SI Chemistry - Full Discipline Demo

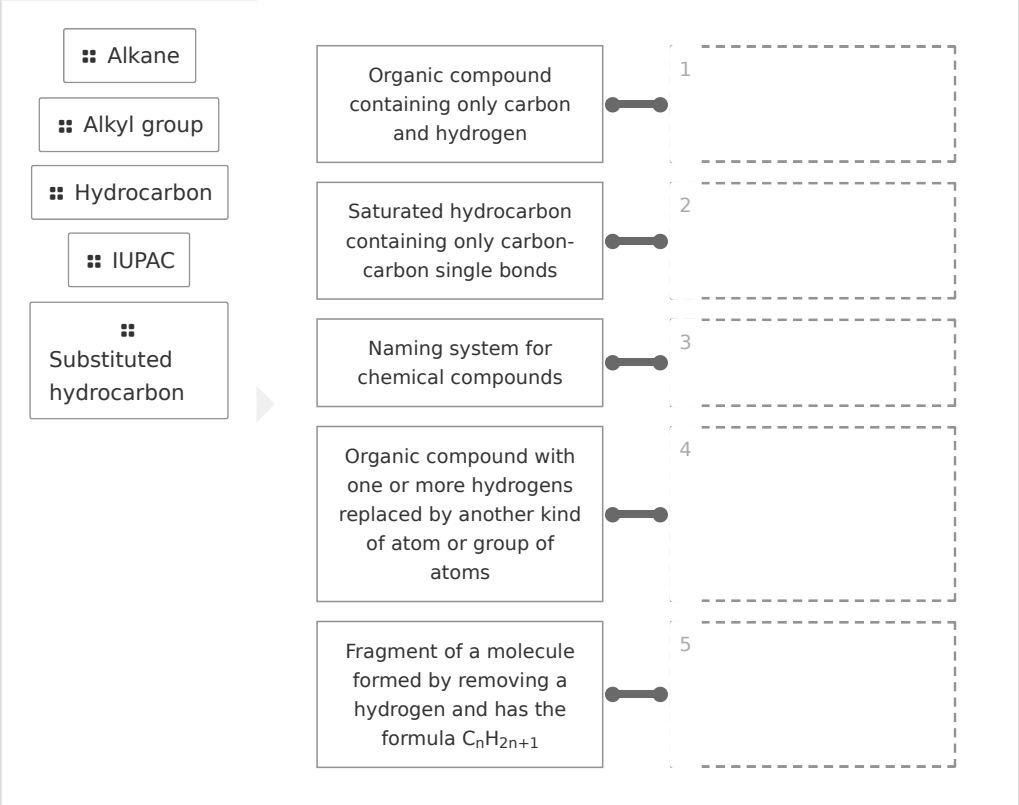
Naming Organic Compounds

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.



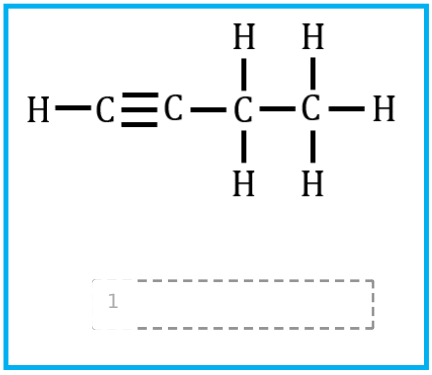
Correct answers:

1 Hydrocarbon 2 Alkane 3 IUPAC 4 Substituted hydrocarbon

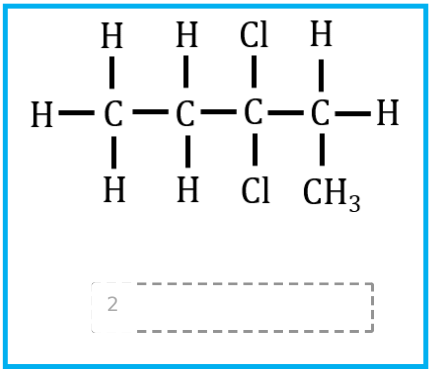
5 Alkyl group

Label each compound structure with the correct name.

