Beckfoot

Subject: Chemistry	Topic: Introduction to Organic Chemistry 3.3.1	Year Group: 12

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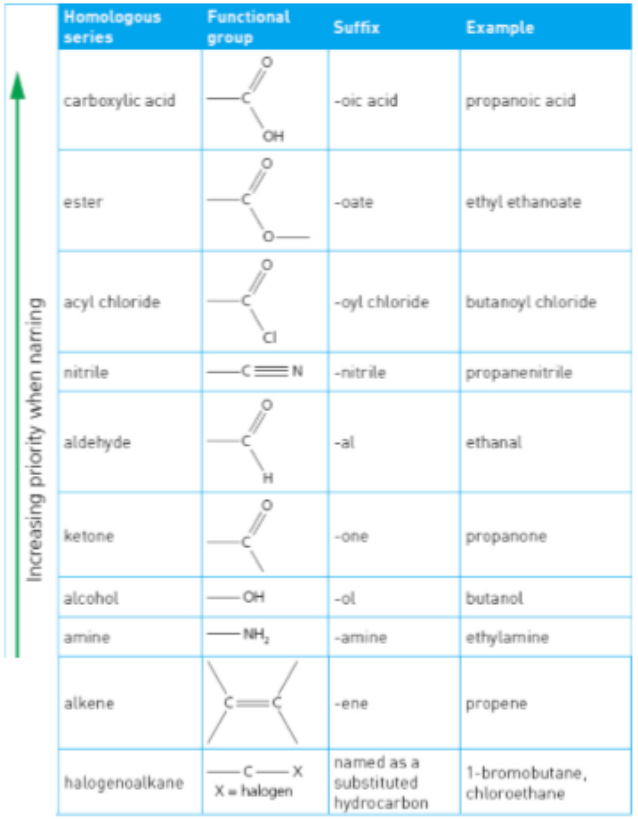
Naming Organic Compounds

1	Identify the longest chain of carbon atoms and name it according to the number of carbons (1=meth, 2=eth, 3=prop, 4=but, 5=pent, 6=hex).
2	Add –ane if there are only single bonds, and –ene if a C=C double bond is present. If the carbon atoms are in a ring, place 'cyclo' at the start of the name.
3	Identify any side chains, such as methyl ($-CH_3$), ethyl ($-CH_2CH_3$), fluoro (–F), chloro (–Cl), bromo (–Br) and iodo (–I). Add the group name as a prefix.
4	Number the carbon chain , starting at the end that would give the substituents the lower number.
5	Number each substituted group and add this number before the group, along with a hyphen. Hyphens should be used in the place between a number and a letter, or a letter and a number.
6	When two of the same group are present, use the term 'di-' e.g. dimethyl (three of the same group are 'tri-', four is 'tetra-' and 5 is 'penta-'. The position of each group must be shown, with a comma placed between the two numbers, for example 2,2-dimethylbutane. Group names are written in alphabetical order.
7	The position of the double bond in an alkene is shown by a number, which shows the first carbon of the double bond e.g. in but-2-ene, the double bond starts on the second carbon.

Functional Groups

1	
2	The functional group is named as part of the longest unbranched chain by adding a suffix at the end of the name (see above). When numbering the carbon chain, the functional group should have the lowest number possible.
3	If a compound has more than one functional group, then it is named according to the priority shown above, with additional groups given a different name e.g. –OH = hydroxy.

Homologous series	Functional group	Suffix	Example
carboxylic acid		-oic acid	propanoic acid
ester		-oate	ethyl ethanoate
acyl chloride		-oyl chloride	butanoyl chloride
nitrile	—C≡N	-nitrile	propanenitrile
aldehyde		-al	ethanal
ketone		-one	propanone
alcohol	—OH	-ol	butanol
amine	$—NH_2$	-amine	ethylamine
alkene	C=C	-ene	propene
halogenoalkane	—C—X, X = halogen	named as a substituted hydrocarbon	1-bromobutane, chloroethane

