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TOPIC 1.2: SEPARATION TECHNIQUES

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THE ABOUT

CHAPTER ANALYSIS

TIME

- Relatively straight forward chapter
- 2 **key** concepts
- 3 **advanced** concepts

EXAM

- Usually tested in MCQs

  Tested as add-on to other chapters

  → Salts, Fuels & Crude Oil

WEIGHTAGE

- Light overall weightage
- Constitute to **0.5%** of marks for past 5 year papers

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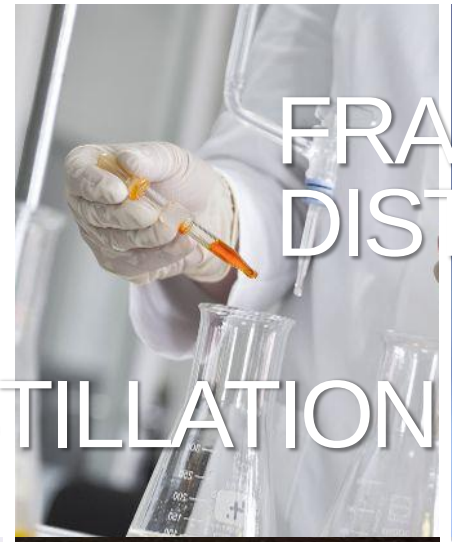
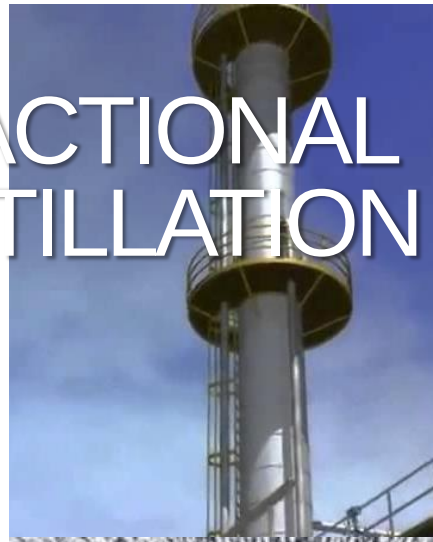
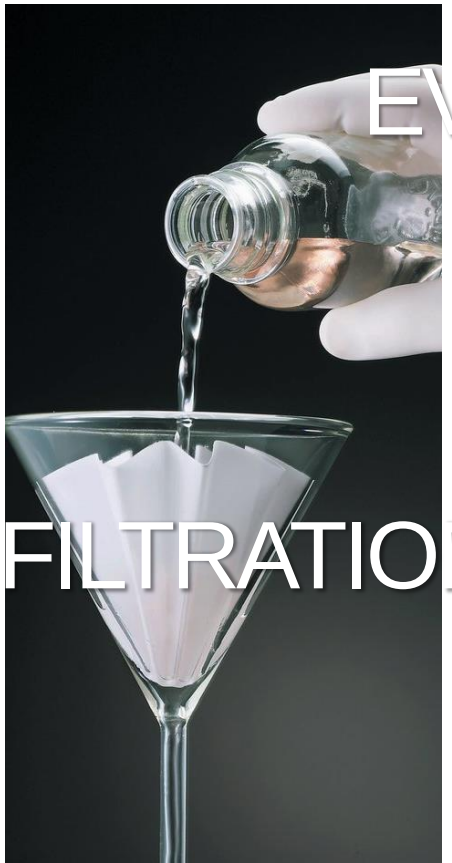
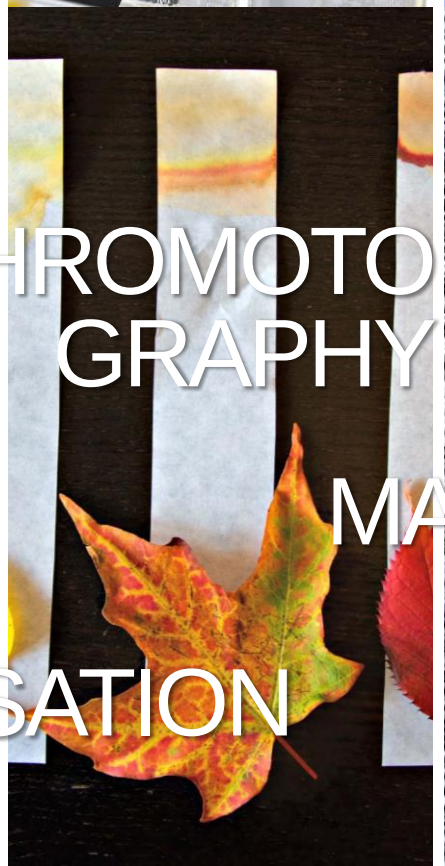
7 DIFFERENT SEPARATION TECHNIQUES









