Chem II Super Fantastic Organic Party Fun-Pack! (The organic packet) Name: Sarah

1. Draw the structure of the following things.
(Show all lone pairs. If a hydrogen is attached to an N or O, show as an "H" . Hydrogens attached to carbons can be shown as dashes.)

ethyl propyl amine

hexanaldehyde

triethylamine

acetic acid

dipropyl ether

propyl formate

2 butanol

benzoic acid

cyclohexanol

cis 2,3 dichloro 2 pentene

butanone

3 octyne

2. Name the following things.

2 heptanone

2,2,5 trimethyl 4ethyl octane

1,2 difluoro benzene (or "ortho difluoro benzene")

ethylamine

1 chloro 4 iodo benzene or 1,4 chloro iodo benzene or para chloro iodo benzene

methyl ethanoate (or methyl acetate)

cyclopentene

trans 3 hexene

cyclohexanone

propanoic acid

2,3,4,4 tetramethyl 5ethyl 2 heptene

ethyl butyl ether

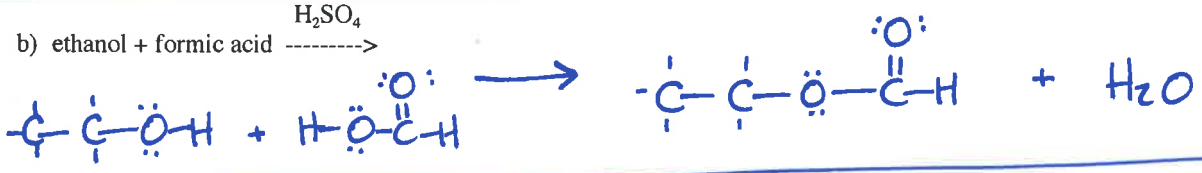
butanaldehyde

3,4 dimethyl 1hexyne

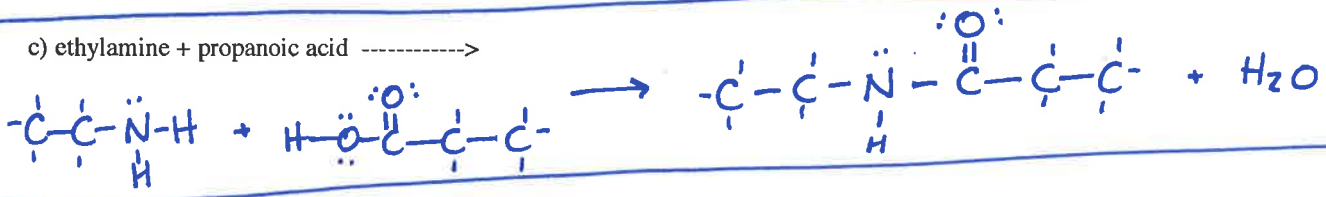
3. Draw structures (unless already shown) for all reactants and products. and just show the organic compound.
For the ones involving $K_2Cr_2O_7$ or $KMnO_4$, oxidize to the max. extent possible, unless otherwise noted.

a)  + H_2 $\xrightarrow{Pt}$ 

b) ethanol + formic acid $\xrightarrow{H_2SO_4}$

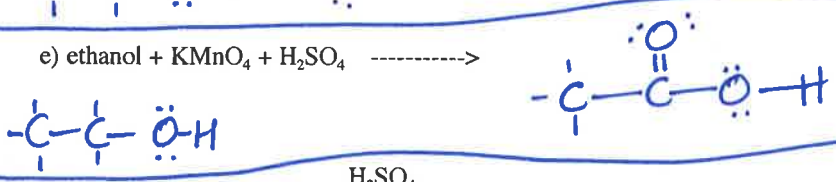


c) ethylamine + propanoic acid ---------->

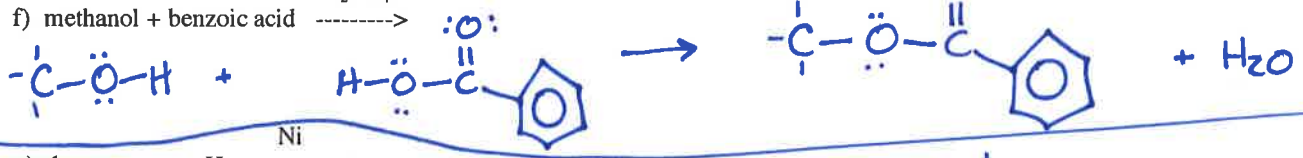


d) ethanol + O_2 ---------->

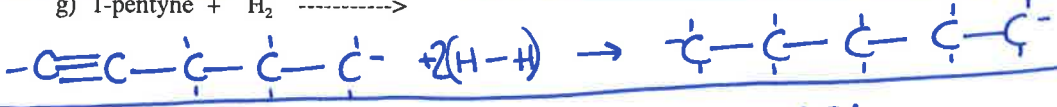
e) ethanol + $KMnO_4$ + H_2SO_4 ---------->



