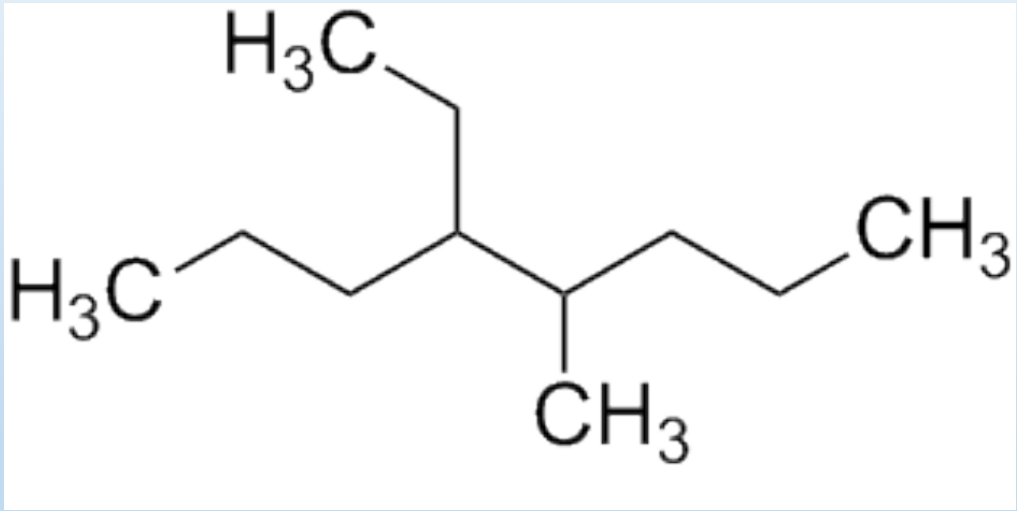
SCH4U Naming & Drawing Organic Compounds

Organic Compounds

- There are over 1 million organic compounds that have been identified.
- Imagine trying to name all these compounds!!!
- Chemists have developed a systematic method to name organic compounds that identify the molecular formula and the structural formula.
- Example: 4-ethyl-5-methyloctane
- From this name alone, chemists can produce the molecular and structural formula.

4-ethyl-5-methyloctane



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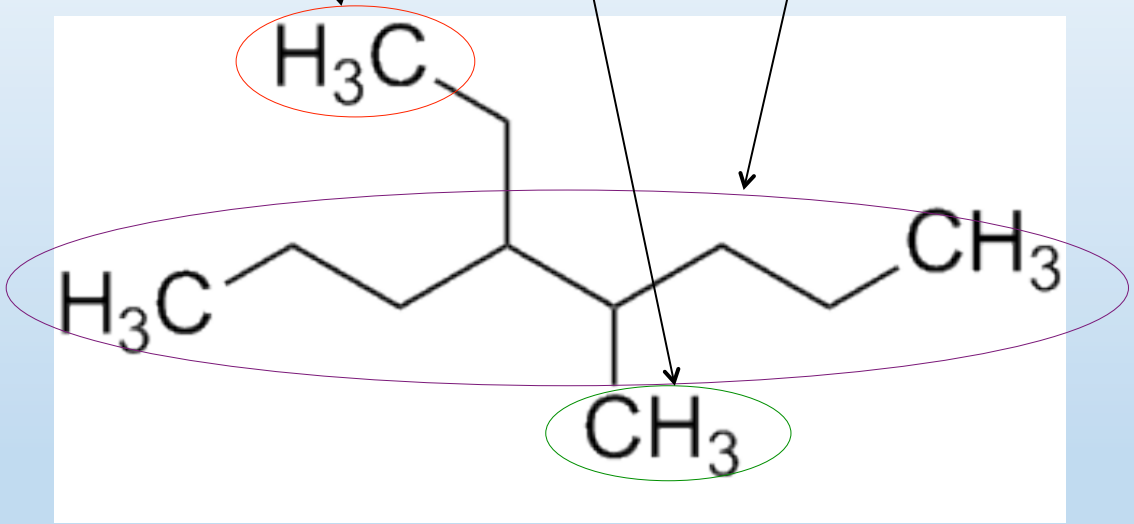
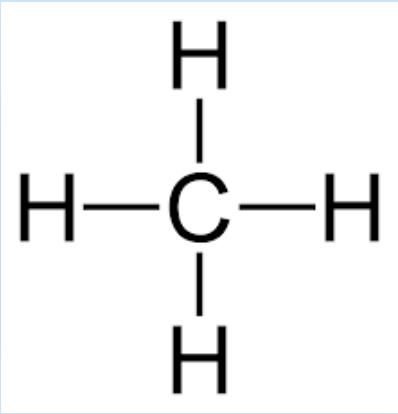


Naming Simple Alkanes

- For naming simple alkanes there is a basic system using a prefix and suffix.
- The prefix indicates how many carbons are in the molecule and the suffix indicates what type of hydrocarbon it is.
- The simplest alkane is methane (CH_4)
- *meth* = 1 carbon atom
- *ane* = alkane



Naming Simple Alkanes

- You are expected to know the names, molecular and structural formulas of the first 10 simple alkanes
- This will help you in naming much more complicated structures.

