→ [Acid, Base & Salt]

Compounds (यौगिक)

Introduction to Acids, Bases and Salts

ACIDS

(अम्ल)

Compound

यौगिक

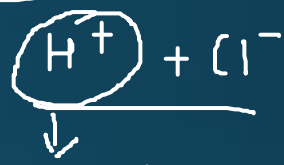
HCl

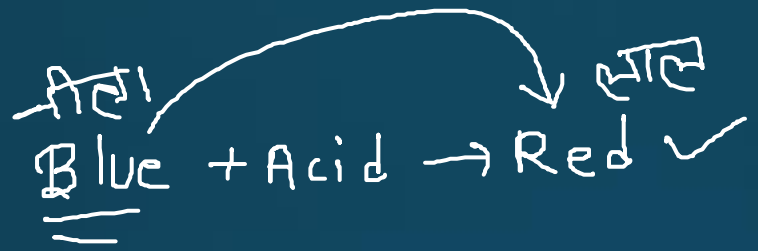
Properties of Acids: अम्लों के गुण

- Produce hydrogen ions [H+] in H_2O.
- Sour taste. खट्टा
- Turn blue litmus red.
- Act as electrolytes in Solution.
- Neutralize solutions carrying hydroxide ions.
- React with several metals releasing Hydrogen gas.

exp:

$HCl + H_2O \rightarrow$





OH⁻

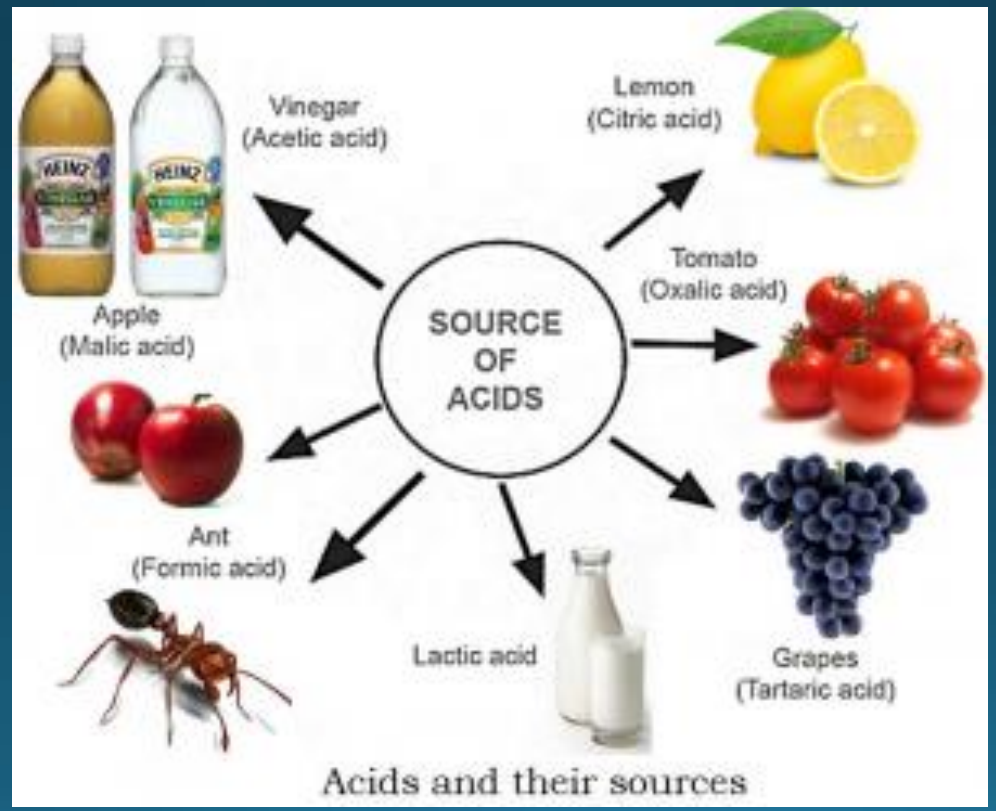
धातु

$H_2 \uparrow$

– React with carbonates releasing CO_2 (g)

– Destroy body tissues.

