

شرح الدرس الثالث Alkynes and Alkenes من وحدة Hydrocarbons منهج انسابير



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شرح الدرس الثاني Alkanes من وحدة Hydrocarbons منهج انسابير

1

شرح الدرس الأول hydrocarbons to Introduction من وحدة Hydrocarbons منهج انسابير

2

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الهيكل الوزاري الجديد منهج انسابير الخطة M المسار المتقدم

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CHEMISTRY

“Hydrocarbons”

Alkenes & Alkynes

Mr. Mouad

مناهج دولة الإمارات

عام، متقدم ونخبة 9،10،11،12

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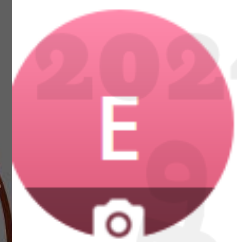
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Module 20

“Hydrocarbons”

Alkenes & Alkynes

Learning Outcomes:

- ***Compare** the properties of **alkenes and alkynes** with those of alkanes.
- ***Describe** the molecular structures of **alkenes and alkynes**.
- ***Name** an **alkene or alkyne** by examining its structure.
- ***Draw** the structure of an **alkene or alkyne** by analyzing its name.



Learning objectives

- **Compare** the properties of alkenes and alkynes with those of alkanes.
- **Describe** the molecular structures of alkenes and alkynes.
- **Name** an alkene or alkyne by examining its structure.
- **Draw** the structure of an alkene or alkyne by analyzing its name.

Alkenes



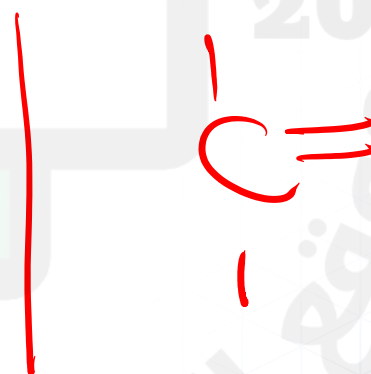
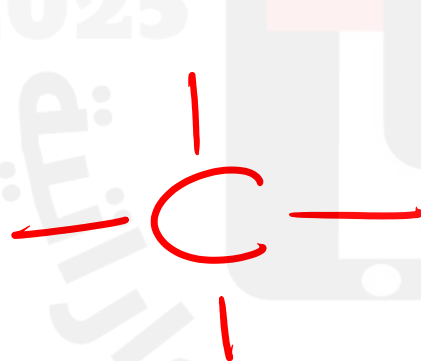
Learning objectives:

- **Identify and Name** an alkene by examining its structure.
- **Draw** the structure of an alkene or alkyne by analyzing its name.
- **Recognize** some properties and applications of Alkenes.

Focus Question & Main Idea

Why do some hydrocarbons form double and triple bonds?

MAIN IDEA Alkenes are hydrocarbons that contain at least one double bond, and alkynes are hydrocarbons that contain at least one triple bond.



New Vocabulary

alkene

alkyne




Review Vocabulary

hormone: chemical produced in one part of an organism and transported to another part, where it causes a physiological change

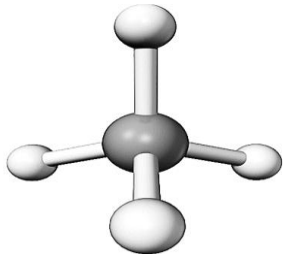
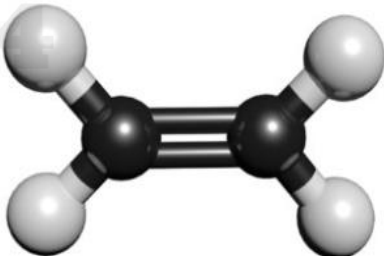
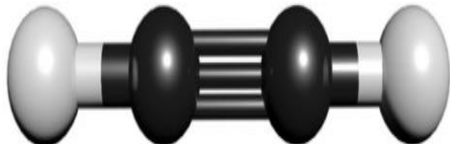


Starter Revision

- Compared with its corresponding **unsaturated** hydrocarbon, a **saturated** (hydrocarbon) has

- 
- a. more hydrogen.
 - b. less hydrogen.
 - c. ~~more oxygen.~~
 - d. ~~less oxygen.~~

Recall: Carbon can form single, double, or triple covalent bonds.

Type of bonding	Bond structure	Example	3D pic
<p><i>more (1)</i></p> <p><i>Saturated</i></p> <p><u>Single</u> (Alkane)</p>	$\begin{array}{c} \\ -C- \\ \end{array}$	<p>Methane</p> $\begin{array}{c} H \\ \\ H-C-H \\ \\ H \end{array}$	
<p><i>unsaturated</i></p> <p><i>less</i></p> <p><i>(#)</i></p> <p>Double (Alkene)</p>	$\begin{array}{c} \diagup \\ C= \\ \diagdown \end{array}$	<p>Ethene</p> $\begin{array}{cc} H & H \\ & \backslash \quad / \\ & C=C \\ & / \quad \backslash \\ H & H \end{array}$	
<p>Triple (Alkyne)</p>	$-C \equiv$	<p>Ethyne</p> $H-C \equiv C-H$	

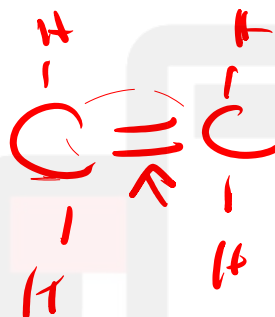
Alkenes

1 C meth
2 C eth

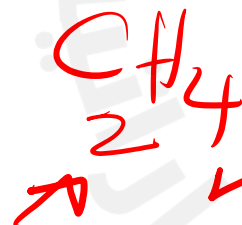


- Alkenes are hydrocarbons that contain **at least one double bond**.

So, the simplest Alkene will be:-



Two "C"



name:-

~~ethane~~

ethene

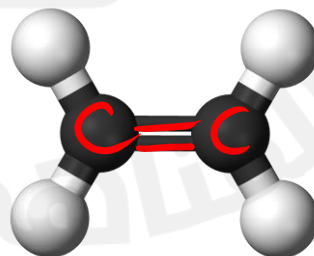
Alkenes end with ene

Alkenes

- Alkenes are hydrocarbons that contain **at least one double bond**.

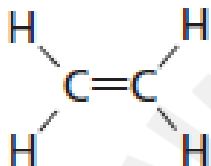
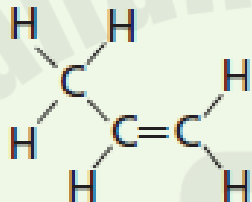
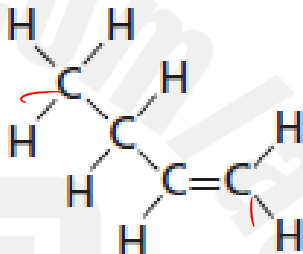
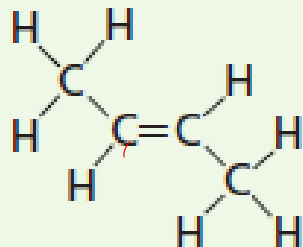
Because an alkene must have a double bond between carbon atoms, **there is no 1-carbon alkene**.

The simplest alkene has two carbon atoms double bonded to each other. The remaining four electrons—two from each carbon atom—are shared with four hydrogen atoms to give the molecule ethene (C_2H_4).



The smallest Alkene
“Ethene”

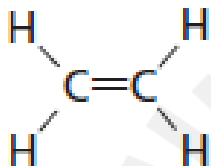
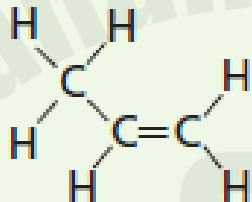
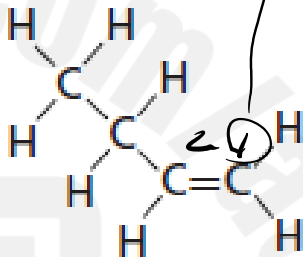
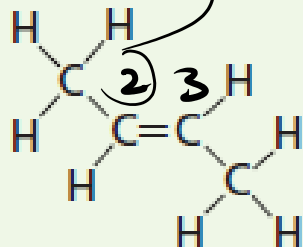
Examples of Alkenes

Name	Ethene	<u>Propene</u>	<u>1-Butene</u>	<u>2-Butene</u>
Molecular formula	<u>C_2H_4</u>	C_3H_6	C_4H_8	C_4H_8
Structural formula				
Condensed structural formula	$CH_2=CH_2$	$CH_3CH=CH_2$	$CH_3CH_2CH=CH_2$	$CH_3CH=CHCH_3$

From the table, deduce the general formula of an alkene with only one double bond.