# of Carbon atoms	Name	Molecular Formula
1	methane	CH_4
2	ethane	C_2H_6
3	propane	C_3H_8
4	butane	C_4H_{10}
5	pentane	C_5H_{12}
6	hexane	C_6H_{14}
7	heptane	C_7H_{16}
8	octane	C_8H_{18}
9	nonane	C_9H_{20}
10	decane	$C_{10}H_{22}$

Monkeys **E**at **P**eeled **B**ananas, **P**andas **H**ear **H**appy **O**tters **N**apping **D**aily

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Test Your Understanding

Name the simple alkane with the molecular formula C_8H_{10}

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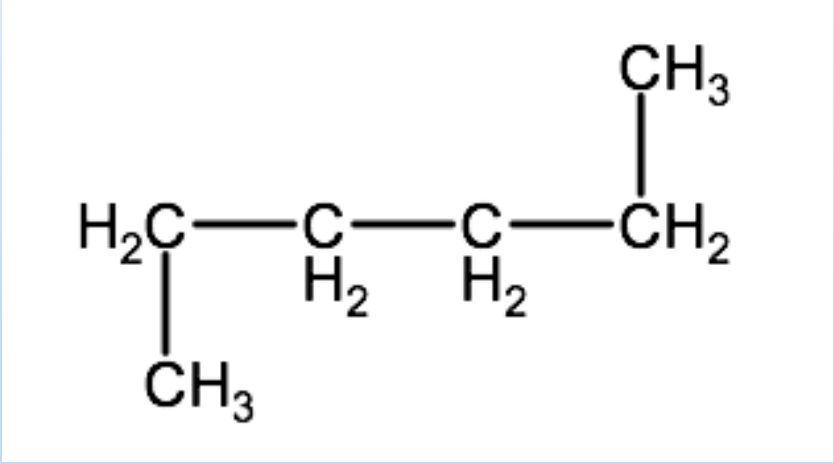
8 carbons = octane

Test Your Understanding

Name the simple alkane drawn below:



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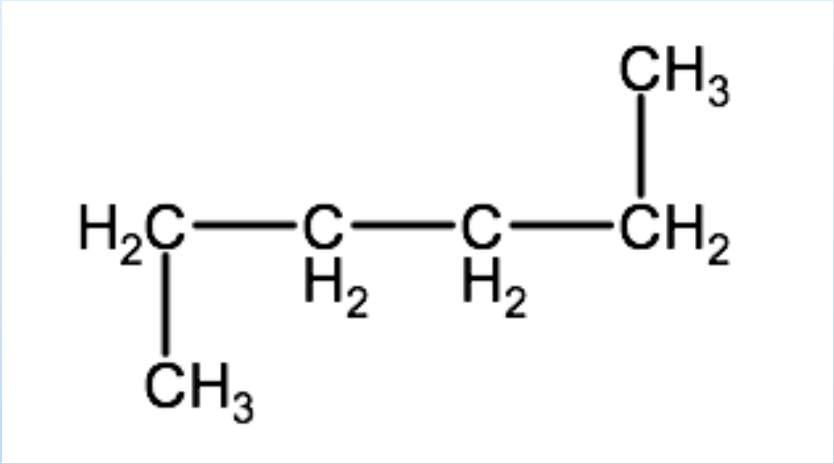

6 carbons = hexane

Drawing Simple Alkanes

- When drawing simple alkanes from their names there are some simple rules to follow.
- Carbon atoms can form 4 bonds total.
- Carbons at the end of each chain are bound to 3 hydrogen atoms and 1 carbon atom (4 total bonds)
- Carbon atoms in the middle of a chain are bound to 2 hydrogen atoms and 2 carbon atoms.

Drawing Simple Alkanes

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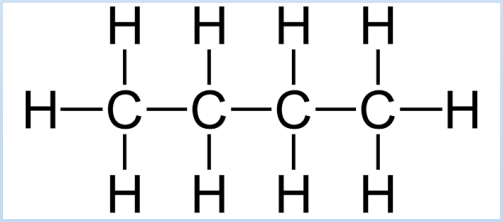
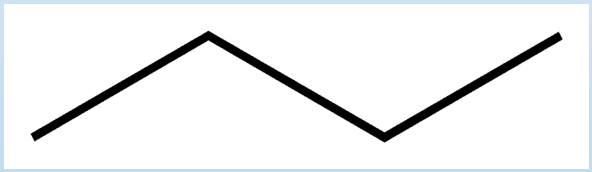
- Carbon atoms in the middle of a chain are bound to 2 hydrogen atoms and 2 carbon atoms.
- **Draw the structural formula, condensed structural formula and line drawing for butane.**

Test Your Understanding

- Draw the structural formula, condensed formula and line drawing for the linear organic compound butane.



