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Chemistry

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Class 10th

Chemical Reaction And Equation

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Chemical Reaction And Equation

Topics to be Covered :-

1. Types of changes in nature.
2. What is chemical Reaction ?
3. Characteristics of chemical Reaction .
   - (i) Change in state
   - (ii) Evolution of gas
   - (iii) Change in colour
   - (iv) Change in temperature
   - (v) Formation of precipitate
4. What is chemical equation ?
5. Rule to Write chemical equation .
6. How Can be a chemical equation made more informative ?
7. Types of chemical Equation .
8. How to balance a chemical Equation
9. Types of chemical Reaction
   - (i) Combination Reaction
   - (ii) Decomposition Reaction
   - (iii) Deco Displacement Reaction
   - (iv) Double Displacement Reaction
   - (v) Precipitation Reaction
   - (vi) Redox Reaction
   - (vii) Oxidation
   - (viii) Reduction
   - (ix) Combustion reaction
10. Effects of oxidation in Everyday life

CHEMICAL REACTIONS AND EQUATION

Types of changes in nature :-

1> Physical changes :- In this change, only the physical properties of the substance get changed, and no new substance is formed. Thus, this change is called physical change.

For Ex :- Boiling of water, melting of ice.

2> Chemical change :- In this change, the composition and chemical properties of the substances get changed, and also new substance is formed.

For Ex :- Respiration of foods, Ripenning of fruits.

3> Radioactive change (Nuclear change)

→ $In + U^{285} \longrightarrow Ba + Kr + n(\text{nucleus}) + \text{Energy}$

(α, β, γ rays)
Alpha, Beta gama

Q. What is Chemical Reactions ?

→ A chemical reaction is a process which transforms one or more substances into new substances, during chemical reactions new substance with new properties are formed.

For Ex :- Iron reacts with oxygen gas to form Iron Oxide

→ The substance which take part in chemical reactions are called Reactants. And the substance which are formed as a result of chemical reactions are called products

$$\underbrace{2H_2(g) + O_2(g)}_{\text{Reactant}} \longrightarrow \underbrace{2H_2O(l)}_{\text{product}}$$

Chemical Reaction And Equation

Characteristics of chemical Reactions

i) change in state
ii) Evolution of gas (↑)
iii) change in colour
iv) change in temperature
v) formation of precipitate

(i) Change in state

→ In chemical reactions, the physical state of products is different from that of the reactants.

For Ex :- (i) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$
Hydrogen gas, Oxygen gas, water

(ii) $NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$
ammonia, hydrogen chloride, ammonium Chloride

(ii) Evolution of gas

→ In some chemical reaction, evolution of gas also takes place.

for Ex :- • When a metal reacts with dilute Sulphuric acid & produces hydrogen gas.

$$Zn(s) + H_2SO_4(dil) \longrightarrow ZnSO_4(aq) + H_2(g)\uparrow$$

• When iron Sulphide reacts with dilute Sulphuric acid & produces hydrogen Sulphide gas

$$FeS(s) + H_2SO_4(dil) \longrightarrow FeSO_4(aq) + H_2S(g)\uparrow$$

(iii) Change in colour

→ In some reactions, the change of colour also occurs.

For ex :- • When red lead oxide is heated, yellow Lead monoxide is formed.

$$2Pb_3O_4\,(s) \xrightarrow{heat} 6PbO\,(s) + O_2(g)\uparrow$$

red Lead oxide (red colour) → Lead monoxide (Yellow colour)

(iv) Change in temperature

→ During a chemical reaction, energy is either evolved or absorbed. The energy may be in the form of heat, light, electricity, sound etc.

* On the basis of temperature change, reaction may be of following types :-

(1) Exothermic reaction :- The chemical Reaction in which heat energy is released is called exothermic reaction.

For Ex :- When Quicklime (CaO) react with water to form Slaked lime.

$$CaO(s) + H_2O\,(l) \longrightarrow Ca(OH)_2(s) + Heat$$

⇒ It is observed that above reaction occurs in beaker's temperature of outer surface of beakers increases, this indicate that in this reaction heat energy is released.

