Answer Key

CHEM 3311-100
Exam 3, November 18, 2010 Time: 2 Hours

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

Your Name (PRINTED IN CAPITAL LETTERS)

_____ _____ _____
Last Name **First Name** **Middle Initial**

Your CU Student ID # (NOT Your Social Security Number)

_____

Your Recitation TA's Name

_____ _____ [-1 if missing or incorrect]
Last Name **First Name**

Circle Your Recitation Day & Time [-1 if missing or incorrect]

Mon 8 AM (Denman)	Tues 8 AM (Denman)	Wed 8 AM (Denman)	Thurs 8 AM (Manion)
Mon 2 PM (Moran)	Tues 5 PM (Manion)	Wed 8AM (Hartwig)	
Mon 5 PM (Denman)		Wed 11 AM (Denman)	
		Wed 12 PM (Hartwig)	
		Wed 5 PM (Denman)	

Grading Details

Page # (Question #s)	**Points Possible**	Points Earned
2 (Q 1&2)	**22**	_____
3 (Q 3)	**12**	_____
4 (Q 4)	**20**	_____
5 (Q 5)	**16**	_____
6 (Q 6)	**20**	_____
7 (Q 7)	**10**	_____
	TOTAL SCORE (out of 100)	_____

General Instructions

(1) This is a CLOSED BOOK exam; nothing is allowed except a few pencils or pens, eraser, and student ID.
(2) Please WRITE LEGIBLY & CLEARLY; minimize erasing! Untidy/illegible work will NOT be graded.
(3) Print your name after acknowledging the student honor code. Write your name on each exam page in the space provided.
(4) Use the back of the exam pages as scratch paper, if necessary.
(5) If suspected of or caught cheating, you will receive at best an F for the exam. The instructor reserves the right to proceed further in compliance with university policies on academic violations.
(6) You may not leave the room after the exam has started. Please leave quietly after you submit your exam to the TA or instructor.

Answer Key

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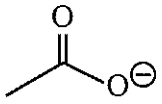
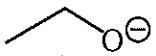
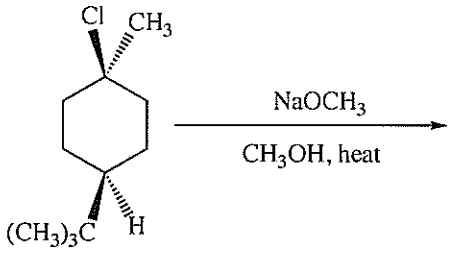
Question 1 (14 points)

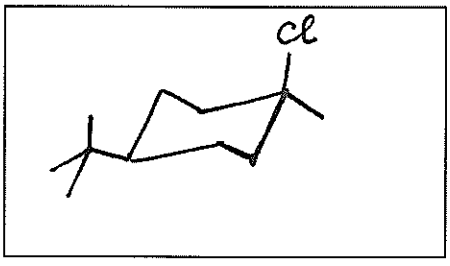
For each pair of species shown below, indicate which is the stronger base and which is the better (more effective) nucleophile. The solvent is indicated below each pair. Each blank box should have a 1 or 2 written inside.

				Stronger Base	Better Nucleophile
(A)	 **1**	or	 **2** in ethanol	2	2
(B)	$CH_3S^{\ominus}$ **1**	or	$CH_3O^{\ominus}$ **2** in acetone	2	1
(C)	$F^{\ominus}$ **1**	or	$I^{\ominus}$ **2** in water	1	2
(D)	$^{\ominus}NH_2$ **1**	or	NH_3 **2** in water	1	1

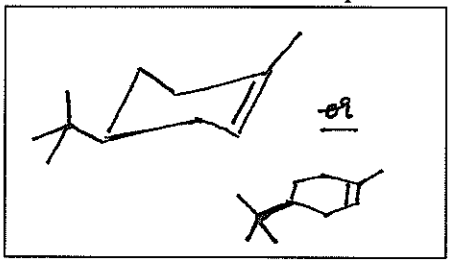
Question 2 (8 points)

Draw (in the box on the left) the most stable chair conformation of the alkyl halide in the reaction shown below. Draw the structure of the major product in the box on the right.





Structure of the MAJOR product



Circle the mechanism for this reaction: E1 (E2) S_N1 S_N2

Answer Key

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Question 3 (12 points)

Multiple Choice: **Circle only the best answer possible**.

(I) Which alkyl bromide reacts fastest with NaCN in DMSO?

(A) CH_3Br (B) CH_3CH_2Br

(C) $(CH_3)_2CHBr$ (D) $(CH_3)_3CBr$

(II) Which alkyl halide reacts fastest with $NaSCH_3$ in CH_3OH?

