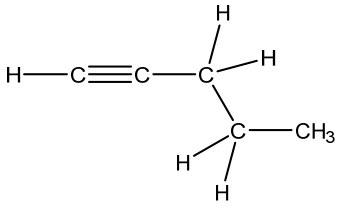
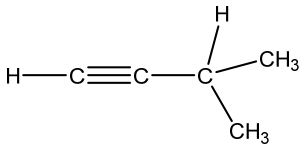
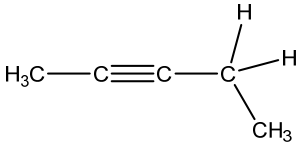
Answers to Practice Test Questions 10
Organic Molecules – Functional Groups and Stereochemistry

Unless a question specifies otherwise, you may draw your organic molecules using expanded, condensed or line-bond structures. You are expected to be able to read all three notations; however, you are not required to draw in line-bond unless the question explicitly asks you to. Always draw lone pairs!

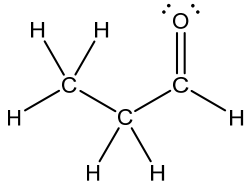
If you are asked to draw a particular number of structures, we won't usually deduct marks for incorrect ones because an incorrect answer will have caused you to miss a correct answer.
If we don't give the total number of structures, we usually deduct marks for incorrect answers because you are showing that you don't understand that the two different pictures represent the same molecule. Because you weren't aiming for a specific total, the incorrect one doesn't make you stop before drawing a complete set. You can't get 10/10 for drawing ten wrong answers as well as the ten right ones!

1.

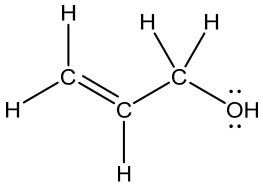
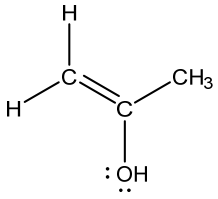
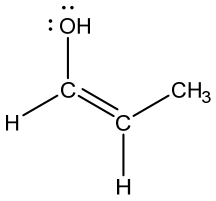
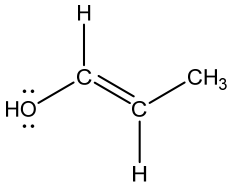
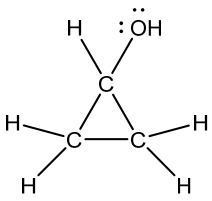




2.

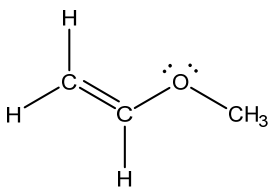
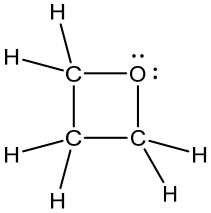
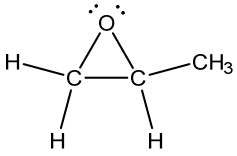
(a)



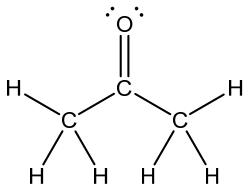
(b) *Any one of the answers below is acceptable. (The last one is the only one that actually exists under normal laboratory conditions. Unless the double bond is part of an aromatic ring, it is unusual to see an OH group directly attached to an alkene or alkyne.)*

