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## S2 New Curriculum chemistry

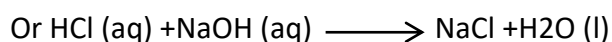
Theme: Acid and Alkalis

Chapter 2 – Salts

### SALTS



A **salt** is a compound formed when an acid reacts with a base, a carbonate or a metal. For example common salt (NaCl) is formed when hydrochloric acid reacts with sodium hydroxide, i.e. Hydrochloric acid + sodium hydroxide  $\longrightarrow$  Sodium chloride + water



#### Types of salts

There are two different types of salts

#### Normal salt

**Normal salt** is the one in which all the replaceable hydrogen from the acid has been replaceable by the metal. Examples of normal salts are:

Sodium chloride NaCl

Sodium sulphate Na<sub>2</sub>SO<sub>4</sub>

Calcium carbonate CaCO<sub>3</sub>

Calcium sulphate CaSO<sub>4</sub>

Calcium chloride  $\text{CaCl}_2$

Ammonium chloride  $\text{NH}_4\text{Cl}$

### Acidic salt

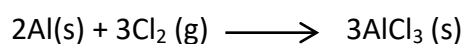
**Acidic salt** is one in which part of replaceable hydrogen of the acid has been replaced by a metal. Examples acidic salts include

- sodium hydrogen carbonate ( $\text{NaHCO}_3$ )
- Sodium hydrogen sulphate  $\text{NaHSO}_4$
- Calcium hydrogen sulphate  $\text{Ca}(\text{HSO}_4)_2$
- Calcium hydrogen carbonate  $\text{Ca}(\text{HCO}_3)_2$  etc.

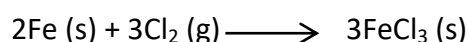
### Preparation of salts

1. By direct combination of metals and non-metal. For example:

Aluminum + Chlorine  $\longrightarrow$  Aluminium chloride

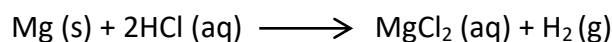


Iron + Chlorine  $\longrightarrow$  Iron chloride



2. By reaction of excess metal with an acid, for example:

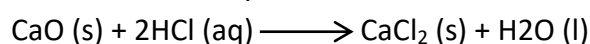
Magnesium + Hydrochloric acid  $\longrightarrow$  Magnesium chloride



The excess metal is filtered off and the solution of the salt is evaporated to dryness to recover the salt.

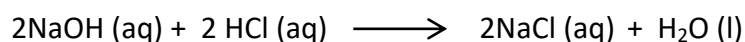
3. By reacting excess metal oxide with an acid, for example

Calcium oxide + Hydrochloric acid  $\longrightarrow$  Calcium chloride + water



4. By neutralisation of an alkali by an acid, for example:

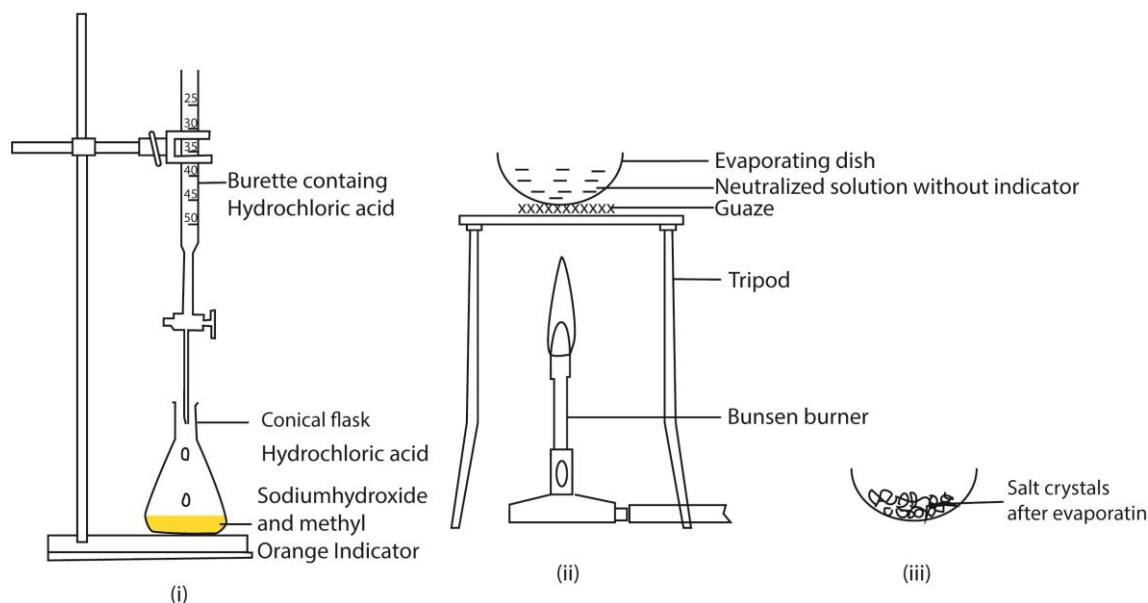
Sodium hydroxide + Hydrochloric acid  $\longrightarrow$  Sodium chloride + water



### Procedure

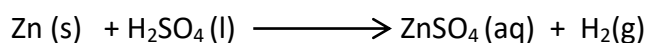
- (i)  $50\text{ cm}^3$  of sodium hydroxide solution titrated with dilute hydrochloric acid solution using methyl orange indicator to find the volume  $x\text{ cm}^3$  of the acid required to neutralize the alkali. The using fresh solutions mix  $50\text{ cm}^3$  of sodium hydroxide and  $x\text{ cm}^3$  of hydrochloric acid to form a neutralized solution without indicator
- (ii) Evaporate the neutralized solution to near dryness in an evaporating dish.
- (iii) Leave the concentrated solution cool and form crystals

