


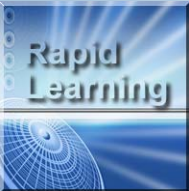
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 **MCAT Organic Chemistry**

Organic Nomenclature I:
How to Name Alkanes, Alkenes,
Alkynes, and Alkyl Halides

MCAT Rapid Learning Series

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Learning Objectives

By completing this tutorial, you will learn about:



- The Prefixes in Nomenclature for the First Ten Alkanes.
- The IUPAC Nomenclature of Alkanes and Alkyl Halides.
- The Common Nomenclature of Alkanes and Alkyl Halides.

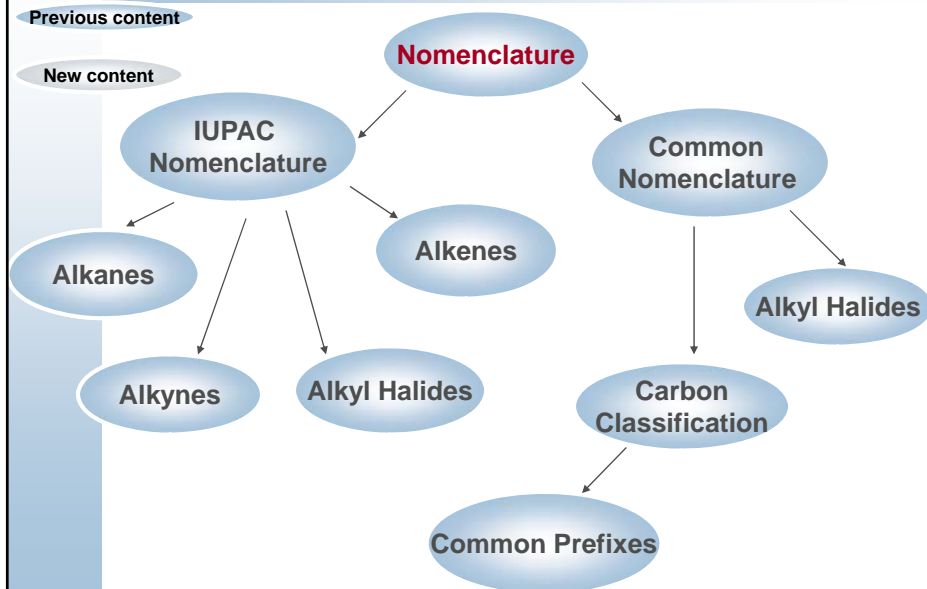
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Nomenclature Concept Map

Previous content


New content



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Two Types of Nomenclature



1. IUPAC Nomenclature – International Union of Pure and Applied Chemistry
2. Common Nomenclature

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IUPAC Nomenclature - 1

- There are two parts to every organic compound's name in the IUPAC system.

Substituents - Parent

The Parent tells us how many carbon atoms can be found in the longest chain.

The substituents indicate any groups that are attached to the longest carbon chain.

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IUPAC Nomenclature - 2

Substituents - Parent

The Parent itself is composed of two parts:

Prefix – Indicates the number of carbon atoms in the longest chain.

Suffix – Indicates the functional group contained in the longest chain of the compound.

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First Ten Alkyl Prefixes

Number of Carbons	Alkyl Prefix	Number of Carbons	Alkyl Prefix
1	Meth-	6	Hex-
2	Eth-	7	Hept-
3	Prop-	8	Oct-
4	But-	9	Non-
5	Pent-	10	Dec-

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IUPAC Nomenclature - 3

- **The substituents are listed alphabetically before the parent.**
 - Use a number to indicate their locations on the main chain.
 - Use a numerical prefix to indicate when more than one of a particular substituent exists in the molecule.
 - If a halogen (F, Cl, Br, or I) is present, use a halogen prefix.

