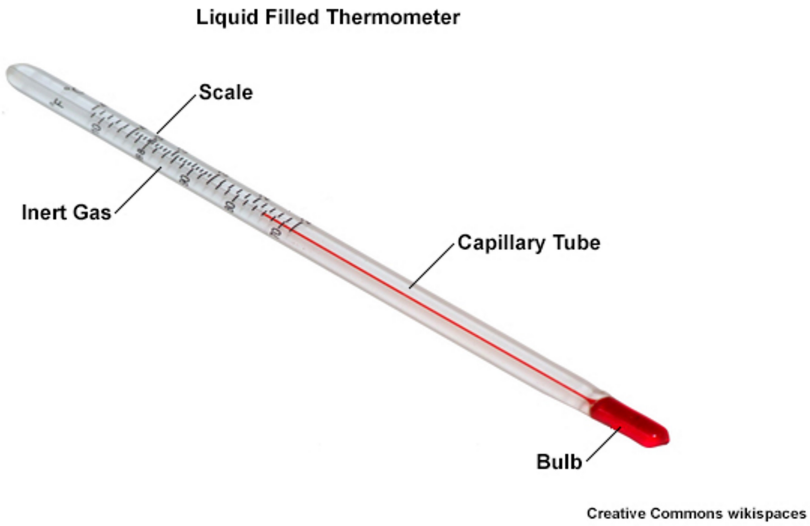
Experimental Technique

Sunday, September 20, 2020 1:54 PM

2.1:
Measurement

Temperature: Is a the measure of a substance's average kinetic energy. It is more commonly known as a measuring unit to measure degree of 'hotness.'

Devices to measure include digital and in-glass thermometers. Digitals are more accurate. In glass thermometers have a bulb which normally contains either alcohol or mercury.



2 fixed points of a thermometer are:

1) 0 °C (melting point of pure ice)
2) 100 °C (boiling point of pure water)

Time:

Can be measured with a stopwatch, either digital or analog. Digital is more accurate. Often times than not, time period is not measured as accurate as possible and this is due to human reaction time.

Mass: It is defined as the fundamental unit that makes up matter.

Physics tip: It is also the property that causes the resistance to a change in motion (Inertia)

Can be measured by digital/electronic balance or weighing scale, with the latter being less accurate.

Volume: It is the amount of space a substance occupies.

In the laboratory, you will be able to different apparatus which are able to measure volume. All of them have varying degrees of accuracy and should be used for different purposes. When doing an experiment, if the instruction does not specify the need to be 'exact' or doing Qualitative Analysis, it would be much more efficient to use apparatus that does not yield such high accuracies.

These apparatus can be used to measure volume:

1) Measuring cylinder
2) Volumetric flask
3) Beaker
4) Burette
5) Pipette
6) Gas syringe

Pipette is the most accurate, followed by burette.

2.2:
Purity

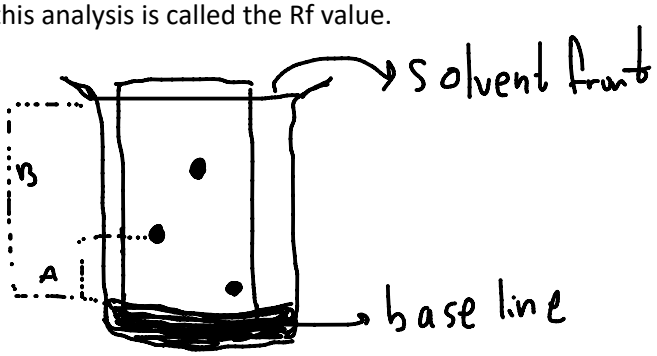
A substance is named pure if it only consists of that substance only, whether element, compound or molecule-wise. A pure substance will have a fixed melting and boiling point. If another substance is in it which disrupt this state of purity, it is known as an impurity.

This concept is very important across different types of industries mainly food science as well as medicine. In medicine, such slight impurities may alter the usage of the drug or even worse, pose life-threatening situations.

