Organic Chemistry

Organic Chemistry and Organic Compounds

- **What is organic chemistry?**

  Study of compounds containing carbon

- Organic **Compounds** - any covalently bonded compound containing carbon (except oxides, carbides, cyanides and carbonates)

Examples

- Foods, fuels (oil, gasoline), fabrics (cotton, wool, nylon), wood & paper, perfumes, flavours, soaps, paints, medicines and many more

Why so many?

- Carbon is unique
  - It has 6 electrons and its electron configuration is $1s^2 2s^2 2p^2$
  - It has 4 valence electrons available for covalent bonding
  - It has the unique ability to form long chains of carbon (100s – 1000s), as well as rings.

Hydrocarbons

- Hydrocarbons - contain only carbon & hydrogen bonded together with strong, non-polar covalent bonds
- alkanes - contain only single bonds
- alkenes - contain one or more carbon - carbon double bond
- alkynes - contain one or more carbon-carbon triple bond

Saturated & Unsaturated Hydrocarbons

- **Saturated hydrocarbons** – contain only _single_ carbon-carbon bonds (_alkanes_) and are relatively stable.

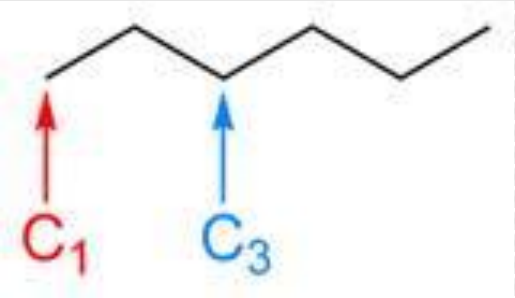
- **Unsaturated hydrocarbons** – contain double carbon-carbon bonds (_alkenes_) or triple carbon-carbon (_alkynes_) bonds and tend to be more reactive.

General Formulas

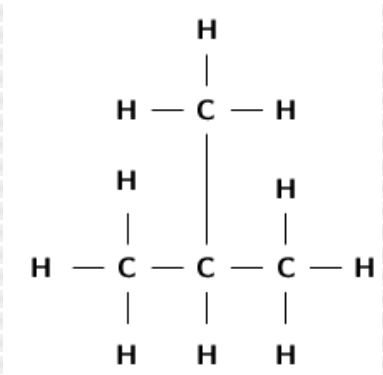
- Alkanes = C_nH_{2n+2}
- Alkenes = C_nH_{2n}
- Alkynes = C_nH_{2n-2}

Types of Formulae

- *Skeletal or line formula -



- *Structural formula -



- Condensed formula – **$CH_3CH_2CHCHCH_2CH_3$**

- Molecular formula - C_4H_{10}

*preferred methods of drawing

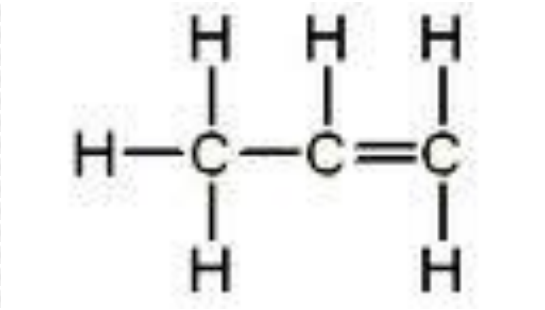
Nomenclature – Naming Compounds

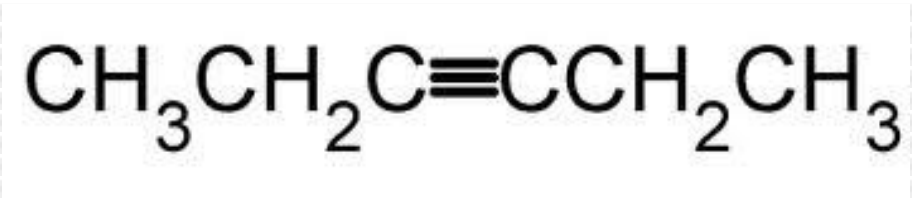
- Must memorize prefixes
- Determine the longest continuous chain of C atoms (that contains the double/triple bond) and use the prefix for the number of carbons
- The chain is numbered so that the first carbon of the double/triple bond has the lowest number possible(and next so that branches have the lowest)
- For the ending of the name, determine if it is an alkane, alkene, or alkyne and then add “ane”, “ene”, or “yne”.

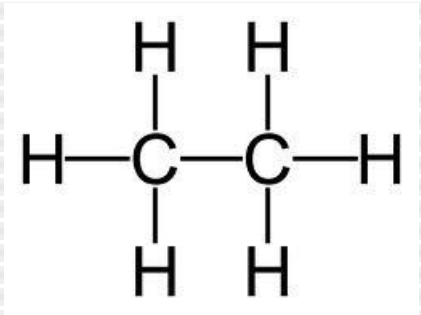
Prefix	# of carbon atoms
Meth-	1
Eth-	2
Prop-	3
But-	4
Pent-	5
Hex-	6
Hept-	7
Oct-	8
Non-	9
Dec-	10

