

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	TARTARIC ACID	MALIC 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. CLASSIFICATION OF 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 <ul style="list-style-type: none">• Strong acid• Weak acid	Dissociate completely to give a – high conc. of H^+ ions. Dissociate partially to give a – low conc. of H^+ ions.	HCl H_2CO_3
BASICITY OF ACIDS <ul style="list-style-type: none">• Monobasic acid• Dibasic acid• Tribasic acid	Dissociate to give - one H^+ ion per molecule of the acid. Dissociate to give - two H^+ ions per molecule of the acid. Dissociate to give – three H^+ ions per molecule of the acid.	HCl H_2SO_4 H_3PO_4

4. PROPERTIES OF ACIDS

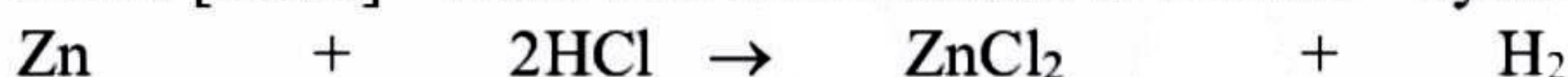
Taste	•Acids – are sour in taste								
Corrosive nature	•Strong acids – are highly corrosive in nature.								
	•Weak acids – are less corrosive and harmless.								
Electrical conductivity	•Strong acids – are generally good conductors of electricity.								
	•Weak acids – are poor conductors of electricity.								
Indicator properties	<table border="1"> <thead> <tr> <th>Indicator</th><th>Colour change in acid medium</th></tr> </thead> <tbody> <tr> <td>Litmus solution</td><td>Blue to red</td></tr> <tr> <td>Methyl orange</td><td>Orange to pink</td></tr> <tr> <td>Phenolphthalein</td><td>Colourless remains colourless.</td></tr> </tbody> </table>	Indicator	Colour change in acid medium	Litmus solution	Blue to red	Methyl orange	Orange to pink	Phenolphthalein	Colourless remains colourless.
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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 ₂ SO ₄ [sulphuric acid]	→	CuSO ₄ [copper sulphate]	+	H ₂ O
Base [hydroxide]		Acid		Salt		Water
NaOH [sodium hydroxide]	+	HCl [hydrochloric acid]	→	NaCl [sodium chloride]	+	H ₂ O

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



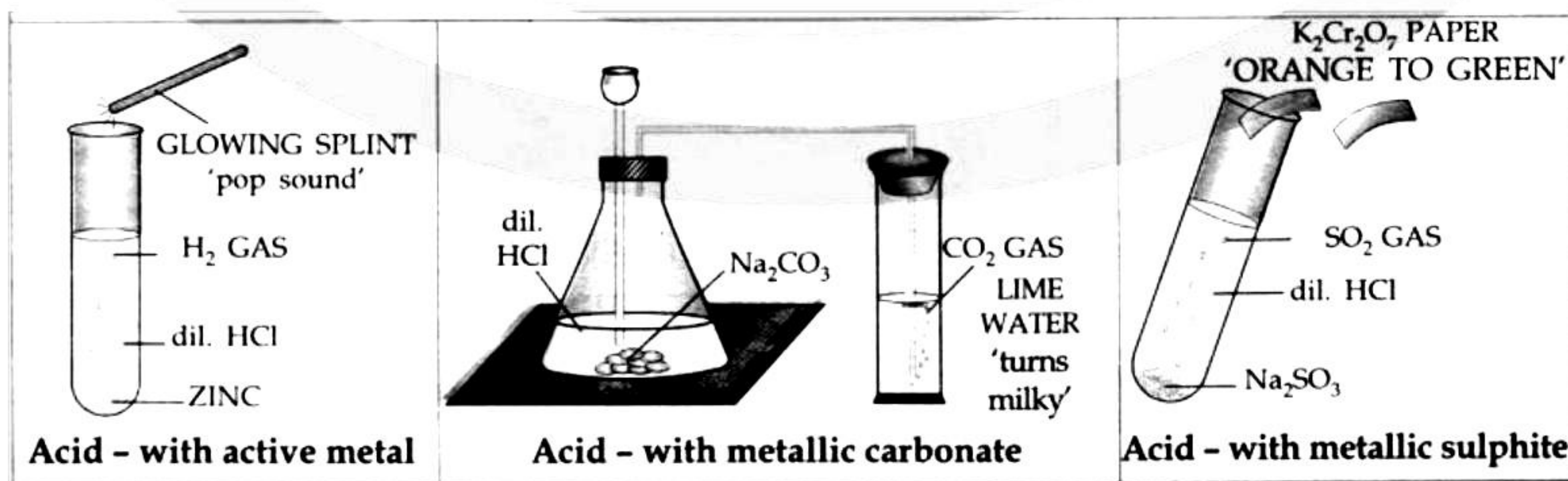
3. **Acids [dilute]** – react with metallic carbonates and bicarbonates to liberate- carbon dioxide gas.



