Appropriate Problems from McMurry Chap 3

Section 3.1: Problems 3-1, 3-2, 3-3, 3-19, 3-22, 3-23, 3-24, 3-25, 3-26c, 3-54

Section 3.4: Problem 3-32

Section 3.3: Problems 3-8, 3-9, 3-10

Section 3.4: Problems 3-11, 3-12, 3-14, 3-20, (the questions that ask you to draw and name multiple isomers can be time consuming, it is likely not necessary to do them all) 3-33 through 3-40

Section 3.7: Problems 3-16, 3-17, 3-21, 3-24, 3-44 through 3-47

Referencing More than One Section
(Section 3.1 and 3.2) 3-48, 3-49, 3-50
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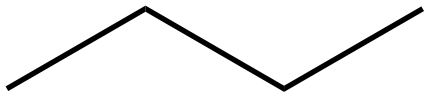
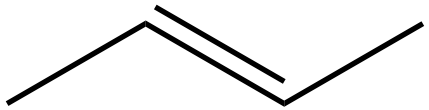
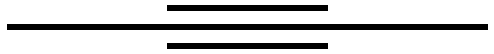
Looking ahead to Chap 4 (Section 3.7 and 3.7) 3-54, (advanced application of VSEPR) 3-55



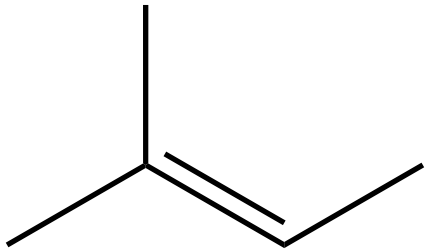
linear, acyclic alkane

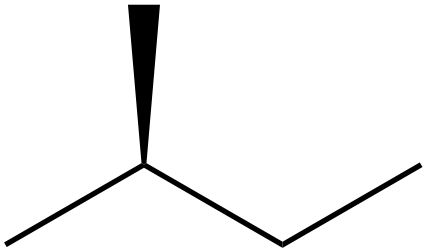


linear, acyclic alkene

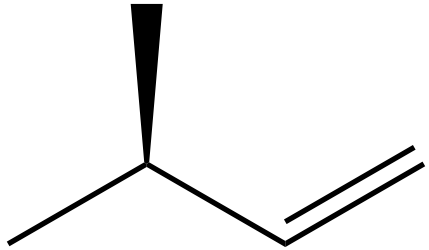


linear, acyclic alkyne

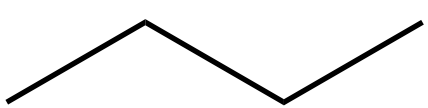


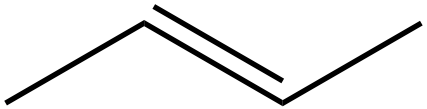


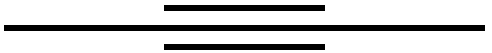
branched, acyclic alkane

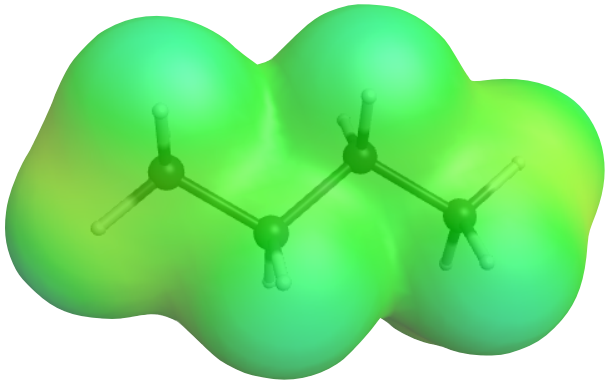


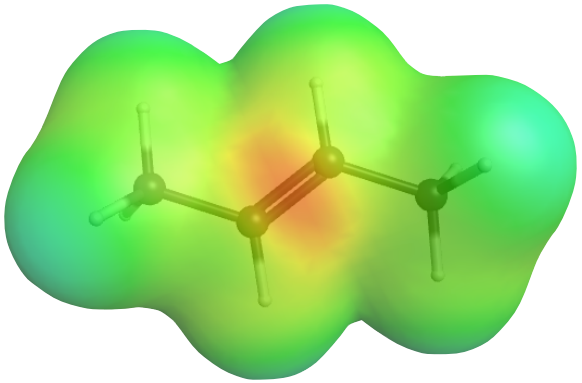
branched, acyclic alkenes

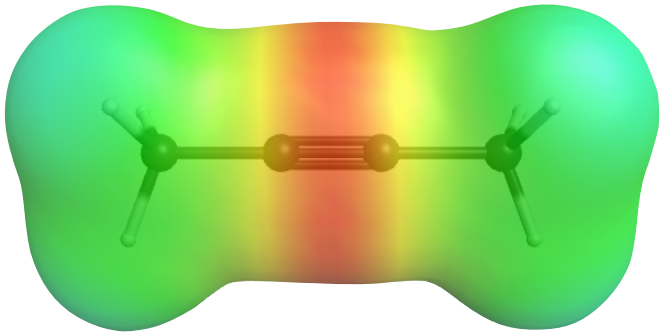




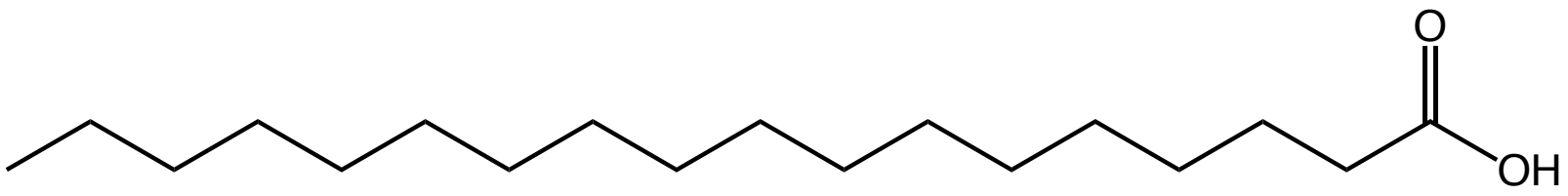




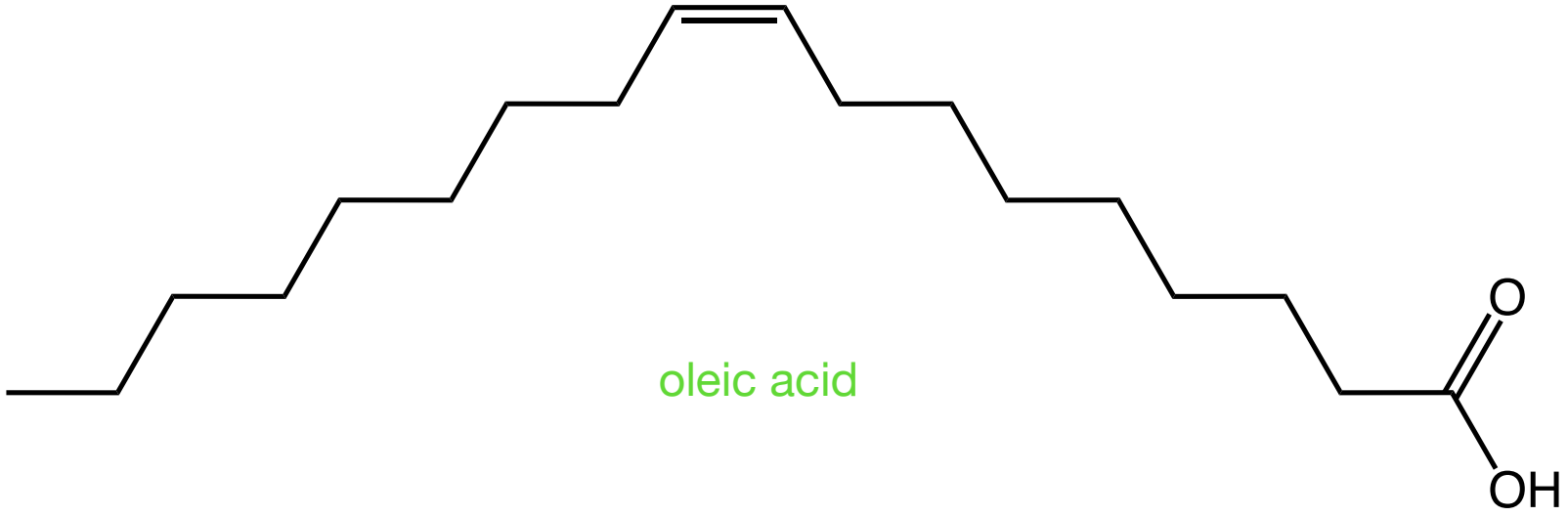




Formulas?

