

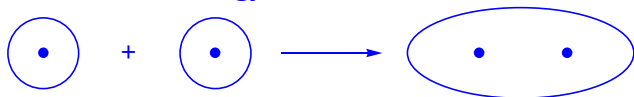
CHM 1321A

Sample Mid-Term 1

1) Give brief explanations for the following. Use structures when possible.

a) bonding orbital (3 points)

- in phase mixing of atomic orbitals
- electron density between atoms
- lower energy



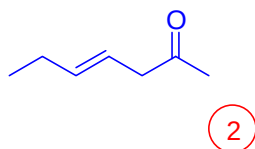
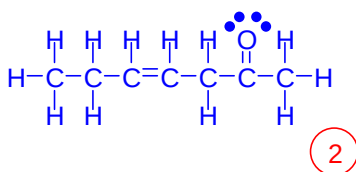
b) antibonding orbital (3 points)

- out of phase mixing of atomic orbitals
- node between atoms
- higher energy

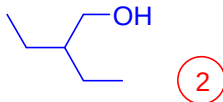
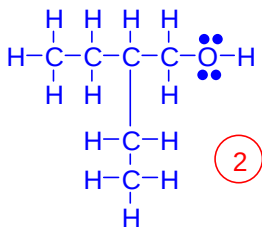


2) Draw the following as Lewis and line structures: (12 points)

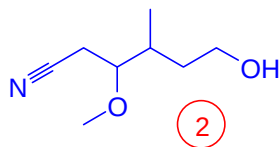
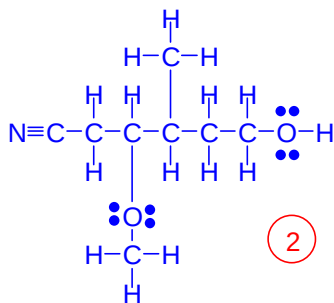
a) $\text{CH}_3\text{CH}_2\text{CHCHCH}_2\text{COCH}_3$



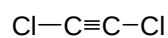
b) $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_2\text{CH}_3)\text{CH}_2\text{OH}$



c) $\text{NCCH}_2\text{CH}(\text{OCH}_3)\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{OH}$



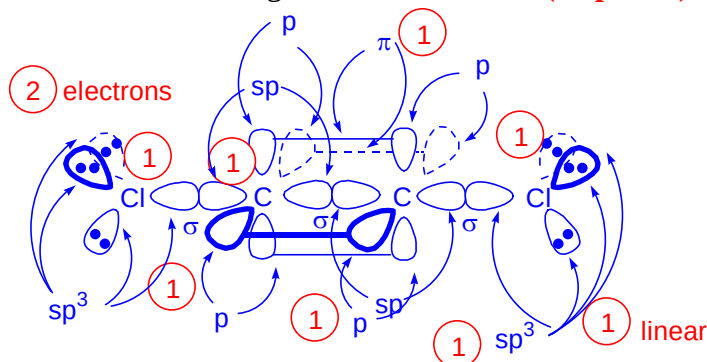
3) For the following compound:



a) What is the hybridization of the carbon and chlorine atoms? (2 points)

C : sp 1
Cl : sp^3 1

b) Show the structure of the molecule using the LCAO method. (10 points)



c) Label the orbitals used and the bonds formed in part b. (6 points)

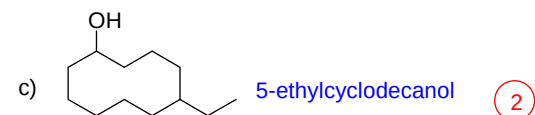
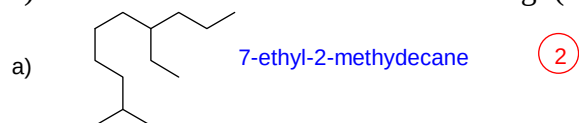
d) What is the geometry of the carbon and chlorine atoms? (2 points)

C : linear 1
Cl : tetrahedral 1

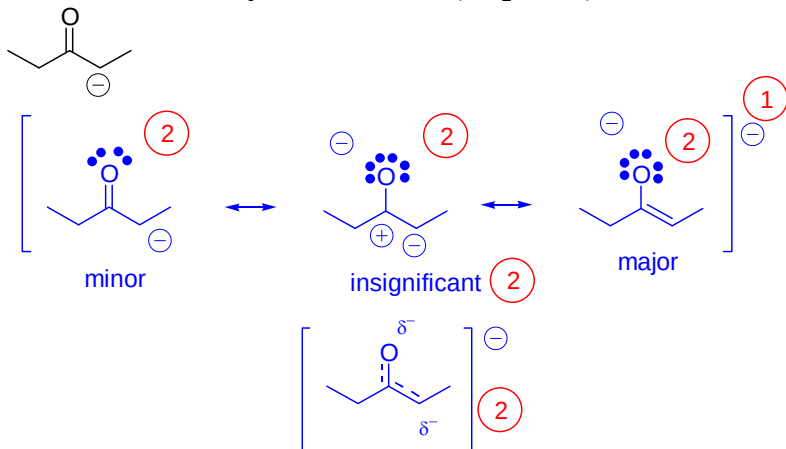
e) What is overall the geometry of the molecule? (1 point)

