CHIMICA ORGANICA

Informazioni sul corso

- Docente: Prof. Paolo Tecilla
    - Edificio C11, secondo piano, stanza 212
    - E-mail: ptecilla@units.it Tel.: 040 558 3726
- Il corso di chimica organica é la BASE per la comprensione di tutti i corsi avanzati di chimica organica e farmaceutica
- 64 ore di lezione (8 CFU) integrate con ore di esercizi per approfondire la materia.
- L'esame si compone di una **prova scritta e di una prova orale**. Lo scritto può comprendere sia domande di teoria a risposta aperta che esercizi su sintesi, trasformazione di gruppi funzionali, stereochimica, etc.. Il superamento dello scritto da accesso alla prova orale che sarà rivolta ad accertare una adeguata conoscenza degli argomenti trattati nel corso. **Dopo aver superato la prova scritta l'esame orale dovrà essere sostenuto entro la sessione autunnale dell'anno in corso.** In caso contrario la prova scritta dovrà essere sostenuta nuovamente. **Durante il corso sono proposti agli studenti che seguono il corso due test scritti (intermedio/finale) che valgono come prova scritta.**
- Ogni anno ci sono sei sessioni d'esame: due sessioni nel periodo Gennaio-Febbraio; due sessioni nel periodo Giugno-Luglio, due sessioni a Settembre. Sessione straordinarie possibili dopo Pasqua o su richiesta (da valutare).

Libri di testo

John McMurry
Chimica Organica
PICCIN-NUOVA LIBRARIA

Brown; Iverson, Anslyn, Foote
Chimica Organica
EdiSES

D'Auria M.V.; Taglialatela Scafati O.; Zampella A.
Guida ragionata allo svolgimento di esercizi di chimica organica
Loghia

Janice Gorzynski Smith
Organic Chemistry
McGraw-Hill

Vollhardt K. Peter; Schore Neil E.
Chimica organica
Zanichelli

Solomons T.W. Graham;
Fryhle Craig B.
Chimica organica
Zanichelli

Seyhan N. Ege
Chimica Organica: Struttura e reattività
Idelson-Gnocchi

Materiale didattico, esercizi, compiti corretti, etc. disponibili su Moodle Federato

ORGANIC CHEMISTRY = Chemistry of Carbon Compounds

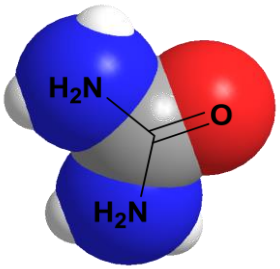
Before 1828:

Non-Living Entities: Inorganic
Living World: Organic ⇒ Vital Spark

1828: The End of Vitalism

Friedrich Woehler
1800-1882

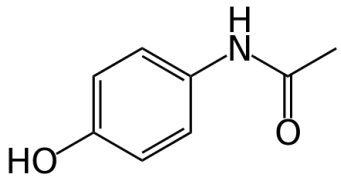
$$Pb(OCN)_2 + 2\ NH_4OH \longrightarrow Pb(OH)_2 + 2\ CO(NH_2)_2$$



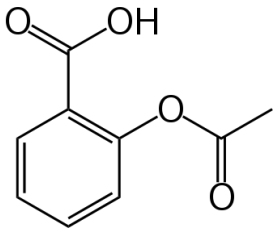
Organic Compounds are Ubiquitous

- There are approximately 60.000.000 organic molecules.
  - *Carbohydrates, lipids, proteins and nucleic acids* are produced by living organisms.
  - We make extensive use of natural products derived, from plants (*cotton*, *paper*, *wood),* from animals *(leather, silk, wool),* from fossil oil *(benzin, oils).*
  - By modifying natural compounds (mainly oil) we also manufacture a wide variety of synthetic products, such as *drugs, plastics, paints, dyes, artificial fibres, fertilizers, aromas, cosmetics, detergents, parfumes, sweeteners,* etc.

