

Chemistry 500

Spring 2000

Dr. Hunter

Problem Sets

Chemistry 500, 1st Ungraded Problem Set

Spring 1997, Dr. Hunter

& Fall; Winter & Spring 1998, 1999, 2000

1. For each of the following molecules, give the correct Lewis structure.

H Cl	H F	H S ^H
H P H H	H N N H H	H H H C C H H H
N N	C O	O O
H C N	H N C	O C O
C S	S C S	S C O
F N F F	H N H F	Cl P Cl Cl
H H C O	H H C F Cl	Cl Cl C O

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1. For each of the following molecules, give the correct Lewis structure.

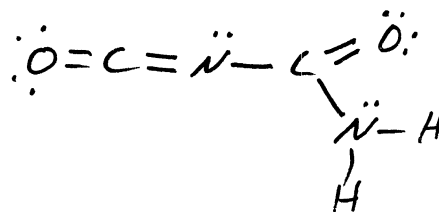
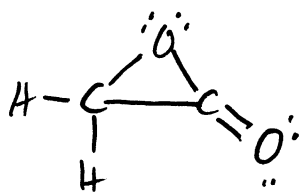
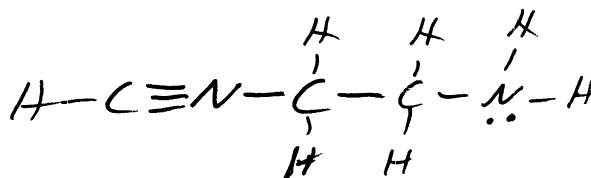
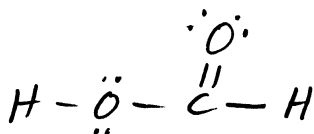
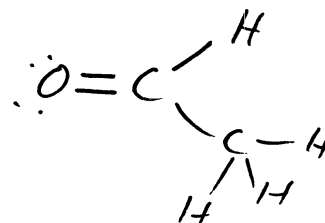
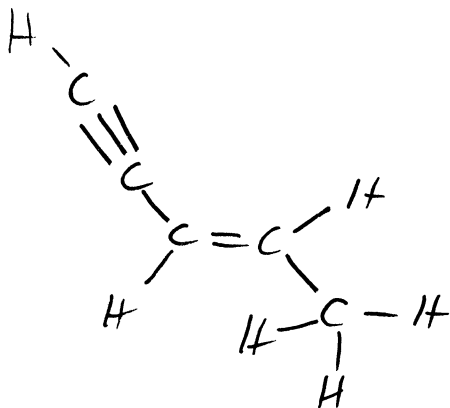
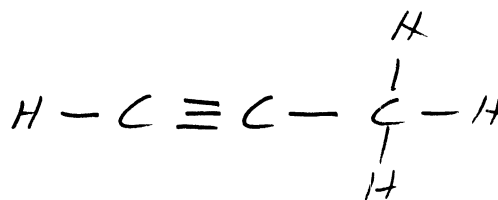
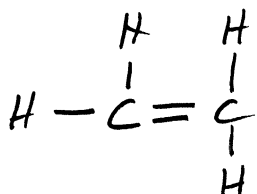
$H - \overset{\cdot\cdot}{\underset{\cdot\cdot}{C}} - I$	$H - \overset{\cdot\cdot}{\underset{\cdot\cdot}{F}}$	$H - \overset{H}{\underset{\cdot\cdot}{S}}$
$H - \overset{\cdot\cdot}{\underset{H}{P}} - H$	$H - \overset{H}{\underset{\cdot\cdot}{N}} - \overset{\cdot\cdot}{\underset{H}{N}} - H$	$\begin{array}{c} H & H \\ & \\ H - C - & C - H \\ & \\ H & H \end{array}$
$:N \equiv N:$	$:C \equiv O:$	$:\overset{\cdot\cdot}{O} = \overset{\cdot\cdot}{O}:$
$H - C \equiv N:$	$H - N \equiv C:$	$:\overset{\cdot\cdot}{O} = C = \overset{\cdot\cdot}{O}:$
$:C \equiv S:$	$:\overset{\cdot\cdot}{S} = C = \overset{\cdot\cdot}{S}:$	$:\overset{\cdot\cdot}{S} = C = \overset{\cdot\cdot}{O}:$
$:\overset{\cdot\cdot}{F} - \overset{\cdot\cdot}{\underset{F}{N}} - \overset{\cdot\cdot}{F}:$	$H - \overset{\cdot\cdot}{\underset{F}{N}} - H$	$:\overset{\cdot\cdot}{Cl} - \overset{\cdot\cdot}{\underset{Cl}{P}} - \overset{\cdot\cdot}{Cl}:$
$\begin{array}{c} H \\ \\ H - C = \overset{\cdot\cdot}{O} \\ \\ \overset{\cdot\cdot}{O} \end{array}$	$\begin{array}{c} H \\ \\ H - C - \overset{\cdot\cdot}{F} \\ \\ \overset{\cdot\cdot}{Cl} \end{array}$	$\begin{array}{c} \overset{\cdot\cdot}{Cl} \\ \\ \overset{\cdot\cdot}{Cl} - C = \overset{\cdot\cdot}{O} \end{array}$

