

CHEM 3311-200

Exam 3

April 12, 2016

Assigned Seat # \_\_\_\_\_

Time: 2 Hours

Please sign the Honor Pledge.

I pledge that

"On my honor, as a University of Colorado-Boulder student, I have neither given nor received unauthorized assistance on this work."

PRINT Last Name, First Name, Middle Initial \_\_\_\_\_

Please Sign Here \_\_\_\_\_

PRINT Recitation TA's name: \_\_\_\_\_

PRINT Recitation Section # \_\_\_\_\_ Recitation Day and Time: \_\_\_\_\_

*PLEASE legibly print your name on each page of the exam.*

Partial Periodic Table

1A 1 H	2A 4 Be	3A 5 B	4A 6 C	5A 7 N	6A 8 O	7A 9 F	8A 10 Ne
3 Li	4 Be	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
11 Na	12 Mg					35 Br	
						53 I	

Recit.	Location	Day	Time	TA
215	EKLC M2B36	Mon	1:00-1:50 PM	Matthew Farmer
227	EKLC M2B36	Tue	3:00-3:50 PM	Ethan Miller
234	EKLC M2B36	Wed	12:00-12:50 PM	Matthew Farmer
236	EKLC M2B36	Wed	2:00-2:50 PM	Ethan Miller
238	EKLC M2B36	Wed	4:00-4:50 PM	Thomas Carey
243	EKLC M2B36	Thu	11:00-11:50 AM	Aaron Crossman
245	EKLC M2B36	Thu	1:00-1:50 PM	Aaron Crossman

*PLEASE read the questions very carefully! Points are assigned to each activity described in the question.*

This is a closed-book exam.

The use of notes, calculators, scratch paper, or cell phones will not be allowed during the exam.

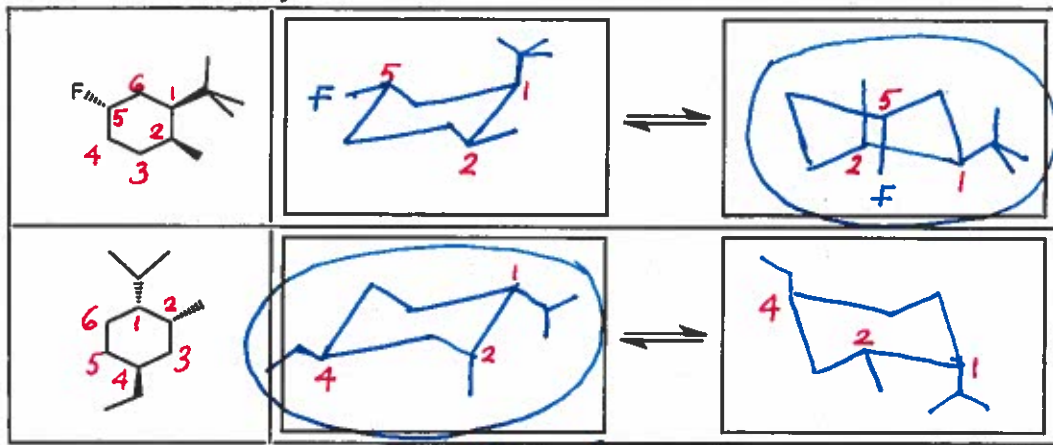
You may use models brought in a clear ziploc bag.

Please put all your answers on the test in the appropriate place. Use the backs of the pages for scratch (there are two additional blank scratch sheets after the last page of the exam). **SCRATCH SHEETS WILL NOT BE GRADED.**

## Table of Acidities

Acid	pK <sub>a</sub> Value	Acid	pK <sub>a</sub> Value	Grading (Points Earned)
HI	-10	Thiol (RSH)	10-12	
HBr	-8.5	H <sub>2</sub> O	15.7	Question 1 (10) _____
HCl	-6	Alcohol (ROH)	16-18	Question 2 (16) _____
H <sub>3</sub> O <sup>+</sup>	-1.7	HC=CH	26	Question 3 (20) _____
HF	3.2	NH <sub>3</sub>	36	Question 4 (15) _____
CH <sub>3</sub> COOH	4.7	H <sub>2</sub>	37	Question 5 (10) _____
HN <sub>3</sub> (hydrazoic acid)	4.7	H <sub>2</sub> C=CH <sub>2</sub>	45	Question 6 (10) _____
NH <sub>4</sub> <sup>+</sup>	9.3	CH <sub>4</sub>	60	Question 7 (8) _____
Phenol	10			Question 8 (11) _____
				(Extra Credit) Question 9 (5) _____
				<b>TOTAL (100) _____</b>

1) (10 points) For each structure shown below, draw **BOTH** chair conformations (in boxes provided) **AND** circle the more stable conformation.

