CHAPTER – 2

ACIDS, BASES AND SALTS

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
– Sulphuric Acid H_2SO_4	Potassium hydroxide KOH
– Nitric Acid HNO_3	Calcium hydroxide $Ca(OH)_2$
– Acetic Acid CH_3 COOH	– Ammonium hydroxide NH_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

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 $\longrightarrow$ Salt + Hydrogen

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

$2HCl + Zn \longrightarrow ZnCl_2 + H_2$

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

$H_2SO_4 + Zn \longrightarrow ZnSO_4 + H_2$

$2CH_3COOH + Zn \longrightarrow (CH_3COO)_2Zn + H_2$

Pop test : When a buring 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 $\longrightarrow$ Salt + Hydrogen

$NaOH + Zn \longrightarrow Na_2ZnO_2 + H_2$

Sodium Zincate

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

Action of Acids with metal Carbonates and metal bicarbonates

Metal Carbonate + Acid $\longrightarrow$ Salt + Carbondioxide + Water

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

Metal bicarbonate + Acid $\longrightarrow$ Salt + Carbondioxide + Water

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

Lime water Test : On passing the CO_2 gas evolved through lime water,

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

On passing excess CO_2 the following reaction takes place

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

Neutralisation Reactions

Base + Acid $\longrightarrow$ Salt + Water

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

Neutralisation reacton 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 $\longrightarrow$ Salt + Water

$\underset{\text{Copperoxide}}{CuO} + \underset{\text{Hydrochloric acid}}{HCl} \longrightarrow \underset{\text{Copper chloride}}{CuCl_2} + \underset{\text{Water}}{H_2O}$

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 $\longrightarrow$ Salt + Water

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

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

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

H_3O^+ – Hydronium ion.

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

$$H^+ + H_2O \longrightarrow H_3O^+$$

– 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 donot 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 as 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 voilet	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_3 COOH, H_2 CO_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_2 SO_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 degredation of sugar and food particles remaining in the mouth. Using toothpaste 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_4 NO_3

Basic Salts : Strong base + weak acid

pH value is more than 7

eg. $CaCO_3$, CH_3 COONa

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.

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

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

Bleaching Power

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

uses in textile, factories and laundry, used as disinfectant

Baking Soda

– Common name – Sodium Hydrogen Carbonate

$$\text{Preparation } \underset{\text{Sodium chloride}}{NaCl} + \underset{\text{Water}}{H_2O} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Ammonia}}{NH_3} \longrightarrow NH_4Cl + \underset{\text{Sodium hydrogen carbonate}}{NaHCO_3}$$

On heating $NaHCO_3$ produces :

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

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 : Recrystallisation of sodium carbonate

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

Uses

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

EXERCISE
(Question Bank)

Very Short answer type questions **(1 mark)**

1. Two solution have pH number 4 and 9 respectively which solution has more H^+ ion concentration?
2. Why should cured and sour substances not be kept in brass and copper vessel?
3. What is the chemical name of bleaching powder?
4. Write down the molecular formula for one strong and one weak acid.
5. Explain why plaster of Paris should be stored in a moisture proof container?
6. Name the gas evolved when dil. sulphuric acid acts on sodium carbonate.
7. What is the use of common salt in soap industry?
8. What do you observe when a buring candle is brought near the testube containing hydrogen gas?
9. Name the indicator used to measure pH values over the whole range.
10. Write the formula of washing powder.

Short Answer Type Questions **(2 marks)**

1. Write two physical properties of an acid
2. Complete the reaction $CaCO_3 + H_2O \longrightarrow$ name the products formed.

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3. A testtube contains solution of NaOH and Phenolphthalein. Why the colour of the solution changes when HCl in added to it.

4. Why metallic oxides are called as basic oxides and non-metallic oxides are calles acidic oxides?

5. In a beakey a solution of HCl is poured and an electric circuit containing bulb is placed systemtically. What happens to the bulb and why?

   What will happen if HCl is repplaced by NaOH?

6, Identify the type of reaction

$$HX + MOH \longrightarrow MX + HOH$$

7. Why all bases are not alkalies but all alkalis are bases?

Answer the following questions in detail **(3 marks)**

1. What is acid rain? What is its pH? How does it affect the aquatic life?

2. What happens when a metal react with dilute hydrochloric acid? Write the reaction

   © $NaOH + Zn \longrightarrow$ __________ + __________.

3. What happens when an acid or a base is added to the water? Why does the beaker appear warm? Why should we always add acid or base to the water and not water to the acid or base.

Answer the following question in detail **(5 marks)**

1. (a) Write down five products formed with the help of common salt on industrial level.

   (b) Write down the chemical name of these compounds and one use of each of them.

2. Fill in the blanks

   a) Acid + _______ $\longrightarrow$ Salt + Water.

   b) ______ + Metal $\longrightarrow$ Salt + ______

   c) Metal carbonate / metal hydrogen carbonate + acid

   $\longrightarrow$ ________ + ________ + ________.

   d) $NaOH \xrightarrow{H_2O}$ ________ + ________

   e) $Na_2CO_3 + 10H_2O \longrightarrow$ ________

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