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ZONAL INSTITUTE OF EDUCATION & TRAINING
CHANDIGARH

STUDY MATERIAL

CLASS X

SUBJECT : SCIENCE

FIRST TERM

SESSION : 2012 - 2013

UNIT I CHEMICAL REACTIONS AND EQUATIONS

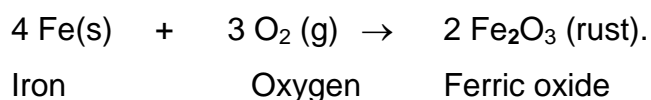
❖ [GIST]

➤ **Physical Change:** Change in physical properties.

- Melting
- Boiling
- Condensation
- [Note- No change occurs in the identity of the substance].

➤ **Chemical Change:**

- Atoms in the reactants are rearranged to form one or more different substances.
- Old bonds are broken, new bonds are formed.
- Reactants lose their properties to form product of different properties.



➤ **Chemical equation:** The symbolic representation of a chemical reaction is called a chemical equation.

Features of a chemical equation:

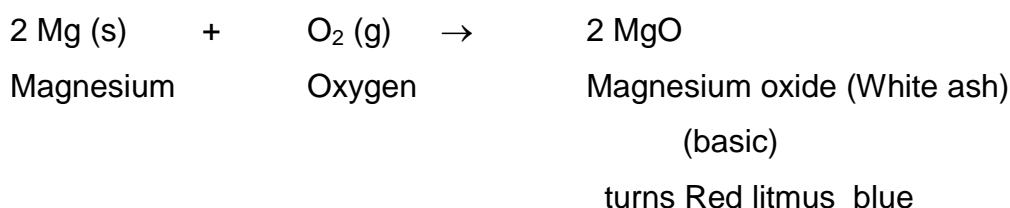
- The reactants are written on the left hand side with a plus sign between them.
- The products are written on the right hand side with a plus sign between them.
- An arrow separates the reactants from the products. The arrow head points towards the products and indicates the direction of the reaction.
- **Skeletal chemical equation:** A chemical equation which simply represents the symbols and formulas of reactants and products taking part in the reaction is known as skeletal chemical equation for a reaction.

For example: For the burning of Magnesium in the air, $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$ is the skeletal equation.

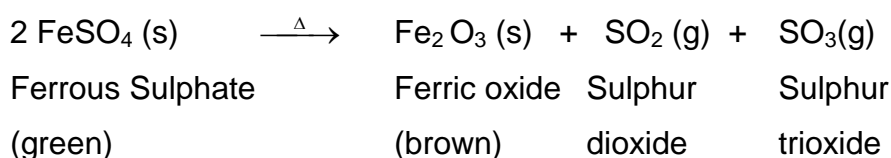
- **Balanced chemical equation:** A balanced equation is a chemical equation in which number of atoms of each element is equal on both sides of the equation i.e number of

Combustion	:	$AB + O_2$	\rightarrow	Oxide of A & B.
Combination	:	$A + B$	\rightarrow	C
Decomposition	:	AB	\rightarrow	$A + B$
Displacement	:	$A + BC (aq)$	\rightarrow	$AC (aq) + B$
Double Displacement	:	$AB (aq) + CD (aq)$	\rightarrow	$AD (aq) + CB$

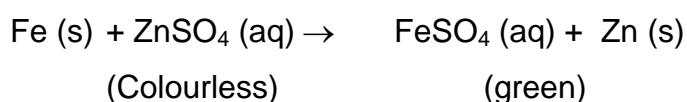
1. **Combination** Rex^n : Two or more reactant combine to form a single product.



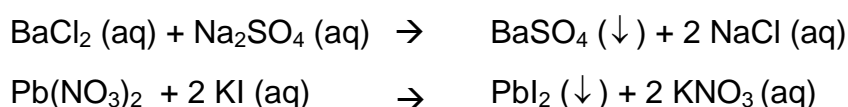
2. **Decomposition Rexⁿ**: A single compound decomposes or break down to give two or more simpler substances.



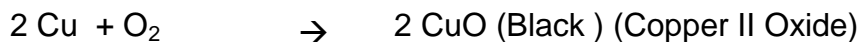
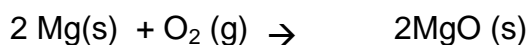
3. **Displacement** Rex^n : A more reactive element [metal] displaces less reactive element [metal] from its aqueous salt sol^n .



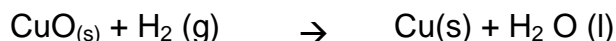
4. **Double Displacement Rexⁿ:** Aqueous solⁿ of two ionic compounds react by exchange of their ions is called double displacement Rexⁿ.



5. **Oxidation Reaction:** In oxidation reaction, addition of oxygen or removal of hydrogen or loss of electron takes place.



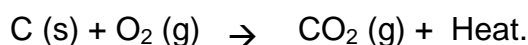
6. **Reduction Reaction:** In reduction rex^n addition of hydrogen or removal of oxygen or gain of electron takes place.



7. **Redox Reaction:** Reaction involving both oxidation and reduction simultaneously.



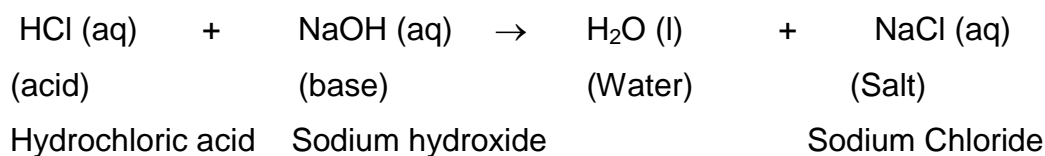
8. **Exothermic rex^n :** Reaction in which heat is evolved.