– corrode metal surface quickly.



Acids and their sources

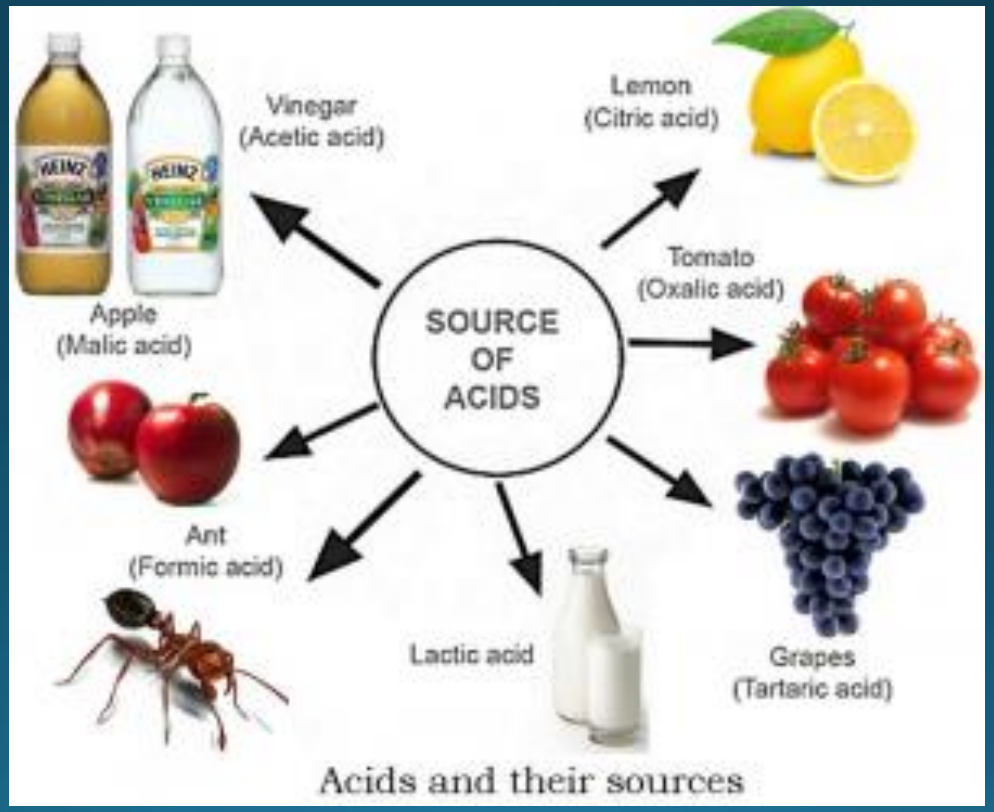
एसिड के गुण:

- H_2O में हाइड्रोजन आयन $[H^+]$ का निर्माण करते हैं।
- खट्टा स्वाद।
- नीला लिटमस लाल करें।
- विलयन में इलेक्ट्रोलाइट्स के रूप में कार्य।
- हाइड्रॉक्साइड आयनों को ले जाने वाले विलयन को उदासीन करें।
- कई धातुओं के साथ प्रतिक्रिया कर हाइड्रोजन गैस देते है।

- कार्बोनेट के साथ अभिक्रिया कर CO_2 देता है

- शरीर के ऊतकों को नष्ट करना।

- धातु की सतह जल्दी संक्षारण ।



Acids and their sources

TYPES (प्रकार) :-

Types of Acids

Acids

Organic Acids

- Acids that occur naturally are called organic acids
- Examples:

Organic Acid	Occurs in
Citric acid	lemon, orange
Tartaric acid	tamarind, grapes
Lactic acid	milk

Mineral (inorganic) Acids

- Acids that are prepared from minerals present in the earth are called mineral acids
- Examples:
  - ✓ Sulphuric acid - H_2SO_4
  - ✓ Hydrochloric acid - HCl
  - ✓ Nitric acid - HNO_3

- **On the basis of origin, acids are classified as :**

a. **Organic acids:** Acids derived from living organisms like plants and animals . For example: citric acid is present in fruits, acetic acid present in vinegar, oxalic acid present in tomato, tartaric acid present in tamarind, lactic acid present in sour milk and curd.

b. **Mineral acids:** They are also called inorganic acids. They are dangerous Example sulphuric acid(H_2SO_4), hydrochloric acid (HCl) etc.

