

Name	General Formula	Examples	
		Name	Structural Formula
alkanes	C_nH_{2n+2}	ethane	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $
alkenes	C_nH_{2n}	ethene	$ \begin{array}{c} \text{H} \quad \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \text{H} \end{array} $
alkynes	C_nH_{2n-2}	ethyne	$\text{H}-\text{C}\equiv\text{C}-\text{H}$

Note: n = number of carbon atoms

Overview:

Organic compounds may be classified in homologous series. A homologous series is a group of compounds having related structures and properties. Each member of a homologous series differs from the preceding by a common increment – this being one carbon atom and two hydrogen atoms. Any homologous series can be represented by a general formula.

The Table:

This table gives the Name, General Formula and Examples of the Structural Formula of three homologous series of hydrocarbons. A hydrocarbon is a compound composed of only carbon and hydrogen.

Homologous Series:

The *alkanes* are saturated hydrocarbons, having only single bonds between adjacent carbon atoms. The name of each alkane ends in –ane. The prefix from Table P indicates the number of carbon atoms. Their chemical formula must match the General Formula given in the table.

The *alkenes* are unsaturated hydrocarbons, having one double bond between two adjacent carbon atoms. The name of each alkene ends in –ene. The prefix from Table P indicates the number of carbon atoms. Their chemical formula must match the General Formula given in the table.

The *alkynes* are unsaturated hydrocarbons, having one triple bond between two adjacent carbon atoms. The name of each alkyne ends in –yne. The prefix from Table P indicates the number of carbon atoms. Their chemical formula must match the General Formula given in the table.

In the General Formula, n represents the number of carbon atoms in the molecule.

General Formula Examples:

- (1) A hydrocarbon from the alkane series contains 4 carbon atoms. What is its molecular formula?

Solution: $n = 4$ and the general formula for alkanes is C_nH_{2n+2} .

Substitution gives: $C_4H_{2(4)+2} = C_4H_{10}$ (butane)

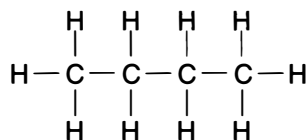
- (2) What homologous series does the hydrocarbon C_3H_4 belong to?

Solution: The number of carbon atoms is 3, thus $n = 3$.

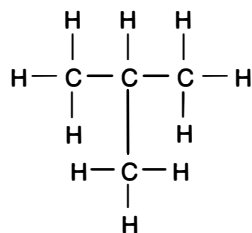
Substituting in the general formula for the alkyne series: $C_3H_{2(3)-2} = C_3H_4$

Additional Information:

- A double bond consists of two shared pairs of electrons (4 electrons). A triple bond consists of three shared pairs of electrons (6 electrons).
- Isomers are compounds with the same molecular formula (number of atoms of each element) but different structural formulas. Structural formulas show the different arrangement of the atoms in the molecules of the isomers of a given compound. The greater the number of carbon atoms in the molecule, the greater the number of isomers. The first hydrocarbon to show isomerism is butane. The structural formulas for the two isomers of butane (C_4H_{10}) are:



Normal butane or n-butane



Isobutane or 2-methylpropane

- Hydrocarbons contain covalent bonds and the molecules are nonpolar.
- Addition is the reaction in which one or more atoms are added to the site of a multiple bond in an unsaturated hydrocarbon, resulting in the formation of a saturated hydrocarbon.
- Substitution is the reaction in which one type of atom or group of atoms replaces another atom or group of atoms. This usually involves the replacement of one or more hydrogen atoms on a saturated hydrocarbon molecule.
- Polymerization is the chemical combination of a large number of molecules of a certain type, called monomers, to form a giant molecule, called a polymer. An example is $n C_2H_4 \rightarrow (C_2H_4)_n$, where the monomer is ethylene and the polymer is polyethylene
- As the molecular mass increases in a homologous series of hydrocarbons, the boiling point of the compounds increases.

