

1. The first atom of organic chemistry is _____
 2. Carbon can make _____ bonds to other carbon atoms.
 3. There are _____ metals in organic chem
 4. To count to ten in organic prefixes I could LOOK at table P, or memorize these prefixes: _____
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5. Carbon can make up to ___ bonds because it has an electron configuration of _____

6. Carbon atoms can make these types of bonds

7. If you have 1 hydrogen atom, and enough hydrogen atoms, how many hydrogen atoms does it take to completely bond one carbon atom? _____

Name all of the SINGLE BONDED CARBON hydrocarbons 1 to 10 carbons in length, draw the structural diagrams for each.

	# C	Name	Structural Diagram
8	1		
9	2		
10	3		
11	4		

	# C	Name	Structural Diagram
12	5		
14	6		
15	7		
16	8		
17	9		
18	10		

Vocabulary

19. Organic Chemistry:

20. Carbon:

21. Hydrocarbons:

22. Homologous Series of Hydrocarbons:

23. ALKANES:

Alkane general formula: _____

ex: the wax alkane has 25 carbon atoms, what is it's formula? _____

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

25. The general formula for alkenes is _____

They have less H's than alkanes because of the double C=C bond.

26. ex: an alkene has 12 carbon atoms, what is it's formula? _____

27. In our class they will contain JUST _____, but in the real world they can have more than one double bond. We'll keep it easy going here.

28. Methene is...

29. Draw the first two alkenes now, ethene and propene.

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

30. Note: propene can turn in space, there is no real left or right, these are identical molecules.

31. 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.

31a.	31.b
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31a. Name of this butene here _____ 31b. Name of butene here _____

32a. Formula of 1-butene _____ 32b. Formula of 2-butene _____

33. Condensed structural formulas for both of these butane molecules

_____ and _____

34. Molecules with the same FORMULA, but different structures are called _____

Draw these next	
35	1-pentene
36	2-pentene
37	3-hexene
38	3-heptene
39	3-octene
40	4-octene
41	1-decene

42. The third homologous series of hydrocarbons are the _____. They have only one _____ bond between the carbon atoms.

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

43. Does METHYNE exist? _____ Why? _____

44. Draw ETHYNE and PROPYNE now.

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45. Draw 1-butyne and 2-butyne Put triple bond in the right place!

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Draw these ALKYNES

46. 1-decyne

47. 1-pentyne

48. 2-pentyne

49. 3-hexyne

What is the general formula for alkynes? _____

If an alkyne has 25 carbons, what is the formula? _____

50. There are...

51. Why do pirates love organic chem?

52. A functional group is...

64. 53. The first, and simplest functional group we will add to hydrocarbons are the...

54.	Halogens	symbols	prefix names

55. Since each halogen has 7 valence electrons, they need just ONE electron for an octet. They can only make _____ bonds only. They bond to the carbon atoms, attached to the chains, not INSIDE the chains of carbon atoms.

Draw and NAME these molecules now.

56	58
57	59

60. The rules to naming Halocarbons:

60a.

60b.

60c.

60d.

61. Draw and name this molecule

62 Take out Table Q, we need to “fix” it.

Alkanes are saturated hydrocarbons because...

Alkenes are....

Alkynes are...

63. There are two new chemical reactions, the first of the organic chemical reactions which we must learn.

name of hydrocarbon	type of hydrocarbon	reaction possible

64. Saturated hydrocarbons are “full up” with H atoms. You can’t ADD to them. What you can do is SUBSTITUTE IN a halogen for a hydrogen atom this way...

ethane + fluorine \rightarrow _____ and _____

65. Another Substitution reaction between propane and Iodine can form either 1iodopropane, or possibly 2iodopropane. In our class we will not be able to tell which will form, make sure your diagram matches your name, that is most important.

66. Halogens can be substituted into hydrocarbons that are _____ (alkanes)

67. When you combine halogens with alkenes, a different reaction happens called _____.

68. That’s because when the double bond “opens up” to a single bond, there is room to add the 2 atoms in.

We’ll do a few more addition reaction in a row... Show the structural diagrams and name the products!

