

ORGANIC CHEMISTRY: ISOMERS

1. For each question below, draw all of the isomers required.

a. Draw all the structural isomers of C_4H_9F . (Hint: 4 isomers)

b. Draw all the structural isomers of C_7H_{16} with a carbon chain of 5 carbon atoms (i.e., the carbon backbone can not contain 7, 6, or 4 carbon atoms.) (Hint: 5 isomers)

c. Draw all the structural isomers of $C_4H_{10}O$. (Hint: 7 isomers)

d. Draw all the structural isomers of $C_4H_8Cl_2$. (Hint: 9 isomers)

e. Draw all the structural, geometric, and cyclic isomers of C_4H_8 . (Hint: 6 isomers)

f. Draw all the structural isomers of $C_6H_3F_2Cl$ that include a benzene ring. (Hint: 6 isomers)

2. In question #1, parts "a"-"d", identify all carbon atoms within each isomer that is a chiral center. Denote the carbon atom that is a chiral center with a *.

3. Using the formula $C_3O_2H_6$ draw the following isomers.

a. Draw two isomers that contain an ester.

b. A molecule that contains a carboxylic acid.

c. A molecule that contains two alcohols but no alkenes.

d. A molecule that contains an ether and an alcohol.

3. Draw all the possible constitutional isomers of the following molecular formulas. The correct number of isomers is given in parenthesis.

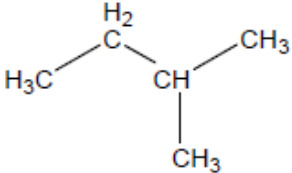
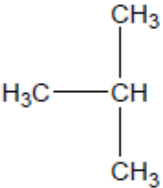
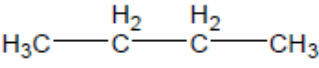
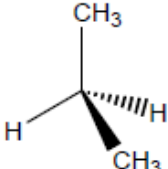
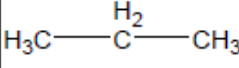
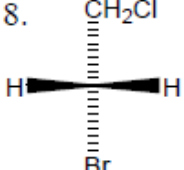
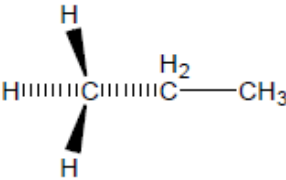
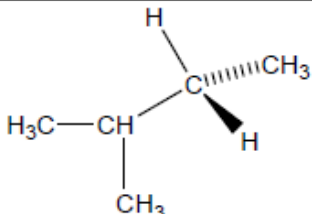
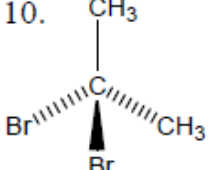
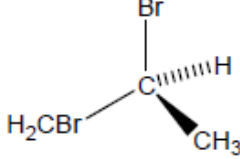
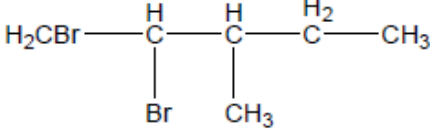
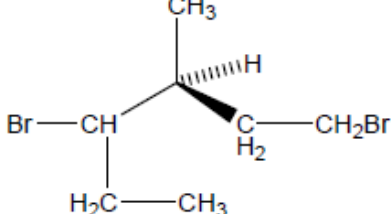
1. C_3H_8O (3)

2. $C_3H_5Cl_3$ (5)

3. Draw all the ketones that have formula C_4H_6O . (3)

4. Draw all the amines where the nitrogen is attached to one carbon with the formula $C_5H_{13}N$. (4)

B. What is the relationship between each of the following pairs of structures? Are they totally *different* molecules (i.e., which do not have the same molecular formula), are they *constitutional isomers*, or are two drawings of the *same* compound?

<p>5. C_4H_{10}</p>	
<p>6.</p> 	
<p>7.</p> 	
<p>8.</p> 	<p>$CH_3-CHClBr$</p>
<p>9.</p> 	
<p>10.</p> 	
<p>11.</p> 	

GEOMETRIC ISOMERS

1. Write and label the cis-trans isomers of the following: *(use bow-tie structures)*

a) 1,2-dichloroethene

cis	trans
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b) 2-butene

cis	trans
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c) 2,3- dibromo-2-pentene

cis	trans
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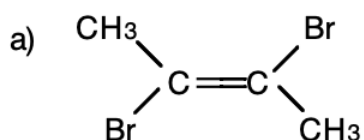
d) 3-hexene

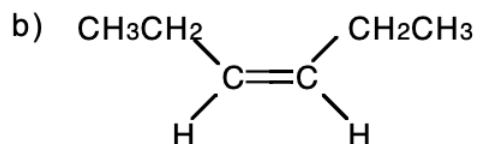
cis	trans
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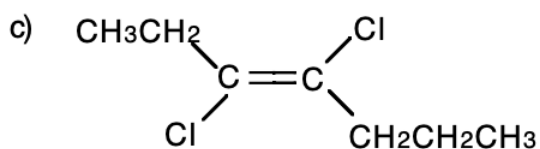
e) 1,2-difluoro-1-butene

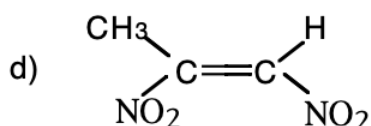
cis	trans
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2. Give the name of each of the following bow-tie structures: (don't forget 'trans' or 'cis')









OPTICAL ISOMERS

1.

2-aminopropanoic acid (alanine) has two enantiomers (optical isomers) because it has a chiral molecule containing an asymmetric carbon atom. One enantiomer is a non-superimposable mirror image of the other.

The two enantiomers rotate the plane of polarisation of plane polarised light in opposite directions, but 2-aminopropanoic acid can also be found as a racemic mixture which has no effect on the plane of polarisation.

2-aminopropanoic acid has the structure:

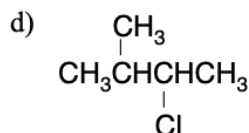
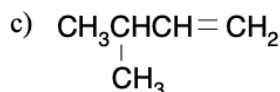
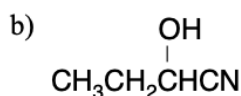
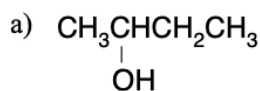
$$\begin{array}{c} \text{CH}_3\text{CHCOOH} \\ | \\ \text{NH}_2 \end{array}$$

a) Draw the structures of the two enantiomers. Use your diagram to explain what is meant by the term *non-superimposable mirror image*.

b) Explain what is meant by a *chiral molecule* and say how you would recognise an *asymmetric carbon atom*.

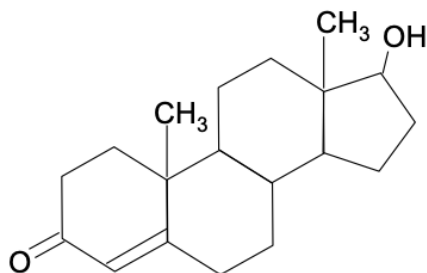
c) Why doesn't a racemic mixture have any effect on the plane of polarisation of plane polarised light?

2. Some, but not all, of the following molecules have optical isomers. For those that do, draw the structures for the two isomers.



3. Draw the structure of the smallest alkane (with a general molecular formula of $\text{C}_n\text{H}_{2n+2}$) which has optical isomers.

4. The structure of the hormone testosterone is:



Sketch this molecule and then draw a circle around all the asymmetric carbon atoms that you can find.