Naming Compounds: Terminology

Define the terms:

Hydrocarbon
Saturated Hydrocarbon
Unsaturated Hydrocarbon
Functional Group
Homologous Series
Structural Isomer
Macromolecule

State a test for unsaturated compounds.

Hydrocarbon:

A compound which contains carbon and hydrogen **only**

Saturated Hydrocarbon:

A hydrocarbon which contains **only** single carbon–carbon bonds

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Unsaturated Hydrocarbon:

A hydrocarbon which contains one or more double carbon–carbon bonds

Test: Unsaturated compounds will decolourise bromine water (from orange to colourless)

Functional Group:

A group of atoms responsible for the characteristic reactions of a compound

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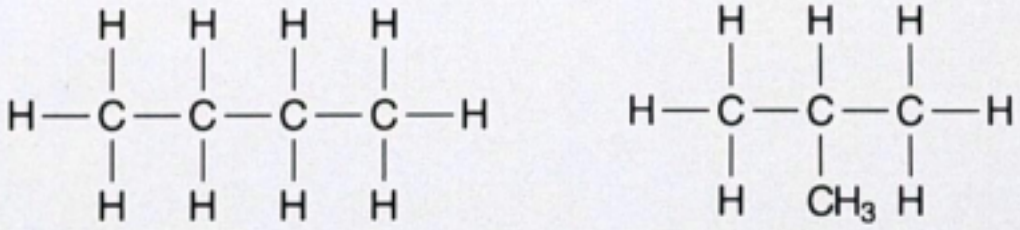
Homologous Series:

- A family of similar compounds with similar chemical properties due to the **same functional group**
- Each successive member differs by a CH_2 group
- Show a trend in physical properties

Structural Isomers:

Compounds with the same formula but different structures, e.g.



Both are C_4H_{10} but one is a straight chain isomer and one is branched

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Macromolecule:

A large molecule built up from small units called **monomers**

Naming Compounds: Functional Groups

How do you name compounds with the following functional groups?

Alkanes

Alkenes

Alcohols

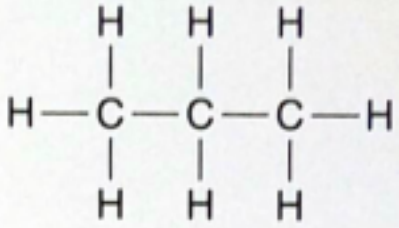
Carboxylic Acids

Esters

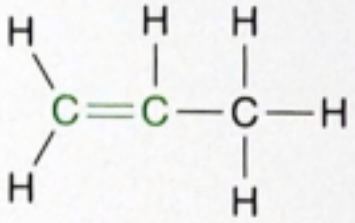
Draw an example of each.

Name the first 4 alkanes.

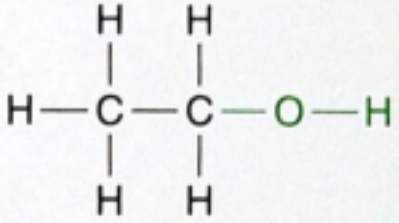
Alkanes: –ane (e.g. propane)



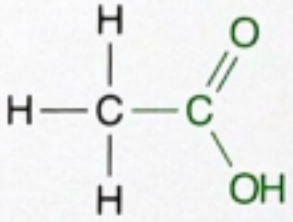
Alkenes: –ene (e.g. propene)



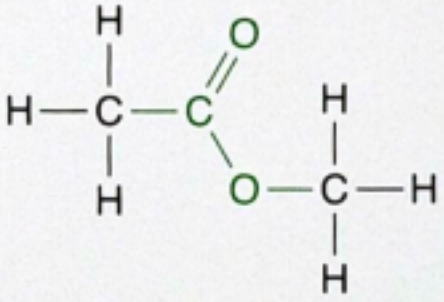
Alcohols: –ol (e.g. ethanol)



Carboxylic Acids: –oic acid (e.g. ethanoic acid)



