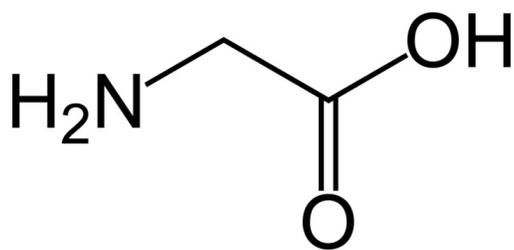
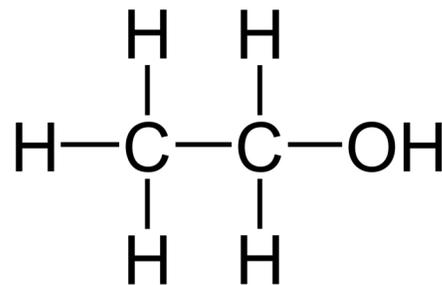
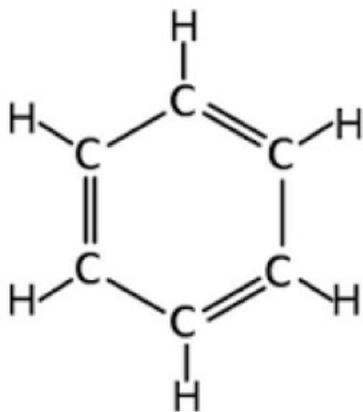
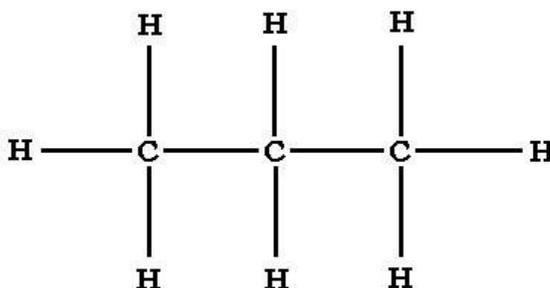
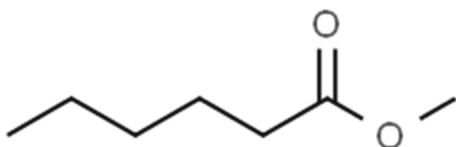

Organic Chem Class Notes



Which one is which?
glycine is an amino acid
ethanol is an alcohol
benzene will give you cancer
methyl hexanoate is why bananas smell
propane is for burning

- _____ is the first atom of organic chemistry.
- Carbon can make _____ bonds to other carbon atoms.
- There are _____ in organic chem
- Write the ten organic prefixes—how to count the carbon atoms in molecules. (LOOK at table P)

1	2	3	4	5
6	7	8	9	10

- Carbon must make ___ bonds because carbon has an electron configuration of _____
- Carbon atoms can make these types of bonds
- Hydrogen atoms have one valence electron, they can only make _____
- What is the name and formula of the simplest hydrocarbon? _____
- _____ are the simplest molecules in organic chem, made up of only hydrogen and carbon atoms.
- Table Q is titled: _____
- Homologous = HOMO + LOGOUS = _____

12. The three “body types” or SERIES are		Example carbon bonding
ALKANES	Which have	
ALKENES	Which have	
ALKYNES	Which have	

14. Alkane Name	# C	Structural Diagram	Molecular formula and Condensed Structural Formulas
	1		
	2		
	3		
	4		
	5		
	6		
	7		

14. Alkane Name	# C	Structural Diagram	Molecular formula and Condensed Structural Formulas
	8		
	9		
	10		

Organic Vocabulary

15. _____ is the study of chemical compounds that at one time were thought to be made only by living organisms like plants or animals. This is not true, nor was it.
16. _____ is the central atom in organic chem. Carbon makes 4 bonds always, because of its electron configuration of 2-4. It can make single or double or even triple bonds to itself.
17. _____ are simple molecules in organic chem, made up of only of Hydrogen and carbon atoms, hence this name.
18. _____ (title to Table Q) means having the “same body type” molecules made up of only H + C. Alkanes, alkenes, and alkynes contain ONLY single bonds, or a double bond, or a triple bond.

