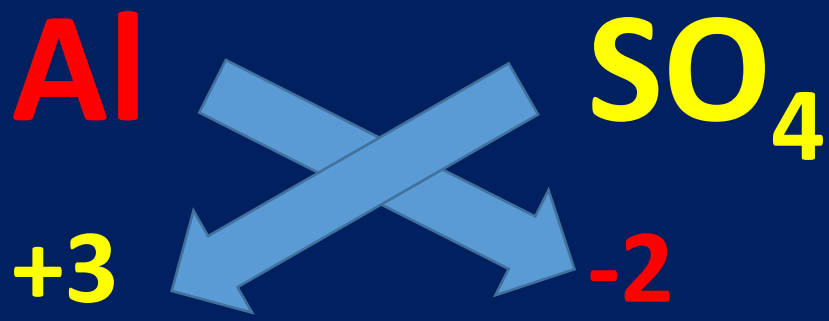
How to form chemical formula



$Al_2(SO_4)_3$

Some Common Cations (positive Ions)

Monovalent		Divalent		Trivalent	
Hydrogen	H^+	Calcium	Ca^{+2}	Chromium	Cr^{+3}
Sodium	Na^+	Magnesium	Mg^{+2}	Aluminium	Al^{+3}
Potassium	K^+	Barium	Ba^{+2}	Iron(III)	Fe^{+3}
Ammonium	NH_4^+	Iron(II)	Fe^{+2}	Gold	Au^{+3}
Silver	Ag^+	Zinc	Zn^{+2}		
Copper(I)	Cu^+	Copper(II)	Cu^{+2}		

Some Common Anions (Negative Ions)

Monovalent		Divalent		Trivalent	
Fluoride	F^-	Sulphide	S^{-2}	Nitride	N^{-3}
Chloride	Cl^-	Oxide	O^{-2}	Phosphide	P^{-3}
Bromide	Br^-	Carbonate	CO_3^{-2}	Phosphate	PO_4^{-3}
Iodide	I^-	Sulphate	SO_4^{-2}	Borate	BO_3^{-3}
Hydride	H^-	Sulphite	SO_3^{-2}		
Hydroxide	OH^-	Oxlate	$C_2O_4^{-2}$		
Hydrogencarbonate		Dichromate	$Cr_2O_7^{-2}$		
Permanganate					
acetate					

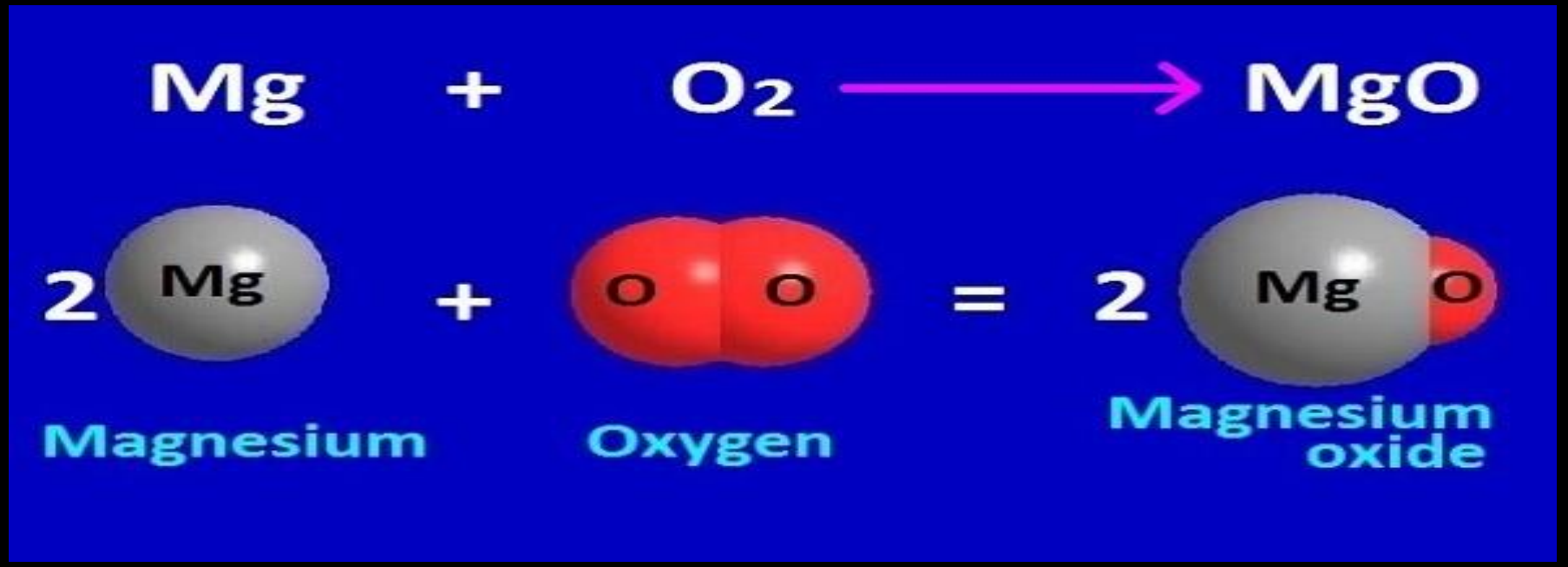
Write the chemical formula of the following-

