Introduction to Organic Chemistry Map

Cambridge International AS & A Level Chemistry · Topic 13 An introduction to AS Level organic chemistry

1 Types of formula

13.1.1–13.1.6

- **Hydrocarbon**: C and H only; alkanes have no functional group
- **Molecular** C_4H_{10}; **empirical** C_2H_5; **general** C_nH_{2n+2}
- **Structural**: $CH_3CH_2CH_2CH_3$; **displayed**: every bond drawn
- **Skeletal**: corners and ends are C; H on C not drawn
- Straight-chained, branched or cyclic

2 Series and names

13.1.3–13.1.5, 13.2.1

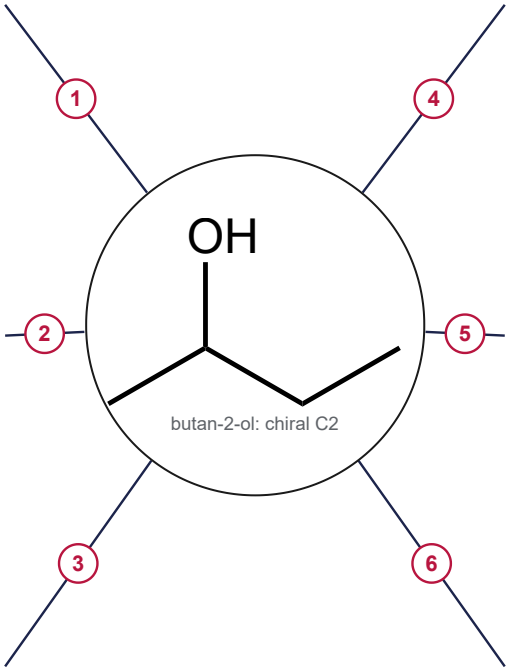
- **Homologous series**: same group and general formula, + CH_2
- **Saturated**: C–C single bonds only; **unsaturated**: C=C or C≡C
- Names up to six carbons: stem, lowest numbers, branches A to Z
- Esters six plus six; nitriles count the C of –C≡N

3 Structural isomers

13.4.1, 13.4.6

- Same molecular formula, different structural formula
- **Chain**: butane, 2-methylpropane
- **Positional**: propan-1-ol, propan-2-ol
- **Functional group**: propanal, propanone
- Isomer counts: C_4H_{10} 2, C_5H_{12} 3, C_6H_{14} 5





4 Stereoisomers

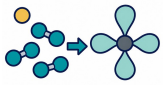
13.4.2–13.4.5

- Same structural formula, different arrangement in space
- **Cis/trans**: C=C (no rotation: π bond) with two different groups on each C
- **Chiral centre**: a C with four different groups
- **Enantiomers**: non-superimposable mirror images
- Rings can show both kinds

5 Shapes and hybridisation

13.3.1–13.3.4

- **sp³**: tetrahedral, 109.5°, four σ bonds
- **sp²**: trigonal planar, 120°, three σ + one π
- **sp**: linear, 180°, two σ + two π
- **Planar**: all atoms in one plane, e.g. ethene
- Double bond σ + π; triple bond σ + 2π



6 Breaking bonds

13.2.1 (c)–(e)

- **Homolytic**: one electron each → free radicals, e.g. Cl•
- **Heterolytic**: both electrons to one atom → ions
- **Nucleophile**: electron pair donor, e.g. OH^-, NH_3
- **Electrophile**: electron pair acceptor, e.g. H^+, $Br^{\delta+}$
- Initiation, propagation, termination

Functional groups (the Cambridge AS table)

the group decides the family, the name and the reactions

Family	Functional group	Name ending / prefix	General formula	Example
alkane	C–C, C–H only	-ane	C_nH_{2n+2}	propane, $CH_3CH_2CH_3$
alkene	C=C	-ene	C_nH_{2n}	propene, $CH_2{=}CHCH_3$
halogenoalkane	C–X (X = Cl, Br, I)	chloro-, bromo-, iodo-	$C_nH_{2n+1}X$	1-bromopropane, $CH_3CH_2CH_2Br$
alcohol	–OH	-ol	$C_nH_{2n+1}OH$	propan-2-ol, $CH_3CH(OH)CH_3$
aldehyde	–CHO	-al	$C_nH_{2n}O$	propanal, CH_3CH_2CHO
ketone	C=O inside the chain	-one	$C_nH_{2n}O$	propanone, CH_3COCH_3
carboxylic acid	–COOH	-oic acid	$C_nH_{2n}O_2$	propanoic acid, CH_3CH_2COOH
ester	–COO–	alkyl -oate	$C_nH_{2n}O_2$	methyl ethanoate, CH_3COOCH_3
amine (primary)	$–NH_2$	-amine	$C_nH_{2n+1}NH_2$	ethylamine, $CH_3CH_2NH_2$
nitrile	–C≡N	-nitrile	$C_nH_{2n+1}CN$	propanenitrile, CH_3CH_2CN

Reactions and mechanisms

Reaction types

- Addition; substitution; elimination
- Hydrolysis (water splits a bond); condensation (a small molecule lost)
- Oxidation [O]; reduction [H]

Mechanisms

- Free-radical substitution (alkanes)
- Electrophilic addition (alkenes)
- Nucleophilic substitution and addition

Curly arrows

- An electron pair moving
- Starts at a bond or a lone pair
- Ends where the new bond forms

Skeletal formulae: each line end or corner is a carbon atom with enough H atoms to make four bonds; a line to a labelled atom is a bond to that atom.

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