Organic Chemistry I
Final Exam Review
Answer Key

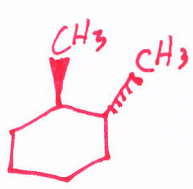
Multiple Choice

1a, 2d, 3d, 4c, 5d, 6c, 7d, 8a, 9d, 10a, 11b, 12e, 13d, 14a, 15a, 16a, 17e

Short Answer

1. Use the information in the table below to answer the following question.

$CH_3 \Leftrightarrow H$	1, 3 diaxial interaction	3.8 kJ/mol
$H \Leftrightarrow H$	eclipsed	4.0 kJ/mol
$H \Leftrightarrow CH_3$	eclipsed	6.0 kJ/mol
$CH_3 \Leftrightarrow CH_3$	eclipsed	11 kJ/mol
$CH_3 \Leftrightarrow CH_3$	gauche	3.8 kJ/mol



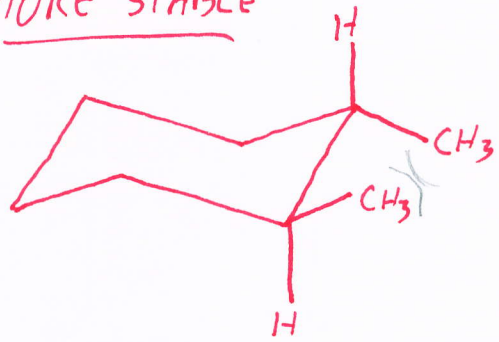
trans-1,2-dimethylcyclohexane

cis-1,4-dimethylcyclohexane

Consider the following two compounds:
trans-1,2-dimethylcyclohexane
cis-1,4-dimethylcyclohexane
Draw the most stable conformation of each molecule. Use the data in the table above to calculate the total strain energy of each structure. Indicate which, if either, is more stable, and calculate the energy difference between the two structures.

trans-1,2 dimethylcyclohexane

MORE STABLE

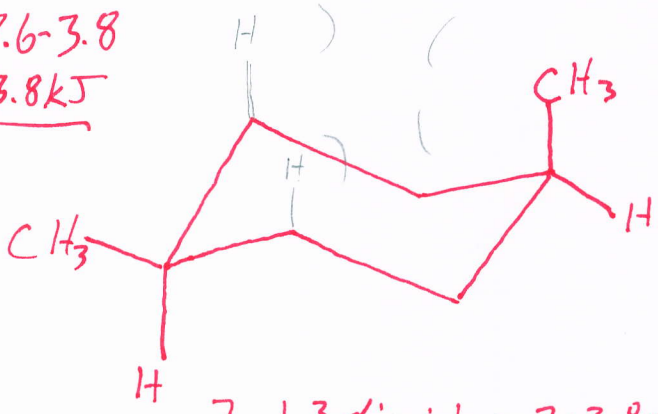


1 $CH_3 \Leftrightarrow CH_3$ Gauche: 3.8kJ

$\Delta E = 7.6 - 3.8$

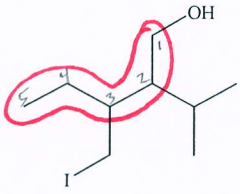
$\Delta E = 3.8 kJ$

cis-1,4-dimethylcyclohexane



2 1,3 diaxials: $2 \times 3.8 = 7.6 kJ$

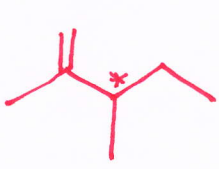
2. Name the following compound:



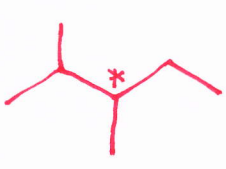
ans: 3-(iodomethyl)-2-isopropyl-1-pentanol

3. Compound **A**, C_7H_{14}, was found to be optically active. On catalytic reduction over a palladium catalyst, one equivalent of hydrogen gas was absorbed, yielding optically active compound **B**, C_7H_{16}. When compound **A** was treated with $KMnO_4$ in an acidic solution, CO_2 bubbled out and compound **C** was formed. Compound **C** has the formula $C_6H_{12}O$, and it is an optically active ketone. Draw the structures of compounds **A**, **B**, and **C**.

