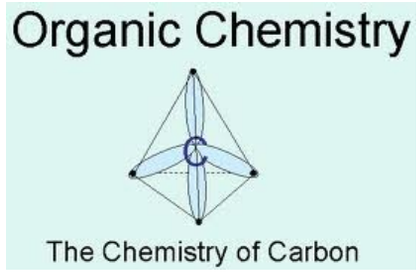
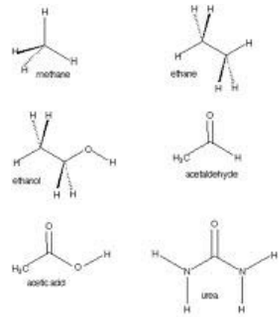
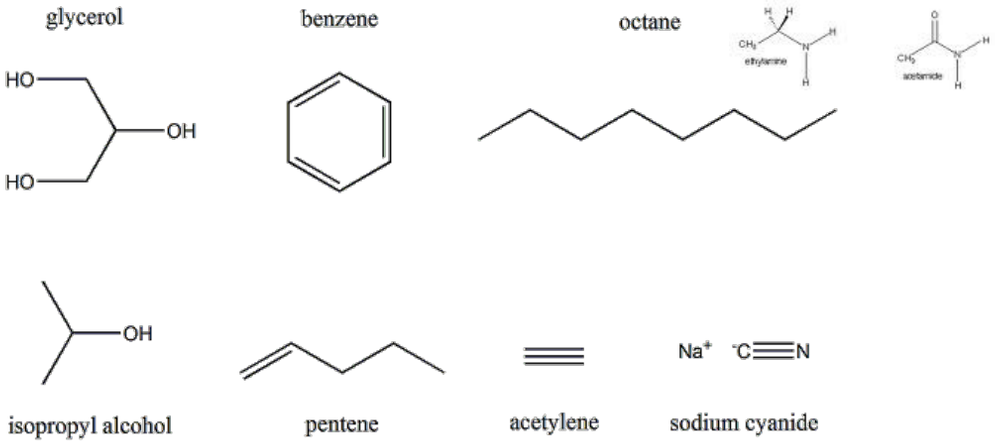






Organic Chemistry is the study of the molecular compounds that contain carbon. Compounds that contain carbon are known as organic compounds.

Most of the the molecules in all living things on Earth are carbon based, meaning that they are made mostly of carbon atoms.

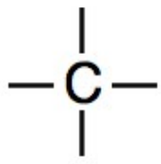
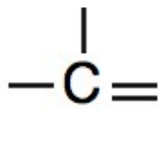
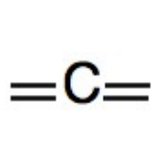
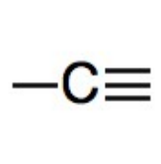
Some examples of carbon based compounds include

- Plastics made from petroleum
- Gasoline
- Cosmetics
- Medicines
- Food products.

An atom is most stable when its outer electron energy level is filled. Carbon has four valence electrons and four empty spots in its outer electron energy level.

Carbon is a group 4A element, meaning that it has 4 valence electrons

Carbon <u>needs</u> to form <u>four bonds</u> with other atoms to become stable

				
Number of single bonds				
Number of double bonds				
Total Number of Bonds				

Functional Groups are characteristic arrangements (structures and bonds) of atoms within a molecule that are largely responsible for the physical and chemical properties of the compound

The simplest carbon compounds are hydrocarbons they contain only **hydrogen and carbon.** These molecules can contain single, double or triple bonds

Hydrocarbons		
Single Bond	C — C	**Alkane**
Double Bond	C = C	**Alkene**
Triple Bond	C ≡ C	**Alkyne**

-Alkanes are a hydrocarbon that contains only carbon-carbon single bonds

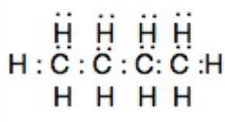
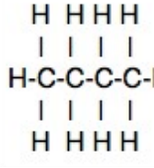
-The general formula for alkanes is C_nH_{2n+2}

-To name Alkanes we use a **prefix** which indicates how many carbon atoms are in the molecule, added to the **suffix *ane*** which indicates that there are only single bonds