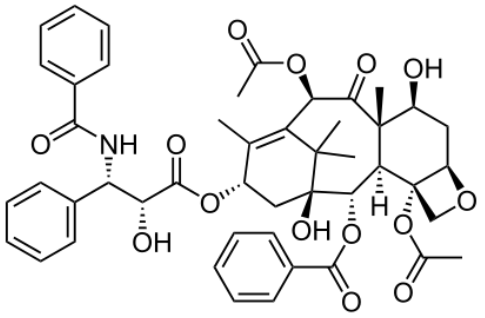
Many drugs are Organic Compounds



Paracetamol

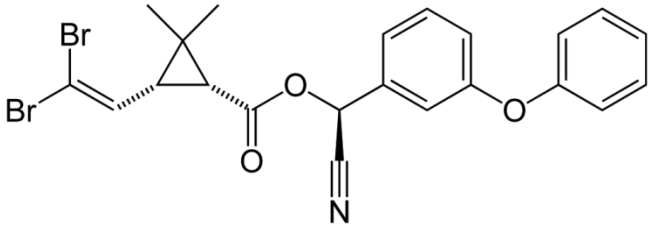


Aspirin

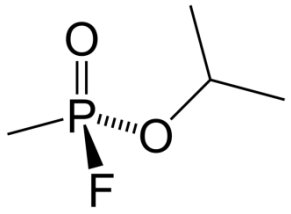


Taxol (chemotherapic)

Many toxic compounds are Organic Compounds

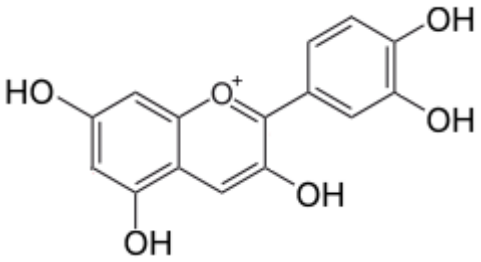


Synthetic Pyrethrin
(insecticide)



Sarin
(nerve agent)

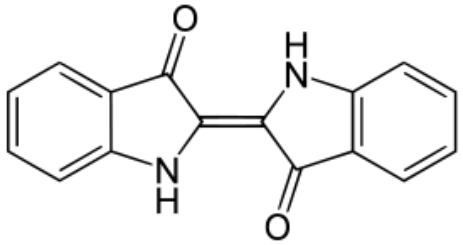
Many colorants are organic compounds



Antocianine
(change color with pH)

Rose
(acidic pH)

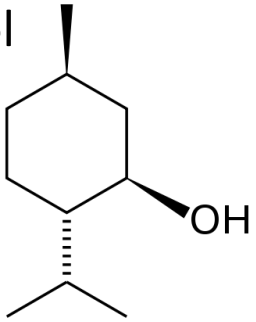
Cornflower
(fiordaliso, basic pH)



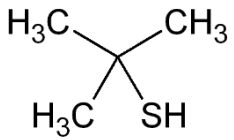
Indigo
(from *Indigofera tinctoria)*

Many odorous substances (nice or nasty) are organic compounds

Menthol



peppermint



Tert-Butylmercaptan
(added to methane)