19. ALKANES...

The Alkane general formula: _____
ex: the alkane with 4 carbon atoms (butane), what is it's formula? _____

20. The second homologous series of hydrocarbons is called the _____

21. The general formula for alkenes is _____
They have less H's than alkanes because of the double C=C bond.

22. An alkene with 5 carbon atoms has the molecular formula of _____

23. In our class _____ double bond,
but in the real world, multiple double bonds are possible in one molecule.

24. Methene is NOT possible.
In order to have a double bond between 2 carbon atoms you need 2 carbon atoms. Meth = _____

25. Draw ethene and propene now

ethene	propene (to the "right")	propene (to the "left")

Draw 2 kinds of butene now. There are 2 different ways to draw butene.
Name them, and write the condensed structural formulas (this is new) as well.

31 draw		
32	name	name
33	Condensed structural formula	Condensed structural formula
34	Isomers share a molecular formula:	

35	1-pentene	
36	2-pentene	
37	1-hexene	
38	3-hexene	

39	40	41
----	----	----

<p>42</p> <pre> H H H H H H H - C - C - C = C - C - C - H H H H H </pre>	<p>43</p> <pre> H H H H H H H H H - C - C = C - C - C - C - C - H H H H H H H H </pre>
<p>42 Name and write out the condensed structural formula</p>	<p>43 Name and write out the condensed structural formula</p>

44. The 3rd group of hydrocarbons are the _____

In our class ALKYNES only have _____ triple bond.

Naming and drawing will be just like the alkenes, the number tells where the triple bond is placed.

45. There is no _____ you need at least two carbon atoms to triple bond together.

<p>46 Draw ETHYNE</p>	<p>Draw PROPYNE</p>
-----------------------	---------------------

<p>47 Draw 1-butyne</p>	<p>Draw 2-butyne</p>
-------------------------	----------------------

48a	1-pentyne	
48b	2-pentyne	
48c	1-heptyne	
48d	3 heptyne	
49		The general formula for all ALKYNES is...
		If an alkyne has nine carbon atoms, what is its formula?

50. Table R lists all _____

51. Functional groups are added to hydrocarbons to make them _____, to make them more difficult, to make them _____ or worse, and to give them a wide variety of new _____.

52. The first, functional group we will add to hydrocarbons are the _____.

53. HALOGENS	symbols	Organic Chem Prefix names

54	54
55	55
56	57

The rules to naming Halocarbons:

58a.

58b.

58c.

58d.

59 Draw	Name
---------	------

60 Draw	Name
---------	------

60 Draw	Name
---------	------

61. Draw these...	
1,1dibromo- 2,2 difluoroethane	
difluoroethyne	
5bromo- 4,4 dichloro- 7,8,8trifluoro- 1,2,3,7 tetra-iodo- octene	

62. name these five molecules...

Name	General Formula	Examples	
		Name	Structural Formula
alkanes	C_nH_{2n+2}	ethane	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $
alkenes	C_nH_{2n}	ethene	$ \begin{array}{c} \text{H} \quad \quad \text{H} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \quad \diagdown \\ \text{H} \quad \quad \text{H} \end{array} $
alkynes	C_nH_{2n-2}	ethyne	$\text{H}-\text{C}\equiv\text{C}-\text{H}$

Note: n = number of carbon atoms

64. Alkanes are _____ because 2 carbon atoms with single bonds can “hold” the most (six) hydrogen atoms

65. Alkenes and Alkynes are both _____ They have a double or triple bond, so the “hold” less hydrogen atoms (4 H or 2 H) than alkanes.

66. Alkanes are saturated, they can't be " _____ " to.

67. Alkanes can undergo _____ reactions only.
(alkanes CANNOT undergo addition reactions).

68. Alkenes & Alkynes are unsaturated, they undergo _____ reactions only.
(alkenes and alkynes CANNOT undergo substitution reactions).