1-butyne | 2-pentyne | 3,3-dichloropentane | Ethene



1



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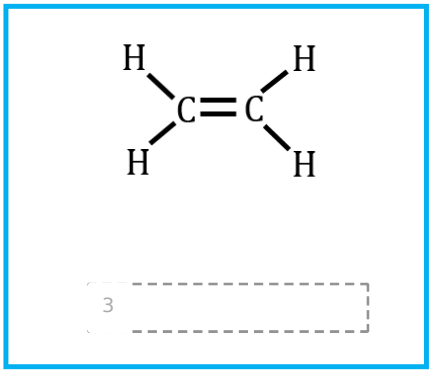

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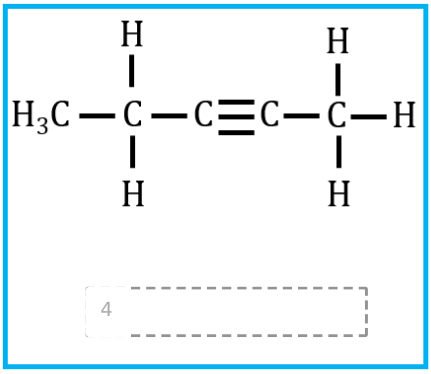
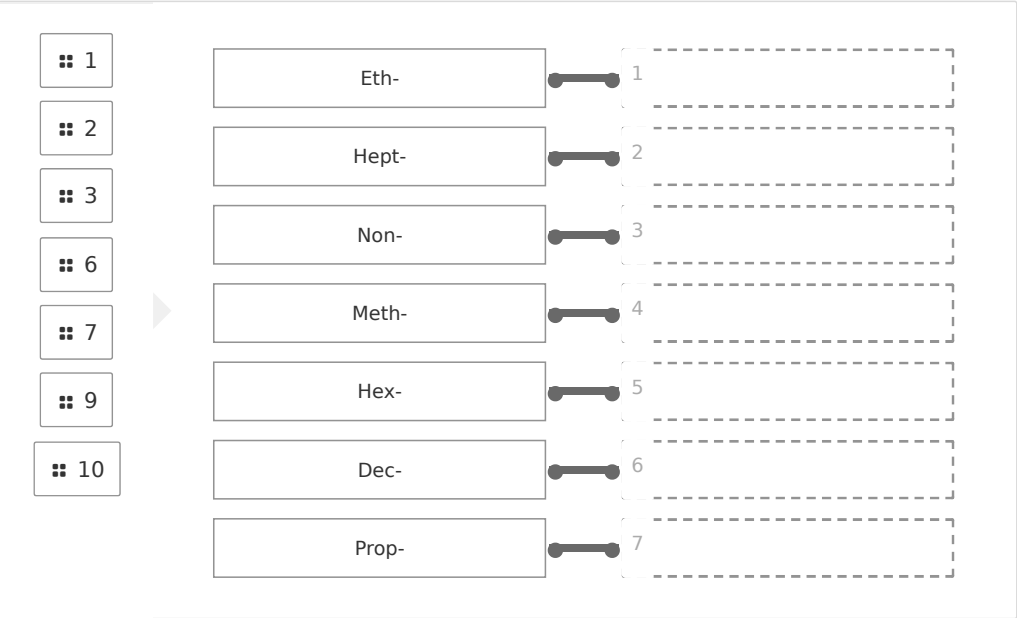


4

Correct answers:

1 1-butyne 2 3,3-dichloropentane 3 Ethene 4 2-pentyne

Match the number of carbon atoms with the correct prefix.



Correct answers:

1 2 2 7 3 9 4 1 5 6 6 10 7 3

Exploration

Every known chemical has a unique name that is derived from the IUPAC naming system.

- True ✔
- False

A substituted hydrocarbon is an organic compound in which one ore more hydrogen atoms is replaced by another type of atom or group of atoms.

- True ✔
- False

The prefix for a hydrocarbon with 6 carbons is _____.

- but-
- hex- ✔
- pent-
- hept-

The suffix for a hydrocarbon with a carbon-carbon double bond is _____.

- -ene ✔
- -yne
- -ane

When naming hydrocarbons, _____ are used between numbers and _____ are used to separate numbers from letters.

- hyphens; commas
- commas; hyphens ✔
- colons; hyphens

The general molecular formula for butane is _____.

