

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										8A
1										2
H										He
3	2A									
Li	Be									
11	12	3A	4A	5A	6A	7A				
Na	Mg	B	C	N	O	F				
		13	14	15	16	17	18			
		Al	Si	P	S	Cl	Ar			
						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.

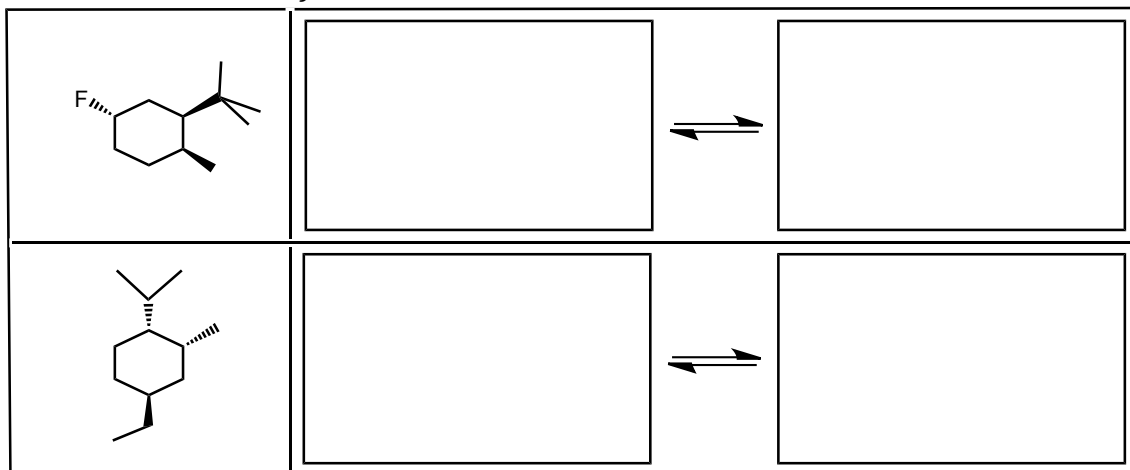
You may use models brought in a clear ziploc bag.

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

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

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

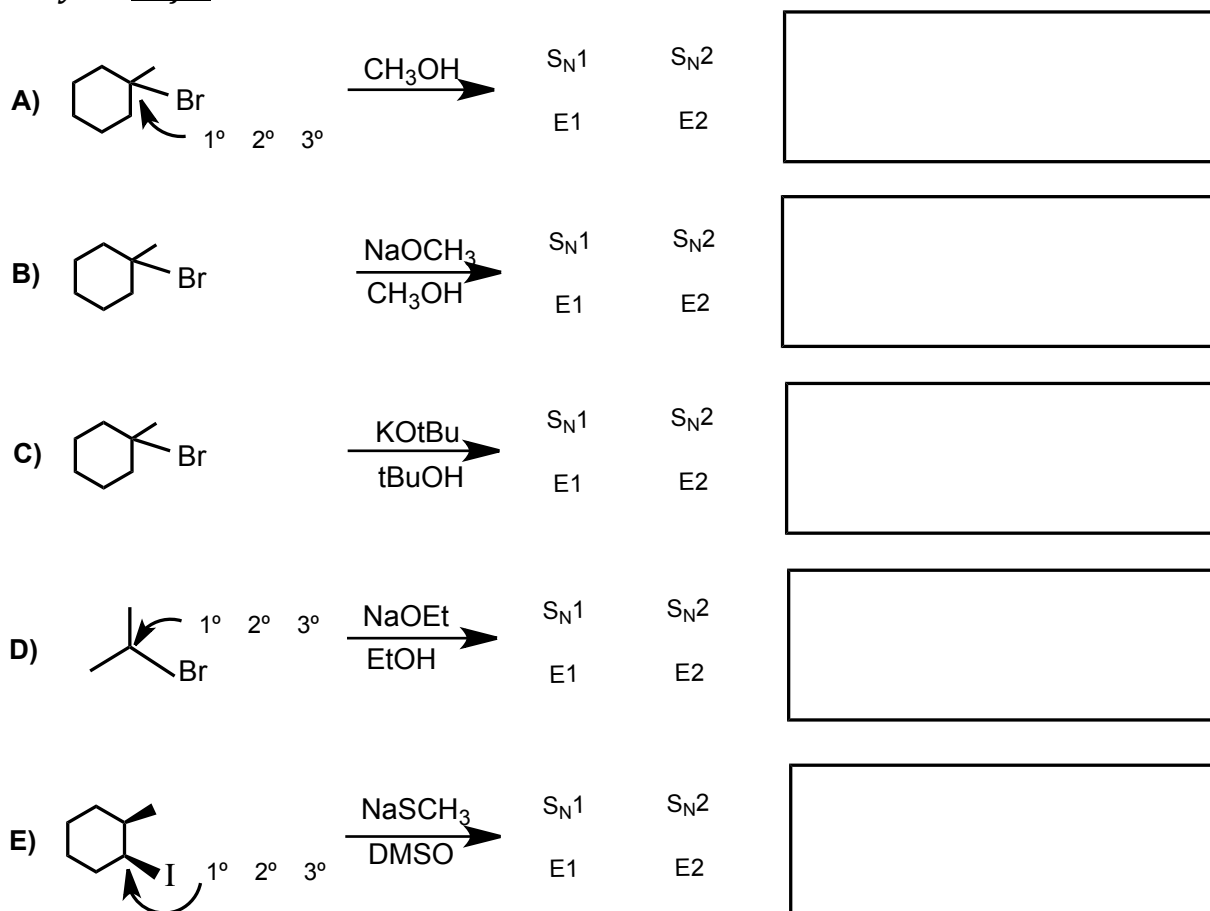


2) (16 points) For each reaction shown below:

