ACIDS, BASES AND SALTS COMPLETE NOTES FOR CLASS 10

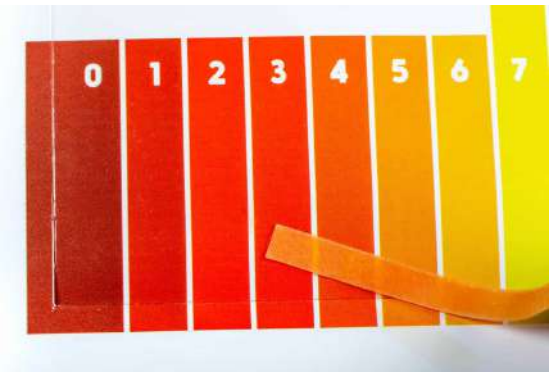
Indicators: An indicator tells us whether the substance we are testing is acidic or basic by change in its colour. Three most common indicators are Litmus, methyl orange and phenolphthalein.

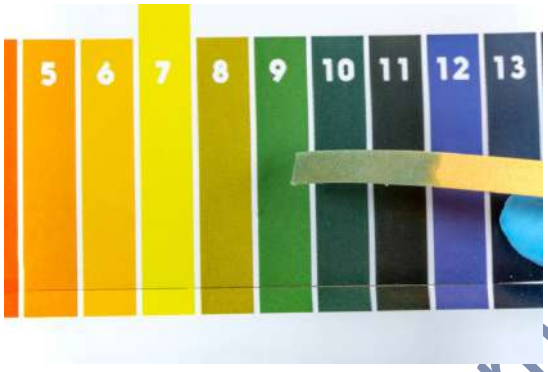
LITMUS

It can be used in the form of litmus solution or in the form of litmus paper. It is a purple dye which is extracted from a type of plant called lichen.

(i) Litmus is a natural indicator.
(ii) Litmus is of two types: blue litmus and red litmus.
(iii) Natural colour of litmus paper is purple.
(iv) Litmus paper is made by leaf of lichen plant.
(v) An acid turns blue litmus to red.
(vi) A base turns red litmus to blue.

Lichen: It is air pollution indicator plant. It is a type of thallophyta plant.





METHYL ORANGE

The natural colour of methyl orange is orange.

(i) Methyl orange indicator gives red colour in acid solution.

(ii) Methyl orange indicator gives yellow colour in basic solution.

PHENOLPHTHALEIN

The natural colour of phenolphthalein is colourless.

(i) Phenolphthalein indicator is colourless in acid solution.

(ii) Phenolphthalein indicator gives pink colour in basic solution.

TURMERIC INDICATOR

It is also a natural indicator. The natural colour of turmeric is yellow.

(i) Turmeric indicator is yellow colour in acid solution.
(ii) Turmeric indicator gives red colour in basic solution.

OLFACTORY INDICATOR

Those substances whose smell changes in acidic or basic solution are called olfactory indicator. It is a substance whose smell varies depending on whether it is mixed with an acidic or basic solution. These types of indicators are used in laboratory to check whether a given solution is a basic or an acidic solution by a process known as olfactory titration.

Acids: It is a chemical substance, usually a liquid, which contains hydrogen and can react with other substances to form salts.

Example: HCl, H_2SO_4, HNO_3 etc

Properties of acids

(i) Acids have sour taste
(ii) Acids turn blue litmus to red.
(iii) It conducts electricity.
(iv) They produce H^+ ions when mixed with water.
(v) Acids lose their acidity when mixed with a base.
(vi) Acids react with metals to form salt and hydrogen gas.

$$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$$

(V) Acids react with metal carbonates or metals hydrogen-carbonates to form salt, carbon dioxide and water.

$$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + CO_2 + H_2O$$

$$NaHCO_3 + HCl \longrightarrow NaCl + CO_2 + H_2O$$

(VI) Acids react with bases to form salt and water.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

(VII) Acids react with metal oxides to form salt and water.

$$CuO + 2HCl \longrightarrow CuCl_2 + H_2O$$

Organic acids

The acids present in plant materials are called organic acids. Organic acids are naturally occurring acids. It is not harmful to eat and drink substances containing naturally occurring acids in them.

Example: Acetic acid, Citric acid, Lactic acid etc.

(i) Acetic acid is found in vinegar.
(ii) Lactic acid is found in sour milk or curd.
(iii) Butyric acid present in butter.
(iv) Citric acid is present in lemons and oranges.
(v) Oxalic acid present in tomatoes.

Mineral acids

The acids prepared from the minerals of the earth are called minerals acids. The mineral acids are man-made acids.

Example: Hydrochloric acid, Sulphuric acid and Nitric acid.

Hydrochloric acids: It is also called muriatic acid.

