CHM151Y CHEMISTRY: THE MOLECULAR SCIENCE ORGANIC CHEMISTRY SECTION

TERM TEST #1 (8%): OCT 19, 2012

PROF. M. TAYLOR

INSTRUCTIONS: The exam time is fifty minutes. Please fill in your name, student number, and lab demonstrator group (where your marked exam will be returned) below. Model kits are allowed. When instructed to begin, you should write your name at the top of each page of the exam. Read the instructions for each problem carefully. Write your answers on the test sheet in the space provided. Only answers written in pen will be considered for re-grading.

(LAST NAME, First name)	
Student number	**Demonstrator Group #**

Question	Total Marks Possible	Marks Awarded
1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
Total	60	

Question 1. [10 marks total]

Indicate whether each of the statements below is true or false by circling the correct answer:

i) The molecule tetrafluoroethylene $F_2C{=}CF_2$ has polar covalent bonds but its dipole moment is zero.

True or False

ii) A solution of the *meso* form of 2,3-difluorobutane in diethyl ether solvent is optically inactive.

True or False

iii) If a solution of an unknown substance is optically inactive, then this substance must be achiral.

True or False

iv) The C–C–C bond angles in cyclobutane are slightly greater than 90 °.

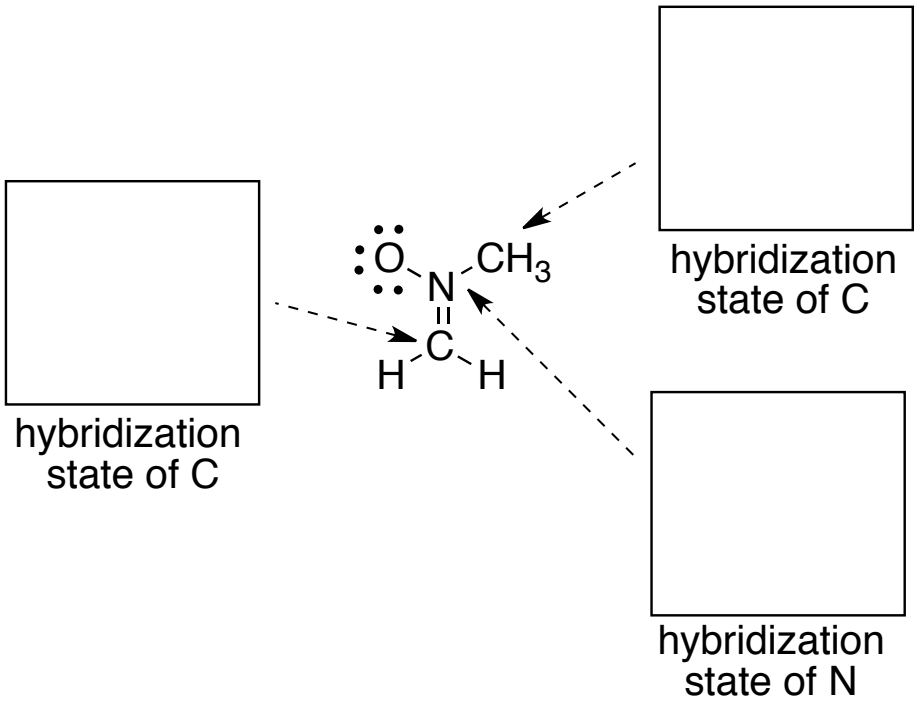
True or False

v) The envelope conformation of cyclopentane reduces angle strain relative to the planar conformation, but incurs additional torsional strain.

True or False

Question 2. [10 marks total]

On the structure provided, fill in any missing formal charges. In the boxes, write the kind of hybridization that you expect for each of the atoms indicated.

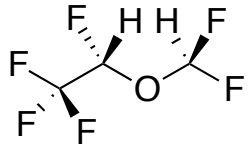


Question 3 [10 marks total] For each of the compounds shown:

i) Indicate whether the molecule is chiral or achiral by circling the correct answer;

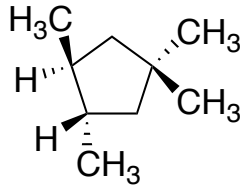
ii) Identify any/all chirality centres by drawing an arrow pointing to each, and assigning its/their configuration as *R* or *S*.

a)



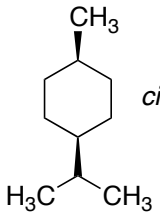
Chiral or Achiral

b)



