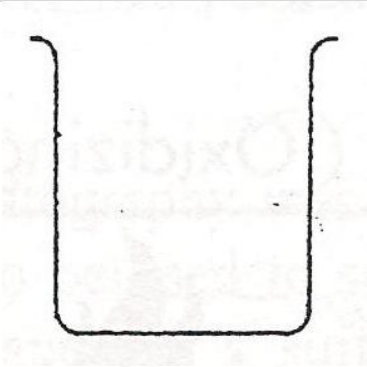
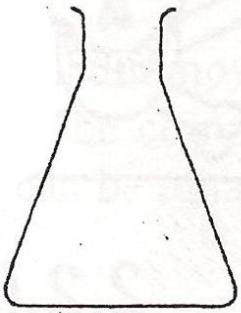
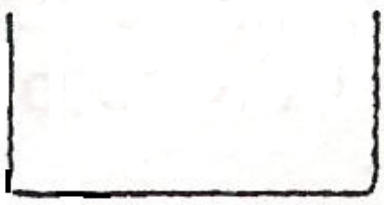
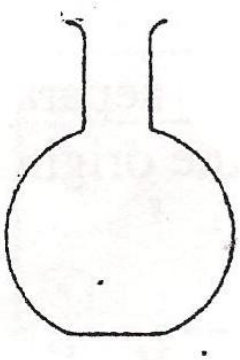
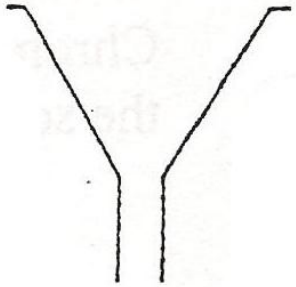
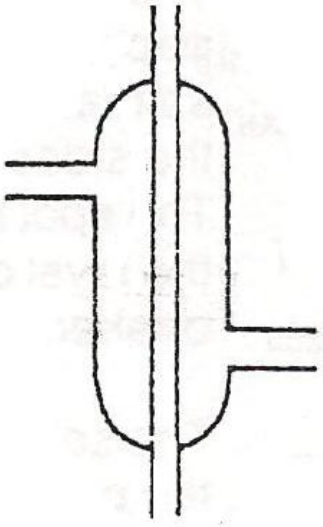
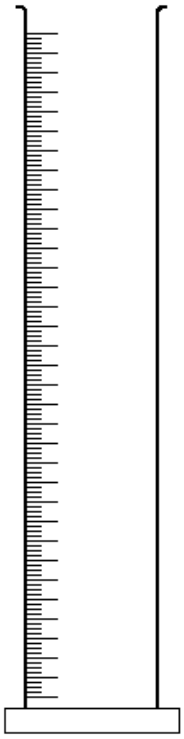
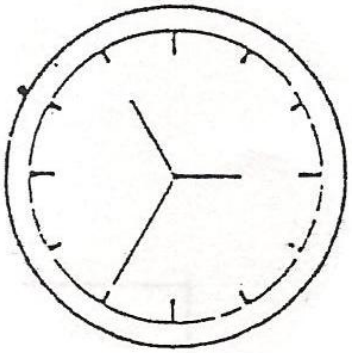
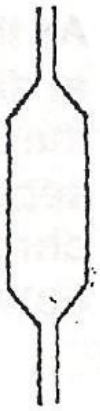
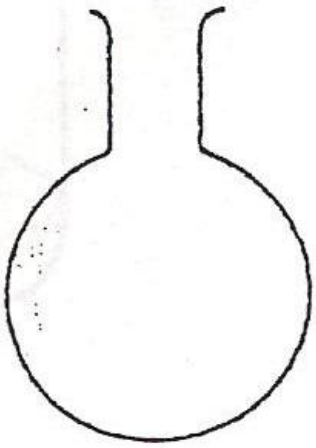
Experimental techniques

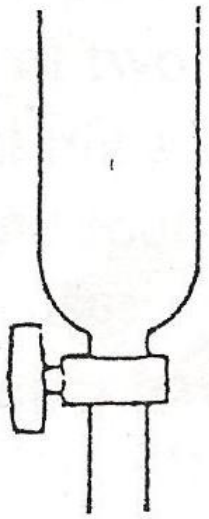
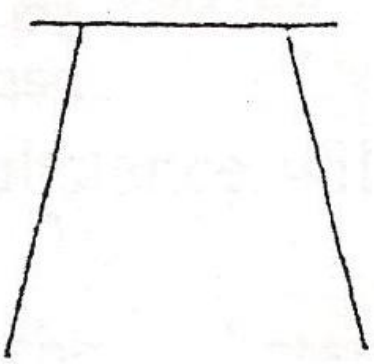
2.1 Measurement

