

HC Unit 13: Organic Chemistry

Name: _____

organic chemistry:

--

Carbon is unique among the elements because:

-- it can have up to four bonds per C atom →

--

--

Basic Definitions

hydrocarbons: compounds containing only ___ and ___

alkanes: hydrocarbons having only _____ bonds

--

alkenes: hydrocarbons having at least one _____ bond

alkynes: hydrocarbons having at least one _____ bond

aromatic hydrocarbons: benzene and compounds ^{w/a}
benzene-related structure

-- -enes, -ynes, and aromatics are _____

“Finer-Point” Definitions

Straight-chain compounds have...

Branched-chain compounds have...

Substituted compounds have...

Branches and H-replacing atoms/groups are collectively called...

Functional group: a characteristic pattern that makes up a portion of a larger molecule

--

-- importance:

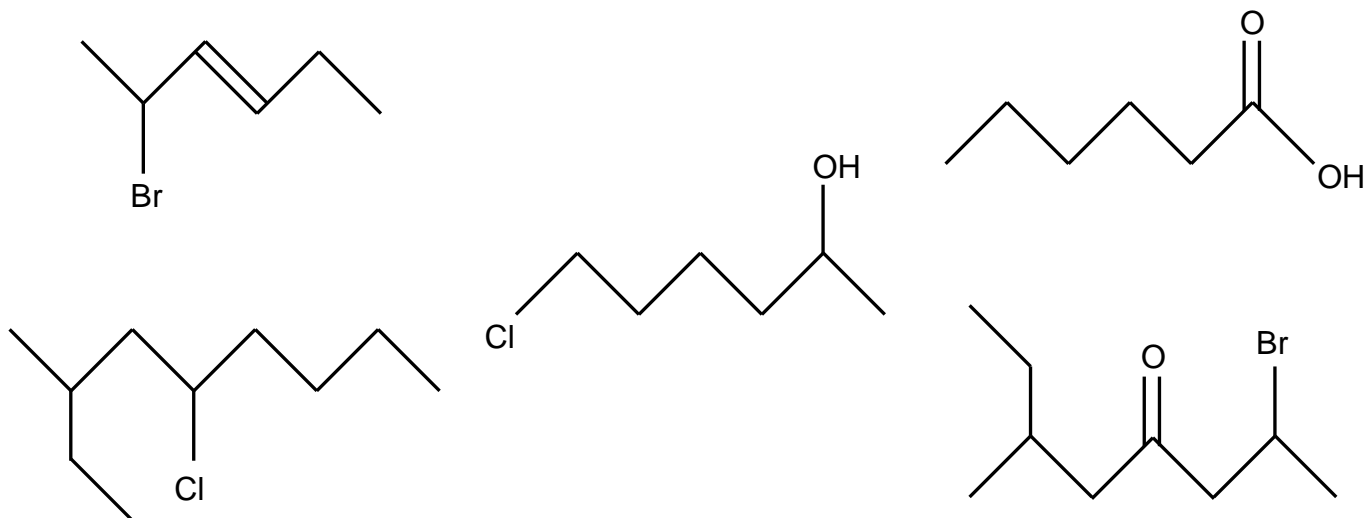
-- several examples of fgs:

alcohols

ketones

carboxylic acids

Many organic compounds are combinations of several categories.



Organic Nomenclature

Memorize the prefixes that tell the # of C atoms in a chain.

1 =	2 =	3 =	4 =	5 =
6 =	7 =	8 =	9 =	10 =

Naming Straight-Chain Alkanes

1. Find the longest continuous chain of C atoms. Choose the appropriate prefix.
2. The name ends with -ane.

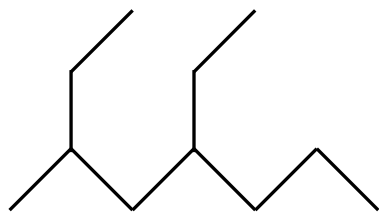
EX. Provide the counterpart to the given. propane



Alkanes: modification for substituent hydrocarbon (HC) groups

1. Number the "longest chain" carbons. Start with the end nearest a branch.
2. Name and give the #ed location of each substituent.
 - HC substituent groups use the prefixes, but end in -yl.
3. List substituents in alphabetical order.

EX. Provide each counterpart.



4-ethyl-2-methylhexane

Alkanes: modification for non-HC substitutions

1. The “longest chain” MUST contain the substituent.

-- example substituents: $-\text{NO}_2$ $-\text{NH}_2$ $-\text{F}$ $-\text{Br}$ $-\text{I}$

2. Number the chain carbons, starting with the end nearest a substituent.

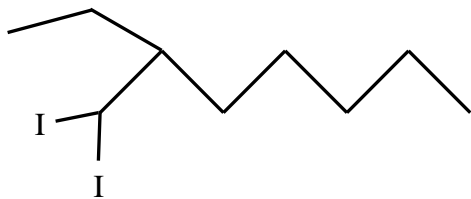
-- A non-HC substituent takes precedence over an HC branch.