- **उत्पत्ति के आधार पर, एसिड को इस प्रकार वर्गीकृत किया जाता है:**

2. कार्बनिक अम्ल: पौधों और जानवरों जैसे जीवित जीवों से प्राप्त एसिड। उदाहरण

के लिए: फलों में साइट्रिक एसिड, सिरका में मौजूद एसिटिक एसिड, टमाटर में मौजूद

ऑक्सालिक एसिड, इमली में मौजूद टारटरिक एसिड, खट्टा दूध और दही में मौजूद

लैक्टिक एसिड होता है।

2. खनिज अम्ल:

इन्हें अकार्बनिक अम्ल भी कहा जाता है। वे खतरनाक हैं

ORGANIC ACIDS (कार्बनिक अम्ल):

1. सिरका (Vinegar) → Acitic Acid
2. आँवला → Vitamin C → Ascorbic Acid
3. नींबू → Citric Acid
4. दही → Lactic Acid
5. टमाटर → Oxalic Acid
6. चींटी, बिच्छु → Foxmic Acid
   → (Methanolc Acid)

⑥ आसु → Sialic Acid

Carbonic Acid

MINERAL ACIDS (खनिज अम्ल):

$\Rightarrow$

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

$H_2SO_4 \rightarrow H^+ + SO_4^-$

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

Strong Acid

➢ On the basis of their strength, acids are classified as :

a. Strong acids: Completely dissociate into its ions in aqueous solutions.

Example: Nitric acid (HNO_3), sulphuric acid (H_2SO_4), hydrochloric acid (HCl).

b. Weak acids: Weak acids are those acids which do not completely dissociate into its ions in aqueous solutions.

For example: carbonic acid (H_2CO), acetic acid (CH_3COOH).

उनकी ताकत के आधार पर, एसिड को निम्न प्रकार से वर्गीकृत किया जाता है:

Strong acids:

सभी mineral acids केवल carbonic acid को छोडकर, strong acid होते हैं।

जैसे कि: sulphuric acid, hydrochloric acid, nitric acid, phosphoric acid इत्यादि।

Weak acids:

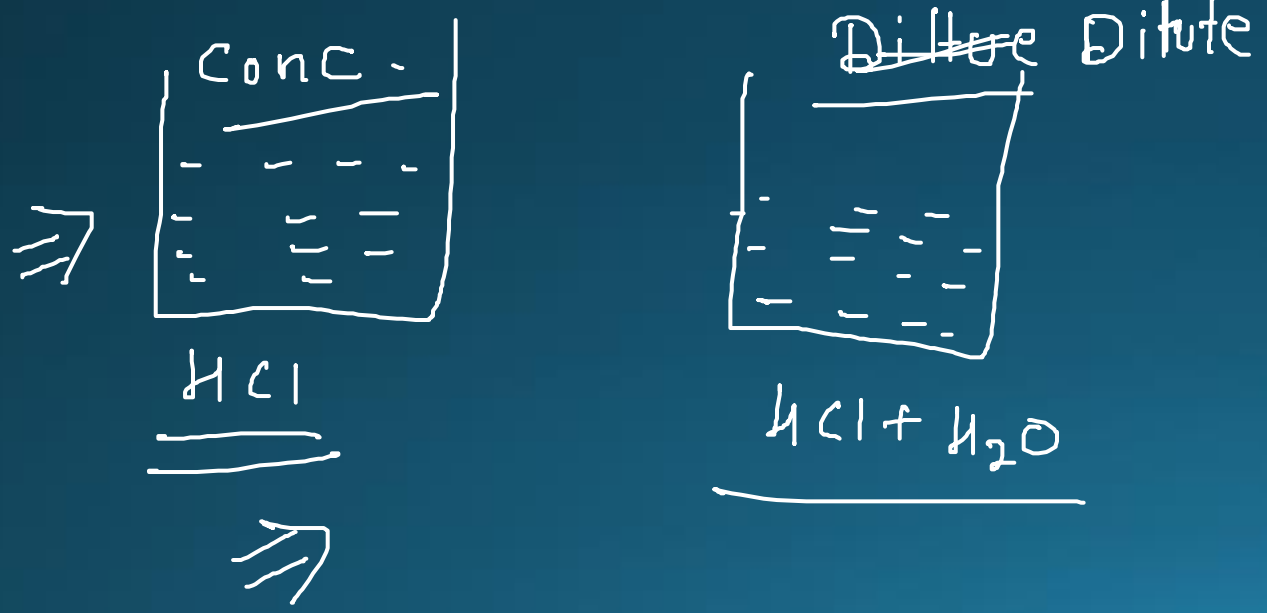
सभी organic acid अर्थात प्राकृतिक श्रोतों से प्राप्त एसिड weak acid होते हैं।