f) methanol + benzoic acid $\xrightarrow{H_2SO_4}$

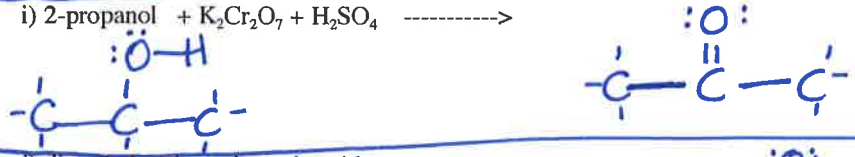


g) 1-pentyne + H_2 $\xrightarrow{Ni}$

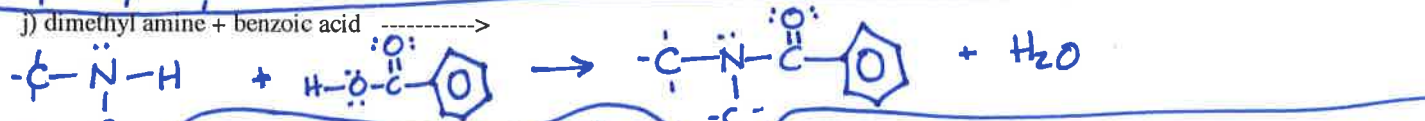


h) n-propanol + $K_2Cr_2O_7$ + H_2SO_4 ---------->

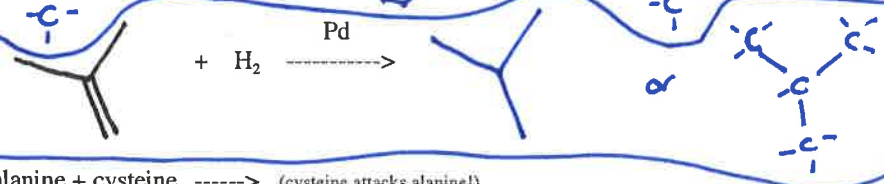
i) 2-propanol + $K_2Cr_2O_7$ + H_2SO_4 ---------->



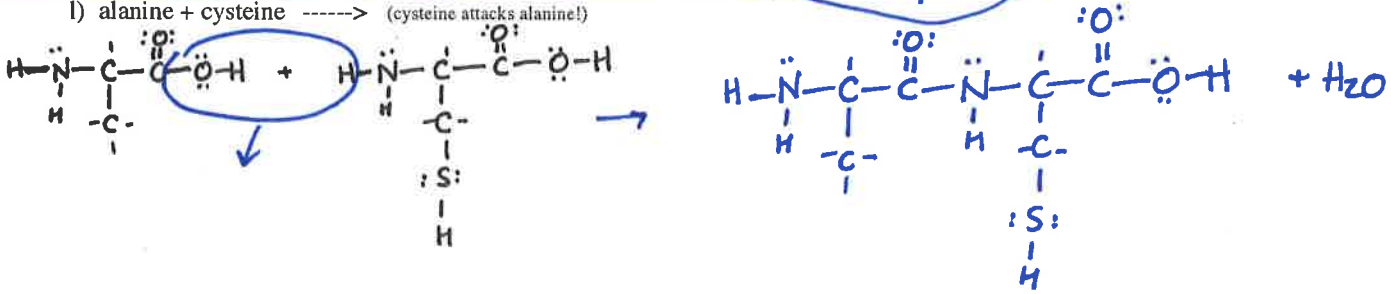
j) dimethyl amine + benzoic acid ---------->