Chemistry 500, 2nd Ungraded Problem Set

Spring 1997, Dr. Hunter

& Fall; Winter & Spring 1998, 1999

1. For each of the following molecules, use the Lewis structure to predict the bond angles and relative bond lengths.



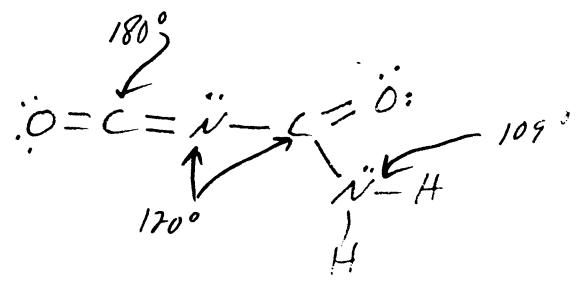
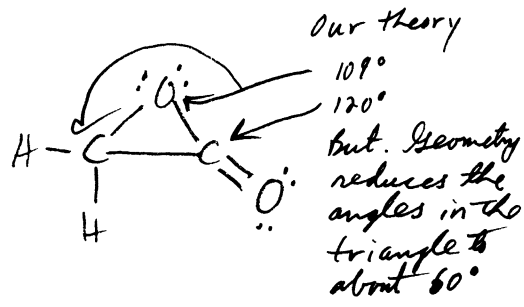
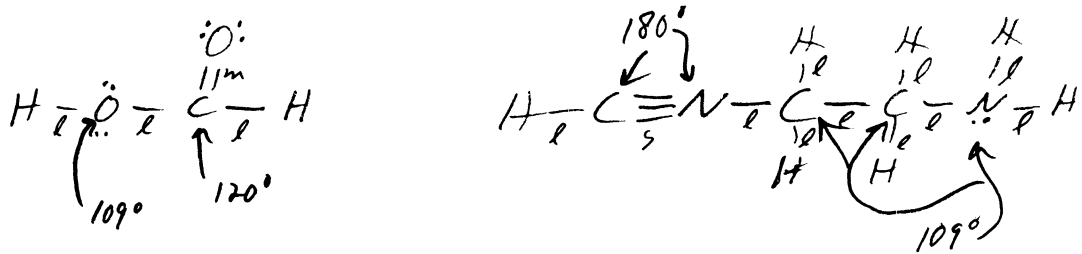
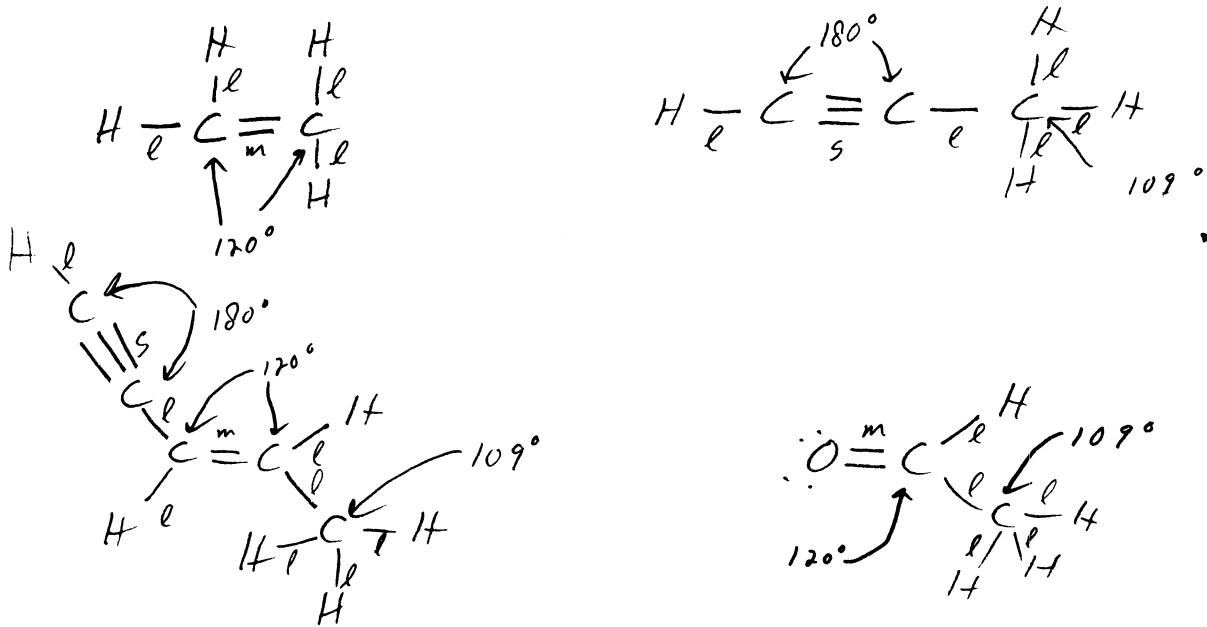
Answers

