

NAMING CYCLOALKANES WORKSHEET

Purpose: The purpose of this assignment is to apply the concepts of structural and chemical properties of cycloalkanes. This assignment will help to increase your familiarity with IUPAC rules for naming and drawing cycloalkanes.

Student Learning Outcomes addressed in this assignment:

After completing this worksheet, you will be able to:

- Generate names for simple hydrocarbons: cycloalkanes.
- Construct the chemical structure of substituted cycloalkane molecules.

Assignment: Read the introduction material and complete the problems that follow. The answers are provided at the end of the worksheet.

Criteria: This is a practice assignment and will not be graded. Points will not be earned or deducted for completing or not completing this worksheet.

Introduction

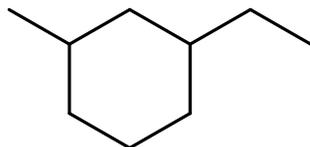
The International Union of Pure and Applied Chemistry (IUPAC) nomenclature system is based on naming the longest chain of carbon atoms connected by single bonds in a molecule, whether in a continuous chain or a ring. Knowing these rules, the names of compounds can be determined based on the molecular structure. Likewise, given an IUPAC name, the connectivity of the atoms makes it possible to illustrate a structural formula. In general, an IUPAC name will have three essential features:

Substituents + Parent Name + Suffix
(Attachments) (How many carbons are in the longest chain?) (Family Name)

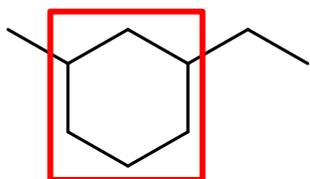
- Names and location of substituents that complete the molecular structure.
- A parent name indicating a major chain or ring of carbon atoms found in the structure.
- A suffix designating functional groups that may be present in the compound.

Steps for Naming Cycloalkanes

Cycloalkanes are cyclic hydrocarbons, meaning that the carbons of the molecule are arranged in the form of a ring. Cycloalkanes are named in a manner like that used for naming alkanes. The principal difference in the rules and procedures occurs in the numbering system. Since a ring has no ends like a chain does, all the carbons of a ring are equivalent.

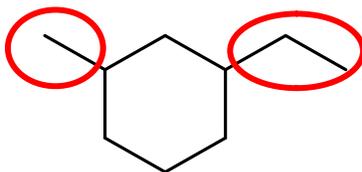


- Step 1.** Determine the parent chain. Count the number of carbon atoms in the ring and in the largest alkyl substituent.
- If the number of carbon atoms in the ring is equal to or greater than the number in the largest substituent, the compound is named as an alkyl-substituted cycloalkane. Therefore, the parent chain is named as cyclo___ane, based on the number of carbon atoms in the ring.
 - If the number of carbon atoms in the ring is less than the number of carbon atoms in the substituent, it is named as a cycloalkyl-substituted alkane. The compound is named based on the rules for naming alkanes.



The longest continuous chain of carbon atoms in this example is the ring which contains six carbon atoms. Therefore, the parent name is *cyclohexane*.

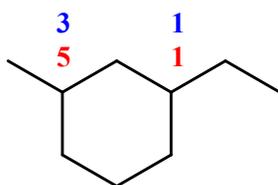
- Step 2.** Identify the substituents in the same manner as with alkanes.



There are two branches that have not been accounted for in the parent chain. Therefore, both substituents must be identified. One substituent consists of a single carbon atom making it a *methyl* group. The second branch contains two carbon atoms making it an *ethyl* group.

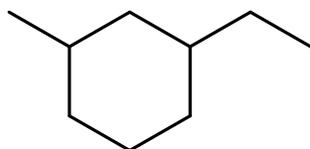
Step 3. Number the carbon atoms in the ring. Carbon 1 will always have a substituent. The alphabetically lowest attachment is assigned carbon number one.

- If there is one substituent, there is no need to show the number 1 of the substituent.
- If two or more substituents are present, start carbon 1 at a site of a substituent. Continue numbering such that the remaining substituents have as low a number as possible.
- When multiple substituents can be assigned the same number, assign the lower number to the substituent that would come first when placed in alphabetical order.



Since there are two substituents present that could both receive the same number, the substituent to receive the lower number is determined based on alphabetical order. Therefore, the ethyl group is attached to carbon 1. Once that is determined, the ring should be numbered to give the methyl group the lower number.

Step 4. Put the name together as in alkanes with the order of: number assigned to substituent based on location, name of substituent followed by the parent name of the compound.

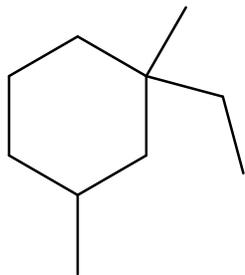


Once all of the steps have been combined, it is determined that the name of the compound in this example is **1-ethyl-3-methylcyclohexane**.

Naming Cycloalkanes Practice Worksheet

1. Give the IUPAC name for each of the following compounds.

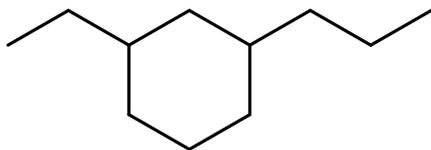
a.



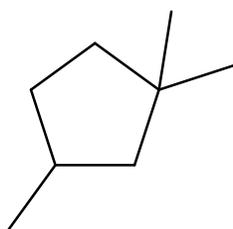
b.



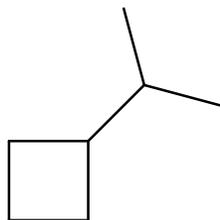
c.



d.



e.



Naming Cycloalkanes Practice Worksheet

2. Use the IUPAC names shown below to draw each structure.

a. 4-ethyl-1,2-dimethylcyclohexane

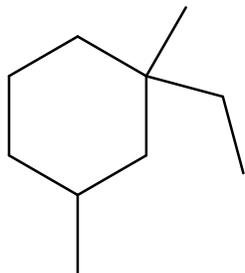
b. 1-ethyl-2-methylcyclobutane

c. methylcyclopentane

Answers

1. Give the IUPAC name for each of the following compounds.

a.



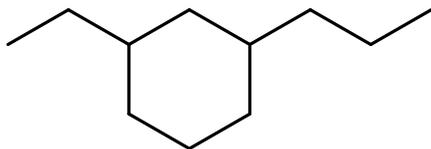
1-ethyl-1,3-dimethylcyclohexane

b.



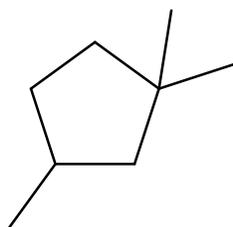
methylcyclopropane

c.



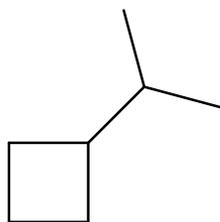
1-ethyl-3-propylcyclohexane

d.



1,1,3-trimethylcyclopentane

e.

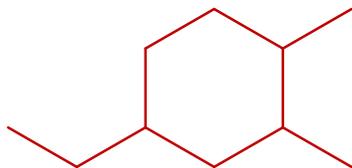


isopropylcyclobutane

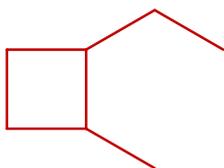
Naming Cycloalkanes Practice Worksheet

3. Use the IUPAC names shown below to draw each structure.

a. 4-ethyl-1,2-dimethylcyclohexane



b. 1-ethyl-2-methylcyclobutane



c. methylcyclopentane