k) + H_2 $\xrightarrow{Pd}$

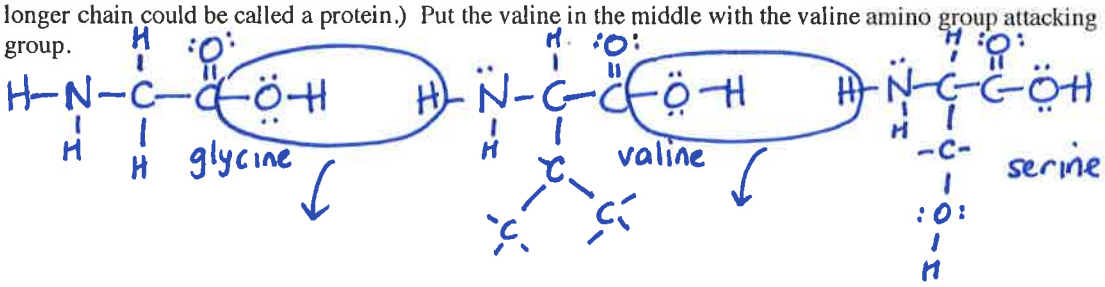


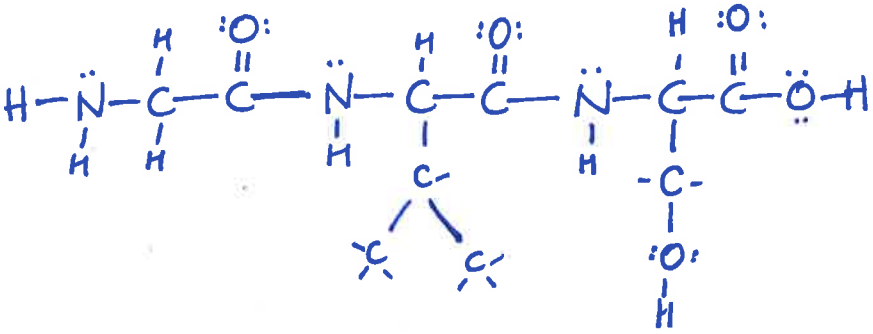
l) alanine + cysteine ------> (cysteine attacks alanine!)



Amino Acids:

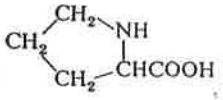
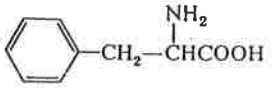
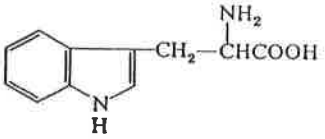
4a. Show how glycine, valine, and serine could form a peptide chain. (A short chain of amino acids is called a polypeptide; a longer chain could be called a protein.) Put the valine in the middle with the valine amino group attacking the glycine carboxyl group.

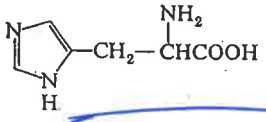
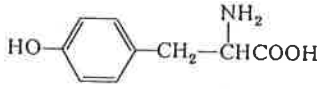




b. What functional group forms when two amino acids link up in protein formation? amide!

TABLE 29.1 Common Amino Acids

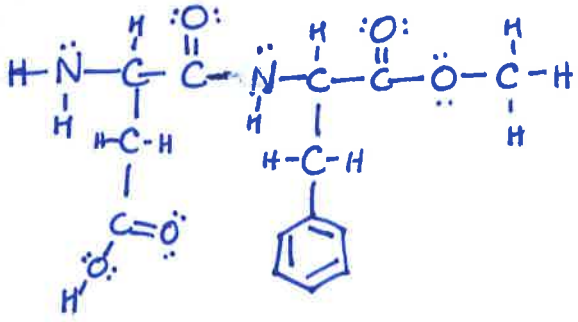
R—CHCOOH (NH$_2$)	Name	Abbreviation
H—	glycine	Gly
CH$_3$—	alanine	Ala
CH$_3$CH—	valine	Val
CH$_3$CHCH$_2$—	leucine	Leu
CH$_3$CH$_2$CH—	isoleucine	Ile
CH$_3$SCH$_2$CH$_2$—	methionine	Met
	proline	Pro
	phenylalanine	Phe
	tryptophan	Trp

R—CHCOOH (NH$_2$)	Name	Abbreviation
HOCCH$_2$— (O)	aspartic acid	Asp
HOCCH$_2$CH$_2$— (O)	glutamic acid	Glu
H$_2$NCH$_2$CH$_2$CH$_2$CH$_2$—	lysine	Lys
H$_2$NCNHCH$_2$CH$_2$CH$_2$— (NH)	arginine	Arg
	histidine	His
HOCH$_2$—	serine	Ser
CH$_3$CH— (OH)	threonine	Thr
HSCH$_2$—	cysteine	Cys
	tyrosine	Tyr
H$_2$NCCH$_2$— (O)	asparagine	Asn
H$_2$NCCH$_2$CH$_2$— (O)	glutamine	Gln

5. Aspartame (aka nutrasweet) is an artificial sweetener. Aspartame is not a sugar. It contains two amino acids: Aspartate/aspartic acid and phenylalanine, plus an extra methyl group.
Draw a picture showing the structure of aspartame:

a. First, connect the amino acids to form the amide bond.
The amino end of phenylalanine "attacks" the acid end of the aspartic acid.

b. The acid part of phenylalanine should still be in your structure, but... now remove the OH from the acid part of phenylalanine and replace it with OCH_3, in order to make a methyl ester. This is the structure of nutrasweet.