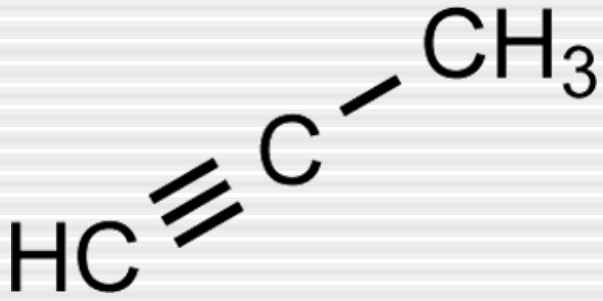
Examples

- Name the following: C_3H_8









Mnemonic for first four prefixes

First four prefixes

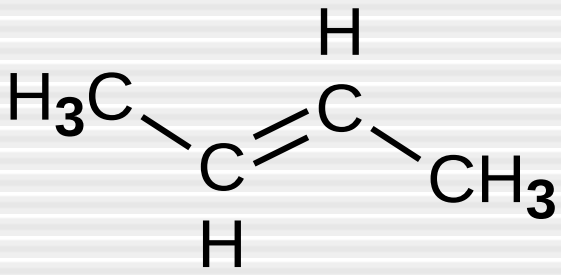
- Meth-
- Eth-
- Prop-
- But-

Monkeys
Eat
Peeled
Bananas

Numbering carbons

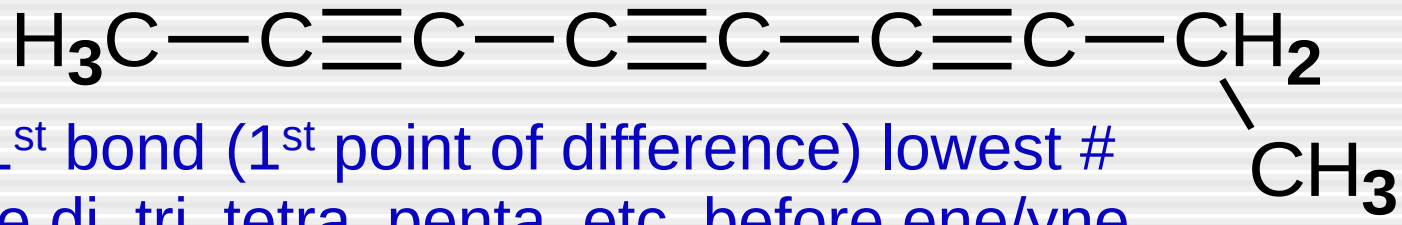
Draw 1-pentene

Name these

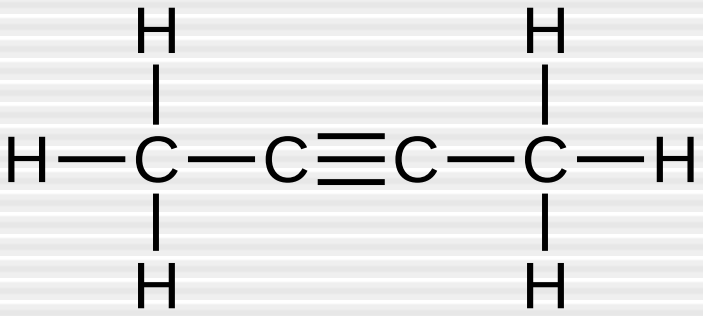


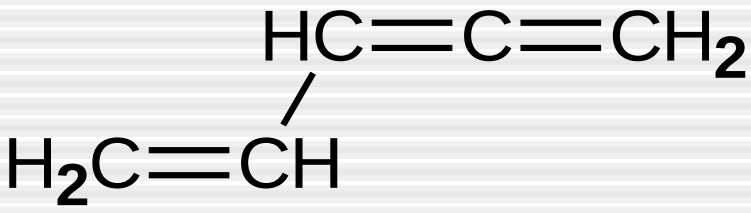
C_2H_4

Multiple multiple bonds



- Give 1st bond (1st point of difference) lowest #
- include di, tri, tetra, penta, etc. before ene/yne
- Comma between #s, hyphen between #-letter





$CH_3CH_2CH_2CH{=}C{=}CH_2$

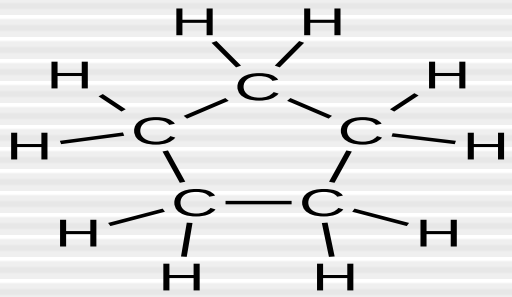
Cyclic structures

- Cyclic structures are circular and have “cyclo” in name

Draw the following:

cyclobutene 1,3-cyclopentadiene cyclopropane

Name the following:



Naming side chains or branches

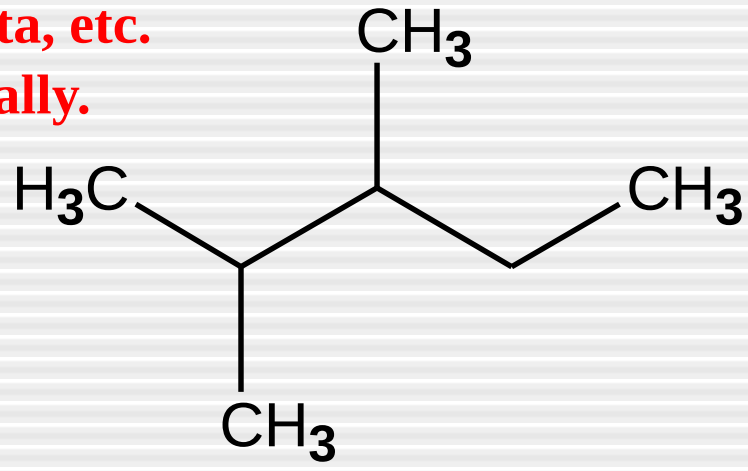
Root/parent name is the longest possible hydrocarbon chain. It must contain multiple bonds if present.

Number the chain starting from the end closest to the branches.

Add -yl to name the side chains and identify the number of each.

If more than one of the same side chain is present, indicate the number using the prefixes – di, tri, tetra, penta, etc.

Order the side chains in the name alphabetically.



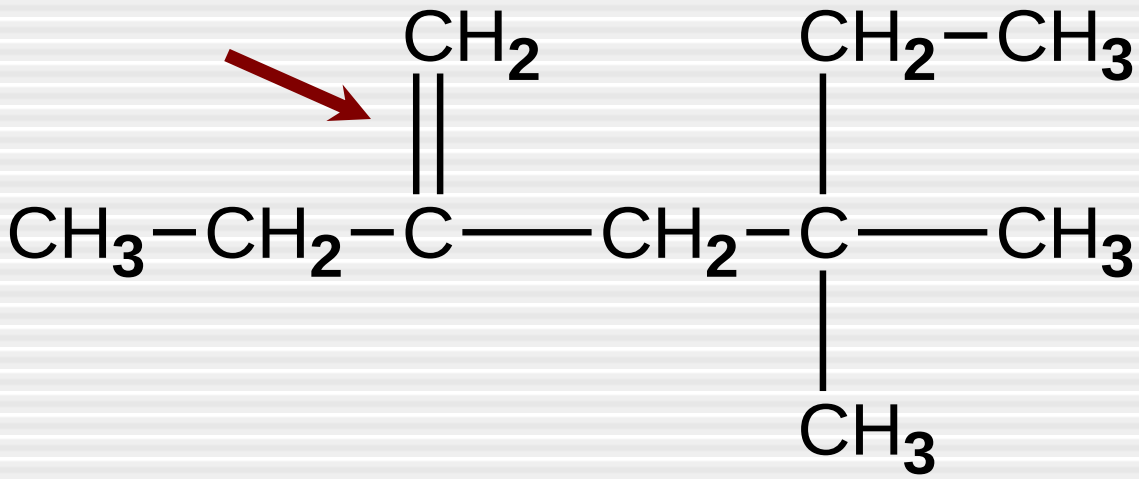
Common side chains include:

CH_3	**- methyl**
CH_3CH_2	**- ethyl**
$CH_3CH_2CH_2$	**- propyl**
$CH_3CH_2CH_2CH_2$	**- butyl**
$(CH_3)_2CH$	**- isopropyl**

Br- (bromo) Cl- (chloro) F- (fluoro) I- (iodo)

