

# CAIE IGCSE Chemistry

## 12.4 Separation and purification

### Notes

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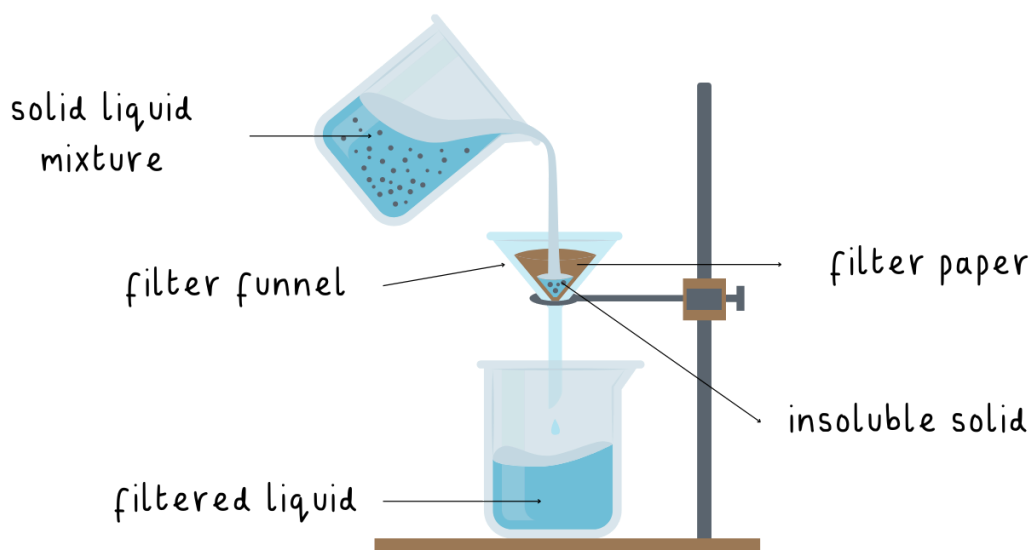
*Describe and explain methods of separation and purification using:*

(a) A suitable solvent

- A solvent is a substance that dissolves a solute
- The type of solvent must be carefully chosen depending on the type of solute that needs to be separated to ensure:
  - No other impurities or components dissolve in the solvent
  - Only the desired substance is dissolved in the solvent

(b) Filtration

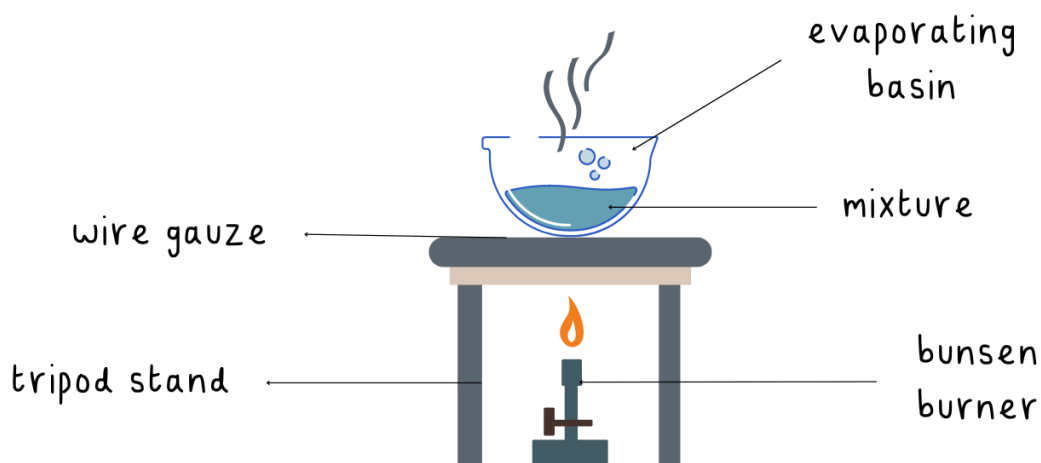
- Filtration separates an insoluble solute, such as a precipitate, from a solution
- Filter paper is placed into a funnel, the small pores only allow liquids to pass through
- The mixture is poured into a beaker through the funnel, leaving the solute behind