Number of Carbon	Prefix	Name	Use
1	Meth		gaseous fuel
2	Eth		gaseous fuel, starting compound for plastic
3	Prop		gaseous fuel
4	But		gaseous fuel
5	Pent		solvents
6	Hex		solvents, liquid fuel
7	Hept		liquid fuel
8	Oct		liquid fuel

There are five ways to represent organic compounds

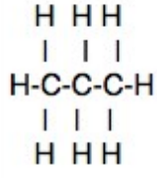
1. Chemical formula: Tells you the number of each type of atom
2. Lewis Dot Diagram: shows how valence electrons are shared (uses dots)
3. Structural Diagram: shows the bonds between atoms (uses a line)
4. Condensed Diagram: only shows the bonds between carbons (uses a line)
5. Line Diagram: A line showing the bonds between atoms. The end of each segment represents a carbon atom

Compound: Butane	
Chemical Formula	C_4H_{10}
Lewis Dot Diagram	
Structural Diagram	
Condensed Diagram	CH_3-CH_2-CH_2-CH_3
Line Diagram	 (4 points means there are 4 carbon)

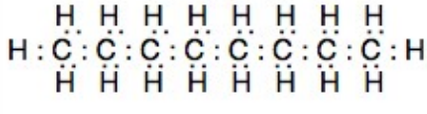
Compound: Ethane	
Chemical Formula	
Lewis Dot Diagram	
Structural Diagram	
Condensed Diagram	
Line Diagram	

Compound:	
Chemical Formula	C_7H_{16}
Lewis Dot Diagram	
Structural Diagram	
Condensed Diagram	
Line Diagram	

Compound:	
Chemical Formula	
Lewis Dot Diagram	
Structural Diagram	
Condensed Diagram	
Line Diagram	

Compound:	
Chemical Formula	
Lewis Dot Diagram	
Structural Diagram	
Condensed Diagram	
Line Diagram	

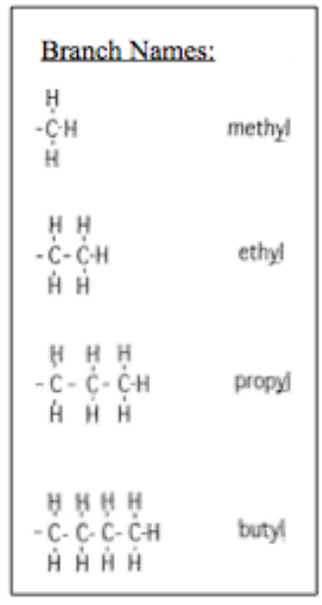
Compound:	
Chemical Formula	
Lewis Dot Diagram	
Structural Diagram	
Condensed Diagram	CH_3-CH_2-CH_2-CH_2-CH_2-CH_3
Line Diagram	

Compound:	
Chemical Formula	
Lewis Dot Diagram	
Structural Diagram	
Condensed Diagram	
Line Diagram	

Compound:	
Chemical Formula	
Lewis Dot Diagram	
Structural Diagram	
Condensed Diagram	CH_4
Line Diagram	

Branched Alkanes: alkane consisting of a long chain with smaller carbon branches attached to it. Each branch gives the alkane new chemical and physical properties

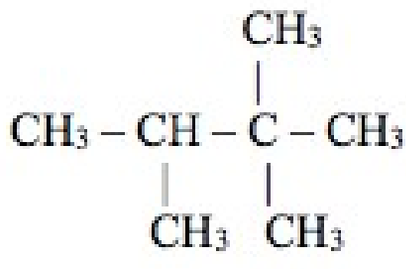
Simply:
Replacing a hydrogen with another carbon group

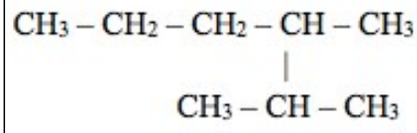


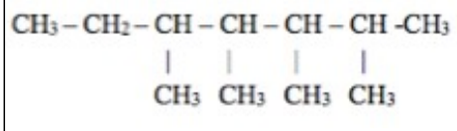
Steps for naming

1. Find the longest continuous chain of carbon atoms in the molecule (circle this chain and label it the parent chain)Name the parent chain as though it is a continuous-chain alkane (i.e. if there are 6 carbons then name it hexane)
2. Find all the branches (circle them individually).
    1. Each branch is called an alkyl group (an alkyl group is a branch of a larger molecule consisting of an alkane with one hydrogen removed)
3. Name each group with the prefix based on the number of carbons within the alkyl group, then add suffix "-yl" to it
4. To tell where each branch is on the parent chain, number the carbons on the parent chain starting at the end nearest the first branch.
5. Communicate the amount of each branch type in the molecule using prefixes
6. Put the name together, starting with the alkyl groups (in alphabetical order) and ending with the parent chain.
   Note: there should be no spacing in the name