(2) Endothermic reaction :- The chemical reaction in which heat energy is absorbed is called endothermic reaction

For Ex :- When Barium hydroxide react with ammonium Chloride to form Barium Chloride.

$$Ba(OH)_2(\ ) + NH_4Cl(s) \longrightarrow BaCl_2(\ ) + NH_3(g) + H_2O(l)$$

⇒ Above reaction occurs in test tube, it is observed that outer surface of testtube becomes cool. it indicates that in this reaction, heat energy is absorbed.

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⑤ formation of precipitate

→ Some chemical reaction show formation of precipitate in the solution when react with two or more substances.

Precipitate:- It is a white insoluble solid formed during a chemical reaction

For ex:- $Pb(NO_3)_2(aq) + 2KI(aq) \longrightarrow PbI_2(s) + 2KNO_3(aq)$

lead nitrate — potassium iodide — lead iodide (Yellow precipitate) — potassium nitrate

$BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + NaCl(aq)$

Barium chloride — Sodium Sulphate — Barium Sulphate (White ppt.) — Sodium chloride

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Q. What is chemical Equations ?

→ Symbolic representation of chemical reactions in terms of symbols and formulas of reactants and the products which will give idea about the chemical change.

For ex:- Sodium hydroxide reacts with hydrochloric acid to form sodium chloride and water.

$$NaOH(\ ) + HCl(g) \longrightarrow NaCl(\ ) + H_2O(l)$$

Chemical Reaction And Equation

Rule to write chemical Equation

(1) Reactant is written in left hand side of arrow plus (+) sign put between the reactants.

(2) Product is written in right hand side of the Arrow.

(3) Symbol or formula of reactant is put in left side of Arrow.

(4) Symbol or formula of product is put in right side of the Arrow.

(5) In between reactant and product arrow ($\longrightarrow$) is given.

How Can a chemical Equation be made more informative

i) The physical state of reactants and products can be represented by using the symbol, S- Solid, L- Liquid, g - gas. & aq - aqeous.

ii) Precipitation can be represented by using an arrow pointing downward (↓) instead of using Symbol (s).

iii) In the same way, the gaseous state of an evolve gas can be represented by using an arrow pointing upward (↑) direction.

For Ex:- $Na_2SO_4(aq) + BaCl_2(aq) \longrightarrow NaCl(aq) + BaSO_4(\downarrow)$

$Pb(NO_3)_2(aq) + KI(aq) \longrightarrow PbI_2(\downarrow) + KNO_3(aq)$.

Chemical Reaction And Equation

Types of chemical Equation

Balanced Equation

The chemical equation in which same no. of atom of different elements found in both reactants and products side is called Balanced Equation.

for Ex:- $2H_2 + O_2 \rightarrow 2H_2O$

Unbalanced or Skeletal Equation

The chemical equation in which unequal no. of atom of different element found in either reactant or product side is called unbalanced Equation.

for Ex:- $H_2 + O_2 \rightarrow H_2O$

How to balance a chemical Equation

=> The process of making different type of atom equal in both reactant or product side is called Balancing of chemical Equation

Q. Why is it necessary to balance a chemical Equation ?

→ It is necessary to balance a chemical Equation Because the Law of conservation of mass given by Antoine laurent lavoisier in 1774. In this Law, he concluded that in a chemical Reaction, mass is neither be created nor be destroyed. Thus, we have to balance a chemical equation.

Rules

① first of all, write the chemical equation in the form of word equation. In which, reactant is written on left side & product is written on right side.

(2) Put the symbol and formula of all the reactant and product in word equation.

(3) Balance the equation by multiplying the symbol and formula to the smallest possible figure.

(4) Finally if possible then indicate physical state of reactant and product.

METHOD OF BALANCING EQUATION

Hit & trial method :—

$3\,BaCl_2 + Al_2(SO_4)_3 \longrightarrow 3\,BaSO_4 + 2\,AlCl_3$

Element	atom in reactant side	atom in product side
Ba	1	1
Cl	2 × 3	3 × 2
Al	2	1 × 2
SO_4	3	1 × 3

→ The hit-and-trial method is a method in which coefficients before the formula or symbols of the reactants and products are adjusted in such a way that the total no. of atoms of each element on both the sides of the equation become equal.

for examples :—

$3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$

$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

$2Pb(NO_3)_2 \longrightarrow PbO + 4NO_2 + 6O_2$.