Esters: alkyl– –oate (e.g. **methyl** ethan**oate**)



Alkanes:

1 Carbon:	**Meth**ane	CH_4
2 Carbons:	**Eth**ane	CH_3CH_3
3 Carbons:	**Prop**ane	$CH_3CH_2CH_3$
4 Carbons:	**But**ane	$CH_3CH_2\,CH_2CH_3$

Reactions of Alkanes

Write equations for the following reactions of alkanes:

Cracking

Cracking Ethane

Combustion

Making Chloroalkanes

Reactions of Alkenes

Write equations for the following reactions of alkenes:

Hydrogenation

Bromination

Hydration

Cracking Alkanes:

$$\text{Alkane} \xrightarrow[\text{Heat}]{\text{Catalyst}} \text{Shorter Alkane} + \text{Alkene}$$

$$\text{e.g. } \underset{\text{decane}}{C_{10}H_{22}} \xrightarrow[\text{Heat}]{\text{Catalyst}} \underset{\text{octane}}{C_8H_{18}} + \underset{\text{ethene}}{C_2H_4}$$

Cracking Ethane:

$$\text{Ethane} \xrightarrow[\text{Heat}]{\text{Catalyst}} \text{Ethene} + \text{Hydrogen}$$

$$\text{e.g. } C_2H_6 \xrightarrow[\text{Heat}]{\text{Catalyst}} C_2H_4 + H_2$$

Combustion of Alkanes:

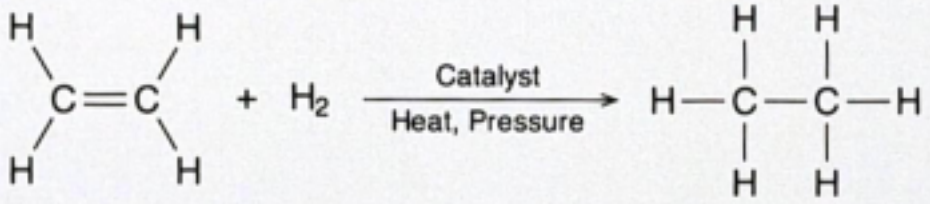
$$\text{Alkane} + \text{Oxygen} \longrightarrow \text{Carbon Dioxide} + \text{Water}$$

$$\text{e.g. } 2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$$

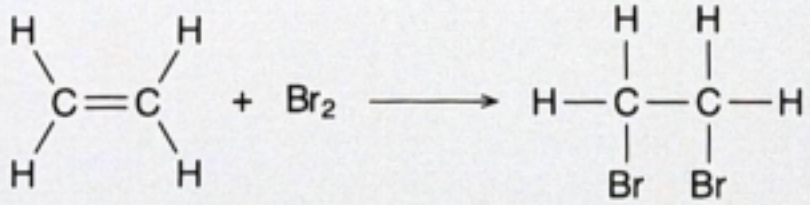
Making Chloroalkanes:

$$\underset{\text{methane}}{CH_4} + Cl_2 \xrightarrow{\text{UV light}} \underset{\text{chloromethane}}{CH_3Cl} + HCl$$

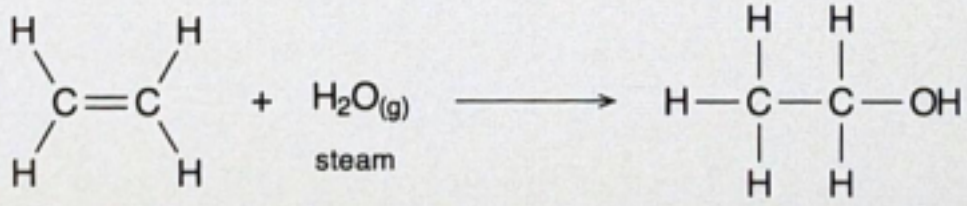
Hydrogenation of Alkenes:



Bromination of Alkenes:



Hydration of Alkenes:



Alcohols

Describe 2 methods of making *Ethanol*.
Give advantages and disadvantages of these 2 methods.

