HOMOLOGOUS SERIES

The numerous organic compounds can be grouped into a comparatively small number of series of families of compounds known as homologous series. A typical series of organic compounds is the alkanes. It is also the simplest homologous series.

The alkanes are a series of hydrocarbons with a general molecular formula of C_nH_{2n+2}, where n is a whole number with a value of 1 or more.

Below is a table containing the properties of the first ten members of the alkane series.

Name	C_nH_{2n+2}	Molar Mass	Physical State	Boiling point	Melting point
Methane	CH_4	16	Gas	-162	-183
Ethane	C_2H_6	30	Gas	-89	-172

Propane	C_3H_8	44	Gas	-42	-187
Butane	C_4H_{10}	58	Gas	-1	-138
Pentane	C_5H_{12}	72	Liquid	36	-130
Hexane	C_6H_{14}	86	Liquid	69	-94
Heptane	C_7H_{16}	100	Liquid	98	-91
Octane	C_8H_{18}	114	Liquid	125	-57
Nonane	C_9H_{20}	128	Liquid	151	-54
Decane	$C_{10}H_{24}$	142	Liquid	174	-30

From the table above, we see that each individual member of the alkane series differs from the preceding or the following member by one carbon atom and two hydrogen atoms, i.e. $–CH_2–$ group. Such a family of compounds is known as a homologous series and each individual member is referred to as homologue.

A homologous series is a family of organic compounds which follows a regular structural pattern, in which each successive member differ in its molecular formula by a $–CH_2–$ group.

Other homologous series include the alkenes (C_nH_{2n}), the alkanols ($C_nH_{2n+1}OH$), and the carboxylic acids ($C_nH_{2n+1}COOH$). Homologous series have the following common characteristics:

General Molecular Formula: All members share a general formula, i.e. C_nH_{2n+2} for the alkanes, C_nH_{2n} for the alkenes and so on.

Difference between successive homologues: Each successive member in such a series differs in its molecular formula by the addition of a $–CH_2–$ group, thus its relative molecular mass increases by 14g.

Physical properties: The physical properties of the members change gradually as the number of carbon atoms per molecule increases. For example, the boiling points of the alkanes increase down the series. Similarly, the melting points and densities of the alkanes also increase, while their solubilities in water decreases down the series.

Chemical properties: The members show similar chemical properties. For example, the alkanes are fairly unreactive under ordinary conditions. They burn in air, forming carbon (IV) oxide and water, and undergo substitution reactions with other substances such as halogens.

General methods of properties: All members can usually be prepared by using the same general

methods, e.g. alkanes can be prepared by the action of hot soda lime on the appropriate sodium salt of an acid.

Akyl groups: Alkyl group includes all groups derived from the alkanes by the loss of a hydrogen atom. They have a general formula of C_nH_{2n+1}. They are named after the parent alkanes by replacing the ending –ane by –yl. Most homologous series are regarded as being derived from this alkyl group. Alkyl groups are given the general symbol, R.

Functional groups: The chemical reactivity of an alkyl compound is determined mainly by a non-alkyl group called functional group. Each functional group has its own characteristics properties. When two or more functional groups occur in one molecule, the properties of one are often modified or influenced by the presence of the others. A functional group can be

defined as an atom, a radical (groups of atoms) or a bond common to a homologous series, and which determines the main chemical properties of the series.