

Alkanes

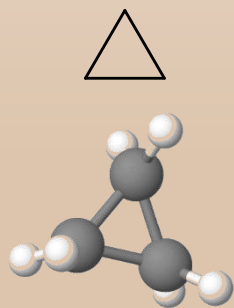
2 - Cycloalkanes and Bicyclics Nomenclature

Dr. Sapna Gupta

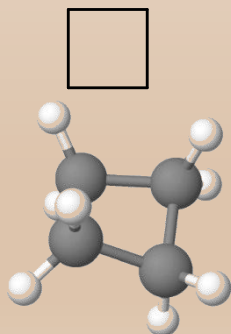
Cycloalkanes Introduction

Cyclo is a ring structure and alkane indicates all single bonds. Basic structures will have rings of carbon atoms of $-\text{CH}_2-$ groups.

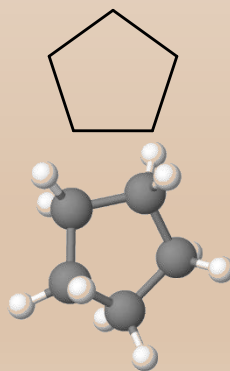
- The general formula is same as alkene: C_nH_{2n} . This indicates that cycloalkanes are missing 2 hydrogens.
- The base/parent name will generally be the cycloalkane. In case where a long chain is attached to cycloalkane then give the name of the chain with cyclic alkane as cycloalkyl group.
- The carbons should be numbered in the ring if there is more than one substituent.
- Lower number is for the lower alphabet substituent.



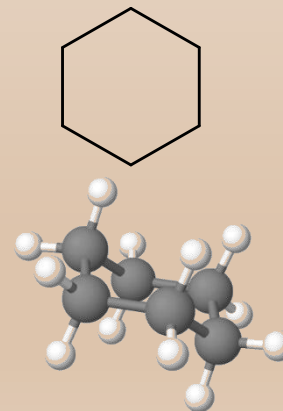
Cyclopropane



cyclobutane



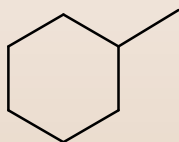
cyclopentane



cyclohexane

Cycloalkanes – Nomenclature

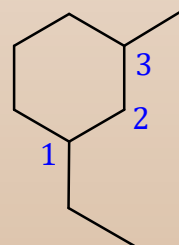
Here are some examples of naming cycloalkanes. Follow the rules we have learned to understand how to name these cycloalkanes.