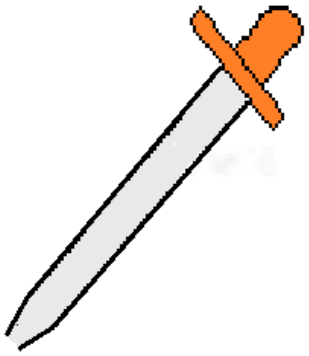
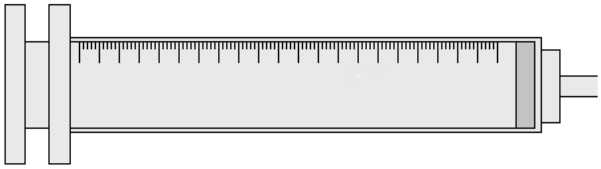
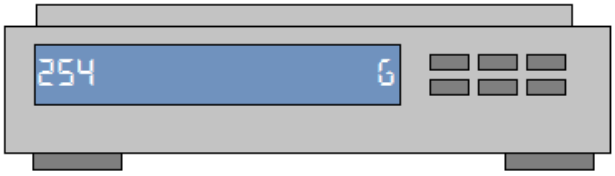
Apparatus used in the lab:

Name	Use	Picture
Beaker	Used to hold liquids	
Burette	Used to add accurate volumes of liquid	
Conical Flask	Used to hold liquids	
Crystallizing dish	Holds solutions evapourating into crystals	

Flat bottomed flask	Used to hold liquids which don't require heating	
Filter funnel	Used to separate solids from liquids	
Condenser	Used to condense vapours	
Measuring cylinder	Used to measure approximate volumes of a liquid	

Clock	Used to measure time in experiments	
Pipette	Used to dispense an accurate volume of liquid, can measure volumes of 10ml to 25ml	
Round bottomed flask	Used for heating liquids evenly	
Spatula	Used to handle small amounts of a solid	

Tap funnel	Used to add a controlled volume of a liquid	
Tripod	Used as a stand for flasks and beakers during heating	
Test tube	Used to hold liquids while being mixed.	

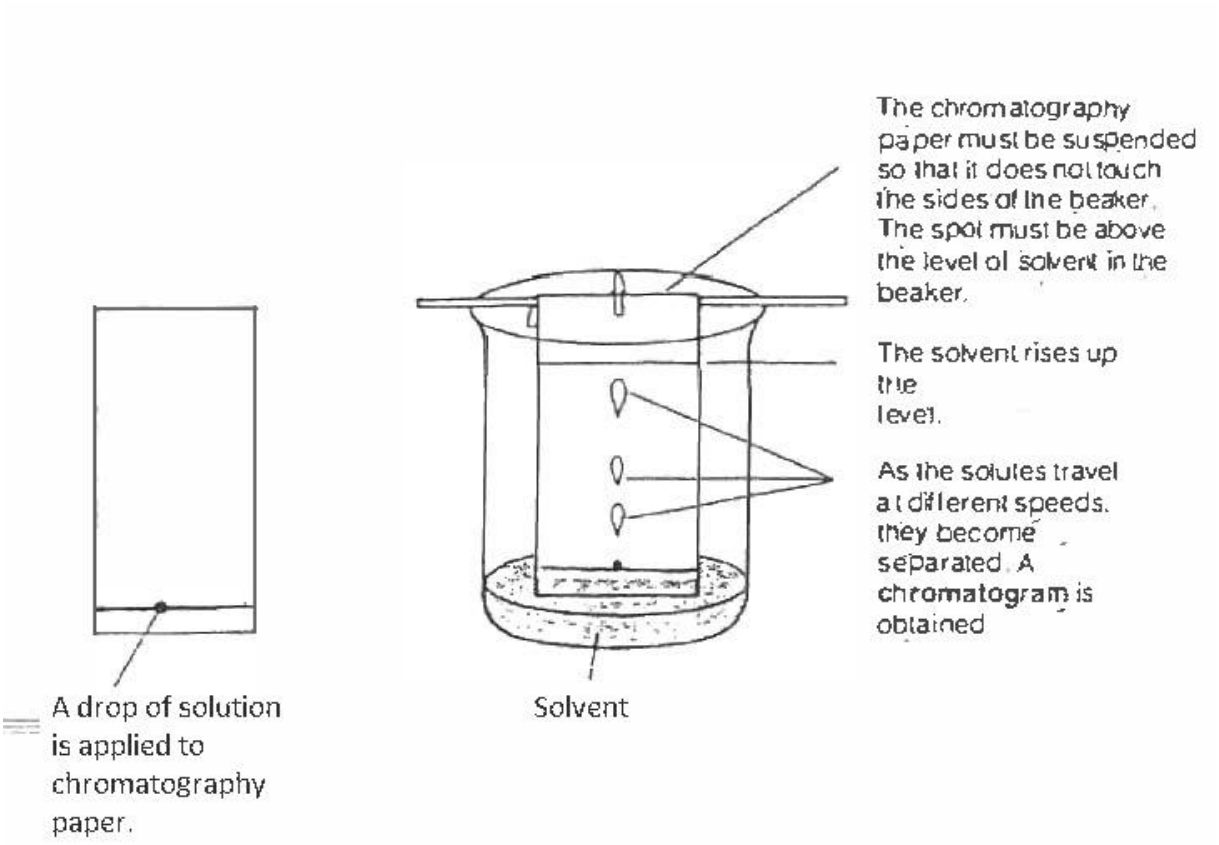
Boiling tube	Used to hold liquids while it is being heated.	
Dropping Pipette	Used to collect a small amount of liquid and drop the collect liquid as drops.	
Gas syringe	Used to collect gases emitted from reactions. Can also measure the volume of gas collected.	
Digital Balance	Used to measure the mass of solids or liquids in grams or kilograms	