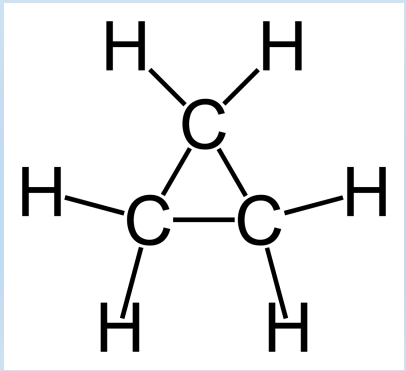
CH_3-CH_2-CH_2-CH_3

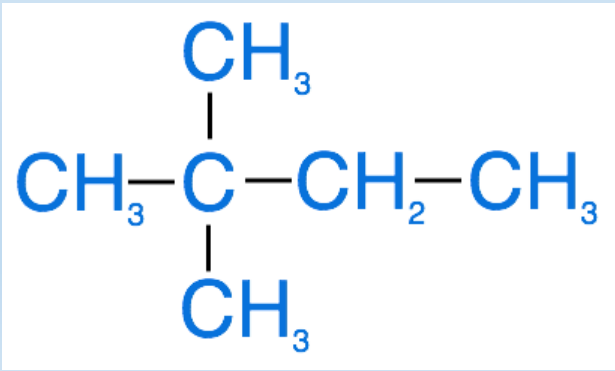


Branched Alkanes

- Alkanes can exist in different shapes such as:
- lines (e.g. propane)
- rings (e.g. cyclopropane
- branched structures (e.g. 2,2-dimethylbutane)