Number of Branches in the Chain	Prefix
1	no prefix
2	di
3	tri
4	tetra
5	penta
6	hexa
7	hepta
8	octa

Structure	Name
	

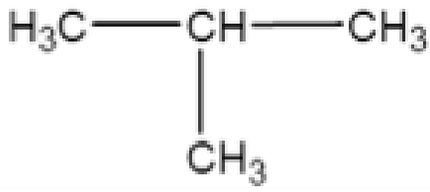
Structure	Name
	

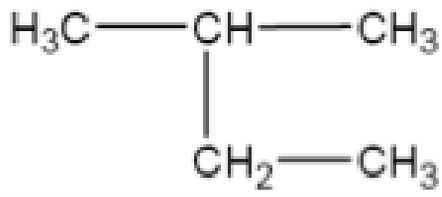
Structure	Name
	

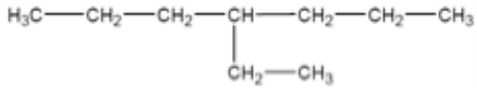
Structure	Name
	3-methylhexane

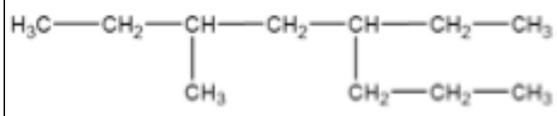
Structure	Name
	3,3-diethyloctane

Structure	Name
	2-methyl-4-ethylhexane

Structure	Name
	

Structure	Name
	

Structure	Name
	

Structure	Name
	

Structure	Name
	4-methyl-5-ethylhexane

Structure	Name
	5-ethyl-4-propylheptane

Structure	Name
	3,4-diethylhexane

Structure	Name
	2,2-dimethylbutane

Structure	Name
	2,4-dimethylpentane

Structure	Name
	2-methyl-4-ethyloctane

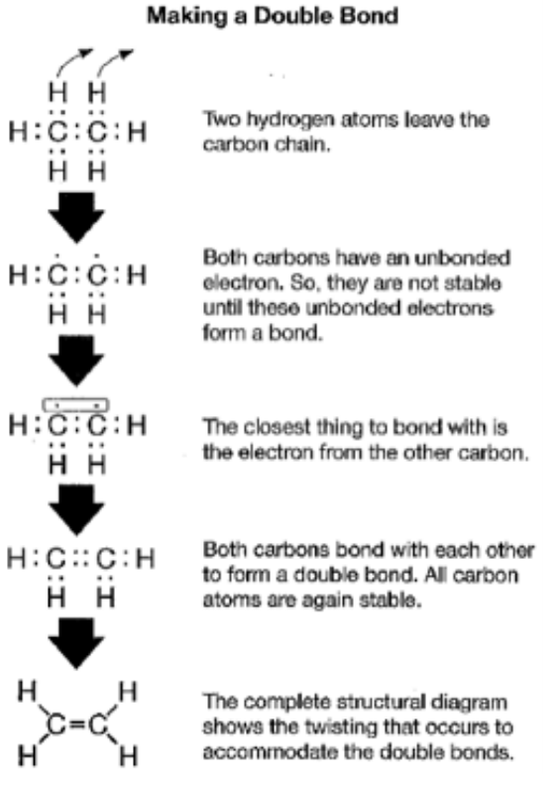
Structure	Name
	2-methyl-4-ethyloctane

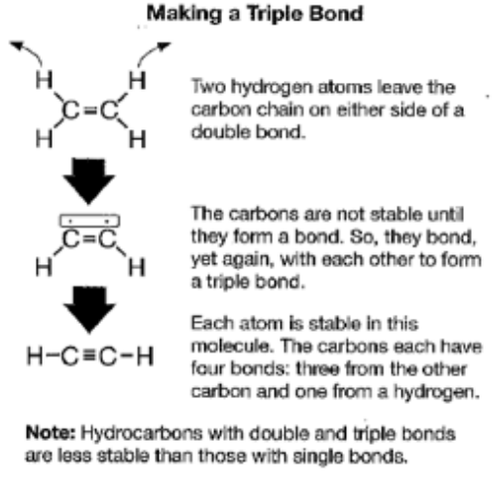
Saturated and Unsaturated Hydrocarbons

So far, we have studied alkanes, which are hydrocarbons containing only carbon – carbon single bonds. Here the carbons have the maximum number of bonds with no other atoms being added to the molecule. Because the bonds between carbons only consist of single bonds, we can call them **saturated hydrocarbons.**

Hydrocarbons can also function without the maximum amount of hydrogen atoms attached to each carbon atoms. When neighboring carbon atoms each lose one hydrogen atom, they can form a double bond, if they lose an additional atom, they can form a triple bond.