C aspartic acid - B phenylalanine

c. Some people can not safely consume aspartame. Which part of the aspartame are they unable to process? (see article).

The phenylalanine amino acid.

Diet can correct PKU illness

Dear Dr. Donohue: We are friends with a lovely family that has eight children. Three of the girls and one of the boys were born with PKU. The others are free of the problem. What causes PKU, and why is protein not good for it? They are all healthy. The mother is expecting another child.

What are the chances of PKU in this child?

—*A.R.*

Dear A.R.: PKU — phenylketonuria — is a genetic condition in which the infant lacks an enzyme that rids the body of excess phenylalanine. Too much phenylalanine in the blood damages the brain. Phenylalanine is an amino acid, and amino acids are the fundamental units of protein.

Many proteins contain this amino acid, and most people can use the amount needed for health and get rid of excess amounts of it. PKU babies cannot do so.

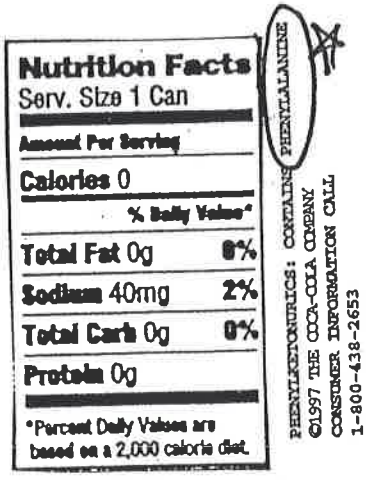
At birth these babies look normal. They might have fair skin and blond hair. If the condition is not detected early, the baby starts vomiting and can suffer from seizures. In time, without restriction of proteins containing phenylalanine, the brain is damaged; serious learning difficulties result.

In many countries, testing all newborns for PKU is standard practice. Since that measure has begun, the number of PKU-damaged children has all but vanished in those countries.

The accepted treatment for this condition is strict avoidance of all proteins that carry the phenylalanine amino acid. When that is done, children who lack the enzyme needed to metabolize that amino acid develop normally physically and in their ability to learn.

You might wonder why this disorder is called phenylketonuria, or PKU, when the source of trouble lies in phenylalanine. It's because phenylketone is the byproduct of the phenylalanine that is found in the urine.

The chances of this woman's next baby being afflicted are one in four.



CARBONATED WATER, CARAMEL COLOR, ASPARTAME, PHOSPHORIC ACID, POTASSIUM BENZOATE (TO PROTECT TASTE), NATURAL FLAVORS, CITRIC ACID.

CANNED UNDER AUTHORITY OF THE COCA-COLA COMPANY, ATLANTA, GA. BY A MEMBER OF THE CCE BOTTLING GROUP, ATLANTA, GEORGIA 30339.

5/8/04

caffeine free Diet coke

DEAR DR. DONOHUE: I have noticed that on some cottage cheese products and diet sodas, there is written: "Phenylketonurics, contains phenylalanine." What is this? Does it have anything to do with cholesterol and triglycerides? I am on a diet and medicine for them.

J.H.

You must be young. In the not-so-distant past, everyone knew about PKU — phenylketonuria. It is a genetic disease that causes the loss of an important enzyme. The enzyme changes phenylalanine, an amino acid found in many foods, into a harmless byproduct. Without the enzyme, blood levels of phenylalanine and phenylketones — harmful byproducts of phenylalanine — rise.

The doctor must put the PKU baby on a diet free of phenylalanine. If the infant continues eating phenylalanine foods, brain damage results.

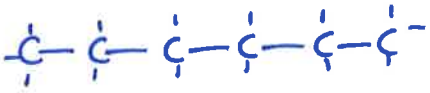
Now that babies are routinely checked for phenylketonuria, PKU disease has practically vanished in North America. Babies who suffer from the missing enzyme develop normally when they avoid phenylalanine.

Depending on circumstances, the phenylalanine diet can be relaxed a bit when the child gets older. However, some form of restriction must be followed for life. That's the reason for the phenylalanine warning.

PKU has nothing to do with cholesterol or triglycerides.

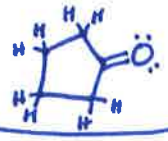
2/2/00

6. For each reaction below:
1) write formulas (CxHyOz) for all reactants (unless the formula is already shown)
2) Predict products (show the formula OR structure).
(For the ones involving $K_2Cr_2O_7$/ $KMnO_4$, just show the organic product.)
3) Balance any reactions involving H_2 or O_2.

