Nature's Chemistry 2

Crude Oil – From the Rocks to the Road

Name_____

Class_____

Teacher_____

Crude Oil, from the Rocks to the Road – Lessons 1-2

Aim: Where does crude oil come from?

Crude oil comes from beneath sedimentary rock, most often on land, but also from beneath the seabed via oil-drilling platforms.

Commonly, crude oil is thought to be the remains of dead plants and animals that have been buried under sediment for millions of years. The plants and animals are said to be slowly converted into crude oil by high temperature, compression and bacterial action.

To get the oil out of the ground, the workers on the rig inject water into the rock. This pushes the oil out of the ground and up pipes to the surface.

1. If you look at a photo of Scotland at night from above, you see lots of light in the North Sea where there isn't any land. Why is this?

Scotland _____ a lot of oil from _____ the North Sea. This oil is extracted from the _____ by people _____ on oil rigs. The rigs are _____ lit up.

2. What is crude oil?

Crude oil is a _____ liquid which is _____ to be the remains of _____ plants and animals from _____ of years ago.

3. How do we get crude oil out of the ground?

Water is _____ into the rocks _____ the ground. This _____ the oil out and up _____ to the surface.

Crude Oil, from the Rocks to the Road – Lesson 3

Aim: How can we make crude oil useful?

The various parts of crude oil have different sizes, weights and boiling temperatures; so, the first step is to separate these components. Because they have different boiling temperatures, they can be separated easily by a process called fractional distillation.

The oil is heated high temperature and boils, forming gases. The gases enter the bottom of a long column (fractional distillation column) that is filled with trays or plates. The trays have many holes or bubble caps (like a loosened cap on a coke bottle) in them to allow the vapor to pass through. They help to collect liquids that form at various heights in the column. There is a temperature difference in the column (hot at the bottom, cool at the top). When the gas reaches a height where the temperature is the same as its boiling point, it becomes a liquid.

1. What is the name for the process where crude oil is split into different parts (fractions)?

Crude oil can be _____ up into different parts (fractions) via a _____ called fractional _____.

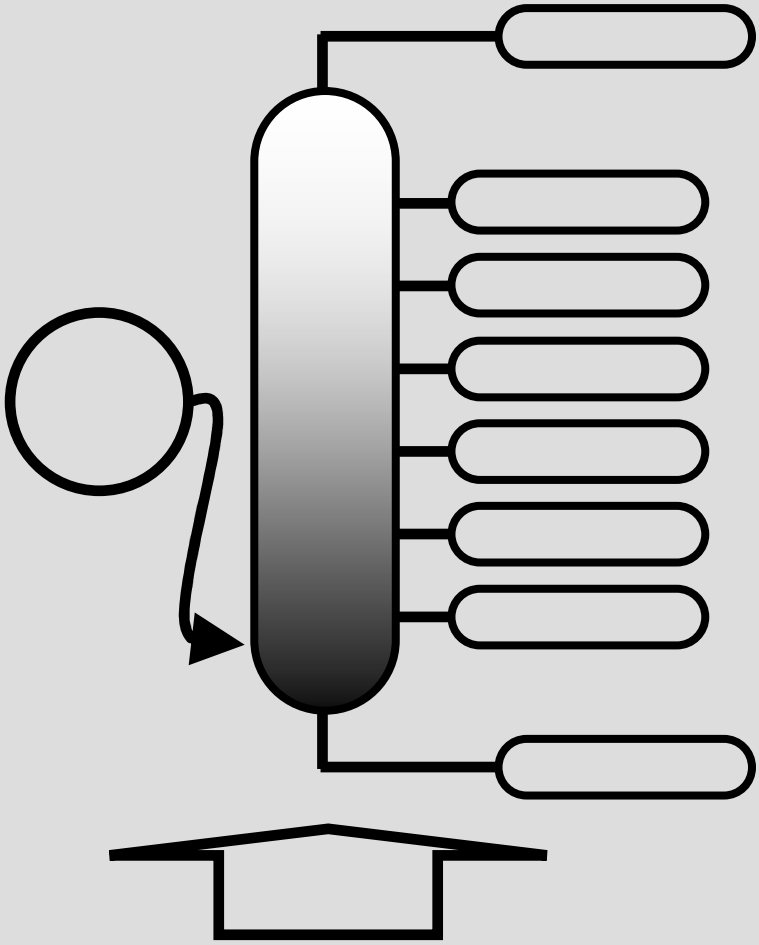
2. How do the gases get through each tray/plate in the column?

Each tray/plate has a _____ or a bubble cap that _____ gasses to pass _____.

3. Why do the gases become liquids at different heights in the column?

The _____ decreases as the _____ move up the column. The gases turn into _____ when they reach a height _____ the temperature is the _____ as their boiling point.