जैसे कि: tartaric acid, oxalic acid, formic acid, acetic acid, इत्यादि।

➢ On the basis of their concentration, acids are classified as :

a. Dilute acids: Have a low concentration of acids in aqueous solutions.

b. Concentrated acids: Have a high concentration of acids in aqueous solutions.



Concentrated Acid (सान्द्र अम्ल):

जलीय घोल, जिसमें अम्ल के घटक का आयतन maximum (सर्वाधिक) हो तथा और अम्ल नहीं घुल सके को सान्द्र अम्ल (Concentrated Acid) कहते हैं।

तनु अम्ल (Dilute Acid):

जलीय घोल, जिसमें अम्ल के घटक का आयतन maximum (सर्वाधिक) नहीं हो तथा और अम्ल घुल सके को जलमिश्रत अम्ल (Concentrated Acid) कहते हैं।

एसिड को dilute कैसे करें ?

Acid को पानी मिलाकर dilute किया जाता है। Acid का dilution एक उष्माक्षेपी प्रक्रिया है।

सावधानी: Acid को dilute करने के लिए पानी में acid को धीरे धीरे मिलाया जाता है। कभी

भी acid में पानी को नहीं मिलाया जाता है क्योंकि acid में पानी मिलाने के कारण काफी

उष्मा निकलेगी तथा अम्ल उछलकर त्वचा पर पर सकता है, जो कि काफ़ी खतरनाक हो

सकता है।

ACID RAIN (अम्ल वर्षा) :-

⇒ Sulphuric Acid, + ② Nitric Acid]

⇒

⇒ HCl

* H_2SO_4 → Battery, explosives.

* HCl → अमोनियम के निर्माण में,
Stomach.

BASE (क्षार या भस्म)

- All metal oxides, metal hydroxides and metal carbonates are bases.

सभी मेटल ऑक्साइड, मेटल हाइड्रॉक्साइड तथा मेटल कार्बोनेट क्षार या भस्म (base) होते हैं।

Example:

(1) कैल्सियम एक (Calcium) alkaline earth metal है, अतः कैल्सियम का ऑक्साइड अर्थात कैल्सियम

ऑक्साइड [Calcium oxide (quick lime)] एवम इसका हाइड्रॉक्साइड (Hydroxide) एवम कार्बोनेट

(Carbonate) अर्थात कैल्सियम हाइड्रॉक्साइड [Calcium hydroxide(slaked lime)] तथा कैल्सियम

कार्बोनेट [Calcium carbonate (lime stone)] क्षार या भस्म (base) हैं।

(2) Sodium एक alkali metal है अतः thus सोडियम ऑक्साइड (sodium oxide), सोडियम हाइड्रॉक्साइड (sodium hydroxide) तथा सोडियम कार्बोनेट (sodium carbonate) क्षार या भस्म (base) हैं।

➢ Properties of Base:

- Produce hydroxide ions [OH^-] in H_2O.
- Water soluble bases are called alkalies.
- Bitter Taste
- Turn Red Litmus blue.
- Act as electrolytes in Solution.
- Neutralize solutions containing H^+ ions.

e.g.: $NaOH + H_2O \rightarrow Na^+ + OH^-$

Red → Blue

Acid + Base → Elec. Conduct.

– Have a slippery, 'soapy' feel.

– Dissolve fatty material.

→ Base

क्षार या भस्म के सामान्य गुण (Properties of Base):

क्षार या भस्म का स्वाद तीखा (Bitter) होता है।

क्षार या भस्म का जलीय घोल छूने में साबुन की तरह होता है।

क्षार या भस्म लाल लिटमस पेपर को ब्लु करता है।

क्षार या भस्म Acid को प्रतिक्रिया के क्रम में उदासीन (Neutralise) बना देता है।

क्षार या भस्म में पानी को मिलाना एक उष्माक्षेपी प्रक्रिया (Exothermic process) है।

क्षार या भस्म Acid (अम्ल) के साथ प्रतिक्रिया कर लवण (Salt) तथा पानी बनाता है।

➢ On the basis of their strength, bases are classified as:

a. Strong bases: Strong bases are those bases which completely dissociate into its ions in aqueous solutions. Example: sodium hydroxide (NaOH), potassium hydroxide (KOH).

K^+ OH^-

b. Weak bases: Weak bases are those bases which do not completely dissociate into its ions in aqueous solutions. For example: ammonium hydroxide (NH_4OH).

➢ On the basis of their concentration, bases are classified as:

a. Dilute bases: Have a low concentration of alkali in aqueous solutions.

b. Concentrated bases: Have a high concentration of alkali in aqueous solutions.

Arrhenius theory of acids and bases

- Arrhenius acid – when dissolved in water, dissociates to give H^+ (aq) or H_3O^+ ion.

Comp. + H_2O ⟶ _ + H^+ or H_3O^+

- Arrhenius base – when dissolved in water, dissociates to give OH^- ion.

Comp + H_2O ⟶ _ + OH^-

- Examples

- **Acids**

Hydrochloric acid (HCl)

Sulphuric acid (H_2SO_4)

Nitric acid (HNO_3)

- **Bases**

Sodium hydroxide (NaOH)

Potassium hydroxide (KOH)

Calcium hydroxide ($Ca(OH)_2$)

Bronsted Lowry theory

- A Bronsted acid is an H^+ (aq) ion donor.
- A Bronsted base is an H^+ (aq) ion acceptor.

Example

- In the reaction: HCl (aq) + NH_3 (aq) → NH^+_4 (aq) + Cl^- (aq)
- HCl – Bronsted acid and Cl^- : its conjugate acid
- NH_3 – Bronsted base and NH^+_4 : its conjugate acid

- **Physical test**

Given are two possible physical tests to identify an acid or a base.

a. Taste: An acid tastes sour whereas a base tastes bitter. The method of taste is not advised as an acid or a base could be contaminated or corrosive.

b. Effect on indicators by acids and bases

- An indicator is a chemical substance which shows a change in its physical properties, mainly color or odor when brought in contact with an acid or a base.

भौतिक परीक्षण

दिए गए एसिड या आधार की पहचान के लिए दो संभावित भौतिक परीक्षण हैं।

1. **स्वाद:** एक एसिड खट्टा स्वाद लेता है जबकि एक बेस कड़वा होता है। स्वाद की विधि को एक एसिड के रूप में सलाह नहीं दी जाती है या एक आधार दूषित या संक्षारक हो सकता है।

2. **संकेतक पर प्रभाव:**

एक संकेतक एक रासायनिक पदार्थ है जो अपने भौतिक गुणों में बदलाव दिखाता है,

मुख्य रूप से रंग या गंध जब एक एसिड या एक आधार के संपर्क में लाया जाता है।

a) Litmus (लिटमस पेपर)

* Natural indicator
* Lichen (लाइकेन)

In a neutral solution – purple

In acidic solution – red → Blue → Red

In basic solution – blue → Red → Blue

- Litmus is also available as strips of paper in two variants – red litmus and blue litmus.
- An acid turns a moist blue litmus paper to red.
- A base turns a moist red litmus paper to blue.