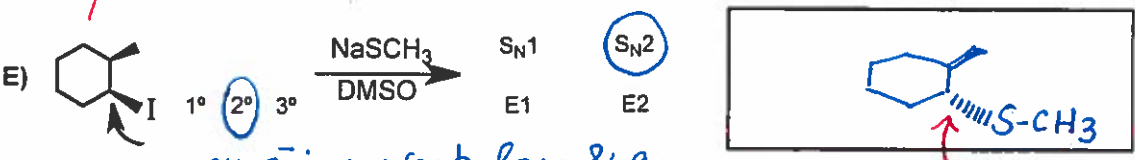
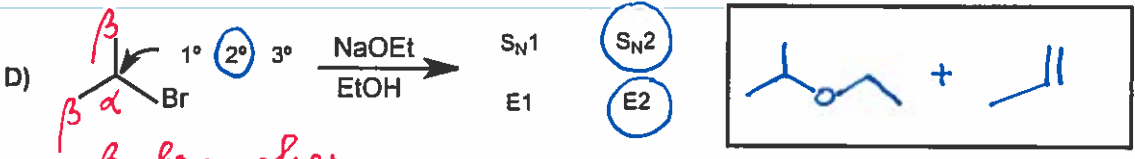
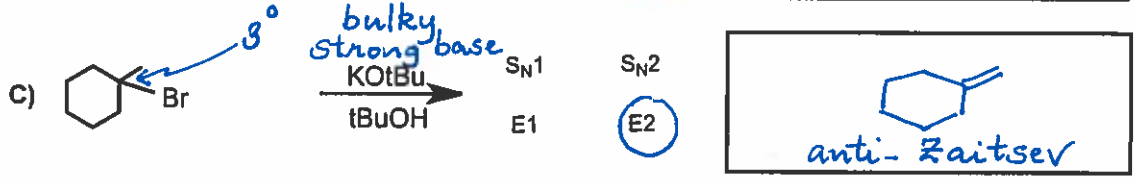
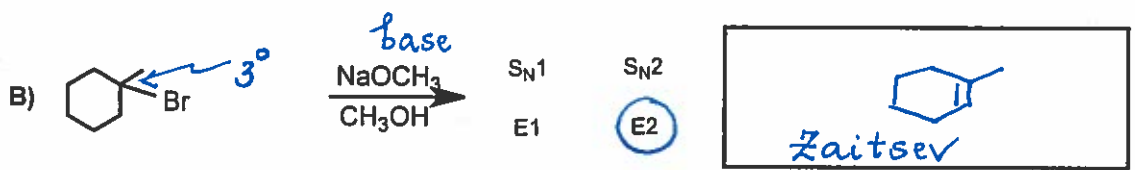
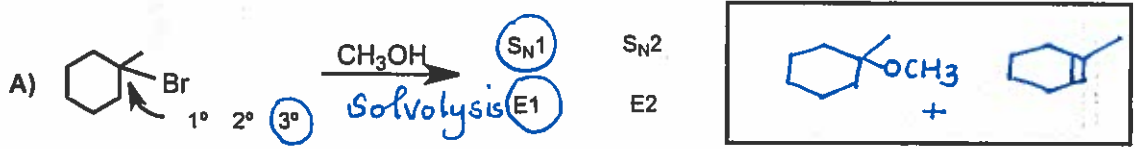


t-butyl is equatorial

isopropyl & ethyl groups are equatorial

2) (16 points) For each reaction shown below:

- (i) classify the alkyl halide (indicated by arrows) by circling 1°, 2°, or 3°
- (ii) circle the mechanism(s) that is (are) most likely under the conditions shown for the given alkyl halide
- (iii) draw the structure of the product(s), showing stereochemistry where relevant. If elimination occurs, show only the major alkene formed.