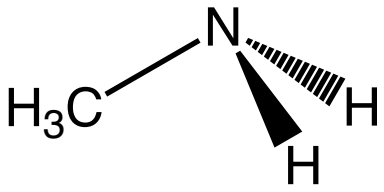


palmitic acid

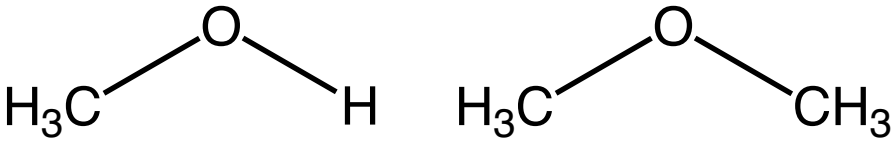


oleic acid

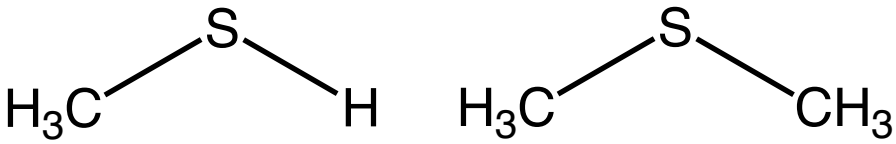
Amines



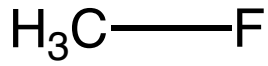
Alcohols and Ethers

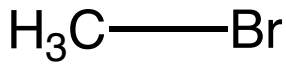


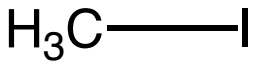
Thiols and Thioethers



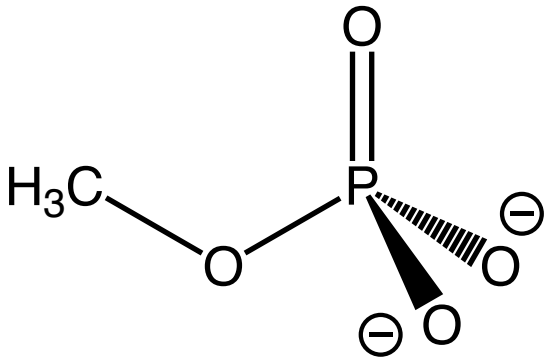
Alkyl Halides

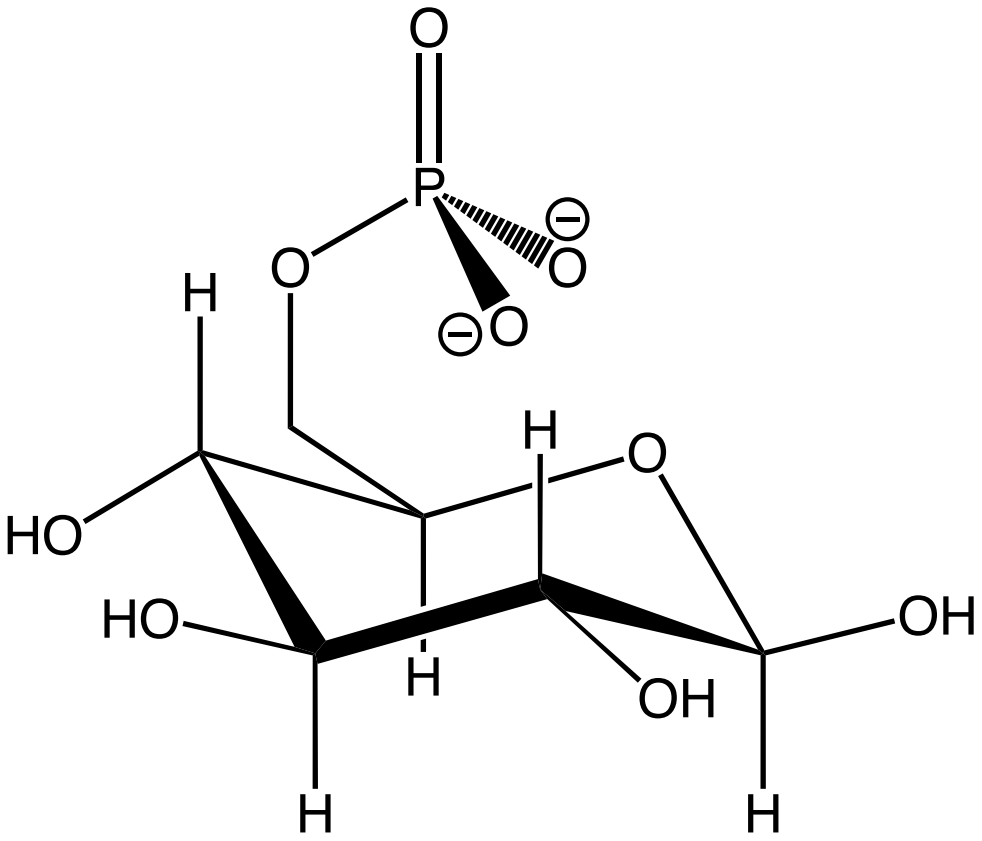


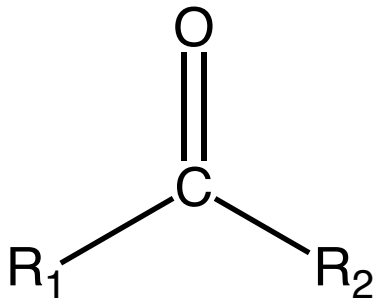


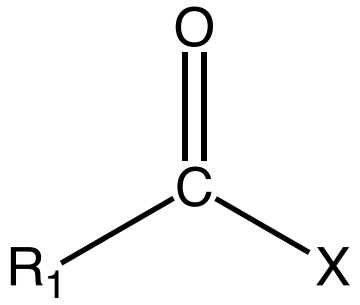


Organophosphates

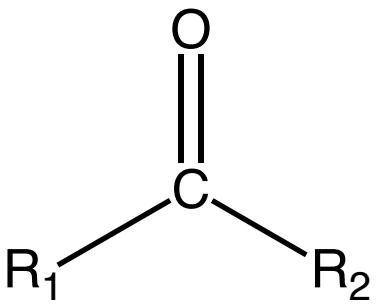





O
C
R1
R2

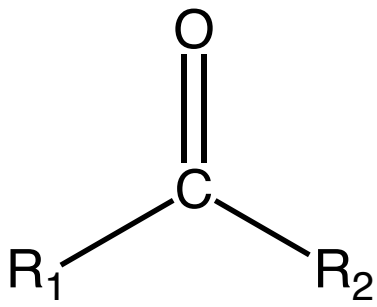

O
C
R1
X

Ketones



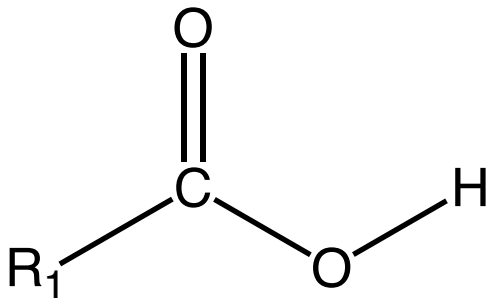
R_1 or $R_2 \neq H$

Aldehydes

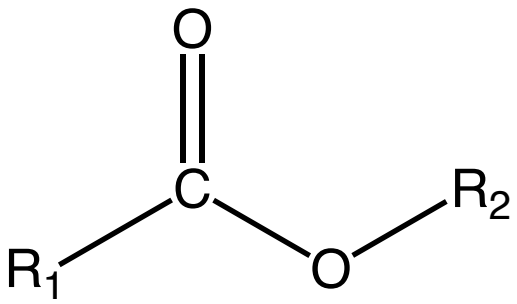


R_1 or $R_2 = H$

Carboxylic Acids and Esters

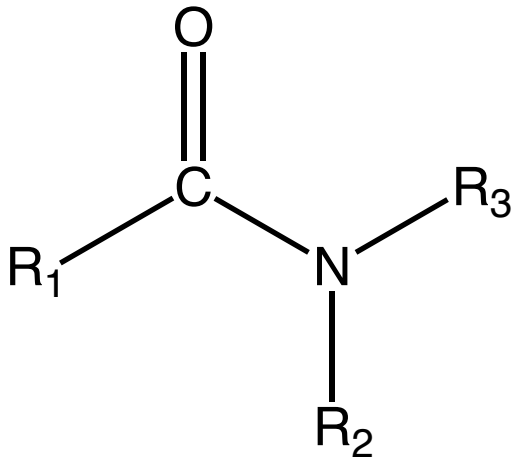


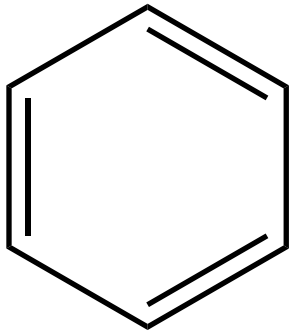
R_1 = H or $R_1 \neq$ H

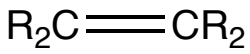


R_1 = H or $R_1 \neq$ H but $R_2 \neq$ H

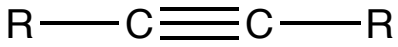
Amides



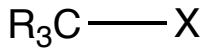




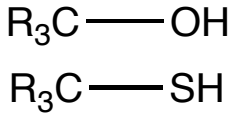
alkenes



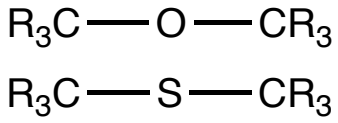
alkynes



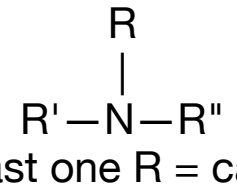
X = Cl, Br, I
Alkyl Halides



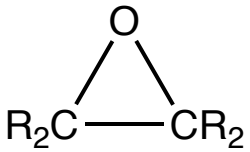
alcohols & thiols



