

Introduction to Organic Chemistry

A-Level Chemistry ■ Topic 13

A-Level Chemistry



Introduction to Organic Chemistry

What we will cover

- 1 Types of formula
- 2 Bond fission
- 3 Nucleophiles & electrophiles
- 4 Mechanisms
- 5 Hybridisation & shapes
- 6 Isomerism



the feedstock of organics

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Formulas and reactions

Types of formula

empirical

CH_2 – simplest ratio

molecular

C_2H_4 – actual numbers

structural

$\text{CH}_2=\text{CH}_2$ – how they join

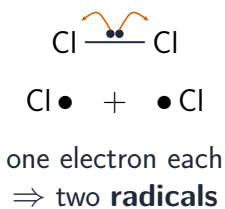
displayed

every bond drawn

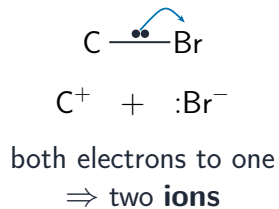
Bond fission

- **homolytic fission** 均裂 – one electron each → two **free radicals** 自由基
- **heterolytic fission** 异裂 – both electrons to one atom → two ions

homolytic fission

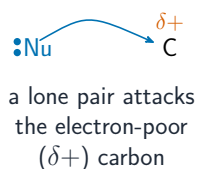


heterolytic fission

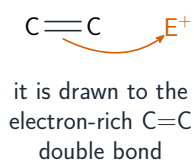


Nucleophiles and electrophiles

nucleophile



electrophile



- a **nucleophile** 亲核试剂 (lone pair) attacks an electron-**poor** centre
- an **electrophile** 亲电试剂 is drawn to an electron-**rich** centre ($\text{C}=\text{C}$)

Reaction types: **addition** 加成,
substitution 取代,
elimination 消去,
hydrolysis 水解.

Mechanisms

free-radical substitution 自由基取代 – alkanes

electrophilic addition 亲电加成 – alkenes

nucleophilic substitution 亲核取代 – halogenoalkanes

nucleophilic addition 亲核加成 – carbonyls

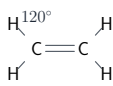
Free-radical steps: **initiation** 引发 → **propagation** 增长 → **termination** 终止. A **curly arrow** 弯箭头 shows a **pair** of electrons moving.

2 Shape and isomerism

Hybridisation and shapes



sp³: 4 single bonds
tetrahedral



sp²: 1 double + 2 single
planar (flat)

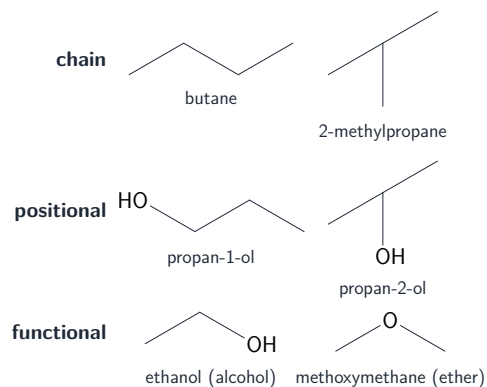


sp: 1 triple bond
linear

- **sp³** – tetrahedral, 109.5°
- **sp²** – planar, 120° (ethene)
- **sp** – linear, 180°

Single = σ ; double = $\sigma + \pi$.

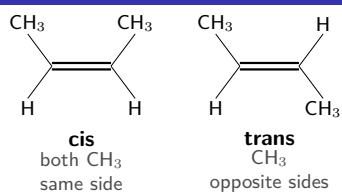
Structural isomerism



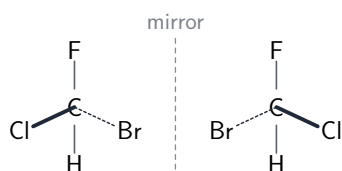
Same molecular formula, atoms joined differently:

- **chain** 链异构
- **positional** 位置异构
- **functional group** 官能团异构

Stereoisomerism



cis vs trans at $\text{C}=\text{C}$



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Recap

Worked example – structural isomers

Draw and name the structural isomers of C_4H_{10} , and state the type of isomerism.

- Straight chain: $CH_3CH_2CH_2CH_3$ – **butane**.
- Branched: $(CH_3)_3CH$ – **2-methylpropane**.
- There are **only two**: a 3-carbon chain cannot take a CH_3 anywhere else.
- Same molecular formula, different skeleton
⇒ **chain isomerism**.

Isomers share a **molecular** formula. **Chain** = different skeleton; **position** = group moved; **functional group** = a different group entirely.

Topic 13 – key takeaways

1 Functional group

the reactive part sets the properties

2 Bond fission

homolytic (radicals) vs heterolytic (ions)

3 Shapes

$sp^3/sp^2/sp$ give tetrahedral/planar/linear

4 Isomerism

structural; cis/trans; optical (chiral)

Check yourself

- 1 Homolytic fission makes two of what?
- 2 A nucleophile attacks an electron-rich or electron-poor centre?
- 3 What is the shape at an sp^2 carbon?
- 4 A chiral carbon has how many different groups?



Answers 1. free radicals 2. electron-poor 3. planar (120°) 4. four