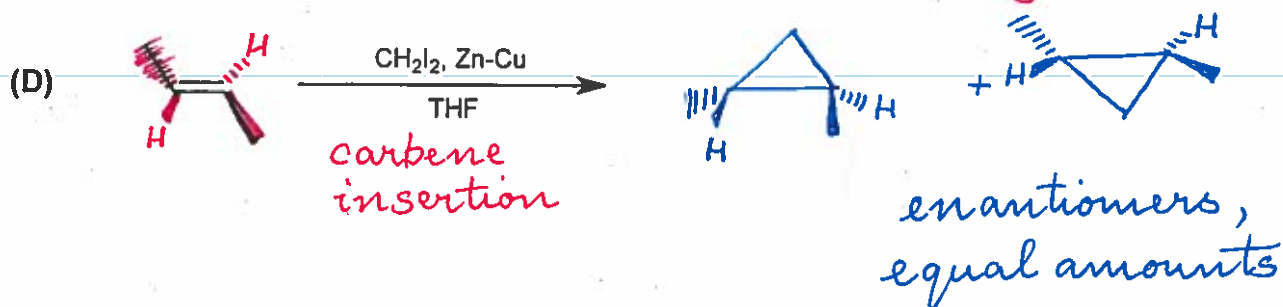
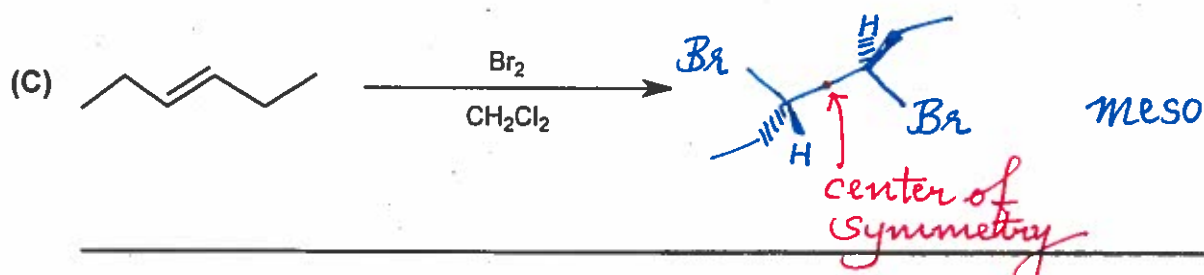
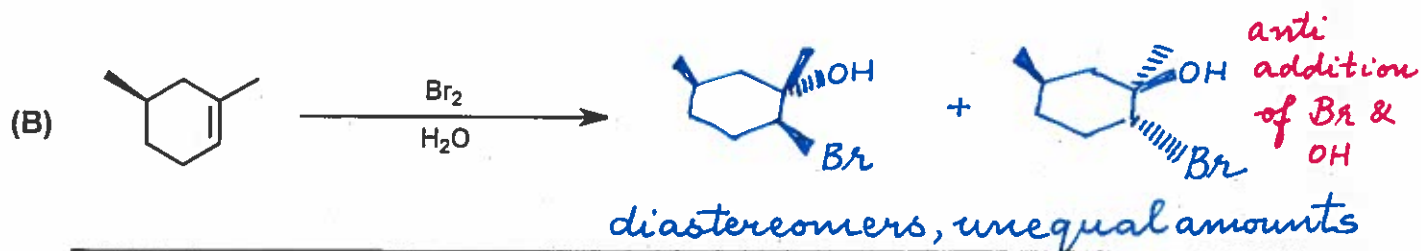
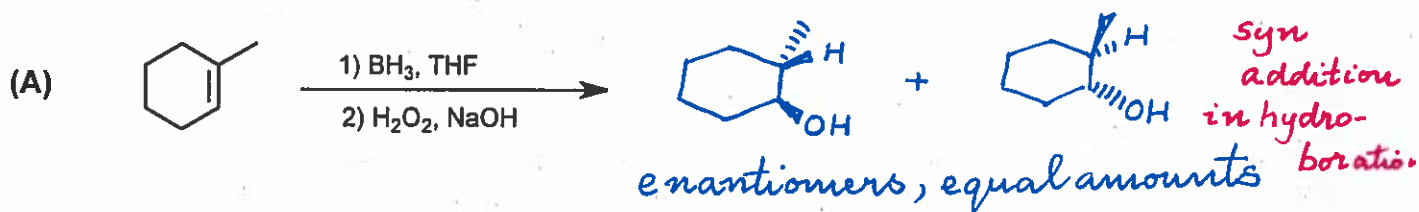
$\text{CH}_3\text{S}^-$  is a weak base & a good nucleophile

