



# DELHI POLICE CONSTABLE

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By  
**ONE OF THE MOST EXPERIENCED  
FACULTY TEAM FROM DELHI**

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**100+ Hrs | 60 Days**

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 **60 DAYS** | **100+ HOURS**

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✓✓✓ 2-3✓

# Introduction to Acids, Bases and Salts

# Classification of matter

- On the basis of

a) composition – elements, compounds and mixtures

b) state – solids, liquids and gases, Plasma, B E Conds.

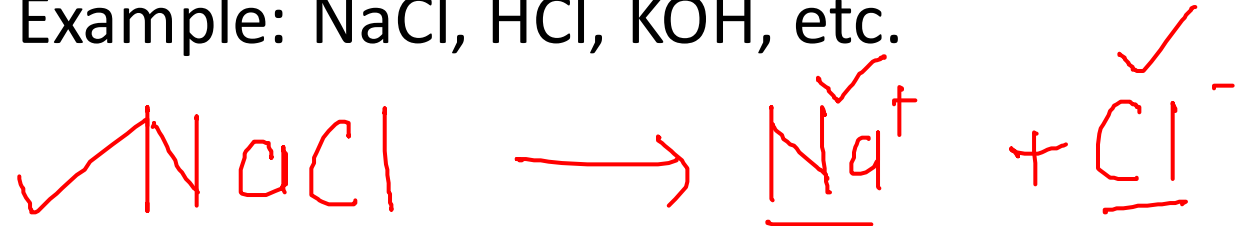
c) solubility – suspensions, colloids and solutions

- Types of mixtures – homogeneous and heterogeneous

- Types of compounds – covalent and ionic

# Ionisable and non-ionisable compounds

- An ionisable compound when dissolved in water or in its molten state, dissociates into ions almost entirely. Example: NaCl, HCl, KOH, etc.



- A non-ionisable compound does not dissociate into ions when dissolved in water or in its molten state. Example: glucose, acetone, etc.

# Properties of Acids:

✓ – Produce hydrogen ions  $[H^+]$  in  $H_2O$ .



✓ – Sour taste.

10/2/2

✓ – Turn blue litmus red.

4 13  
Blue  $\xrightarrow{+}$  Red

✓ – Act as electrolytes in Solution.

– Neutralize solutions carrying hydroxide ions.  $[$

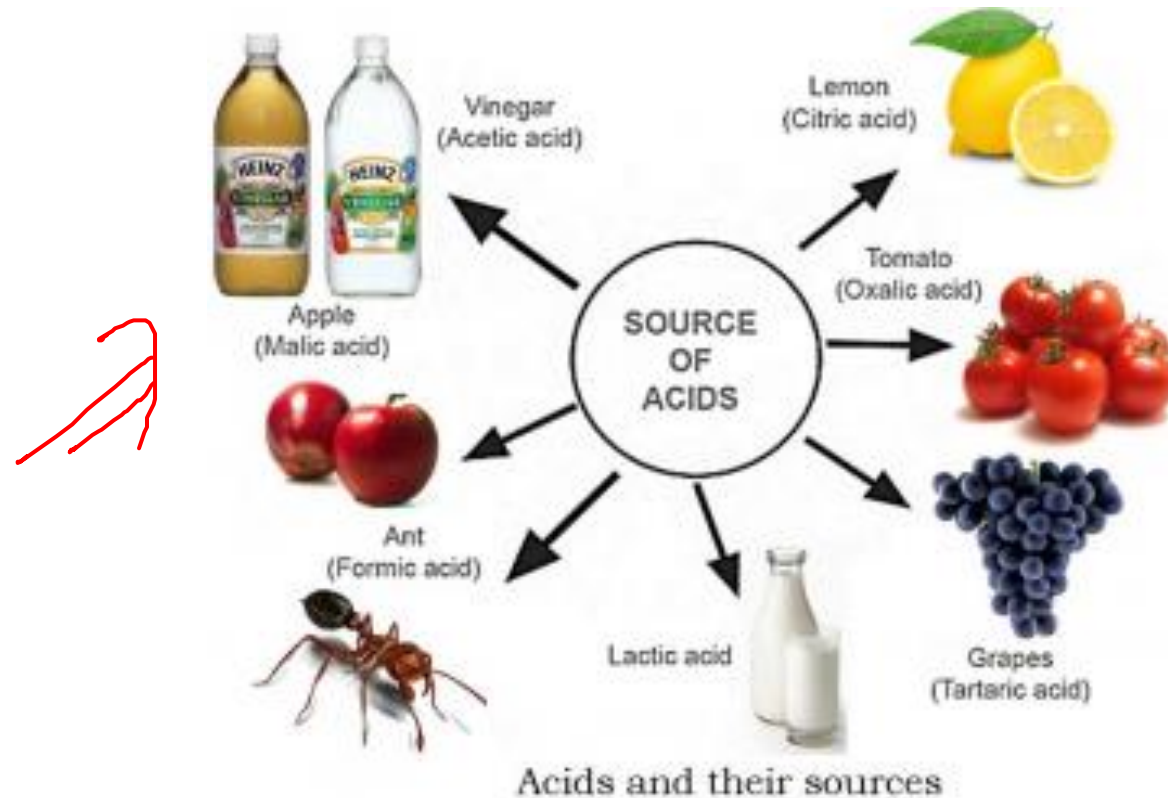
– React with several metals releasing Hydrogen gas.



– React with carbonates releasing  $\text{CO}_2$  (g)

– Destroy body tissues.

– corrode metal surface quickly.



# • 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.
- Strong ✓  
✓ **b. Mineral acids:** They are also called inorganic acids. They are dangerous  
Example sulphuric acid( $H_2SO_4$ ), hydrochloric acid ( $HCl$ ) etc.

## ➤ 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<sub>3</sub>), sulphuric acid (H<sub>2</sub>SO<sub>4</sub>), 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<sub>2</sub>CO), acetic acid (CH<sub>3</sub>COOH).