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PURE SUBSTANCE VS IMPURE MIXTURE

	Pure Substance	Impure Mixture
Definition	**Only one** type of substance	**Two or more** substances
Physical properties	**Fixed** proportion	Any ratio
	Fixed M.P. & B.P.	Have a **range of M.P. & B.P.**
	Single spot on chromatogram	Multiple spots on a chromatogram

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COMPOUND VS MIXTURE

	Compound	Mixture
Formation	**Chemically** combined	**Physically** combined
Separation technique	Can be separated using chemical methods (Decomposition, electrolysis, reduction with carbon)	Can be separated using physical methods (**separation techniques**)
Composition	**Fixed** ratio	Any ratio
m.p/b.p	**Fixed** mp & bp	Have a **range of M.P. & B.P.**

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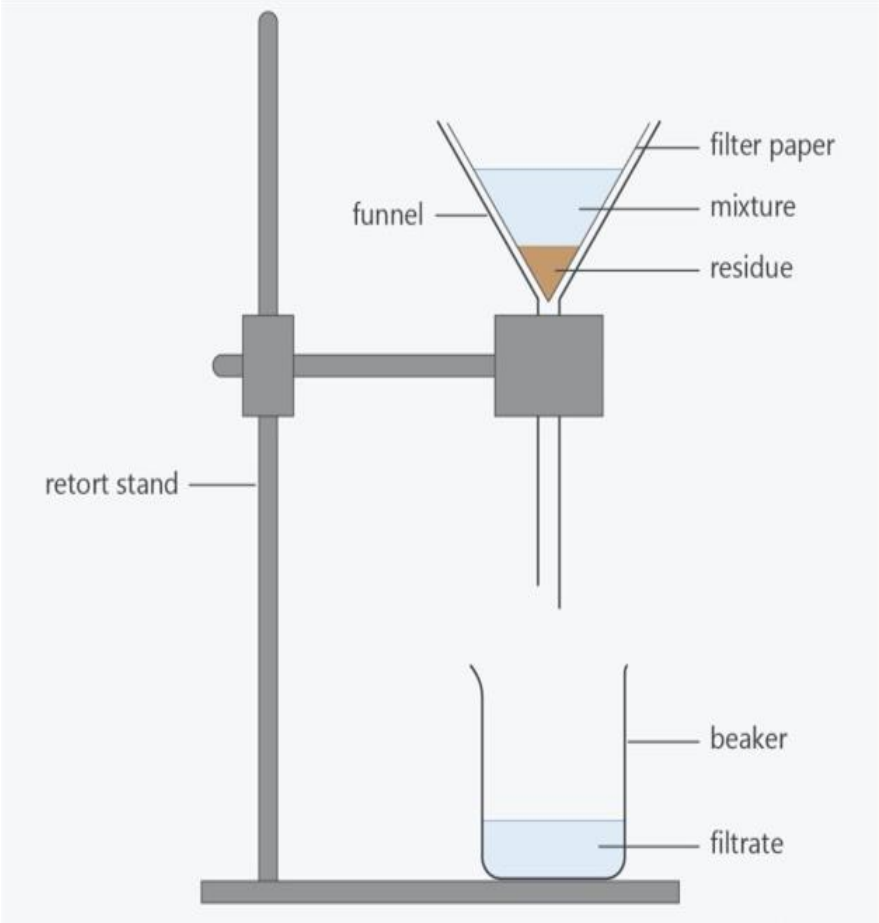
FILTRATION



1) Put a filter paper onto the filter funnel.