(A) CH_3F (B) CH_3Cl (C) CH_3Br (D) CH_3I

(III) In which solvent will CH_3CH_2I react fastest with NaF?

(A) CH_3OH (B) HCO_2H

(C) DMSO (D) C_2H_5OH

(IV) Which base yields the maximum amount of the E2 product when reacted with 1-bromo-4-methylpentane?

(A) NaOH

(B) $NaOCH_3$

(C) $NaOCH_2CH_3$

(D) $NaOC(CH_3)_3$

(V) Starting with 1-hexene, which synthetic sequence yields 2-cyanohexane?

(A) Reaction with H_2SO_4 (cat.), H_2O; followed by reaction with NaCN

(B) Reaction with HBr; followed by reaction with NaCN

(C) Reaction with HBr in the presence of ROOR; followed by reaction with NaCN

(D) Reaction with Br_2 in water; followed by reaction with NaCN

Answer Key

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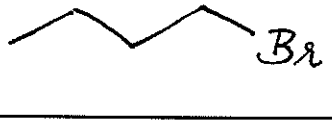
Question 4 (20 points)

Circle the alkyl halide that reacts faster in each reaction under the specified conditions. Label the **faster reaction as S_N1/E1, S_N2, or E2** in the small box on the right. To receive partial credit, draw the structure of each alkyl halide in the appropriate box.

(A) 1-Bromobutane or 1-iodobutane with NaCN in DMSO?

1-Bromobutane 

1-Iodobutane 

S_N2

(B) 1-Chloro-2-methylbutane or 1-chloropentane with NaI in acetone?

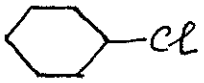
1-Chloro-2-methylbutane 

1-Chloropentane 

S_N2

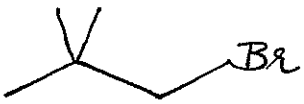
(C) Hexyl chloride or cyclohexyl chloride with NaN_3 in aqueous ethanol?

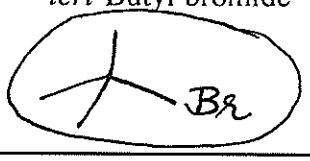
Hexyl chloride 

Cyclohexyl chloride 

S_N2

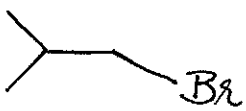
(D) Solvolysis of 1-bromo-2,2-dimethylpropane or *tert*-butyl bromide in ethanol?

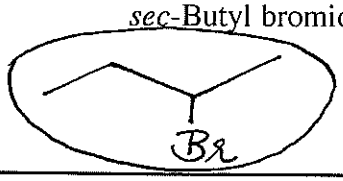
1-Bromo-2,2-dimethylpropane 

tert-Butyl bromide 

S_N1/E1

(E) Solvolysis of isobutyl bromide or *sec*-butyl bromide in aqueous formic acid?

isobutyl bromide 

sec-Butyl bromide 

S_N1/E1

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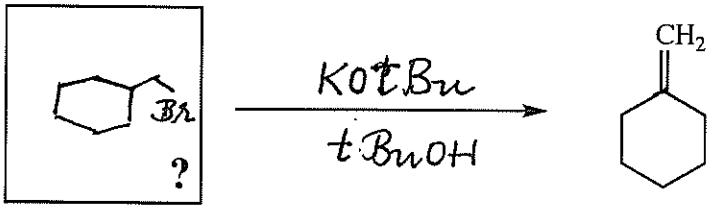
Question 5 (16 points)

Complete each transformation by **filling in the correct reagents or major product of that particular step** (indicated by question marks "?") using ONLY the reactants/reagents/solvents listed in the appropriate section. Your synthesis must lead to the highest yield possible in each step.

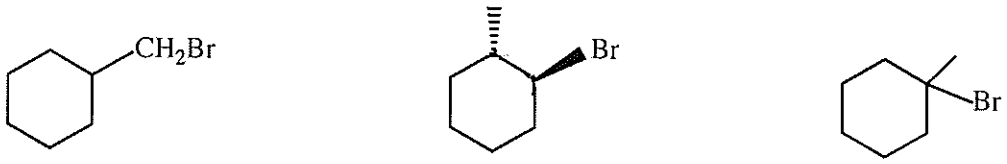
(A)