mineral



organic



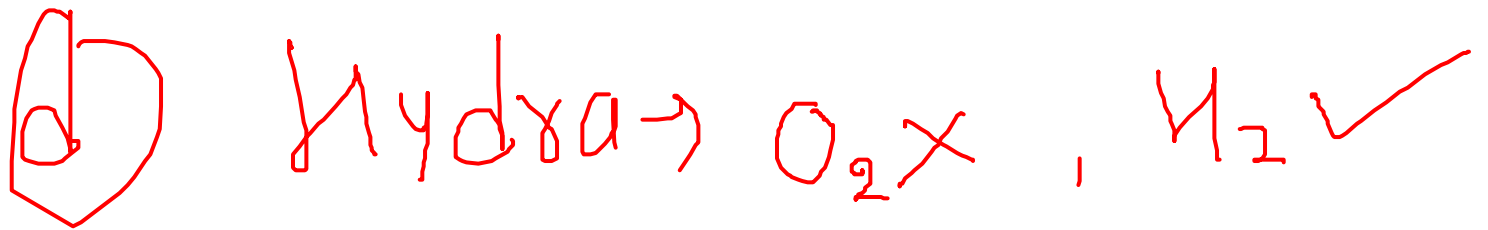
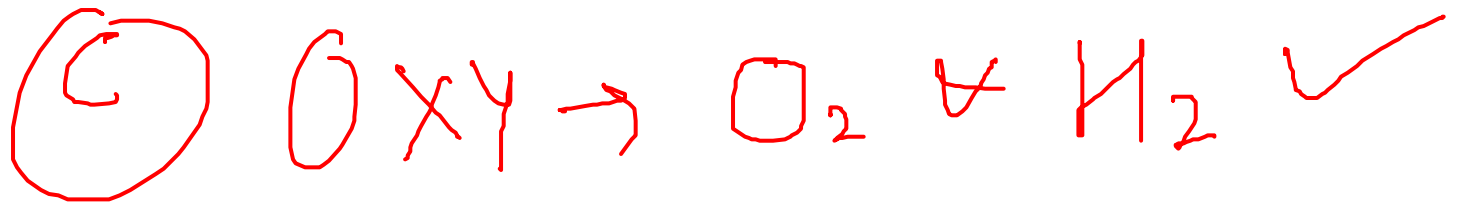
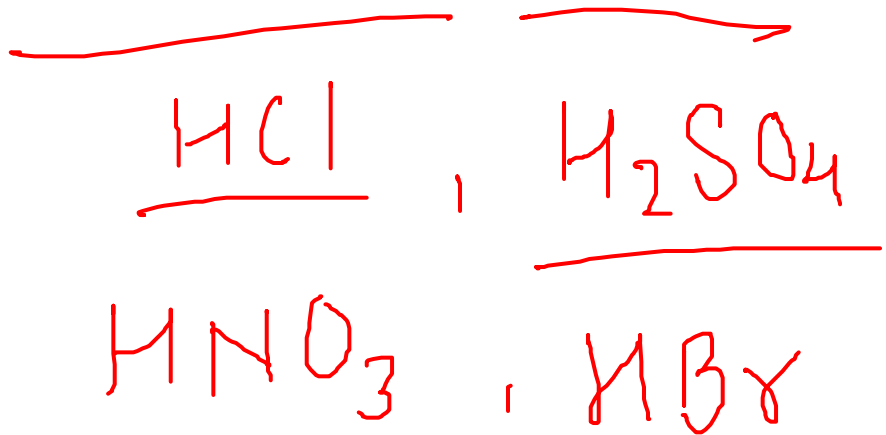
➤ On the basis of their concentration, acids are classified as :

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

(Impure)

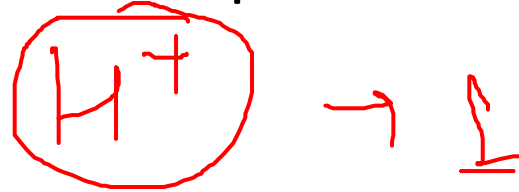
b. Concentrated acids: Have a high concentration of acids in aqueous solutions.

(Pure form)



➤ On the basis of number of hydrogen ion, acids can be classified as :

✓ Monoprotic acid – Such type of acid produces one mole of  $H^+$  ions per mole of acid, e.g., HCl, HNO<sub>3</sub>



✓ Diprotic acid – They can produce two moles of  $H^+$  ions per mole of acid, e.g., H<sub>2</sub>SO<sub>4</sub>.



✓ Triprotic acid – They produce three moles of  $H^+$  ions per mole of acid, e.g., H<sub>3</sub>PO<sub>4</sub>.



✓ Polyprotic – They can produce more than three  $H^+$  ions per mole of acid.



# ➤ Properties of Base:

– Produce hydroxide ions  $[OH^-]$  in  $H_2O$ .

Imp  
⇒  $[OH^-]$

– Water soluble bases are called alkalies.

Imp.

– Bitter Taste

– Turn Red Litmus blue.

R → B ✓

– Act as electrolytes in Solution.

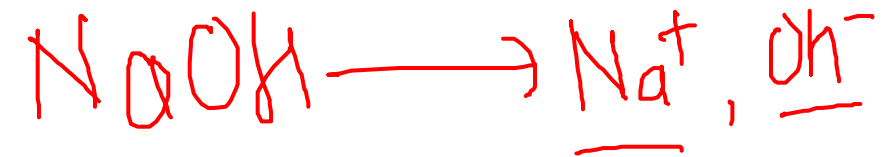
– Neutralize solutions containing  $H^+$  ions.

– Have a slippery, 'soapy' feel.

– Dissolve fatty material.

## ➤ 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).



b. Weak bases: Weak bases are those bases which do not completely dissociate into its ions in aqueous solutions. For example: ammonium hydroxide (NH<sub>4</sub>OH).





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

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

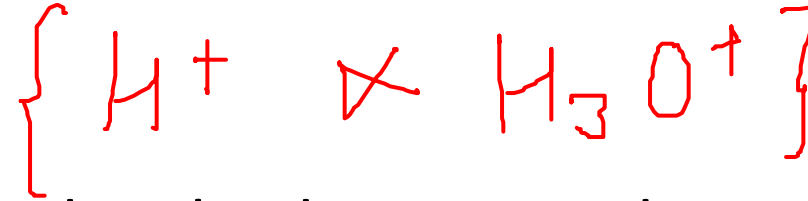
✓ ↳ Impure

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

↳ Pure

# • Arrhenius theory of acids and bases

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



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

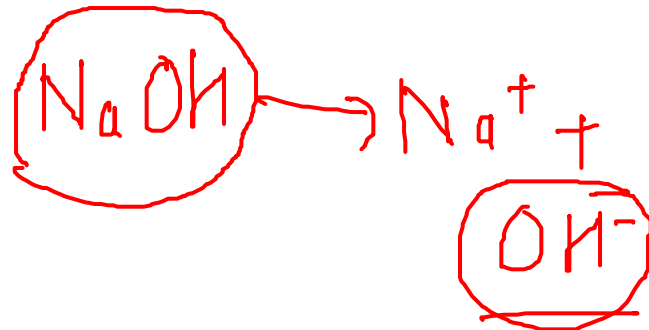
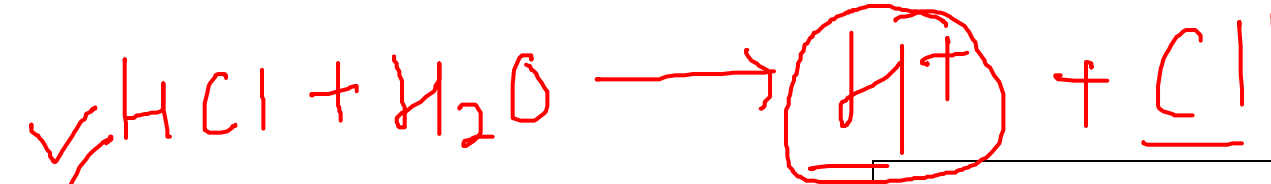
- Examples

## • 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.

✓  
 $H^+ \rightarrow$  Donor  $\rightarrow$  Acid

$H^+ \rightarrow$  Acceptor

## • Example

• In the reaction:  $HCl$  (aq) +  $NH_3$  (aq)  $\rightarrow$   $NH_4^+$  (aq) +  $Cl^-$  (aq)

•  $HCl$  – Bronsted acid and  $Cl^-$  : its conjugate acid

•  $NH_3$  – Bronsted base and  $NH_4^+$  : its conjugate acid

## • Physical test (m 2m<sup>2</sup>)

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 रंगद्रव्य (Dye) (indicators)

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

रंग

↓  
गंध

# • a) Litmus (Lichen ~~अम्ल~~). (Natural indicator)

In a neutral solution – purple ✓

In acidic solution – red ✓

In basic solution – blue ✓

Neutral → Acid ✓  
Base ✓

- Litmus is also available as strips of paper in two variants – red litmus and blue litmus. ✓