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



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



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

	HCl	HNO ₃	H ₂ SO 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 ₂ S	• Aqua regia-which is 1 part of conc. HNO ₃ + 3 parts of conc. HCl	• Gases- H ₂ , CO, CO ₂ , CO ₂ & H ₂ S
• Metallurgy	• In cleaning metal surfaces- before galvanizing	• For etching simple designs - on copper and brassware	• In cleaning metal surfaces – before galvanizing

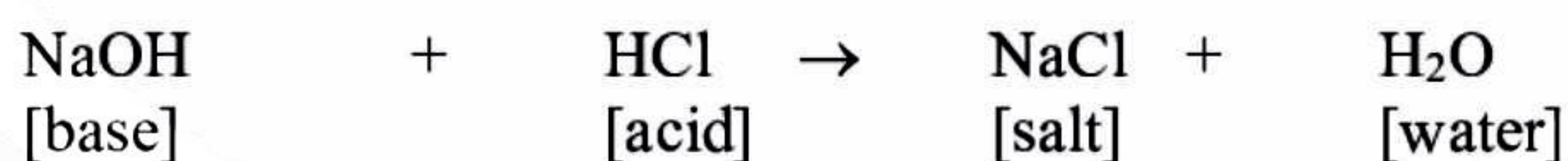
8. USES OF OTHER ACIDS

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

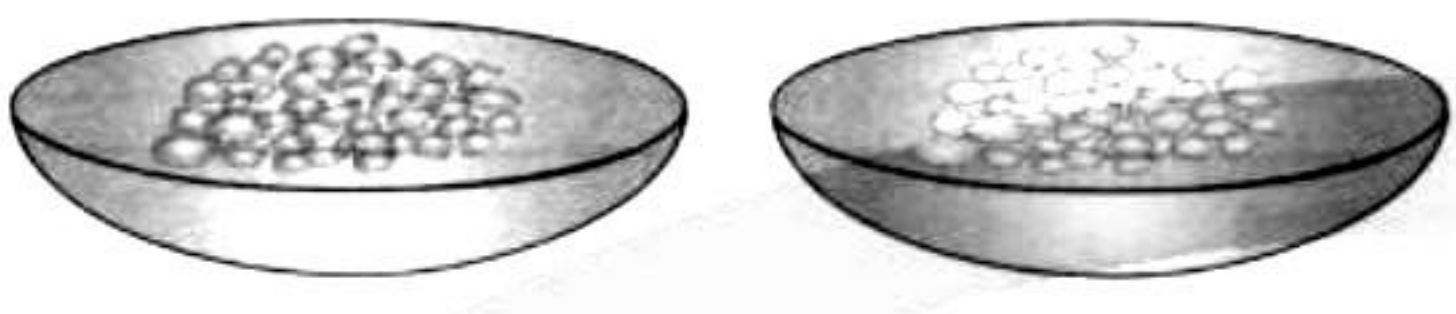
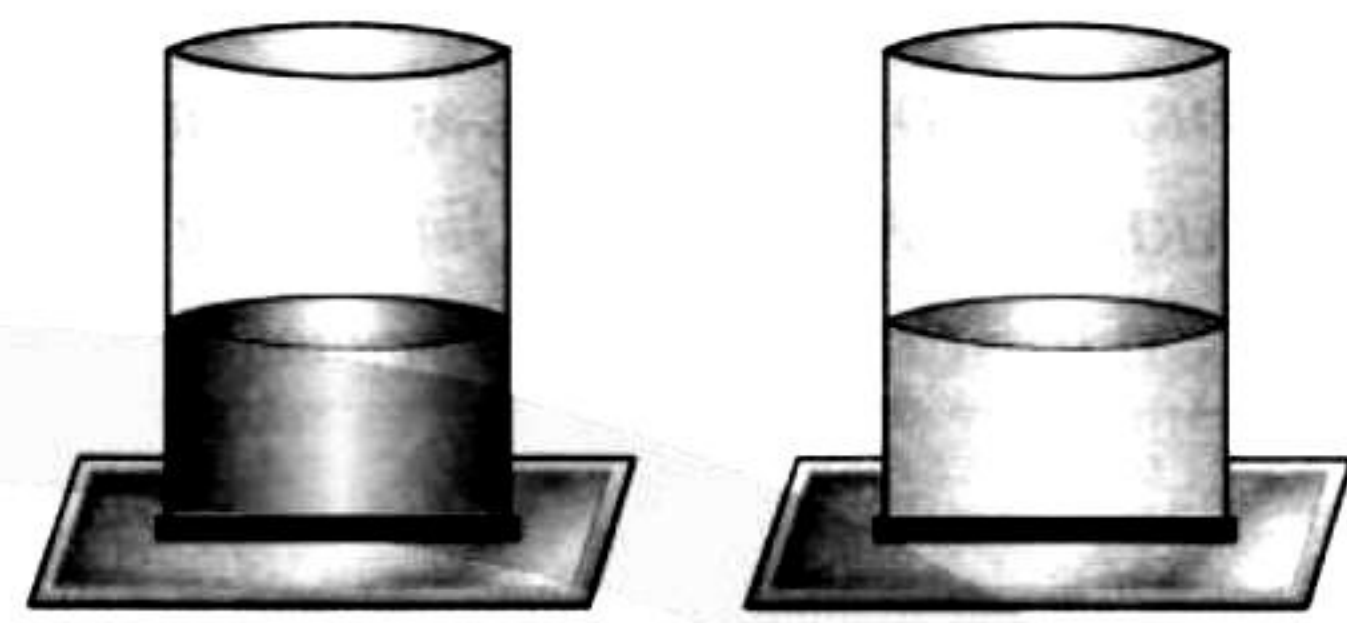