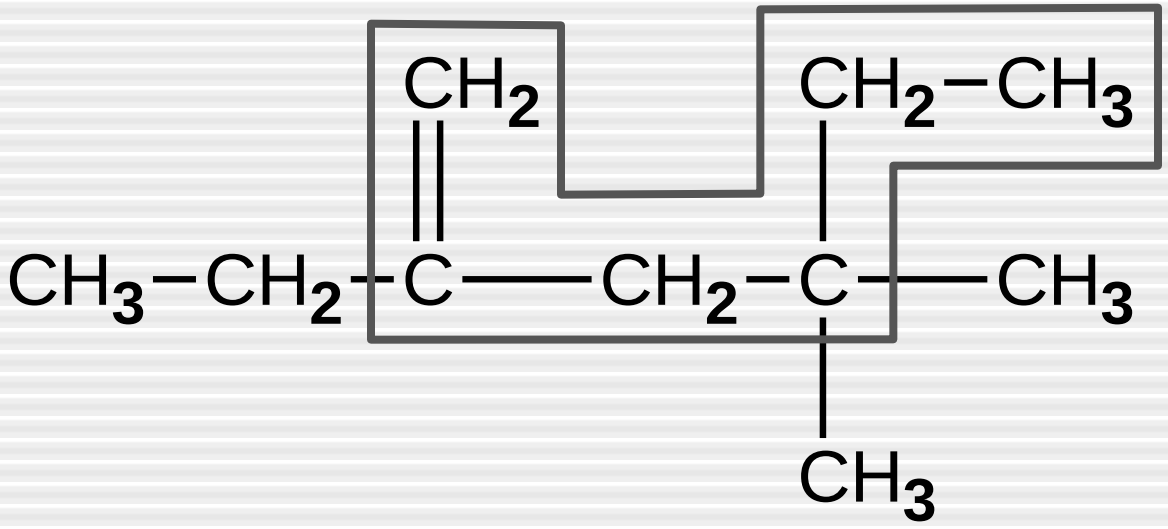
Naming side chains

Example: name the following structure



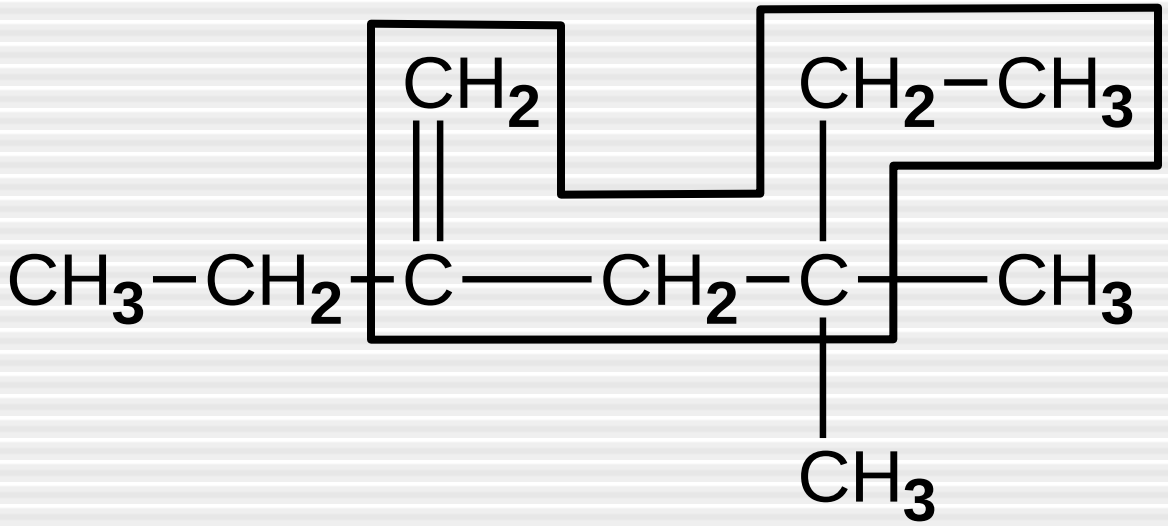
Step 1 - choose the correct ending

Naming side chains



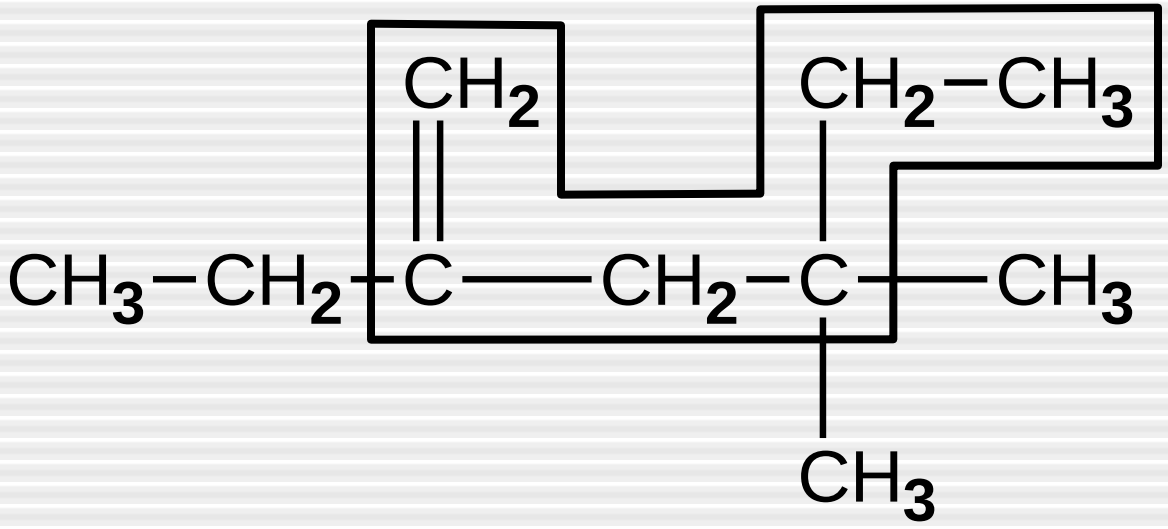
Step 2 - find the longest chain

Naming side chains



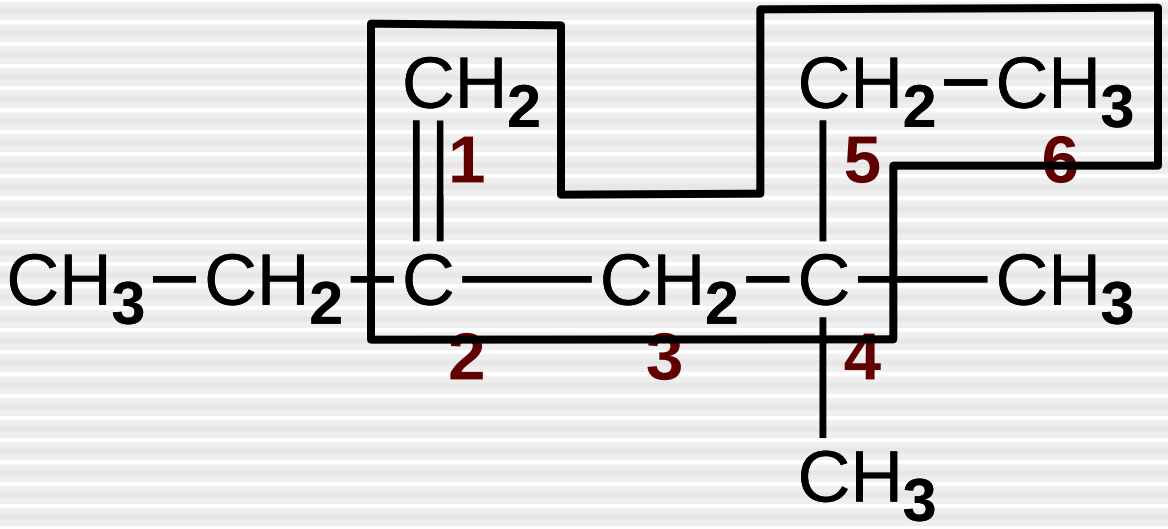
Step 3 - add the prefix naming the longest chain