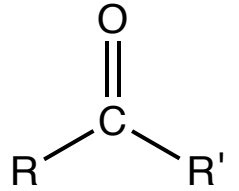
ethers & thioethers



at least one R = carbon
amines



epoxides



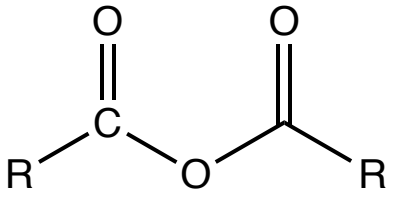
ketones (R, R'≠ H) and
aldehydes (R or R' = H)

$RC(=O)NR_2$
amides

$RC(=O)OR$
esters (R ≠ H)

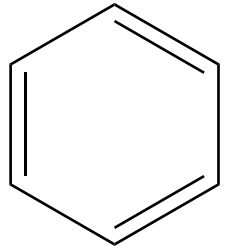
$RC(=O)SR$
thioesters (R ≠ H)

$RC(=O)OH$
carboxylic acids



anhydrides

$RC(=O)Cl$
acid chlorides



aromatics

and more…

Nomenclature of Alkanes

Early names were based on the number of C atoms in the alkane, and the names came from a variety of places — and we're "stuck" with them for the first four

CH_3OH methanol the name is derived from a word coined by French chemists, Jean-Baptiste Dumas and Eugene Peligot, from "methy" (Greek for alcoholic liquid)" + hȳlē (Greek for "forest, wood, timber, material")[1]

CH_3CH_2OH "eth" to distinguish it from méthylène derived from French and German chemists "äthyl" in German[2]

$CH_3CH_2CO_2H$ based on observation that it was the first (shortest chained) carboxylic acid that behaved like a fatty acid
pro (from protos for first) + pion (from pion for fat) => propionic acid[3]

$CH_3CH_2CH_2CO_2H$ isolated from butter => butyric acid[4]

[1] https://en.wikipedia.org/wiki/Methanol#History

[2] https://chemistry.stackexchange.com/questions/142839/why-is-ethane-in-methane, https://gallica.bnf.fr/ark:/12148/bpt6k6569005x/f15.item

