



Government of Tamilnadu
Department of Employment and Training

Course : TNPSC Group II Exam
Subject : Chemistry
Topic : **Acids, Bases and Salts**

© Copyright

The Department of Employment and Training has prepared the TNPSC Group-II Preliminary and Main Exam study material in the form of e-content for the benefit of Competitive Exam aspirants and it is being uploaded in this Virtual Learning Portal. This e-content study material is the sole property of the Department of Employment and Training. No one (either an individual or an institution) is allowed to make copy or reproduce the matter in any form. The trespassers will be prosecuted under the Indian Copyright Act.

It is a cost-free service provided to the job seekers who are preparing for the Competitive Exams.

Commissioner,
Department of Employment and Training.

ACIDS, BASES AND SALTS

Acids

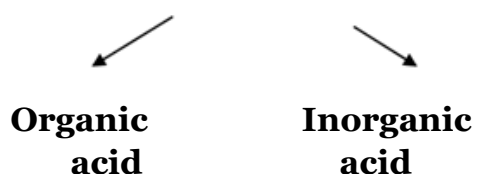
- ❖ The word acid is derived from the Latin name “acids” which means sour taste. Substances with sour taste are acids. Lemon juice, vinegar and grape juice have sour taste.
- ❖ Acid is a substance which give ions when dissolved with water. All hydrogen available substances are not considered as a acid. Acid change blue litmus to red.
- ❖ They are colorless with phenolphthalein and pink with methyl orange.

Basicity

- ❖ For acids, we use the terms basicity
- ❖ Refers to number of replaceable hydrogen atoms present in one molecule of an acid.
- ❖ Ex. Ammonia (NH_3), Methane (CH_4)

Types

I. Classification of acids based on their sources



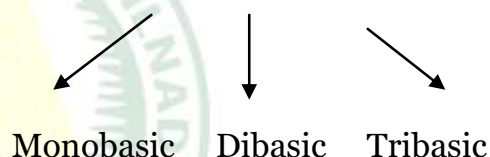
1. Organic Acid:

- ❖ Acids present in plants and animals are organic acids. Ex. HCOOH , CH_3COOH .

2. Inorganic Acid:

- ❖ Acids from rocks and minerals are inorganic acids (or) mineral acids. Ex. Hydrochloric Acid.

II. Classification of acids based on their basicity



1. Monobasic Acid

- ❖ It is an acid which give one hydrogen ion per molecule of the acid in solution. eg. HCl , HNO_3

2. Dibasic Acid

- ❖ It is an acid which gives two hydrogen ions per molecule of the acid in solution. eg. H_2SO_4 , H_2CO_3

3. Tribasic Acid

- ❖ It is an acid which gives three hydrogen ions per molecule of the acid in solution. eg. H_3PO_4 .

III. Classification of acids based on ionization

Strong Acids Weak Acids

Strong Acids:

- ❖ These are acids which ionise completely in water. eg. HCl

Weak Acids:

- ❖ These are acids which ionise partially in water. eg. CH_3COOH

IV. Classification of acids based on concentration

Concentrated Acid Dilute Acid

Concentrated Acid:

- ❖ It is an acid having a relatively high percentage of acid in its aqueous solution.

Dilute Acid:

- ❖ It is an acid having a relatively low percentage of acid in aqueous solution.

Acids used in day to day life

S.No.	Acids	Sources
1.	Citric Acid	Citrus fruits like lemons and oranges
2.	Lactic Acid	Sour milk
3.	Formic Acid (IUPAC: Methanoic Acid)	Stings of ants and bees
4.	Butyric Acid	Butter
5.	Acetic Acid (IUPAC: Ethanoic Acid)	Vinegar
6.	Tartaric Acid	Tamarind, grapes

7.	Malic Acid	Apple
8.	Uric Acid	Urine
9.	Oxalic Acid	Tomato
10.	Stearic Acid	Fats
11.	Cholic Acid	Bile water
12.	Ascorbic Acid	Brinjal
13.	Amino Acid	Proteins
14.	Nucleic Acid	DNA & RNA
15.	Acetyl Salicyclic Acid	Aspirin

Some important inorganic Acids used in laboratory

Chemical Name	Other Name	Molecular Formula
Hydrochloric Acid	Muriatic Acid	HCl
Sulphuric Acid	Oil of vitriol (or) king of chemicals	H_2SO_4
Nitric Acid	Aqua fortis	HNO_3

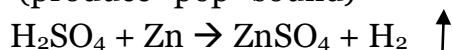
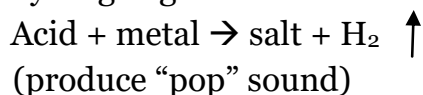
Physical properties of Acids:

- Inorganic acids are colourless. Sometimes sulphuric acid is light brown colour, concentrated Hydrochloric acid is light yellow in colour due to impurities present in it. Some organic acids are colourless solid. ex. Benzoic Acid.
- Except some organic acid, remaining all acids are soluble in water.
- Inorganic acids are highly corrosive in nature. It affects the surface of the metals and skin of the body.