Naming side chains



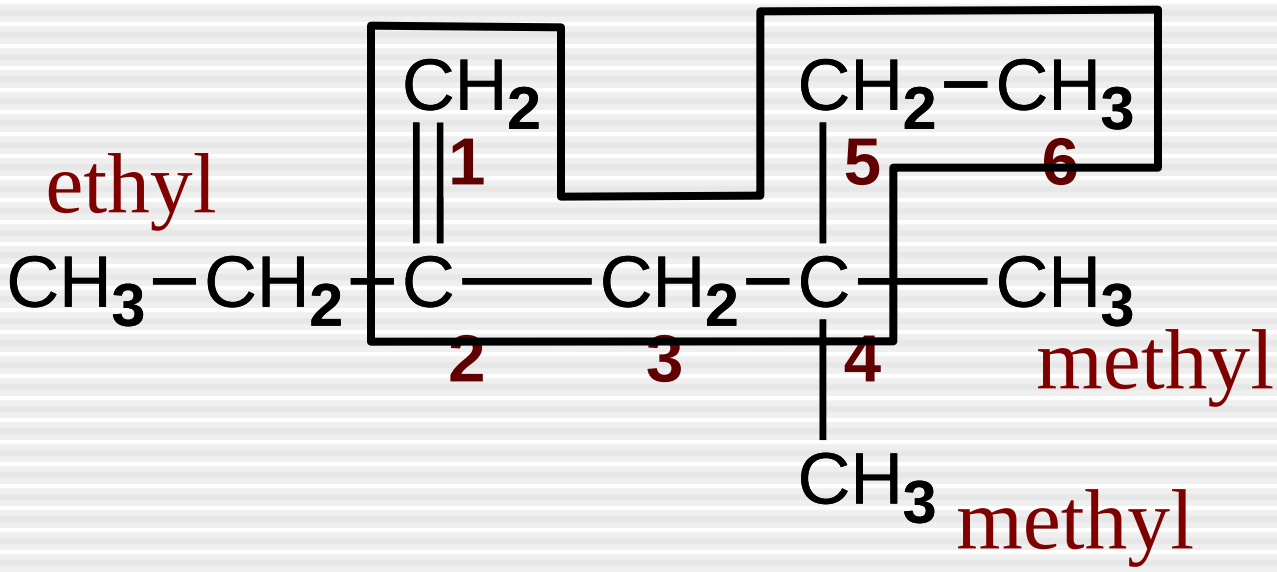
Step 4 - number the longest chain with the lowest number closest to the double bond