[3] https://en.wikipedia.org/wiki/Propionic_acid

[4] https://en.wikipedia.org/wiki/Butyric_acid

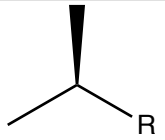
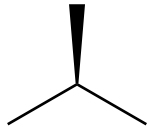
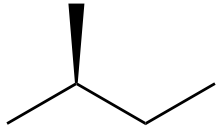
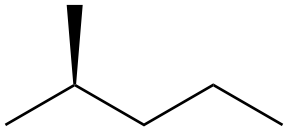
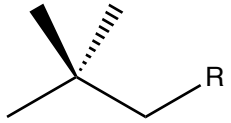
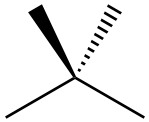
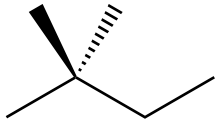
Nomenclature of Alkanes: Original Scheme based names on number of C atoms present

methane	CH_4
ethane	C_2H_6
propane	C_3H_8
butane	C_4H_{10}
pentane	C_5H_{12}
hexane	C_6H_{14}
heptane	C_7H_{16}
octane	C_8H_{18}
nonane	C_9H_{20}
decane	$C_{10}H_{22}$
undecane	$C_{11}H_{24}$
dodecane	$C_{12}H_{26}$

Nomenclature of Alkanes: Original Scheme based names on number of C atoms present but nonsystematic nomenclature becomes problematic quickly….

methane	CH_4	1 isomer
ethane	C_2H_6	1 isomer
propane	C_3H_8	1 isomer
butane	C_4H_{10}	2 isomers
pentane	C_5H_{12}	3 isomers
hexane	C_6H_{14}	5 isomers
heptane	C_7H_{16}	...
octane	C_8H_{18}	
nonane	C_9H_{20}	
decane	$C_{10}H_{22}$	
undecane	$C_{11}H_{24}$	
dodecane	$C_{12}H_{26}$	

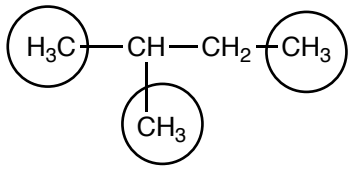
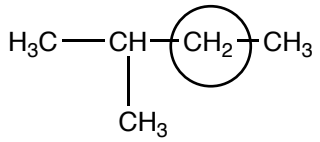
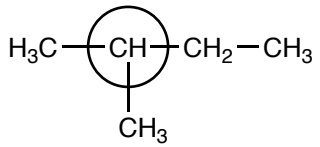
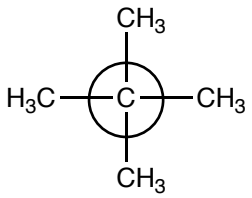
But before getting into the systematic nomenclature of Substituted Alkanes: non-IUPAC names based on total number of C atoms present

the “iso” group		
isobutane	R = CH_3 (4 C’s)	
isopentane	R = CH_2CH_3 (5 C’s)	
isohexane	R = $CH_2CH_2CH_3$ (6 C’s)	
the “neo” group		
neopentane	R = H (5 C’s)	
neohexane	R = CH_3 (6 C’s)	

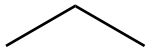
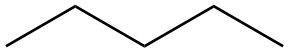
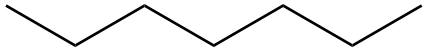
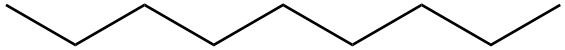
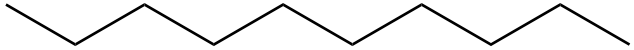
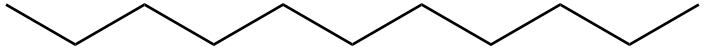
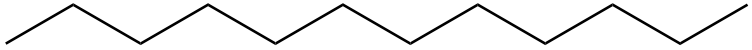
Each of these molecules could be used as an adjective to describe a group; for example, the top one where the R is not defined we could say that the defined parts are an isopropyl group. It’s three carbons (propane) in the shape of the iso group.

But before getting into the systematic nomenclature of Substituted Alkanes: non-IUPAC names based on total number of C atoms present and position of functional group

Degree of Substitution

1° primary (*n*-) 
2° secondary (*sec*-, *s*-) 
3° tertiary (*tert*-, *t*-) 
4° quaternary 

Nomenclature of Alkanes: IUPAC Names based on the number of C's in the longest continuous chain of C atoms

methane	CH_4	
ethane	CH_3CH_3	
propane	$CH_3CH_2CH_3$	
butane	$CH_3CH_2CH_2CH_3$	
pentane	$CH_3CH_2CH_2CH_2CH_3$	
hexane	$CH_3CH_2CH_2CH_2CH_2CH_3$	
heptane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$	
octane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	
nonane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	
decane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	
undecane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	
dodecane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	

Nomenclature of Alkanes: IUPAC Names based on the number of C's in the longest continuous chain of C atoms

Determine longest continuous chain.

- This is the **parent hydrocarbon**
- If compound has two or more chains of the same length, parent hydrocarbon is chain with greatest number of substituents

List the name of substituent(s) before the name of the parent hydrocarbon along with the number of the carbon to which it is attached--Substituents are listed in alphabetical order – neglecting prefixes such as di- tri- tert- etc.

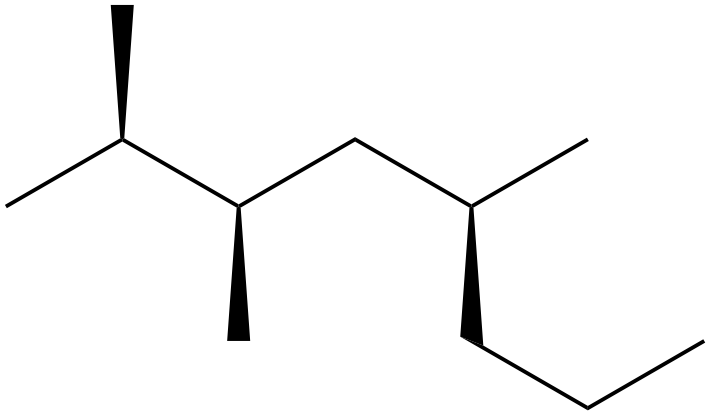
- Find and list all of the substituents
- Names of alkyl substituents are based on the length of the substituent.
- Names for branched substituent such as *sec*-butyl and *tert*-butyl are acceptable, but systematic substituent names are preferable.
    - The numbering system for a branched substituent begins with the carbon attached to the parent hydrocarbon
    - This number together with the substituent name is placed inside parentheses
- Number the substituents
    - in the direction that gives the lower number for the lowest-numbered substituent. (Lowest possible number for all substituents on the parent chain)
    - When both directions yield the same lower number for the lowest numbered substituent, select the direction that yields the lower number for the next lowest numbered substituent
    - If same substituent numbers are obtained in either direction, number in the direction giving lowest number to the first (alphabetically) named substituent

Form of name: #-followed by substituent name followed by parent hydrocarbon name

position#-**stuff hanging off longest chain****longest chain of C atoms****functional group ending**

