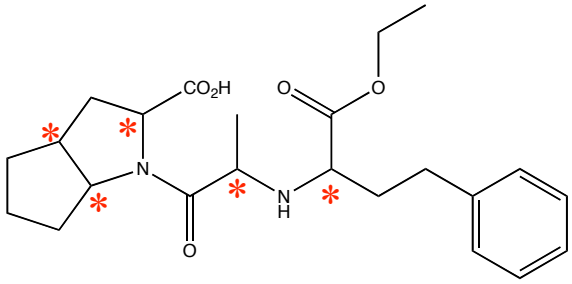
Organic Chemistry I for the Life Sciences
CHM 223
Test 2
Chapters 5, 15/16 **Name**_____

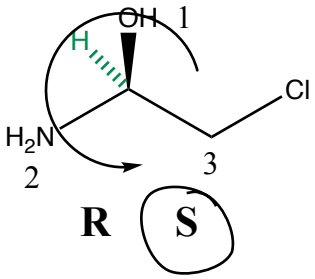
1. Which one of the following most accurately describes diastereomers?

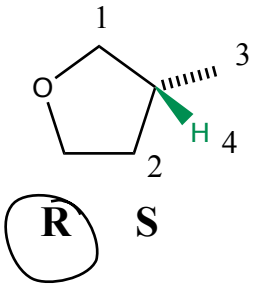
A. superimposable mirror image isomers
B. nonsuperimposable mirror image isomers
C. superimposable non-mirror image isomers
D. nonsuperimposable non-mirror image isomers

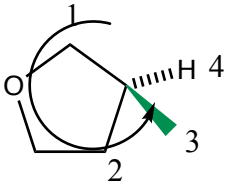
2. Rampiril™ is a drug used to control blood pressure in people with chronically high blood pressure. It is drawn below without any indications as to stereochemistry. Identify and label all of the stereogenic carbons in Rampiril™ with a * ?



3. Clearly rank the substituents attached to the stereogenic carbon atoms in the two compounds below and circle either R or S below the structure in accordance with your rankings:







enantiomer! = S

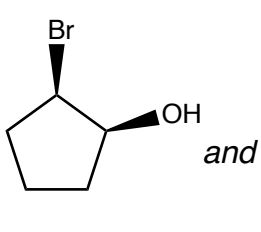
4. Which of the following solutions are ***optically inactive*** (may be more than one)?

A. solution containing a racemic mixture of enantiomers
B. solution containing an achiral molecule
C. solution containing a single enantiomer
D. solution containing a meso compound

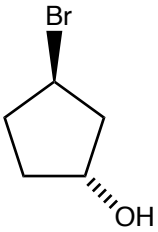
5. (2R,3S)-2-chloro-3-bromoheptane has a specific rotation of +78°, and a boiling point of 67 °C. Which of the following MUST be true (may be more than one)?

A. (2S,3R)-2-chloro-3-bromoheptane is a mirror image isomer
B. (2S,3S)-2-chloro-3-bromoheptane will have a specific rotation of –78°
C. (2S,3R)-2-chloro-3-bromoheptane has a boiling point of –67 °C
D. (2R,3R)-2-chloro-3-bromoheptane is chiral

6. What is the relationship between the following pairs of compounds?



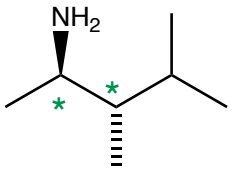
and



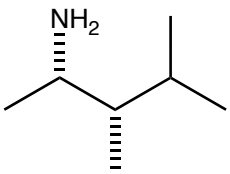
1,2- 1,3-

relationship: **constitutional isomers**

these two compounds have different connectivities



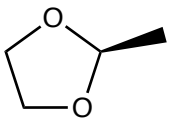
and



relationship: **diastereomers**

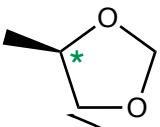
only ONE of the stereogenic centers is inverted; for enantiomers, BOTH need to be inverted!

7. Which of the molecules below is (are) chiral (may be more than one answer)?



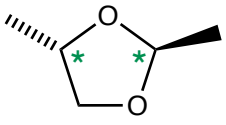
A

no stereogenic centers



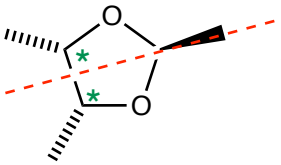
B

a single stereogenic center



C

two stereogenic centers but no plane of symmetry



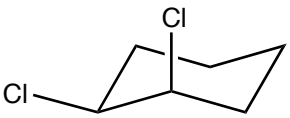
D

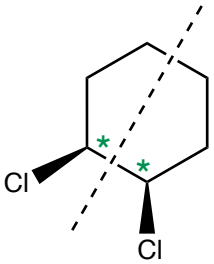
two stereogenic centers with a plane of symmetry

* = stereogenic center

8. Jimmy says the compound below must be chiral because he can't find a plane of symmetry. Do you agree with Jimmy? If not, provide clearly drawn structural evidence to support your answer.