3. Name and give the #ed location of each substituent.

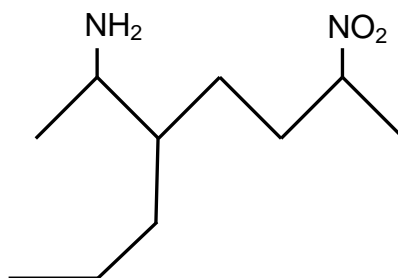
-- If necessary, choose #s so that their sum is as low as possible.

EX. Provide each counterpart.

3-bromo-2-chlorohexane



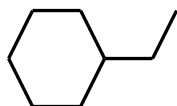
2-methyl-1-nitrobutane



Alkanes: modification for cycloalkanes

-- Use the *cyclo-* prefix before the word “alkane.”

EX. Provide each counterpart.



1-bromo-1-chloro-2-methylcyclopentane

Naming Alkenes and Alkynes

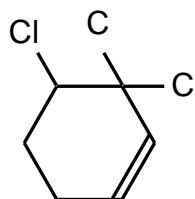
1. The C-chain MUST include the multiple bond. Use *-ene* or *-yne*, as appropriate.
2. Number so that you get to the multiple bond ASAP.
 - The multiple bond takes precedence over branching or substituents.
3. Use *di-* or *tri-* right before *-ene* or *-yne* if you have two or three multiple bonds.

EX. Provide each counterpart.

1-butyne



7-fluoro-6-methyl-3-octyne



Benzene, Phenol, and Toluene

These are the “Big Three” aromatic compounds.

benzene

phenol

toluene

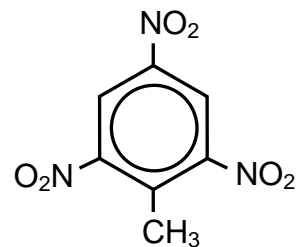
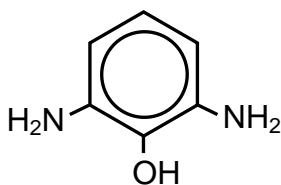
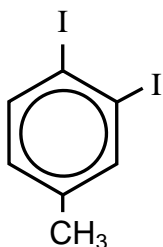
For phenols and toluenes, the C to which the $-OH$ or $-CH_3$ is attached is carbon #1.

EX. Provide each counterpart.

bromobenzene

ethylbenzene

2-propylphenol



ortho-

meta-

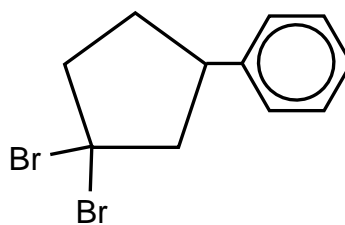
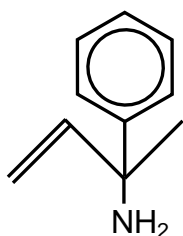
para-dichlorobenzene

For this class, if a benzene ring is connected to an **interior** C atom in a hydrocarbon chain, it is called a phenyl ("FENN uhl") group. It looks like THIS and has the formula...

EX. Provide each counterpart.

2-bromo-2-chloro-3-phenylpentane

3-nitro-2,4-diphenylhexane



Alcohols

Alcohols contain the hydroxyl group.

--

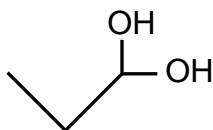
Primary (1°) alcohols have one OH; secondary (2°) have two; tertiary (3°) have three.

Naming Alcohols

1. Without being redundant, specify the location of the OH group(s); the suffix is *-ol*.
2. Use *di-* or *tri-* right before *-ol* if you have a secondary or tertiary alcohol.

EX. Provide each counterpart.

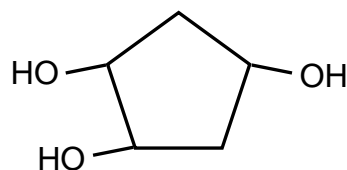
1-propanol



3-ethylphenol

3-ethylcyclohexanol

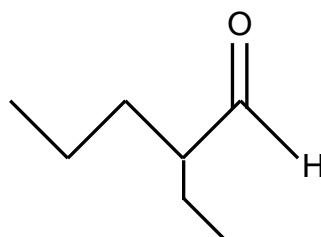
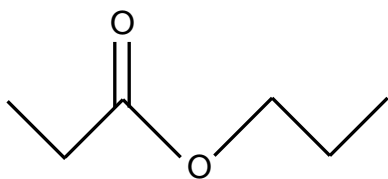
5-bromo-2-propyl-6-chloro-1-hexanol



Functional groups containing the <u>carbonyl group</u>	Ketones	Aldehydes	Esters	Carboxylic Acids
	Names end in <i>-one</i> , ^w /the C in the carbonyl having the lowest possible number.	Names end in <i>-al</i> , ^w /the C in the carbonyl being C #1.	The C in the carbonyl is C #1. Whatever is attached to the <i>-O-</i> is named first, then the name ends in <i>-oate</i> .	Names end in <i>-oic acid</i> , ^w /the C in the carbonyl being C #1.