2.2

(a) Criteria of purity

Chromatography:

Chromatography is used to separate several substances dissolved in a solution. A drop of the solution is placed on the origin line at the bottom of a chromatography paper.



The different solutes in the solution move up the paper with the solvent, but at different speeds. A solute, which is very soluble in the solvent, travels through the paper faster than a solute, which is only slightly soluble.

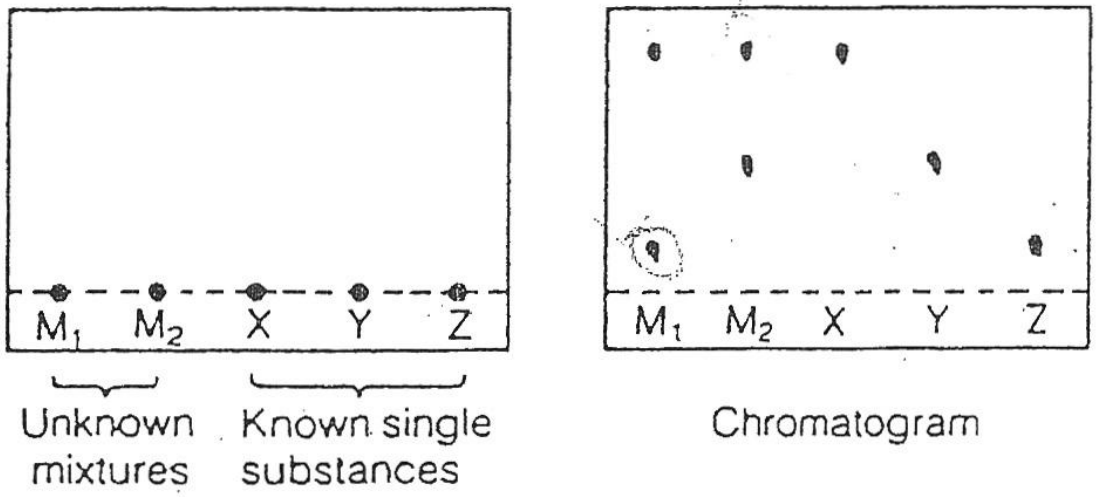
When the solvent reaches the top of the paper, the process is stopped. Different solutes will have traveled different distances. The result is a chromatogram.

Chromatography is only suitable for separating very small quantities. It is not only used to determine what a mixture consists of, but it is also used as a purity test. A single pure substance will produce only one spot.

Chromatography was originally devised to separate coloured substances in solution. It can also be used to separate colourless substances, which can be seen by spraying the filter paper by a suitable chemical called a locating agent, which colours the spots produced.