Naming side chains



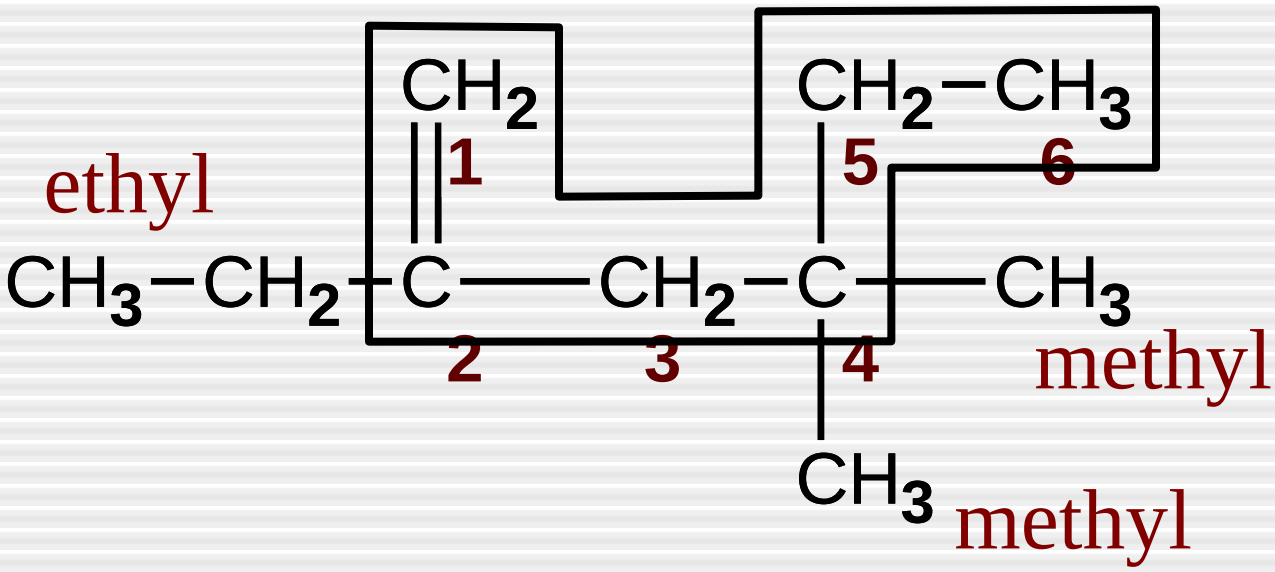
Step 5 - add that number to the name

Naming side chains



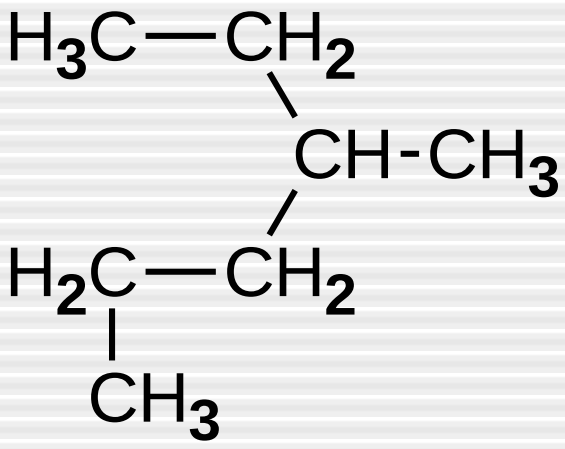
Step 6 - Name the side chains

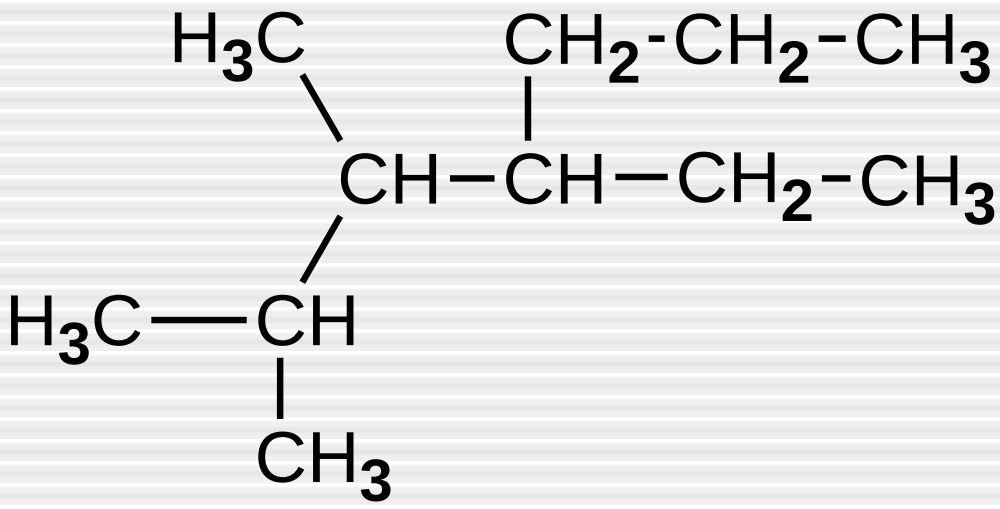
Naming side chains

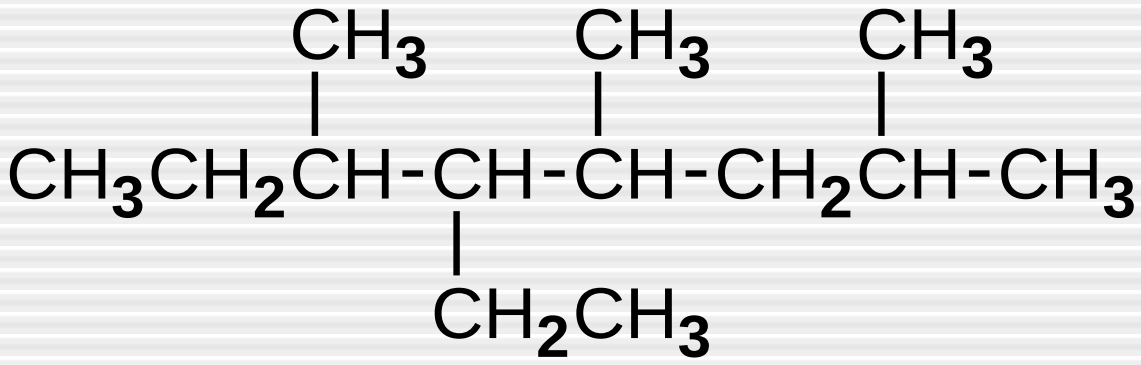


Step 7 - Place the side chains in alphabetical order & name the compound

Name





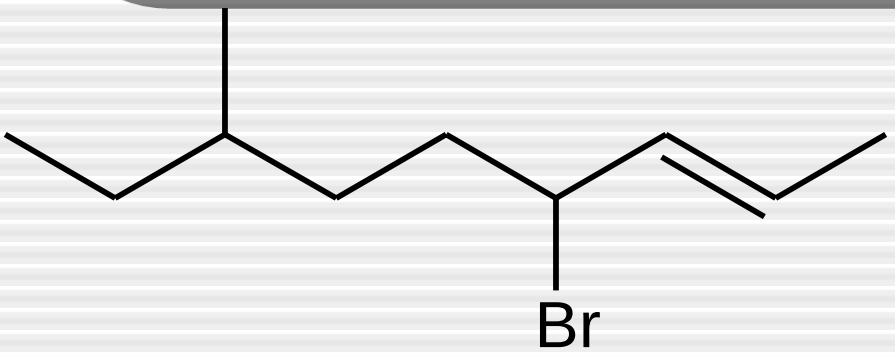


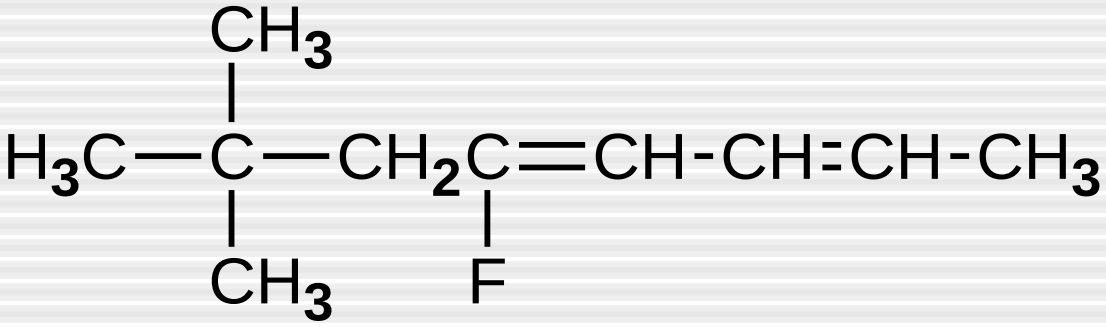
Draw the structures below

3-ethyl-2-methylpentane

