

Chapter 3. Organic Compounds: Alkanes and Their Stereochemistry

Functional Group:

Be able to identify and name any of the functional groups listed on Table 3.1, pages 76-77.

Summary of important functional groups:

1. hydrocarbons
 - alkanes
 - alkenes
 - alkynes
 - arenes
2. alkyl halides
3. oxygen-containing compounds
 - Those with C—O single bonds:
 - alcohols
 - phenols
 - ethers
 - Those with C=O double bonds:
 - aldehydes
 - ketones
 - carboxylic acids
 - carboxylic acid derivatives: (replace _____)
 - with —OR
 - with —NR₂
 - with —Cl
4. nitrogen-containing compounds
 - amines
 - nitriles
 - nitro- containing compounds

Alkanes and Alkane Isomers

Alkanes are _____, also called _____ compounds

General formula:

methane

ethane

propane

butane

Isomers:

There are different kinds of isomers. One type of isomers: _____

ex: C₄H₁₀

Important: These are _____ with _____.

Alkyl groups

If a _____ is removed from an _____, you get an _____.

methane

methyl

ethane

ethyl

propane

propyl

isopropyl

butane

butyl

sec-butyl

isobutane

isobutyl

tert-butyl

“sec-“ and “tert-“ indicate

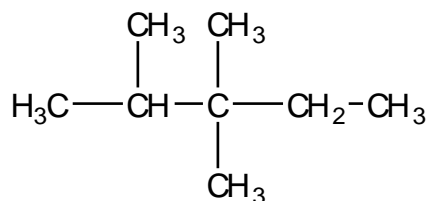
primary

secondary

tertiary

quaternary

Example:



Know the parent names:

Know the number prefixes:

Naming Alkanes

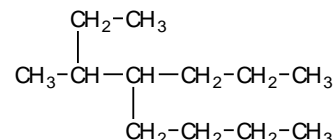
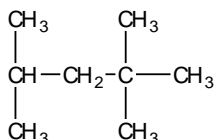
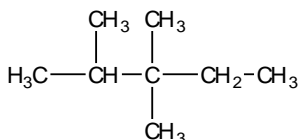
When trying to determine if two compounds are identical or if they are isomers, _____.

IUPAC Rules

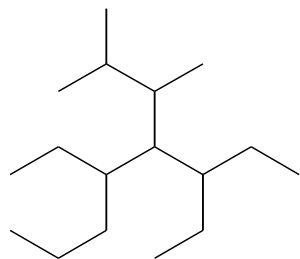
- Find the _____.
 - Find the _____.
 - If two different chains of equal length are present, choose _____.
- Number the _____ in the _____.
 - Begin at the end closer to the _____.
 - If branching occurs an equal distance from both ends, look at the _____.
- Identify and number the _____.

There must always be as many _____ in the name as there are _____.
- Write the name as a _____
 - substituents in _____
 - don't alphabetize based on _____
 - dimethyl starts with _____
 - sec-butyl starts with _____
 - tert-butyl starts with _____
 - isopropyl starts with _____
- Substituents which are also branched are called _____.
 - name complex substituents using the rules above.
 - put the names of complex substituents _____
 - number from the _____ of _____.
 - alphabetize according to _____
- Names of the halogen substituents:

Examples:



From a previous test: What is the IUPAC name of this compound?



Properties of Alkanes

1. **Chemical Reactivity:** Alkanes are fairly _____ and only generally undergo only two types of reactions:

1)

2)

2. Physical Properties:

1) Boiling Point and Melting Point generally _____ with increasing molecular weight.

Examples: CH_4 BP =

CH_3CH_3 BP =

$\text{CH}_3\text{CH}_2\text{CH}_3$ BP =

2) Boiling Point generally _____ with increased branching

pentane

2-methylbutane

2,2-dimethylpropane

These boiling point changes can be explained by _____.

• These are intermolecular attractions due to _____.

• These increase with increasing _____

- the larger the molecule, the more _____

- straight-chain molecules have _____ surface area and are more _____

than their branched chain isomers.

Conformations of Ethane

Stereochemistry –

Two *conformations* of ethane:

conformations –

conformer

Newman Projections of ethane:

the eclipsed conformer

the staggered conformer

Any other intermediate conformation is called _____.

Important: The _____ conformation is lower in energy than the _____ conformation.

• This is due to

• The difference in energy between staggered and eclipsed ethane is _____.

• This energy difference is referred to as _____ or the _____.

