

Section IA: Question 1 (2 points)

1) Which structure represents a thiol?

- (A) CH_3SCH_3 (B) $\text{CH}_3\text{S-SCH}_3$ (C) CH_3SH (D) $(\text{CH}_3)_3\text{SO}$

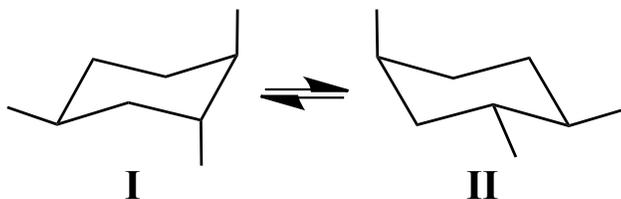
Section IB: Question 2-13 (4 points each; total: 48 points)2) What is the strongest intermolecular force in $\text{CH}_3\text{CH}_2\text{F}$?

- (A) Dispersion forces (B) Dipole-dipole (C) Hydrogen Bonding (D) Ion-dipole

3) Rank compounds I, II and III in order of *increasing* boiling point.

- I. $\text{CH}_3\text{CH}_2\text{OH}$ II. $\text{CH}_3\text{CH}_2\text{CH}_3$ III. $\text{CH}_3\text{CH}_2\text{F}$

- (A) $\text{I} < \text{II} < \text{III}$ (B) $\text{II} < \text{I} < \text{III}$ (C) $\text{III} < \text{II} < \text{I}$ (D) $\text{II} < \text{III} < \text{I}$

4) Which statement is *correct* concerning the relative stabilities of conformations **I** and **II**?

- (A) **I** is more stable than **II**.
 (B) **II** is more stable than **I**.
 (C) **I** and **II** have equal stabilities.
 (D) More information is required to answer this question.

5) How are these two structures related?



- (A) Constitutional isomers (B) Different conformations of the same compound
 (C) Homomers (identical) (D) Stereoisomers

6) In the **most stable** conformation of *cis*-1-*tert*-butyl-3-methylcyclohexane,

- (A) both substituents are equatorial.
- (B) both substituents are axial.
- (C) the *tert*-butyl substituent is equatorial and the methyl group is axial.
- (D) the *tert*-butyl substituent is axial and the methyl group is equatorial.

7) Select the answer that describes the **best** method to prepare the nucleophile $C_2H_5S^-$.

- (A) $C_2H_5SH + H_2O \rightleftharpoons$
- (B) $C_2H_5SH + I^- \rightleftharpoons$
- (C) $C_2H_5SH + CH_3COO^- \rightleftharpoons$
- (D) $C_2H_5SH + ^-OC_2H_5 \rightleftharpoons$

8) When 1-chloro-4-fluorobutane is reacted with 1 equivalent of NaI in acetone, a precipitate is formed. What is the chemical identity of the precipitate?

- (A) NaCl
- (B) NaF
- (C) 1-fluoro-4-iodobutane
- (D) 1-chloro-4-iodobutane

9) Which bromide reacts fastest with CH_3OH by the S_N1 mechanism?

- (A) 1-Bromopentane
- (B) 2-Bromo-2-methylbutane
- (C) 3-Bromopentane
- (D) 1-Bromo-2,2-dimethylpropane

10) Which statement does **not correctly** describe S_N2 reactions of alkyl halides?