(i) It is found in stomach.
(ii) Chemical formula of hydrochloric acid is HCl.
(iii) PH value of HCl is 0.
(iv) It activate enzyme.
(v) Before galvanization, iron is washed in HCl.
(vi) It is used as bathroom cleaner.

(vii) It is used an Aqua-Regia solution. Aqua Regia is also called Royal acids. Colour of aqua regia is yellowish orange.

(viii) It is used in leather cleaning.

Sulphuric acids: It is also called king of acids/ king of chemical/ oil of vitriol.

(i) It is called battery acid because it is used in battery.

(ii) PH value of Sulphuric acid is 1.

(iii) It is present in Acid rain.

(iv) It is used in fire extinguisher.

Nitric acid: It is used to make Aqua-Regia Solution. It is used to make explosives.

Example of explosives: RDX, TNT and Gun powder.

RDX: Abbreviation of RDX is Research development explosives or Royal Demolition explosive.

(i) Chemical name of RDX is cyclotrinitro methyl trinitro Amine.
(ii) RDX is discovered by Fredrick Henning.
(iii) Chemical formula of RDX is $C_3H_6O_6N_6$.

TNT: Abbreviation of TNT is Trinitrotoluene.

(i) TNT is discovered by Joseph Wilbrand in 1863.
(ii) Chemical formula of TNT is $C_7H_5O_6N_3$.

Gun Powder: Gun powder is discovered by Rojjer Baken. It is the mixture of nitric acid, potassium nitrate, sulphur and charcoal.

All the acids can be divided into two groups:

Strong acids: An acid which is completely ionized in water and thus produces a large amount of hydrogen ions is called a strong acid. All the mineral acids are strong acids.

Ex: HCl, H_2SO_4, and HNO_3.

Weak acids: An acid which is partially ionized in water and thus produces a small amount of hydrogen ions is called a weak acid. The organic acids are weak acids.

Ex: Acetic acid, formic acid, citric acid, tartaric acid, citric

Concentrated acids: It is one which contains the minimum possible amount of water in it.

Dilute acids: It is one which contains much more of water in it.

Diluting acids: The dilution of a concentrated acid should always be done by adding concentrated acid to water gradually with stirring and not by adding water to concentrated acid.

Acids have corrosive nature

Some acids are highly corrosive in nature which means that they corrode or rust metals. Acids are never stored in metal containers because they gradually corrode and eat up the metal container.

Ex: If concentrated sulphuric acid falls accidently on skin, clothes or wood, it causes severe burns on the skin; it cuts holes in the clothes, and burns the wood producing black spots on its surface.

What do all acids have in common?

An acid is a substance which dissociates on dissolving in water to produce hydrogen ions.

$HCl \longrightarrow H^+ + Cl^-$

$HNO_3 \longrightarrow H^+ + NO_3^-$

BASES

It is a chemical substance which can neutralize an acid. Bases are substances that, in aqueous solution, release hydroxide ions.

Example: NaOH, KOH, $Mg(OH)_2$, NH_4OH etc.

Properties of bases:

(i) Bases have a bitter taste and soapy to touch.
(ii) Bases conduct electricity in solution.
(iii) All metal oxides and metal hydroxides are bases.
(iv) A base soluble in water is called an alkali.
(v) All the bases change the colour of red litmus to blue.
(vi) Bases react with some metals to form hydrogen gas.

$2NaOH + Zn \longrightarrow Na_2ZnO_2 + H_2$

(vii) Bases react with acids to form salt and water.

$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

(viii) Bases react with non-metal oxides to form salt and water.

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

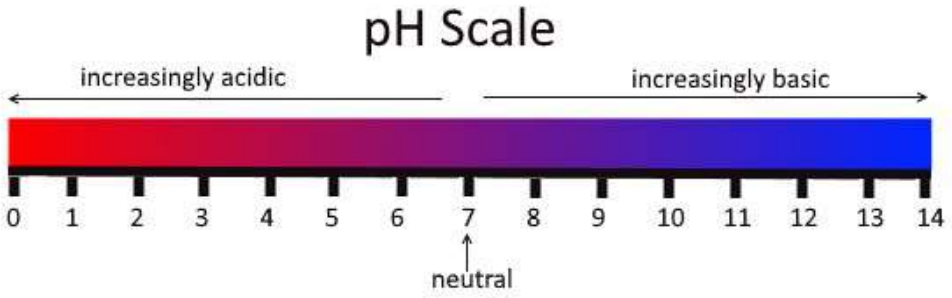
Strong Bases: A weak base is one that only partially dissociates to give ions in solution.

Ex: NaOH, KOH etc.

Weak Bases: A strong base is one that fully dissociates to give ions in solutions.

Ex: NH_4OH, $Ca(OH)_2$ etc.

pH scale: The strength of an acid or base is measured on a scale of numbers called the pH scale.