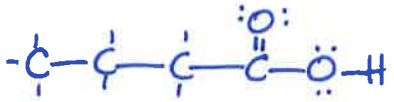
a) 2-hexyne + 2 H_2 $\xrightarrow{Pd}$ C_6H_{14} or 

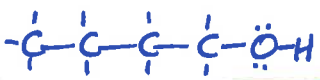
C_6H_{10}

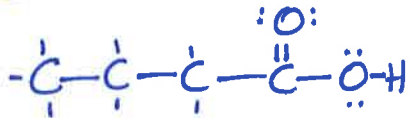
b) cyclopentanone + $13O_2$ ------> $10CO_2$ + $8H_2O$

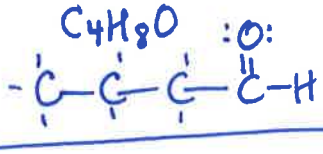
$2C_5H_8O$ 

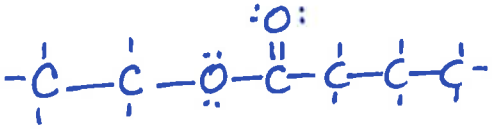
$20 + 8 = 28$

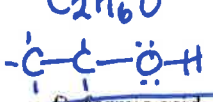
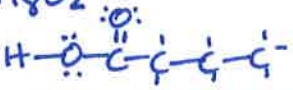
c) 1-butanol + $K_2Cr_2O_7$ + H_2SO_4 ------> (as far as possible)  $C_4H_8O_2$

$C_4H_{10}O$ 

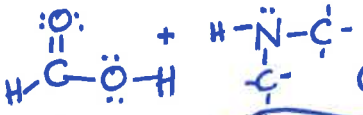
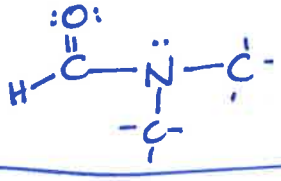
d) butanaldehyde + $KMnO_4$ + H_2SO_4 ------> (as far as possible)  $C_4H_8O_2$

C_4H_8O 

e) ethanol + butanoic acid $\xrightarrow{H_2SO_4}$ $C_6H_{12}O_2$  + H_2O

C_2H_6O  $C_4H_8O_2$ 

f) formic acid + dimethylamine ------>

CH_2O_2  C_2H_7N  + H_2O (C_3H_7NO)

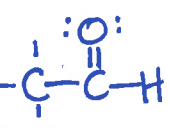
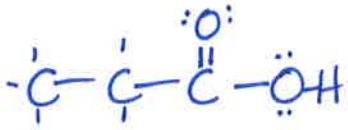
g) 1-methyl cyclopentene + H_2 ------> C_6H_{12}

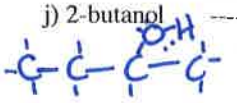
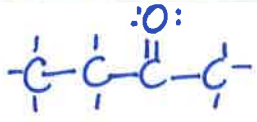
C_6H_{10}  

h) $C_{57}H_{104}O_6$* + $3H_2$ $\xrightarrow{Pt}$ $C_{57}H_{110}O_6$

3 C=C bonds total in the triolein, so 6 H's can add.

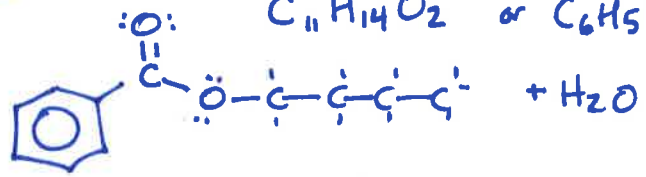
*This is a fat/triglyceride called triolein, found in olive oil.
All three fatty acid side chains are from oleic acid, which is a monounsaturated fatty acid.
Therefore each of the three fatty acid side chains has 1 double bond)

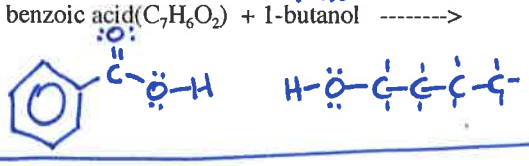
i) 1-propanol  C_3H_8O $\xrightarrow[\text{(first step)}]{K_2Cr_2O_7,\ H_2SO_4}$  C_3H_6O $\xrightarrow[\text{(second step)}]{K_2Cr_2O_7,\ H_2SO_4}$ $C_3H_6O_2$ 