Nomenclature of Alkanes

position#-**stuff hanging off longest chain****longest chain of C atoms****functional group ending**



Nomenclature of Alkanes

position#-**stuff hanging off longest chain****longest chain of C atoms****functional group ending**

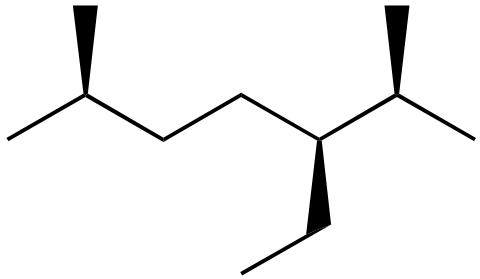
longest chain:

parent alkane name:

functional group (?) and position:

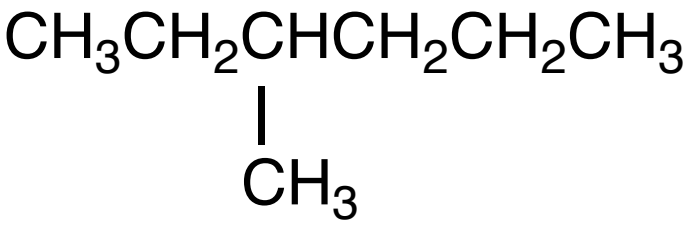
substituent names:

substituent positions:



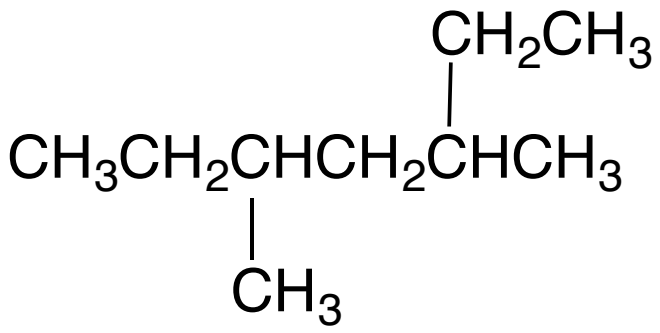
Nomenclature of Alkanes

position#-**stuff hanging off longest chain** **longest chain of C atoms** **functional group ending**

longest chain: parent alkane name: functional group (?) and position: substituent names: substituent positions:	 name:

Nomenclature of Alkanes

position#-**stuff hanging off longest chain****longest chain of C atoms****functional group ending**

longest chain: parent alkane name: functional group (?) and position: substituent names: substituent positions:	 name:

Nomenclature of Alkyl Halides

position#-**stuff hanging off longest chain****longest chain of C atoms****functional group ending**

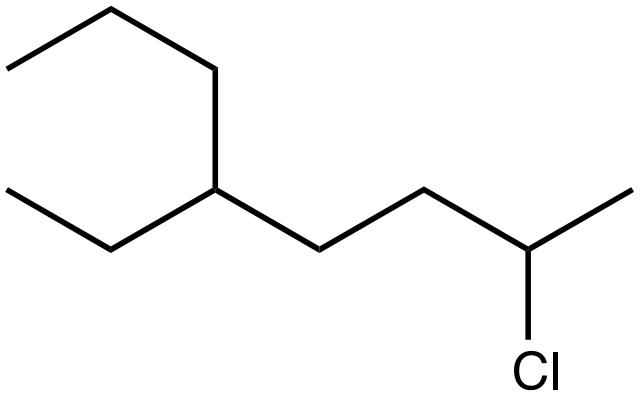
longest chain:

parent alkane name:

functional group (?) and position:

substituent names:

substituent positions:



Nomenclature of Alkyl Halides and Ethers

position#-**stuff hanging off longest chain****longest chain of C atoms****functional group ending**

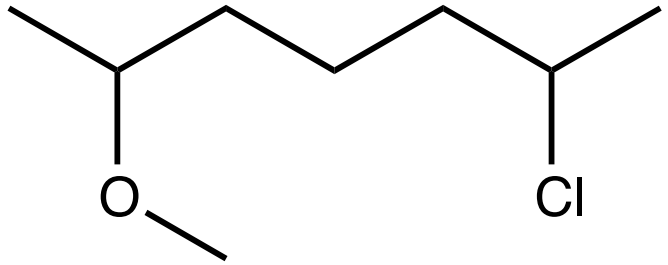
longest chain:

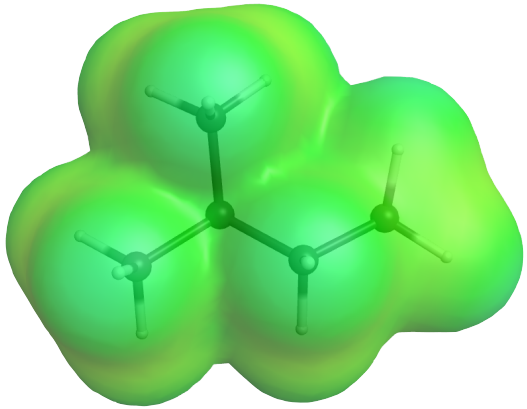
parent alkane name:

functional group (?) and position:

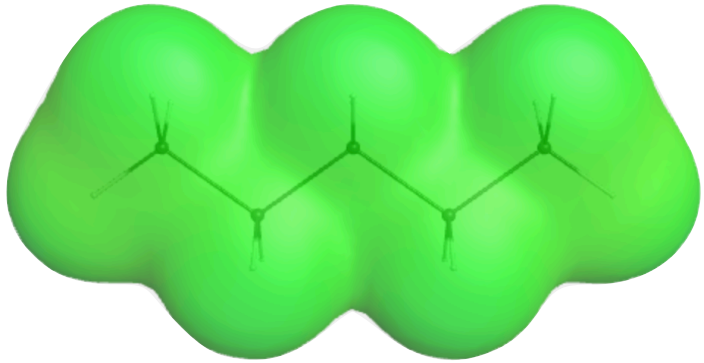
substituent names:

substituent positions:

