Introduction to Organic Chemistry Map

Edexcel International A Level Chemistry · Unit 1 · Topic 4A

1 Types of formula

4.5

- **Molecular**: the actual atoms, C_4H_{10}
- **Empirical**: simplest ratio, C_2H_5
- **General**: a whole series, 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



2 Homologous series

4.4

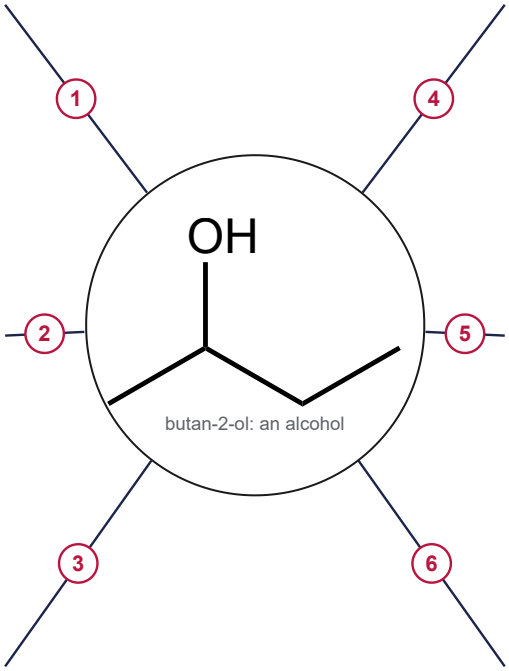
- Same functional group and same general formula
- Neighbouring members differ by CH_2
- Similar chemical reactions (the functional group reacts)
- Gradual trend in physical properties: boiling point rises with chain length
- Cycloalkanes: C_nH_{2n}

3 Naming (IUPAC)

4.5

- Stem: the longest chain with the group (meth, eth, prop, but, pent, hex, hept, oct, non, dec)
- Number for the lowest numbers
- Branches in alphabetical order; di-, tri- for repeats
- Commas between numbers; dashes between numbers and letters





4 Structural isomers

4.10–4.11

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

5 Breaking bonds

4.7–4.8

- **Homolytic**: one electron to each atom → free radicals (fish-hook arrows)
- **Heterolytic**: both electrons to one atom → ions (full arrow)
- **Free radical**: a species with an unpaired electron, e.g. Cl•
- **Electrophile**: an electron pair acceptor, e.g. H^+, $Br^{\delta+}$

6 Types of reaction

4.6

- **Addition**: two molecules make one (C_2H_4 + Br_2)
- **Substitution**: an atom or group is replaced (CH_4 + Cl_2)
- **Oxidation**: gains O or loses H; **reduction**: the reverse
- **Polymerisation**: many monomers make a polymer
- Also: elimination, hydrolysis

Functional groups

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

Worked examples

Hazard and risk

- **Hazard**: potential to cause harm
- **Risk**: the chance that harm happens
- Reduce risk: smaller scale; precautions for the hazard; a less hazardous substance or method

Naming: a worked example

- $(CH_3)_2CHCH(CH_3)CH_2CH_3$: longest chain 5 (pentane)
- two methyls on C2 and C3
- → **2,3-dimethylpentane**

Isomers of C_5H_{12}

- pentane (a chain of 5)
- 2-methylbutane (4 + one branch)
- 2,2-dimethylpropane (3 + two branches)
- cyclopentane is C_5H_{10}: not an isomer

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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