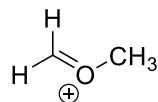
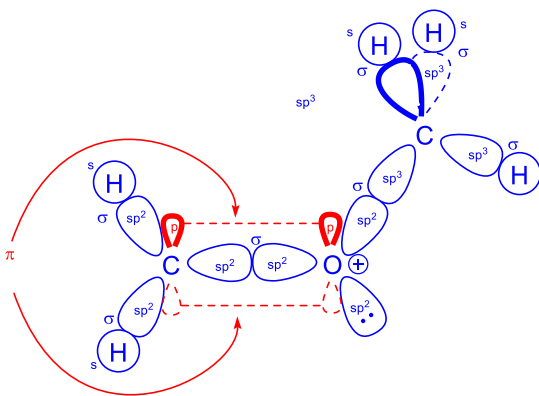


**CHM 1321 A**  
**Mid Term 1 Version A Answers**

1) For the following compound



a) Use the LCAO method to show orbital structure the compound (**6 Points**).



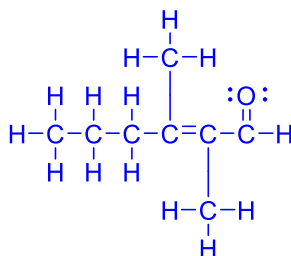
b) Label all the atomic orbitals used and the bonds formed in part a (**6 Points**).

2) Draw 2,3-dimethylhex-2-enal as: (**6 points**)

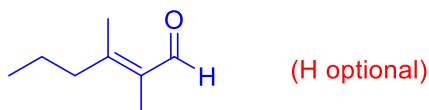
a) A condensed formula



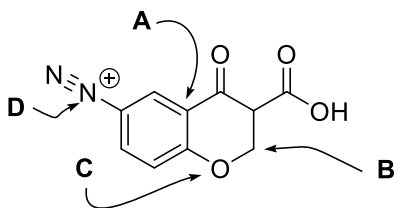
b) A Lewis structure



c) A line structure



3) For the following compound:



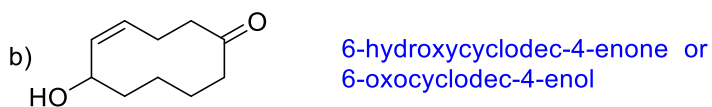
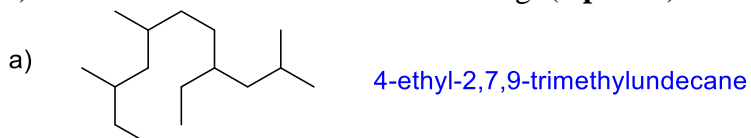
a) What is the hybridization of the indicated atoms? (**4 points**)

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)

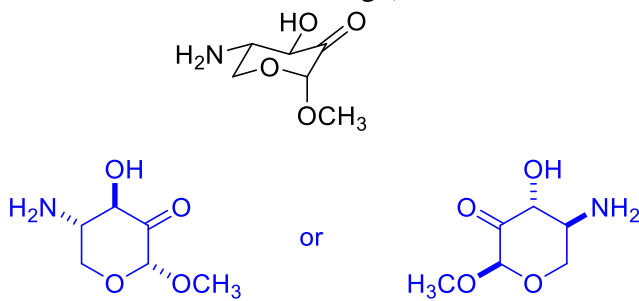
Atom A =  $\sigma + \pi$   
 Atom B =  $\sigma$   
 Atom C =  $\sigma$   
 Atom D =  $\sigma + \pi$

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

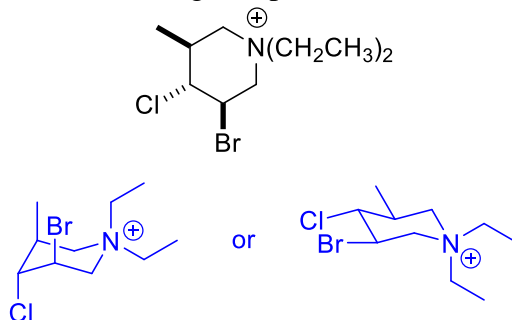


5) For the following:

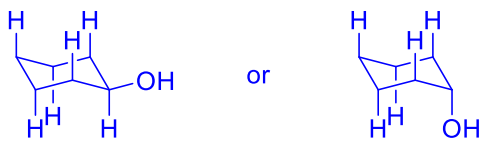
a) Draw the "hexagon" line structure of the following (be sure to indicate stereochemistry). (3 points)



