Organic and Biochemistry

Name: _____

AP Chemistry Lecture Outline

Video 2503 (3:10)

Introduction to Organic and Biochemistry

organic chemistry:

biochemistry:

--

Carbon is unique among the elements because:

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

--

--

Video 2506 (9:10)

Basic Definitions hydrocarbons: compounds containing only __ and __

alkanes: hydrocarbons having only _____ bonds

--

--

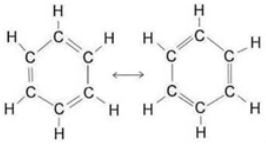
--

structural isomers: same molecular formula, different…

alkenes: hydrocarbons having at least one _____ bond

alkynes: hydrocarbons having at least one _____ bond

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



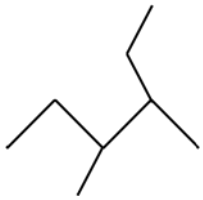
-- –enes, –ynes, and aromatics are _____

Video
2509
(9:33)

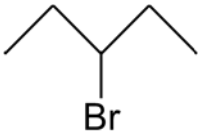
Finer-Point Definitions

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 m'cule

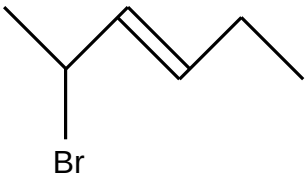
--

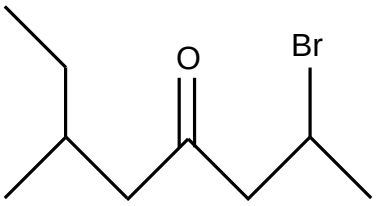
-- importance:

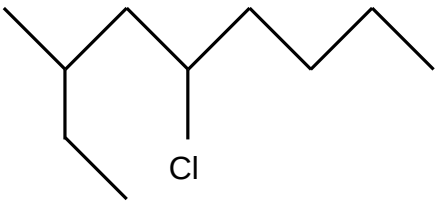
-- several examples of fgs:

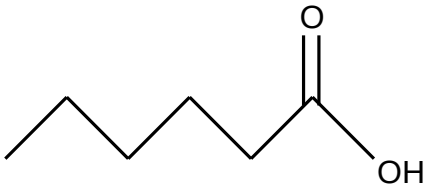
alcohols ketones carboxylic acids

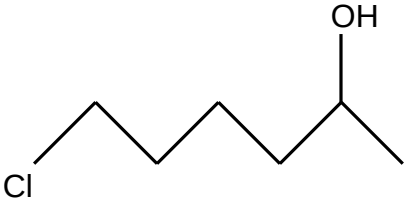
Many organic compounds are combinations of several categories.







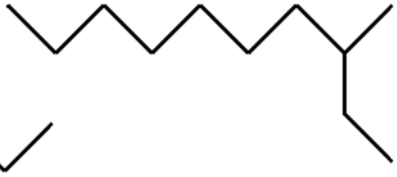


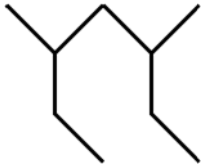


Video 2512 (9:49)

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.

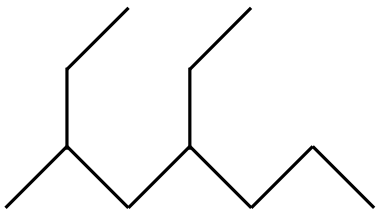
EX. Provide the counterpart to the given. propane

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 based on the # of Cs, but end in –yl.
3. List substituents in alphabetical order.

EX. Provide each counterpart.

4-ethyl-2-methylhexane



Video 2515 (10:30)

Alkanes: modification for non-HC substituents

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

   -- example substituents: $–NO_2$ $–NH_2$ –F –Br –I

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

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

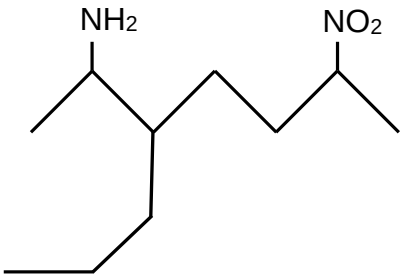
3. Name and give the #ed location of each substituent.

   -- 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

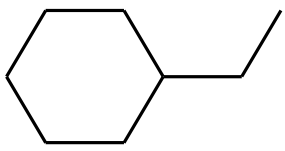


Alkanes: modification for **cycloalkanes**

-- Use the *cyclo-* prefix before the “-ane” part.

EX. Provide each counterpart.