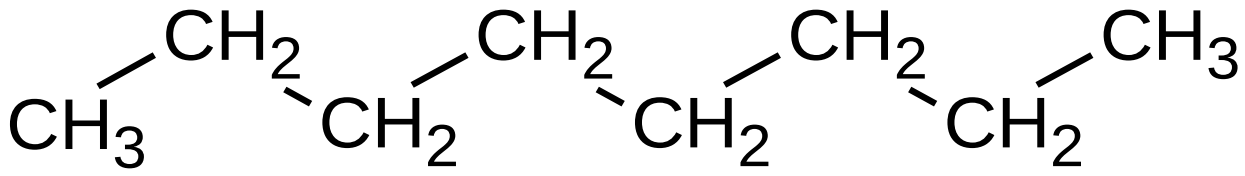
3-ethyl-1,5,5-trimethylcyclohexene

More practice



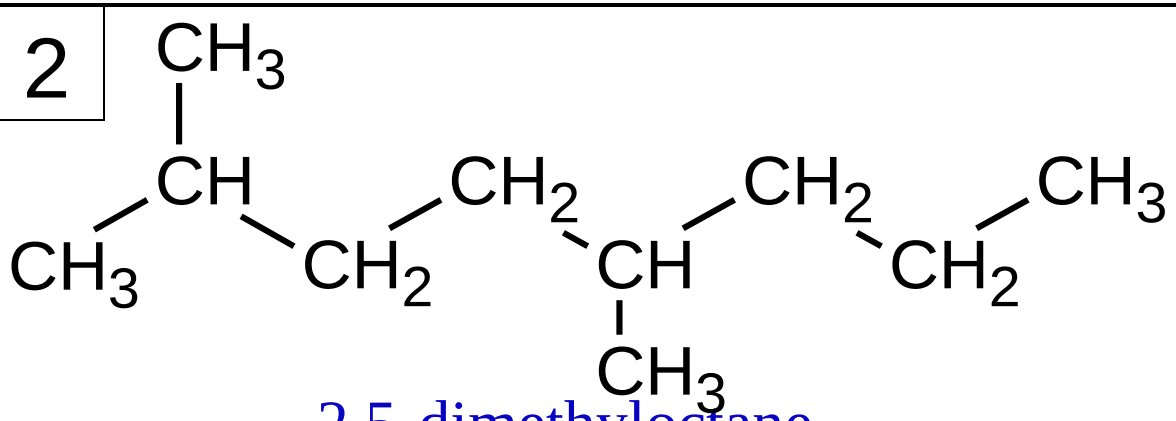


1



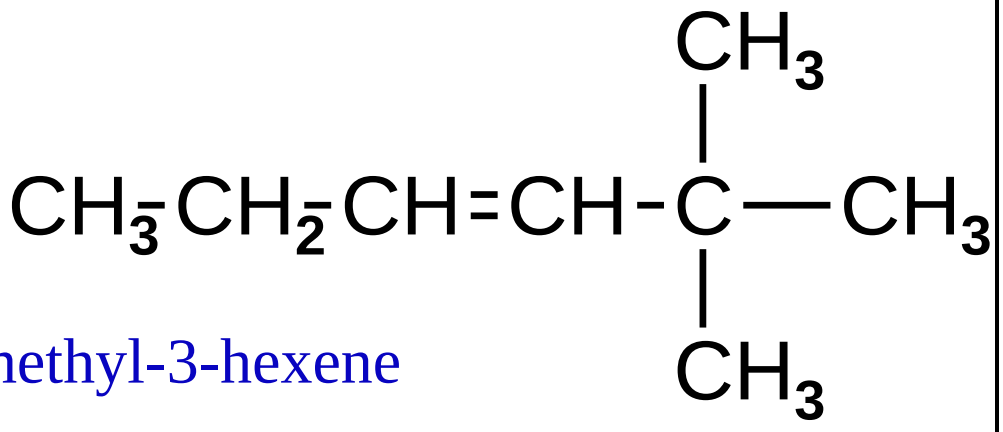
octane

2



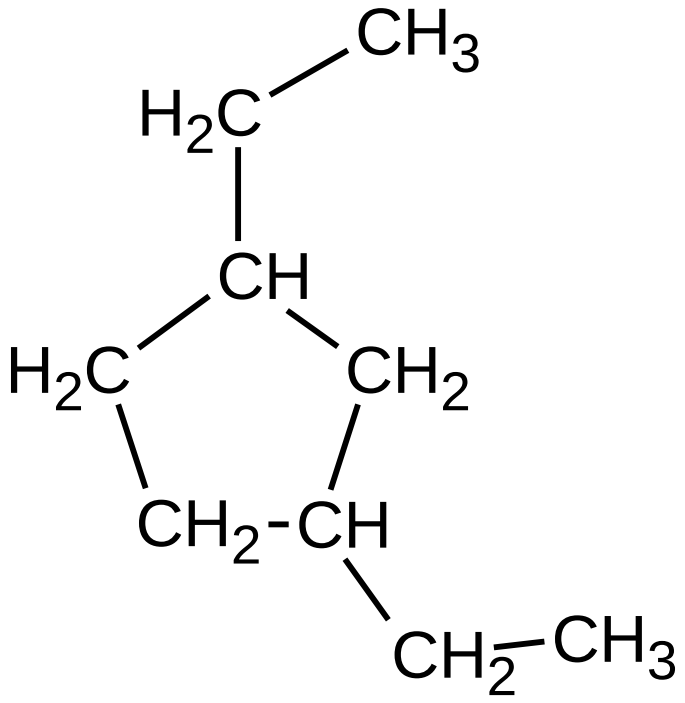
2,5-dimethyloctane

3



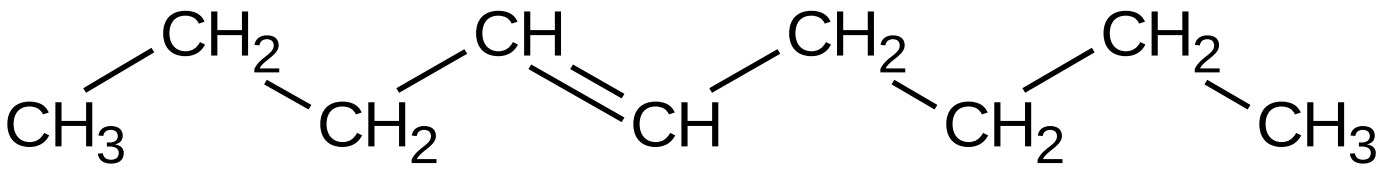
2,2-dimethyl-3-hexene

4



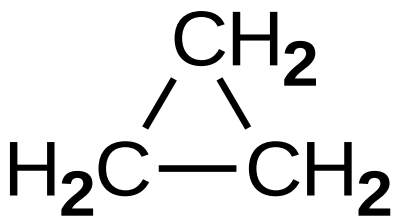
1,3-diethylcyclopentane

5



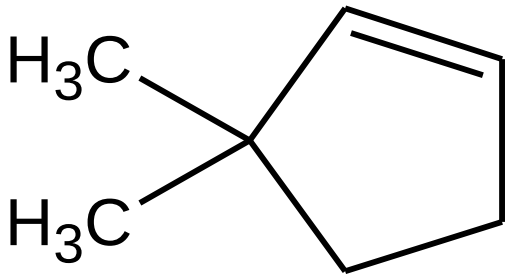
4-nonene

6



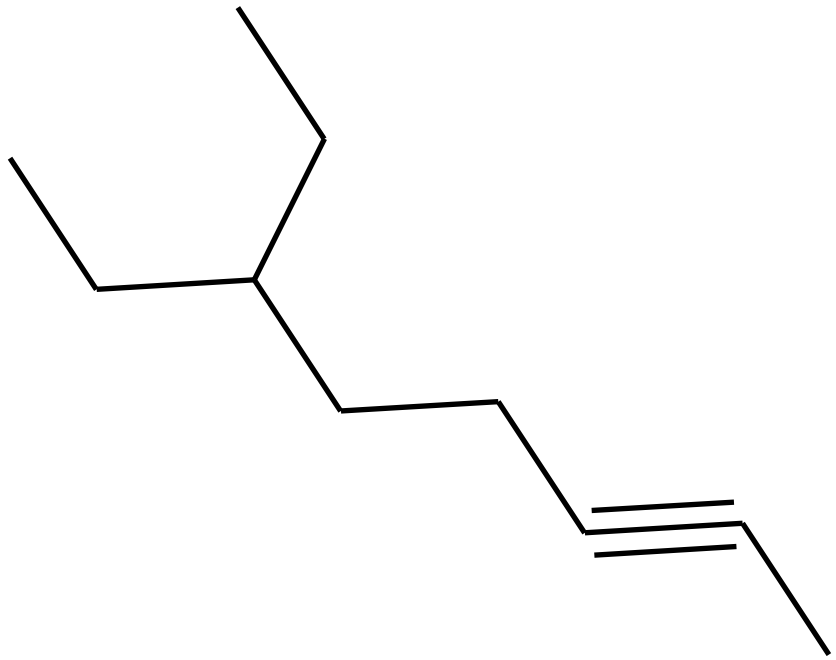
cyclopropane

7