An impure substance will melt at a **lower temperature** and boil at a **higher temperature.** A way to remember this is that melting point is lower than boiling point and hence will get lower as well.

Paper Chromatography: It is an analytical technique which separates mixtures into its individual components. This technique takes advantage of the solubility of different types of material in a particular solvent. This is why different spots can travel different distances in the paper.

Process:
1) Mixture is dissolved in suitable solvent (eg: water or ethanol)
2) Solution travel across paper
3) The further it travels, the more soluble. The more attracted it is to the paper, the less it travels. If the mixture does not separate into individual components, mixture is not soluble in that solvent
4) The distance it travels determines the classification of that component. The value that helps with this analysis is called the Rf value.



$Rf = \frac{A}{B}$

* If colourless, locating agent is sprayed

Substance has specific Rf values. This is how drug tests are performed around. Certain drugs already have their Rf values identified and hence, can be detected.

From this technique, it can be assumed that the number of substances in a mixture is the number of dots. To add to that, if the dots travel an equal distance, they are of the same substance.

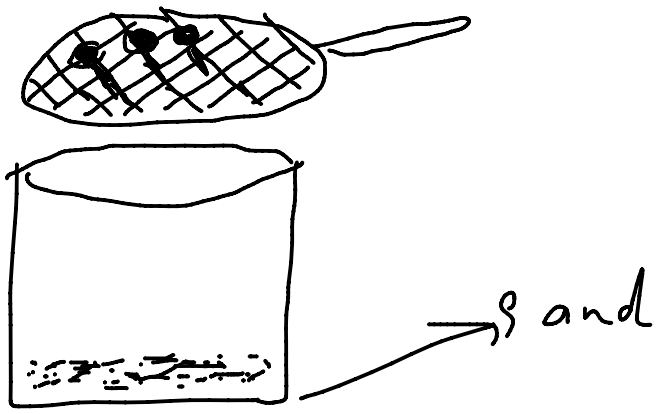
Other uses of this technique is also in determination of DNA.

2.2:
Methods of Purification

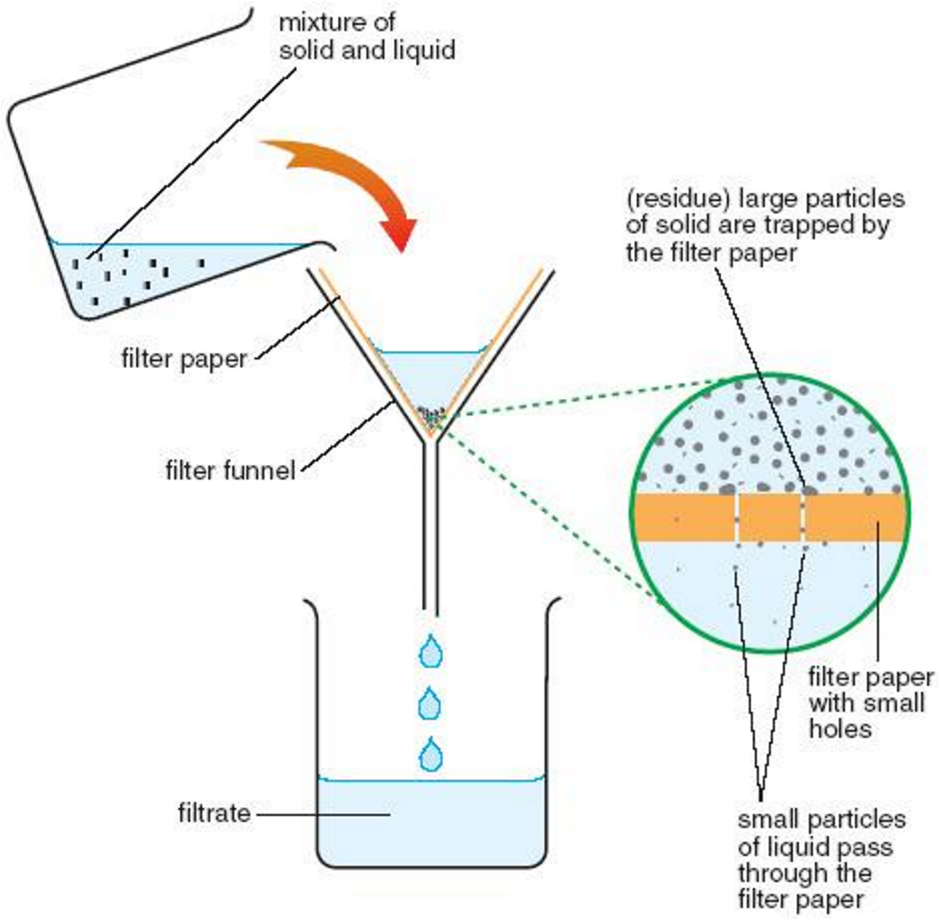
Mixtures are substances that can be separated by these methods as they are physically combined, unlike molecules and compounds, which require more complex methods such as that of electrolysis. The techniques that can be used are:

1) Sieving
2) Filtration
3) Crystallization/evaporation
4) Distillation
5) Fractional distillation

Sieving: the seperation technique used when the mixture is made up of 2 substances that have varying sized. For example, sand and iron nails.

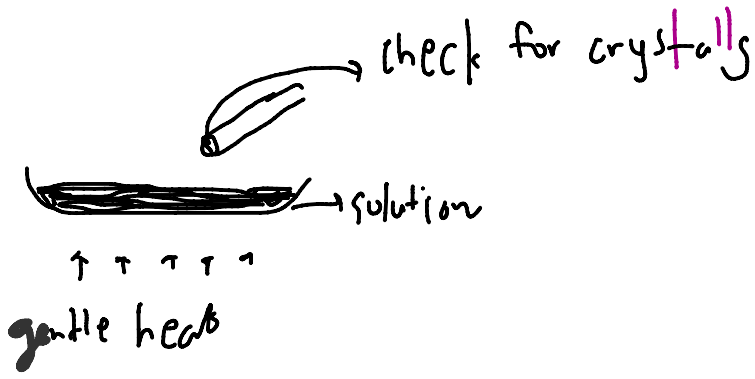


Filtration: The separation technique used for two substances that are insoluble with each other and that one of them is in liquid or aqueous state. For example, a mixture of water and AgCl (silver chloride is insoluble in water)



https://sites.google.com/site/christianscienceeportfolio/math/separation-techniques

Crystallization or Evaporation: The separation technique where solute can be taken from a mixture. For example, sugar solution.