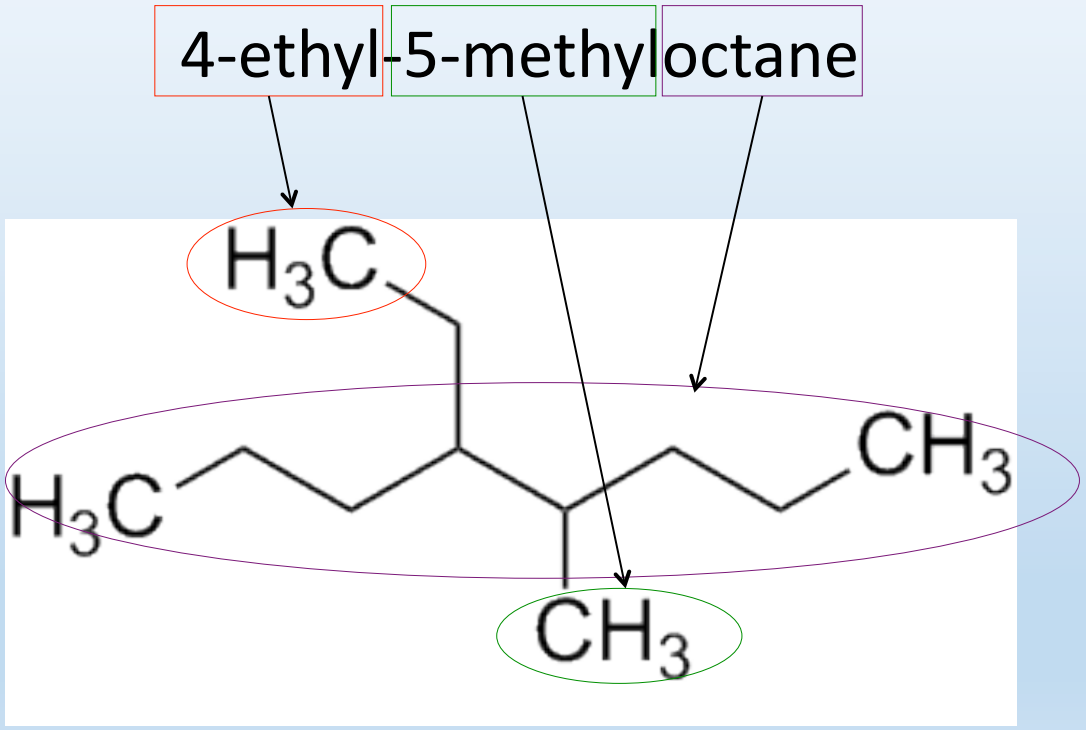
CH_3-CH_2-CH_3





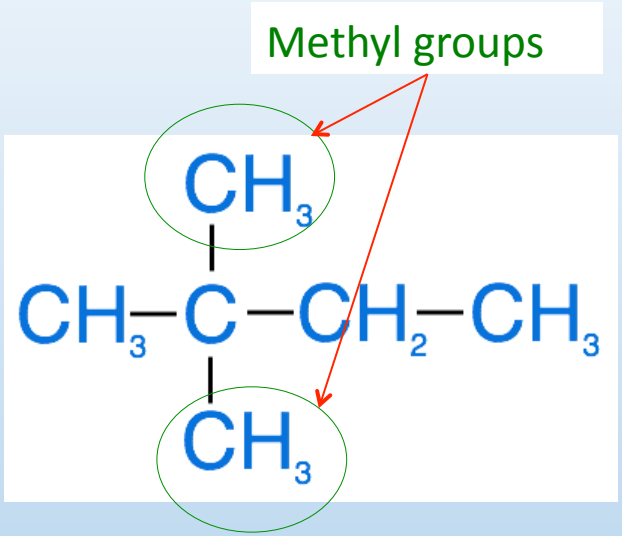
Naming Branched Alkanes

- When naming branched alkanes, the name must indicate the following:
- Length of the main carbon chain (how many carbons are in it).
- Names of the branching groups.
- Carbon atoms that the groups branch from.



Alkyl Groups

- If an organic compound has a hydrocarbon group that branches off from it, the branched group is called an alkyl group.
- Naming alkyl group follows the same rules as for simple alkanes, but the suffix changes to –yl.
- For example a branch that contains an alkyl group with 1 carbon would be identified as **meth*yl***
- A alkyl group that contains 3 carbons would be called **prop*yl***

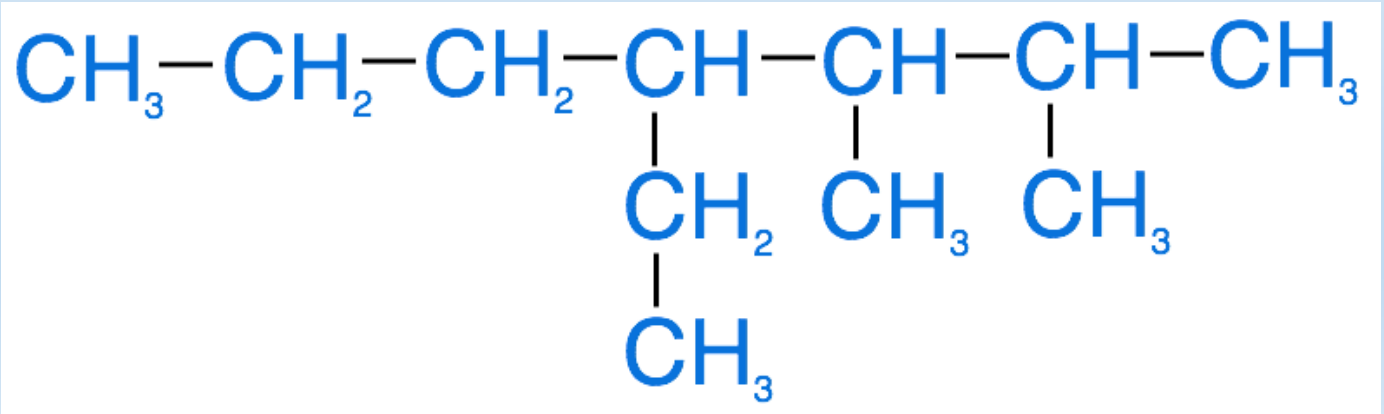


Naming Complex Alkanes

- To deal with complex compounds, chemists have created a structured naming system developed by the IUPAC.
- Using this system you can take the name of a complex compound and translate the name into its structure.
- When naming organic compounds commas are used to separate numbers and dashes (-) are used to separate numbers and words
- Example: **4-ethyl-2,3-dimethylheptane**

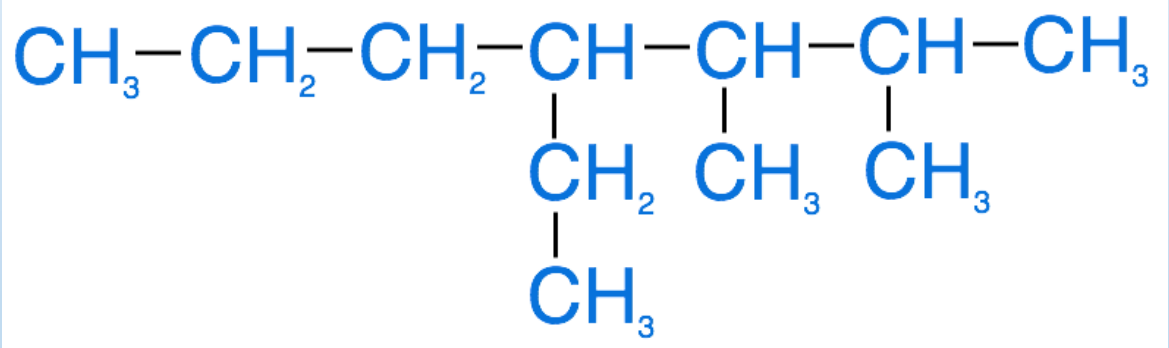
Rules of Naming Organic Compounds

- When naming organic compounds you must identify:
  - the longest continuous carbon chain. This is known as the parent chain and will form the root name of the molecule.
  - the number of carbons in each branched alkyl group.
  - the carbon in the parent chain that a branched alkyl group branches from.



