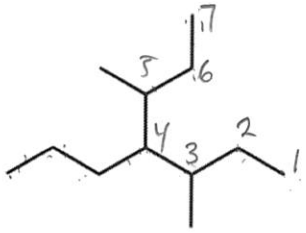
1. Name each of the following compounds using IUPAC (systematic) names. (20 points)

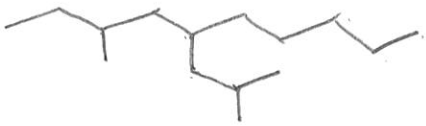
a. 

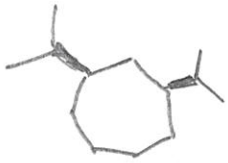
3,5-dimethyl-4-propylheptane

b. 

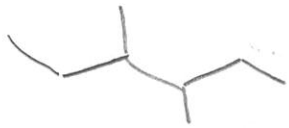
1,4-dimethylbicyclo[2.2.2]octane

2. Draw structures for the following compounds. (20 points)

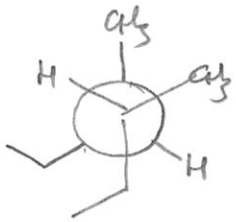
a. 3-methyl-5-(2-methylpropyl)decane 

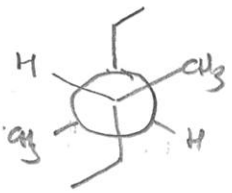
b. *cis*-1,3-diisopropylcycloheptane 

3. Consider the molecule below. Using Newman projections, draw the lowest energy and the highest energy conformations around the C3-C4 bond. In each conformation, label it as *staggered* or *eclipsed*, and indicate what type of strain is present – torsional, steric, angle, or some combination of them – be specific about this. (50 points)



Lowest energy (5)



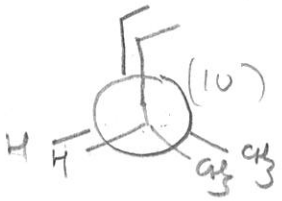
or 

(10)

Staggered (5)

Steric only (5)

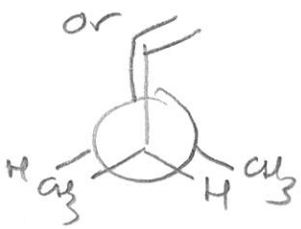
Highest energy (5)



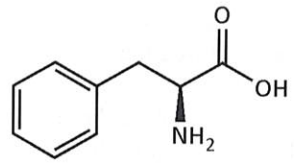
(10)

Steric + torsional strain (5)

eclipsed (5)

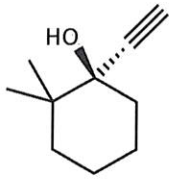
or 

5. Assign the *configurations* of each stereocenter in the following compounds using the appropriate notation. (15 points)

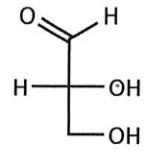
a. 

phenylalanine

(S)

b. 

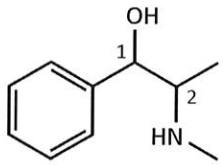
(S)

c. 

glyceraldehyde

(R)

6. Ephedra alkaloids have the general structure shown below. They are found in the extract of the plant *Ephedra sinica,* which has been used to treat many medical conditions (such as asthma) and has been used in traditional Chinese Herbal Medicine for over 2000 years. The IUPAC name is provided for the structure but none of the stereochemistry is shown. (20 points)

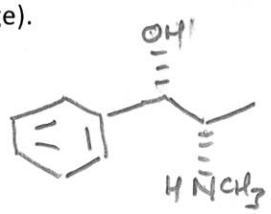


2-(methylamino)-1-phenylpropan-1-ol

a. How many stereoisomers are possible for the ephedra alkaloids (shown above)?

4 ($2^2 = 4$)

b. The decongestant known as Sudafed® contains one of these alkaloids and is called **pseudoephedrine** and has the *absolute configuration* of (1*S*,2*S*). Draw this isomer using appropriate notation (line, dash, and wedge).



c. The alkaloid called **ephedrine** is a *diastereomer* of **pseudoephedrine**. Draw a possible structure for **ephedrine** and label each stereocenter with appropriate notation.

d. Write the complete IUPAC name for the *enantiomer* of **pseudoephedrine** using the correct notation for stereochemistry (and in the correct format).

