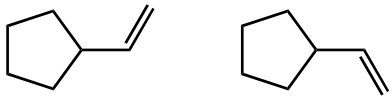
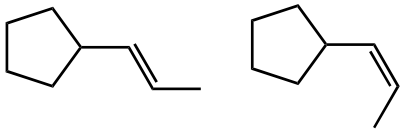
Homework - Chapter 6
Chem 2310

Name _____

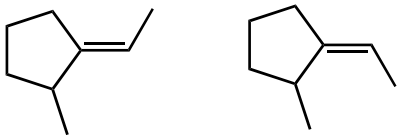
I. Stereoisomers containing C=C

1. Are the following pairs of compounds stereoisomers, or are they the same compound? Explain. (Use models!)

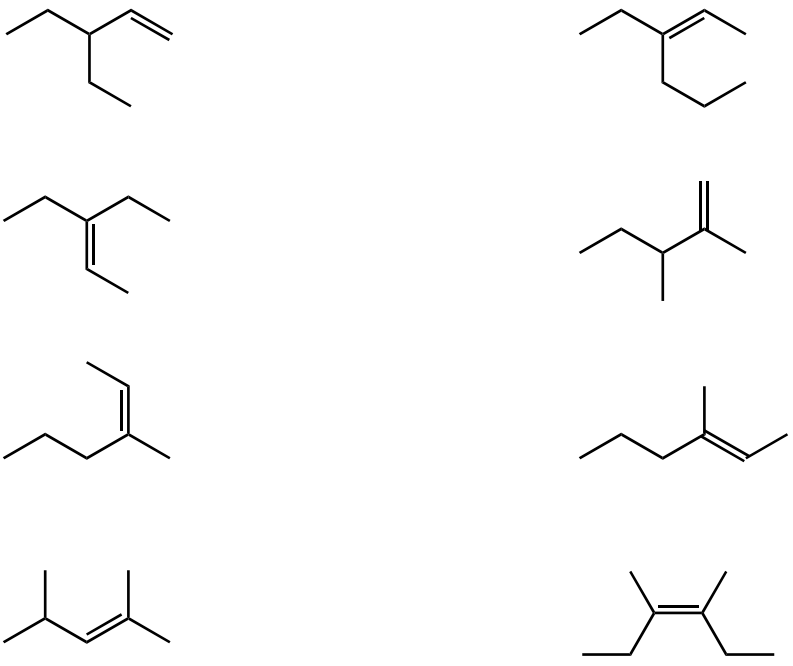
a) 

b) 

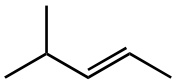
c) 

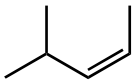
d) 

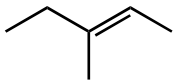
2. Which of the following compounds will have a stereoisomer? If they will, draw it.

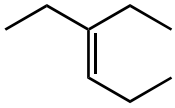


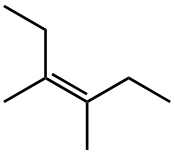
3. Label the following as cis or trans, or E or Z, or neither, as appropriate.

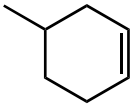
a) 

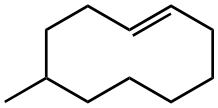
b) 

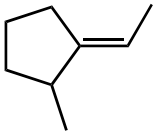
c) 

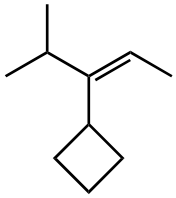
d) 

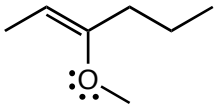
e) 

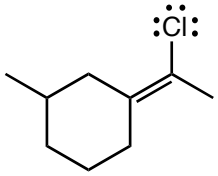
f) 

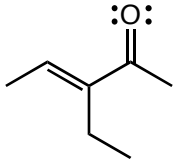
g) 

h) 

i) 

