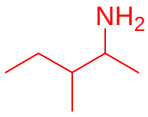
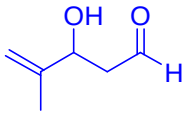
CHM 1321A
Mid Term 1 version b Answers

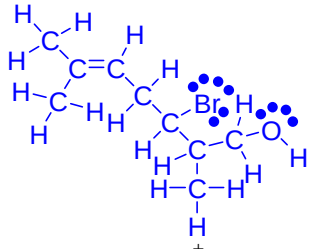
1) Draw the following as line structures: (**6 points**)
   a) $CH_3CH_2CH(CH_3)CH(NH_2)CH_3$



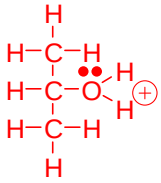
   b) $CH_2C(CH_3)CH(OH)CH_2CHO$



2) Draw the following as Lewis structures: (**6 points**)
   a) $(CH_3)_2CCHCH_2CHBrCH(CH_3)CH_2OH$

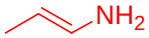


   b) $(CH_3)_2CHOH_2^+$

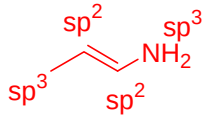


3) For the following compound:
$CH_3CHCHNH_2$

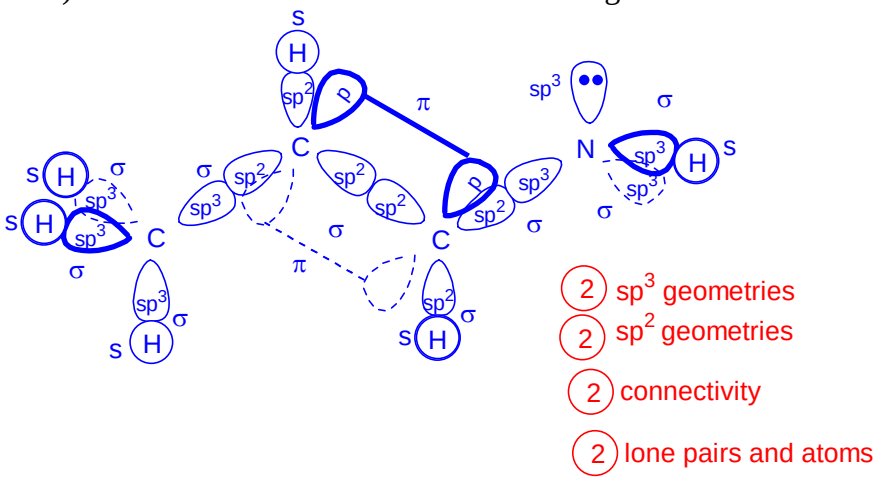
a) Draw the molecule as a line structure (**2 Points**)



b) What is the hybridization of both carbons and of the nitrogen? (**4 points**)



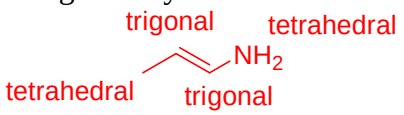
c) Show the structure of the molecule using the LCAO method. (**8 points**)



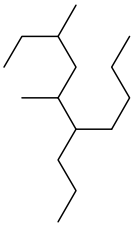
d) Label all the atomic orbitals used in part c. (**7 points**)

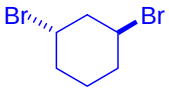
e) Label the bonds in part c (**5 Points**)

f) What is the geometry of both carbons and the nitrogen? (**4 points**)

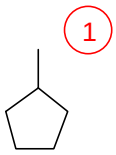
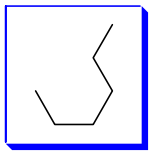


4) Give IUPAC names or structures for the following: (**6 points**)

a)  3,5-dimethyl-6-propyldecane

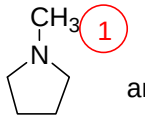
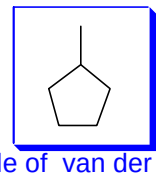
b) trans-1,3-dibromocyclobutane 

5) For each of the following pairs, circle the compound indicated. Briefly justify your choice in each case. (**9 points**)

a)  and  Which has the lowest melting point?

1

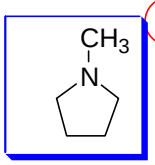
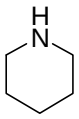
Both structures are capable of van der Waals interactions only.
First structure is a ring. Rings pack together better than open-chain compounds, and so these molecules will "stick" together better thus raising the melting point.

b)  and  Which is least soluble in water?

1 2

Second structure capable of van der Waals interactions only.
First structure capable of hydrogen bonding to water, in addition to having dipole-dipole and van der Waals interactions.

2

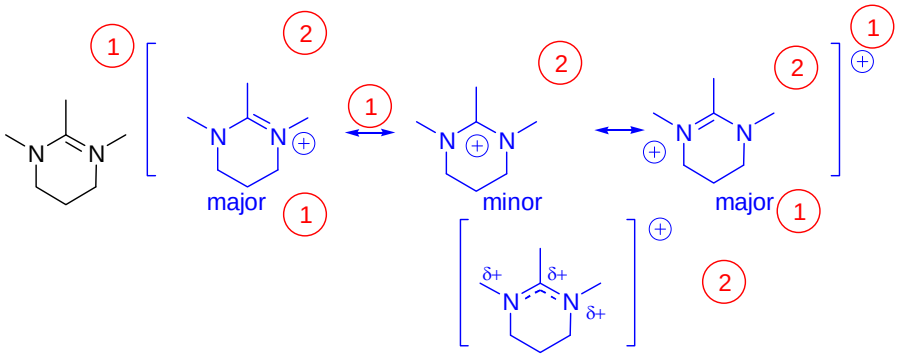
c)  and  Which has the lowest boiling point?