1. Magnesium Oxide
2. Copper(II) Bromide
3. Aluminium nitrate
4. Calcium phosphate
5. Magnesium acetate
6. Mercury(II) chloride
7. Silver Nitrate
8. Barium Sulphate
9. Silver Chloride
10. Calcium Hydroxide

Chemical Reactions and Equation

- **CHEMICAL REACTIONS-** it is a process in which one or more than one new substance are formed.

Ex. Magnesium + Oxygen → Magnesium oxide
(White powder)



Ex.2 Zinc + Sulphuric acid → Zinc sulphate + Hydrogen

Two types of substance present in chemical reaction-

1- Reactants

2- Products

Reactants- The substances which take part in a chemical reaction are called reactants.

Products- It is a new substances which are formed in a chemical reactions.

Magnesium + **Oxygen** → Magnesium oxide

(Reactants) (Products)

Physical change- It is a Temporary change.
A physical change affects only physical properties i.e shape, size, etc.

Chemical change- It is a permanent Change.
Chemical change both physical and chemical properties of the substance including its composition.

CHEMICAL CHANGE vs PHYSICAL CHANGE

Combustion

Rotting

Melting

Shredding

Rusting

Digestion

Boiling

Chopping

Characteristics of chemical reactions-

1. Evolution of a gas,
2. Formation of a precipitate,
3. Change in colour,
4. Change in temperature,
5. Change in state,

1-Evolution of a gas- Some chemical reactions are characterised by the evolution of gas,

Ex.1 $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

Zinc — dil. Sulphuric Acid — Zinc sulphate

Ex.2 $Zn + H_2SO_4 \longrightarrow ZnSO_4 + SO_2 + H_2O$

Zinc — Con. Sulphuric Acid — Zinc sulphate

Gas Evolution Reaction Examples

$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$

Zinc — Sulfuric acid — Zinc sulfate — Hydrogen

$Na_2SO_3 + 2\,HCl \longrightarrow 2\,NaCl + H_2O + SO_2\uparrow$

Sodium sulfite — Hydrochloric acid — Sodium chloride — Water — Sulfur dioxide

$Na_2S + 2\,HCl \longrightarrow 2\,NaCl + H_2S\uparrow$

Sodium sulfide — Hydrochloric acid — Sodium chloride — Hydrogen sulfide

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2. Formation of a precipitate-

Insoluble part present in solution is called precipitate.

Ex.1 $Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2NaCl$
(White ppt)

Ex.2 $2KI + Pb(NO_3)_2 \longrightarrow PbI_2 + 2KNO_3$
(yellow ppt)

3- Change in Colour-

Ex.1 Citric acid + $KMnO_4$ (Purple(pink)) ⟶ Colourless

Ex.2 Acidified $K_2Cr_2O_7$ + $SO_2(g)$ ⟶ Green

4- Change in temperature-

Ex. CaO + H_2O ⟶ $Ca(OH)_2$ (Temprature increases)

(Quicklime) (slaked lime)

5. Change in state-

Chemical Equations: States

The state of each substance may be denoted

$$Mg_{(s)} + O_{2(g)} \longrightarrow MgO_{(s)}$$

State Designations:

(*g*) gas
(*l*) liquid
(*s*) solid
(*aq*) aqueous (dissolved in water)