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Numerical Prefixes for Naming Identical Groups

1	Mono-	6	Hexa-
2	Di-	7	Hepta-
3	Tri-	8	Octa-
4	Tetra-	9	Nona-
5	Penta-	10	Deca-

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Halogen Prefixes

Halogen	Prefix
F	Fluoro-
Cl	Chloro-
Br	Bromo-
I	Iodo-

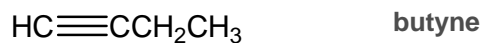
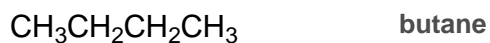
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IUPAC Nomenclature – Rule #1

First Rule

- The longest, continuous carbon chain is the parent compound.
- Use the suffixes “-ane” for alkanes, “-ene” for alkenes, and “-yne” for alkynes.



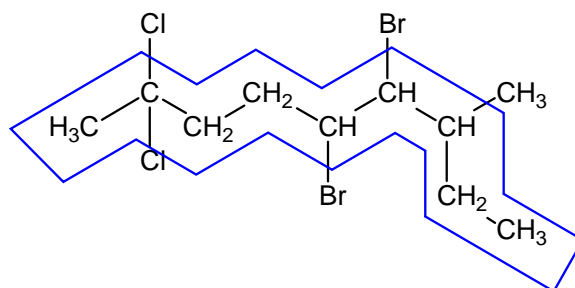
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IUPAC Nomenclature – Rule #2

Second Rule

- Circle the longest carbon chain to aid in identifying the parent compound.



In this example, the longest chain contains 9 carbons so the parent name is **nonane**.

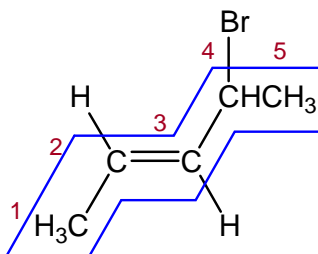
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IUPAC Nomenclature – Rule #3

Third Rule

- Number the carbon chain in alkenes and alkynes so that the multiple bonds have the lowest possible number.



In this example, numbering from left to right gives the double bond the lowest possible number.

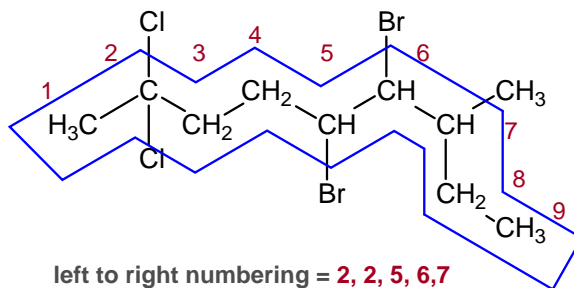
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IUPAC Nomenclature – Rule #4

Fourth Rule

- For alkanes, number the parent chain from the end that gives the lower number to the substituent encountered first.



left to right numbering = 2, 2, 5, 6, 7

right to left numbering = 3, 4, 5, 8, 8

Numbering from the left takes priority in this case.

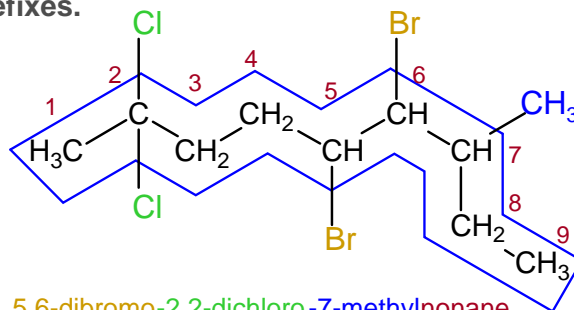
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IUPAC Nomenclature – Rule #5

Fifth Rule

- Give the location of each substituent with a number.
- Use numerical prefixes if more than one identical group is present.
- Use “yl” on alkyl prefixes.
- Alphabetize the groups, ignoring all numerical prefixes.



5,6-dibromo-2,2-dichloro-7-methylnonane

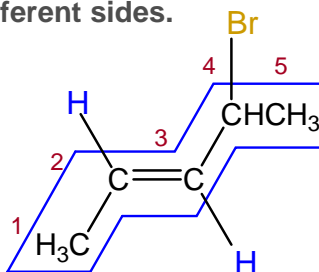
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IUPAC Nomenclature – Rule #6

Sixth Rule

- For alkenes, use *cis* if same groups are on same side of the double bond or *trans* if same groups are on different sides.

