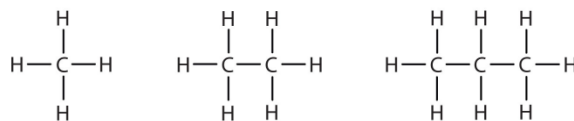


# Crude Oil and Fuels – HT

START



Methane                      Ethane                      Propane

What's the fourth alkane called?  
Can you draw its structure?



## What are alkanes?

- Crude oil is a mixture containing alkanes that are saturated hydrocarbons. Their names end in 'ane'
- They have the general formula  $C_nH_{2n+2}$ . This means they have twice as much hydrogen as carbon, plus another 2!

## Key words:

1. **Mixture:** a substance (like crude oil) made up of different compounds that are not chemically bonded together and can easily be separated.
2. **Hydrocarbon:** a substance from crude oil made up of only atoms of hydrogen and carbon joined by covalent bonds.
3. **Fraction:** a part of crude oil containing hydrocarbons of similar boiling point.
4. **Distillation:** a method of separating a mixture that involves first heating a substance to its boiling point to evaporate it and then to condense it as it cools.
5. **Saturated hydrocarbon** contains the maximum amount of hydrogen and only single covalent bonds.
6. **Alkane:** A special type of hydrocarbon that containing only single bonds and carbon and hydrogen atoms only.
7. **Flammable:** Catches fire easily
8. **Combustion:** When a fuel reacts with oxygen releasing heat and light energy.
9. **Cracking:** Used to break to long chain hydrocarbons down into shorter more useful ones.
10. **Thermal Decomposition:** Occurs when a substances is heated and splits up. E.g. an alkane  $\rightarrow$  alkane and an alkene

## How is crude oil separated?

By a process called fractional distillation. This works because crude oil is a mixture of substances with different boiling points.

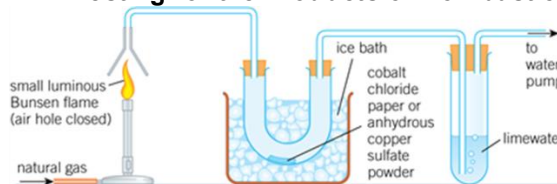
1. First the mixture is heated until it evaporates.
2. It is placed into the bottom of a tall column.
3. The hydrocarbons with the highest boiling point condense first. They have the most carbon atoms.
4. The hydrocarbons with the lowest boiling points rise up the column.
5. When it is cool enough they then condense and are collected. These contain the least carbon atoms.

## What is combustion?

Combustion is when a fuel is burnt in oxygen to release energy.

Complete Combustion	Incomplete Combustion
Plenty of oxygen	Limited supply of oxygen
Produces Carbon Dioxide ( $CO_2$ )	Produces Carbon Monoxide ( $CO$ )
Produces water	
$C_4H_{12} + O_2 \rightarrow CO_2 + H_2O$	$C_3H_6 + O_2 \rightarrow CO + H_2O$

## Testing for the Products of Combustion



Short chain hydrocarbons are useful because they are more flammable and burn more cleanly  
Long chain hydrocarbons are less flammable and burn with a dirty flame.

- Black deposits form in the funnel, this is **unburnt carbon** (soot)
- The **water** bath condenses the water vapour and this turns the cobalt chloride paper from blue to pink.
- The limewater turns from colourless to cloudy when the **carbon dioxide** is bubbled through it.

## Testing for Saturation

Alkenes react with **bromine water** to turn from orange to **colourless** whereas alkanes do not. It's useful if you want to tell the different between the two!

Alkenes react with bromine because they have a double bond, alkanes cannot as they don't have any – so nothing happens!

## Cracking

-Long chain hydrocarbons are heated with a catalyst to speed up the reaction.

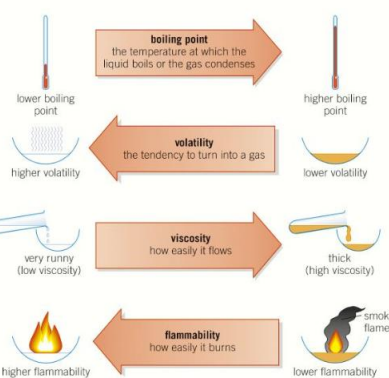
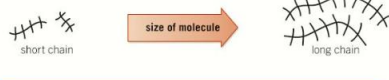
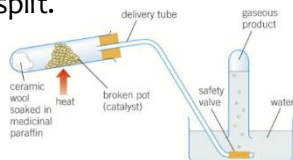
-As the long chain hydrocarbons pass over the catalyst they split by thermal decomposition to produce a mixture of alkanes and alkenes.

-This helps to meet the high **demand** for shorter chain hydrocarbons when their **supply** is limited.

## Catalytic cracking conditions –

Hydrocarbons heated and vaporised, hot powdered aluminium catalyst.

**Steam cracking** – Hydrocarbons heated and vaporised, then mixed with steam, heated to very high temperatures, molecules then split.

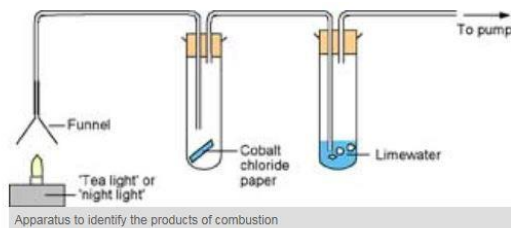


1. What is crude oil?
2. What 2 elements do you find in hydrocarbons?
3. Draw and name the first 4 alkanes.
4. What is their general formula?
5. What does fractional distillation do?
6. Write 5 bullet points detailing fractional distillation.
7. Fill out the table comparing the properties of short and long-chained hydrocarbons:

	Small-chained hydrocarbons	Long-chained hydrocarbons
Boiling point		
Volatility		
Viscosity		
Flammability		

8. What is complete combustion?
9. What is incomplete combustion?

This diagram shows the practical to identify the products of combustion. What changes should you see and what would these changes indicate?



10. What is cracking?
11. What are the two types of cracking?
12. Why is cracking important? (in your answer, use these keywords: hydrocarbon, supply, demand, long, short)
13. Describe how cracking is carried out.
14. What two type of molecules are produced during cracking?
15. What does bromine test for?
16. What result would you expect to see for a positive test?
17. What result would you expect to see for the following:

	Test with bromine water result
Propene	
Methane	
Butene	
Heptene	
Decane	

18. Why are alkenes considered unsaturated whilst alkanes are considered saturated?