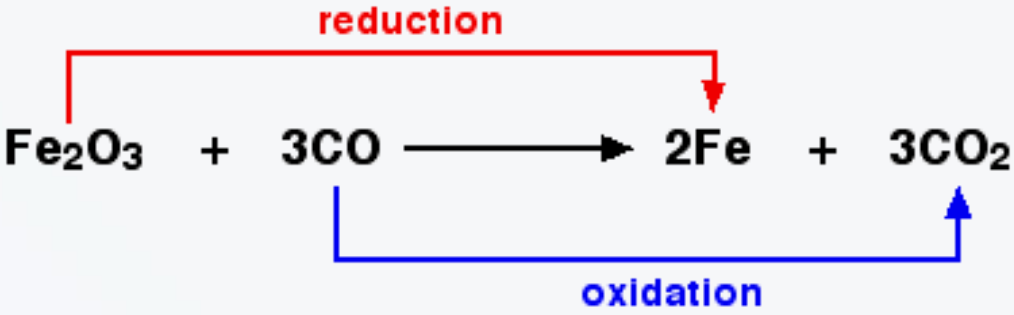
RESPIRATION IS A EXOTRHERMIC REACTIONS

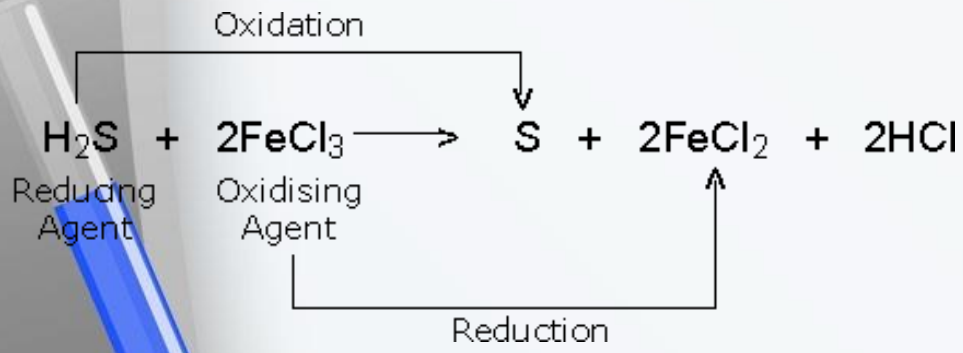
- In the process of respiration , the complex substances are broken down into similar substances and then converted to glucose. In the whole process, energy (or heat) is released.
- We know that a reaction in which heat is released along with the formation of products is known as a exothermic reaction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

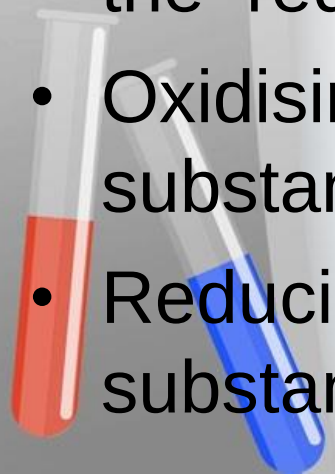
- Reaction involving both oxidation and reduction process , occuring simutaneously are known as redox reaction. Example



- 

OXIDISING AND REDUCING AGENT

- An oxidising agent is a substance which help in oxidation. In the above equation, the ferric oxide is the oxidising agent/ reduced substance.
- An reducing agent is a substance which help in reduction. In the equation, the carbon monoxide is the reducing agent/oxidised substance.
- 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

The destruction of metal layer by layer by the action of air and water is called corrosion.

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

- Corrosion of Iron:

  $4Fe(s) + 3O_2(\text{from air}) + xH_2O(\text{moisture}) \rightarrow 2Fe_2O_3.xH_2O(\text{rust})$

- Corrosion of copper:

  $Cu(s) + H_2O(\text{moisture}) + CO_2(\text{from air}) \rightarrow CuCO_3.Cu(OH)_2(\text{green})$

- Corrosion of silver:

  $Ag(s) + H_2S(\text{from air}) \rightarrow Ag_2S(\text{black}) + H_2(g)$

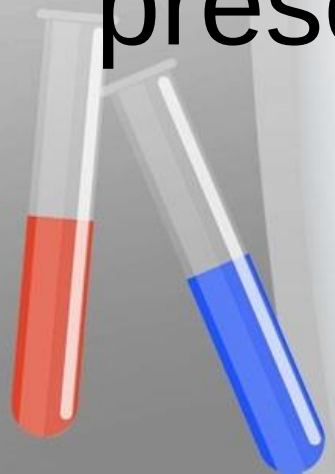
- The rusting of iron can be prevented by painting , oiling , galvanizing, anodizing etc
- Galvanization is a method of protecting steel and iron from rusting by coating them with a thin layer of zinc

2) Rancidity

- The degradation of oil and fat containing compound in presence of oxygen is called rancidity.
- When fats and oils are oxidised, they become rancid and their smell and taste change.

PREVENTION OF RANCIDITY

(i) Use of air-tight containers.
(ii) Packaging with nitrogen.
(iii) Refrigeration.
(iv) Addition of antioxidants or preservatives.




Thank You