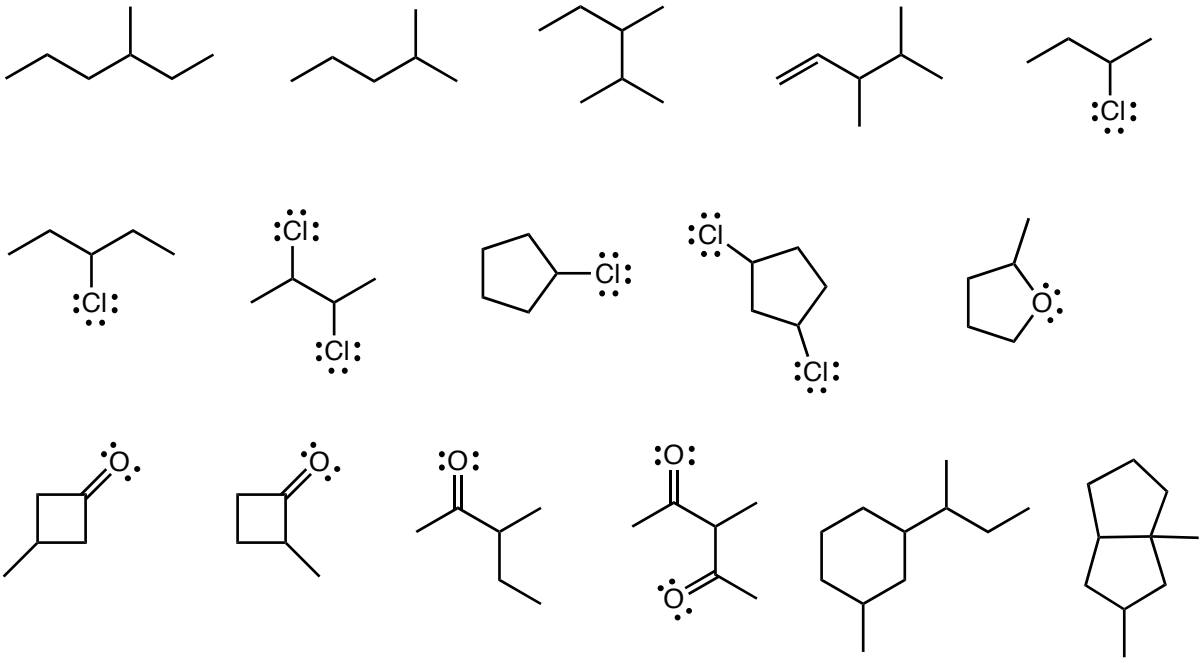
j) 

k) 

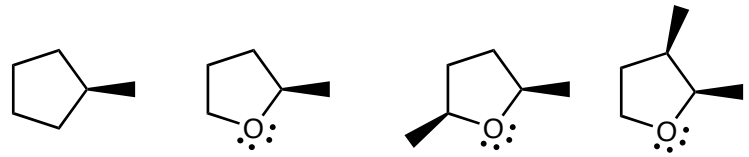
l) 

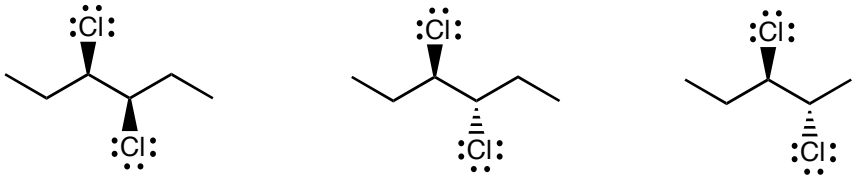
II. Introduction to Chirality

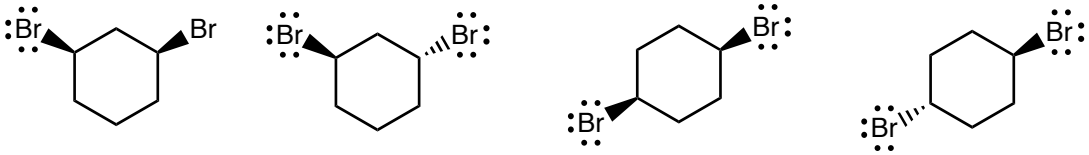
4. Circle the asymmetric carbons (if any) in each of the following compounds.