Chemistry 500, 2nd Ungraded Problem Set

Spring 1997, Dr. Hunter

⊗ Fall

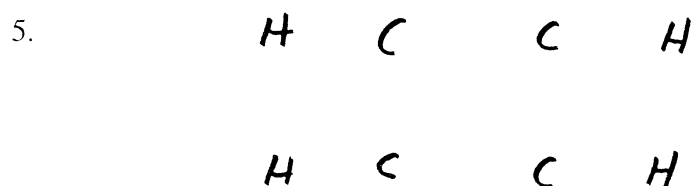
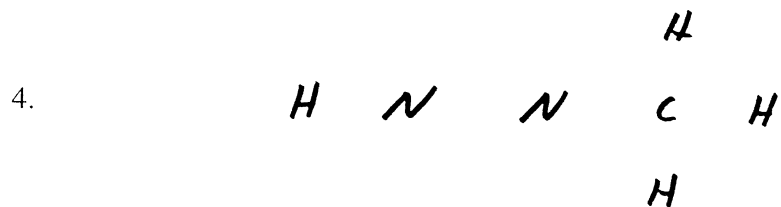
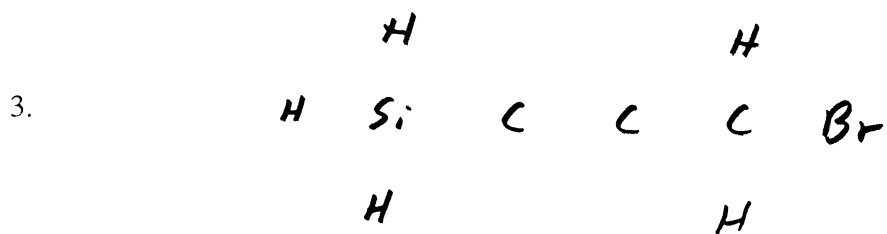
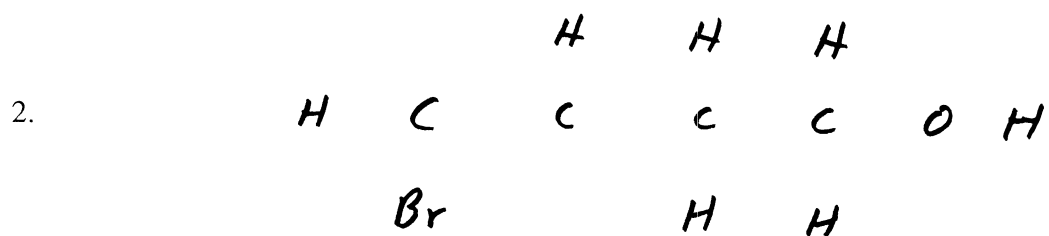
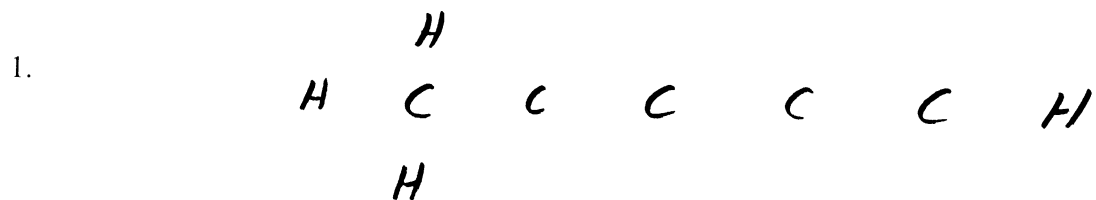
1. For each of the following molecules, use the Lewis structure to predict the bond angles and relative bond lengths.

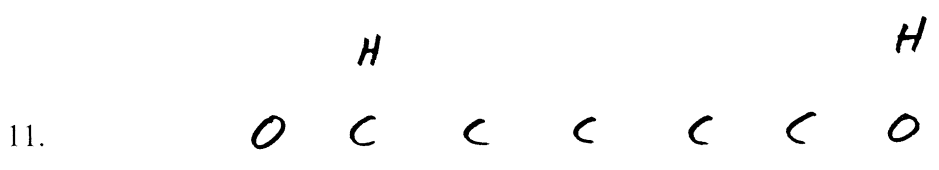
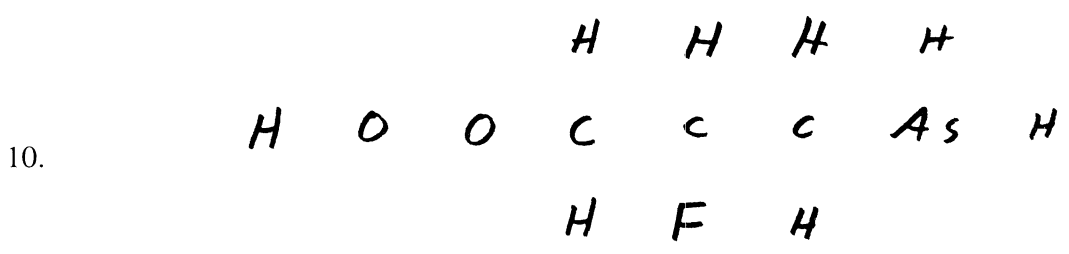
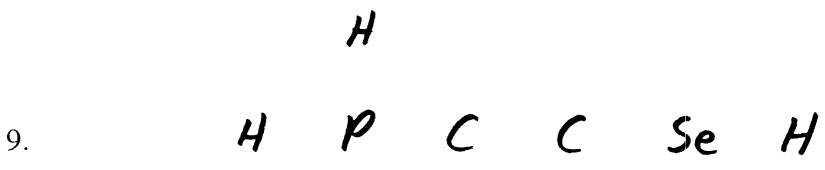
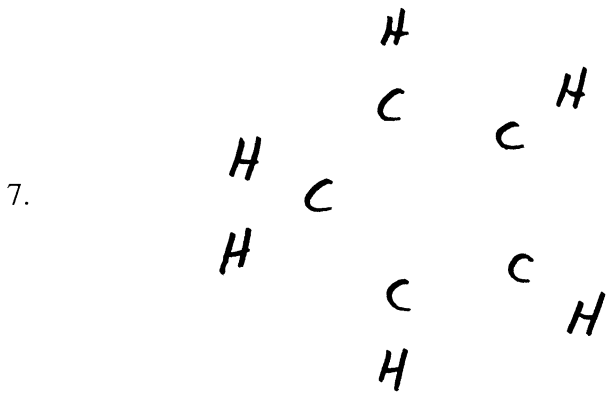
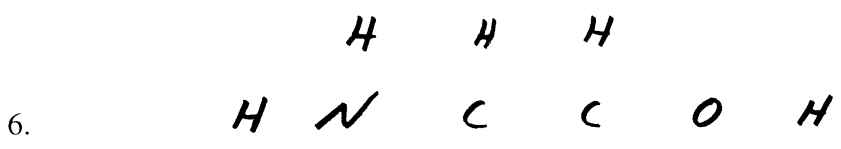


