Acid Base and Salts

ACIDS

1. ACIDS-THE TERM

- THE TERM-'acid' is derived from the latin word meaning 'sour'
- ACIDS ARE DERIVED FROM –both minerals as well as plants.
- ACIDS DERIVED FROM MINERALS – are called 'inorganic' or 'mineral acids' e.g. hydrochloric acid, sulphuric acid, nitric acid.
- ACIDS DERIVED FROM PLANTS –are called organic acids e.g. citric acid, tartaric acid.

2. ACIDS- OCCURRENCE [Source]

Oranges & Lemons	**Grapes**	**Apples**	**Rancid butter**	**Vinegar**
CITRIC ACID	TARTATIC ACID	MALLIC ACID	BUTYRIC ACID	ACETIC ACID
Sour milk	**Wasps & white ants**	**Common salt**	**Metallic sulphate**	**Nitre**
LACTIC ACID	FORMIC ACID	HYDROCHLORIC ACID	SULPHURIC ACID	NITRIC ACID

3. CLASSIFICATIONOF ACIDS

Acids dissociate in aqueous solutions – to give hydrogen ions [H^+]

Based on this dissociation, acids are classified in terms of their strength and basicity.

- STRENGTH OF ACIDS- depends on the – 'concentration of hydrogen ions' in solution.
- BASICITY OF ACIDS – depends on the – 'number of hydrogen ions' in solution.

CLASSIFICATION	DISSOCIATION IN AQUEOUS SOLUTION	EXAMPLE
STRENGTH OF ACIDS		
• Strong acid	Dissociate completely to give a – high conc. of H^+ ions.	HCl
• Weak acid	Dissociate partially to give a – low conc. of H^+ ions.	H_2CO_3
BASICITY OF ACIDS		
• Monobasic acid	Dissociate to give - one H^+ ion per molecule of the acid.	HCl
• Dibasic acid	Dissociate to give - two H^+ ions per molecule of the acid.	H_2SO_4
• Tribasic acid	Dissociate to give – three H^+ ions per molecule of the acid.	H_3PO_4

4. PROPERTIES OF ACIDS

Taste **Corrosive nature** **Electrical conductivity** **Indicator properties**	• Acids – are sour in taste • Strong acids – are highly corrosive in nature. • Weak acids – are less corrosive and harmless. • Strong acids – are generally good conductors of electricity. • Weak acids – are poor conductors of electricity.

Indicator	Colour change in acid medium
Litmus solution	Blue to red
Methyl orange	Orange to pink
Phenolphthalein	Colourless remains colourless.

CHEMICAL PROPERTIES OF ACIDS

1. Acids [dilute] – react with bases to give – salt and water only [neutralization reaction].

Base **[oxide]**		***Acid***		***Salt***		***Water***
CuO [copper oxide]	+	**H_2SO_4** [sulphuric acid]	→	**$CuSO_4$** [copper sulphate]	+	**H_2O**
Base **[hydroxide]**		***Acid***		***Salt***		***Water***
NaOH [sodium hydroxide]	+	**HCl** [hydrochloric acid]	→	**NaCl** [sodium chloride]	+	**H_2O**

2. Acids [dilute] – react with active metals to liberate – hydrogen gas.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

3. Acids [dilute] – react with metallic carbonates and bicarbonates to liberate- carbon dioxide gas.

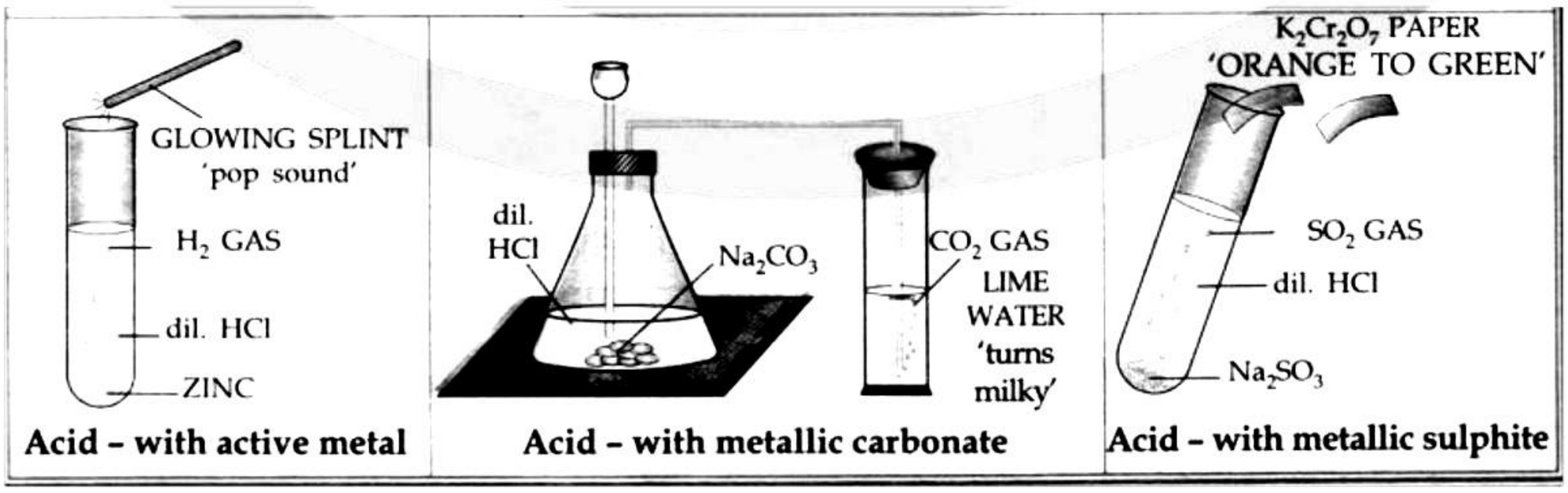
$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