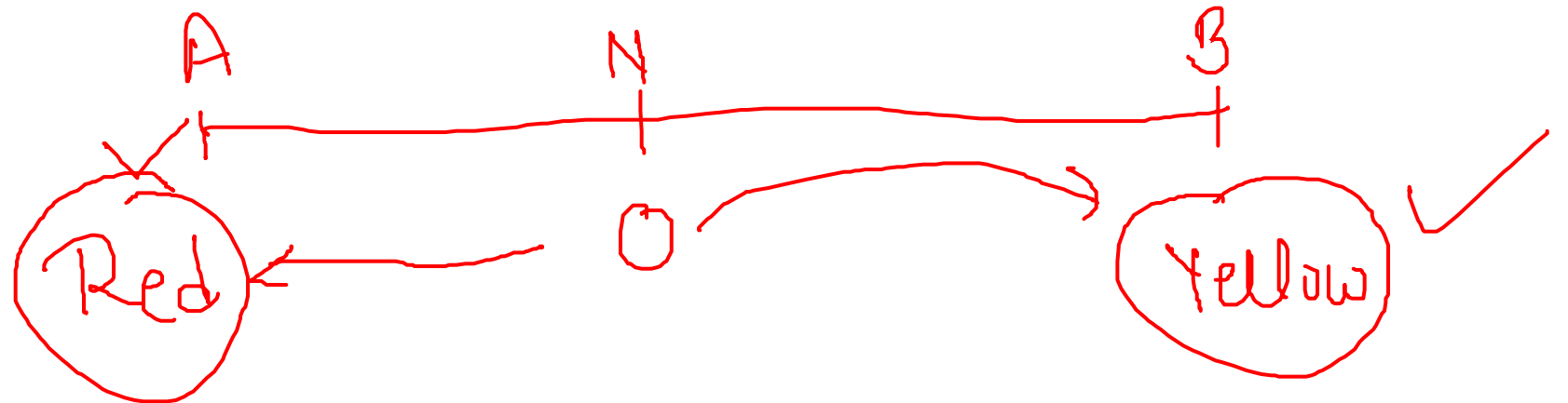
- An acid turns a moist blue litmus paper to red.
- A base turns a moist red litmus paper to blue.

## • 2 b) Methyl orange ✓

In a neutral solution – orange

In acidic solution – red ✓

In basic solution – yellow ✓



- **c) Phenolphthalein** (man made)

In a neutral solution – colourless

In acidic solution – remains colourless

In basic solution – pink

# Reactions of acids and bases ✓

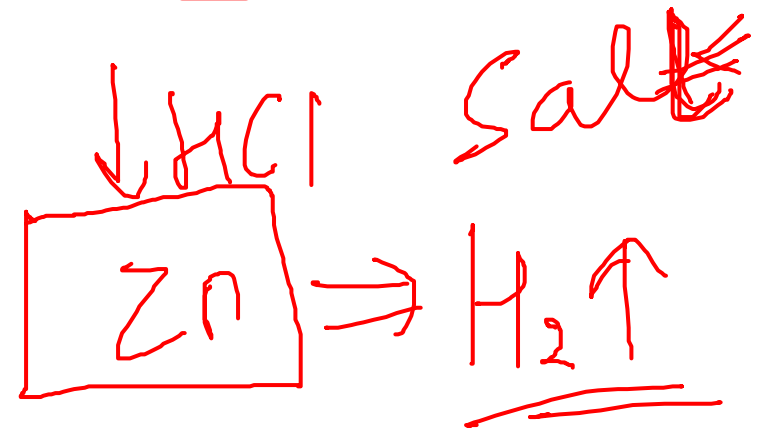
## a) Reaction of acids and bases with metals

Acid + active metal → salt + hydrogen + heat

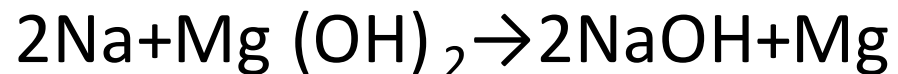


↓  
Salt

Base + metal → salt + hydrogen + heat



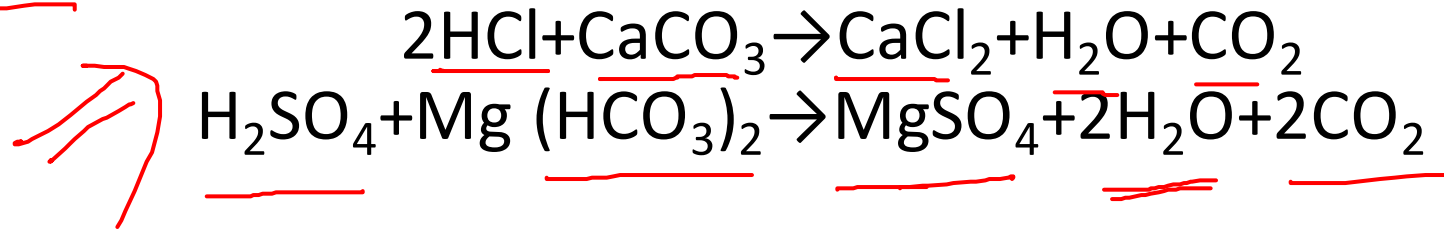
\* A more reactive metal displaces the less reactive metal from its base.





## b) Reaction of acids with metal carbonates and bicarbonates

Acid + metal carbonate or bicarbonate → salt + water + carbon dioxide.



- Effervescence indicates liberation of  $\text{CO}_2$  gas.

CO

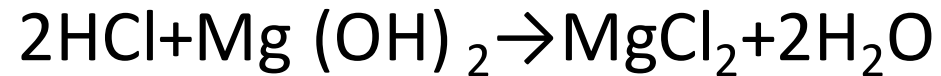
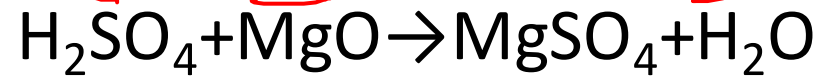
## c) Neutralisation reaction



