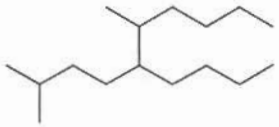
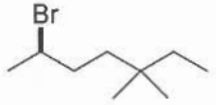
1. (10 pts) Provide a proper IUPAC name for the following molecules:



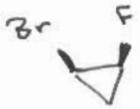
2,6-dimethyl-5-n-butyl decane



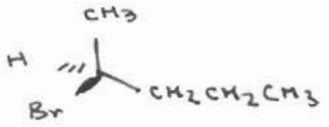
R-2-bromo-5,5-dimethyl heptane

Provide structures for each of the following names.

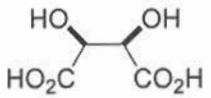
Cis-1-bromo-2-fluoro-cyclopropane

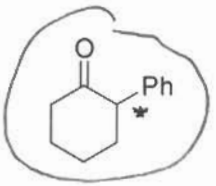


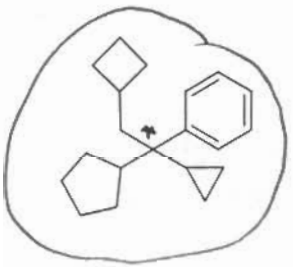
S-2-bromo-pentane

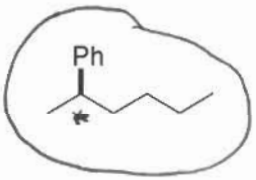


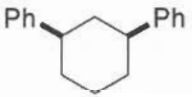
2. (15 pts) Circle the following chiral molecules. Identify any stereocenters.





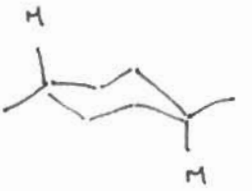






3. (15 pts) Draw the most stable chair conformation of trans-1, 4-dimethylcyclohexane.

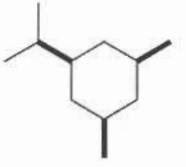
≡



- both - CH_3 groups equatorial

Draw the two chair conformations for the following cyclohexane and label the substituents as axial or equatorial (you do not have to draw in all the hydrogens). Label which conformation is more stable. Is this molecule chiral?

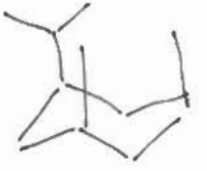
↑
no plane of symmetry



Most Stable

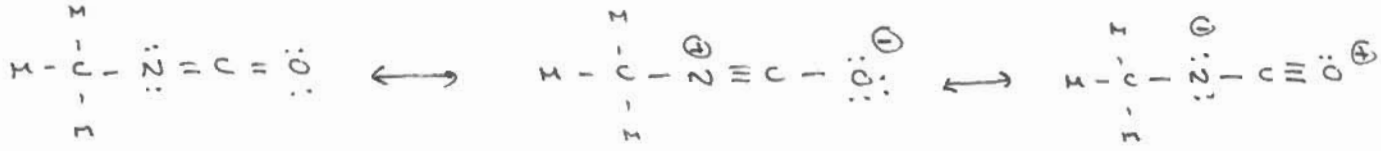
all groups equatorial

⟶



all groups axial

4. (15 pts) Draw a Lewis structure of methyl isocyanate, CH_3NCO, in which all the atoms have filled octets. Show all non-bonding electrons and formal charges. Draw any resonance contributors to the structure you first drew in which <u>all the atoms have filled octets</u>. Rank your structures in order of stability



best - no charge

second

worst - ⊖ charge on less electronegative atom N

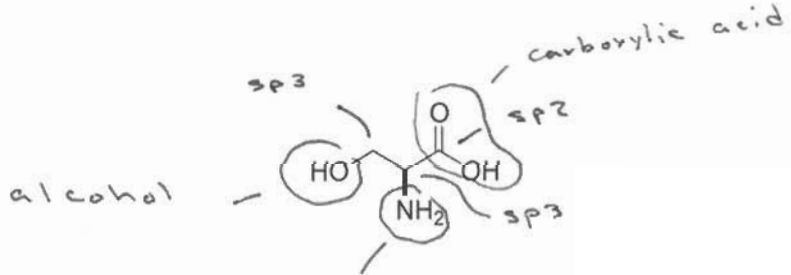
For the following molecule:

Indicate the hybridization at each carbon.