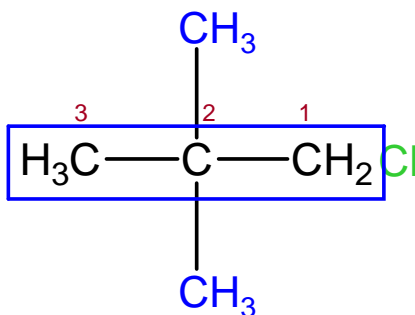


trans-4-bromo -2-pentene

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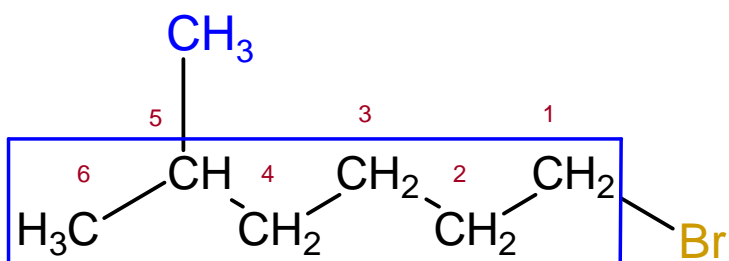
Give the IUPAC Name – Example 1



1-chloro-2,2-dimethyl propane

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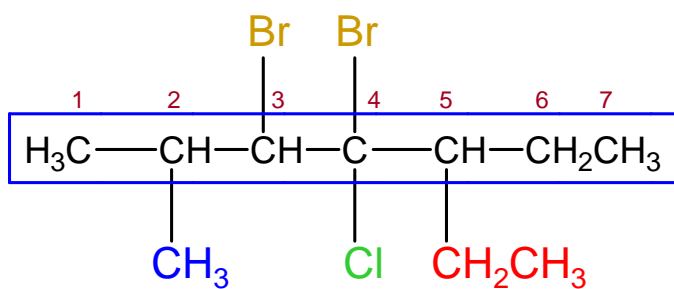
? Give the IUPAC Name - Example 2



1-bromo-5-methylhexane

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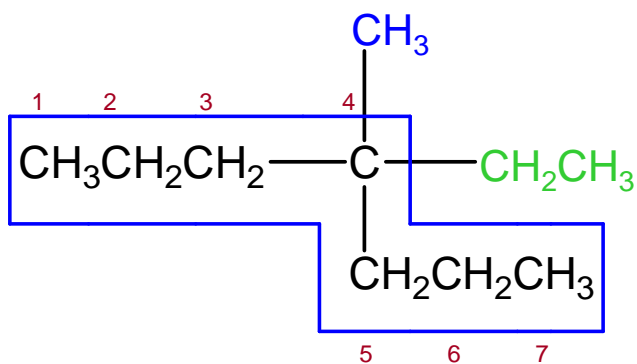
? Give the IUPAC Name - Example 3



3,4-dibromo-4-chloro-5-ethyl-2-methylheptane

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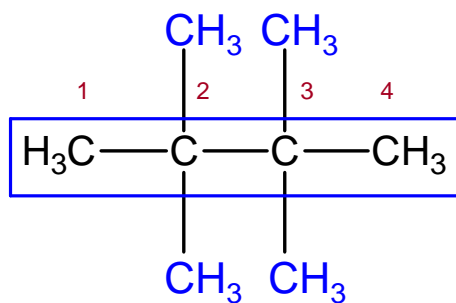
? Give the IUPAC Name - Example 4



4-ethyl-4-methyl heptane

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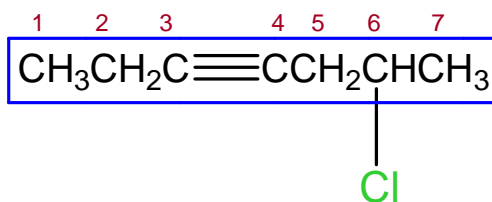
? Give the IUPAC Name - Example 5



2,2,3,3-tetramethyl butane

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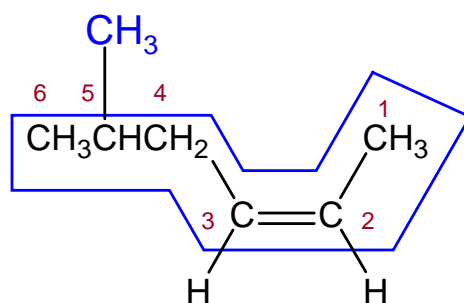
? Give the IUPAC Name - Example 6



6-chloro -3-heptyne

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? Give the IUPAC Name - Example 7



cis-5-methyl-2-hexene

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IUPAC Nomenclature Summary - 1

Rules:

The longest continuous carbon chain is the parent compound.