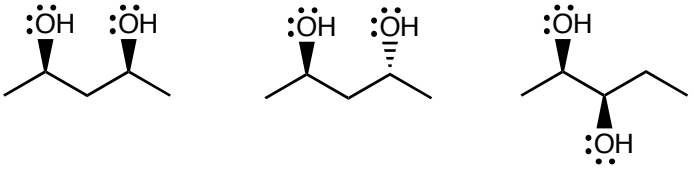


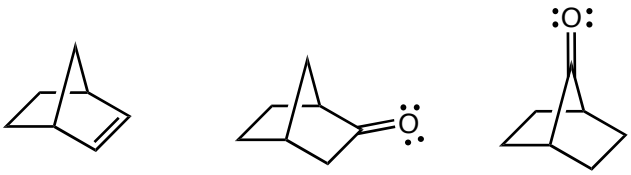
5. Build a model of each of the following compounds. Circle all of those that DO NOT contain a plane of symmetry.

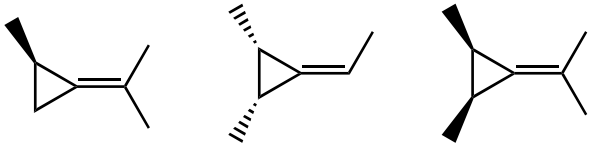
a) 

b) 

c) 

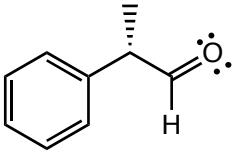
d) 

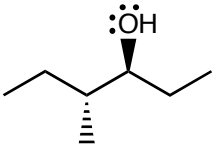
e) 

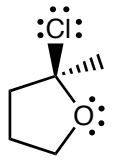
f) 

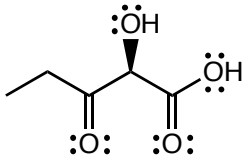
6. Label the stereocenters in each of the following compounds as R or S.

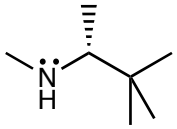
a) 

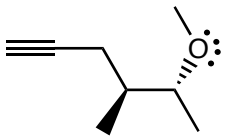
b) 

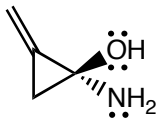
c) 

d) 

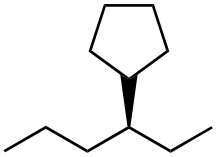
e) 

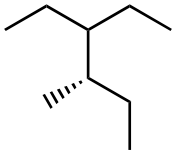
f) 

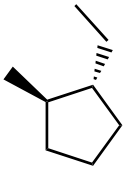
g) 

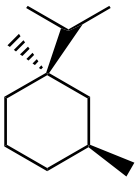
h) 

7. Name the following compounds.

a) 

b) 

c) 

d) 

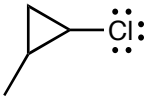
8. Draw the structures of the following compounds.

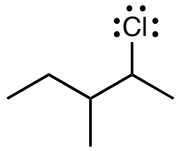
a) (3S,4R)-4-ethyl-3-methylheptane

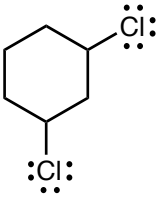
b) (1R,3S)-1-isopropyl-3-methylcyclohexane

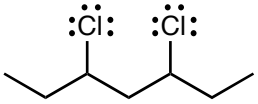
III. Compounds with two or more stereoisomers

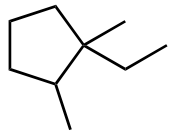
9. Identify the stereocenters of the following compounds. Then draw all of the stereoisomers. Label all pairs of enantiomers and all meso compounds. Use models!