Chemical Reaction And Equation

Types of Chemical Reaction

1. Combination reaction
2. Decomposition reaction
3. Displacement reaction
4. Double displacement reaction
5. Precipitation reaction
6. Oxidation Reaction
7. Reduction Reaction
8. Redox Reaction

Combination Reaction

→ The chemical reaction in which two or more than two substance combine to form single new substance is called combination reaction.

Eg:- $A + B + C \longrightarrow D$ (representation)

$2Mg + O_2 \longrightarrow 2MgO$

$3Mg + 2N \longrightarrow Mg_3N_2$

→ When Quicklime (CaO) react with water to form Slaked lime.

$CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(s) + Heat$

Decomposition reaction :— The chemical Reaction in which single complex substance Breaks into two or more than two simpler substance is called decomposition reaction.

→ It is just reverse of combination Reaction.

Ex:- When Calcium Carbonate ($CaCO_3$) heated it breaks down into Calcium Oxide and Carbon dioxide.

$$CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2 \uparrow$$

Ex.2 When ferrous sulphate heated it breaks into ferric oxide, sulphur dioxide & sulphur trioxide.

$$2FeSO_4(s) \xrightarrow{\Delta} Fe_2O_3(s) + SO_2(g) + SO_3(g)$$

There are three types of Decomposition Reaction:-

i) Thermal decomposition :- These reactions use energy in the form of heat for decomposition of reactant.

For ex :- anhydrous ferrous sulphate

$$FeSO_4 \cdot 7H_2O \xrightarrow{\Delta} FeSO_4 + 7H_2O$$

→ When anhydrous ferrous sulphate is heated strongly, it decomposes to give ferric oxide and oxides of sulphur.

$$2FeSO_4(s) \xrightarrow{\Delta} Fe_2O_3(s) + SO_2(g) + SO_3(g).$$

ii) Electrolytic decomposition :- These reactions involve the use of electrical energy of the decomposition of the reactant molecule.

For ex :- $2H_2O(l) \xrightarrow{\text{electricity}} 2H_2(g) + O_2(g)$

iii) photolysis or photochemical decomposition :- These reactions involve the use of light energy for the purpose of decomposition.

For ex :- (i) When silver chloride breaks in the presence of sunlight, it forms silver and chlorine.

$$2AgCl(s) \xrightarrow{\text{sunlight}} 2Ag(s) + Cl_2(\uparrow)$$

(11) When Silver bromide breaks in the presence of sunlight it forms Silver and Bromine.

$$2AgBr(s) \xrightarrow{\text{Sunlight}} 2Ag(s) + Br_2(l)$$

Note: In Earlier times, photolytic decomposition was used for Black and White photography.

Reactivity Series

K – Potassium
Na – Sodium
Ca – calcium
Mg – Magnesium
Al – Aluminium
Zn – Zinc
Fe – Iron
Sn – Tin
Pb – Lead
H – Hydrogen
Cu – Copper
Hg – Mercury
Ag – Silver
~~Pt – Platinum~~
Au – Gold
Pt – platinum

Displacement Reaction :- Those reactions in which a more reactive element displaces or removes another less reactive element from a compound are called displacement reaction.

Representation :- $AB + C \longrightarrow BC + A$

For Ex :- When Zinc reacts with Copper Sulphate Solution then Zinc Sulphate is form.

$$Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$$

We know that Zn is more reactive so it displaces the copper from $CuSO_4$ solution and forms $ZnSO_4$.

Examples :- $MgSO_4 + Ca \longrightarrow CaSO_4 + Mg$

$Al_2(SO_4)_3 + Mg \longrightarrow MgSO_4 + Al$.

Double Displacement Reaction :- The reaction in which two different atoms or groups of atoms are displaced by other atoms or groups of atoms or in which two compounds react by an exchange or displacement of ions to form a new compounds are called Double Displacement Reaction.

Representation :- $AB + CD \longrightarrow AC + BD$.

for Ex :- ~~$BaSO_4 + Na_2SO_4$~~ ——

$BaCl_2 + Na_2SO_4 \longrightarrow BaSO_4 + 2NaCl$

$2NaOH + CuSO_4 \longrightarrow Na_2SO_4 + Cu(OH)_2$.

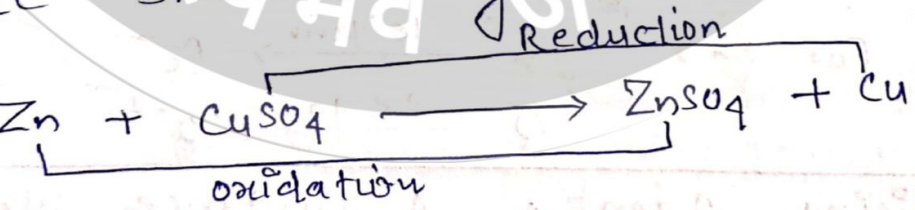
Precipitation Reaction :— It is a type of chemical Reaction in which two soluble salt in aqeous solution combine and forms one of the product insoluble salt called a precipitation reaction.

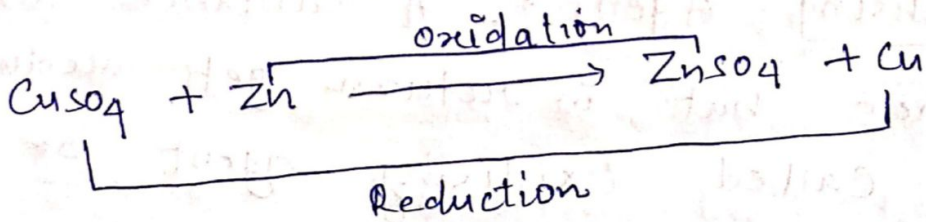
for Ex :- $Na_2SO_4\,(aq) + BaCl_2(aq) \longrightarrow NaCl\,(aq) + BaSO_4\,(s)$ (white ppt.)

REDOX REACTION

→ The reaction in which oxidation & reduction takes place simultaneously is called Redox Reaction

For Ex :-





Chemical Reaction And Equation

Oxidation :-

→ The addition of oxygen to a substance is called Oxidation.

Eg :- $2Mg + O_2 \longrightarrow 2MgO$.

→ The removal of hydrogen from a substance is called Oxidation

Eg :- $H_2S + Cl_2 \longrightarrow 2HCl + S$

→ loss of electron is also called Oxidation reaction

Eg :- $_{11}Na^0 \xrightarrow{1e^- \text{ loss}} Na^{+1}$, $_{12}Mg^0 \xrightarrow{2e^- \text{ loss}} Mg^{2+}$

Reduction :-

→ The addition of hydrogen to a substance is called Reduction Reaction.

For Ex :- $Mg + H_2 \longrightarrow MgH_2$

→ The removal of oxygen from a substance is called reduction reaction.

for Ex :- $CuO + H_2 \longrightarrow Cu + H_2O$

→ Gain of electron is also called reduction reac^n.

for Ex :- $Fe \xrightarrow{1e^- \text{ gain}} Fe^-$

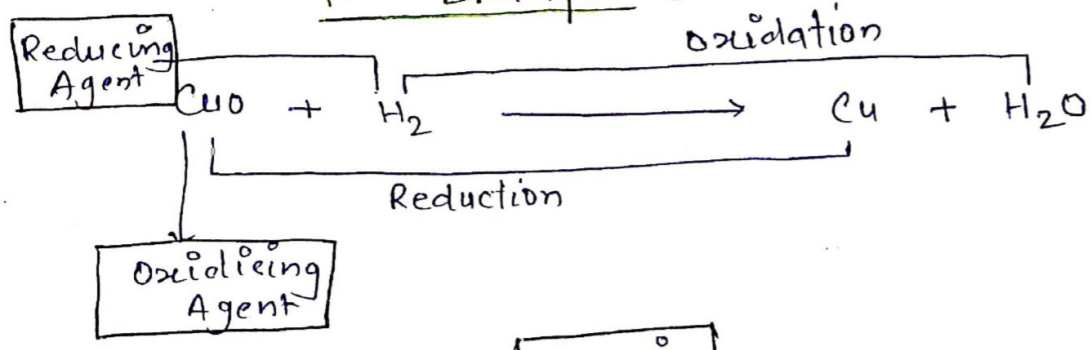
$O \xrightarrow{2e^- \text{ gain}} O^{-2}$

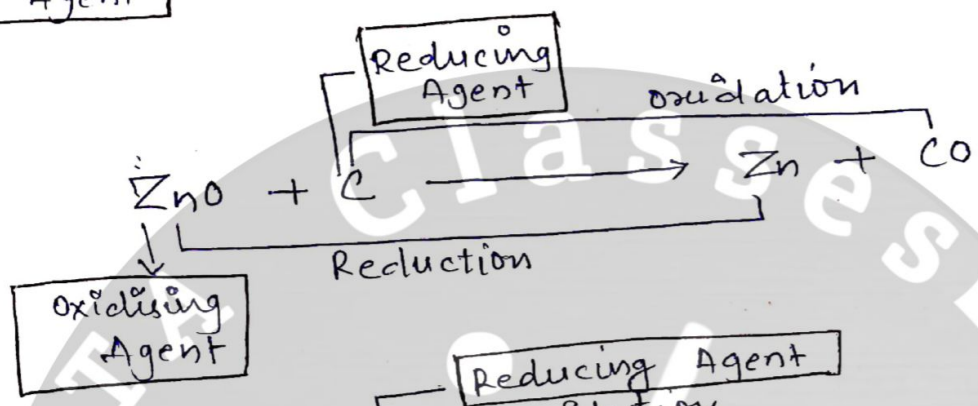
#=> Oxidising Agent :- A subtance which Oxidised other but in return gets reduced itself- is called Oxidising agent or Oxidant.

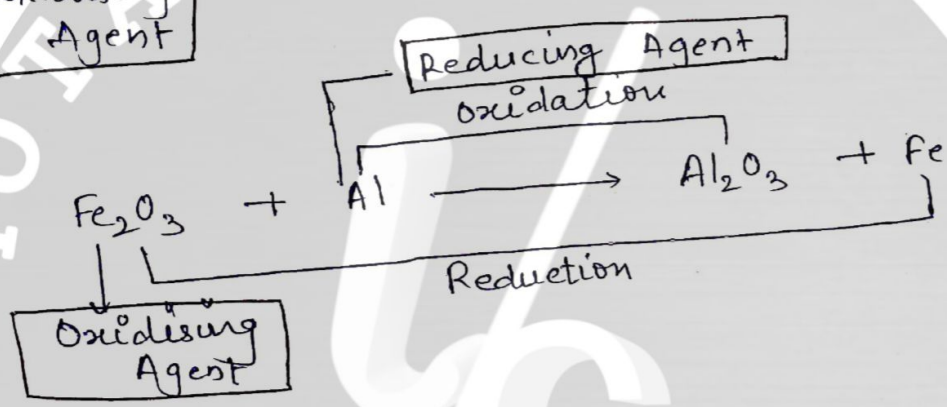
#=> Reducing Agent :- A substance which reduced other and gets Oxidised itself is called Reducing Agent.

Chemical Reaction And Equation

For Examples :—







Combustion reaction :-

→ When carbon compounds burns in presence of ~~Oxygen~~ oxygen it always gives CO_2 and water is known as Combustion reaction.

- $CH_4 + O_2 \longrightarrow CO_2 + H_2O$

Effects of Oxidation in everyday life

- Corrosion : ⟶ The phenomena of gradual degradation of upper surface of metal due to presence of air & moisture is called corrosion

For exa :- (1) $Fe + O_2 + H_2O \longrightarrow \underset{\text{(Rust)}}{Fe_2O_3 \cdot X H_2O}$
(green) (Brown)

Note :- The corrosion of iron is precisely known as Rusting.

$$Cu + CO_2 + H_2O \longrightarrow CuCO_3 \cdot Cu(OH)_2$$
(green).

$$Ag + H_2S + O_2 \longrightarrow Ag_2S + H_2O$$
(Black).

Prevention of rusting.

i) Rusting of iron can be prevented by covering its surface with paint greese, that doesn't allow air or moisture to come in contact with it and no rusting occurs. This is known as Barrier protection.

ii) Rusting of iron can be prevented by Galvanization. Zinc metal doesn't ~~co~~ corrode on exposure to air. so, Zinc coating protect Iron from rusting.

iii) Rusting of iron can be prevented by electroplating.

iv) Rusting can also be prevented by converting it into an alloy with chromium and nickel. This alloy is called stainless steel.

Rancidity:- It is the process of slow oxidation of oil and fat present in the food materials resulting in the change of smell and taste in them.

How to prevent Rancidity:-

i) Keeping food materials in airtight container.

ii) Refrigeration of cooked food at low temperature.

iii) Packing of food item like potato chips etc in packets containing nitrogen gas instead of air.

iv) Avoid keeping the worked food and food materials in direct sunlight.