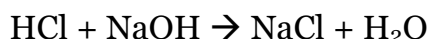
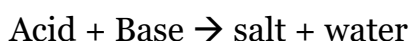
4. Acids are sour in taste
5. Acids are good conductor of electricity.

Chemical properties

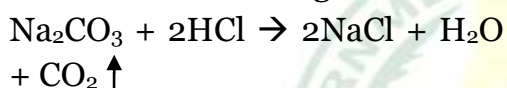
1. Acids react with metal to evolve hydrogen gas.



2. Acids react with base to form salt and water



3. Acids react with carbonate salts to produce carbon dioxide gas.



(change lime water into milky)

Strongest acid in the world

- ❖ HFSO_3 – Hydro fluoro sulphuric Acid (or) Fluoro sulphuric Acid

WHO SAYS WHAT:

Lavoisier

- ❖ Oxygen is basic substance of all acids.

Dacis

- ❖ Hydrogen is basic substance of all acids.

Arrhenius

- ❖ Hydrogen given substance is acid.
Hydroxide given substance is base.

Lowery - Bronstead

- ❖ Loss of protons is acid (H^+), gain of protons is base.

Uses of Acid

Uses of Inorganic Acid

1. In Chemical laboratories as reagents.

2. Industries for manufacturing dyes, drugs, paints, perfumes, fertilizers and explosives.
3. The extraction of glue from bones and metals from its ore.
4. Refining petroleum.

Uses of organic Acids

1. As food preservatives
2. As a source of vitamin
3. To add flavour to food stuffs and drinks.

Uses of HCl

1. HCl present in gastric juices are responsible for the digestion.
2. Used as bathroom cleaner.
3. As a pickling agent before galvanization

Uses of HNO_3

1. In the manufacture of fertilizers like ammonium nitrate.
2. In the manufacture of explosive like TNT (Trinitro toluene), TNB (Trinitro benzene), Picric acid (Trinitro phenol) etc
3. Nitro Glycerine (Dynamite)

Uses of Sulphuric Acid (H_2SO_4)

1. In lead storage battery
2. In the manufacture of HCl
3. In the manufacture of Alum
4. In the manufacture of fertilizers, drugs, detergents & explosives.

Uses of Boric Acids

1. As an antiseptic

Calcium Hydride is used as Hydrogen source in laboratories

Uses of Phosphoric Acids

1. It forms phosphatic fertilizers
2. PO_4^{3-} is involved in providing energy for chemical reactions in our body.

Uses of Ascorbic Acids

- Sources of Vitamin C

Uses of Citric Acids

- Flavouring agent & food preservative

Uses of Acetic Acids

- Flavouring agent & food preservative

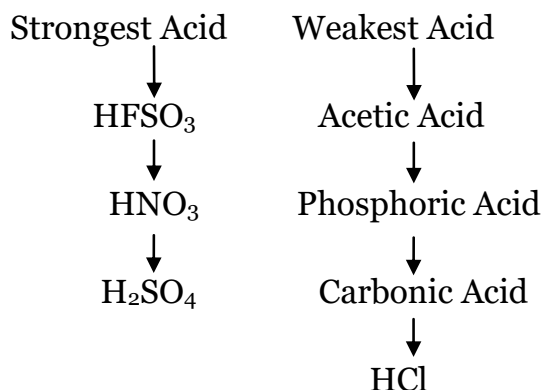
Uses of Tartaric Acids

1. Souring agent for Pickles
2. A component of baking powder (sodium bicarbonate, tartaric acid)

Bases

- ❖ Alkali derived from the arabic word “alquili” which means plant ashes.
- ❖ All alkalis are bases, but not all bases are alkali.
- ❖ Bases is a substance of metallic hydroxide (or) oxide which releases hydroxide ions when dissolved in water.
- ❖ Acid rain-Sulphuric Acid, Nitric Acid
- ❖ Dissolves glass-Hydrofluoric Acid

❖ Eye wash – Boric Acid

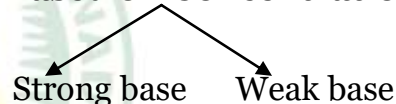


Acidity of the base

- ❖ The number of replaceable hydroxide ions per molecule of the base are known as acidity of the base.