4. Acids [dilute] – react with metallic sulphites and bisulphites to liberate- sulphur dioxide gas.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + SO_2$$

5. Acids [dilute] – react with metallic sulphides to liberate- hydrogen sulphide gas.

$$ZnS + H_2SO_4 \rightarrow ZnSO_4 + H_2S$$



Acid – with active metal | **Acid – with metallic carbonate** | **Acid – with metallic sulphite**

7. USES OF ACIDS-HYDROCHLORIC, NITRIC AND SULPHURIC ACIDS

	HCl	**HNO_3**	H_2SO_4
INDUSTRIAL USES- • Manufacture of	• Dyes and drugs • Silver chloride • Glucose	• Dyes, drugs &perfumes • Nitrates • Fertilizers & explosives	• Dyes, drugs & paints • Hydrochloric & nitric acid • Fertilizers & explosives
GENERAL USES- • Preparation of	• Gases- SO_2, CO_2 and H_2S	• Aqua regia-which is 1 part of conc. HNO_3 + 3 parts of conc. HCl	• **Gases-** H_2, CO, CO_2, CO_2 & H_2S
• Metallurgy	• In cleaning metal surfaces- before galvanizing	• For etching simple designs - on copper and brassware	• In cleaning metal surfaces – before galvanizing

8. USES OF OTHER ACIDS

Acid	**Uses**
1. CITRIC ACID **2. ACETIC ACID** **3. TARTARIC ACID** **4. BORIC ACID** **5. CARBONIC ACID** **6. OXALIC ACID**	• As a food preservative •As a source of vitamin C [citrus fruits] • As a food preservative •In flavouring and cooking[vinegar] • In the preparation of baking powder • As an eye wash • In flavouring drinks • For removing ink stains

BASES

1. BASES – THE TERM

- **THE TERM-** 'Bases' are oxides or hydroxides of metals. [including ammonium hydroxide]
- **BASES ARE COMPOUNDS** – which react with acids to give salt and water

NaOH	+	HCl	→	NaCl	+	H_2O
[base]		[acid]		[salt]		[water]

