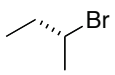
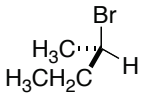
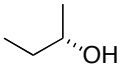
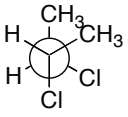
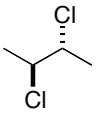
CHM 1321 A
Mid Term 1 Answers Version A

1) Identify the stereochemical relationship between the following pairs of molecules (enantiomers, diastereomers, same molecule, meso compound) (**3 Points**)

a)  and  relationship Same

b)  and (R)-butan-2-ol relationship Enantiomers

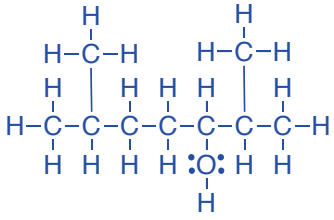
c)  and  relationship Meso Compound (also accepted same)

2) Draw 2,6-dimethylheptan-3-ol as: (**6 points**)

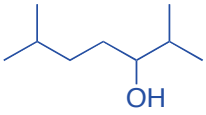
a) A condensed formula

$(CH_3)_2CHCH_2CH_2CHOHCH(CH_3)_2$

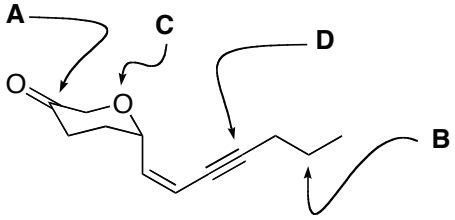
b) A Lewis structure



c) A line structure



3) For the following compound:



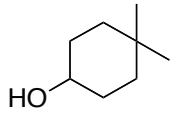
a) What is the hybridization of the indicated atoms? (**4 points**)

Atom A = ___sp^2_____
Atom B = ___ sp^3_____
Atom C = ___ sp^3_____
Atom D = ___ sp____

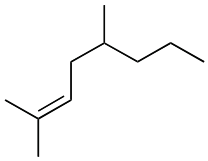
b) What type of molecular orbitals connect the following atoms to other atoms? (**6 points**)

Atom A = __σ + π____
Atom B = ___ σ____
Atom C = ___ σ _____
Atom D = ___ σ + π ___

4) Give IUPAC names for the following: (**4 points**)

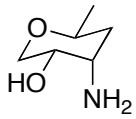
a) 

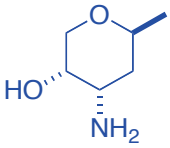
4,4-dimethylcyclohexanol

b) 
2,5-dimethyloct-2-ene

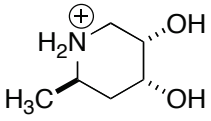
5) For the following:

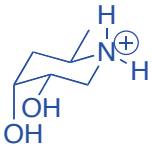
a) Draw the "hexagon" line structure of the following (be sure to indicate stereochemistry). (**3 points**)

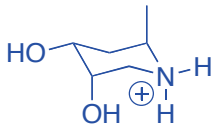




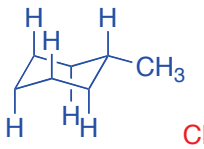
b) Draw <u>one</u> chair conformation of the following compound. (**4 Points**)

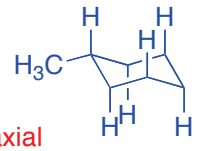




or


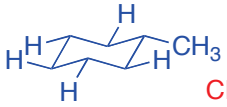
c) Draw <u>one</u> chair conformation of cyclohexyl bromide showing ALL OF THE AXIAL HYDROGENS. (**3 Points**)

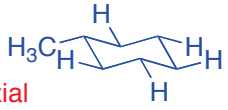


or


CH_3 can be axial

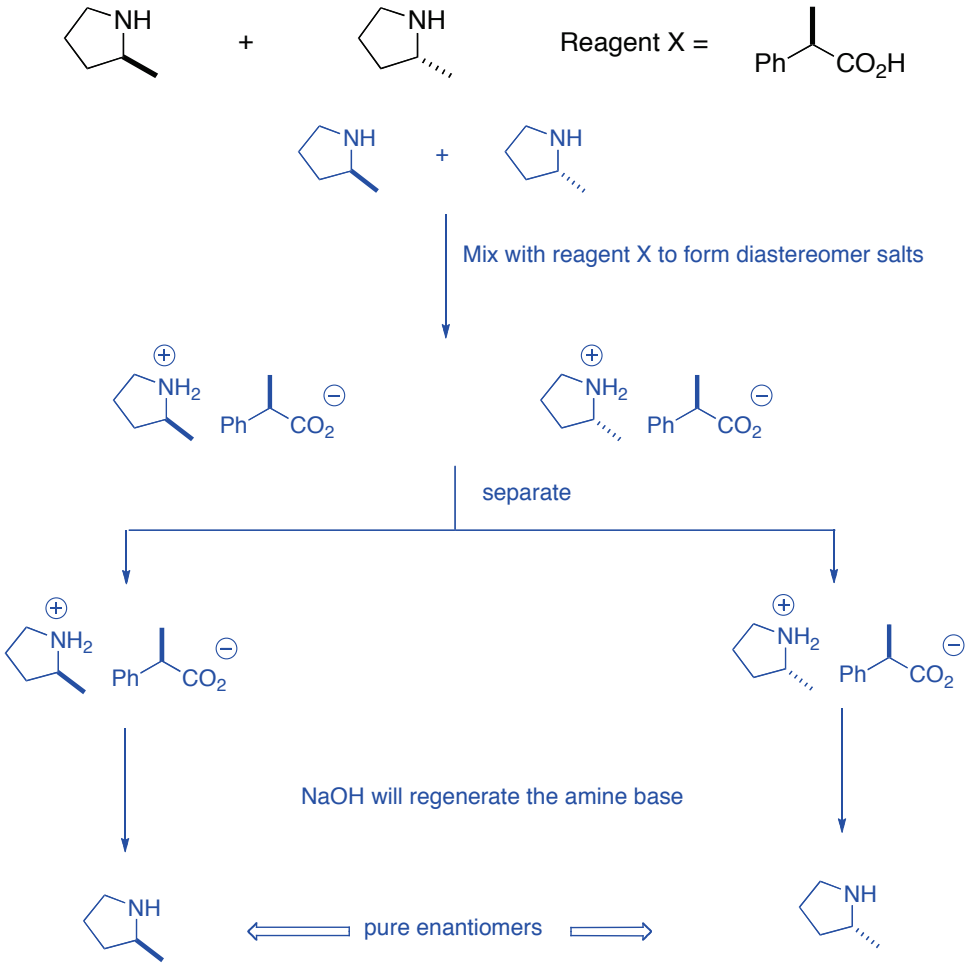
d) Draw <u>the same</u> chair conformation of cyclohexyl bromide showing ALL OF THE EQUATORIAL HYDROGENS. (**3 Points**)