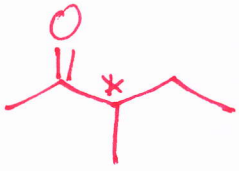
A



B

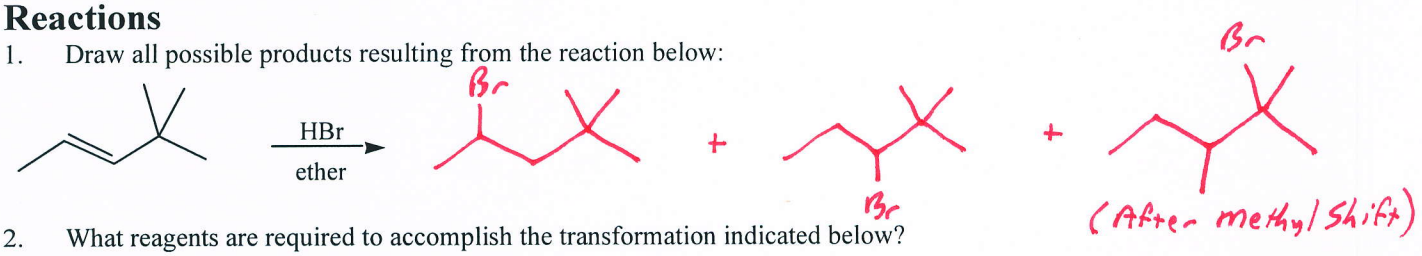


C

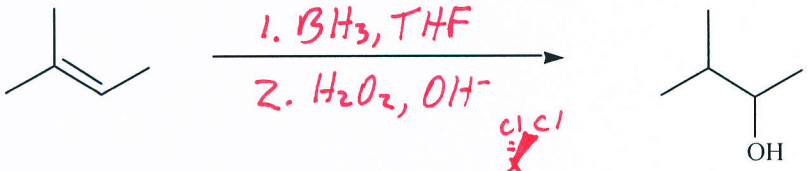


Reactions

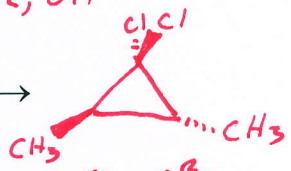
1. Draw all possible products resulting from the reaction below:



2. What reagents are required to accomplish the transformation indicated below?



3. *trans*-2-butene $\xrightarrow{CHCl_3,\ KOH}$



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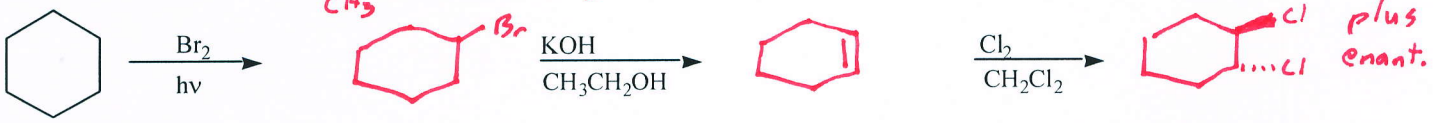

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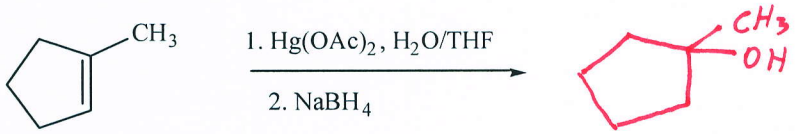

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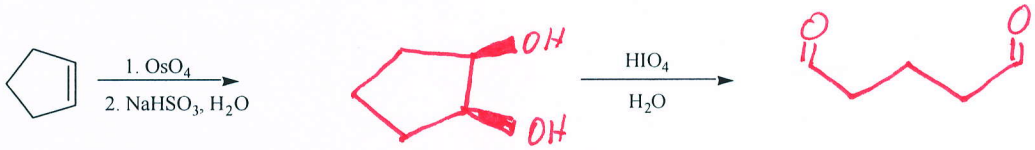

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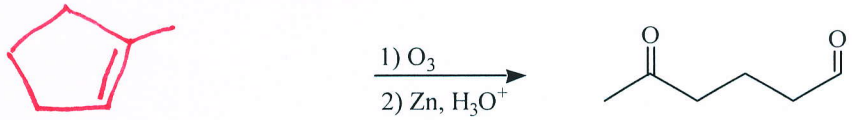