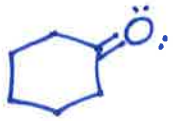
j) 2-butanol $C_4H_{10}O$  $\xrightarrow[\text{(first step)}]{K_2Cr_2O_7,\ H_2SO_4}$  $\xrightarrow[\text{(second step)}]{K_2Cr_2O_7,\ H_2SO_4}$ N.R. (stops at a ketone)

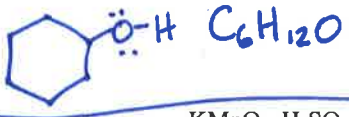
k) 1-butyne + $2H_2$ $\xrightarrow{Pt}$ C_4H_{10} (butane)

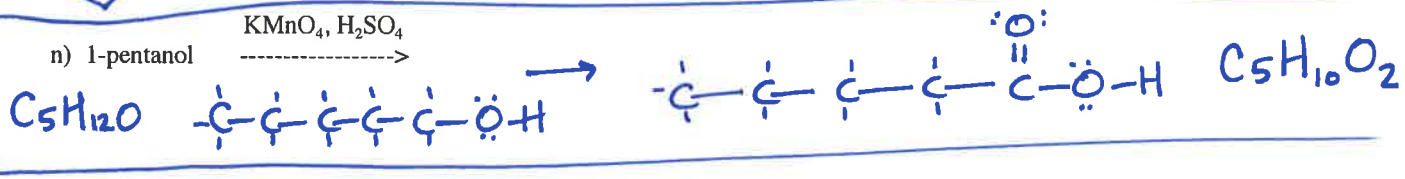
C_4H_6

l) benzoic acid($C_7H_6O_2$) + 1-butanol ($C_4H_{10}O$) $\xrightarrow{H_2SO_4}$  $C_{11}H_{14}O_2$ or $C_6H_5COOC_4H_9$ + H_2O



m) cyclohexanol $\xrightarrow{KMnO_4,\ H_2SO_4}$  cyclohexanone $C_6H_{10}O$

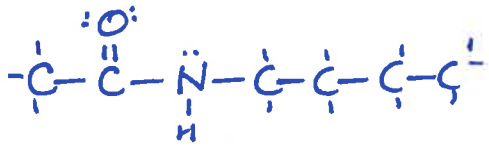
 $C_6H_{12}O$

n) 1-pentanol $\xrightarrow{KMnO_4,\ H_2SO_4}$ 

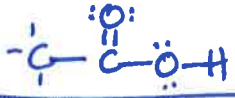
$C_5H_{12}O$ $C_5H_{10}O_2$

o) 1-pentanol + O_2 ------>

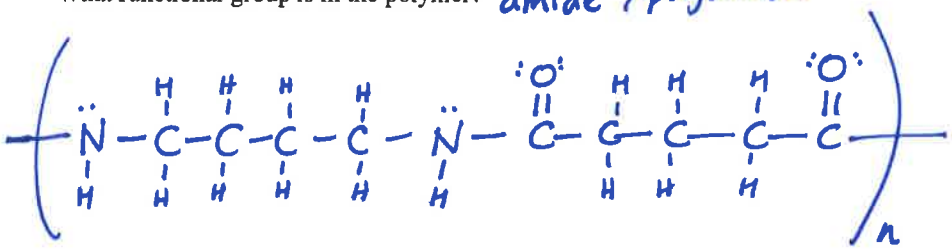
$2\,C_5H_{12}O + 15\,O_2 \longrightarrow 10\,CO_2 + 12\,H_2O$ $\quad 20+12 = 32$

p) acetic acid + $CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2$ ------>  $C_6H_{13}NO + H_2O$

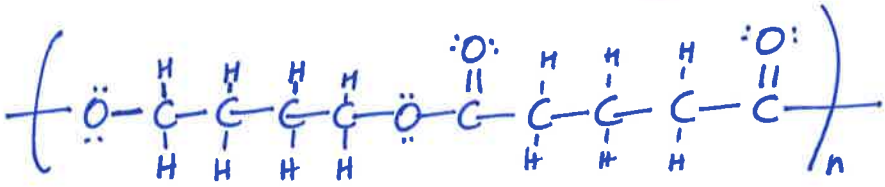
$C_2H_4O_2$



7a. Show how these two compounds could combine to make a polymer:
$H_2N\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2$ and $HOOC\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}COOH$
What functional group is in the polymer? amide / polyamide

 $(+2n\,H_2O)$

b. Show how these two compounds could combine to make a polymer.
$HO\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}OH$ and $HOOC\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}COOH$
What functional group is in the polymer? ester / polyester

