Class10 CHAPTER – 2

ACIDS, BASES AND SALTS (Notes)

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Acids	Bases
– Sour in taste	– Bitter in taste
– Change the blue litmus to red	– Change red litmus to blue
– eg. Hydrochloric Acid HCl	eg. Sodium hydroxide NaOH
– SulphuricAcidH_2SO_4	Potassium hydroxide KOH
– NitricAcidHNO_3	Calcium hydroxide $Ca(OH)_2$
– Acetic Acid CH_3COOH	– AmmoniumhydroxideNH_4OH

❑ Some Naturally occuring acids

Vinegar	–	Acetic Acid
Orange	–	Citric Acid
Lemon	–	Citric Acid
Tamarind	–	Tartaric Acid
Tomato	–	Oxalic Acid
Sour milk (Curd)	–	Lactic Acid
Ant and Nettle sting	–	Methanoic Acid (Formic acid)

❑ Acid – Base Indicators – Indicate the presence of an acid or base in a solution.

❑ Litmus solution – It is a natural indicator. It is a purple day extracted from Lichens. Other examples are Red Cabbage and coloured petals of Petunia and turmeric.

- Olfactory indicators – Show odour changes in acidic or basic media. eg. onion and clove.
- Acid – Base Indicators

S. No.	Name of the Indicator	Colour Change With Acid	Colour Change with Base
A.	Blue litmus solution	To red	No change
B.	Red litmus solution	No change	To blue
C.	Turmeric	No change	To red
D.	Methyl orange	To red	To yellow
E.	Phenolphthalein (colourless)	No change	To pink

- Dilute Acid : Contains only a small amounts of acid and a large amount of water.
- Concentrated Acid : A concentrated acid contains a large amount of acid and a small amount of water.
- **Chemical Properties of Acids and Bases**

  Acid + Metal $\rightarrow$ Salt + Hydrogen

  (Refer activity 2.3 on page No. 19 of NCERT Book)

  $2HCl + Zn \rightarrow ZnCl_2 + H_2$

  $2HNO_3 + Zn \rightarrow Zn(NO_3)_2 + H_2$

  $H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2$

  $2CH_3COOH + Zn \rightarrow (CH_3COO)_2Zn + H_2$
- **Pop test :** When a burning candle is brought near a test tube containing hydrogen gas it burns with a 'Pop' sound. This test is conducted for examining the presence of hydrogen gas.
- Base + Metal $\rightarrow$ Salt + Hydrogen

$NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$
Sodium Zincate

Note – Such reactions are not possible with all the metals.

❑ **Action of Acids with metal Carbonates and metal bicarbonates**

Metal Carbonate + Acid $\rightarrow$ Salt + Carbon dioxide + Water

$Na_2CO_{3(s)} + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + H_2O(l) + CO_{2(g)}$

Metal bicarbonate + Acid $\rightarrow$ Salt + Carbon dioxide + Water

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

❑ **Lime water Test (Test for CO_2) :** On passing the CO_2 gas evolved through lime water,

$Ca(OH)_2\,(aq) + CO_{2(g)} \rightarrow CaCO_{3(s)} + H_2O(l)$
Lime water White precipitate

If we passing excess $CO_2$for long time milkiness disappears because Calcium hydrogen carbonate will form is soluble in water.

On passing excess CO_2 the following reaction takes place

$CaCO_{3(s)} + H_2O_{(l)} + CO_{2(g)} \rightarrow Ca(HCO_3)_2\ aq$
Soluble in water

❑ **Neutralisation Reactions**

Base + Acid $\rightarrow$ Salt + Water

$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O(l)$

Neutralisation reaction takes place when the effect of a base is nullified by an acid and vice versa to give salt and water.

❑ **Reactions of metal oxides with acids**

Metal Oxide + Acid $\rightarrow$ Salt + Water

CuO	+	HCl	$\rightarrow$	$CuCl_2$	+	H_2O
Copper oxide		Hydrochloric acid		Copper chloride		+ Water

Note : Appearance of blue green colour of the solution because of formation of $CuCl_2$.

Metallic oxides are said to be basic oxides because they give salt and water on reacting with acids.

- **Reaction of Non Metallic Oxide with Base**

Non metallic oxide + Base $\rightarrow$ Salt + Water

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

Note : Non Metallic oxides are said to be acidic in nature because on reacting with a base they produce Salt and Water.