9. **Endothermic rex^n :** Rex^n in which heat is absorbed.



10. **Neutralisation rex^n :** When an acid and a base react together to form salt and water.



➤ **Law of Conservation of Mass**

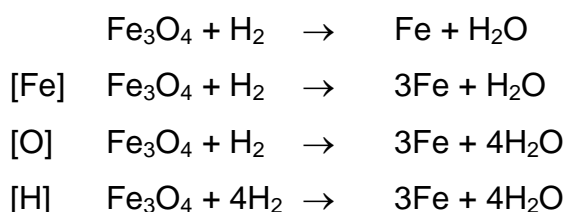
In a chemical reaction matter is conserved.

Total no. of atoms = Total no. of atoms

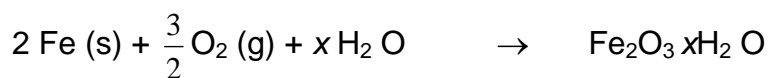
Total mass = Total mass.

[While Balancing a Chemical Equation Formula of reactants and products should not be changed].

Balancing:



- **Corrosion:** Process of slowly reacting up of metals due to attack of atmospheric gases like O_2 , CO_2 etc.



Rust(hydrated Iron (III)oxide)

Prevention: Painting, Galvanization, oiling/ greasing.

Corrosion of Aluminium has **advantage**, since Al_2O_3 formed as a result of corrosion act as protective layer.

- **Rancidity:** Oxidation of oils or fats in a food, resulting into a bad smell and taste.

Prevention: Adding anti-oxidants.

Vacuum Packing

Replacing air by Nitrogen

Refrigeration of food stuff.

❖ [KEY POINTS]

- A chemical reaction involves a chemical change in which substances react to form new substances with entirely new properties. Substances that react or take part in the reaction are known as reactants and the substances formed are known as products.
- During a chemical reaction, there is a breaking of bonds between atoms of the reacting molecules to give products.
- A chemical reaction can be observed with the help of any of the following observations:
 - Evolution of a gas
 - Change in temperature
 - Formation of a precipitate
 - Change in colour
 - Change of state
- Physical change: If a change involves change in colour or state but no new substance is formed, then it is a physical change.

- Chemical change: If a change involves formation of new substances, it is a chemical change.
- Exothermic and endothermic reactions: If heat is evolved during a reaction, then such a reaction is known as Exothermic reaction. If heat is absorbed from the surroundings, then such a reaction is known as endothermic reaction.
- As per the law of conservation of mass, the total mass of the elements present in the products of a chemical reaction is equal to the total mass of the elements present in the reactants.
- The process of equating the number of atoms on both the sides of a chemical equation is known as balancing of a chemical equation.
- The first step in balancing a chemical equation is to write the number of atoms of each element present on the left hand side and right hand side.
- We should always start balancing with the compound that contains maximum number of atoms.

It can be reactant or a product. Then in that compound select the element which has the maximum number of atoms.

- While balancing a chemical equation, the molecular formulas of the reactants and products should not change. The molecular formulas are simply multiplied by suitable coefficients.
- To make a chemical equation more informative, the reaction conditions such as temperature, pressure or catalyst are written on the arrow separating the reactants and products.
- The evolution of gas is indicated by an upward arrow.
- The formation of precipitate is indicated by a downward arrow.
- Heat evolved during the reaction is written as + Heat on the product side.
- Heat absorbed during the reaction is written as + Heat on the reactant side.
- **Combination reaction** is a reaction in which 2 or more substances combine to give a single product.
- Combination reaction can be between two elements, between an element and a compound or between two compounds.
- **Decomposition reaction:** In a decomposition reaction, a single reactant decomposes to give two or more products.
- Decomposition reactions require energy in the form of heat, light or electricity

Types of decomposition reactions:

- Decomposition reactions which require heat are known as thermolytic.
- Decomposition reactions which require light are known as photolytic.
- Decomposition reactions which require electricity are known as electrolytic.
- **Displacement reaction:** A reaction in which a more active element displaces less active element from its salt solution.
- The reactivity series is a list of metals arranged in the order of decreasing reactivity.
- The most reactive metal is placed at the top and the least reactive metal is placed at the bottom.
- **Double displacement reaction:** A chemical reaction in which there is an exchange of ions between the reactants to give new substances is called double displacement reaction.
- **Precipitation reaction:** An insoluble solid known as precipitate is formed during a double displacement reaction. Such reactions are also known as precipitation reactions.
- **Redox reaction:** A reaction in which oxidation and reduction take place simultaneously in a reaction, is known as a redox reaction.
- Oxidation is a chemical process in which a substance gains oxygen or loses hydrogen.
- Reduction is a chemical process in which a substance gains hydrogen or loses oxygen.
- If a substance gains oxygen or loses hydrogen during a reaction, it is said to be oxidised.
- If a substance gains hydrogen or loses oxygen during a reaction, it is said to be reduced.
- A substance that loses oxygen or gains hydrogen is known as an oxidising agent.
- A substance that loses hydrogen or gains oxygen is known as a reducing agent.
- An oxidising agent gets reduced whereas a reducing agent gets oxidised.
- In terms of electronic concept, Oxidation is defined as a loss of electrons while reduction is defined as a gain of electrons.