The Carbon Atom

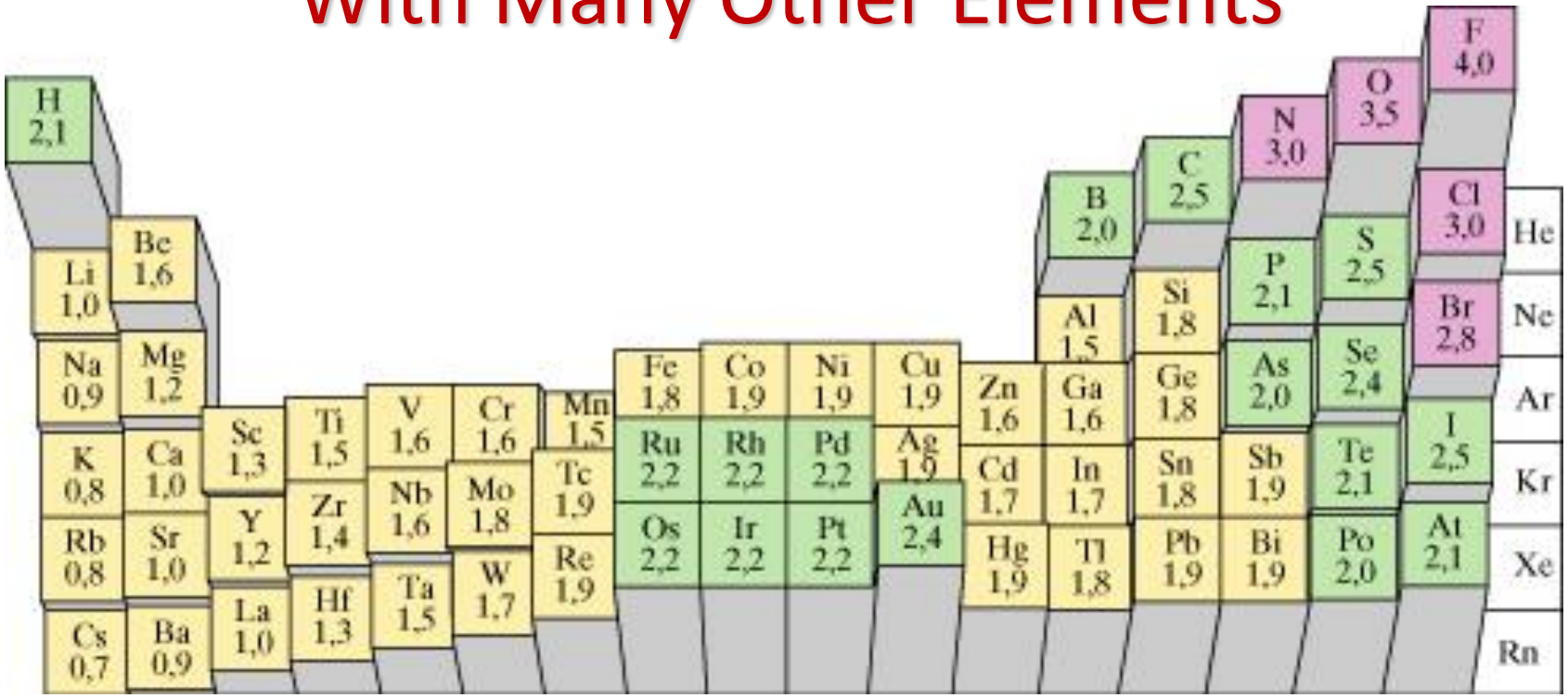
- Atomic Number: 6 (number of protons)
- Atomic weight: 12.01 (weight average of the atomic mass of the isotopes)
- 2 Isotopes

