Dr. Steven Pedersen December 12, 2016

Chemistry 3A

Final Exam

Student name: ANSWER KEY

Student ID: ________________ (Also include your SID in the top left corner of each page)

Student signature: ____

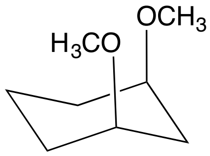
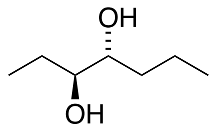
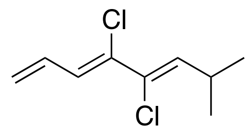
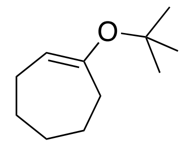
Problem 1	________	(21 pts)
Problem 2	________	(30 pts)
Problem 3	________	(40 pts)
Problem 4	________	(14 pts)
Problem 5	________	(30 pts)
Problem 6	________	(15 pts)
Problem 7	________	(24 pts)
Problem 8	________	(16 pts)
Problem 9	________	(14 pts)
Problem 10	________	(21 pts)
Total Points	_________	(225 pts)

No Calculators Allowed
No Molecular Models Allowed
Be Sure Your Exam has 15 Pages

ALL ANSWERS MUST BE ON THE FRONT OF EACH PAGE. ANY ANSWERS ON THE BACK OF A PAGE WILL NOT BE CONSIDERED FOR GRADING.

1. (21 pts)

A. Match the structure with a name. Place the letter of the correct name in the box below each structure.

			
H	B	O	J

A. (3*S*,4*S*)-3,4-heptanediol

B. (3*S*,4*R*)-3,4-heptanediol

C. (3*S*,4*R*)-3,4-hexanediol

D. (4*R*,6*S*)-4,6-heptanediol

E. (1*S*,3*S*)-1,3-dimethoxycyclohexane

F. (2*R*,4*S*)-2,4-dimethoxycyclohexane

G. (1*R*,3*R*)-1,3-dimethoxycyclohexane

H. (1*R*,3*S*)-1,3-dimethoxycyclohexane

I. 1-(*tert*-butoxy)-3-cycloheptene

J. 1-(*tert*-butoxy)-1-cycloheptene

K. 1-(*tert*-butoxy)-1-cyclooctene

L. 1-(*sec*-butoxy)-1-cycloheptene

M. (3*Z*,6*Z*)-4,5-dichloro-7-methyl-1,3,5-octatriene

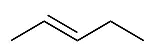
N. (1*Z*,5*Z*)-4,5-dichloro-7-methyl-1,3,5-octatriene

O. (3*Z*,5*Z*)-4,5-dichloro-7-methyl-1,3,5-octatriene

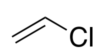
P. (3*Z*,5*Z*)-6-isopropyl-4,5-dichloro-7-methyl-1,3,5-octatriene

B. Draw a structure for each of the following names. For cycloalkanes use flat rings.

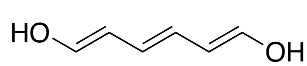
- *trans*-2-pentene



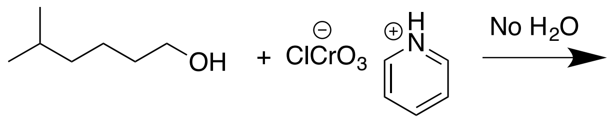
- chloroethene (i.e. vinylchloride)

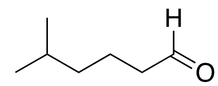


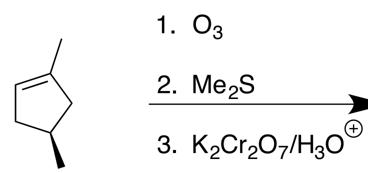
- (1*E*,3*E*,5*E*)-1,3,5-hexatriene-1,6-diol

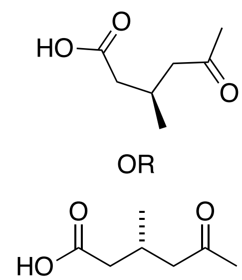


2. Predict all of the possible organic product(s) from the following reactions. Where relevant, show all stereoisomers. Pay particular attention to any information given in the product boxes. Each redundant or wrong answer within a box cancels one correct in the same box. (30 pts)

