CHEMISTRY CLASS -X

Module-3/4

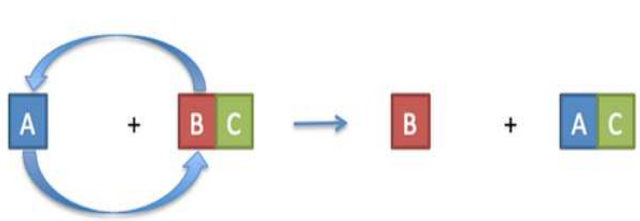
Chapter -1

Chemical Reactions and Equations

A K Sindhu
PGT(SS) Chemistry
AECS-Kudankulam

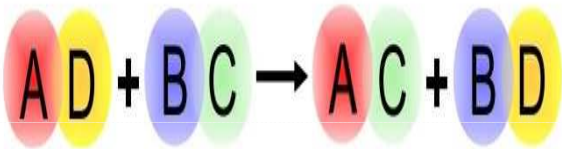
OUTLINE

- Displacement Reaction.



Single Displacement Reaction

- Double Displacement Reaction



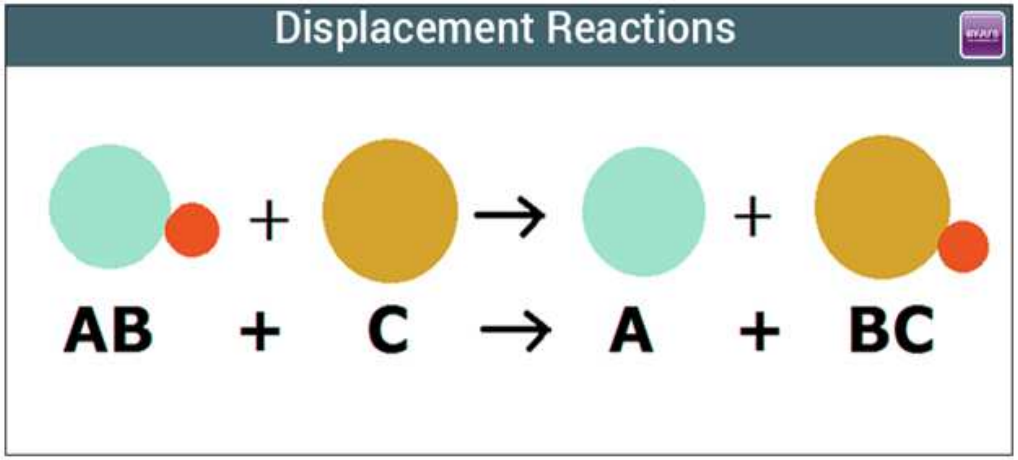
- Neutralisation Reaction

Displacement Reaction

- A **single-displacement reaction**, is a chemical reaction in which one (or more) element(s) replaces an/other element(s) in a compound. It can be represented generically as:

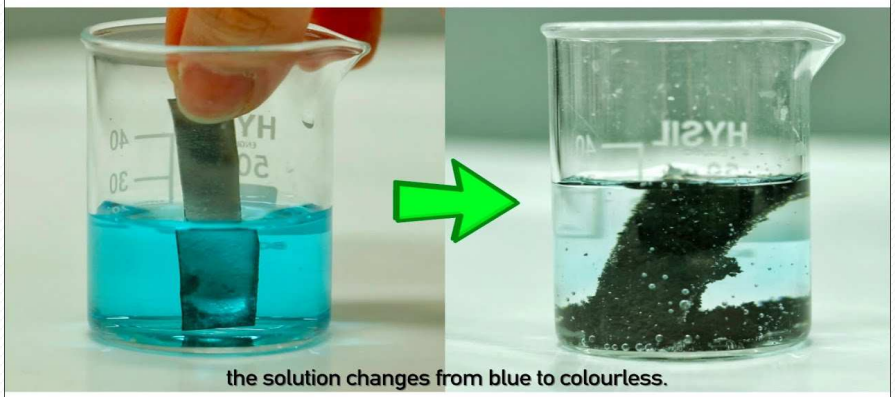
  $A + B\text{-}C \rightarrow A\text{-}C + B$