- Corrosion is the slow eating up of metals by the action of air and moisture on their surfaces. Corrosion in case of Iron is known as Rusting.
- Chemically, rust is hydrated ferric oxide ($\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$)
- Advantages of corrosion: Though corrosion is undesirable, it can be advantageous in case of aluminium which on exposure to air, gets coated with a protective layer of aluminium oxide. This protects the metal underneath from further corrosion and damage.
- Rancidity: When oils and fats or foods containing oils and fats are exposed to air, they get oxidised due to which the food becomes stale and gives a bad taste or smell. This is called Rancidity.
- Rancidity can be prevented by:
 - a Adding antioxidants i.e. the substances which prevent oxidation
 - b Refrigeration
 - c Storing the food in air-tight containers

❖ [SUGGESTED ACTIVITIES]

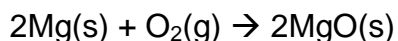
- Combination reaction b/w Magnesium ribbon and Oxygen from air.
- Combination reaction b/w Quick Lime and Water.
- Thermal decomposition of Ferrous Sulphate.
- Thermal decomposition of Lead Nitrate
- Formation of hydrogen gas by the action of dil. Sulphuric Acid on Zinc
- Displacement reaction b/w Iron /Copper Sulphate, Zinc/ Copper Sulphate
- Double displacement reaction b/w Lead Nitrate & Potassium Iodide.
- Double displacement reaction b/w Sodium Sulphate & Barium Chloride.
- Photodecomposition of Silver Chloride
- Oxidation of Copper to Copper Oxide
- Exothermic and Endothermic Reaction.

❖ [QUESTION BANK]

Very Short answer type questions :

1. What happens when magnesium ribbon burns in air?

Ans. When magnesium ribbon burns in air, it combines with the oxygen to form magnesium oxide.



2. Name the gas evolved when zinc reacts with dil. HCl.

Ans. Hydrogen gas is evolved.

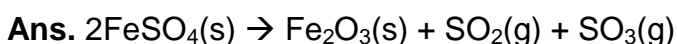
3. What is a chemical equation?

Ans. A chemical equation is a symbolic notation that uses formulae instead of words to represent a chemical equation.

4. On what chemical law, balancing of chemical equation is based?

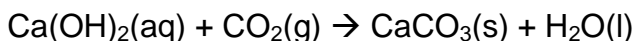
Ans. Balancing of a chemical equation is based on the law of conservation of mass.

5. Represent decomposition of ferrous sulphate with the help of balanced chemical equation.



6. When carbon dioxide is passed through lime water, it turns milky, why?

Ans. Lime water (calcium hydroxide) combines with carbon dioxide to form a suspension of calcium carbonate which makes lime water milky.



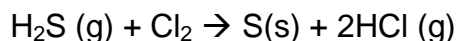
7. A zinc rod is left for nearly 20 minutes in a copper sulphate solution. What change would you observe in zinc rod?

Ans. Zinc rod will change into zinc sulphate.

8. What type of reaction is this: $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$

Ans. It is a double displacement reaction.

9. Identify the compound oxidized in the following reaction.



Ans. H_2S is oxidized.

10. What is rust?

Ans. Rust is mainly hydrated iron (III) oxide, $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$.

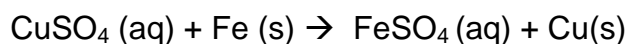
11. How does the food become rancid ?

Ans. Food becomes rancid when fat and oils present in the food are oxidized.

Short answer type questions:

1. An iron knife kept dipped in a blue copper sulphate solution turns the blue solution light green. Why?

Ans. As we know iron is more reactive than copper. So, it displaces Cu from CuSO_4 solution and forms ferrous sulphate which is of Light Green Colour.



Blue colour light green colour

2. A copper coin is kept in a solution of silver nitrate for some time. What will happen to the coin and the colour of the solution?

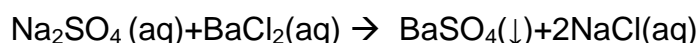
Ans: We know that copper is more reactive than silver, so it will displace silver from its salt solution: $\text{Cu(s)} + 2\text{AgNO}_3\text{(aq)} \rightarrow \text{Cu(NO}_3)_2\text{(aq)} + 2\text{Ag(s)}$

So the solution will turn blue due to the formation of copper nitrate.

3. What do you understand by precipitation reaction? Explain with suitable examples.

Ans. Precipitate. When two reactants react and product formed remains insoluble and settles as a solid it is called a precipitate. Such reactions in which precipitate is formed are called precipitation reactions. For example,

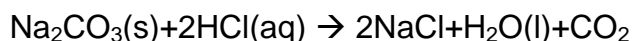
i) When aqueous solution of sodium sulphate is mixed with the aqueous solution or barium chloride, barium sulphate comes in the form of white precipitate



- ii) When aqueous solution of sodium chloride is mixed with the aqueous solution of silver nitrate, silver chloride comes in the form of white precipitate.

4. What is lime-water test for the detection of carbon dioxide?

Ans. When carbon dioxide gas is passed through lime water, it turns milky due to the formation of milky suspension (precipitate) of calcium carbonate. Carbon dioxide is produced by the action of dilute HCl on sodium carbonate.



Carbon dioxide gas produced in this reaction is passed through lime water it changes to milky colour due to the formation of calcium carbonate.

Long answer type questions:

1. What is corrosion? State the conditions necessary for rusting of iron. How rusting is harmful ?

Ans: *Corrosion:* The process of eating away of the metal by the action of atmospheric reagents changing the metal into its compound is called corrosion.

Rusting of Iron : When iron and iron objects are exposed to atmosphere, they are attacked by air and moisture (water) of the atmosphere and a brown and orange colored layer is formed on the surface. It is called rust which is mainly hydrated iron (III) oxide $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$.

