GERMANNA
ACADEMIC CENTER
FOR EXCELLENCE

Naming Organic Compounds: Alkanes

Chemical nomenclature assigns compounds a unique name that allows them to be easily identified and structurally understood. The International Union of Pure and Applied Chemistry (IUPAC) is the organization that assigns names to chemical compounds, and these names generally have three distinct features: a root name indicating either the major carbon chain or the ring of atoms found in the compound; a suffix indicating functional groups that may be present in the compound; and names of substituent groups, other than hydrogen, that may also be present in the compound. This handout will cover how to correctly name alkanes using IUPAC methods.

You can navigate to specific sections of this handout by clicking the links below.

Important Terms

When naming alkanes, it is helpful to know the following terms:

- *Alkanes* are organic compounds that only contain single bonds between carbon elements. Alkanes are often referred to as saturated hydrocarbons. Alkane compounds end in **–ane**.
- The longest continuous carbon chain in the compound is the *parent chain*. Parent chains utilize prefixes to show the amount of carbons in the chain.
- A *substituent* is a side chain group that branches off from the parent chain of the compound. Substituents utilize prefixes to show how many carbons are in the chain

- *Alkyl groups* are substituents that consist of just carbons and hydrogens (C_nH_{2n+1}). Alkyl groups begin with a prefix, determined by the number of carbons, and end in **-yl**.

Useful Prefixes

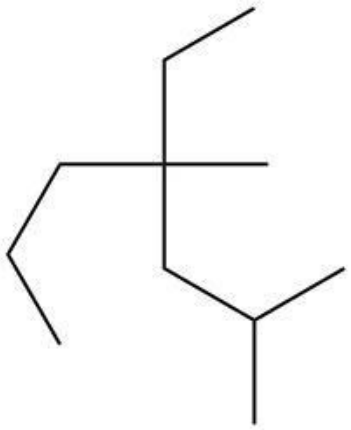
Number of Carbons	Prefix Assigned
1	Meth-
2	Eth-
3	Prop-
4	But-
5	Pent-

Number of Carbons	Prefix Assigned
6	Hex-
7	Hept-
8	Oct-
9	Non-
10	Dec-

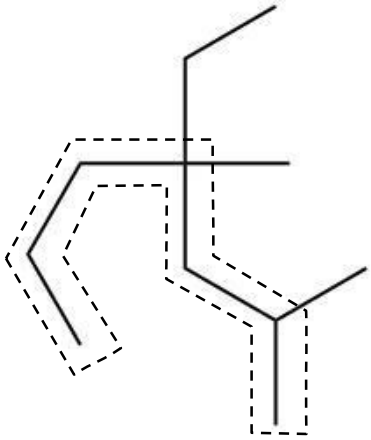
Lastly, if the compound is in a ring, use the prefix **cyclo-**.

Naming

When naming alkanes, commas are used between numbers, and dashes are used between letters and numbers. There are **no** spaces in the name. The five steps to naming alkanes are as follows:

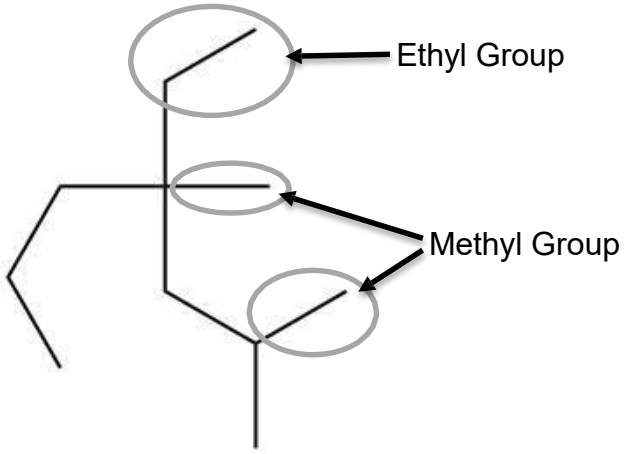


Step 1: Identify the parent chain, the longest continuous chain of carbons. If chains of equal length are competing for selection as the parent chain, the parent chain will be determined by the chain whose substituents have the lowest assigned numbers (see step 3). The parent chain will be named using a prefix based on the number of carbons.



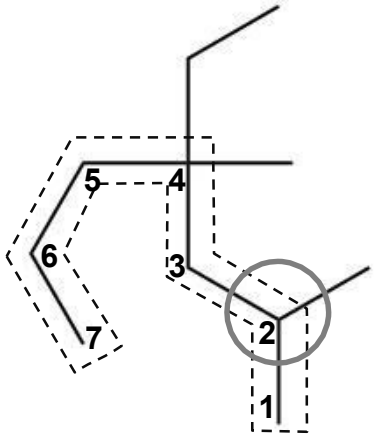
The parent chain in this problem is outlined with a dashed line. There are seven carbons in the parent chain; therefore, it is a heptane.