- **b) Methyl orange** (मेथिल ऑरेंज)

In a neutral solution – orange

In acidic solution – red

In basic solution – yellow

c) Phenolphthalein

In a neutral solution – colorless

In acidic solution – remains colorless

In basic solution – pink

TURMERIC (हल्दी):-

- Neutral Solution → Yellow
- Acid Solution → Yellow
- Base Solution → Red ✓

* Olfactory indicators:- ① Onion →

(Related to Smell)

② Vanilla →

Reactions of acids and bases

a) Reaction of acids and bases with metals

Acid + active metal ⟶ salt + hydrogen + heat

$$2HCl + Mg \rightarrow MgCl_2 + H_2 (\uparrow)$$

Base + metal ⟶ salt + hydrogen + heat

$$2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2 (\uparrow)$$

A more reactive metal displaces the less reactive metal from its base.

$$2Na + Mg(OH)_2 \rightarrow 2NaOH + Mg$$

b) Neutralisation reaction

1. Reaction of metal oxides and hydroxides with acids

Metal oxides or metal hydroxides are basic in nature.

Acid + base → salt + water + heat

$H_2SO_4 + MgO \rightarrow MgSO_4 + H_2O$

$2HCl + Mg(OH)_2 \rightarrow MgCl_2 + 2H_2O$

2. Reaction of non-metal oxides with bases

Non-metal oxides are acidic in nature

Base + Non-metal oxide → salt + water + heat

$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

CO_2

Acids and bases in water

- When added to water, acids and bases dissociate into their respective ions and help in conducting electricity.

* Acid or Base + water → X

⇒ ions के Form में Break होंगे,

$NaCl + H_2O \rightarrow Na^+ + Cl^-$

$NaOH + H_2O \rightarrow Na^+ + OH^-$

Difference between a base and an alkali

- **Base-** 1. Bases undergo neutralisation reaction with acids.

2. They are comprised of metal oxides, metal hydroxides, metal carbonates and metal bicarbonates.

3. Most of them are insoluble in water.

- **Alkali – 1.** An alkali is an aqueous solution of a base, (mainly metallic hydroxides).

2. It dissolves in water and dissociates to give OH^- ion.

3. All alkalis are bases, but not all bases are alkalis.

अलकली (Alkalis)

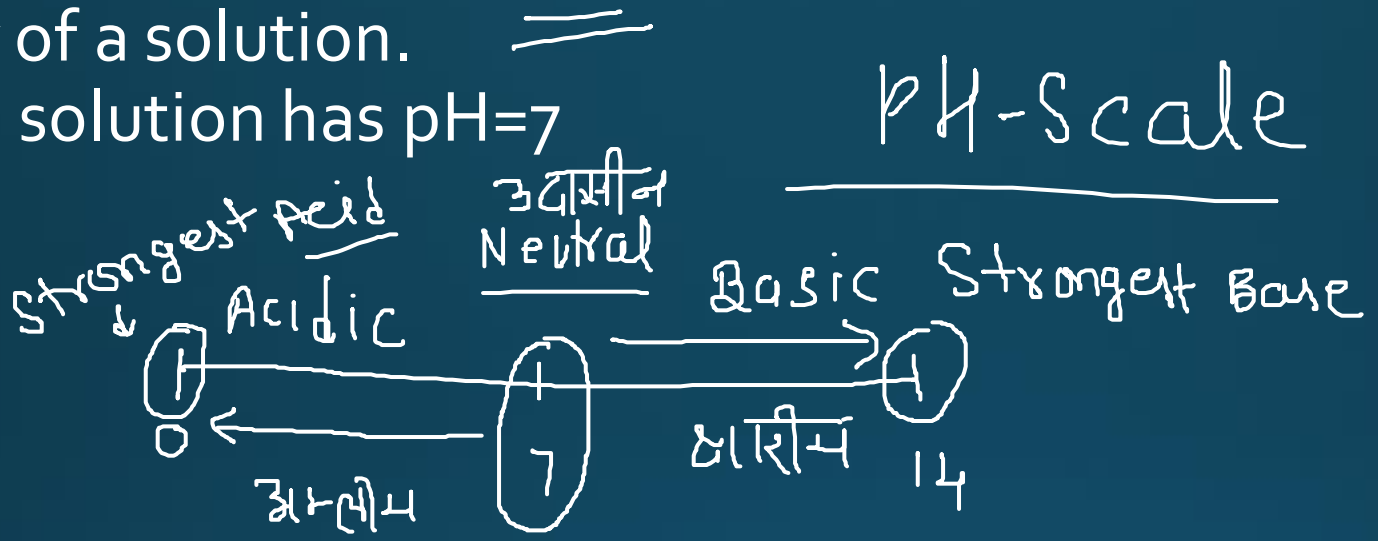
क्षार या भस्म, जो पानी में घुलनशील हैं को अलकली (Alkali) कहा जाता है।