Write equations for the following reactions:
Combustion of Ethanol
Making Carboxylic Acids
Making Esters

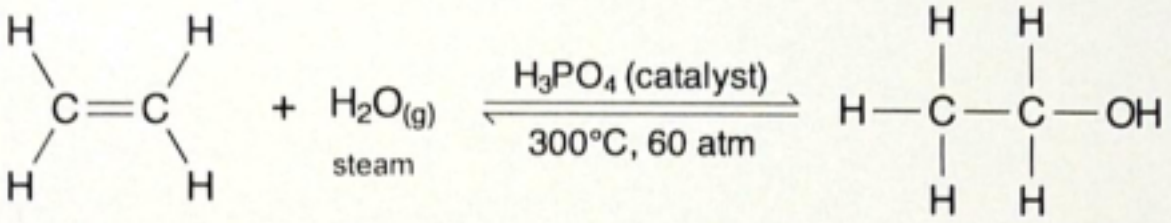
Making Ethanol:

Fermentation of Sugars:

- The sugar is dissolved in water and yeast is added, at about 37 °C
- Ethanol and carbon dioxide are produced in the **absence** of air

$$\underset{\text{glucose}}{C_6H_{12}O_6} \xrightarrow[37°C]{\text{Yeast}} 2\underset{\text{ethanol}}{C_2H_5OH} + 2CO_2$$

Hydration of Ethene:



Advantages and Disadvantages:

Method	Advantages	Disadvantages
Fermentation	Uses a renewable resource (e.g. sugar cane)	• Growing crops requires a lot of land • It is a slow, batch process • Yeast stops working when ethanol reaches a certain concentration
Hydration	• Fast, continuous process • Produces pure ethanol	• Ethene is non-renewable (made from crude oil which is running out) • Requires huge energy resources • Reversible reaction so yield is low

Combustion of Ethanol:

$$C_2H_5OH_{(l)} + 3O_{2\,(g)} \longrightarrow 2CO_{2\,(g)} + 3H_2O_{(g)}$$

Making Ethanoic Acid:

- By oxidation, using acidified potassium manganate(VII):

$$\text{Ethanol} \xrightarrow[\text{Heat}]{\text{Acidified Potassium Manganate(VII)}} \text{Ethanoic Acid}$$

- By fermentation in the **presence** of air

Making Esters:

$$\text{Carboxylic Acid} + \text{Alcohol} \xrightarrow[\text{Heat}]{\text{Conc. Acid (catalyst)}} \text{Ester}$$

Fossil Fuels

Give 3 examples of Fossil Fuels.
How were they formed?

What is the chemical composition of petroleum (crude oil)?
How are the different components separated?

How does the size of the molecules in petroleum affect their properties?

Fossil Fuels:

- Coal
- Natural Gas (Methane)
- Petroleum (Crude Oil)

Formation:

Formed from the remains of plants & animals that lived millions of years ago

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Composition of Petroleum (Crude Oil):

A mixture of hydrocarbons of different sizes

Fractional Distillation of Petroleum:

The different length hydrocarbons have different boiling points, so they can be separated by fractional distillation *(see diagram)*