Chemical Equations-

The method of representing a chemical reaction with the help of symbols and formulae is known as a chemical equation.

$$Mg_{(s)} + O_{2\,(g)} \longrightarrow MgO_{(S)}$$

How to balance a Chemical equation-

(i)First method- Ex. $Fe + H_2O \rightarrow Fe_3O_4 + H_2$

Element Reactant Product

Ex. $\mathbf{H_2 + N_2 \rightarrow NH_3}$

Ex. $K + H_2O \rightarrow KOH + H_2$

Ex. $Fe + Cl_2 \rightarrow FeCl_3$

2nd method – First balance metal then non-metal .

After balancing non-metal again check metal

After balancing metal and non-metal balance the oxygen and then after hydrogen.

Metals- Na, Mg, Al, Ca, Cu, Fe, Zn , Ba, Mn,

Non metals- C, N, Cl, Br, I, P, N,

OXYGEN-

HYDROGEN-

(i) $Mg_3N_2 + H_2O \rightarrow Mg(OH)_2 + NH_3$

(ii) $Al_4C_3 + H_2O \rightarrow CH_4 + Al(OH)_3$

(iii) $NH_3 + CaOCl_2 \rightarrow CaCl_2 + N_2 + H_2O$

(iv) $C_6H_6 + O_2 \rightarrow CO_2 + H_2O$

(v) $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$

(vi) $CH_4 + O_2 \rightarrow CO_2 + H_2O$

(vii) $Al_2(SO_4)_3 + NaOH \rightarrow Al(OH)_3 + Na_2SO_4$

(viii) $Ca_3P_2 + HCl \rightarrow CaCl_2 + PH_3$

(ix) $CO_2 + H_2O \rightarrow C_6H_{12}O_6 + O_2 + H_2O$

(x) $Mn_3O_4 + Al \rightarrow Al_2O_3 + Mn$

3rd Method-

Why do we need to balance a chemical equation-

The chemical equations are balanced to satisfy the law of conservation of mass which says that matter can neither be created nor destroyed in a chemical reaction. So the total mass of all the elements present in the products of a chemical reaction should be equal to the total mass of all the elements present in the reactants.

Ex. $2Mg + O_2 \rightarrow 2MgO$

Types of Chemical Reactions-

1. COMBINATION REACTIONS
2. DECOMPOSITION REACTIONS
3. DISPLACEMENT REACTIONS
4. DOUBLE DISPLACEMENT REACTIONS
5. OXIDATION AND REDUTION REACTIONS
6. ENDOTHERMIC AND EXOTHERMIC REACTIONS

1- COMBINATION REACTIONS- The reaction in which two or more than two reactants combine to form a single product are called combination reactions.

Ex.

$$\mathbf{2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO(s)}$$

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

$$2Na + Cl_2 \rightarrow 2NaCl$$

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

1. **DECOMPOSITION REACTIONS –** In This reaction a compound splits into two or more substance is called decomposition reaction .

Ex. $CaCO_3 \xrightarrow{\triangle} CaO + CO_2$

This reaction is an antagonistic reaction of combination reaction.

