Naming salts

A **salt** is any **compound** formed by the **neutralisation** of an **acid** by a **base**.

The name of a salt has two parts. The first part comes from the metal, metal oxide or metal carbonate. The second part comes from the acid.

You can always work out the name of the salt by looking at the reactants:

- nitric acid always produces salts that end in nitrate and contain the **nitrate** ion, NO_3-hydrochloric acid always produces salts that end in chloride and contain the **chloride** ion, Cl^-
- sulfuric acid always produces salts that end in **sulfate** and contain the sulfate ion, SO_4^{2-}

For example, if potassium oxide reacts with sulfuric acid, the products will be potassium sulfate and water.

The table shows some more examples:

Metal		Acid		Salt
Sodium hydroxide	reacts with	Hydro**chloric** acid	to make	**Sodium chloride**
Copper oxide	reacts with	Hydro**chloric** acid	to make	**Copper chloride**
Sodium hydroxide	reacts with	**Sulf**uric acid	to make	**Sodium sulfate**
Zinc oxide	reacts with	**Sulf**uric acid	to make	**Zinc sulfate**

Note that ammonia forms **ammonium** salts when it reacts with acids. For instance, **ammonia** reacts with **hydrochloric acid** to make **ammonium chloride**.

Making insoluble salts

To make an **insoluble** salt, two **soluble** salts need to react together in a **precipitation reaction**.

The table shows soluble and insoluble salts:

Soluble	Insoluble
All nitrates	None
All common sodium, potassium and ammonium salts	None
Most common sulfates	Calcium sulfate and barium sulfate
Most common chlorides	Silver chloride
Sodium, potassium and ammonium	Most common carbonates

We can see from the table that silver chloride is an insoluble salt. It can be made by reacting a soluble silver salt with a soluble chloride salt.

Silver nitrate and sodium chloride are both soluble. When their solutions are mixed together, soluble sodium nitrate and insoluble silver chloride are made:

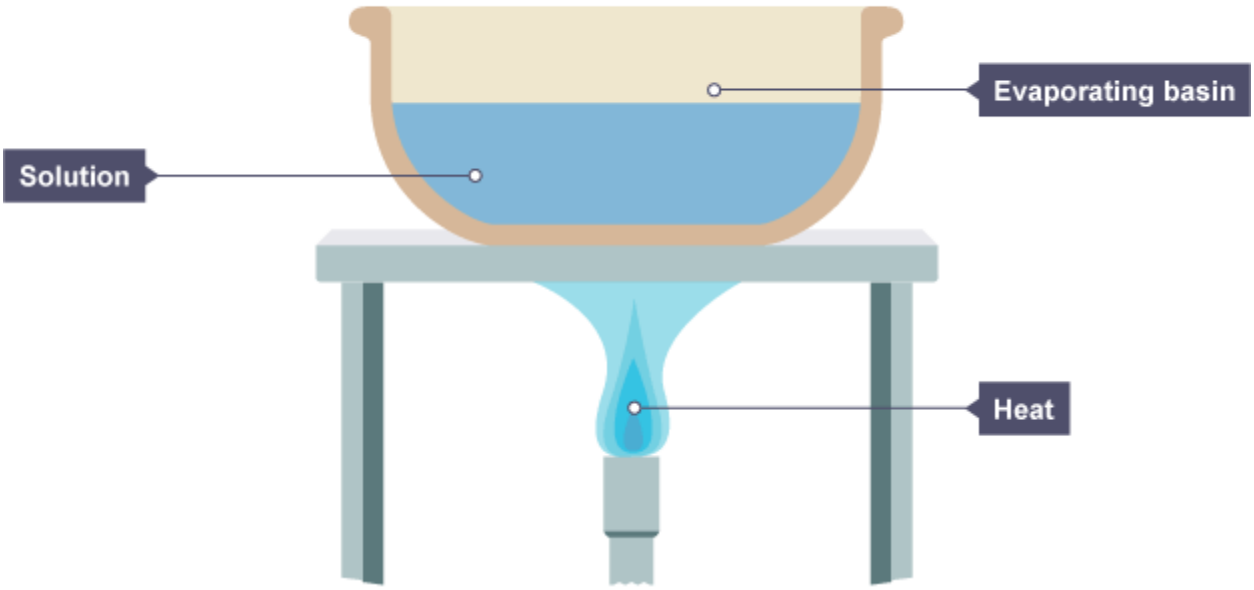
silver nitrate + sodium chloride → sodium nitrate + silver chloride

$AgNO_3(aq) + NaCl(aq) \rightarrow NaNO_3(aq) + AgCl(s)$

The silver chloride appears as tiny particles **suspended** in the reaction mixture - this is the **precipitate**. The precipitate can be filtered, washed with water on the filter paper, and then dried in an oven

Making a salt from an alkali

If you are using an alkali - which is a soluble base - then you need to add just enough acid to make a neutral solution (check a small sample with **universal indicator paper**).
Warm the salt solution to **evaporate** the water. You get larger crystals if you evaporate the water slowly.