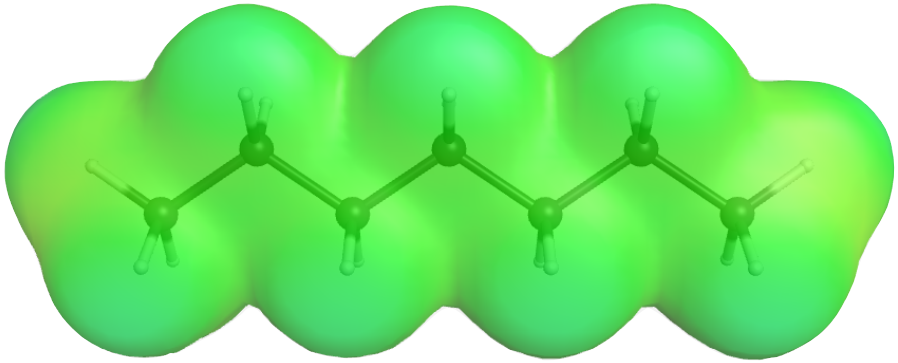




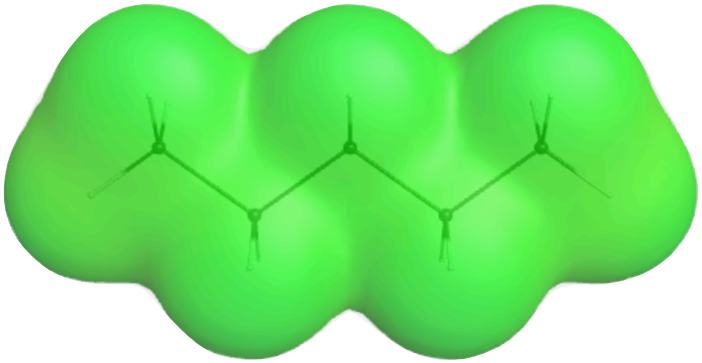
BP = 27.8 °C

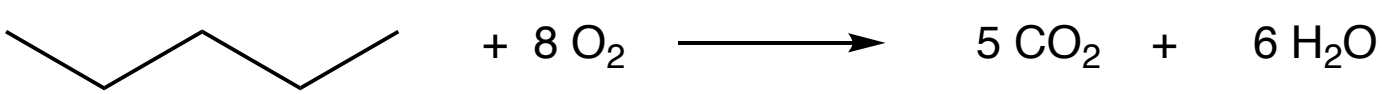


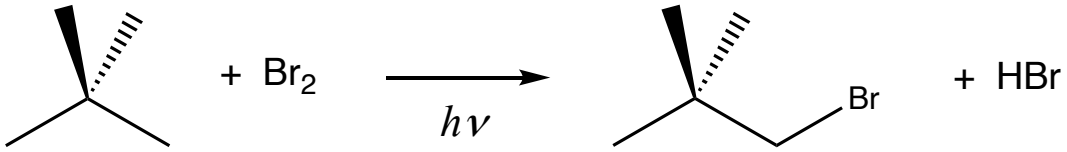
BP = 35.9 °C



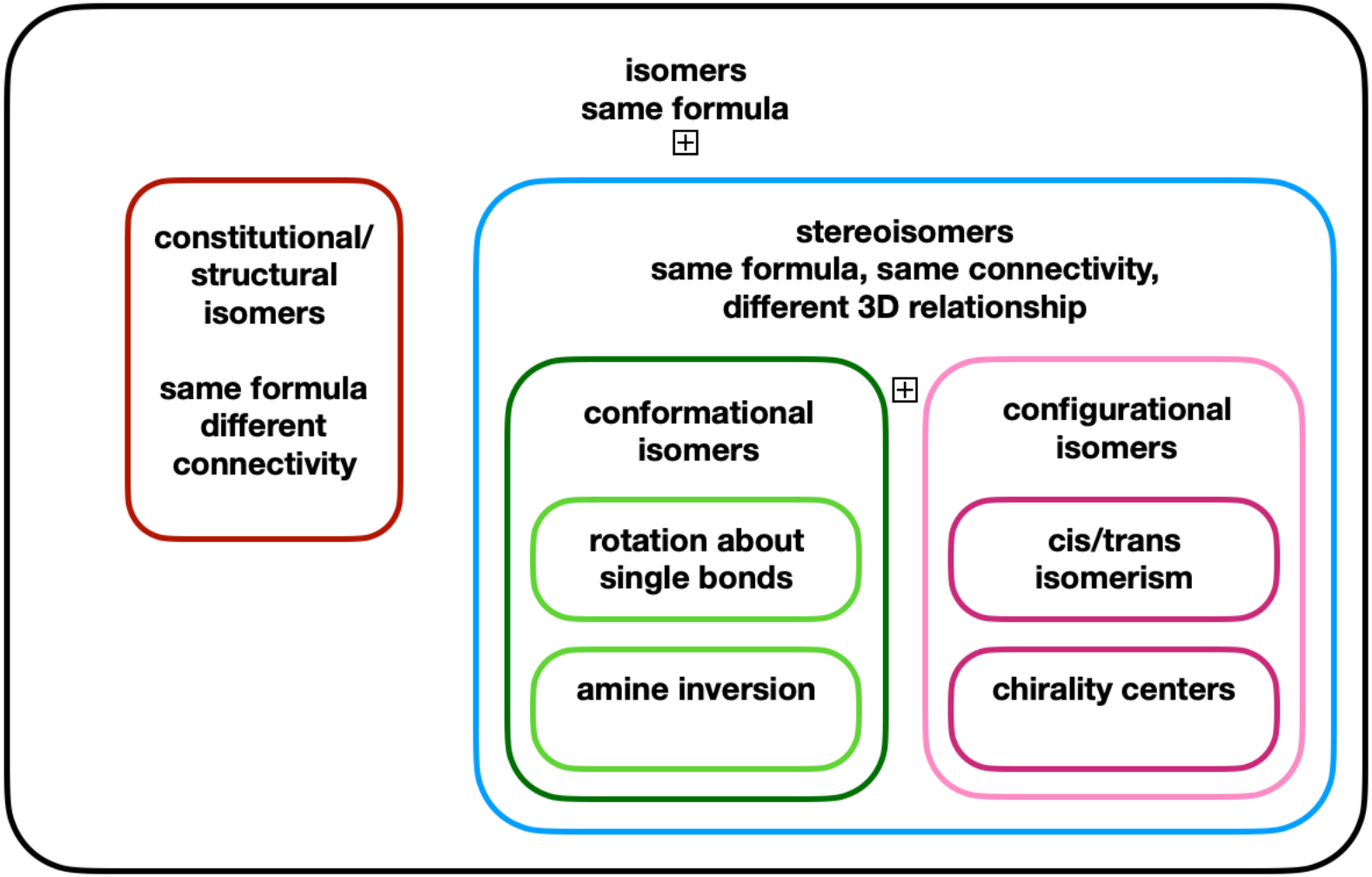
BP = 101 °C

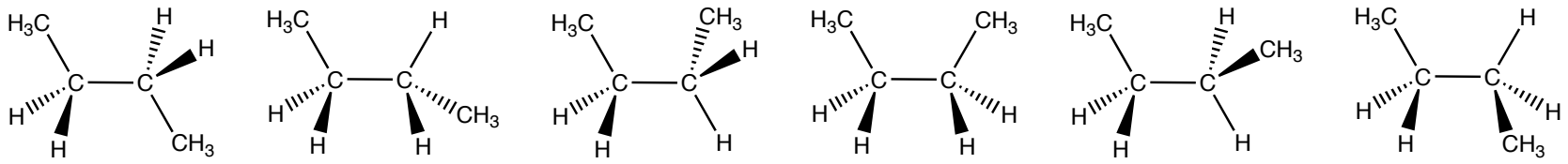



+ 8 O2
5 CO2 + 6 H2O


+ Br2
hν
Br
+ HBr

Isomers


isomers
same formula
⊞
constitutional/
structural
isomers
same formula
different
connectivity
stereoisomers
same formula, same connectivity,
different 3D relationship
conformational
isomers
rotation about
single bonds
amine inversion
⊞
configurational
isomers
cis/trans
isomerism
chirality centers