Use “-ane” for alkanes, “-ene” for alkenes, and “-yne” for alkynes.

Circle the carbon chain to aid in identifying the parent compound.

Number the carbon chain in alkenes and alkynes so that multiple bonds have the lowest number, then number the substituents.

For alkanes, number the parent chain from the end that gives the lower number to the substituent encountered first.

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IUPAC Nomenclature Summary - 2

Rules:

Give the location of each substituent with a number.

Use numerical prefixes if more than one identical group is present.


Use “-yl” on alkyl prefixes.

Alphabetize the groups, ignoring all numerical prefixes.

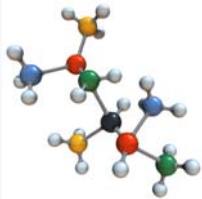
For alkenes, use *cis* if similar groups are on same side or *trans* if similar groups are on different sides.

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Common Nomenclature



1. Classification of Carbons
2. Rules

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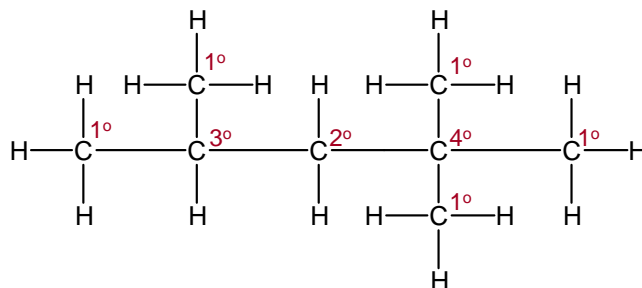
Classification of Carbons

Carbons are classified by the number of carbons directly attached to them.

Number of Carbons Directly Attached	Classification of Carbon
Zero carbons	Zero degree
One carbon	Primary degree
Two carbons	Secondary degree
Three carbons	Tertiary degree
Four carbons	Quaternary degree

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? Classify the Carbons on this Structure



How many 0° carbons are present? There are none.

How many 1° carbons are present? 5

How many 2° carbons are present? 1

How many 3° carbons are present? 1

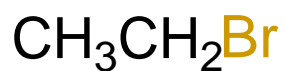
How many 4° carbons are present? 1

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> Common Nomenclature – Rule #1

First Rule

- Name as “**alkyl halide**”.
- Use all of the carbons in the “**alkyl**” name.



ethyl **bromide**

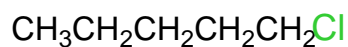
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Common Nomenclature – Rule #2

Second Rule

- Use prefix “n” if structure is straight chain, with halogen on one end.



n-pentyl chloride

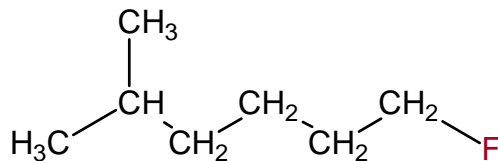
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Common Nomenclature – Rule #3

Third Rule

- Use prefix “iso” if structure contains two methyls attached to a -CH, with the halogen on the opposite end.



isoheptyl fluoride

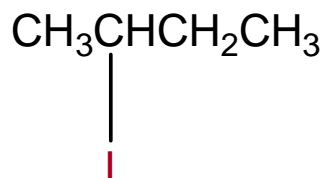
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Common Nomenclature – Rule #4

Fourth Rule

- Use prefix “**sec**” if halogen is attached to a secondary carbon.
- Only use if total number of carbons is four.



sec-butyl **iodide**

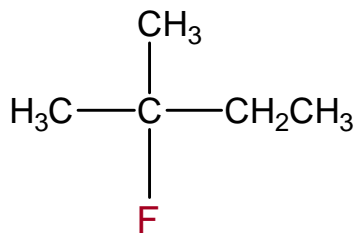
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Common Nomenclature – Rule #5

