

CAIE Chemistry A-level

29: An Introduction to Organic Chemistry

(A-level only)

Notes

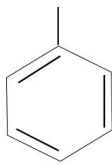
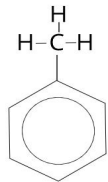
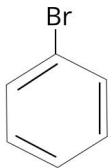
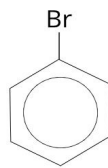
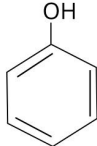
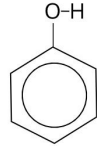
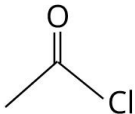
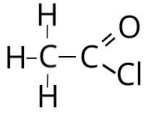
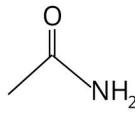
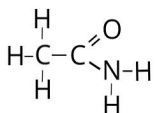
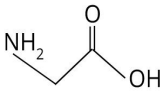
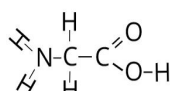
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Formulae, Functional Groups and Naming of Organic Compounds

Table 1 shows the different types of compounds you are expected to be able to name.

Table 1

Homologous series	Prefix or suffix	Example name	Example molecular formula	Example structural formula	Example skeletal formula	Example displayed formula
Arenes	-benzene Or phenyl-	methylbenzene	C_7H_8	$C_6H_5CH_3$		
Halogenoarenes	Fluoro- /Chloro- /Bromo- /Iodo- -benzene	bromobenzene	C_6H_5Br	C_6H_5Br		
Phenols	-phenol Or -benzenol	Phenol	C_6H_6O	C_6H_5OH		
Acyl chlorides	-oyl chloride	Ethanoyl chloride	C_2H_3OCl	CH_3COCl		
Amides	-amide	Ethanamide	C_2H_5NO	CH_3CONH_2		
Amino acids	Amino- -oic acid	Aminoethanoic acid	$C_2H_5O_2N$	H_2NCH_2COOH		

Naming Organic Compounds

Follow these rules when naming organic compounds:

1. Identify the **longest carbon chain** that contains the functional group.
2. Identify the **functional group** on the chain. This gives you the suffix or prefix of the compound.



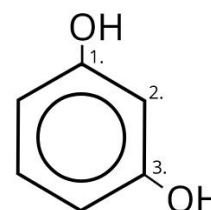
- Count along the carbon chain so that the **functional group has the lowest number**. See the example below to illustrate this.
- If there are any **side chains**, add these as **prefixes** (e.g. methyl-) to the beginning of the name. Do the same if there are other (less important) functional groups. Put these at the start of the name in **alphabetical order**.
- If there are **two or more identical functional groups** or side chains use the prefixes di-, tri- and tetra- before that section of the name.

Naming Simple Aromatic Compounds

When it comes to naming aromatic compounds, the method to go about it is similar to the one above. The main difference is the **benzene ring** which means you count the carbons in the circle.

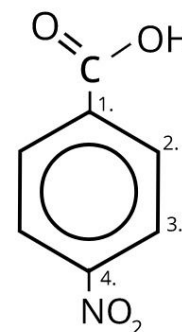
Example:

- There are **two alcohol groups** on the benzene. This means the suffix is **-benzenol**, as seen in the table above.
- Counting from the first alcohol as '1', the second alcohol group is on the third carbon in the chain. This gives the overall name **benzene-1,3-diol**.



Example 2:

- The biggest group on the benzene chain is the **carboxylic acid** so start counting from there. The **nitro-group** is on the fourth carbon.
- The overall name therefore is: **4-nitrobenzoic acid**.



Characteristic Organic Reactions Terminology

The following terms are important in organic chemistry so you must make sure you are familiar with them:

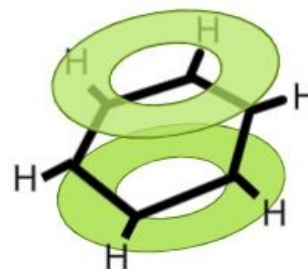
- Functional group** - a group of atoms responsible for the characteristic reactions of an organic compound.
- Electrophile** - a molecule or substance that acts as an electron pair acceptor.
- Addition** - a reaction where two or more molecules react to form a larger molecule.
- Elimination** - a reaction in which two substituents are removed from a molecule in a mechanism with one or two steps.