69. Ethene + bromine...	
70. 2-pentene + fluorine...	

71. Ethyne and chlorine....	
72. 1-pentyne and iodine...	
73. Draw and name these halocarbons	
74. Show the structural models, name the com- pounds	
75. Only 1 halogen atom at a time can be substituted into a saturated hydrocarbon molecule.	
76.	

77. Draw 3-bromo, 4,5-dichloro, 1-heptene

78. Draw 5,5,5-trifluoro, 1-pentyne

79. Draw and name this molecule

80. The next 4 functional groups: Alcohols, ethers, aldehydes & ketones. Draw their functional groups.

Alcohols	Ethers	Aldehydes	Ketones

81. Important to note, alcohols are molecules with the “-OH” group. This is NOT _____

82. When the hydroxide anion is ionically bonded to a metal, that’s an Arrhenius base.

Alcohols are...

83. The “general formula” for alcohols is...

The “R” group stands in for the attached carbon chain.

84. Draw methanol, the one carbon alcohol molecule. 

85. Write the condensed structural formula for methanol _____

86. Draw ethanol 2 different ways. Once with the “-OH” group on the right side, once on the left bottom.

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87. Draw both propanol molecules, put the alcohol group “-OH” on the 1st carbon atom, then the 2nd one.

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88. These are different _____

Isomers are...

89. Draw and name the three different 5-carbon alcohol molecules.

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90. These are ALL of the alcohols in our regents level classes. Can you draw every one of them yet?

# carbons	names of the alcohols
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

91. Why isn't there a 7 heptanol?

Ether molecules are easy to recognize because they have a single atom of oxygen in the middle, and make single bonds left and right (or up and down!)

92. Ethers have a functional group that looks like this:

93. They have an R group on one side, and an R prime group on the other. What's that mean?

There is NO WAY to attach a hydrocarbon to the oxygen atom in the middle of an ether. There is NO ROOM in a saturated hydrocarbon to bond to this oxygen atom. SO, we have to remove a single atom of "H", to create an opening.

94. Methane, minus one hydrogen atom is called a _____ group, abbreviated as

95. Ethane, minus one hydrogen atom is called a _____ group.

96. Propane, minus one hydrogen atom is called a _____ group.

97. Butane, minus one hydrogen atom is called a _____ group.

98. Then would come....

99. Draw these ethers...

Methyl ethyl ether	Propyl butyl ether	Diethyl ether
Pentyl methyl ether	Dimethyl ether	Hexyl ethyl ether

100. Think...

What is the smallest ether possible? _____ In our class, what is the biggest ether? _____

What is the second biggest ether? _____

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

Can there be alcohol groups or halogens 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? _____

101. Aldehydes + Ketones we will examine together, since they are nearly the same thing. When they both have the same number of carbon atoms, they are _____ of each other.

102. They both have a C=O bond, just in different places.

111. Aldehydes always have the C=O at the end of a hydrocarbon chain. They have a unique suffix name.

112. Ketones always have the C=O in the middle of a hydrocarbon chain. They have a different suffix name.

113. Draw and name the three carbon aldehyde and the three carbon ketone. Add the condensed structural formulas as well.

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114. Draw METHANAL, Draw ETHANAL

The smallest ketone has to be propanone, there has to be at least 3 carbon atoms to have a middle carbon atom to attach the functional group to)

Draw BUTANAL	Draw BUTANONE
Draw 2-PENTANONE	Draw 3-PENTANONE

Organic Acids

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

116. 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!)

117. Draw the functional group going to the left and to the right side.

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118A. draw methanoic acid	B. draw ethanoic acid
C. draw propanoic acid	D. draw hexanoic acid
E. draw nonanoic acid	

119. The whole list of acids includes the six above, plus butanoic (4 carbons), pentanoic (_____), heptanoic (_____), octanoic (_____), and finally, decanoic (_____) acid

120. All acid names end with the _____

121. Organic acids have an acid group or _____, and it's the LAST "H" that ionizes into water.

122. On table K, the last acid is called 2 different names. Write both of the formulas, and name them both.

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123. Draw Propanoic acid "to the left" and "to the right". Be sure you can see it in both directions.