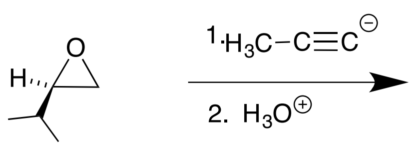


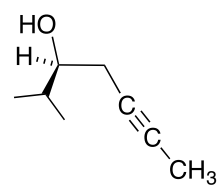




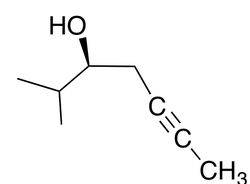


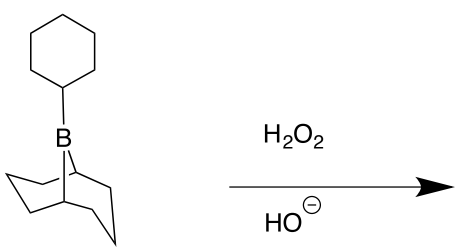
+ Me_2SO

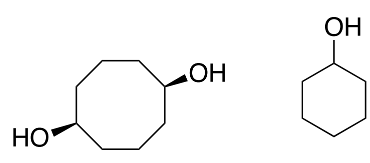




OR







All ring products must be drawn as flat rings.

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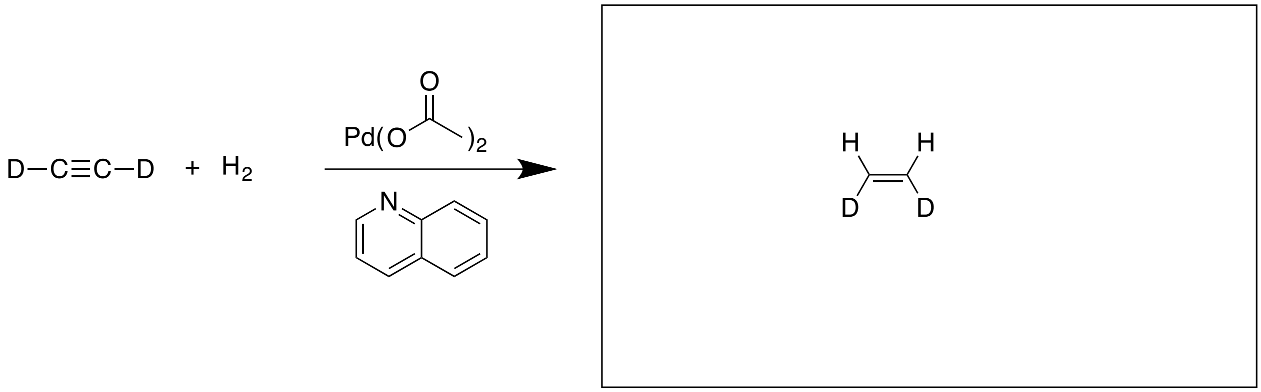
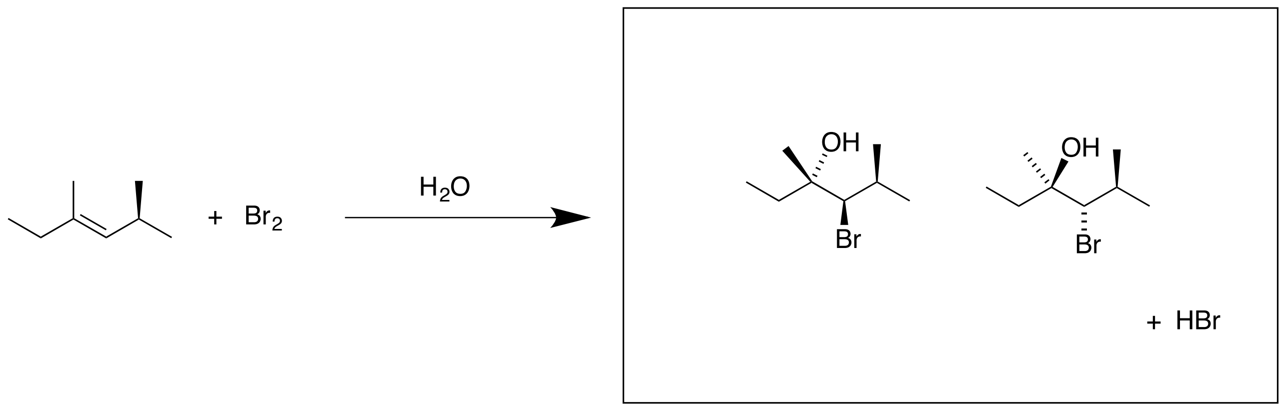
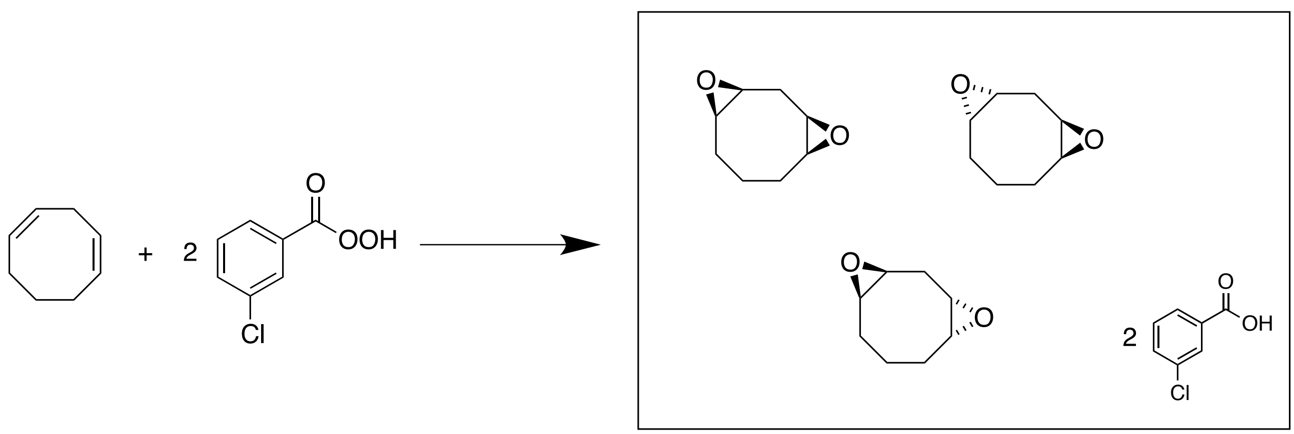
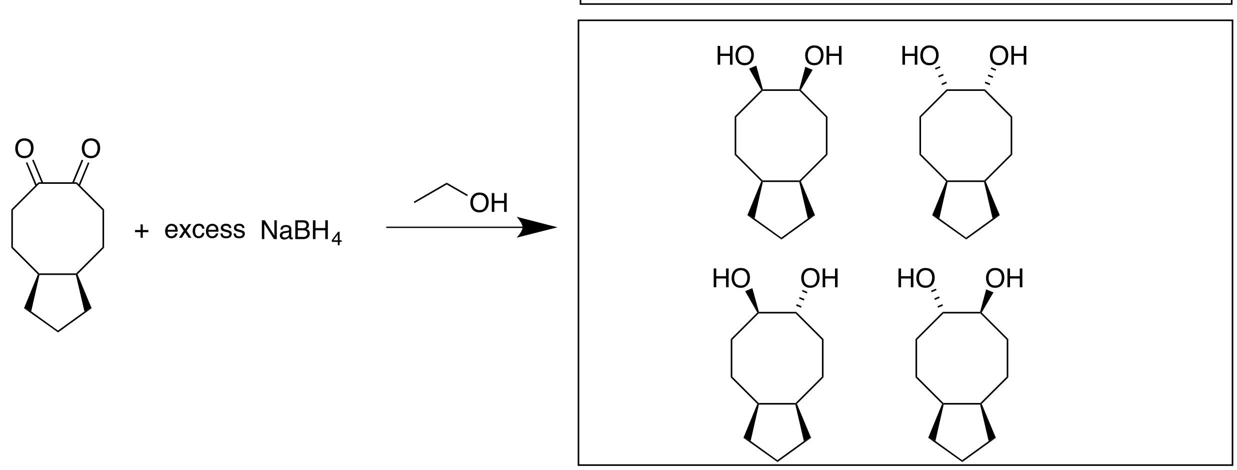