$long \equiv l$
 $medium \equiv m$
 $short \equiv s$

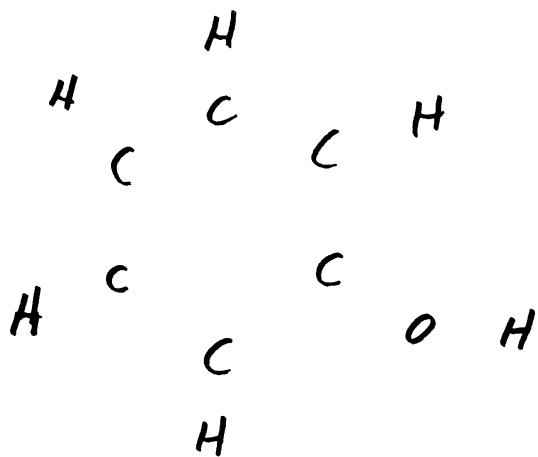
Chemistry 500, Lewis Structure Problem Set

For each of the following molecules, determine the expected number of valence electrons, draw the Lewis structure, count the number of valence electrons on the structure you have drawn, and check if your Lewis structure is correct.

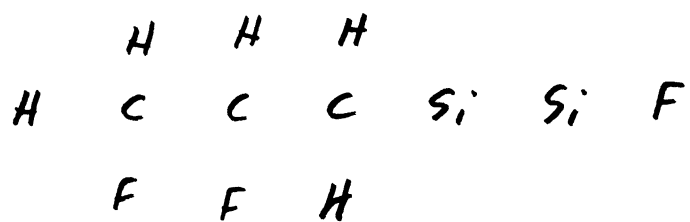




12.



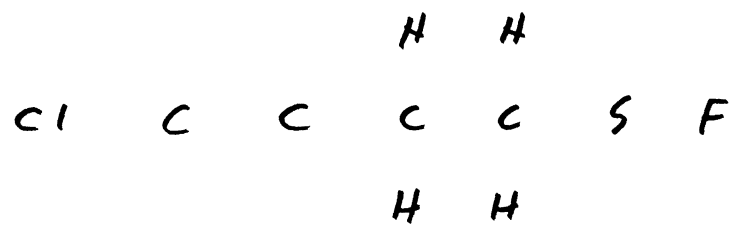
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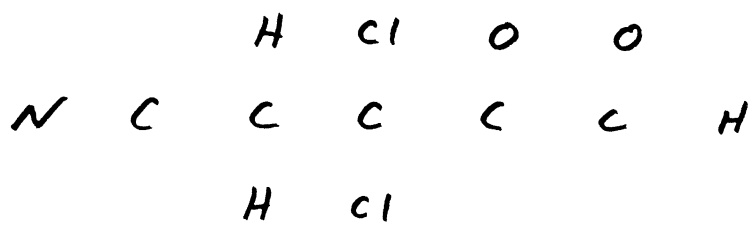
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15.