2) Pour the mixture into the filter funnel.

3) The **residue** will remain in the filter funnel while the **filtrate** will be collected in the beaker.

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MAGNETIC SEPARATION

Magnetic Materials

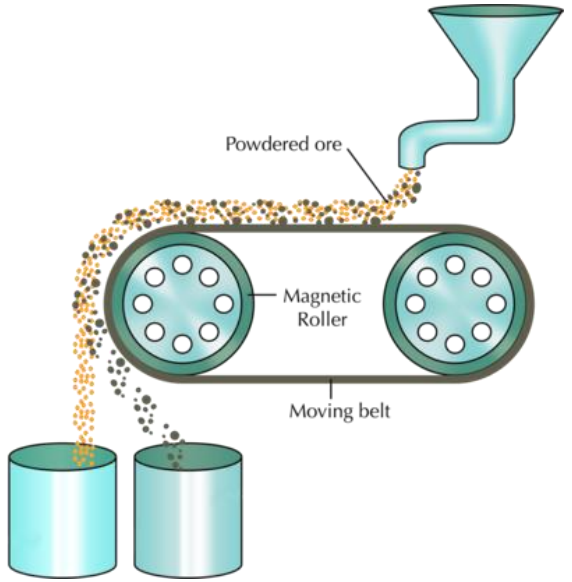
Nickel

I ron

C obalt

S teel

Magnetic separation is used to separate magnetic material from a mixture with other non-magnetic materials. (Scrapeyard)



St' Nics girls are pretty right? Know a Nicholas that is handsome? Are you attracted? That's right, magnetic material.

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KEY CONCEPT

Many students are confused when it comes to these 2 separation techniques:

How **exactly are they different and in which scenarios** do we use them?

TWO METHODS
EVAPORATION TO DRYNESS
CRYSTALLISATION

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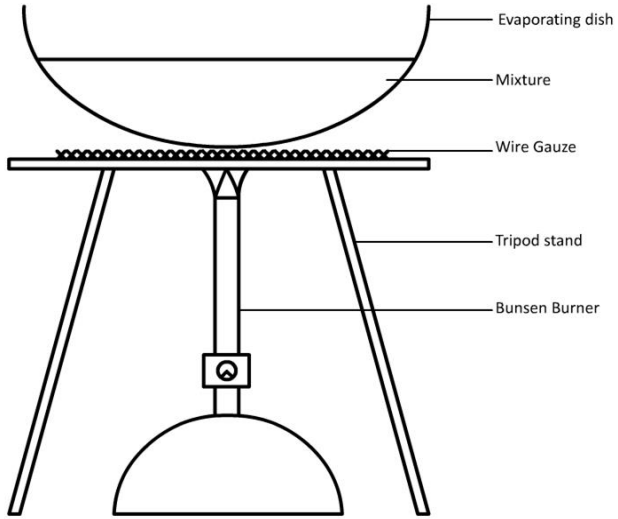
EVAPORATION TO DRYNESS



For this method, the solution is heated until all the **water is evaporated** completely, **leaving behind only the solid.**

However, a **limitation** to this method is that it **cannot be used for solids that decompose on heating**.

For example, sugar decomposes upon heating, salt however does not.

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*A saturated solution contains the maximum amount of solute that can be dissolved in the solvent at a particular temperature.

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CRYSTALLISATION

Crystallisation is different from evaporation to dryness.

The aim of crystallisation aim is not to evaporate ALL of the water, but rather it focuses on heating it till saturation. After which, it is left to cool in order to obtain the crystals.

This **is used for crystals that decompose upon heating to be collected.** (ie: sugar)

Steps:

1) Heat the solution till saturation.
2) Allow the saturated solution to cool and pure solid crystals will form slowly.
3) Filter to collect the crystals.
4) Wash the crystals with cold distilled water and dry between sheets of filter paper.

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Ultimately, what it boils down to the nature of the salt.

The critical question to ask is:

Will the solute **decompose under heating**?

If yes, use crystallisation.

If not, use evaporation to dryness.