Making a salt from an alkali

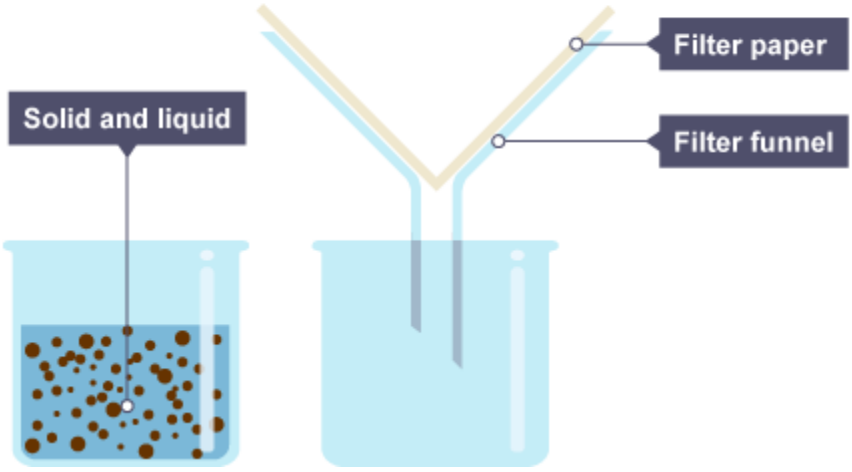
1. A solution is placed in an evaporating basin and heated with a Bunsen burner

2solution is reduced to a concentrated solution by evaporation

3 Leave it to cool down through air

Making a salt from an insoluble metal oxide or carbonate

Copper oxide and other transition metal oxides or hydroxides do not dissolve in water. If the **base** is insoluble, then an extra step is needed to form a salt.
You add the base to the warm acid until no more will dissolve and you have some base left over – this is called an 'excess'. You filter the mixture to remove the excess base, and then evaporate the water in the **filtrate** to leave the salt behind.



Making a salt from an insoluble metal oxide or carbonate

1. Mix the solid and liquid and set aside the insoluble precipitate to settle down
2. Filter the precipitate through the funnel with a filter paper
3. Leave the extra water to drip and the precipitate to dry.

Acid-alkali titrations

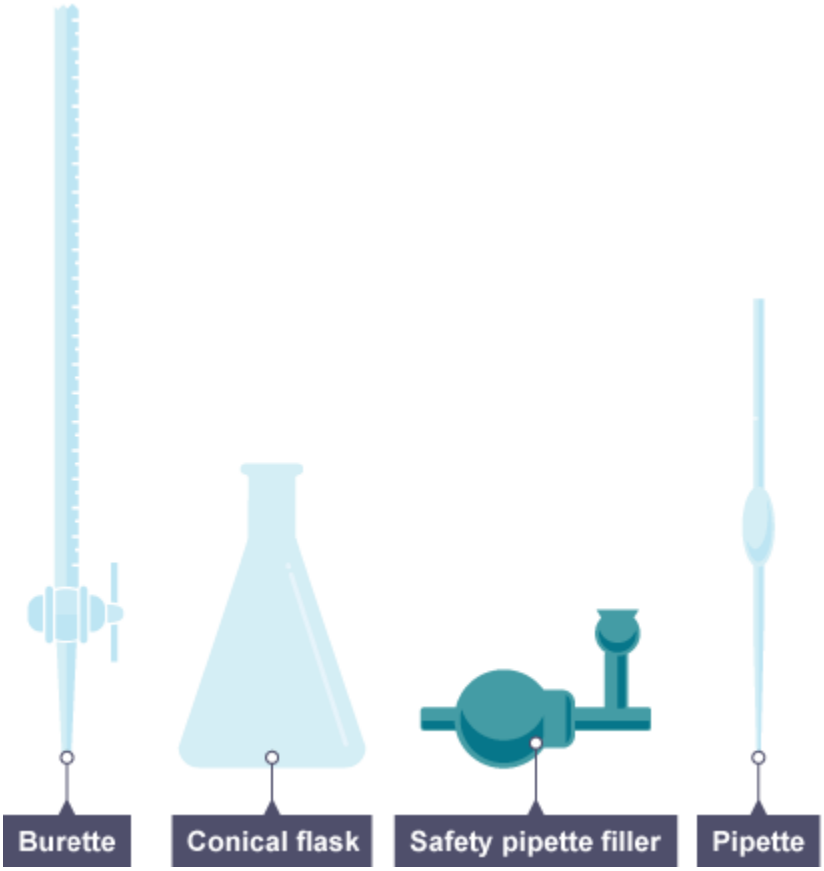
The concentration of an **acid** or **alkali** can be calculated by carrying out an experiment called a **titration**.