Harmful Effect of Rusting : Hydrated iron (III) oxide is brittle substance and moves away from the surface thus the object is damaged. The objects get holes, cavities and rough surface.

Conditions necessary for rusting:

- i) Open surfaces of the metal.
- ii) Presence of air (Oxygen).
- iii) Presence of moisture (water).

2. What is rancidity? Write the common method to prevent it.

Ans. When food item are kept unprotected for some time, they give some unpleasant smell and taste and become rancid. This process is called rancidity. Actually, the micro organisms oxidize the fat and oils present in them. So, oxidation of food items need to be prevented to protect them.

Common methods to Prevent Rancidity of Food item:

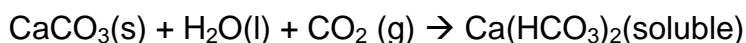
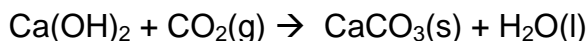
- i) Keeping the food at low temperature
- ii) Keeping food item in air tight containers
- iii) By filling nitrogen in the food storage bags.

3. a) Why cannot a chemical change be normally reversed ?
 b) Why is it always essential to balance a chemical equation?
 c) What happens when CO₂ gas is passed through lime water and why does it disappear on passing excess CO₂?
 d) Can rusting of iron takes place in distilled water?

Ans: a. In a chemical change some bonds are broken and some bonds are formed. The products are quite different from the reactants. Therefore it normally can't be reversed.

b. A chemical equation has to be balanced to satisfy the law of conservation of mass.

c. On passing CO₂ gas through lime water, it turns milky due to formation of insoluble calcium carbonate which dissolves on passing excess CO₂ due to formation of soluble calcium bicarbonate.



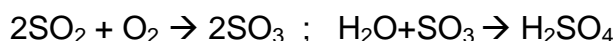
d. No, rusting of iron cannot take place in distilled water because it neither contains dissolved oxygen nor CO₂ both are essential for rusting of iron.

❖ [HOTS QUESTIONS]

1. The marble statues often slowly get corroded when kept in open for a long time.

Assign a suitable explanation

Ans. SO₂, NO₂ gases are released into the atmosphere from various sources. These dissolve in rain water to give acid which corrodes marble statues



2. You are given the following materials (a) marble chips (b) dilute hydrochloric acid (c) Zinc granules, identify the type of reaction when marble chips and Zinc granules are added separately to acid taken in two test tubes.

Ans. (a) marble chips react with dilute hydrochloric acid to form calcium chloride and carbon dioxide. It is a double displacement reaction



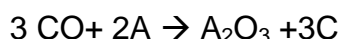
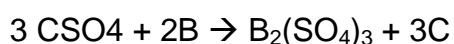
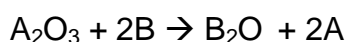
(b) Zinc granules react with dilute hydrochloric acid to give hydrogen gas. It is a displacement reaction $\text{Zn(s)} + 2\text{HCl} \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(\text{g})$

3. The gases hydrogen & chlorine do not react with each other even if kept together for a long time. However, in the presence of sunlight, they readily combine. What does actually happen?

Ans. In chemical reactions, energy is needed to break the bonds present in the reacting molecules so that they may combine to form the products. In this reaction, sunlight is the source of energy in the form of photons. The energy made available by sunlight helps in breaking the bonds & this leads to chemical reaction between hydrogen & chlorine.



4. **A**, **B** and **C** are three elements which undergo chemical reactions in the following way:



Answer the following

- Which element is most reactive?
- Which element is least reactive?

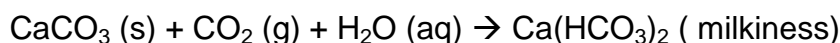
Ans: a) The most reactive element is 'B'. It has displaced both 'A' and 'C' from their compounds.

b) The least reactive element is 'C' as it has been displaced by both 'A' and 'B'.

5. A water insoluble substance =X' on reacting with dilute H_2SO_4 released a colourless and odourless gas accompanied by brisk effervescence. When the gas was passed

through water, the solution obtained turn blue litmus red . On bubbling the gas through lime water, it initially became milky and the milkiness disappeared when the gas was passed in excess. Identify the substance =X' and write the chemical equations of the reaction involved .

Ans: The water insoluble substance 'X' is most probably metal carbonate (CaCO_3). The chemical reaction that involved are given below

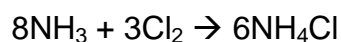


6. Ahmad took a magnesium ribbon (cleaned) and burned it on a flame. The white powder formed was taken in a test tube and water was added to it. He then tested the solution formed with red and blue litmus paper. What change was seen? Why?

Ans. Red litmus paper turned blue. Blue litmus paper remained blue.

This is because the magnesium ribbon on burning in air forms the white magnesium oxide. Which dissolved in water, it forms magnesium hydroxide, which is basic in nature.

7. Give one example of a combination reaction in which an element combines with a compound to give you a new compound.



❖ [REACTION WORKSHEET]

Write balanced equations for the following word equations.