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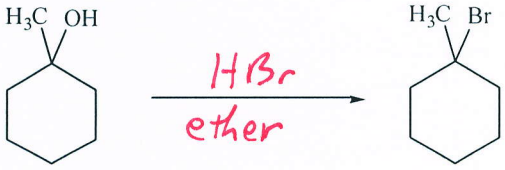

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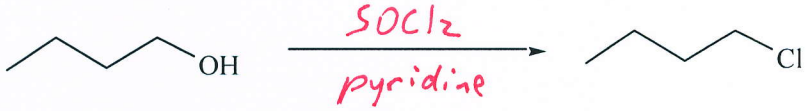
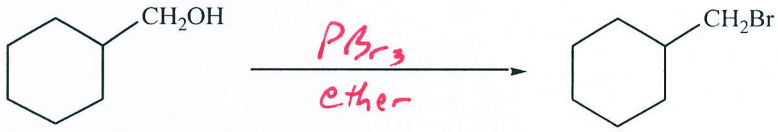
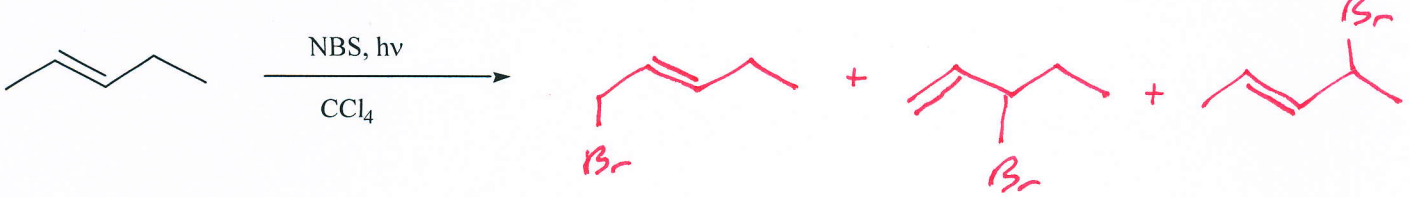


10.

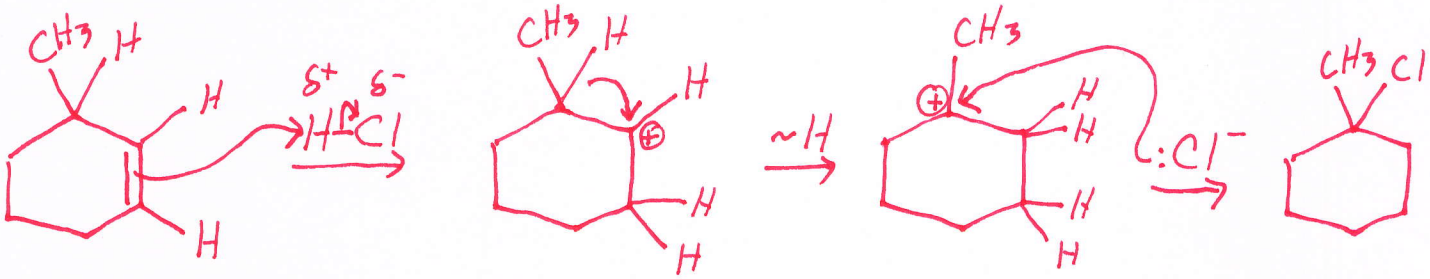


11. Draw all possible products for the following reaction:

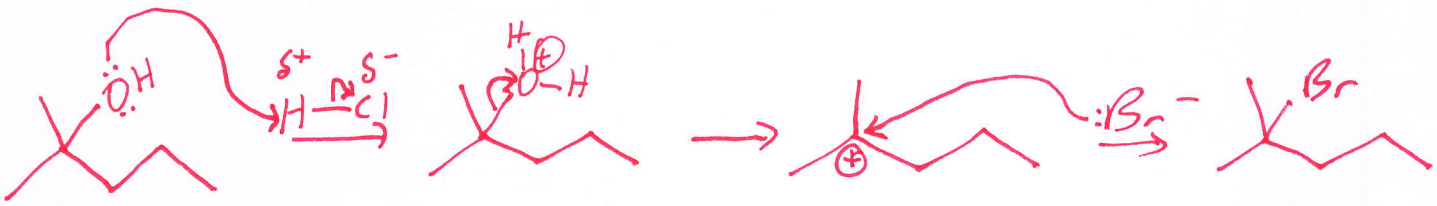


Mechanism

1. When 3-methylcyclohexene reacts with HCl in ether, one of the products is 1-chloro-1-methylcyclohexane. Show the <u>complete mechanism</u> for the formation of this product using the curved arrow formalism.



