

Organic Chemistry — Foundations

01 · FUNCTIONAL GROUPS

Class	Group	Suffix
alkane	C–C	-ane
alkene	C=C	-ene
halogenoalkane	–X	halogeno-
alcohol	–OH	-ol
aldehyde	–CHO	-al
ketone	C=O	-one
carboxylic acid	–COOH	-oic acid
ester	–COO–	-oate
amine	–NH ₂	-amine
amide	–CONH ₂	-amide
nitrile	–C≡N	-nitrile

02 · NAMING RULES

1 · Longest chain containing the group gives the stem. 2 · Number from the end giving the group the **lowest locant**. 3 · Substituents alphabetically, with di- and tri- as needed.

Commas between numbers, hyphens between numbers and letters: 2,3-dimethylbutane.

03 · HOMOLOGOUS SERIES

A family with the **same general formula and functional group**, each member differing by CH₂, showing a gradual change in physical properties and similar chemical properties.

General formulae: alkane C_nH_{2n+2}, alkene C_nH_{2n}, alcohol C_nH_{2n+1}OH, carboxylic acid C_nH_{2n+1}COOH.

04 · PRIMARY, SECONDARY, TERTIARY

Classified by how many carbon atoms are attached to the carbon carrying the functional group: **1° one, 2° two, 3° three**.

This decides the products of alcohol oxidation and the mechanism of halogenoalkane substitution, so identify it before predicting anything.

05 · STRUCTURAL ISOMERISM

Same molecular formula, different structural formula. Three kinds:

Chain — branching differs: butane and 2-methylpropane.

Position — the group sits on a different carbon: propan-1-ol and propan-2-ol.

Functional group — different group entirely: propanal and propanone, or ethanol and methoxymethane.

06 · CIS–TRANS ISOMERISM

Needs a **C=C** (rotation is blocked by the π bond) and **two different groups on each carbon** of the double bond.

In the **cis** isomer the like groups are on the same side; in **trans** they are on opposite sides. But-2-ene shows it; but-1-ene does not.

07 · OPTICAL ISOMERISM

Arises at a **chiral carbon** — one bonded to four different groups. The two forms are non-superimposable mirror images called enantiomers.

They are identical in every physical and chemical property except that they **rotate plane-polarised light** in opposite directions and react differently with other chiral molecules. A 50:50 mixture is racemic and shows no rotation.

08 · WORKED EXAMPLE — COUNT THE ISOMERS

How many structural isomers has C₄H₈, and which show cis–trans?

but-1-ene · but-2-ene · 2-methylpropene · cyclobutane · methylcyclopropane

Only **but-2-ene** has two different groups on each C of the C=C, so only it exists as cis and trans forms.

09 · TYPES OF FORMULA

Type	Propan-1-ol
empirical	C ₃ H ₈ O
molecular	C ₃ H ₈ O
structural	CH ₃ CH ₂ CH ₂ OH
displayed	every bond drawn
skeletal	lines for the carbon chain

10 · BOND FISSION

Homolytic — each atom takes one electron, giving two **radicals**. Shown with single-headed (fish-hook) arrows. Typical of UV-initiated reactions.

Heterolytic — one atom takes both electrons, giving a cation and an anion. Shown with double-headed curly arrows, which always start at a lone pair or a bond and point at where the pair goes.

11 · ATTACKING SPECIES

Nucleophile — an electron-pair donor, attracted to electron-poor carbon: OH[–], CN[–], NH₃, H₂O.

Electrophile — an electron-pair acceptor, attracted to electron-rich sites: NO₂⁺, Br⁺, H⁺, the δ⁺ end of a polarised bond.

Radical — a species with an unpaired electron, formed by homolysis.

12 · REACTION TYPES TO NAME

Addition — two molecules become one (alkene + Br₂).

Substitution — one atom or group replaces another.

Elimination — a small molecule is lost, forming a double bond.

Hydrolysis — split by water or aqueous acid/alkali.

Oxidation / reduction — judged by gain or loss of oxygen or hydrogen; use [O] and [H] in equations.

13 · WORKED EXAMPLE — NAME THE COMPOUND

Name CH₃CH(CH₃)CH₂CH(OH)CH₃.

Longest chain containing the –OH: five carbons → pentan-ol

Number from the end nearest the –OH → carbon 2

Methyl branch on carbon 4

→ **4-methylpentan-2-ol**, a secondary alcohol.

MARKS LOST HERE

— Numbering the chain from the wrong end, or missing the longest chain when it bends on the page.

— Claiming cis–trans isomerism when one carbon of the C=C carries two identical groups.

— Drawing a curly arrow from an atom instead of from a bond or lone pair.

— Calling a species a nucleophile without saying it donates an electron pair.