- Displacement reaction can also be defined as – "More reactive metal displaces less reactive metal from its salt solution."
- Examples- $Fe + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu$
- $2AgNO_3 + Cu \longrightarrow Cu(NO_3)_2 + 2Ag$
- $Zn + HCl \longrightarrow ZnCl_2 + H_2$
- $Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$

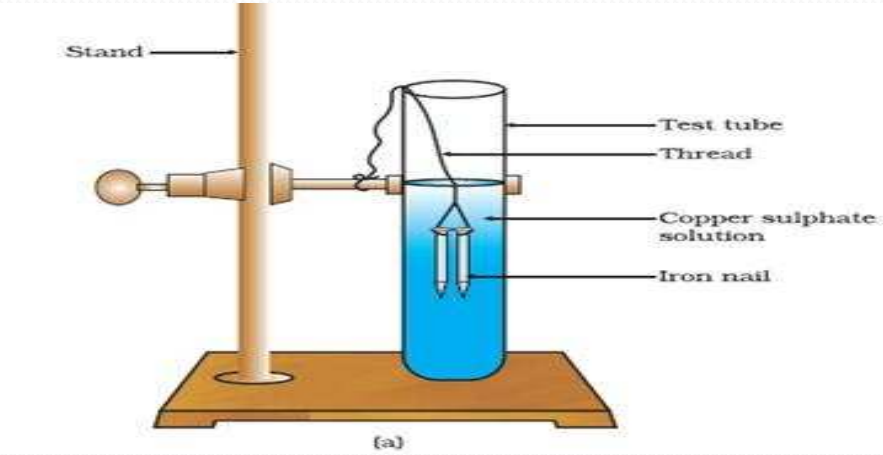


Characteristics of Displacement reaction

- High reactive metal displaces low reactive metal.
- The displacement process is slow.
- In this type of reaction metal displaces other metal from its salt solution.
- $Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$
  (Copper sulphate) (Zinc sulphate)
  $Pb(s) + CuCl_2(aq) \rightarrow PbCl_2(aq) + Cu(s)$
  (Copper chloride) (Lead chloride)
- Zinc and lead are more reactive elements than copper. They displace copper from its compounds.



- **Activity 1.9 NCERT TEXT**
- **Experiment**-Take three iron nails and clean them by rubbing with sand paper.Take two test tubes marked as (A) and (B). In each test tube, take about 10 ml copper sulphate solution.Tie two iron nails with a thread and immerse them carefully in the copper sulphate solution in test tube B for about 20 minutes . Keep one iron nail aside for comparison. After 20 minutes, take out the iron nails from the copper sulphate solution. Compare the intensity of the blue colour of copper sulphate solutions in test tubes (A) and (B).



- **Observation**-The iron nail become brownish in colour and the blue colour of copper sulphate solution fade. Solution's colour changes to light green
- **Inference**- In this reaction, iron has displaced or removed another element, copper, from copper sulphate solution. This reaction is known asdisplacement reaction. Green colour is duet o the formation of ferrous sulphate(Iron (II) sulphate).

$$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$$

(Copper sulphate) (Iron sulphate)