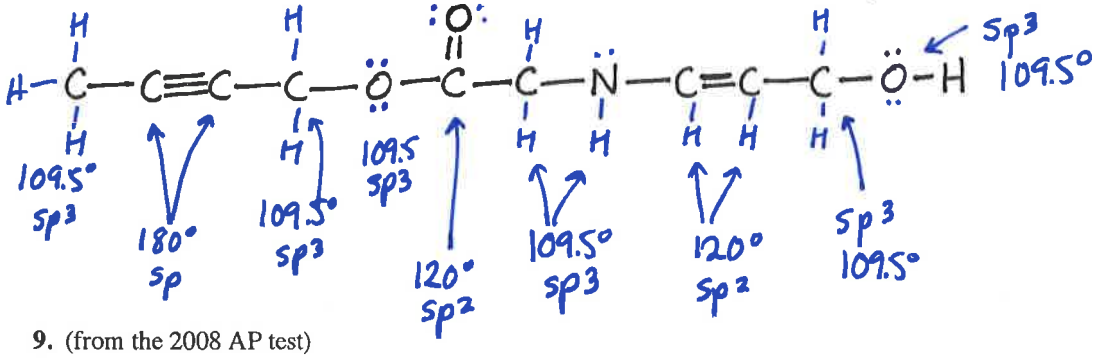
 $(+2n\,H_2O)$

c. When the above two polymers (in a and b) form, the reaction is called "condensation polymerization." Why? H_2O is produced when the polymer forms.

8a. Add hydrogens and lone pairs where they are needed.

b. Determine number of sigma and pi bonds in the molecule: σ 25 π 4

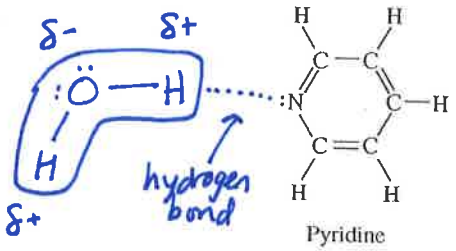
c. Label the ideal bond angle and hybridization for every atom in the main chain of this molecule.



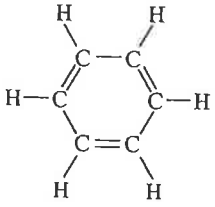
9. (from the 2008 AP test)

Answer the following questions by using principles of molecular structure and intermolecular forces.

(a) Structures of the pyridine molecule and the benzene molecule are shown below. Pyridine is soluble in water, whereas benzene is not soluble in water. Account for the difference in solubility. You must discuss both of the substances in your answer.



Pyridine

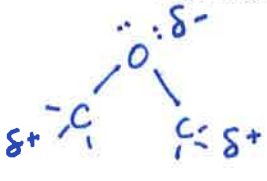


Benzene

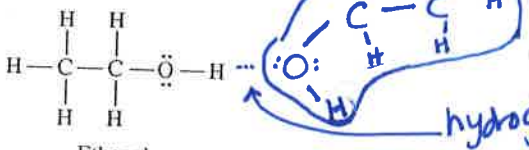
The "Like Dissolves Like" Rule says that two compounds can dissolve together only if they have similar polarities (both polar or both nonpolar) water is polar due to the O-H bond.

pyridine is polar due to its C-N bonds, and it can hydrogen bond with water: the H-bond is between the H (in H_2O) and N (in pyridine); see picture above. pyridine can dissolve in H_2O because both molecules are polar; the two molecules can have a dipole-dipole interaction. (in fact, it can H-bond w/ water) Benzene is nonpolar due to being symmetrical and its low electroneg. difference between C and H. so it can not have dipole-dipole interactions with water.

(b) Structures of the dimethyl ether molecule and the ethanol molecule are shown below. The normal boiling point of dimethyl ether is 250 K, whereas the normal boiling point of ethanol is 351 K. Account for the difference in boiling points. You must discuss both of the substances in your answer.



Dimethyl Ether



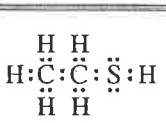
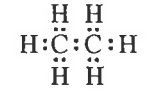
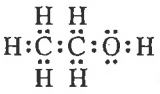
Ethanol

Dimethyl ether is polar due to the C-O bonds, so dimethyl ether has Dipole-Dipole attractions between molecules (and it also has London Forces). But dimethyl ether can not Hydrogen bond with each other, due to no O-H bond.

ethanol has an O-H bond, so it not only has London Forces and Dipole-Dipole Forces; it also has Hydrogen bonding between molecules (see picture). In other words, ethanol is more polar than dimethyl ether, and therefore has stronger intermolecular forces, and higher boiling point, since more energy is needed to separate molecules from each other.

10. Use the information in the table below to respond to the statements and questions that follow. Your answers should be in terms of principles of molecular structure and intermolecular forces.

