THE BRITISH SCHOOL OF KUWAIT

CHEMISTRY IGCSE

TOPIC 2: Experimental Techniques

TOPIC	CORE	SUPPLEMENT
2.1 Measurement	Name appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes and measuring cylinders	
2.2 (a) Criteria of purity	Describe paper chromatography	Outline how chromatography techniques can be applied to colourless substances by exposing chromatograms to substances called locating agents (Knowledge of specific locating agents is not required.)
	Interpret simple chromatograms	
	Understand the importance of purity in substances in everyday life, e.g. foodstuffs and drugs	
2.2 (b) Methods of purification	Describe methods of purification by the use of a suitable solvent, filtration, crystallisation, distillation (including use of fractionating column) Refer to the fractional distillation of: crude oil, fermented liquor.	
	Suggest suitable purification techniques, given information about the substances involved	

♦ Criteria of purity

All chemicals are normally found impure (mixed with other things). If they are dug up from the ground a major impurity will be silicon dioxide (sand). In many industries purity is important and a lot of money is spent purifying products before they can be sold. For example in the pharmaceuticals (medicine) industry, between 80-90% of the cost of a medicine can come from purifying the product.

♦ Chromatography

Chromatography is very useful and used extensively (a lot) in research and industry. It can be used in three different ways:

1. To separate a mixture of compounds
2. To test the purity of a substance
3. To identify the substances found in a mixture

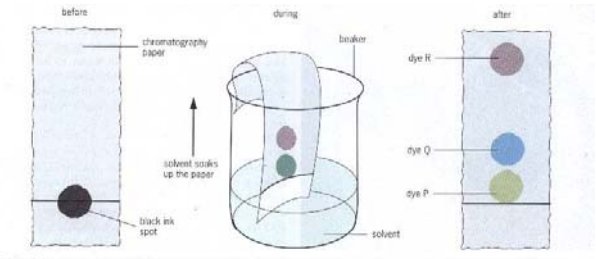


Figure 2.24 (a, top) Chromatographic separation of black ink. (b, bottom) The black ink separates into three dyes: P, Q and R

How chromatography works:
For chromatography to work, the substance you are analysing MUST dissolve in a solvent (usually water)
There are a number of different types of chromatography. In school we use simple paper chromatography. Although this is used in industry another type of chromatography is used more widely outside of school.
In simple chromatography as the water travels up the chromatography paper it pulls with it molecules from the mixture. The heavier the molecule, the harder it is for the water to pull it up the paper. In this way chromatography separates a mixture by mass, the heavier molecules staying near the bottom of the paper and the lighter molecules travelling with the water to the top of the paper.
In this way chromatography is used to separate a mixture of substances.

Testing for purity:
As well as using melting point, the purity of a substance can be checked with chromatography. If the chromatogram shows only one spot of colour after chromatography, the original substance must be pure.

The Identification of unknown substances
A chromatogram can help us identify the molecules separated by chromatography. If we measure the distance from the pencil line to the centre of our coloured spot and the distance from the pencil line to the highest level that the solvent travelled to up the paper we can mathematically work out a value called the R.f. value as follows:

R.f. = distance travelled by the spot / distance travelled by solvent

Different molecules will have different R.f. values and can therefore be identified by these values. For example: The Amino acids that make up proteins can be identified using chromatography.

♦ Distillation

This is a method for separating miscible liquids (liquids that mix) or liquids containing dissolved salts.
Distillation involves two processes: -

1. Boiling
2. Condensing

There are two types of distillation

1. Simple Distillation
2. Fractional distillation

Simple Distillation
From the diagram we can see that in simple distillation we first heat up our mixture until it boils, the liquid in our mixture with the lower boiling point, boils first leaving the other liquid behind. The vapour produced by this first liquid enters the condenser where it is cooled and turned back into a liquid running into our beaker. We have now separated our two liquids, the liquid with the higher boiling point remains in our round-bottomed flask, but the liquid with the lower boiling point is now in the beaker and has been separated from the other liquid.
Simple distillation works where the liquids have very different boiling points

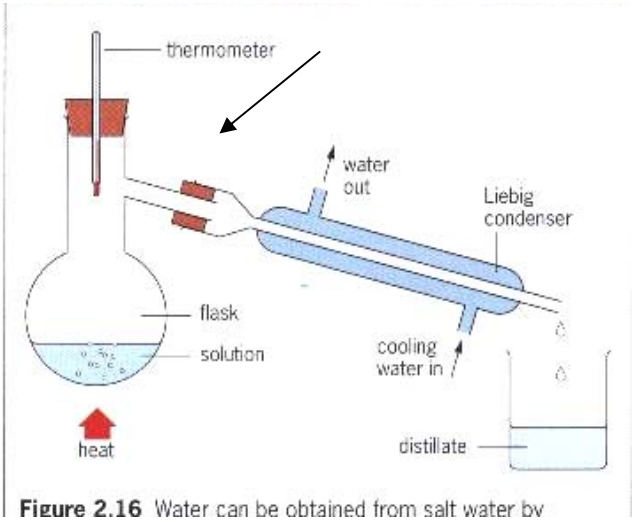


Figure 2.16 Water can be obtained from salt water by

FRACTIONAL DISTILLATION

Liquids with boiling points that are close together cannot be separated by simple distillation, this is because as the liquid with the lower boiling point starts to boil it will pull up with it some molecules of the other liquid and so the vapour produced will not be pure but a mixture of the two liquids.

Before we can get a pure vapour and a pure liquid product we have to separate out the vapour produced by our boiling liquid, this is done in a fractionating column.