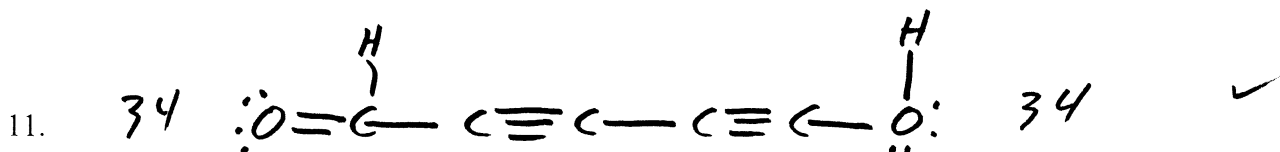
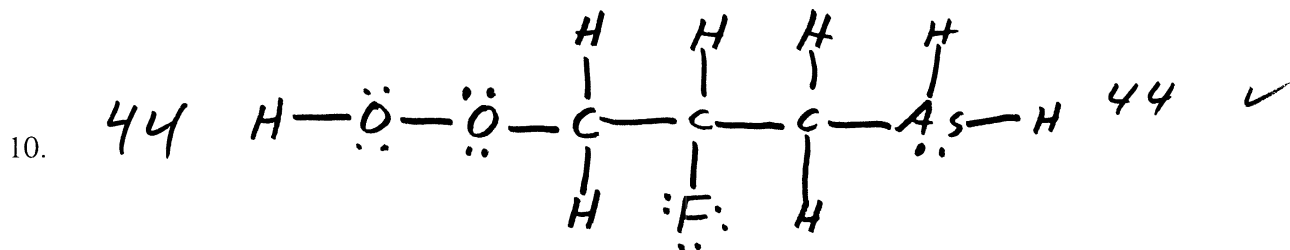
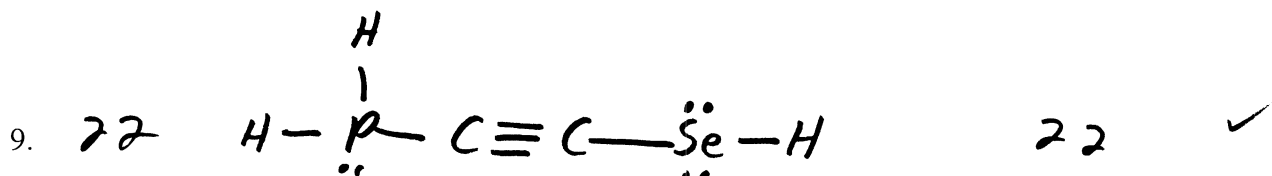
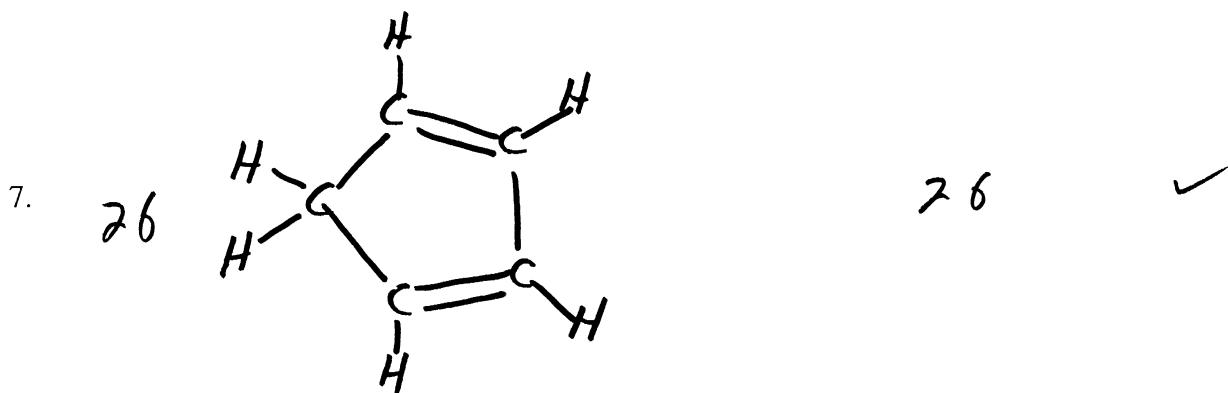
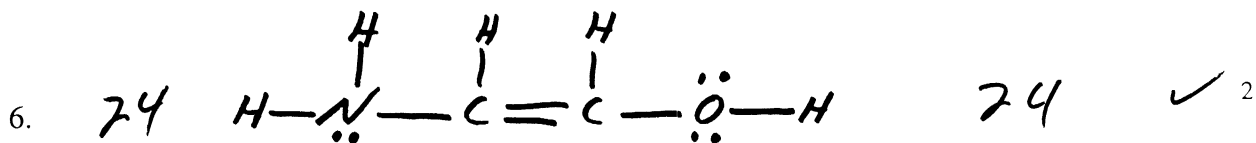
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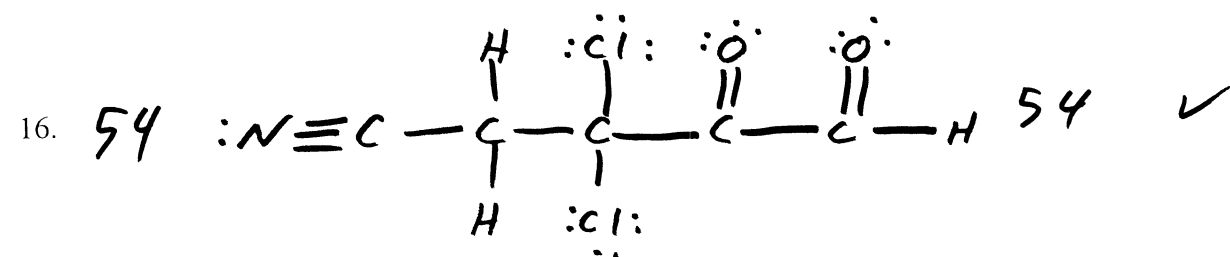
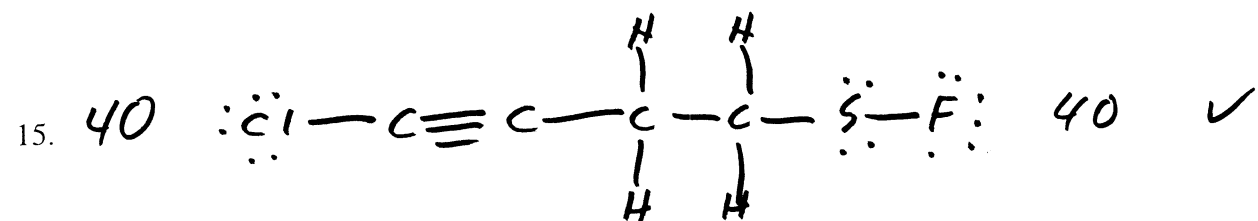
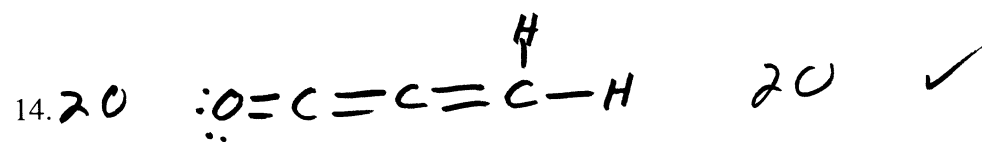
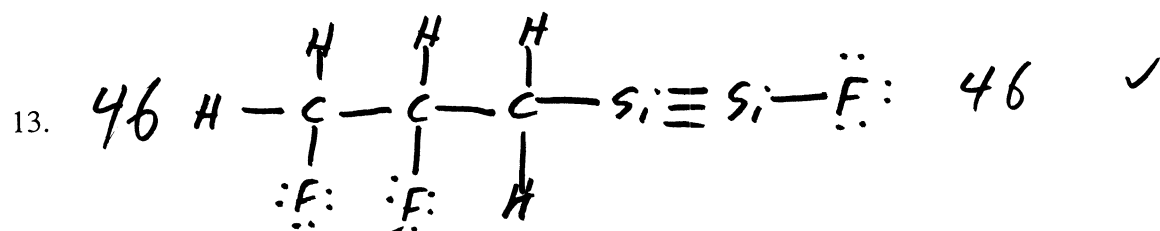
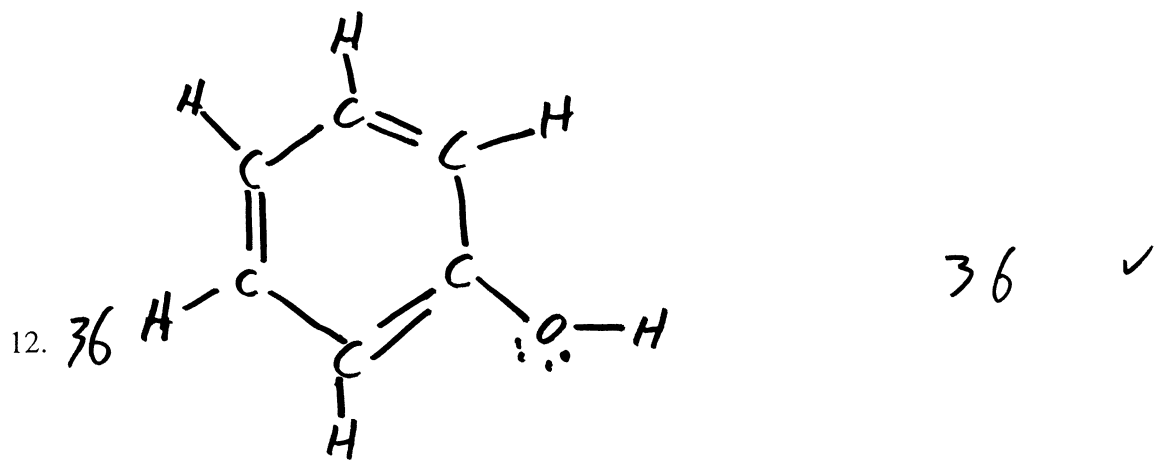


