# Introduction To Organic Chemistry

> The existence of a great number of different organic compounds has raised up the need to classify them into "families" ( yell U! 5 jee) [ [ ]







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#### Hydrocarbons

100 SED DA STE DANGER CONTENTION · The family of "Hydrocarbons" is the simplest family of organic compounds, containing only hydrogen and carbon atoms.

· Hydrocarbons are non-polar molecules, insoluble in water and soluble in non-polar solvents.

Hydrocarbons have low melting and boiling points.

There are four basic types of hydrocarbons:

Alkanes (C-C)

- Alkenes (C=C)

- Alkynes (C≡C) 乙 🗀

Aromatic hydrocarbons ( ) حالاروطاعة ( )

#### Types of Hydrocarbons

TABLE E.S. The	Four Hydrocurbon Types		- Execute - 11 31
Altere	Ethene	CH <sub>2</sub> CH <sub>2</sub>	89 mg
Alliane	Etryione (Etherne)	CH <sub>2</sub> -CH <sub>2</sub>	30 ">
Altyne	Acetylene (Ethyret)	CH-OI	H-yC-13A-C-H
Assemble	Correre	C,H <sub>c</sub>	

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7. 1/2 /2/dec

Alkenes (C=C bond)

Hydrocarbons (contain only carbon and hydrogen)

Alkynes (C≡C bond)

Aromatic (contains benzene ring)

Aliphatic

Generic Formula\*

 $C_nH_{2n+2}$ 

Generic Formula\*

 $C_nH_{2n}$ 

Generic Formula\*

 $C_nH_{2n-2}$ 

Benzene Formula

C<sub>6</sub>H<sub>6</sub>

Example

Ethane

Ethene

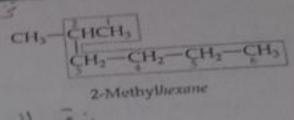
Ethyne



Benzene

## Nomenclature of Alkanes

のでとういろしているとしている 1. Find the longest continuous chain of carbon atoms in the molecule and use this chain as the base name (see



- the table of base names) serious of 2. Number the carbon atoms in the longest chain, beginning with the end nearest to a substituent julicy of Portal Com
- 3. Name each substituent (prefixes)

  4. Begin the name with the number or numbers of carbon atoms to which each substituent is bonded.
- 5. When two or more substituents are present, list them alphabetically

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# Names of Substituent Groups (Branches)

- Carbon Groups (alkyl groups, R):
  - Methyl CH3-
  - Ethyl CH3CH2-
  - Propyl CH3CH2CH2-
  - Butyl CH3CH2CH2CH2-

CH <sub>3</sub>	
H-C-	Isopropyl
CH-	

- Halogens:
  - Fluoro F-
  - Chloro CI-
  - Bromo Br -
  - lodo I -

#### Properties of Alkanes

Boiling points of Alkanes increase as chain length increases.

Molecular	Stall × First Ten Members of the Straight Gr Condensed Structural Formula	Name	Solat (*C)
Formula	Cundented attacks	Methane	-161
CH4	CH <sub>4</sub>	Ethane	- 974
CoHe	CH <sub>2</sub> CH <sub>2</sub>	Programs	~44
Cotta	CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>	Butane	-0.5
LH10	CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>	Pentane	36
Miller	CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub> CH <sub>3</sub>	Hexane	68
His	CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub> CH <sub>3</sub>	Heptane	98
His	CH_CH_CH_CH_CH_CH_CH_CH_	Octane	125
His	CH3CH2CH2CH2CH2CH2CH2		151
H <sub>20</sub>	CH3CH2CH2CH2CH2CH2CH2CH2	Nonune	
H22	CH,CH,CH,CH,CH,CH,CH,CH,CH,CH,	Decane	174

#### Isomers of Alkanes

> Isomers: compounds that have the same molecular formula but different chemical structures (i.e. different order of bonding).

TREES TAX U.S.	man of California Easter				
Nonematic Name (Common Name)	Mountainal Formula	Condensed Smotored Fermile	Space Hilling Model	Malling Point FSS	France P.C.2
Notice (induction)	H H H H	arararar	8	THE	-01
5. Nikolog Sprograms (Inchrosoria)	11 11 - 11 - 11 - 11 - 1	OI,-OI-OI,	w.	-045	-11%
horizona - porrelation)	# C C C C C	CHOROLOGICH,	999	-1875	781
Marky Systems rependency	H-C-4-11 H H-C-4-11 H H-C-4-11 H	OI, OI,-OI,-OI,	30	-161-5	-316
Character (prospersed opening special second	H-C-H H-C-H H-C-H	04-0-04	1	-110	***

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# Names of Substituent Groups (Branches)

of substituent in the molecule, list them "alphabetically".