3. Using the picture you drew in the picture memory game, complete the diagram below.



Crude Oil, from the Rocks to the Road – Lesson 4

Aim: What molecules do we find in Crude Oil?

*Once crude oil has been split up into different fractions, we need to be able to say what molecules are in those fractions. The molecules only contain carbon and hydrogen so we say that they are "**hydrocarbons**" (hydro = hydrogen, carbon = carbon!). The family of hydrocarbons can be further split into other families such as **alkanes**. Alkanes only have single bonds between the carbon atoms and are said to be "**saturated**".*

1. What is a hydrocarbon?

A hydrocarbon is a _____ that only _____ carbon and hydrogen.

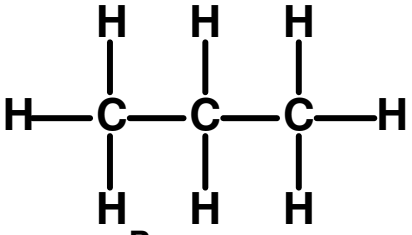
3. What is important about the bonds between the carbon atoms in the family of alkanes?

Alkenes contain _____ bonds whereas _____ do not.

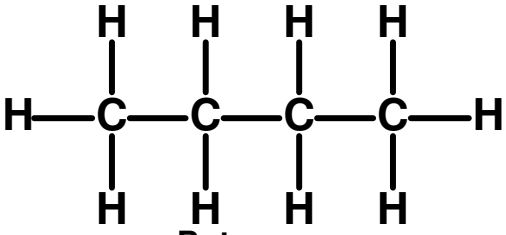
To give an alkane a name, we look at the number of carbons in the longest chain.

Name	*Number of carbons in the longest chain*
Methane	*1*
Ethane	*2*
Propane	*3*
Butane	*4*
Pentane	*5*
Hexane	*6*
Heptane	*7*
Octane	*8*

We can draw the full structural formula of propane and butane as shown below:



Propane



Butane

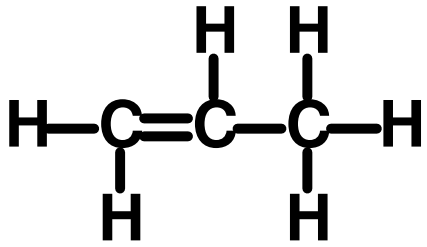
4. Draw the structures of pentane and ethane

*Another family of hydrocarbons is the **alkenes**. Alkenes have at least one double bond between carbon atoms and are said to be "**unsaturated**".*

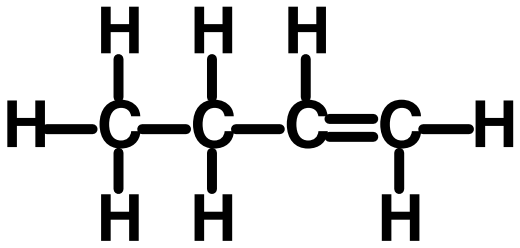
To give an alkene a name, we look at the number of carbons in the longest chain.

Name	*Number of carbons in the longest chain*
Ethene	*2*
Propene	*3*
Butene	*4*
Pentene	*5*
Hexene	*6*
Heptene	*7*
Octene	*8*

We can draw the full structural formula of propene and butene as shown below:



Propene



Butene

5. Draw the structures of pentene and ethene

Crude Oil, from the Rocks to the Road – Lesson 4

Aim: How can we tell the difference between alkanes and alkenes?

*Bromine water is a yellow/brown colour. If you shake Bromine water in a test tube of an alkene then the colour will change from yellow to colourless. A chemist would call this "**decolourisation**". This does not occur for.alkanes and other saturated (no double bonds) hydrocarbons. The reason for the change is that the bromine molecule (Br_2) is broken in two and each Bromine atom forms a bond with a carbon that previously had a double bond.*

e.g.

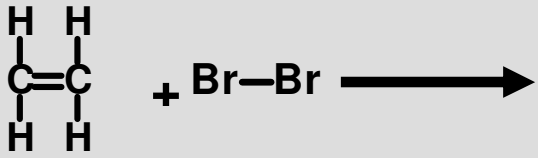
Ethene + Bromine ⟶ Dibromoethane

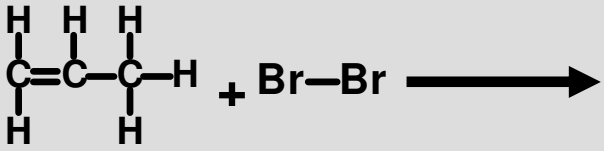
C_2H_4 + Br_2 ⟶ $C_2H_4Br_2$

1. Complete the word equations below

Propene + Bromine → _____
Butene + _____ → Dibromobutane
_____ + Bromine → Dibromohexane
Pentene + Bromine → _____
Octene + Bromine → Dibromooctane
Decene + _____ → Dibromodecane
Dodecene + Bromine → _____

