

Organic Chemistry

IGCSE Chemistry ■ Topic 11

IGCSE Chemistry



What we will cover

1 Homologous series & naming

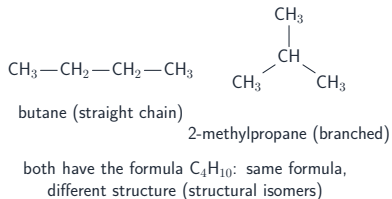
2 Fuels & fractional distillation

3 Alkanes & cracking

4 Alkenes

5 Alcohols & acids

6 Polymers

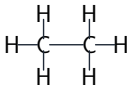


alkanes and cracking

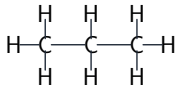
Homologous series and formulae



methane



ethane



propane



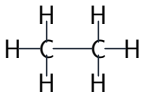
each step adds a CH_2 unit

general formula $\text{C}_n\text{H}_{2n+2}$

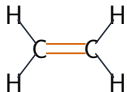


Crude oil is separated by fractional distillation

Saturated, unsaturated and isomers



ethane C_2H_6
saturated: single C–C bond



ethene C_2H_4
unsaturated:
C=C double bond



Polymers persist and can pollute the environment

Naming organic compounds

endings = family

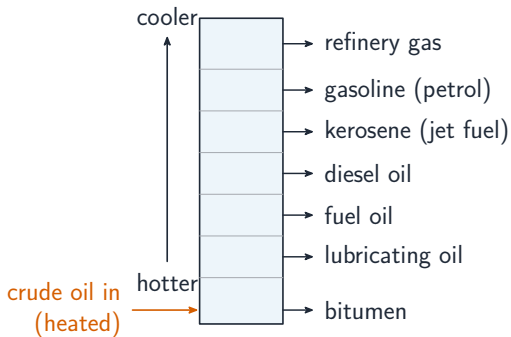
-ane alkane, -ene alkene,
-ol alcohol, -oic acid

prefixes = carbons

meth- 1, eth- 2,
prop- 3, but- 4

A number locates the group: but-1-ene vs but-2-ene; propan-1-ol vs propan-2-ol.

Fuels: fractional distillation



up the column: smaller molecules,
lower boiling points, more volatile

Petroleum 石油 is split into **fractions** 馏分 by boiling point in a tall column.

Top (cool): short chains, more **volatile** 挥发性, low **viscosity** 黏度. Bottom (hot): long chains, **bitumen** 沥青.

Alkanes

combustion 燃烧

burn in $\text{O}_2 \rightarrow \text{CO}_2 + \text{water}$

substitution 取代反应

+ Cl_2 in **UV light** 紫外线

Alkanes are **saturated** & generally unreactive. $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$ (a photochemical reaction).

Cracking

large alkane molecule



heat + catalyst



smaller alkane + alkene (C=C)

Cracking 裂化 breaks a big alkane into a smaller alkane + an **alkene**, using heat & a catalyst. It makes useful small molecules & alkenes for plastics.

Alkenes and the bromine test

shake with orange bromine water



alkene:
turns colourless

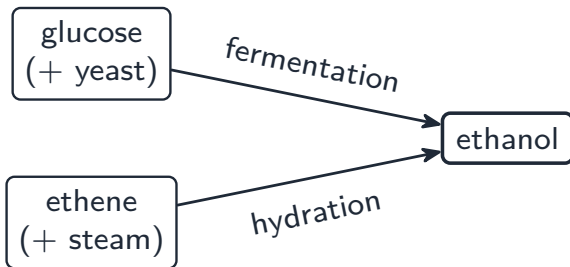


alkane:
stays orange

The $C=C$ makes alkenes reactive
(**addition reactions** 加成反应).

Test: shake with orange **bromine water** 溴水. An alkene **decolourises** it; an alkane does not.

Alcohols and ethanol



Ethanol 乙醇 ($-\text{OH}$) two ways:

- **fermentation** 发酵 of glucose (yeast; renewable, slow)
- **hydration** 水合 of ethene (steam + catalyst; fast, pure)

Used as a fuel & **solvent** 溶剂.

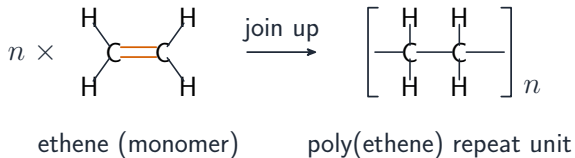
Carboxylic acids and esters



Carboxylic acids 羧酸 ($-\text{COOH}$)
react with metals, bases &
carbonates (giving ethanoates).

Acid + alcohol $\xrightarrow{\text{catalyst}}$ an
ester 酯 + water.

Polymers



A **polymer** 聚合物 joins many **monomers** 单体.

- **addition** 加聚 – alkenes join, no other product
- **condensation** 缩聚 – water lost (nylon, PET)

Many plastics do not break down.

Worked example – alkane or alkene?

Two colourless liquids are ethane and ethene. Give a test that tells them apart.

- Add **aqueous bromine** and shake.
- Ethene has a **C=C double bond**: it **adds** bromine across it.
- The bromine is **decolourised** (orange → colourless): ethene.
- Ethane is **saturated** – no double bond – so the bromine **stays orange**.

“Decolourised” means **orange → colourless**, not “turns white”. Unsaturated = has C=C = decolourises bromine water.

Topic 11 – key takeaways

1 Series

same functional group; differ by CH_2

2 Fuels

fractional distillation by boiling point

3 Alkenes

$\text{C}=\text{C}$; decolourise bromine water

4 Polymers

addition (alkenes) & condensation

Check yourself

- 1 What is the general formula of the alkanes?
- 2 How are crude oil fractions separated?
- 3 What does an alkene do to bromine water?
- 4 What two things join in addition polymerisation?



Answers 1. C_nH_{2n+2} 2. fractional distillation 3. decolourises it (orange to colourless)
4. many alkene monomers