



# ORGANIC CHEMISTRY

NOMENCLATURE: NAMING ORGANIC COMPOUNDS

CHEMISTRY 165 // SPRING 2020

DR. MIOY T. HUYNH | 2020

# How to read organic structures

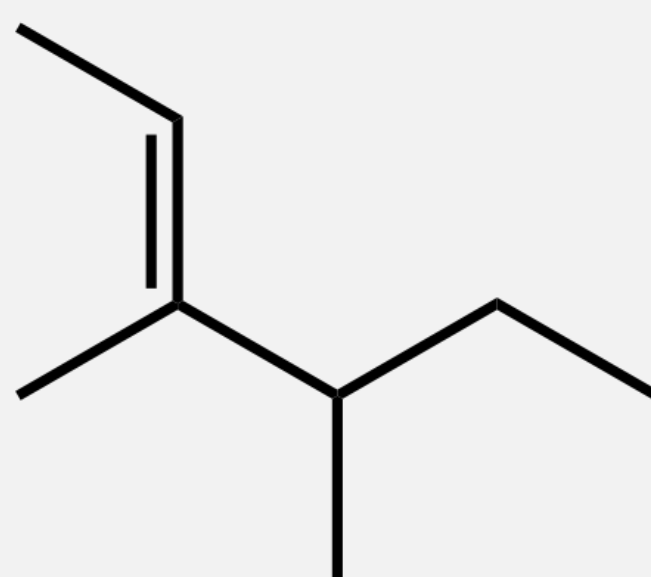
Organic chemistry deals predominantly with carbons (C) and hydrogens (H).  
Because of this the octet rule ( $8 e^-$ ) is satisfied most of the time.

As such, we often introduce two shorthands to produce skeletal structures:

- 1) We don't explicitly draw all the H atoms bonded to each C atom.  
This is to say that we assume that H atoms complete the octet on C.
- 2) We also don't write out the C atoms.

## PRACTICE EXERCISE

How many carbon and hydrogen atoms are in the following compound?



skeletal structure

C atoms =

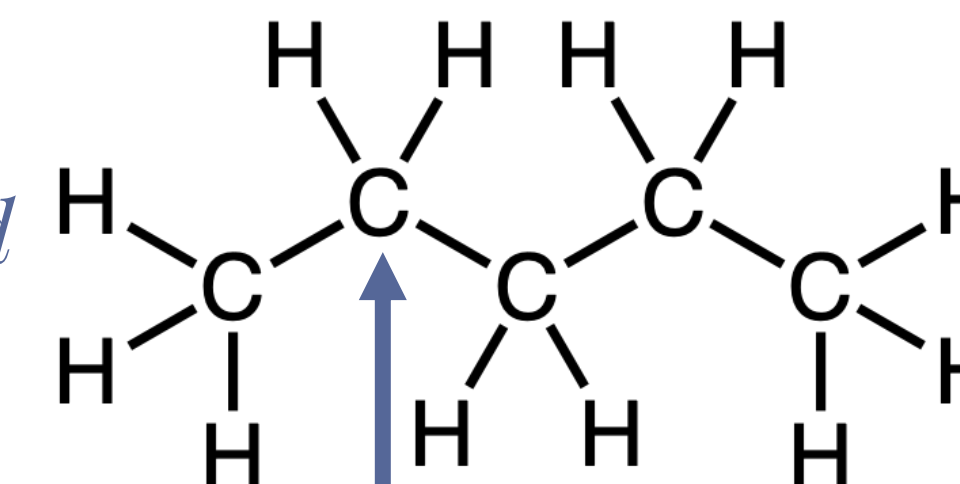
H atoms =

$C_xH_y =$

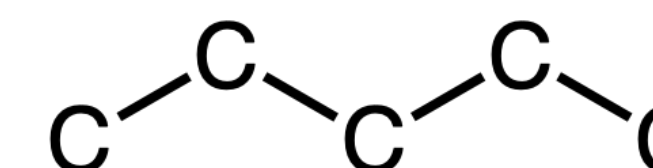
*molecular  
formula*  
( $C_5H_{12}$ )



*expanded  
formula*



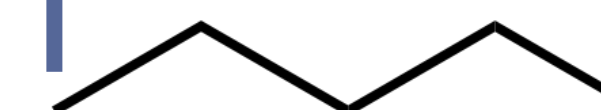
(each carbon  
has an octet)



(each vertex is  
a carbon atom)



skeletal  
structure



# How to read organic structures

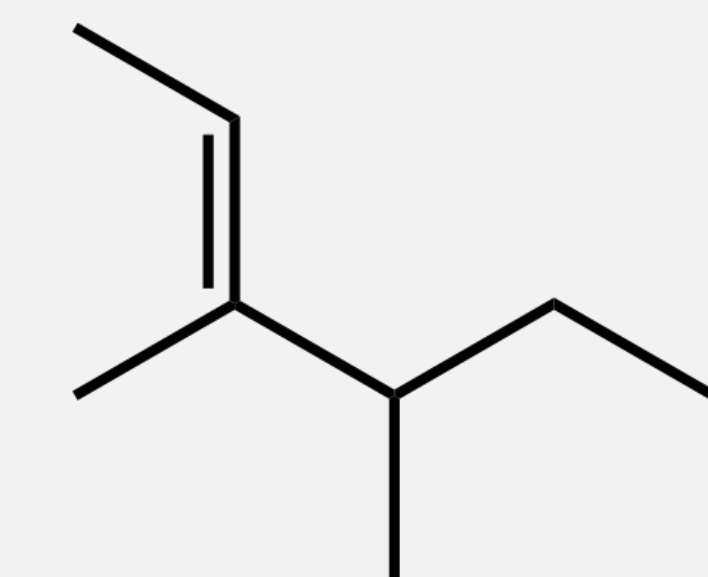
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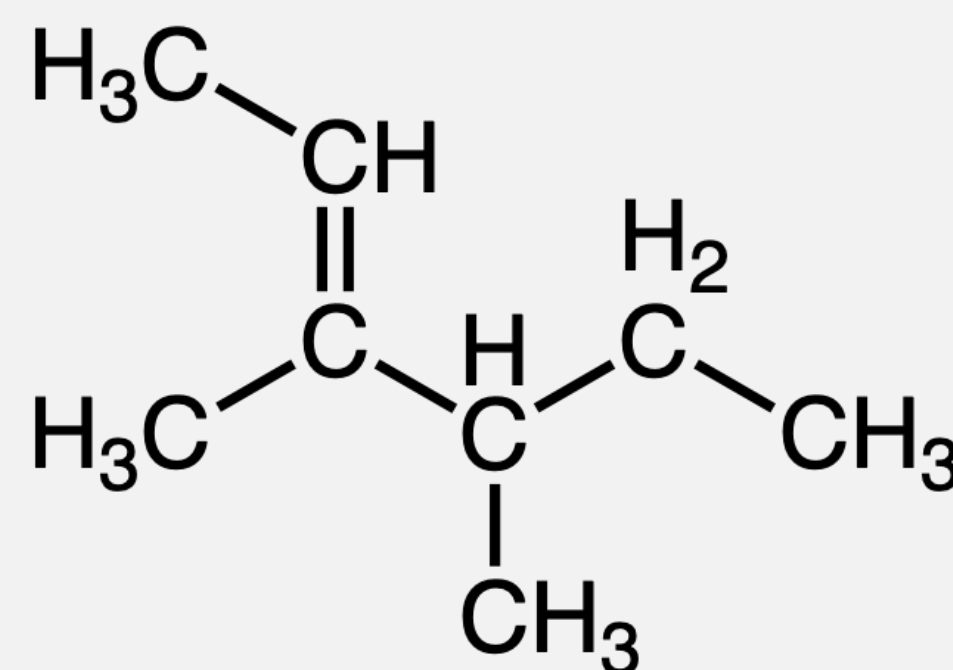
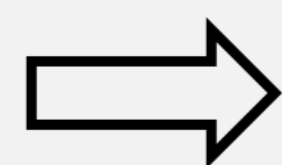
- 1) We don't explicitly draw all the H atoms bonded to each C atom.  
This is to say that we assume that H atoms complete the octet on C.
- 2) We also don't write out the C atoms.

## PRACTICE EXERCISE

How many carbon and hydrogen atoms are in the following compound?



*skeletal structure*



*condensed formula*

C atoms = 8

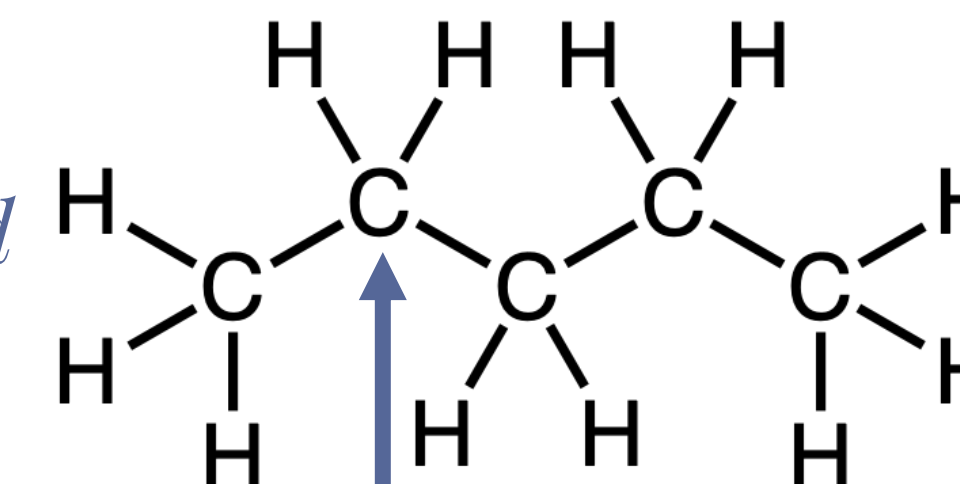
H atoms = 16

$\text{C}_x\text{H}_y = \text{C}_8\text{H}_{16}$

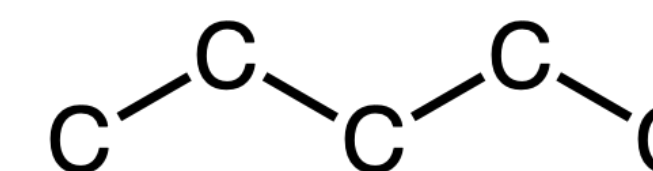
*molecular  
formula  
( $\text{C}_5\text{H}_{12}$ )*



*expanded  
formula*



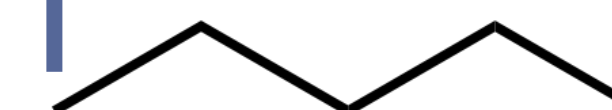
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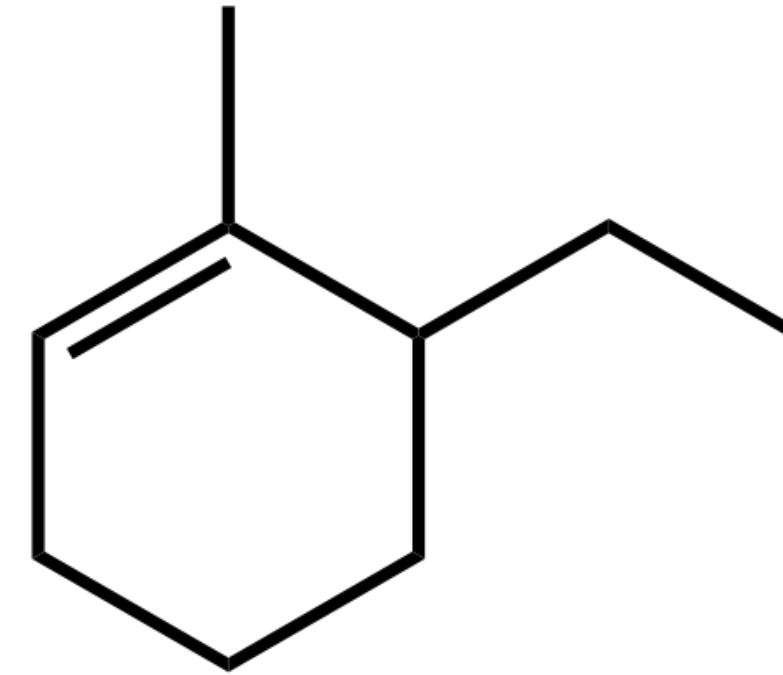
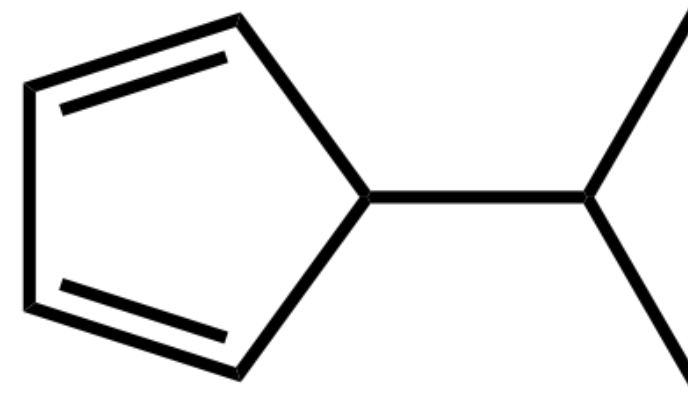
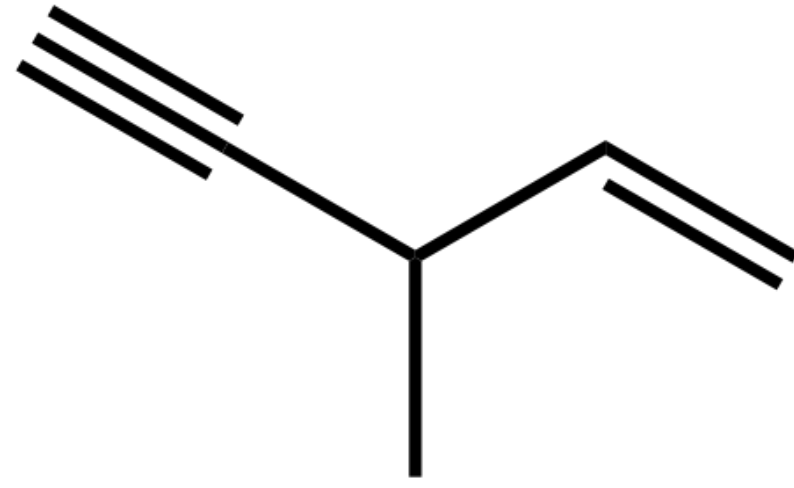
*skeletal  
structure*



# PRACTICE PROBLEM 1

Give the chemical formula ( $C_xH_y$ ) for each of the following organic compounds drawn.