Hydrocarbons with double and triple bonds are called **unsaturated hydrocarbons**. They are given this name because they are missing their maximum number of bonds to hydrogen atoms.





Alkenes: Organic compounds containing one or more double bonds

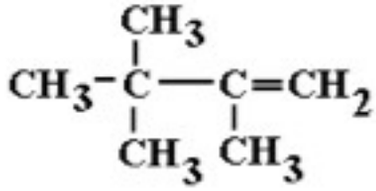
General Formula of alkenes: C_nH_{2n}

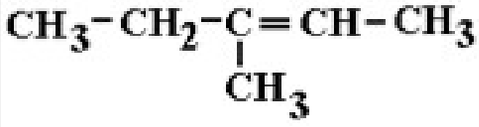
How many hydrogen atoms would a 7 carbon alkene have? _____

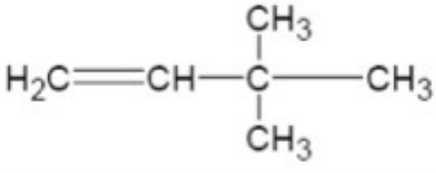
Steps for naming Alkenes:

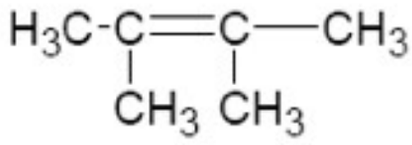
1. Find the longest chain which includes all double bonds
2. Number the carbons in the continuous chain so that the carbons with the double bond have the lowest number possible
3. Provide the prefix (based on the number of carbons in the continuous chain). The suffix "-ene" (instead of –ane) is used to name the compound as an alkene type. Before the parent, place the number indicating location of the double bond
4. Identify the other branches/groups and include it in the name

Note: for any hydrocarbons with more than one double bond, you indicate the amount by writing –di –tri –tetra –penta – hexa before the suffix

Structure	Name
	2,3,3-trimethyl-1-butene

Structure	Name
	3-methyl-2-pentene

Structure	Name
	3,3-dimethyl-1-butene

Structure	Name
	

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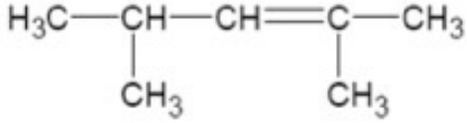
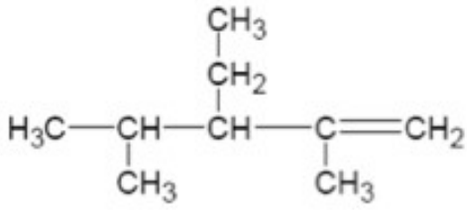
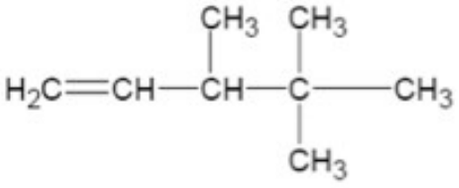
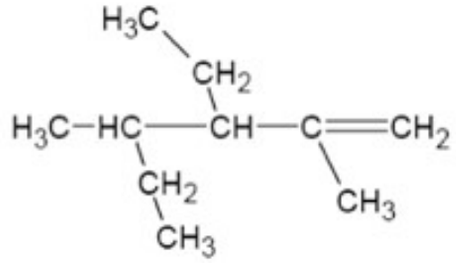
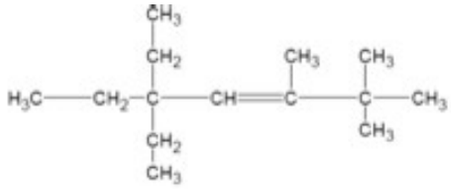
	

