

Organic Chemistry

IGCSE Chemistry ■ Topic 11

IGCSE Chemistry



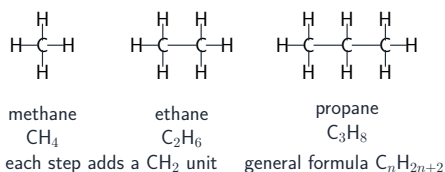
Organic Chemistry

What we will cover

- 1 Homologous series & naming
- 2 Fuels & fractional distillation
- 3 Alkanes & cracking
- 4 Alkenes
- 5 Alcohols & acids
- 6 Polymers

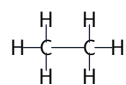
1 Families

Homologous series and formulae

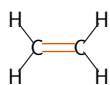


- The **molecular formula** 分子式 shows how many of each atom there are, for example C_2H_6 .
- The **displayed formula** 结构式 shows every atom and every bond drawn out in full.
- The **structural formula** 结构简式 shows how the atoms are arranged without drawing every bond, for example $\text{CH}_3\text{CH}_2\text{OH}$.
- The **general formula** 通式 works for a whole family, for example

Saturated, unsaturated and isomers



ethane C_2H_6
saturated: single C–C bond



ethene C_2H_4
unsaturated: C=C double bond

- Learn each **homologous series** by its functional group and general formula: alkanes $\text{C}_n\text{H}_{2n+2}$, alkenes...
- The **bromine water test** for unsaturation: an alkene (with its $\text{C}=\text{C}$) turns orange bromine water colourless; an alkane leaves it orange.
- **Cracking** breaks large, less useful alkanes into smaller alkanes and alkenes, using heat and a catalyst.

Naming organic compounds

endings = family

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

prefixes = carbons

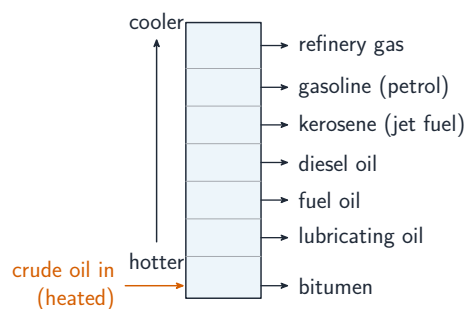
meth- 1, eth- 2,
prop- 3, but- 4

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

2 Fuels and alkanes

Organic Chemistry
└ Fuels and alkanes

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.

Organic Chemistry
└ Fuels and alkanes

Alkanes

combustion 燃烧

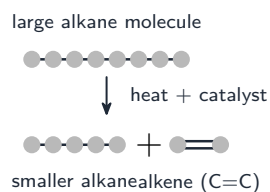
burn in $O_2 \rightarrow CO_2 + \text{water}$

substitution 取代反应

+ Cl_2 in **UV light** 紫外线

Alkanes are **saturated** & generally unreactive. $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ (a photochemical reaction).

Cracking



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.

3 Alkenes, alcohols, acids

Alkenes and the bromine test

shake with orange bromine water



alkene:
turns colourless

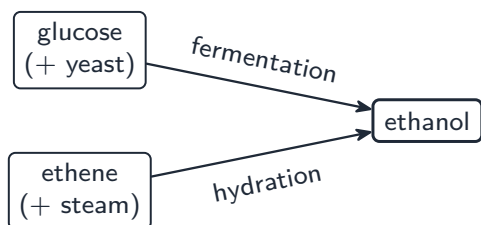


alkane:
stays orange

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 (–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

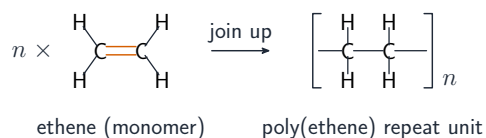


Carboxylic acids 羧酸 (–COOH) react with metals, bases & carbonates (giving ethanoates).

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

4 Polymers

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.

5

Recap

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. $\text{C}_n\text{H}_{2n+2}$ 2. fractional distillation 3. decolourises it (orange to colourless)
4. many alkene monomers