2. Show the complete mechanism for the reaction of 2-methyl-2-pentanol with HBr.



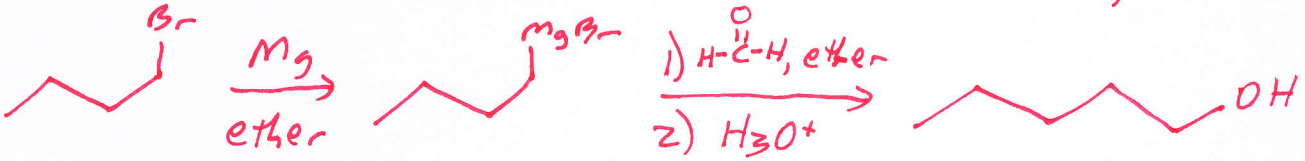
Synthesis

1. acetylene as your only source of carbon $\xrightarrow{???}$ 3-methyl-3-pentanol

Please see the last page.

2. 1-bromobutane $\xrightarrow{???}$ 1-pentanol

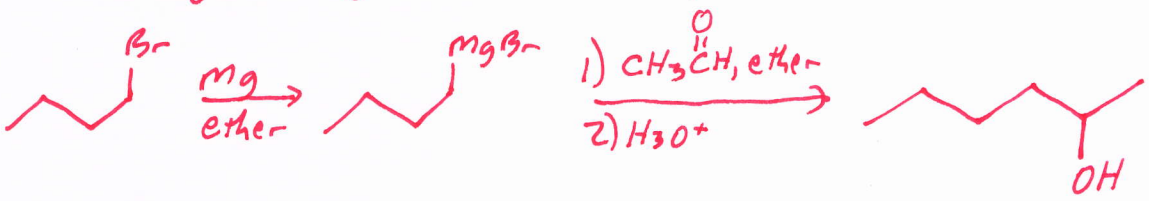
- Starting with a 4 carbon compound, make a 5 carbon, 1° alcohol
- To do this, react a Grignard Reagent with Formaldehyde



3. 1-bromobutane $\xrightarrow{???}$ 2-hexanol

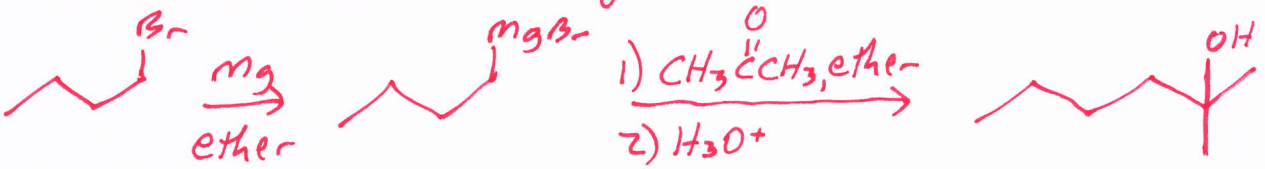
4 carbon compound → 6 carbon, 2° alc

Use Grignard Reagent with an aldehyde:

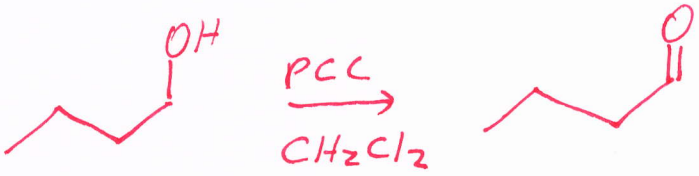


4. 1-bromobutane $\xrightarrow{???}$ 2-methyl-2-hexanol

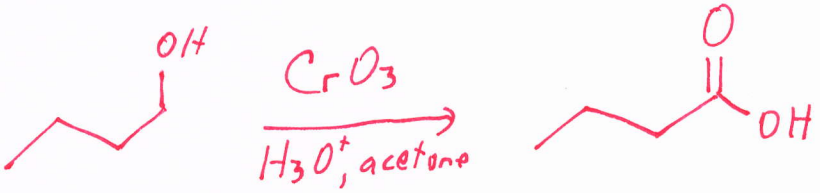
1° alkyl halide will form a Grignard Reagent that will react with a ketone to give a 3° alcohol:



5. 1-butanol $\xrightarrow{???}$ butanal



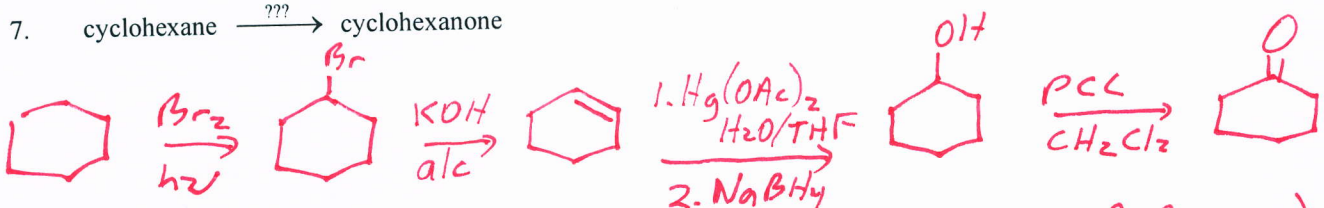
6. 1-butanol $\xrightarrow{???}$ butanoic acid



(or use $\xrightarrow{KMnO_4}$)

(although CrO_3/H_3O^+/acetone is preferred)

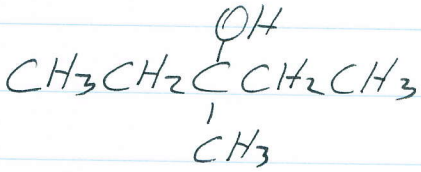
7. cyclohexane $\xrightarrow{???}$ cyclohexanone



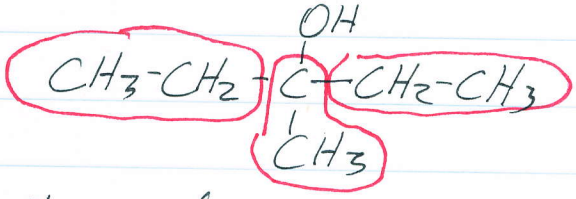
(or use $\xrightarrow[H_3O^+, \text{acetone}]{CrO_3}$)

Synthesis Problem # 1

Using acetylene (ethyne) as your only source of carbon, synthesize 3-methyl-3-pentanol:



Since acetylene is the only source of carbon, look at the product, and find all of the two-carbon units:



Each of these two carbon units must come from acetylene.

Also, remember that we can make a 3° alcohol by reacting a Grignard Reagent with a Ketone.

1) Make Bromoethane: $H-C\equiv C-H \xrightarrow[\text{Lindlar's catalyst}]{H_2} H_2C=CH_2 \xrightarrow[\text{ether}]{HBr} CH_3CH_2Br$

2) Make the Grignard Reagent: $CH_3CH_2Br \xrightarrow[\text{ether}]{Mg} CH_3CH_2MgBr$ (from step 1)

3) Make the 4 carbon ketone, then the Grignard Rxn → 3° alcohol

$H-C\equiv C-H \xrightarrow[2.\ CH_3CH_2Br\ (\text{from step 1})]{1.\ NaNH_2, NH_3} CH_3CH_2C\equiv CH \xrightarrow[HgSO_4]{H_2SO_4, H_2O} CH_3CH_2\overset{O}{\overset{\|}{C}}CH_3$

$CH_3CH_2\overset{O}{\overset{\|}{C}}CH_3 \xrightarrow[2.\ H_3O^+]{\text{from step 2}\ 1.\ CH_3CH_2MgBr, \text{ether}} CH_3CH_2\overset{OH}{\overset{|}{C}}-CH_2CH_3$ (with CH_3 on the central C)