A chromatogram can be made of some known pure substances and one unknown. The positions of the different components of the unknown substance can be compared to those

of the known substances. The figure below shows how results can be obtained by this method.



The results show that M_1 is a mixture of X and Z
and M_2 is a mixture of X and Y.

How to obtain results from the chromatograms

<u>Testing for purity:</u>

Testing for purity of many substances such as foodstuffs and drugs can be carried by either one of two methods:

1. By making a chromatogram for the substance. A single pure substance will produce only one spot.

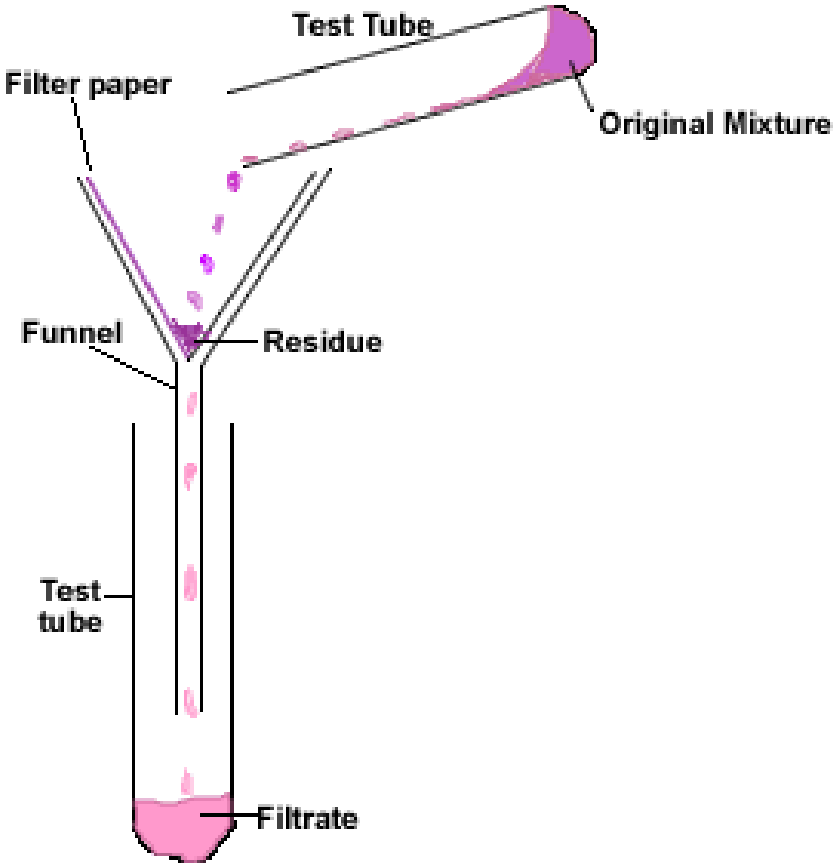
2. By measuring the melting point or the boiling point of the substance. Pure substances have their own fixed melting & boiling points.

(b) Methods of purification

1) Filtration:

This method is used to separate:

- A solid from a liquid
- An insoluble solid from a soluble one. The soluble solid is dissolved and can be removed by evapouration



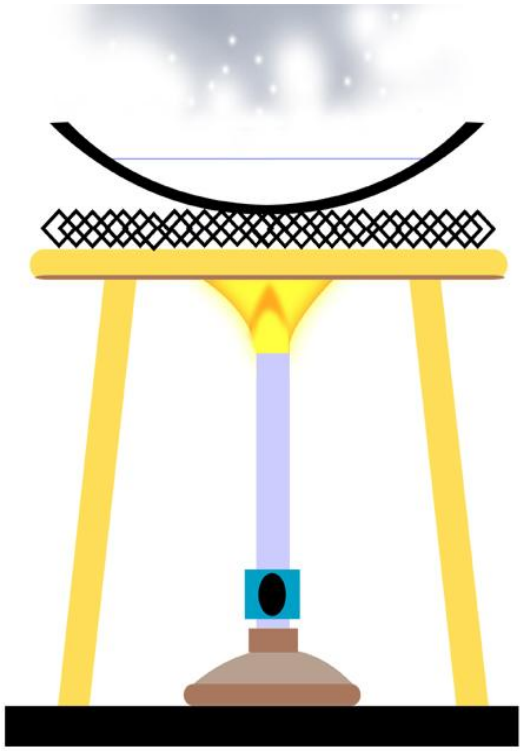
Filtration is carried out by pouring the mixture through the filter paper. The liquid that goes through is called the filtrate; the solid that remains behind is the residue. To obtain the pure sample of the soluble solid the filtrate is evapourated.