- C_4H_{10} ✔
- C_4H_8
- C_4H_{12}

Exercise 1

Determine the molecular formula for the following hydrocarbons:

a. Hexane

b. Methane

c. Propyne

d. 1-pentene

e. 2-octyne

f. Decane

g. Heptane

h. 4-nonene

a. Hexane = C_6H_{14}
b. Methane = CH_4
c. Propyne = C_3H_4
d. 1-pentene = C_5H_{10}
e. 2-octyne = C_8H_{14}
f. Decane = $C_{10}H_{22}$
g. Heptane = C_7H_{16}
h. 4-nonene = C_9H_{18}

Describe the difference between a saturated hydrocarbon and an unsaturated hydrocarbon. Name 3 saturated hydrocarbons and 3 unsaturated hydrocarbons from Table 3 and Table 4.

A saturated hydrocarbon is a hydrocarbon consisting of all carbon-carbon single bonds allowing for a maximum amount of bonds to hydrogen; whereas an unsaturated hydrocarbon is a hydrocarbon consisting of one or more double or triple bonds. The saturated hydrocarbons from Table 3 and Table 4 include butane, decane, nonane, methane, and propane. The unsaturated hydrocarbons from Data Table 1 and Table 4 include propyne, ethene, 2-octyne, 1-pentene, 3-heptene, 2-pentyne, 3-nonene, 1-heptyne, ethyne, 1-butene, and 4-decyne.

In your own words list the rules for naming hydrocarbons and substituted hydrocarbons. Be detailed in listing all rules including priority for numbering carbons, prefixes and suffixes, and the structure of the name.

First, the number of carbons in the longest chain must be counted. Then, the suffix for the base name must be determined based on the type of carbon-carbon bonds present. The prefix for the base name is determined by the number of carbons present in the parent chain. Next, the carbons in the longest chain are counted with priority given to any double or triple bonds, followed by the location of any substituents. If there are no double or triple carbon-carbon bonds, then the priority is given to the substituent with the lowest number. Substituents should be named with the suffix –yl, except for the halogens which will replace the –ine with –o. Greek prefixes are used in naming the substituents if more than one of the same substituent are present on each compound. Each substituent will be given its own number corresponding to the carbon it is attached to. If a double or triple bond is present then the number of the first carbon for which the bond exists must also be included in the name. The name of the compound is written using hyphens to separate numbers from letters, and commas to separate numbers from numbers.

Data Table 1: Hydrocarbon Names
(SAMPLE ANSWER BELOW)

Structure Number	Compound Name
1	Butane
2	Propyne
3	Methane
4	Ethene
5	2-octyne
6	1-pentene
7	Nonane
8	3-heptene

Photo 1: 2-pentyne
(SAMPLE ANSWER BELOW)

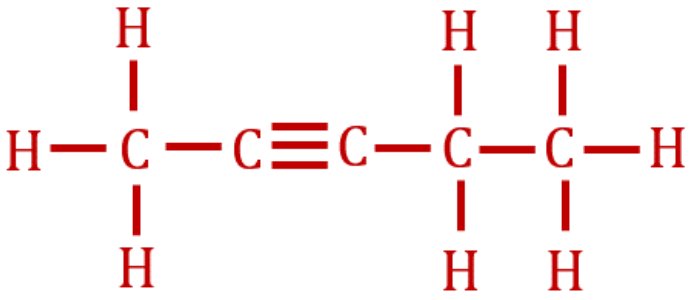


Photo 2: Decane
(SAMPLE ANSWER BELOW)

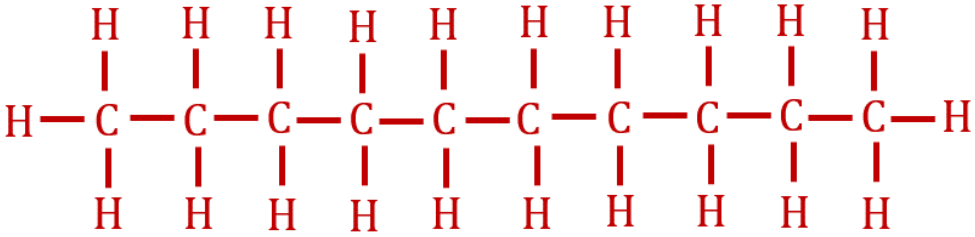


Photo 3: 3-nonene
(SAMPLE ANSWER BELOW)