(c) Crystallisation

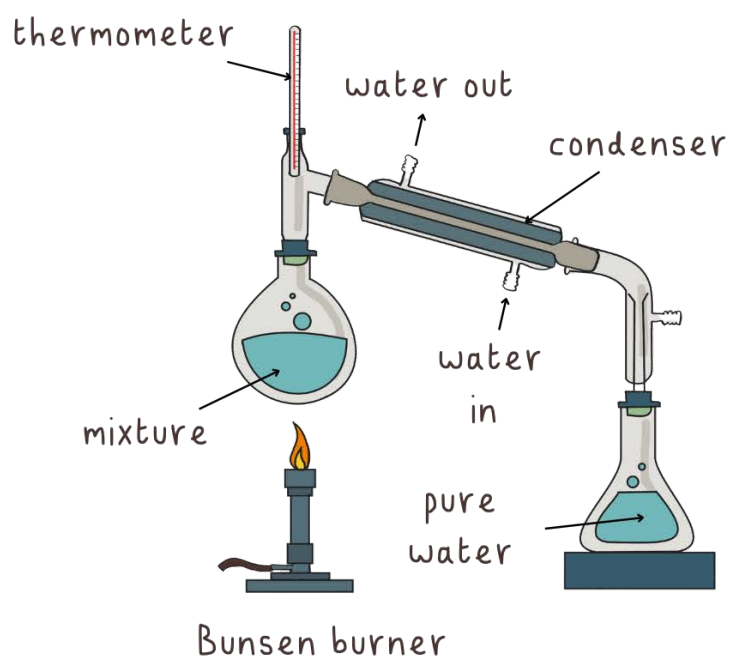
- Crystallisation separates a soluble salt from the solution it is dissolved in
- Method:
  - Heat the solution in a evaporating dish over a bunsen burner until boiling  
Specify that no more than half of the solution is boiled off before it is removed from the heat
  - Remove from the heat and allow the solution to cool and evaporate
  - The saturated solution will leave behind crystals of the salt as it cools
  - The crystals will grow and can be collected and allowed to dry





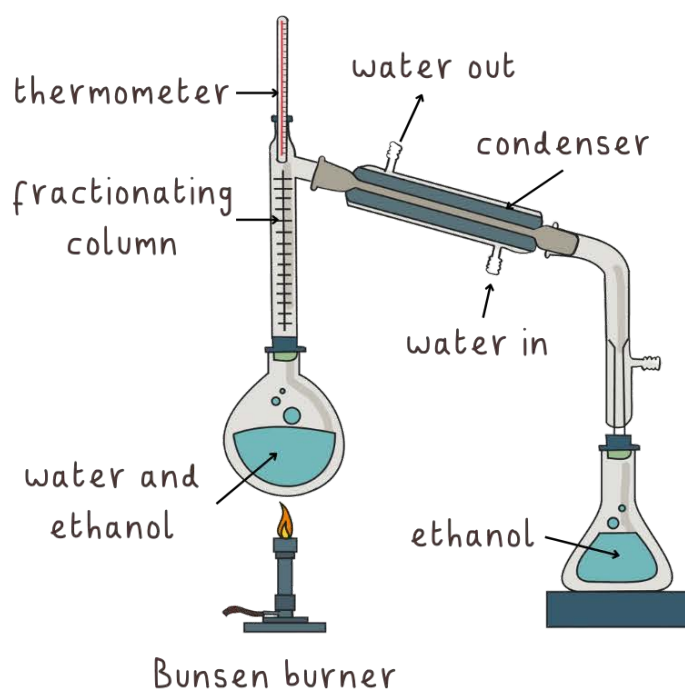
(d) Simple distillation

- Simple distillation separates a solvent from a solution, e.g. producing water from a salt solution
- Simple distillation works because the dissolved solute has a much higher boiling point than the solvent, e.g. salt has a higher boiling point than the water so the water will boil and evaporate first and the salt stays behind
- The water vapour will cool and condense as it travels through the condenser, collecting in a separate flask
- The remaining solution becomes more concentrated in solute as the amount of solvent in it decreases.



### (e) Fractional distillation

- Fractional distillation separates a pure liquid from a mixture of liquids, e.g. separating water and ethanol.
- Fractional distillation works because the liquids have different boiling points, e.g. pure ethanol boils at  $78^{\circ}\text{C}$  whereas water boils at  $100^{\circ}\text{C}$ .
- The mixture is heated to the boiling point of the liquid with the lowest boiling point, which will evaporate first, pass through the condenser and collect in its fraction. This process is repeated, until every component of the mixture has evaporated in its associated boiling point and separated into its individual fractions
- The many hydrocarbons in crude oil are separated using fractional distillation:
  - Heated crude oil is piped in at the bottom of the fractionating column.
  - The vaporised oil rises up the column and the various fractions are constantly tapped off at the different levels where they condense.
  - The fractions can be processed to produce fuels and feedstock for the petrochemical industry.



### Separating a mixture of gases

- To separate a mixture of gases, one method would be to cool the mixture to convert the state from gaseous to liquid, then use fractional distillation to separate the different gases into their individual components



*Suggest suitable separation and purification techniques, given information about the substances involved*

Method of separation	What is separated
<b>Filtration</b>	Insoluble solute from a solution
<b>Crystallisation</b>	Soluble solute from a solution (e.g. dissolved salt)
<b>Simple distillation</b>	Solvent from a solution
<b>Fractional distillation</b>	Mixture of miscible (dissolved) liquids

*Identify substances and assess their purity using melting point and boiling point information*

- Pure substances melt and boil at specific temperatures
- This melting and boiling points data can be used to distinguish pure substances from mixtures (which melt over a range of temperatures due to them consisting of 2 or more elements or compounds)
- To identify an unknown substance, the melting point or boiling point of the substance can be tested experimentally and the value can be compared to a database of the values of known substances
- To assess the purity of a substance, the melting point or boiling point of the substance can be tested experimentally and the value is compared to the database value. The more similar the value, the higher the purity of the substance.