1-bromo-1-chloro-2-methylcyclopentane



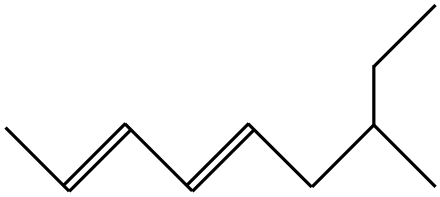
Video 2518 (9:55)

Alkenes and Alkynes

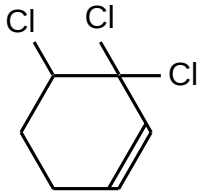
1. The C-chain MUST include the multiple bond. Use *–ene* or *–yne*, as appropriate.
2. Number so that you get to the multiple bond ASAP.
   -- The multiple bond takes precedence over branching or substituents.
3. Use *di-* or *tri-* right before *–ene* or *–yne* if you have two or three multiple bonds.

EX. Provide each counterpart.

1-butyne

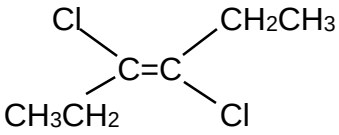


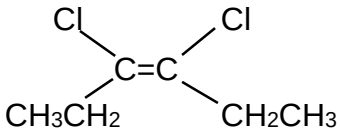
7-fluoro-6-methyl-3-octyne



4. For geometric isomers (different spatial arrangements of atoms), use *cis-* (same) or *trans-* (opposite). Geometric isomerism is possible only with…

EX.





Video 2521 (7:25)

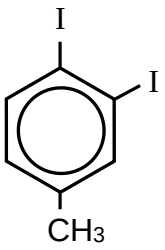
Benzene, Phenol, and Toluene These are the “Big Three” aromatic compounds.

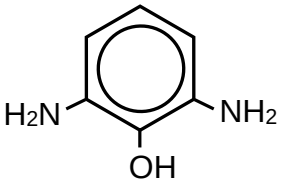
For phenols and toluenes, the C to which the –OH or $–CH_3$ is attached is carbon #1.

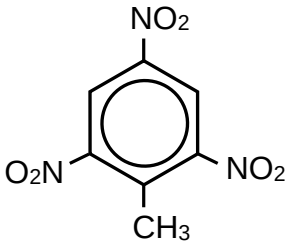
<u>benzene</u> <u>phenol</u> <u>toluene</u>

EX. Provide each counterpart.

bromobenzene ethylbenzene 2-propylphenol







Video 2524 (5:41)

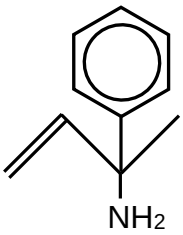
ortho- meta- para-dichlorobenzene

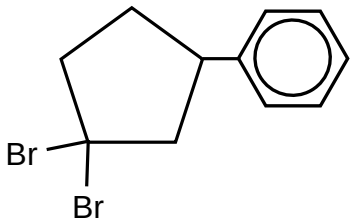
For this class, if a benzene ring is connected to an **interior** C atom in a hydrocarbon chain, it is called a phenyl ("FENN uhl") group. It looks like THIS and has the formula…

EX. Provide each counterpart.

2-bromo-2-chloro-3-phenylpentane

3-nitro-2,4-diphenylhexane





Video 2527 (8:40)

Alcohols Alcohols contain the <u>hydroxyl</u> group.

-- low molar mass alcohols are soluble in…

-- all alcohols have higher BPs than their parent alkanes

<u>Primary</u> (1º) alcohols have one "R" group;

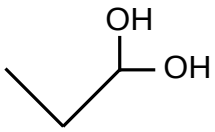
<u>secondary</u> (2º) have two;

<u>tertiary</u> (3º) 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 two or three OHs.

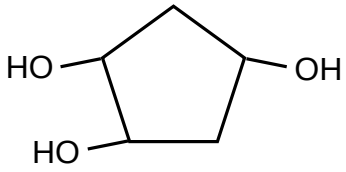
EX. Provide each counterpart.

1-propanol 

3-ethylphenol

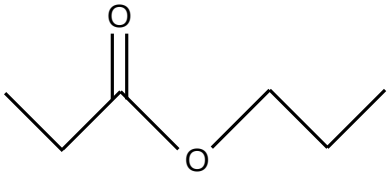
3-ethylcyclohexanol

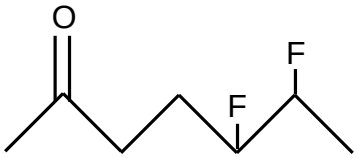
5-bromo-6-chloro-2-propyl-1-hexanol

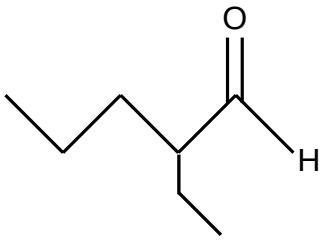


Video 2530 (10:18) **Functional groups containing the <u>carbonyl</u> group**	**Ketones**	**Aldehydes**	**Esters**	**Carboxylic Acids**
	Names end in *–one*, ʷ/the C in the carbonyl having the lowest possible number.	Names end in *–al*, ʷ/the C in the carbonyl being C #1.	The C in the carbonyl is C #1. Whatever is attached to the –O– is named first, then the name ends in *–oate*.	Names end in *–oic acid*, ʷ/the C in the carbonyl being C #1.