inversion of configuration

## 3) (20 points)

For each reaction shown below, *draw the structures of the products.*

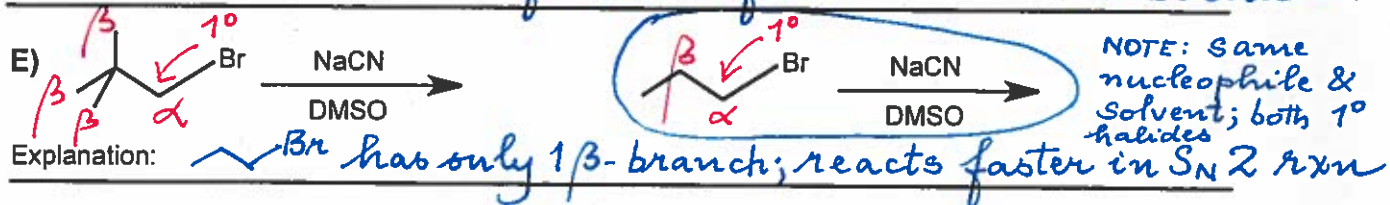
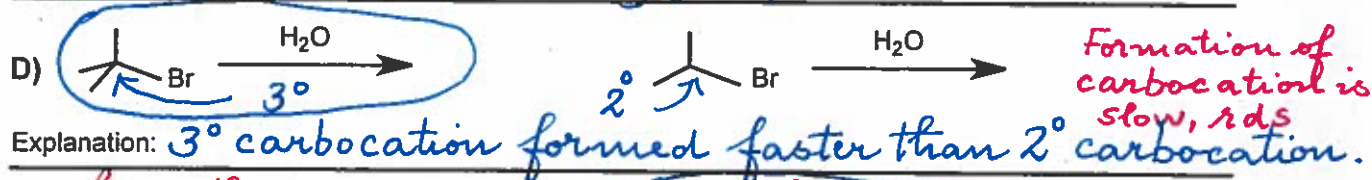
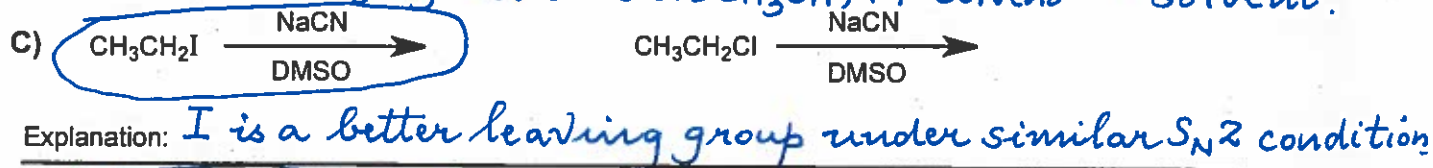
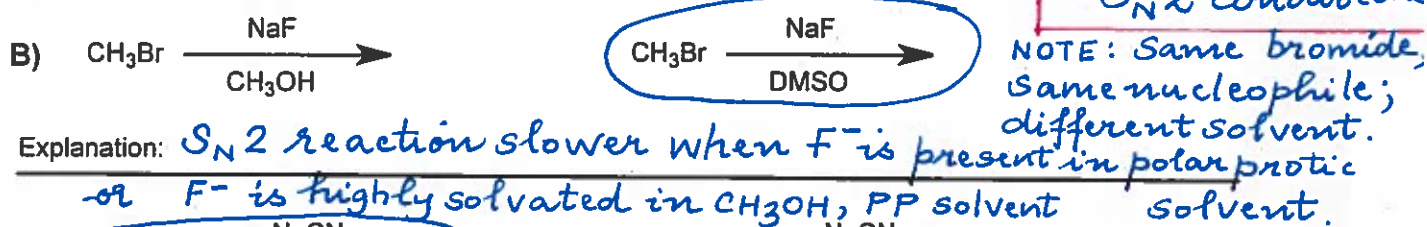
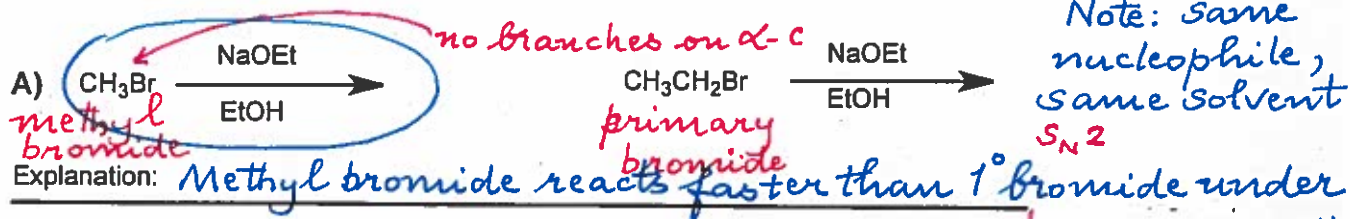
- If a mixture of stereoisomers is formed, draw **ALL** stereoisomers using wedges and dashes to indicate configuration, and specify whether they are related as *diastereomers* or *enantiomers* and formed in *equal* or *unequal* amounts.
- If a *meso* compound is formed, *specify meso* and draw only 1 structure with stereochemistry.