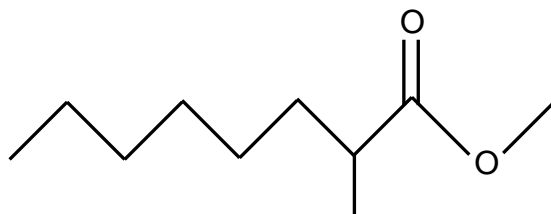
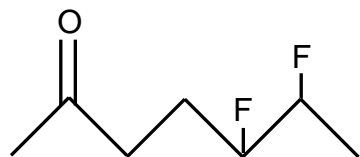
EX. Provide each counterpart.

3-hexanone



3-propylhexanoic acid

3-phenylbutanal



4,4,4-trifluorobutanoic acid

Other Functional Groups to Recognize

Ethers (“EETH erz”)	Amines (“uh MEENZ”)	Amides (“uh MIDZ” or “AM idz”)

Organic Reactions

combustion of hydrocarbons OR compounds ^{w/}only C, H, and O: products are...

EX. Write the equation for the complete combustion of 2-methyl-2-pentene.

Write the equation for the complete combustion of ethylbutanoate.

substitution: an H atom is removed and "something else" is put in its place

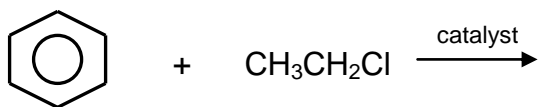
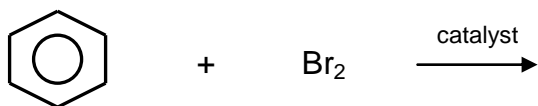
-- In halogenation, a _____ atom replaces an H.

EX. Write an equation for the reaction between ethane and chlorine.

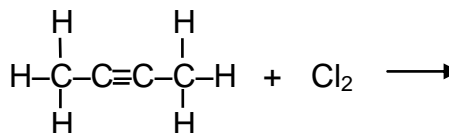
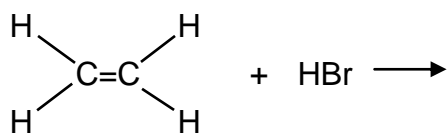
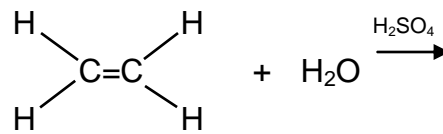
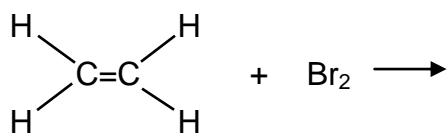
If more chlorine is provided, the reaction will produce...

AND SO ON.

Substitution occurs with aromatic compounds, too.



addition: a multiple bond is broken and two "things" are inserted

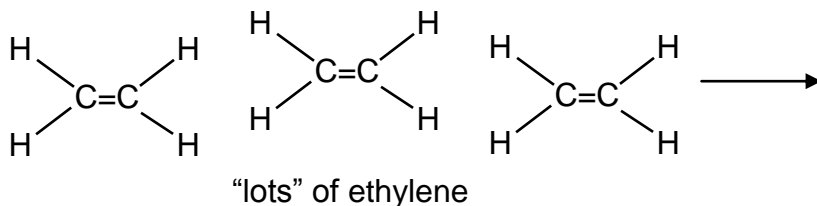


A specific addition rxn is hydrogenation, in which ___ is added across a multiple C-C bond.

-- requires a catalyst (usually a finely-divided _____) to rupture the multiple bond

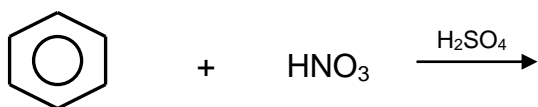


Another addition reaction is polymerization.



condensation (or elimination, or dehydration): _____ is a product

-- One reactant provides an ____, the other provides an ____.



-- Amides can be formed in condensation rxns between carboxylic acids and amines.

EX. Write the equation for the reaction between butanoic acid and nitrogen trihydride.

Esterification is a condensation reaction between a carboxylic acid and an alcohol.

EX. Write the equation for the reaction between butanoic acid and 1-butanol.

EX. Write the equation for the reaction between 3-phenyl-2-propenoic acid and ethanol.