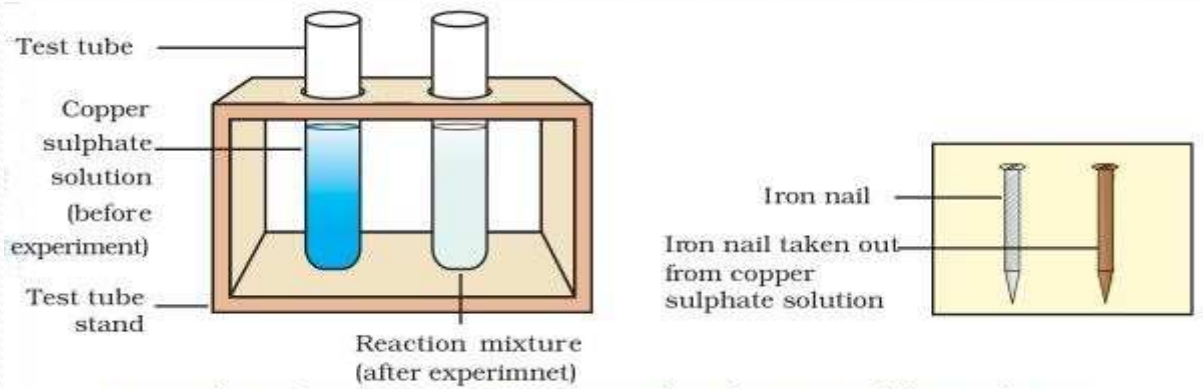
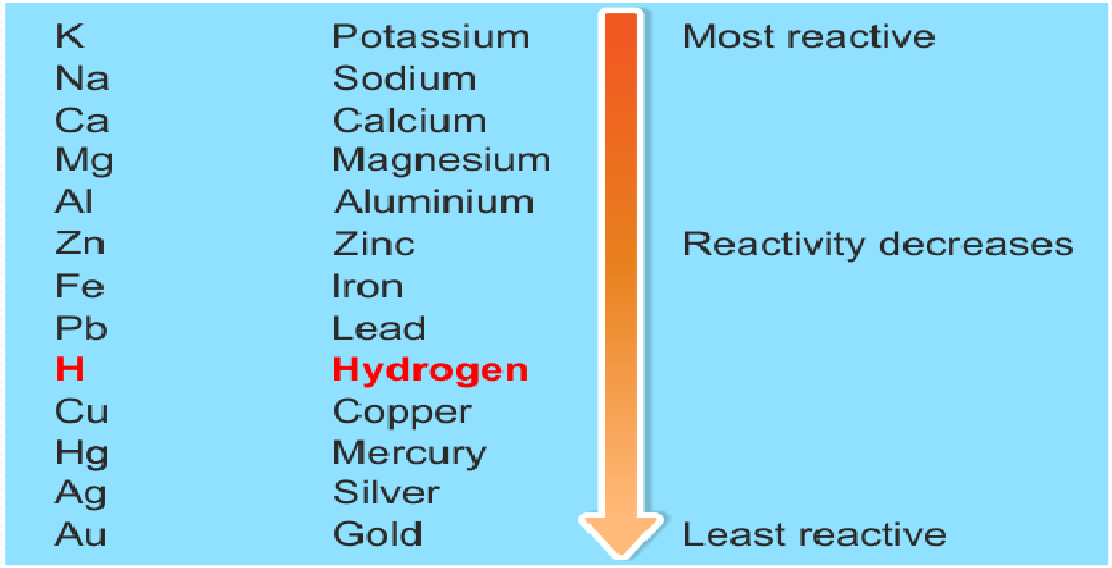


Fig: Single Displacement Reaction- Iron nails with copper sulphate solution

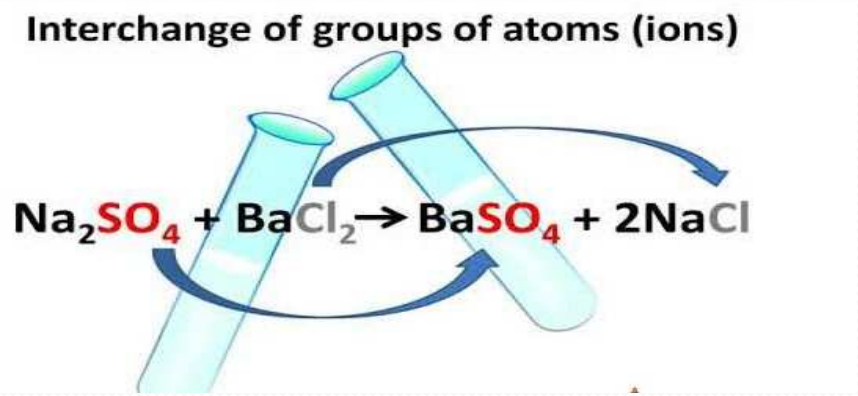
Reactivity Series(Metals)