Chiral or Achiral

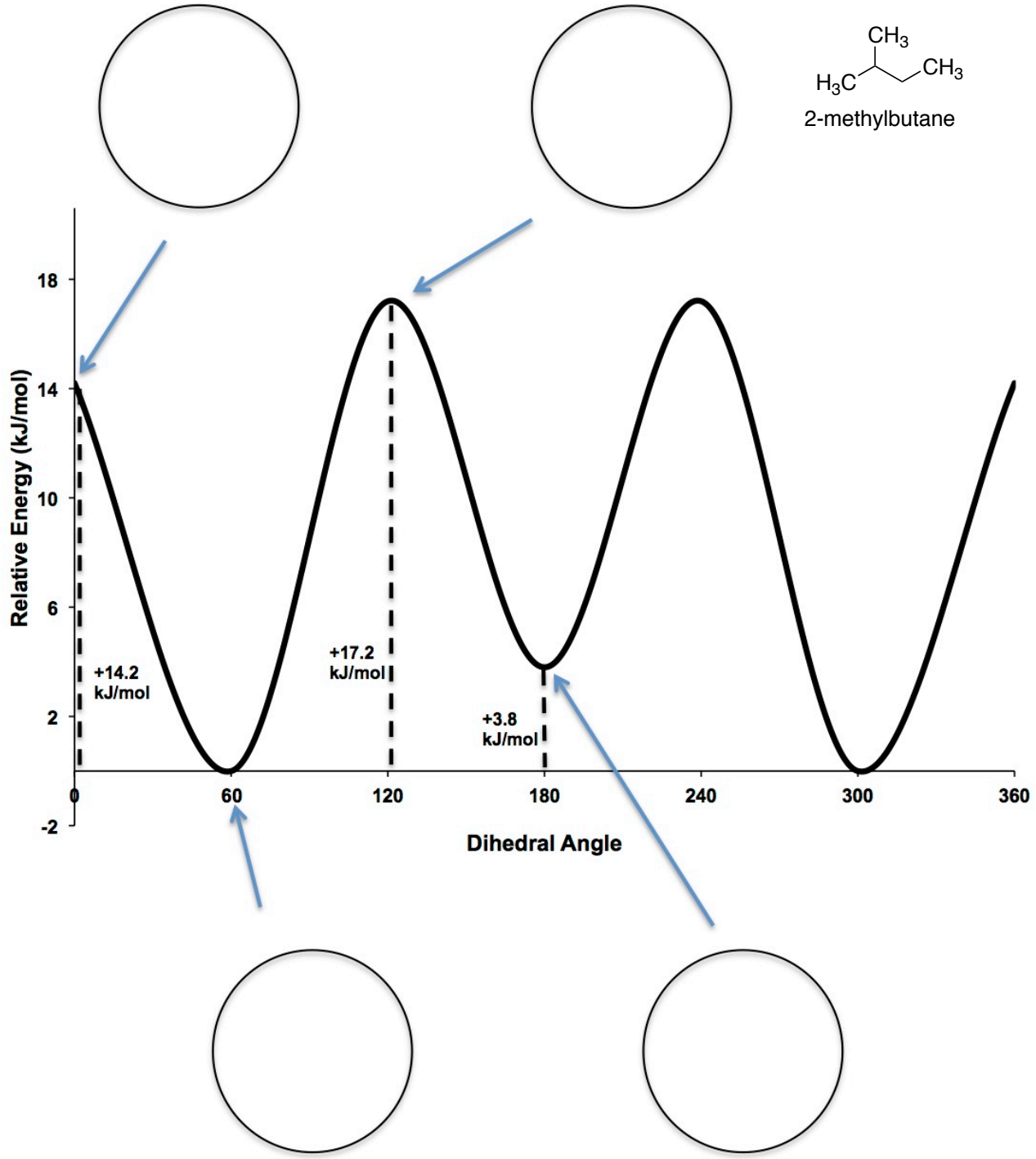
Question 4a) [6 marks] Draw the two possible chair conformations of *cis*-1-isopropyl-4-methylcyclohexane. Make sure that the positions of your substituents (axial versus equatorial) are shown clearly.



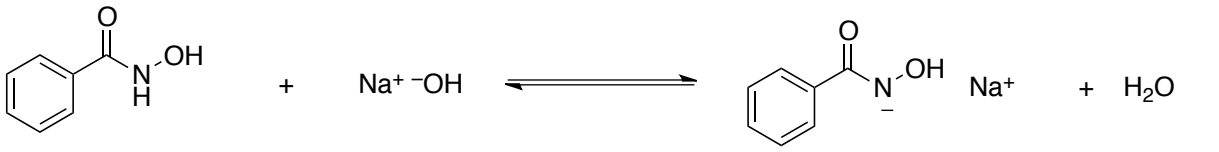
cis-1-isopropyl-4-methylcyclohexane

4b) [4 marks] If the two chair conformations of *cis*-1-isopropyl-4-methylcyclohexane differ in energy by 1.6 kJ/mol, and the energy penalty for a 1,3-diaxial interaction between CH_3 and H is 3.8 kJ/mol, what is the energy penalty for a 1,3-diaxial interaction between isopropyl and H? (Please show your work)

Question 5. [10 marks] A graph of energy versus dihedral angle for rotation about the C2–C3 bond of 2-methylbutane is shown below. For each dihedral angle indicated, use the template provided to draw a Newman projection (*sighting along the C2–C3 bond*) illustrating the orientation of substituents. Be sure that your Newman projections are consistent with the data from the graph shown.



Question 6a) [2 marks] Based on the pK_a values given, predict whether the equilibrium shown below will lie to the left (favoring starting materials) or the right (favoring products) by circling the correct answer:



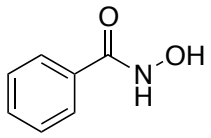
benzhydroxamic acid
pK_a = 8.9

pK_a = 15.7

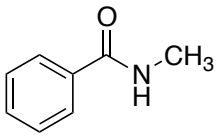
equilibrium lies to the left ***or*** equilibrium lies to the right

6b) [5 marks] The NH group of benzhydroxamic acid (see above) is more acidic than its OH group. Draw two resonance structures of the conjugate base of benzhydroxamic acid, being sure to indicate all lone pairs and any formal charges necessary. Briefly explain why deprotonation of the NH group is preferred over the OH group in this case.

6c) [3 marks] Benzhydroxamic acid is a stronger acid than *N*-methylbenzamide (both undergo deprotonation of their NH groups). Draw the conjugate bases of both and, in one sentence, propose an explanation for the higher acidity of benzhydroxamic acid.



benzhydroxamic acid



N-methylbenzamide

END OF TERM TEST