GRAYS TUITION CENTRE – Online Tutoring

WEEK: 5

Week Beginning: (18/01/2021)

Subject: SCIENCE

Year: 8

Lesson Objective:

- Separating mixtures

Keywords/ Concepts

- Filtration
- Evaporation
- Chromatography
- Simple/Fractional Distillation
- Melting/Boiling Points

Class Questions

Homework

- Worksheets

Additional Notes

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Classwork

Separating Mixtures

There are all sorts of ways you can separate mixtures. You've got to know four of them.

Mixtures Can be Separated Using Physical Methods

There are four separation techniques you need to be familiar with.

1) FILTRATION 2) EVAPORATION 3) CHROMATOGRAPHY 4) DISTILLATION (see next page).

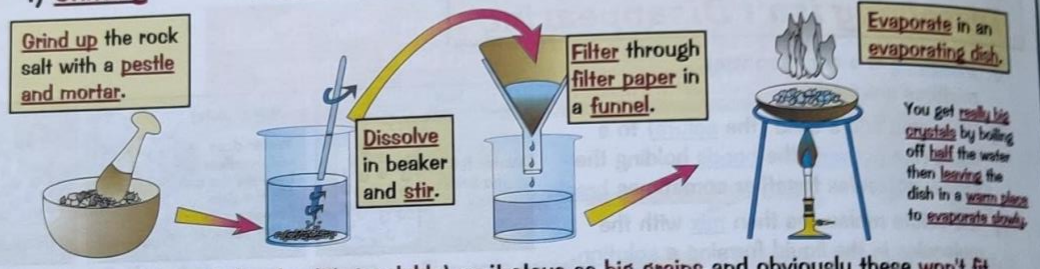
All four make use of the different properties of the constituent parts to separate them out.

Filtration and Evaporation — E.g. for the Separation of Rock Salt

1) Rock Salt is simply a mixture of salt and sand (they spread it on the roads in winter).
2) Salt and sand are both compounds — but salt dissolves in water and sand doesn't.
This vital difference in their physical properties gives us a great way to separate them.

You Need to Learn the Four Steps of the Method:

1) Grinding 2) Dissolving 3) Filtering 4) Evaporating



- The sand doesn't dissolve (it's insoluble) so it stays as big grains and obviously these won't fit through the tiny holes in the filter paper — so it collects on the filter paper.
- The salt is dissolved in solution so it does go through — and when the water's evaporated, the salt forms as crystals in the evaporating dish. This is called crystallisation. (Surprise surprise.)

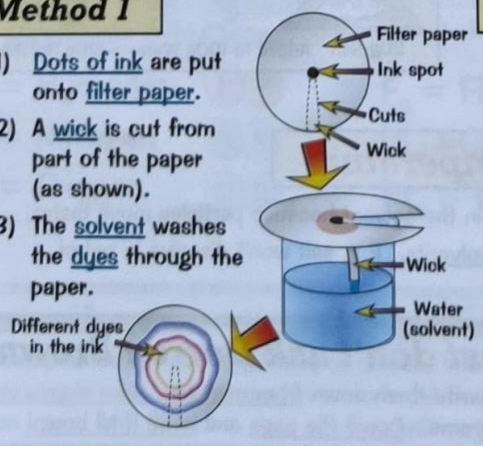
Chromatography is Ideal for Separating Dyes in Inks

1) Different dyes in ink will wash through paper at different rates.
2) Some will stick to the paper and others will dissolve in the solvent (see below) and travel through it quickly.

Chromatography can also be used to identify blood samples and investigate chlorophyll.

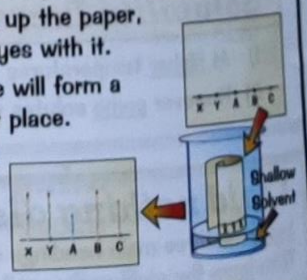
Method 1

1) Dots of ink are put onto filter paper.
2) A wick is cut from part of the paper (as shown).
3) The solvent washes the dyes through the paper.