अलकली (Alkali) alkaline metals का एक basic ionic salt है। Lithium, sodium, potassium, आदि alkali metals कहलाते हैं, जैसे कि: Beryllium, magnesium, calcium इत्यादि।

Ammonium hydroxide भी एक बहुत ही महत्वपूर्ण क्षार या भस्म है। हालाँकि यह non-metal का एक हाइड्रोक्साइड है।

अमोनिया (Ammonia) non-metal का एक hydride (salt) है, परंतु यह एक क्षार या भस्म है।

- **Universal indicator**
- A universal indicator has a pH range from 0 to 14 that indicates the acidity or alkalinity of a solution.
  A neutral solution has pH=7



- **pH**

$pH = -\log_{10}[H^+]$

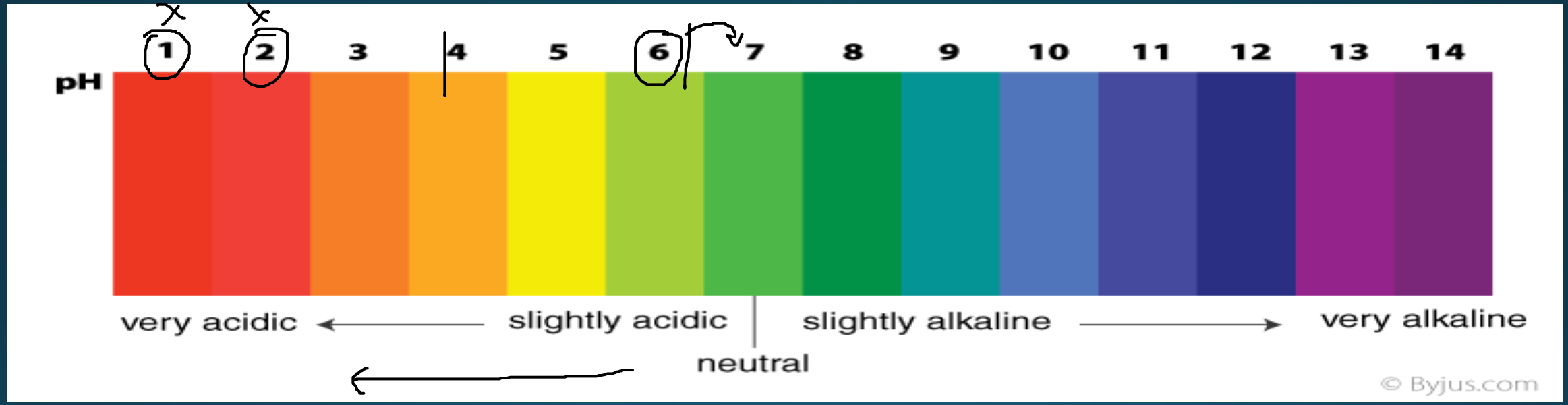
In pure water, $[H^+]=[OH^-]=10^{-7}$ mol/L. Hence, the pH of pure water is 7.