	Reactants	products
69 Names		
69 Structural diagrams		
70 Names		
70 Structural diagrams		

	Reactants structures and names	Products structures and names
71a		
71b		
71c		
71d		

72. Halogens can be substituted ONLY into _____
 these are the alkanes.

73. It happens _____ AT A TIME.

74. When you combine halogens with unsaturated hydrocarbons (alkenes/alkynes) a different reaction

happens called an _____ reaction.

That's because when the double bond "opens up" to a single bond, and it opens up 2 spots for BOTH halogen atoms to join the molecule, or, a triple bond opens up into a double bond, and again, you ADD both halogens at once.

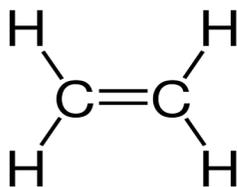
Examples of ADDITION Reactions (unsaturated hydrocarbon + halogen molecule)

75 word

Ethene

+ Bromine form

75 drawings



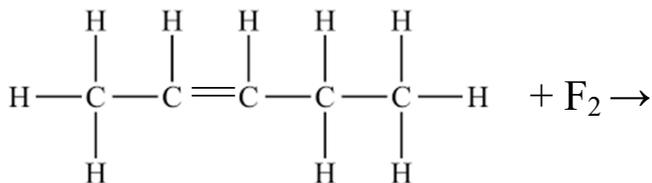
+ Br₂ →

76 word

2-pentene

+ fluorine form

76 drawings



+ F₂ →

77 word

Ethyne

+ chlorine form

77 drawings



+ Cl₂ →

78 word

1-pentyne

+ iodine

78 drawings

+ I₂ →

79. Draw the functional groups for alcohols and ethers	Functional group	General formula
Alcohols		
ethers		

“R” means the functional group bonds to a hydrocarbon here.

The R' (say R prime) means the functional group makes a bond to a different hydrocarbon here.

ALCOHOLS

80. Alcohols have an “-OH” group which is _____.
Alcohols are MOLECULAR not ionic.

81. When the hydroxide anion is ionically bonded to a metal, that's an Arrhenius _____.
Like... (*NaOH*, or *KOH*)

82. Alcohols are _____

	How many carbons?	Structural diagram	Condensed structural formula
83 Draw methanol	1 carbon		CH ₃ OH
Draw ethanol	2 carbons		
84 Draw ethanol with -OH on the “right” end	2 carbons		
Draw ethanol with -OH on the “bottom left”	2 carbons		

Add names	How many carbons?	Structural diagram	Condensed structural formula
85 Draw	3 carbon		
85 Draw	3 carbon		
86. These are different ISOMERS...			

<p>87. Draw and name the three different 5-carbon alcohol molecules</p> <p>Name the base chain (count carbon atoms)</p> <p>Enumerate where the alcohol group is located.</p> <p>Alcohol names always end with the –anol suffix</p>	

C atoms names of the alcohol molecules (these are ALL of the alcohol molecules in high school chem)

1	methanol
2	ethanol
3	1-propanol, 2-propanol
4	1-butanol, 2-butanol
5	1-pentanol, 2-pentanol, 3-pentanol
6	1-hexanol, 2-hexanol, 3-hexanol
7	1-heptanol, 2-heptanol, 3-heptanol, 4-heptanol
8	1-octanol, 2-octanol, 3-octanol, 4-octanol
9	1-nonanol, 2-nonanol, 3-nonanol, 4-nonanol, 5-nonanol
10	1-decanol, 2-decanol, 3-decanol, 4-decanol, 5-decanol

Naming Alcohols

COUNT the number of carbon atoms.

DETERMINE where the functional group is attached. When needed, number that carbon in the name.

Alcohol names always end with the -anol suffix

89. Why is there not an alcohol molecule named 4-pentanol?
(Draw it, you can)

ETHERS

Ether molecules are easy to recognize because they have a single atom of oxygen in the middle, and make single bonds to the left and right

90. Ethers functional group looks like this: _____

91. and a general formula that looks like this: _____

92. Which means an R group is attached to an oxygen atom, and a different R prime group on the other side.

93	Methane	Take away one "H" atom to form...	Methyl group
94	Ethane		
95	Propane		

96	Butane	Take away one "H" atom to form...	butyl group
----	--------	-----------------------------------	-------------

Alkanes are SATURATED, they cannot be bonded to anything else, there is no way to do that, UNLESS one H atom is removed, and that provides an OPEN BOND, to attach (say) to an oxygen atom in an ether.

