

Name: _____

Date: _____

AQA A-LEVEL CHEMISTRY

Fractional Distillation: Separating Crude Oil into Fractions

Learn Pack

Guided notes, worked examples and practice questions to be completed alongside the lesson.



Crude Oil

Crude oil is a naturally occurring complex mixture of hydrocarbons. Crude oil contains hundreds (or even thousands) of different hydrocarbon molecules with different chain lengths and therefore different physical properties.

Because they are all mixed together, crude oil

cannot be used efficiently until the hydrocarbons have been separated into _____ by fractional distillation.

Lesson Objectives:

- Know what crude oil is and why it must be separated before it can be used.
- Understand how fractional distillation separates hydrocarbons into useful fractions.
- Understand why hydrocarbons condense at different heights within a fractionating column.

Fractional Distillation

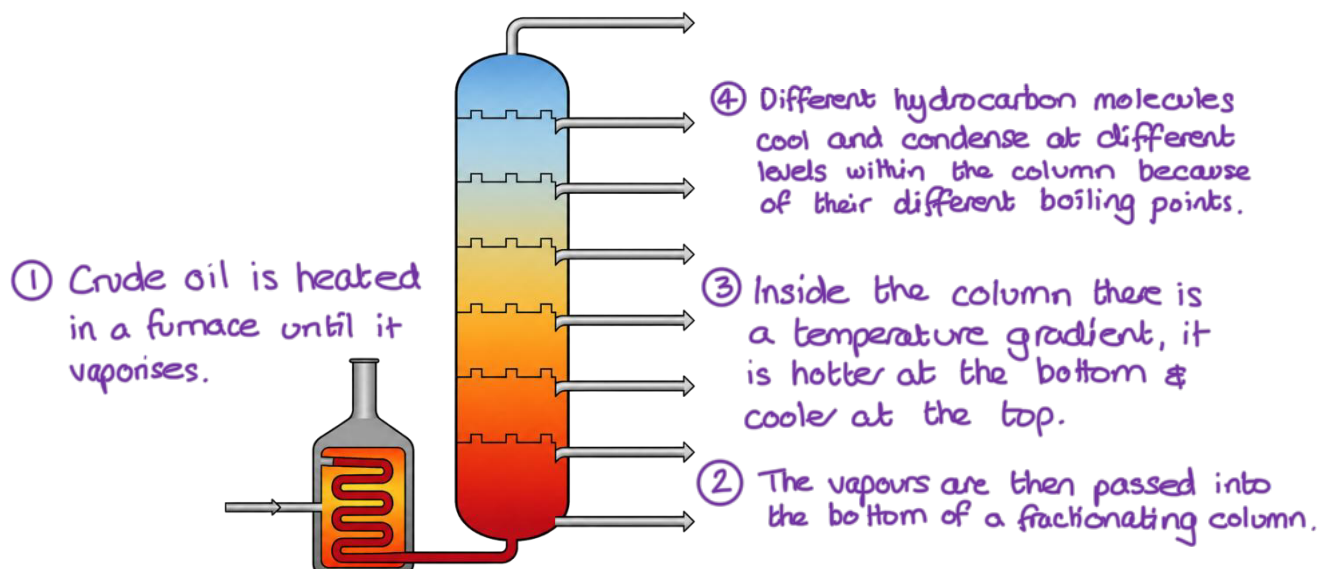
What is fractional distillation?

The industrial process of separating crude oil into fractions based upon their boiling points

Define the term fraction:

A mixture of hydrocarbon molecules with similar boiling points.

Annotate the diagram below to describe how fractional distillation works:



How Fractional Distillation Works

Fractional distillation works because of two key scientific ideas:

1. Hydrocarbon molecules have different boiling points.

This is because as the carbon chain length increases the molecules get larger. This means that the number of van der Waals' forces acting between the molecules increases, therefore more energy is needed to overcome them and so the boiling point increases.