2. Complete the equations below with either a full structural formula or a molecular formula



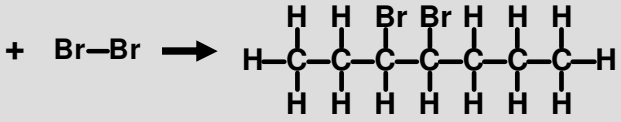


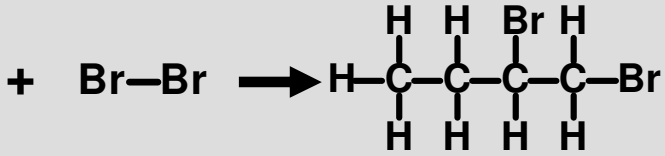
$C_5H_{10} + Br_2 \longrightarrow$

$C_8H_{16} + Br_2 \longrightarrow$

$+ Br_2 \longrightarrow C_9H_{18}Br_2$

$+ Br_2 \longrightarrow C_4H_8Br_2$





3. Why does the bromo-compound (the product of the reaction) have "-ane" at the end of the name instead of "-ene"?

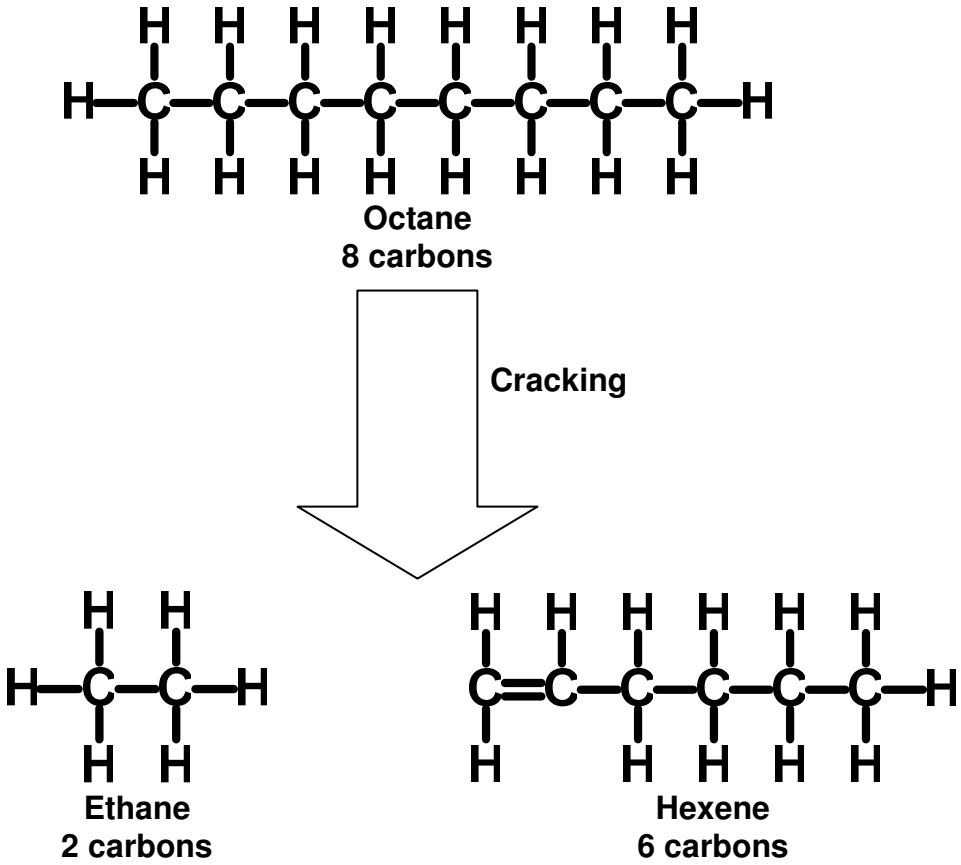
The product of the _____ is saturated (has no _____ bonds) so it is much more like an _____ than an alkene.

Crude Oil, from the Rocks to the Road – Lesson 6

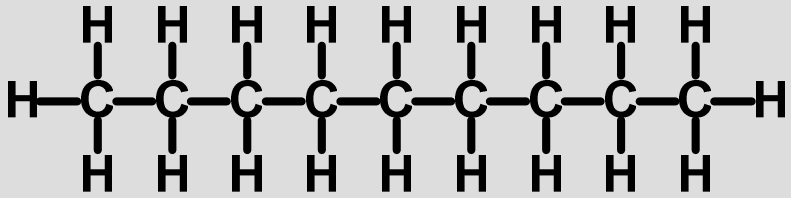
Aim: How can we change a long hydrocarbon into a short hydrocarbon?