- Potassium chloride + Silver nitrate \rightarrow Potassium nitrate + Silver chloride
- Aluminum hydroxide + Sodium nitrate \rightarrow Aluminum nitrate + Sodium hydroxide
- Iron metal + Copper(II) sulphate \rightarrow Iron(ii) sulphate + copper metal

4. Aluminum metal + Copper(II) chloride → Aluminum chloride + copper metal
 5. Potassium bromide → Potassium metal + Bromine
 6. Calcium carbonate → Calcium oxide + Carbon dioxide gas
 7. Zinc metal + Oxygen gas → Zinc oxide
 8. Chlorine gas + Sodium metal → Sodium chloride
 9. Aluminum sulphate + Barium chloride → Aluminum chloride + Barium sulphate
 10. Sodium hydrogen carbonate → Sodium carbonate + Carbon dioxide + Water
-

UNIT-II ACIDS, BASES & SALTS

❖ [GIST]

➤ Properties of Acids:

- Produce hydrogen ions $[H^+]$ in H_2O .
- Sour taste.
- Turn blue litmus red.
- Act as electrolytes in sol^n .
- Neutralize solutions carrying hydroxide ions.
- React with several metals releasing Hydrogen gas.
- React with carbonates releasing CO_2 (g)
- Destroy body tissues.
- corrode metal surface quickly.

➤ On the basis of origin, acids are classified as :

- a. Organic acids:** Acids derived from living organisms like plants and animals . For example: citric acid is present in fruits, acetic acid present in vinegar, oxalic acid present in tomato, tartaric acid present in tamarind, lactic acid present in sour milk and curd.
- b. Mineral acids:** They are also called inorganic acids. They are dangerous and corrosive. For example: sulphuric acid (H_2SO_4), hydrochloric acid (HCl) etc.

➤ On the basis of their strength, acids are classified as :

- a. Strong acids:** Completely dissociate into its ions in aqueous solutions. Example: nitric acid (HNO_3), sulphuric acid (H_2SO_4), hydrochloric acid (HCl).
- b. Weak acids:** Weak acids are those acids which do not completely dissociate into its ions in aqueous solutions. For example: carbonic acid (H_2CO_3), acetic acid (CH_3COOH).

➤ **On the basis of their concentration, acids are classified as :**

- a. **Dilute acids:** Have a low concentration of acids in aqueous solutions.
- b. **Concentrated acids:** Have a high concentration of acids in aqueous solutions.

➤ **On the basis of number of hydrogen ion, acids can be classified as :**

Monoprotic acid – Such type of acid produces one mole of H^+ ions per mole of acid, e.g., HCl , HNO_3 .

Diprotic acid – They can produce two moles of H^+ ions per mole of acid, e.g., H_2SO_4 .

Triprotic acid – They produce three moles of H^+ ions per mole of acid, e.g., H_3PO_4 .

Polyprotic – They can produce more than three H^+ ions per mole of acid.

➤ **Properties of Base:**

- Produce hydroxide ions $[OH^-]$ in H_2O .
- Water soluble bases are called alkalies.
- Bitter Taste
- Turn Red Litmus blue.
- Act as electrolytes in solⁿ.
- Neutralize solutions containing H^+ ions.
- Have a slippery, 'soapy' feel.
- Dissolve fatty material.

➤ **On the basis of their strength, bases are classified as:**

- a. **Strong bases:** Strong bases are those bases which completely dissociate into its ions in aqueous solutions. Example: sodium hydroxide ($NaOH$), potassium hydroxide (KOH).
- b. **Weak bases:** Weak bases are those bases which do not completely dissociate into its ions in aqueous solutions. For example: ammonium hydroxide (NH_4OH).

➤ **On the basis of their concentration, bases are classified as:**

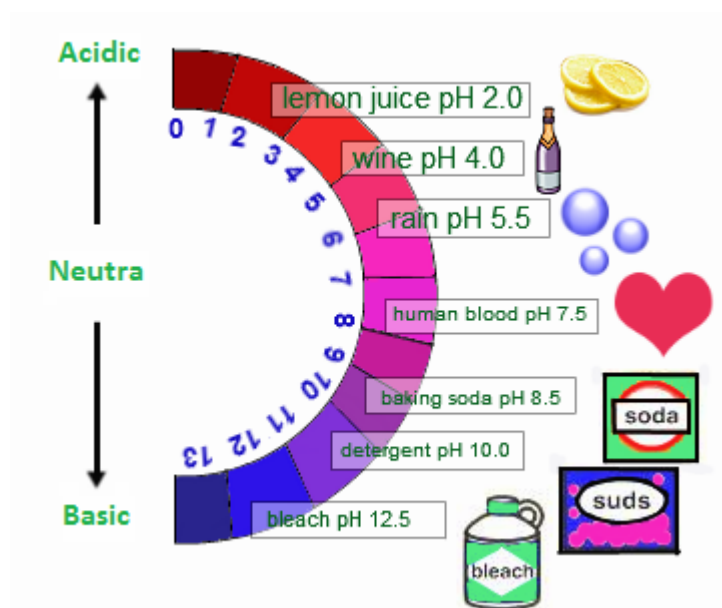
- Dilute bases:** Have a low concentration of alkali in aqueous solutions.
- Concentrated bases:** Have a high concentration of alkali in aqueous solutions.

➤ **Strength Of Acid Or Base Solutions:**

A scale for measuring hydrogen ion concentration in a solution, called pH scale has been developed. The p in pH stands for 'potenz' in German, meaning power.

p ≡ potential or Power H ≡ Hydrogen

pH = 7	Neutral Solution	$\text{H}_3\text{O}^+ = \text{OH}^-$
pH > 7	Basic Solution	$\text{H}_3\text{O}^+ < \text{OH}^-$
pH < 7	Acidic Solution	$\text{H}_3\text{O}^+ > \text{OH}^-$
Range of pH is from 1 to 14		



➤ **pH Sensitivity of Plants & Animals:**

- Human body works in a narrow range of pH 7 to 7.8. Acidity can be lethal for plants and animals.