Naming Complex Alkanes

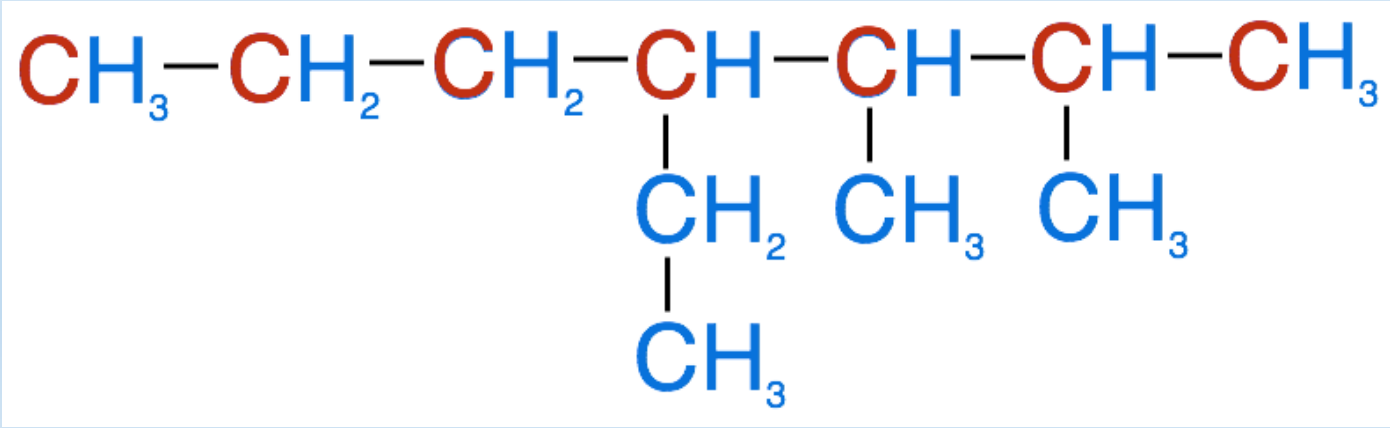
- 1. Identify the parent chain. This is the longest **continuous** carbon chain within the molecule.



Naming Complex Alkanes

1. Identify the parent chain. This is the longest **continuous** carbon chain within the molecule.

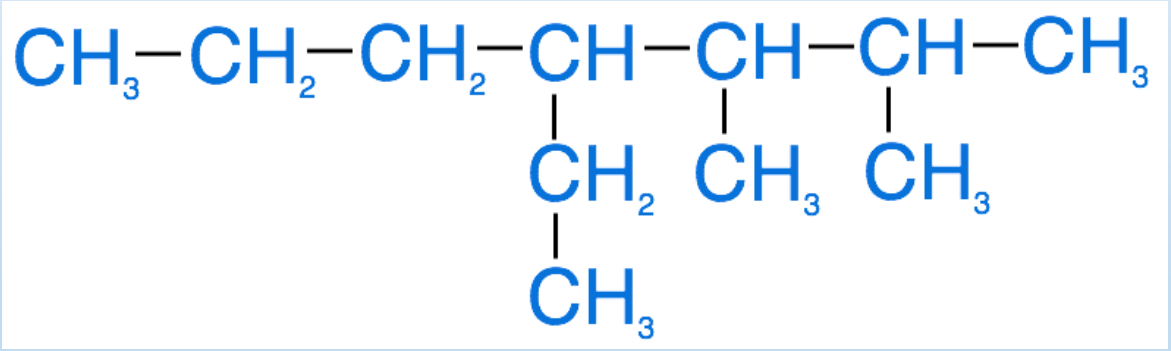
- The parent chain has 7 carbons. Therefore the **root name** is **heptane**