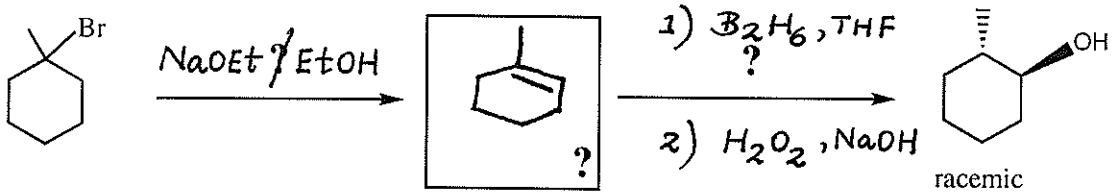
Compounds provided:

NaOEt/EtOH

KOtBu/tBuOH



(B)



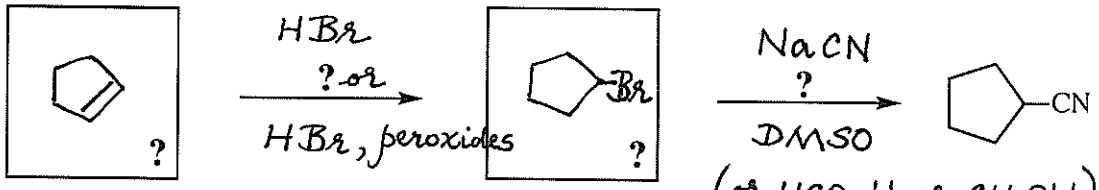
racemic

Compounds provided:

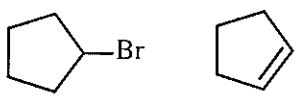
H_2SO_4, heat H_2O, H_3O^+ $Hg(OAc)_2$, THF/H_2O

B_2H_6, THF $NaBH_4$, NaOH H_2O_2, NaOH NaOEt/EtOH

(C)



Chemicals provided:



Br_2, CH_2Cl_2 Br_2, H_2O HBr NaBr

HBr, peroxides DMSO HCOOH CH_3OH NaCN

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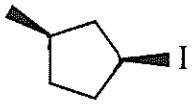
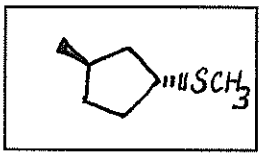
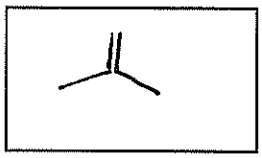
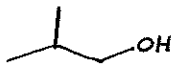
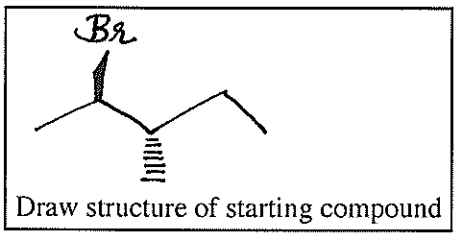
Question 6 (20 points)

Complete each reaction by filling in the reactant, reagent and/or solvent, or **major product** as necessary. Wherever relevant, show appropriate stereochemistry using dashes and wedges.

(A)  $\xrightarrow[\text{DMSO}]{NaSCH_3}$ 

(B) $(CH_3)_3CCl \xrightarrow[CH_3OH]{NaOCH_3}$  $\xrightarrow[2)\ H_2O_2, NaOH]{1)\ B_2H_6, THF}$  2-Methyl-1-propanol

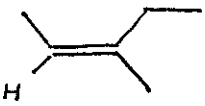
(C) (2R,3S)-2-bromo-3-methylpentane



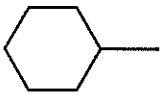
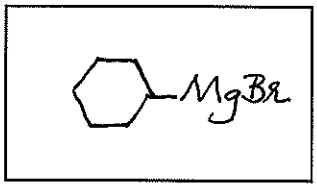
Draw structure of starting compound