Linear 1

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

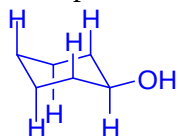


5) Draw the important resonance forms for the following. Identify the major and minor forms and show the resonance hybrid structure. (10 points)



6) For 1-hydroxycyclohexane

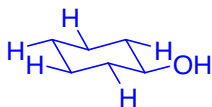
a) Draw one chair form of the compound showing all axial hydrogens. (4 points)



(2) Chair with OH

(2) Axial H's

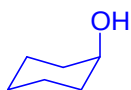
b) Re-draw the same chair, showing all the equatorial hydrogens (do not draw axial hydrogens). (4 points)



(2) Same chair with OH

(2) Equatorial H's

c) Draw the **other** chair form of the compound (no hydrogens except on O). (3 points)



(2) Chair "flipped"

(1) OH "flipped"

d) Indicate which chair form is the most stable (part a or c). Briefly justify your choice. (2 points)

The form with the OH equatorial is most stable (a or c will depend on which chairs were drawn).

Substituents in axial positions are sterically crowded. 2

e) When the chair forms interconvert, draw and name the high-energy intermediate structure. (2 points)



(1) structure with OH

Boat

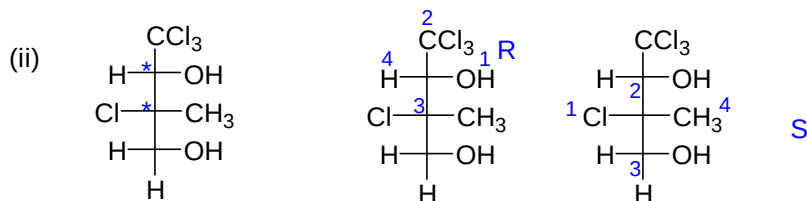
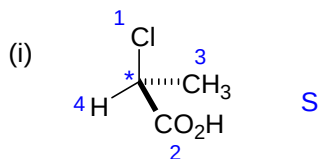
(1)

7) For the following compounds

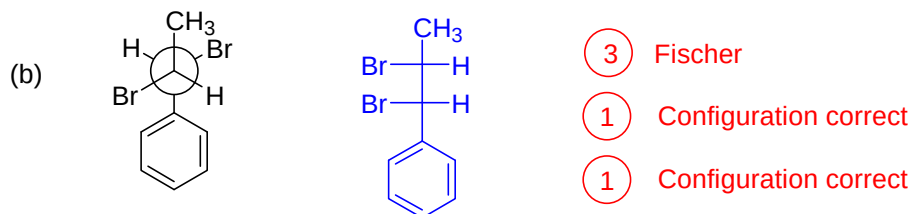
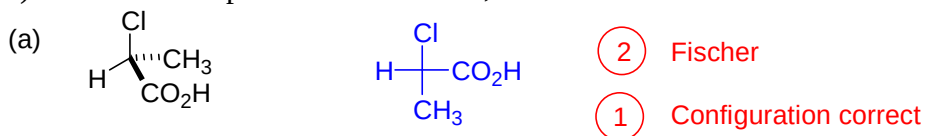
a) show the stereogenic centre(s) by labeling them with a star (*) (3 points)

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)

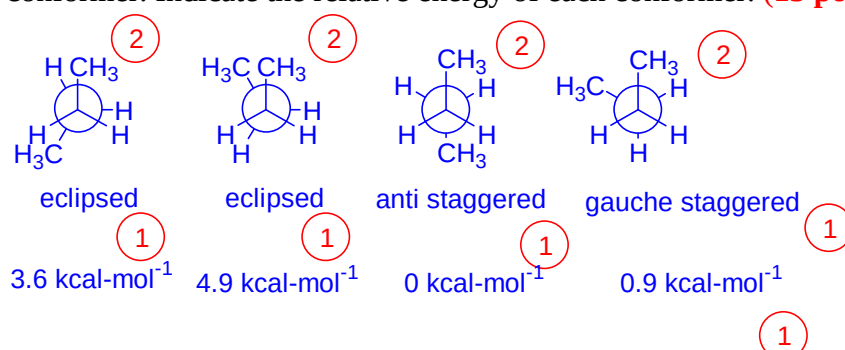
c) Determine the configuration of each stereocentre (3 points)



8) For each compound shown below, convert the structure to the Fischer projection. (8 points)



9) Show two types of eclipsed, one anti and one gauche staggered conformation of butane. Clearly identify each conformer. Indicate the relative energy of each conformer. (13 points).



10) Arrange the following in order of increasing boiling point. Briefly justify your choice. (4 points)