Classification of bases

I. Based on Concentration



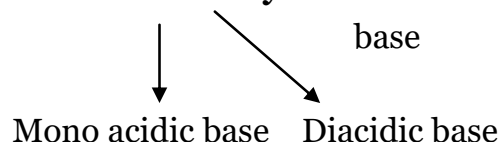
Strong base

- ❖ Completely ionized Ex. NaOH, KOH

Weak base

- ❖ Partially ionized. Ex. NH_4OH , $\text{Ca}(\text{OH})_2$

II. Based on Acidity → Tri acidic base



Mono acidic base

- ❖ It is a base which ionises in water to give one hydroxide ion per molecule.

Eg. NaOH, KOH

Titanium is called Strategic metal because it is lighter than iron.

Diacidic base

- ❖ It is a base which ionizes in water to give two hydroxide ions per molecule.

Eg. Ca(OH)_2 , Mg(OH)_2

Tri Acidic base

- ❖ It is a base which ionises in water to give three hydroxide ions per molecule.

Eg. Al(OH)_3 , Fe(OH)_3

III. Based on concentration

Concentrated alkali Dilute alkali

Concentrated alkali

- ❖ It is an alkali having a relatively high percentage of alkali in aqueous solution.

Dilute alkali

- ❖ It is an alkali having a relatively low percentage of alkali in its aqueous solution.

Some bases used in day today life

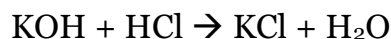
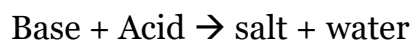
Sl. No.	Name	Other Name	Formula	Solubility in water
1.	Sodium hydroxide	Caustic soda	NaOH	soluble
2.	Potassium hydroxide	Caustic potash	KOH	soluble
3.	Calcium hydroxide	Slaked lime	Ca(OH)_2	Partially soluble
4.	Calcium oxide	Quick lime	CaO	insoluble
5.	Iron (II) hydroxide	Ferric hydroxide	Fe(OH)_3	insoluble
6.	Magnesium hydroxide	Milk of Magnesia	Mg(OH)_2	insoluble

Physical properties of bases

1. Bases are colourless, odourless but iron and copper hydroxides have definite colour.
2. Bases are bitter in taste.
3. Bases are corrosive in nature.
4. Bases feel soapy on touching.
5. Bases are good conductor of electricity.
6. Bases have hydroxyl ions, only non-metallic hydroxide is Ammonium hydroxide (NH_4OH).

Chemical Properties

1. Bases react with water to form salt and water, these reactions are called neutralization reaction.



2. Bases react with metal to produce hydrogen gas.



Uses of bases

1. In industries for manufacture of soap, textile, plastic

Excess of copper in human beings cause disease called WILSON

2. For manufacturing paper, pulp and medicine
3. To remove grease and stains from clothes.

Indicator

- ❖ Indicator are a group of compounds that change colour when added to solutions containing either acidic (or) basic substances.

Indicator	Colour in Acid	Colour in base
Litmus	Red	Blue
Phenolphthalin	Colourless	Pink
Turmeric	Yellow	Brick Red
Beetroot juice	Pink	Pale yellow
Red Cabbage juice	Pink / Red	Green
Methyl orange	Pink	Yellow

Salts

- ❖ Acids react with base to form salt and water. This reactions are known as neutralization reaction.
- ❖ It is an exothermic reaction.
- ❖ Acid + Base → salt + water + heat

Types of salts

1. Simple salt: **Ex.** Sodium chloride, Potassium chloride, Sodium sulphate
2. Acidic salt: **Ex.** Sodium bi sulphate, Potassium bi sulphate, Sodium bi carbonate

3. Basic salts: **Ex.** Basic magnesium chloride, Basic lead chloride
4. Double salts: **Ex.** Potash alum, Mohr salt
5. Complete salt: **Ex.** Sodium potassium carbonate, Bleaching powder
6. Complex salt: **Ex.** Potassium ferro cyanide, Sodium Zinc cyanide

General Properties of Salts

1. Salts of Sodium and potassium are colourless. **Ex.** Nacl, Kcl but Copper, Iron, Chromium salts are coloured. **Ex.** Copper sulphate – Blue colour, Potassium dichromate-Reddish orange,
2. Generally metallic salts are soluble in water but some metallic carbonates, oxides, sulphates are insoluble in water.**Ex.** Calcium Carbonate
3. Salts have high melting and boiling points
4. Aqueous solution of metallic salts conduct electricity.