Example:
Sugar decomposes under heat, crystallisation is the correct choice.
Salt has high melting & boiling point, evaporation to dryness will get the job done.

EVAPORATION TO DRYNESS VS CRYSTALLISATION

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When do we do simple distillation and when do we do fractional distillation?

Is one method better than the other?

KEY CONCEPT

FATHER & SON
SIMPLE DISTILLATION &
FRACTIONAL DISTILLATION

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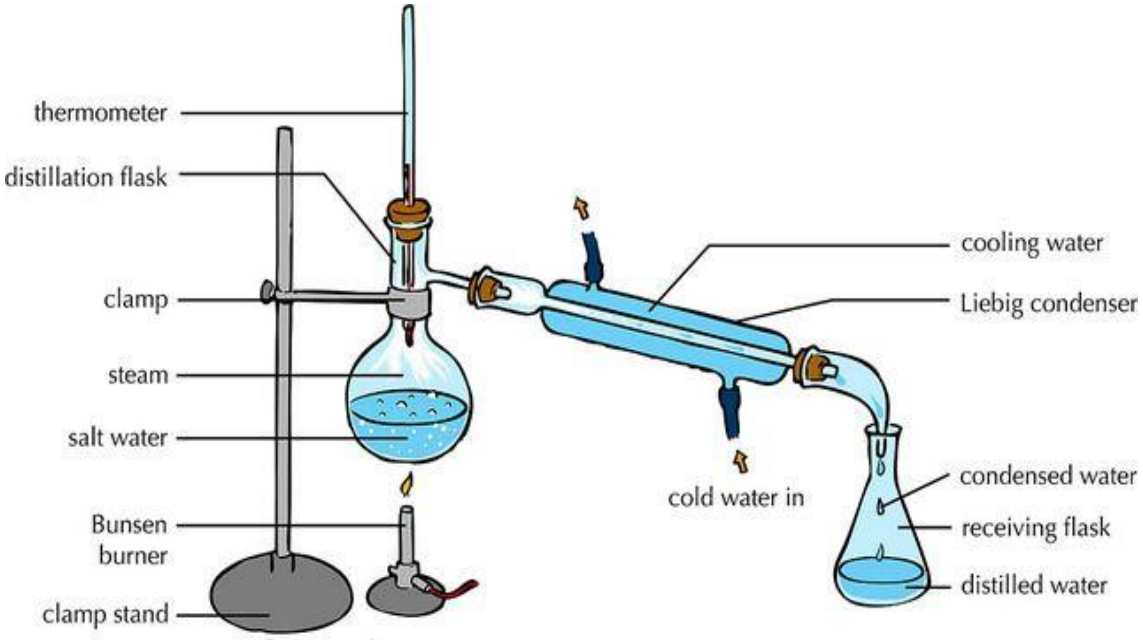
KEY CONCEPT

SIMPLE DISTILLATION



1) Heat the solution in a round-bottomed flask for even heat distribution. Boiling chips are added to prevent vigorous movement of liquid which ensure smooth boiling.

2) The water boils and water vapour rises and enters the condenser. The water vapour cools down in the condenser and is collected as a distillate.

3) The **distillate** is collected in a conical flask to prevent spillage.