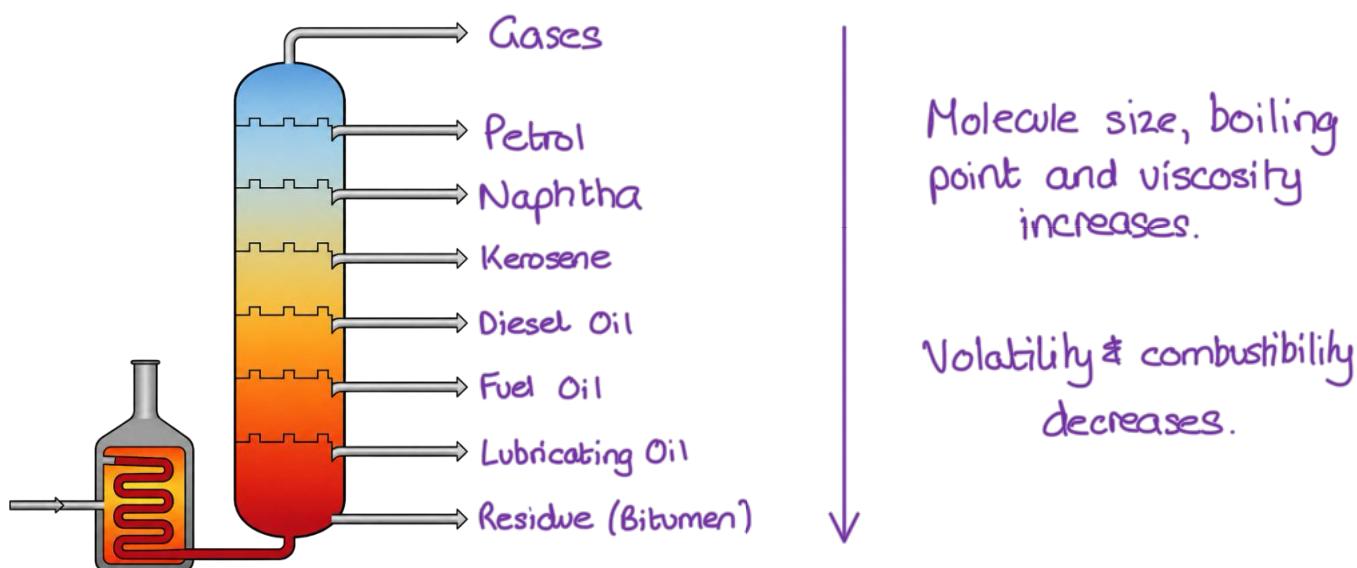
2. The fractionating column has a temperature gradient.

The column is hotter at the bottom and cooler at the top. This means that hydrocarbons reach temperatures below their boiling points at different heights or levels within the column.

Larger hydrocarbon molecules with their higher boiling points will therefore condense at the bottom whilst smaller hydrocarbon molecules with the lower boiling points will condense nearer the top.

Fractions of Crude Oil

Label the fractions on the diagram below before annotating the diagram to show the trends in molecule size, boiling point, viscosity, volatility and combustibility:



Fractional Distillation vs Laboratory Distillation

Complete the table below:

	Laboratory Fractional Distillation	Industrial Fractional Distillation
Separates	Simple mixtures	Complex mixtures
Produces	Two pure substances	Multiple fractions

What is the same about both processes?

They both separate substances from mixtures based upon their boiling points.

What is different about both processes?

Fractional distillation separates complex mixtures into fractions where as simple distillation separates simple mixtures into pure substances.

Practise Questions – Fact Recall

1. What is crude oil?

A complex mixture of hydrocarbon molecules.

2. Define the term *fraction*.

Mixture of hydrocarbon molecules with similar boiling points.

3. Describe the process of fractional distillation.

Crude oil is heated in a furnace until it vaporises. The vapours are passed into a fractionating column that has a temperature gradient. Different hydrocarbons cool and condense at different heights depending on their boiling point.

4. Identify the two key features that allows the separation of crude oil by fractional distillation.

Different hydrocarbons have different boiling points.
The fractionating column contains a temperature gradient.

5. Explain why larger hydrocarbons have higher boiling points.

The larger the molecule, the greater the number of van der Waals' forces between molecules, so the higher the boiling point.

Practise Questions – Application

1. A hydrocarbon condenses near the top of the fractionating column. Predict whether it has; a high or low boiling point, a short or long carbon chain, a high or low viscosity, a high or low volatility. Explain your reasoning.

The top of the column is cooler than the bottom which means the hydrocarbon must have a short chain as it has a low boiling point - This is because short chain hydrocarbons have fewer van der Waals' forces between the molecules. This will also mean the substance has a low viscosity and high volatility.