Examples of Alkenes

C_5H_{10} Pentene

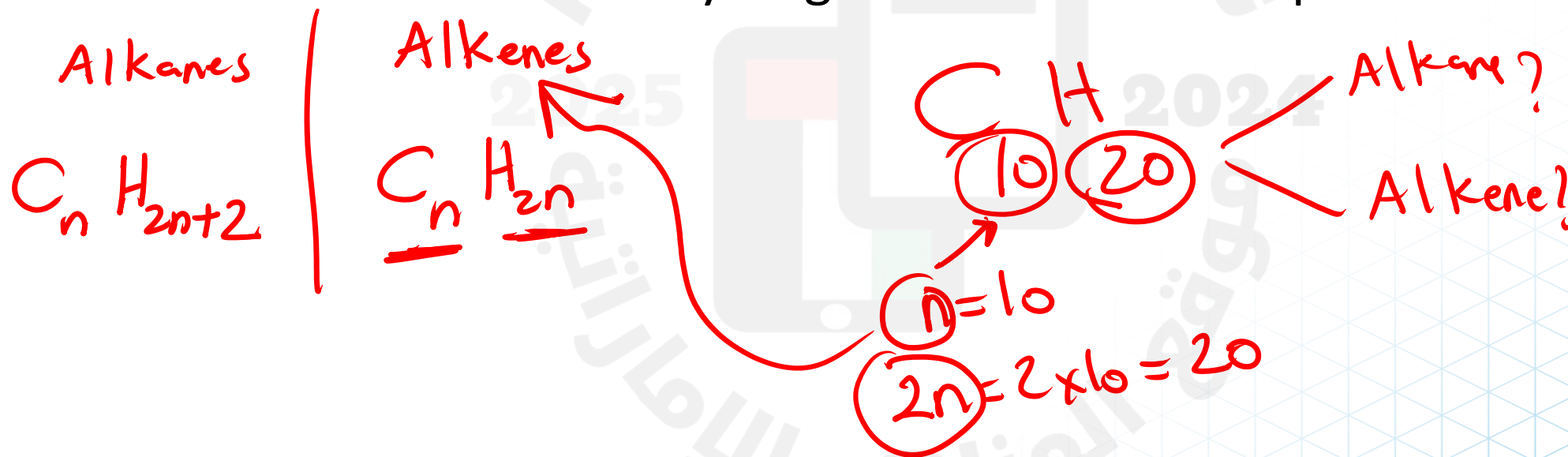
Name	Ethene	Propene	1-Butene	2-Butene
Molecular formula	C_2H_4	C_3H_6	C_4H_8	C_4H_8
Structural formula				
Condensed structural formula	$CH_2=CH_2$	$CH_3CH=CH_2$	$CH_3CH_2CH=CH_2$	$CH_3CH=CHCH_3$

You can conclude from the table; you will see that each molecular formulas for the substances shown in the table, has twice as many hydrogen atoms as carbon atoms,

The general formula for the series is C_nH_{2n} . This formula is true for alkenes with only one double bond.

Alkenes

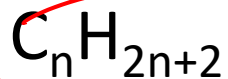
- Unsaturated hydrocarbons that contain one or more double covalent bonds between carbon atoms in a chain are called **alkenes**.
- For alkenes with only one double bond, the relationship between the numbers of carbon and hydrogen atoms can be expressed as: C_nH_{2n}



Activity

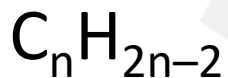
The general formula for non-cyclic (Straight chain) alkenes is

a.

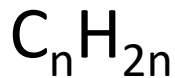


Alkanes

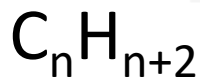
b.



c.



d.



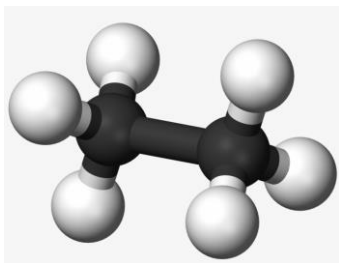
Activity

The formula CH₃CH₂CH₂CH₂CH=CH₂ represents an

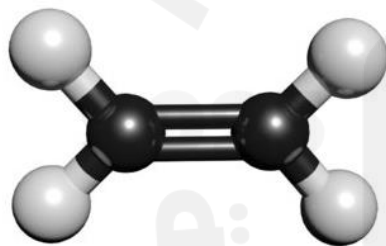
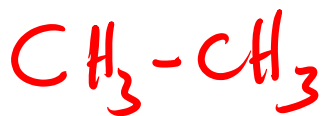
- a. alkane.
- b. alkyne.
- c. alcohol.
- ☒ d. alkene.

Naming Alkenes (with 2 or 3 carbons)

- Alkenes are named in much the same way as alkanes.
- Their names are formed by changing the -ane ending of the corresponding alkane to -ene.



Alkane: Ethane C_2H_6

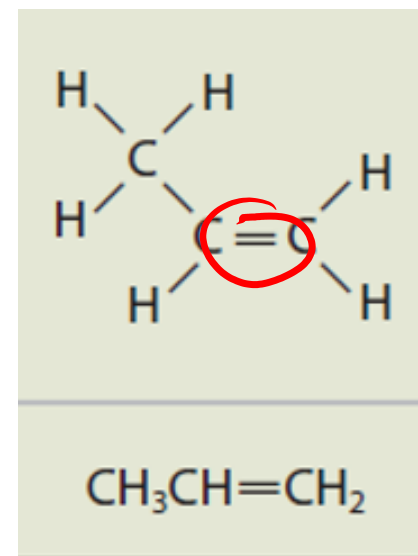


Alkene: Ethene C_2H_4

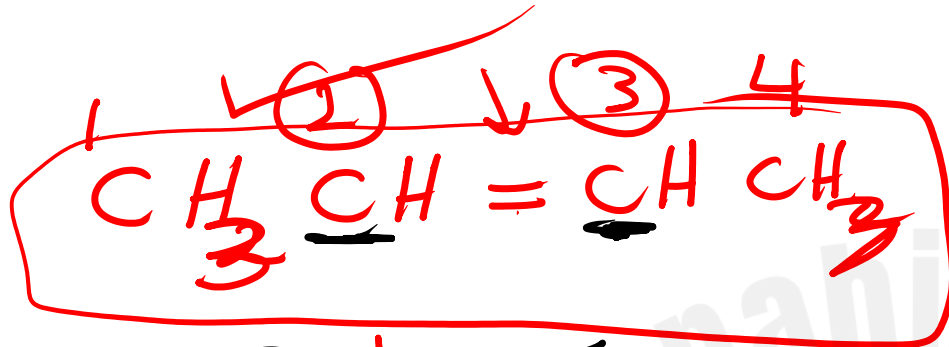


Propane C_3H_8

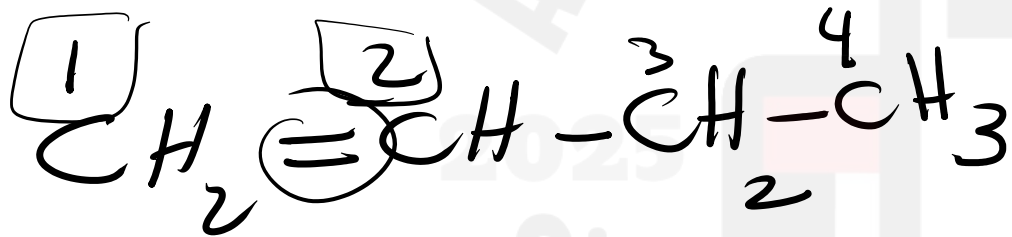
Propene



4 - carbons (but-)



