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Chapter 1 : Homologous Series of Alkanes, Alkenes and Alkynes with Examples

The homologous series of alkanes is the simplest and probably most often cited example but there are many other homologous series of organic compounds. Examples of some other important homologous series are listed below.

For example, ethene 2 carbons is the smallest alkene and ethanenitrile 2 carbons is the smallest nitrile. For more information, including diagrams of molecular structures and examples of each of the series listed above, visit the links on the name of each of the series. Properties of Compounds within the same Homologous Series: Two types of properties of substances of all types, incl. They are the chemical properties of the substance and the physical properties of the substance. Chemical Properties Organic compounds that are part of the same homologous series generally have similar chemical properties as each other, due to the presence of the same functional group in the molecules of all compounds in the series. Even though members of the same homologous series generally have similar chemical properties there may still be trends through the group e. Physical Properties Physical properties of organic compounds that are part of the same homologous series follow trends through the series. A common example of trends within homologous series is that of the boiling points of the members of the series. See, for example, boiling points of alkanes. As mentioned above, the trends in physical properties of compounds within a homologous series are primarily due to the progression of sizes and therefore weights of the molecules that form the homologous series. Using the example of the boiling points of alkanes, ethane having a higher boiling point than methane is explained by molecules of ethane C_2H_6 having more Van der Waals forces intermolecular forces with neighbouring molecules than is true for methane CH_4 due to the greater number of atoms forming molecules of ethane, compared with methane. More Terminology about Homologous Series: Successive members of a homologous series are called homologues. A homologation reaction is a chemical process which converts one member of a homologous series to the next member. We have occasionally seen "homologous series" written as " homologus series ", which is a mis-spelling. This is one of many pages about types of organic compounds in our Organic Chemistry Section. Similar and related pages describe hydrocarbons , alkanes , haloalkanes , alkenes, alkynes , cycloalkanes , aromatic hydrocarbons arenes , alcohols , esters , ethers , aldehydes , ketones , carboxylic acids , acid chlorides , acid anhydrides , azo dyes, amines , amides , nitriles , amino acids chemistry , peptides, proteins chemistry , polypeptides and others. If you need further information ask your chemistry tutor. See related pages listed top-left or visit the Introduction to Chemistry page. Further information may be found by entering a search term below: Also on this website:

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Chapter 2 : Alkanes & the Alkane Homologous Series: Easy exam revision notes for GSCE Chemistry

Alkanes & the Alkane Homologous Series. Crude oil is a complex mixture of hydrocarbons. Hydrocarbons are chain molecules of varying lengths made from hydrogen and carbon atoms only, joined together by covalent bonds.