97	Pentane would become _____	Hexane would become _____
	Heptane would become _____	Octane would become _____
	Nonane would become _____	Decane would become _____

98. Methyl ethyl ether	
Propyl butyl ether	
Pentyl methyl ether	
99 Diethyl ether	
Dimethyl ether	
Hexyl ethyl ether	

100.

What's the smallest possible ether? _____

What's the biggest ether? _____

What is the 2d biggest ether? _____

Can there be double bonds, or triple bonds in *our* ethers? _____

Can there be alcohols or halogens be attached to *our* ethers? _____

Can there be two functional groups right next to each other? _____

Can there be 2 or more alcohol groups on one molecule? _____

ALDEHYDES and KETONES

101. Aldehydes + Ketones we will examine together, since they are _____ thing.

When they both have the same number of carbon atoms, they are _____.

102. Both have a _____ bond, just in different places.

103. Aldehydes always have the C=O at the end of a hydrocarbon chain.

WRITE:

104. Ketones always have the C=O in the middle of a hydrocarbon chain.

WRITE:

105. Name and draw the 3 carbon aldehyde

Name and draw the 3 carbon ketone

106. Draw these aldehydes and ketones

METHANAL HCHO

BUTANONE $\text{CH}_3\text{COCH}_2\text{CH}_3$

ETHANAL CH_3CHO

2-PENTANONE $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CH}_3$

BUTANAL $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$

3-PENTANONE $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$

Organic Acids

107. An organic acid will release _____ in solution, just like Arrhenius acids.

108. Organic acids contain the acid functional group called the “_____” group

The R is the hydrocarbon chain that the acid group attaches to. This -COOH group always attaches at the end of the chain in our class (otherwise they get too complicated to name - wait until college!)

109. Acid functional group to the “left” side	109. Acid functional group to the “right” side
110a draw methanoic acid	110b draw ethanoic acid
110c draw propanoic acid	110d draw hexanoic acid
110e draw nonanoic acid	

111. The whole list of acids in high school includes (fill in the blanks) (think too)

# carbon atoms	Name	Condensed Structural formula
1	Methanoic acid	HCOOH
2	Ethanoic acid	
3	Propanoic acid	
4	Butanoic acid	CH ₃ (CH ₂) ₂ COOH
5	Pentanoic acid	
6	Hexanoic acid	
7	Heptanoic acid	
8	Octanoic acid	CH ₃ (CH ₂) ₆ COOH
9	Nonanoic acid	
10	Decanoic acid	

112. Copy this chart... these are the same molecules with different names.

<i>Acetic Acid</i>	<i>Ethanoic Acid</i>

These molecules are identical but have different names. Acetic is “inorganic” style.
 Ethanoic is “organic” style. But they are identical molecules.
 Both are weak acids, both are weak electrolytes, both are vinegar, both are the same thing with different names.

114. Draw Propanoic acid “to the left” and “to the right”. Be sure you can see it in both directions.

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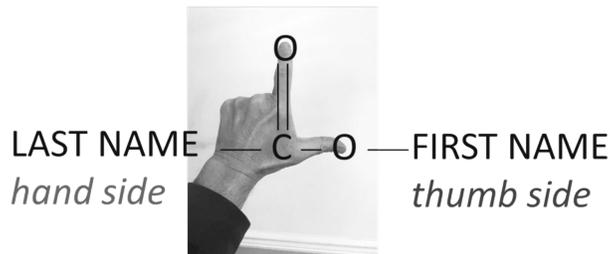
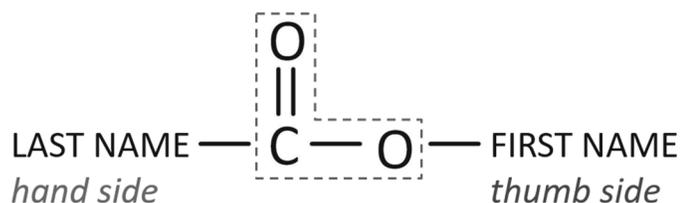
ESTERS

115. The next functional group are the ESTERS. They tend to smell _____.

They form from a reaction between an _____ and an _____.