Fifth Rule

- Use prefix “**tert**” if halogen is attached to a tertiary carbon.
- Only use if total number of carbons is four or five.



tert-pentyl **fluoride**

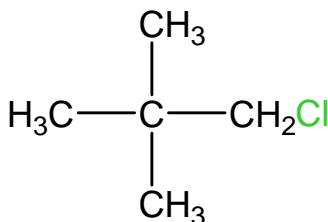
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Common Nomenclature – Rule #6

Sixth Rule

- Use prefix “**neo**” if halogen is attached to a primary carbon, which in turn is attached to a quaternary carbon.



neopentyl **chloride**

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Common Nomenclature Summary

Rules:

Name as an “**alkyl halide**”.
Use all of the carbons in the “**alkyl**” name.

Use prefix “**n**” if structure is a straight chain, with a halogen on one end.


Use prefix “**iso**” if structure contains two methyls on a CH, with a halogen on the opposite end.

Use prefix “**sec**” if a halogen is attached to a secondary carbon.
Only use if total number of carbons is four.


Use prefix “**tert**” if a halogen is attached to a tertiary carbon.
Only use if total number of carbons is four or five.

Use prefix “**neo**” if a halogen is attached to a primary carbon, which in turn is attached to a quaternary carbon.


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Nomenclature Problem Solving Strategies



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Nomenclature Exam Strategy - 1

- **IUPAC System**
 - Preferred system of nomenclature in organic chemistry.
 - Devised by the **I**nternational **U**nion of **P**ure and **A**ppplied **C**hemistry.
- **Common System**
 - Older way of naming compounds.
 - Used in naming simple, well-known molecules.

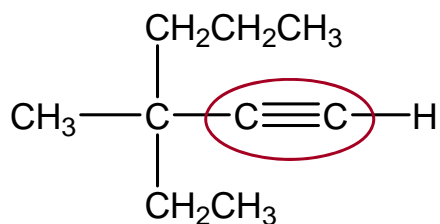
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Nomenclature Exam Strategy - 2

IUPAC Nomenclature Strategies:

Tip 1: Determine the functional group(s) present in the molecule.



What functional group is in the molecule above?

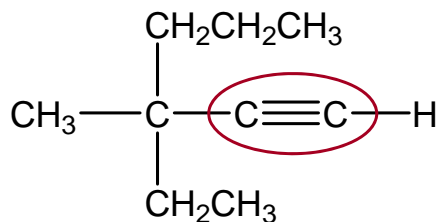
An alkyne!

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Nomenclature Exam Strategy - 3

Tip 2: Determine the suffix for that functional group.



The suffix for alkynes is:

“-yne”.

The IUPAC name of this compound is:

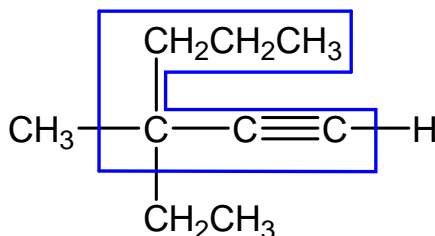
yne

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Nomenclature Exam Strategy - 4

Tip 3: Find the longest, continuous carbon chain that contains the functional group. Use the appropriate alkyl prefix.



How long is the longest carbon chain?

6 carbons long

The IUPAC name of this compound is:

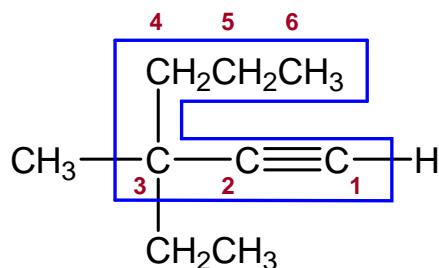
hex yne

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Nomenclature Exam Strategy - 5

Tip 4: Determine how to number the carbon chain.



The chain must be numbered so that the multiple bond functional group receives the lowest possible number.

