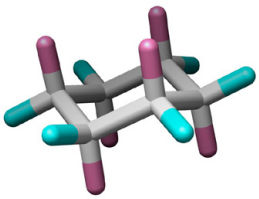


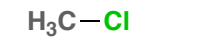
Chem 341 • Organic Chemistry I

Lecture Summary 07 • September 07, 2007

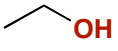
Chapter 2 - Polar Covalent Bonds; Acids and Bases

Alkyl Substituents

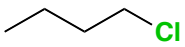
When an alkane is a smaller part of a larger molecule (a substituent), it is called an 'alkyl' group. The parent name for the number of carbons remains the same, but it is given a 'yl' ending indicating it is a sub-part of the molecule. See for example several common names for some organic molecules shown below. Note that for chlorobutane, there are four different constitutional isomers possible. *Normal* butane refers to the straight chain. If the chlorine is moved to a secondary carbin it is called a *secondary* chloride. If the carbon skeleton is changed, it becomes an *iso*-butyl group and if the chlorine is attached to the tertiary carbon it is a *tert*-butyl group. These common names are still in use, though there is a more exact systematic naming system that is easier to understand (but longer names).



methyl chloride

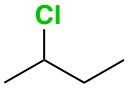


ethyl alcohol



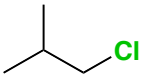
n-butyl chloride

1-chlorobutane



sec-butyl chloride

2-chlorobutane



iso-butyl chloride

1-chloro-2-methylpropane

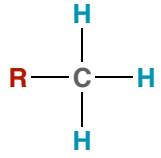
tert-butyl chloride

2-chloro-2-methylpropane

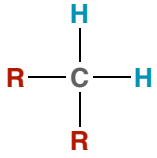
Degree of Alkyl Substitution

We designate a kind of carbon (or kind of functional group attached to that carbon) according to how many other alkyl groups are attached to it. For example, a carbon on the end of a chain (with one alkyl group) would be a *primary* carbon. The hydrogens attached to that carbon would be called primary hydrogens. An alcohol attached to a primary carbon would be called a primary alcohol. The same with *secondary*, and *tertiary*. A *quaternary* carbon has four alkyl groups (an no more bonds available for other functional groups).

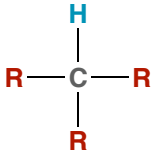
R = any carbon alkyl group



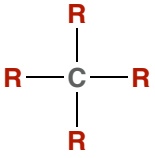
primary carbon
1°



secondary carbon
2°



tertiary carbon
3°



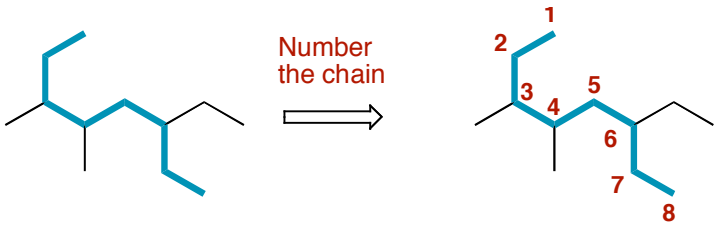
quaternary carbon
4°

Nomenclature (Naming) Rules

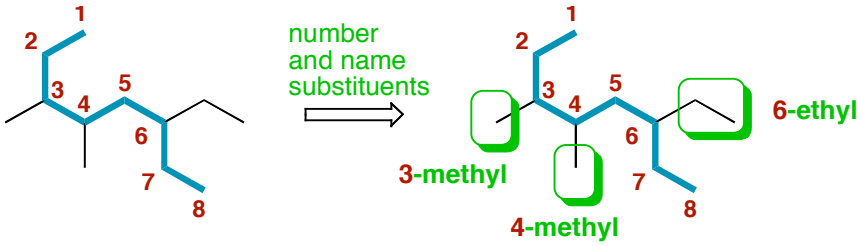
The International Union of Pure and Applied Chemists (IUPAC) has designed a systematic naming system that avoids confusion among all the complex organic structures that are possible. Names are made up of a prefix, a parent chain designating the longest carbon chain, and an ending.

Rule #1 - Find the longest continuous chain of carbons. If there is more than one possibility, choose the chain that is more branched. This is reference to as the PARENT chain.

Rule #2 - Number the chain beginning at the end of the nearest substituent. If there are substituents equal distance from either end, look for the next nearest branch. Etc.



Rule #3 - Identify the substituents with a number and a name. If there are more than one substituent on the same carbon, they would each have the same number.



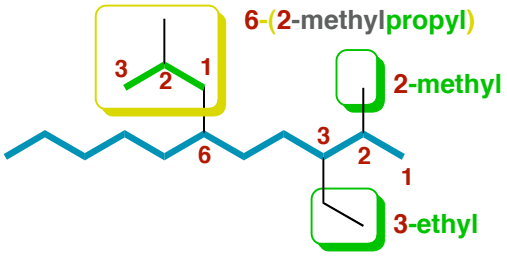
Rule #4 - Write the name for the molecule using hyphens between prefixes and commas between numbers. If there is more than one substituent with the same name, indicate the number of them using di, tri, tetra, etc. Prefixes are arranged in alphabetical order according to the substituent name.

Thus, the entire name for the molecule above is:

6-ethyl-3,4-dimethyloctane

Complex substituents - sometimes molecules have substituents (not part of the parent chain) that have additional branching. While there are some common names for 3- or 4-carbon complex side chains (eg. Isobutyl), IUPAC has a systematic way of naming these groups as well. Basically, you follow similar rules as naming, but do it on a sub-part of the molecule. The main difference is that you always start numbering the side chain starting at the point of attachment as carbon number 1.

Start at the point of attachment as number 1 and find the longest continuous carbon chain. This is the parent substituent. Number and name any branching groups according to this. All of the subname is enclosed in parentheses and placed into the full name of the molecule.

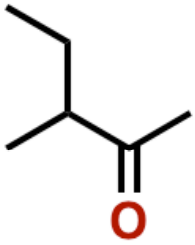


3ethyl-2-methyl-6-(2-methylpropyl)decane

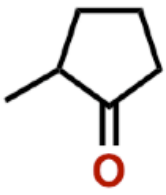
complex substituent - could also be called *iso*butyl

Quiz of the day

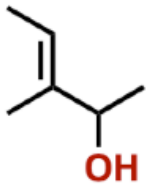
Q: Which of the structures to the right is **NOT** a constitutional isomer of the molecule shown below?



☑ **1:**



☐ **2:**



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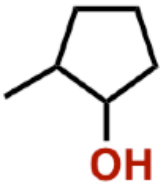

☐ **4:**