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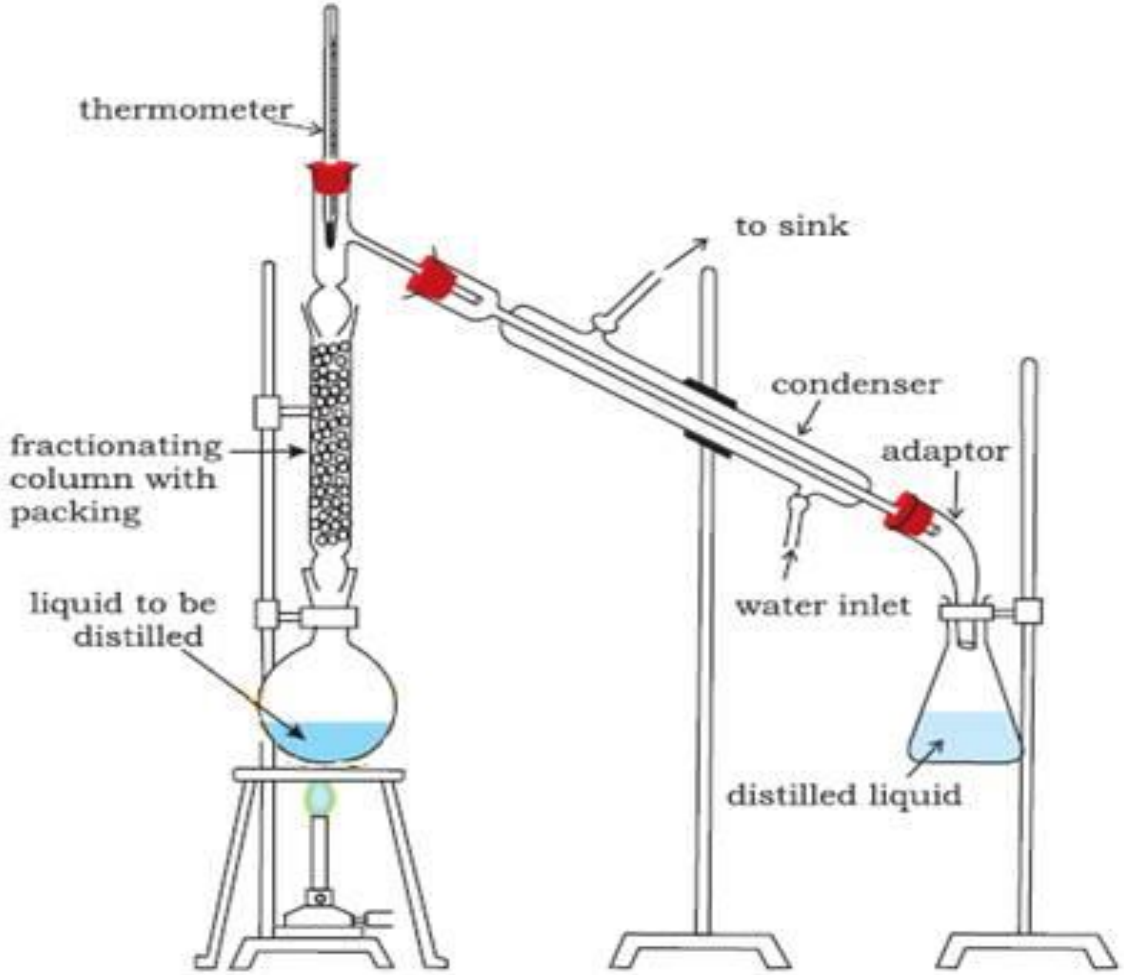
KEY CONCEPT

FRACTIONAL DISTILLATION



1) Heat the mixture. The liquid with the lowest boiling point will be the first to be vaporised.

2) Its vapour will rise up to the top of the fractionating column, cooled as it passes through the condenser and be collected as the distillate. Ensure the temperature remains the same until all of first vapour has condensed.

3) Collect the distillate in the conical flask.

4) Repeat the process and collect the different substances that were in the mixture.

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things to note

Understanding the science behind fractional distillation

Difference in boiling points

The rationale behind fractional distillation is the miscible liquids in the solution having a minimum of **at least 10°C** difference in boiling point.

By boiling the liquids at their respective boiling point, it allows us to separate them.

Purpose of fractionating column

A fractionating column contains a large number of glass beads, creating **a larger surface area for condensation of vapours** for substances that have yet to reach their boiling point. This would only allow the intended vapour to escape.

Purpose of thermometer

The thermometer is placed at the tip of the fractionating column, right before the gas enters the condenser.

By doing so, we can **monitor the temperature of the gas that is escaping** accurately, allowing us to adjust the intensity of the heat accordingly.

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KEY CONCEPT

FATHER & SON
SIMPLE DISTILLATION & FRACTIONAL DISTILLATION

So in which situations is simple distillation used and which situations do we use fractional distillation?

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*Key concept from Fuel and Crude Oil chapter in Organic Chemistry.