— *answer* —

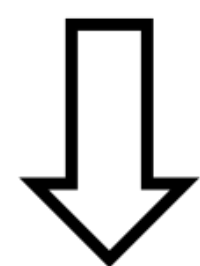
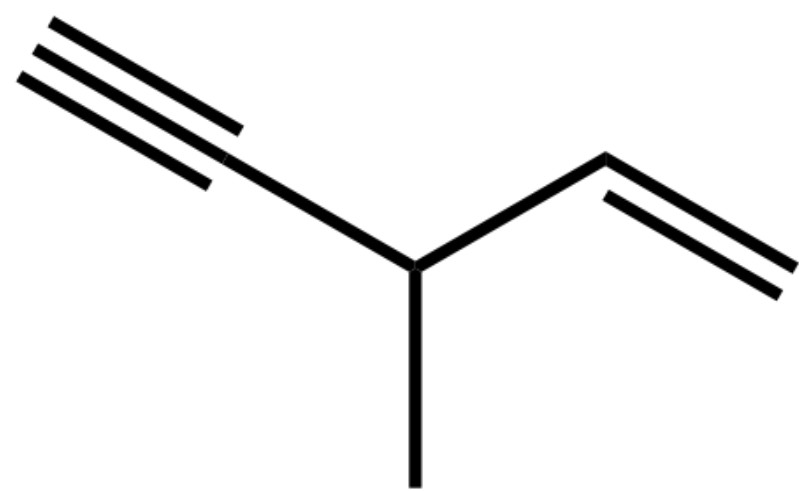




# PRACTICE PROBLEM 1

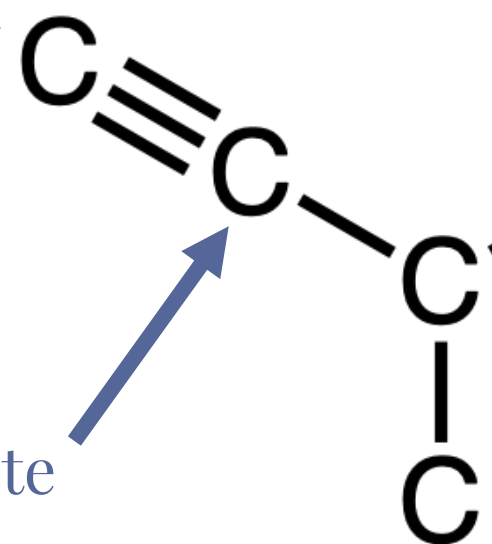
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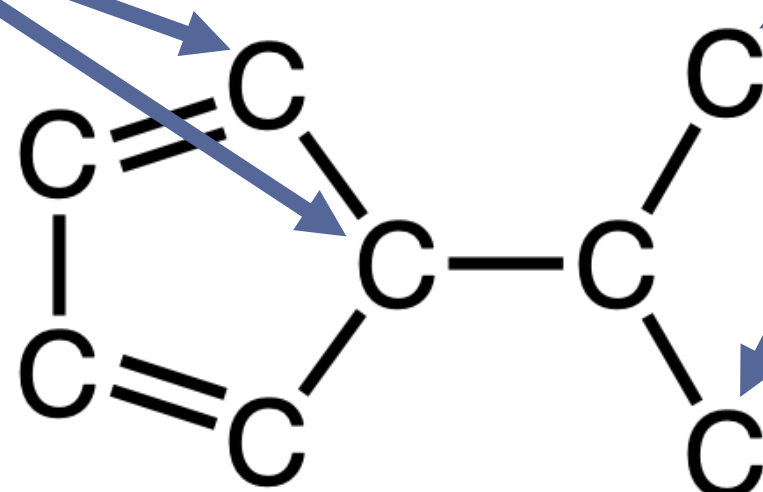
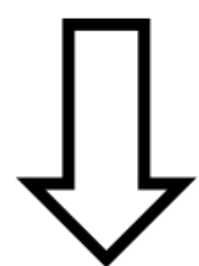
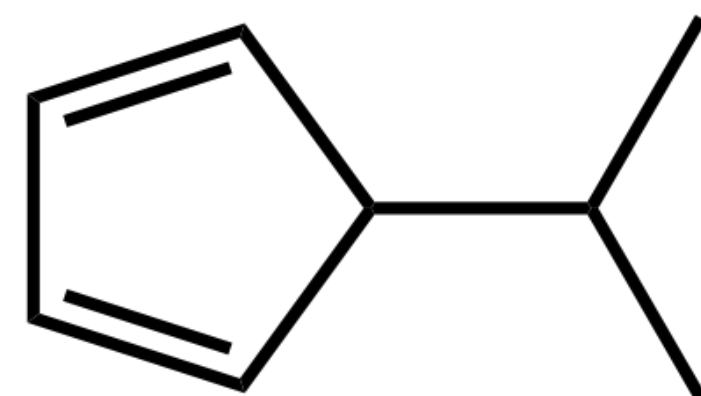
needs 1 H atom to complete octet

octet complete

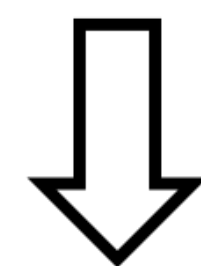
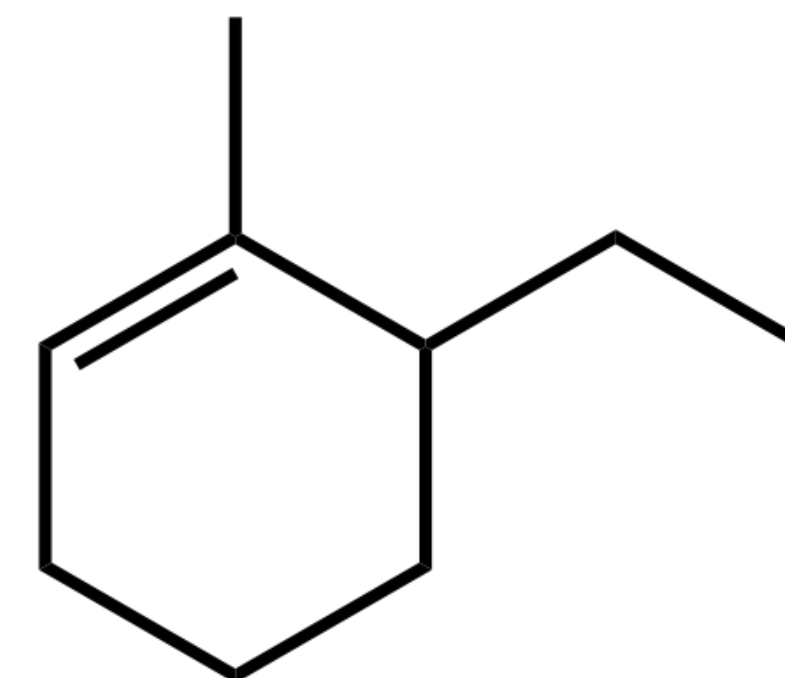
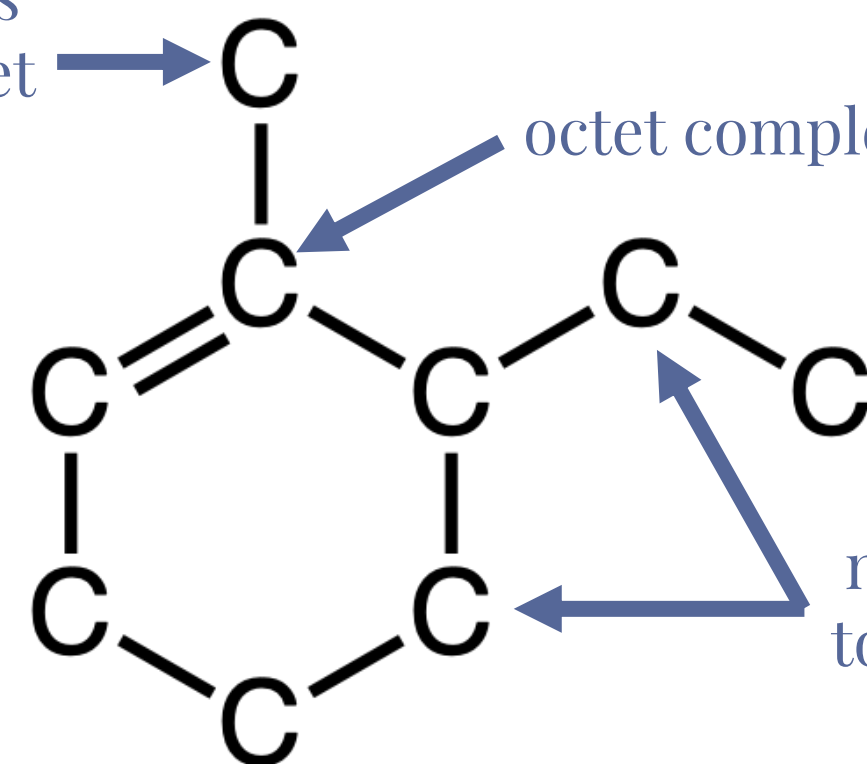


needs 1 H atom to complete octet

needs 2 H atoms to complete octet

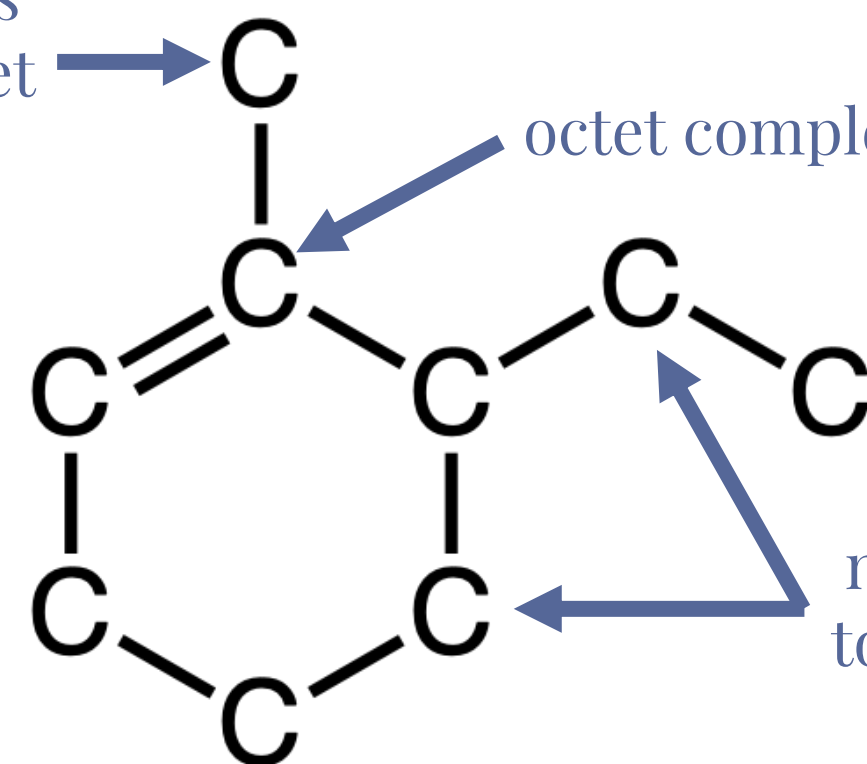


needs 3 H atoms to complete octet



octet complete

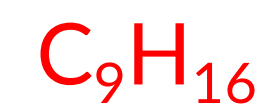
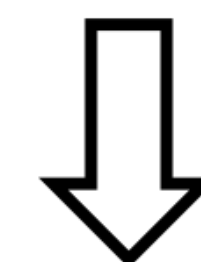
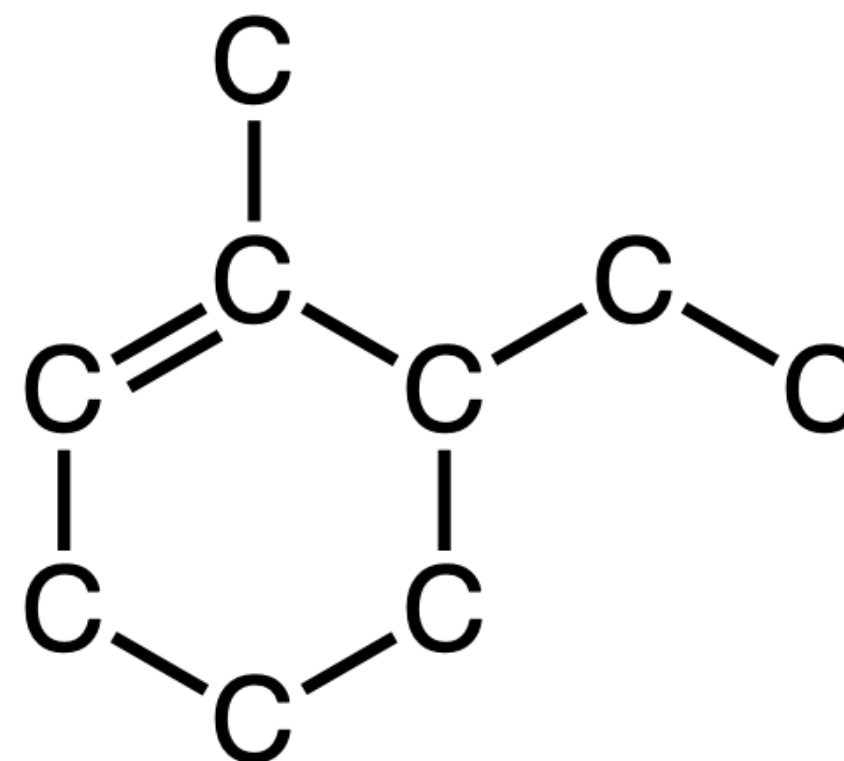
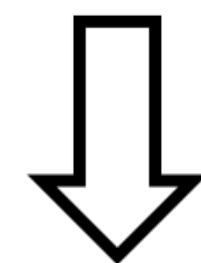
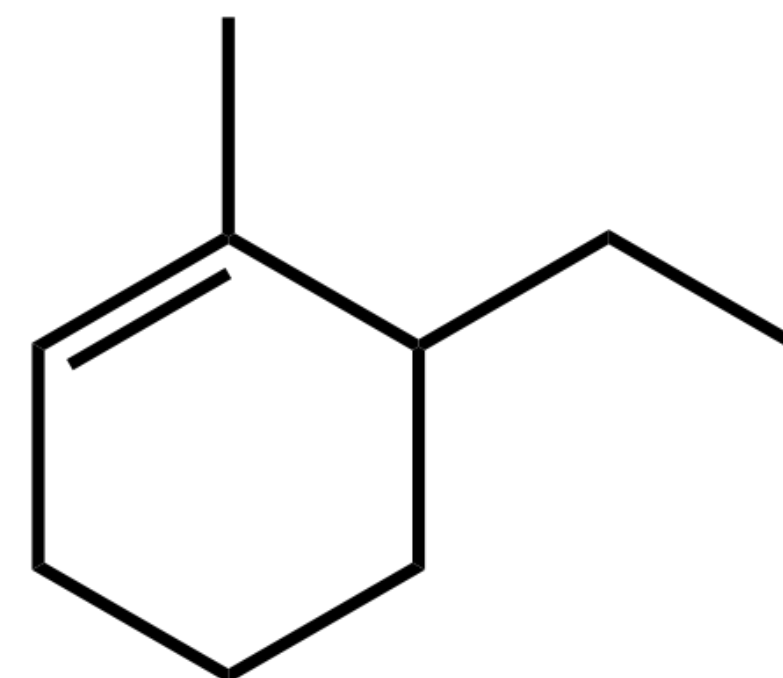
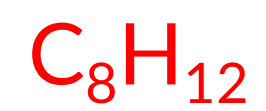
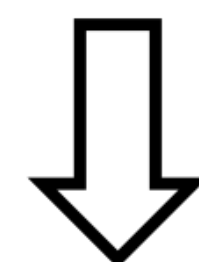
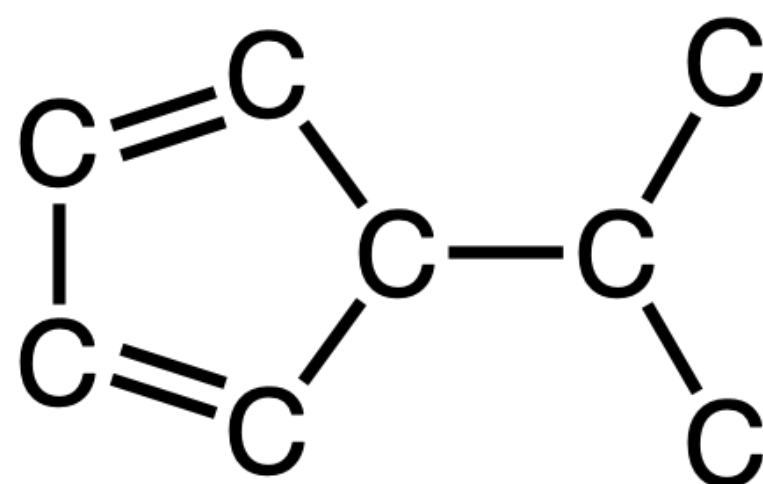
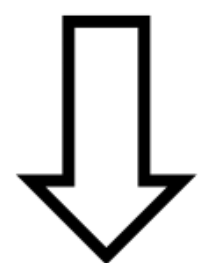
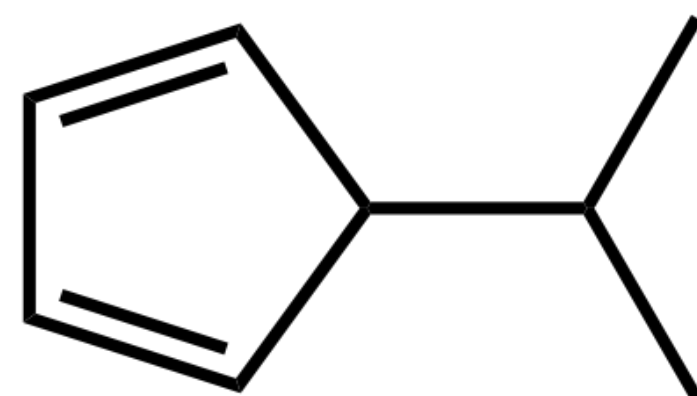
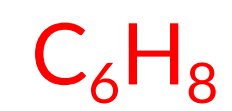
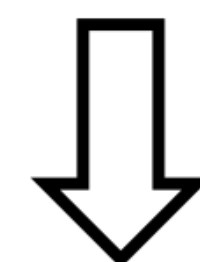
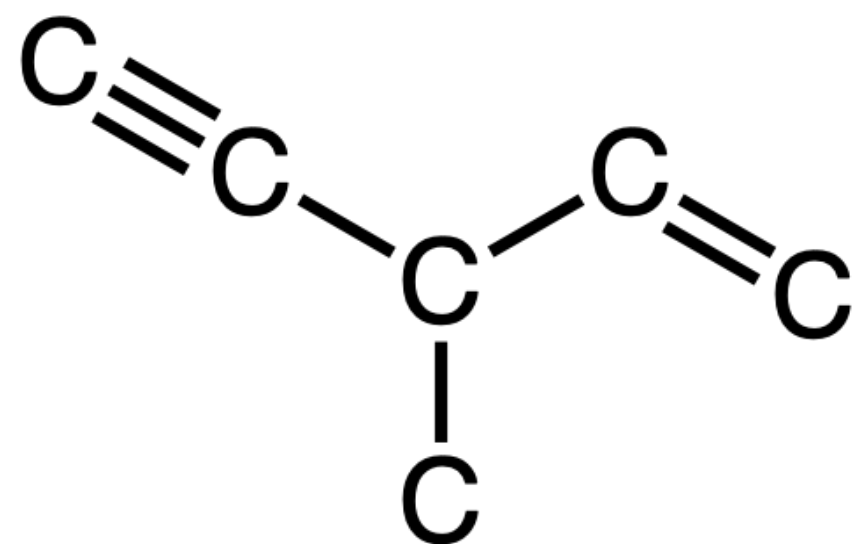
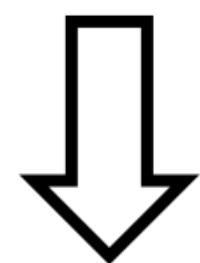
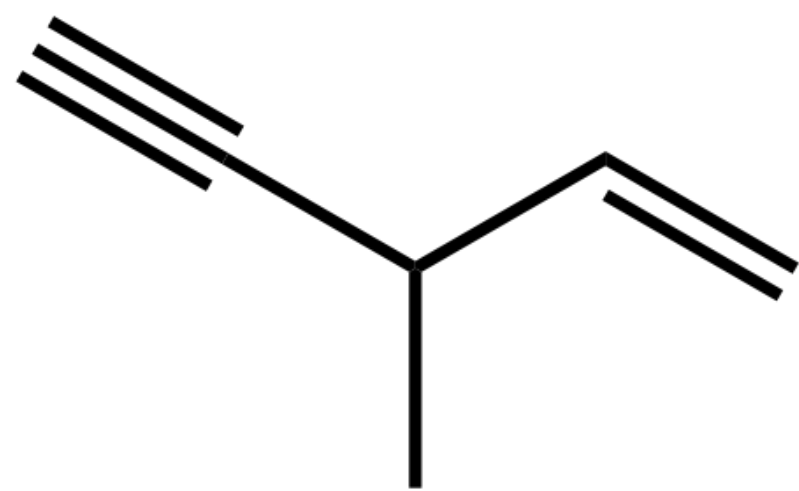
needs 2 H atoms to complete octet



