

CAIE IGCSE Chemistry

7.3 Preparation of salts

Notes

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Describe the preparation, separation and purification of soluble salts by reaction of an acid with:

- A salt is formed when a metal or ammonium ion replaces the hydrogen ions in an acid:
 - Hydrochloric acid will form X chloride
 - Sulfuric acid will form X sulfate
 - Nitric acid will form X nitrate
 - X is the metal ion
- A soluble salt is prepared by reacting an acid with an insoluble reactant, such as metal oxides and metal hydroxides (which are bases)

(a) An alkali by titration

- When an acid and an alkali are reacted together, a soluble salt and water is formed
- To prepare the soluble salt, known volumes of an acid and alkali are needed, which are found through a titration (see 12.2 for more detailed notes) investigating how much of each is required for neutralisation to occur.
- Once these known quantities are found, these volumes are combined to produce a solution containing the soluble salt and water
- To separate the soluble salt, the water is evaporated away by heating the solution gently in an evaporating dish
- Remove the evaporating dish from the heat and allow it to cool
- The salt will form crystals which can be filtered, washed and dried

(b) Excess metal (c) Excess insoluble base (d) Excess insoluble carbonate

- A soluble salt can also be prepared by reacting an acid with an insoluble reactant
- Examples of insoluble reactants:
 - Excess metal
 - Excess insoluble base (metal oxides and metal hydroxides)
 - Excess insoluble carbonate
- Method:
 - Add dilute acid into a beaker and heat over a bunsen burner or in a water bath
 - Add the insoluble reactant gradually whilst stirring, until the insoluble metal, base or carbonate is in excess (will not dissolve further)
 - Filter the solution, containing the soluble salt and water, into an evaporating dish
 - To separate the soluble salt, the water is evaporated away by heating the solution gently in an evaporating dish
 - Remove the evaporating dish from the heat and allow it to cool
 - The salt will form crystals which can be filtered, washed and dried



Describe the general solubility rules for salts:

To be able to prepare a soluble salt, you must be able to identify whether a salt is soluble or insoluble

Type of salt	Soluble or insoluble
Sodium, potassium and ammonium salts	Soluble
Nitrates	Soluble
Chlorides (excluding lead and silver chloride)	Soluble
Sulfates (excluding barium, calcium and lead sulfate)	Soluble
Carbonates (excluding sodium, potassium and ammonium carbonate)	Insoluble
Hydroxides (excluding sodium, potassium and ammonium hydroxide. Calcium hydroxide is partially soluble)	Insoluble

Define a hydrated substance and an anhydrous substance

- A hydrated substance is a substance that is chemically combined with water
E.g. Hydrated copper (II) sulfate
- An anhydrous substance is a substance that does not contain water
E.g. Anhydrous copper (II) sulfate



(Extended only) Describe the preparation of insoluble salts by precipitation

- To prepare an insoluble salt, a precipitation reaction is used since the insoluble salt formed is in the form of a precipitate
- Two soluble salts are combined together to form the insoluble salt, to select these you must be aware of the solubilities of salts using the table above
 - E.g. All nitrates are soluble and all sodium, potassium and ammonium salts are soluble, so any combination of these will produce a precipitate
 - E.g. To prepare potassium nitrate: sodium nitrate and potassium sulfate can be combined
- Method:
 - Dissolve the soluble salts in separate test tubes with water to form aqueous solutions
 - Once fully dissolved, add the two solutions into a beaker and stir, a precipitate will form
 - Separate the precipitate from the mixture through filtration
 - The precipitate will collect in the filter paper, wash it with water to remove any excess solution on the surface before placing in the oven to dry

(Extended only) Define the term water of crystallisation

- Water of crystallisation refers to the water molecules that are present in hydrated crystals
- They are usually indicated by a black dot in the molecular formula, dividing the water molecules from the rest of the compound
 - E.g. There are 5 molecules of water of crystallisation in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
 - E.g. There are 6 molecules of water of crystallisation in $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$