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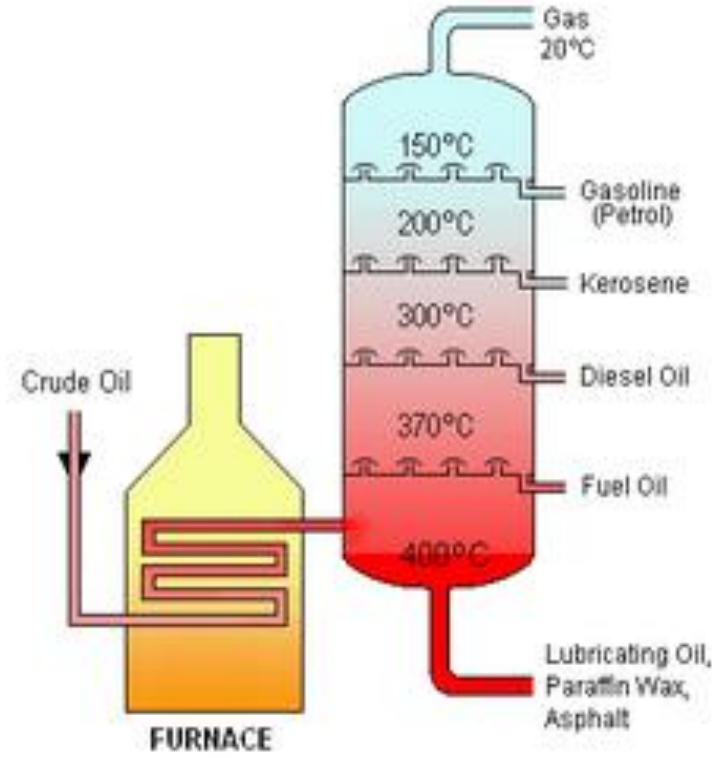
APPLICATION: OIL REFINERY



See you again soon!

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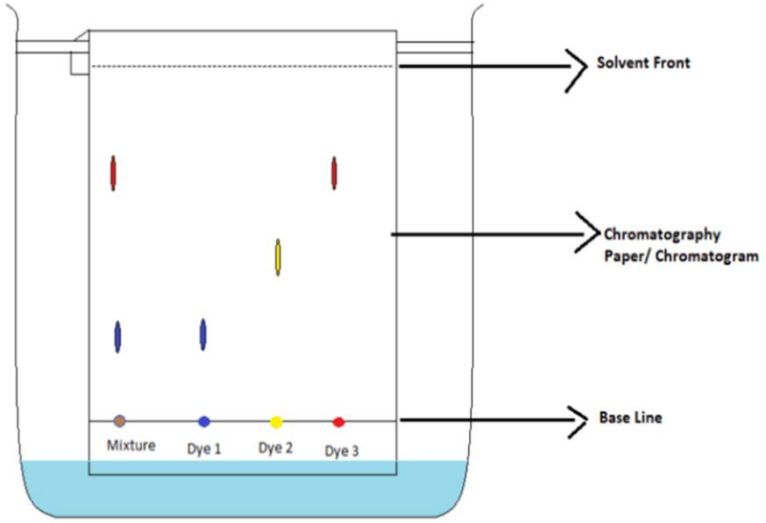
CHROMATOGRAPHY

Chromatography is used to separate and identify miscible solutes that are dissolved together. (Food substances, dye etc...)

The different components can be identified by comparing their **Rf values (retention factor).**

Chromatography works under this principle: **the rate at which a particular solute moves relative to the solvent is fixed.**



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things to note

Chromatography is a method used to separate and identify small amounts of solutes that are dissolved in solvents.

Substance solubility in solvent

A **substance's solubility in a particular solvent** is commonly the main reason which results in **differing R_f values**.

Locating Agent

For colourless substances, a **locating agent** is required **to make the colourless solution visible.**

Knowing the names of specific locating agents is not needed. Yay!

Precaution

Starting line should be drawn with pencil instead of ink as the **ink may dissolve in the solute,** causing the results to be inaccurate. Commonly tested!

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