or


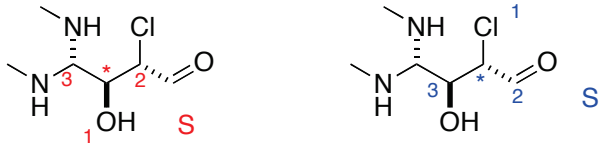
CH_3 can be axial

6) Use a flow chart to illustrate how you could separate a mixture of the following compounds using reagent X. Be sure to include all steps. (**7 points**)

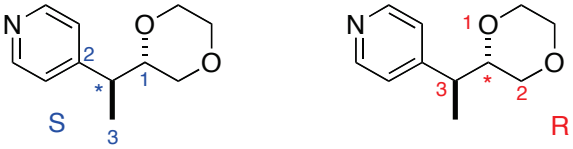


7) For the following compounds
   a) show the stereogenic centre(s) by labeling them with a star (*)(**4 points**)
   b) determine the priorities of the substituents on each stereogenic centre. For compounds with more than one centre, make sure you clearly indicate which priorities refer to which centre. (re-drawing the structure helps) (**8 points**)
   c) Determine the configuration of each stereocentre (**4 points**)

(i)



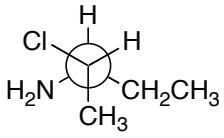
(ii)

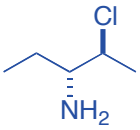


8) For each compound shown below, convert the structure to zig-zag (line) notation (include stereochemistry). (**4 points**)

(a)

(b)





9) The specific rotation of the pure (S) form of methamphetamine is -20.0°. Heisenberg is selling some methamphetamine to Gus. To save money, Jessie makes a mixture of the active (R) form and the inactive (S) form. Gus asks Gale to measure the optical rotation of the test batch, and he gets a value of the specific rotation of +10°.

a) What is the enantiomeric excess of the sample? (**3 points**)

$$\text{ee = optical purity} = \frac{[\alpha]_{sample}}{[\alpha]_{pure}} \times 100\%$$

$$50\% = \frac{10}{20} \times 100\%$$

b) Which isomer is in excess and why? (**2 points**)

the rotation of the sample is positive so the R isomer is in excess

c) What is the composition of the mixture (how much R form and how much S form)? (**3 points**)

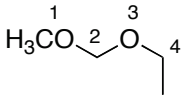
$$\text{ee = optical purity} = \frac{|R - S|}{R + S} \times 100\% \qquad R + S = 100$$

$$50\% = \frac{100 - 2S}{100} \times 100\%$$

$$S = 25$$

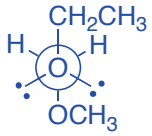
Mixture is 25% S isomer and 75% R isomer

10) For the following compound, draw the appropriate Newman projection along the C2-O3 bond of the following:

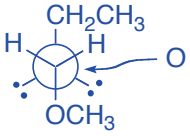


a) The most stable conformer and name the conformer. (**4 Points)**

anti-staggered

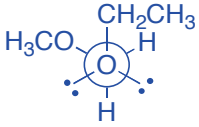


or

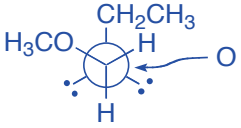


b) The second most stable conformer and name the conformer. (**4 Points)**

gauche

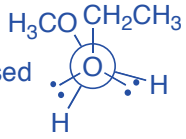


or

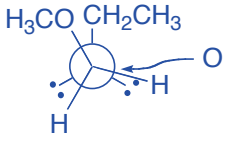


c) The least stable conformer and name the conformer. (**4 Points)**

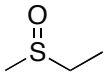
totally eclipsed



or



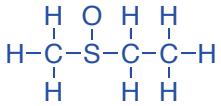
BONUS! The following molecule is chiral. Provide a brief explanation of why this is possible (it may be helpful to draw a Lewis structure of the molecule). (**2 Points**)



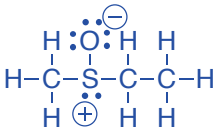
3 X carbon = 4 X 3 = 12
1 X oxygen = 6 X 1 = 6
1 X sulfur = 6 X 1 = 6
8 X hydrogen = 8 X 1 = 8

32 valence electrons

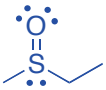
connect with single bonds



12 bonds accounts for 24 electrons



remaining electrons are distributed and formal charges calculated



Final structure has a sulfur with 4 different substituents
it is a chirality center and therefore the molecule is chiral