### 1. Reaction of metal oxides and hydroxides with acids

Metal oxides or metal hydroxides are basic in nature. ~~is m imp~~

✓ Acid + base → salt + water + heat ✓



### 2. Reaction of non-metal oxides with bases

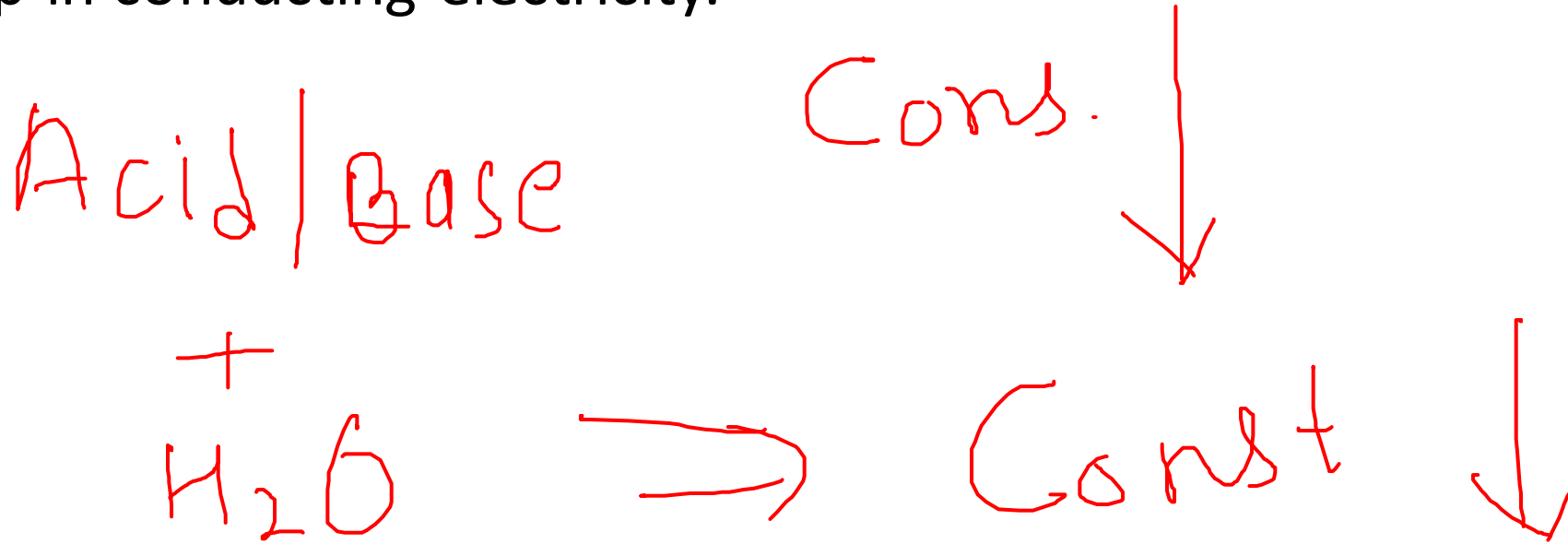
Non-metal oxides are acidic in nature

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



# • Acids and bases in water

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

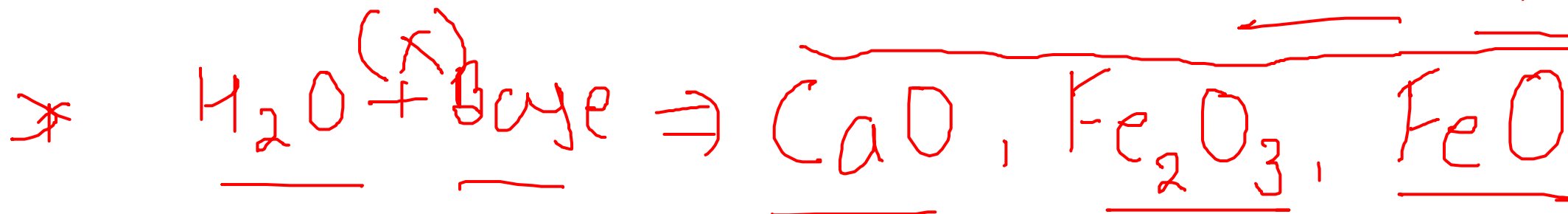
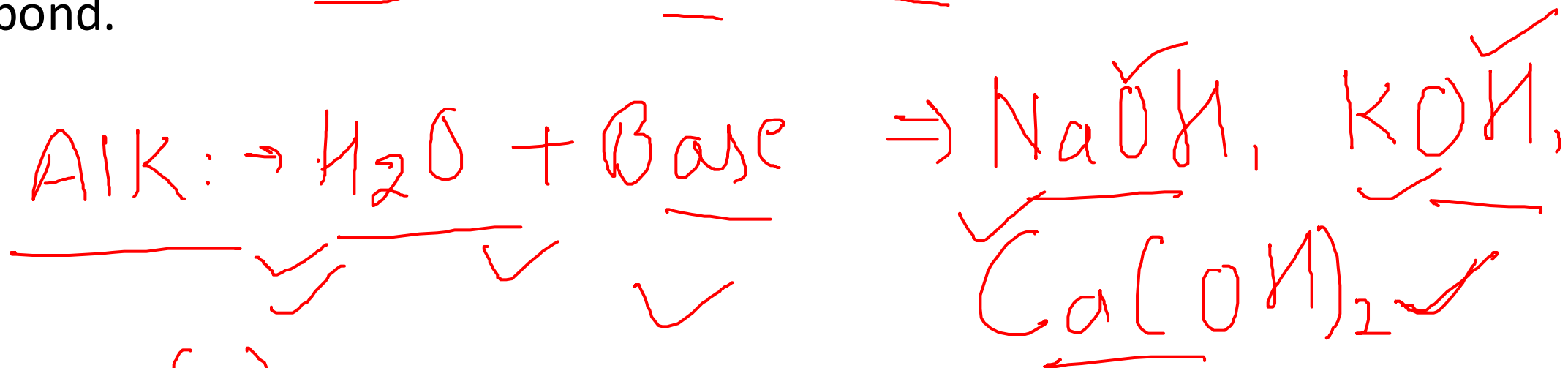


# Difference between a base and an alkali

- **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. *अम्ल*
- **Alkali –** 1. An alkali is an aqueous solution of a base, (mainly metallic hydroxides). ✓  
2. It dissolves in water and dissociates to give  $\text{OH}^-$  ion.  
3. All alkalis are bases, but not all bases are alkalis. *नहीं*

# • Hydronium ion imp.

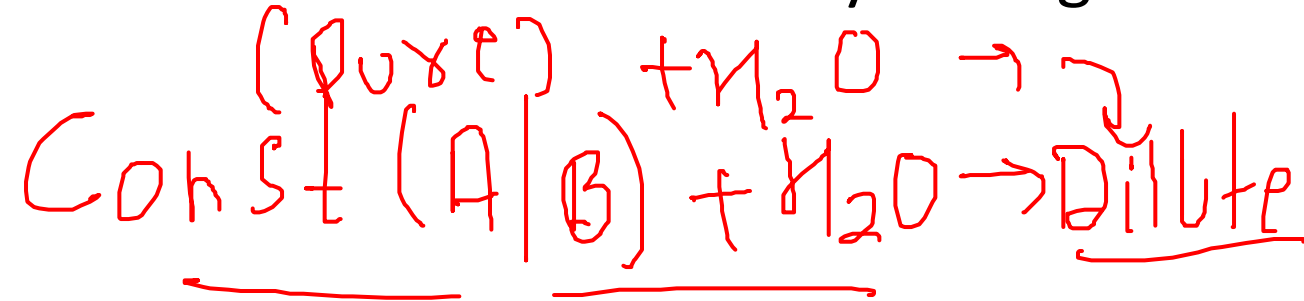
Hydronium ion is formed when a hydrogen ion accepts a lone pair of electrons from the oxygen atom of a water molecule, forming a coordinate covalent bond.



# • Dilution

Dilution is the process of reducing the concentration of a solution by adding more solvent (usually water) to it.

It is a highly exothermic process.



To dilute acid, the acid must be added to water and not the other way round.

Water  $\rightarrow$  Acid  $\checkmark$

Acid  $\rightarrow$  water (X)

# Strength of acids and bases

- **Strong acid or base:** When all molecules of a given amount of an acid or a base dissociate completely in water to furnish their respective ions,  $\text{H}^+(\text{aq})$  for acid and  $\text{OH}^-(\text{aq})$  for base).
- **Weak acid or base:** When only a few of the molecules of a given amount of an acid or a base dissociate in water to furnish their respective ions,  $\text{H}^+(\text{aq})$  for acid and  $\text{OH}^-(\text{aq})$  for Base.

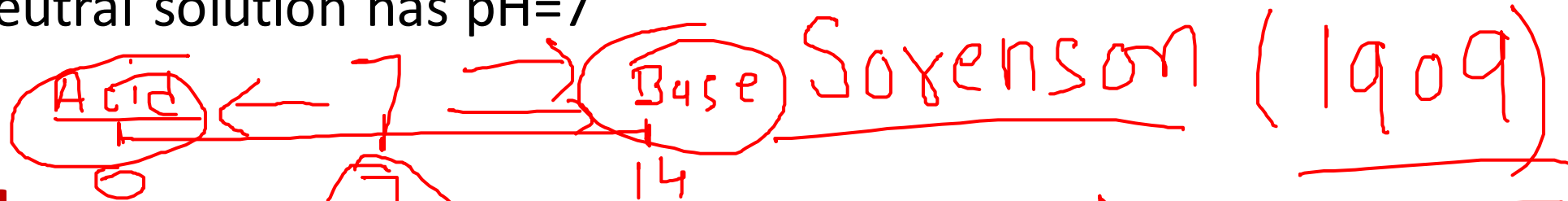
- **Dilute acid:** contains less number of  $\text{H}^+(\text{aq})$  ions per unit volume.
- **Concentrated acid:** contains more number of  $\text{H}^+(\text{aq})$  ions per unit volume.