H3C
H
H
C
C
H
H
CH3
H3C
H
H
C
C
CH3
H
H
H3C
CH3
H
H
C
C
H
H
H3C
CH3
H
H
C
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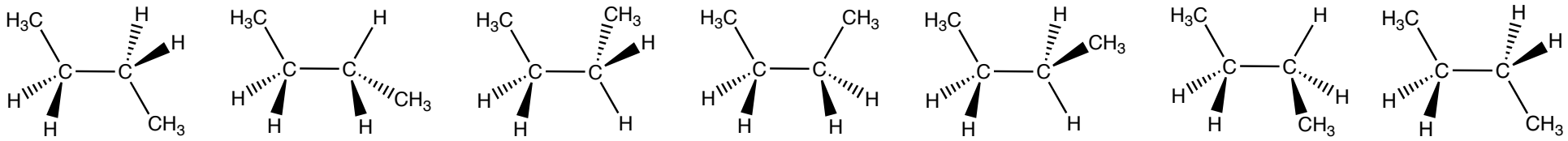
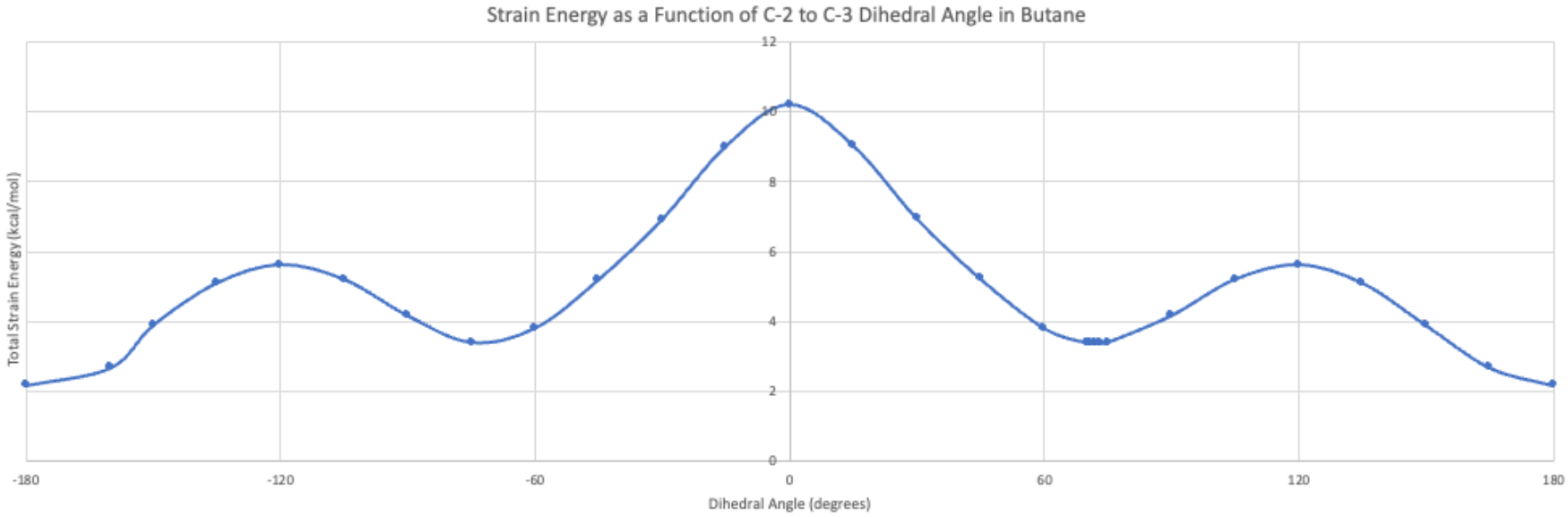
H
H3C
H
H
C
C
H
H
CH3

