ACIDS, BASES AND SALTS

Gist of the Lesson:

1. Acids are sour in taste, turn blue litmus red, and dissolve in water to release H^+ ions.

   E.g. HCl, H_2SO_4, HNO_3 etc.

2. Bases are bitter in taste, have soapy touch, turn red litmus blue and give hydroxide ions in solution.

   E.g. NaOH, KOH etc.

3. A salt is a compound which is formed by neutralization reaction between an acid and base.

   E.g. Sodium chloride.

4. **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

Sr. No.	INDICATORS	COLOUR IN ACIDIC MEDIUM	COLOUR IN BASIC MEDIUM
1	Litmus Solution	**Red**	**Blue**
2	Methyl Orange	**Pink**	**Orange**
3	Phenolphthalein	**Colourless**	**Pink**
4	Methyl Red	**Yellow**	**Red**

5. Chemical properties of acids:

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

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

ii) Acids react with metal carbonate and metal hydrogen carbonate to give carbon dioxide.

$NaHCO_3 + HCl \rightarrow NaClH_2O + CO_2$

iii) Acids react with bases to give salt and water. This reaction is called as Neutralization Reaction.

$NaOH + HCl \rightarrow NaCl + H_2O$

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

$CuO + H_2SO_4 \rightarrow CuSO4 + H_2O$

6. 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 are evolved.

$2NaOH + Zn\ Na_2ZnO2 + H_2$

ii) Reaction with acids -

Bases react with acids to form salt and water.

$KOH + HCl\ KCl + H_2O$

iii) Reaction with Non -metallic oxides -

These oxides are generally acidic in nature. They react with bases to form salt and water.

$2NaOH + CO_2\ \ Na_2CO_3 + H_2O$

7. PH Scale:

The concentration of hydrogen ion in solution is expressed in terms of pH. The pH of a solution is defined as the negative logarithm of hydrogen ion concentration in moles per liter.

$pH = - \log [H+]$

For water or neutral solutions, pH = 7; for acidic solutions, pH < 7; for basic solutions, pH > 7

8. Some Important Chemical Compounds:

a) 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.

b) Sodium Hydroxide or Caustic Soda (NaOH)

It is prepared by passing electricity through an aqueous solution of sodium chloride also known as brine.

$2NaCl\ (aq) + 2\ H_2O\ (1)\ 2NaOH\ (aq) + Cl_2\ (g) + H_2\ (g)$

This process is known as chlor-alkali process.

Properties:

1. It is white translucent solid.
2. Crystals of sodium hydroxide are deliquescent.
3. It is readily soluble in water and gives strong alkaline solution.

One Mark Questions (One Word or One Sentence)

1. What are antacids?

A. Antacids are mild alkalies and contain sodium hydrogen carbonate. These are used for getting relief from acidity and indigestion and sometimes, even headache. When taken orally, it reacts with hydrochloric acid present in the stomach and reduces its strength by consuming some of it. For Example: Milk of Magnesia.

2. What are olfactory Indicators?

A. Olfactory indicators are substances which have different odour in acid and base solutions. For example, vanilla essence has characteristic pleasant smell in acid solution and no smell in alkali solution.

3. How do metals react with bases?

A. Only some metals react with bases to form salts. For example, zinc (Zn) on warming with sodium hydroxide gives sodium zincates and hydrogen gas.

$$Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$$

4. What is a neutralization reaction? Give some examples?

A. When the effect of a base is nullified by an acid and vice versa, it is called Neutralization Reaction. In general, a neutralization reaction is written as:

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

5. What are acids? How are they produced?

A. (a) Acids are the chemicals which contain hydrogen atom and are sour in taste.

(b) They are produced when oxides of non-metals react with water.

Common acids are:

(i) HCl—Hydrochloric acid,

(ii) H_2SO_4—Sulphuric acid,

(iii) HNO_3— Nitric acid etc.

6. Why the vessels of copper and brass need 'Kalai'?

A. Acids react with brass and copper and corrode them. Hence 'Kalai" is needed to prevent them from corrosion.

7. What is bleaching powder? How is it prepared?

A. $CaOCl_2$ (calcium oxychloride) is bleaching powder.

8. Which gas is used in fire extinguishers?

A. Carbon dioxide.

9. What is the pH of blood?

A. Approximately 7.4.

10. Name two non-metal oxides?

A. CO_2 and SO_2

11. Name two organic acids?

A. Citric acid, lactic acid.

12. Name two mineral acids?

A. Hydrochloric acid, sulphuric acid.

13. What is the range of pH scale?

A. 0 to 14

14. Name a mild base used as an antacid?

A. Milk of magnesia.

15. Name the raw material for preparing plaster of Paris?

A. Gypsum or calcium sulphate

16. Give one example of natural indicator?

A. Litmus.

17. Give the chemical formula of soda ash?

A. Na_2CO_3.

18. Name two naturally occurring acids?

A. Citric acid, acetic acid.

Two Marks Questions (30 words)

1. What are indicators? Name four acid-base indicators and mention their colour change?

A. Indicators are chemical substances which give different colours in acidic or basic solutions.

(i) Methyl orange gives pink colour with acid solution and yellow colour with base solution.