Cadmium rod is used in nuclear reactor to slow down the speed of neutron.

Some salts are used in day today life

No	Common Name	Chemical Name	Formula
1	Simple salt	Sodium Chloride	NaCl
2	Washing soda	Hydrated Sodium Carbonate	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
3	Bread soda	Sodium bicarbonate	$\text{NaO} \cdot \text{CO}_3$
4	Bleaching powder	Calicum oxychloride	CaOCl_2
5	Limestone	Calcium Carbonate	CaCO_3
6	Chile salt peter	Sodium nitrate	NaNO_3
7	Hyposulfite	Sodium thio sulphate	$\text{Na}_2\text{S}_2\text{O}_3$
8	Epsom salt	Hydrated magnesium sulphate	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
9	Plaster of paris	Hydrated calcium sulphate	$\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$
10	Blue vitriol	Hydrated copper sulphate	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

Uses of Salts:

1. Sodium Chloride (NaCl)

- Preserve pickles, fish, meat, vegetables

2. Sodium benzoate

- It is used to preserve food items.

3. Calcium Carbonate

- It is used to prepare chalk piece

4. Silver Nitrate

- It is used to prepare hair dyes.

❖ For acidic solution (H^+) $> 10^{-7}\text{M}$, pH

< 7

❖ For basic solution (H^+) $< 10^{-7}\text{M}$, pH

> 7

❖ When OH^- ions are taken into account the pH expression is replaced by pOH

$$\text{pOH} = -\log_{10}(\text{OH}^-)$$

pH Scale

- ❖ pH stands for the power of hydrogen ion concentration in a solution.
- ❖ Whether a solution is acidic (or) basic (or) neutral.
- ❖ pH scale was introduced by S.P.L Sorenson.
- ❖ It is mathematically expressed as $\text{pH} = -\log_{10}(\text{H}^+)$
- ❖ For neutral solution (H^+) $= 10^{-7}\text{M}$, $\text{pH} = 7$

Importance of pH in Everyday Life

1. pH in Human Body : Using pH factor, the general health condition of our body can be examined. At pH level 6.9, the body becomes prone to viral infections like cold, cough and flu. Cancer cells thrive inside the body at a pH of 5.5.
2. The pH of a normal, healthy human skin is 4.5 to 6. Proper skin pH is essential for a healthy complexion. pH of stomach fluid is approximately

Wood Furniture are coated with zinc chloride to prevent termites

- 2.0. This fluid is essential for the digestion of food.
3. Human blood pH range is 7.35 to 7.45. Any increase or decrease in this value, leads to diseases. The ideal pH for blood is 7.4.
4. pH of saliva normally ranges between 6.5 to 7.5
5. White enamel coating of our teeth is calcium phosphate, the hardest substance in our body. It does not dissolve in water. If pH of mouth falls below 5.5, the enamel gets corroded.
6. Toothpastes which are generally basic and used for cleaning the teeth can neutralize the excess acid and prevent tooth decay.
7. pH of Soil In agriculture, the pH of soil is very important. Citrus fruits require slightly alkaline soil, while rice requires acidic soil and sugarcane requires neutral soil.
8. pH of Rain Water is approximately 7 showing the high level of its purity and neutrality. If rain water is polluted by SO₂ and NO₂, acid rain occurs.

The pH value of some common liquids

Liquid	pH
Lemon Juice	2.5
Wine	2.8
Apple juice	3.0
Vinegar	3.0
Urine	4.8
Coffee	5.0
Saliva	6.5
Milk	6.5
Blood	7.4
Pure water	7.0
Sea water	8.5
Toothpaste	9.0
Milk of magnesia	10.5

Problems

1. Hydrogen ion concentration of a solution is 0.001M. What is the pH value?

Solution

$$\begin{aligned}
 \text{pH} &= -\log_{10}(\text{H}^+) \\
 &= -\log_{10}(0.001) \\
 &= -\log_{10}(10^{-3}) \\
 &= -(-3) \log 10^{10} \quad \text{pH} = 3
 \end{aligned}$$

2. Hydroxide ion concentration of a solution is 0.001 m. What is the pH value?

$$pOH = -\log_{10}(10^{-3})$$

$$pOH = 3 \quad pH = 14 - pOH$$

$$= 14 - 3 \quad pH = 11$$

$$pOH = -\log_{10}(OH^-)$$

