Easily Legible Printed Name:_____

CHEM 3351 (100), Fall 2016
Professor Walba
Third Hour Exam
November 15, 2016

scores:

1)

2)

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4)

5)

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CU Honor Code Pledge: On my honor, as a University of Colorado at Boulder Student, I have neither given nor received unauthorized assistance.

Signature: _____

Recitation TA Name: _____

Recitation day and time: _____

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). DO NOT PUT ANSWERS ON THE SCRATCH SHEETS.

PLEASE read the questions very carefully!

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

Partial Periodic Table

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

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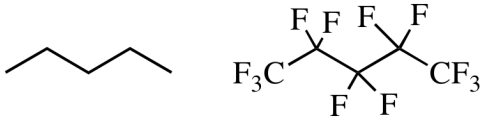
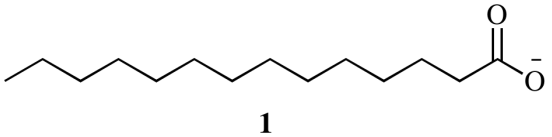
1 (20 pts) a) For each of the following pairs of compounds, circle the one with the higher boiling point, and give the major reason why. Hint: In each case, the major reason will be one of the following weak intermolecular interactions: van der Waals attractions, dipole-dipole interactions, or hydrogen bonding.

b) Soap is mostly a mixture of long-chain acid salts such as myristic acid potassium salt (**1**). Often the structure of a soap molecule is represented by a squiggle for the hydrocarbon chain, and a ball at the end representing the "polar head group" (**2**). In the space below the structures, draw a picture using the squiggle model for the soap molecules, showing what you expect would happen if you put many of these molecules into water.



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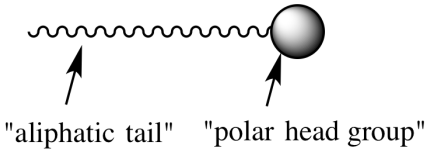

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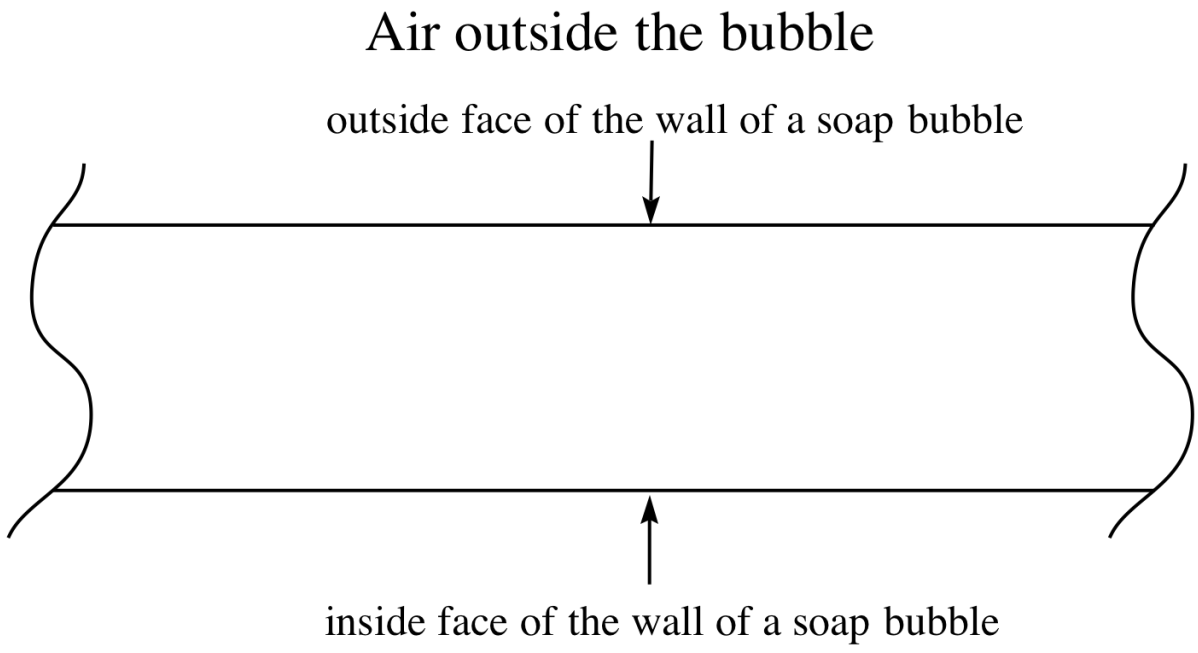
Q1 - continued

c) Grease is mostly hydrocarbon, and is very insoluble in water. This makes hard to wash your greasy hands in pure water. However, as you know, if you add a little soap, the grease magically goes into the water. Well, maybe it's not magic. Draw a cartoon suggesting how the soap might make the grease water-soluble.

d) Soap bubbles are "fluidy" spherical objects that are almost all just air. There is air on the outside of the soap bubble, and there's air on the inside. There is a flexible spherical "wall" between the air on the outside and the inside that's made out of soap molecules and water.