Reactions with halogens[edit] Main article: Free radical halogenation Alkanes react with halogens in a so-called free radical halogenation reaction. The hydrogen atoms of the alkane are progressively replaced by halogen atoms. Free radicals are the reactive species that participate in the reaction, which usually leads to a mixture of products. The reaction is highly exothermic , and can lead to an explosion. These reactions are an important industrial route to halogenated hydrocarbons. There are three steps: Initiation the halogen radicals form by homolysis. Usually, energy in the form of heat or light is required. Chain reaction or Propagation then takes placeâ€"the halogen radical abstracts a hydrogen from the alkane to give an alkyl radical. Chain termination where the radicals recombine. Experiments have shown that all halogenation produces a mixture of all possible isomers, indicating that all hydrogen atoms are susceptible to reaction. The mixture produced, however, is not a statistical mixture: Secondary and tertiary hydrogen atoms are preferentially replaced due to the greater stability of secondary and tertiary free-radicals. An example can be seen in the monobromination of propane: Cracking chemistry Cracking breaks larger molecules into smaller ones. This can be done with a thermal or catalytic method. The thermal cracking process follows a homolytic mechanism with formation of free-radicals. The catalytic cracking process involves the presence of acid catalysts usually solid acids such as silica-alumina and zeolites , which promote a heterolytic asymmetric breakage of bonds yielding pairs of ions of opposite charges, usually a carbocation and the very unstable hydride anion. Carbon-localized free radicals and cations are both highly unstable and undergo processes of chain rearrangement, Câ€"C scission in position beta i. In both types of processes, the corresponding reactive intermediates radicals, ions are permanently regenerated, and thus they proceed by a self-propagating chain mechanism. The chain of reactions is eventually terminated by radical or ion recombination. Isomerization and reformation[edit] Dragan and his colleague were the first to report about isomerization in alkanes. In isomerization, the alkanes become branched-chain isomers. In other words, it does not lose any carbons or hydrogens, keeping the same molecular weight. Both of these processes raise the octane number of the substance. Butane is the most common alkane that is put under the process of isomerization, as it makes many branched alkanes with high octane numbers. Alkanes can be chlorosulfonated and nitrated , although both reactions require special conditions. The fermentation of alkanes to carboxylic acids is of some technical importance. In the Reed reaction , sulfur dioxide , chlorine and light convert hydrocarbons to sulfonyl chlorides. Nucleophilic Abstraction can be used to separate an alkane from a metal. Alkyl groups can be transferred from one compound to another by transmetalation reactions. Methane and ethane have also been detected in the tail of the comet Hyakutake. Chemical analysis showed that the abundances of ethane and methane were roughly equal, which is thought to imply that its ices formed in interstellar space, away from the Sun, which would have evaporated these volatile molecules. Occurrence of alkanes on Earth[edit] Traces of methane gas about 0. These hydrocarbons were formed when marine animals and plants zooplankton and phytoplankton died and sank to the bottom of ancient seas and were covered with sediments in an anoxic environment and converted over many millions of years at high temperatures and high pressure to their current form. Natural gas resulted thereby for example from the following reaction: They have formed over millions of years and once exhausted cannot be readily replaced. The depletion of these hydrocarbons reserves is the basis for what is known as the energy crisis. Methane is also present in what is called biogas , produced by animals and decaying matter, which is a possible renewable energy source. Alkanes have a low solubility in water, so the content in the oceans is negligible; however, at high pressures and low temperatures such as at the bottom of the oceans , methane can co-crystallize with water to form a solid methane clathrate methane hydrate. Although this cannot be commercially exploited at the present time, the amount of combustible energy of the known methane clathrate fields exceeds the energy content of all the natural gas and oil deposits put together. Methane extracted from methane clathrate is, therefore, a candidate for future fuels. Acyclic alkanes occur in nature in various ways. Certain types of bacteria can metabolize alkanes: The energy is released by the oxidation of hydrogen: The methane output of cattle and other herbivores , which can release 30 to 50 gallons per day, [23] and of termites , [24] is also due to methanogens. They also produce this simplest of all alkanes in the intestines of humans. Methanogenic archaea are, hence, at the end of the carbon cycle , with carbon being released back into the atmosphere after having been fixed by photosynthesis. It is probable that our current deposits of natural gas were formed in a similar way. Some specialized yeasts, e. The fungus Amorphotheca resinae prefers the longer-chain alkanes in aviation fuel , and can cause serious problems for aircraft in tropical regions. The carbon chains in plant alkanes are usually odd-numbered, between 27 and 33 carbon atoms in length [27] and are made by the plants by decarboxylation of even-numbered fatty acids. The exact composition of the layer of wax is not only species-dependent but changes also with the season and such environmental factors as lighting conditions, temperature or humidity. The Jeffrey pine is noted for producing exceptionally high levels of n- heptane in its resin, for which reason its distillate was designated as the zero point for one octane rating. Floral scents have also long been known to contain volatile alkane components, and n- nonane is a significant component in the scent of some roses. They are important as pheromones , chemical messenger materials, on which insects depend for communication. In some species, e. With others like the tsetse fly Glossina morsitans morsitans, the pheromone contains the four alkanes 2-methylheptadecane $C_{18}H_{38}$, 17,dimethylheptatriacontane $C_{39}H_{80}$, 15,dimethylheptatriacontane $C_{39}H_{80}$ and 15,19,trimethylheptatriacontane $C_{40}H_{82}$, and acts by smell over longer distances. Waggle-dancing honey bees produce and release two alkanes, tricosane and pentacosane. Sand bees use pheromones in order to identify a mate; in the case of A. The orchid takes advantage of this mating arrangement to get the male bee to collect and disseminate its pollen; parts of its flower not only resemble the appearance of sand bees but also produce large quantities of the three alkanes in the same ratio as female sand bees. As a result, numerous males are lured to the blooms and attempt to copulate with their imaginary partner:

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Chapter 3 : What Is a Homologous Series? | Sciencing

Homologous series is a series of compounds with similar chemical properties and same functional group differing with the successive member by CH2. Carbon chains of varying length have been observed in organic compounds having the same general formula.

What Is a Homologous Series? Homologous series are referenced frequently in organic chemistry, where compounds can differ by the length of their carbon chain. These differences can have an effect on the physical properties of the chemicals, such as boiling point. Repeating Unit The defining characteristic of a homologous series is a repeating unit. For example, the alkane group contains the CH2 repeating unit. This means that the compounds are identical with the exception of the number of CH2 units in the compound. Organic compounds also have functional groups, which define the basic properties of the compound. All of the compounds in a homologous series have the same functional group, with differing numbers of repeating units. Homologation Reaction A homologation reaction is a reaction in which the number of repeating groups of a compound is increased. As a result, the compound becomes a different member of its homologous series. For example, the Ardnt-Eistert homologation process is used to increase the number of repeating units in a carboxylic acid. In this case, the process involves a number of different reactions that reconfigure and rearrange the atoms in the molecule. Each alkane has two hydrogen atoms in addition to its CH2 units. For example, the first alkane is methane, which has a formula of CH4. The second alkane is ethane, which has two carbon atoms. Therefore, it has a formula of C2H6; it has two CH2 groups and two additional hydrogen atoms. Boiling Point The boiling point of the compounds in a homologous series increases as more units are added. This occurs because the surface area of the compound increases when the length of the compound does. The functional group of a compound defines its initial boiling point. Then, as the homologous series lengthens, the boiling point gets slightly higher with each successive increase in repeating unit.

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Chapter 4 : Homologous series - Wikipedia

In organic chemistry, a homologous series is a series of compounds with the same functional group and similar chemical properties in which the members of the series differ by the number of repeating units they contain.

Describe structural isomers as compounds with the same molecular formula, but with different arrangements of atoms. As in the statement, the actual arrangement of the atoms within the molecule is different in structural isomers. Deduce structural formula for the isomers of the non-cyclic alkanes up to C6 The alkane with six carbon atoms has the molecular formula C6H14 Deduce structural formula for the isomers of the straight chain alkenes up to C6 If the alkene is to remain a straight chain then it cannot have any branching. This means that the only isomerism available is changing the position of the double bond. Ethene and propene cannot have any functional group positional isomers, while butene can be butene and butene. Pentene has also got two functional group positional isomers, pentene and pentene. Hexene has three isomers, hexene, hexene and hexene. Apply IUPAC rules for naming the isomers of the straight chain alkenes up to C6 The position on the carbon chain at which the double bond begins is included in the name if there is any ambiguity. Deduce structural formula for compounds containing up to six carbon atoms with one of the following functional groups, alcohol, aldehyde, ketone, carboxylic acid and halide. Apply IUPAC rules for naming compounds containing up to six carbon atoms with one of the following functional groups, alcohol, aldehyde, ketone, carboxylic acid and halide. Nomenclature - alcohols The -OH group is indicated by the suffix -anol. Hence a carbon chain with four carbons that has the OH group on carbon number 2 in the chain becomes butanol. Nomenclature - aldehydes Aldehydes have a terminating -CHO group carbonyl with a hydrogen attached , which gives the suffix -anal. This does not need a locant, as it must be at the end of a chain. It must not be forgotten that the carbon atom of the CHO has to be included in the longest chain for the root of the name. This is indicated by the suffix -anone. Nomenclature - carboxylic acids Carboxylic acids have a terminating -COOH group carbonyl with an OH attached , which gives the suffix -anoic acid. It must not be forgotten that the carbon atom of the COOH has to be included in the longest chain for the root of the name. Locants locating numbers are used to locate the position of the halogen group if there is any ambiguity. Hence, a carbon chain with four carbons that has a Cl atom on carbon number 2 in the chain becomes 2-chlorobutane. Multiple groups are indicated using multipliers immediately before the group or atom that is being multiplied: Identify the following functional groups when present in structural formulas: This takes the name amino- followed by the carbon chain root, or the carbon chain root followed by -ylamine. Amines are basic compounds. They are found in many natural organic sources, such as plant extracts and fish oils. Aromatic compounds benzene containing compounds The benzene ring has a ring of six carbon atoms each of which is attached to a hydrogen atom. If the benzene ring is attached to something else a hydrogen must be lost.