(2010 AP)

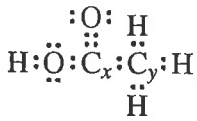
Compound	Formula	Lewis Electron-Dot Diagram
Ethanethiol	CH_3CH_2SH	
Ethane	CH_3CH_3	
Ethanol	CH_3CH_2OH	
Ethyne	C_2H_2	H–C≡C–H

(a) Draw the complete Lewis electron-dot diagram for ethyne in the appropriate cell in the table above.

(b) Which of the four molecules contains the shortest carbon-to-carbon bond? Explain.

Ethyne has the shortest Carbon-carbon bond. Ethyne has a triple bond (C≡C). The other three molecules have C—C (single bonds), which are longer than triple bonds.

(c) A Lewis electron-dot diagram of a molecule of ethanoic acid is given below. The carbon atoms in the molecule are labeled x and y, respectively.



Identify the geometry of the arrangement of atoms bonded to each of the following.

(i) Carbon x Trigonal planar

(ii) Carbon y Tetrahedral

(d) Energy is required to boil ethanol. Consider the statement "As ethanol boils, energy goes into breaking C–C bonds, C–H bonds, C–O bonds, and O–H bonds." Is the statement true or false? Justify your answer.

This is a false statement!!! Boiling is just a phase change; which is a physical change, not a chemical change. Bonds within the molecule do not break during a phase change. only the attractive forces between ethanol molecules must be overcome.

(e) Identify a compound from the table above that is nonpolar. Justify your answer.

Could choose ethane or ethyne. either way, justification is same: C_2H_6 / C_2H_2 has only C-C and C-H bonds, which have a low difference in electronegativity, and any bond polarity cancels out anyway due to the symmetry of the molecule. (or, no net dipole moment since molecule is symmetrical)

(f) Ethanol is completely soluble in water, whereas ethanethiol has limited solubility in water. Account for the difference in solubilities between the two compounds in terms of intermolecular forces.

H_2O is very polar. Ethanol is also very polar, and can form Hydrogen bonds with H_2O (between ethanol's O and water's H, or vice versa). So ethanol is highly soluble in H_2O. Ethanethiol is slightly polar due to the S-H bond, but it can not form H-bonds with water, so is less soluble than ethanol.

(2003 AP)

Compound Name	Compound Formula	ΔH°_{vap} (kJ mol^{-1})
Propane	$CH_3CH_2CH_3$	19.0
Propanone	CH_3COCH_3	32.0
1-propanol	$CH_3CH_2CH_2OH$	47.3

11.

Using the information in the table above, answer the following questions about organic compounds.

(a) For propanone,

(i) draw the complete structural formula (showing all atoms and bonds); (they didn't ask for correct geometry)

(ii) predict the approximate carbon-to-carbon-to-carbon bond angle.

The bond angle is 120°

(b) For each pair of compounds below, explain why they do not have the same value for their standard heat of vaporization, ΔH°_{vap}. (You must include specific information about both compounds in each pair.)

(i) Propane and propanone

propane is nonpolar, so has only London Dispersion Forces as an intermolecular force. propanone is polar, due to its C=O bond, so it has London Dispesion forces and Dipole-Dipole interactions. Therefore propanone has stronger intermolecular forces (IMF) than propane, so more energy is needed to vaporize propanone than propane.

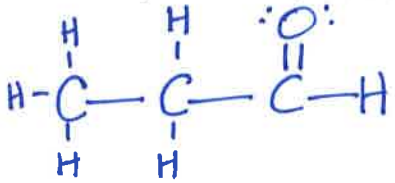
(ii) Propanone and 1-propanol

propanone is polar due to C=O, so it has London Forces and Dipole-Dipole forces. but propanone can not Hydrogen bond with other propanones due to no O-H bond. Propanol can Hydrogen bond due to its O-H. (and has London and Dipole-Dipole forces too) So propanol has stronger IMF, and therefore a higher heat of vaporization.

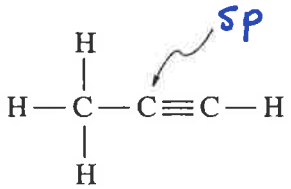
(c) Draw the complete structural formula for an isomer of the molecule you drew in part (a) (i).

isomer: must still be C_3H_6O

Try an aldehyde instead of a ketone.



(d) Given the structural formula for propyne below,



6 σ bonds
2 π bonds

(i) indicate the hybridization of the carbon atom indicated by the arrow in the structure above; sp

(ii) indicate the total number of sigma (σ) bonds and the total number of pi (π) bonds in the molecule.