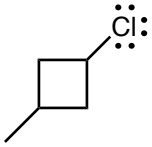
a) 

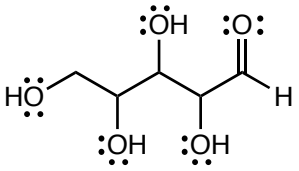
b) 

c) 

d) 

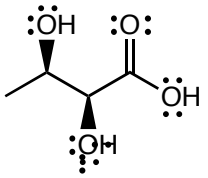
e) 

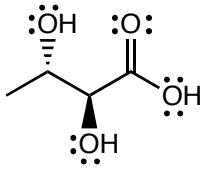
f) 

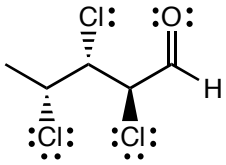
g) 

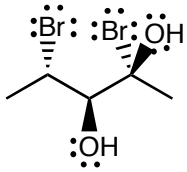
Use Fischer projections!

10. Draw the Fischer projection for the following compounds (use models!). Label each as D or L. (Note - this isn't something I would expect you to be able to do without models - but it is a good way to make sure you understand what Fischer projections mean.)

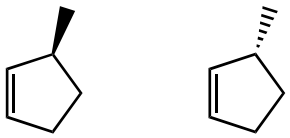
a) 

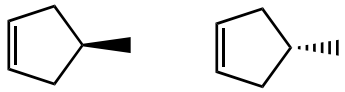
b) 

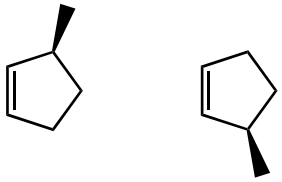
c) 

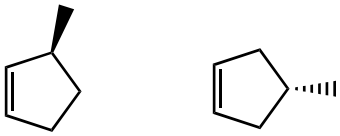
d) 

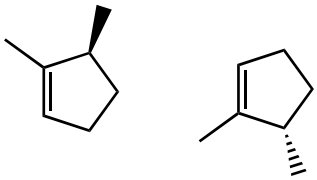
11. What is the relationship between each of the following pairs of compounds? The possibilities are: not isomers, constitutional isomers, enantiomers, diastereomers, meso, or identical compounds. Use models!

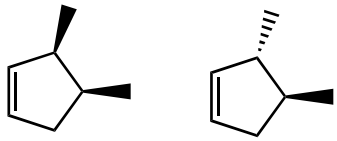
a) 

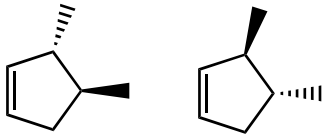
b) 

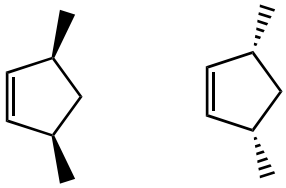
c) 

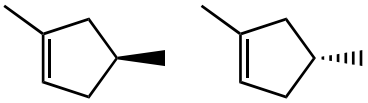
d) 

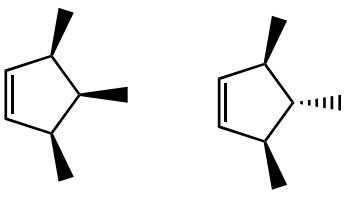
e) 

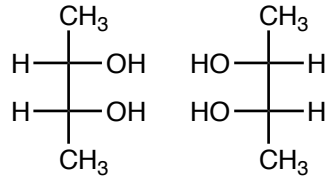
f) 

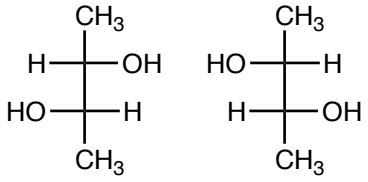
g) 

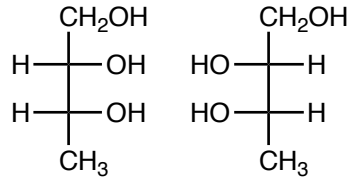
h) 