Set 1 — Homologous Series of Hydrocarbons

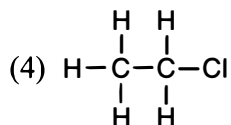
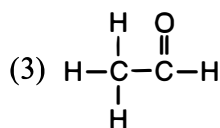
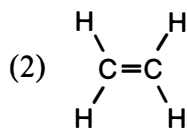
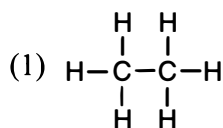
1. Which element has atoms that can form single, double, and triple covalent bonds with other atoms of the same element?
(1) hydrogen (3) fluorine
(2) oxygen (4) carbon 1 _____
2. What is the general formula for the members of the alkane series?
(1) C_nH_{2n} (3) C_nH_{2n-2}
(2) C_nH_{2n+2} (4) C_nH_{2n-6} 2 _____
3. Which hydrocarbon is saturated?
(1) propene (3) butene
(2) ethyne (4) heptane 3 _____
4. Which formula represents a saturated hydrocarbon?
(1) C_2H_2 (3) C_3H_4
(2) C_2H_4 (4) C_3H_8 4 _____
5. A double carbon-carbon bond is found in a molecule of
(1) pentane (3) pentyne
(2) pentene (4) pentanol 5 _____
6. A straight-chain hydrocarbon that has only one double bond in each molecule has the general formula
(1) C_nH_{2n-6} (3) C_nH_{2n}
(2) C_nH_{2n-2} (4) C_nH_{2n+2} 6 _____
7. Which formula represents an unsaturated hydrocarbon?
(1) C_2H_6 (3) C_5H_8
(2) C_3H_8 (4) C_6H_{14} 7 _____
8. Which general formula represents the homologous series of hydrocarbons that includes the compound 1-heptyne?
(1) C_nH_{2n-6} (3) C_nH_{2n}
(2) C_nH_{2n-2} (4) C_nH_{2n+2} 8 _____
9. A carbon-carbon triple bond is found in a molecule of
(1) butane (3) butene
(2) butanone (4) butyne 9 _____
10. Which formula represents propyne?
(1) C_3H_4 (3) C_5H_8
(2) C_3H_6 (4) C_5H_{10} 10 _____
11. What is the total number of electrons shared in the bonds between the two carbon atoms in a molecule of
 $H - C \equiv C - H$?
(1) 6 (3) 3
(2) 2 (4) 8 11 _____
12. Which formula represents an alkene?
(1) C_2H_6 (3) C_4H_{10}
(2) C_3H_6 (4) C_5H_{12} 12 _____

13. Which compound is classified as a hydrocarbon?

- (1) ethane
- (2) ethanol
- (3) chloroethane
- (4) ethanoic acid

13 _____

14. Which formula represents an unsaturated hydrocarbon?



14 _____

15. Which compound is a saturated hydrocarbon?

- (1) hexane
- (2) hexene
- (3) hexanol
- (4) hexanal

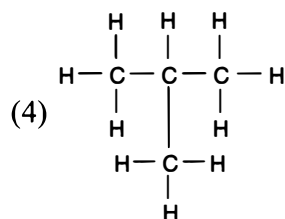
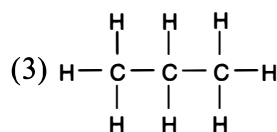
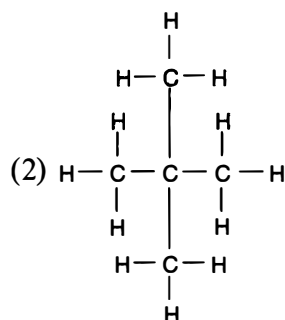
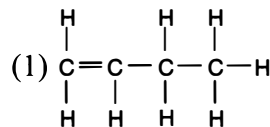
15 _____

16. The isomers butane and methylpropane differ in their

- (1) total number of bonds per molecule
- (2) structural formulas
- (3) total number of atoms per molecule
- (4) molecular formulas

16 _____

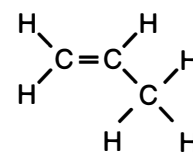
17. Which formula is an isomer of butane?



17 _____

18. Given the

structural formula:



What is the IUPAC name of this compound?

- (1) propane
- (2) propene
- (3) propanone
- (4) propanal

18 _____

19. Which formula correctly represents the product of an addition reaction between ethene and chlorine?

- (1) CH_2Cl_2
- (2) CH_3Cl
- (3) $\text{C}_2\text{H}_4\text{Cl}_2$
- (4) $\text{C}_2\text{H}_3\text{Cl}$

19 _____