Jimmy



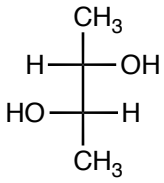


sorry Jimmy! When drawn as a flat cyclohexane chair, the two chlorines are on the same side of the ring. So whereas there are two stereogenic centers in the molecule, the molecule is still achiral because there is a plane of symmetry! It is a meso compound!

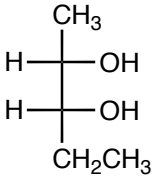
9. Which of the following must be taken into account to provide the specific rotation of a chiral compound (may be more than one answer):

A. temperature of the solution
B. concentration of the solution
C. wavelength of light used
D. length of the sample tube
E. gravitational effects

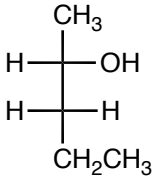
10. Which of the following are meso compounds (may be more than one)?



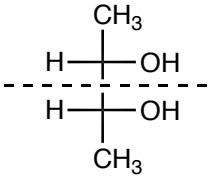
A



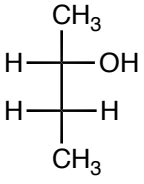
B



C



D



E

meso compound: has two or more stereogenic carbons but retains a plane of symmetry

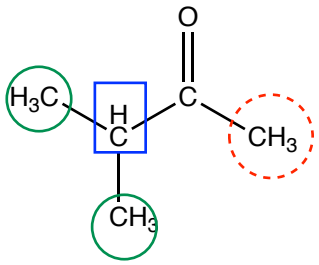
sat CH C–O

11. A compound has particularly relevant stretches in the IR spectrum at 2950 and 1175 cm^{-1}. To what class of compound does this compound most likely belong?

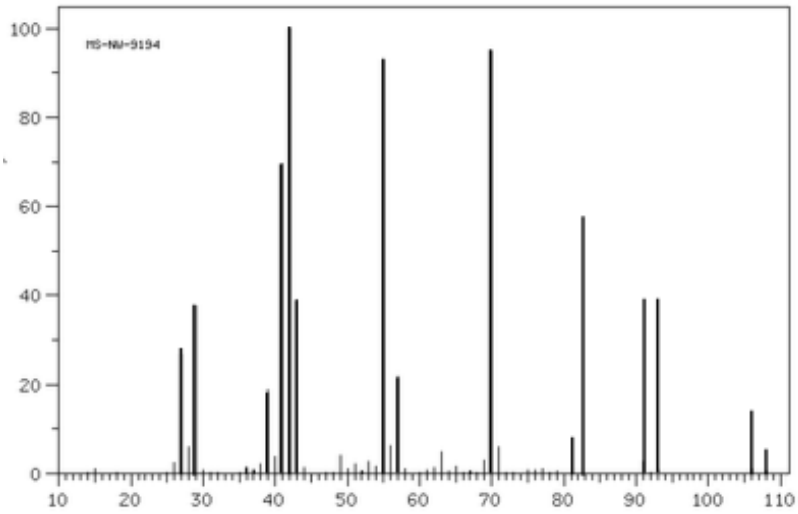
A. Alcohol B. Ester C. Alkene D. Ether E. Aldehyde

12. Provide the structure of a ketone with a molecular ion peak in the mass spectrum of 86, and three chemical environments in the ^1H NMR spectrum.

