

NOMENCLATURE OF ORGANIC COMPOUNDS

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The term nomenclature means the system of naming of organic compounds. In case of aliphatic compounds, two systems of nomenclature are generally used 1) Trivial or Common system, and 2) IUPAC system.

Trivial or common system: In the early stages of the development of organic chemistry, organic compounds were named after the source from which they were first isolated. For example:

Name of compounds	Source
Urea	Urine of Mammals
Methyl alcohol (wood spirit)	Destructive distillation of wood
Acetic Acid	Acetum (means Vinegar)
Formic acid	Formicus (latin name means red ants) destructive distillation of red ants
Citric acid	Citrus fruits

These names of organic compounds are called trivial names or common names.

IUPAC system: Because of the unique property of catenation and isomerism, carbon forms a large number of organic compounds. It became difficult to remember them by their common names. In order to systematize the nomenclature of organic compounds, IUPAC (International Union of Pure and Applied Chemistry) system of nomenclature was first introduced in 1947. Later it was revised and updated in 1993.

General Rules of IUPAC system for naming organic compounds:

The IUPAC name of any organic compounds essentially consists three parts: 1) Word Root 2) Suffix 3) Prefix and are elaborated below:

- 1) Word Root:** It is the basic unit of the name. It denotes the number of carbon atoms present in the principal chain (the longest possible continuous chain of carbon atoms including the functional group and the multiple bonds) of the organic molecules.

Extra 'a' given in parentheses is used only if primary suffix to be added to the word root begins with consonant.

In general, the word root for any carbon chain is alk.

- 1) Suffix:** There are two type of suffixes.

- a) Primary suffix:** A primary is always added to the word root to indicate whether the carbon chain is saturated or

CHAIN LENGTH	WORD ROOT	CHAIN LENGTH	WORD ROOT
C1	Meth	C7	Hept (a)-
C2	Eth	C8	oct (a) -
C3	prop (a)-	C9	non (a) -
C4	But (a) -	C10	Dec (a) -
C5	Pent (a) -	C11	Undec (a) -
C6	Hex (a) -	C12	Dodec(a)

unsaturated. The three basic primary suffixes are -ane,-ene,-eyn.

TYPE OF CARBON CHAIN		PRIMARY SUFFIX	GERENAL NAME
TYPE OF CHAIN	Unsaturated with two double bonds	diene	Alkadiene
Saturated (containing single bonds only)	-ane		Alkane
Unsaturated with two triple bonds	diyne		Alkadiyne
Unsaturated with one double bond	-ene		Alkene
Unsaturated with one triple bond	eyn		Alkyne

If principal chain contains two, three, or double or triple bonds, numerical prefixes such as di, tri, or tera etc. are added to the primary suffix. For example:

ORGANIC COMPOUNDS	WORD ROOT	PRIMARY SUFFIX	IUPAC NAME
CH ₃ CH ₂ CH ₂ CH ₃	But	ane	Butane
CH ₃ CH=CH ₂	Prop	ene	Propene
CH≡CH	Eth	yne	Ethyne
CH ₂ =CH—CH=CH ₂	Buta*	diene	Butadiene
CH≡C—C≡CH	Buta*	diyne	Butadiyne

Extra* 'a' has been added to the word root since the primary suffix i.e. diene or diyne begins with a consonant i.e. 'd' instead of a vowel.

b) Secondary Suffix: A secondary suffix is then added to the primary suffix to indicate the nature of the functional group present in the organic compound.

CLASS OF ORGANIC COMPOUNDS	FUNCTIONAL GROUP	SECONDARY SUFFIX
Alcohols	OH	-ol
Aldehydes	-CHO	-al
Ketones	>C=O	-one
Carboxylic acid	-COOH	-oic acid
Acid amides	-CONH ₂	-amide
Acid chlorides	-COCl	-oyl chloride
Esters	-COOR	alky-----oate
Nitriles	-CN	nitrile
Thiol	-SH	thiol
Amines	-NH ₂	amine

It may be noted that while adding secondary suffix to the primary suffix, the terminal 'e' of the primary suffix (i.e., ane, ene, yne) is dropped if the secondary suffix begins with a vowel but is retained if the secondary suffix begins with a consonant. For example:

ORGANIC COMPOUNDS	WORD ROOT	PRIMARY SUFFIX	SECONDARY SUFFIX	IUPAC NAME
CH ₃ CH ₂ OH	Eth	an(e)*	ol	Ethanol
CH ₃ CH ₂ CH ₂ NH ₂	Prop	an(e)*	amine	Propanamine
CH ₃ CH ₂ CH ₂ COOH	But	an(e)*	Oic acid	Butanoic acid
CH ₃ CH ₂ CN	Prop	ane	nitrile	Propane nitrile
CH ₂ =CH ₂ CHO	Prop	en(e)*	al	Prop-2-en-1-al
CH≡CCOOH	Prop	yn(e)*	oic acid	Prop-2-yn-1-oic acid

The terminal 'e'* from the primary suffix has been dropped because the secondary suffix begins with a vowel.