The pH scale ranges from 0 to 14.

$$\Rightarrow \begin{cases} pH = \log_{10}\frac{1}{[H^+]} \\ pH = -\log_{10}[H^+] \end{cases}$$

If pH < 7 – acidic solution
If pH > 7- basic solution

* pH ⇒ $-\log_{10}[H^+]$ potential of H^+ ion



(i) 5 - 6 (ii) 6 - 7

(ii) 2 - 3

(iii) 2 - 1

Blood → pH

→ 7.3 - 7.4

Importance of pH in everyday life

1. **pH sensitivity of plants and animals :** Plants and animals are sensitive to pH. Crucial life processes such as digestion of food, functions of enzymes and hormones happen at a certain pH value.

2. **pH of a soil** The pH of a soil optimal for the growth of plants or crops is 6.5 to 7.0.

3. **pH in the digestive system** The process of digestion happens at a specific pH in our stomach which is 1.5 – 4.
The pH of the interaction of enzymes, while food is being digested, is influenced by HCl in our stomach.

- **4. pH in tooth decay** Tooth decay happens when the teeth are exposed to an acidic environment of pH 5.5 and below.

- **5. pH of self-defence by animals and plants** Acidic substances are used by animals and plants as a self-defence mechanism.

- For example, bee and plants like nettle secrete a highly acidic substance for self-defence.

- These secreted acidic substances have a specific pH.

Salts :-

Acid + Base → Salt + Water

HCl + NaOH → [NaCl] + H_2O

- Salts: A salt is a combination of an anion of an acid and a cation of a base. Examples – KCl, $NaNO_3$, $CaSO_4$, etc.
- Salts are usually prepared by the neutralisation reaction of an acid and a base.
- **Common salt:** Sodium Chloride (NaCl) is referred to as common salt because it's used all over the world for cooking.
- **Family of salts :** Salts having the same cation or anion belong to the same family. For example, NaCl, KCl, LiCl.

- **pH of salts**

HCl, H_2SO_4

* H_2CO_3 ⇒ Weak

NaOH → Strong Base

- A salt of a strong acid and a strong base will be neutral in nature. pH = 7 (approx.).

$$H_2CO_3 + NaOH \longrightarrow Na_2CO_3 + H_2O$$

Basic Salt

- A salt of a weak acid and a strong base will be basic in nature. pH > 7.
- A salt of a strong acid and a weak base will be acidic in nature. pH < 7.
- The pH of a salt of a weak acid and a weak base is determined by conducting a pH test.

⇒

- Strong Acid + Strong Base → Neutral Salt, pH = 7
- Weak Acid + Strong Base → Basic Salt, pH > 7
- Strong Acid + Weak Base → Acidic Salt, pH < 7

- **Sodium hydroxide**

Chemical formula – NaOH

Also known as – caustic soda

- **Bleaching powder**

Chemical formula – $Ca(OCl)Cl$ or $CaOCl_2$

- # Baking soda

Chemical name – Sodium hydrogen carbonate

Chemical formula – $NaHCO_3$

- **Uses:**
  1. Textile industry
  2. Paper industry
  3. Disinfectant

- # Washing soda

Chemical name – Sodium carbonate deca hydrate

Chemical formula – $Na_2CO_3.10H_2O$

- **Uses**
  1. In glass, soap and paper industries
  2. Softening of water
  3. Domestic cleaner

- **<u>Crystals of salts</u>** Certain salts form crystals by combining with a definite proportion of water. The water that combines with the salt is called water of crystallisation.

- Plaster of paris

- Gypsum, $CaSO_4.2H_2O$ (s) on heating at 100°C (373K) gives $CaSO_4$. ½ H_2O and 3/2 H_2O

- $CaSO_4$. ½ H_2O is plaster of paris.

- $CaSO_4$. ½ H_2O means two formula units of $CaSO_4$ share one molecule of water.

- **Uses** – cast for healing fractures.

SAFALTA CLASS™
An Initiative by अमर उजाला

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