- **pH of Digestive System:** Stomach secretes HCl to kill bacteria in the food. The inner lining of stomach protects vital cells from this acidic pH.
- **pH and tooth decay:** Lower pH because of sour food and sweet food can cause tooth decay. The pH of mouth should always be more than 5.5.
- **pH as self defense mechanism in plants & animals:** Certain animals like bee and plants like nettle secrete highly acidic substance for self defense.

➤ **Properties of salts:**

- Salts form by the combination of acid and base through neutralization reaction.
- The acidic and basic nature of salts depends on the acid and base combined in neutralization reaction.

Acid	Base	Salt	Example
Strong	Strong	Neutral	$\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
Strong	Weak	Acidic	$\text{HCl} + \text{NH}_4\text{OH} \rightarrow \text{NH}_4\text{Cl} + \text{H}_2\text{O}$
Weak	Strong	Basic	$\text{CH}_3\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$
Weak	Weak	Neutral	$\text{CH}_3\text{COOH} + \text{NH}_4\text{OH} \rightarrow \text{CH}_3\text{COONH}_4 + \text{H}_2\text{O}$

- The most common salt is sodium chloride or table salt which forms by the combination of sodium hydroxide (base) and hydrochloric acid.
 - Other examples include Epsom salts (MgSO_4) used in bath salts, ammonium nitrate (NH_4NO_3) used as fertilizer, and baking soda (NaHCO_3) used in cooking.
 - The pH of salts solution depends on the strength of acids and base combined in neutralization reaction.
- **Indicators** – Indicators are substances which indicate the acidic or basic nature of the solution by their colour change.

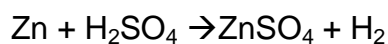
The colour of some acid – base indicators in acidic and basic medium are given below :

S. No.	Indicators	Colour in	Colour in
		acidic medium	basic medium
1	Litmus solution	Red	Blue
2	Methyl Orange	Pink	Orange
3	Phenolphthalein	Colourless	Pink
4	Methyl red	Yellow	Red



Chemical properties of acids:

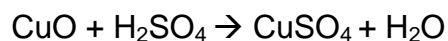
i) Acids react with active metals to give hydrogen gas.



ii) Acids react with metal carbonate and metal hydrogen carbonate to give carbon dioxide. $\text{NaHCO}_3 + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$

iii) Acids react with bases to give salt and water. This reaction is called as neutralization reaction. $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

iv) Acids react with metals oxides to give salt and water.



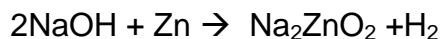
Addition of Acids or Bases to Water

The process of dissolving an acid, specially nitric acid or sulfuric acid or a base in water is a highly exothermic one. As a rule: Always add acid to water and never the other way! The acid must be added slowly to water with constant stirring. If one mixes the other way by adding water to a concentrated acid, the heat generated causes the mixture to splash out and cause burns.

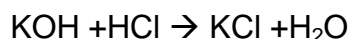
➤ **Chemical properties of Bases:**

i) Reaction with Metals - Certain reactive metals such as Zinc, Aluminium, and

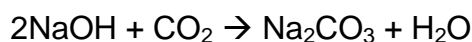
Tin react with alkali solutions on heating and hydrogen gas is evolved.



ii) Reaction with acids -Bases react with acids to form salt and water.



iii) Reaction with Non-metallic oxides – These oxides are generally acidic in nature. They react with bases to form salt and water.



➤ **Some Important Chemical Compounds:**

• **Common Salt (NaCl)**

Sodium chloride is known as common salt. Its main source is sea water. It is also exists in the form of rocks and is called rock salt.

Common salt is an important component of our food. It is also used for preparing sodium hydroxide, baking soda, washing soda etc.

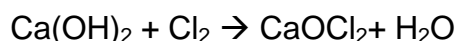
• **Sodium hydroxide (NaOH)**

Prepared by Chlor Alkali process :Electricity is passed through an aqueous solution of Sodium chloride (called brine). Sodium chloride decomposes to form sodium hydroxide. Chlorine gas is formed at the anode, and hydrogen gas at the cathode. Sodium hydroxide solution is formed near the cathode.



• **Bleaching powder:** Bleaching powder is represented as CaOCl_2 , though the actual composition is quite complex.

Bleaching powder is produced by the action of chlorine on dry slaked lime.



- **Baking soda:** Sodium hydrogen carbonate (NaHCO_3)

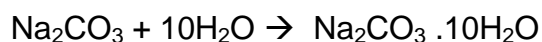
Preparation: $\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2 + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl} + \text{NaHCO}_3$

- **Washing soda:** Sodium carbonate $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

In the first step, sodium carbonate is obtained by heating baking soda.

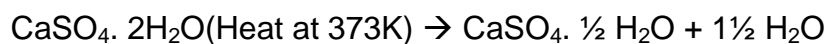


Then washing soda is produced by recrystallisation of sodium carbonate.



- **Plaster of Paris:** Calcium sulphate hemihydrate $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$

Prepared by heating Gypsum at 373K.



❖ [KEY POINTS]

- Acid is a compound which yields hydrogen ion (H^+), when dissolved in water.
- Acid is sour to the taste and corrosive in nature. The pH value for acids is less than 7.
- Generally, all acids readily react with metal to release hydrogen gas. For example, metal zinc reacts with hydrochloric acid to form zinc chloride and hydrogen gas.
- Acid react with limestone (CaCO_3) to produce carbon dioxide. For example, hydrochloric acid reacts with limestone to produce carbonic acid and calcium chloride.
- Acid can be classified in organic and inorganic acids. Acetic acid (CH_3COOH) is the best example of organic acid, while acid produced from minerals are termed as inorganic acids like sulfuric acid (H_2SO_4), hydrochloric acid (HCl).
- Acid converts blue litmus paper to red in color.
- Acids have tendency to corrode metal surface quickly.
- Acids and bases conduct electricity because they produce ions in water. There is a flow of electric current through the solution by ions.