Key Vocabulary

1	Empirical Formula	Shows the simplest whole number ratio of the atoms of each element in a compound.
2	Molecular Formula	Shows the actual number of atoms of each element in a compound.
3	General Formula	A type of empirical formula that represents the composition of any member of a homologous series.
4	Structural Formula	Shows the arrangement of atoms carbon by carbon with the attached hydrogens and functional groups, without showing the bonds.
5	Displayed Formula	Shows all atoms and all covalent bonds in a compound.
6	Skeletal Formula	An abbreviated diagrammatic representation of a compound which do not show carbon or hydrogen atoms.
7	Homologous Series	A group of compounds with the same general formula.
8	Functional Group	A group of atoms which are responsible for the characteristic reactions of a compound.
9	Structural Isomerism	Molecules with the same molecular formula but different structural formula.
10	Stereoisomerism	Molecules with the same structural formula but different arrangement of atoms in space.
11	Aliphatic Compounds	Hydrocarbon molecules/groups which have single, double or triple bonds.
12	Aromatic Compounds	Organic molecules which contain a ring of delocalised electrons.

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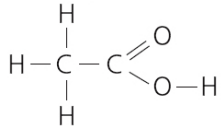
Displayed formulae

1. When drawing a displayed formula, all atoms (including carbon and hydrogen atoms), and all covalent bonds are shown.

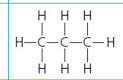
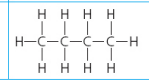


2. It is particularly important not to forget the covalent bond between the oxygen and the hydrogen atoms of the alcohol or carboxylic acid functional groups.

Skeletal formulae

1. A skeletal formula is a bare 'stick-like' representation of a molecule. Carbon and hydrogen atoms are not drawn, however other atoms such as halogens, nitrogen and oxygen atoms are. Each line in a skeletal formula shows a C-C bond.

2.

Name	Displayed formula	Skeletal formula
Ethane		
Propane		
Butane		

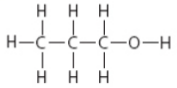
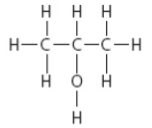
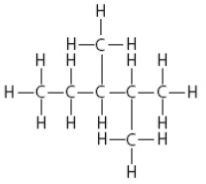
3. The end of the chain represents a $-CH_3$ group, unless a different atom is shown.

Structural formulae

1. The structural formula of a compound shows the arrangements of atoms, carbon by carbon with the attached hydrogens and functional groups, without showing the bonds.

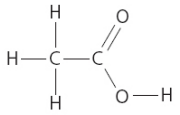
2. Each carbon is written separately followed by the atoms which are attached to it. When a group of atoms are attached to a carbon, brackets are used to indicate that the group is not part of the main carbon chain.

3.

Name	Structural formula	Displayed formula
Propan-1-ol	$CH_3CH_2CH_2OH$	
Propan-2-ol	$CH_3C(OH)HCH_3$	
2,3-dimethylpentane	$CH_3CH_2CH(CH_3)CH(CH_3)_2$	

Empirical and molecular formulae

1. The empirical formula shows the ratio of the different types of atom in a compound, whereas the molecular formula shows the actual number of each type of atom in a compound.

2. 

Ethanoic acid has a molecular formula of $C_2H_4O_2$ and an empirical formula of CH_2O.

General formulae

1. Each homologous series can be represented with a general formula, using n as the number of carbon atoms. Some common general formula are:

Alkanes	C_nH_{2n+2}
Alkenes/Cycloalkanes	C_nH_{2n}
Alcohols	$C_nH_{2n+1}OH$

2. To work out the formula of a given member of a homologous series, replace n in the general formula with the number of carbons. For example, an alkane with three carbon atoms as a molecular formula $C_2H_{2x3+2} = C_2H_6$.

Structural isomerism

1. There are three types of structural isomer

Position (note: not positional)

A substituted group or functional group is on a different position in the carbon chain e.g. 2-methylpentane and 3-methylpentane, or but-1-ene and but-2-ene.

Chain

In chain isomers, the longest carbon chain is different e.g. butane and 2-methylpropane. These isomers are easily recognised by noting that the root of the name (i.e. meth-, eth-, prop-, but-) will be different.

Functional group

Functional group isomers have different functional groups. Common examples include:

Alkenes and cycloalkanes; aldehydes and ketones; Carboxylic acids and esters.