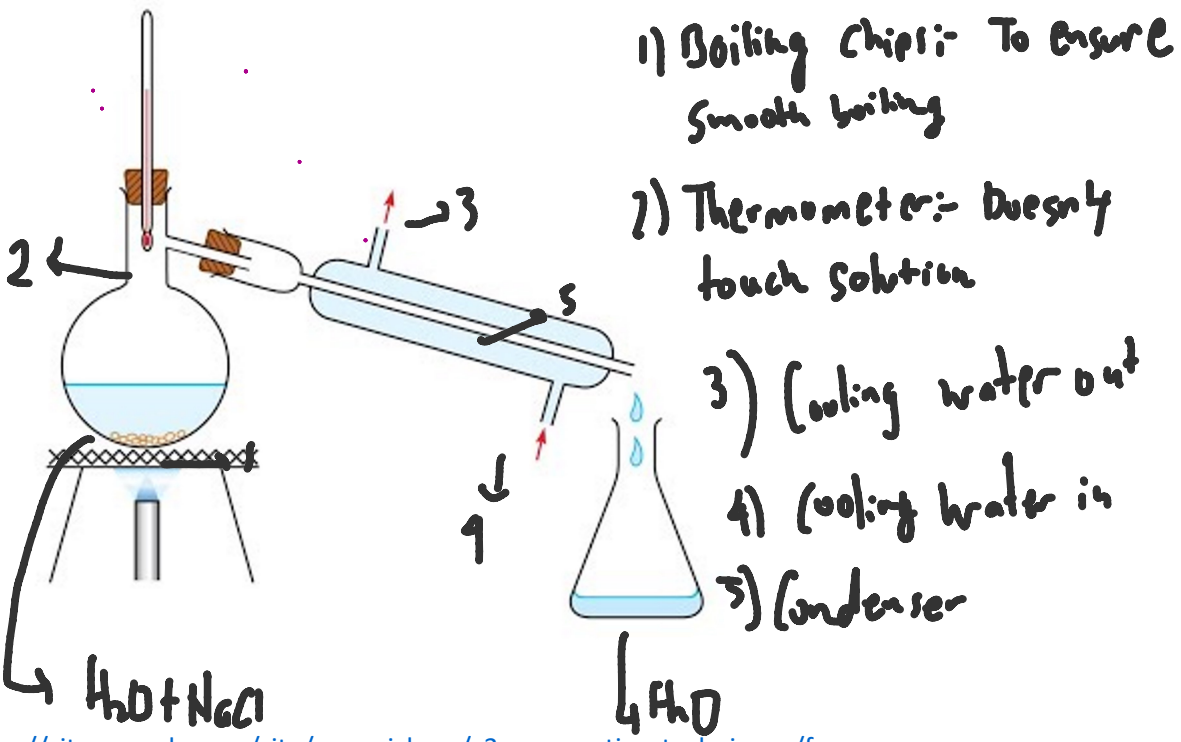


Steps:

1) Start heating up the solution. Only a gentle intensity of heat is required
2) Every now and then, dip a glass rode into the solution and check if there lies any formation of crystals I the tip
3) If crystals more, this means the solution has reached its **crystallization point**. Stop heating and leave it to cool
4) If further separation is required to purify the solute, rinse gently with distilled water and undergo filtration.

Distillation: It is a separation technique where it is able to separate a solvent from a solution.

For example, extracting water from salt solution.

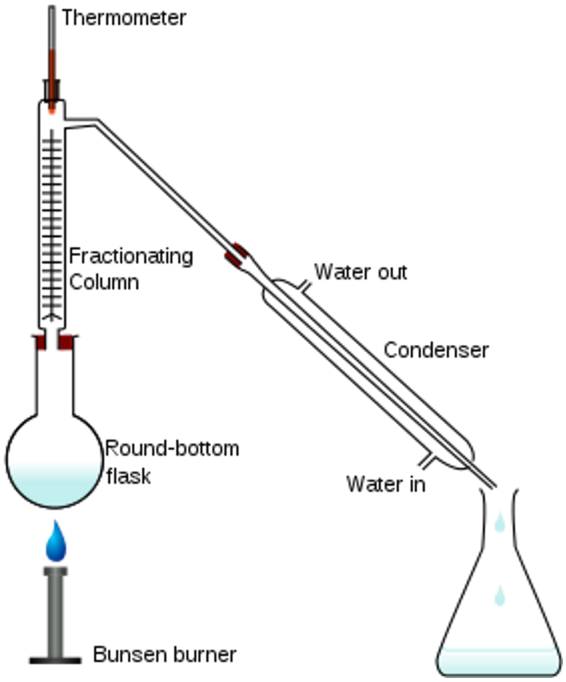


https://sites.google.com/site/sqssscichem/c3---separation-techniques/faq

Process:

1) Mixture will undergo heating
2) When the boiling point on one of the substances is reached, it will start to boil of as vapour
3) This vapor will travel to the condenser, where it will lose its energy to the water in the condenser.
4) Water is collected as its boiling point is considerably lower compared to water

Fractional distillation: A separation technique specifically used to separate a mixture of liquids into its individual components. These liquids usually have boiling points that are close to each other and hence cannot be separated with the technique before. Examples are petroleum and product of fermentation.