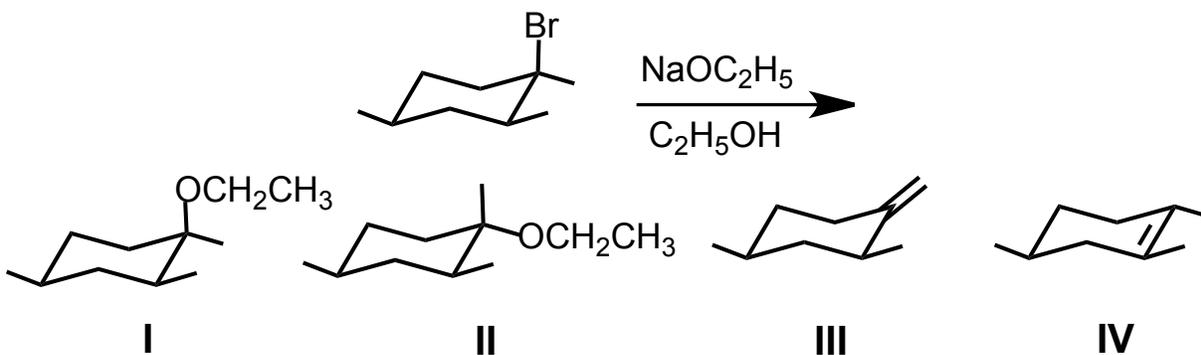
- (A) Reaction rate is first-order in both [alkyl halide] and [nucleophile].
- (B) The nucleophile approaches from the backside of the carbon-halogen bond.
- (C) Tertiary halides react faster than secondary halides.
- (D) The mechanism is best described as a concerted, one-step mechanism.

11) Select all the polar, aprotic solvents.

- I. CH_3OH
- II. CH_3COCH_3 (acetone)
- III. DMF (N,N-dimethylformamide)

- (A) I and II
- (B) II and III
- (C) I and III
- (D) I, II and III

12) Select the *major* product in the reaction shown.



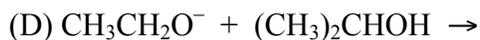
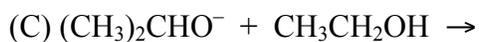
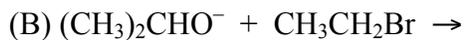
(A) I

(B) II

(C) III

(D) IV

13) Which reaction produces the highest yield of $\text{CH}_3\text{CH}_2\text{OCH}(\text{CH}_3)_2$?



CHEM 3311-200
Exam 3
April 14, 2015

Assigned Seat # _____
Recitation Section # _____
(Note: -5 points for missing
Recitation section #)

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

Section II: SHORT ANSWER Questions 14-17 (total: 50 points)

For Grading Purposes Only

Points Earned on Short Answer Section

Question 14 (10 points) _____

Question 15 (13 points) _____

Question 16 (12 points) _____

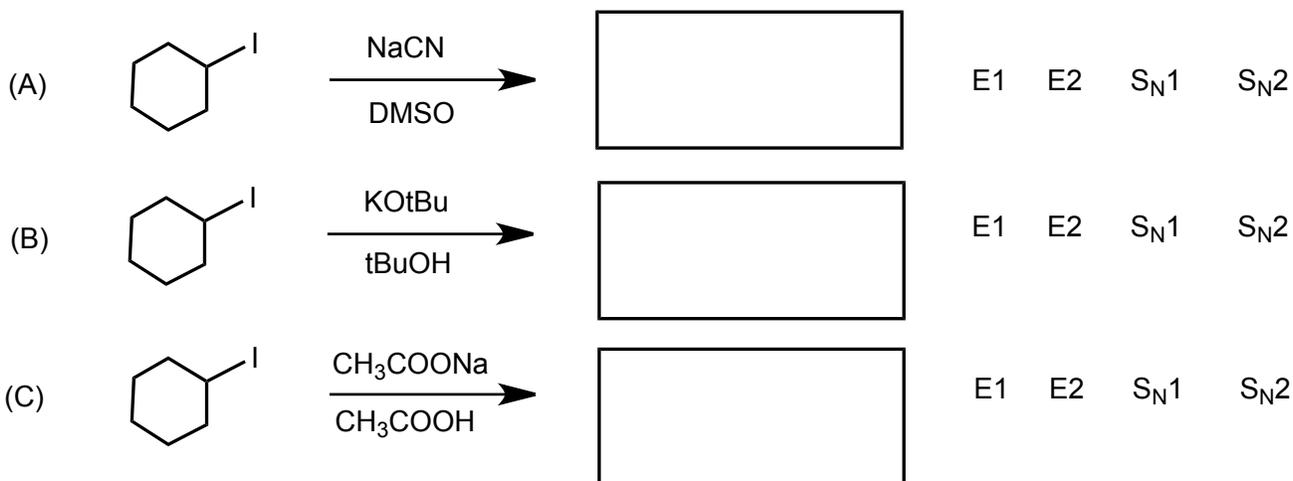
Question 17 (15 points) _____

Bonus Question (10 points) _____

Total Points (50 possible) _____

14) 10 points

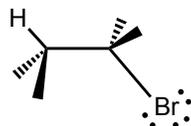
Draw the structure of the product(s) formed in each reaction, showing stereochemistry where appropriate. Circle the mechanism(s) using the labels on the right.