Chemistry 500, Lewis Structure Problem Set

For each of the following molecules, determine the expected number of valence electrons, draw the Lewis structure, count the number of valence electrons on the structure you have drawn, and check if your Lewis structure is correct.

	<i>Expected #</i>	<i>Lewis Structure</i>	<i>Found #</i>	<i>Go</i>
1.	24	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{C}\equiv\text{C}-\text{C}\equiv\text{C}-\text{H} \\ \\ \text{H} \end{array}$	24	✓
2.	36	$\begin{array}{ccccccc} & & \text{H} & & \text{H} & & \text{H} \\ & & & & & & \\ \text{H}-\text{C} & = & \text{C} & - & \text{C} & - & \text{C} & - & \ddot{\text{O}} & - & \text{H} \\ & & & & & & & & \ddot{\phantom{\text{O}}} & & \\ \text{:Br:} & & & & \text{H} & & \text{H} & & & & \end{array}$	36	✓
3.	28	$\begin{array}{ccccccc} & & \text{H} & & & & \text{H} \\ & & & & & & \\ \text{H}-\text{Si} & - & \text{C} & \equiv & \text{C} & - & \text{C} & - & \text{Br:} \\ & & & & & & & & \ddot{\phantom{\text{Br}}} \\ \text{H} & & & & & & \text{H} & & \end{array}$	28	✓
4.	18	$\begin{array}{ccccccc} & & & & \text{H} & & \\ & & & & & & \\ \text{H}-\ddot{\text{N}} & = & \ddot{\text{N}} & - & \text{C} & - & \text{H} \\ & & & & & & \\ & & & & \text{H} & & \end{array}$	18	✓
5.	20	$\begin{array}{ccccccc} \text{H} & - & \text{C} & - & \text{C} & - & \text{H} \\ & & & & & & \\ \text{H} & - & \text{C} & - & \text{C} & - & \text{H} \end{array}$	20	✓





Chemistry 500

Structural Isomers Problem Set

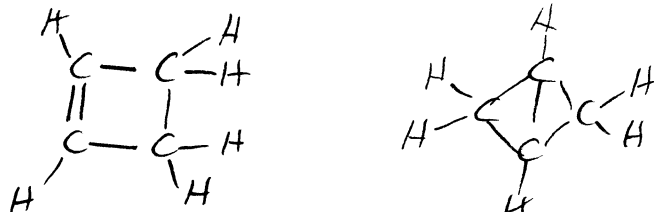
For each of the following molecular formulae, draw all of the structural isomers (up to a maximum of 5 for each). Be sure that you show all atoms and bonds for each.