$\xrightarrow[CH_3OH]{NaOCH_3}$

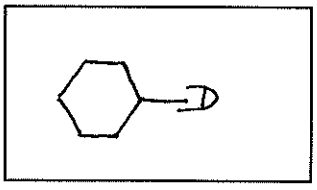
major elimination product

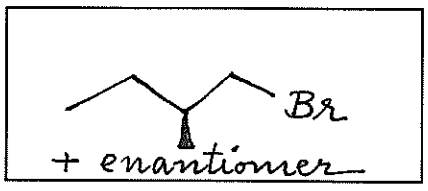


Name: (Z)-3-methyl-2-pentene

(D)  + Mg $\xrightarrow[THF]{}$ 

$\xrightarrow{CH_3OD}$



(E) $CH_3CH_2CH{=}CH_2$ + Br_2 $\xrightarrow[CH_3OH]{}$ 

+ enantiomer

Answer Key

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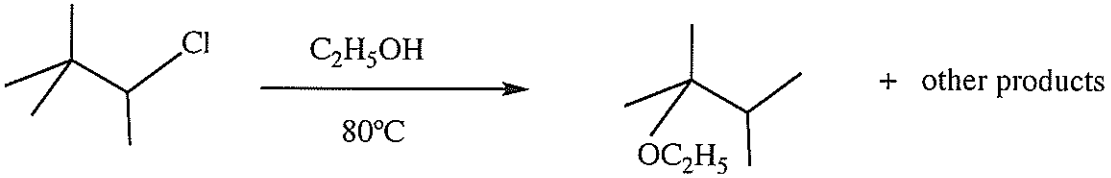
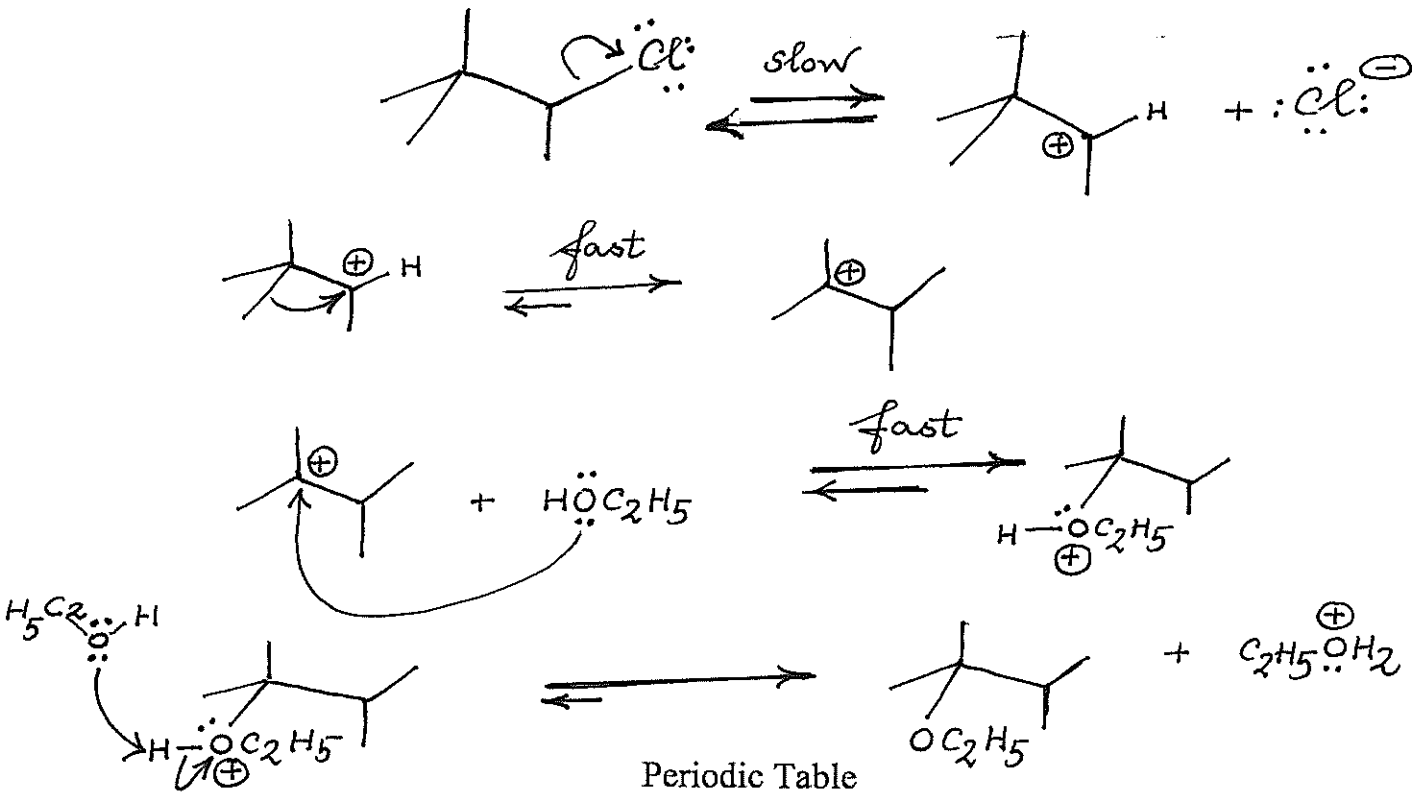
Question 7 (10 points)

Consider the reaction shown below:



Propose a **stepwise** mechanism for the formation of the product shown using the arrow-pushing formalism; lone pairs and formal charges must be shown, especially where significant/relevant.



Periodic Table

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Ha	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac															