GRAVITY CLASSES

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11th & 12th BOARD
(NEET & JEE)

5th - 10th (All Subject)

NOTES

CHEMISTRY

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CHEMICAL REACTIONS AND EQUATIONS

 # Chemical Reactions:- Chemical reaction is a process during which one or more substances undergo a chemical change, with the absorption or release of energy, so as to form one or more new substances.

→ The substances which take part in a chemical reaction are called reactants and the substances formed after the reaction, the new substances formed are called products.

For example, $\underbrace{\text{Hydrogen} + \text{Oxygen}}_{\text{Reactants}} \longrightarrow \underbrace{\text{Water}}_{\text{Products}}$

→ Some of the examples are burning of fules, fermentation of grapes, formation of curd from milk, cooking of food, digestion of food in our bodies, process of respiration and rusting of iron.

The rate of chemical reactions, which depends on the following parameters.

(i) Temperature (ii) Pressure
(iii) Concentration of the Reactants (iv) Physical states of the reactants
(v) Catalysts used

→ Burning of magnesium wire/ribbon in air.

$$\underset{\text{(Ribbon)}}{\text{Magnesium}} + \underset{\text{(From Air)}}{\text{Oxygen}} \xrightarrow{\text{Heat}} \underset{\text{(White Powder)}}{\text{Magnesium Oxide}}$$

→ We notice that the ribbon burns with a dazzling white flame.

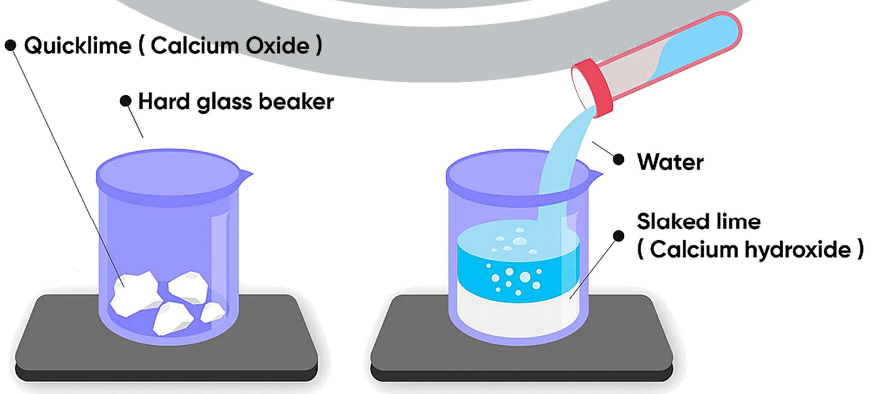
 # Characteristics of Chemical Reactions:- The important characteristics of chemical reactions are:-

(i) Change in Colour (ii) Change in State
(iii) Change in Temperature (iv) Formation of a Precipitate
(v) Evolution of a Gas

(i) Change in Colour

(ii) Change in State:- Wax

(iii) Change in Temperature:- We must know that calcium hydroxide is known as 'slaked lime' and calcium oxide is known as quicklime. When we add water to calcium oxide (quicklime), slaked lime is formed and a lot of heat energy is produced due to which the reaction mixture becomes hot. This reaction is an exothermic reaction.



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→ When barium hydroxide [$Ba(OH)_2$] is added to ammonium chloride (NH_4Cl) (taken in a test-tube) and stirred with a glass rod, barium chloride, ammonia and water are formed as a result of the reaction. A lot of heat energy is absorbed during this reaction and the temperature of reaction mixture falls. It is an endothermic reaction.

→ Coal burns in air to form carbon dioxide and heat energy is released.

(iv) Formation of a precipitate.

→ Precipitate is an insoluble substance formed as a product of a chemical reaction. For example, when potassium iodile solution is added to a solution of lead nitrate, a yellow precipitate of lead iodile is formed. A change in colour, this reaction also shows change in state.

→ When dilute sulphuric acid is added to barium chloride solution (taken in a test-tube) a white precipitate of barium sulphate is formed.

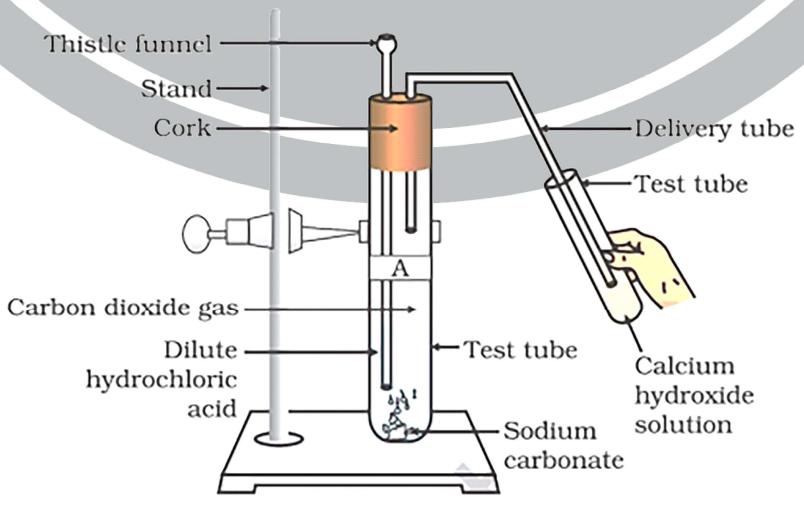
(v) Evolution of a Gas:- When zinc granules react with dilute sulphuric acid, bubbles are produced. These bubbles are of hydrogen gas. We can also use dilute hydrochloric acid in place of dilute sulphuric acid.

→ Dilute sulphuric acid reacts with zinc to produce hydrogen gas. The gas evolves and escapes in the form of bubbles.

→ On touching conical flask with our hand, we find that it is hot.

→ When dilute hydrochloric acid is poured over sodium carbonate in a test-tube, carbon dioxide gas is evolved. So, this reaction is characterised by the evolution of carbon dioxide gas.

$$\underset{\text{Hydrochloric Acid}}{2HCl(aq)} + \underset{\text{Sodium Carbonate}}{Na_2CO_3(s)} \longrightarrow \underset{\text{Sodium Chloride}}{2NaCl(aq)} + \underset{\text{Carbon Dioxide}}{CO_2(g)} + \underset{\text{Water}}{H_2O(l)}$$



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Chemical Equations:-

$$\underbrace{\text{Magnesium} + \text{Oxygen}}_{\text{Reactants}} \xrightarrow{\text{heat}} \underbrace{\text{Magnesium Oxide}}_{\text{Products}}$$

→ A chemical equation that represents a chemical reaction briefly in words is called a word equation.

✳ **Writing a Chemical Equation:-**

→ A chemical equation is a statement that describes a chemical reaction in terms of symbols and formulae.

$$Mg + O_2 \longrightarrow MgO$$

→ A chemical equation in which the number of atoms of each element is same on the side of reactants and products is called a balanced chemical equation.

$$Mg + O_2 \longrightarrow MgO$$

$$2Mg + O_2 \longrightarrow 2MgO$$

Balancing Chemical Equations

(a) Coppere Sulphate + Sodium Hydroxide → Copper Hydroxide + Sodium Sulphate

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

	In Reactants	In Products
No. Of Cu atoms	1	1
No. of S atoms	1	1
No. of O atoms	5	6
No. of Na atoms	1	2
No. of H atoms	1	2

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

→ $\boxed{CuSO_4(aq) + 2NaOH(aq) \longrightarrow Cu(OH)_2(s) + Na_2SO_4(aq)}$

(b) $\text{Methane} + \text{Oxygen} \longrightarrow \text{Carbon Dioxide} + \text{Water}$

→ $CH_4 + O_2 \longrightarrow CO_2 + H_2O$

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

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

→ $\boxed{CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g) + \text{Heat Energy}}$

(c) $\text{Hydrogen} + \text{Nitrogen} \longrightarrow \text{Ammonia}$

→ $H_2 + N_2 \longrightarrow NH_3$

→ $\boxed{3H_2 + N_2 \longrightarrow 2NH_3}$

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(d) $Pb(NO_3)_2 \longrightarrow PbO + NO_2 + O_2$

→ $Pb(NO_3)_2 \longrightarrow PbO + 2NO_2 + O_2$

→ $2Pb(NO_3)_2 \longrightarrow 2PbO + 2NO_2 + O_2$

→ $\boxed{2Pb(NO_3)_2 \longrightarrow 2PbO + 4NO_2 + O_2}$

 # Types of Chemical Reaction:- Chemical reactions are classified in the following different types:-

(1) Combination Reactions **(2)** Decomposition Reactions
(3) Displacement Reactions **(4)** Double Displacement Reactions
(5) Oxidation and Reduction Reactions

1. Combination Reactions:- When two elements or compounds react chemically to form a single new compound, then the chemical reaction that takes place is called a Combination Reaction or a Composition Reaction.

$(A) + (B) \longrightarrow (A)(B)$

Ex. $2Mg(s) + O_2(g) \xrightarrow{\Delta} 2MgO(s) + Heat$

$\underset{\text{Quicklime}}{CaO(s)} + H_2O(l) \longrightarrow \underset{\text{Slaked lime}}{Ca(OH)_2(aq)} + Heat$

→ Calcium hydroxide is sparingly soluble in water. A suspension of calcium hydroxide in water is used for whitewashing the walls. When the walls are whitewashed, calcium hydroxide slowly reacts with the carbon dioxide present in air to form a thin layer of calcium carbonate.

$\underset{\text{Calcium hydroxide}}{Ca(OH)_2(aq)} + \underset{\text{Carbon dioxide}}{CO_2(g)} \longrightarrow \underset{\text{Calcium carbonate}}{CaCO_3(s)} + \underset{\text{Water}}{H_2O(l)}$

The calcium carbonate so formed gives a white shine to the walls. It is interesting to note that chemical formula of chalk and marble is $CaCO_3$.

- **When two elements react:-**

→ $\underset{\text{Hydrogen}}{2H_2(g)} + \underset{\text{Oxygen}}{O_2(g)} \longrightarrow \underset{\text{Water}}{2H_2O(l)} + Heat$

→ $\underset{\text{Carbon}}{C(s)} + \underset{\text{Oxygen}}{O_2(g)} \xrightarrow{heat} \underset{\text{Carbon Dioxide}}{CO_2(g)} + Heat$

- **When one element and one compound react:-**

$\underset{\text{Carbon Monoxide}}{2CO(g)} + \underset{\text{Oxygen}}{O_2(g)} \longrightarrow \underset{\text{Carbon Dioxide}}{2CO_2(g)} + Heat$

- **When two compounds react:-**

$\underset{\text{Ammonia}}{NH_3(g)} + \underset{\text{Hydrogen Chloride}}{HCl(g)} \longrightarrow \underset{\text{Ammonium Chloride}}{NH_4Cl(s)}$

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2. Decomposition Reactions:- When a chemical compound decomposes on heating or absorbing some kind of energy, so as to form two or more substances (elements or compounds), then the chemical reaction that takes place is called a decomposition reaction or a decombination reaction.

$$\underbrace{(A)—(B)}_{\text{Compound}} \longrightarrow \underbrace{(A)+(B)}_{\text{(A and B could be element or compounds)}}$$

→ Decomposition reaction is the reverse of composition reaction. Decomposition reactions are carried out by applying **heat, light or electricity**.

$$\underbrace{2KClO_3(s)}_{\text{Potassium Chlorate}} \xrightarrow[MnO_2]{\Delta} \underbrace{2KCl(s)}_{\text{Potassium Chloride}} + \underbrace{3O_2(g)}_{\text{Oxygen}}$$

$$\underbrace{2FeSO_4.7H_2O(s)}_{\text{Hydrated ferrus sulphate}} \xrightarrow{\Delta} \underbrace{Fe_2O_3(s)}_{\text{Ferric oxide}} + \underbrace{SO_2(g)}_{\text{Sulphur dioxide}} + \underbrace{SO_3(g)}_{\text{Sulphur trioxide}} + \underbrace{14H_2O(g)}_{\text{Steam}}$$

→ The ferric oxide is in the form of brownish black residue. The smell is due to sulphur dioxide gas. The steamy fumes are due to the liberation of water of crystallisation in the form of steam.

$$\underbrace{2Pb(NO_3)_2(s)}_{\text{Lead nitrate}} \xrightarrow{\Delta} \underbrace{2PbO(s)}_{\text{Lead monoxide}} + \underbrace{4NO_2(g)}_{\text{Nitrogen dioxide}} + \underbrace{O_2(g)}_{\text{Oxygen}}$$

→ In the above reaction, the residue (lead monoxide) is reddish brown when hot and yellow when cold. Nitrogen dioxide gas is reddish brown in colour.

→ $$\text{Metal Carbonate} \xrightarrow{\text{heat}} \text{Metal Oxide} + \text{Carbon Dioxide Gas}$$

$$\underbrace{CaCO_3(s)}_{\substack{\text{Calcium carbonate}\\ \text{(Limestone)}}} \xrightarrow{\text{heat}} \underbrace{CaO(s)}_{\text{Calcium oxide}} + \underbrace{CO_2(g)}_{\text{Carbon dioxide}}$$

Marble or limestone is naturally occurring form of calcium carbonate.

Note:- Thermal decomposition of calcium carbonate (limestone) into calcium oxide and carbon dioxide is an important decomposition reaction for various industries.

→ Before the discovery of cement, a slurry of quicklime (CaO) and powdered bricks or sand was used for joining bricks in construction. Even Taj Mahal is made from lime and sand slurry.

→ These days limestone and clay are baked to form cement, in which an active ingredient is quicklime. Furthermore, slaked lime suspension is used for whitewashing. Slaked lime is an excellent germicide and is spread over open drains, roads, etc.

→ Another important example of decomposition reaction is the digestion of food. The food that we eat contains complex organic compounds, such as fats, proteins, carbohydrates, etc. These compounds decompose in our digestive system by the action of enzymes to form simple substances, such as glucose and amino acids.

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2.(i) Photo-decomposition Reactions:- When a chemical compound decomposes on absorbing light energy, so as to form two or more substances (elements or compounds) then the reaction that takes place is called a Photo-decomposition Reaction.

Let us see the photolysis of silver chloride. It decomposes to form silver metal and chlorine gas. The reaction for this decomposition is:

$$\underbrace{2AgCl(s)}_{\text{Silver Chloride}} \xrightarrow{\text{Sunlight}} \underbrace{2Ag(s)}_{\text{Silver}} + \underbrace{Cl_2(g)}_{\text{Chlorine}}$$

→ It is useful to know that silver metal has two allotropic forms, i.e., white silver with which you are familiar and grey silver.

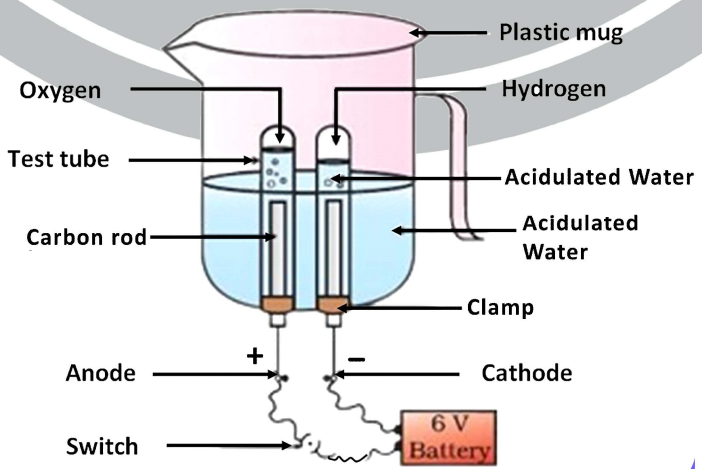
→ If the activity is repeated with silver bromide or silver iodile, similar reactions take place. However, rate of reaction is fastest in case of silver iodile and slowest in case of silver chloride.

$$\underbrace{2AgBr(s)}_{\text{Silver Bromide}} \xrightarrow{\text{Sunlight}} \underbrace{2Ag(s)}_{\text{Silver}} + \underbrace{Br_2(g)}_{\text{Bromide}}$$

$$\underbrace{2AgI(s)}_{\text{Silver iodide}} \xrightarrow{\text{Sunlight}} \underbrace{2Ag}_{\text{Silver}} + \underbrace{I_2(g)}_{\text{Iodine}}$$

→ Black and white photographic films are coated with either silver chloride or silver bromide or silver iodide.

2.(ii) Electrolytic-decomposition Reaction:- Decomposition reactions that take place with the absorption of electric energy are called Electrolytic-decomposition reaction.



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- **Observations:-**

→ Tiny bubbles of colourless gas are formed at each electrode. These bubbles leave the electrodes and rise up in the test tubes.

→ Volume of gas collected at the cathode is twice the volume of the gas collected at the anode because one molecular of water has one atom oxygen and two atoms of hydrogen.

→ The gas collected at the cathode is hydrogen and the gas collected at the anode is oxygen.

→ The electro-decomposition reaction can be expressed as follows.

$$\underbrace{2H_2O(aq)}_{\text{Acidulated Water}} \xrightarrow{\text{Electric current}} \underbrace{2H_2(g)}_{\text{Hydrogen (at cathode)}} + \underbrace{O_2(g)}_{\text{Oxygen (at anode)}}$$

More Ex.:-

$$\underbrace{2NaCl(l)}_{\text{Fused Sodium chloride}} \xrightarrow{\text{Electric current}} \underbrace{2Na(s)}_{\text{Sodium (at cathode)}} + \underbrace{Cl_2(g)}_{\text{Chlorine Gas (at anode)}}$$

$$\underbrace{2Al_2O_3(l)}_{\text{Aluminium oxide}} \xrightarrow{\text{Electric current}} \underbrace{4Al(s)}_{\text{Aluminium metal}} + \underbrace{3O_2(g)}_{\text{Oxygen gas}}$$

3. Displacement Reactions:- When a more active element displaces a less active element from its aqueous ionic compound, the reaction that takes place is called a Displacement Reaction.

$$\underbrace{(A)—(B)}_{\substack{\text{Compound of less}\\ \text{active Element A}}} + \underbrace{(C)}_{\substack{\text{More active}\\ \text{Element C}}} \longrightarrow \underbrace{(C)—(B)}_{\substack{\text{Compound of more}\\ \text{active Element}}} + \underbrace{(A)}_{\substack{\text{Less active Element}\\ \text{is Displaced}}}$$

- **Rule for Displacement Reactions:-** A metal higher in the metal activity series displaces a metal lower in metal activity series from its ionic compound in aqueous solution.

Reactivity Series of Metals			
	Potassium	**K**	**(Most Reactive Metal)**
These Metals are more reactive than Hydrogen	Sodium	Na	↓
	Calcium	Ca	
	Magnesium	Mg	
	Aluminium	Al	
	Zinc	Zn	
	Iron	Fe	
	Tin	Sn	
	Lead	Pb	
	[Hydrogen]	**[H]**	
These Metals are less reactive than Hydrogen	Copper	Cu	
	Mercury	Hg	
	Silver	Ag	
	Gold	Au	**Least Reactive Metal**

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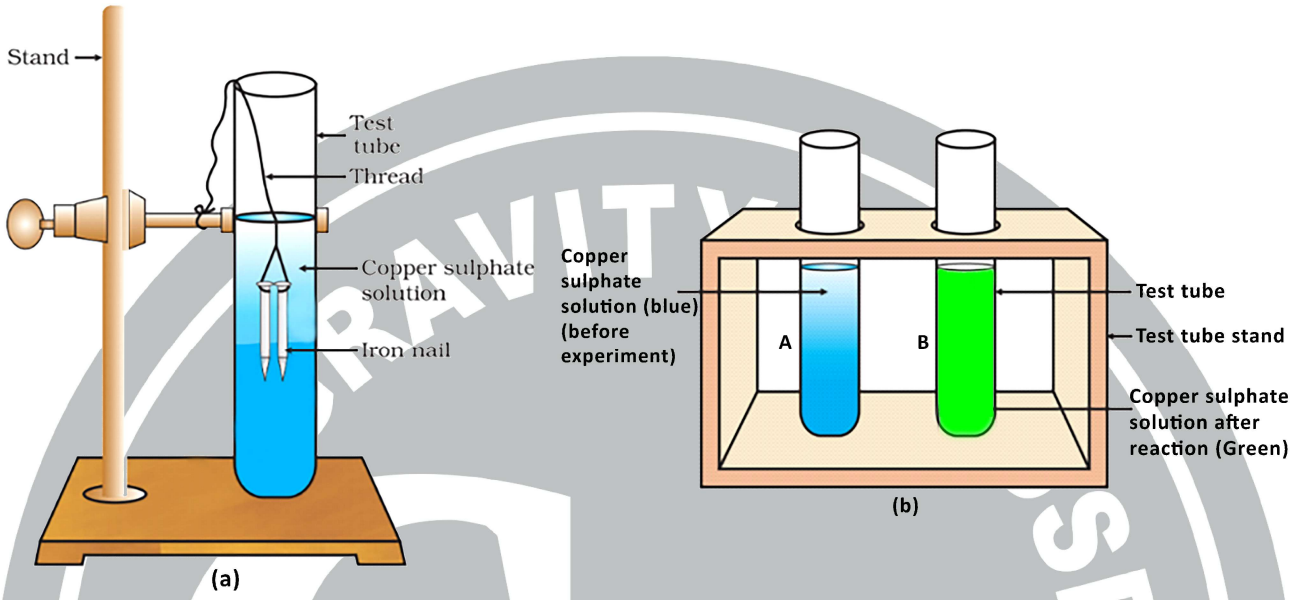
Ex.- $\underbrace{CuSO_4(aq)}_{\text{Copper sulphate}} + \underbrace{Fe(s)}_{\text{Iron}} \longrightarrow \underbrace{FeSO_4(aq)}_{\text{Ferrous Sulphate}} + \underbrace{Cu(s)}_{\text{Copper}}$

$\underbrace{FeSO_4(aq)}_{\text{Ferrous sulphate}} + \underbrace{Cu(s)}_{\text{Copper}} \longrightarrow \text{No Reaction}$



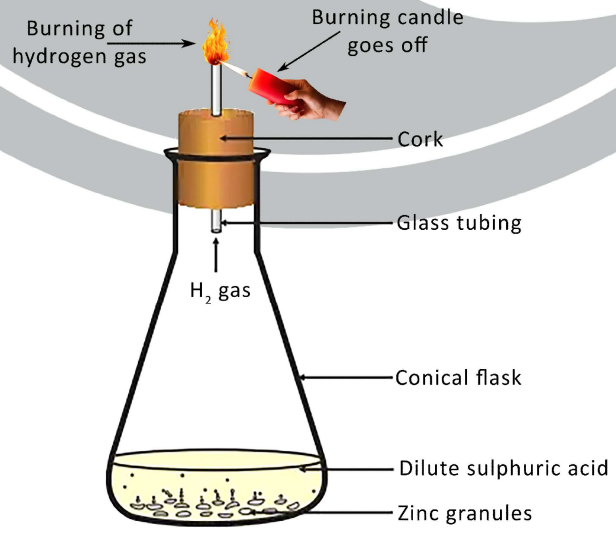
- **Observations:-**

→ The nail after the experiment is coated with a reddish brown deposit. The deposit is copper metal that is displaced from the copper sulphate solution.

→ The colour of copper sulphate solution in test tube B becomes green while colour of copper sulphate solution in test tube A is blue.

$\underbrace{CuSO_4(aq)}_{\substack{\text{Copper sulphate}\\\text{(blue)}}} + \underbrace{Zn(s)}_{\substack{\text{Zinc}\\\text{(Silver white)}}} \longrightarrow \underbrace{ZnSO_4(aq)}_{\substack{\text{Zinc sulphate}\\\text{(Colourless)}}} + \underbrace{Cu(s)}_{\substack{\text{Copper}\\\text{(Reddish brown)}}}$

$\underbrace{Zn(s)}_{\text{Zinc}} + \underbrace{H_2SO_4(aq)}_{\text{Dilute sulphuric acid}} \longrightarrow \underbrace{ZnSO_4(aq)}_{\text{Zinc sulphate}} + \underbrace{H_2(g)}_{\text{Hydrogen}}$



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$$\underset{\text{Iron}}{Fe(s)} + \underset{\text{Dilute sulphuric acid}}{H_2SO_4(aq)} \longrightarrow \underset{\text{Ferrous sulphate}}{FeSO_4(aq)} + \underset{\text{Hydrogen}}{H_2(g)}$$

$$\underset{\text{Aluminium}}{2Al(s)} + \underset{\text{Dilute sulphuric acid}}{6HCl(aq)} \longrightarrow \underset{\text{Aluminium chloride}}{2AlCl_3(aq)} + \underset{\text{Hydrogen}}{3H_2(g)}$$

$$\underset{\text{Magnesium}}{Mg(s)} + \underset{\text{Dilute hydrochloric acid}}{2HCl(aq)} \longrightarrow \underset{\text{Magnesium chloride}}{MgCl_2(aq)} + \underset{\text{Hydrogen}}{H_2(g)}$$

4. Double Displacement Reactions:- A chemical reaction in which two ionic compounds in their aqueous solutions react by exchanging their ions/ radicals to form two new compounds is called a Double Displacement Reaction.

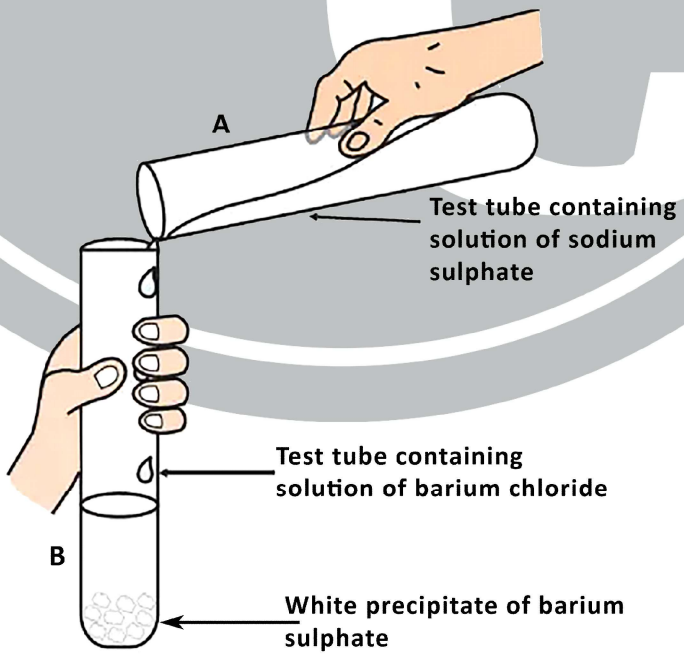
$$(A)—(B) + (C)—(D) \longrightarrow (A)—(D) + (C)—(B)$$

Chemical double displacement reactions can be classified into two kinds.

4.(a) Precipitation Reactions:- When aqueous solutions of two ionic compounds react by exchanging their ions/radicals, to form two new compounds, such that one of the products formed is an insoluble salt and hence, forms a precipitate so the double displacement reaction is said to be a precipitation reaction.

$$\underset{\text{Lead nitrate (colourless)}}{Pb(NO_3)_2(aq)} + \underset{\text{Potassium iodide (colourless)}}{2KI(aq)} \longrightarrow \underset{\text{Lead iodidi (yellow ppt)}}{PbI_2(\downarrow)} + \underset{\text{Potassium nitrate}}{2KNO_3(aq)}$$

$$\underset{\text{Sodium sulphate}}{Na_2SO_4(aq)} + \underset{\text{Barium chloride}}{BaCl_2(aq)} \longrightarrow \underset{\text{Sodium chloride}}{2NaCl_2(aq)} + \underset{\text{Barium sulphate (white ppt)}}{BaSO_4(\downarrow)}$$



- **Observation:-** You will observe that at once a white precipitate is formed. This white precipitate is due to the formation of insoluble barium sulphate. This is a double displacement reaction.