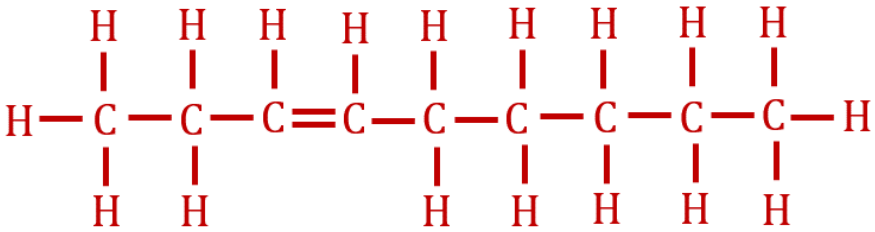


Photo 4: 1-heptyne
(SAMPLE ANSWER BELOW)

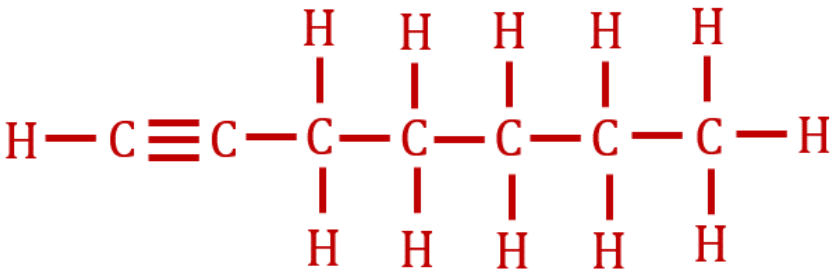


Photo 5: Ethyne
(SAMPLE ANSWER BELOW)

Photo 6: 1-butene
(SAMPLE ANSWER BELOW)

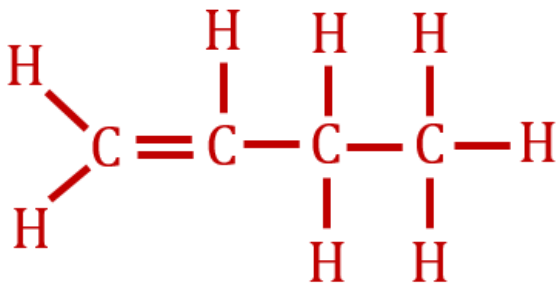


Photo 7: 4-decyne
(SAMPLE ANSWER BELOW)

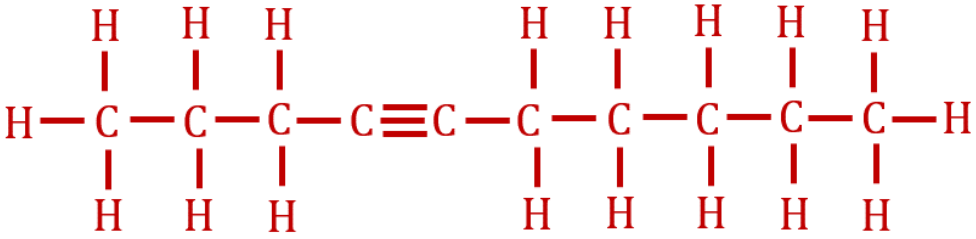
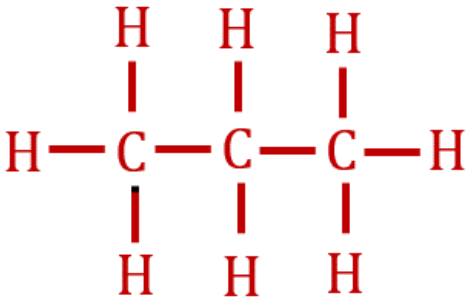


Photo 8: Propane
(SAMPLE ANSWER BELOW)



Data Table 2: Organic Compound Names
(SAMPLE ANSWER BELOW)

Structure Number	Compound Name
9	2-chloropentane
10	2,3-difluoro-4-methyl-1-hexene
11	2,6-dimethyl-4-propyl-1-heptene
12	3-bromo-3-chloro-1-butyne
13	2-bromo-3,6,6-trichloro-4-methyl-1-octene
14	4-ethyl-4-methylheptane
15	2-chloro-2-fluoro-3-heptyne
16	2,2,8,8-tetrabromo-4,6-diethyl-6-fluorodecane

Photo 9: 3-bromo-2,2-dimethylbutane
(SAMPLE ANSWER BELOW)