(1R,2R)-2-(methylamino)-1-phenylpropan-1-ol

7. Indicate whether the following statements are *absolutely* true or false. (25 points)

a. All *enantiomers* are optically active. True

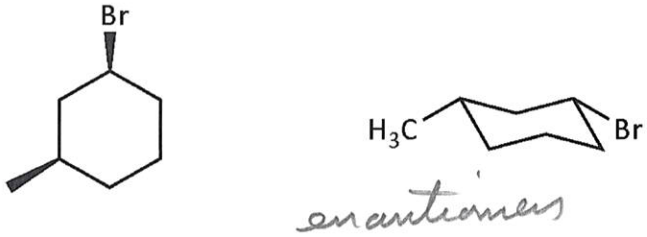
b. (2*R*,3*R*)-pentane-2,3-diol is the *diastereomer* of (2*S*,3*R*)-pentane-2,3-diol. True

c. If a molecule lacks a sigma plane of symmetry (σ) then it is achiral. False

d. All *meso* compounds have [α] = 0. True

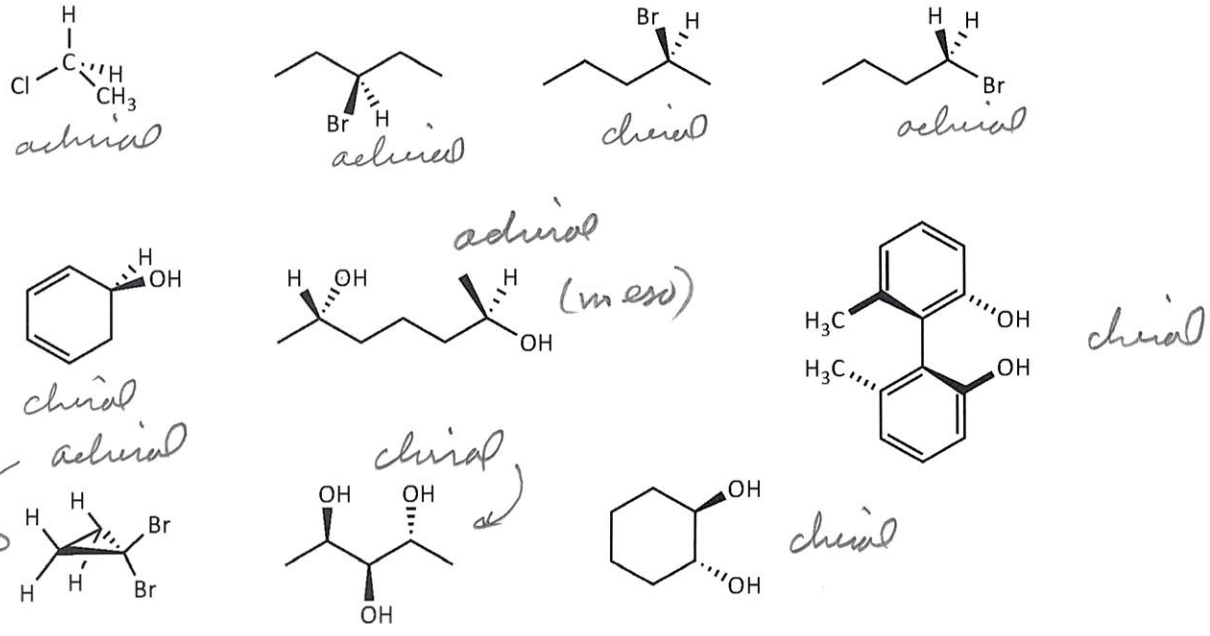
e. *trans*-1,3-dimethylcyclobutane is achiral. True

8. What is the relationship between the following two structures? Are they *enantiomers*, *diastereomers*, *constitutional isomers*, or *identical*? (5 points)



enantiomers

9. Indicate whether each compound below is *chiral* or *achiral.* (50 points)



achiral

achiral

chiral

achiral

chiral

achiral (meso)

chiral

achiral

chiral

chiral