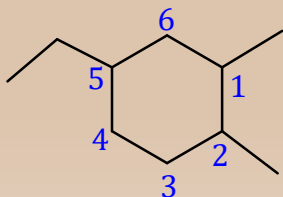
methylcyclohexane



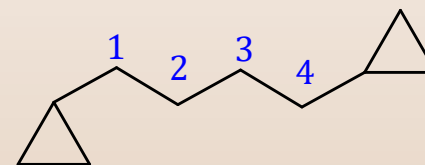
1-ethyl-1-methylcyclopentane



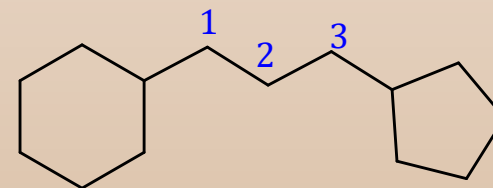
1-ethyl-3-methylcyclohexane



5-ethyl-1,2-dimethylcyclohexane



1,4-dicyclopropylbutane

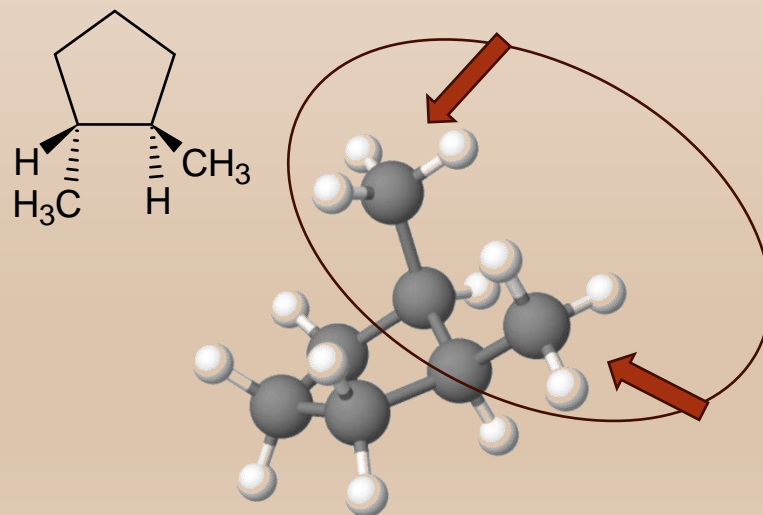
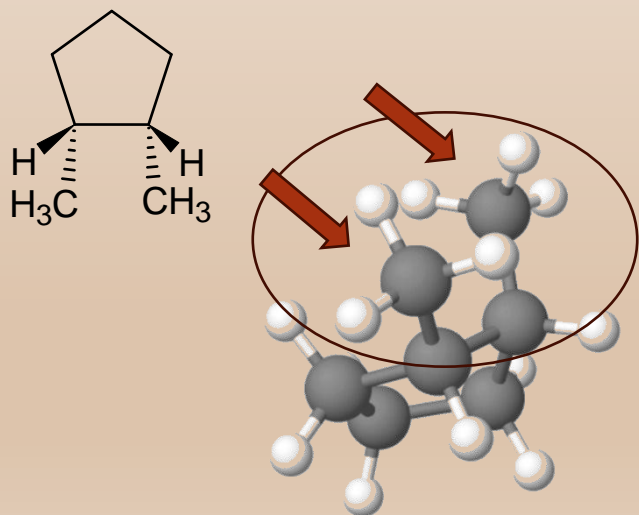


1-cyclohexyl-3-cyclopentylpropane

Cis and Trans Isomers

Cyclic compounds cannot be rotated around the single bonds, or the ring will break. For that reason, substituents are stuck in their spatial region. This affects the structure and its chemical properties. We have to then know how to name these compounds to know the location of these groups. This is given by cis and trans.

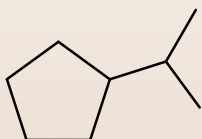
- Cis: When hydrogens are on same side of ring. (*See the red highlights below.*)
- Trans: When hydrogens are on opposite sides of ring.



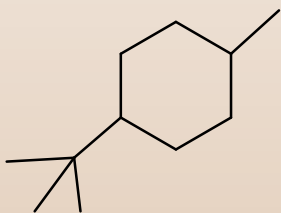
Solved Problem: Naming and Writing Structures

Write the names or draw the structures of the compounds given below.

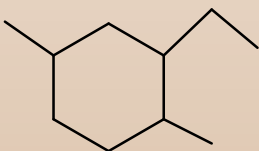
ANSWERS



Isopropylcyclopentane



1-t-butyl-4-methylcyclohexane



1-ethyl-2,5-dimethylcyclohexane

1-ethyl-1-methylcyclopropane

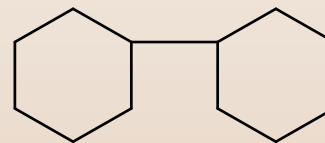
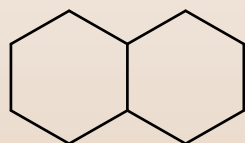


2-cyclopentylheptane

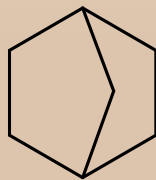
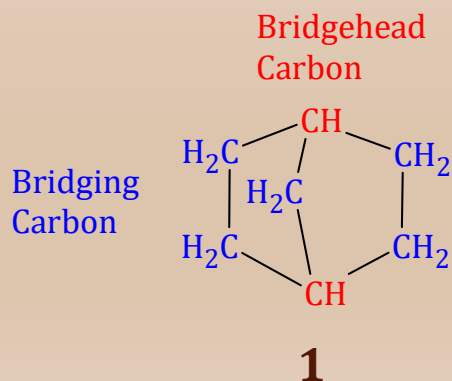


Bicyclic Compounds Introduction

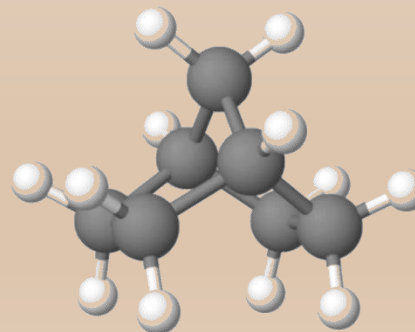
Bicycloalkanes contain 2 rings fused together, the first structure below. Fused means two carbons are connected to the other ring. In the second structure the two rings are connected by a bond. The name of this compound is cyclohexylcyclohexane.