(c) *Any one of the answers below is acceptable.*

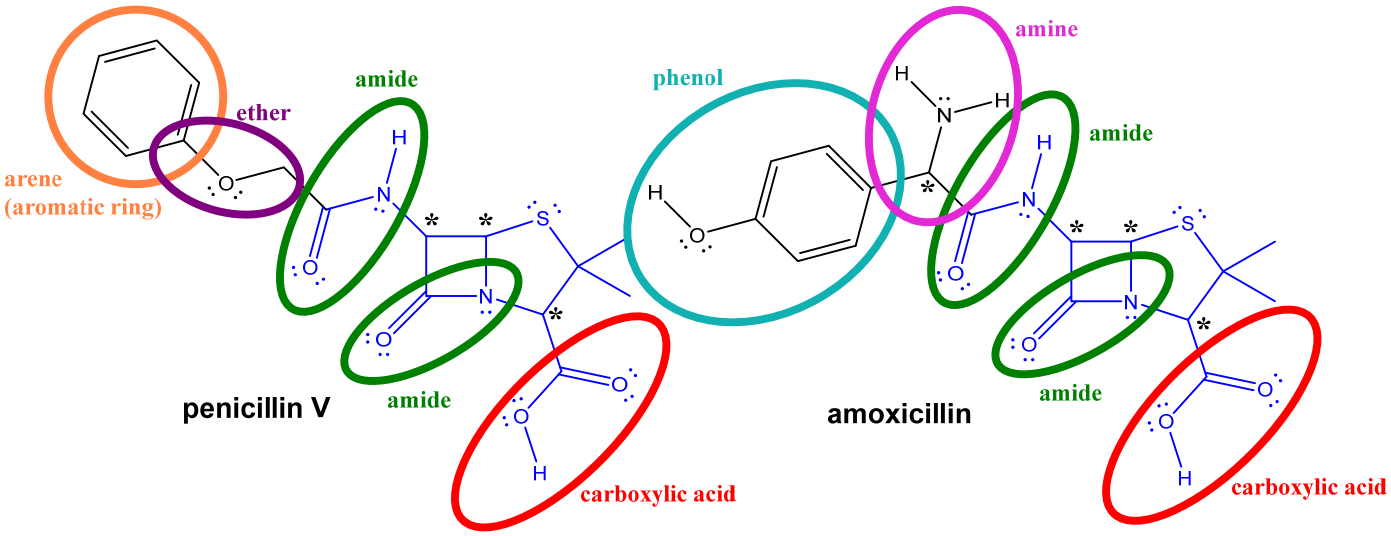




(d)



3.

(a)

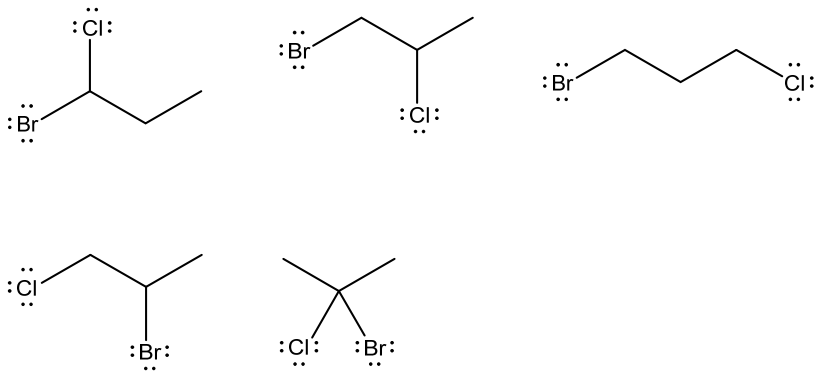


It is also acceptable to label the phenol as an arene (aromatic ring) and an alcohol. In that case, those two groups would each be circled separately.

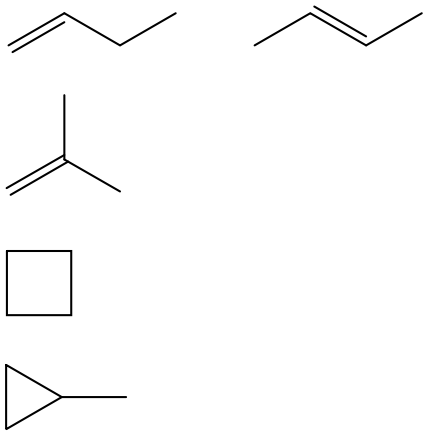
(b) *chirality centers are marked with an asterisk (*) on the pictures above*

4. *Only one stereoisomer for each answer is shown. If you drew cis instead of trans, it's still right. Answers are shown in line-bond notation to make it easier to see how the structures differ. It is completely acceptable for your answers to be in expanded or condensed notation.*