(ii) Phenolphthalein is colour less in acid solution while it turns into pink colour in base solution.

(iii) Litmus solution turns red in acid solution and blue in base solution.

(iv) Bromothymol blue is blue in base solution and is yellow in acid solution.

2. What are non-metallic oxides? Substantiate your answer?

A. Non-metallic oxides in water forms acidic solution. For example, carbon dioxide in water forms carbonic acid. We can prove it because aqueous solution of carbon dioxide turns blue litmus red. Further aqueous solution of carbon dioxide is neutralized by a base, calcium hydroxide [Ca $(OH)_2$], to form salt and water.

$$CO_2 + Ca(OH)_2 + H_2O \longrightarrow CaCO_3 + 2H_2O$$

3. Name four acids and bases. Write their formulae?

A. **Acids:**

(i) Hydrochloric acid — HCl

(ii) Sulphuric acid — H_2SO_4

(iii) Nitric acid — HNO_3

(iv) Acetic acid — CH_3COOH

Bases:

(i) Sodium hydroxide — NaOH

(ii) Calcium hydroxide — Ca $(OH)_2$

(iii) Ammonium hydroxide — NH_4OH

(iv) Magnesium hydroxide — Mg $(OH)_2$

4. Why are acids not stored in metal containers? Container vessels made from which material are aide to store acids?

A. Metals like sodium, magnesium and calcium, react vigorously with mineral acids and give hydrogen. Aluminum, zinc, and iron react less vigorously with mineral acids. However, some metals like copper, silver and gold do not react with acids. Some metals like sodium and calcium react with sulphuric violently and are unsafe. So mineral acids (except carbonic acid) react with metal and produce corrosion on the surface of metal container. Therefore, acid are not stored in metal containers.

Vessels made from glass or ceramic are considered safe for storing mineral acids.

5. How will you prepare dilute acid solution?

A. It is always desirable to add acid to water, keeping the solution continuously stirred, while preparing dilute solutions of acids, particularly nitric acid and sulphuric acid. We should always add acid to water, otherwise, so much heat is produced during the dilution process that the container, specially that of glass, may break. The hot contents may also cause an explosion and spill on our clothes and body. This may cut our clothes and also result into serious acid burns.

6. What is acid rain? How does it affect our aquatic life?

A. When the pH of rain water is less than 5.6, it is called acid rain. When acid rain flows into the rivers, it lowers the pH of the river water. Since our body works within a narrow pH range close to 7 (7.0—7.8), the survival of aquatic life in river waters mixed with rain water becomes difficult.

7. What is water of Crystallization? Give two examples?

A. Water of crystallization is the fixed number of water molecules Present in one formula unit of a salt. For example, chemical formula of hydrated copper sulphate is $CuSO_4$.$5H_2O$. Copper sulpha has 5 molecules of water of crystallisation. Sodium carbonate (Na_2CO_3. $10H_2O$) contain ten molecules of water of crystallisation.

8. State some important uses of sodium chloride?

A. Uses of sodium chloride:

(i) It is an essential constituent of our daily life and is used for making food items.

(ii) It is used for the manufacture of soap.

(iii) Mixed with ice, it is used as a freezing mixture.

(iv) It is used as a preservative for meat, fish and pickles.

(v) It is used for the industrial preparation of a number of compounds like hydrochloric acid, washing soda, caustic soda etc.

9. What is plaster of Paris? How is it prepared? Give its important uses?

A. $CaSO_4$. ½H_2O is known as plaster of Paris.

This is prepared by heating gypsum to 120-130°C.

$$2CaSO_4.2H_2O \xrightarrow[120-130^\circ C]{heat} \underset{Plaster\ of\ paris}{(CaSO_4)_2\ H_2O} + 3H_2O(g)$$

Uses of plaster of Paris:

(i) It is used in making chalks and fire proof materials.

(ii) Used for making patient plasters used in surgery and for plastering fractured parts of the body.

(iii) Mixed with alum, it is used as cement in ornamental casting and for making moulds in pottery work.

Similar Question:

A compound which is prepared from gypsum has the property of hardening when mixed with proper quantity of water. Identify the compound. Write the chemical equation of it preparation. Mention one important use of the compound.

Three Marks Questions (50 words)

1. Name some common bases?

A. Some common bases are:

		Chemical Name	Chemical Formula
(i)	Caustic soda	Sodium hydroxide	NaOH
(ii)	Caustic potash	Potassium hydroxide	KOH
(iii)	Lime water	Calcium hydroxide	$Ca(OH)_2$
(iv)	Milk of magnesia	Magnesium hydroxide	$Mg(OH)_2$.