2-butene



1-butene

Alkenes



we need
to show
the location
of the
double bond

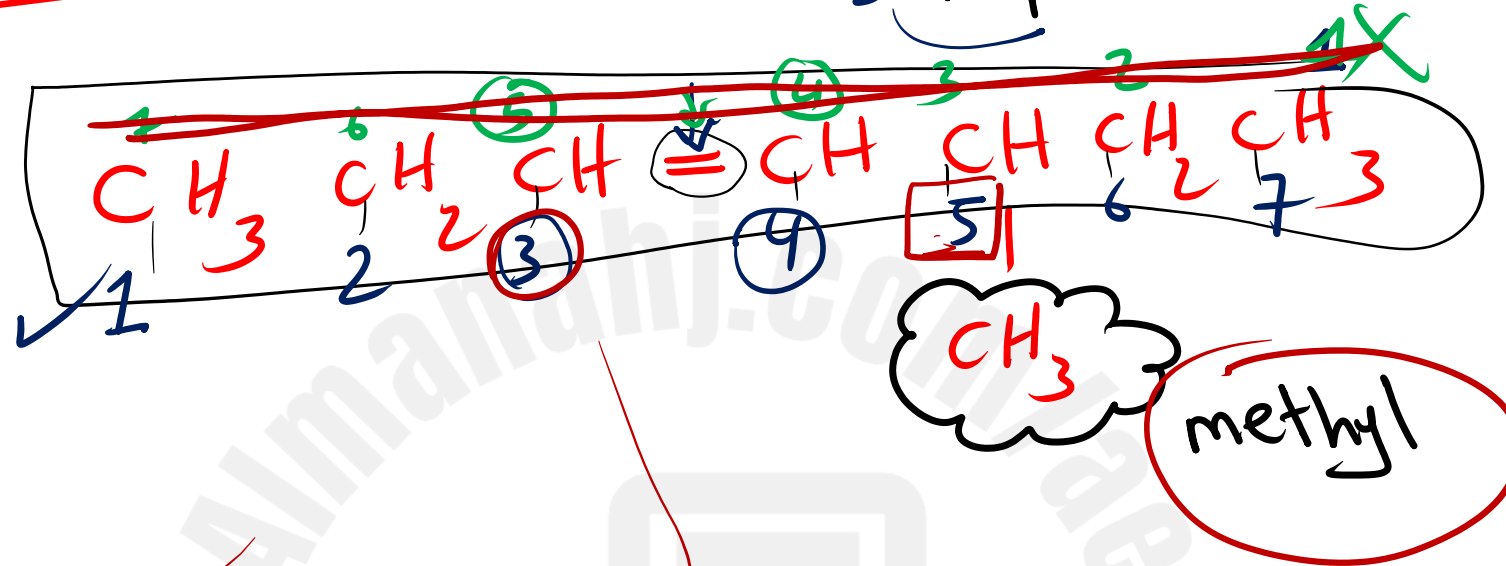
* The parent chain:- It is the longest chain of carbons that contains the double bond



This will be the
parent chain
hexene

Name this Molecule:-

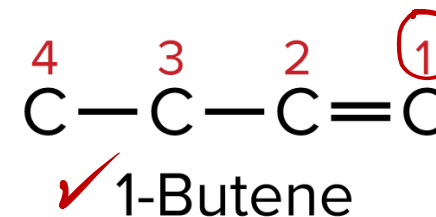
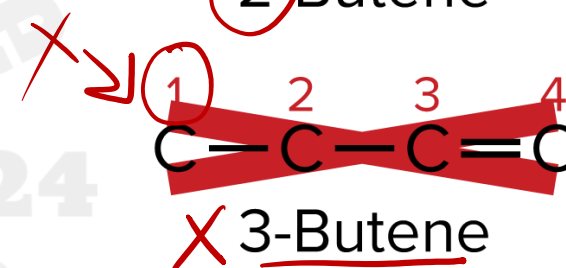
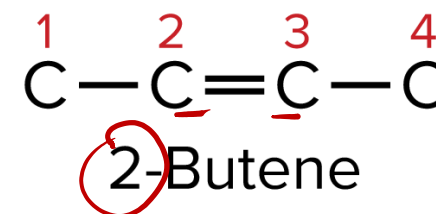
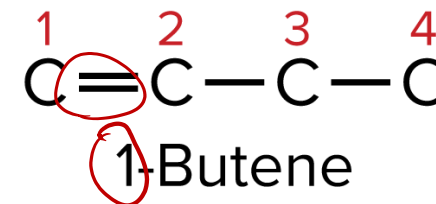
~~4-heptene~~
3-heptene



5-methyl-3-heptene

Naming Alkenes (with 4 or more carbons)

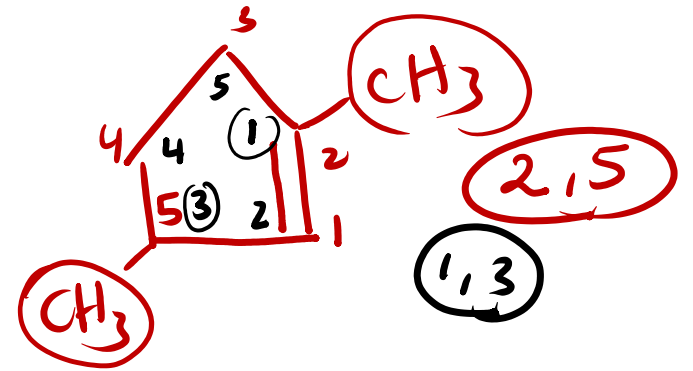
- To name alkenes with four or more carbons in the chain, it is necessary to specify the location of the double bond, fig. 21.12.
- This is done by **numbering the carbons in the parent chain**, starting at the end of the chain that will give the first carbon in the double bond the lowest number. Then, use only that number in the name.



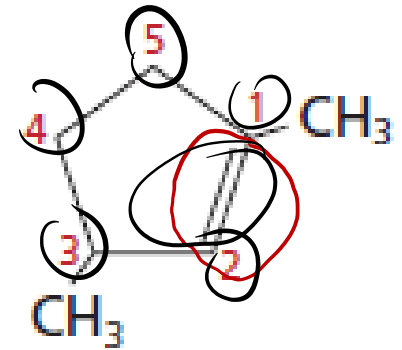
a. Straight-chain alkenes

cycloalkenes

Naming Alkenes (Cyclic Alkenes)



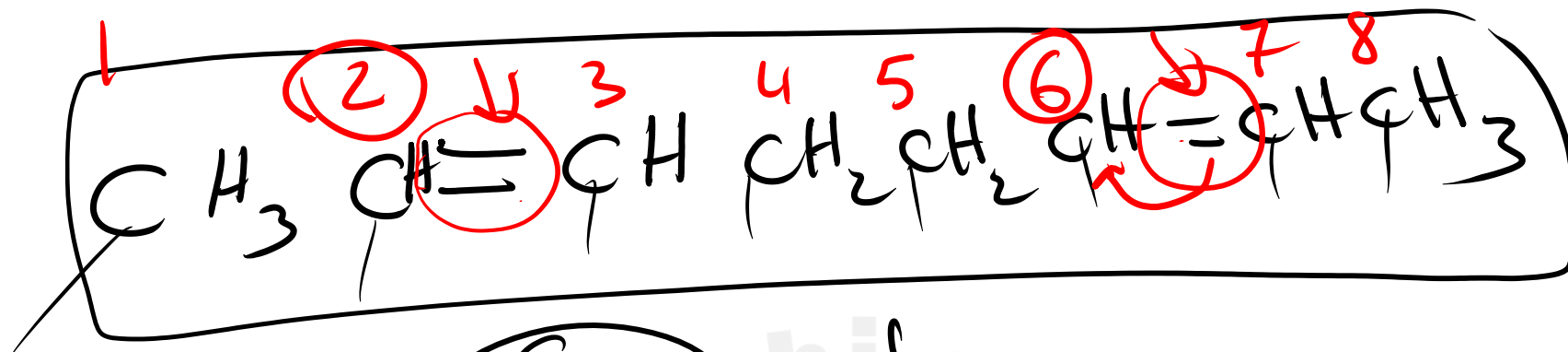
- **Cyclic alkenes or cycloalkenes** are named in much the same way as cyclic alkanes; however, carbon number 1 must be one of the carbons connected by the double bond. In the figure, note the numbering in the compound.



b. Cyclic alkenes

1,3-dimethylcyclopentene

- The name of this compound is 1,3-dimethylcyclopentene.



8C oct-
~~octene~~

Two \Rightarrow di
 Three \Rightarrow tri

octadiene

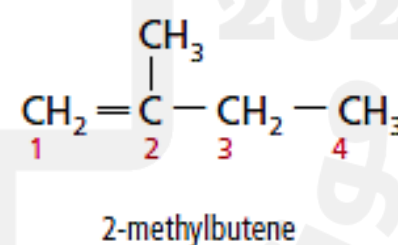
2,6-octadiene

Naming branched-chain alkenes

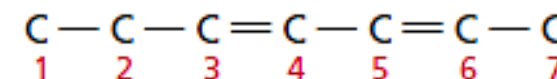
When naming branched chain alkenes, follow the IUPAC rules for naming branched-chain alkanes, but with two exceptions:

1. First, in alkenes, **the parent chain is always the longest chain that contains the double bond**, whether or not it is the longest chain of carbon atoms.
2. Second, **the position of the double bond**, not the branches, determines how the chain is numbered.