Naming Complex Alkanes

1. root name is heptane

2. Identify all of the branched groups (also known as the substituent groups) attached to the parent chain.



Naming Complex Alkanes

1. root name is heptane
2. 2 methyl groups, 1 ethyl group

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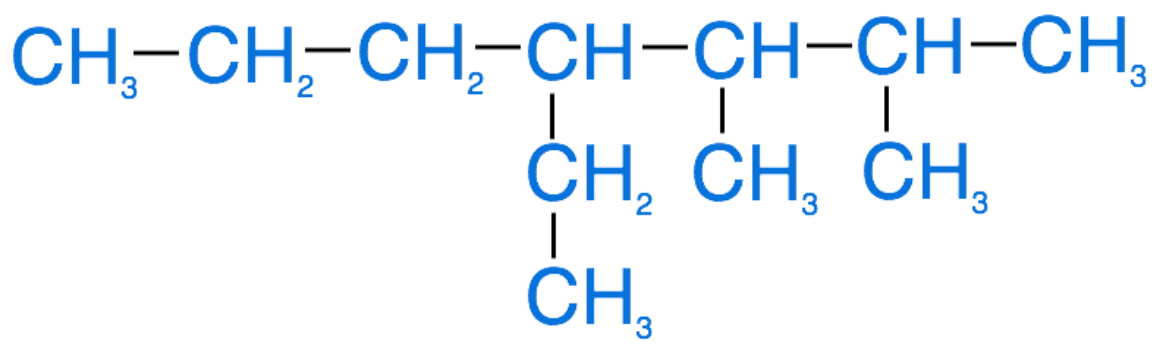
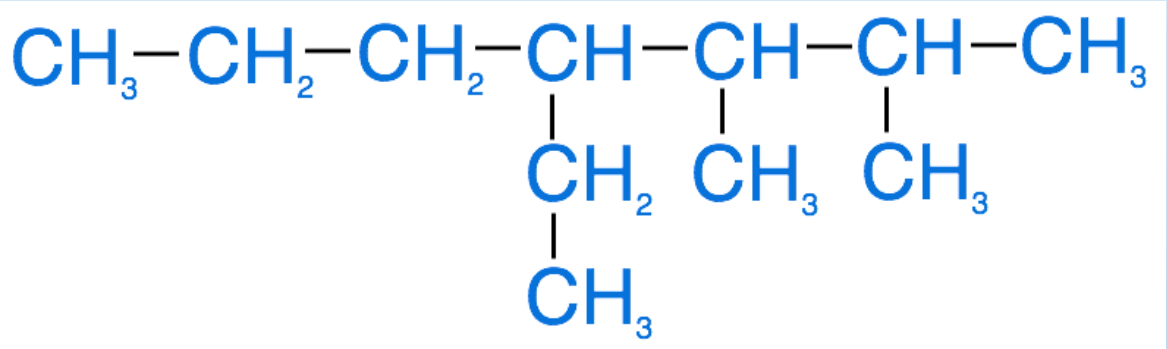
- 2 methyl groups
- 1 ethyl group



Naming Complex Alkanes

1. root name is heptane
2. 2 methyl groups, 1 ethyl group

3. Number the parent chain's carbons from the end so that the substituents are attached to the lowest possible numbers.



Naming Complex Alkanes

1. root name is heptane
2. 2 methyl groups, 1 ethyl group
3. 2-methyl, 3-methyl, 4-ethyl

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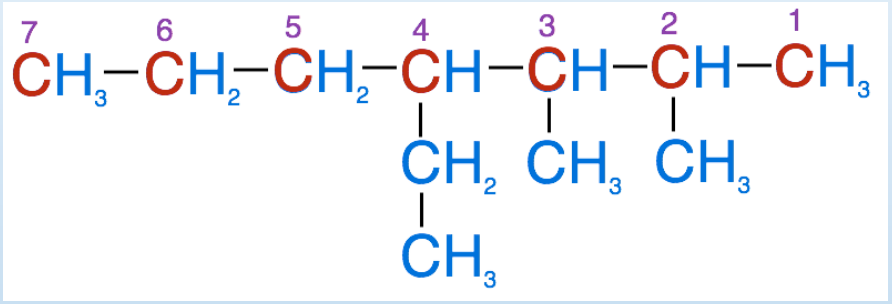
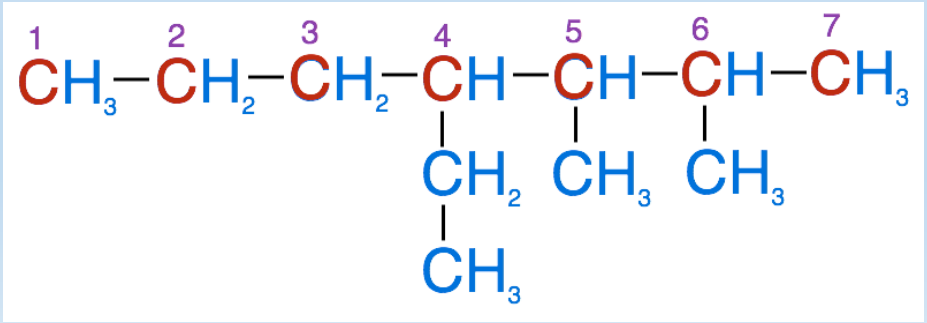