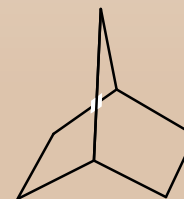
Bicyclics have two kinds of carbon, the bridgehead (red), and bridging carbons (blue), structure **1** below. Bridging carbons are the bridges that join the two bridgehead carbons. Structure **1** shows there are two of 2 carbon bridges and one of 1 carbon bridge. The line structure, **2**, shows a better visual. The actual 3D structure is shown as **3**, which is also shown as the line structure, **4**.



2



3

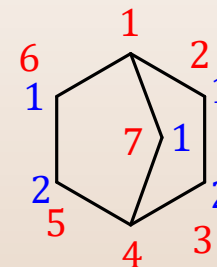


4

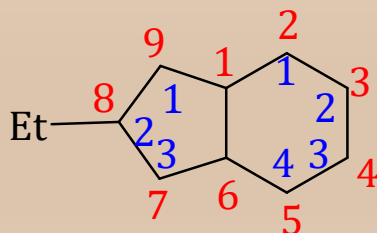
Bicyclic Compounds Nomenclature

The naming is slightly different for bicyclics. Follow the rules below.

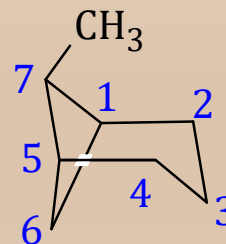
1. Count the total number of carbons in the rings. There are 7 as marked by the numbers in red in the structure below. This is the parent name.
2. The blue numbers are the bridging carbons.
3. Start with the prefix bicyclo-, use square brackets to write the number of carbons in each bridge in reverse chronological order, and finally the parent name.
4. When substituents are present, number the largest ring and continue to the smaller to the smallest ring. In bicyclics the substituent can get a large number and it does not have to be closer to bridgehead carbon.



Bicyclo[2.2.1]heptane



8-ethylbicyclo[4.3.0]nonane



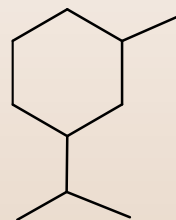
7-methylbicyclo[3.1.1]heptane

Solved Problem: Naming and Writing Structures

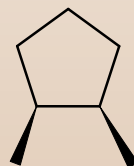
Show the structures of the compounds given below.

ANSWERS

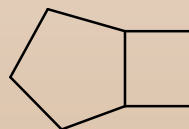
a) 1-ethyl-2-methylcyclohexane



b) Cis-1,2-dimethylcyclopentane



c) Bicyclo [3.2.0] heptane



Solved Problem: Naming and Writing Structures

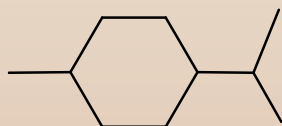
What is wrong with the names of the structures given below. Write the correct name.

- a) 1-methyl-4-isopropylcyclohexane
- b) 6-methyl[2.2.2]nonane

To answer this question you should draw the structure of the name given and then check the name for correctness.

ANSWERS

- a) 1-methyl-4-isopropylcyclohexane

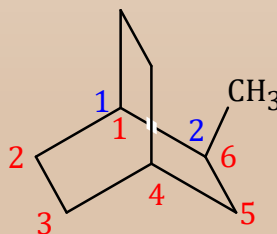
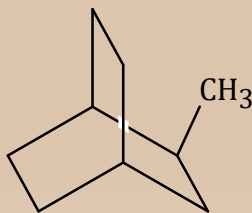


Alphabetization is wrong and so numbering is also incorrect.

Correct name is:

1-isopropyl-4-methylcyclohexane

- a) 6-methyl[2.2.2]nonane



It is not possible to have nonane with 2+2+2+2 (bridgehead) carbons. It will be a decane. It is possible that mistakenly the name has included the C of the methyl in its parent name. Most likely the parent is octane. And finally locant should be 2 since all bridges are same. Correct name is:
2-methyl[2.2.2]octane

Key Words/Concepts

- Know that alkenes and cycloalkanes have same molecular formula.
- Know where to start numbering.
- Know whether to name the ring or straight chain.
- Bicyclo nomenclature.