Decantation

It is an alternative method in which the solid is left to settle. Then the liquid is poured leaving the solid behind.

2) Evapouration:

This evapouration is used to recover a solute form its solution. For example, to recover NaCl from sea water, sea water is boiled so that water is released as a vapour and NaCl is left in the evapourating basin.



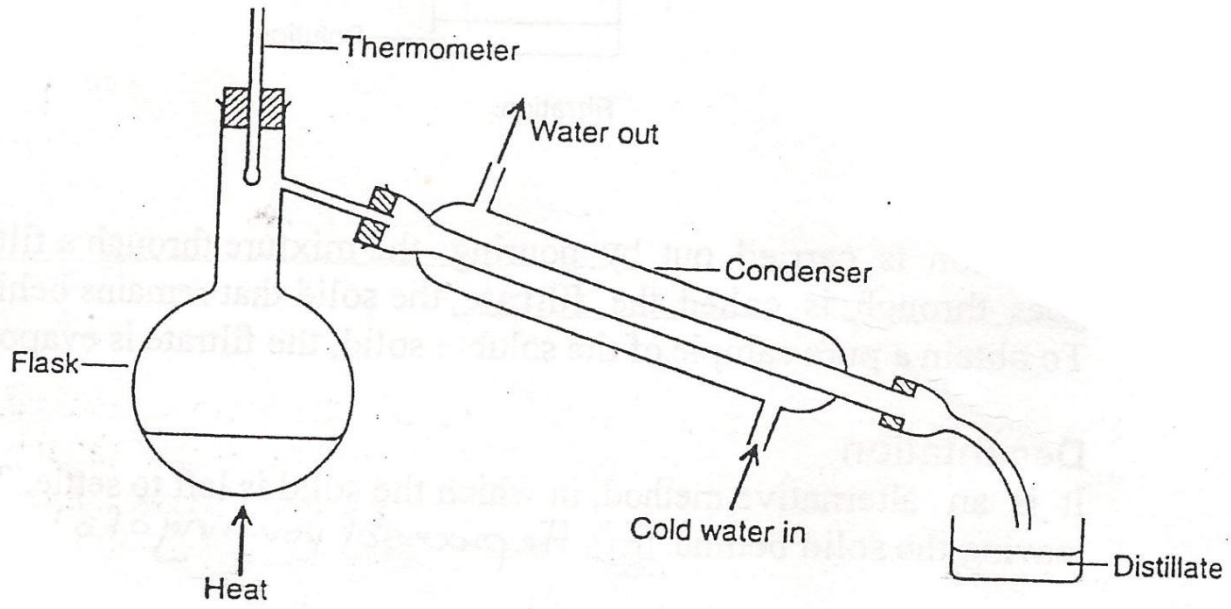
The solution is boiled so that the liquid is released as a gas and the solid is left in the evapourating basin.

Crystallization

It is an alternative method to recover a solute from its solution. The solution is evapourated to the crystallization point, i.e. the point at which crystals of the solute will form on cooling, which can filtered out, washed and dried.

3) Distillation

This method is used to recover a solvent from a solution e.g. getting pure water from sea water. Distillation involves boiling followed by condensation. When the flask is heated the solution boils and steam passes into the condenser where it is cooled by cold water passing through the outer condenser tube. The steam condenses and the distillate (distilled water) collects in the receiver. The salts (impurities) are left in the flask.