# PRACTICE PROBLEM 1

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— *answer* —

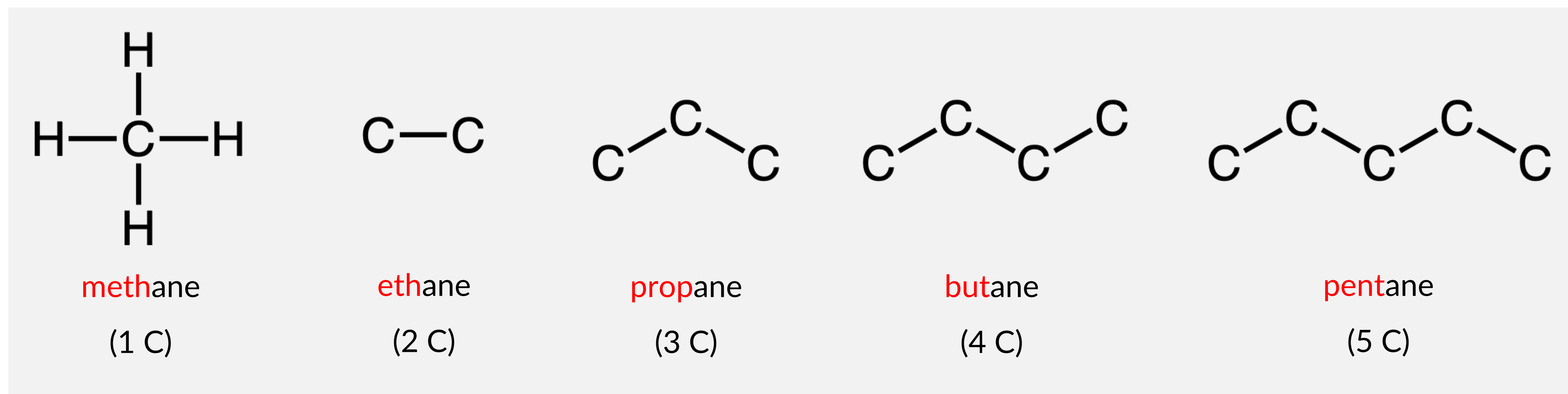


# Some basic vocabulary: carbon chains

Because many organic compounds consist of chains of carbon atoms, we introduce some important roots.

Let us first deal with a class of hydrocarbons called alkanes, which are composed of carbon atoms linked together with *only* single bonds. We will give this class of compounds the suffix “-ane”.

*The first four roots in this series require some memorization.*



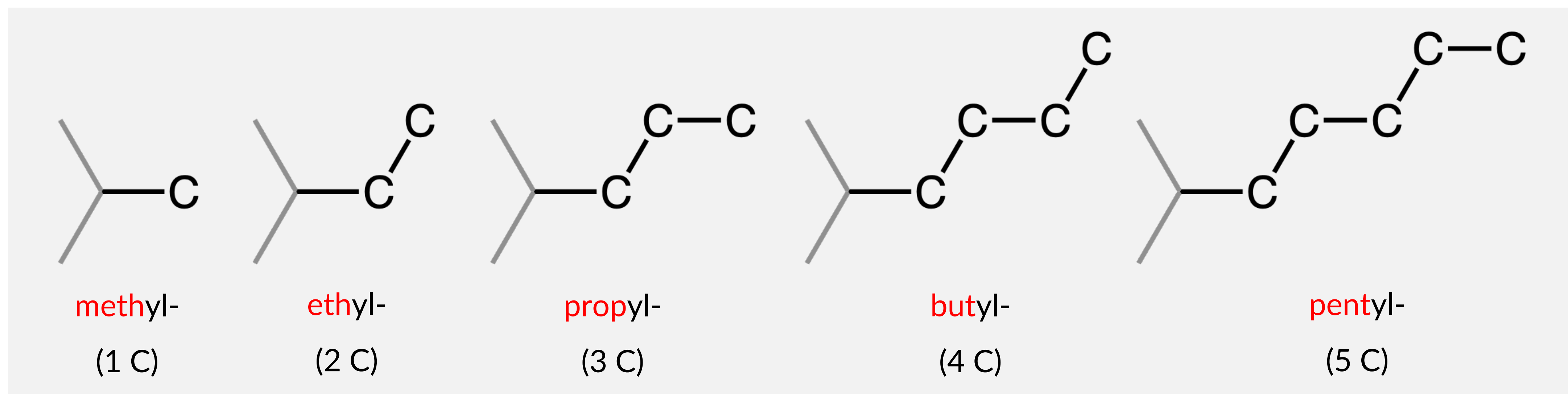
After a 4 C chain (**but-**), roots continue with Greek names: **hex-** (6 C), **hept-** (7 C), **oct-** (8 C), **non-** (9 C), **dec-** (10 C)

# Some basic vocabulary: carbon groups

Sometimes we have carbon chains that branch off other carbon chains. One of these chains is designated as the parent (main) chain and the others are designed side chains (or substituents).

These substituents are still given the roots we saw previously but given a suffix of “-yl” to let us know it is not the parent (main) chain.

Consider the following examples of different length alkyl groups (-R) off a 3-carbon main chain in gray (propane):



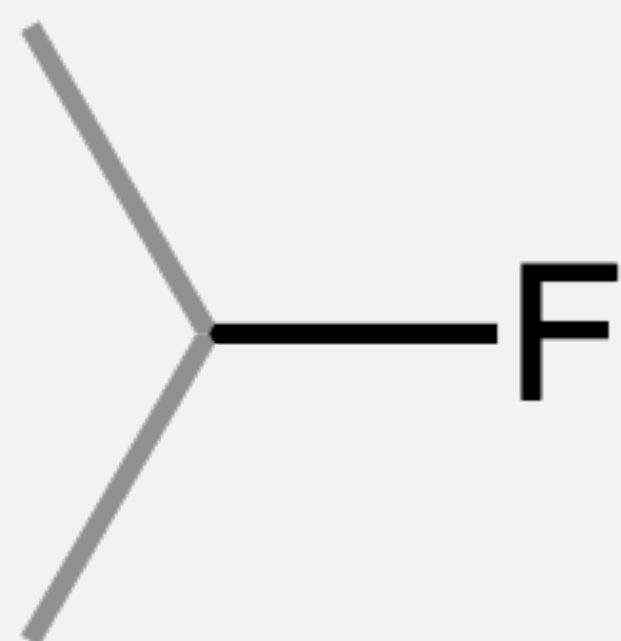


# Some basic vocabulary: halogen groups

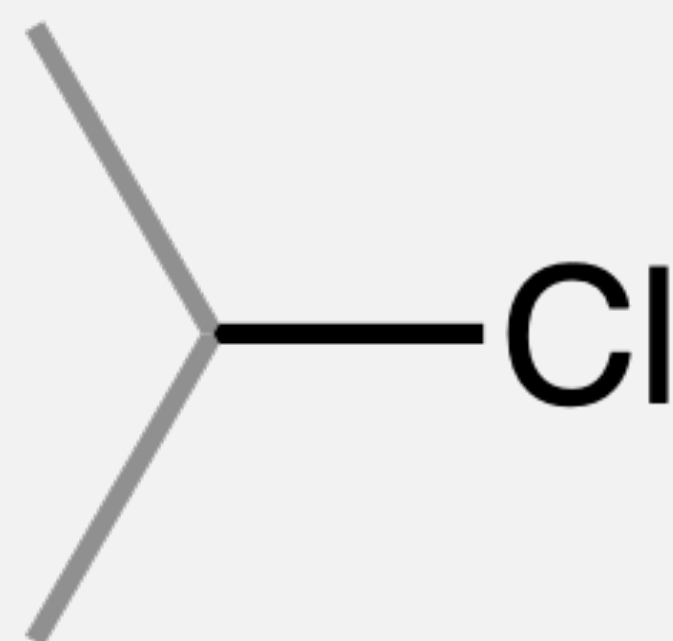
Sometimes we have halogen substituents branch off the parent (main) carbon chain.

These halogen substituents are still given the root of the halogen but given a suffix of “-o”.

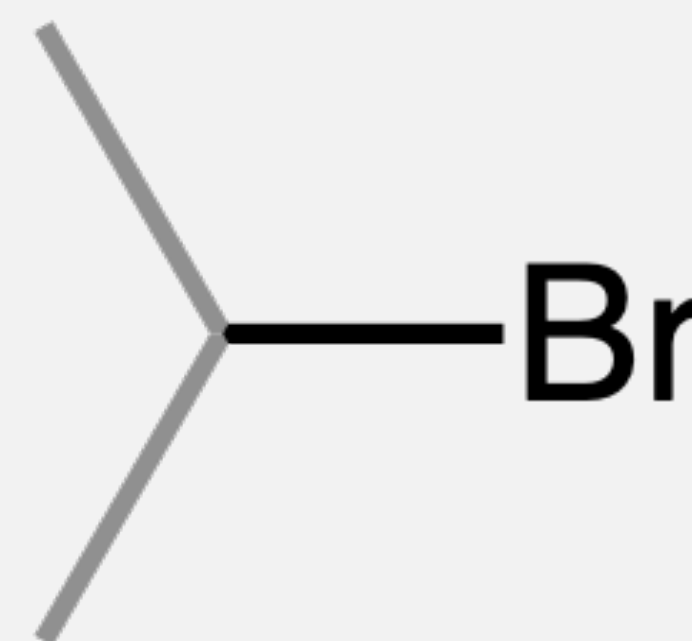
Consider the following examples of different halogen groups (-X) off a 3-carbon main chain in gray (propane):



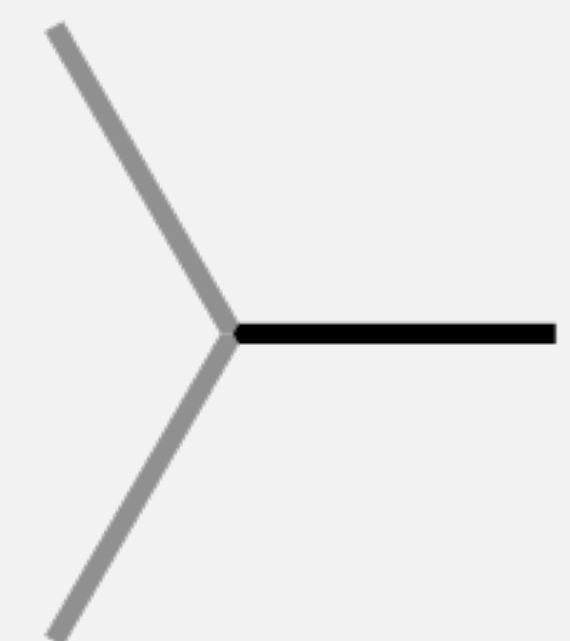
fluoro-



chloro-



bromo-



iodo-

# How to name alkanes (Part 1)

Let us start with a simple exercise:  $C_6H_{14}$

Try to name the following compounds following the rules:

## NAMING CONVENTIONS:

1. Identify and name the longest carbon chain. See *red* roots.
2. Identify and name the substituents attached to this chain. See *blue* names.
3. Number the longest carbon chain from the side nearest to a substituent. See *red* numbers.