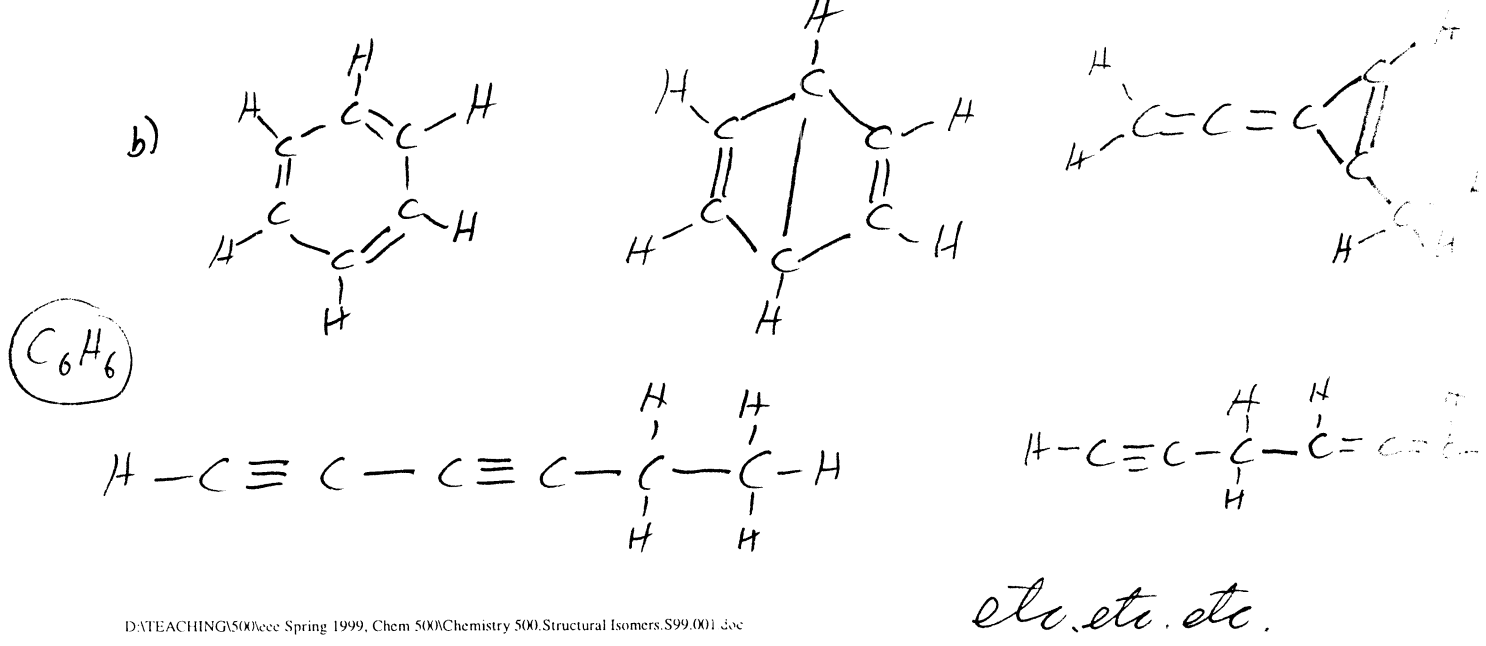
- a. C_4H_6
- b. C_6H_6
- c. C_3H_8O
- d. C_3H_6O
- e. $C_3H_6O_2$
- f. $C_4H_{10}O$
- g. C_4H_9F
- h. $C_4H_8Cl_2$
- i. C_3H_9N
- j. C_3H_7N
- k. C_4H_5N

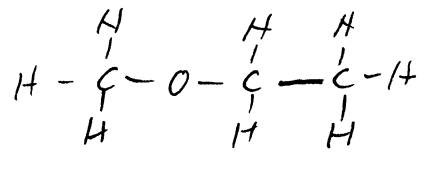
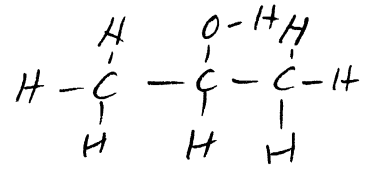
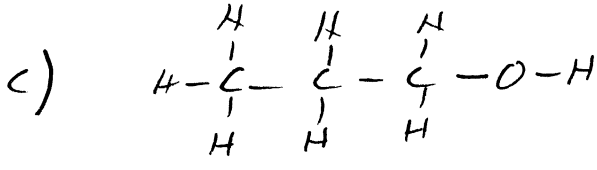
Chemistry 500

Structural Isomers Problem Set

For each of the following molecular formulae, draw all of the structural isomers (up to a maximum of 5 for each). Be sure that you show all atoms and bonds for each.

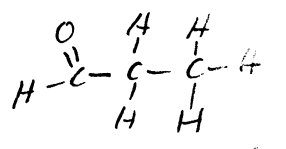
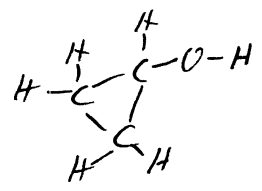
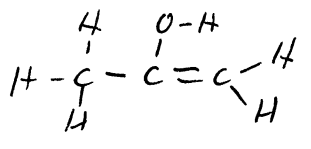
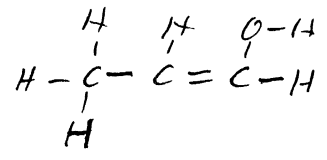
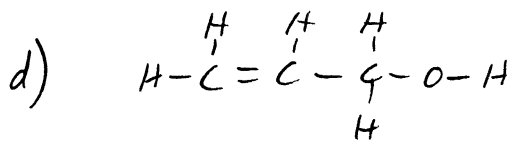
- a. C_4H_6 a) $H-C \equiv C - \overset{\overset{H}{|}}{C} - \overset{\overset{H}{|}}{C} - H$ (C_4H_6)
- b. C_6H_6
- c. C_3H_8O
- d. C_3H_6O $H - \overset{\overset{H}{|}}{C} - C \equiv C - \overset{\overset{H}{|}}{C} - H$
- e. $C_3H_6O_2$
- f. $C_4H_{10}O$ $H - \overset{\overset{H}{|}}{C} = C = \overset{\overset{H}{|}}{C} - \overset{\overset{H}{|}}{C} - H$
- g. C_4H_9F
- h. $C_4H_8Cl_2$
- i. C_3H_9N  *etc. etc.*
- j. C_3H_7N
- k. C_4H_5N





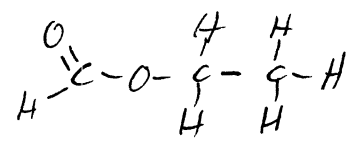
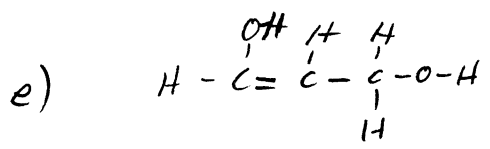
only 3!

$\text{C}_3\text{H}_8\text{O}$

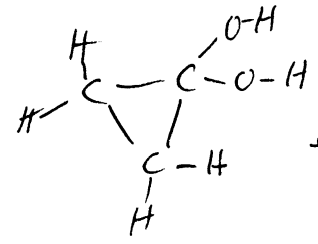
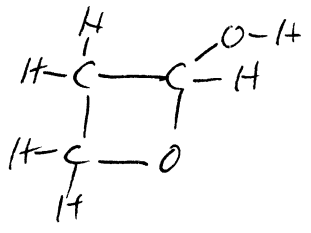
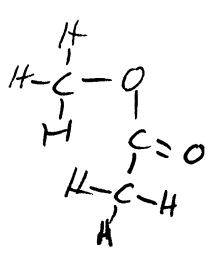


etc.