$$\frac{86}{14} = 6 \text{ heavy atoms}$$



13. Which one of the following is the most likely molecular formula for the alkyl halide in the mass spectrum below?

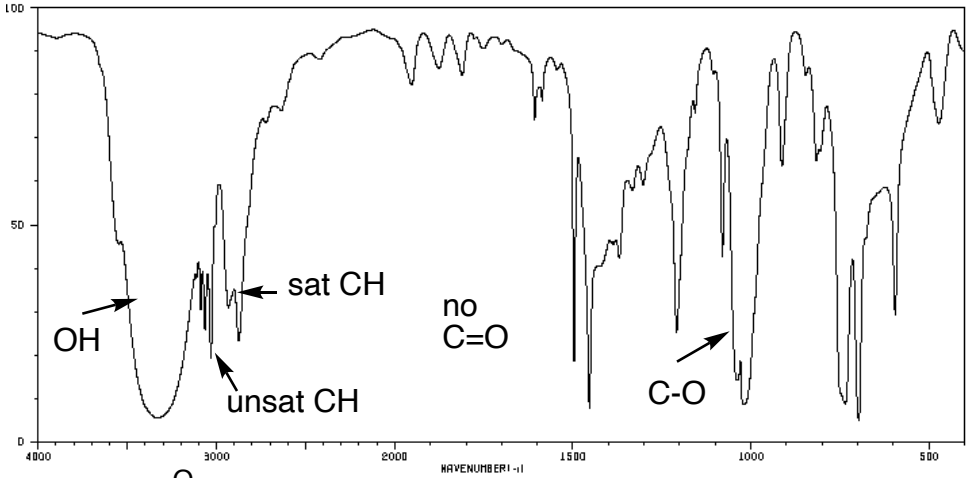


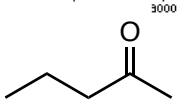
• two signals at highest mass in 3: 1 ratio suggests a Cl atom is present

$$\frac{106-35}{14} = 5 \text{ heavy atoms + Cl}$$

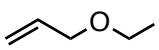
A. $C_5H_{11}Cl$
B. $C_5H_{11}Br$
C. C_2H_5Cl
D. C_2H_5Br
E. $C_8H_{10}Cl$
E. $C_8H_{10}Br$

14. Which of the structures below is most compatible with the provided IR spectrum?

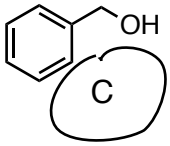




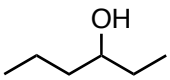
A
• no C=O, OH, unsat CH



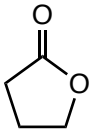
B
• no OH



C

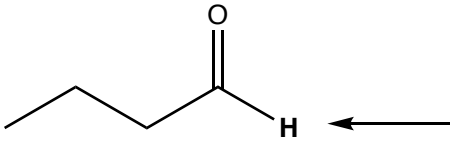


D
• no unsat CH



E
• no C=O, OH, unsat CH

15. Predict the chemical shift and multiplicity for the hydrogen atom in bold below:

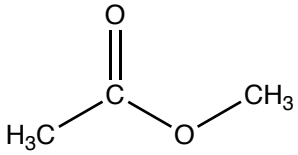


chemical shift range: 9-10 ppm

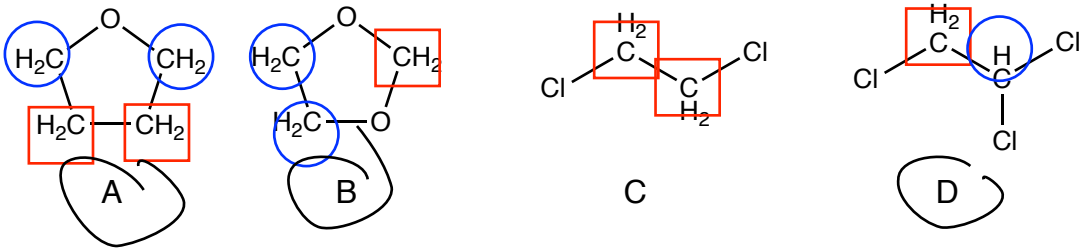
multiplicity: triplet

16. The biggest peak in the mass spectrum is referred to as the ____**base**_____ peak, and the peak at highest mass in the mass spectrum is referred to as the __**molecular ion**__ peak.

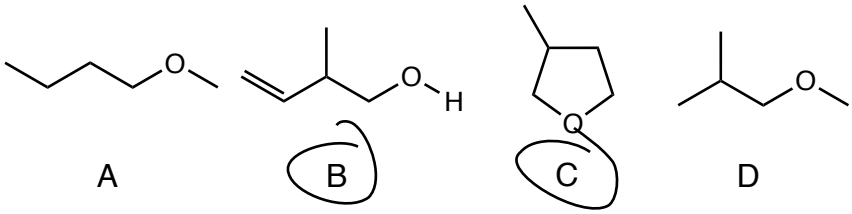
17. Provide the complete structure of an ester with 5 heavy atoms.



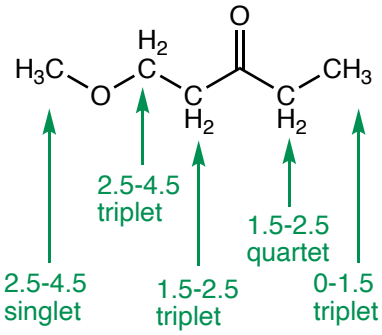
18. Which of the compounds below have exactly two chemical environments in the ^{1}H NMR spectrum (may be more than one answer)?



19. A compound has molecular formula $C_5H_{10}O$. Which of the following is (are) consistent (may be more than one)?



20. Which one of the following predictions is true for the compound shown below:



A. it will have a total of four triplets
B. it will have only one predicted signal in the 2.5-4.5 PPM region
C. there will be only one quartet in the 1.5-2.5 PPM region
D. there will be only one singlet in the 0-1.5 PPM region