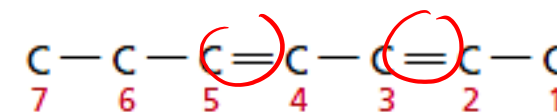
The positions of the double bonds in alkenes are numbered in a way that gives the lowest set of numbers. This is true of both branched and straight chain alkenes.



a. Single double bond



or



2,4-heptadiene

b. Two double bonds

Naming branched-chain alkenes

- For alkenes with **more than one double bond**, you must indicate the position of the double bond(s) using a prefix (*di-*, *tri-*, etc.) before the suffix *-ene*.
Example: 2,4-heptadiene
- The positions of the bonds are numbered to give the lowest set of numbers.

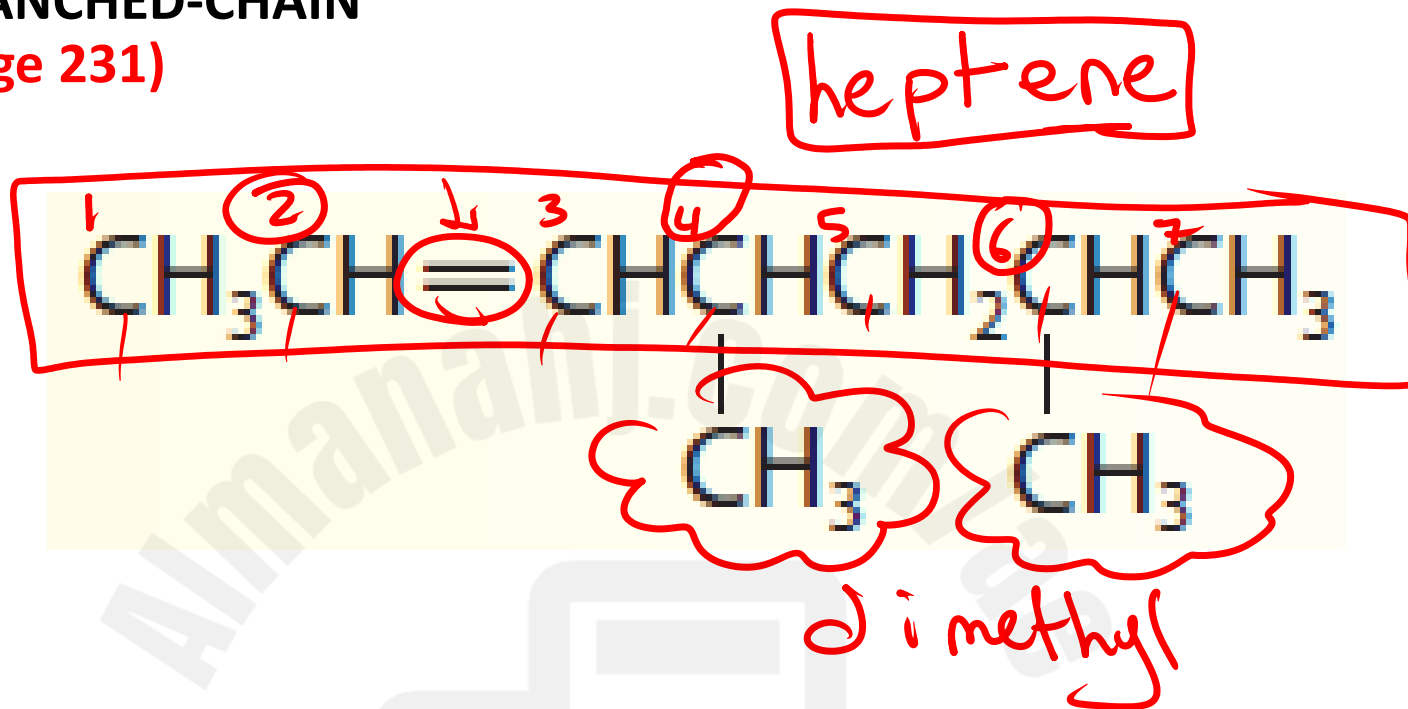
NAMING BRANCHED-CHAIN ALKENES (Page 231)

IN-CLASS EXAMPLE

Use with Example Problem 3.

Problem

Name the alkene shown.



4,6-dimethyl-2-heptene ✓

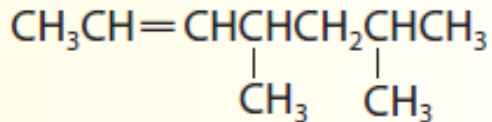
NAMING BRANCHED-CHAIN ALKENES (Page 231)

IN-CLASS EXAMPLE

Use with Example Problem 3.

Problem

Name the alkene shown.



Response

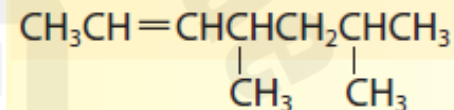
ANALYZE THE PROBLEM

You are given a branched-chain alkene that contains one double bond and two alkyl groups. Follow the IUPAC rules to name the organic compound.

SOLVE FOR THE UNKNOWN

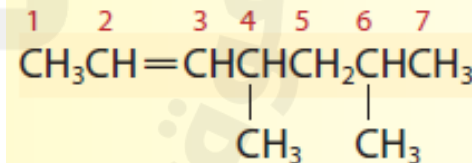
Step 1. The longest continuous-carbon chain that includes the double bond contains seven carbons. The 7-carbon alkane is heptane, but the name is changed to heptene because a double bond is present.

- Heptene parent chain



Step 2. Number the chain to give the lowest number to the double bond.

- 2-heptene parent chain

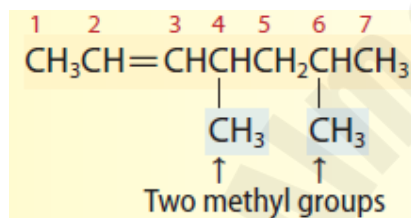


NAMING BRANCHED-CHAIN ALKENES

IN-CLASS EXAMPLE

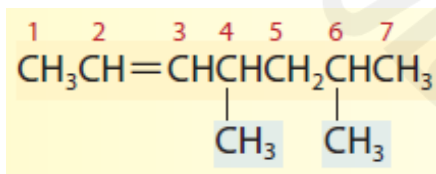
Step 3. Name each substituent.

- Each substituent is a methyl group.



Step 4. Determine how many of each substituent is present, and assign the correct prefix to represent that number. Then, include the position numbers to get the complete prefix.

- 2-heptene parent chain
- Two methyl groups at Positions 4 and 6
- Prefix is 4,6-dimethyl

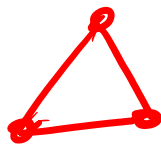


Step 5. The names of substituents do not have to be alphabetized because they are the same. Apply the complete prefix to the name of the parent alkene chain. Use commas between numbers, and hyphens between numbers and words. Write the name 4,6-dimethyl-2-heptene.

EVALUATE THE ANSWER

The longest carbon chain includes the double bond, and the position of the double bond has the lowest possible number. Correct prefixes and alkyl group names designate the branches.

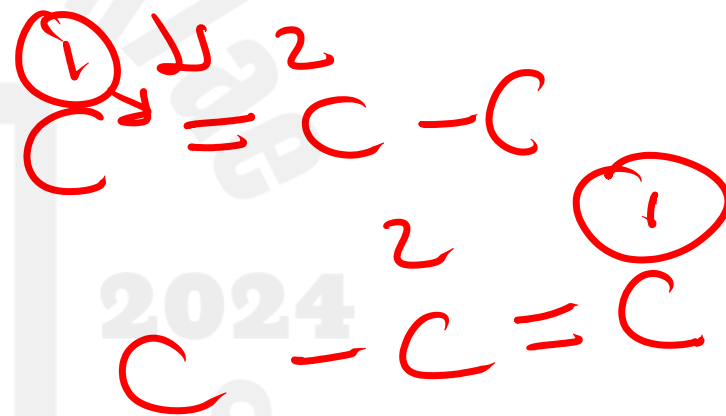
Check



Prop

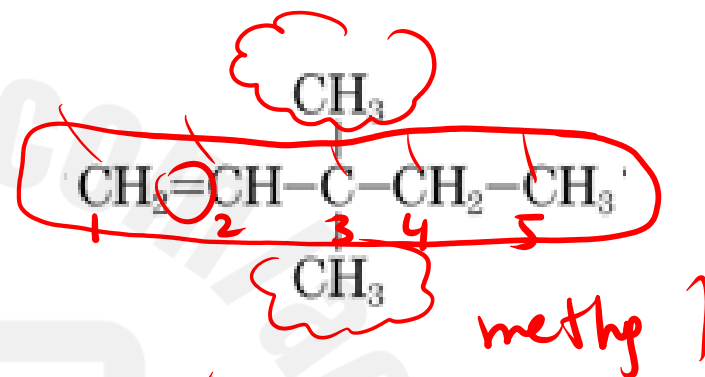
Name the alkene with the formula CH_3CHCH_2 .