(i) The pH scale has values from 0 to 14.
(ii) Full form of pH is potential of hydrogen.
(iii) pH scale is discovered by Sorenson in 1909.
(iv) pH value of acid is less than 7.
(v) Lower the pH value, stronger the acid.
(vi) pH value of base is more than 7.
(vii) The higher the pH, the stronger the base.
(viii) Neutral substances have a pH of exactly 7.
(ix) The pH of pure water is 7.

Solution	pH	Solution	pH
Conc. HCl	0	Blood	7.4
Dilute H_2SO_4	1	Eggs	7.8
Lemon juice	2.5	Toothpaste	8
Vinegar	4	Baking soda	8.5
Coffee	5	Washing soda	9
Soft drink	6	Milk of magnesia	10.5
Milk	6.5	Household ammonia	11.6
Pure water	7	Dilute NaOH	13
Saliva	7.4	Conc. NaOH	14

Universal indicators: It is a blend of pH indicator solutions designed to identify the pH of solution over a wide range of values. There are several different formulas for universal indicators, but most are the based on a patented formula developed by Yamada in 1933.

SALTS

It is a compound formed from an acid by the replacement of the hydrogen in the acid by a metal. Salts are formed when acids react with bases.

Examples:

(i) Sodium chloride (NaCl)
(ii) Zinc chlorides ($ZnCl_2$)
(iii) Sodium sulphate ($CaSO_4$)
(iv) Calcium carbonates ($CaCO_3$)

Family of salts

If two salts have same positive or negative radicals, they are called to be of same family. Salts having common acidic or basic radicals are said to belong to same family. Example: Sodium chloride (NaCl) and Calcium chloride ($CaCl_2$) belong to chloride family. Calcium chloride ($CaCl_2$) and calcium sulphate ($CaSO_4$) belong to calcium family.

The pH of salt solutions

(i) The salts of strong acids and strong bases give neutral solutions having (pH = 7).

(ii) The salts of strong acids and weak bases give acidic solution (having pH less than 7).

(iii) The salts of weak acids and strong bases give basic solutions (having pH more than 7).

COMMON SALTS

Common salt can be made by the combination of sodium hydroxide and hydrochloric acid.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

(i) The chemical name of common salt is Sodium chloride (NaCl).

(ii) Sodium chloride commonly known as salt.

(iii) It is neutral salt.
(iv) It is also called table salt and rock salt.
(v) It is a white powder which is used in preparing food, especially vegetables and pulses etc.

How common salt is obtained

The sea water is first collected and it is kept for evaporation. When the water is fully evaporated the salt remains. By this way salt is obtained from sea water. Sea water contains a large amount of common salt and the salts of other metals dissolved in it.

Uses of Common salt (or Sodium chloride)

(i) It is used in manufacture of soap.
(ii) It is used to melt ice which collects on the roads during winter in cold countries.
(iii) Common salt is used in cooking food.
(iv) It is used as a preservative in pickles and in curing meat and fish.

CHEMICALS FROM COMMON SALTS

1. **Sodium hydroxide:** It is commonly known as caustic soda. The chemical formula of of sodium hydroxide is NaOH.

   Production of hydroxide: It is produced by the electrolysis of a concentrated aqueous solution of sodium chloride (which is called brine).

$$2NaCl + 2H_2O \longrightarrow 2NaOH + Cl_2 + H_2$$

(i) The process of electrolysis of sodium chloride is called chlor-alkali process.

(ii) The three useful products obtained by the electrolysis of sodium chloride solution are sodium hydroxide, chlorine and hydrogen.

Uses of Sodium Hydroxide

- It is major ingredient in drain and oven cleaners.
- It is used in chemical manufacturing, oil refining, hydraulic fracturing, water treatment and metal processing.
- It is used for making artificial textile fibres such as rayon.
- It is used in the manufacture of fabric, plastic wrap, paper and soap.

Uses of Chlorine

- It is used to get rid of the smell of putrefaction.
- It is used as a disinfectant.
- Chlorine is used in the treatment of drinking water to kill bacteria.
- It is used to clean swimming pools.
- It is used in the production of paper and paper products.
- It is used as an antiseptic.

Washing soda

Washing soda is a chemical compound that can be used to remove stubborn strains from laundry and is an essential component is most homemade laundry detergent for powder, liquid or single pod formulas. It is sodium carbonate containing 10 molecules of water of crystallization.

(i) Formula of washing soda is $Na_2CO_3.10H_2O$.

(ii) Sodium carbonate which does not contain any water of crystallization is called anhydrous sodium carbonate, Na_2CO_3.

(iii) Anhydrous sodium carbonate is commonly known as soda ash.

Production of washing soda

In the following three steps, washing soda is prepared from sodium chloride or common salt.

