ACIDS, BASES AND SALTS

Acid :- A substance that gives $H^+(aq)$ as only +ve ion in aqueous solution.

Example :- HCl, H_2SO_4, HNO_3, CH_3COOH (acetic acid)
↓
vinegar mein hota hai

(i) Acids are sour (khatte) in taste.
(ii) Acids turns blue litmus red.

BASE :- A substance which is

(i) Bitter (kadwa) in taste.
(ii) Soapy in touch.
(iii) Turns Red litmus blue
(iv) increase Hydroxyl ions $OH^-(aq)$ in aqueous solution.

Examples :-
- NaOH (Sodium Hydroxide) → Strong Base
- KOH (Potassium Hydroxide) → Strong Base
- NH_4OH (Ammonium Hydroxide) → Weak Base
- $Mg(OH)_2$ (Magnesium Hydroxide)
- $Ca(OH)_2$ (Calcium Hydroxide)
- MgO, ZnO, CaO (oxide)

INDICATORS :- Tells wheather a substance is acid or Base.

TRICK

LaBouR → Litmus, Blue, Red
TRY (Turmeric, Yellow) → Red
PoPCorn (Pink → Colourless) with → Phenolphthalein
MaYoR (Yellow) → Methyl orange Range, Red

Indicators	Base	Acid
(1) Litmus	Blue	Red
(2) Turmeric (Yellow)	Red	Yellow
(3) Phenolphthalein (colourless)	Pink	Colourless
(4) Methyl orange Range	Yellow	Red

Important points :- (i) Litmus solution is originally purple in colour where no acid or base is added.
(ii) Pure water has no effect on colour of litmus.
(iii) it is natural indicator extracted from plant.

OLFACTORY INDICATORS :- Substances whose smell odour changes in acidic or basic medium.

Examples :- onion, vanilla essence, clove oil

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Acid Retains smell — Base loses smell

Trick Ek badi si factory (olfactory) mein jayenge.
Vanilla Icecream (Vanilla essence) lenge.
Aur ush par laung (clove oil) Aur onion daal kar khayenge.

Acid and Base in water :-

(1) Acids produce H^+ ions in aqueous (water) solution.

$H_2SO_4 \xrightarrow{H_2O} 2H^+(aq) + SO_4^{2-}$

$HCl \xrightarrow{H_2O} H^+$

$HCl(dry\ gas) \xrightarrow{H_2O} X$

Trick

- Acid ki pehchan. pani mein H^+
- separation of H^+ and Cl^-/SO_4^{2-} etc cannot happen without water.

- H^+ of acid combines with water(H_2O) to form H_3O^+ (Hydronium ion)

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

- H^+ acid do not stay alone.
- H^+ of acid combines with H_2O to form Hydronium ion. So, we say acid gives H_3O^+(Hydronium ion) or $H^+(aq)$ ion.

This $H^+(aq)$ ion or H_3O^+ (Hydronium ion) gives common properties to all acids.

Preparation of HCl gas :-

$NaCl(aq) + H_2SO_4(conc.) \longrightarrow Na_2SO_4(aq) + HCl(g)$

$HCl(g) \xrightarrow{\text{dry blue litmus}}$ No change

$HCl(g) \xrightarrow{\text{moist blue litmus}}$ Red colour

$HCl(g) + H_2O \longrightarrow H_3O^+ + Cl^-$

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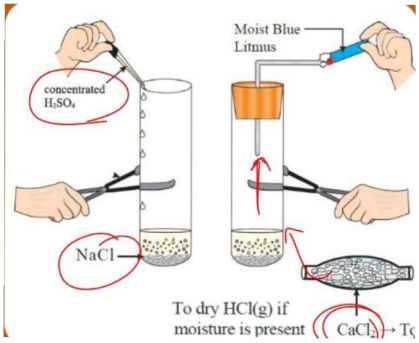


(2) Bases increase OH^- (Hydroxy) ions in water.