D—C≡C—D + H2
Pd(O)2
O
N
H H
D D

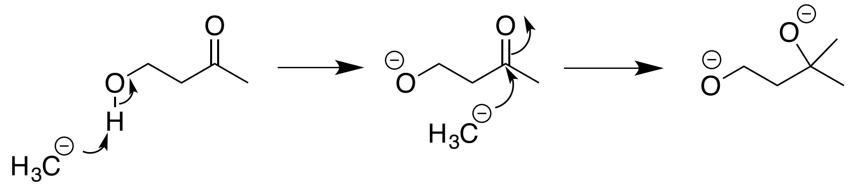

+ Br2
H2O
OH
Br
OH
Br
+ HBr

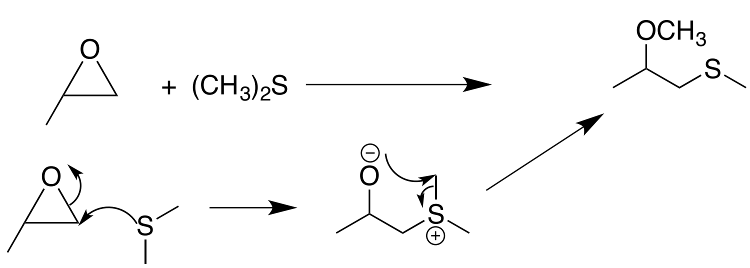

+ 2
O
OOH
Cl
O
O
O
O
O
O
2
O
OH
Cl


O O
+ excess NaBH4
OH
HO OH
HO OH
HO OH
HO OH

3. Write logical arrow-pushing mechanisms for the following reactions. Be sure that your mechanism accounts for all products shown. (40 pts)

To receive full credit, the order of the steps in this reaction must be carried out correctly.





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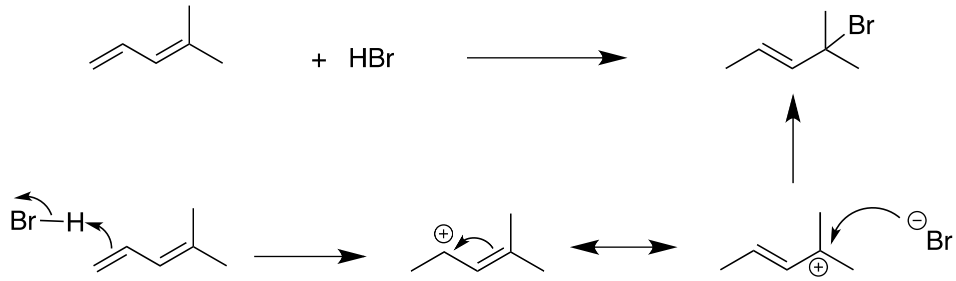
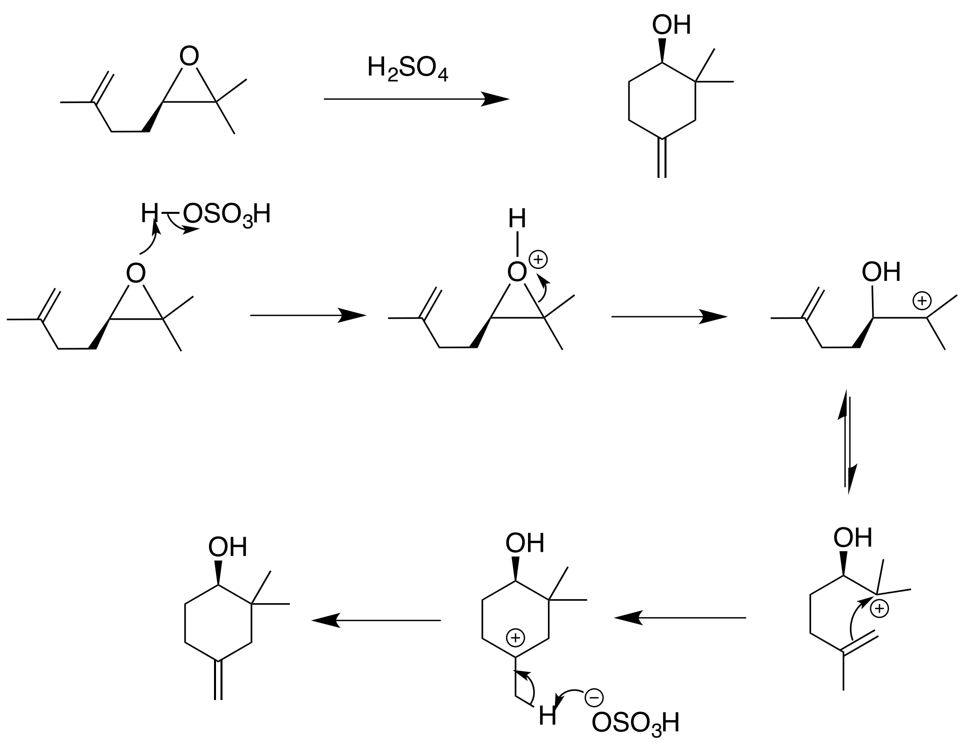
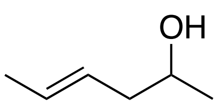
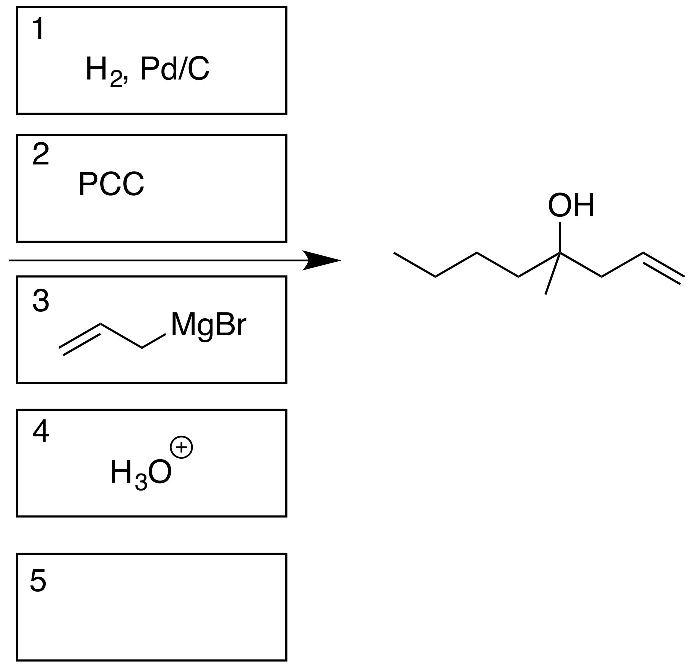