## 4. (15 points)

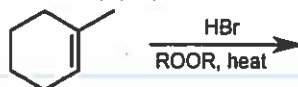
For each pair of reactions,

(i) circle the faster reaction, and

(ii) explain in ten words or less why the reaction is faster.

## 5. (10 points)

Random addition occurs in the reaction shown below:



(i) Draw ALL stereoisomeric products using wedges and dashes to indicate configuration. (8 points)

(ii) Label ALL stereocenters with the absolute configuration labels R or S. (2 points)



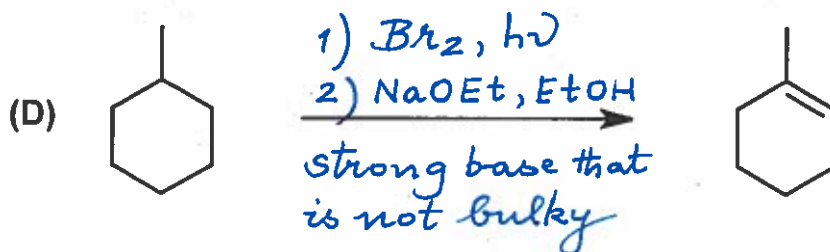
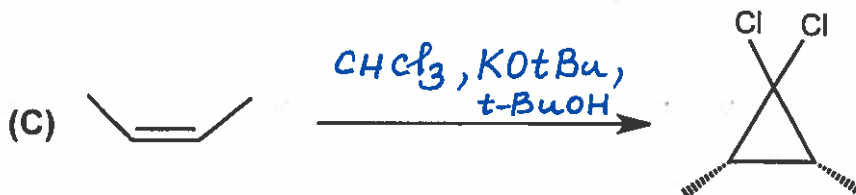
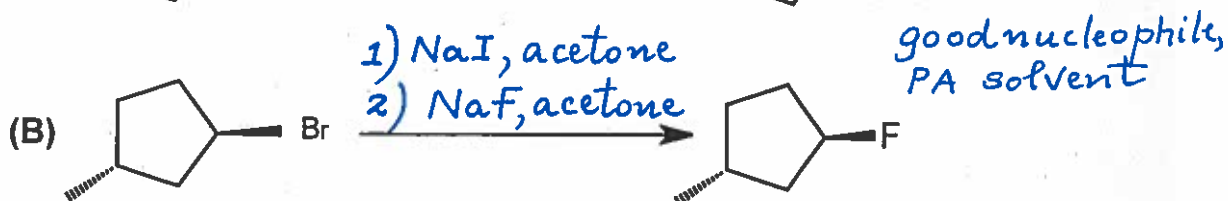
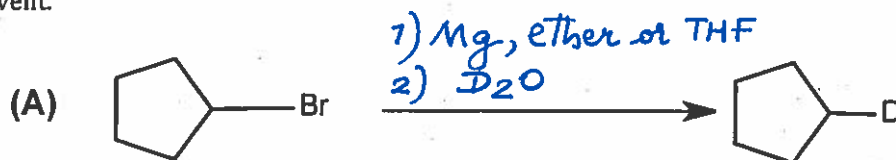
Points earned: Question 4 \_\_\_\_\_ /15

Question 5 \_\_\_\_\_ /10

## 6. (10 points)

Propose reagents for accomplishing each transformation shown below. Make your synthesis efficient (i.e., target molecule should be the major product).

