# Introduction to organics knowledge organiser

## 1. Keywords

| | |
|---|---|
| Functional group: | An atom or group of atoms, such as a carboxyl group, that replaces hydrogen in an organic compound and that defines the structure of a family of compounds and determines the properties of the family. |
| Homologous series | A series of related chemical compounds that have the same functional group(s) but differ in formula by a fixed group of atoms. |
| Isomer | two or more compounds with the same formula but a different arrangement of atoms in the molecule and different properties |

## 2. Functional groups.

| Homologous series | Prefix or suffix | Functional group |
|---|---|---|
| Alkanes | -ane | C—C |
| Alkenes | -ene | C=C |
| Alcohols | hydroxy-/-ol | -OH |
| Carboxylic acid | -oic acid | -COOH |
| Haloalkane | Chloro-<br>Bromo-<br>Iodo- | -Cl<br>-Br<br>-I |
| Aldehydes | -ale | |
| Ketones | -one | |
| Amines | Amino-/-ine | -NH |
| Nitril | Cyano-/-nitrile | -CN |
| Amides | -amide | $-NH_2$ |

## 3. International Union of Pure and Applied Chemistry (IUPAC) rules

1.Identification of the longest “parent” hydrocarbon chain.

2.Identification of the parent functional group, if any, with the highest order of precedence.

3.Identification of the side-chains branching off the parent one.

4.Identification of the remaining functional groups, if any, and naming them by their ionic prefixes (such as hydroxy for -OH, oxy for =O, oxyalkane for O-R, etc.).Different side-chains and functional groups will be grouped together in alphabetical order. (The prefixes di-, tri-, etc. are not taken into consideration for grouping alphabetically.

5.Identification of double/triple bonds.

6.Numbering of the chain. So that the functional group with the highest precedence has the lowest possible number.

7.Numbering of the various substituents and bonds with their functional group. If there is more than one of the same type of substituent/double bond, a prefix is added showing how many there are (di – 2 tri – 3 tetra – 4 then as for the number of carbons below with 'a' added).

Adding of punctuation:

Commas are put between numbers (#) •Hyphens are put between a number(#) and a letter •Successive words are merged into one word

Order of precedence of groups:

Cations> Carboxylic acids>Esters>Amide>Nitrile>Aldehyde>Ketone>Alcohol>Amines

## 3. Chain nomenclature

| Number of C atoms | 1C | 2C | 3C | 4C | 5C | 6C | 7C | 8C | 9C | 10C |
|---|---|---|---|---|---|---|---|---|---|---|
| prefix | Meth- | Eth- | Prop- | But- | Pent- | Hex- | Hept- | Oct- | Non- | Dec- |

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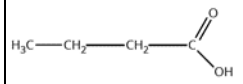
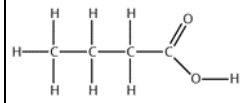
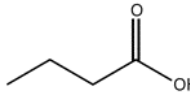
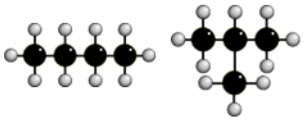
## 4. Types of chemical formulas

| Chemical Formula | Definition | Example |
|---|---|---|
| Molecular Formula (written) | shows the actual number of atoms of each element in a molecule. | $C_4H_8O_2$ |
| Empirical Formula (written) | shows the simplest whole number ratio of atoms of in a compound. | $C_2H_4O$ |
| Structural Formula (drawn) | shows the minimal detail that shows the arrangement of atoms in a molecule. |  |
| Displayed Formula (drawn) | shows the relative positioning of atoms and the bonds between them, all bonds shown |  |
| Skeletal Formula (drawn) | shows only the bonds of the carbon skeleton and any functional groups. C atoms not shown, nor H atoms bonded to C atoms. |  |

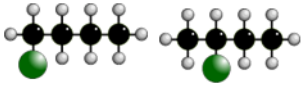
**STRUCTURAL ISOMERISM**

Same molecular formula but different structural formulae

**CHAIN ISOMERISM**



**POSITION ISOMERISM**



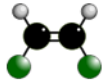
**FUNCTIONAL GROUP ISOMERISM**

**STEREOISOMERISM**

Same molecular formula but atoms occupy different positions in space.

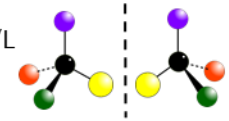
**GEOMETRICAL ISOMERISM**

Occurs due to the restricted rotation of C=C double bonds (E/Z or trans/cis)

E-trans   Z-cis

**OPTICAL ISOMERISM**

Occurs when molecules have a chiral centre. Get two non-superimposable mirror images.

Two options R/L 

## 5. Cahn-Ingold-Prelog (CIP) rules

These rules help with naming geometric isomers E/Z:

1.Compare the atomic number of the atoms directly attached to the double bond; the group having the atom of higher atomic number receives higher priority.

2.If there is a tie, we must consider the atoms at distance 2 from the double bond—as a list is made for each group of the atoms bonded to the one directly attached to the double bond. Each list is arranged in order of decreasing atomic number. Then the lists are compared atom by atom; at the earliest difference, the group containing the atom of higher atomic number receives higher priority.

3.If there is still a tie step 2 is repeated for the atoms at distance 3 from the double bond.

4.If two groups differ only in isotopes, then the larger atomic mass is used to set the priority.

This process is repeated recursively, each time with atoms one bond farther from the double bond, until the tie is broken.

E: the higher priority groups are on opposite sides of the double bond.
Z : the higher priority groups are on the same side of the double bond.