$\text{C}_3\text{H}_6\text{O}$

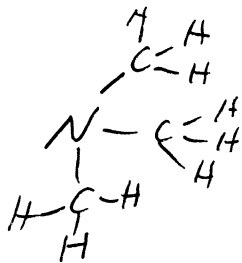
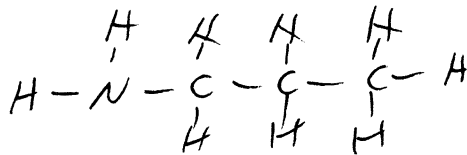
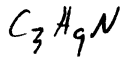
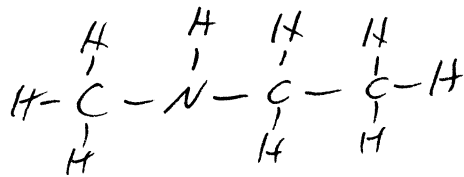


$\text{C}_3\text{H}_6\text{O}_2$

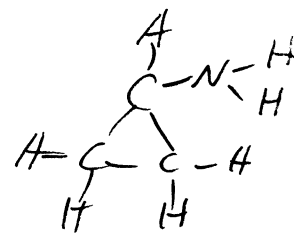
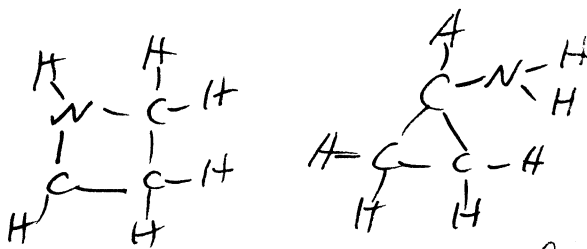
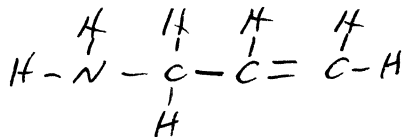
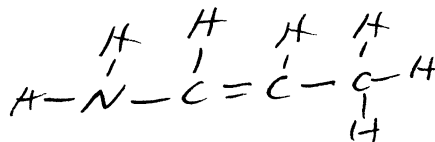
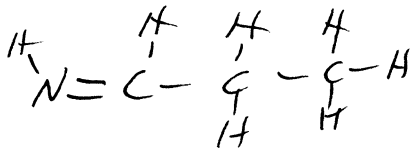


etc. etc.

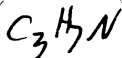
i)



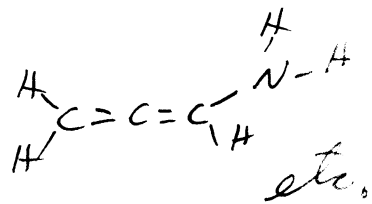
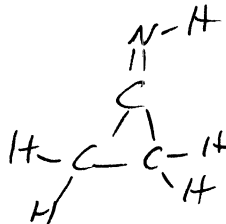
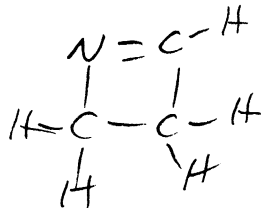
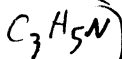
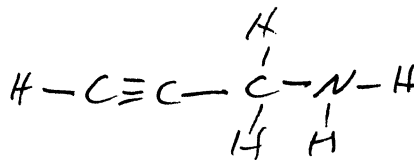
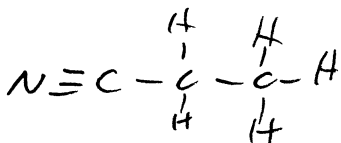
j)



etc.



k)



etc.

Chemistry 500
Balancing Chemical Reactions Practice Sheet

- 1) $S_8 + Br_2 \rightarrow SBr_2$
- 2) $S_8 + NO_2 \rightarrow SO_2 + N_2$
- 3) $S_8 + NO_3 \rightarrow SO_2 + NO$
- 4) $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$
- 5) $C_7H_{14} + O_2 \rightarrow CO + H_2$
- 6) $C_6H_6 + HNO_3 \rightarrow C_6H_5NO_2 + H_2O$
- 7) $C_3H_4 + I_2 \rightarrow C_3H_4I_2$
- 8) $CO_2 + Cl_2 \rightarrow CCl_4 + O_2$
- 9) $S_7 + P_2O_5 + O_2 \rightarrow SO_3 + P_4$
- 10) $N_2 + C_2H_6 \rightarrow N_2H_4 + C_2H_2$
- 11) $C_5H_{10} + O_2 \rightarrow CH_2O$
- 12) $C_6H_{12}O_6 + F_2 \rightarrow C_6H_6F_6 + H_2O + O_2$
- 13) $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
- 14) $C_6O_6Cr + Cl_2 \rightarrow CrCl_3 + CO$
- 15) $P_4 + HCl + O_2 \rightarrow PCl_3 + H_2O$
- 16) $H_3PO_4 + C \rightarrow P_4 + CO + H_2O$
- 17) $Na + C_2Cl_6 \rightarrow NaCl + C_2Cl_2$
- 18) $NOCl + WC_6O_6 \rightarrow WN_2O_2Cl_2 + CO$
- 19) $NH_3 + CO \rightarrow CH_4 + N_2 + O_2$
- 20) $PCl_3 + H_2O \rightarrow H_3PO_3 + HCl$

Chemistry 500
Balancing Chemical Reactions Practice Sheet