- Series in which metals are arranged in increasing order of reactivity.
- Most reactive metal is present at the top of the series.
- Least reactive metal is present at the bottom of the series.
- Metal lying above in the series can displace the metal lying below in the series from its salt solution



Double Displacement Reaction

- A double displacement reaction is a type of reaction in which two reactants exchange ions to form two new compounds. Double displacement reactions typically result in the formation of a product that is a precipitate.
- Double displacement reactions take the form:
  $AB + CD \rightarrow AD + CB$
- **Examples**-$Pb(NO_3)_2(aq) + 2\ KI(aq) \rightarrow 2\ KNO_3(aq) + PbI_2(s)\downarrow$
- $AgNO3(aq) + NaCl(aq) \rightarrow AgCl(s)\downarrow + NaNO3(aq)$
- $FeCl3(aq) + NH4OH(aq) \rightarrow NH4Cl(aq) + Fe(OH)3(s)\downarrow$
- $Al(NO3)3(aq) + NH4OH(aq) \longrightarrow Al(OH)3(s)\downarrow + NH4NO3(aq)$

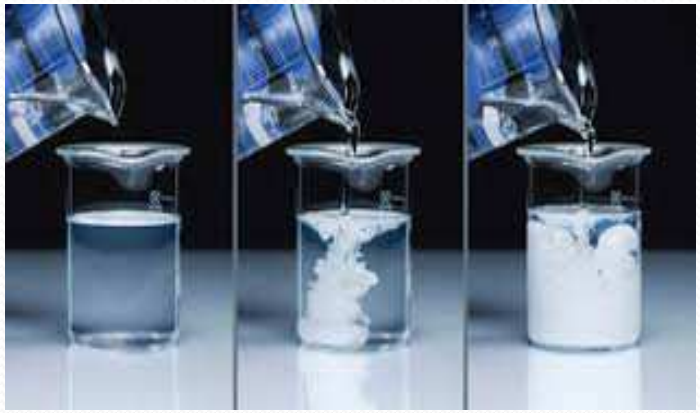


- **Activity 1.10 NCERT TEXT**
- **Experiment**-Take about 3 mL of sodium sulphate solution in a test tube.In another test tube, take about 3 mL of barium chloride solution. Mix the two solutions.

  Observation-A **white ppt** is formed which settles down in a colourless solution.
- **Inference**-This insoluble substance formed is known as a precipitate. Any reaction that produces a precipitate can be called a precipitation reaction.

$$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s)\downarrow + 2NaCl(aq)$$

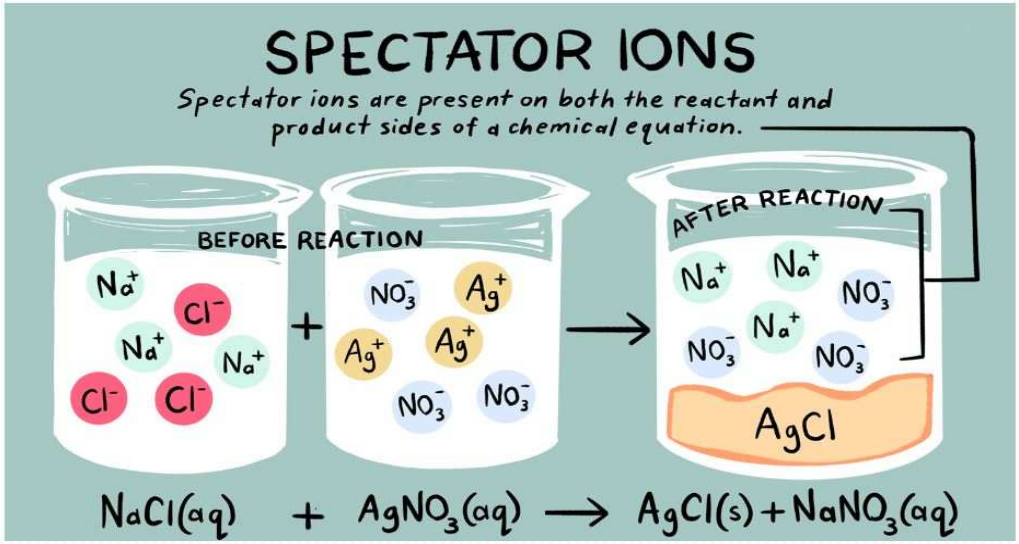
- (Sodium Sulphate) (Barium Chloride) (Barium Sulphate) (Sodium Chloride)



Formation of Barium sulphate precipitate

Characteristics of Double Displacement Reaction

- A double displacement reaction is a type of chemical reaction in which the reactant ions exchange places to form new products.
- Usually, a double displacement reaction results in precipitate formation.
- The chemical bonds between the reactants may be either covalent or ionic.
- A double displacement reaction is also called a double replacement reaction, salt metathesis reaction, or double decomposition.



Neutralisation Reaction

- A neutralization reaction is a chemical reaction between an acid and a base which produces a more neutral solution.
- The classic example of a neutralization is the reaction between an acid and a base to yield a salt and water:
- acid + base → salt + water
- $HCl + NaOH \longrightarrow NaCl + H_2O$
- $HCl + KOH \longrightarrow KCl + H_2O$
- $2HNO_3 + Mg(OH)_2 \longrightarrow Mg(NO_3)_2 + 2H_2O$

Characteristics of a neutralisation reaction

- Neutralization is a process when acids and bases react to form salt and water.
- The pH of the neutralized solution depends on the strength of acid or base involved in it.
- If a strong acid is mixed with a strong base then the salt formed is neutral.
- $KOH + HNO_3 \longrightarrow KNO_3 + H_2O$
- If a strong acid is mixed with a weak base then the salt formed is acidic.
- $HCl + NH_4OH \longrightarrow NH_4Cl + H_2O$
- If a weak acid is mixed with a strong acid then the salt formed is basic.
- $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$
- While strong acids and strong bases completely dissociate, weak acids and bases only partially dissociate to form an equilibrium mixture. The neutralization remains incomplete.

Ionic Equations for Neutralisation reaction

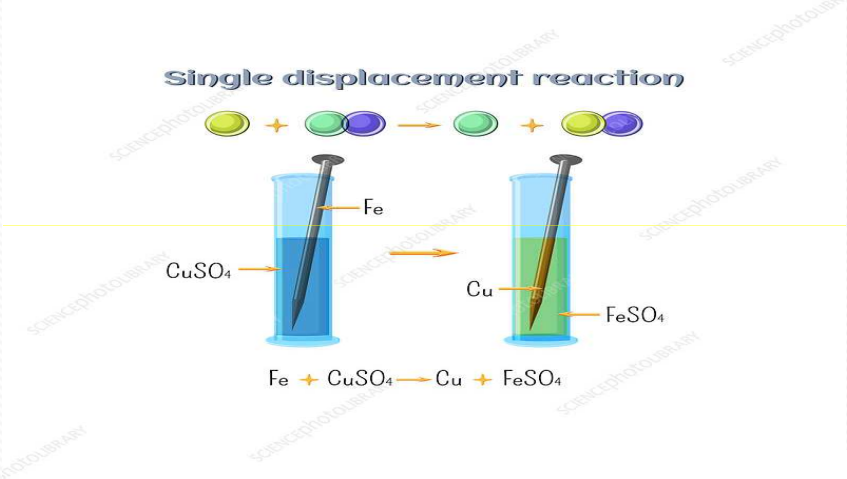
- When equal amounts of a strong acid such as hydrochloric acid are mixed with a strong base such as sodium hydroxide, the result is a neutral solution. The products of the reaction do not have the characteristics of either an acid or a base. Here is the balanced molecular equation.
- $HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$
- Chemical reactions occurring in aqueous solution are more accurately represented with a net ionic equation. The full ionic equation for the neutralization of hydrochloric acid by sodium hydroxide is written as follows:
- $H^+(aq) + Cl^-(aq) + Na^+(aq) + OH^-(aq) \longrightarrow Na^+(aq) + Cl^-(aq) + H_2O$
- Since the acid and base are both strong, they are fully ionized and so are written as ions, as is the NaCl formed as a product. The sodium and chloride ions are spectator ions in the reaction, leaving the following as the net ionic reaction.
- $H^+(aq) + OH^-(aq) \longrightarrow H_2O$