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

$KOH \xrightarrow{H_2O} K^+(aq) + OH^-(aq)$

$Mg(OH)_2 \xrightarrow{H_2O} Mg^{2+}(aq) + 2OH^-(aq)$

Alkalis :- some bases are water soluble, these are called Alkalies.

very soluble :- $NaOH$, KOH, $NH_4(OH)$

Partially soluble :- $Mg(OH)_2$, $Ca(OH)_2$, $Ba(OH)_2$

Base But not alkali :- $Zn(OH)_2$, $Fe(OH)_2$, $Cu(OH)_2$

Acid + water is a highly exothermic

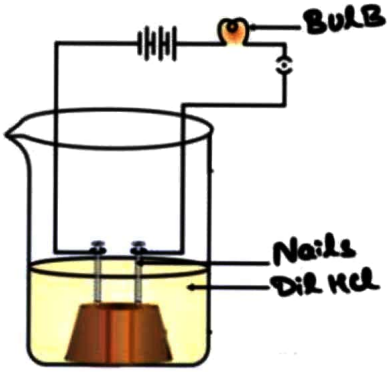
- Always add Acid slowly to water with constant stirring.
- if water is added to a concentrated acid, the heat generated may cause the mixture to splash out and cause burns. The glass container also break due to Heat given out.

Trick

AaThuW
Acid to water

Acid and Alkali ~ Electric current ?

- Electric current through the solution is carried by ions.
- Solution of Acids :- HCl, H_2SO_4, HNO_3 and CH_3COOH generates ions and hence they conduct electricity.
- Alkalis also generate ions :- NaOH, KOH, $Mg(OH)_2$, NH_4OH and hence conduct electricity.
- Glucose, Alcohol do not generate ions and hence do not conduct electricity.



Reaction with Metal

Metal + Acid (dil) ⟶ Salt + $H_2\uparrow$

$Zn + 2HCl\,(dil) \longrightarrow ZnCl_2 + H_2\uparrow$

$2\overset{+3}{Al} + 6H\overset{-1}{Cl} \longrightarrow 2AlCl_3 + 3H_2\uparrow$

$\overset{+2}{Cu} + \overset{-2}{H_2SO_4} \longrightarrow CuSO_4 + H_2\uparrow$ X

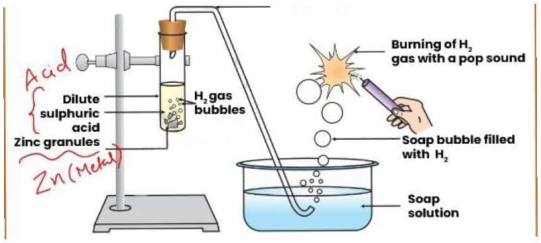
Trick

Katrina	K (Potasium)
Ne	Na (sodium)
car	Ca (calcium)
Mangi	Mg (Magnesium)
Alto	Al (Aluminium)
Zen	Zn (Zinc)
Ferrari	Fe (iron)
Firbi	Pb (lead)
Hath	H (Hydrogen)
kyu	Cu (copper)
Mili	Hg (Mercury)
silver	Ag (silver)
Audi	Au (Gold)

- Metals jo above 'Hydrogen' hote hai wo acid se reaction karte hai Aur salt, $H_2\uparrow$ dete hai
  Jo metal 'Hydrogen' se niche hai wo reaction nhi dega like Cu, Hg.

Prepartion of Hydrogen gas

$H_2SO_4(dil) + Zn \longrightarrow ZnSO_4 + H_2\uparrow$



(1) Zn granules gives more surface area for reaction.
(2) $ZnSO_4$ is white coloured salt called white vitriol.
(3) H_2 gas burns with pop sound and extinguish a candle combustible but not supporter of combustion.