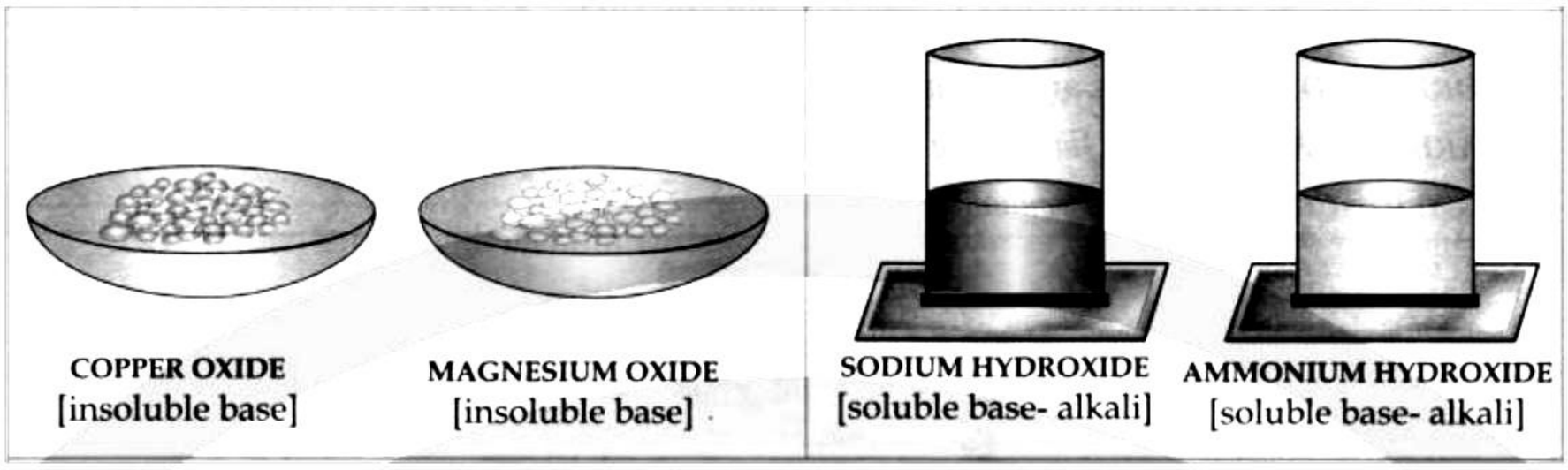
2. ALKALIS

THE TERM –'Alkalis' are bases which are soluble in water
ALL ALKALIS ARE BASES – but all bases are not alkalis
Since certain bases are insoluble in water.

EXAMPLE OF BASES AND ALKALIS

Bases [insoluble in water]	**Alkalis** [bases soluble in water]
OXIDES OF METALS •CuO • MgO • PbO	OXIDES OF METALS • K_2O • Na_2O

HYDROXIDES OF METALS	HYDROXIDES OF METALS
• $Fe(OH)_2$ • $Pb(OH)_2$ • $Al(OH)_3$	•NaOH • KOH • NH_4OH



COPPER OXIDE [insoluble base]

MAGNESIUM OXIDE [insoluble base]

SODIUM HYDROXIDE [soluble base- alkali]

AMMONIUM HYDROXIDE [soluble base- alkali]

3. CLASSIFICTION OF BASES [ALKALIS]

Bases dissociate in aqueous solutions- to give hydroxyl ions [OH^-]

Based on this dissociation, bases are classified in terms of their strength and acidity.

- STRENGTH OF BASES – depends on the – 'concentration of hydroxyl ions' in solution.
- ACIDITY OF BASES- depends on the –'number of hydroxyl ions' in solution.

CLASSIFICATION	DISSOCIATION IN AQUEOUS SOLUTION	EXAMPLE
STRENGTH OF BASES		
• Strong alkali	Dissociate completely to give a - high conc. of OH^- ions.	KOH
• Weak alkali	Dissociate partially to give a - low conc. of OH^- ions.	NH_4OH
ACIDITY OF BASES		
• Monoacidic base	Dissociate to give – one OH^- ion per molecule of the base.	NaOH
• Diacidic base	Dissociate to give – two OH^- ions per molecule of the base.	$Ca(OH)_2$
• Triacidic base	Dissociate to give – three OH^- ions per molecule of the base.	$Fe(OH)_3$ [insoluble]

5. PREPARATION OF BASES

METHOD						BASE FORMED	
DIRECT COMBINATION							
• *combination of* metal and oxygen	**4Na** **Metal**	+	**O_2** **Oxygen**	→		**$2Na_2O$**	
DISSOLUTION IN WATER							
• *dissolution of* basic oxides in water	**Na_2O** **Basic oxide**	+	**H_2O** **Water**	→		**2NaOH**	
• *dissolution of* active metals in water	**2Na** **Active metal**	+	**$2H_2O$** **Water**	→		**2NaOH**	**+ H_2**
PRECIPITATION METHOD							
• *reaction of* aq. salt soln. & strong base	**$AlCl_3$** **Salt** [soln.]	+	**3NaOH** **Base**	→		**$Al(OH)_3$ ↓** **Precipitate**	**+ 3NaCl**

PROPERTIES OF BASES :

Taste	•Bases – are bitter in taste
Corrosive nature	•Strong bases [caustic alkalis] – are highly corrosive in nature. •Weak bases – are less corrosive
Electrical conductivity	•Strong alkalis – are generally good conductors of electricity •Weak alkalis – are poor conductors of electricity
Indicator properties	**Indicator** / **Colour change in alkali medium** Litmus solution – Red to blue Methyl orange – Orange to yellow Phenolphthalein – Colourless to pink

CHEMICAL PROPERTIES OF BASES

1. Bases — react with acids to give - salt and water only [neutralization reaction].

***Base* [oxide]**		***Acid***		***Salt***		***Water***
CuO **[copper oxide]**	**+**	**H_2SO_4** **[sulphuric acid]**	**→**	**$CuSO_4$** **[copper sulphate]**	**+**	**H_2O**
***Base* [hydroxide]**		***Acid***		***Salt***		***Water***
NaOH **[sodium hydroxide]**	**+**	**HCl** **[hydrochloric acid]**	**→**	**NaCl** **[sodium chloride]**	**+**	**H_2O**

2. **Alkalis –react with ammonium salts to liberate – ammonia gas.**

NH_4Cl + NaOH → NaCl + H_2O + NH_3

[ammonium chloride] [ammonia]

3. **Alkalis — react with salt solutions to give – precipitates of insoluble metallic hydroxides.**

$CuSO_4$ + 2NaOH → Na_2SO_4 + $Cu(OH)_2\downarrow$

[copper sulphate] [copper hydroxide - blue ppl.]