  ^{12}C (99,98%): 6 protons, 6 neutrons

  ^{13}C (1,11%): 6 protons, 7 neutrons

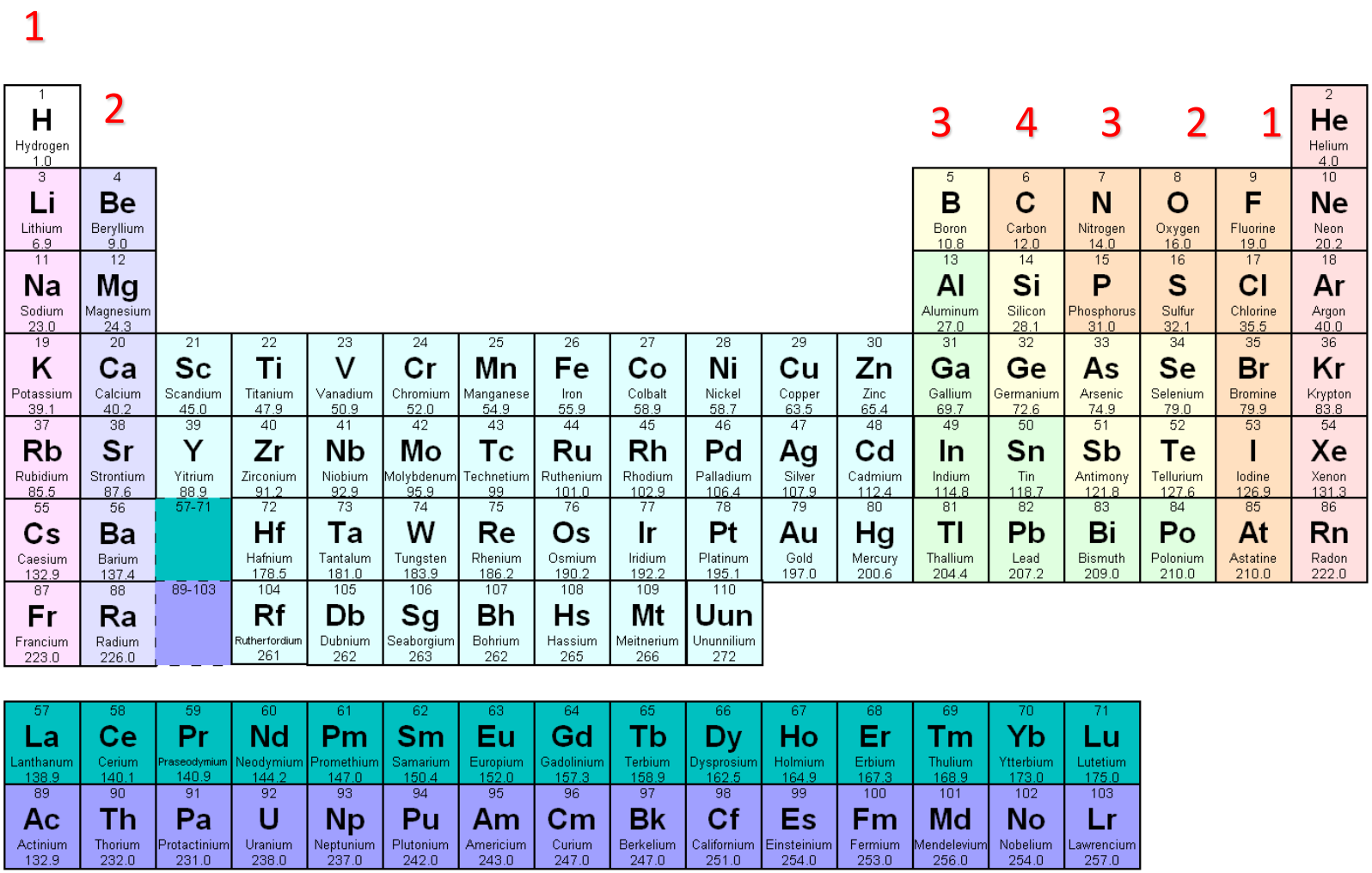
- Electron Configuration: $1s^2$ $2s^2\ 2p^2$