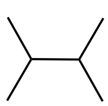
4. Provide the reagents and any other organic compounds necessary to synthesize the indicated product(s) from the starting material shown. For each problem, five boxes are provided in which to place each step of your synthesis. **No synthesis will require more than five steps. However, some or all, may require fewer than five steps.** (14 pts)

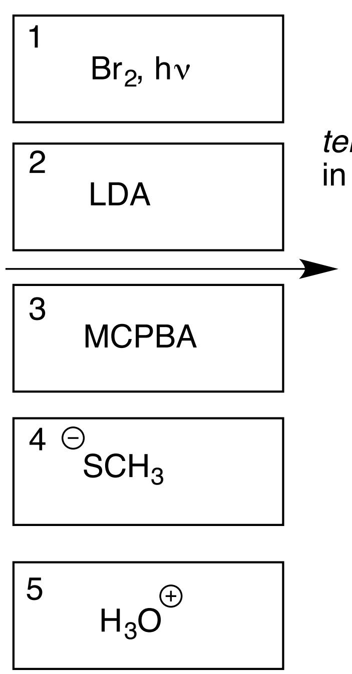




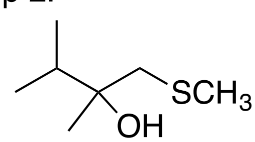
Steps 1 and 2 can be reversed.

If the wrong carbanion is used in step 3, then there is no credit for step 4.

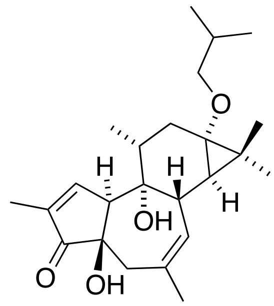




tert-butoxide can also be used in step 2.



5. (30 pts)
The phorbols are a class of naturally occurring organic compounds with potential therapeutic uses. The following questions will be about the phorbol compound shown below.