→ **Double Displacement Reactions:-**

$$\underbrace{AgNO_3(aq)}_{\text{Silver nitrate (colourless)}} + \underbrace{NaCl(aq)}_{\text{Sodium chloride (colourless)}} \longrightarrow \underbrace{AgCl(\downarrow)}_{\text{Silver chloride}} + \underbrace{NaNO_3(aq)}_{\text{Sodium nitrate}}$$

$$\underbrace{2NaOH(aq)}_{\substack{\text{Sodium hydroxide}\\ \text{(Colourless)}}} + \underbrace{CuSO_4(aq)}_{\substack{\text{Copper sulphate}\\ \text{(Blue)}}} \longrightarrow \underbrace{Na_2SO_4(aq)}_{\text{Sodium sulphate}} + \underbrace{Cu(OH)_2(\downarrow)}_{\substack{\text{Copper hydroxide}\\ \text{(blue ppt)}}}$$

4.(b) Neutralisation Reactions:- When an aqueous solution of an acid reacts with a base (alkali) by exchanging their ions/radicals to form salt and water as the products the reaction that takes place is called as a Neutralisation Reaction.

$$\text{Acid} + \text{Base/Alkali} \longrightarrow \text{Salt} + \text{Water}$$

$$\underbrace{H_2SO_4(aq)}_{\text{Sulphuric Acid}} + \underbrace{2NaOH(aq)}_{\text{Sodium Hydroxide}} \longrightarrow \underbrace{Na_2SO_4(aq)}_{\text{Sodium Sulphate}} + \underbrace{2H_2O(l)}_{\text{Water}}$$

$$\underbrace{2HCl(aq)}_{\text{Hydrochloric Acid}} + \underbrace{Mg(OH)_2(aq)}_{\text{Magnesium Hydroxide}} \longrightarrow \underbrace{MgCl_2(aq)}_{\text{Magnesium Chloride}} + \underbrace{2H_2O(l)}_{\text{Water}}$$

✳ **Oxidation and Reduction Reactions:-**

- **Oxidation:-** The oxidation of a substance takes place when:-
  (i) There is addition of oxygen to a substance.
  (ii) There is removal of hydrogen from a substance.
  (iii) Loss of e^- is oxidation.

→ The substance that causes the addition of oxygen or removal of hydrogen is called an Oxidising Agent.
Ex.- O_2, O_3- (ozone), Cl_2, (H_2O_2)-(Hydrogenperoxide), H_2SO_4.

- **Reduction:-** The reduction of a substance take place when:-
  (i) There is addition of hydrogen to a substance.
  (ii) There is removal of oxygen from a substance.
  (iii) Gain of e^- is reduction.

→ The substance that causes the addition of hydrogen or removal of oxygen is called a Reducing Agent. Na, K, Ca, Al, Zn, Hydrogen (H_2), Carbon (C).

$$\underbrace{2Cu(s)}_{\substack{\text{Copper}\\ \text{(Reddish Green)}}} + \underbrace{O_2(g)}_{\text{Oxygen}} \longrightarrow \underbrace{2CuO(s)}_{\substack{\text{Copper oxide}\\ \text{(Black)}}}$$

- **Observations:-** You will observe that reddish brown coloured copper will slowly change to a black colour. This black substance is copper oxide that is formed when oxygen is added to copper.

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Now, go on heating the glass tube and slowly pass hydrogen gas over the black copper oxide for 10 minutes or more. Black copper oxide slowly regains its original reddish brown colour.

$$\underbrace{CuO(s)}_{\text{Copper Oxide (black)}} + \underbrace{H_2(g)}_{\text{Hydrogen}} \longrightarrow \underbrace{Cu(s)}_{\substack{\text{Copper} \\ \text{(reddish brown)}}} + \underbrace{H_2O(l)}_{\text{Water}}$$

→ Oxidation-Reduction reaction, oxidation and reduction take place simultaneously.

→ Hydrogen is acting as a reducing agent and copper oxide is acting as an oxidising agent.

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

$$\underbrace{MnO_2(s)}_{\text{Manganese Dioxide}} + \underbrace{4HCl(aq)}_{\text{Hydrochloric Acid}} \longrightarrow \underbrace{MnCl_2(aq)}_{\text{Manganese Chloride}} + \underbrace{2H_2O(l)}_{\text{Water}} + \underbrace{Cl_2O(g)}_{\text{Chloring}}$$

$$2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$$

$$\underbrace{4Na(s)}_{\text{Sodium}} + \underbrace{O_2(g)}_{\text{Oxygen}} \longrightarrow \underbrace{2Na_2O(s)}_{\text{Sodium Oxide}}$$

Oxidation and Reduction Reactions in Everyday Life:-

→ Formation of layers of undesired compounds such as metallic oxides, metallic hydroxides or metal sulphides on the surface of metals is called corrosion of metals.