2. Baking soda is used in small amount in maling bread and cake. It helps to make these soft and spongy. An aqueous solution of baking soda turns red litmus blue. It is also used in soda acid fire extinguisher.

Use this information to answer the following questions

(i) How does Baking Soda help to make cakes and bread soft and spongy?

(ii) How does it help in extinguishing fire?

(iii)Is the pH value of baking soda solution lesser than or greater than 7?

A. (i) On heating sodium bicarbonate, the main constituent of baking soda, decomposes to produce CO_2. This causes cakes and bread to become light, soft and spongy.

(ii) Baking soda on reaction with sulphuric acid gives CO_2 vigorously. CO_2 helps to extinguish fire.

(iii) The pH of baking soda solution should be greater than 7.

3. What is antichlor? Why do you use antichlor after treating the clothes with bleaching powder?

A. Antichlor is a substance used to remove excess of chlorine from a material/cloth. Examples are sodium bisulphate and sodium thiosulphate.

After the clothes are treated with bleaching powder and acid solution, some chlorine remains sticking to the fiber which may injure it if not removed quickly

after bleaching is over. Chlorine is removed by reaction with sodium bisulphite as given below:

$$NaHSO_3 + Cl_2 + H_2O \longrightarrow NaHSO_4 + 2HCI.$$

Five Marks Questions (70 words)

1. Describe the importance of pH in everyday life?

A. **1.pH in our digestive system:** Our stomach produces hydrochloric acid of pH about 1.4. This dilute hydrochloric acid helps in digesting our food without harming the stomach. Sometime, excess of acid is produced in the stomach for various reasons such as overeating. The excess acid in the stomach causes indigestion which produces pain and irritation. In order to cure indigestion and get rid of pain, we can take bases called antacids. Being basic in nature, antacids react with excess acid in the stomach and neutralize it. The two common antacids used for curing indigestion due to acidity are Magnesium hydroxide (Milk of Magnesia) and Sodium hydrogen carbonate.

2. pH change as the cause of tooth decay: When we eat food containing sugar, then the bacteria present in our mouth break down the sugar to form acids such as lactic acid. Thus, acid is formed in the mouth after a sugary food has been eaten. This acid lowers the pH in the mouth making it acidic. Tooth decay starts when the pH of acid formed in the mouth falls below 5.5. This is because then the acid becomes strong enough to attack the enamel of our teeth and corrode it. This sets in tooth decay. The best way to prevent tooth decay is to clean the mouth thoroughly after eating food by rinsing it, with lots of clean water. Many tooth pastes contain bases to neutralise the mouth acid. The pH of tooth paste is about 8.0. Therefore, using the tooth paste, which is generally basic, for cleaning the tooth can neutralise the excess acid in mouth and prevent tooth decay.

3. Soil pH and plant growth: Most of the plants grow best when the pH of the soil is close to 7. If the soil is too acidic or too basic the plants grow badly or do not grow at all. The soil may be acidic or basic naturally. The soil pH is also affected by the use of chemical fertilisers in the fields.

Most often the soil in the fields in too acidic. If the soil is too acidic, (having low pH), then it is treated with materials like quick lime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate). If the soil is too alkaline then its basicity is reduced by adding decaying organic matter which are acidic.

4. pH change and survival of animals: Our body works well within a narrow pH a range of 7.0 to 7.8. If due to some re n, this pH range gets disturbed in the body of person, then many ailments can occur. The aquatic animals (like fish) can survive in river water within a narrow -angel of pH change.

When the pH of rain water is about 5.6, it is called acid rain. Too much acid rain can lower the pH of river water to such an extent (and make it so acidic) that the survival of aquatic animals becomes difficult. The high acidity of river water can even kill the aquatic animals (like fish).

Acids are also present on other planets.

For Example: The atmosphere of planet Venus is made up of thick white and yellowish clouds of sulphuric acid. Hence, life cannot exist on the planet Venus.

2. Name the products of electrolysis of brine and state their uses?

A. **Products of electrolysis of brine are:** H_2 gas, sodium hydroxide and chlorine gas.

Uses of chlorine gas:

(i) It is used for water treatment by MCD.

(ii) It is used in Swimming pools as disinfectant

(iii) It is used for the manufacture of PVC, CECs, bleaching powder and pesticides.

Uses of H_2 Gas:

(i) It is used as fuel.

(ii) It is used for the manufacture of ammonia.

(iii) It is used for manufacture of ghee, manganese etc.

Uses of NaOH:

(i) It is used for degreasing metals.

(ii) It is used for the manufacture of soaps and detergents.

(iii) It is used in artificial fiber industry.