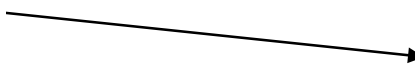
ESTERS

124. The next functional group are the ESTERS. They tend to smell really good. They form from a reaction

between an _____ and an _____.

125. This reaction is called _____.

126. The ester functional group looks like this:



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

127. One side is called the _____ thumb side. (thumb first!)

128. The other makes up the “last name” of the ester.

129. We ALWAYS name the _____ first.

130. Draw methyl propanoate, to the right, and to the left.

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The “methyl” is on the oxygen thumb side. The propanoate is on the back of the hand side.

$\text{CH}_3\text{CH}_2\text{COOCH}_3$ Esters have a “COO” group.

131. Draw butyl pentanoate (start with the functional group in the middle of the page, then add the first name group on the oxygen thumb side).

We will ALWAYS name the “R” group on the oxygen thumb FIRST. The R groups will be Methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, or decyl. There are no other choices.

On the “other” side of the ester, we’ll start with prefix names for the carbons, but they all end in –anoate, like: Methanoate, Ethanoate, Propanoate... or Octanoate, Nonanoate, or Decanoate.

132. Draw these now...

Methyl hexanoate	Ethyl methanoate
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133. Now draw *Ethyl propanoate* and its isomer, *Propyl ethanoate*. These are NOT the same molecule.

<i>Ethyl propanoate</i>	<i>Propyl ethanoate</i>
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134. Final note, ALWAYS put in the “H” in the methanoate molecules. That “H” is mandatory. Otherwise it looks like you either forgot to finish, or don’t know what to do at all. That H in the methanoate says YOU KNOW you’re done on that side. Draw Propyl Methanoate

Amines + Amides are similar to each other (in the same way the aldehydes + ketones were).

135. The Amines + Amides both contain _____

136. Count to 3 for nitrogen: _____ must always make _____ bonds.

137. Amines are always found in the _____ of a chain

138. Amides are always found on _____ of a chain.

139. Although N atoms can make bonds to 3 chains, in our class they will always bond to one carbon, and two hydrogen atoms only.

140. draw the amine functional group	141. draw the amide functional group
142. draw methanamine	143. draw methanimide
144. draw ethanamine	145. draw ethanamide
146. draw 3-pentanamine	147. draw pentanamide (no number? why?)

Organic Chemical Reactions. **These include Substitution, Addition, Fermentation,**

148 Write out the substitution reaction where one atom of fluorine substitutes in for one atom of hydrogen in a propane molecule. Label all molecules. (propane plus fluorine makes....)

149. Draw this SUBSTITUTION reaction. Label all molecules. (Ethane + chlorine yields...)

150. Draw this SUBSTITUTION reaction. Label all molecules (Butane + iodine yields 2-iodobutane + HI)

For ADDITION reactions, we'll start with a halogen and a UNSATURATED hydrocarbon (an alkene or an alkyne). We ADD the halogen into it, FORMING ONE PRODUCT.

151. Let's draw and write the structural diagrams for: Ethene + Bromine yields 1,2 dibromoethane

Draw the structural diagrams showing these next two addition reactions

152. Draw: Propene + chlorine \rightarrow 1,2dichloropropane

153. Ethyne and fluorine \rightarrow 1,2 difluoroethene

Next up is FERMENTATION, which is the organic chemical reaction that produces alcohol that adults drink in beer and wine (and whiskey, etc.). There is only one form of alcohol that doesn't kill you outright, that is ethanol. Too much of this one will kill you as well. It's not for you, not yet. Be patient, 21 is not too far away and it's really just not that great anyway.

154. Fermentation is the organic reaction that forms both _____ + _____

155. This reaction does not happen outside of _____ (with water).

156. Simply, it's:

157. Balance this simple reaction converting glucose (in anaerobic respiration by yeast) into the two products. The sugar used by the yeast varies, as does the balancing of this reaction.