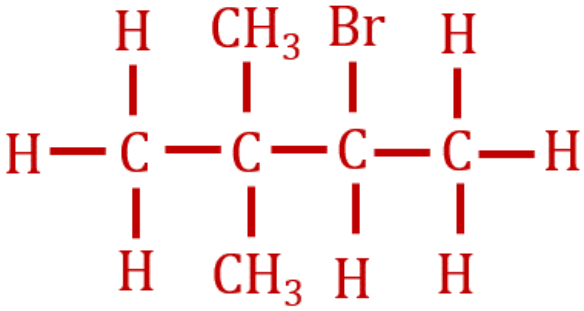


Photo 10: 3-bromo-4-ethyl-1,1,1-trifluoro-5-methylheptane
(SAMPLE ANSWER BELOW)

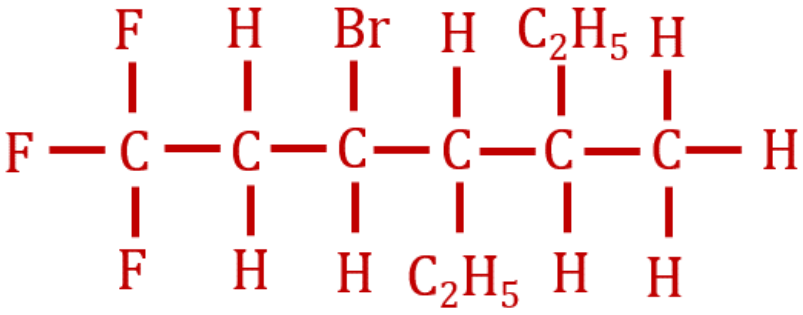


Photo 11: 4-chloro-2,5,6-trimethyl-1-heptene
(SAMPLE ANSWER BELOW)

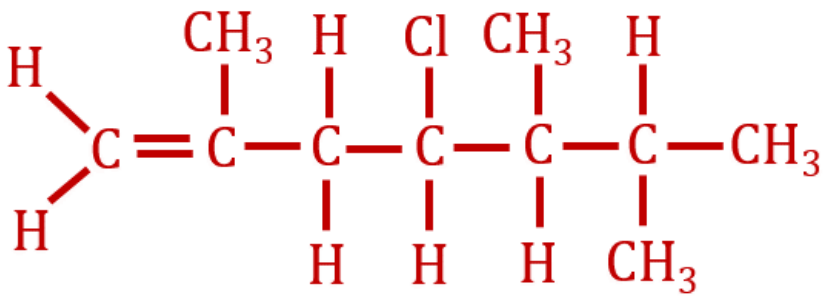


Photo 12: 5-bromo-4,4-dichloro-1-hexyne
(SAMPLE ANSWER BELOW)

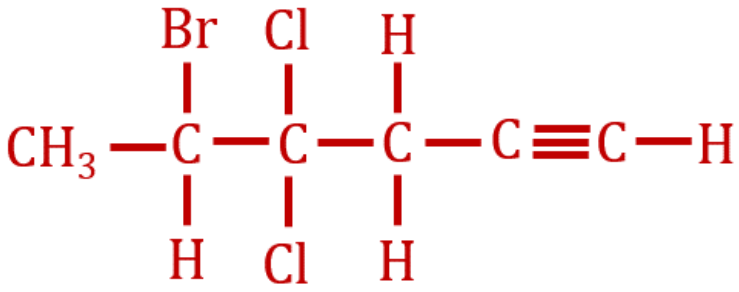


Photo 13: 1,2-dichloroethene
(SAMPLE ANSWER BELOW)

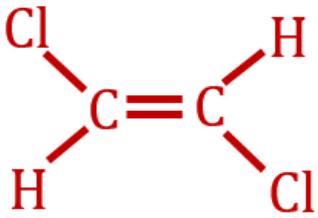


Photo 14: 5-butyl-6-fluoro-5-methyl-3-nonyne
(SAMPLE ANSWER BELOW)

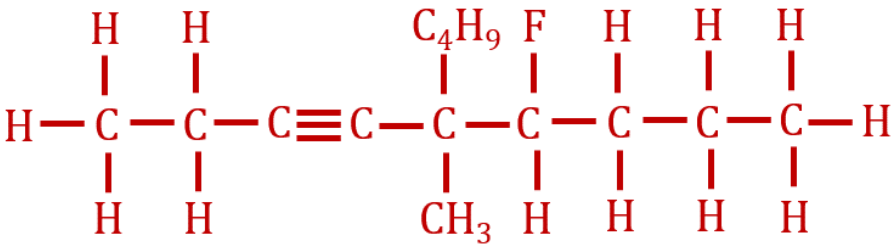


Photo 15: 1,1-dichloropropene
(SAMPLE ANSWER BELOW)