- a. ~~ethene~~
- b. ~~cyclopropene~~
- c. 1-propene
- d. 2-propene



Check

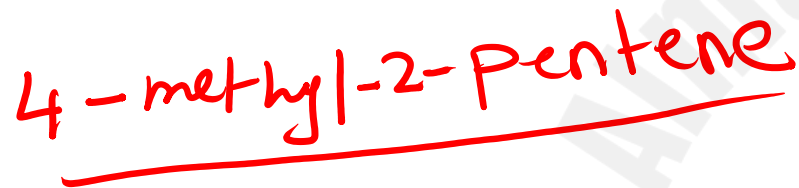
What is the correct IUPAC name for



- a. ~~1-pentene~~
- b. ~~4-pentene~~
- c. 3,3-dimethyl-1-pentene
- d. 3,3-dimethyl-4-pentene

3,3-dimethyl-1-pentene

Use the IUPAC rules to name the following structures.



2,2,6-trimethyl-3-octene

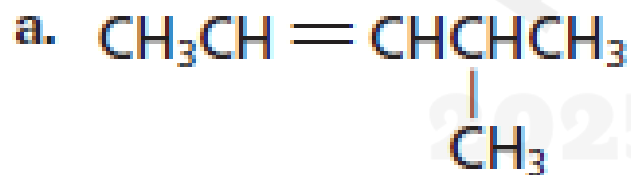


Alkene $C=C$



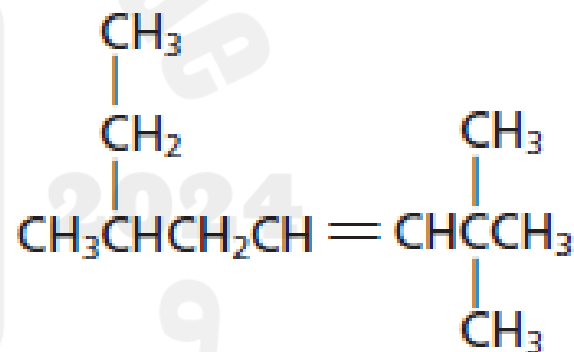
Practice Problems Page 232

Use the IUPAC rules to name the following structures.



4-methyl-2-pentene

b.



2,2,6-trimethyl-3-octene

Properties of Alkenes (Page 232)



Physical: ✓

- Like alkanes, alkenes are nonpolar and therefore have low solubility in water.
- relatively low melting and boiling points.

ذوبان ضئيل

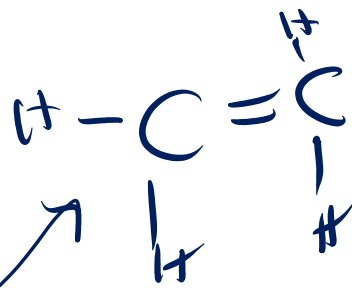
Chemical:

- alkenes are more reactive than alkanes because the second covalent bond increases the electron density between two carbon atoms, providing a good site for chemical reactivity.
- Reactants that attract electrons can pull the electrons away from the double bond.

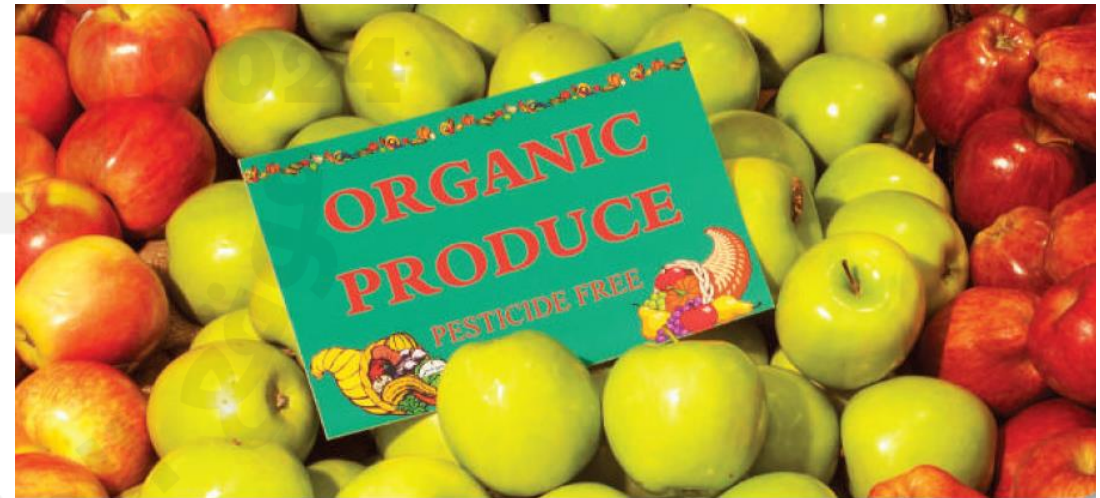
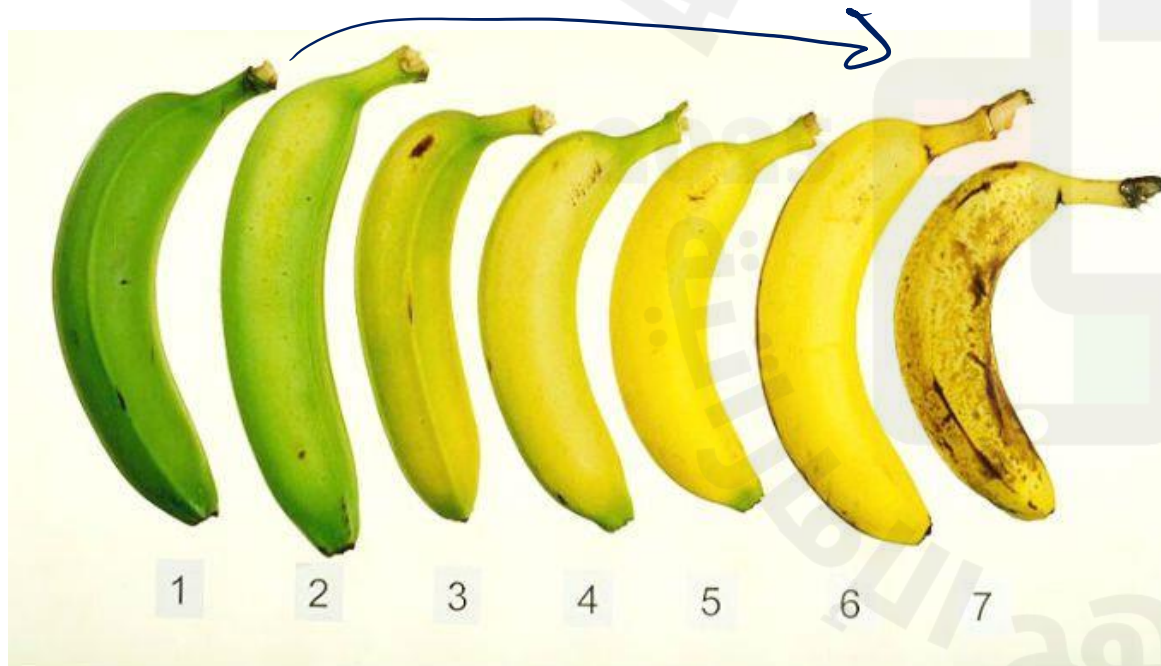


double

Uses of alkenes



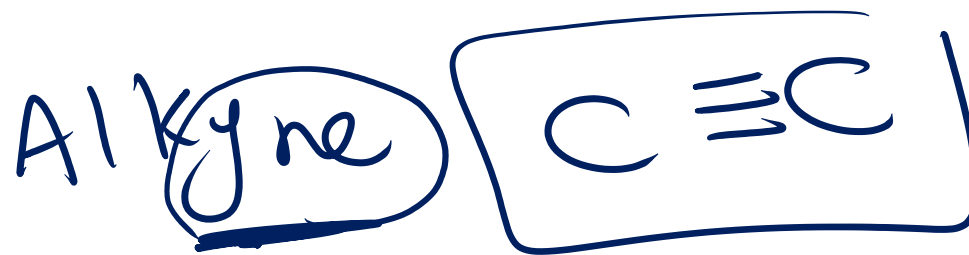
- Several alkenes occur naturally in living organisms. For example, ethene is a hormone produced naturally by plants. It causes fruit to ripen and plays a part in causing **leaves to fall** from deciduous trees in **preparation for winter**.
- The fruits in grocery stores ripen artificially when they are exposed to ethene.