Phorbol A

A. How many degrees of unsaturation does Phorbol A contain?__*7*__

B. If 1 millimole of Phorbol A was reacted with 5 millimoles of sodium hydride, how many millimoles of hydrogen, H_2, would be formed? (Hint: an excess of sodium hydride might have been used). __*2*___

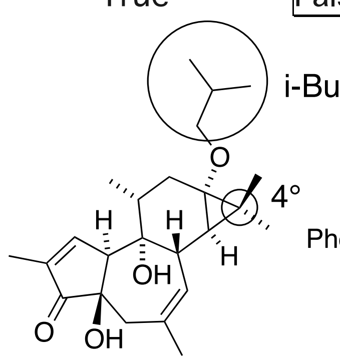
C. A straight in poker means that you have five sequential cards. For example, the 5,6,7,8 and 9 (of any suit). What ring size in Phorbol A is missing to claim that we have a "straight" of rings?__*four*_

D. On the structure of Phorbol A shown at the bottom of the page, circle the isobutyl group and label it i-Bu.

E. On the structure of Phorbol A shown at the bottom of the page, circle all quaternary carbons and label them 4° (there is at least one). Wrong answers cancel right answers.

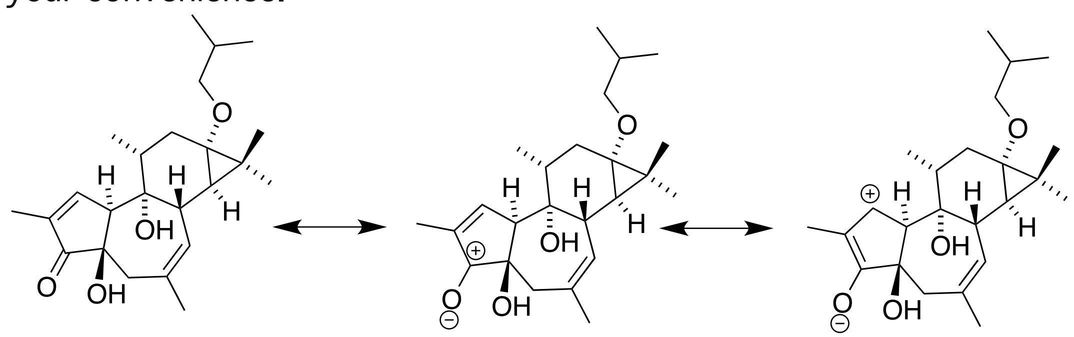
F. True or false. There is only one trisubstituted double bond in Phorbol A. Circle your answer below.

