Last Name	**First Name**	**MI**

Student ID Number:

Circle the name of your TA: **HEATHER / CARI / KAUSHIK / RYAN**

Discussion Section – Day: **Time:**

Total Score

/ 100

Chem 30A Fall 2005

MIDTERM #1

(50 Min)

Weds October 26th

INTERPRETATION OF THE QUESTIONS IS PART OF THE EXAM –
DO NOT ASK FOR THE QUESTIONS TO BE EXPLAINED TO YOU

ONLY ANSWERS WRITTEN IN THE BOXES PROVIDED WILL BE GRADED

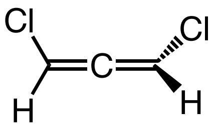
*******DO NOT OPEN THIS EXAM UNTIL INSTRUCTED TO DO SO******

Q1	/ 32	Q3	/ 44
Q2	/ 39	Total	/ 100

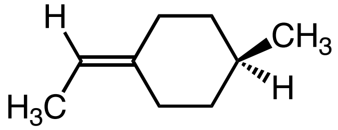
"Once you eliminate the impossible, whatever remains, no matter how improbable, must be the truth." – Sherlock Holmes (by Sir Arthur Conan Doyle)

Q1. Indicate whether each molecule drawn below is chiral or achiral by writing either "CHIRAL" or "ACHIRAL" in the box below each one. Be sure of your choices, as each correct answer is worth 2 points BUT each incorrect answer scores –1 point (i.e., don't just guess). *Hint: it may help you to draw the mirror image in each case...*

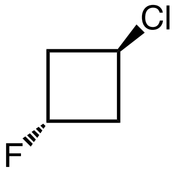
(a)



(b)



(c)



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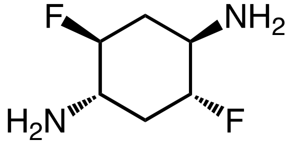
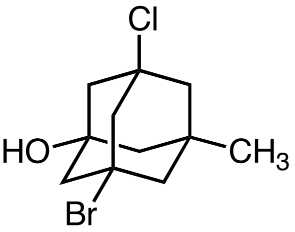
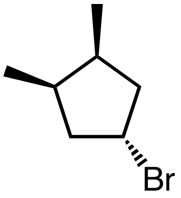


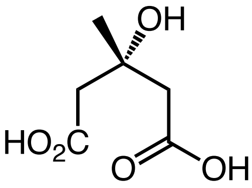
(e)



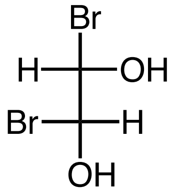
(f)



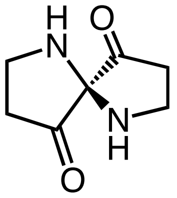
(g)



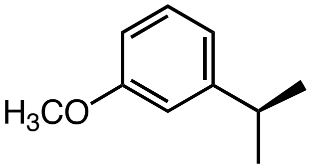
(h)



(i)



(j)



***Question 1** is continued on the next page...*

(k) In the box below, draw (using line formula) the structure of the lowest molecular mass ACYCLIC ALKANE (i.e., no rings allowed) that is chiral. No isotopes allowed (i.e., no deuterium etc)! Name the compound according to systematic IUPAC rules. Note: you will only get credit for the compound name if you have the correct compound. (4 pt structure, 2 pt name)

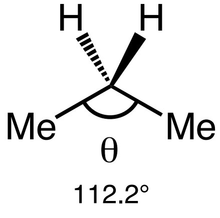
Name:

(l) In the box below, draw (using line formula) the structure of the lowest molecular mass CYCLIC ALKANE that is chiral. No isotopes allowed (i.e., no deuterium etc)! Name the compound according to systematic IUPAC rules. Note: you will only get credit for the compound name if you have the correct compound. (4 pt structure, 2 pt name)

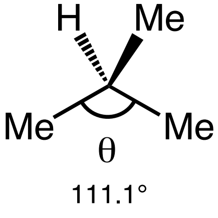
Name:

Q2. (a) In the box below, briefly explain the trend observed for the angle labeled as θ in compounds **A**, **B**, and **C**. (2 pt)