- 2-methyl
- 3-methyl
- 4-ethyl



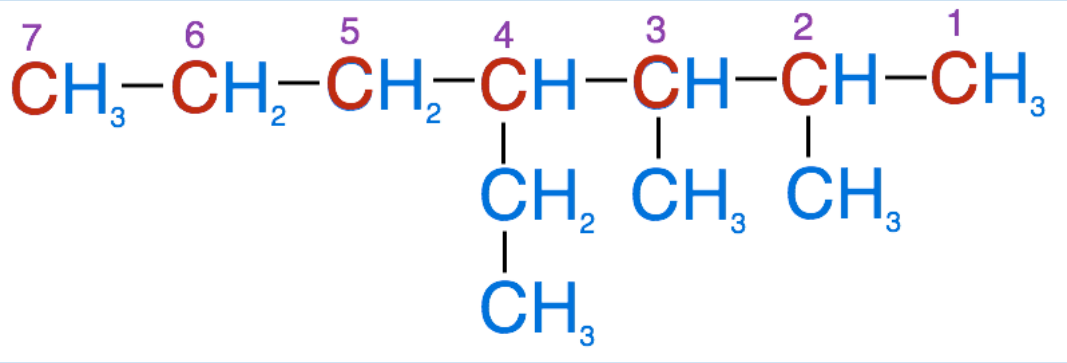
- 6-methyl
- 5-methyl
- 4-ethyl

Naming Complex Alkanes

1. root name is heptane
2. 2 methyl groups, 1 ethyl group
3. 2-methyl, 3-methyl, 4-ethyl
4. 2,3-dimethyl

4. If there is more than one of the same substituent type, use a prefix to indicate the total number of that substituent (2 = di-, 3 = tri-, 4 = tetra-) and a number to indicate the location of each substituent.

- There are 2 methyl groups, located at carbons 2 and 3, so we use the prefix di- and the numbering system 2,3. Combine these 2 rules and we have 2,3-dimethyl to identify the 2 methyl groups.



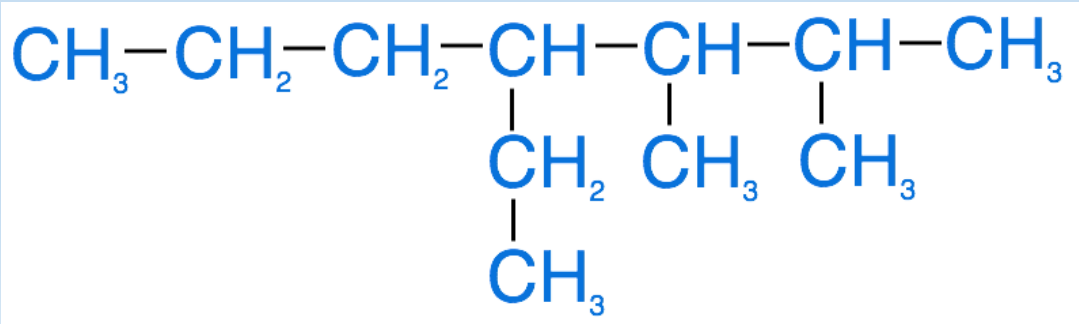
Naming Complex Alkanes

1. root name is heptane
2. 2 methyl groups, 1 ethyl group
3. 2-methyl, 3-methyl, 4-ethyl
4. 2,3-dimethyl

5. list the names of the substituents in alphabetical order, **ignoring the prefixes** and add the root name at the end.

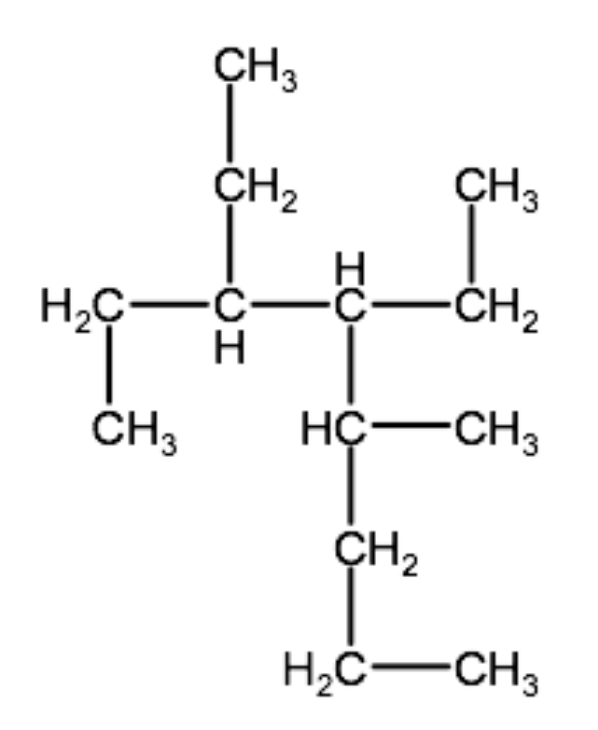
- in our example, we will list **4-ethyl** first, followed by **2,3-dimethyl** followed by the root name: **heptane**. So for this molecule, the proper IUPAC name is:

