

LAST NAME: _____**FIRST NAME:** _____**Student number:** _____

CHM1321 C: ORGANIC CHEMISTRY I

MIDTERM 1A - 2016

Time allowed: 80 minutes

There are 9 pages in this test. A periodic table is provided at the end. You may GENTLY remove this page and use it to cover your work. Any scratch work should be done on this page. You may keep this page afterwards if you wish.

Molecular model kits (in a clear plastic bag or container) are allowed. Calculators and all other aids are not allowed. You may answer in pen or pencil, and may use different colours.

Please show all work to receive part marks.

Cellular phones, unauthorized electronic devices and course notes are not allowed during this exam. Phones and devices must be turned off and put away in your bag. Do not keep them in your possession, such as in your pockets. If caught with such a device or document, the following may occur: you will be asked to leave immediately the exam, academic fraud allegations will be filed which may result in you obtaining a 0 (zero) for the exam.

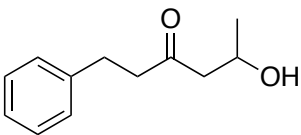
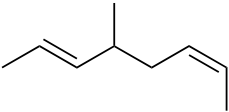
By signing below, you acknowledge that you have read and ensured that you are complying with the above statement.

Signature: _____

Part	A	B	C	Total
Points	10 (+2)	20	20	50 (+2)
Mark				
TA				

Part A – 1 or 2 points per question

1. (5 pts) Give the line structure or the IUPAC names for the following compounds:

STRUCTURE	NAME
	
	<i>m</i> -diethylbenzene
	

2. (0.5 pt) In valence bond theory, which atomic orbitals overlap to form the σ_{C-H} molecular orbitals of ethane, CH_3CH_3 ?

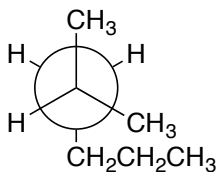
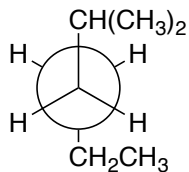
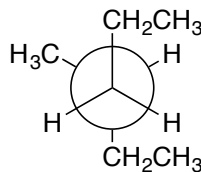
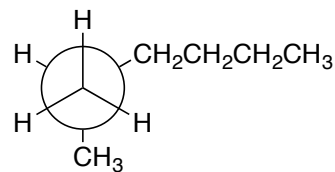
- C $2p$ + H $1s$
- C $2sp$ + H $1s$
- C $2sp^2$ + H $1s$
- C $2sp^3$ + H $1s$

3. (0.5 pt) The two chair conformers of *cis*-1,2-dibromocyclohexane are of equal stability.

TRUE

FALSE

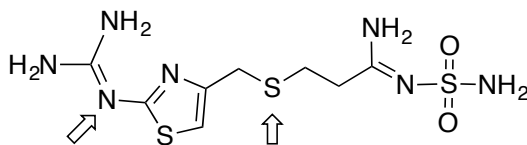
4. (0.5 pt) Which of the following Newman projections represents 3-methylhexane?

**A****B****C****D**

5. (0.5 pt) Which of the following is *not* true regarding the properties of alkanes?

- alkanes are nonpolar
- alkanes burn in air to give H_2O and CO_2
- alkanes are highly miscible with water
- the strongest intermolecular force between alkane molecules are van der Waals interactions

6. (3 pts) The molecule shown below is known as Pepcid, a drug used to reduce gastric acid production. State the hybridization, geometry, and approximate bond angles of the indicated atoms.