This reaction are three types-

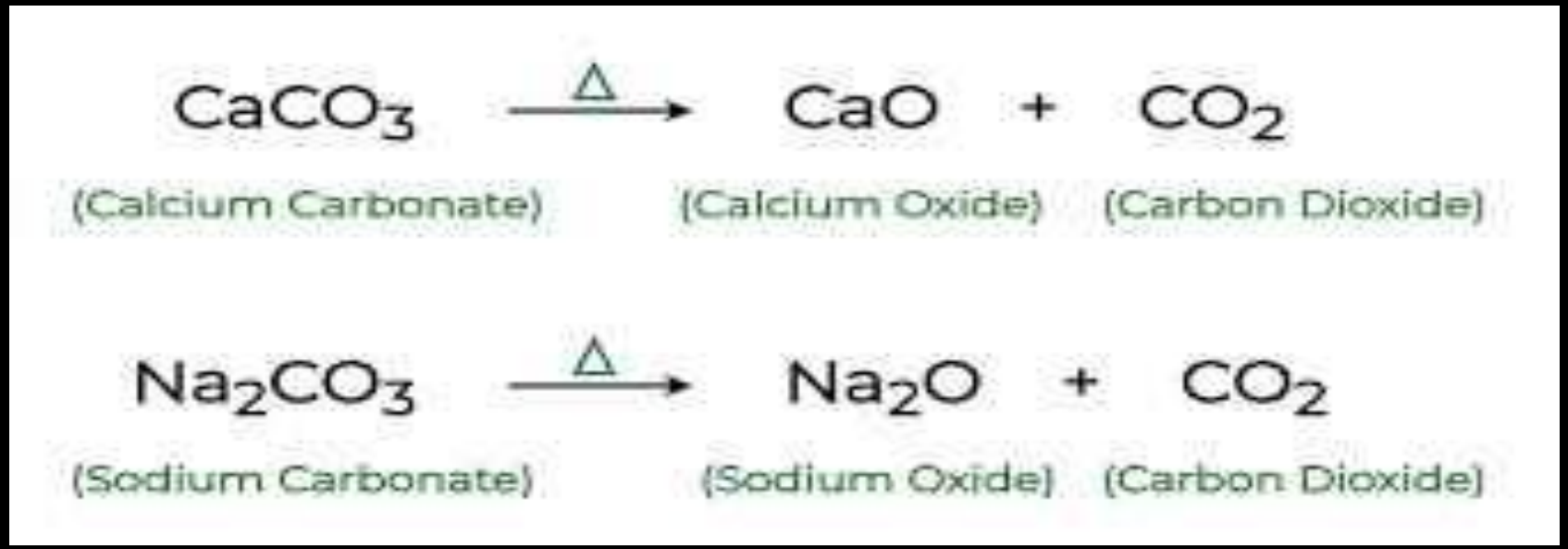
1. **Thermal Decomposition reaction-**

2-Electrolytic decomposition reaction

3-Photolysis decomposition reaction

1-Thermal Decomposition reaction –

when decomposition is carried out by heating is called thermal decomposition reaction. **Ex.**



$$2KClO_3 \xrightarrow{\triangle} 2KCl + 3O_2$$

Potassium chlorate

$$2FeSO_4 \xrightarrow{\triangle} Fe_2O_3 + SO_2 + SO_3$$

Ferrous sulphate

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

Lead nitrate — Yellow — brown Fumes

2-Electrolytic decomposition reaction –

when decomposition is carried out by passing electricity is called Electrolytic decomposition reaction.

Ex.

$$2H_2O(l) \xrightarrow{\text{electricity}} \underset{\text{Cathode}}{2H_2} + \underset{\text{Anode}}{O_2}$$

$$2NaCl \rightarrow \underset{\text{Cathode}}{2Na} + \underset{\text{Anode}}{Cl_2}$$

3-Photolysis decomposition reaction-

when decomposition is carried out in presence of sunlight is called Photolysis decomposition reaction.

Ex. $2AgCl(s) \rightarrow 2Ag(s) + 2Cl_2(g)$

White (greyish white) **(yellowish green)**

Ex . $2AgBr(s) \rightarrow 2Ag(s) + Br_2$

(pale yellow) (greyish white) **(Red brown)**

3-DISPLACEMENT REACTIONS- The reaction in which more reactive element displaces less reactive element from its solution is called DISPLACEMENT REACTIONs.

Ex. $Fe(s)$ + $CuSO_4(aq)$ → $FeSO_4(aq)$ + $Cu(s)$

(grey) (blue colour) (greenish)

$Zn(s)$ + $CuSO_4(aq)$ → $ZnSO_4(aq)$ + $Cu(s)$

(blue colour) (colourless)

$$Pb(s) + CuCl_2(aq) \rightarrow PbCl_2(aq) + Cu(s)$$

$Cu(s) + ZnSO_4(aq) \rightarrow$ No reaction

$$Cu(s) + 2AgNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2Ag(s)$$

(Red brown) (colourless) (blue colour)

Reactivity Series of metals –

K	Potassium
Na	sodium
Ca	calcium
Mg	magnesium
Al	Aluminium
Zn	Zinc
Cr	chromium
Fe	Iron
Ni	Nickel
Sn	Tin
Pb	Lead
H	Hydrogen
Cu	Cupper
Hg	Mercury
Ag	Silver
Au	Gold

4- DOUBLE DISPLACEMENT REACTIONS-

Those reactions in which new compounds are formed by mutual exchange of ions between two compounds are called DOUBLE DISPLACEMENT REACTIONS.