Shapes of organic molecules

Bonding in Benzene

Benzene is a **planar molecule** with bond angles of **120°**. All the carbon-to-carbon bonds are identical so it has a regular hexagonal shape. There are C-H and C-C sigma bonds as well as a **delocalised pi system** above and below the carbon ring. One electron from each carbon is delocalised into the pi (π) system which **contains 6 electrons**.



Isomerism

Optical Isomerism

Optical isomerism is another branch of stereoisomerism. It occurs when there is a **chiral centre**, (explained in more depth in 'What is a chiral centre?' on the following page). Optical isomers have the same molecular and structural formula but they are **mirror images of one another**. The two mirror images are called **enantiomers**, they have identical physical and chemical properties except one. These enantiomers can only be identified by their ability to rotate **plane polarised light** in equal and opposite directions. If there is an equal mixture of each enantiomer then this is called a **racemic mixture**. This mix has no effect on plane polarised light as the equal and opposite rotations cancel out to zero.

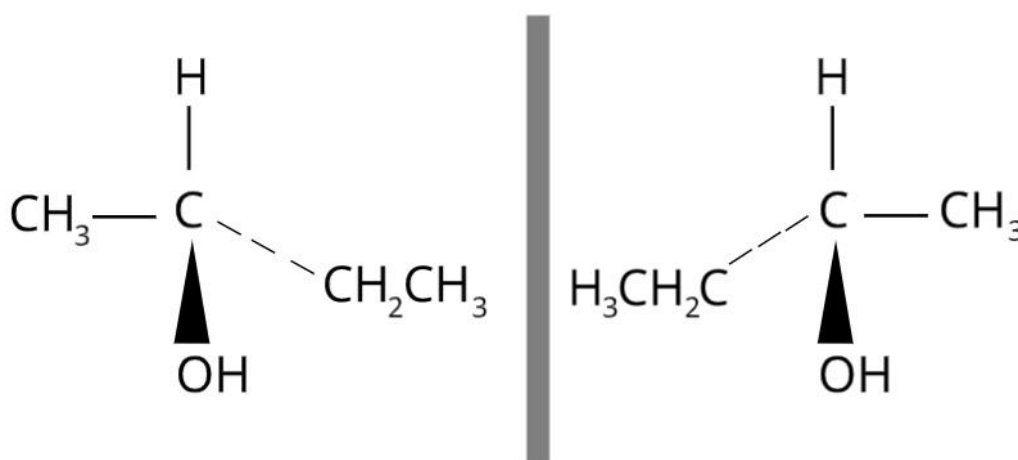
What is a Chiral Centre?

A chiral centre is an **atom with four different groups bonded** to it. This arrangement creates compounds which are **non-superimposable mirror images** of each other. If a compound has a chiral centre, it will display **optical isomerism**.

It is possible for compounds to have **more than one chiral centre**.

Spotting chiral centres:

Chiral centres can be spotted in organic compounds by identifying a **carbon atom which is bonded to four different groups**.



A chiral drug extracted from a **natural source** often contains a **single optical isomer**.

Synthetic drugs often only contain a single optical isomer:

- **More effective**
- **Fewer side effects**
- **Reduces cost** long term as money isn't wasted producing the optical isomer that is ineffective.

Optical isomers of a molecule have different arrangements of bonds so they have different shapes. This means that only one of the enantiomers may fit into the **active site** (binding site) of an enzyme. As a result, **only one of the enantiomers will cause the desirable effect**.

Enzymes as Catalysts

The active site is the part of the **tertiary (3D) structure** of an enzyme where a substance with exactly the right shape will bind. The specific shape of the **active site** means that only one (or a few) specific molecules with the right shape can bind and react. The active site also contains R groups (from the amino acids which make up the protein) that may help the reactant bind to the active site.

The **specific** action of an enzyme with a reactant is explained with the **lock and key model** (where the enzyme is the lock, the active site is the key hole and the reactant is the key). As only one enantiomer often has the desired effect then the other may have to be removed.