Method 2

1) Put spots of inks onto a pencil baseline on filter paper.
2) Roll the sheet up and put it in a beaker.
3) The solvent seeps up the paper, carrying the ink dyes with it.
4) Each different dye will form a spot in a different place.
5) You can compare a forged ink to a known ink to see which it is.



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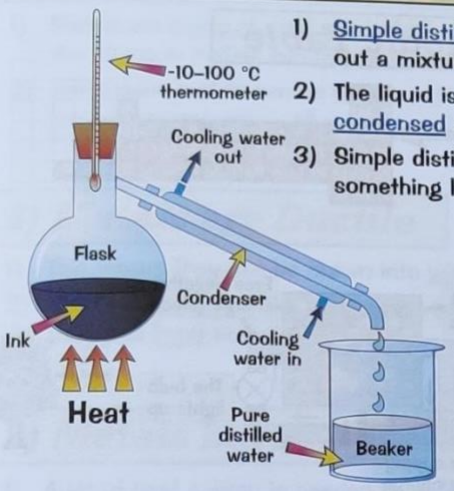
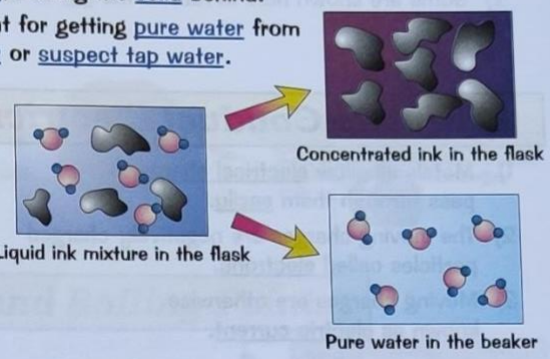
Separating Mixtures

Simple Distillation Separates Pure Water from Ink

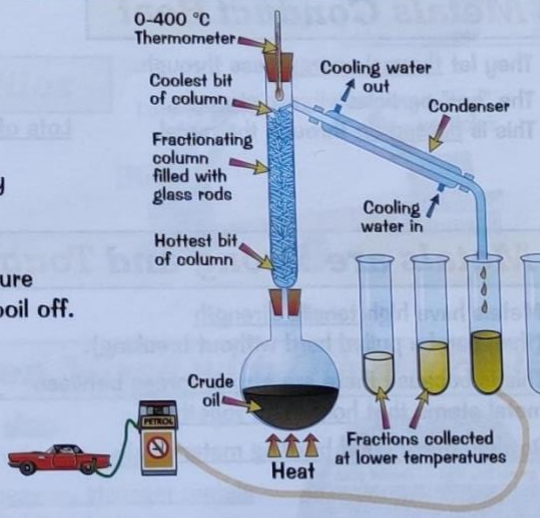


1) Simple distillation can be used for separating out a mixture of a liquid and a solid.
2) The liquid is heated and boils off. It's then cooled, condensed and collected, leaving the solid behind.
3) Simple distillation is great for getting pure water from something like sea water or suspect tap water.



Fractional Distillation Separates Mixed Liquids

1) Fractional distillation is used for separating a mixture of liquids like crude oil.
2) Different liquids will boil off at different temperatures, around their own boiling point.
3) The fractionating column ensures that the "wrong" liquids condense back down, and only the liquid properly boiling at the temperature on the thermometer will make it to the top.
4) When each liquid has boiled off, the temperature reading rises until the next fraction starts to boil off. This means the fractions are obtained pure.
5) Real life examples include:
   - distilling whisky,
   - separating crude oil into petrol, diesel and other fuels.