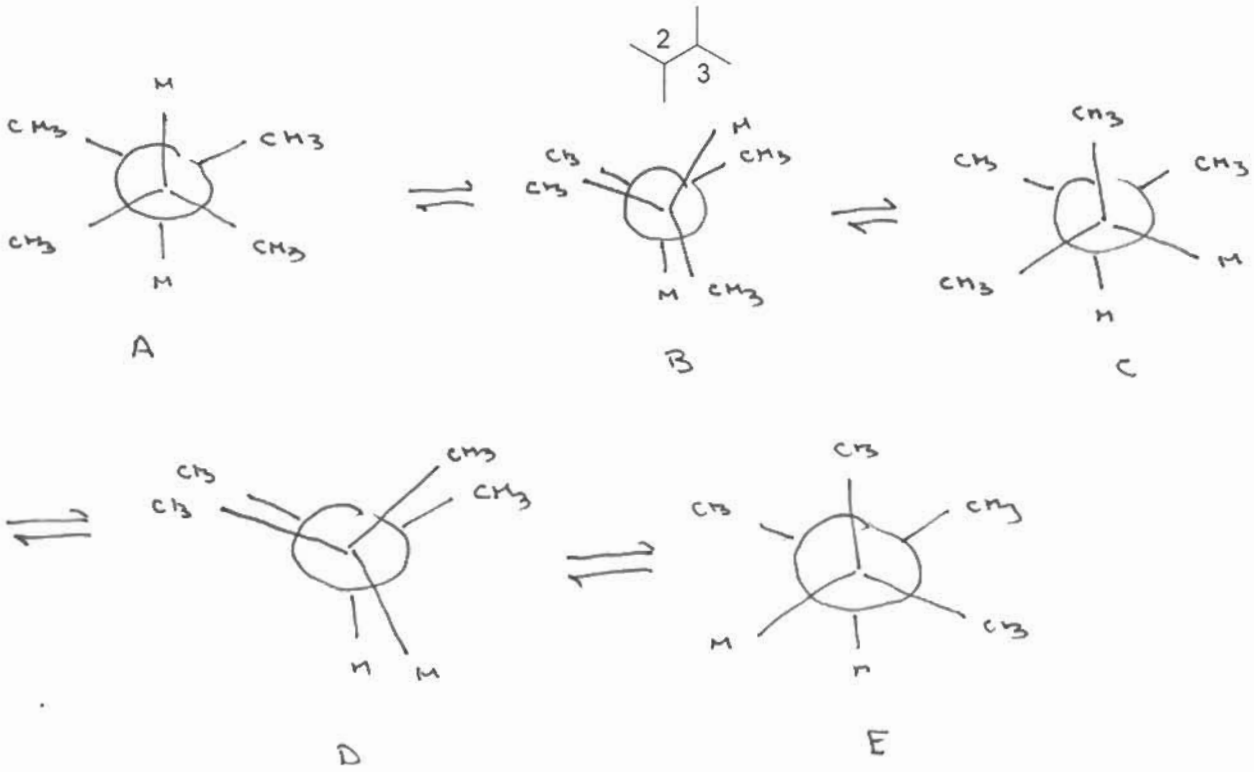
Indicate the shape about each carbon. sp^3 - tetrahedral ; sp^2 trigonal planar

Identify any functional groups in this molecule.

Is this molecule chiral? yes



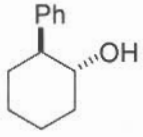
5. (15 pts) Draw Newman projections for the each of the staggered and eclipsed conformations between the C2-C3 bond of 2, 3-dimethyl buthane. Label the most and least stable conformations.



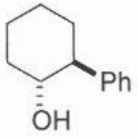
A - most stable; staggered, - CH_3 groups separated compared to C + E, which are equal in energy;

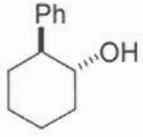
D least stable; eclipsed with - CH_3's eclipsed

6. (15 pts) Indicate how the following pairs of molecules are related. (Identical, constitutional isomers, enantiomers, diastereomers, or conformers. Note: Conformers of enantiomers or diastereomers should be labeled as enantiomers or diastereomers).

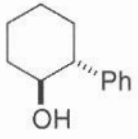


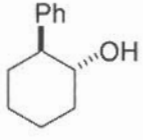
identical



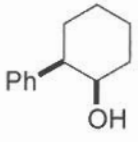


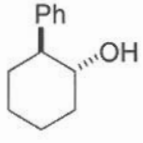
enantiomers



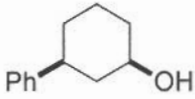


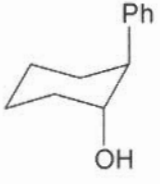
diastereomers



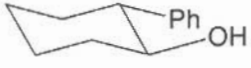


constitutional isomers

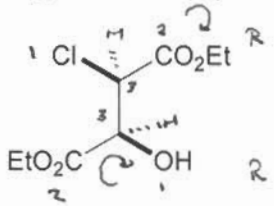




conformers

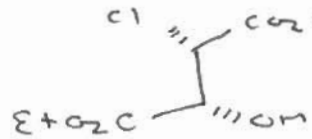


7. (15 pts) Consider the following molecule (**A**) for which the specific rotation is – 8.5°.



A

Draw the structure of the enantiomer of compound **A**. What would the specific rotation of this molecule be?



$[\alpha] = +8.5°$

A mixture of **A** and its enantiomer has an observed specific rotation of –0.85°. What is the percent ee of this mixture and what is the percent composition of **A** and its enantiomer in this mixture?

$\frac{-0.85°}{-8.5°} \times 100 =$ 10% enantiomeric excess of A (–)

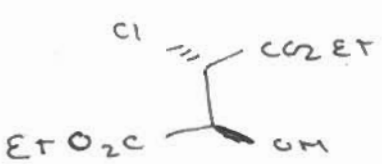
remaining 90% racemic :. 45% A (–) + 45% A (+)

:. Composition 55% A (–) : 45% A (+) (enantiomer)

How many stereocenters are present in molecule **A**? How many possible stereoisomers of **A** exist?

2 $\qquad 2^N = 2^2 = 4$

Draw the structure of a diastereomer of compound **A**. Based upon the information given, what can you say regarding the optical rotation of the molecule that you have drawn as the diastereomer of **A**?



- diastereomers will have different physical properties
- no relationship exists
- cannot predict rotation

8. (10 pts) Draw four constitutional isomers of C_3H_6O. Your answer should include: an aldehyde, a ketone, and two ethers.

C_3H_6O $\quad \frac{2(3)+2-6}{2} = 1$ unsaturation

 ketone, aldehyde

 ether,  ether