- **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**

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

$$\Rightarrow \log_{10} \frac{1}{[H^+]}$$

$$pH = \frac{1}{[H^+]}$$

Acid  
Base ✓

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.

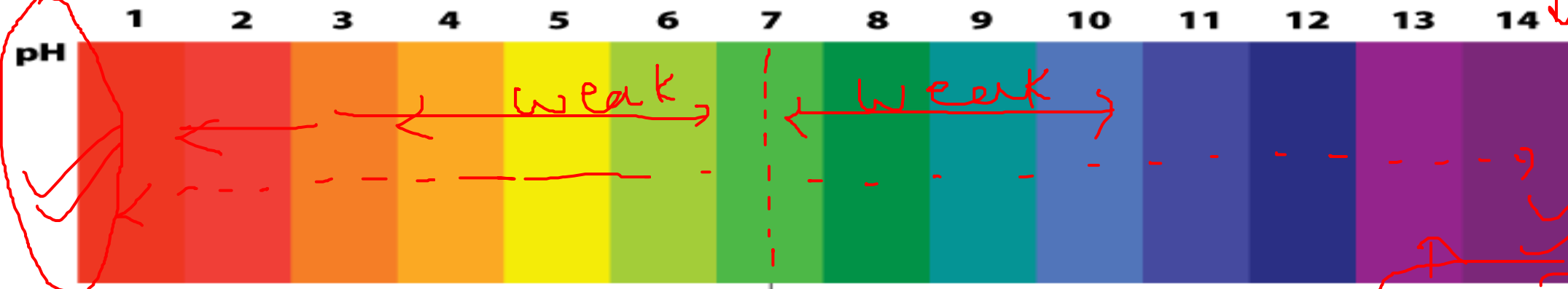
If pH < 7 – acidic solution ✓

If pH > 7 – basic solution ✓

Strongest acid

Strongest base

Base



very acidic ← slightly acidic | slightly alkaline → very alkaline

neutral

# 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.

← 6.5 → 7 ✓

3. pH in the digestive system The process of digestion happens at a specific pH in our stomach which is 1.5 – 4. ✓ HCl  
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.

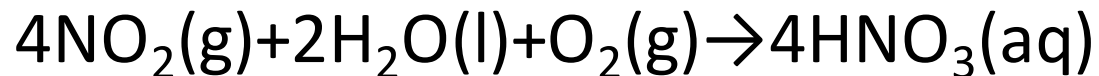
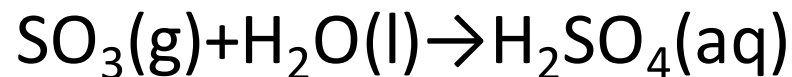
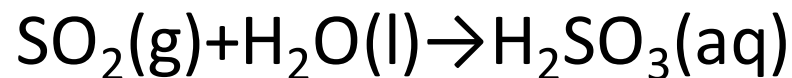
- **5. pH of self-defence by animals and plants** Acidic substances are used by animals and plants as a self-defence mechanism.

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

- These secreted acidic substances have a specific pH.

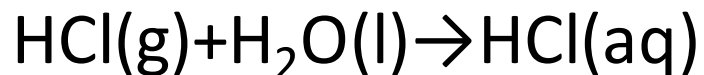
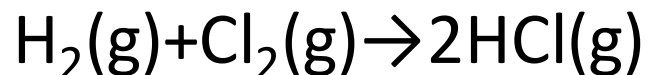
# Manufacture of Acids and Bases

- a) Non-metal oxide + water → acid

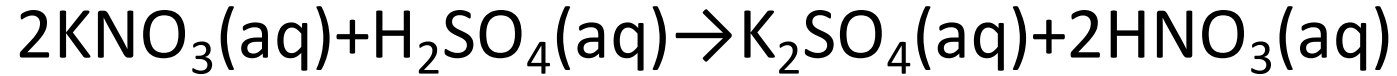
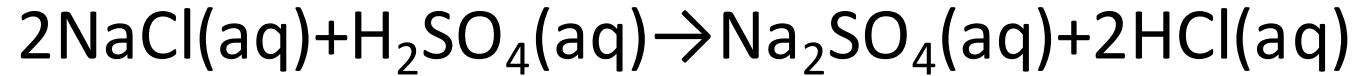


Non-metal oxides are thus referred to as acid anhydrides.

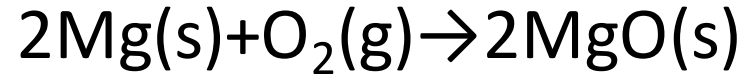
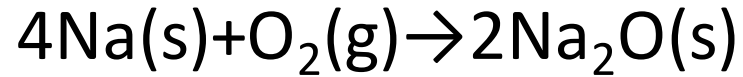
- b) Hydrogen + halogen → acid



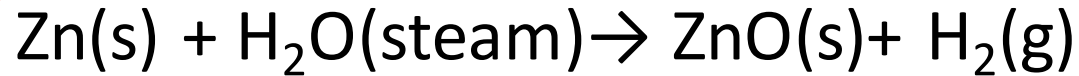
- **c) Metallic salt + conc. sulphuric acid → salt + more volatile acid**



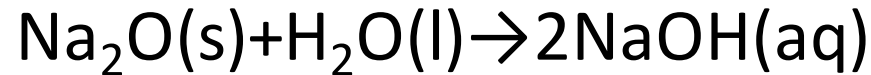
- **d) Metal + oxygen → metallic oxide (base)**



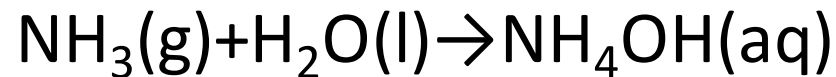
- **e) Metal + water → base or alkali + hydrogen**



- **f) Few metallic oxides + water → alkali**



- **g) Ammonia + water → ammonium hydroxide**

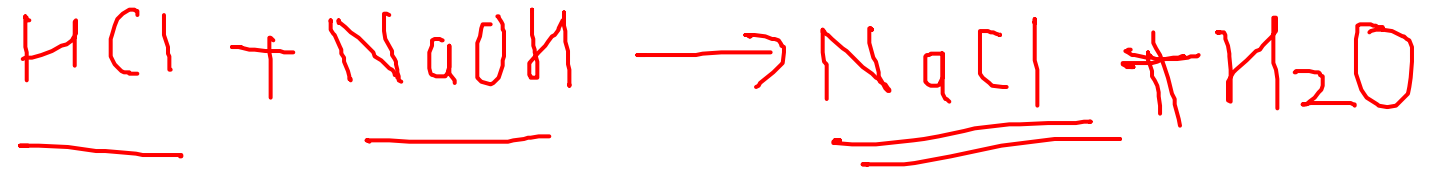


# Salts



- Salts: A salt is a combination of an anion of an acid and a cation of a base.  
Examples – KCl, NaNO<sub>3</sub>, CaSO<sub>4</sub>, etc. NaCl
- 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



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



- Sodium hydroxide

Chemical formula – NaOH

Also known as – caustic soda

**Preparation (Chlor-alkali process):**

Electrolysis of brine (solution of common salt, NaCl) is carried out.

At anode: Cl<sub>2</sub> is released

At cathode: H<sub>2</sub> is released

Sodium hydroxide remains in the solution.