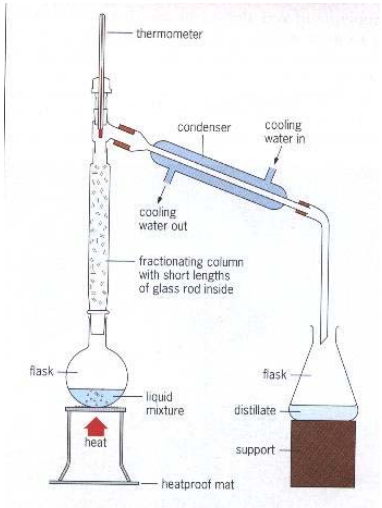
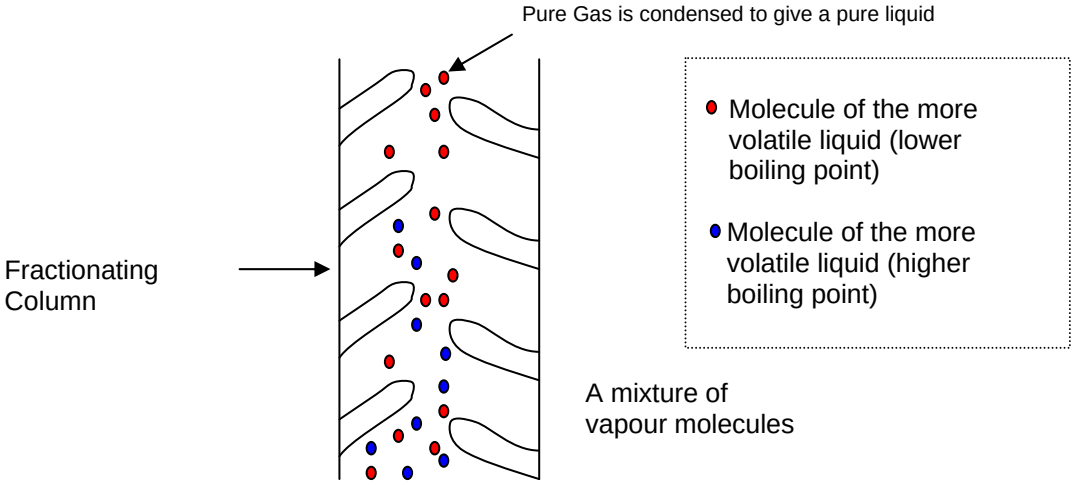


Figure 2.20 Typical fractional distillation apparatus



♦ Other Separation Techniques

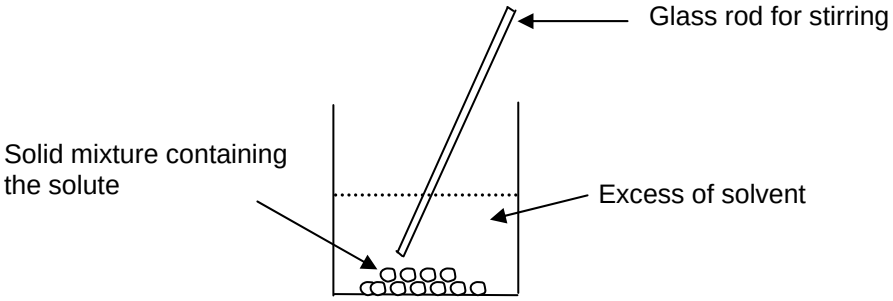
- Separating two immiscible liquids E.g. Oil and water: Use a **separating funnel**.
- Separating a suspension of a solid in a liquid E.g. Blood: Use a **centrifuge**
- Separating a soluble solid from an insoluble solid

Many mixtures consist of solids that have different solubility's. For example Sand and Sodium Chloride.

We can separate this mixture in three stages: - Dissolving
Filtering
Re-crystallisation

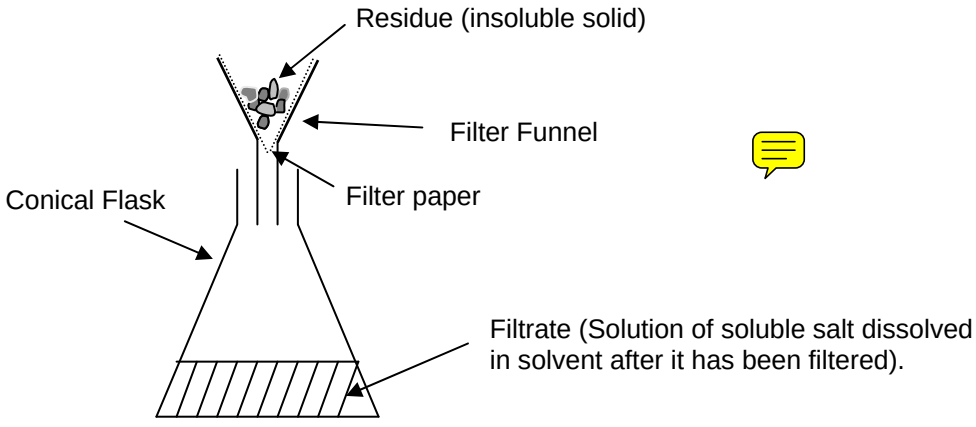
Dissolving

The first stage of the separation is to dissolve the soluble solid (solute) in a suitable solvent, normally water. In order to dissolve the solute, the solid mixture needs to be added to an excess of solvent and stirred.



Filtering

Once the solute has dissolved it can be separated from the insoluble solid by filtering.



Once the mixture has been separated the residue needs to be purified by washing it with extra solvent. The extra solvent will wash off any solute particles stuck to the wet residue.

Crystallisation

To get the pure solid solute back from the solution you need to heat the solution in an evaporating basin.