

Nomenclature

IUPAC nomenclature for organic chemistry

What is IUPAC nomenclature?

- A systematic method of naming organic chemical compounds as recommended by the International Union of Pure and Applied Chemistry (IUPAC).
- It provides an unambiguous structure.
- Official IUPAC naming recommendations are not always followed in practice, and the common or trivial name may be used.

rules for alkane nomenclature

- Find and name the longest carbon chain
- Name the groups attached to the longest carbon chain
- Number the chain consecutively, starting at the end nearest a substituted group
- Designate the location of each substituent group
- Assemble the name by listing groups in alphabetical order and the main chain last

Main chain and alkyl group names

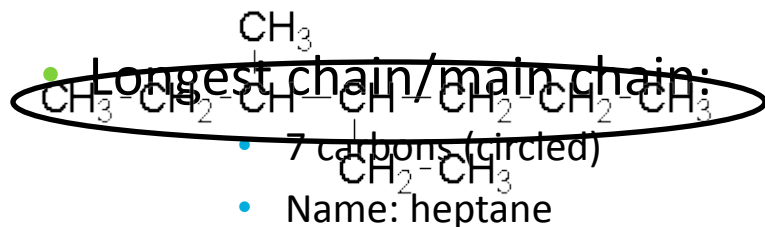
Main chain names

Name	# of Carbons	Name	# of Carbons
methane	1	hexane	6
ethane	2	heptane	7
propane	3	octane	8
butane	4	nonane	9
pentane	5	decane	10

Name	# of Carbons	Name	# of Carbons
methyl	1	butyl	4
ethyl	2	pentyl	5
propyl	3	Hexyl	6

Group	$(\text{CH}_3)_2\text{CH}-$	$\begin{matrix} (\text{CH}_3)_2\text{CH} \\ \\ \text{CH}_2- \end{matrix}$	$\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)-$	$(\text{CH}_3)_3\text{C}-$
Name	Isopropyl	Isobutyl	sec-Butyl	tert-Butyl

Example



• Side chain groups:

Answer:

- 1-carbon group at position 3
- Name: 3-methyl

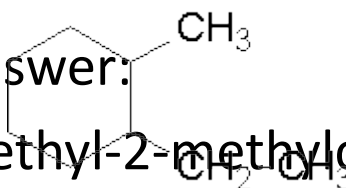
4-ethyl-3-methylheptane

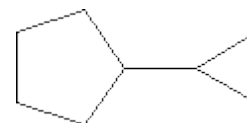
- 2-carbon group at position 4
- Name: 4-methyl

Naming ring compounds

- Same rules as alkane nomenclature except:
- A cyclo- prefix is added to the root name
- Groups are numbered to give multiple substituents the lowest possible numbers
- When there is only one substituent, it does not need to be numbered
- A ring can also be named as a substituent

Example

- Answer: 
- 1-ethyl-2-methylcyclohexane

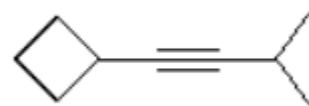
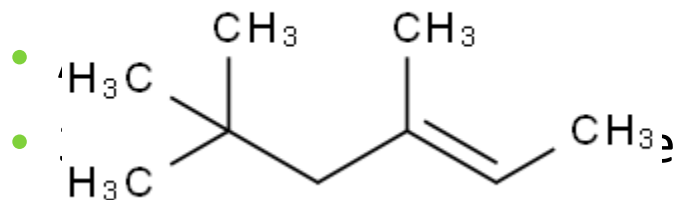


Answer:
cyclopropylcyclopentane

naming alkenes and alkynes

- -Ene suffix for alkene and -yne suffix for alkyne
- The root chain must be the longest chain that includes both carbon atoms of the double bond
- Number the root chain from the end nearest a double bond carbon atom (or triple bond carbon atom)
- The smaller of the two numbers designating the carbon atoms of the double/triple bond is used as the locator of alkenes/alkynes

Examples



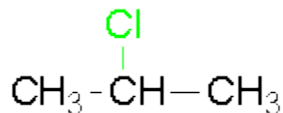
Answer:

1-cyclobutyl-3-methyl-1-butyne

Naming organic halides

- Same naming rules as before
- Halide substituents are named as fluoro (-F), chloro (-Cl), bromo (-Br), or iodo (-I)

Example:



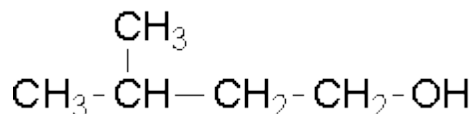
Answer:

2-chloropropane

Naming Alcohols

- Drop the –ane ending of the parent compound and adding –ol
- When there's a higher priority group present, -OH can be named as a substituent using the name hydroxy

Example:



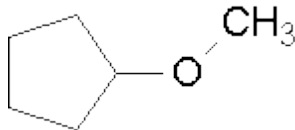
Answer:

3-methyl-1-butanol

Naming Ethers

- Name each of the two carbon groups followed by the word ether (Common naming rule)
- -OR group can also be named as a substituent using the group

Example: methoxy (IUPAC)



Answer:

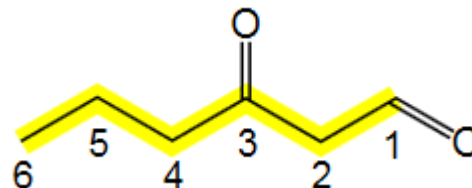
cyclopentyl methyl ether or
methoxycyclopentane

Naming aldehydes and ketones

- Aldehydes are named by dropping the –e of the parent name and adding –al
- The substituent name for aldehyde group is formyl
- When one or more –CHO groups are attached to the ring, the ring is named followed by carbaldehyde
- Ketones are named by dropping the –e ending and adding –one
- The substituent name is oxo

Examples

- Answer: $\begin{array}{c} \text{CH}_3 \quad \text{O} \\ | \quad || \\ \text{CH}_3 - \text{CH} - \text{C} - \text{H} \end{array}$
- 2-methylpropanal



Answer:

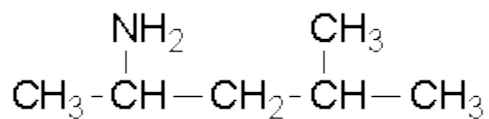
3-oxohexanal

Naming Amines

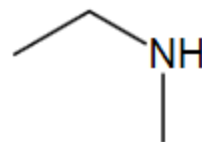
- Primary Amines (R-NH₂):
 - Replace the -e of the parent group with the word amine
 - Can also name it as a substituent using the name amino
- Secondary Amines (R₂NH):
 - Use an upper case N to designate the second alkyl group that is on the nitrogen atom
- Tertiary Amines (R₃N):
 - Named the same way as secondary amines

Examples

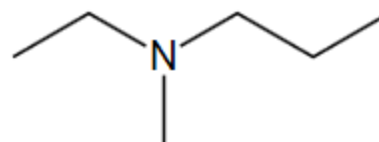
- 4-methyl-2-pentamine



- N-methylethanamine



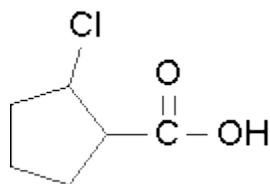
- N-ethyl-N-methylpropanamine



Naming carboxylic acids

- Carboxylic acids are named by dropping the –e ending and adding the –oic acid
- The substituent name for a –COOH group is carboxy

Example:



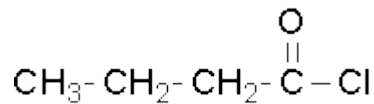
Answer:

2-chlorocyclopentanoic acid

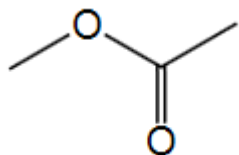
Naming carboxylic acid derivatives

- Acid Halides:
 - Replace the -e ending and add -oyl halide
 - Halide can be bromide, chloride, etc.
- Acid Anhydrides:
 - Symmetrical acid anhydrides are named by replacing acid with anhydride
 - Unsymmetrical acid anhydrides are named by naming each carboxylic acid component and then the word anhydride
- Esters:
 - First name the group that came from the alcohol and drop the -oic acid and add -oate
- Amides:
 - Replace the -oic acid ending with -amide

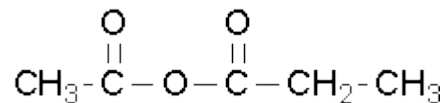
Examples



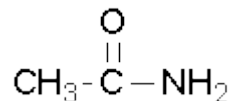
- Answer:
- Butanoyl chloride



Answer:
Methyl ethanoate
(common name: acetate)



Answer:
Ethanoic propanoic anhydride



Answer:
ethanamide

References

- For more detailed rules and examples including common naming rules, please consult the organic chemistry by wade textbook
- Workshop prepared by Qing Wang