SALT - The Term –

- NEUTRALIZATION REACTION INVOLVES -
  A reaction of a base with an acid to give - salt and water only.
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- REPLACEMENT OF H^+ ION OF THE ACID -
  The hydrogen ion $1H^+J$ aq. of the acid is replaced by the - metal atom (Na^+) of the base - forming a salt - NaCl.

- A SALT - is a compound formed by partial or complete replacement of the hydrogen ion [H^+] of an acid - by a metal [basic radical].

2. IMPORTANT TYPES OF SALTS

NORMAL SALT	Formed by – ***complete*** replacement of the – ***hydrogen ion*** of an ***acid*** by a ***metal.***	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ **Normal salt**
ACID SALT	Formed by – ***partial*** replacement of the – ***hydrogen ion*** of an ***acid*** by a ***metal.***	$NaOH + H_2SO_4 \rightarrow NaHSO_4 + H_2O$ **Acid salt**
BASIC SALT	Formed by – ***incomplete*** neutralization of a – ***base*** with an ***acid.***	$Zn(OH)_2 + HCl \rightarrow Zn(OH)Cl + H_2O$ **Basic salt**
HYDRATED SALT	A salt which contains a – ***definite number*** of ***water molecules*** – as ***water of crystallization.***	Copper sulphate $CuSO_4 \cdot 5H_2O$ Sodium carbonate $Na_2CO_3 \cdot 10H_2O$

3. PREPARATION OF SOLUBLE SALTS –general methods

ACTION OF ACID ON-

1. Active metals 2. Metallic oxides 3. Metallic carbonates 4. Metallic hydroxides

REACTANT			ACID [DIL.]		SOLUBLE SALT		
ACTIVE METAL							
Zinc	Zn	+	H_2SO_4	→	$ZnSO_4$	+	H_2
Iron	Fe	+	H_2SO_4	→	$FeSO_4$	+	H_2
METAL OXIDE							
Copper oxide	CuO	+	H_2SO_4	→	$CuSO_4$	+	H_2O
Lead oxide	PbO	+	$2HNO_3$	→	$Pb(NO_3)_2$	+	H_2O
METAL CARBONATE							
Magnesium carbonate	$MgCO_3$	+	H_2SO_4	→	$MgSO_4$	+	$H_2O + CO_2$
Lead carbonate	$PbCO_3$	+	$2HNO_3$	→	$Pb(NO_3)_2$	+	$H_2O + CO_2$
METAL HYDROXIDE							
Sodium hydroxide [soluble]	$2NaOH$	+	H_2SO_4	→	Na_2SO_4	+	$2H_2O$
Copper hydroxide [insoluble]	$Cu(OH)_2$	+	H_2SO_4	→	$CuSO_4$	+	$2H_2O$

4. PREPARATION OF INSOLUBLE SALTS – General methods

A. PRECIPITATION

By double decomposition of two salt solutions

SALT SOLUTION I		SALT SOLUTION II		SOLUBLE SALT		INSOLUBLE SALT [PRECIPITATED]
$Pb(NO_3)_2$ Lead nitrate	+	$2NaCl$ Sodium chloride	→	$2NaNO_3$	+	$PbCl_2 \downarrow$ Lead chloride
$CaCl_2$ Calcium chloride	+	Na_2CO_3 Sodium carbonate	→	$2NaCl$	+	$CaCO_3 \downarrow$ Calcium carbonate

B. DIRECT COMBINATION OR SYNTHESIS

METAL		NON-METAL		INSOLUBLE SALT
Zn **Zinc**	**+**	**S** **Sulphur**	**$\xrightarrow{\Delta}$**	**ZnS** **Zinc sulphide**
Fe **Iron**	**+**	**S** **Sulphur**	**$\xrightarrow{\Delta}$**	**FeS** **Iron [II] sulphide**

6. USES OF SOME SALTS

SALT	USES
• SODIUM CHLORIDE • SODIUM CARBONATE • COPPER SULPHATE • AMMONIUM NITRATE	• Cooking food preservative, manufacture of chlorine • Manufacture of –glass, detergents • Electroplating and fungicide • Fertilizers