✡ Base + Metal ⟶ salt + H_2

- $2NaOH(aq) + Zn(s) \longrightarrow Na_2ZnO_2(s) + H_2\uparrow$
  (sodium zincate)

✡ Does not happen with all metals

Trick NaTuZanaTu
Na_2ZnO_2

Neutralisation

✡ Acid + Base ⟶ salt + water

$H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$

- $HCl(aq) + NaOH(aq) \longrightarrow NaCl + H_2O$
- $H_2SO_4 + Ca(OH)_2 \longrightarrow CaSO_4 + H_2O$
- $CH_3COOH + Mg(OH)_2 \longrightarrow Mg(CH_3COO)_2 + H_2O$

✡ Metal oxide + Acid ⟶ salt + water
(ZnO/CuO/MgO/CaO)

- $CuO(s) + 2HCl(dil) \longrightarrow CuCl_2(aq) + H_2O$
  (Black solid) (Blue-green)

✡ **Trick** Black Cop on OX doing colgate Green Blue colour.
CuO Black ⟶ $CuCl_2$

Generally Metal oxide are basic in nature because they react with Acid to give salt & water.

✡ Non-Metal oxide + Base ⟶ salt + water
($SO_2/SO_3/CO_2/NO_2$)

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

Generally Non-Metal oxide are acidic in nature because they react with Base to give salt and water.

✡ Acid + Metal carbonate (CO_3^{2-}) ⟶ salt + CO_2 + $H_2O\uparrow$
OR
Metal Hydrogen carbonate HCO_3^- (Bicarbonate)

- $2HCl(dil) + Na_2CO_3$ (sodium carbonate) ⟶ $CO_2\uparrow + 2NaCl + H_2O$
- $2H_2SO_4(dil) + NaHCO_3$ (sodium bicarbonate) ⟶ $2CO_2\uparrow + Na_2SO_4 + 2H_2O$

CO_2 turns lime water Milky

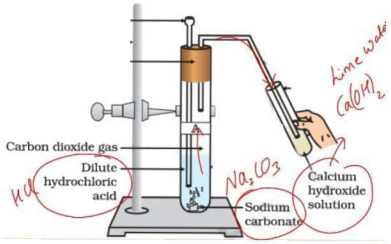
- $CO_2(g) + Ca(OH)_2(aq) \longrightarrow CaCO_3(s)\downarrow + H_2O$
  (lime water) → White PPT calcium carbonate

on passing excess of CO_2, milkiness disappear.

- $CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2(aq)$
  soluble in water
  calcium Hydrogen carbonate/Bicarbonate.

✡ Lime water $\xrightarrow{CO_2}$ milky $\xrightarrow{\text{excess } CO_2}$ Milkiness disappear.

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



strength of Acid and Base

strong Acid :- H_2SO_4, HCl, HNO_3
- Gives more concentration of H^+ ion.

Weak Acid :- CH_3COOH (acetic acid), citric acid, Lactic acid, H_2CO_3 (carbonic acid)
- Gives less conc. of $H^+(aq)$ ions

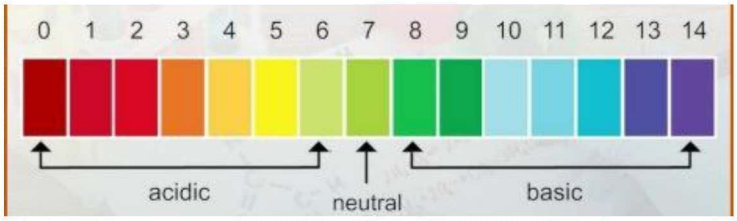
strong Base :- NaOH, KOH, $Ca(OH)_2$
- Gives more concentration of OH^- ions.

Weak Base :- NH_4OH, $Zn(OH)_2$, $Cu(OH)_2$, $Fe(OH)_2$.
Gives less concentration of OH^- ions.