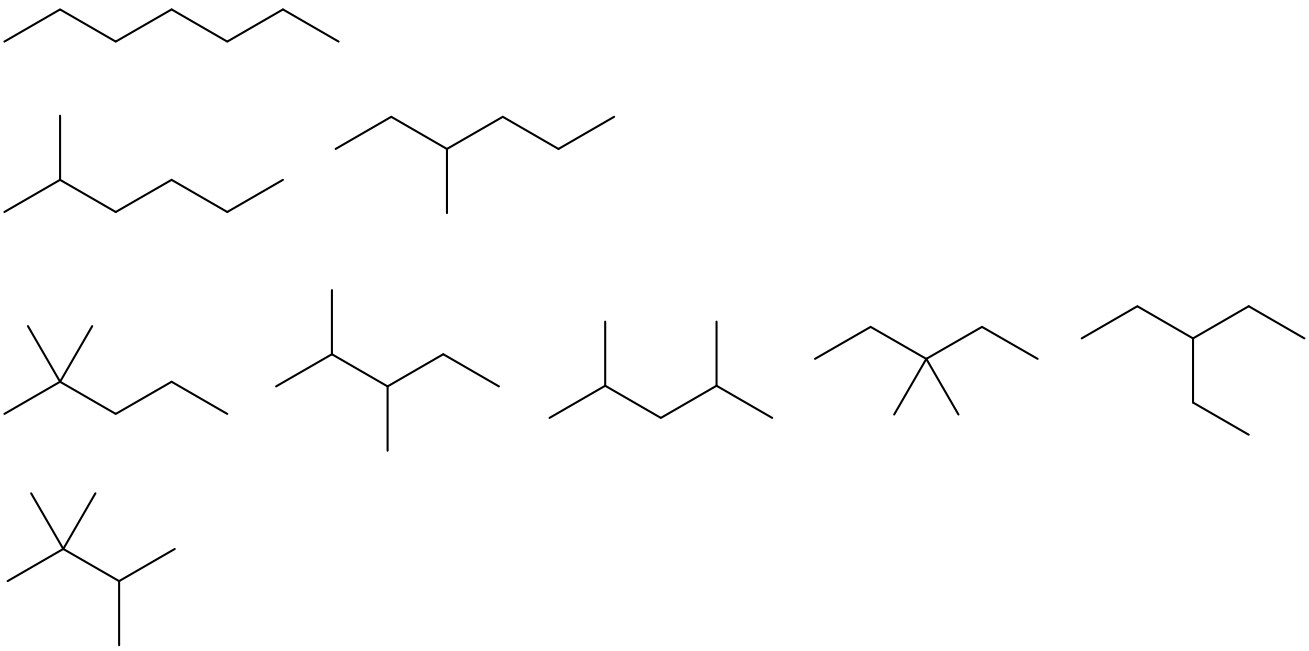
(a)



(b)

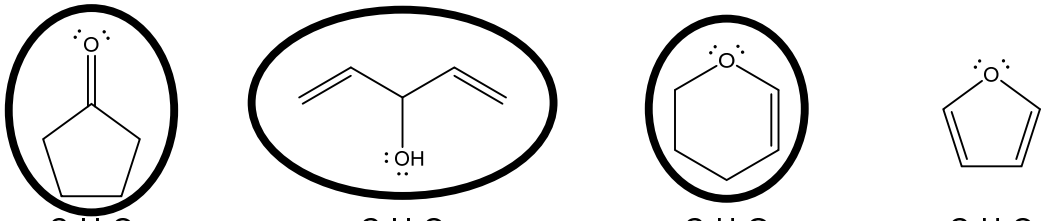


(c)