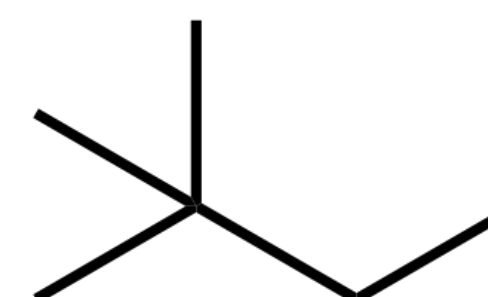
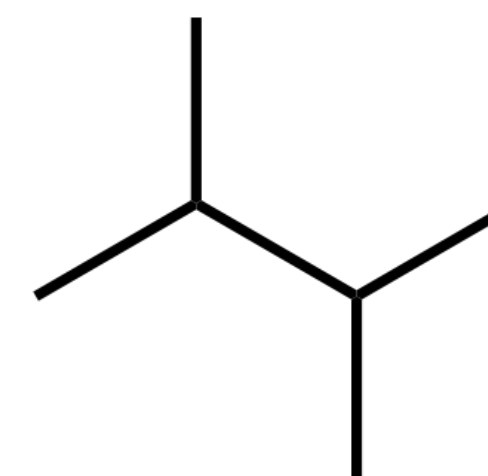
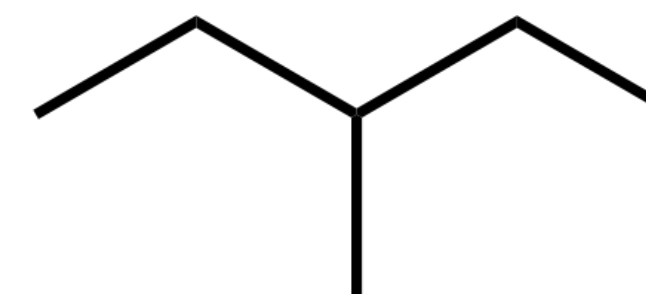
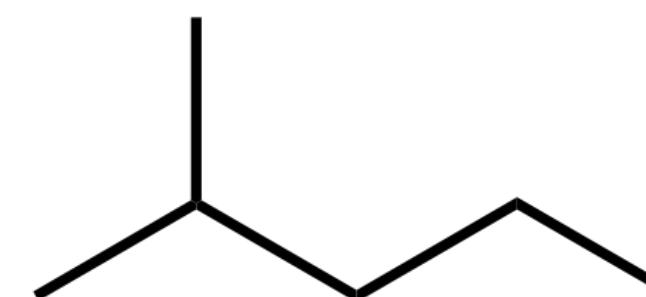
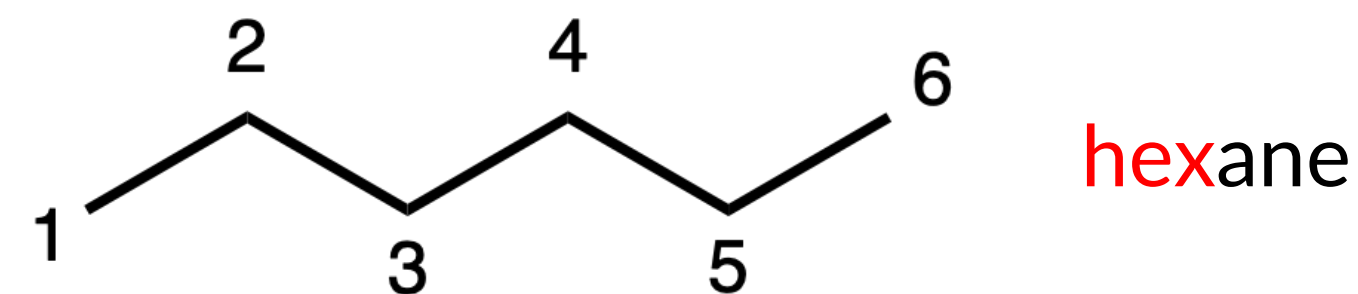
*(If more than one type of substituent, then start on the side nearest to the first cited/alphabetized substituent.)*

4. Label the location(s) of each substituent(s) by the number of the carbon atom to which it is attached.
5. List the groups in alphabetical order by the roots.

*(If more than one substituent, then use prefixes:*

*“di-” “tri-” “tetra-” “penta-” ...*

*but do not alphabetize using the prefix; use the root!)*



# How to name alkanes (Part 1)

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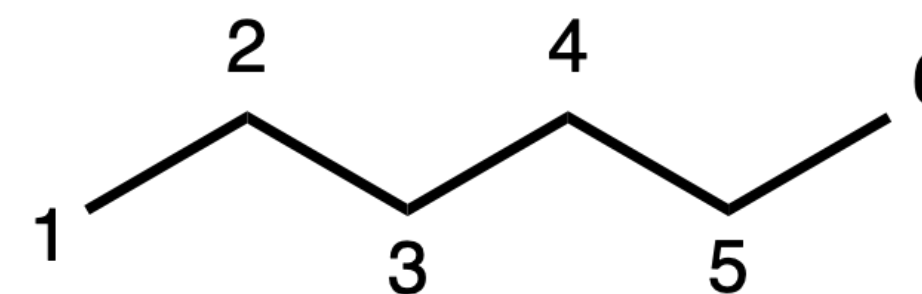
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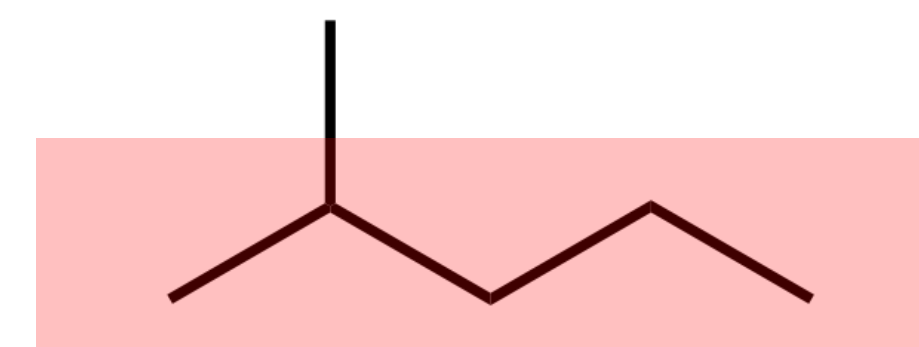
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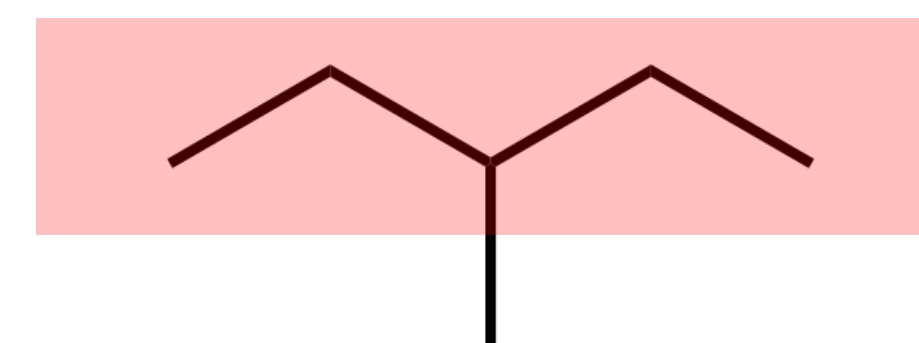
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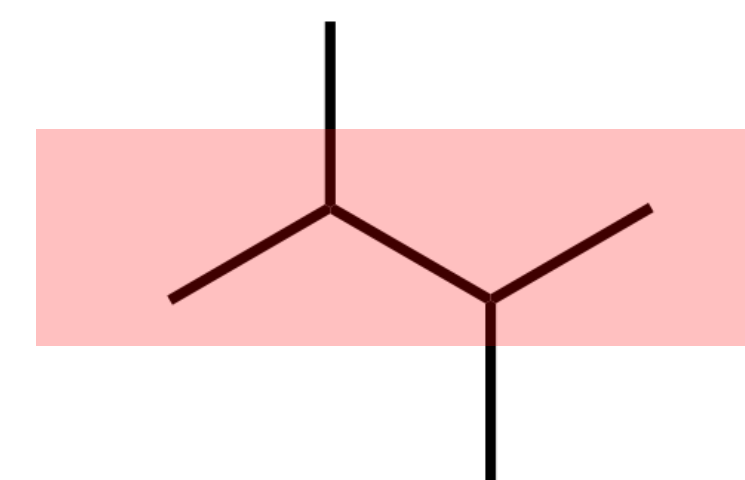
hexane



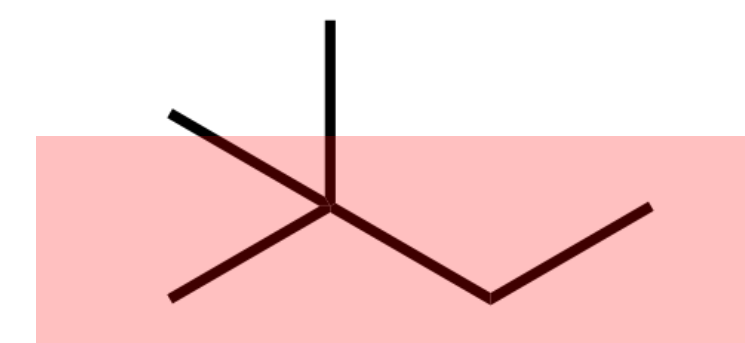
pentane



pentane



butane



butane

# How to name alkanes (Part 1)

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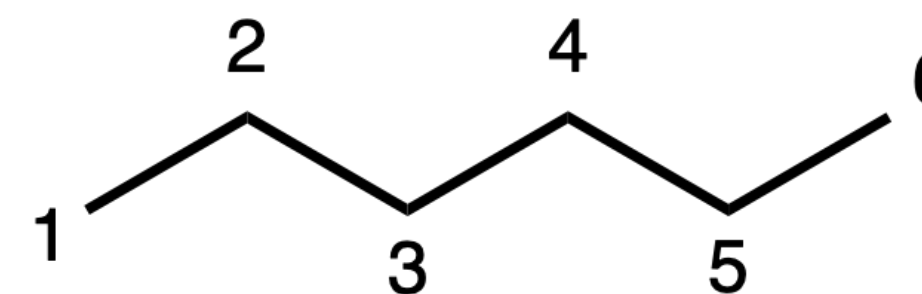
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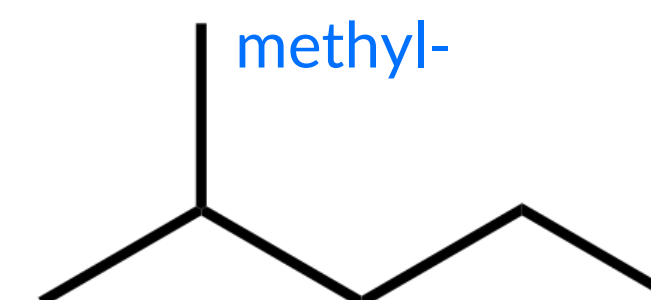
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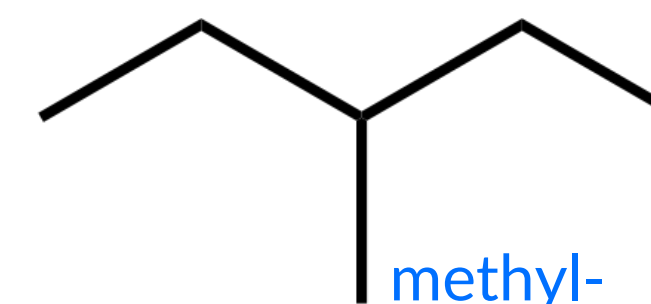
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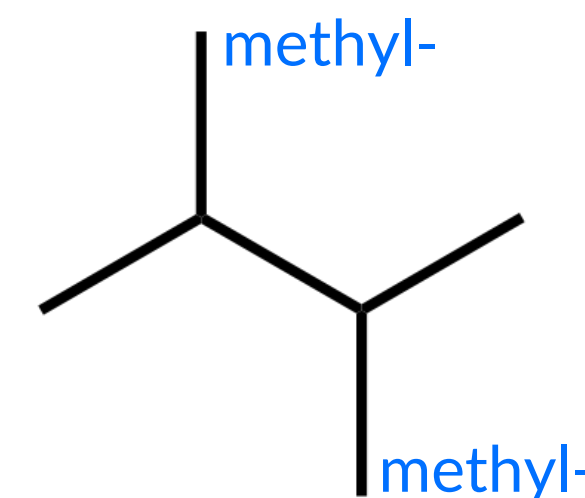
hexane



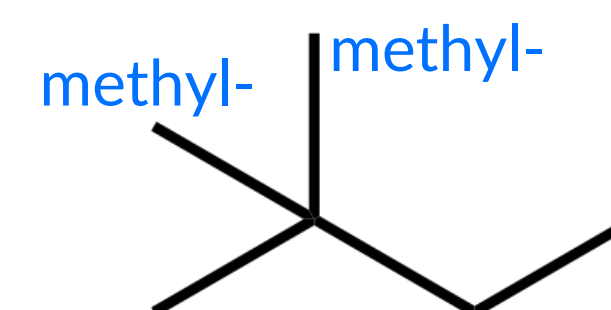
methylpentane



methylpentane



methylbutane



methylbutane

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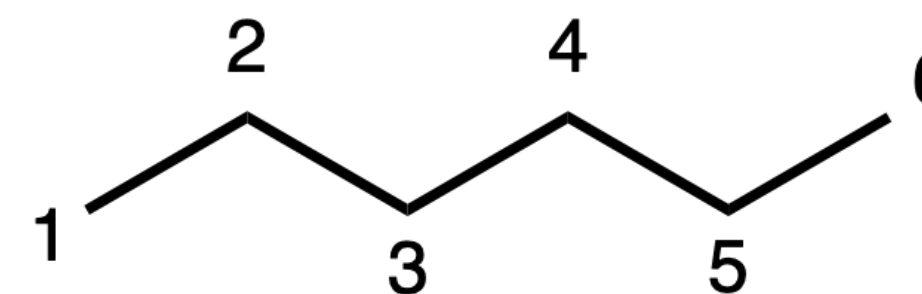
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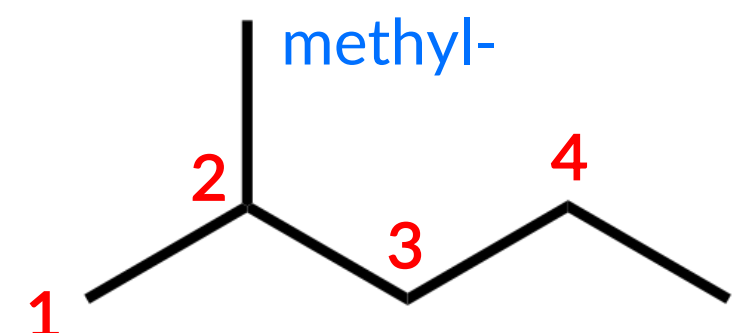
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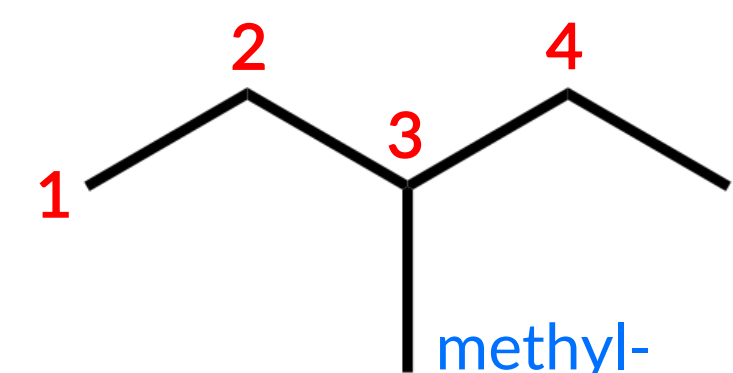
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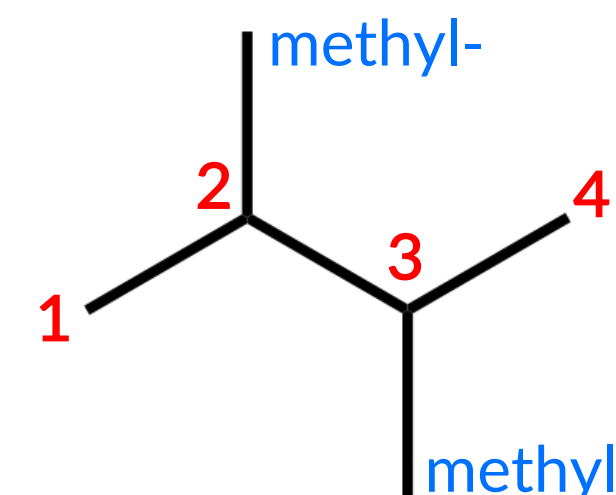
hexane