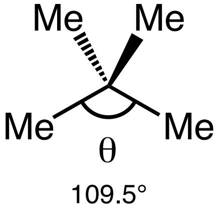
A



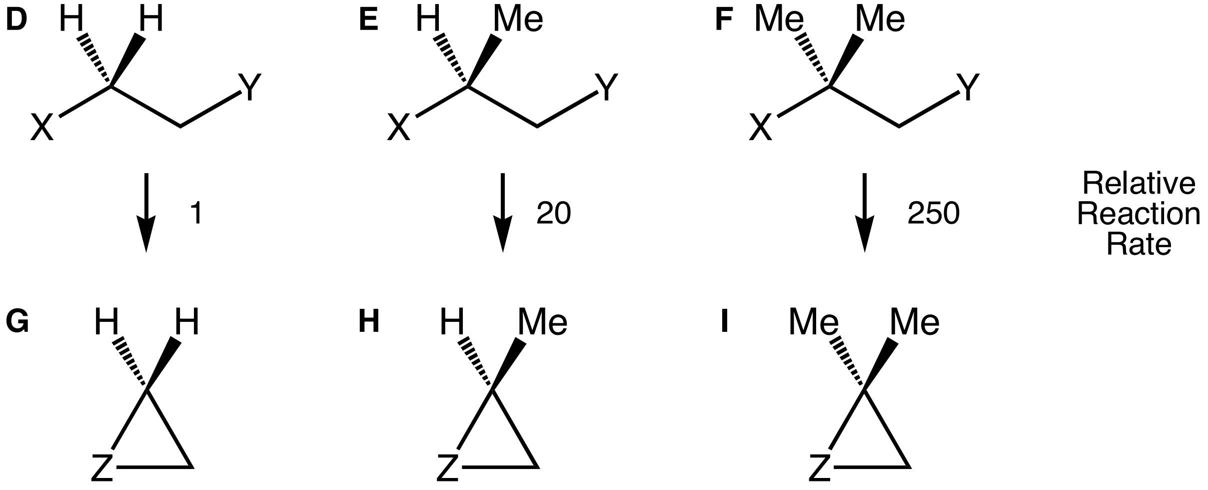
B



C

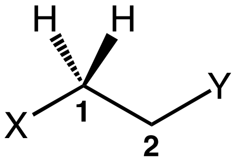


(b) Compounds **D**, **E**, and **F** undergo cyclization reactions to give compounds **G**, **H**, and **I**, respectively (it doesn't matter what X and Y are, just appreciate that they react together to close the ring at Z). Using an argument based solely upon bond angles, explain briefly in the box below why the reaction of **F** to give **I** is faster than the reaction of **E** to give **H**, which, in turn, is faster than **D** to give **G**. (4 pt)

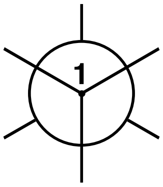


Question 2 is continued on the next page...

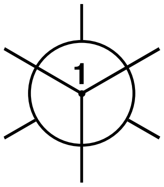
(c) For compound **D**, complete the Newman projections of the three different staggered conformations (**S1**, **S2**, and **S3**). Draw them as if you are looking down the C1–C2 bond (6 pt)



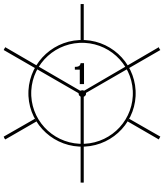
D



S1



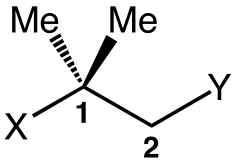
S2



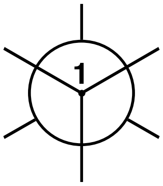
S3

(d) Assuming that the X and Y groups have greater steric demands than hydrogen (H), comment briefly upon the relative energies of conformers **S1**, **S2**, and **S3**. (3 pt)

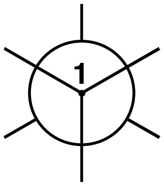
(e) For compound **F**, complete the Newman projections of the three different staggered conformations (**S4**, **S5**, and **S6**). Draw them as if you are looking down the C1–C2 bond (6 pt)



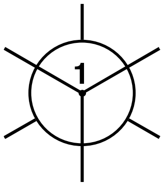
F



S4



S5



S6

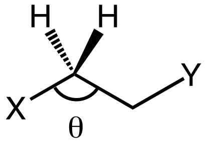
(f) Assuming that methyl (Me), X and Y groups all have the same steric demands, comment briefly upon the relative energies of conformers **S4**, **S5**, and **S6**. (3 pt)

***Question 2** is continued on the next page...*

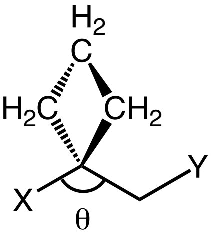
(g) After considering the relative energies of the staggered conformations associated with compounds **D** and **F**, construct an argument NOT based upon bond angles to explain briefly why the reaction of **F** to give **I** is faster than the reaction of **D** to give **G**. (8 pt)

(h) Now compare compound **D** with compound **J**. In the box below, indicate which compound you would expect to have the larger value of θ and why. (3 pt)