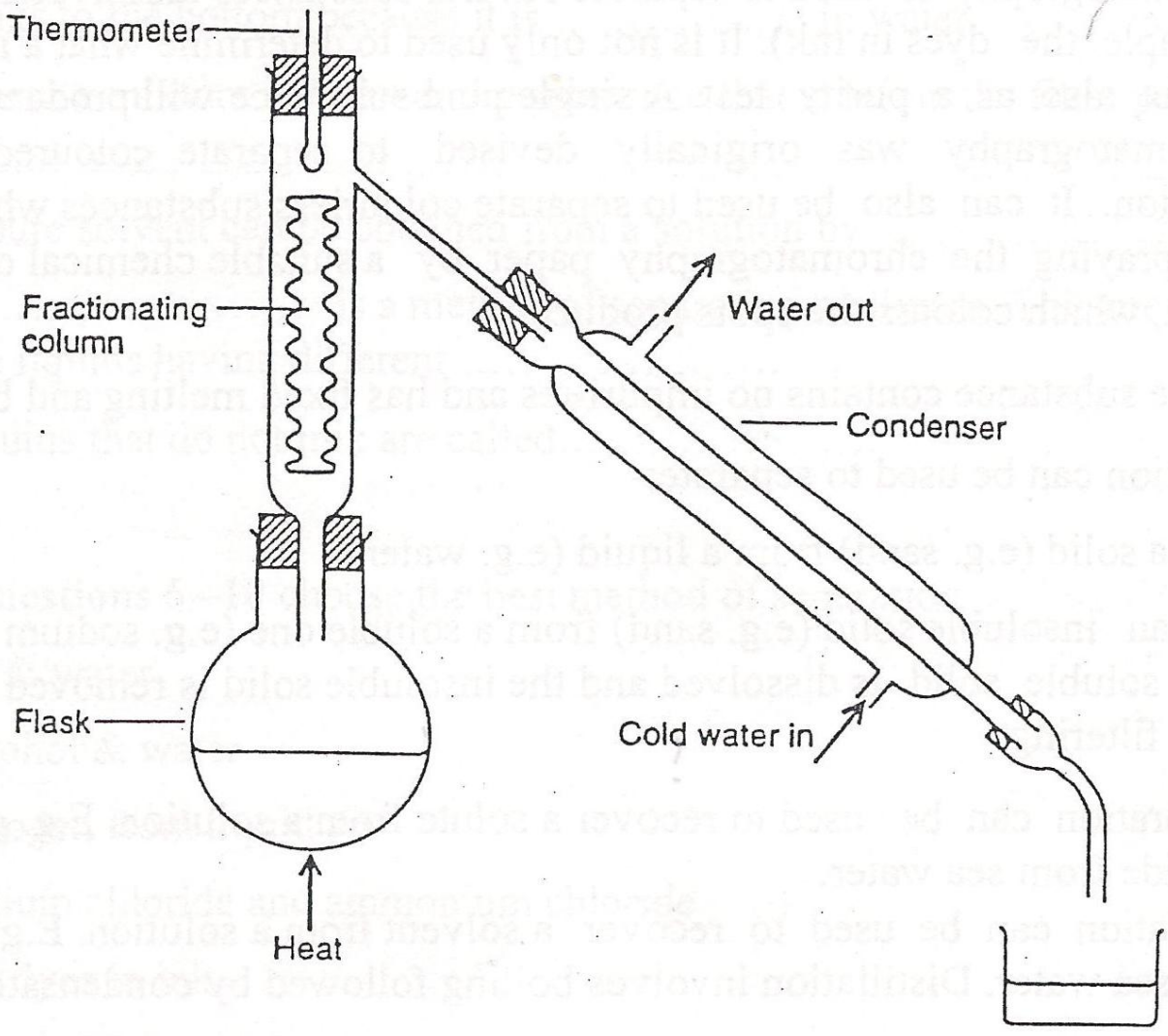
4) Sublimation:

Sublimation is used to separate a mixture of two substances where only one of the two substances sublimes.

For example, if a mixture of ammonium chloride and sodium chloride is heated, the ammonium chloride turns directly to vapour (sublimes) but the sodium chloride remains unchanged. When the vapour is cooled, solid ammonium chloride collects free from sodium chloride.

5) Fractional distillation:

This method is used to separate a mixture of miscible liquids with different boiling points. e.g. a mixture of ethanol (78°C) and water (100°C).



Fractional distillation

The mixture in the flask is heated so that it boils. Both ethanol vapour and water vapour go up the fractionating column until the vapour of water (the liquid with higher boiling point 100°C) condenses in the fractionating column and drips back into the flask, while the vapour of alcohol (the liquid with lower boiling point 78°C) reaches the top of the column and distils over and is collected first.

Important applications of fractional distillation
a. The separation of liquid air into oxygen and nitrogen.
b. The separation of crude oil (petroleum) into useful fractions.
c. The separation of fermented liquor into alcohol and water.

If the liquids are immiscible (such as a mixture of oil and water) they can be separated using a tap funnel.