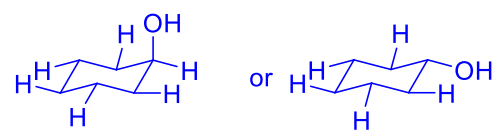
b) Draw one chair conformation of the following compound. (4 Points)



c) Draw one chair conformation of cyclohexanol showing ALL OF THE AXIAL HYDROGENS. (3 Points)

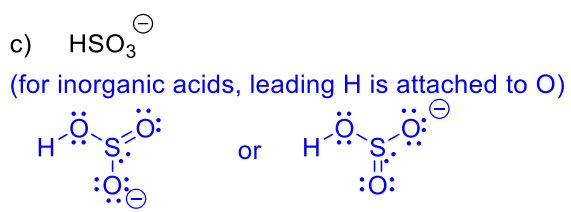
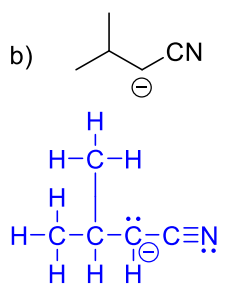
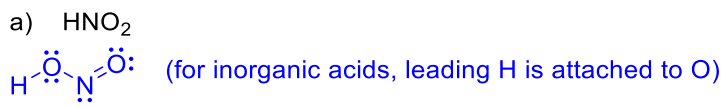


d) Draw the other chair conformation of cyclohexanol showing ALL OF THE EQUATORIAL HYDROGENS. (3 Points)

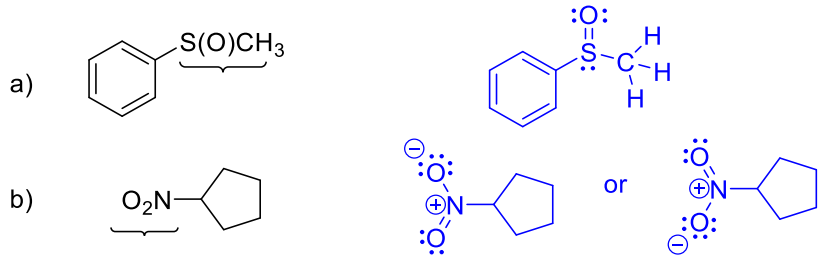


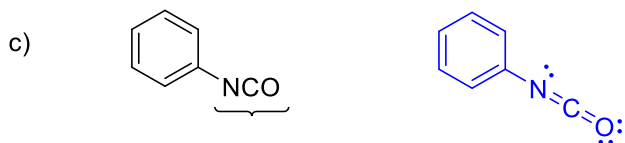
e) Which of the two structures has the highest energy and why? (2 Points)  
 The highest energy structure will be the one in which the OH is axial. Whether this is c or d depends on which chair you drew first.  
 The conformer in which the large group (OH) is in an axial position is least stable (highest energy).

6) Draw the following molecules as Lewis structures. (6 points)



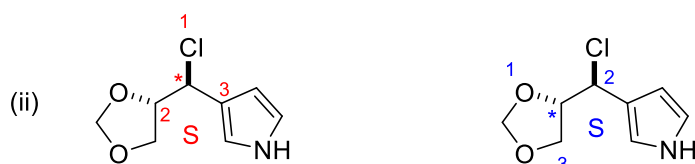
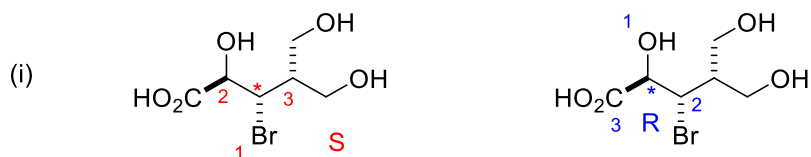
7) Re-draw the following molecules showing the full Lewis structure at the indicated location. (6 Points)



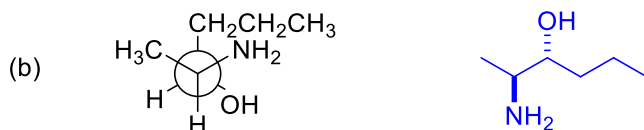
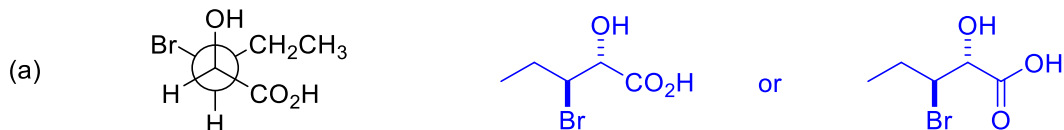