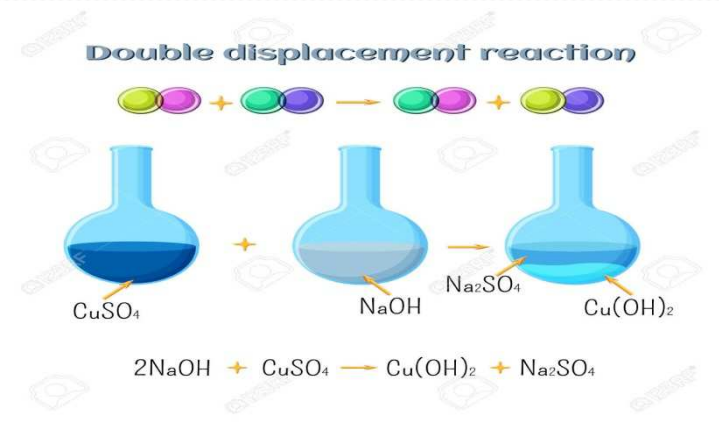
Application of Neutralisation Reaction

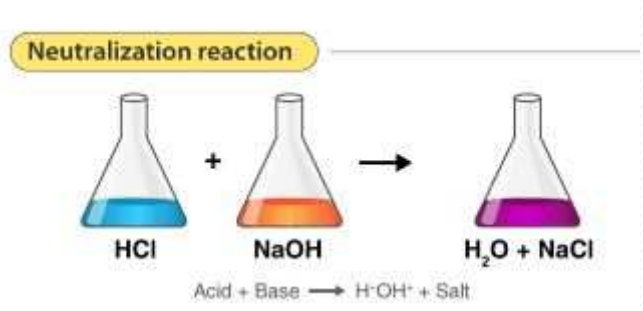
- Pouring concrete and working it are messy jobs. In the process, a lot of wastewater with an alkaline pH is generated. As per regulations this wastewater should be cleaned up at the site. One practical way to neutralize the basic pH is to bubble CO_2 into the water. The carbon dioxide forms a weak acid (carbonic acid, H_2CO_3) in solution which serves to bring the alkaline pH down to something closer to neutral.

- In the rubber industry, ammonia solution, NH_4OH, is used to prevent the coagulation of latex because ammonia solution, NH_4OH, can neutralize the acid (lactic acid) produced by bacteria in the latex.
- Bee stings contain formic acid and are acidic in nature, these stings can be neutralized by applying a base like baking soda.
- Acidity or gastric problems arise due to an increase of acid in the stomach, Anti-acids or antacids are medicines containing bases such as NaHCO3 (sodium bicarbonate) Mg(OH)2 (magnesium hydroxide) neutralize excess of acid in the stomach
- Most food particles are acidic in nature. For example, lemonade, chocolate, etc. Such foods produce acid in our mouth which reacts with enamel i.e. calcium phosphate and leads to cavities. Using toothpaste while brushing helps to neutralize the acid since toothpaste is a base.

Summary


Single displacement reaction
Fe
CuSO4
Cu
FeSO4
Fe + CuSO4 → Cu + FeSO4


Double displacement reaction
CuSO4
NaOH
Na2SO4
Cu(OH)2
2NaOH + CuSO4 → Cu(OH)2 + Na2SO4


Neutralization reaction
HCl
NaOH
H2O + NaCl
Acid + Base → H-OH + Salt

THANK YOU