Step 2: Identify all of the substituents. There are three alkyl groups in this compound. The groups are circled and labeled.

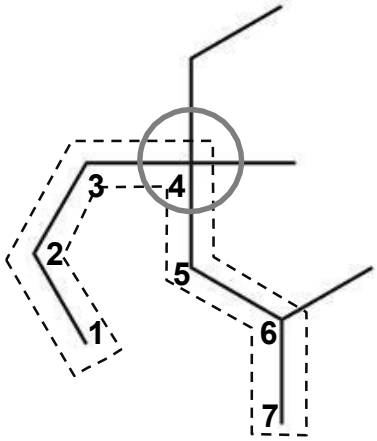


Step 3: Number the carbons of the parent chain from the end that gives one of the substituents the lowest number. If two or more side chains are in equivalent positions, assign the lowest number to the substituent that will come first alphabetically. If a halogen is attached, it will receive priority (it will receive a lower substituent number) to the alkyl group.

The rule for numbering the carbons on the parent chain dictates that the first substituent must be closest to 1. In addition, the numbering must be sequential from one end of the parent chain to the other. Therefore, the example on the left is correct.



Correctly numbered carbons

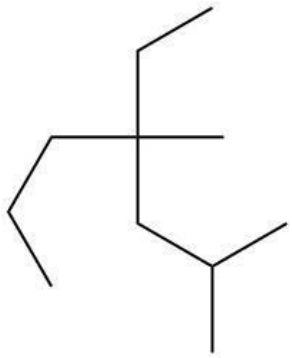


Incorrectly numbered carbons

Step 4: Pair up the substituent with its location on the parent chain. If the same substituent occurs more than once, the location is given for each and separated with a comma. In addition, the number of times the substituent group occurs is indicated by a prefix (di, tri, etc.). If a halogen is present, only include the root of the halogen's name ending in **–o** (bromo, chloro, fluoro, etc.).

In this problem ethyl is attached on carbon 4. One methyl occurs on carbon 4 and the other on carbon 2. Because there are two methyl groups, the prefix "di" will be added.

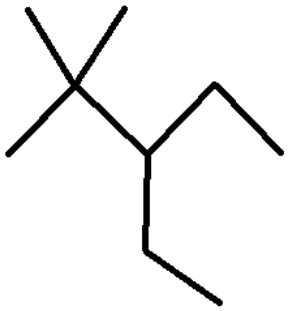
Step 5: Put the name together by alphabetizing the substituents and attaching their assigned carbon number before the prefix. Commas are used between numbers, and dashes are used between letters and numbers.



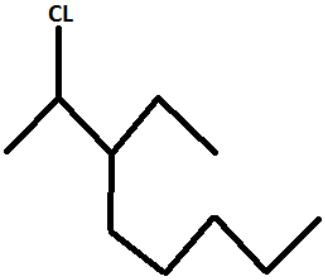
This compound is named 4-ethyl-2,4-dimethylheptane.

Practice Problems

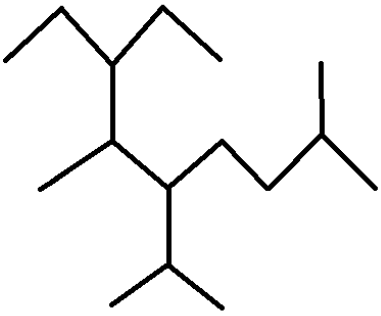
1.) Give the IUPAC name for the following compound:



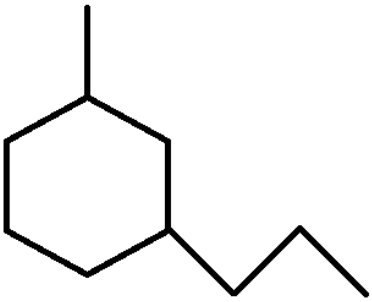
2.) Give the IUPAC name for the following compound:



3.) Give the IUPAC name for the following compound:



4.) Give the IUPAC name for the following compound:



Solutions

1.) 3-ethyl-2,2-dimethylpentane

2.) 2-chloro-3-ethyloctane

3.) 7-ethyl-5-isopropyl-2,6-dimethylnonane

4.) 1-methyl-3-propylcyclohexane

Additional Practice Quizzes

1. This quiz focuses on syntax and naming alkanes and other types of organic molecules. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/Questions/Nomencl/nomencl.htm
2. Quiz 1 focuses on naming and drawing alkanes. http://www.chembio.uoguelph.ca/educmat/chm19104/nomenclature/quizes.html