True $\boxed{\text{False}}$

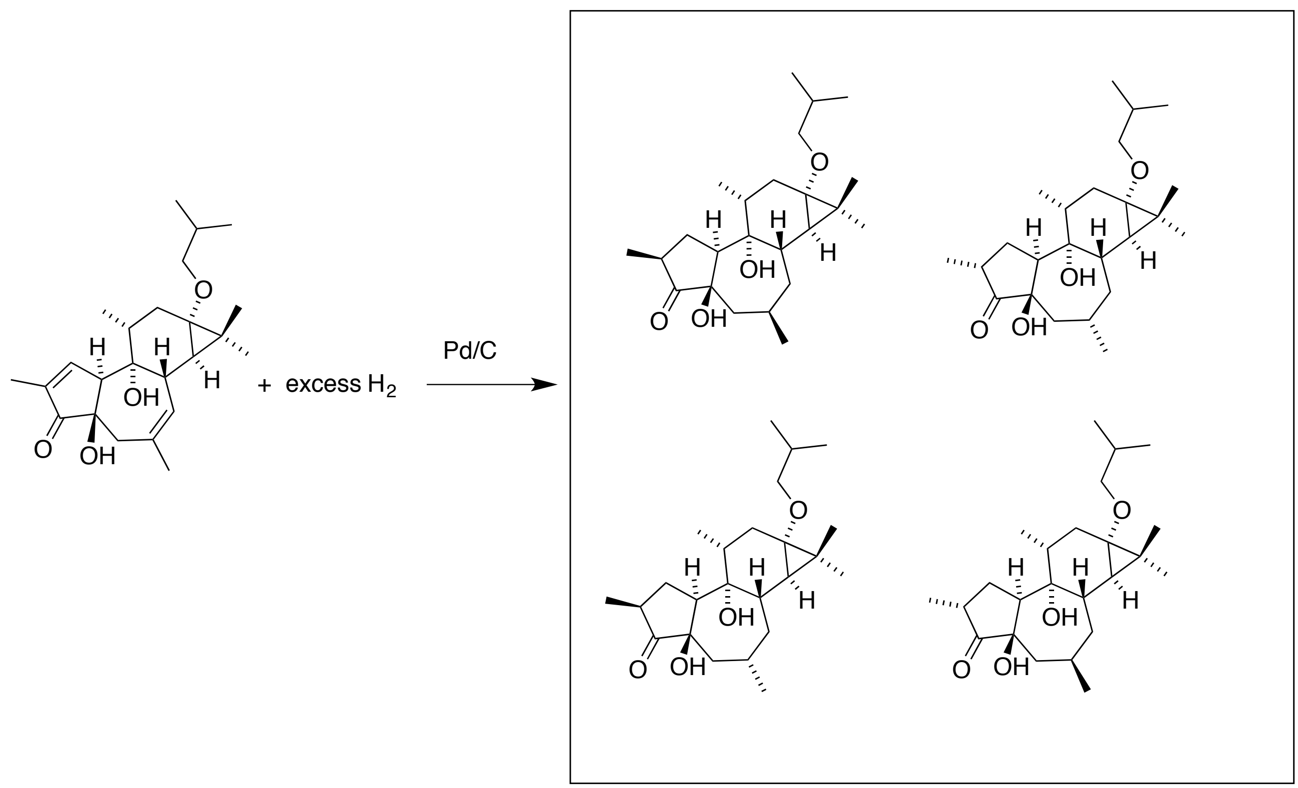


Phorbol A

G. There are two additional reasonable and valid resonance structures you can draw for Phorbol A. Draw them below. The skeletons have been provided for your convenience.

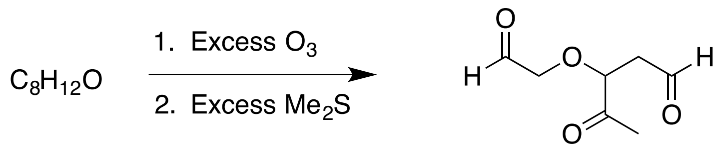


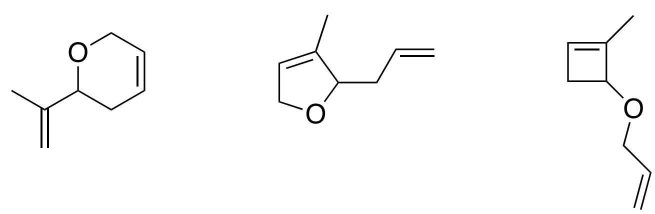
H. The reaction shown below produces four stereoisomers. The primary skeletons are supplied for you. There are two substituents missing that will need to be added back to complete the structure in each case. Wrong answers cancel right answers. Redundant answers cancel each other.



6. (15 points)

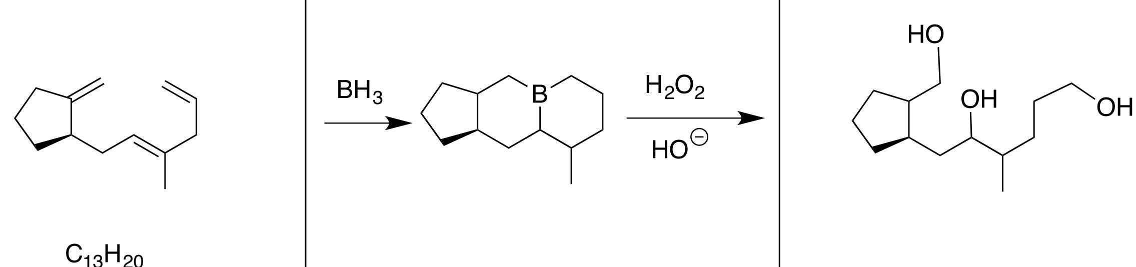
A. An unknown compound with the molecular formula $C_8H_{12}O$ was treated with excess ozone followed by excess dimethyl sulfide. After the reaction was complete, the mixture was added to water and then diethyl ether was added to extract any organic products that were not soluble in water. The product obtained from the ether extracts is shown below. Based on this structure and any information provided above, draw all possible structures of $C_8H_{12}O$ in the box provided. Wrong answers cancel right answers.





Draw all the possible structures of C_8H_{12} based on the above information. You do NOT need to include stereosiomers.