1

Second structure can hydrogen bond with itself in addition to having van der Waals and dipole interactions.
First structure capable of dipole-dipole and van der Waals only.
Hydrogen bonds are stronger than dipole interactions so the second structure will experience stronger intermolecular forces and have a higher boiling point.

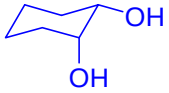
2

6) Draw the important resonance forms for the following. Identify the major and minor forms and show the resonance hybrid structure. (**12 points**)

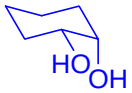


7) For *cis*-1,2-dihydroxycyclohexane

a) Draw one chair form of the compound. (**4 points**)



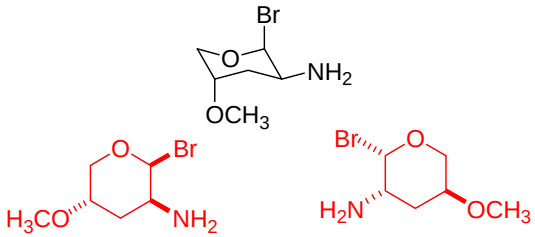
b) Draw the **other** chair form of the compound. (**3 points**)



c) Indicate which chair form is the most stable (part a or b) and justify your choice. (**3 points**)

They have equal energy. Each has one OH axial and one OH equatorial

8) Convert the following chair representation to a simple line structure (hexagon) showing stereochemistry (**4 points**)



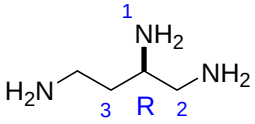
9) For the following compounds

a) show the stereogenic centre(s) by labeling them with a star (*)(**3 points**)

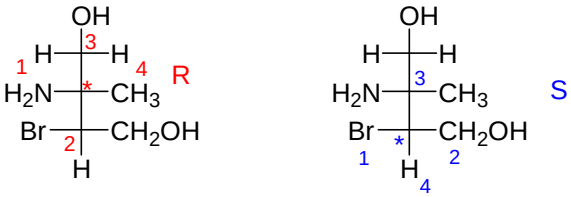
b) determine the priorities of the substituents on each stereogenic centre. For compounds with more than one centre, make sure you clearly indicate which priorities refer to which centre. (re-drawing the structure helps) (**6 points**)

c) Determine the configuration of each stereocentre (**3 points**)

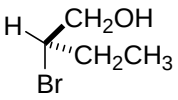
(i)

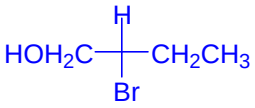


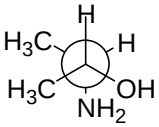
(ii)

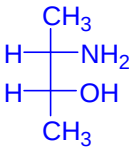


10) For each compound shown below, convert the structure to a Fischer projection. (**4 points**)

(a) 



(b) 



11) The specific rotation of (R)-cocaine is -60.0° in CH_2Cl_2. The police confiscate a sample of cocaine that gives a rotation of -15.0° (*c* = 1.0, CH_2Cl_2). What is the composition of enantiomers (R and S) in the sample, and which isomer is in excess (**6 points**)?

Rotation of sample is negative, so the R isomer is in excess

$$\text{optical purity} = \frac{15}{60} \times 100\ \% = 25\ \%$$

$$\text{optical purity} = ee = \frac{R - S}{S + R} \times 100\ \% = 25\ \%$$

$$S + R = 100$$

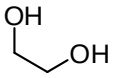
$$S = 100 - R$$

$$ee = 25\ \% = \frac{RS - 100}{100} \times 100\ \%$$

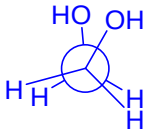
$$R = 62.5$$

$$S = 37.5$$

12) For the following compound, draw the Newman projection along the carbon-carbon bonds of the following:



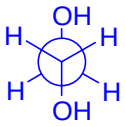
a) The <u>least</u> stable conformer and name the conformer. (**4 Points)**



Eclipsed

Least stable (1), Newman correct (2) name (1)

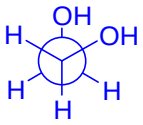
b) The <u>most</u> stable conformer and name the conformer. (**4 Points)**



Anti-Staggered

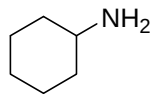
Most stable (1), Newman correct (2) name (1)

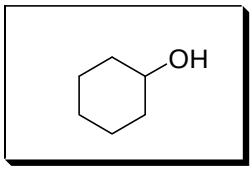
c) The <u>second most</u> stable conformer and name the conformer. (**4 Points)**



Gauche Staggered second most stable (1), Newman correct (2) name (1)

Bonus: Which of the following alcohols is the strongest acid? You must justify your answer to get the marks. (**2 Points**)





oxygen right of nitrogen in periodic tabel
oxygen is more electronegative
better able to stabilize negative charge
weaker conjugate base
stronger acid