Since the wall is **much** thinner than the circumference of the sphere, at the molecular level it looks flat. Draw a cartoon of what the bubble's wall looks like at the molecular level, using the lines below to represent a small part of the wall of the bubble from the side.



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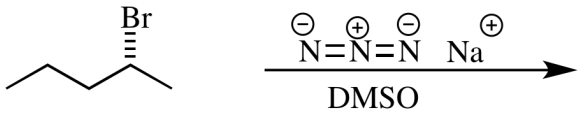
2) (20 pts) Give the **single major product** for each of the following reactions, carefully showing stereochemistry using wedges and dashes if appropriate. If a racemate is formed, show only one enantiomer and label it "rac." Assume chiral starting materials are single pure enantiomers unless they are labeled "rac."

a)



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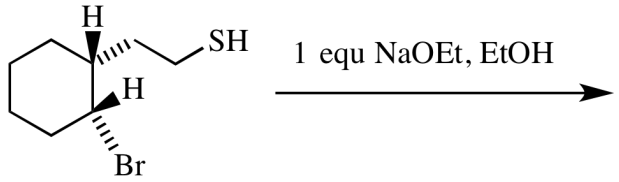

$C_8H_{14}S$

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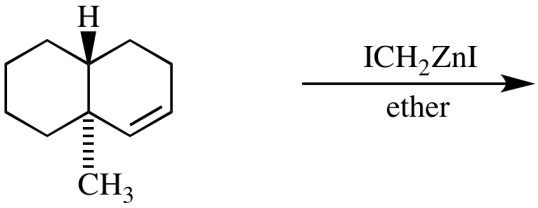
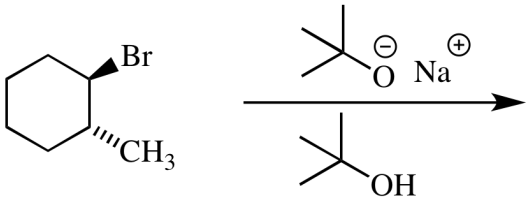
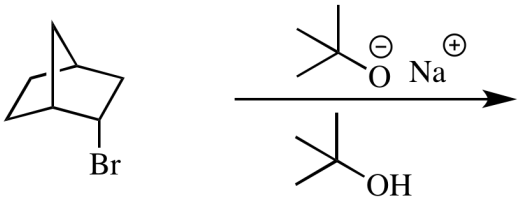
c)



d)



e)



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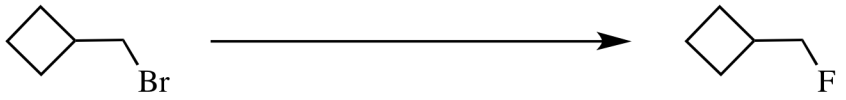
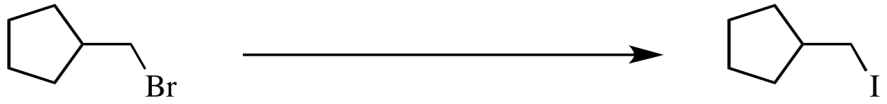
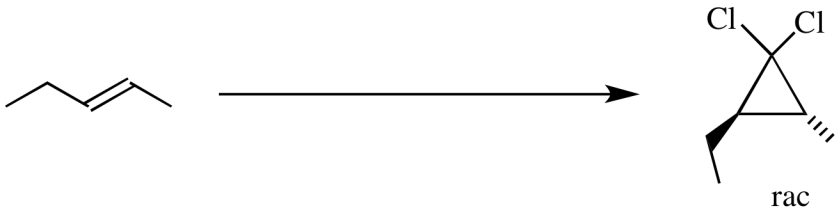
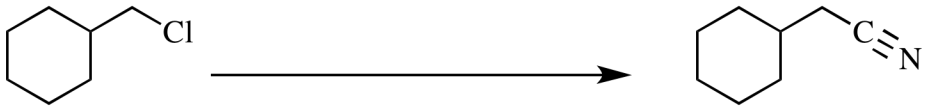
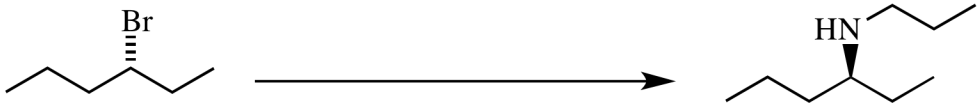
3) (20 pts) Propose reagents for accomplishing each of the following transformations. For reactions involving sequential addition of reagents, label the two steps using letters. Make your synthesis efficient (i.e. the target product should be the major product). Assume chiral starting materials and products are single pure enantiomers unless they are labeled "rac."

a) 

b) 

c) 

d) 

e) 

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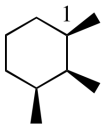
4) (20 pts) a) Carefully draw both flip-chair forms for compound **1** below. Please leave out the H atoms. Carbon **1** is labeled in the "flat cyclohexane" – make this the **right-most carbon** in your chair conformations.