8) For the following compounds

- show the stereogenic centre(s) by labeling them with a star (\*) **(4 points)**
- 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)**
- Determine the configuration of each stereocentre **(4 points)**



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



10) A solution of 30.0 mg of (l)-glucose was dissolved in 6 mL of water and placed in a 100 mm cell. Using the sodium D line, a rotation of  $0.026^\circ$  was found at  $27^\circ\text{C}$ .

- What is the sample concentration in the units most commonly used for this measurement? **(3 Points)**

$$c = \frac{30.0 \text{ mg}}{6 \text{ mL}} \times \frac{\text{g}}{1000 \text{ mg}} \times \frac{100 \text{ mL}}{(100 \text{ mL})}$$

$$= 0.50 \text{ g/100 mL}$$

c is in units of g/100 mL (or g/dL)

- Determine the specific rotation of the sample. **(4 Points)**

$$[\alpha]_D^{27} = \frac{100 \alpha}{c \cdot l}$$

$$= \frac{(100)(0.026)}{(1)(0.50)}$$

$$= + 5.2^\circ$$

11) The specific rotation of the pure (S) form of Ivermectin is  $-42.0^\circ$ .

- a) What is the specific rotation of a 5 g sample that contains the (R) isomer of Ivermectin in 93 % enantiomeric excess? (3 points)

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

$$93\% = \frac{[\alpha]_{\text{sample}}}{42} \times 100\%$$

$$[\alpha]_{\text{sample}} = + 39.1^\circ \quad (\text{R isomer gives + rotation})$$

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

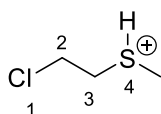
$$ee = \text{optical purity} = \frac{|d - l|}{d + l} \times 100\% \quad d + l = 100$$

$$93\% = \frac{|100 - 2l|}{100} \times 100\%$$

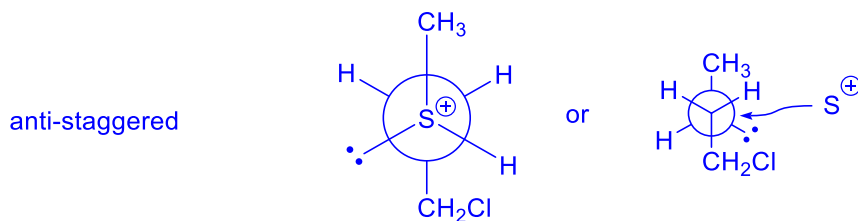
$$l = 3.5$$

Mixture is 96.5 % R isomer and 3.5 % S isomer

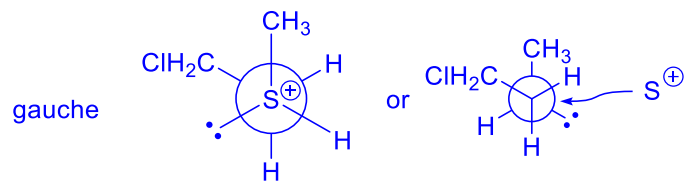
12) For the following compound, draw the appropriate Newman projection along the C3-S4 bond of the following:



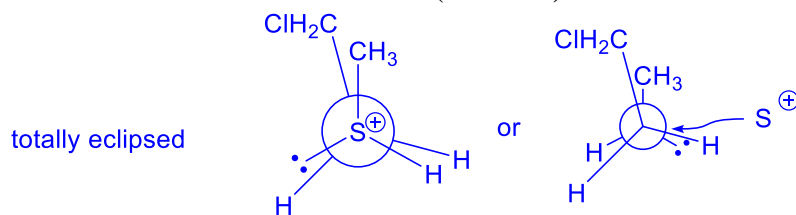
- a) The most stable conformer and name the conformer. (4 Points)



- b) The conformer that results after a  $120^\circ$  rotation about the C3-S4 bond and name the conformer. (4 Points)



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



**BONUS!** Draw the Newman projection of the following molecule as viewed along the C=O bond (it may be helpful to construct a model). (2 Points)

