

**O-level**

## **SALTS**

A salt is a compound formed when the replaceable hydrogen atom(s) of an acid are replaced by a metal or ammonium ion ( $\text{NH}_4^+$ )

### **Types of salts**

There two different types of salts

- Normal salt
- Acidic salt

### **Normal salt**

It is the one in which all the replaceable hydrogen from the acid has been replaceable by the metal ion(s).

Example

Sodium chloride	$\text{NaCl}$
Sodium sulphate	$\text{Na}_2\text{SO}_4$
Calcium carbonate	$\text{CaCO}_3$
Calcium sulphate	$\text{CaSO}_4$
Calcium chloride	$\text{CaCl}_2$
Ammonium chloride	$\text{NH}_4\text{Cl}$

The formation of the normal salt is illustrated by the equation below;



## Acidic salt

Is a salt in which part of replaceable hydrogen of the acid has been replaced by a metal

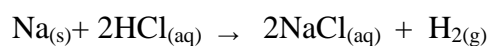


Examples include

- 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. From metal salt by direct combination of metals or oxide with acid e.g.



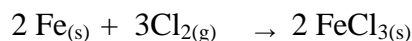
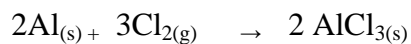
The mixture is dried using a drying agent or evaporating to dryness

2. **By neutralisation;** this is the process by which a base reacts with an acid to form a salt and water only e.g. Sodium chloride can be prepared from sodium hydroxide and dilute hydrochloric acid .



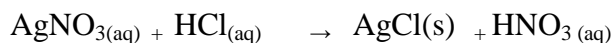
3. **Direct combination(synthesis);**

Aluminium chloride and iron (III)chloride can be prepared from the element directly



## Precipitation

Insoluble zinc carbonate, silver chloride (AgCl), and lead chloride can be prepared by precipitation e.g. silver chloride is prepared from solution of silver nitrate and dilute hydrochloric acid where a precipitate of silver chloride is formed.



The precipitate of AgCl is washed several times with distilled water.

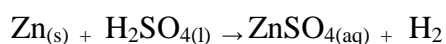
NOTE: insoluble salts can be prepared by either precipitation method or direct synthesis

Other examples of salts prepared by precipitation include;

- Lead chloride (PbCl<sub>2</sub>)
- Lead sulphate (PbSO<sub>4</sub>), barium sulphate (BaSO<sub>4</sub>) etc.

## Preparation of zinc sulphate from zinc

- Add dilute H<sub>2</sub>SO<sub>4(s)</sub> mixed with little copper sulphate to zinc in a beaker
- Add more zinc to saturate the solution
  - Filter to remove the un dissolved 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

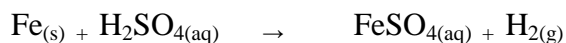


## Preparation of iron (II) sulphate-7-water (FeSO<sub>4</sub>·7H<sub>2</sub>O)

- 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

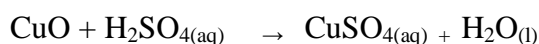


- Cool to room temperature
- Filter the crystals of iron (II) sulphate-7-water
- Wash the crystals with cold distilled water
- Dry the crystals between filter papers

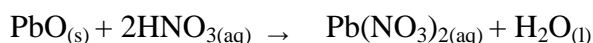
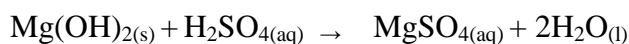


### Preparation of copper (II) sulphate-5-water from copper oxide

- 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.
- $$2\text{NaOH}_{(aq)} + \text{H}_2\text{SO}_{4(aq)} \rightarrow \text{Na}_2\text{SO}_{4(aq)} + 2\text{H}_2\text{O}_{(l)}$$
- 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.



## EXERCISE

1(a) Nitric acid is a strong monobasic acid. Explain what is meant by the term;

(i) Strong acid

(ii) Basicity

(a) State two properties of Nitric acid as an acid.

1. 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>

2002: 2<sub>(2)</sub>; 2003: 44, 13, 31, 14<sub>(2)</sub>; 1989: 12, 3, 41, 1, 9; 1990: 23; 1992: 28, 14, 13<sub>(2)</sub>; 1994: 4, 5, 14; 1996: 9, 10; 1995: 11, 15, 8<sub>(2)</sub>, 35; 1999: 14; 2004: 12<sub>(2)</sub>; 2012: 12<sub>(2)</sub>, 13<sub>(2)</sub>, 8; 2006: 13, 11, 2<sub>(2)</sub>; 12<sub>(2)</sub>; 2000: 43, 45; 2001: 19; 1991: 20; 1993: 8, 26; 1998: 4, 9, 33, 48; 1999: 13, 3; 2007: 7, 41, 47, 3<sub>(2)</sub>; 2005: 15, 20, 23, 28; 2008: 16, 49; 2009: 12, 15, 20, 21, 23, 32, 36, 39; 1997: 3, 7, 20, 1<sub>(2)</sub>; 2010: 9<sub>(2)</sub>. ; 2015: 7