- **Bleaching powder**

Chemical formula – Ca(OCl)Cl or CaOCl<sub>2</sub>

**Preparation** – Ca(OH)<sub>2</sub>(aq) + Cl<sub>2</sub>(g) → CaOCl<sub>2</sub>(aq) + H<sub>2</sub>O(l)

On interaction with water – bleaching powder releases chlorine which is responsible for bleaching action.

- Baking soda (on imp.)

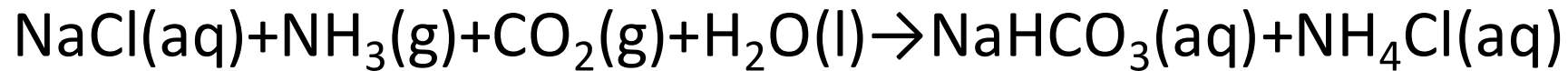
Chemical name – Sodium hydrogen carbonate

Chemical formula – NaHCO<sub>3</sub> ✓

**Preparation (Solvay process) – ✗**

a. Limestone is heated:  $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$

b.  $\text{CO}_2$  is passed through a concentrated solution of sodium chloride and ammonia:



- Uses:

1. Textile industry ✓

2. Paper industry ✓

3. Disinfectant ✓

# • Washing soda

Chemical name – Sodium ~~hydrogen~~ carbonate

Chemical formula – ~~NaHCO<sub>3</sub>~~



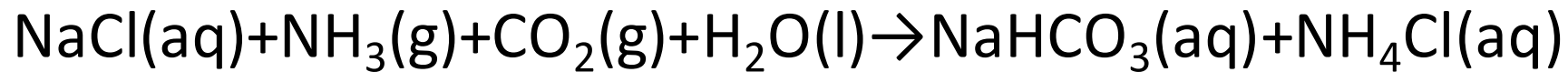
$\text{H}^+ = 16.5 \text{ ml/l}$

$\text{pH} = -\log_{10} \frac{1}{[\text{H}^+]}$

**Preparation (Solvay process) – x**

a. Limestone is heated:  $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$

b.  $\text{CO}_2$  is passed through a concentrated solution of sodium chloride and ammonia:

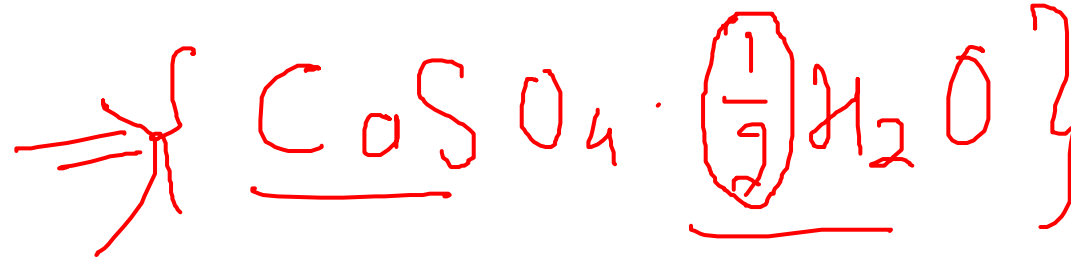


## • Uses

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

- **Crystals of salts** 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,  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  (s) on heating at  $100^\circ\text{C}$  (373K) gives  $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$  and  $3/2 \text{H}_2\text{O}$
- $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$  is plaster of paris.
- $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$  means two formula units of  $\text{CaSO}_4$  share one molecule of water.
- **Uses** – cast for healing fractures.

## ➤ [KEY POINTS] ⇒ Summarise

- Acid is a compound which yields hydrogen ion ( $H^+$ ), when dissolved in water.
- Acid is sour to the taste and corrosive in nature. The pH value for acids is less than 7.
- Generally, all acids readily react with metal to release hydrogen gas. For example, metal zinc reacts with hydrochloric acid to form zinc chloride and hydrogen gas.
- Acid react with limestone ( $CaCO_3$ ) to produce carbon dioxide. For example, hydrochloric acid reacts with limestone to produce carbonic acid and calcium chloride.

- Acid can be classified in organic and inorganic acids. Acetic acid ( $\text{CH}_3\text{COOH}$ ) is the best example of organic acid, while acid produced from minerals are termed as inorganic acids like sulfuric acid ( $\text{H}_2\text{SO}_4$ ), hydrochloric acid ( $\text{HCl}$ ).
- Acid converts blue litmus paper to red in color.
- Acids have tendency to corrode metal surface quickly.
- Acids and bases conduct electricity because they produce ions in water. There is a flow of electric current through the solution by ions.

- Indicators are those chemical substances which behave differently in acidic and basic medium and help in determining the chemical nature of the substance.
- Acid base indicators indicate the presence of an acid or a base by a change in their colour or smell.
- Indicators can be natural or synthetic.



Colour  $\rightarrow$  Indicator

**Olfactory indicators:** These are those indicators whose odour changes in acidic or basic medium.

**Onion :** Smell of onion diminishes in a base and remains as it is in an acid.

**Vanilla:** The odour of vanilla essence disappears when it is added to a base. The odour of vanilla essence persists when it is added to an acid.

**Turmeric:** In acids, yellow colour of turmeric remains yellow. In bases, yellow colour of turmeric turns red.

- Living organisms are pH sensitive. Human body works within a pH range of 7.0 to 7.8.
- Rain water with a pH less than 5.6 is called acid rain. This acid rain if it flows into river water makes the survival of aquatic life difficult.
- Plants also require a specific pH range of soil for their healthy growth.
- pH is also significant as it is used in self defence by animals and plants. Bees use acids in their sting. To neutralise the effect a mild base like baking soda can be used.
- Water of crystallisation: It is the fixed number of water molecules present in one formula unit of a salt.
- Phenolphthalein solution is colorless in acidic solution and turns methyl orange solution to red.

- Bases are compound which yields hydroxide ion ( $\text{OH}^-$ ), when dissolved in water.
- Bases are bitter to taste and corrosive in nature. They feel slippery and soapy.
- Bases are good conductor of electricity and show pH value more than 7.
- Bases react with oils and grease to form soap molecules.
- Bases convert red litmus paper to blue in color.
- Bases also have the tendency to corrode metal surface.

- A reaction between a base and a metal is similar as for acid to form salt and release hydrogen gas. But this reaction can only occur when a metal is strong enough to displace another metal from its parent constituent.



- Phenolphthalein solution turns pink in color in basic solution. Bases turn methyl orange to yellow.

Red cabbage juice which is purple in color changes to yellow in basic medium.

- A salt is defined as a compound formed by the complete or incomplete replacement of the hydrogen ion of an acid by a basic radical.
- A normal salt is formed by the **complete** replacement of the hydrogen ion of an acid by a basic radical whereas an **acid** salt is formed by the **incomplete** replacement of the hydrogen ion of an acid by a basic radical.
- Phenolphthalein solution turns pink in color in basic solution. Bases turn methyl orange to yellow.



- A normal salt is formed by the **complete** replacement of the hydrogen ion of an acid by a basic radical whereas an **acid** salt is formed by the **incomplete** replacement of the hydrogen ion of an acid by a basic radical.

