

Chapter 11

Introduction to Organic Chemistry: Hydrocarbons

Organic Compounds

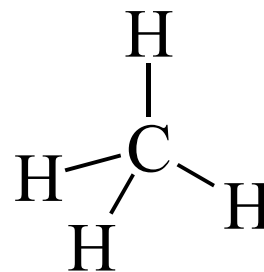
An **organic compound**

- is a compound made from **carbon and hydrogen** atoms
- may also contain other nonmetals such as oxygen, sulfur, nitrogen, phosphorus, or a halogen
- is often found in common products such as **gasoline**, medicines, shampoos, plastics, and perfumes

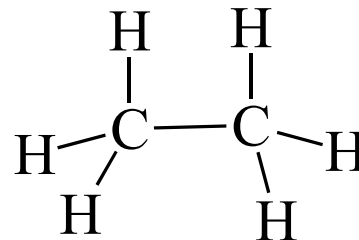
The formulas of organic compounds are written with **carbon first**, followed by hydrogen, and then any other elements.

Hydrocarbons

- **Hydrocarbons** are organic compounds that contain only carbon and hydrogen.
- In organic molecules, every carbon has **four** bonds.

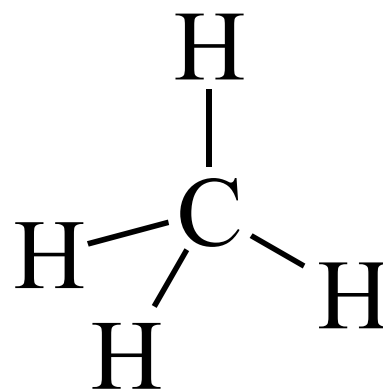


- **Saturated hydrocarbons** contain only **single** bonds.



“Saturated”

- **Saturated:** every carbon atom is bonded to the **maximum number of hydrogens possible** under normal valence rules.
- No more hydrogens can be added **without breaking existing C–C single bonds**



Alkanes — Saturated Hydrocarbons

- **Definition:** Hydrocarbons with only single C–C and C–H bonds
- **Saturated:** Each carbon bonded to the maximum number of hydrogens (general formula C_nH_{2n+2})
- **Structure:** Tetrahedral carbons, 109° bond angles
- **Properties:** Nonpolar, low boiling points, insoluble in water, flammable fuels
- **Forms:** Straight chain, branched, and cycloalkanes (rings have 2 fewer H than open chain)

Alkane Representations

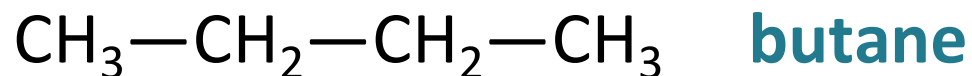
- An alkane molecule can be represented in several ways:
- as a molecular formula
- as a ball-and-stick model
- as an expanded structural formula
- as a condensed structural formula
- as a line-angle formula

Condensed Structural Formulas

In a **condensed structural formula**,

- each carbon atom and its attached hydrogen atoms are written as a group
- a **subscript** indicates the **number** of hydrogen atoms bonded to each carbon atom

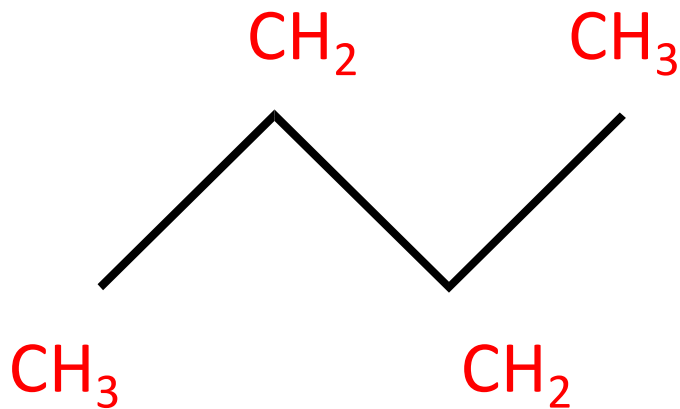
The condensed structural formula of butane has four carbon atoms.



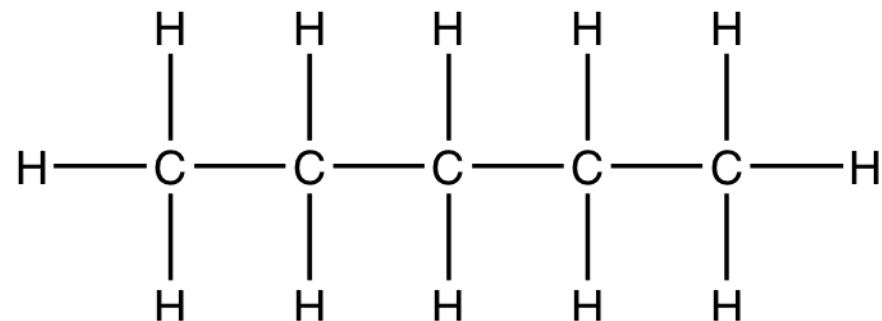
Writing Skeletal (line-angle) Formulas

Alkane compounds can also be represented by...

- **line-angle formulas**, which show the carbon skeleton in which carbon atoms are represented at the end of each line or at each corner



Given the following expanded structural formula, provide the



- A. molecular formula
- B. condensed structural formula
- C. line-angle formula

Naming Alkanes

1. Find the Longest Chain:

Select the continuous carbon chain with the most carbons → base name (*meth-*, *eth-*, *prop-*, *but-*, *pent-*, ...) + **-ane** ending.

2. Number the Chain:

Give the **lowest possible numbers** to substituents (alkyl or halo groups).

3. Name Substituents:

- groups of carbon atoms attached to carbon chains
- **Alkyl:** named with an **yl** ending. Ex) *methyl*, *ethyl*, *propyl* ...
- **Halogens:** *fluoro*, *chloro*, *bromo*, *iodo*

4. Combine & Alphabetize:

List substituents in **alphabetical order** with their numbers; use prefixes (*di-*, *tri-*) but **don't alphabetize** those prefixes.