1 

b) Indicate under the two chair structures their strain energy in units of gauche butane interactions (GB) and syn pentane interactions (SP). Just for your own information, a simple Spartan calculation suggests an SP is worth 7GB of strain energy.

c) Circle the more stable conformation of compound **1**. If the two conformations have the same strain energy, indicate they are the same.

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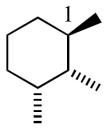
d) Carefully draw both flip-chair forms for compound **2** below. Please leave out the H atoms.

2 

e) Indicate under the two chair structures their strain energy in units of gauche butane interactions (GB) and syn pentane interactions (SP). A simple Spartan calculation suggests one SP is worth about 7GB of strain energy.

f) Circle the more stable conformation of compound **2**. If the two conformations have the same strain energy, indicate they are the same.

g) Which trimethylcyclohexane isomer, **1**, or **2**, is more stable (has a lower heat of formation)? If the two compounds have the same strain energy, write "same."

Put your answer in the box→ 

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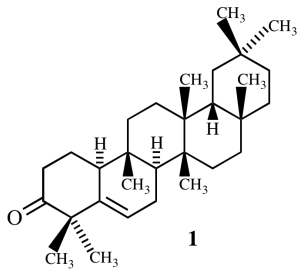
Q4 – continued

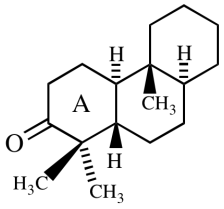
h) The intimidating molecule below (compound **1**) is Friedeline – a major component of cork. It's one of a family of pentacyclic triterpene natural products, which were challenging targets for total synthesis in the 1970s. Friedelin was especially challenging due to the fairly huge amount of strain in the system (the synthesis was 30 steps).



1

Even drawing a perspective chair conformation of Friedeline is extremely challenging. However, the first three rings of Friedelane, the product of hydrogenation of Friedeline, is relatively easy to draw as a perspective chair.

i) Draw the chair conformation for the tricyclic ketone compound **2**. Hint: Start your drawing with the A ring, with the carbonyl carbon (the one with a double bond to an O atom) as the left-most carbon of a chair cyclohexane, with that carbon "bending up"



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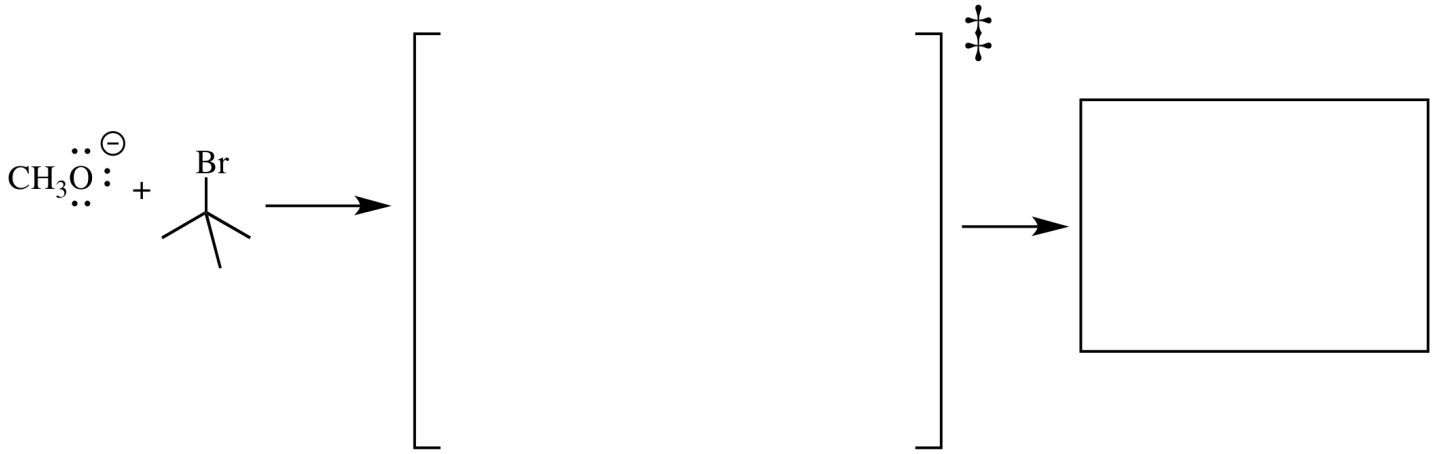
5) (20 pts) a) Cyanide ion reacts with 2-bromopropane to give one clean product. Give the product in the box below-right, and carefully draw the rate-determining transition state leading to that product in between the square brackets below-middle.

b) Methoxide ion reacts with 2-bromo-2-methylpropane to give one clean product. Give the product in the box below-right, and carefully draw the rate-determining transition state leading to that product in between the square brackets below-middle.



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