Check Purity with Melting and Boiling Points

1) A pure chemical substance has fixed melting and boiling points. E.g. pure water boils at 100 °C and pure ice melts at 0 °C. These figures are known for a huge range of substances.
2) This helps us to identify unknown substances, e.g. if a liquid boils at exactly 100 °C it's likely to be pure water.
3) Impurities change melting and boiling points, e.g. impurities in water cause it to boil above 100 °C.
4) This means you can test the purity of a substance you've separated from a mixture.

Pure Substance	Melting Point °C	Boiling Point °C
Water	0	100
Ethanol	-114	78
Aluminium	660	2520

Revise mixtures — just filter out the important bits...

Teachers love asking you about separation techniques (strange, I know), so make sure you've got all the facts AND the diagrams absolutely 100% learnt. Make sure you know how to check purity too.

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Separating Mixtures

Q1 Mixtures can be **separated** by different methods. For each of the mixtures below say which **method** you would use to separate them. Write F for **filtration**, D for **distillation**, E for **evaporation** and C for **chromatography** below the relevant diagram.

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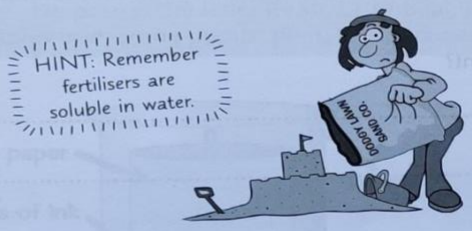
Q2 The local garden centre sells lawn sand, which is a **mixture** of **sharp sand** and **fertiliser** (ammonium nitrate). It should be made up from a **50/50** mix of each, measured by weight. Your neighbour has bought some but believes that the garden centre has cheated her by adding more of the sand (which is not as valuable as the fertiliser). Your neighbour has asked you to help her prove that she has been cheated. Outline briefly the steps you would take to test her idea and explain briefly **why** you are doing each step.



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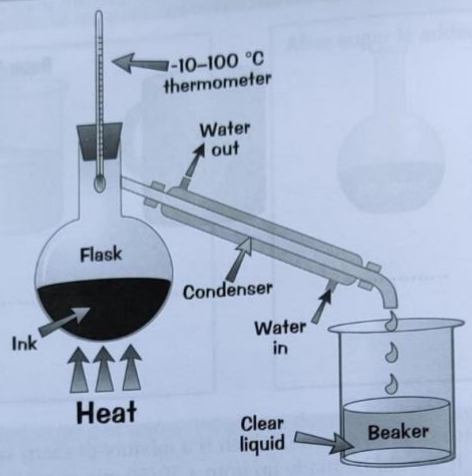
Homework

Separating Mixtures

Q3 Byron was told that ink is a mixture of dye and water. He decided to test this theory using the apparatus below to separate the mixture.



After heating the ink for a while he found that a **clear liquid** collected in the beaker.

a) What is the name of this method?

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b) Why did he use a **condenser** in his experiment?

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c) Tick (✔) the statement that is **true** about this experiment.

- ☐ The dyes in the ink boil off, cool, and are collected in the beaker.
- ☐ The ink boils off, cools and is collected in the beaker.
- ☐ The water in the ink boils off, cools and is collected in the beaker.
- ☐ The dyes and water in the ink boil off, cool and are collected in the beaker.

d) Suggest **one** other mixture that Byron could obtain **pure water** from using this method.

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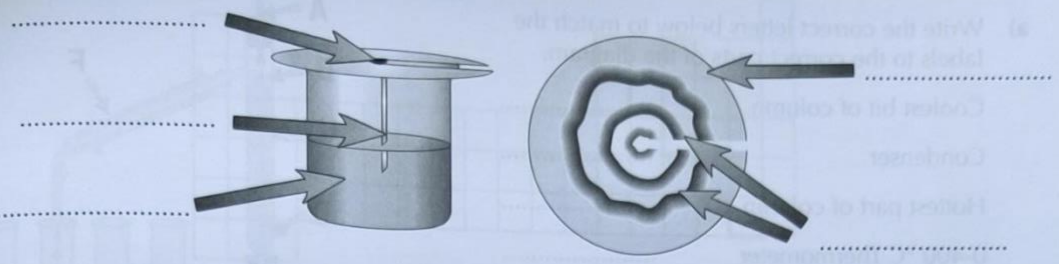
Separating Mixtures

Q4 **Chromatography** is used to **separate** the different dyes in an ink.

a) The picture below shows one method of chromatography. Fill in all the labels on the diagram.



b) Briefly describe how chromatography works.