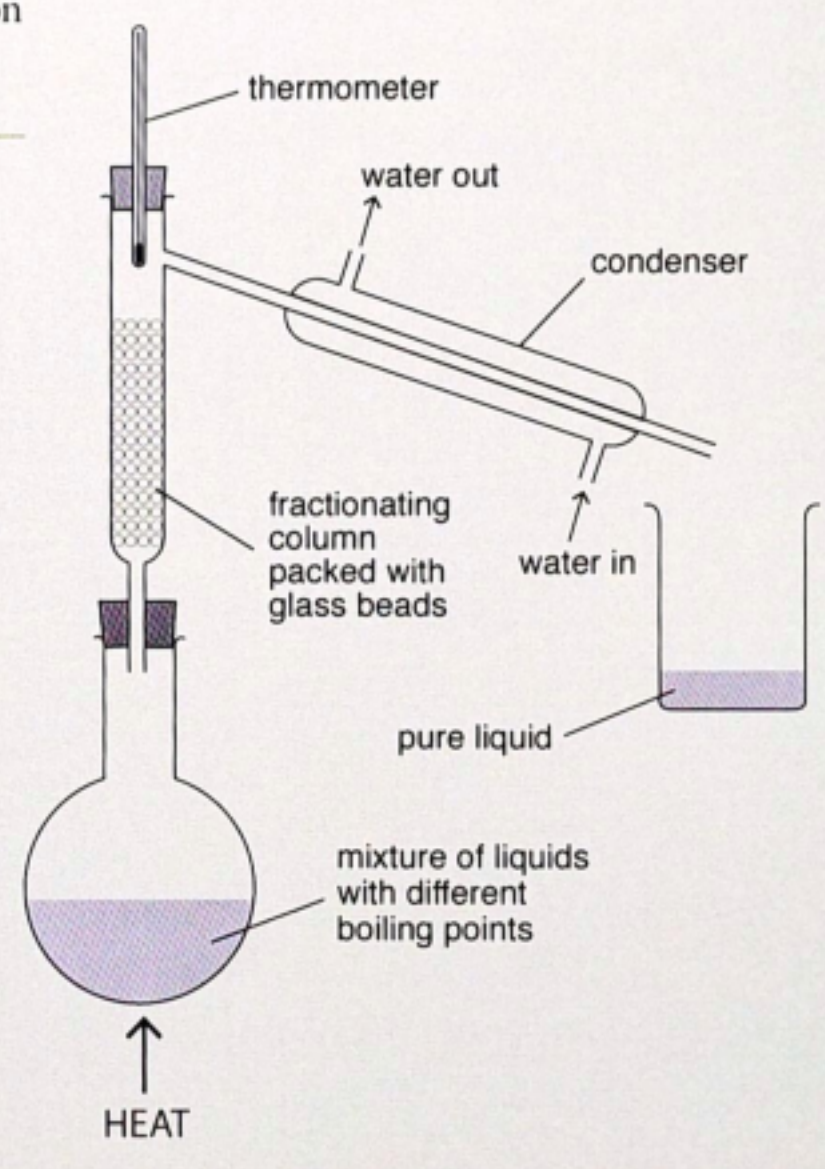
Trends in properties:

Larger molecules:

- have higher boiling points
- have higher viscosities
- are less volatile
- burn less easily