- All acidic solutions conduct electricity

Refer activity 2.3 on page 22 of NCERT Book

– Glowing of bulb indicates that there is a flow of electric current through the solution.

- **Acids or bases in a Water Solution**

Acids produce H^+ ions in the presence of water

$HCl + H_2O \rightarrow H_3O^+ + Cl^-$

H_3O^+ – Hydronium ion.

– H^+ ion cannot exist alone. It exists as $H^+(aq)$ or (H_3O^+) hydronium ion.

$H^+ + H_2O \rightarrow H_3O^+$

– Bases provide (OH^-) ions in the presence of water

$NaOH_{(s)} \xrightarrow{H_2O} Na^+_{(aq)} + OH^-_{(aq)}$

$$KOH_{(s)} \xrightarrow{H_2O} K^{+}{}_{(aq)} + OH^{-}{}_{(aq)}$$

$$Mg(OH)_{2(s)} \xrightarrow{H_2O} Mg^{2+}(aq) + 2OH^{-}(aq)$$

❑ **Alkalis**

All bases do not dissolve in water. An alkali is a base that dissolves in water.

Common alkalis are

NaOH	Sodium hydroxide
KOH	Potassium hydroxide
$Ca(OH)_2$	Calcium hydroxide

NH_4OH :Ammonium hydroxide

Note : All alkalis are bases but all bases are not alkalis.

❑ Precaution must be taken while mixing acid or base with water. The acid must always be added to water with constant stirring. Otherwise heat generated may cause the mixture to splash out and cause burn. The container may also break due to excessive local heating. It is highly exothermic reaction.

When an acid or a base is mixed with water they become dilute. This results in the decrease in the concentration of H_3O+ or OH^- per unit volume in acids and bases respectively.

❑ **Strength of an Acid or Base**

Strength of acids and bases depends on the no. of H^+ ions and OH^-ions produced respectively.

With the help of a universal indicator we can find the strength of an acid or base. This indicator is called PH scale. pH = Potenz in German means power.

This scale measures from 0 (very acidic) to 14 (very alkaline) 7 Neutral (water in Neutral).

pH paper : Is a paper which is used for measuring PH.

Variation of PH

S. No.	pH Value	Colour of the pH Paper	Nature of Solution	H^+ ion Conc.	OH^- ion Conc.
1.	0	Dark red	Highly acidic	Very high	very low
2.	4	Orange or yellow	Acidic	high	low
3.	7:	Green	Neutral	Equal	Equal
4.	10	Bluish green or blue	Alkaline	low	high
5.	14	Dark blue or violet	Highly basic	very low	very high

– Strong Acids give rise to more H^+ ions.

eg. HCl, H_2SO_4 and HNO_3.

– Weak Acids give rise to less H^+ ions eg.

CH_3COOH, H_2CO_3 (Carbonic acid)

– Strong Bases – Strong bases give rise to more OH^- ions. eg. NaOH, KOH, $Ca(OH)_2$

– Weak Bases : give rise to less OH^- ions.

eg. NH_4OH

❑ More about Salts

Salts and their derivation

S. No.	Name of Salt	Formula	Derived from	Derived from
1.	Potassium Sulphate	K_2SO_4	KOH	H_2SO_4
2.	Sodium Sulphate	Na_2SO_4	NaOH	H_2SO_4
3.	Sodium Chloride	NaCl	NaOH	HCl
4.	Ammonium Chloride	NH_4Cl	NH_4OH	HCl

Note : NaCl and Na_2SO_4 belong to the family of sodium salts as they have the same radicals. Similarly NaCl and KCl belong to the family of chloride salts.

Importance of pH in our daily life

- Importance of pH in our digestive system – pH level of our body regulates our digestive system. In case of indigestion our stomach produces acid in a very large quantity because of which we feel pain and irritation in our stomach. To get relief from this pain antacids are used. These antacids neutralises the excess acid and we get relief.
- pH of Acid Rain : When pH of rain water is less than 5.6 it is called Acid Rain. When this acidic rain flows into rivers these also get acidic, which causes a threat to the survival of aquatic life.
- pH of Soil : Plants require a specific range of pH for their healthy growth. If pH of soil of any particular place is less or more than normal than the farmers add suitable fertilizers to it.
- Our body functions between the range of 7.0 to 7.8 living organisms can survive only in the narrow range of pH change.
- Tooth decay and pH : Bacteria present in the mouth produce acids by degredationofsugarandfoodparticlesremaininginthemouth.Usingtoothpaste which is generally basic can neutralise the excess acid and prevent tooth decay.
- Bee sting or Nettle sting contains methanoic acid which causes pain and irritation. When we use a weak base like baking soda on it we get relief.