3,3-dimethylcyclopentene

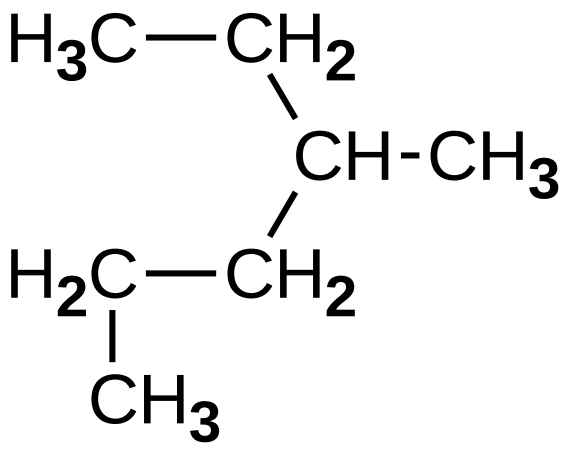
8



6-ethyl-2-octyne

9

3-methylhexane



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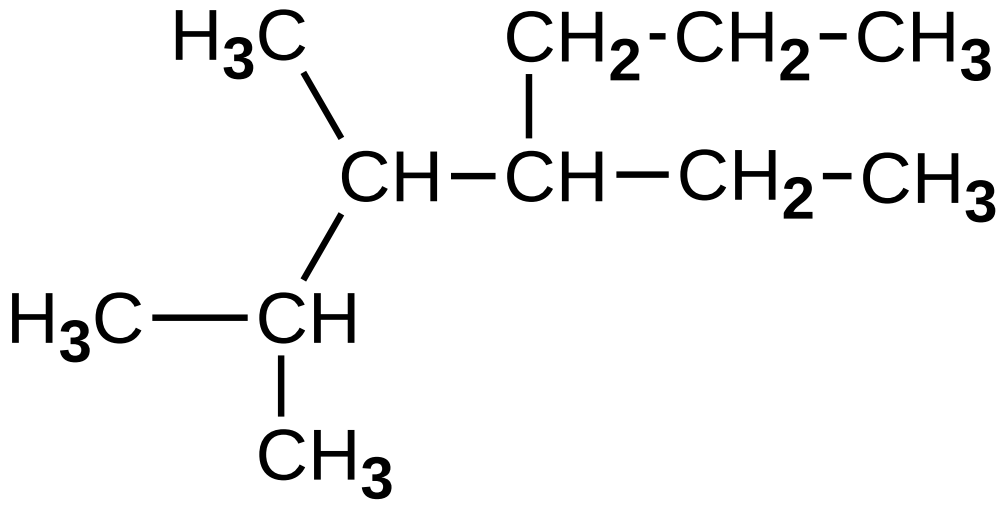
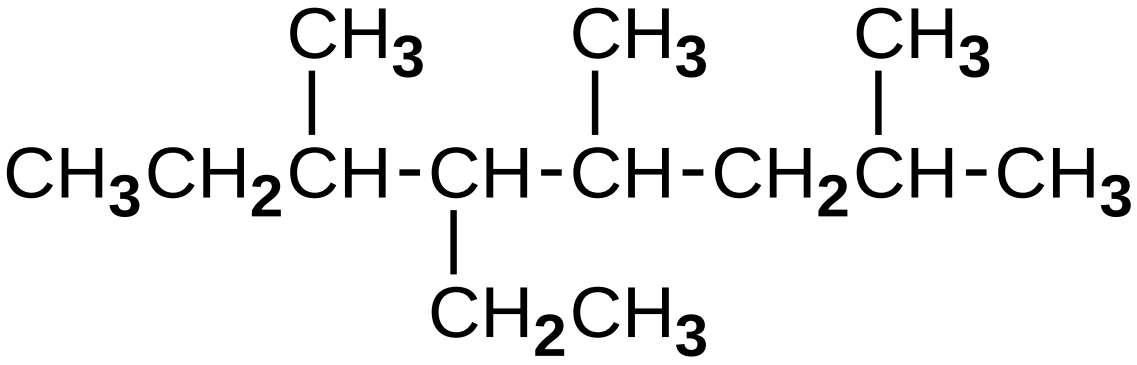


4-ethyl-2,3-dimethylheptane

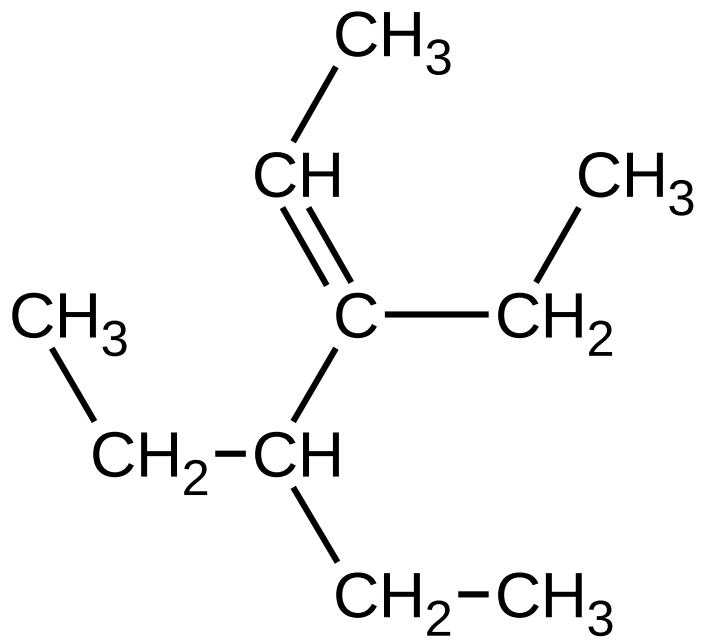
11



5-ethyl-2,4,6-trimethyloctane

12

3,4-diethyl-2-hexene



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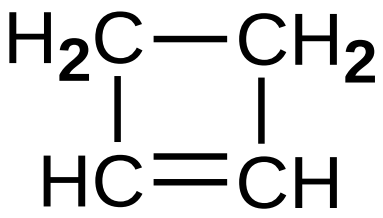
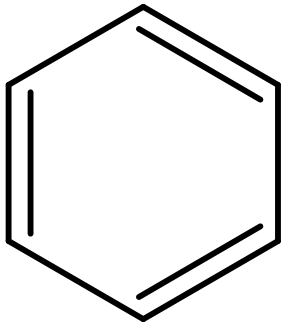