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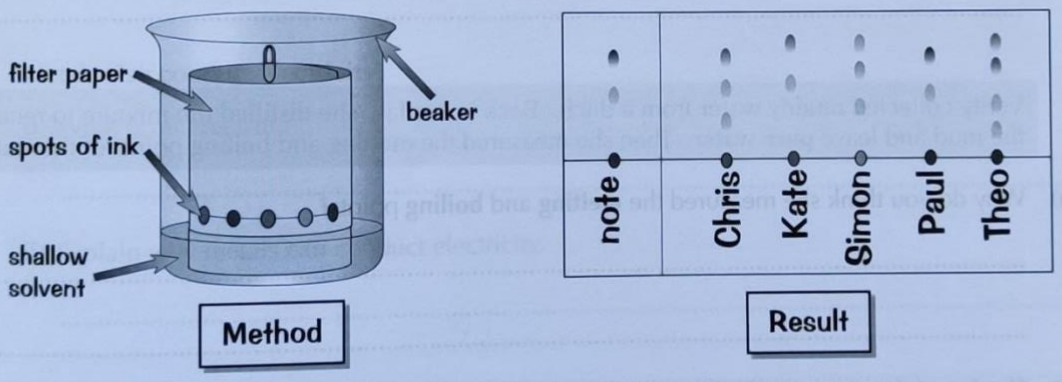
Q5 The Headmaster received an anonymous note from a Year 9 pupil demanding more chips at lunch time. He passed the letter to Mr. D. Orbital, Head of Chemistry, who analysed it along with **ink samples** from some pupils' pens. The pictures below show the analysis method and his **results**.



a) How many dyes were in the suspect's ink? .....

b) Who is likely to be the guilty pupil? .....

c) Give a clear **explanation** of the reason for your decision: .....

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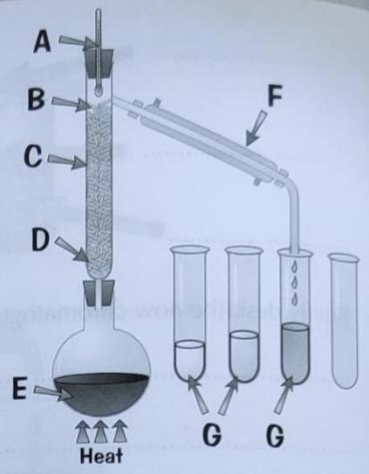
Separating Mixtures

Q6 Crude oil is a **mixture** of different liquids like petrol and diesel. Like all **mixtures of liquids**, it can separated using **fractional distillation** using the apparatus below.



a) Write the correct letters below to match the labels to the correct parts of the diagram.

Coolest bit of column .....

Condenser .....

Hottest part of column .....

0-400 °C Thermometer .....

Fractionating column .....

Collected fractions .....

Crude oil .....

b) Briefly **describe** the fractional distillation of **crude oil**.

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Q7 Verity collected **muddy water** from a ditch. Back in her lab, she **distilled** the mixture to remove the mud and leave **pure water**. Then she measured the **melting** and **boiling** points of the water.

a) Why do you think she measured the **melting** and **boiling** points?

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b) She found that the water **boiled at 100 °C** and **froze at 0 °C**. What does this tell you?

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c) Reg did the **same** experiment and found that the water **boiled at 102 °C** and **froze at –3 °C**. What does this tell you about the water that Reg distilled? Explain your answer.

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