1. Carbon Forms Covalent Bonds With Many Other Elements



Electronegativity

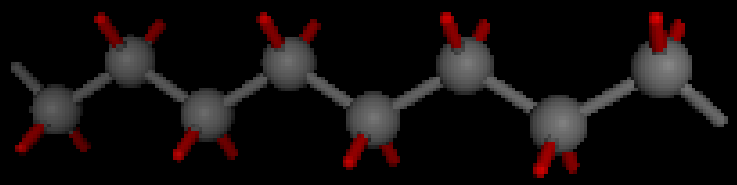
2. Carbon Is Tetravalent

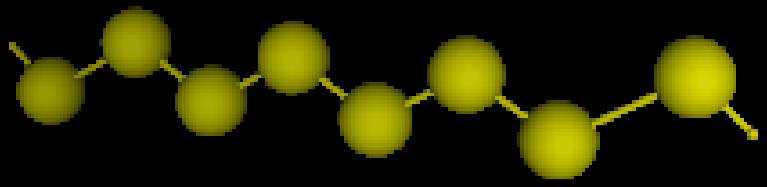


3. Carbon Forms Very Strong Bonds

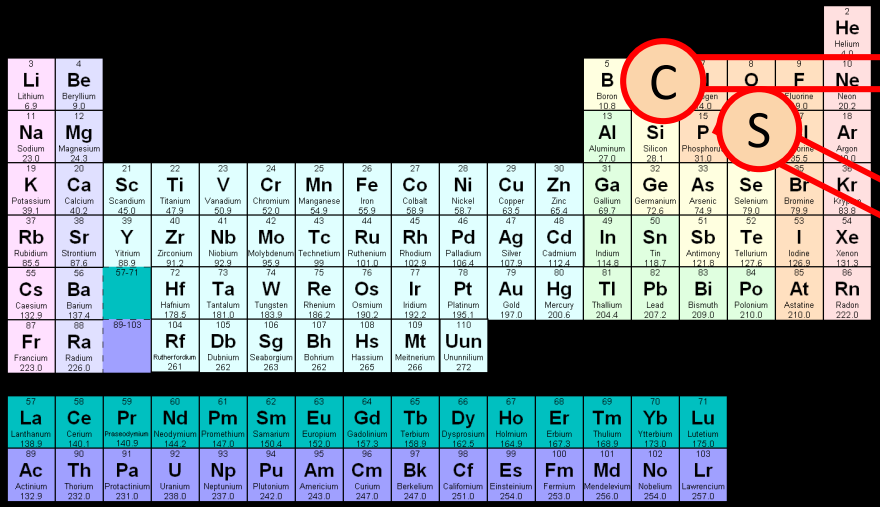
Bond	Bond Dissociation Energy (kJ/M)
C—C	360
C—H	400-550
C—O	350-400
C—N	360
N—N	250
O—O	180

4 Carbon forms chains





Energy	(kJ/mol)
C-C	360
N-N	230-280
O-O	160-200



$2s^2 2p^2$

$3s^2 3p^4$

5. Carbon Forms Multiple Bonds

Bond	Bond Dissociation Energy (kJ/M)
C—C	360
C=C	700
C≡C	950
C—O	400
C=O	750
C—N	360
C=N	700
C≡N	950

Organic Chemistry

- Structure
- Reactivity
- *Structure* and *reactivity* are correlated.

STRUCTURE  REACTIVITY

Goals

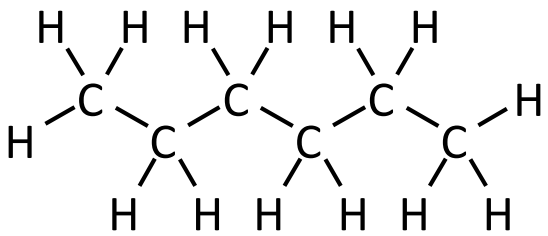
- Assign Structure and Name to Organic Compounds.
- Predict:
  - The tridimensional structure
  - The effects on reactivity (reaction rates and equilibrium constants)
- Understand the reactivity of functional groups
- Design simple synthetic pathways
- Communicate with an appropriate language

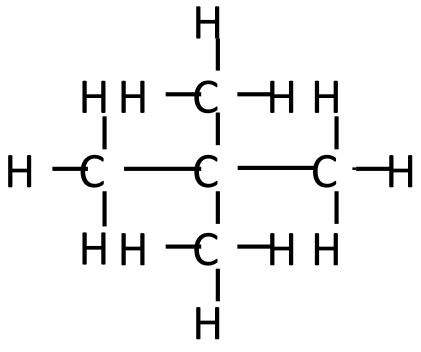
The course of Organic Chemistry is at the basis of all the other organic chemistry courses and of those of pharmaceutical chemistry!