Materials

The apparatus needed includes:

- a **pipette** to accurately measure a certain **volume** of acid or alkali
- a **pipette filler** to use the pipette safely
- a **conical flask** to contain the liquid from the pipette

- a **burette** to add small, measured volumes of one reactant to the other reactant in the conical flask



Apparatus needed to carry out a titration

Method

This is an outline method for carrying out a titration in which an acid is added to alkali.

1. Use the pipette and pipette filler to add 25 cm^3 of alkali to a clean conical flask.
2. Add a few drops of **indicator** and put the conical flask on a white tile.
3. Fill the burette with acid and note the starting volume.
4. Slowly add the acid from the burette to the alkali in the conical flask, swirling to mix.
5. Stop adding the acid when the end-point is reached (the appropriate colour change in the indicator happens). Note the final volume reading.
6. Repeat steps 1 to 5 until you get **concordant** readings (see explanation below).

The same method works for adding an alkali to an acid – just swap around the liquids that go into the conical flask and burette.

The titre

The difference between the reading at the start and the final reading gives the volume of acid (or alkali) added. This volume is called the **titre**.
For example, if the reading at the start is 1.00 cm^3 and the final reading is 26.50 cm^3, then the titre is 25.50 cm^3 (26.50 – 1.00). The titre will depend upon the volume of liquid in the conical flask, and the concentrations of the acid and alkali used.
Repeat the titration several times until the titre is **concordant** (you have at least two titres within 0.20 cm^3 of each other).

Titration results are recorded in a table like this:

Titration	Rough	1	2	3
End vol (cm^3)	26.80	24.60	24.90	25.00
Start vol (cm^3)	1.00	0.00	0.60	0.20
Titre (cm^3)	25.80	24.60	24.30	24.80

You can ignore the first (rough) titration result. Titrations 1 and 3 have results that are within 0.20 cm^3 of each other but the result for titration 2 is too low. You would calculate the mean titre for titrations 1 and 3, and ignore titration 2:
Mean titre = (24.60 + 24.80) ÷ 2 = 49.40 ÷ 2 = 24.70 cm^3

Making salts

1

Which acid is used to make salts that have names ending in sulfate?

- Sulfamic acid

- Nitric acid
- Sulfuric acid

2

What ion is present in nitric acid?

- NO_3^-
- NH_4^+
- OH^-

3

Zinc oxide + nitric acid →…

- Zinc nitrate + water
- Zinc chloride + hydrogen
- Zinc nitrate + water + carbon dioxide

4

Which two chemicals could you react to make ammonium chloride?

- Ammonium hydroxide and hydrochloric acid
- Ammonia and sulfuric acid
- Potassium hydroxide and nitric acid

5

Calcium carbonate + hydrochloric acid →…

- Calcium chloride + hydrogen
- Calcium chloride + water + carbon dioxide
- Calcium sulfate + water

6

Which of these salts is most likely to be soluble?

- Potassium nitrate
- Iron carbonate
- Copper oxide

7

What is the name of the precipitate made from the reaction between silver nitrate and sodium chloride?

- Sodium nitrate
- Silver chloride
- Water

8

When producing a soluble salt in a reaction between an acid and an alkali, how can you prepare dry solid crystals from the solution?

- Filtration
- Chromatography
- Evaporation

9

When performing an acid-alkali titration, what piece of apparatus is used to place a fixed volume of the first solution into the conical flask?

- Burette
- Pipette
- Beaker

10

When processing titration results, what do you do with results that are very close together?

- Take an average

- Ignore them
- Pick one