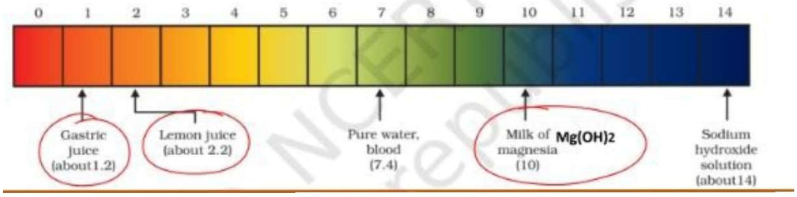
pH P(Potenz → Power)H → Hydrogen

✓ Measure $H^+(aq)$ Ions concentration in a solution.
✓ pH ranges from 0 (very acidic) to 14 (Very Basic)
✡ pH↓ → $H^+(aq)$↑ → Acidic↑

pH < 7 Acidic
pH = 7 Neutral
pH > 7 Base



Universal Indicators :- substance which detect nature of chemical as acid or base and also measures strength of it.



Red ke taraf — R O Y G B I V — Vilot ketaraf

Acid | Neutral | Basic

Importance of pH in Everydaylife :-

(1) pH range for Human body :- 7.0 to 7.8
- PH of rain water < 5.6 ⇒ Acid rain
- Acid rain → River → PH of river↓ (Acquatic life survival difficult.)

(2) Stomach produce HCl (aq) :-
- Help in digestion of food.
- Durning indigestion, stomach produce too much acid. ✓cause pain and irration.
- People use Antacid (milk of magnesia $Mg(OH)_2$ mild Base)
- Antacid neutralise excess of acid.

(3) pH in mouth < 5.5 ⇒ Tooth decay (due to sugar and food degradation)
- Toothpaste (basic in nature) neutralises excess acid.

(4) Honey bee sting → acid (formic acid)
- Treatment - mild Base like Baking soda ($NaHCO_3$)

(5) Nettle stinging hair — methanol Acid ↓ painful when touched
- Remedy → rubbing area with dock plant
- Dock plant often grows besides nettle → Nature provides neutralisation.

pH of salts?

Acid + Base ⟶ salt + water

✓ strong acid + strong Base ⟶ Neutral salt + water pH=7
✓ Weak acid + strong Base ⟶ Basic salt + water pH>7
✓ strong acid + Weak Base ⟶ Acidic salt + water pH<7

✡ NaCl (Neutral salt) e.g $NaOH$ (S.B) + HCl (S.A) ⟶ Neutral ($NaCl$)
✡ KNO_3 (Neutral salt) e.g $NaOH$ (SB) + HNO_3 (S.A) ⟶ Neutral (KNO_3)
✡ $NaHCO_3$ (Basic salt) e.g $NaOH$ (SB) + H_2CO_3 (WA) ⟶ Basic salt ($NaHCO_3$)

Naturally occuring Acids

	Natural source	Acid	Trick
①	Vinegar	Acetic acid	sirka pikar Acting karne lage.
②	Orange	citric acid	Orange cheela andar city nikli.
③	Tamarind	Tartaric acid	Imlee ko tar se bandha
④	Tomato	Oxalic acid	Tamatar OX ne khaya.

Natural source	Acid	Trick
Sour milk (Curd)	lactic Acid	Dahi ko lake me feka.
lemon	Citric Acid	Lemon cheela andar city nikli
Ant sting	Methanoic acid	Ant ne khaya Methi ka paratha.
Nettle sting	Methanoic acid	Net me fasa Methi ka paratha.

Common salt (NaCl) [Rock salt]

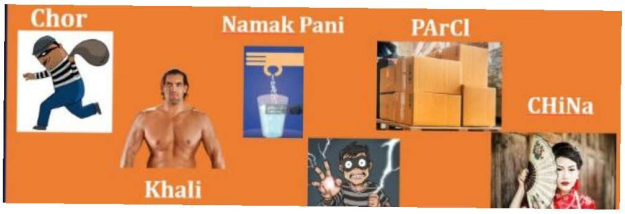
✓ found in deposits in rock bed.
✓ Common salt (NaCl) is raw material for various chemical.