***Volatile** = evaporates easily*

***Low viscosity** = runnier*

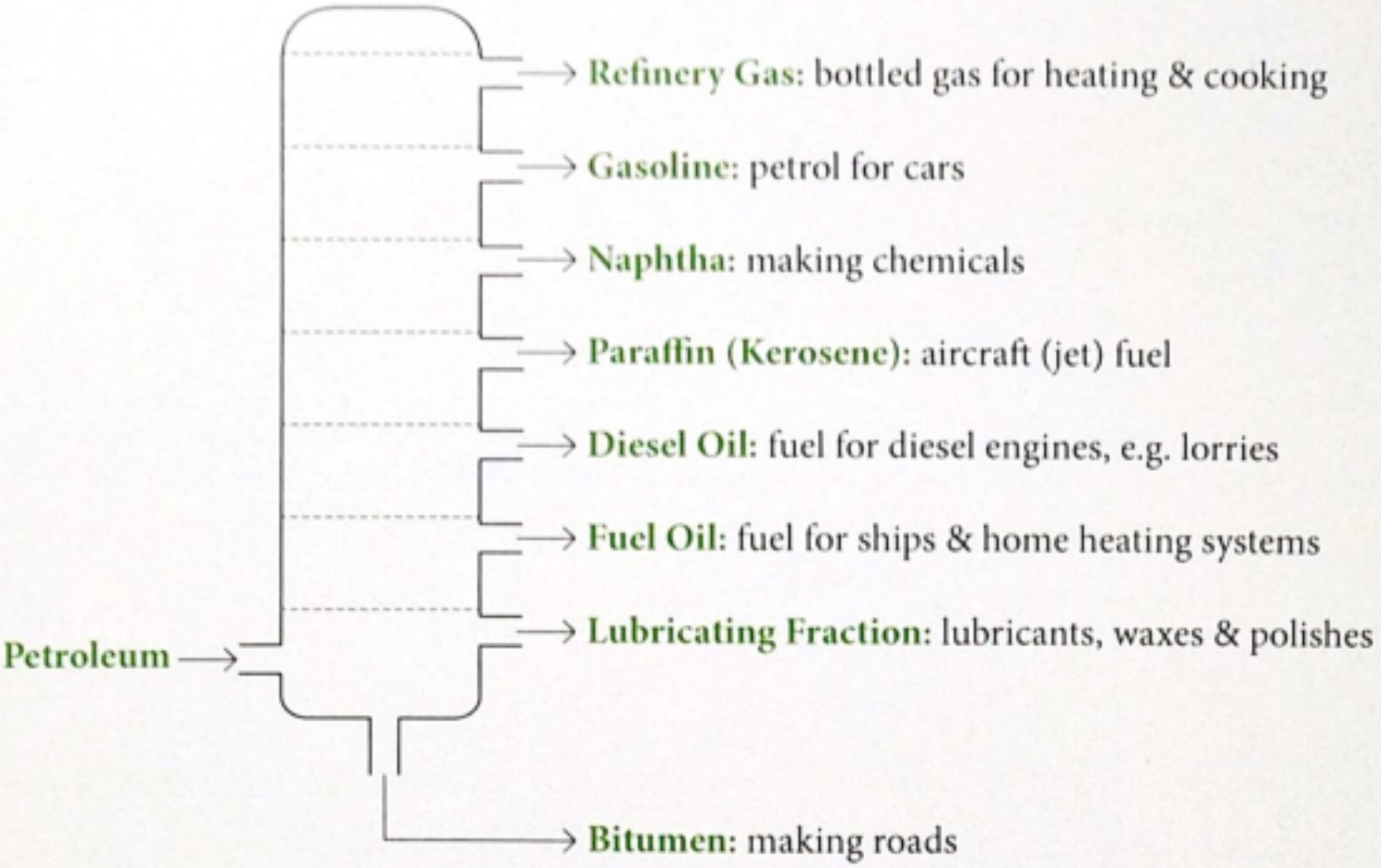


Uses of Alkanes, Alkenes & Ethanol

State uses for the 8 different ***Fractions*** obtained when petroleum (crude oil) is refined industrially.
Show the order in which they exit the refinery tower.

State uses for:
Alkenes
Ethanol

Uses of Petroleum Fractions:



The fractionating tower is hottest at the bottom and coolest at the top
Molecules that exit higher up the tower are smaller and have a lower boiling point

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Use of Alkenes:

Making plastics (by polymerisation)

Uses of Ethanol:

- as a solvent
- as a fuel (it can be added to petrol to make gasohol)

Polymers

What is a *Polymer*?

Explain what is meant by *Addition Polymer.*
Draw and describe the structure of the
plastic *Poly(propene)*.

Explain what is meant by a *Condensation Polymer*,
giving examples.