Ex. (i) $\mathbf{Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)}$

(White ppt)

(ii) $\mathbf{Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)}$

(yellow ppt)

(iii) $CuSO_4(aq) + H_2S(g) \rightarrow CuS(s) + H_2SO_4(aq)$

(black ppt)

5- OXIDATION AND REDUTION REACTIONS-

1. **OXIDATION REACTIONS-** The addition of oxygen to a substance or removal of hydrogen from a substance is called oxidation.

Ex. $C + O_2 \rightarrow CO_2$

Ex. $2Cu + O_2 \rightarrow 2CuO$

Ex. $HCl \rightarrow H_2 + Cl_2$

2- REDUTION REACTIONS- The addition hydrogen to a substance or removal of oxygen from a substance is called reduction .

Ex. $H_2O \rightarrow H_2 + O_2$

Ex. $H_2 + Cl_2 \rightarrow 2HCl$

REDOX REACTION - The reaction in which one reactant gets oxidised while other gets reduced is called redox reaction.

Ex. $ZnO + C \rightarrow Zn + CO$

Ex . $CuO + H_2 \rightarrow Cu + H_2O$

Oxidising Agent -

The substance which gets reduced is called oxidising agents.

Reducing agent-

The substance which gets oxidised is called reducing agent .

Q.1 Identify the substances that are oxidised and the substances that are reduced in the following reactions. (NCERT)

(i) $4Na(s) + O_2(g) \rightarrow 2Na_2O(s)$

(ii) $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(l)$

Q.2 Identify the component oxidised in the following reaction.

$$H_2S + Cl_2 \rightarrow S + 2HCl$$

Q.3 $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

(i) Name the substance Oxidised.

(ii) Name the oxidising agent.

(iii) Name the substance reduced.

(iv) Name the reducing agent.

Q. 4 $PbO + C \rightarrow 2Pb + CO_2$

(i) Name the substance Oxidised.

(ii) Name the oxidising agent.

(iii) Name the substance reduced.

(iv) Name the reducing agent.

Q. 5 $SO_2 + H_2S \rightarrow 2H_2O + 3S$

(i) Name the substance Oxidised.

(ii) Name the oxidising agent.

(iii) Name the substance reduced.

(iv) Name the reducing agent.

Chemical reactions also classify on the basis of temperature are Two types-

1-Endothermic Reaction –

2-Exothermic Reaction –

(i)Endothermic Reaction – The reaction which requires energy in the form of heat ,light , electricity is called endothermic reaction.

Ex . Decomposition by heat , light, electricity.

(i) Exothermic Reaction - Reaction in which heat (energy) is released along with formation of product is called exothermic reaction.

Ex. Burning of natural gas.

(i) $CH_4(g) + O_2 \rightarrow CO_2 + H_2O + \text{heat}$

Ex. Respiration is an exothermic process.

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

EFFECTS OF OXIDATION REACTIONS IN EVERYDAY LIFE.

There are two common effects of oxidation reactions which we observe in daily life.

1-Corrosion of metals,
1-Rancidity of food.

1-Corrosion- It is the process in which metals are eaten up gradually by the action of air,moisture or acid on their surface.

During the corrosion of iron is oxidised by the oxygen of air in the presence of water to form of hydrated iron (III) oxide called rust,

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

(Rust)

Ex. Rusting of iron

Black coating on silver

Green Coating on cupper

Prevention of rusting-

1- Rusting of iron can be prevented by painting.

2- Rusting of iron can be prevented by applying grease or oil.

3- Rusting of iron can be prevented by galvanisation.The process of depositing a thin layer of zinc metal on iron object is called galvanisation.

1-Rancidity-

The oxidation of fats and oils of foods when exposed to air is called rancidity.
It leads to bad smell and bad taste of food.

Rancidity can be prevented by -

1- It is prevented by storing food in air tight containers.

2- It can be prevented by packaging fat and oil containing food in nitrogen gas.

3- Rancidity can be reduced by keeping food in refrefrigerators.

4- It can be prevented by adding anti oxidants to food containing fats and oils.

Ex. BHA (butylated hydroxy-Anisol)
BHT (butylated hydroxy- Toluene)

THE END