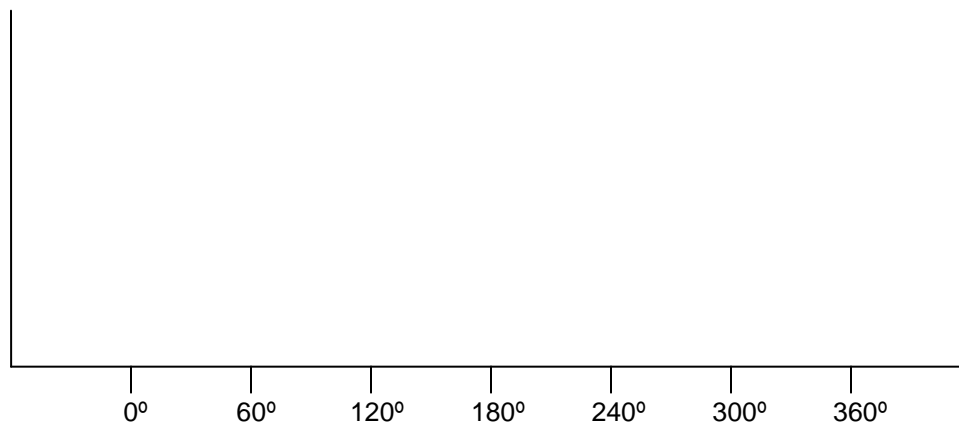
Draw the Newman projection of eclipsed ethane again:

If the total torsional strain is _____, then each “H↔H” eclipse costs about _____.

Important: *Torsional strain results from* _____.

The simplest way of thinking of torsional strain:

This is illustrated by comparing the distance between H atoms:



Conformations of Propane

Draw two Newman Projections of propane, sighting along the C1-C2 axis:

eclipsed propane

staggered propane

_____ propane is more stable than _____ propane by _____.

Since each "H↔H" eclipse costs _____, a "H↔CH₃" eclipse costs about _____.

Conformations of Butane

There are two different eclipsed conformations of butane.

Sighting along the C2-C3 axis, draw the Newman projections of two different eclipsed conformations, and calculate the total strain energy of each.

There are two different staggered conformations of butane:

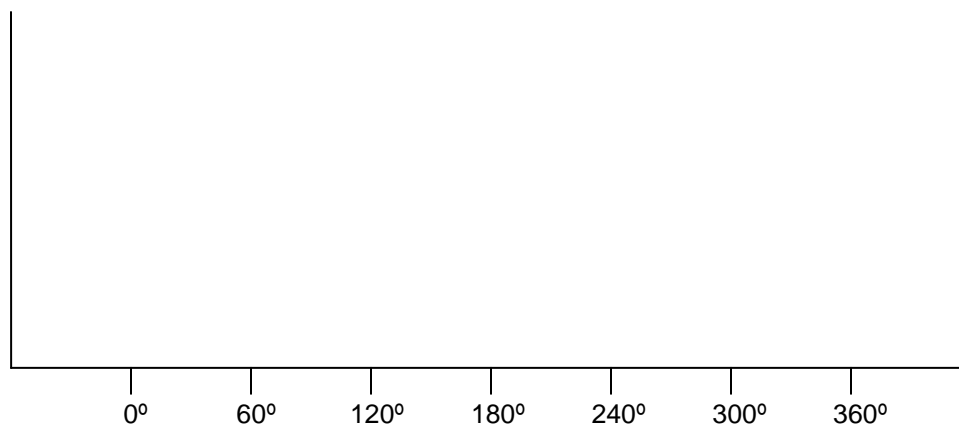
The lowest energy conformation of butane is the _____ conformation.

The _____ conformation is lower in energy than the _____ conformation by _____.

The _____ conformation does not have any _____ strain, but it does have _____ strain.

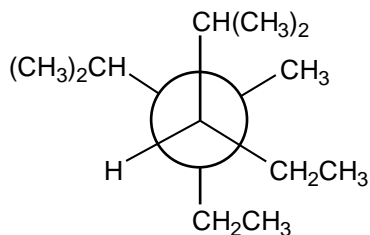
Steric strain:

Summary of Energy Costs:



Question: What would be the lowest energy conformation for a larger chain alkane such as pentane?

From a previous exam: What is the IUPAC name of the compound shown?



From a previous exam: Consider the molecule 2,2-dimethylbutane. Sighting along the C2-C3 axis, draw the Newman projection of the *most* stable conformation, and draw the Newman projection of the *least* stable conformation. Calculate the total strain energy present in each conformation.