✳ **Rusting of Iron:-**

$$\underbrace{4Fe(s)}_{\text{Iron}} + \underbrace{3O_2(g)}_{\text{Oxygen}} + \underbrace{2xH_2O(l)}_{\text{Water}} \longrightarrow \underbrace{2Fe_2O_3.xH_2O(s)}_{\text{Hydrated Iron (III) Oxide (Rust)}}$$

- **Rusting:-** The slow conversion of iron into <u>hydrated ferric oxide</u> in the presence of moisture and air is called rusting.
- **Rust:-** The flaky, non stucky brown powder formed on the surface of iron, when iron is exposed to moist air is called rust.

→ Experiment to show that both air and water are necessary for rusing:- In an absolutely clean and dry test tube place 2g of <u>anhydrous calcium chloride</u> and then a <u>shining iron nail</u>. Put a stopper on the test tube and place it aside for a week. The anhydrous calcium chloride is used <u>to absorb moisture</u> from the enclosed air. It is seen that the nail does not rust. Thus, we can conclude that **<u>dry air does not cause Rusting</u>.**

- **Conditions necessary for rusting of iron:-** Iron rusts, only if its surface comes in contact with <u>(a) oxygen</u> and (b) moisture. If any of the above mentioned conditioned is not fulfilled iron does not rust.

(a) Iron generally rusts in air, because air always contains oxygen gas and moisture.

(b) Iron is found to rust in natural water. It is because, natural water always contains dissolved oxygen.

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Prevention of Rusting:-

1. **By coating with red lead oxide** paint (Pb_3O_4) or tar:- The underside of ships, bridges, electric poles, etc. is coated with tar or led lead oxide paint.
2. **By Painting.**
3. **By Enamelling:-** Enamelling is the process of baking a mixture of silicates on the surface of iron at high temperature.
4. **By Oil and Grease.**
5. **Plastic Coating.**
6. **By Galvanising:-** In this process iron sheets are dipped in molten zinc and then passed through heavy rollers when zinc metal forms a protective layer over iron.
7. **By converting Iron into Stainless Steel:-** When 12 to 20% chromium is incorporated in iron with 0.1 to 0.7% of carbon, it develops a special property due to which it does not rust in moist air. Such a sample of iron is called Stainless Steel (S.S). Stainless steel is used for making surgical instruments, kitchen utensils, cutlery, tools, etc.

Corrosion of Other Metals:-

1. **Corrosion of Copper:-** The position of copper in the metal activity series is below hydrogen and hence it is not expected to corrode. However it is found that when objects made of copper are kept in moist air, containing carbon dioxide for prolonged time, they get coated with a greenish coating. It is because carbon dioxide gas in the presence of moisture and oxygen slowly reacts with copper to form basic copper carbonate [$CuCO_3 + Cu(OH)_2$], which is green in colour.

$$Cu + \underbrace{H_2O + CO_2 + O_2}_{\text{Moist}} \longrightarrow \underbrace{Cu(OH)_2}_{\text{Copper hydroxide}} + \underbrace{CuCo_3}_{\text{Copper carbonate}}$$

2. **Corroison of Silver:-** The position of silver is below copper in the metal activity series and hence it is not expected to corrode in moist air. However, it is found that objects of silver, get coated with a blackish powder in few weeks. It is because air always contains trace of hydrogen sulphide gas. The hydrogen sulphide gas reacts with silver slowly to form silver sulphide which is black in colour.
3. **Corrosion of Gold and Titanium.**

✳ **Rancidity:** The aerial oxidation of food materials containing fats and oils such that they become stale and start smelling bad is called Rancidity.

→ The rancidity can be controlled by keeping the food at low temperatures in refrigerators as low temperatuure slows down the rate of oxidation.

→ The snack manufactures pack snacks in plastic bags. The air is flushed out from the bags and then dry nitrogen is filled in. This prevents oxygen from coming in contact with packed snacks and they do not get oxidised.

GRAVITY CLASSES

"Come Gravity Feel Success"

11th - 12th
NEET, IIT/JEE

5 - 10th
ICSE & CBSE BOARD

AMU JAMIA NDA

MD REHAN RAZA
LITERA VALLEY SCHOOL
94%

Xth (CBSE)
2025
RESULT

HIBA AHMAD
MOUNT ASSISI SCHOOL
2ND RANK IN SCHOOL
94%

ASAD HAQUE
DELHI PUBLIC SCHOOL
87%

ALVINA TANVEER
BISHOP SCOTT GIRLS SCHOOL
88%

1st RANK IN SCHOOL

MD SHALIN IRSHAD
BLUE PEARL HIGH SCHOOL
87%

TOPPERS 2024

97% 
SHADMAN ALI

93% 
KASHAF EJAZ

91.4% 
ALIYA AFREEN

ER. AMIR SIR / ER. ASAD SIR 7004166363, 7717752909