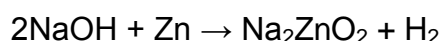
- Indicators are those chemical substances which behave differently in acidic and basic medium and help in determining the chemical nature of the substance.
- Acid base indicators indicate the presence of an acid or a base by a change in their colour or smell.
- Indicators can be natural or synthetic.
- **Olfactory indicators:** These are those indicators whose odour changes in acidic or basic medium.

Onion : Smell of onion diminishes in a base and remains as it is in an acid.

Vanilla: The odour of vanilla essence disappears when it is added to a base. The odour of vanilla essence persists when it is added to an acid.

- **Turmeric:** In acids, yellow colour of turmeric remains yellow. In bases, yellow colour of turmeric turns red.
- **Litmus:** Litmus is a natural indicator. Litmus solution is a purple dye which is extracted from lichen. Acids turn blue litmus red. Bases turn red litmus blue.
- Water is essential for acids and bases to change the colour of litmus paper.
- Remember that litmus paper will act as an indicator only if either the litmus paper is moist or the acid or base is in the form of aqueous solution. This is because acids and bases release H^+ and OH^- ions respectively in aqueous solutions.
- **Phenolphthalein:** Phenolphthalein remains colourless in acids but turn pink in bases.
- **Methyl orange:** Methyl orange turns pink in acids and becomes yellow in bases.
- Living organisms are pH sensitive. Human body works within a pH range of 7.0 to 7.8.
- Rain water with a pH less than 5.6 is called acid rain. This acid rain if it flows into river water makes the survival of aquatic life difficult.
- Plants also require a specific pH range of soil for their healthy growth.
- pH is also significant as it is used in self defence by animals and plants. Bees use acids in their sting. To neutralise the effect a mild base like baking soda can be used.
- Water of crystallisation: It is the fixed number of water molecules present in one formula unit of a salt.
- Phenolphthalein solution is colorless in acidic solution and turns methyl orange solution to red. Red cabbage juice which is purple in color changes to red in acidic medium.
- Bases are compound which yields hydroxide ion (OH^-), when dissolved in water.
- Bases are bitter to taste and corrosive in nature. They feel slippery and soapy.

- Bases are good conductor of electricity and show pH value more than 7.
- Bases react with oils and grease to form soap molecules.
- Bases convert red litmus paper to blue in color.
- Bases also have the tendency to corrode metal surface.
- A reaction between a base and a metal is similar as for acid to form salt and release hydrogen gas. But this reaction can only occur when a metal is strong enough to displace another metal from its parent constituent.



- Phenolphthalein solution turns pink in color in basic solution. Bases turn methyl orange to yellow. Red cabbage juice which is purple in color changes to yellow in basic medium.
- **Strong bases:** They are completely ionized in water to produce hydroxide ions, e.g, sodium hydroxide: $\text{NaOH}_{(s)} \rightleftharpoons \text{Na}^+_{(aq)} + \text{OH}^-_{(aq)}$
- **Weak bases:** Partially ionize and equilibrium lies mostly towards reactants side, e.g, ammonia in water: $\text{NH}_{3(aq)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{NH}_4^+_{(aq)} + \text{OH}^-_{(aq)}$
- A salt is defined as a compound formed by the complete or incomplete replacement of the hydrogen ion of an acid by a basic radical.
- A **normal** salt is formed by the **complete** replacement of the hydrogen ion of an acid by a basic radical whereas an **acid** salt is formed by the **incomplete** replacement of the hydrogen ion of an acid by a basic radical.

❖ [SUGGESTED ACTIVITIES]

- Testing of various samples for acidic character using different indicators.
- Test of acids & Bases using olfactory indicators.
- Reaction of metal carbonate & metal hydrogen carbonate with Acids.
- Neutralization reaction b/w Acid & Base.
- Conduction of Electricity by aqueous solution of Acid.
- pH of different types of soil.

- Effect of presence of water of crystallization in the colour of CuSO_4 .
- Formulas of salts & identification of their acids & bases
- Effect of dilution on the pH value.
- Properties of HCl [with litmus , Zn metal, Sodium Carbonate]
- Properties of NaOH [with litmus , Zn metal, Sodium Carbonate]
- pH of different salts

❖ [QUESTION BANK]

1. Define the terms: Acid, alkali and salt.

Ans: An acid is a compound, which releases hydronium ions (H_3O^+) as the only positive ions in solution.

An alkali is a compound, which releases hydroxyl ions (OH^-) as the only negative ions in solution.

A salt is one of the products of neutralization between an acid and a base; water being the only other product.

OR

A salt gives positive ions other than H^+ ion and negative ions other than OH^- ion in solution.

2. Identify the number of replaceable hydrogen ions (H^+) in the following acids:

HCl, CH_3COOH , H_2SO_4 , H_3PO_4 .

Ans: HCl = 1 CH_3COOH = 1 H_2SO_4 = 2 H_3PO_4 = 3.

3. What is a neutralization reaction?

Ans: Neutralization is essentially a chemical reaction between H_3O^+ ions of an acid with OH^- ions of the base, to give undissociated molecules of water.

4. What are strong and weak acids? Give one example of each?

Ans: A strong acid is one, which is almost completely dissociated in solution.

Examples: Dilute nitric acid, dilute sulphuric acid and dilute hydrochloric acid.