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Chapter 5 : Homologous series of alkanes - Wikimedia Commons

The defining characteristic of a homologous series is a repeating unit. For example, the alkane group contains the CH2 repeating unit. This means that the compounds are identical with the exception of the number of CH2 units in the compound.

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, so that the first four members are gases at room temperature and standard pressure; members with five to seventeen carbon atoms per molecule are volatile liquids; while the higher members are wax-like solids. Similarly, the melting points and densities of the alkanes also increase, while their solubility in water decreases down the series. 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 Preparation: All members can usually be prepared by using the same general methods, e. The univalent group which is formed from an alkane by the loss of a hydrogen atom is known as the alkyl group. Thus, the compound that is formed by substitution can be considered as being made up of the alkyl group and the substituent group. For example, chloromethane, CH3CI, is composed of the methyl group, CH3-, obtained from methane, CH4, by the loss of a hydrogen atom linked to the substituent chlorine atom. The general term alkyl group includes all groups derived from the alkanes by the loss of a hydrogen atom. They are named after the parent alkanes by replacing the ending â€”ane by â€”yl. Alkyl groups are given the genral symbol, R. The table below shows the relationship between the parent alkane, alkyl group and their formula. The alkyl groups derived from the first six members of the parent alkane series. Functional Groups The alkyl group of a compound is fairly inert chemically because of the stability of the carbon-hydrogen bonds. The chemical reactivity of an alkyl compound is determined mainly by the substituent group. These groups are referred to as the functional groups, e. 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. Thus, the presence of the functional group or groups determines the chemical, properties of a homologous series. A functional group is an atom, a radical group of atoms or a bond common to a homologous series, and which determines the main chemical properties of the series. The homologous series derived from alkanes. The table above gives the general formulae and specifies the functional groups present in ma y of the homologous series which are derived from the alkanes. Effect of the Alkyl and Functional Groups The functional group determines the basic chemistry of a compound, while the alkyl group affects the physical properties of a compound. For example, the polar hydroxyl group in the alkanols promotes solubility in water but the non-polar alkyl group opposes it. For all alkyl groups larger than C4H9-, this opposing effect is sufficient to greatly limit the solubility of the compound in water. More from my site.

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Chapter 6 : BBC Bitesize - GCSE Chemistry (Single Science) - Alkanes and alkenes - Revision 2

Homologous series of alkanes. From Wikimedia Commons, the free media repository. Jump to navigation Jump to search. Deutsch: Alkane.