2) Prefix: There are two types of prefix.

(i) Primary prefix: A primary prefix is used simply to distinguish cyclic from acyclic compounds for example --- in case of carbocyclic compounds, a primary prefix, cyclo is used immediately before the word root Cyclo (primary prefix) + pent (word root) + ane (primary suffix)= Cyclopentane (IUPAC Name)



If the prefix cyclo is not used, it simply indicates that the compound is acyclic or open chain.

(ii) Secondary prefix: In IUPAC system of nomenclature certain groups are not considered as functional group but instead are treated as substituent. These are called secondary prefix and are added immediately before the word root (or the primary prefix in case of carbocyclic compounds) in alphabetical order to denote the side chain or substituent groups.

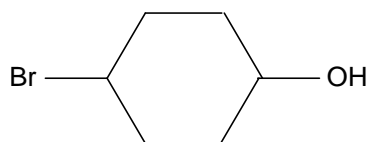
SUBSTITUENT GROUP	SECONDARY PREFIX	SUBSTITUENT GROUP	SECONDARY PREFIX
---F	Fluoro	-OCH ₃	methoxy
-Cl	chloro	-OC ₂ H ₅	ethoxy
-Br	Bromo	-CH ₃	methyl
-I	Iodo	-C ₂ H ₅	ethyl
-NO ₂	Nitro	-CH ₂ CH ₂ CH ₃	n-propyl
-NO	Nitroso	-CH(CH ₃) ₂	isopropyl
-N≡N	Diazo	-C(CH ₃) ₃	tert-butyl
-OR	alkoxy		

The complete IUPAC Name of an organic compound consists of the following parts:

Secondary prefix + primary prefix + word root + primary suffix + secondary suffix.

For example:

ORGANIC COMPOUNDS	SECONDARY PREFIX	WORD ROOT	PRIMARY SUFFIX	IUPAC NAME
CH ₃ CH ₂ Br	Bromo		ane	Bromoethane
CH ₃ NO ₂	Nitro		ane	Nitromethane
C ₂ H ₅ OC ₂ H ₅	Ethoxy		ane	Ethoxyethane



4-Bromo +cyclo + hex + ane + 1-ol =4-Bromo-cyclohexan-1-ol
(IUPAC NAME)

1. (sec. prefix +primary prefix +word root +primary suffix +sec. suffix)

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ASSIGNMENT

- The suffix for alcohols, aldehydes, and ketones according to IUPAC system are respectively
 –ane , -ald , -keto
 –ol , -al , -one
 –ol - , -al , -ket
 –ol , - de , -ne
- According to the IUPAC system , $\text{CH}_3\text{CH}_2\text{COCl}$ is named as
 (A) Chloropropane
 (B) Propanoyl chloride
 (C) Chloropropanyl
 (D) Propanyl chloride
- The IUPAC name for the compound

$$\begin{array}{c} \text{CH}_3\text{-CH-CH}_2\text{-CH-CH}_3 \\ | \quad | \\ \text{C}_2\text{H}_5 \quad \text{OH} \end{array}$$
 (A) 4-Ethylpentan-2-ol
 (B) 2-ethylpentan-4-ol]
 (C) 4-methyl-2-hydroxy hexane
 (D) 4-methylhexan-2-ol
- The correct IUPAC name for the compound
 $(\text{CH}_3)_3\text{COH}$ is
 (A) Trimethylmethan-1-ol
 (B) 1-Butanol
 (C) 1,1,1 Trimethylmethan-1-ol
 (D) 2-Methylpropan-2-ol
- Which of the following contains acetic acid
 (A) Vinegar
 (B) Molasses
 (C) Coal tar
 (D) Butter
- The IUPAC Name of the compound

$$\begin{array}{c} \text{CH}_3\text{-CH-CHO} \\ | \\ \text{CH}_2\text{-CH}_3 \end{array}$$
 is
 (A) Butan-2-aldehyde
 (B) 2-Ethylpropanal
 (C) 2-Methylbutana
 (D) 3-Methylpropanal
- The Grain alcohol is the common name of
 (A) Amyl alcohol
 (B) Ethyl alcohol
 (C) Methyl alcohol
 (D) Formic acid



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ANSWERS TO ASSIGNMENT

1 (B) 2 (B) 3 (D) 4 (D) 5 (A) 6 (C) 7 (B)