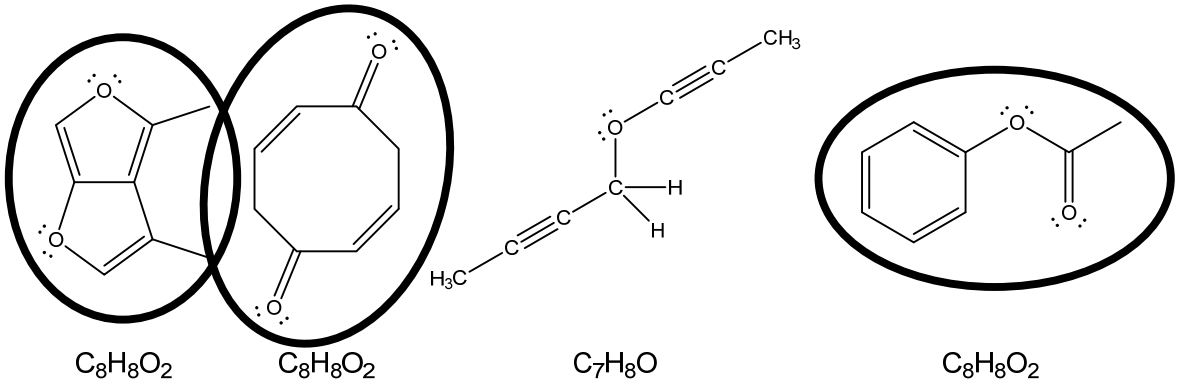
5.

(a)



C_5H_8O C_5H_8O C_5H_8O C_4H_4O

(b)



$C_8H_8O_2$ $C_8H_8O_2$ C_7H_8O $C_8H_8O_2$

6.

(a) enantiomers

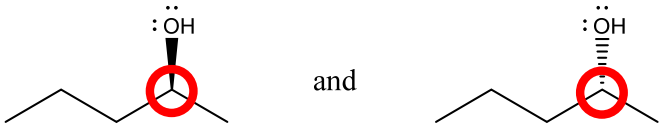
(b) enantiomers

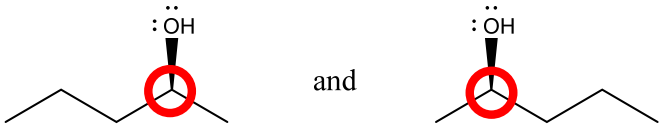
(c) neither (they are diastereomers – stereoisomers that are not enantiomers)

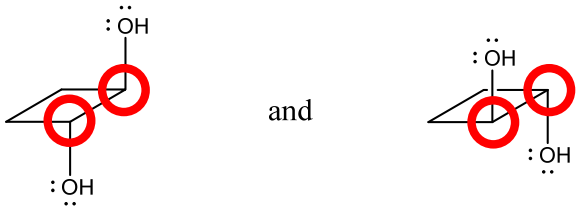
(d) enantiomers

7.

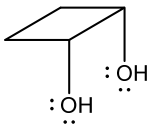
(a)





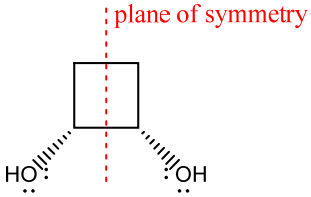


(b)



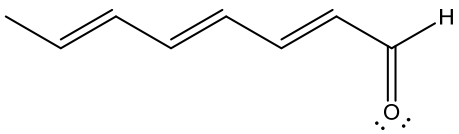
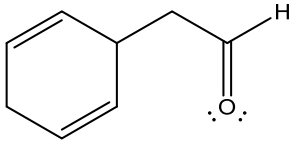
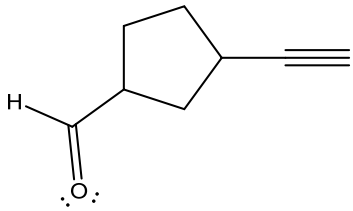
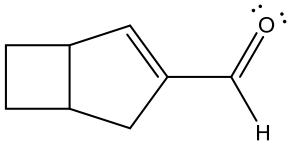
is not chiral because it is superimposable with its mirror image.

One way to tell that this molecule is not chiral is to look for the plane of symmetry. It is easier to see in a top view (as opposed to the side view shown above):

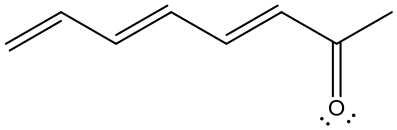
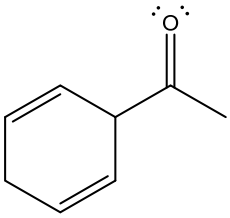
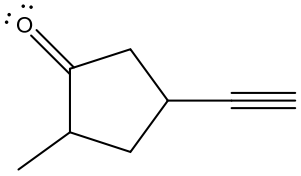
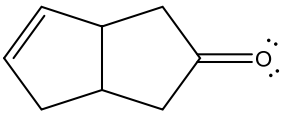


8.

(a) *Any aldehyde with the molecular formula $C_8H_{10}O$.*
Acceptable answers include (but are not limited to):

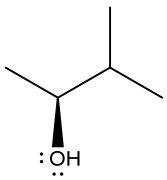
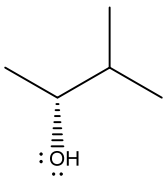
(b) *Any ketone with the molecular formula $C_8H_{10}O$.*
Acceptable answers include (but are not limited to):

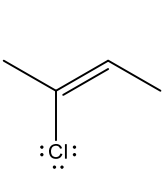
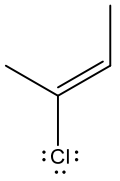
9. *Look for molecules that are chiral (i.e. not superimposable with their mirror image) and/or which can be described using the terms 'cis' and 'trans'.*

(a) no stereoisomer

(b) no stereoisomer

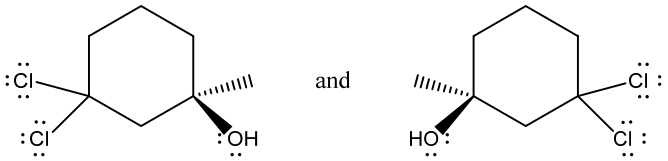
(c)  and  are enantiomers

The unnecessary wedge on the methyl group has been removed for clarity in the images above.

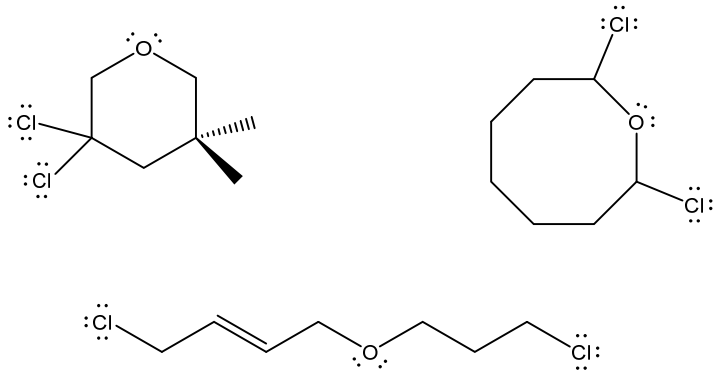
(d)  and  are geometric isomers

10.

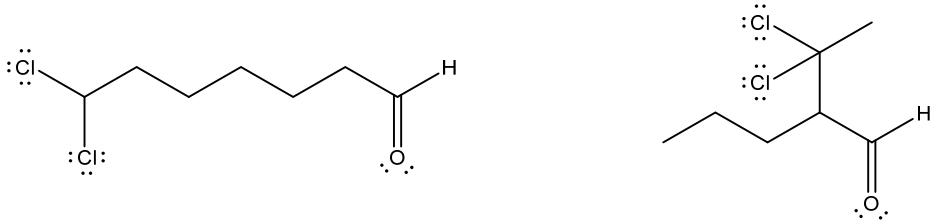
(a) Yes. There are two enantiomers of this structure.
They look like:



(b) *Any ether with the molecular formula* $C_7H_{12}Cl_2O$.
It must have either one ring or one double bond.
Acceptable answers include (but are not limited to):

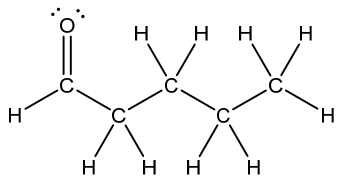


(c) *Any aldehyde with the molecular formula* $C_7H_{12}Cl_2O$.
It must have no rings and only one double bond $(C = O)$.
Acceptable answers include (but are not limited to):

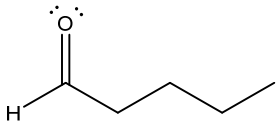


11.