There are MANY kinds of sugar just like there are many kinds of alcohol, or many kinds of esters, etc.



158. Next reaction is called POLYMERIZATION, the making of polymers (which are _____)

159. POLYMERIZATION means..

160. Many “mers”. A “mer” is a UNIT or a single molecule. When you have millions of molecules with double bonds, that can be “opened up” by catalysts, these molecules can be linked together in long strands or chains. They have no official formula. They can be of ANY length. They get tangled together. Depending on what the molecules are, they end up with different properties. Draw the polymerization reaction as best you can here

161. Some different plastics that you are familiar with are...

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.

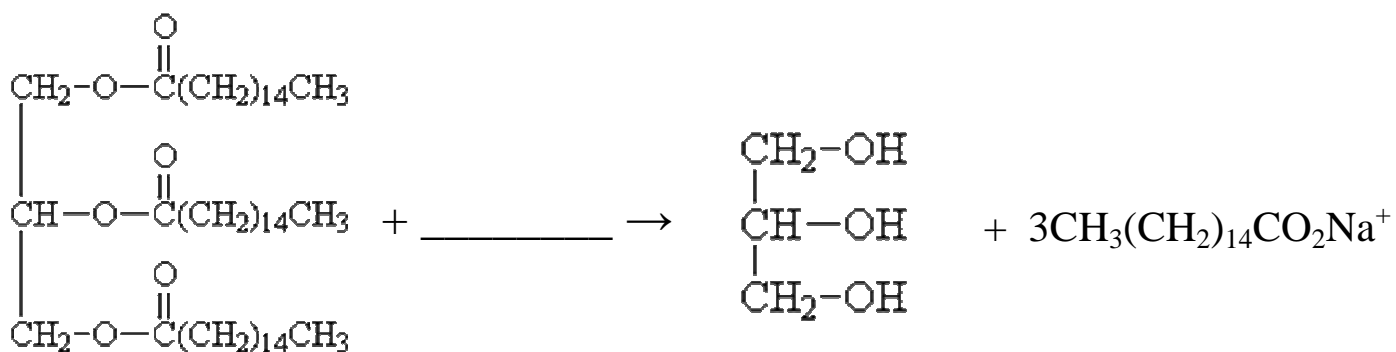
162. Combine propanoic acid + ethanol

163. Draw the reactant molecules and product molecules (and write the product names)
 butanoic acid + 1-propanol form an ester + water

164. The Last reaction in organic chem for us is soap making. If you misspell soap, you get the first 4 letters of the reaction name, SAPONIFICATION. This is easy to recognize because we can't name any of the large molecules, but we can recognize the functional groups in them.

165. The word equation for soap making is always:

166.



These molecule are all too big to name, they can change to different sized chains, different bases, different kinds of alcohol molecules, and therefore, different kinds of soap can form. Lots of soaps exist. (Use them)

167. Isomer

168. Write out the structural diagrams and figure out the chemical formulas for these two molecules.

	Structural diagrams	Condensed structural formulas
Ethanol		
Dimethyl ether		

These two molecules are ISOMERS because they have the same....

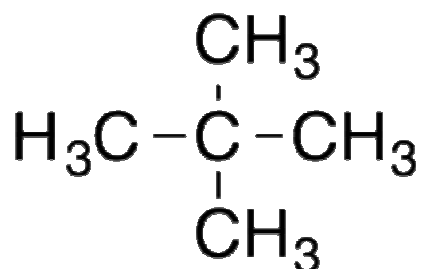
But different _____ and different properties. Drink one (at 21) and you will get a little tipsy; drink the other and get a little bit....

169. Draw hexane now this simple way. Then draw a pentane with a methyl group on the second carbon.

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Branched hydrocarbons can also be isomers. Hexane + 2-methyl pentane are isomers because they both have this formula: _____. They are built differently, and have different properties.

170. Name this, draw an isomer of it too.



171. Draw 4-ethyl 3-methyl nonane

172. Draw pentane + 2methylbutane. Are these isomers?

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