D

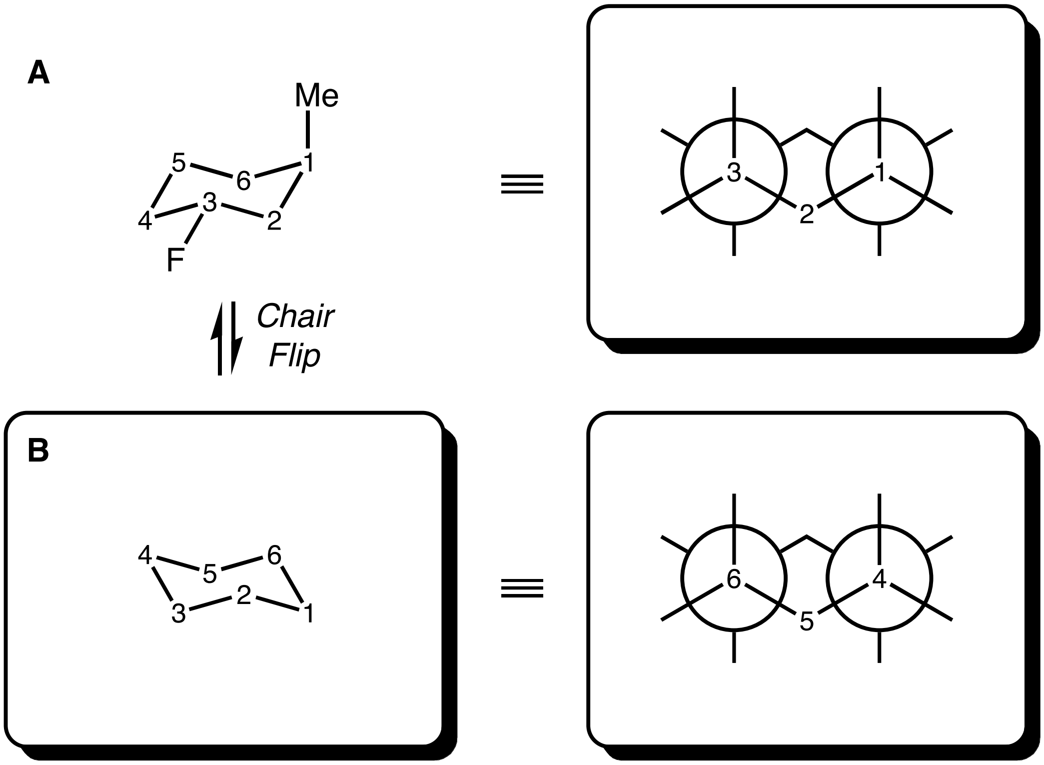


J

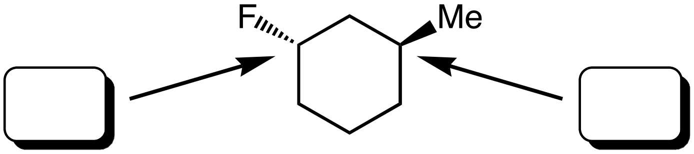


(i) You have given TWO reasons (one in part b and one in part g) to explain why the reaction of **F** to give **I** is faster than the reaction of **D** to give **G**. In the knowledge that **J** cyclizes faster than **D**, comment upon which effect is more important for this series of compounds. (4 pt)

Q3. (a) *trans*-1-Fluoro-3-methylcyclohexane can exist in two different chair conformations, **A** and **B**. Complete the picture of conformer **B** by drawing in a bond to one methyl (Me) group and one fluorine (F) atom in the appropriate positions. In the two boxes to the right, complete the corresponding Newman projections by filling in methyl (Me) groups, hydrogen (H) atoms, AND fluorine atoms (F) where appropriate. (8 pt)



(b) *trans*-1-Fluoro-3-methylcyclohexane is redrawn below. Assign each chiral center either an R or S configuration by writing R or S in each small box. Is this molecule the SAME as that shown in part a, or is it the ENANTIOMER, or a DIASTEREOISOMER? (6 pt)



Relationship with part (a)

(c) In relation to the compound shown above in part b, draw in the boxes below, (i) a diastereoisomer, (ii) a chiral constitutional isomer that still contains a cyclohexane ring, and (iii) an achiral constitutional isomer that still contains a cyclohexane ring. (9 pt)

(i)

Diastereoisomer

(ii)

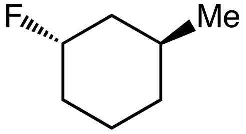
Constitutional Isomer
Chiral

(iii)

Constitutional Isomer
Achiral

***Question 3** is continued on the next page...*

(d) By replacing ONE of the hydrogen atoms in *trans*-1-fluoro-3-methylcyclohexane with a fluorine atom, draw in the boxes below (i) a molecule that is achiral, and (ii) a molecule that contains only ONE chiral center. (6 pt)



trans-1-fluoro-3-methyl-cyclohexane

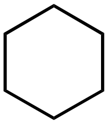
(i)

Achiral

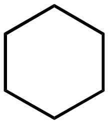
(ii)

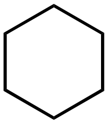
One chiral center

(e) There are five ACHIRAL isomers of trifluorocyclohexane – there are two pairs of diastereoisomers and one compound that exists as a single stereoisomer. In the appropriate boxes below, draw these five structures (you choose in what positions to add three fluorine (F) atoms to the cyclohexane rings drawn in the boxes below – be sure to use wedged and dashed lines where appropriate) (15 pt)

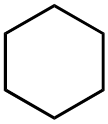


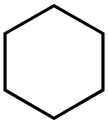
⇦ Diastereoisomers ⇨





⇦ Diastereoisomers ⇨





single stereoisomer