2. ALKALIS

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 ₂ O • Na ₂ O

HYDROXIDES OF METALS • Fe(OH) ₂ • Pb(OH) ₂ • Al(OH) ₃		HYDROXIDES OF METALS • NaOH • KOH • NH ₄ OH	
			
COPPER OXIDE [insoluble base]	MAGNESIUM OXIDE [insoluble base]	SODIUM HYDROXIDE [soluble base- alkali]	AMMONIUM HYDROXIDE [soluble base- alkali]

3. CLASSIFICATION 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 <ul style="list-style-type: none"> • Strong alkali • Weak alkali 	Dissociate completely to give a - high conc. of OH ⁻ ions. Dissociate partially to give a - low conc. of OH ⁻ ions.	KOH NH ₄ OH
ACIDITY OF BASES <ul style="list-style-type: none"> • Monoacidic base • Diacidic base • Triacidic base 	Dissociate to give – one OH ⁻ ion per molecule of the base. Dissociate to give – two OH ⁻ ions per molecule of the base. Dissociate to give – three OH ⁻ ions per molecule of the base.	NaOH Ca(OH) ₂ Fe(OH) ₃ [insoluble]

5. PREPARATION OF BASES

METHOD				BASE FORMED
DIRECT COMBINATION <ul style="list-style-type: none"> • combination of metal and oxygen 	4Na Metal	+	O₂ Oxygen	→ 2Na₂O
DISSOLUTION IN WATER <ul style="list-style-type: none"> • dissolution of basic oxides in water 	Na₂O Basic oxide	+	H₂O Water	→ 2NaOH
<ul style="list-style-type: none"> • dissolution of active metals in water 	2Na Active metal	+	2H₂O Water	→ 2NaOH + H₂
PRECIPITATION METHOD <ul style="list-style-type: none"> • reaction of aq. salt soln. & strong base 	AlCl₃ Salt [soln.]	+	3NaOH Base	→ Al(OH)₃ ↓ + 3NaCl Precipitate

PROPERTIES OF BASES :

Taste Corrosive nature Electrical conductivity Indicator properties	<ul style="list-style-type: none"> • Bases – are bitter in taste • Strong bases [caustic alkalis] – are highly corrosive in nature. • Weak bases – are less corrosive • Strong alkalis – are generally good conductors of electricity • Weak alkalis – are poor conductors of electricity 	
	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]	+	H₂SO₄ [sulphuric acid]	→	CuSO₄ [copper sulphate]	+	H₂O
Base [hydroxide]		Acid		Salt		Water
NaOH [sodium hydroxide]	+	HCl [hydrochloric acid]	→	NaCl [sodium chloride]	+	H₂O