Structure	Name
	

Structure	Name
	

Structure	Name
	

Structure	Name
	

Structure	Name
	3 - methyl-2-hexene

Structure	Name
	2,3 - dimethyl-1,2-pentadiene

Structure	Name
	3,4-diethyl-2-hexene

Structure	Name
	2,4-dimethyl-2-pentene

Structure	Name
	4-methyl-2-5heptadiene

Structure	Name
	3-methyl-4-ethyl-2-octene

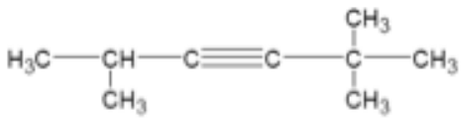
Structure	Name
	6-methyl-3-octene

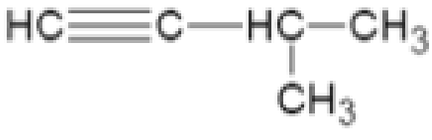
Structure	Name
	2,5-octdiene

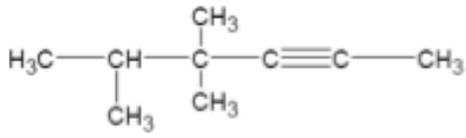
Structure	Name
	2-methyl-4-ethyloctane

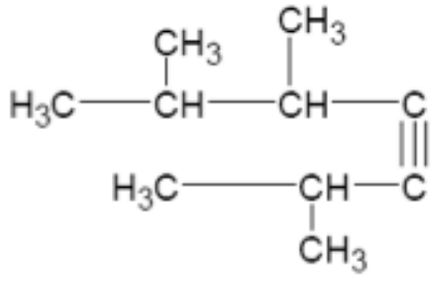
Structure	Name
	5-ethyl-2-methyl-2-propyl-1-heptene

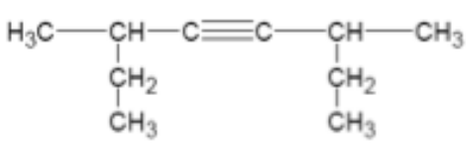
Structure	Name
	2-ethyl-6-methyl-1,6-octdiene

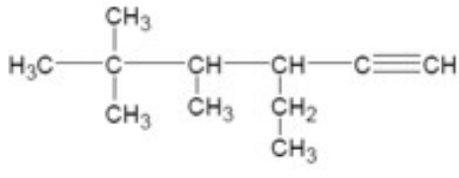
Structure	Name
	2,2,5-trimethyl-3-hexyne

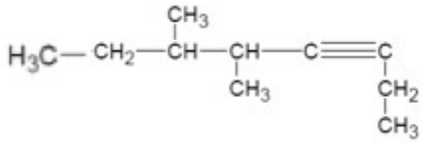
Structure	Name
	3-methyl-1-butyne

Structure	Name
	4,4,5-trimethyl-2-hexyne

Structure	Name
	2,5,6-trimethyl-3-heptyne

Structure	Name
	3,6-dimethyl-4-octyne

Structure	Name
	3-ethyl-4,5,5-trimethyl-1-hexyne

Structure	Name
	

Structure	Name
	5,5 - diethyl - 2 - methylhept - 3 - yne

Structure	Name
	buta-1,2-diyne

Structure	Name
	3-ethylpent-1-yne

Structure	Name
	3,3-dimethylbut-1-yne

Structure	Name
	4,4,5-trimethylhex-2-yne

Structure	Name
	4-ethyl-4-methylpent-2-yne

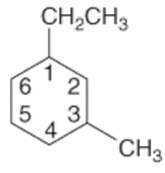
Structure	Name
	3,4-dimethyloct-1-yne

Structure	Name
	hex-1-yne

Alkanes - Nomenclature

With two different substituents, number the ring to assign the lower number to the substituents alphabetically.

Begin numbering at the ethyl group.