$NaOH$ (sodium Hydroxide), $CaOCl_2$ (bleaching powder), $NaHCO_3$ (baking soda)

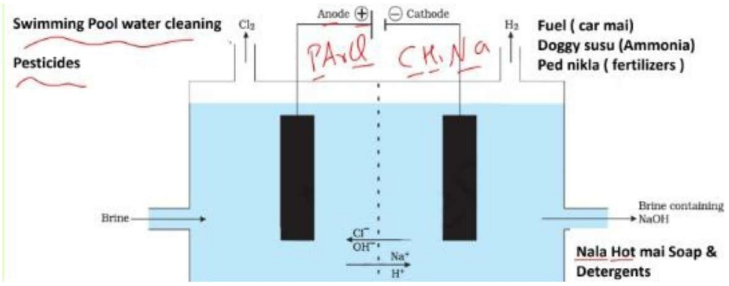
(1) Sodium Hydroxide / caustic soda (NaOH) : Chlor-Alkali process.

$$2NaCl(aq) + 2H_2O(l) \xrightarrow{\text{electric current}} 2NaOH(aq) + Cl_2(g) + H_2(g)$$

Brine — (near cathode) — (Cl_2 at anode) — (H_2 at cathode)



Trick :- khali sahab ne chor ko pakada, namak-pani pilaya.
bijali ka jhatka diya parcel mein pack kiya Aur china bhej diya.



(2) Bleaching powder:- ($CaOCl_2$)

$$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$$

(slaked lime) — (Bleaching powder)

(1) Bleaching cotton and linen wood pulp in paper factories, Bleaching washed clothes.
(2) Oxidising agent.
(3) Make drinking water free form germs.

(3) Baking Soda ($NaHCO_3$)

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

sodium Hydrogen carbonate baking soda.

Trick Bakri Soda (Baking soda) — Bhai on car Bonut ($NaHCO_3$)

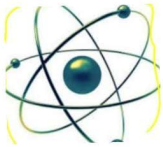
(1) for making tasty crispy pakora.
(2) for faster cooking
(3) Neutralise acidity (mild base) Antacid.
(4) Soda-Acid fire extinguisher.
(5) Delay curdling of milk.

For making Baking soda :—

✡ Baking soda + Tartic acid

$NaHCO_3 + H^+ \longrightarrow CO_2 \longrightarrow$ Cause bread or cake to rise making them soft or spongy.

(4) washing soda ($Na_2CO_3 \cdot 10H_2O$)



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

$$Na_2CO_3 + 10H_2O \longrightarrow Na_2CO_3 \cdot 10H_2O$$

(1) Glass, soap and paper industry.
(2) Removing permanent hardness.

Trick Hardy sandhu ne nirma washingsoda se parmanu kodhoya.

Water of Crystallization

✓ Fixed number of water molecules present in one formula unit of salt.

- $CuSO_4 \cdot 5H_2O$ (copper sulphate crystals)
- $Na_2CO_3 \cdot 10(H_2O)$ washing soda (sodium carbonate decahydrate)
- $CaSO_4 \cdot 2H_2O$ (Gypsum) "Jibh" se yaad rakho
- $FeSO_4 \cdot 7H_2O$ (ferrous sulphate crystals)

✡ $FeSO_4 \cdot 7H_2O$ (Green) $\xrightarrow{Heat}$ $FeSO_4$ (white) $\xrightarrow{Heat}$ Fe_2O_3 (Brown) $+ SO_2 + SO_3$

✡ $CuSO_4 \cdot 5H_2O$ (Blue) $\xrightarrow{Heat}$ $CuSO_4 + 5H_2O$ (white)

Plaster of Paris (POP)

- POP [$CaSO_4 \cdot 1/2\ H_2O$] White powder.

$$CaSO_4 \cdot 2H_2O \xrightarrow[\Delta]{373K,\ 100^\circ C} 3/2\ H_2O + CaSO_4 \cdot 1/2\ H_2O$$

(Gypsum) (POP)

POP + water ⟶ Gypsum

- POP is used for making toys, making surface smooth and materials of decoration.