2. Alkalis –react with ammonium salts to liberate – ammonia gas.
$$\text{NH}_4\text{Cl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O} + \text{NH}_3$$

[ammonium chloride] [ammonia]
3. Alkalis — react with salt solutions to give – precipitates of insoluble metallic hydroxides.
$$\text{CuSO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + \text{Cu(OH)}_2\downarrow$$

[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.



- 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 - <i>complete</i> replacement of the - <i>hydrogen ion</i> of an <i>acid</i> by a <i>metal</i> .	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ Normal salt
ACID SALT	Formed by - <i>partial</i> replacement of the - <i>hydrogen ion</i> of an <i>acid</i> by a <i>metal</i> .	$NaOH + H_2SO_4 \rightarrow NaHSO_4 + H_2O$ Acid salt
BASIC SALT	Formed by - <i>incomplete</i> neutralization of a - <i>base</i> with an <i>acid</i> .	$Zn(OH)_2 + HCl \rightarrow Zn(OH)Cl + H_2O$ Basic salt
HYDRATED SALT	A salt which contains a - <i>definite number of water molecules</i> - as <i>water of crystallization</i> .	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				
<i>Zinc</i>	$\text{Zn} +$	$\text{H}_2\text{SO}_4 \rightarrow$	$\text{ZnSO}_4 +$	H_2
<i>Iron</i>	$\text{Fe} +$	$\text{H}_2\text{SO}_4 \rightarrow$	$\text{FeSO}_4 +$	H_2
METAL OXIDE				
<i>Copper oxide</i>	$\text{CuO} +$	$\text{H}_2\text{SO}_4 \rightarrow$	$\text{CuSO}_4 +$	H_2O
<i>Lead oxide</i>	$\text{PbO} +$	$2\text{HNO}_3 \rightarrow$	$\text{Pb}(\text{NO}_3)_2 +$	H_2O
METAL CARBONATE				
<i>Magnesium carbonate</i>	$\text{MgCO}_3 +$	$\text{H}_2\text{SO}_4 \rightarrow$	$\text{MgSO}_4 +$	$\text{H}_2\text{O} + \text{CO}_2$
<i>Lead carbonate</i>	$\text{PbCO}_3 +$	$2\text{HNO}_3 \rightarrow$	$\text{Pb}(\text{NO}_3)_2 +$	$\text{H}_2\text{O} + \text{CO}_2$
METAL HYDROXIDE				
<i>Sodium hydroxide [soluble]</i>	$2\text{NaOH} +$	$\text{H}_2\text{SO}_4 \rightarrow$	$\text{Na}_2\text{SO}_4 +$	$2\text{H}_2\text{O}$
<i>Copper hydroxide [insoluble]</i>	$\text{Cu}(\text{OH})_2 +$	$\text{H}_2\text{SO}_4 \rightarrow$	$\text{CuSO}_4 +$	$2\text{H}_2\text{O}$

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]
$\text{Pb}(\text{NO}_3)_2 +$ Lead nitrate	$2\text{NaCl} \rightarrow$ Sodium chloride	$2\text{NaNO}_3 +$	$\text{PbCl}_2 \downarrow$ Lead chloride
$\text{CaCl}_2 +$ Calcium chloride	$\text{Na}_2\text{CO}_3 \rightarrow$ Sodium carbonate	$2\text{NaCl} +$	$\text{CaCO}_3 \downarrow$ Calcium carbonate

B. DIRECT COMBINATION OR SYNTHESIS

METAL		NON-METAL	INSOLUBLE SALT
Zn Zinc	+	S Sulphur	ZnS Zinc sulphide
Fe Iron	+	S Sulphur	FeS Iron [II] sulphide

6. USES OF SOME SALTS

SALT	USES
<ul style="list-style-type: none"> SODIUM CHLORIDE SODIUM CARBONATE COPPER SULPHATE AMMONIUM NITRATE 	<ul style="list-style-type: none"> Cooking food preservative, manufacture of chlorine Manufacture of –glass, detergents Electroplating and fungicide Fertilizers