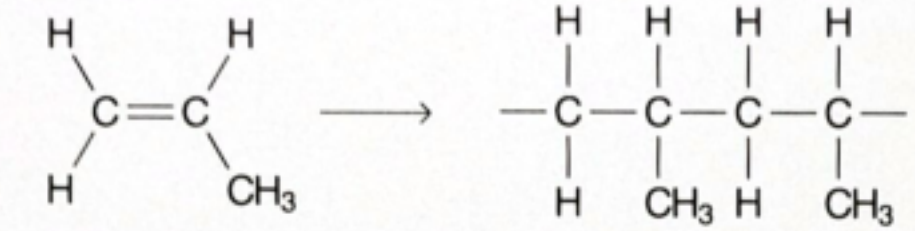
*Polymer:

A large molecule built up from small units called **monomers**

Addition Polymers:

- Made from a **single** monomer which has a C=C double bond
- Forms when the double bonds in **alkene** monomers break and the monomers join together

e.g. **Poly(propene)**



Monomer: propene

Polymer: poly(propene)

Just put "poly" in front of the name of the monomer (and add brackets) to name the polymer

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Condensation Polymers:

- A polymer formed when one or two different monomers, each containing **two functional groups,** join together to form a chain
- A small molecule (usually H_2O) is eliminated between each pair of monomers

Examples:

- Natural polymers, e.g. proteins, complex carbohydrates (e.g. starch)
- Synthetic polymers, e.g. Nylon, Terylene

Condensation Polymers

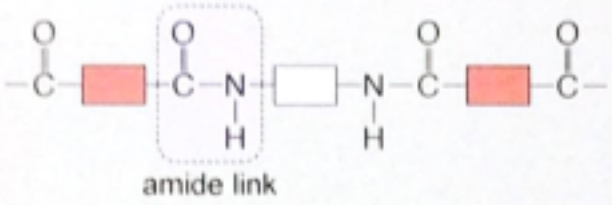
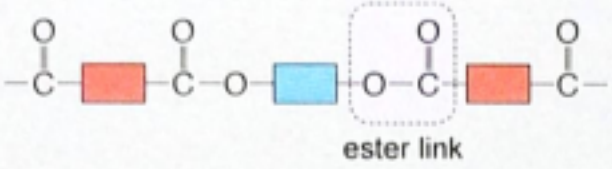
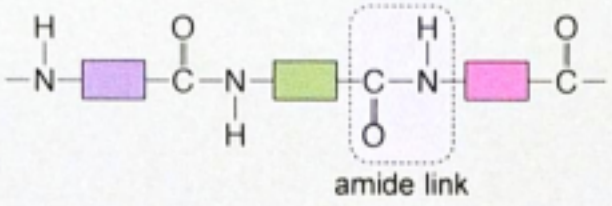
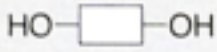
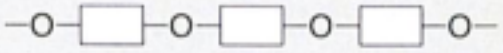
Name 4 types of Condensation Polymer, giving the following information for each:

Name of monomer(s)
Diagram of monomer(s)
Diagram of polymer structure
Natural or Synthetic?
Type of link
Where it is used/found

What is *Hydrolysis*?
Explain how natural polymers can be *Hydrolysed*.
Name the simple compounds formed.

Explain how *Chromatography* can be useful after hydrolysis.

Condensation Polymers:

Monomer(s)	Polymer	Link	Found in
Amide:  Carboxylic acid: 	**Nylon:** synthetic polymer 	Amide	Thread, ropes, fishing nets, carpets
Carboxylic acid:  Alcohol: 	**Terylene:** synthetic polymer 	Ester	Thread, shirts, clothing, bed-linen
Amino acid: 	**Protein:** natural polymer 	Amide	Food
Glucose: 	**Complex Carbohydrate:** natural polymer 	–	Food, cellulose

Hydrolysis of Natural Polymers:

- Hydrolysis is a reaction in which a molecule is broken down using water
- This happens in the body using enzymes; in the lab it can be done using acid or with enzymes
- Condensation polymers break down to form their **monomers**

Chromatography:

- When polymers (e.g. proteins) are hydrolysed a mixture of monomers (e.g. amino acids) are produced
- Paper Chromatography can be used to separate and identify the monomers as they all have different R_f values