48. Which of the following properties is true for a tooth paste? [2018-I]
- It is acidic
  - It is neutral
  - It is basic
  - It is made up of Calcium phosphate, the material of tooth enamel
49. Which one of the following gives the highest amount of hydrogen ions ( $\text{H}^+$ )? [2018-I]
- Sodium hydroxide solution
  - Milk of magnesia
  - Lemon juice
  - Gastric juice
50. Which one of the following reactions will give NO (nitric oxide) gas as one of the products? [2018-II]
- $3\text{Cu} + 8\text{HNO}_3 (\text{dilute}) \rightarrow$
  - $\text{Cu} + 4\text{HNO}_3 (\text{conc.}) \rightarrow$
  - $4\text{Zn} + 10\text{HNO}_3 (\text{dilute}) \rightarrow$
  - $\text{Zn} + 4\text{HNO}_3 (\text{conc.}) \rightarrow$
51. Which one of the following is a tribasic acid? [2018-II]
- Hydrochloric acid
  - Nitric acid
  - Sulphuric acid
  - Phosphoric acid
52. The solution of which one of the following will have pH less than 7? [2018-II]
- NaOH
  - KCl
  - $\text{FeCl}_3$
  - NaCl
53. Which one of the followings an oxidation-reduction reaction? [2018-II]
- $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
  - $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$
  - $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$
  - $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$
54. In which of the following pairs are the ions isoelectronic? [2019-I]
- $\text{Mg}^{2+}$ , Ar
  - $\text{Na}^+$ ,  $\text{O}^{2-}$
  - $\text{Al}^{3+}$ ,  $\text{Cl}^-$
  - $\text{K}^+$ , Ne
55. Which one of the following statements is NOT correct for the given reaction? [2019-I]
- $$\text{Fe(s)} + \text{CuSO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{Cu(s)}$$
- Iron is the reducing agent
  - The solution turns green in colour after the reaction
  - Copper is a more reactive metal than iron
  - The reaction is an example of a redox reaction
13. Which one among the following is not a property of salt? [2010-II]
- Salts have ordered packing arrangements called lattices
  - Salts have low melting points but high boiling points
  - Salts are brittle
  - Salts conduct electricity when dissolved in water or even in the molten state
14. Which among the following statements with regard to pH scale is/are correct? [2010-II]
- It is a logarithmic scale.
  - The scale is limited to 0-14 because the ionic product of water is about  $10^{-14}$
  - The lower the value of pH, the greater is the acidity of the solution.
- Select the correct answer using the code given below
- I and II only
  - I, II and III
  - I and III only
  - II only
15. An oxidising agent is a substance which [2010-II]
- increases the oxidation number of an element in a given substance
  - decreases the oxidation number of an element in a given substance
  - is oxidised itself in an oxidation reduction reaction
  - loses electrons in an oxidation-reduction reaction

20. In oxidation
1. Hydrogen is displaced from a substance.
  2. an electropositive element is added to or proportion of electropositive element increases in a substance.

[2011-II]

Select the correct answer using the code given below:

- (a) 1 only (b) 2 only  
(c) Both 1 and 2 (d) Neither 1 nor 2

21. Which of the following statements regarding oxidation and reduction are correct?

1. In oxidation, loss of electron takes place whereas in reduction, gain of electron takes place.
2. In oxidation, gain of electron takes place whereas in reduction, loss of electron takes place.
3. Oxidizing agent decreases the oxidation number but reducing agent increases the oxidation number.
4. Oxidizing agent increases the oxidation number but reducing agent reduces the oxidation number.

[2012-I]

Select the correct answer using the code given below :

Code :

- (a) 1 and 3 (b) 2 and 4  
(c) 2 and 3 (d) 1 and 4

22. Sometimes, indigestion is caused by the secretion of too much hydrochloric acid in the stomach. To ease the pain caused, a tablet can be taken that reacts to reduce the amount of acid present. Which one among the following would be *inappropriate* for a manufacturer to include as a major reactant in the tablet?

- (a)  $\text{CaCO}_3$  (b)  $\text{MgCO}_3$   
(c)  $\text{NaOH}$  (d)  $\text{Mg(OH)}_2$

32. **Statement I:** Very little hydrogen is produced when sulphuric acid is added to calcium.

**Statement II:** The salt that is produced, calcium sulphate, is insoluble.

33. The pH of the solution obtained by dissolving pure sodium chloride in water is

[2013-II]

- (a) acidic  
(b) basic  
(c) neutral  
(d) dependent on the amount of sodium chloride dissolved in water

34. Turmeric (Haldi) rapidly becomes colourless on addition of

[2013-II]

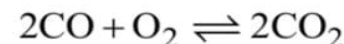
- (a) Baking soda (b) Vinegar  
(c) Lemon juice (d) Alcohol

35. Which of the following is/are amphoteric?

[2014-I]

- (a)  $\text{Al(OH)}_3$  (s) and  $\text{Fe(OH)}_3$  (s)  
(b)  $\text{Al(OH)}_3$  (s) and  $\text{HCO}_3^-$  (aq)  
(c)  $\text{Ba(OH)}_2$  (s) and  $\text{NaOH}$  (aq)  
(d)  $\text{Al(OH)}_3$  (s) only

36. Note the following balanced chemical equation: [2014-I]



Which one of the following statements is significant in relation to the above chemical equation?

- (a) One can add to a vessel only 2 mol of CO for each mol of  $\text{O}_2$  added  
(b) No matter how much of these two reagents are added to a vessel, 1 mol of  $\text{O}_2$  is consumed  
(c) When they react, CO reacts with  $\text{O}_2$  in a 2 : 1 mol ratio  
(d) When 2 mol of CO and 1 mol of  $\text{O}_2$  are placed in a vessel, they will react to give 1 mol of  $\text{CO}_2$



11. Arrange the following bases in increasing order of their, basic strength  
[2009-II]

1. Sodium hydroxide
2. Magnesium hydroxide
3. Aluminium hydroxide
4. Ammonium hydroxide

Select the correct answer using the code given below

**Codes:**

	A	B	C	D
(a)	4	2	1	3
(b)	4	1	2	3
(c)	4	3	2	1
(d)	1	2	3	4

12. The concentration of hydrochloric acid in a given solution is  $10^{-8}$  M. What is the value of pH for this solution ?

[2009-II]

- |         |                    |
|---------|--------------------|
| (a) 7   | (b) > 7 but not 14 |
| (c) < 7 | (d) 14             |

41. The cleaning action of soap and detergent in water is due to the formation of  
[2015-I]  
(a) Micelle (b) Salt  
(c) Base (d) Acid
42. Boric acid is an acid because its molecule:  
[2015-II]  
(a) accepts  $\text{OH}^-$  from water releasing proton  
(b) combines with proton from water molecule  
(c) contains replaceable  $\text{H}^+$  ion  
(d) gives up a proton
43. Which one of the following is a reduction reaction?  
[2016-I]  
(a)  $2\text{Mg(s)} + \text{O}_2\text{(g)} \longrightarrow 2\text{MgO(s)}$   
(b)  $\text{S(s)} + \text{O}_2\text{(g)} \longrightarrow \text{SO}_2\text{(g)}$   
(c)  $2\text{HgO(s)} \xrightarrow{\text{heat}} 2\text{Hg(l)} + \text{O}_2\text{(g)}$   
(d)  $\text{Mg(s)} + \text{S(s)} \longrightarrow \text{MgS(s)}$
44. Suppose you have four test tubes labelled as 'A', 'B', 'C', and 'D'. 'A' contains plain water, 'B' contains solution of an alkali, 'C' contains solution of an acid, and 'D' contains solution of sodium chloride. Which one of these solutions will turn phenolphthalein solution pink?  
[2016-I]  
(a) Solution 'A' (b) Solution 'B'  
(c) Solution 'C' (d) Solution 'D'
45. Which one of the following elements will **not** react with dilute HCl to produce  $\text{H}_2$ ?  
[2016-I]  
(a) Hg (b) Al  
(c) Mg (d) Fe
46. Which one of the following is a cause of acid rains?  
[2017-II]  
(a) Ozone (b) Ammonia  
(c) Sulphur dioxide (d) Carbon monoxide
47. The desirable range of pH for drinking water is  
[2017-II]  
(a) 6.5 to 8.5 (b) 5.0 to 6.5  
(c) 6.5 to 7.0 (d) 7.0 to 8.5