The IUPAC name of this compound is:

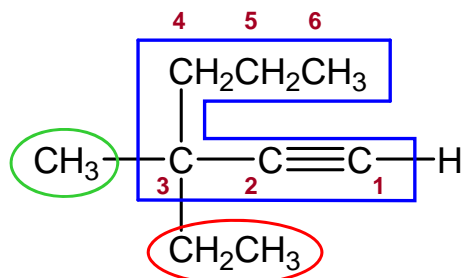
1- hex yne

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Nomenclature Exam Strategy - 6

Tip 5: List the location, number, and type of any substituent present.



List of substituents: **3-methyl-**

3-ethyl-

The IUPAC name of this compound is:

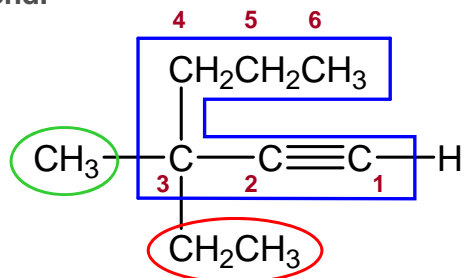
1-hex yne

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Nomenclature Exam Strategy - 7

Tip 6: Do not worry about alphabetizing the substituents until the end.



List of substituents: **3-methyl-**

3-ethyl-

The IUPAC name of this compound is:

3-ethyl-3-methyl-1-hex yne

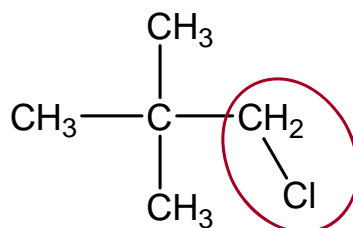
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Nomenclature Exam Strategy - 8

Common Nomenclature Strategies:

Tip 1: Determine the functional group(s) present in the molecule.



What functional group is in the molecule above?

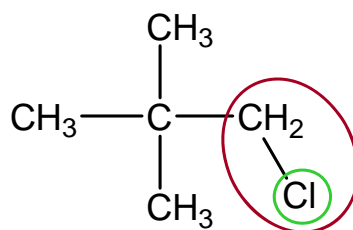
An alkyl halide!

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Nomenclature Exam Strategy - 9

Tip 2: Name as an “alkyl halide”. Determine the halide first.



Which halide is present? Chlorine

The common name of this compound is:

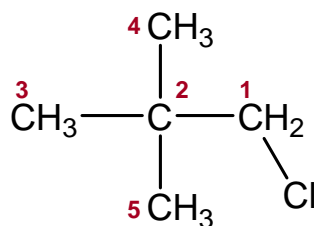
chloride

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Nomenclature Exam Strategy - 10

Tip 3: Count all the carbons in the alkyl portion of the molecule.



How many carbons are in the molecule? 5 carbons

The common name of this compound is:

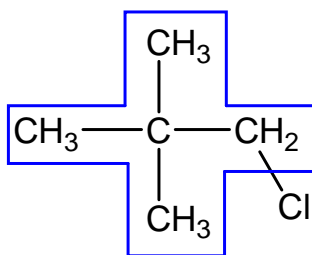
pentyl chloride

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Nomenclature Exam Strategy - 11

Tip 4: Study the alkyl portion to determine which common prefix should be used.



Which common prefix should be used? neo

The common name of this compound is:

neopentyl chloride

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Learning Summary

There are two parts to every compound's IUPAC name: Substituents-Parent.

The carbon chains in alkenes and alkynes are numbered so that the multiple bonds receive the lowest possible number.

The IUPAC suffix for alkanes is "-ane"; for alkenes is "-ene"; for alkynes is "-yne". Alkyl halides are always named as substituents.

In common nomenclature, all the carbons in the molecule are used to determine the alkyl name.

Carbons are classified by the number of carbons directly attached to them.

The longest, continuous carbon chain is the parent compound.

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Congratulations!


You have successfully completed the tutorial

Organic Nomenclature I:

How to Name Alkanes, Alkenes, Alkynes, and Alkyl Halides.


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Step 1: Concepts – Core Tutorial (Just Completed)
→ **Step 2: Practice – Interactive Problem Drill**
Step 3: Recap – Super Review Cheat Sheet

Go for it!



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