Drawing molecules

Condensed Formula

- Different degrees of condensation

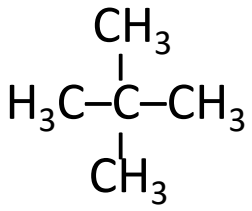




$CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_3$

$CH_3CH_2CH_2CH_2CH_2CH_3$

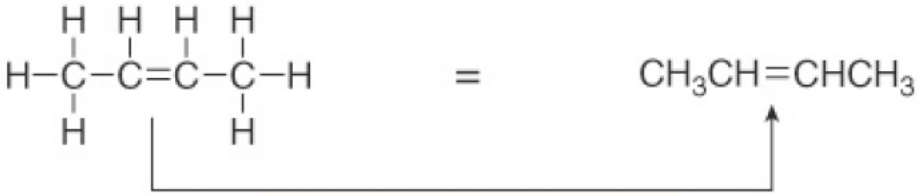
$CH_3(CH_2)_4CH_3$



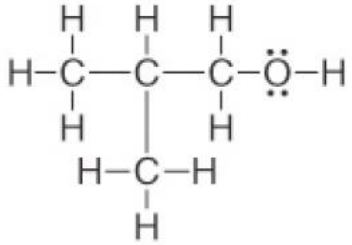
Certain bonds are maintained

$C(CH_3)_4$ or $(CH_3)_4C$

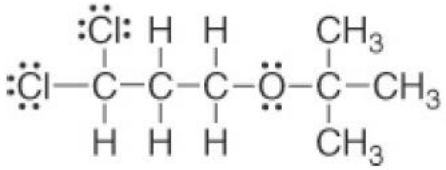
Condensed Formula



The double bond is maintained

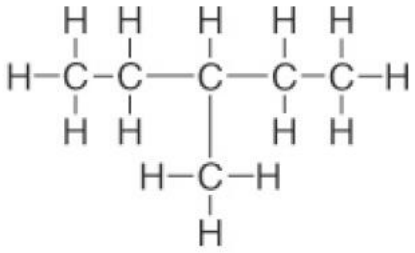


lone pairs are omitted



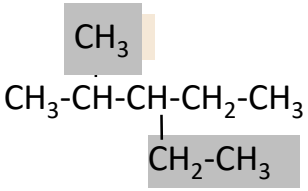
Condensed Formula

- Complex structures can be written on a single line using parentheses.



= $CH_3CH_2CHCH_2CH_3$ (with CH_3 branch) or $CH_3CH_2CH(CH_3)CH_2CH_3$

The middle CH_3 group is bonded outside the chain



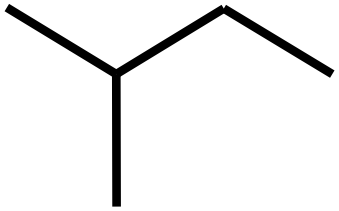
= $CH_3CH(CH_3)CH(CH_2CH_3)CH_2CH_3$

Branched alkanes

Skeletal (Linear) Formula

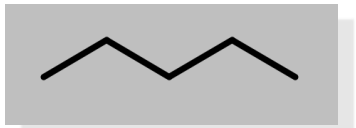
Minimal, non ambiguous, information

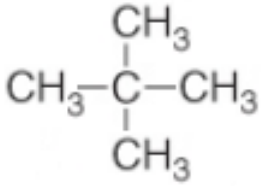
- Carbon atoms are omitted and lie on interseptions between bonds and at the end of the chain.
- Hydrogen atoms are omitted. Each carbon atom free valence is saturated with hydrogens.
- Atoms other than C and H (heteroatoms) are not omitted.

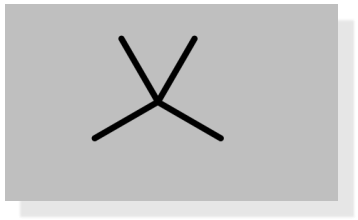


Skeletal (Linear) Formula

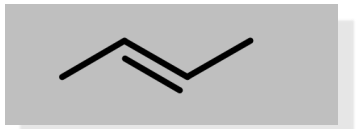
$CH_3CH_2CH_2CH_2CH_3$



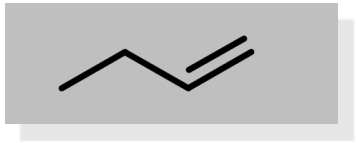




$CH_3CH{=}CHCH_3$

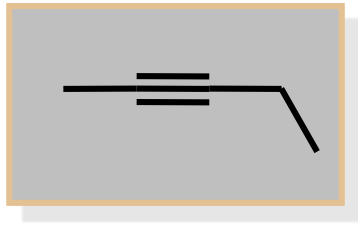


$CH_3CH_2CH{=}CH_2$



$H{-}C{\equiv}C{-}CH_3$

$CH_3{-}C{\equiv}C{-}CH_2CH_3$



Examples