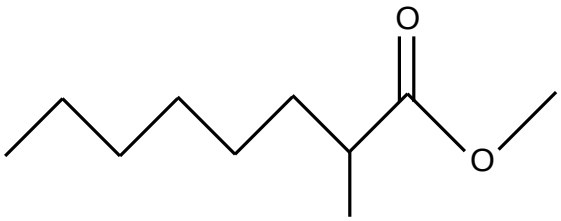
EX. Provide each counterpart.

3-hexanone 

3-phenylbutanal 



3-propylhexanoic acid



4,4,4-trifluorobutanoic acid

Video 2533 (2:49)

Other Functional Groups to Recognize

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

Video 2536 (7:20)

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

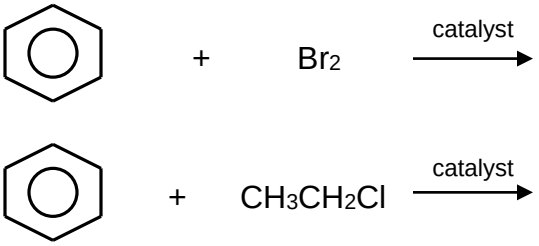
-- In halogenation, a _____ atom replaces an H.

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

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

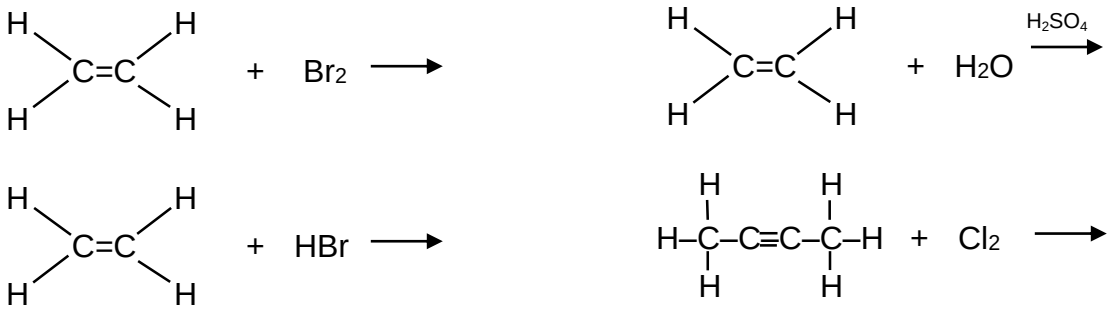
AND SO ON.

Substitution occurs with aromatic compounds, too.



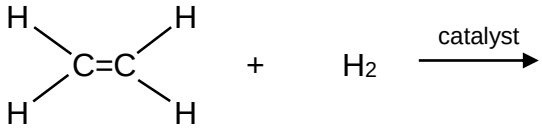
Video 2539 (4:53)

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

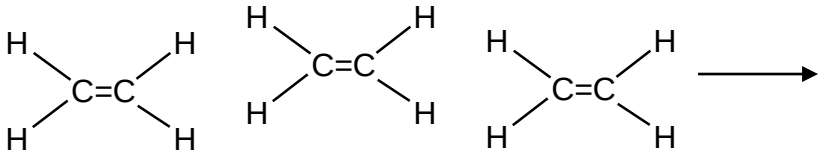


A specific addition rxn is hydrogenation, in which ___ is added across a multiple C-C bond.

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



Another addition reaction is polymerization.



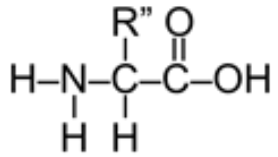
"lots" of ethylene

Video 2542 (6:26)

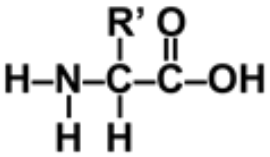
condensation (or elimination, or dehydration): _____ is a product

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

-- Condensation reactions polymerize amino acids into…



amino acid #1



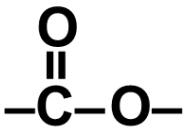
amino acid #2

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

EX. Write the equation for the reaction between butanoic acid and ammonia.

Video 2545 (5:33)

Esterification is a condensation reaction that occurs specifically 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.