A weak acid is one, which is only partially ionized in solution (degree of dissociation is $>30\%$). Examples: Acetic acid, carbonic acid and sulphurous acid.

5. Why is acetic acid called a weak acid though there are 4 'H' atoms in the molecule ?

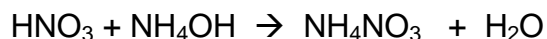
Ans: Acetic acid is called a monobasic acid because only one of the 4 'H' atoms of the acid is released as H^+ ion in solution.

6. How does a strong acid differ from a concentrated acid?

Ans: The strength of an acid depends upon its dissociation power whereas concentration depends on water content in the acid.

7. Name a salt of a strong acid HNO_3 and a weak base like NH_4OH . Represent the reaction that takes place.

Ans: The salt that results due to the above reaction is Ammonium nitrate (NH_4NO_3). The reaction is represented as:



8. i) Name a strong base and a weak base.

ii) Name a hydrated salt.

Ans: i) A strong base is sodium hydroxide ($NaOH$) and a weak base is ammonium hydroxide (NH_4OH).

ii) A hydrated salt is copper sulphate crystals ($CuSO_4 \cdot 5H_2O$).

9. Name the following:

i) Two non-hydrated crystalline salts

ii) Two neutral salts

iii) Two basic salts

iv) Two acid salts

Ans: i) Two non-hydrated crystalline salts are: sodium chloride ($NaCl$) and

potassium nitrate (KNO_3)

- ii) Two neutral salts are: sodium chloride (NaCl) and sodium sulphate (Na_2SO_4)
- iii) Two basic salts are: basic copper carbonate ($\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$) and basic lead carbonate ($\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$)
- iv) Two acid salts are: sodium bicarbonate (NaHCO_3) and sodium phosphate (NaH_2PO_4)

10. Name the salts of sulphuric acid.

Ans: The salts of sulphuric acid are bisulphate and sulphate. Examples:

NaHSO_4 , KHSO_4 and Na_2SO_4 .

➤ [HOTS]

1. What are indicators ? Name some common indicators.

Ans. Indicators are substances that undergo definite color change in acids and bases solution. Some common indicators are – Litmus solution, methyl orange, phenolphthalein etc.

2. What are alkalis? Write three examples.

Ans. The bases which dissolve in water to give OH^- ions in solution are called alkalis, such as- NaOH , KOH , $\text{Ca}(\text{OH})_2$.

3. While diluting the acid, why is it recommended that acids should be added to water and not water to acid?

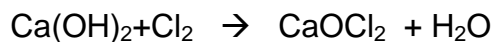
Ans. Mixing of water and acid is a highly exothermic process. When water is added to acid, due to small amount of water, evolved heat will change it to vapour and acid will spill out and may cause injury. So it is advised to mix acid to water and not water to acid.

4. Write the composition of baking powder. What will happen if tartaric acid is not added to it?

Ans. Baking powder is a mixture of sodium bicarbonate and tartaric acid. This acid neutralizes sodium carbonate formed on decomposition of baking soda. If tartaric acid is not present in baking powder, the food materials such as cake will taste bitter due to the presence of sodium carbonate.

5. What is Bleaching powder? How is it prepared and write its two uses.

Ans. Bleaching powder is Calcium oxy chloride and its formula is CaOCl_2 . It is prepared by passing chlorine gas through slaked lime.



Two uses of bleaching powder-

1. It is used to disinfect water
2. It is used to bleach cotton and paper

6. A student working in the laboratory added some water to a syrupy liquid taken in a tube. The tube immediately cracked and the liquid which escaped out of it, produced blisters on the skin of the student. What actually happened?

Ans. The syrupy liquid was concentrated sulphuric acid. On adding water, large amount of heat is released. For this reason the tube cracked and the acid produced blisters on the skin.

7. A compound X of sodium is commonly used for making crispy pakoras. It is also used for curing acidity in the stomach. Identify 'X'. What is its formula? State the reaction that takes place when it is heated.

Ans. The compound X is baking soda, a constituent of baking powder. Its chemical name is sodium hydrogen carbonate and its formula is NaHCO_3 .

On heating this compound gives CO_2 gas.



8. Dry hydrogen chloride gas does not turn blue litmus whereas hydrochloric acid does. Give one reason.

Ans. In the dry state, hydrogen chloride (HCl) does not release H^+ ions. Therefore, it cannot behave as an acid. When dissolved in water, it forms hydrochloric acid. It dissociates to give H^+ ion in solution and behaves as an acid. $\text{HCl} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ (\text{aq}) + \text{Cl}^- (\text{aq})$

9. Why is Plaster of Paris written as $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$? How is it possible to have half a water molecule attached to CaSO_4 ?

Ans. The actual formula of Plaster of Paris is $2\text{CaSO}_4 \cdot \text{H}_2\text{O}$ which means that one molecule of H_2O is associated with two molecules of CaSO_4 . The formula for simplicity is written as $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$.

Reference sites : Chemistry	
activities	<u>http://chemistry.about.com/od/chemistryactivities/Chemistry Activities for Kids.htm</u>
Video	<u>http://www.learnnext.com/user/CBSE-Chemistry-Class-X.htm</u>
Notes	<u>http://www.docbrown.info/page03/AcidsBasesSalts.htm</u>
Amazing chemical reactions	<u>http://listverse.com/2008/03/04/top-10-amazing-chemical-reactions/</u>
Work Sheets	<u>http://misterguch.brinkster.net/equationworksheets.html</u>
Work Sheets	<u>http://chemistryadda.blogspot.in/2012/04/x-chemical-reactions-and-equations.html</u>
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