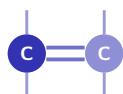


Hydrocarbons

A-Level Chemistry ■ Topic 14

A-Level Chemistry



Hydrocarbons

What we will cover

- 1 Alkanes: making & combustion
- 2 Free-radical substitution
- 3 Alkenes & their reactions
- 4 The bromine test
- 5 Addition polymerisation
- 6 Markovnikov's rule



methane, the simplest alkane

1 Alkanes

Hydrocarbons

└ Alkanes

Alkanes: making and combustion

complete 完全燃烧

plenty of $O_2 \rightarrow CO_2 + H_2O$

incomplete 不完全燃烧

too little $O_2 \rightarrow CO + \text{soot}$

Alkanes 烷烃 (C_nH_{2n+2}) are made by **hydrogenation** 氢化 of alkenes or **cracking** 裂化; they are unreactive (strong, non-polar bonds).

Hydrocarbons

└ Alkanes

Free-radical substitution

1. **initiation** $Cl_2 \xrightarrow{UV} 2Cl^\bullet$
UV light splits $Cl-Cl$ into two radicals
2. **propagation** $Cl^\bullet + C_2H_6 \rightarrow C_2H_5^\bullet + HCl$
 $C_2H_5^\bullet + Cl_2 \rightarrow C_2H_5Cl + Cl^\bullet$
each radical makes a new radical, so the chain continues
3. **termination** $Cl^\bullet + C_2H_5^\bullet \rightarrow C_2H_5Cl$
two radicals join, ending the chain

Alkanes react with a halogen in **UV light** 紫外线:

- **initiation** 引发 – UV makes radicals
- **propagation** 增长 – carries the chain
- **termination** 终止 – two radicals join

2 Alkenes

Alkenes and their reactions

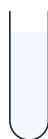


Alkenes 烯烃 (C_nH_{2n}) have a reactive $C=C$, attacked by **electrophilic addition** 亲电加成:

- $H_2/Ni \rightarrow$ alkane; steam $\rightarrow$ alcohol
- $HX \rightarrow$ halogenoalkane; $X_2 \rightarrow$ dihalide

The bromine test

shake with orange bromine water



with an **alkene**
turns colourless
(decolourised)

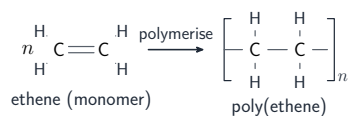


with an **alkane**
stays orange
(no reaction)

Shake with orange **bromine water** 溴水:

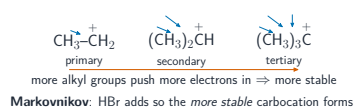
An alkene **decolourises** it (electrophilic addition); an alkane leaves it orange.

Addition polymerisation



In **addition polymerisation** 加成聚合, many alkene molecules open their $C=C$ and join into one long chain – with **no other product**. Ethene $\rightarrow$ poly(ethene), a **polymer** 聚合物.

Mechanism and Markovnikov's rule



A **carbocation** 碳正离子 forms in electrophilic addition.

Alkyl groups push electrons in (the **inductive effect** 诱导效应), so tertiary > secondary > primary – the more stable one forms (**Markovnikov's rule** 马氏规则).

3

Recap

Worked example – which product is major?

But-1-ene reacts with HBr . Name the major product and explain why.

- The $C=C$ π electrons attack the δ^+ H of $H-Br$: **electrophilic addition**.
- Two **carbocations** 碳正离子 are possible: a **secondary** one or a **primary** one.
- Alkyl groups **push electron density** in, spreading the charge, so the secondary is more stable.
- Br^- attacks it: major product **2-bromobutane**.

Always route through the **more stable carbocation**. Stability: tertiary > secondary > primary.

Topic 14 – key takeaways

1 Alkanes

combustion; free-radical substitution in UV

2 Alkenes

electrophilic addition across C=C

3 Bromine test

alkene decolourises bromine water

4 Markovnikov

the more stable carbocation forms

Check yourself

- 1 What two products does incomplete combustion add?
- 2 What light is needed for free-radical substitution?
- 3 What does an alkene do to bromine water?
- 4 Which carbocation is most stable: 1°, 2° or 3°?



Answers 1. carbon monoxide and soot 2. ultraviolet 3. decolourises it 4. tertiary (3°)