Butane or MethylPropane C4H10 could be either of these two different molecules: These are named butane and 2-methylpropane, respectively What is structural isomerism? Isomers are molecules that have the same molecular formula, but have a different arrangement of the atoms in space. That excludes any different arrangements which are simply due to the molecule rotating as a whole, or rotating about particular bonds. For example, both of the following are the same molecule. They are not isomers; both are butane. There are also endless other possible ways that this molecule could twist itself. There is completely free rotation around all the carbon-carbon single bonds. If you had a model of a molecule in front of you, you would have to take it to pieces and rebuild it if you wanted to make an isomer of that molecule. In structural isomerism, the atoms are arranged in a completely different order. This is easier to see with specific examples. What follows looks at some of the ways that structural isomers can arise. The names of the various forms of structural isomerism probably do not matter all that much, but you must be aware of the different possibilities when you come to draw isomers. Chain isomerism These isomers arise because of the possibility of branching in carbon chains. For example, there are two isomers of butane, C4H In one of them, the carbon atoms lie in a "straight chain" whereas in the other the chain is branched. Be careful not to draw "false" isomers which are just twisted versions of the original molecule. For example, this structure is just the straight chain version of butane rotated about the central carbon-carbon bond. You could easily see this with a model. If you think you can find any others, they are simply twisted versions of the ones below. If in doubt make some models.

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Chapter 7 : IB Chemistry standard level: Organic chemistry

The alkanes, alkenes and cycloalkanes are examples of homologous series. A homologous series is a group of chemicals which have similar chemical properties and can be represented by a general formula.

In the case of the names of alkanes beginning with n- , the n- part is included to specify the linear as opposed to a branched or cyclic form of that particular alkane. Recall that in some cases the atoms forming alkanes may be arranged in different ways, hence the alkane may exist in the forms of several different structural isomers. The following chart of boiling points of alkanes against the number of carbon atoms in each includes values for larger alkanes with up to 50 carbon atoms. Discussion of Chart of melting and boiling points of alkanes: Actual values plotted on the above chart are represented by red squares in the case of boiling points and green triangles in the case of melting points. Values have been plotted for each of the first 12 linear alkanes and also for linear alkanes with each of 20, 30, 40 and 50 carbon atoms. The dotted lines in red between the points representing boiling points and in green between the points representing melting points indicate likely approximate values for the alkanes with numbers of carbon atoms in their chains for which specific values were not available with which to draw the chart. Why include both melting points and boiling points? There are three main states of matter: What is the state solid, liquid or gas of each alkane compound at 20oC? In general such trends can also be described mathematically by equations describing the curve that best fits each series of points - not required for UK GCSE Chemistry. Why only plot resuts for Linear Alkanes? This is a simplification to make the chart easier to explain and discuss. The boiling and melting points of branched alkanes differ from those of linear alkanes. Recall that alkanes that include 4 or more carbon atoms show structural isomerism, meaning that there are two or more different structural formulae that you can draw for each molecular formula. Structural isomers of alkanes may include cycloalkanes and various branched alkanes. Each isomer has a different melting and boiling point. As the number of carbon atoms in alkanes increase the number of different isomers increases dramatically. To give an indication of the variation in boiling points of different isomers of the same alkane, cycloalkanes have boiling points typically around 10oC to 20oC higher than the corresponding linear alkane. This is one of many pages about types of organic compounds in our Organic Chemistry Section. Similar and related pages describe hydrocarbons , alkanes , haloalkanes , alkenes, alkynes , cycloalkanes , aromatic hydrocarbons arenes , alcohols , esters , ethers , aldehydes , ketones , carboxylic acids , acid chlorides , acid anhydrides , azo dyes, amines , amides , nitriles , amino acids chemistry , peptides, proteins chemistry , polypeptides and others. If you need further information ask your chemistry tutor. See related pages listed top-left or visit the Introduction to Chemistry page. Further information may be found by entering a search term below: Also on this website:

Chapter 8 : BBC Bitesize - National 5 Chemistry - Homologous series - Revision 1

The alkanes are a homologous series of hydrocarbons. This means that they have similar chemical properties to each other and they have trends in physical properties. For example, as the chain.

Chapter 9 : Organic chemistry: - Homologous series

Homologous series Organic compounds are grouped into different homologous series. Alkanes form a homologous series and so do alkenes. A homologous series is a group or family of organic compounds that has certain characteristics: (a) Members of the series can [ ].