(i) A cold and concentrated sodium chloride solution is reacted with ammonia and carbon dioxide to obtain sodium hydrogen carbonate.
The sodium hydrogen carbonate is slightly soluble in water, so it precipitates out as solid.

$$NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$$

(iii) Sodium hydrogen carbonate is separated by filtration, dried and heated. On heating, sodium hydrogen carbonate decomposes to form sodium carbonate:

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

(iv) Anhydrous sodium carbonate or soda ash is dissolved in water and recrystallised to get washing soda crystals containing 10 molecules of water of crystallisation.

$$Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3.10H_2O$$

PROPERTIES OF WASHING SODA

(i) The solution of washing soda in water is alkaline which turns red litmus to blue.
(ii) It is one of the few metal carbonates which are soluble in water.
(iii) Washing soda has detergent properties because it can remove dirt and grease from dirty clothes.
(iv) It is a transparent crystalline solid.

Uses of washing soda

(i) Washing soda is used in the manufacture of sodium compound such as borax.
(ii) It is used in the manufacture of glass, soap and paper.
(iii) It is used to removing permanent hardness of water.
(iv) It is used in paper, textile, soap, and detergent industries.
(v) It is used as a cleansing agent for domestic purpose like washing clothes.

BAKING SODA

The chemical name of baking soda is sodium hydrogencarbonate. The formula of baking soda is $NaHCO_3$. It is also called sodium bicarbonate.

PRODUCTION OF BAKING SODA

Baking soda is produced on a large scale by reacting a cold and concentrated solution sodium chloride with ammonia and carbon dioxide:

$$NaCl + NH_3\ H_2O + CO_2 \rightarrow NaHCO_3 + NH_4Cl$$

PROPERTIES OF BAKING SODA

(i) It is a mild, non-corrosive base.
(ii) It consists of white crystals which are sparingly in water.
(iii) When sodium hydrogencarbonate is heated, then it decomposes to give sodium carbonate with the evolution of carbon dioxide gas:
$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$

USES OF BAKING SODA

(i) It is used as an antacid in medical to remove acidity of the stomach.
(ii) It is used in fire extinguisher.
(iii) It is used in fermentation.
(iv) It is used in making baking powder in making cakes, bread etc.
(v) It is used in making fluffy.

BLEACHING POWDER

A substance which removes colour from coloured substances and makes them colourless is called a bleaching agent.

(i) The chemical formula of bleaching powder is $CaOCl_2$.
(ii) The chemical name of bleaching powder is calcium oxychloride.
(iii) It is also called chloride of lime.

PROPERTIES OF BLEACHING POWDER

(i) It is soluble in cold water.
(ii) It is a white powder which gives a strong smell of chlorine.
(iii) Bleaching powder reacts with dilute acids to produce chlorine.

$$CaOCl_2 + H_2SO_4 \rightarrow CaSO_4 + Cl_2 + H_2O$$

USES OF BLEACHING POWDER

(i) It is used in cotton bleaching and hair bleaching.
(ii) It is used in cosmetic.
(iii) It is used for the manufacture of chloroform ($CHCl_3$).
(iv) It is used as an oxidizing agent in many chemical industries.
(v) It is used for disinfecting drinking water supply.

PLASTER OF PARIS

Plaster of Paris is calcium sulphate half-hydrate. The formula of plaster of Paris is $CaSO_4.1/2H_2O$. It is commonly known as P.O.P.

PREPARATION OF PLASTER OF PARIS

Plaster of Paris is prepared by heating gypsum ($CaSO_4.2H_2O$) to a temperature of 100 degree Celsius. When gypsum is heated to a temperature of 100 degree Celsius, it loses three-fourths of its water of crystallization and forms plaster Paris:

$CaSO_4.2H_2O \rightarrow CaSO_4.1/2H_2O + 3/4H_2O$

PROPERTIES OF PLASTER OF PARIS

(i) It has a very remarkable property of setting into a hard mass on wetting with water.
(ii) It is a white powder.
(iii) Plaster of Paris should be stored in a moisture-proof container because the presence of moisture can cause slow setting of plaster of Paris by bringing about its hydration.

USES OF PLASTER OF PARIS

(i) It is used in false ceiling.
(ii) It is used in making toys, cosmetics, black-boad chalk and casts for statues.
(iii) It is used for making surfaces smooth before painting them and for making ornament designs on the ceiling of houses and other buildings.
(iv) It is used as a fire-proofing material.

WATER OF CRYSTALLISATION

The water molecules which form part of the structure of a crystal are called water of crystallization.

Hydrated Salts: The salts which contain water of crystallization are called hydrated salts.

Ex: Iron sulphate crystal contain 7 molecules of water of crystallization per formula unit and hence written as $FeSO_4.7H_2O$.

Ex: Sodium carbonate crystals contain 10 molecules of water of crystallization per formula unit hence written as $Na_2CO_3.10H_2O$.