Uses of alkenes

- **Ethene** is also the starting material for the synthesis of the plastic polyethylene, which is used to manufacture many products, including plastic bags, rope, and milk jugs.
- Other alkenes are responsible for the scents of lemons, limes, and pine trees.



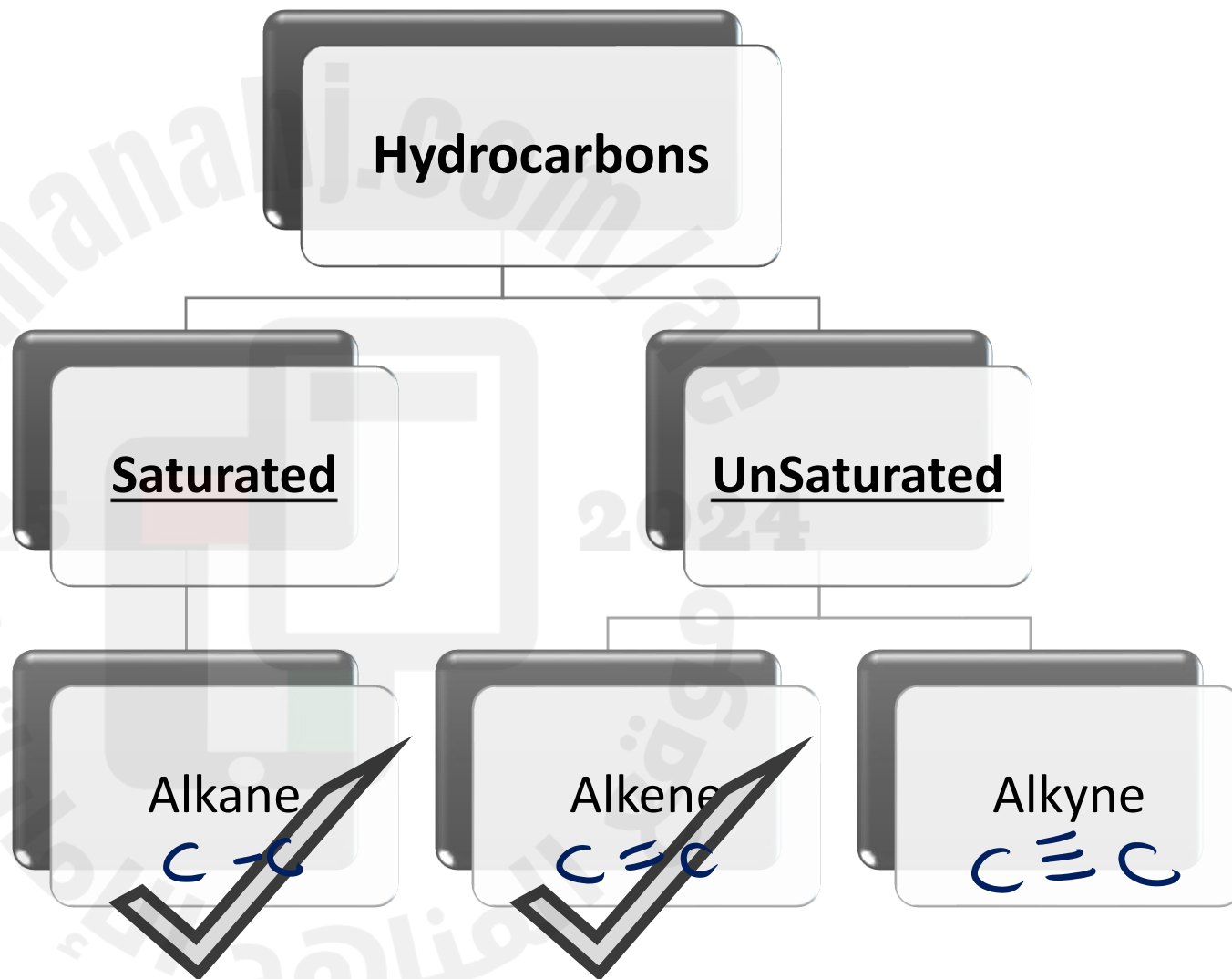


Learning objectives:

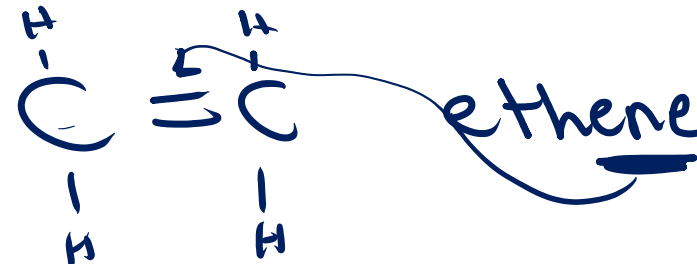
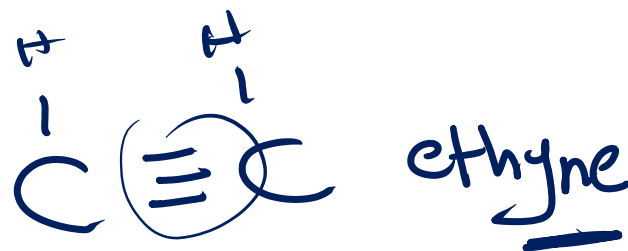
- **Identify and Name** an alkyne by examining its structure.
- **Draw** the structure of alkyne by analyzing its name.

Introduction

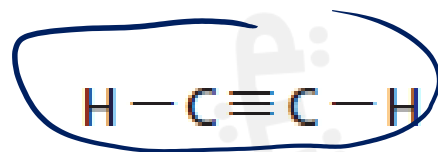
We have covered
Alkanes and Alkene, and
this period we will cover
Alkyne



Alkyne



- Alkynes are **Unsaturated hydrocarbons** that contain at least one triple bond.
- The simplest and most used alkyne is **ethyne (C₂H₂)**, which is widely known by its **common name acetylene**.



Models of ethyne (acetylene)

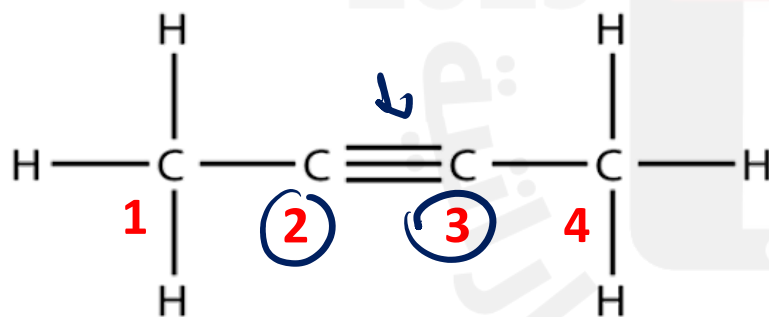
Naming alkynes

- Straight-chain alkynes and branched-chain alkynes are named in the same way as alkenes. The only difference is that the name of the parent chain ends in -yne rather than -ene.
- Alkynes with **one triple covalent bond** form a homologous series with the general formula C_nH_{2n-2} .