3-Ethyl-2,4,5-trimethylheptane

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#### Nomenclature of Alkanes: Exercises

3 2 1 CH<sub>3</sub>CHCH<sub>2</sub>CH<sub>3</sub> CH<sub>2</sub>CH<sub>3</sub> 4 5

> 3-Methyl 3-Methylpentane

1 2 3 4 CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> 5 6 7 8

4-Ethyl 4-Ethyloctane ¹CH<sub>3</sub>—²CH<sub>2</sub>—³CH—CH<sub>3</sub> CH<sub>3</sub>—⁴CH—<sup>5</sup>CH<sub>2</sub> <sup>7</sup>CH<sub>3</sub>—<sup>6</sup>CH<sub>2</sub>

3,4-dimethylheptane

CH<sub>2</sub>CH<sub>3</sub> 1 2 3 4 5 6 7 8 CH<sub>3</sub>CH<sub>2</sub>CHCHCH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> CH<sub>3</sub>

4-Ethyl-3-methylocatane NOT 3,3-Methyl-4-ehyloctane 

### Nomenclature of Alkanes: Exercises

CH<sub>3</sub>CHCH<sub>3</sub> 2-lodopropane

CH<sub>3</sub>
CH<sub>3</sub>CHCH<sub>3</sub>-Br
1-Bromo-2methylpropane

CH<sub>3</sub>CH<sub>3</sub>-Br Bromosthane

CH,CH,CH,CH,-Br

CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CHCH<sub>2</sub>CH<sub>2</sub>-CI 1-chlorohexane

CH,CH,CH,-1

er chichchichi

2-Bromobutane

CH<sub>3</sub>CHCH<sub>3</sub>-Cl 1-Chloro-2-methylbutane

#### > Practice: Name the following compounds:

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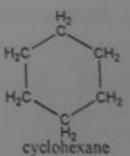
#### Cycloalkanes

Carbon can also form cyclic (ringed) structures.

The general formula of cycloalkanes is C<sub>n</sub>H<sub>2n</sub>

- Five- and six-carbon rings are most stable.
- Smaller rings than five carbon atoms are quite strained because the angle of C-C bond must be less than 109.5°.

H<sub>2</sub>C — CH<sub>2</sub> H<sub>2</sub>C — CH<sub>2</sub> cyclobutane H<sub>2</sub>C CH<sub>2</sub>
Cyclopentane





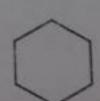
cyclopropane



cyclobutane



cyclopentane



cyclohexane

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#### Nomenclature of Alkenes

CH3-CH2-CH2-CH2-CH=CH2

1-Hexene

CH<sub>3</sub>-CH<sub>2</sub>-CH-CH<sub>2</sub>-CH=CH<sub>2</sub>

4-methyl-1-hexene

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сн<sub>2</sub>сн<sub>3</sub> сн<sub>3</sub>-сн<sub>2</sub>-сн-с=сн<sub>2</sub> сн<sub>2</sub>сн<sub>3</sub>

2,3-diethyl-1-pentene

Note: If an alkene contains two or more double bonds, the location of each is indicated by numerical prefix, and the ending of the name is altered to identify the number of double bonds: diene(two), triene (three): Example: CH<sub>2</sub>=CH-CH<sub>2</sub>-CH=CH<sub>2</sub> is named: 1,4-pentadiene.

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#### ALLEY DE LA CAULTON

#### Addition Reactions of Alkenes

- One important reaction of alkenes is the Addition Reaction:
  - -In which, two atoms (e.g., bromine) add across the double bond.
  - -One  $\pi$ -bond (from C=C) and one  $\sigma$ -bond (from Br-Br) are replaced by two  $\sigma$ -bonds (2 C-Br); therefore,  $\Delta H$  is negative.

$$H_2C=CH_2 + Br_2 \longrightarrow H_2C-CH_2$$

Br Br

#### Nomenclature of Alkenes

Example Give the IJPAC name of the following attenue

Step [1] Find the longest chain that contains both carbon atoms of the double bond.

6.0's in the longest shain

hexane --- hexane

F. File DI

Change the vane ending of the parant alkane to vene.

テクッントアセン

Step [2] Muriber the carbon chain to give the double bond the lower number, and apply all other rules of nomenclature

(iii) Wumber the chart, and name using the first number assigned to the C+C

. Number the chain to put the C=C at C2 and C4.

2-heren

(b) Name and number the substituents

tives methyl groups at C2, C3, and C5

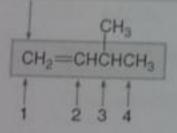
Answer: 2,3,5-trimothyl-2-hexene

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#### Nomenclature of Alkenes

Start numbering here.



CH<sub>3</sub> methyl group at C3

CH<sub>2</sub>=CHCHCH<sub>3</sub>

Answer: 3-methyl-1-butene

7 C's ---- heptene

Both C's of the C=C are contained in this long chain.

Correct: 2-ethyl-1-heptene

8 C's

Both C's of the C=C are NOT contained in this long chain.