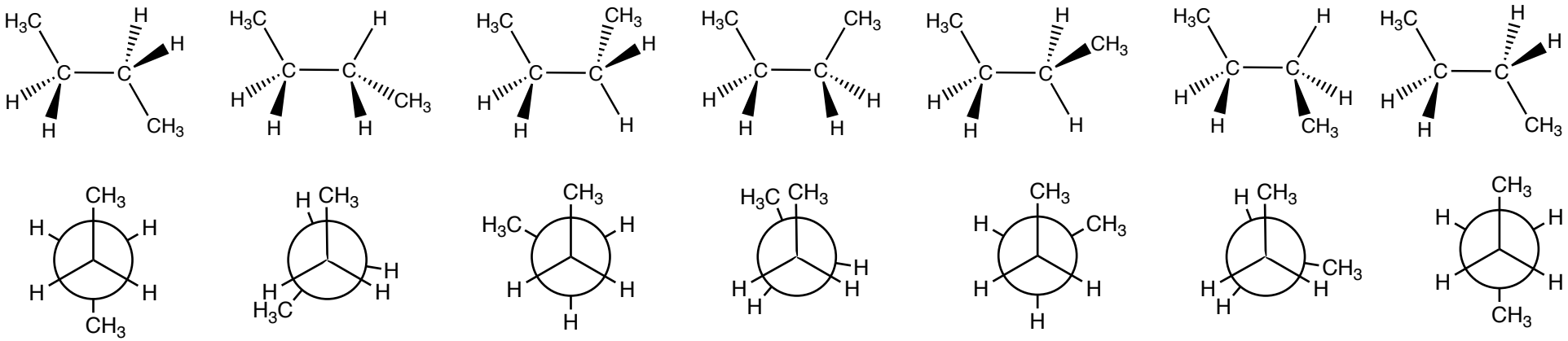


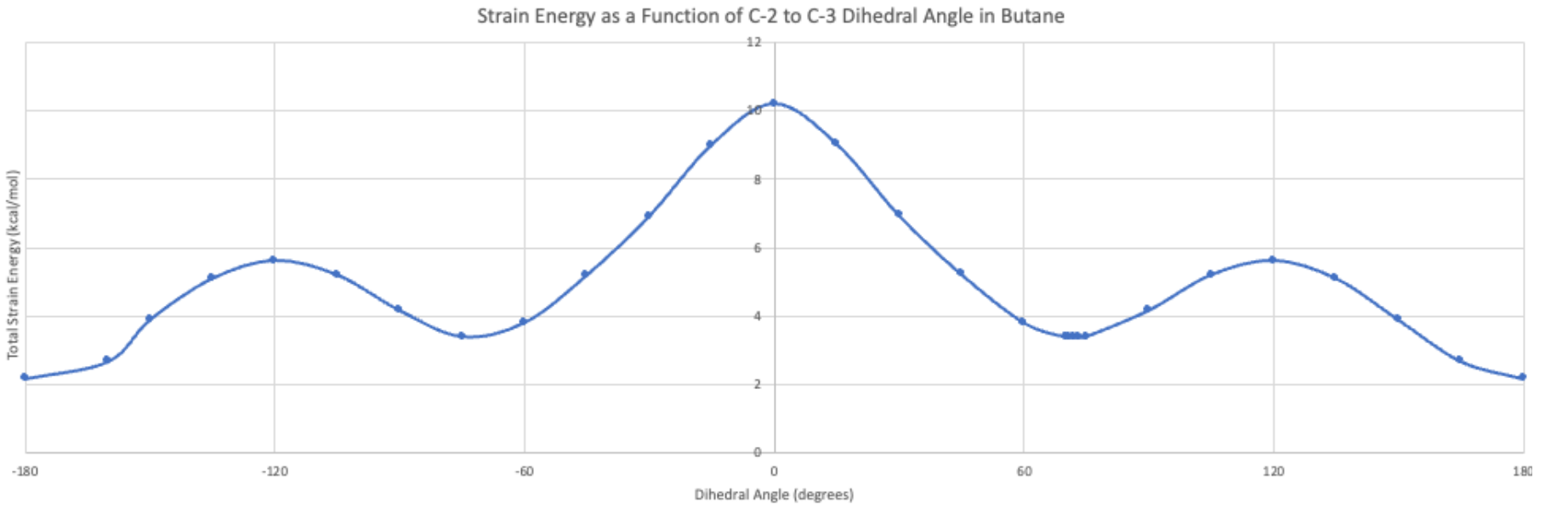


https://www.westfield.ma.edu/cmasi/organic/newman/newman-plain.html

Rotation around Single Bonds: Newman Projections

Sections 3.6 - 3.7



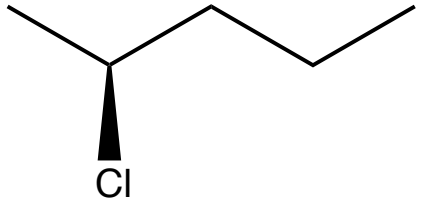


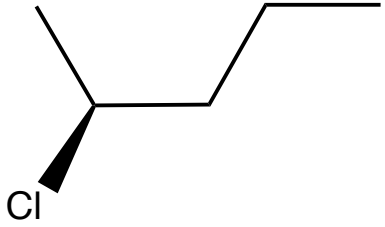
Showing 3-D Relationships (stereochemistry) Using Newman Projections

Drawn as though one is looking along a bond

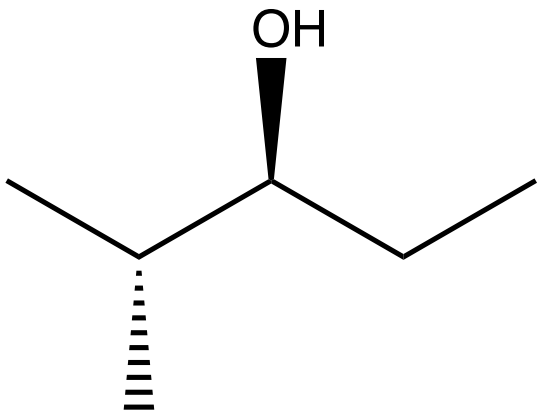
Front carbon is a where three bonds come together

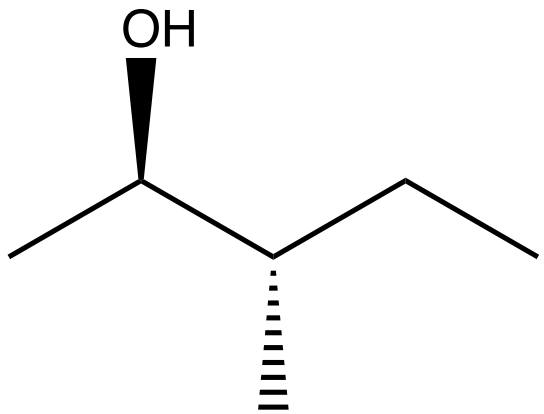
Back carbon is a large circle



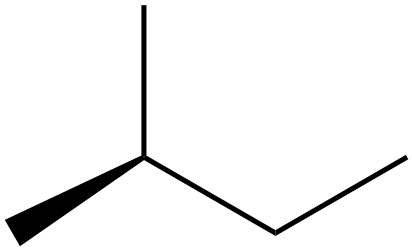


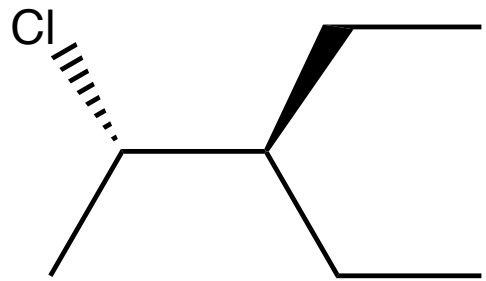
Draw the Newman projection along the C_2 to C_3 bond in the following structure



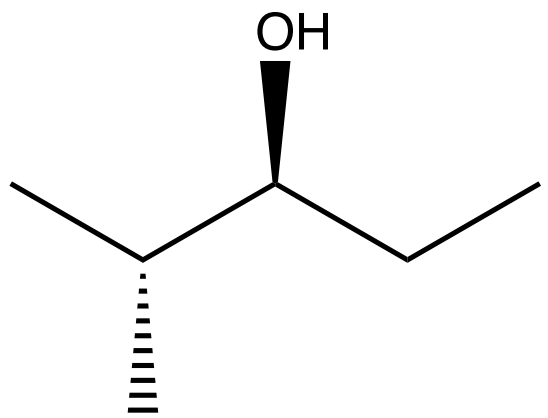


Draw the Newman projection along the C_3 to C_2 bond in the following structure

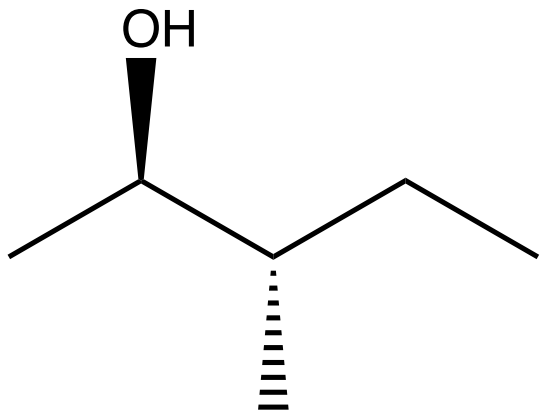




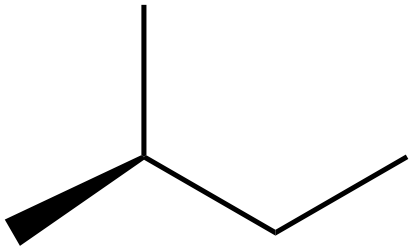
Draw the Newman projection along the C_2 to C_3 bond in the following structure



Draw the Newman projection along the C_2 to C_3 bond in the following structure



Draw the Newman projection along the C_3 to C_2 bond in the following structure



Draw the Newman projection along the C_3 to C_2 bond in the following structure