116. This reaction is called _____.

117. The ester functional group looks like this:	
--	--



The ESTER group makes an “L” shape, like your hand.

118. The THUMB side, is the _____ side.

119. The hand side, or _____ side.

120. We ALWAYS name ESTERS the _____ first.

121. Thumb to the _____ of the functional group.

122. Thumb to the _____ of the functional group, either direction!

123. Draw Methyl Propanoate (ester) in both directions, left and right.

To the right

Condensed structural
formula...

To the left

Condensed structural
formula...

124. Draw
butyl propanoate

125. Draw
methyl hexanoate

125. Draw
ethyl methanoate

126. Draw ethyl propanoate (2—3)	
126. Draw propyl ethanoate (3—2)	
127. Draw propyl methanoate (3—1)	

Amines and Amides

Amines and Amides are similar (in the same way aldehydes + ketones were).

128. The Amines + Amides both contain _____.

129. Count to 3 for nitrogen, N must always make _____ bonds.

130. Amine groups can be on the _____ of a hydrocarbon chain

131. Amide groups are always _____ of a hydrocarbon chain.

Change the table as shown now. In our class, these are simpler with -NH₂ ends

132. Nitrogen atoms can form bonds of 3 chains...

133. In amides, the "NH₂" part bonds...

R—

134. draw methanamine

135. draw methanimide

136. draw ethanamine

137. draw ethanamide

138. draw 3-pentanamine

139. draw pentanamide (no number?)

Organic Chemical Reactions: Substitution, Addition, Fermentation, Esterification, Polymerization and Saponification

140. Propane + fluorine yields 1-fluoropropane + HF

141. Ethane + chlorine yields...

142. Butane + iodine yields 2-iodobutane + HI

143. Ethene + Bromine yields 1,2 dibromoethane

144. Propene + chlorine → 1,2-dichloropropane

145. Ethyne and fluorine → 1,2 difluoroethene

146. Fermentation is the organic chemical reaction that YEAST can turn

_____ into _____ and _____

147. Yeast excrete waste products called ethanol + CO₂

148.

149. Balance this reaction: glucose forms ethanol and carbon dioxide gas

150. Polymerization...

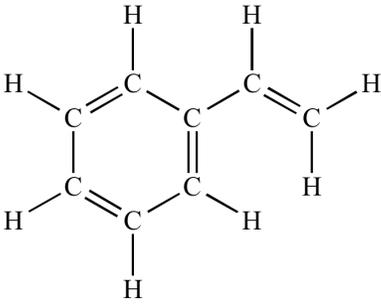
151. POLY—MER—IZATION

152. A “mer” is a molecule or unit.

153. A lot of “mers” (draw the diagrams...)

the polyethene formula is $(-\text{CH}_2\text{CH}_2-)_n$

This means that the “unit” of 2 carbons and 4 hydrogen atoms link together to form chains of

154. Other polymers that you are familiar with		"mer"
PVC, or polyvinyl chloride	Polychlorethene	
Polyethylene	Polyethene	
Styrofoam	Polystyrene	
Teflon	Tetrachloroethene	

ESTERIFICATION

is the reaction between acids and alcohols. These molecules "face" each other, functional groups close, and we take out HOH (water). The rest of the molecules then bond together making an ester with that famous COO group in the middle making an "L" shape.

155. _____

156. Combine propanoic acid + ethanol

157. butanoic acid + 1-propanol form an ester + water

SAPONIFICATION (what if you "misspell this?")