- Some of these transformations may require more than one reaction. Carefully indicate sequential addition of reagents for steps 1), 2), 3), etc., as needed.
- If the solvent plays an important role in driving the reaction towards desired product, please list the solvent.



## 7) (8 points)

Circle all the reactions that are described by a concerted (one-step) mechanism.

E1

E2

S<sub>N</sub>1S<sub>N</sub>2

Hydroboration of 1-methylcyclohexene

Bromination of (Z)-2-butene

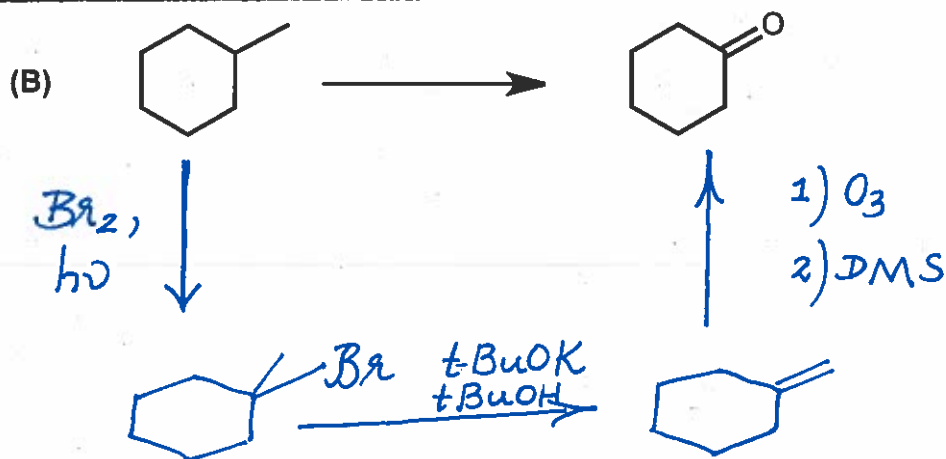
Carbene insertion reaction

Points earned: Question 6 \_\_\_\_/10

Question 7 \_\_\_\_/8

## 8) (11 points)

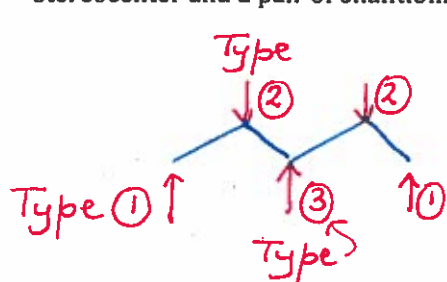
Propose a synthesis for each of the target molecules using the starting material shown. If more than one step is necessary, show the product of each step and the reagents and solvents required. *Do not show the mechanism.*



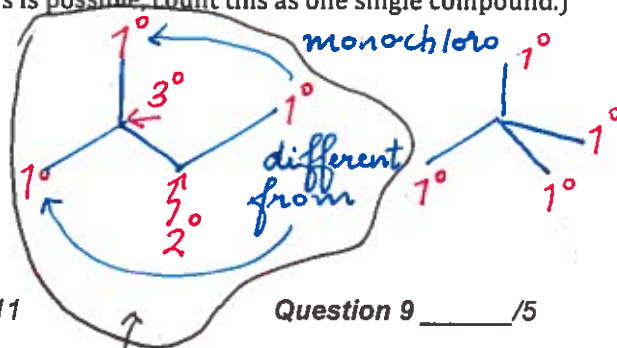
## 9) Extra Credit (5 points)

Draw ALL the constitutional isomers of  $\text{C}_5\text{H}_{12}$ .

Circle the isomer that produces 4 different monochlorinated products when the alkane is reacted with  $\text{Cl}_2$  in the presence of light (ignore stereochemistry in the products; i.e., if a product contains 1 or more asymmetric carbon atoms, do NOT count the stereoisomers separately. For example, if there is one stereocenter and a pair of enantiomers is possible, count this as one single compound.)



Points earned: Question 8 \_\_\_\_\_ /11



Question 9 \_\_\_\_\_ /5

Draw all monochloro products & name them to confirm # of products.

4 different monochloro products, ignoring stereochemistry