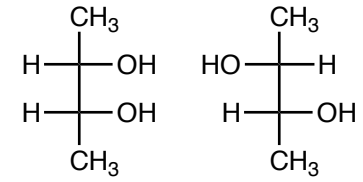
i) 

j) 

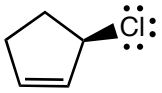
k) 

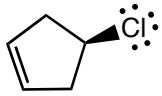
l) 

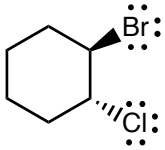
m) 

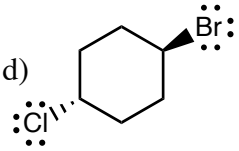
n) 

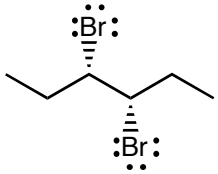
12. Look at each compound below and decide if it is chiral or not. If it is not, label it as "achiral" or "meso." If it is chiral, draw an enantiomer of the compound, without changing the location of the main carbon chain or ring. You may wish to make your best guess on paper and then use models to check your thinking!

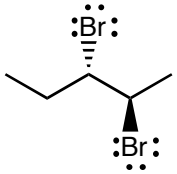
a) 

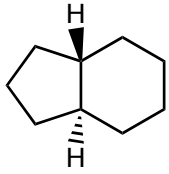
b) 

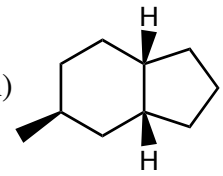
c) 

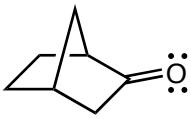
d) 

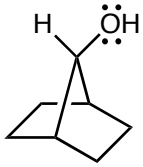
e) 

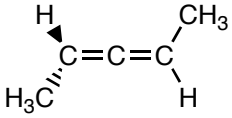
f) 

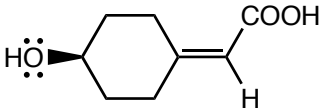
g) 

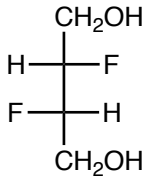
h) 

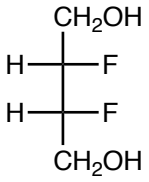
i) 

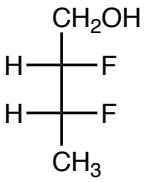
j) 

k) 

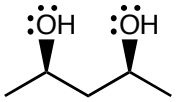
l) 

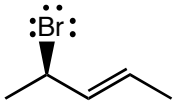
m) 

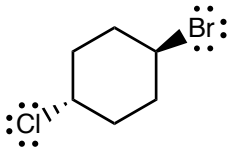
n) 

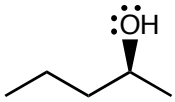
o) 

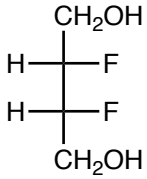
13. Draw a diastereomer of the following compounds or write "none" if none exists.

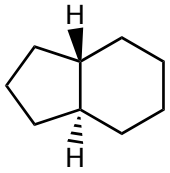
a) 

b) 

c) 

d) 

e) 

f) 

IV. Physical Properties of Chiral Compounds

14. Are the following statements true or false?

____ All chiral molecules have asymmetric carbons.
____ If a compound contains two asymmetric carbons, it will always be chiral.
____ If a compound has one asymmetric carbon, it will always be chiral.
____ A compound that contains a plane of symmetry is never chiral.
____ A compound with a non-superimposable mirror image is always chiral.
____ Constitutional isomers have different molecular formulas.
____ An enantiomer is a type of stereoisomer.
____ Enantiomers have opposite melting points.
____ The cis and trans forms of an alkene have the same boiling point.
____ If (R)-2-chlorobutane has a specific rotation of +36.2° then (S)-2-chlorobutane will have a specific rotation of -36.2°.
____ R enantiomers always have a + angle of rotation, while S enantiomers always have a - angle of rotation.