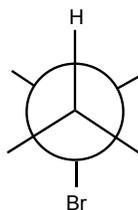
15) 13 points

When (2*R*,3*R*)-2-bromo-3-methylpentane reacts in the presence of C₂H₅ONa in C₂H₅OH, an alkene is formed.

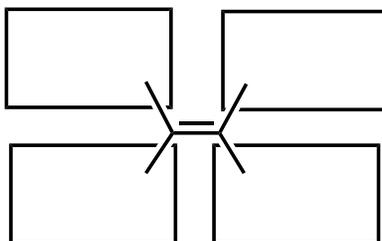
- (A) Draw the structure of (2*R*,3*R*)-2-bromo-3-methylpentane using the skeletal line-and-wedge projection shown below. NOTE: You must draw the atoms (H) or groups (Me for methyl and Et for ethyl) attached to the solid- and dotted-wedges to represent (2*R*,3*R*)-2-bromo-3-methylpentane!!!!



- (B) Complete the Newman projection (using the skeletal framework shown) for the anti-coplanar arrangement that leads to the product.



- (C) Draw the structure of the major product, showing correct stereochemistry. Place H, CH₃ or CH₃CH₂ in the appropriate boxes.

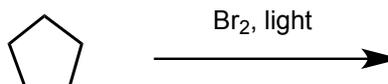


- (D) Write the correct IUPAC name of this compound.

- (E) Draw the line-and-wedge projection for (2*R*,3*R*)-2-bromo-3-methylpentane, as in part (A), and show the direction of arrows for the E2 mechanism. You must include the base and show how it participates,

16) 12 points

For the reaction shown below:



(A) Write the initiation step, showing the arrow pushing mechanism for this step. Show all lone pairs.

(B) Write the arrow pushing mechanism for the *first* propagation step. Show all lone pairs.(C) Calculate ΔH for the *first* propagation step using the bond energies provided.

Bond Type	Bond Energy (kJ/mol)
C-H in cyclopentane	395
C-Br in bromocyclopentane	284
Br-Br	192
H-Br	366

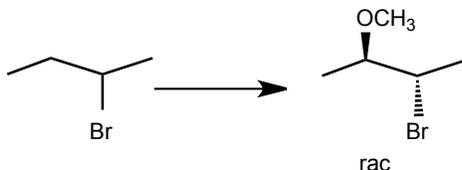
Show your calculations.

$\Delta H =$ Show sign and magnitude.

17) 15 points

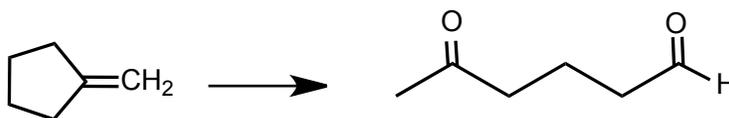
Propose a synthetic route to the desired product using the starting material shown and any other reagents you need. If more than one step is necessary, show the product of each step. Do NOT show mechanisms. Some types of reactions such as hydroboration-oxidation, oxymercuration-reduction, etc. should be presented as a single step using (1), (2), etc. to represent the reactions involved. Please show stereochemistry where necessary.

(A) 6 points



Propose a synthetic route to the desired product using the starting material shown and any other reagents you need. If more than one step is necessary, show the product of each step. Do NOT show mechanisms. Some types of reactions such as hydroboration-oxidation, oxymercuration-reduction, etc. should be presented as a single step using (1), (2), etc. to represent the reactions involved. Please show stereochemistry where necessary.

(B) 9 points



BONUS SYNTHESIS QUESTION (10 points)