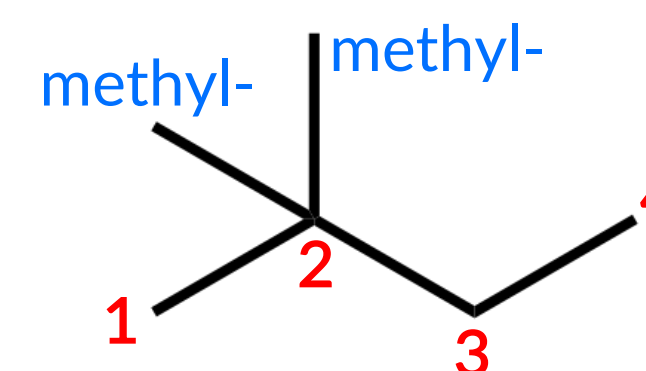
methylpentane



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methylbutane



methylbutane



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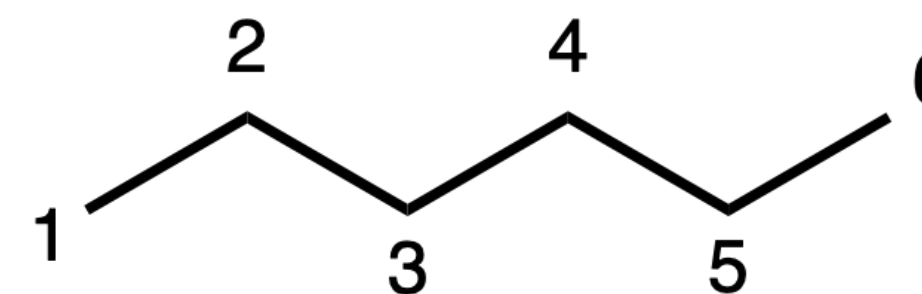
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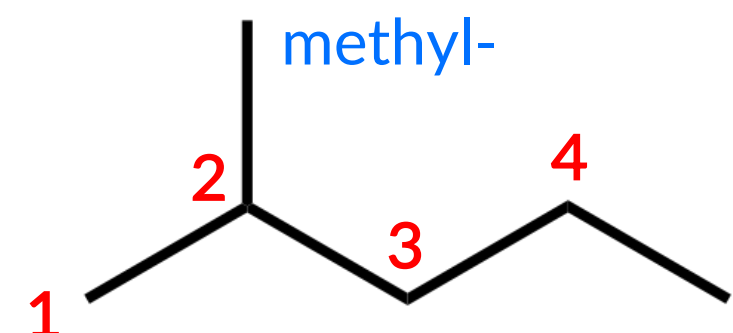
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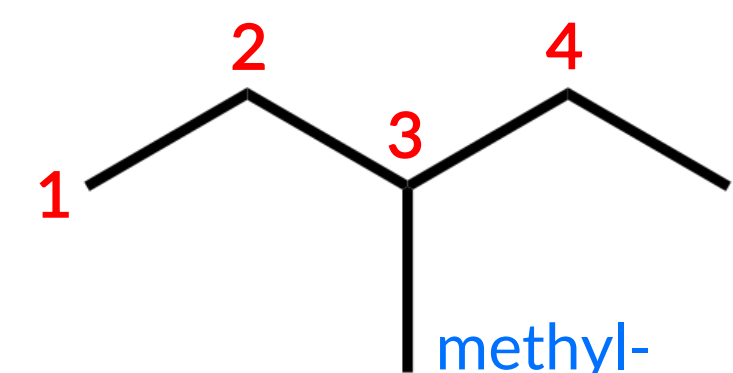
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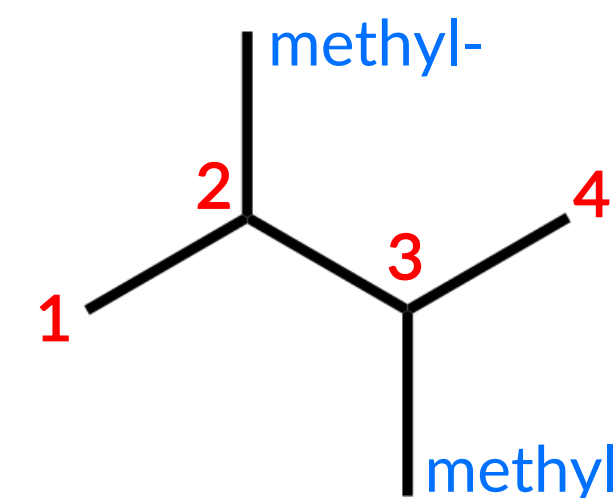
hexane



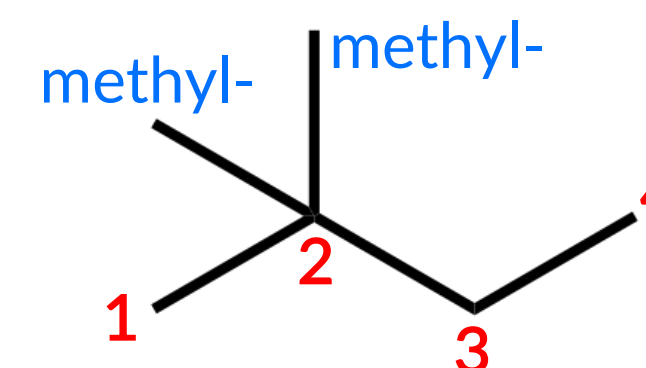
2-methylpentane



3-methylpentane



2,3-dimethylbutane



2,2-dimethylbutane

# How to name alkanes (Part 2)

Let us move to a more complex exercise:  $C_6H_{14}Br_2Cl$

Try to name the following compounds following the rules!

## NAMING CONVENTIONS:

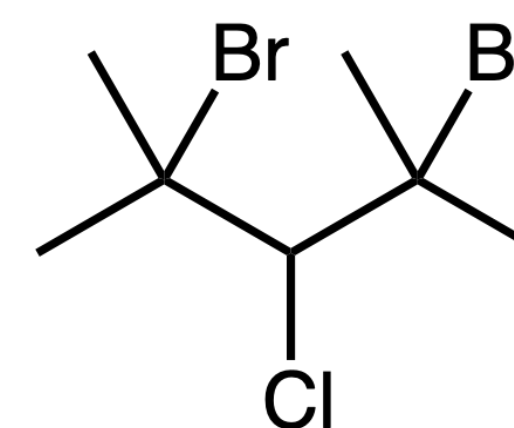
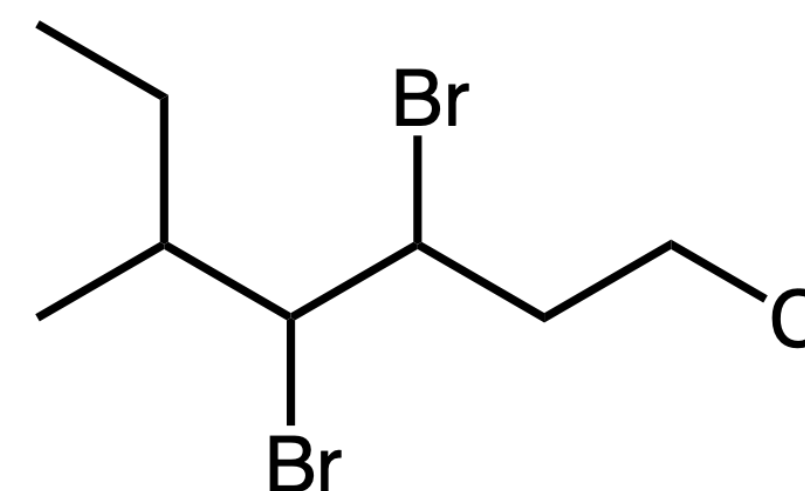
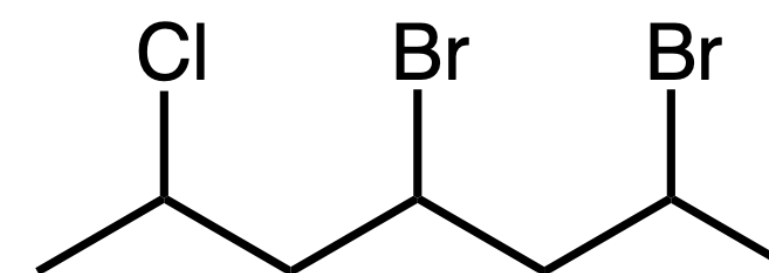
1. Identify and name the longest carbon chain. See *red* roots.
2. Identify and name the substituents attached to this chain. See *blue* names.
3. Number the longest carbon chain from the side nearest to a substituent. See *red* numbers.  
*(If more than one type of substituent, then start on the side nearest to the first cited/alphabetized substituent.)*
4. Label the location(s) of each substituent(s) by the number of the carbon atom to which it is attached.

5. List the groups in alphabetical order by the roots.

*(If more than one substituent, then use prefixes:*

*“di-” “tri-” “tetra-” “penta-” ...*

*but do not alphabetize using the prefix; use the root!)*



# How to name alkanes (Part 2)

Let us move to a more complex exercise:  $C_6H_{14}Br_2Cl$

Try to name the following compounds following the rules!

## NAMING CONVENTIONS:

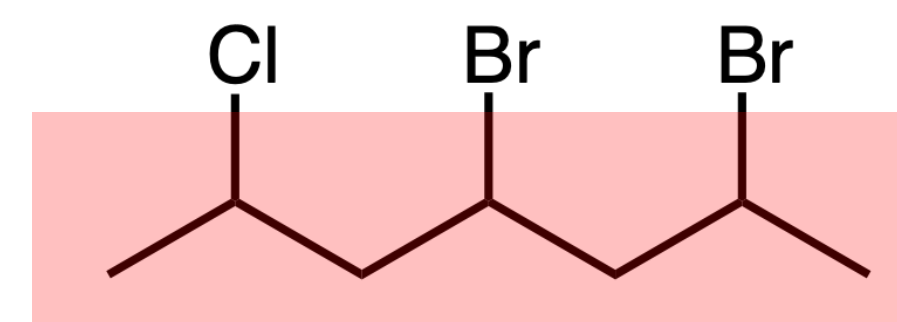
1. Identify and name the longest carbon chain. See *red roots*.
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3. Number the longest carbon chain from the side nearest to a substituent. See *red numbers*.  
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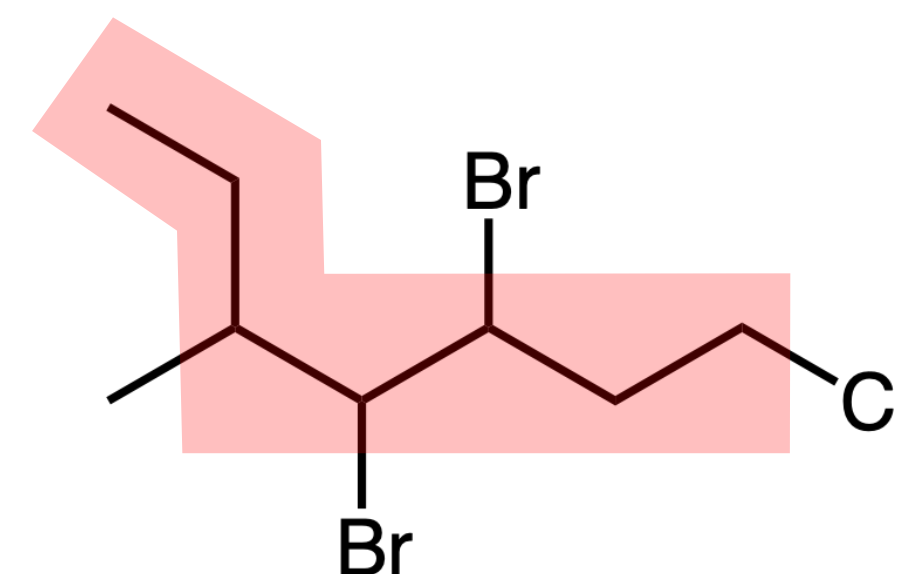
*(If more than one substituent, then use prefixes:*

*“di-” “tri-” “tetra-” “penta-” ...*

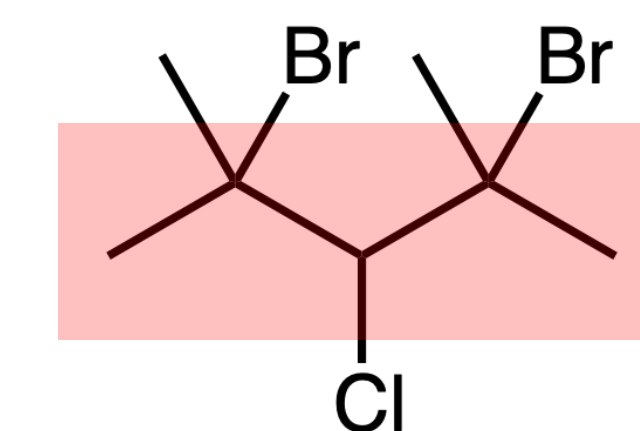
*but do not alphabetize using the prefix; use the root!)*



heptane



heptane



pentane

# How to name alkanes (Part 2)

Let us move to a more complex exercise:  $C_6H_{14}Br_2Cl$

Try to name the following compounds following the rules!