(a)

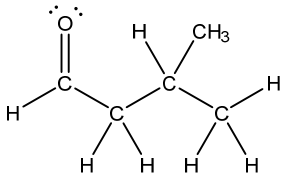


or

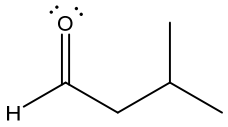


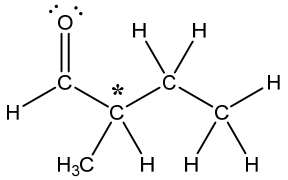
When an aldehyde is drawn using line-bond notation, we still draw the H attached to the C of the carbonyl group because it is an important part of that functional group (defining the group as an aldehyde rather than a ketone).

(b)



or





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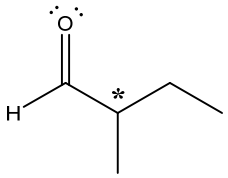

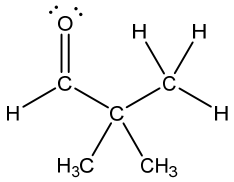

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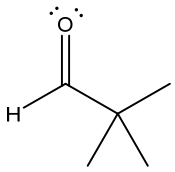
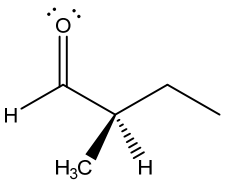


(c) *See asterisks (*) on answers to part (b).*

(d)



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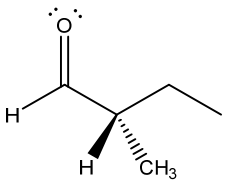
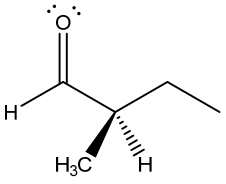


or:



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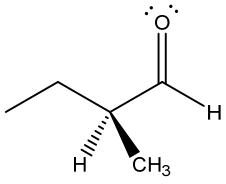
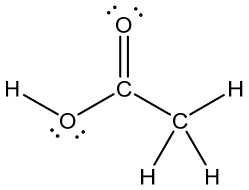


12.

(a)



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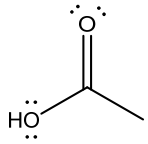
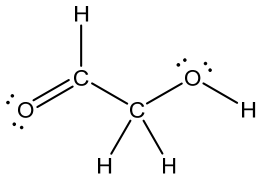
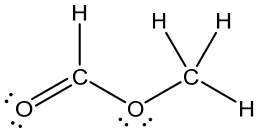
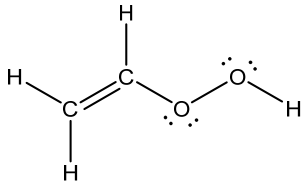
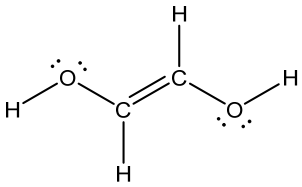


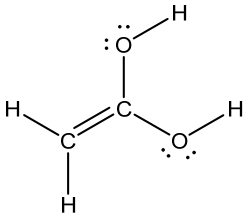
(b)



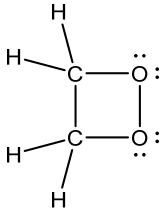


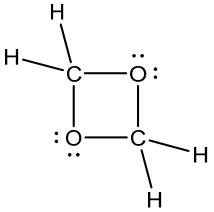


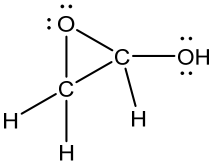


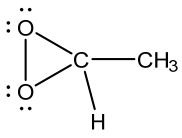


only structural isomers were requested
so *cis* or *trans* but not both
(trans shown here)



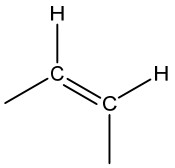




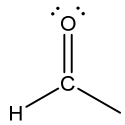


13. *None of the answers below are complete. They show the required component(s) only; however, your answer must be a complete molecule, so you need to attach something to the "hanging bonds".*

