

Purity, Formulations and Chromatography Notes

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A pure substance – consists only of one element or one compound.

A mixture – consists of two or more different substances, not chemically joined together.

A formulation – a mixture that has been designed to do something useful. Formulations include fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods. That covers most/all substances in chemistry.

Melting point and boiling point

These terms get a lot of use in chemistry but what do they mean?

Melting point: the temperature at which a substance changes from a solid state to a liquid state.

Boiling point: the temperature at which a substance changes from a liquid state to a gas state.

Chromatography

Paper chromatography: chromatography carried out by spotting (placing) drops of the sample on to paper and then allowing a solvent to move up the paper. Different components in the samples travel up the paper in the solvent at different rates.

Note: The line is drawn in pencil as pencil (graphite) is not soluble in water.

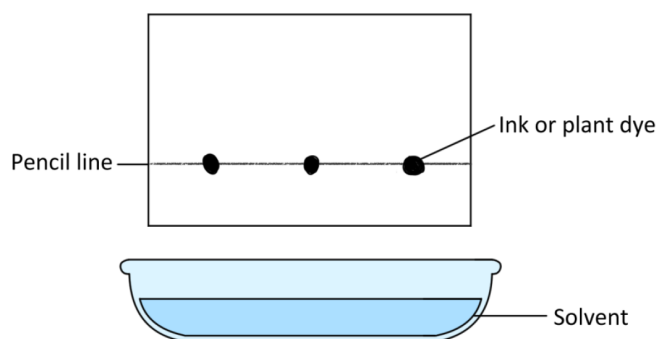
Where is chromatography used? Paper chromatography is used to separate mixtures of soluble substances such as inks. It can be used in forensic science to help police determine which pen was used to write a letter for example.

How does chromatography work? Basically, paper chromatography separates different substances based on their solubility. Less soluble substances don't move very far while very soluble materials could be found quite near the top.

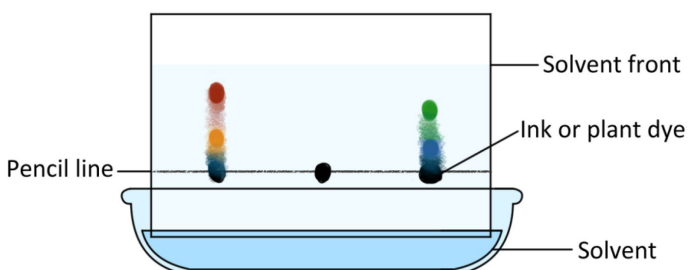
Chromatography has **two** phases the stationary phase and the mobile phase.

1. In the **stationary phase**, the samples are placed on to the paper.
2. In the **mobile phase**, the solvent moves up the paper, carrying the solutes as it moves.

The different dissolved substances in a mixture are attracted to the two phases in different proportions. This causes them to move at different rates through the paper.



The stationary phase



The mobile phase

You could also see questions on Gas Chromatography. Not much comes up for Gas chromatography at GCSE, it's more of an A level thing, and most students panic and think they have never been taught this. But chances are it was covered when you did paper chromatography it just isn't as memorable as there isn't a practical.

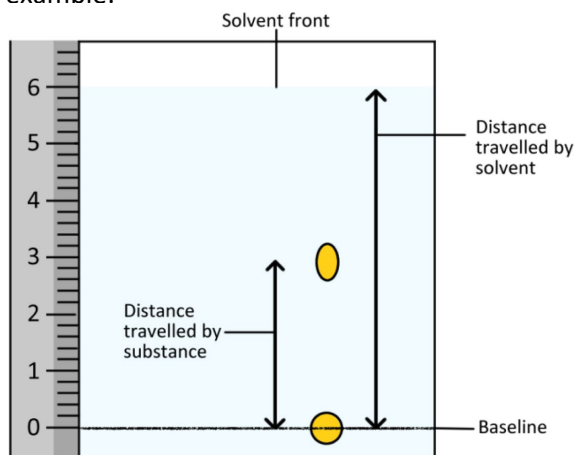
Calculating R_f

What is R_f and how do we calculate it? R_f is a value that represents how far a specific substance travels up the chromatography paper compared to the solvent. Every pure substance travels a specific distance in a given solvent, the R_f value acts as a unique numerical identifier that can be used to figure out what an unknown chemical is.

How is R_f calculated? The R_f value of a sample is calculated using the following formula:

$$R_f = \frac{\text{distance moved by the substance}}{\text{distance moved by the solvent}}$$

Take the following example:



$$R_f = \frac{3}{6}$$

$$R_f = 0.5$$

That's it 😊 R_f does not have a unit.

Exam hint: your calculated R_f value should be between 0 to 1. If you get values outside of this range something has gone wrong.

And finally, let's look at how to answer a very popular exam paper question. These types of questions ask you how to get a pure dry sample of a substance, usually out of a reaction that they give you in the question.

Take this example.

“Describe how a sample of pure, dry nickel sulfate crystals can be obtained from the mixture of nickel sulfate solution and excess solid nickel carbonate in the beaker.”

Ideal Answer

Content:	Marks
First, we should filter the solution to remove any remaining solid nickel carbonate.	(1)
Any two of the remaining points used correctly:	
<u>The filtrate/solution should then be heated in an evaporation dish to remove some of the water.</u>	(1)
<u>The solution should then be left to cool and crystallise.</u>	(1)
<u>Dry the crystals between two pieces of filter paper.</u>	(1)
	Total: 3 marks

The underlined content is the key information that you must mention to get the mark.