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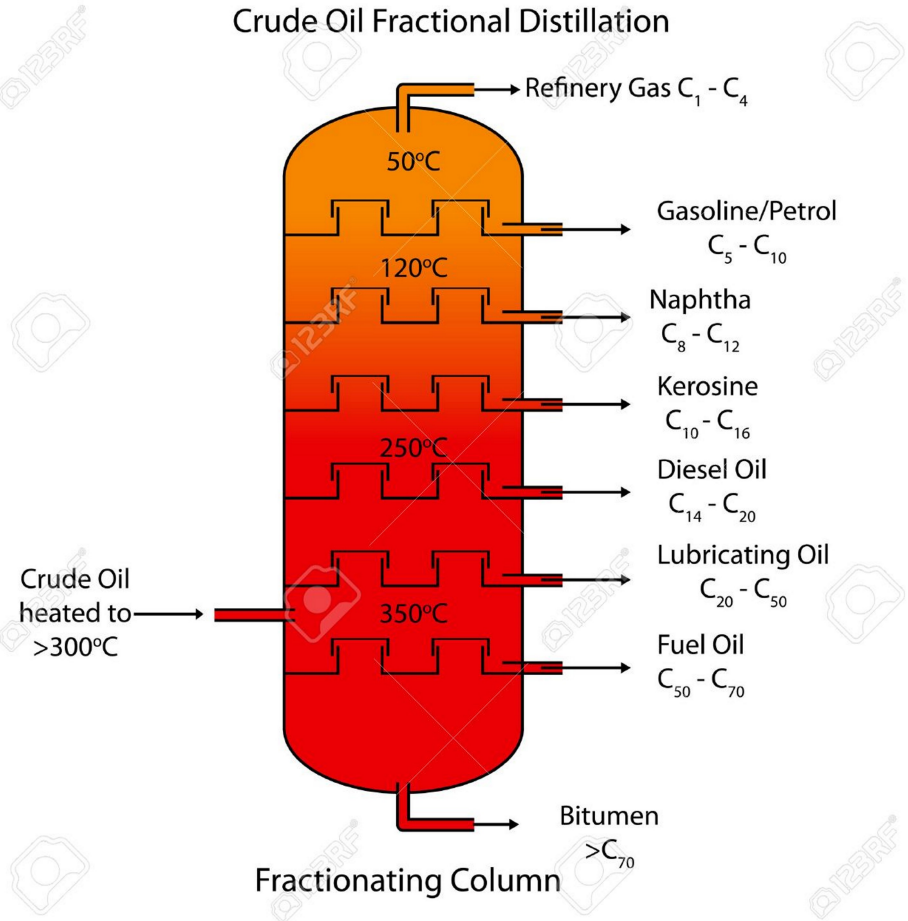

https://www.britannica.com/science/fractional-distillation

Usage of Fractionating Column?
The fractionating column is there to avoid more than 1 type of liquid to boil or evaporate at the same time. As stated earlier, a lot of the individual components have very similar boiling points and hence may evaporate at the same time. The way fractionating columns work requires a deeper context but for now, it is required for us to understand that at a certain temperature, due to proximity in boiling point, two components may start to turn into gas, whether through boiling or evaporation. As they travel upwards, the temperature gradient decreases. The component which turned into gas due to evaporation will have less energy and hence, as it travels upward, when its energy corresponds to that of a liquid, it will condense back to the mixture.

In exams, it is crucial to first understand what is being asked. For example. Obtaining salt from water would require a different method compared to obtaining water from salt. General tips that can be said would be:

1) If it is colorless, spray a locating agent
2) If the mixture that is being separated are biology-related like amino acids, these substances do not like heat, hence, chromatography is used
3) If sugar is the one being obtained, crystallization is preferred over evaporation as evaporation heats till dryness hence crystals may not form