### Preparation of salt by neutralization



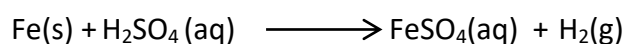
### Preparation of zinc sulphate from zinc

- Add dilute  $\text{H}_2\text{SO}_4(\text{s})$  mixed with little copper sulphate and zinc in a beaker
- Add more zinc to saturate the solution
- Filter to remove the undissolved zinc
- Warm the filtrate to concentrate it
- Cool to room temperature
- Filter the crystals of zinc sulphate-7-water
- Wash the crystals with little cold distilled water
- Dry the crystals between filter papers



### Preparation of iron (II) sulphate-7-water( $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ )

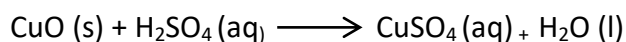
- Add warm dilute sulphuric acid to iron filling in a beaker
- Add more iron fillings to saturate the solution
- Filter to remove the un dissolved iron filings
- Warm the filtrate slightly to concentrate it
- Cool to room temperature
- Filter the crystals of iron(II) sulphate-7-water
- Wash the crystals with cold distilled water
- Dry the crystals between filter papers



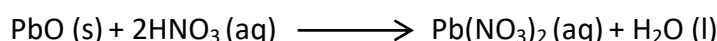
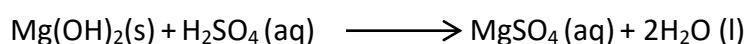
### Preparation of copper (II) sulphate-5-water from copper oxide

- Pour dilute sulphuric acid in a beaker, warm gently. (to increase on the solubility)
- Add copper oxide to the warm acid.

- Add more copper oxide to saturate the solution.
- Filter to remove the un dissolved copper oxide
- Evaporate the filtrate concentrate it cool to room temperature
- Filter the crystals of copper(II) sulphate-5-water
- Wash the crystals with little cold distilled water
- Dry the crystals between the filter paper

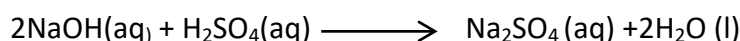


N.B: Magnesium sulphate, zinc sulphate, and lead (II) nitrate can be prepared in the same way.

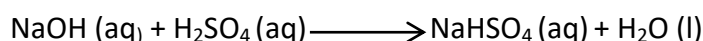


#### Preparation of sodium hydrogen sulphate.

- Add 20cm<sup>3</sup> of 2M NaOH in a clean conical flask.
- Titrate with 2M H<sub>2</sub>SO<sub>4</sub> from a burette using methyl orange indicator.
- The solution formed contains sodium sulphate.



- Note the volume of H<sub>2</sub>SO<sub>4</sub> used, say x cm<sup>3</sup>.
- Measure another 20 cm<sup>3</sup> of 2M NaOH in a clean beaker.
- Add 2x cm<sup>3</sup> of 2M H<sub>2</sub>SO<sub>4</sub>
- The solution formed contains sodium hydrogen sulphate.



#### **Solubility of salts**

Solubility is a measurement of how much of a substance will dissolve in a given volume of a liquid at a given temperature.

- All sulphates are soluble, except barium sulphate, calcium sulphate and lead (II) sulphate
- All chlorides are soluble except silver chloride. Lead (ii) chloride dissolves in hot water but reforms on cooling
- All carbonates are insoluble except potassium, sodium and ammonium carbonates
- All nitrates are soluble

#### **Some examples where salts are useful**

Salts are incredibly versatile and play a crucial role in various fields. Here are some examples of their usefulness:

- **Food Industry** – Sodium chloride (table salt) enhances flavor and preserves food.

- **Agriculture** – Fertilizers contain salts like ammonium nitrate and potassium chloride to support plant growth.
- **Medicine** – Salts like magnesium sulfate (Epsom salt) are used for muscle relaxation, while sodium bicarbonate helps with indigestion.
- **Water Treatment** – Salts help soften hard water, making it more suitable for household use.
- **Chemical Manufacturing** – Sodium chloride is a key ingredient in producing chlorine and caustic soda.
- **Deicing Roads** – Rock salt effectively melts ice, ensuring safer travel during winter months.
- **Textile Industry** – Sodium sulfate is used in dyeing fabrics.
- **Photography** – Silver nitrate is used in film development.
- **Construction** – Calcium carbonate is a component in cement and plaster.
- **Electronics** – Some salts are used in batteries and circuit boards.

### Revision questions

1. (a) Define the following terms. Giving two examples in each case;
  - (i) Normal salt
  - (ii) Acid salt
 (b) Write an equation for the reaction between NaOH(aq) and dilute H<sub>2</sub>SO<sub>4</sub>
2. Normal salts can be prepared by neutralization
  - (a) What is neutralization?
  - (b) What are the products of neutralization?
  - (c) What are application of neutralization reaction in every day life
3. (a) What is solubility?
  - (b) In the table below tick the appropriate box.

Type of salt	Soluble	insoluble
Barium sulphate		
Copper sulphate		
Barium nitrate		
Potassium carbonate		
Sodium chloride		
Lead carbonate		

4. Give one use of each of salts in the table below

Ammonium chloride	
Ammonium nitrate	
Copper (II) sulphate	
Lead nitrate	
Magnesium sulphate	
Sodium chloride	

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Thanks

Dr. Bbosa Science