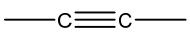
(a) *Any valid molecule containing the following piece:*



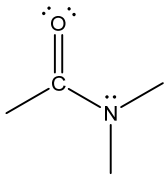
(b) *Any molecule with the formula C_5H_8O containing the following piece:*



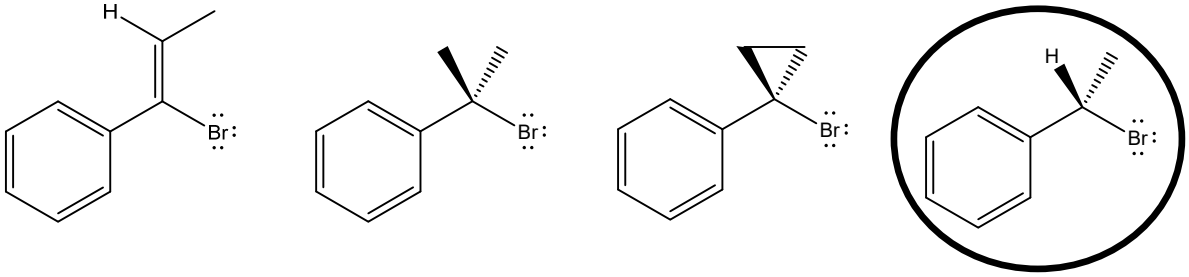
(c) *Any valid molecule containing both of the following pieces:*



and

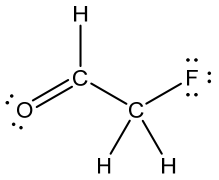
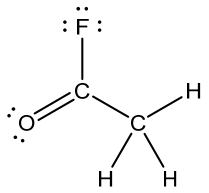
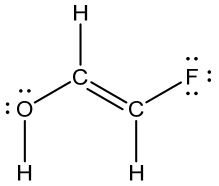
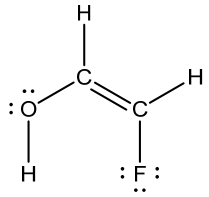
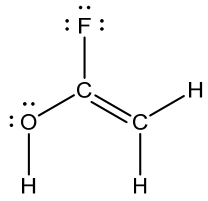
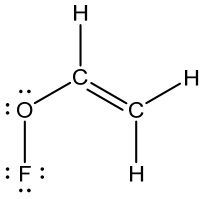
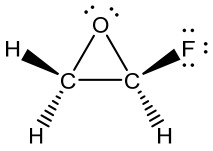
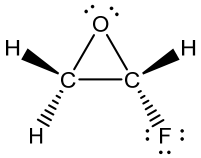


14. Circle each of the molecules below which is chiral.



On a question like this, marks are deducted for incorrect circles. We are not giving anybody full marks for just circling everything! (Unless, of course, that was the correct answer.)

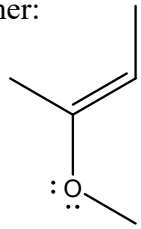
15.

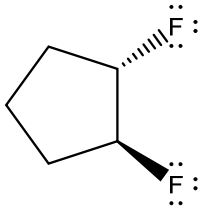
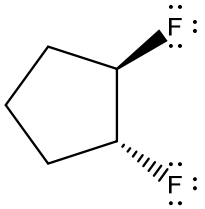
16.

(a) i. does not have a stereoisomer

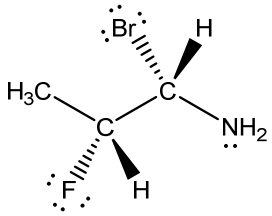
ii. has a geometric isomer:



iii. has geometric isomers *(which happen to be enantiomers of each other)*:


and


iv. has an enantiomer *(and other stereoisomers called diastereomers)*:



(b) i. alcohol and ether
(a senior student who recognized this as a hemiacetal would also get credit)
ii. alkene and ether
iii. n/a *(it would be fine to identify this as a haloalkane)*
iv. amine

(c)