1. In surgery, metal pins are used for joining together broken bones. These metal pins remain uncorroded in the body. What is the material of these pins ?
- (a) Copper (b) Iron  
(c) Aluminium (d) Titanium [2006-II]
2. In a redox reaction,  $\text{Na}_2\text{S}_2\text{O}_3$  changes to  $\text{Na}_2\text{S}_4\text{O}_6$ . What is the equivalent weight of  $\text{Na}_2\text{S}_2\text{O}_3$  ?
- (a) Same as its molecular weight  
(b)  $1/2 \times$  (its molecular weight)  
(c)  $1/3 \times$  (its molecular weight)  
(d)  $1/4 \times$  (its molecular weight) [2006-II]
3. What is the correct order of oxidation states of sulphur in anions  $\text{SO}_3^{2-}$ ,  $\text{S}_2\text{O}_4^{2-}$  and  $\text{S}_2\text{O}_6^{2-}$  ?
- (a)  $\text{S}_2\text{O}_4^{2-} < \text{SO}_3^{2-} < \text{S}_2\text{O}_6^{2-}$   
(b)  $\text{S}_2\text{O}_6^{2-} < \text{S}_2\text{O}_4^{2-} < \text{SO}_3^{2-}$   
(c)  $\text{SO}_3^{2-} < \text{S}_2\text{O}_4^{2-} < \text{S}_2\text{O}_6^{2-}$   
(d)  $\text{S}_2\text{O}_4^{2-} < \text{S}_2\text{O}_6^{2-} < \text{SO}_3^{2-}$  [2007-II]

26. In  $\text{KMnO}_4$  molecule, the oxidation states of the elements Potassium (K), Manganese (Mn) and Oxygen (O) are respectively [2012-II]
- (a) +1, +5, -2 (b) +1, +7, -2  
(c) 0, 0, 0 (d) +1, +7, 0
27. Which one among the following is an electrochemical cell that **cannot** be charged ? [2012-II]
- (a) Electrolytic cell (b) Storage cell  
(c) Primary cell (d) Fuel cell
28. The pH of fresh milk is 6. When it turns sour, the pH [2013-I]
- (a) becomes  $< 6$   
(b) remains the same i.e., 6  
(c) becomes  $> 6$   
(d) becomes neutral, i.e., 7
29. The following questions consist of two statements, one labelled as the Assertion (A) and the other as 'Reason (R), You are to examine these two statements carefully and select the answers to these items using the codes given below:
- Assertion (A) :** Most coloured flowers when exposed to chlorine get bleached. [2006-I]
- Reason (R) :**  $\text{HCl}$  produced by the action of chlorine on water oxidises coloured matter to colourless compound.
- (a) Both A and R are individually true and R is the correct explanation of A  
(b) Both A and R are individually true but R is NOT the correct explanation of A  
(c) A is true but R is false  
(d) A is false but R is true



27. Which one among the following is an electrochemical cell that **cannot** be charged ? [2012-II]

- (a) Electrolytic cell                      (b) Storage cell  
(c) Primary cell                            (d) Fuel cell

28. The pH of fresh milk is 6. When it turns sour, the pH [2013-I]

(a) becomes  $< 6$   
(b) remains the same i.e., 6  
(c) becomes  $> 6$   
(d) becomes neutral, i.e., 7

29. The following questions consist of two statements, one labelled as the Assertion (A) and the other as 'Reason (R), You are to examine these two statements carefully and select the answers to these items using the codes given below:

- Assertion (A) :** Most coloured flowers when exposed to chlorine get bleached. [2006-I]

- Reason (R) :** HCl produced by the action of chlorine on water oxidises coloured matter to colourless compound.

- (a) Both A and R are individually true and R is the correct explanation of A
- (b) Both A and R are individually true but R is NOT the correct explanation of A
- (c) A is true but R is false
- (d) A is false but R is true

4. Which one of the following salts when dissolved in water makes the solution basic?
- (a) Sodium chloride                      (b) Copper sulphate  
(c) Ferric chloride                      (d) Sodium acetate [2007-II]
5. Which one of the following is correct?  
Due to continuous use of calcium superphosphates as fertilizer in soil, the pH of soil becomes
- (a) more than 7                      (b) less than 7  
(c) equal to 7                      (d) Cannot be predicted  
[2007-II]
6. Which of the following salts are insoluble in water ?
- (a) Chlorides of Fe and Mn  
(b) Nitrates of Ag and Pb  
(c) Carbonates of Pb and Cu  
(d) Phosphates of Na and  $\text{NH}_4$  [2008-I]
7. Consider the following:  
The concentration of hydrogen ions in an aqueous solution is expressed by its
1. pH                      2. pOH  
3.  $\text{pK}_a$                       4.  $\text{pK}_w$

38. The burning sensation of bee sting can be stopped by rubbing the affected area with soap. This is because

[2014-II]

- (a) a bee sting is acidic and soap, an alkali, neutralizes it
- (b) a bee sting is alkaline and soap, an acid, neutralizes it
- (c) soap cleans the affected area and removes the sting
- (d) soap acts as an anesthetic and dulls the sensation

39. Which of the following element combinations will form ionic compounds?

[2014-II]

- 1. Ca ( $Z = 20$ ) and Ti ( $Z = 22$ )
- 2. Si ( $Z = 14$ ) and Br ( $Z = 35$ )
- 3. Mg ( $Z = 12$ ) and Cl ( $Z = 17$ )

Select the correct answer using the code given below.

- (a) 2 only
- (b) 3 only
- (c) 2 and 3 only
- (d) 1, 2 and 3

40. Match List I with List II and select the correct answer using the code given below the Lists :

[2015-I]

**DIRECTIONS (Qs. 30-31) :** *This question consist of two statements, Statement I and Statement II. You are to examine these two statements carefully and select the answer to these items using the codes given below.*

---

(a) Both the statements individually true and Statement II is the correct explanation of Statement I. 37

(b) Both the statements are individually true but Statement II is not correct explanation of Statement I.

(c) Statement I is true but Statement II is false.

(d) Statement I is false but Statement II is true.

30. **Statement I :** Metal ions are Lewis acids. 38

**Statement II :** Metal ions are electron pair acceptors.

[2011-II]

31. **Statement I :** After cutting an apple or a banana, the colour of the cut surface becomes brown.

**Statement II :** Polyphenolic compounds present in fruits get oxidized in air and show colour. [2012-I]

16. Neutral water with pH about 7 becomes slightly acidic when aerated. This is because *[2010-II]*
- (a) oxygen from air is dissolved in the water which makes the water acidic
  - (b) dirt, which get contaminated with the water during aeration makes the water acidic
  - (c) ultraviolet radiation dissociates water molecules and makes water acidic
  - (d) carbon-dioxide from air is dissolved
17. In the reaction  $4\text{Fe} + 3\text{O}_2 \rightarrow 4\text{Fe}^{3+} + 6\text{O}^{2-}$  *[2010-II]*
- Which of the following statements is incorrect?
- (a) It is a redox reaction
  - (b) Metallic iron acts as a reducing agent
  - (c)  $\text{O}_2$  acts as an oxidising agent
  - (d) Metallic iron is reduced to  $\text{Fe}^{3+}$
18. Human stomach produces acid 'X' which helps in digestion of food. Acid 'X' is *[2011-I]*
- (a) acetic acid
  - (b) methanoic acid
  - (c) hydrochloric acid
  - (d) citric acid
19. Bases turn red litmus blue and acids turn blue litmus red. A student tested a liquid with a red litmus paper and it stayed red with no change. This shows that the liquid *[2011-II]*
- (a) must be pure water
  - (b) must be an acid
  - (c) is not a base
  - (d) is neither a base nor an acid

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