Neutral Salts : Strong Acid + Strong base pH value is 7

eg. NaCl, $CaSO_4$

Acidic Salts : Strong Acid + weak base pH value is less than 7

eq. NH_4Cl, NH_4NO_3

Basic Salts : Strong base + weak acid pH value is more than 7

Salt NaCl

at cathode | at anode

H_2
used in fuels
and fertilizers

Cl_2
water treatment
PVC, CFC's, pesticides

NaOH
soap and detergent
making, paper and
fibre making

HCl
used in industry, medicines
and cosmetics

Bleach
Household, bleaching
fabric

eg.

$CaCO_3$, CH_3COONa

- ❑ Chemicals from Common Salt
  - – Sodium chloride is called as common salt used in our food. It is derived from seawater.
  - – Rock Salt is the brown coloured large crystals. This s mined like coal.
  - – Common Salt is an important raw material for many materials of daily use such as.

    Sodium Hydroxide
    Washing Soda
    Bleaching Power.

- ❑ **Sodium Hydroxide**

  Preparation : Prepared by the method called chlor-alkali

  Called chlor-alkali because we get chlorine and a base in this.

  $$2NaCl_{(aq)} + 2H_2O(l) \rightarrow 2NaOH_{(aq)} + Cl_{2(g)} + H_{2(g)}$$

- ❑ Bleaching Power

  $$\text{Preparation} \rightarrow \underset{\text{calcium hydroxide}}{Ca(OH)_2} + \underset{\text{chlorine}}{Cl_2} \rightarrow \underset{\text{bleaching power}}{CaOCl_2} + \underset{\text{water}}{H_2O}$$

  uses in textile, factories and laundry, used as disinfectant (Learn from Text book)

- ❑ Baking Soda
  - – Common name – Sodium Hydrogen Carbonate

  Preparation

  $$\underset{\text{Sodium Chloride}}{NaCl} + \underset{\text{Water}}{H_2O} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Ammonia}}{NH_3} \rightarrow \underset{\text{Ammonium Chloride}}{NH_4Cl} + \underset{\text{Sodium hydrogen carbonate}}{NaHCO_3}$$

  On heating $NaHCO_3$ produces :

$$NaHCO_3 \xrightarrow{Heat} Na_2CO_3 + H_2O + CO_2$$

CO_2 produced causes dough to rise and make cakes, pastries spongy.

Uses : In household, ingredients of antacid

In making baking power

On heating baking powder produces

$$NaHCO_3 + H^+ \longrightarrow CO_2 + H_2O + \text{Sodium Salt of acid}$$

❑ Washing Soda

Preparation : Recrystallization of sodium carbonate

$$Na_2CO_3 + 10H_2O \xrightarrow{Heat} Na_2CO_3.\ 10H_2O$$

Uses

- Used in glass, soap and paper industry – Cleaning agent for domestic purposes.
- Removal of hardness of water. – Manufacture of borax.

❑ Water of crystallisation : Fixed no. of water molecules present in one formula unit of a salt.

- On heating copper sulphate crystals water droplets appear, formula of hydrated copper sulphate – $CuSO_4.\ 5H_2O$.
- gypsum also contains water of crystallisation.
- Formula of gypsum – $CaSO_4.2H_2O$
- On heating gypsum at 373k it becomes $CaSO_4.\frac{1}{2}H_2O$ is Plaster of Paris.
- Plaster of Paris is used as plaster for fractured bones.
- When plaster of Paris is mixed with water it changes to gypsum.

$$CaSO_4.\tfrac{1}{2}\ H_2O + 1\tfrac{1}{2}\ H_2O \longrightarrow CaSO_4.2H_2O$$

Uses of plaster of Paris : Making toys, decorative material and smooth surfaces.