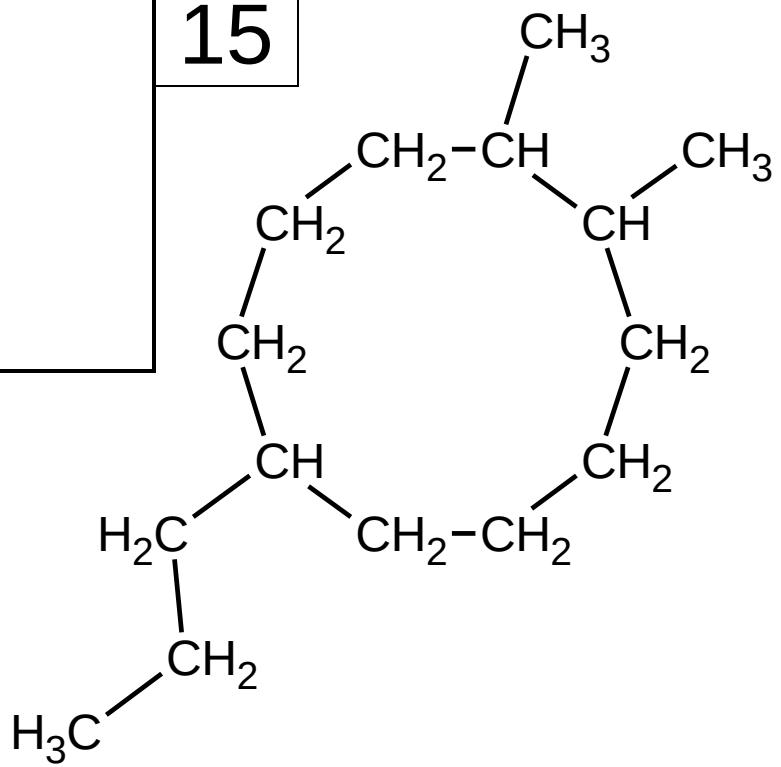
cyclobutene

14



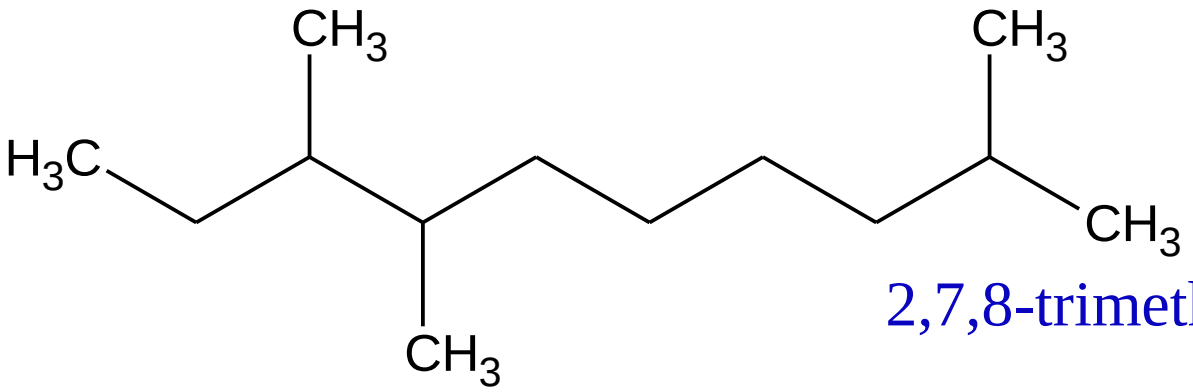
benzene

15



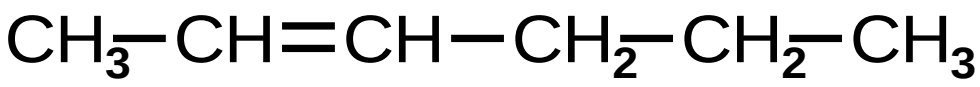
1,2-dimethyl-6-propylcyclodecane

16



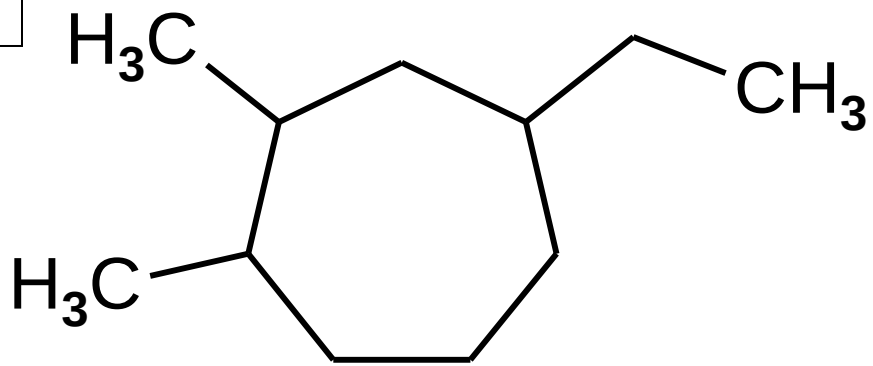
2,7,8-trimethyldecane

17



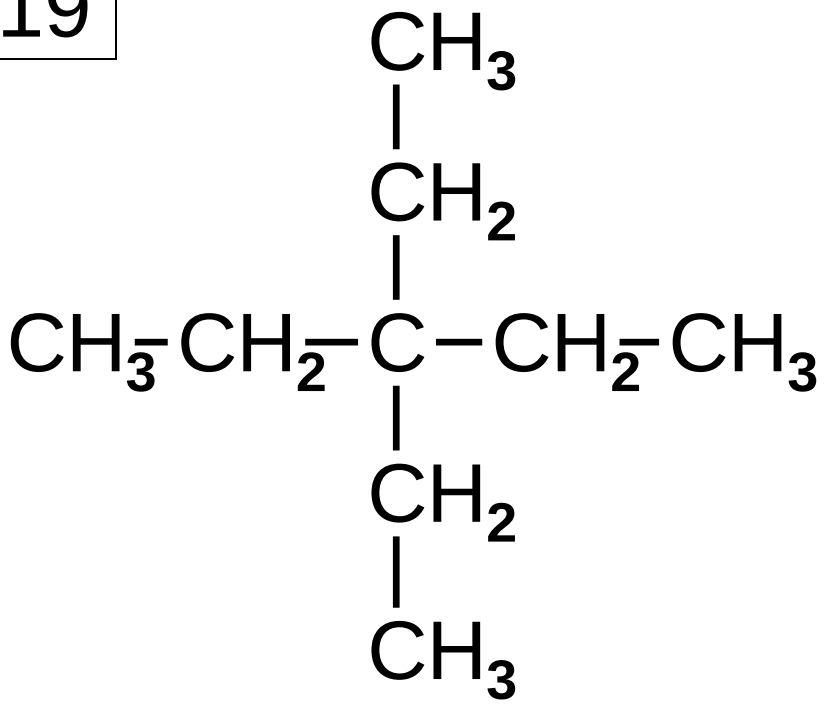
2-hexene

18



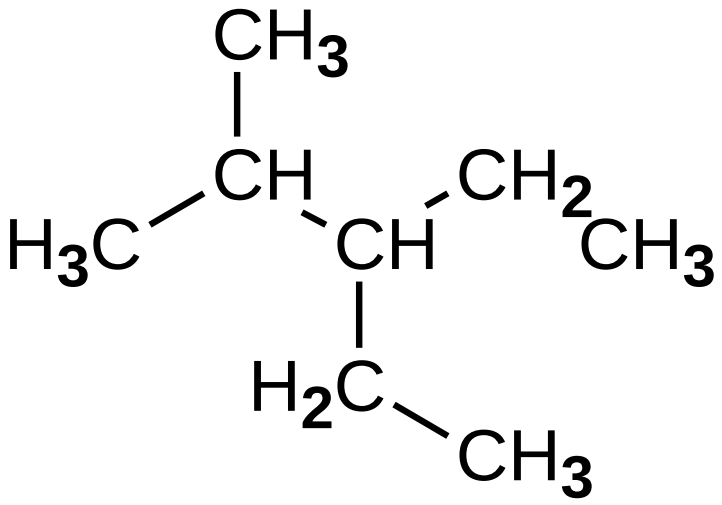
4-ethyl-1,2-dimethylcycloheptane

19



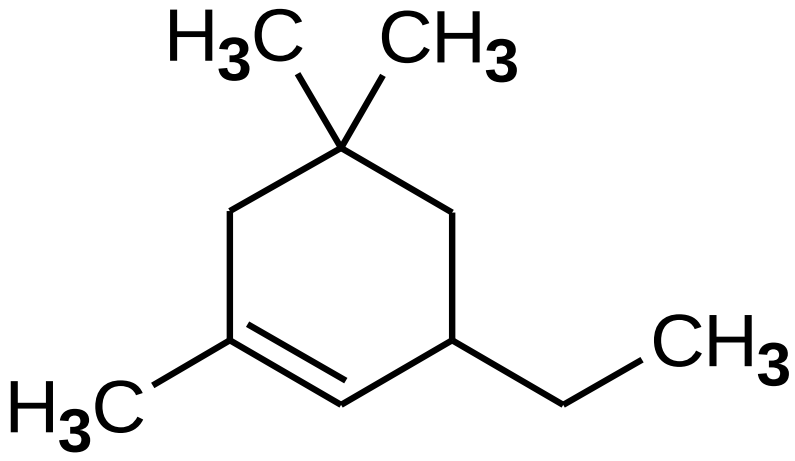
3,3-diethylpentane

20



3-ethyl-2-methylpentane

21



3-ethyl-1,5,5-trimethylcyclohexene

Common Nomenclature Pitfalls

- Did not find the longest carbon chain
- Numbered chain from the wrong end
- Forgot to repeat number for each identical branch
- Forgot to use di-, tri-, tetra-, etc.
- Confusing propyl / isopropyl, etc.
- Writing the name as more than one word
- Incorrect punctuation