15. A rotation of +1.74° was observed for a solution of glyceraldehyde when a solution of 2.0 g in 10 ml of water was measured in a 10 cm cell. What is the specific rotation of glyceraldehyde?

16. The specific rotation of one enantiomer of tartaric acid is +12.0°. Calculate what the observed rotation would be if 1.0 g of the compound were dissolved in 20 ml of ethanol and measured in a 20 cm cell.

17. If X represents one enantiomer and O represents the other, and X has a specific rotation of +10°:

a) Draw a mixture containing 9 X's and 3 O's.

What is the % of X's and the % of O's?

What is the %ee?

What is the optical purity?

What is the rotation of the mixture?

b) Draw a mixture with a 80% ee and a negative rotation.

How many O's and how many X's did you use?

What is the rotation of the mixture?

18. Given that the specific rotation of (S)-2-iodobutane is +15.9°, answer the following questions.

a) What is the specific rotation of (R)-2-iodobutane?

b) What rotation would be observed if a mixture of 50% (S)-2-iodobutane and 50% (R)-2-iodobutane were measured?

c) What is the optical purity of a solution with a 90% ee?

d) What % ee would a mixture of 80% R and 20% S enantiomer have?

e) In a 40% ee mixture, what percentage of the two enantiomers would be present?

f) What is the optical purity of a solution with an rotation of -11.1°?

g) What rotation would be observed for a 60% ee mixture in which R is in excess?

h) What rotation would be observed for a mixture of 65% R and 35% S?

19. Match the following words with their definitions.

_____ chiral
_____ achiral
_____ stereocenter
_____ stereoisomer
_____ asymmetric carbon
_____ enantiomer
_____ diastereomer
_____ optically active
_____ racemic mixture
_____ optical purity
_____ meso compound
_____ enantiomeric excess
_____ stereochemical correlation
_____ resolution of enantiomers

A. the separation of two enantiomers in a racemic mixture
B. a solution which rotates the plane of polarized light
C. a compound which has a non-superimposable mirror image
D. an atom in which if two groups are switched, a stereoisomer results
E. two isomers which have the same molecular formula & connectivity, but a different orientation in space
F. one of two non-superimposable mirror images
G. a carbon with four different groups on it
H. the ratio of the specific rotation of a mixture of two enantiomers to the rotation of a single enantiomer
I. a compound containing two or more stereocenters arranged so that their is a plane of symmetry
J. one of two compounds which are stereoisomers but not enantiomers
K. a compound whose mirror image is identical to the original
L. an equal mixture of two enantiomers
M. matching up R and S structures with + and - rotations
N. the percentage of excess of one enantiomer over the other.

20. Which of the following solutions are optically active? Write yes or no in the blank and explain your answer in the space below each solution. Drawings and models may help! (Hint - consider the chirality, relative amounts, and relationship of the compounds.)

a) _____ 0.15 g of (R)-3-methylhexane

b) _____ 2.0 g of (R)-3-methylhexane and 2.0 g of (S)-3-methylhexane

c) _____ 2.0 g of (R)-3-methylhexane and 3.0 g of (S)-3-methylhexane

d) _____ 0.56 g of (3R,4S)-3,4-dimethylhexane

e) _____ 2.12 g of (3R,4R)-3,4-dimethylhexane

f) _____ 244 mg of (3R,4R)-3,4-dimethylhexane and 244 mg of (3S,4S)-3,4-dimethylhexane

g) _____ 92 mg of (3R,4S)-4-ethyl-3-methylheptane and 92 mg of (3S,4R)-4-ethyl-3-methylheptane

h) _____ 8.32 g of (3S,4S)-4-ethyl-3-methylheptane and 8.32 g of (3S,4R)-4-ethyl-3-methylheptane

i) _____ 6.15 g of (3R,4R)-4-ethyl-3-methylheptane and 9.46 g of (3S,4S)-4-ethyl-3-methylheptane