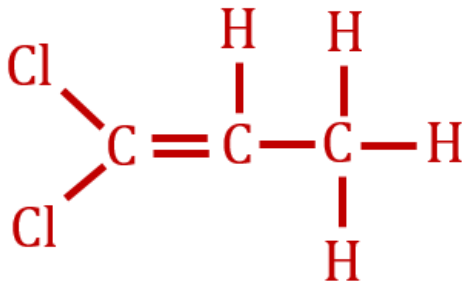
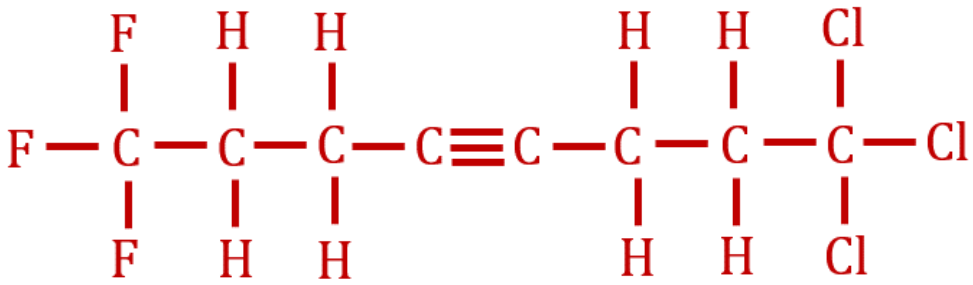


Photo 16: 1,1,1-trichloro-8,8,8-trifluoro-4-octyne
(SAMPLE ANSWER BELOW)



Competency Review

The IUPAC name consists of _____.

- a 3D relationship
- numbered subtituents
- an ending suffix
- the number of carbons and numbered substituents
- All of the above ✔

A hydrocarbon consists entirely of carbon and hydrogen atoms.

- True ✔
- False

A hydrocarbon chain consisting of a triple carbon-carbon bond will have the suffix _____.

- -ene
- -yne ✔
- -ane

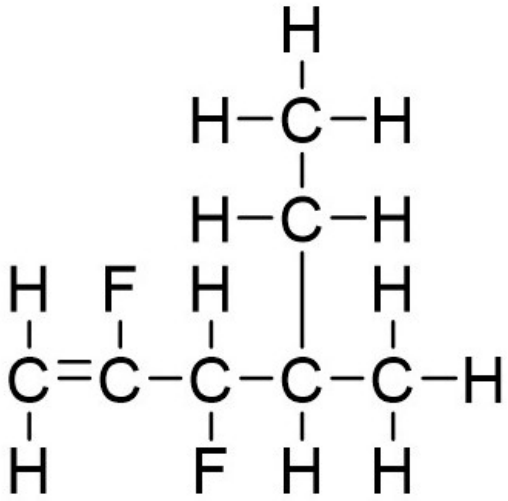
The formula for the carbon compound ethene is _____.

- C_2H_6
- C_2H_4 ✔
- C_2H_2
- C_3H_8

A _____ has priority over substituents when numbering the parent carbon chain.

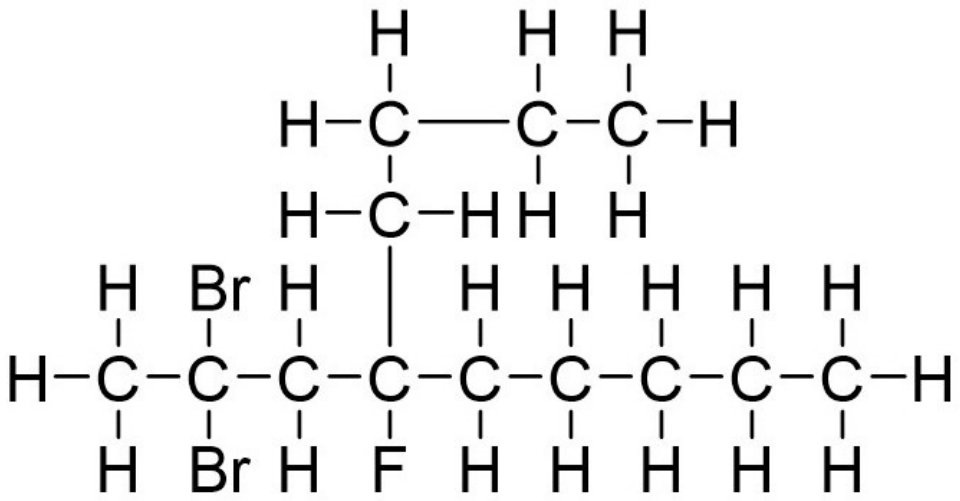
- single bond
- double bond
- triple bond
- double or triple bond ✔