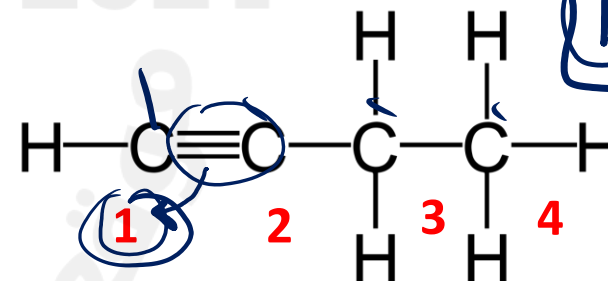
Alkyne

Alkene
 C_nH_{2n}

Alkane
 C_nH_{2n+2}



2-Butyne

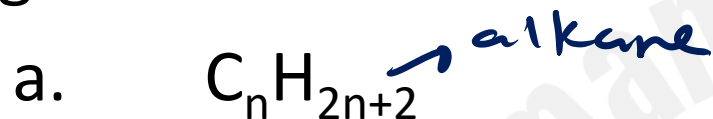


1-Butyne

1-butyne

Check

- The general formula for noncyclic (straight chain) alkynes is



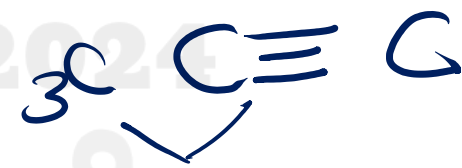
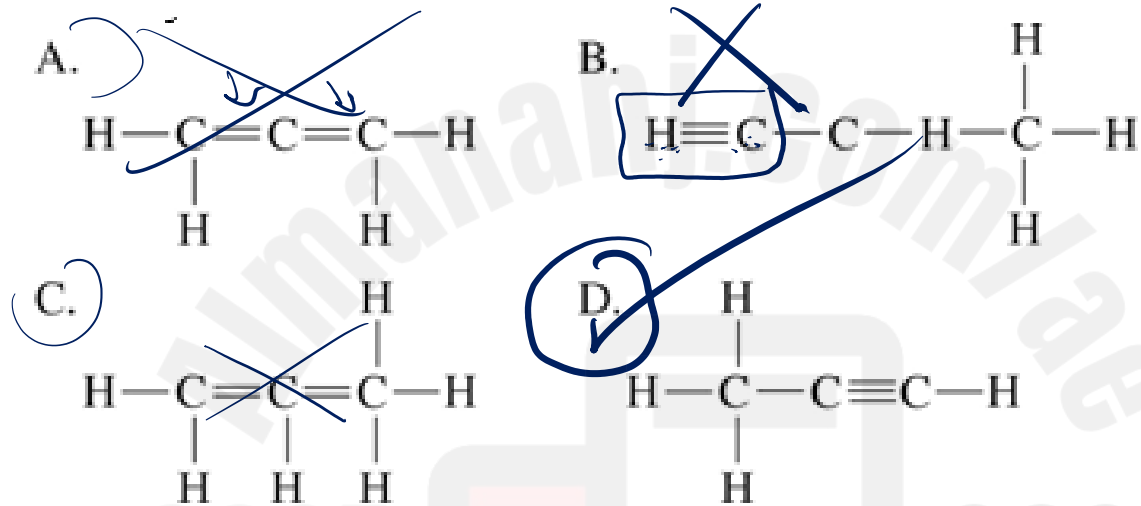
Examples of Alkynes

Name	Molecular Formula	Structural Formula	Condensed Structural Formula
Ethyne	C_2H_2	$H-C \equiv C-H$	$CH \equiv CH$
Propyne	C_3H_4	$ \begin{array}{c} H \\ \\ H-C \equiv C-C-H \\ \\ H \end{array} $	$CH \equiv CCH_3$
1-Butyne	C_4H_6	$ \begin{array}{c} H \quad H \\ \quad \\ H-C \equiv C-C-C-H \\ \quad \\ H \quad H \end{array} $	$CH \equiv CCH_2CH_3$
2-Butyne	C_4H_6	$ \begin{array}{c} H \quad \quad H \\ \quad \quad \\ H-C-C \equiv C-C-H \\ \quad \quad \\ H \quad \quad H \end{array} $	$CH_3C \equiv CCH_3$

Check

- What is the name of the alkyne with the formula C_2H_2 ?
 - a. ethane
 - b. ethene
 - c. ethyne
 - d. ethylene

Check



Which of the figures above is the structural formula for propyne?

A

B

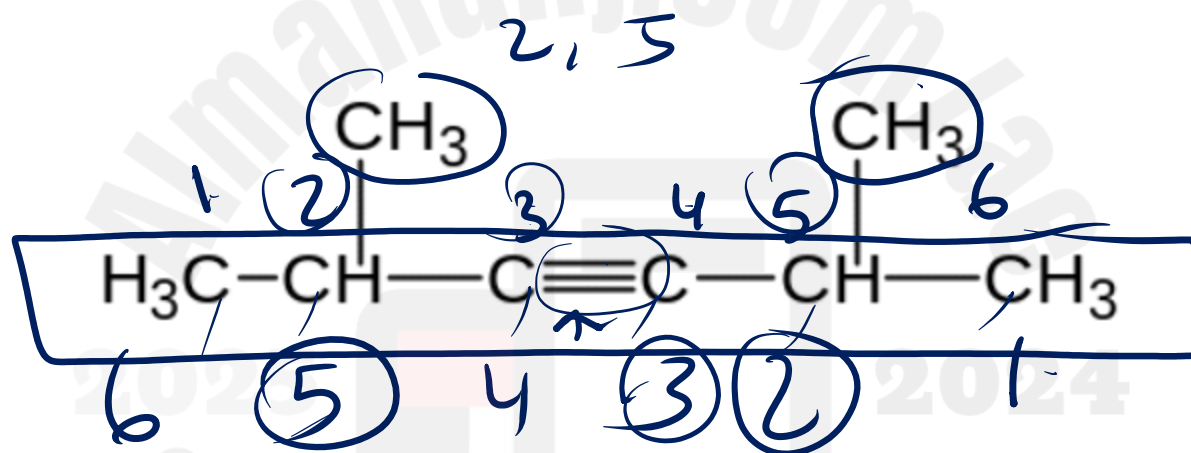
C

D

Check

- What is the name of this hydrocarbon?

parent chain



2,5-dimethyl-3-hexyne



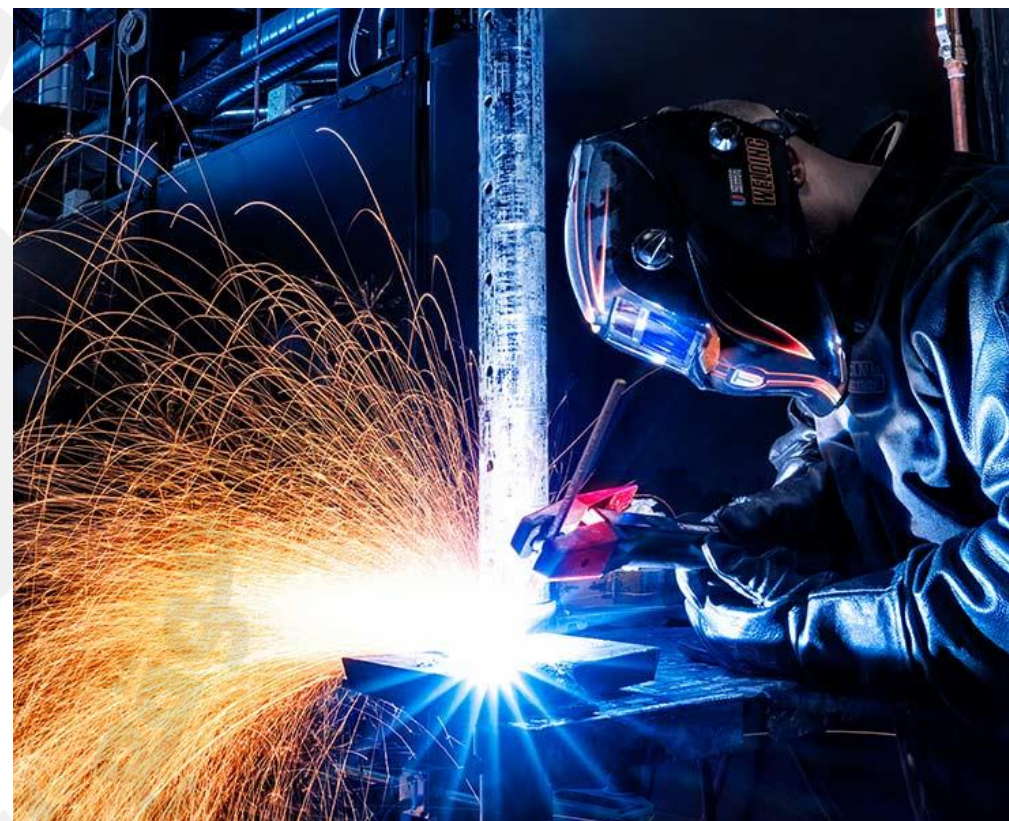
Properties of alkynes

- Alkynes have physical and chemical properties similar to those of alkenes. Alkynes undergo many of the reactions' alkenes undergo.
- However, **alkynes** are generally **more reactive** than **alkenes** because the triple bonds of alkynes have even greater electron density than the double bonds of alkenes.
- This cluster of electrons is effective at inducing dipoles in nearby molecules, causing them to become unevenly charged and thus reactive.