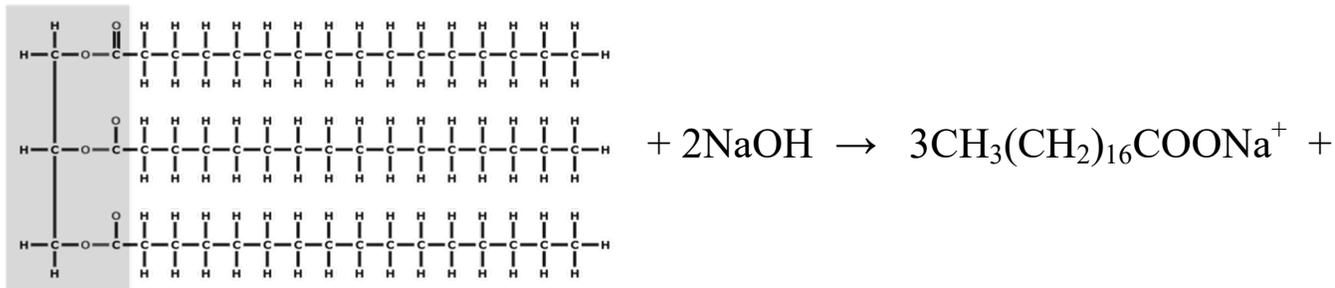
158. saponification is the organic chemical reaction that makes _____

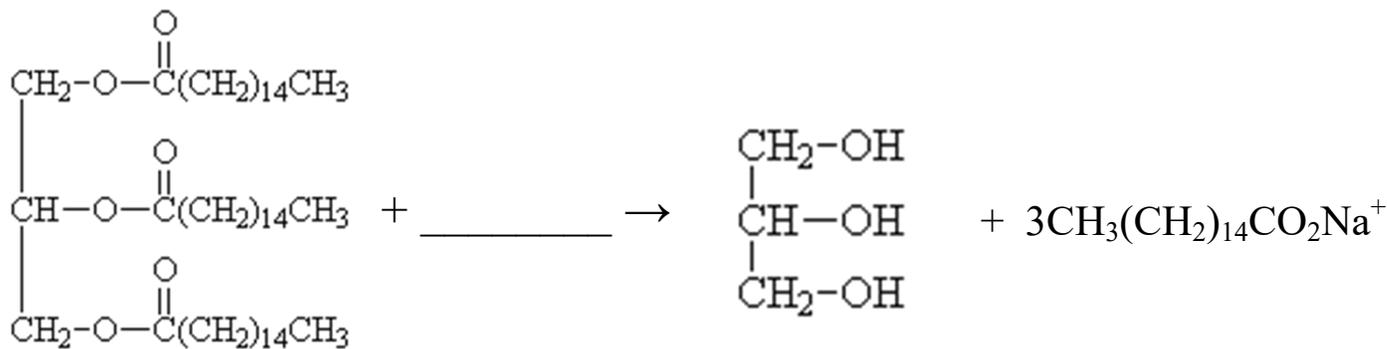
159. The word equation for making soap is always...

160. The reactants for saponification

161. products of saponification

Triglyceride





Circle the triple ester + three bases make circle the triple alcohol + three soap "molecules"

ISOMERS and Branched Hydrocarbons (first vocabulary)

isotopes	chemically identical atoms with different atomic masses (different # neutrons) which are the reason for average atomic masses being decimals.
allotropes	Examples are graphite and diamonds, both pure carbon They are bonded differently and have different properties. If you don't believe that, try to take the regents with a diamond, or get engaged with a pencil! Also, oxygen and ozone, O ₂ and O ₃ are allotropes.
167. isomers	

168. Examples include ethanol and dimethyl ether. Draw the structural + chemical formulas for these.		
	Structural diagrams	Condensed structural formulas
Ethanol		
Dimethyl ether		

169. Draw hexane

Draw 2methylhexane which is a pentane with a "methyl" group attached to carbon #2.

170. Draw this, name this, then draw an isomer of it.

171. Draw 4-methyl, 5-ethyl nonane

172. Draw 7ethyl, 8-fluoro, 2-nonyne