Usually, it's the shorter hydrocarbons that are the most useful for fuels, making plastics etc. That means that we need a process to split up less-useful long hydrocarbons into more useful shorter ones. This process is called ***cracking*** *and usually requires a* ***catalyst*** *and a* ***high temperature****. The products that you get depend on the temperature but the* ***total number of carbons in all the products*** *combined will always be the* ***same as the number of carbons in the reactant****. The products from a cracking reaction will always contain* ***at least one alkene****.*

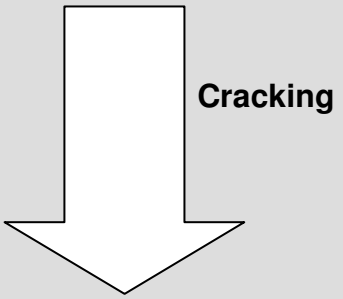
e.g.



1. Draw an alkane and an alkene that could be created by the following cracking reaction.



Nonane
9 carbons



_____ene
4 carbons

_____ane
5 carbons

2. Fill in the gaps with the name of either an alkene or an alkane.

Octane → Butane + B_____
Octane → Pentane + P_____
Octane → H_____ + Ethene
Nonane → H_____ + Ethene
Hexane → P_____ + Propane
Decane → Heptene + P_____
H_____ → Pentane + Ethene

Crude Oil, from the Rocks to the Road – Lesson 7

Aim: What is a plastic?

*A chemist would call a plastic a "**polymer**" – a long-chain molecule made up of many smaller molecules called "**monomers**". The monomer is usually an alkene.*

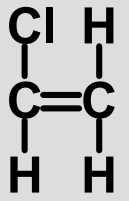
1. What is a polymer?

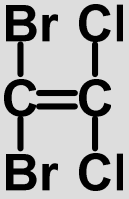
A "polymer" ___ a long-_____ molecule made up of _____ smaller molecules.

2. What is a polymer made up of?

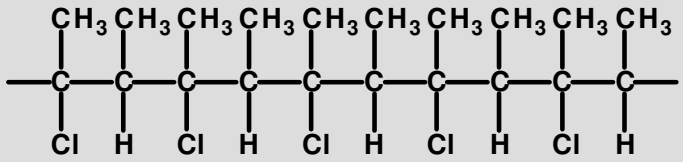
A _____ is made of _____ molecules called _____.

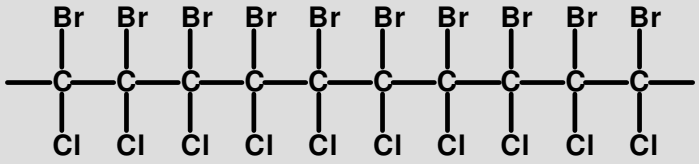
3. Draw the polymers made from the following monomers





4. Draw the monomers that would be used to make the following polymers.

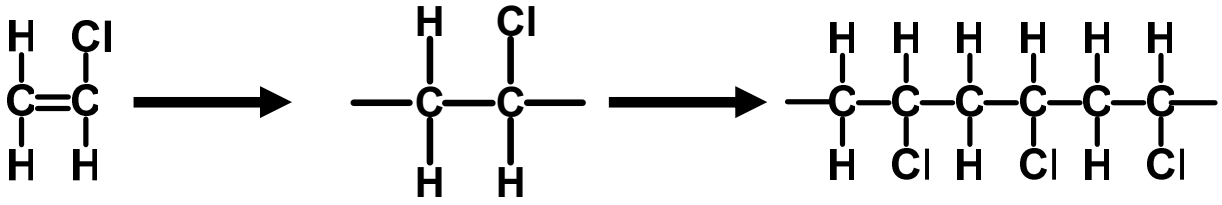




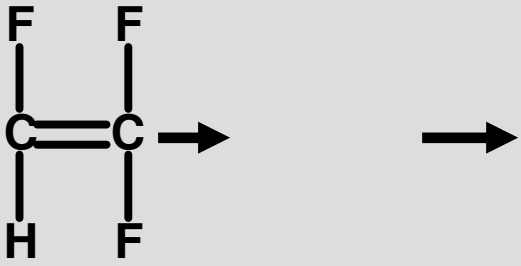
Crude Oil, from the Rocks to the Road – Lesson 8

Aim: How can we make a plastic?

*Many polymers are made by "**addition polymerisation**". This is a chemical reaction where a double bond is broken to create new, single bonds. In this case, the double bond in a monomer is broken to make new, single bonds to other monomers.*
i.e.



1. Use the diagram above to draw an equivalent diagram for the polymerisation of trifluoroethene.



2. Why might the "solar concentrator" polymer you were shown in class be useful?

The "_____ _____" is used to concentrate _____. This means that a much _____ area of solar cells can be _____ and this will be cheaper.