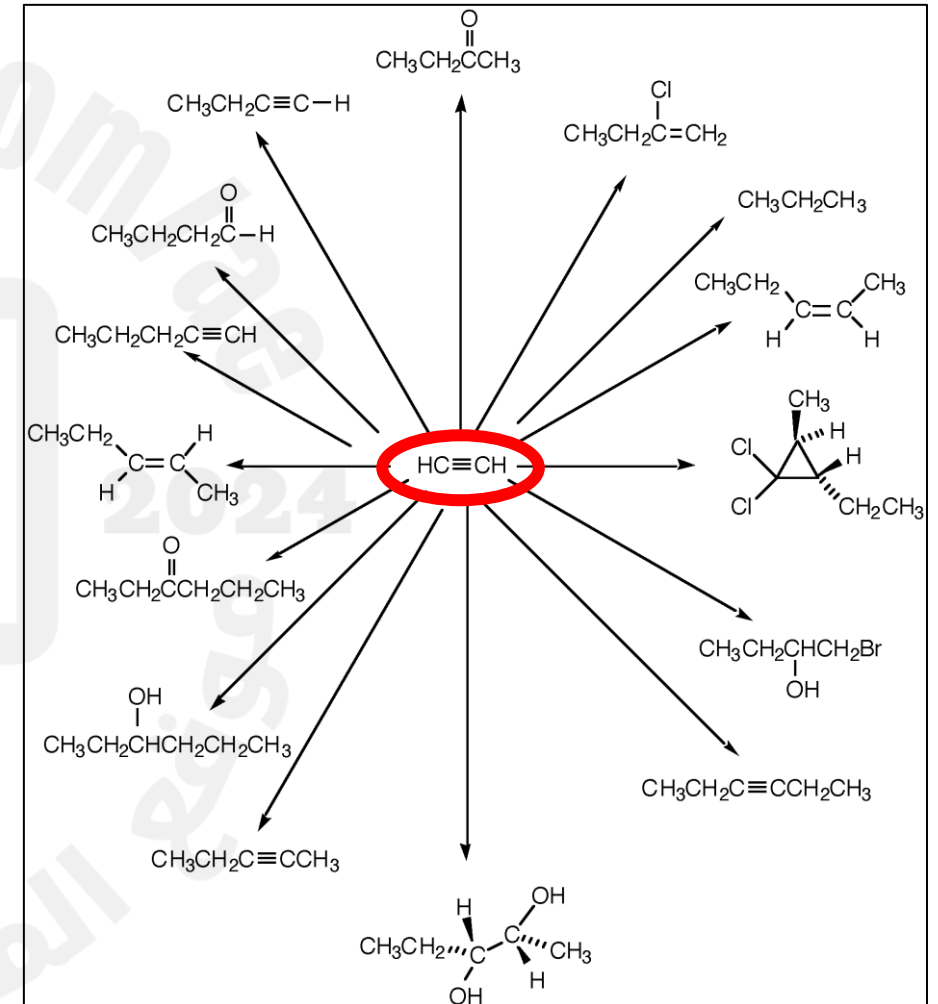


Uses of alkynes

- **Ethyne**—known commonly as **acetylene**—is a by-product of oil refining and is also made in large quantities by the reaction of calcium carbide (CaC_2) with water.
- When supplied with enough oxygen, ethyne burns with an intensely hot flame that can reach temperatures as high as 3000°C .
- **Acetylene torches** are commonly used in welding.




- Because the triple bond makes alkynes reactive, simple alkynes like ethyne are used as starting materials in the manufacture of **plastics** and **other organic chemicals** used in industry.




Plenary

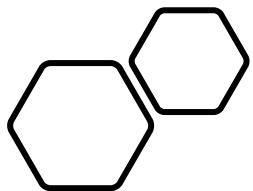
Why are simple alkynes like ethyne often used as a starting material for manufacturing plastics?

 Alkynes are never used in manufacturing.

 They have properties that are very different from alkenes, which cannot be used.

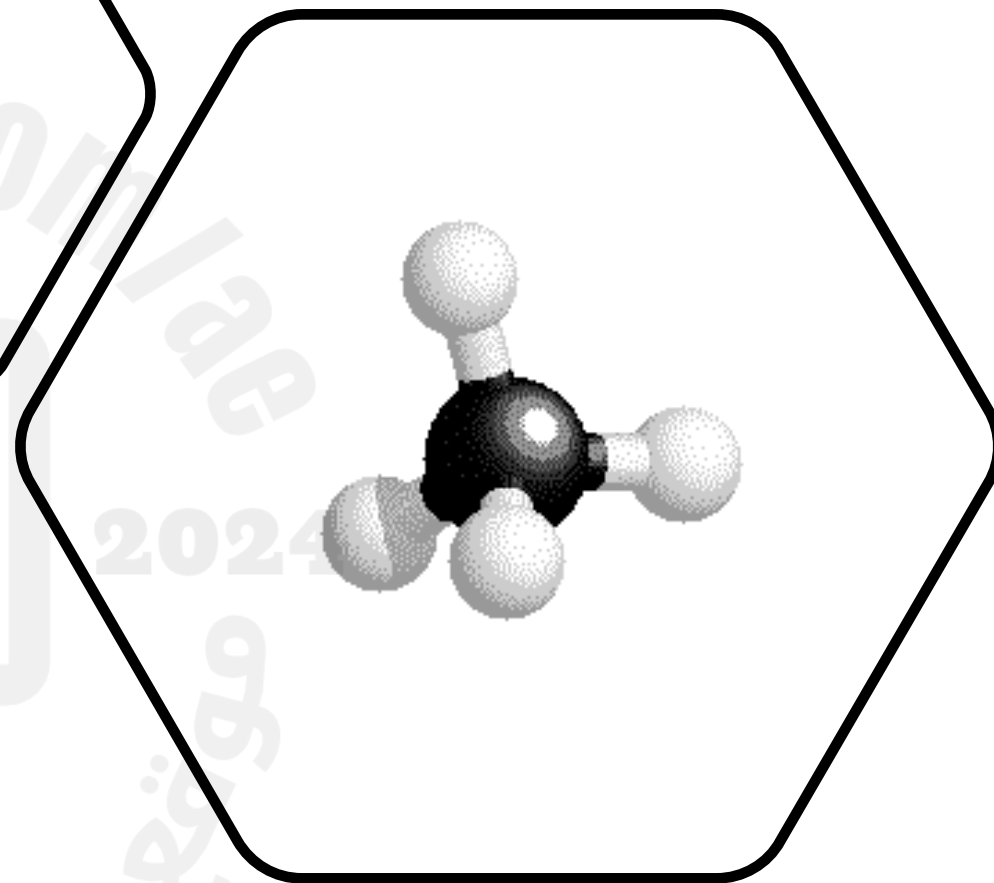
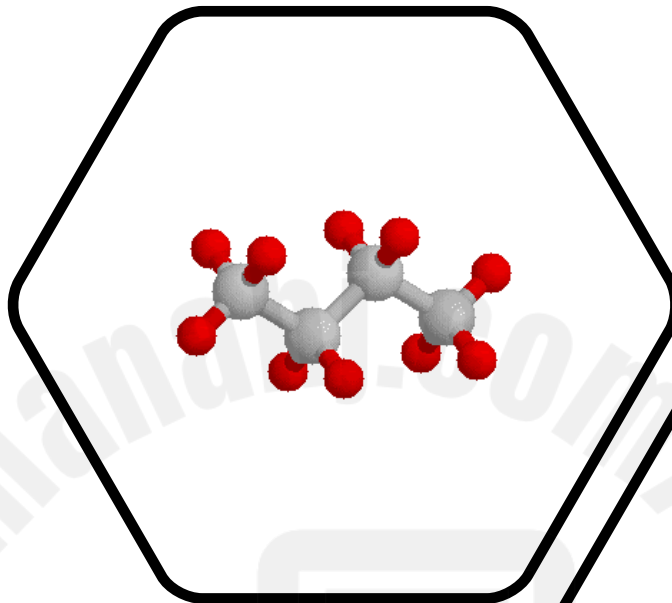
 They are insoluble in nonpolar compounds.

 Their triple bond makes them highly reactive. **CORRECT**



Section Summary

- Alkenes and alkynes are hydrocarbons that contain at least one double or triple bond, respectively.
- Alkenes and alkynes are nonpolar compounds with greater reactivity than alkanes but with other properties similar to those of alkanes.



Plenary

1. Which of the following is NOT true of alkenes?

 A They are saturated. **CORRECT**


 They have at least one double bond.


 They can have a cyclic structure.


 There are no one-carbon alkenes.

Plenary

2. Which of the following is a correctly named alkene?

 1,3-butane

 1,3-butene

 3-butene

 1-butene

CORRECT

Plenary

3. Which of the following is a property of alkenes?



They are polar molecules.



They have high boiling points.

c

They are relatively insoluble in water.

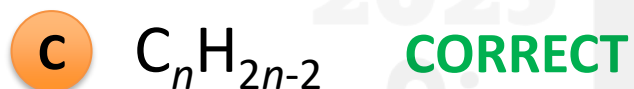
CORRECT




They have high melting points.

Plenary

4. Identify the relationship between the number of carbon and hydrogen atoms in alkynes with one triple bond?



 There no relationship between the number of carbon and hydrogen atoms.