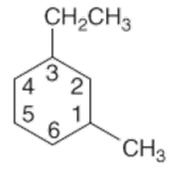


- ethyl group at **C1**
- methyl group at **C3**

earlier letter → lower number

Correct: **1-ethyl-3-methylcyclohexane**

Begin numbering at the methyl group.



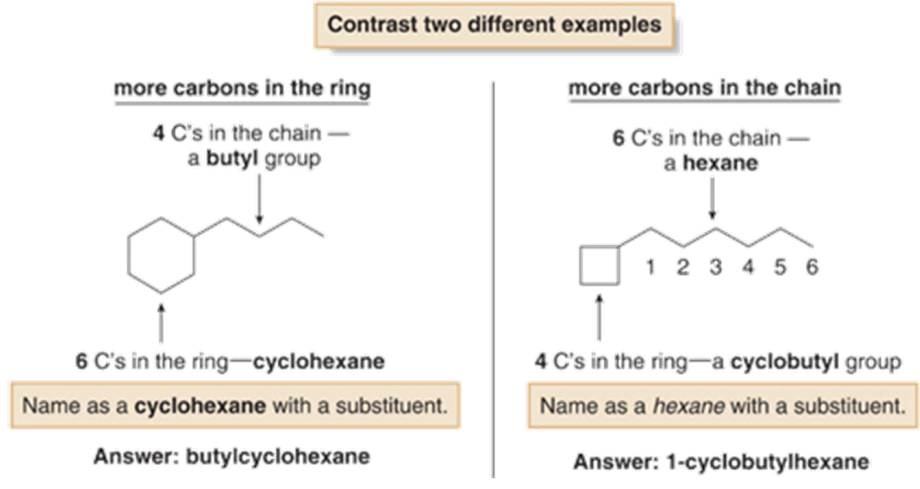
- methyl group at **C1**
- ethyl group at **C3**

Incorrect: 3-ethyl-1-methylcyclohexane

Note the special case of an alkane composed of both a ring and a long chain. If the number of carbons in the ring is greater than or equal to the number of carbons in the longest chain, the compound is named as a cycloalkane.

Alkanes - Nomenclature

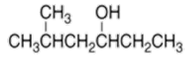
Figure 4.2 Naming compounds containing both a ring and a long chain of carbon atoms



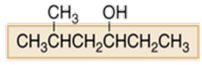
Alcohols - Nomenclature

HOW TO Name an Alcohol Using the IUPAC System

Example Give the IUPAC name of the following alcohol:



Step [1] Find the longest carbon chain containing the carbon bonded to the OH group.



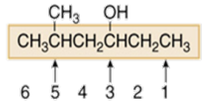
6 C's in the longest chain

6 C's → hexane → hexanol

- Change the **-e** ending of the parent alkane to the suffix ***-ol.***

Step [2] Number the carbon chain to give the OH group the lower number, and apply all other rules of nomenclature.

a. **Number** the chain.

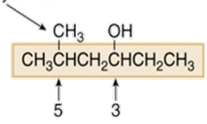


- Number the chain to put the OH group at C3, not C4.

3-hexanol

b. **Name** and **number** the substituents.

methyl at C5

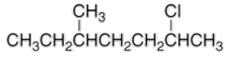


Answer: 5-methyl-3-hexanol

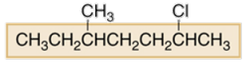
Alkyl Halides - Nomenclature

HOW TO Name an Alkyl Halide Using the IUPAC System

Example Give the IUPAC name of the following alkyl halide:



Step [1] Find the parent carbon chain containing the halogen.



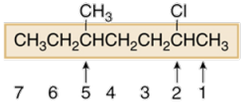
7 C's in the longest chain

7 C's ----→ heptane

- Name the parent chain as an ***alkane,*** with the halogen as a substituent bonded to the longest chain.

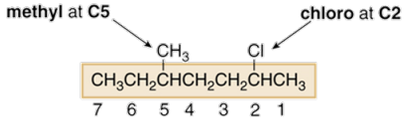
Step [2] Apply all other rules of nomenclature.

a. **Number** the chain.



- Begin at the end nearest the first substituent, either alkyl or halogen.

b. **Name** and **number** the substituents.



c. **Alphabetize: c** for **c**hloro, then **m** for **m**ethyl.

ANSWER: 2-chloro-5-methylheptane