The name for the chemical structure in the image below is _____.



- 2-fluoro-3-fluoro-1-methylbutene
- 1-ethyl-2,3-fluoro-1-methylbutene
- 2,3-difluoro-4-methyl-1-hexene ✔
- 2,3-fluoro-4-ethyl-5-methylpentene

The name for the chemical structure in the image below is _____.



- 5-(2,2-dibromopropyl)-5-fluorodecane ✔
- 2,2-dibromo-4-pentyl-4-fluorooctane
- 8,8-dibromo-6-butyl-6-fluorononane
- 2,2-dibromo-4-butyl-4-fluorononane

The formula for 1-decyne is _____.

- $C_{10}H_{22}$
- $C_{10}H_{18}$ ✔
- $C_{10}H_{20}$
- None of the above

The general molecular formula for a hydrocarbon with single bonds and one double bond is _____.

- C_nH_{2n-2}
- C_nH_{2n+2}
- C_nH_{2n} ✔

In order to draw the chemical structure for 1-butyne, a _____ must be placed between the first and second carbons of the chain.

- single bond
- double bond
- methyl group
- triple bond ✔

Extension Questions

Heptane is an alkane. Write the chemical formula and describe the chemical structure of heptane. Conduct internet research to determine the major uses and properties of heptane. Include information regarding its importance in gasoline and any hazards associated with heptane. (SAMPLE ANSWER BELOW)

Chemical Formula = C_7H_{16}

Heptane is a straight chain saturated hydrocarbon with only single bonds. The molar mass of heptane is 100.21 and has a melting point of -91 to -90.1°C and a boiling point of 98.1 to 98.7°C. Heptane is a colorless liquid with a gasoline-like odor at room temperature. It also readily gives off fumes. Both the fumes and liquid are highly flammable.

There are two main uses of heptane. The first is its use in the gasoline industry. 100% pure heptane was given an octane scale rating of zero, making it the standard zero point for determining the octane rating of all gasolines. The higher the octane rating of a gasoline, the more expensive it is, as it is deemed better for your engine. Using pure heptane as gas, with its zero octane rating, is a poor option for your car. This is because heptane burns very explosively, which can cause major engine knocking, unlike slower burning gasolines with higher octane ratings. Even though it is not used for fuel alone, there is a complex mixture of heptane in gasoline.

The second major use of heptane is in laboratories, where it is used as a solvent and to determine the presence of organic compounds. Since good laboratory solvent is one that dissolves the reagents without interfering with the reaction, heptane is very useful because it has almost no reactivity with other molecules and will dissolve organic molecules that do not dissolve in water. Heptane is widely used in labs as a totally non-polar solvent. It is used to dissolve oil spots to determine the presence of organic compounds on stained paper, and to distinguish aqueous halogens that are the same color. For example, bromine and iodine are both brown in their aqueous state. When mixed with heptane, iodine will turn purple whereas bromine will remain brown.

State at least 3 reasons that scientists need to follow the rules for naming chemical compounds established by the IUPAC, and include potential hazards or problems if the incorrect name is used. (SAMPLE ANSWER BELOW)

The naming of chemical compounds is essential in working with pharmaceuticals, factories that use chemicals, and the treatment of invasive plants. If incorrect names were used in pharmaceuticals it could lead to the patient receiving the wrong medication, which could be toxic or unhelpful in treating their conditions. In factories, incorrect chemical names could pose a major hazard since some chemicals become explosive when they are mixed together. Or, the product the factory is making could be unusable if the wrong chemical is used, causing a major economical problem for the factory. If the wrong chemical is used to treat specific invasive plants, then natural plants and/or animals could die from the exposure.