## NAMING CONVENTIONS:

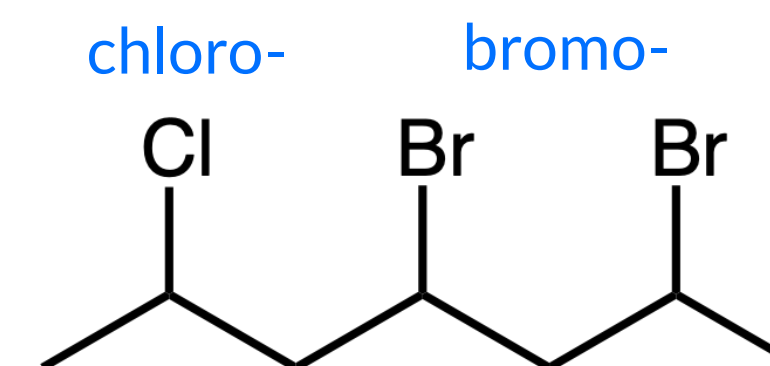
1. Identify and name the longest carbon chain. See *red roots*.
2. Identify and name the substituents attached to this chain. See *blue names*.
3. Number the longest carbon chain from the side nearest to a substituent. See *red numbers*.  
*(If more than one type of substituent, then start on the side nearest to the first cited/alphabetized substituent.)*
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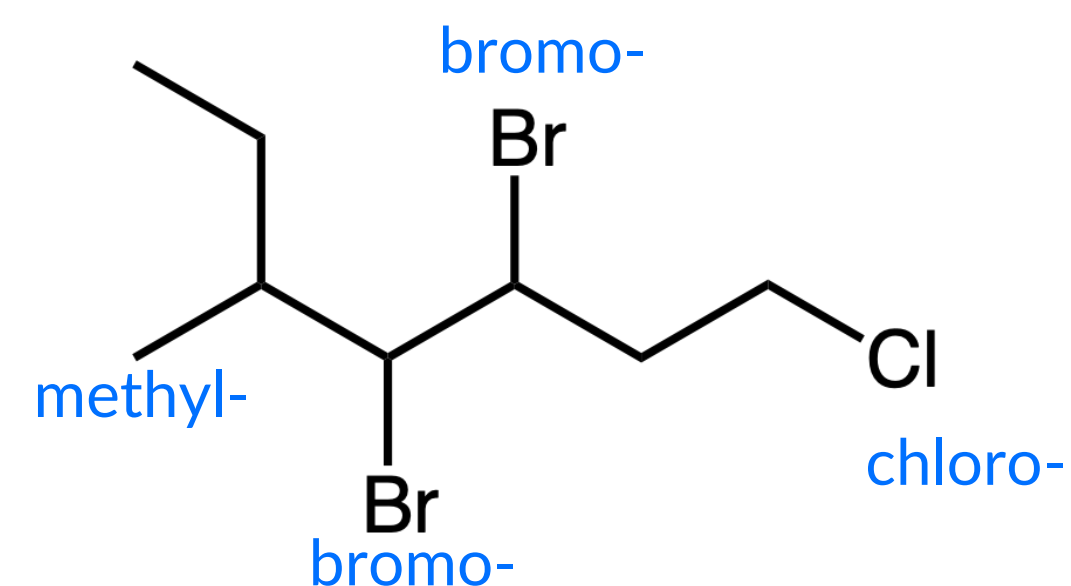
*(If more than one substituent, then use prefixes:*

*“di-” “tri-” “tetra-” “penta-” ...*

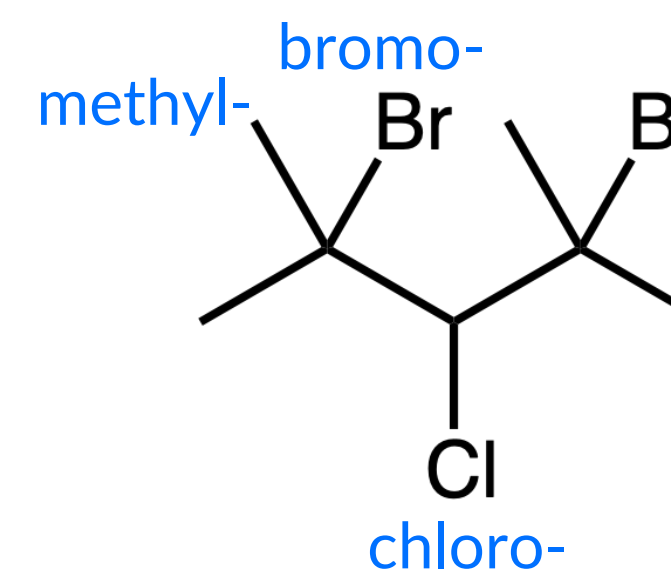
*but do not alphabetize using the prefix; use the root!)*



heptane



heptane



pentane



# How to name alkanes (Part 2)

Let us move to a more complex exercise:  $C_6H_{14}Br_2Cl$

Try to name the following compounds following the rules!

## NAMING CONVENTIONS:

1. Identify and name the longest carbon chain. See *red roots*.
2. Identify and name the substituents attached to this chain. See *blue names*.

- ➔ 3. Number the longest carbon chain from the side nearest to a substituent. See *red numbers*.

*(If more than one type of substituent, then start on the side nearest to the first cited/alphabetized substituent.)*

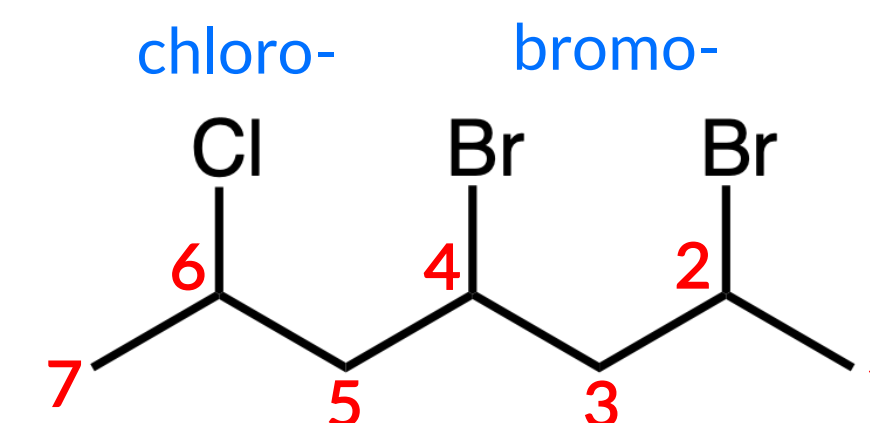
4. Label the location(s) of each substituent(s) by the number of the carbon atom to which it is attached.

5. List the groups in alphabetical order by the roots.

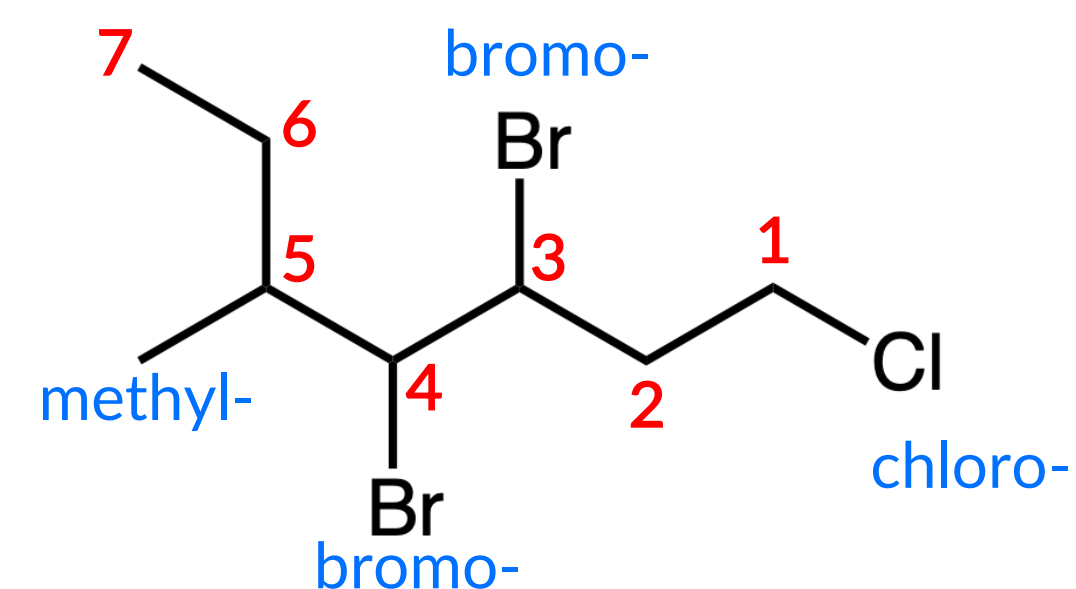
*(If more than one substituent, then use prefixes:*

*“di-” “tri-” “tetra-” “penta-” ...*

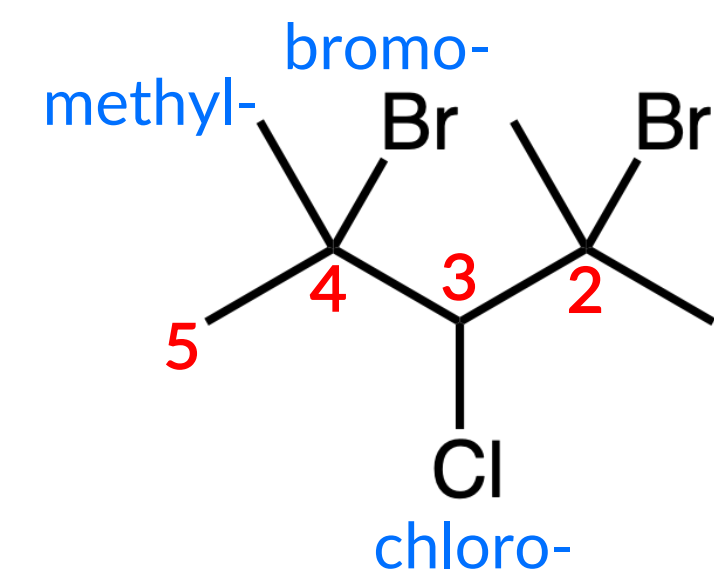
*but do not alphabetize using the prefix; use the root!)*



heptane



heptane



pentane



# How to name alkanes (Part 2)

Let us move to a more complex exercise:  $C_6H_{14}Br_2Cl$

Try to name the following compounds following the rules!

## NAMING CONVENTIONS:

1. Identify and name the longest carbon chain. See *red roots*.
2. Identify and name the substituents attached to this chain. See *blue names*.

3. Number the longest carbon chain from the side nearest to a substituent. See *red numbers*.

*(If more than one type of substituent, then start on the side nearest to the first cited/alphabetized substituent.)*

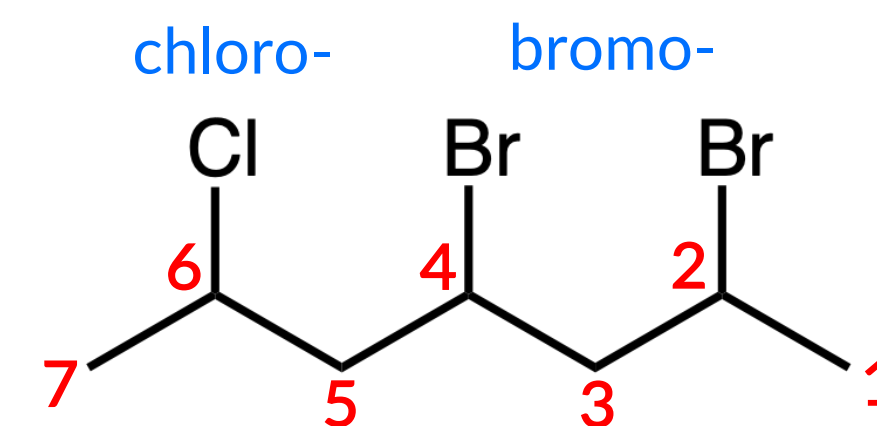
- ➡ 4. Label the location(s) of each substituent(s) by the number of the carbon atom to which it is attached.

- ➡ 5. List the groups in alphabetical order by the roots.

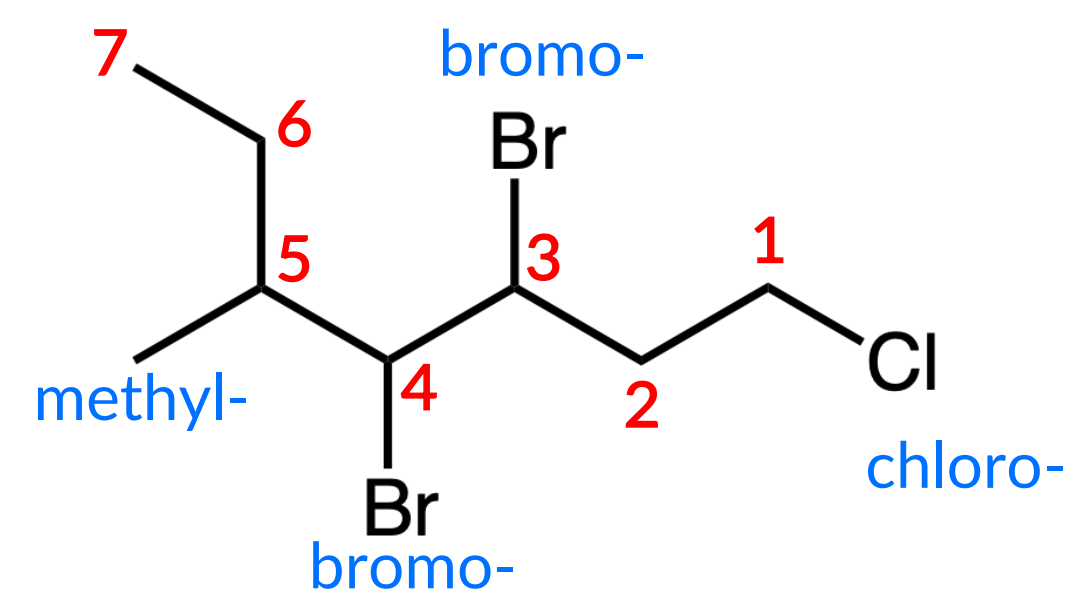
*(If more than one substituent, then use prefixes:*

*“di-” “tri-” “tetra-” “penta-” ...*

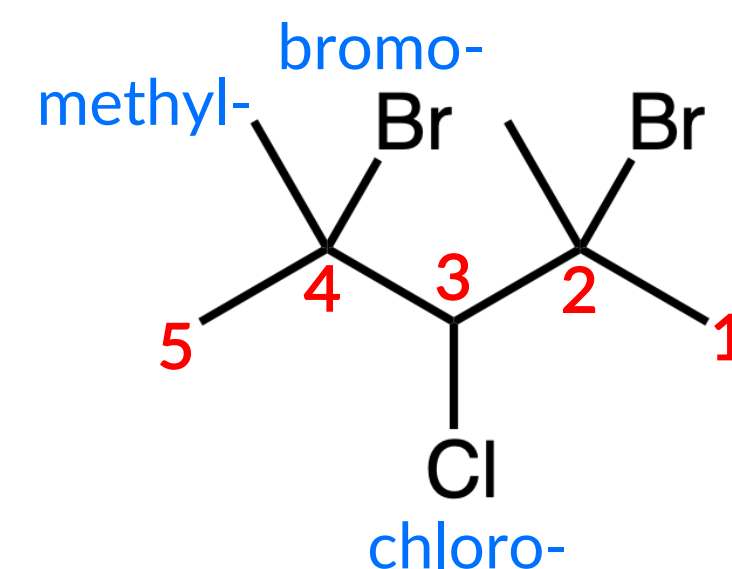
*but do not alphabetize using the prefix; use the root!)*



2,4-dibromo-6-chloroheptane



3,4-dibromo-1-chloro-5-methylheptane



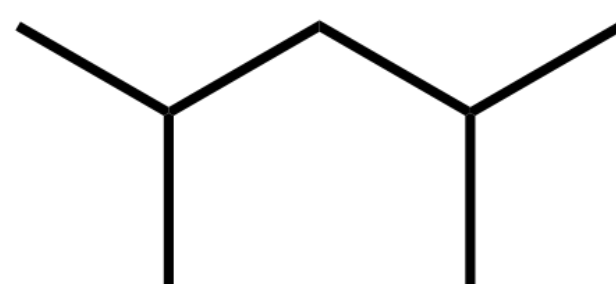
2,4-dibromo-3-chloro-2,4-dimethylpentane

# PRACTICE PROBLEM 2

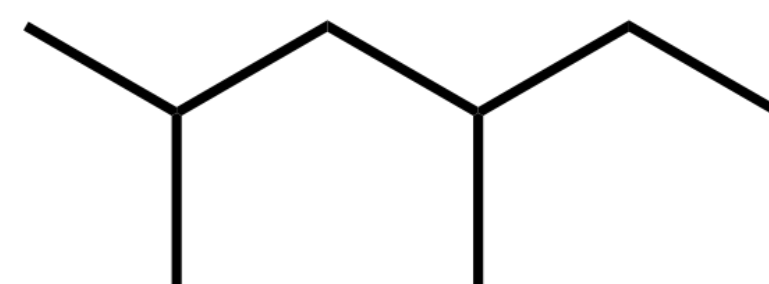
Match each of the following names to the structures (A–L) drawn.