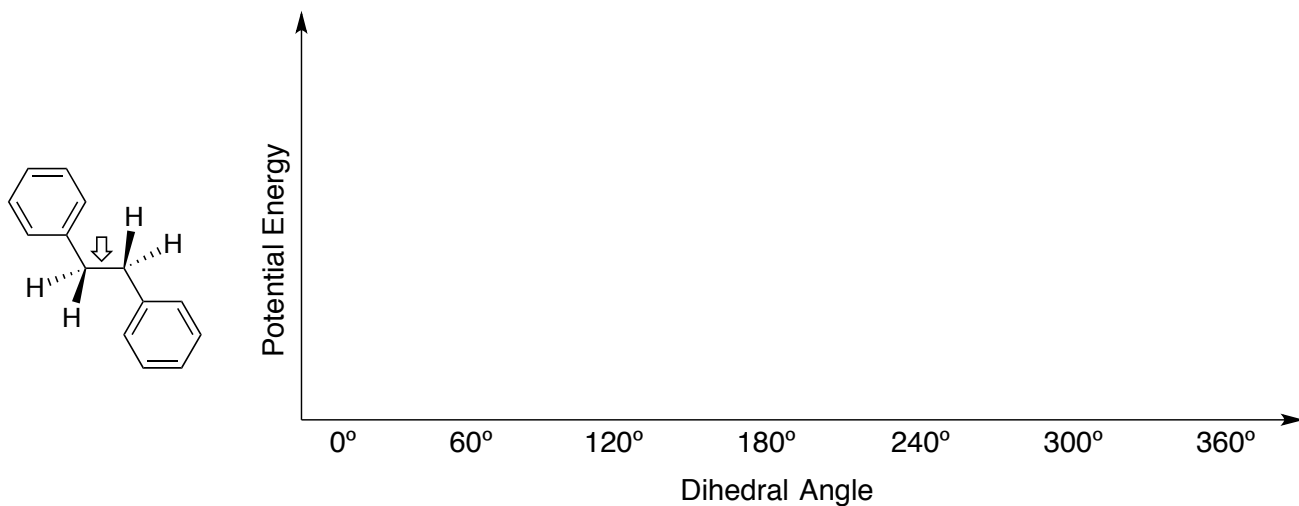


BONUS (+1.5 pts)

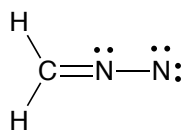
7. Draw line structures of three tertiary alcohols that have the formula $\text{C}_6\text{H}_{14}\text{O}$.

Part B

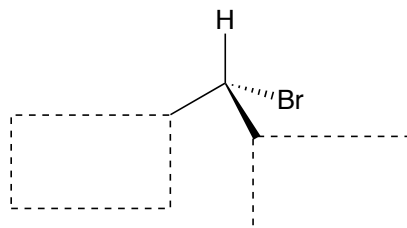
8. (5 pts) Consider the various conformers of following molecule along the indicated bond. On the following axes, sketch the potential energy diagram (as accurately as possible) as the bond is rotated. Draw and name the Newman projections for the highest and lowest energy conformers and label them on your graph.



9. (5 pts) Draw the two other possible resonance structures for the following species, using electron-pushing arrows to show the conversion between resonance forms. Label the most stable resonance form.

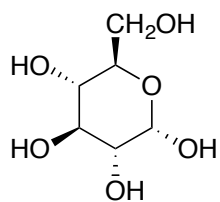


10. (2 pts) Complete the following diagram so that it represents (*R*)-2-bromobutane.



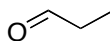
11. (3 pts) Clearly indicate the specific relationship (structural isomers, conformers, enantiomers, etc.) between the following pairs of molecules.

12. (5 pts) The molecule below is glucose, an important carbohydrate. Draw the two chair conformers of this compound and indicate the more stable conformer (if applicable).

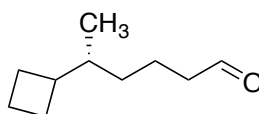


Part C

13. (6 pts) Draw the following molecule using the LCAO (hybridization) method. Label all the orbitals (p , sp , sp^2 , or sp^3) and the bonds (σ or π). Include a legend if you're using different colours.



14. (4 pts) For the following molecule, identify any stereocentres with an asterisk (*). Give the full name of the molecule (including any relevant stereochemistry). To receive full marks, show all your work.



15. (5 pts) You are attempting to separate pentanal and 2-pentanol using TLC. In your first attempt, you use hexane as your mobile phase, and unfortunately obtained the resulting TLC at right (note that I've shown the spots as oval shapes).

- Why did this separation not work? Explain in one or two sentences.
- What modification would you make in your second attempt? Why?
- If you achieved a good separation on your second attempt, which compound would have the larger R_f value?



16.(5 pts) Using the template below, complete the molecular orbital diagram of NO by adding electrons and completing the appropriate labels. What is the bond order in this species? Why are the atomic orbitals of oxygen shown at a lower energy than nitrogen?

