

Organic Chemistry

Naming and functional groups of carbon-containing compounds

Carbon Bonding

- Carbon forms four bonds when it makes compounds
- Recall that carbon dioxide and carbonates are inorganic compounds.

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Definitions

- **Hydrocarbon** – a molecule that contains only carbon and hydrogen.
- **Saturated hydrocarbon** – a molecule that contains only carbon-carbon single bonds.
- **Unsaturated hydrocarbon** – molecule that contains one or more carbon-carbon double and/or triple bonds.
- **Hydrocarbon derivative** - a molecule that contains carbon, hydrogen, and other elements.

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Hydrocarbons, Saturated

Class	Structure	Example	Name	Ending
alkane	C—C	CH ₃ —CH ₃	ethane	-ane
		CH ₄	methane	
		CH ₃ CH ₂ CH ₃	propane	

Bond Line Drawings

Bond-line drawings represent molecules in a compact way. Each end or bend in a line is a carbon atom (unless another atom is indicated).

Convert a bond-line drawing into a molecule by drawing the atom frame. Next, draw H atoms around each carbon so that each carbon forms 4 bonds.

	Bond-Line Drawing	Atom Frame	Molecule
Butane:		C-C-C-C	CH ₃ CH ₂ CH ₂ CH ₃
Acetone:			
Benzene:			

Be able to determine the organic class of a structure using the bond-line drawing or the molecule drawing.

Hydrocarbons, Unsaturated

Class	Structure	Example	Name	Ending
alkene	C=C	CH ₂ =CH ₂	ethene	-ene
benzene		C ₆ H ₆	benzene	-ene
alkyne	C≡C	CHECH	ethyne	-yne

The R- Group

- An "R-" group means a group that contains carbon.
- Form an R- group by removing a hydrogen from a hydrocarbon or a hydrocarbon derivative
- For example, removing a hydrogen from ethane forms an ethyl group
- The R- group can sometimes be H-, as long as it does not change the classification of a compound.

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Name Alkanes and R- Groups

Name of alkane	Name of R- Group
methane	methyl
ethane	ethyl
propane	propyl
butane	butyl
pentane	pentyl
hexane	hexyl
heptane	heptyl
octane	octyl

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The Ar- Group

- Ar- means aryl group (or benzene).
- Form an Ar- group by removing a proton (H) from benzene and then adding a substituent in place of that H.
- The aryl (Ar-) group is also called a phenyl group.

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The Carbonyl Group

- A carbonyl group is C=O
- Carbon forms four bonds, so a carbonyl carbon (C) can have up to two other atoms attached to it.


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The “-”

- A “-” at the end of a molecule or structure indicates an attach point for a hydrogen, R- group, or Ar- group.
- Inside a structure, a “-” indicates a single bond between two atoms.

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5 Hydrocarbon Derivatives Do Not Have a Carbonyl Group

	Class	Structure	Example	Name	Ending
1	organic				
	halide	C—X	CH ₃ —Cl	methyl chloride	-ide
		R—X	CH ₃ CH ₂ —Cl	ethyl chloride	
		Ar—X	C ₆ H ₅ —Cl	phenyl chloride	
2	alcohol	C—OH	CH ₃ —OH	methanol	-ol
		R—OH	CH ₃ CH ₂ —OH	ethanol	
3	phenol	Ar—OH		phenol	-ol

5 Hydrocarbon Derivatives Do Not Have a Carbonyl Group

Class	Structure	Example	Name	Ending
4 ether	$C-O-C$	CH_3-O-CH_3	dimethyl ether	-ether
	$R-O-R$	$CH_3-O-CH_2CH_3$	methyl ethyl ether	
	$Ar-O-Ar$			
5 amine	$\begin{array}{c} \\ C-N- \\ \end{array}$	CH_3-NH_2	methyl amine	-amine
	$R-NH_2$	$CH_3CH_2-NH_2$	ethyl amine	
		$(CH_3)_2-NH$	dimethyl amine	
		$(CH_3)_3-N$	trimethyl amine	

5 Hydrocarbon Derivatives Have a Carbonyl Group

Class	Structure	Example	Name	Ending
1 aldehyde	$\begin{array}{c} -CH \\ \\ O \end{array}$	$\begin{array}{c} HCH \\ \\ O \end{array}$	formaldehyde (methanal)	-aldehyde, -al
2 ketone	$\begin{array}{c} RCR \\ \\ O \end{array}$	$\begin{array}{c} CH_3CCH_3 \\ \\ O \end{array}$	propanone (dimethyl ketone)	-one
3 carboxylic acid	$\begin{array}{c} -COH \\ \\ O \end{array}$	$\begin{array}{c} HCOH \\ \\ O \end{array}$	formic acid (methanoic acid)	-ic acid

5 Hydrocarbon Derivatives Have a Carbonyl Group

Class	Structure	Example	Name	Ending
4 ester	$\begin{array}{c} -COR \\ \\ O \end{array}$	$\begin{array}{c} HCOCH_3 \\ \\ O \end{array}$	methyl methanoate (methyl formate)	-oate, -ate
5 amide	$\begin{array}{c} \\ -CN- \\ \\ O \end{array}$	CH_3CNH_2	ethanamide	-amide
		CH_3CNHCH_3		
		$CH_3CN(CH_3)_2$		

• Identify the class of each compound:

• Structure _____ Class

•  ketone

•  alkene

•  organic halide

•  carboxylic acid

•  organic halide

•  ketone, ether, ester