— answer —

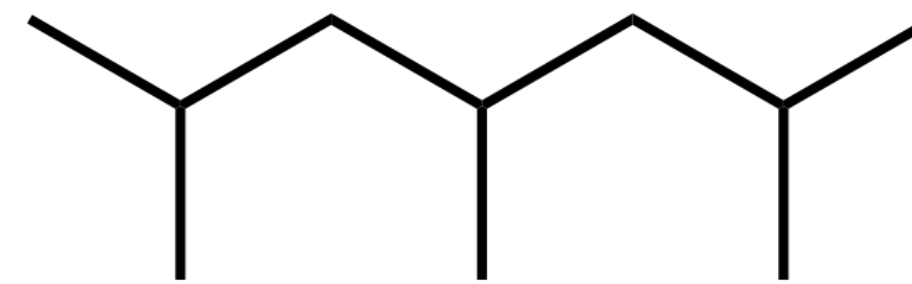
4-methylheptane



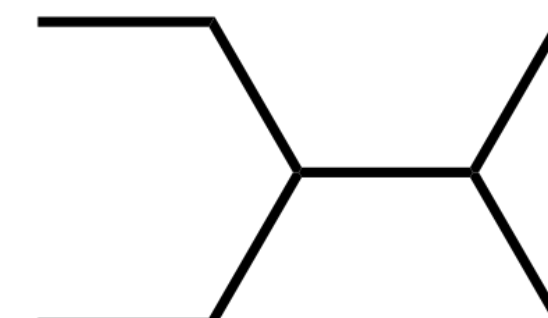
A



B

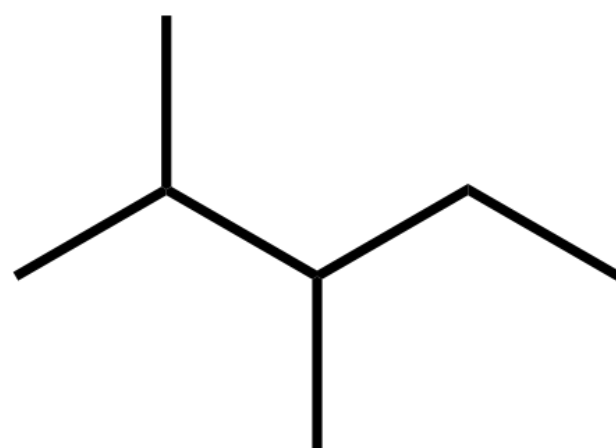


C

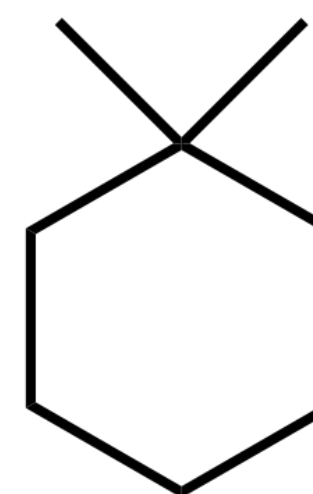


D

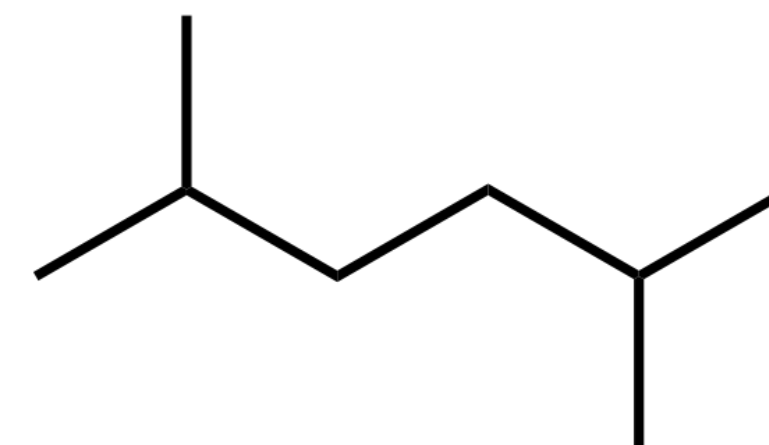
2,4-dimethylhexane



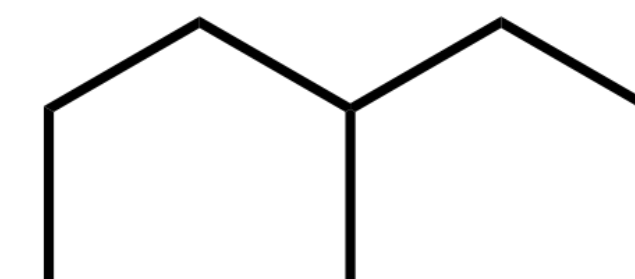
E



F



G



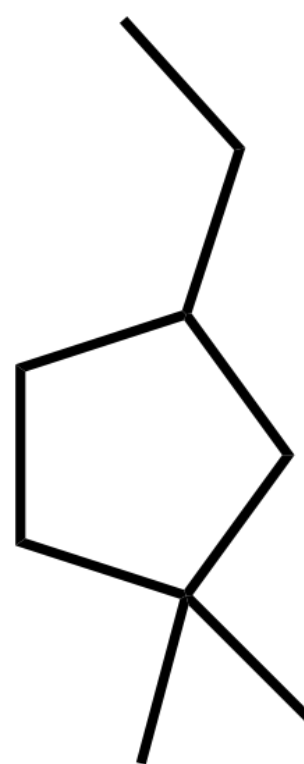
H

2,2-dimethylhexane

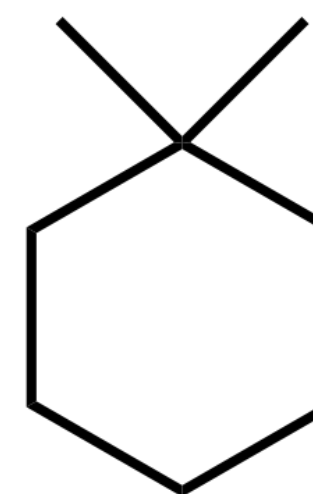
2,3-dimethylpentane

1,1-dimethylcyclohexane

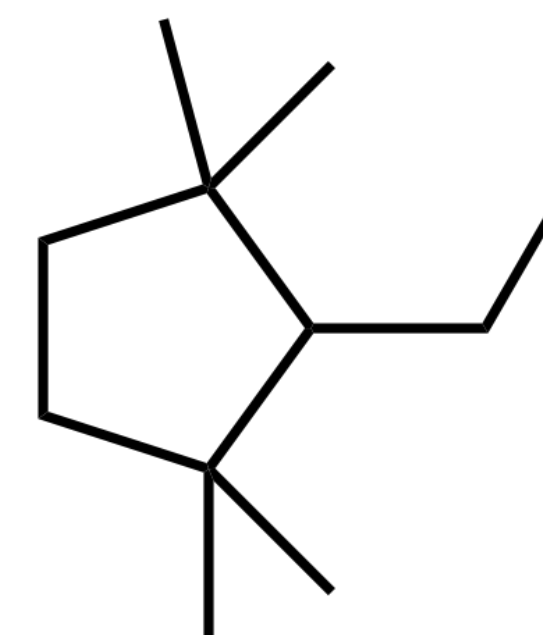
1-ethyl-3,3-dimethylcyclopentane



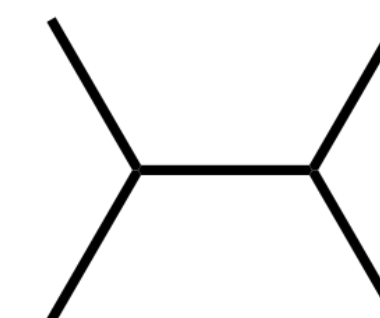
I



J



K



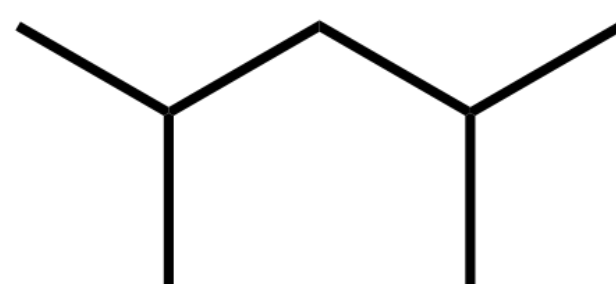
L

# PRACTICE PROBLEM 2

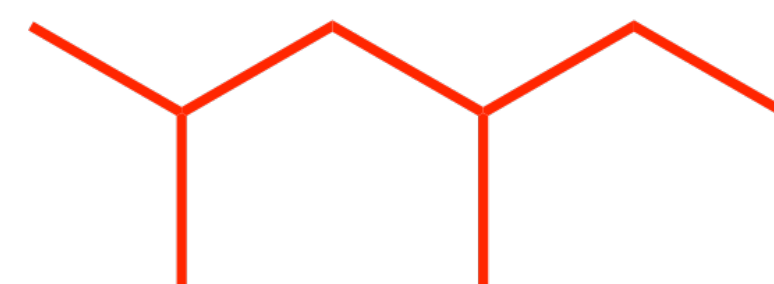
Match each of the following names to the structures (A–L) drawn.

— answer —

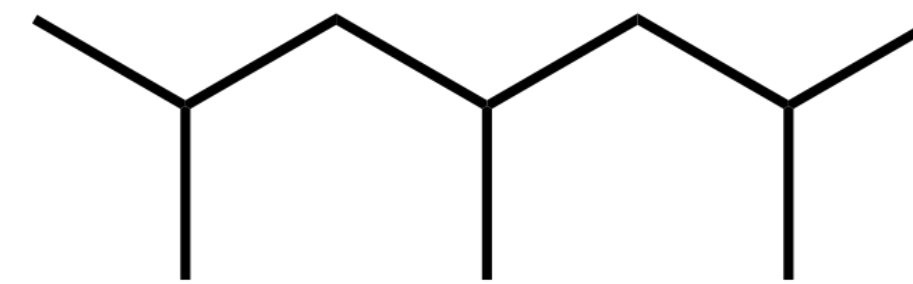
4-methylheptane (H)



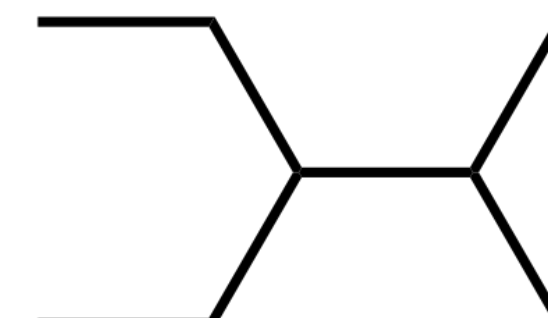
A



B



C



D

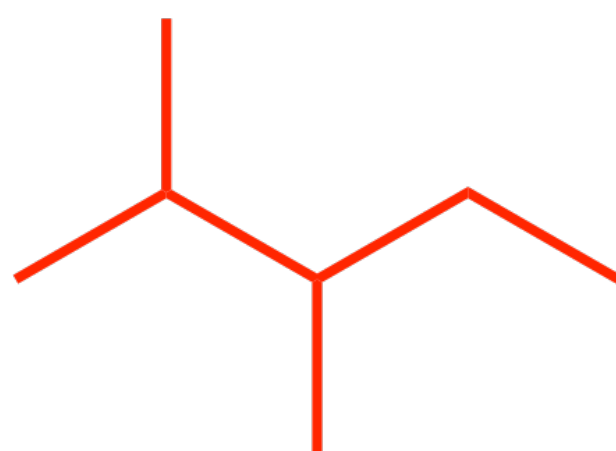
2,4-dimethylhexane (B)

2,2-dimethylhexane (F)

2,3-dimethylpentane (E)

1,1-dimethylcyclohexane (J)

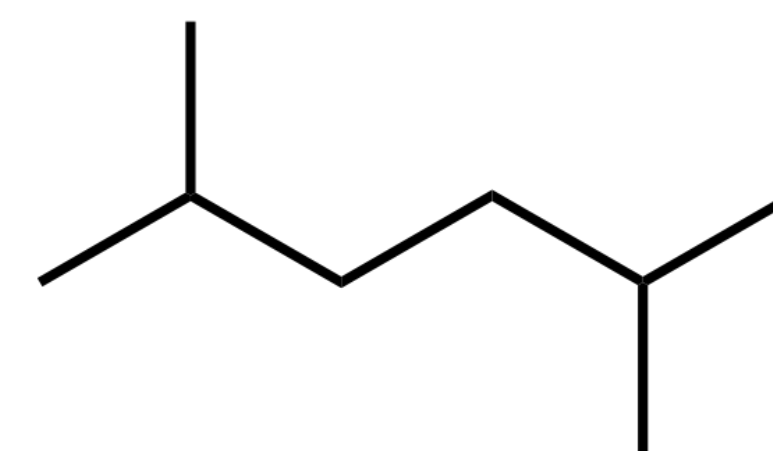
1-ethyl-3,3-dimethylcyclopentane (I)



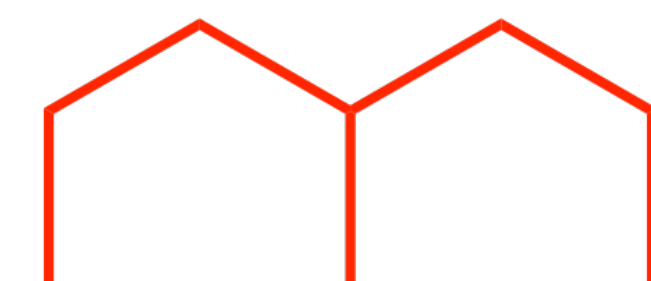
E



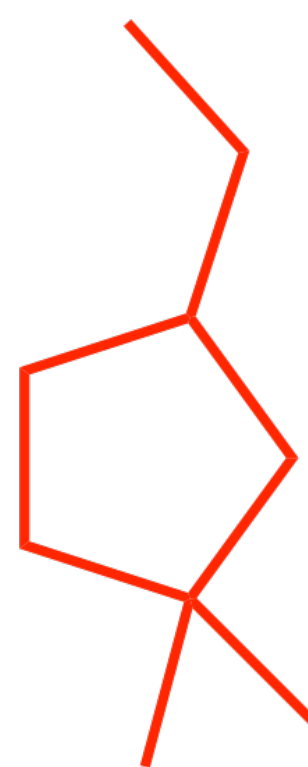
F



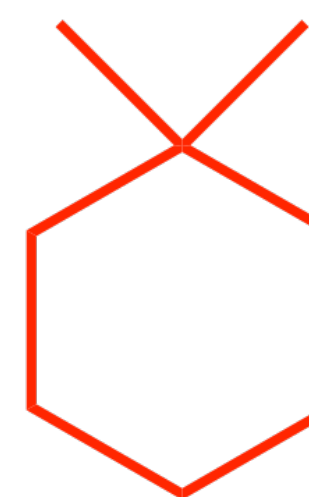
G



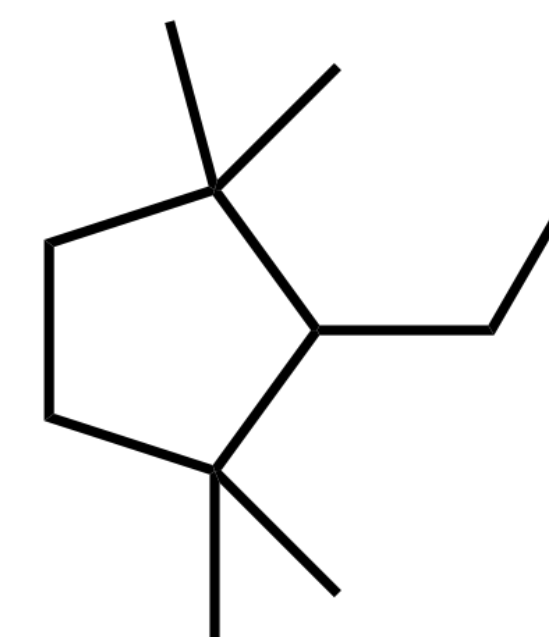
H



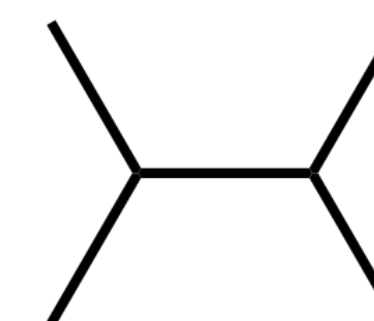
I



J



K



L

# How to name alkenes (& alkynes)

## NAMING CONVENTIONS:

1. Identify and name the longest carbon chain. See *red* roots.

*This chain must include both carbons on the double bond!*

2. Identify and name the substituents attached to this chain. See *blue* names.

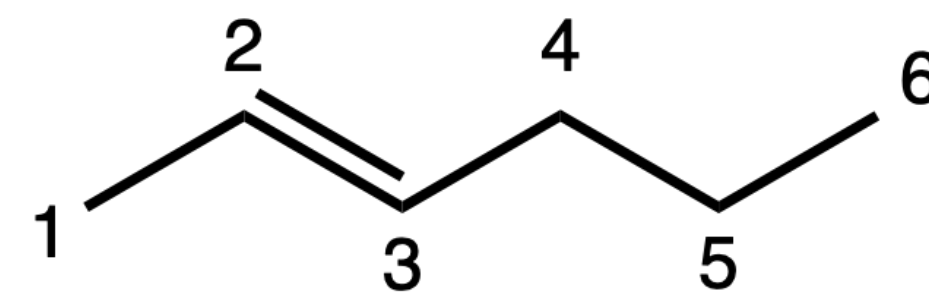
3. Number the longest carbon chain from side nearest the double bond. See *red* numbers.