4-ethyl-2,3-dimethylheptane



Test Your Understanding

- Name the following alkane using IUPAC convention



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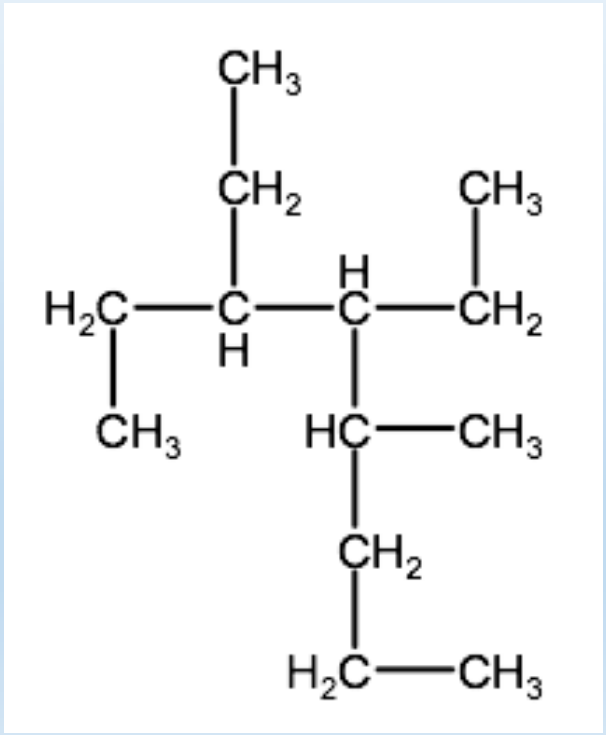

3,4-diethyl-5-methyloctane

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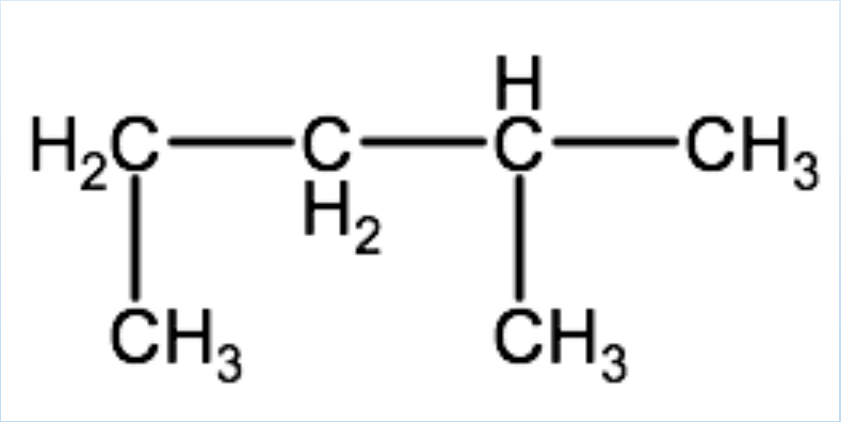
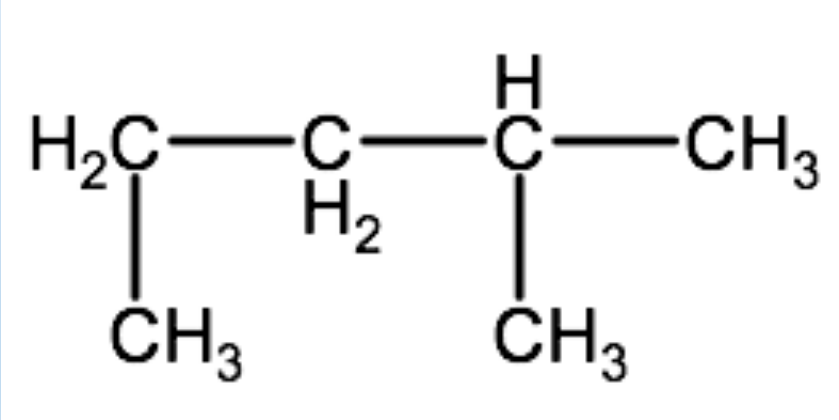


Test Your Understanding

- Name the following alkane using IUPAC convention
- 2-methylpentane



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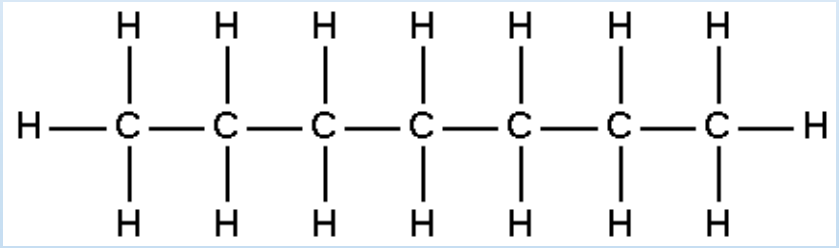

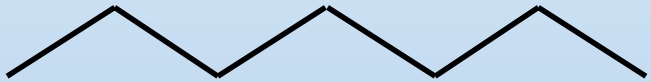

CH_3-CH_2-CH_2-CH_2-CH_2-CH_2CH_3