(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

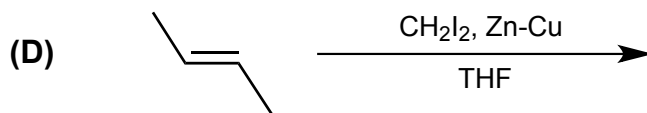
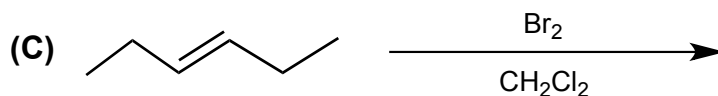
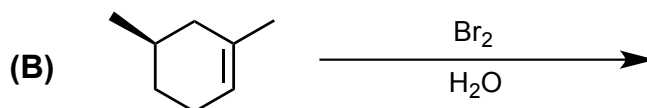
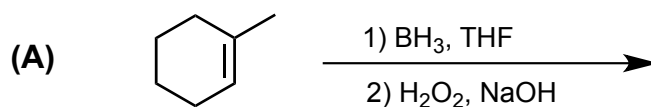
(iii) **draw the structure of the product(s)**, showing stereochemistry where relevant. If elimination occurs, show **only the major alkene** formed.



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.

Explanation: _____



Explanation: _____



Explanation: _____



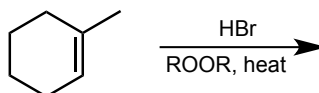
Explanation: _____



Explanation: _____

5. (10 points)

Random addition occurs in the reaction shown below:



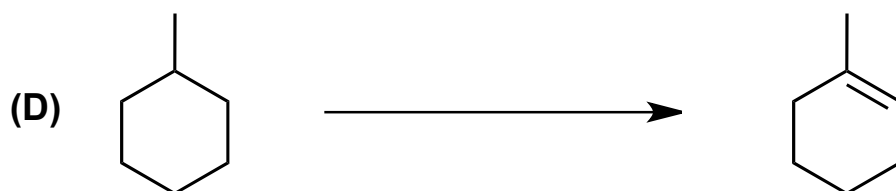
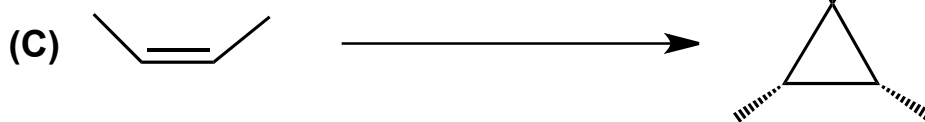
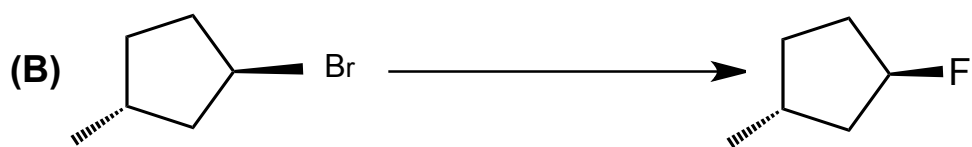
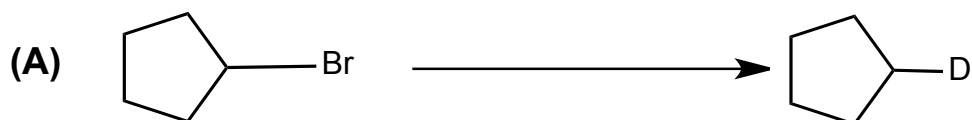
(i) Draw ALL stereoisomeric products using wedges and dashes to indicate configuration. (8 points)

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

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_N1 S_N2

Hydroboration of 1-methylcyclohexene

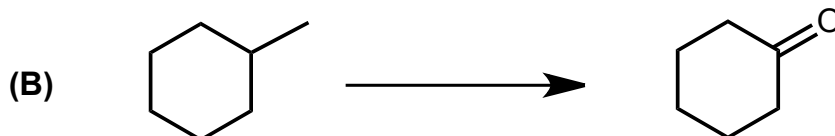
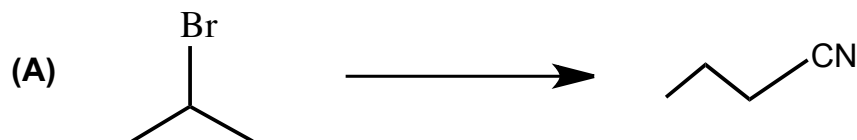
Bromination of (Z)-2-butene

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 C_5H_{12} .

Circle the isomer that produces 4 different monochlorinated products when the alkane is reacted with 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.)