Incorrect

#### Ethers (R-O-R)

Ethers: compounds in which two hydrocarbon groups (R) are bonded to one oxygen atom.

ROR'

Ethers can be formed from two molecules of alcohol by splitting out a molecule of water (Condensation Reaction). This reaction is catalyzed by sulfuric acid.

 $CH_3CH_2$ —OH + H— $OCH_2CH_3$   $\xrightarrow{H_2SO_4}$   $CH_3CH_2$ —O— $CH_2CH_3 + H_2O$ 

Ethers tend to be quite unreactive.
Therefore, they are common solvents for organic reactions.

CH<sub>2</sub>CH<sub>2</sub> CH<sub>2</sub> CH<sub>2</sub> CH<sub>2</sub> CH<sub>2</sub>

Diethyl ether

Tetrahydrofuran (THF)

Some Ethers are used as medical "anesthetics" that inhibit pain signals to the brain during surgeries.

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# Aldehydes (R-CO-H) and Ketones (R-CO-R')

R-C-H

R-C-R'

O II -C- C

STR & R'

Alkyl Group (e.g. CH3-)

In Aldehydes, at least one "H" is attached to the carbonyl (C=O) carbon atom.

H—C—H CH3—C—H

Methanal Ethanal

Formaldehyde Acetaldehyde

In Ketones, there are two "C" bonded to the carbonyl (C=O) carbon atom.

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CH<sub>3</sub>-C-CH<sub>3</sub>

Propanone
Acetone

CH<sub>3</sub>-C-CH<sub>2</sub>CH<sub>3</sub>

2-Butanone
Methyl ethyl ketone

- The systematic names of <u>aldehydes</u> are ended by the suffix -<u>al</u> and that of <u>ketones</u> are ended by the suffix -<u>one</u>.
- They can be prepared by the controlled oxidation of alcohols.

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#### Nomenclature of Alkynes

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#### Addition Reactions of Alkynes

- · Alkynes undergo many of the same reactions that alkenes do.
- · As with alkenes, the drive for the addition reaction is the replacement of  $\pi$ -bonds by  $\sigma$ -bonds.

2,2,3,3-Tetrachlorobutane

# estors

Esters carboxylic acids with alcohols: can be synthesized by Condensation Reactions

The name of any ester consists of the name of the "R" group coming from the alcohol followed by the name of the group coming from the carboxylic acid, with the -lc replaced by -ate.

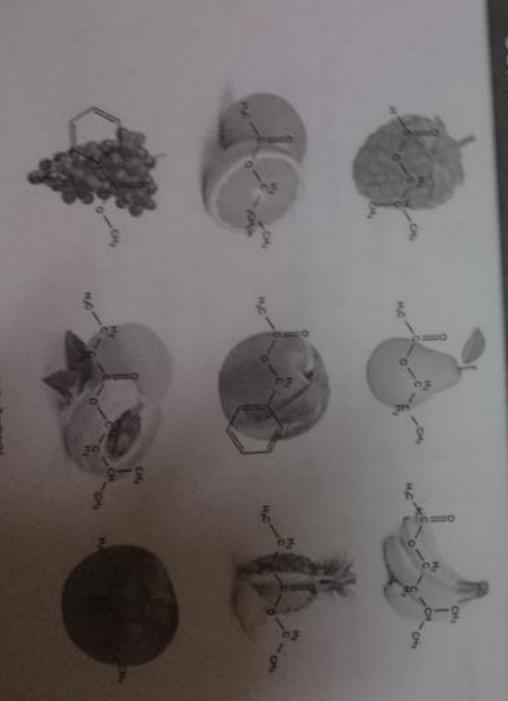
alcohol, For example, the ester formed from ethyl CH<sub>3</sub>(CH<sub>2</sub>)<sub>2</sub>COOH, is: CH3CH2OH. and butyric acid,

Ethyl butyrate

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# Common Fruit Esters



# Saponification Reaction of Esters

The hydrolysis of an ester in the presence of a base is called 

- Naturally occurring esters include fats and oils, and in making soap an animal fat or a vegetable oil is boiled with a strong base.
- The resultant soap consists of a mixture of salts of long-chain form during the

Saponification reaction.

CH<sub>3</sub>CH<sub>2</sub>-C-O-CH<sub>3</sub> + Na OH - CH<sub>3</sub>CH<sub>2</sub>-C-ONa + CH<sub>3</sub>OH Methyl propionate

O 2018 Presion Education Inc. - This Presidential NOT an Assembline to the Torthoon | 1 - Chica y | Amines (R-NH<sub>2</sub>) and Amides (R-CO-NH<sub>2</sub>)

Amines are compounds in which one or more hydrogen atoms of ammonia (NH<sub>3</sub>) are replaced by alkyl groups (R):

CH3CH2NH2

(CH3)3N

Trimethylamine

Phenylamine

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Amines are the most common Organic Bases.