*If the double bond is in the middle, start from end nearest a substituent. If more than one type of substituent, then start on the side nearest to the first cited/alphabetized substituent.*

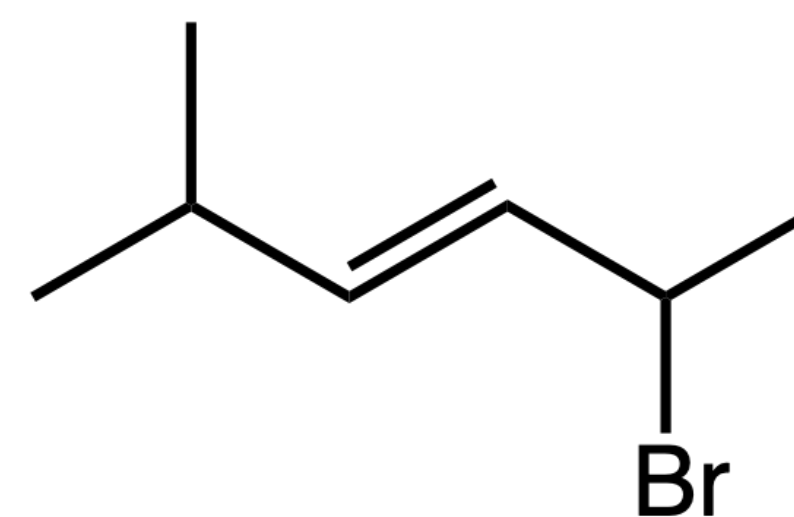
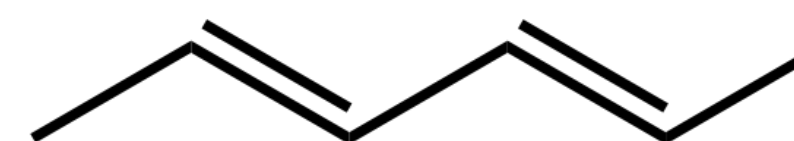
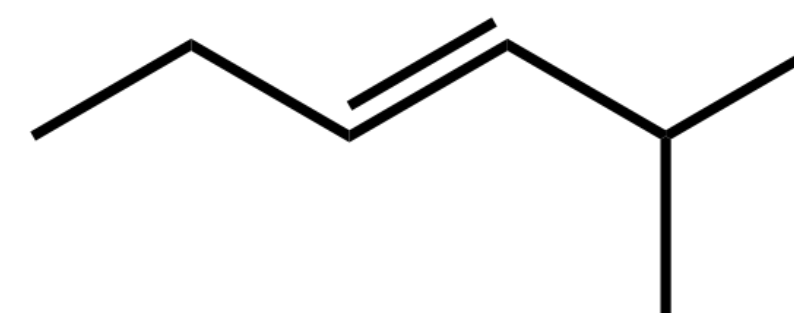
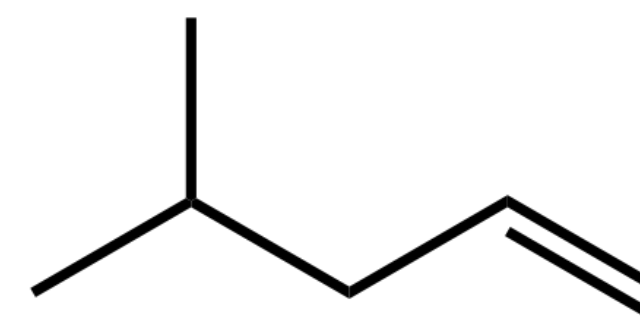
4. Label the location(s) of each substituent(s) by the number of the carbon atom to which it is attached.

5. If more than one double bond, use prefixes (*diene*, *triene*, etc.) and label the location(s) of each double bond.

6. List the groups in alphabetical order by the roots.



2-*hex*ene  
(*hex*-2-ene)



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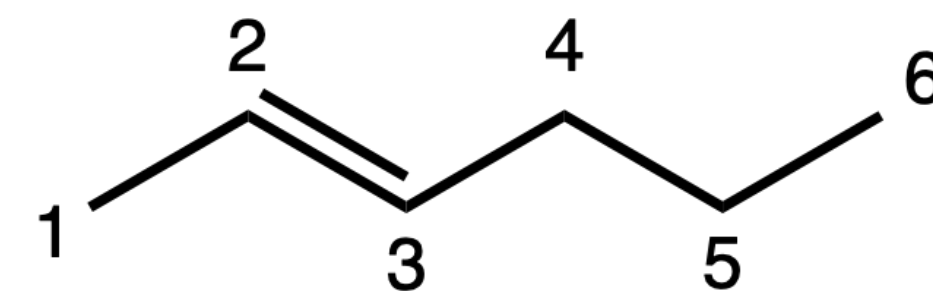
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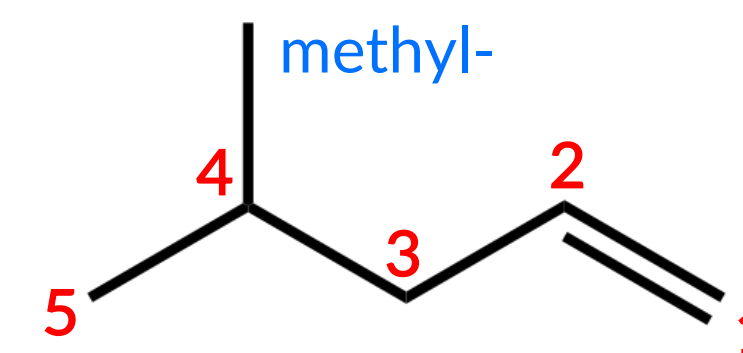
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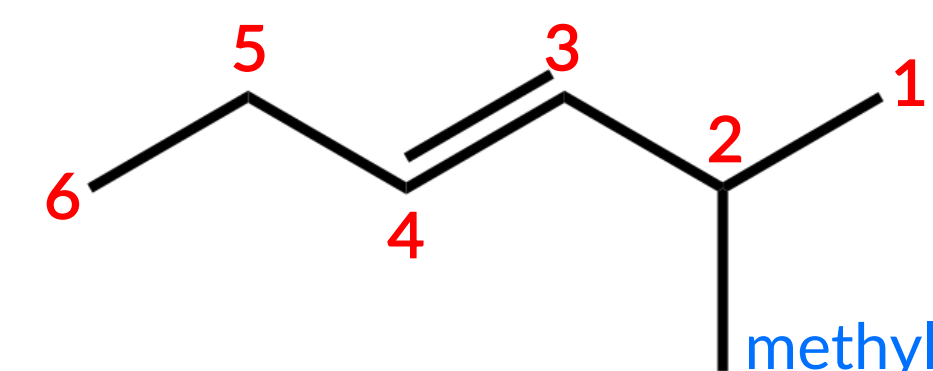
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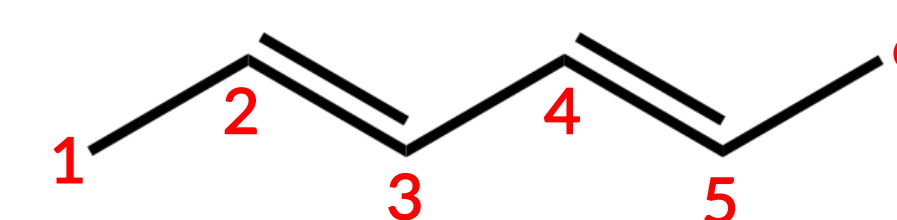
2-*hex*ene  
(or *hex*-2-ene)



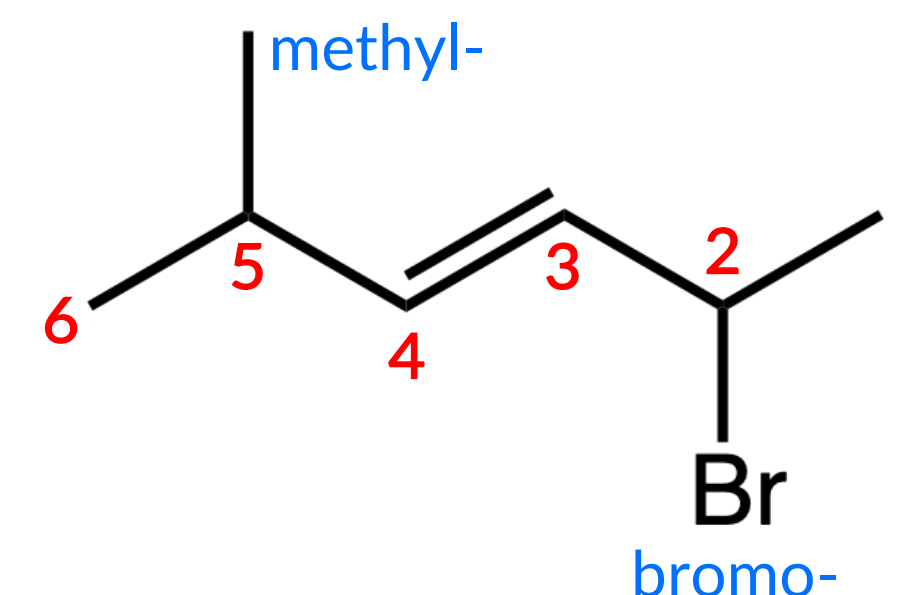
4-*methyl*-1-*pent*ene  
(or 4-*methylpent*-1-ene)



2-*methyl*-3-*hex*ene  
(or 2-*methylhex*-3-ene)



2,4-*hexa*diene  
(or *hexa*-2,4-diene)



2-*bromo*-5-*methyl*-3-*hex*ene  
(or 2-*bromo*-5-*methylhex*-3-ene)



## PRACTICE PROBLEM 3

Draw the structures based on the following chemical names. Ignore *cis/trans* isomerism.

— *answer* —

1-chloro-5,5-dimethylhept-3-yne

6-methylhept-3-ene

3,4-dichlorocyclopent-1-ene

2-chloro-4-methylhexa-2,4-diene

3,3-diethyl-1-iodopentane

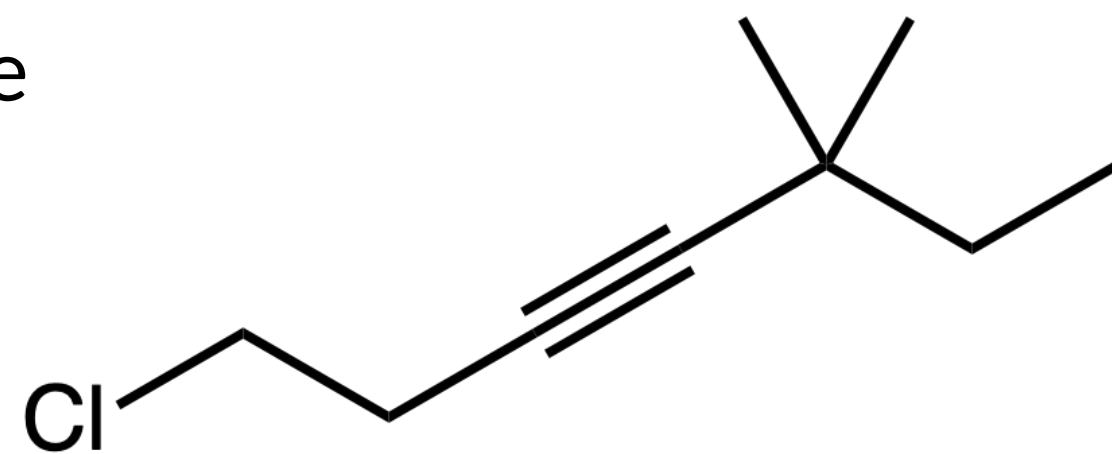
4-methylpent-2-yne

# PRACTICE PROBLEM 3

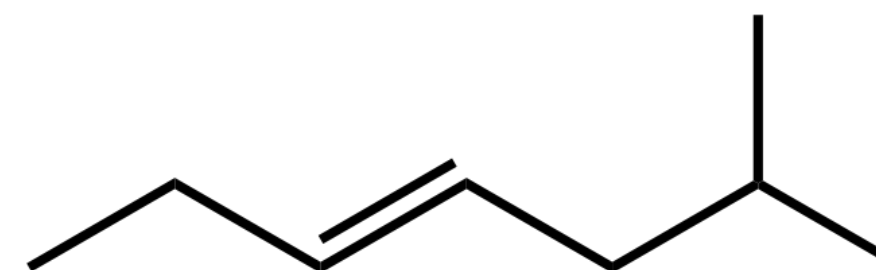
Draw the structures based on the following chemical names. Ignore *cis/trans* isomerism.

— answer —

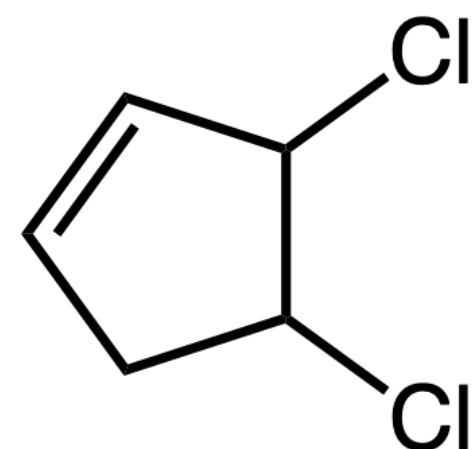
1-chloro-5,5-dimethylhept-3-yne



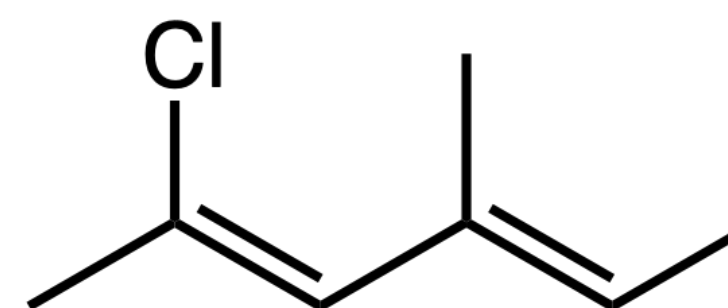
6-methylhept-3-ene



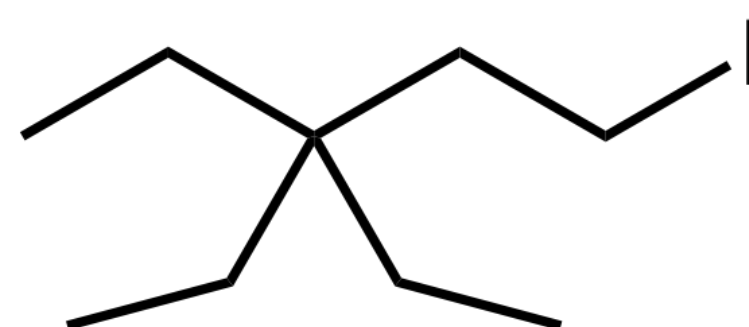
3,4-dichlorocyclopent-1-ene



2-chloro-4-methylhexa-2,4-diene



3,3-diethyl-1-iodopentane



4-methylpent-2-yne