B. Fill in the two blank boxes.



C. The carbanion shown below has been observed in outer space. Provide the IUPAC name of this carbanions conjugate acid.

$$H-C\equiv C-C\equiv C-C\equiv C-C\equiv C^{\ominus}$$

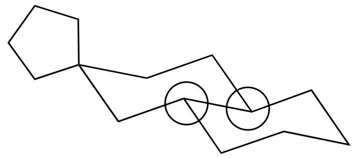
IUPAC name of conjugate acid:

1,3,5,7-octatetrayne or octa-1,3,5,7-tetrayne

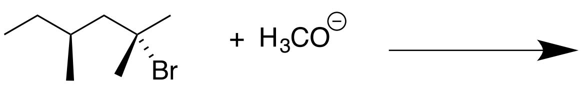
Been There Before

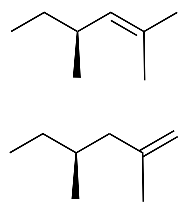
7. (24 points)

A. On the compound shown, circle all bridgehead atoms. Be sure that your circle only includes one atom (not including hydrogen atoms). Wrong answers cancel right answers.



B. Predict all of the possible organic product(s) from the following reactions. Where relevant, show all stereoisomers. Pay particular attention to any information given in the product boxes. Each redundant or wrong answer within a box cancels one correct in the same box. (30 pts)

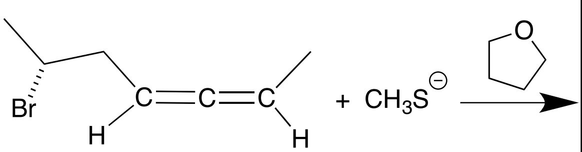




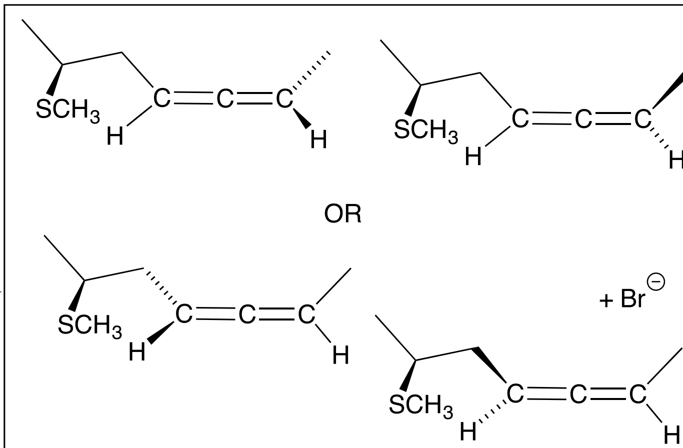
Requirements:
1. If a wedged Me group is shown at the SP2 carbon, it is wrong. However,in this case, do not cancel another correct answer.
2. If there is another answer, that is incorrect based on where the alkene is, then this would cancel a correct answer in the box.
3. The wedged Me group at the stereocenter must remain wedged. If it drawn flat or dashed, that will be a wrong answer, which will then cancel a correct answer in the box.
4. If they show a substitution product, then that will cancel a correct answer in the box.

No Substitution + CH_3OH

1.If a flat line is drawn to the SMe group, the answer is wrong. Which would then cancel any correct answer in the box.
2. No wedge and dash on SP2 carbon means 0 points.

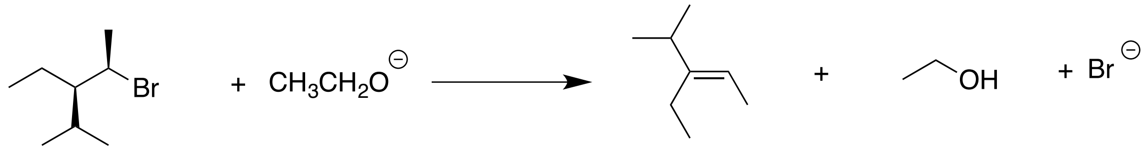


This is an S_N2 reaction!

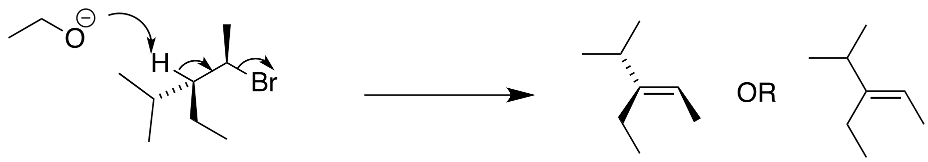


Two Stereoisomers

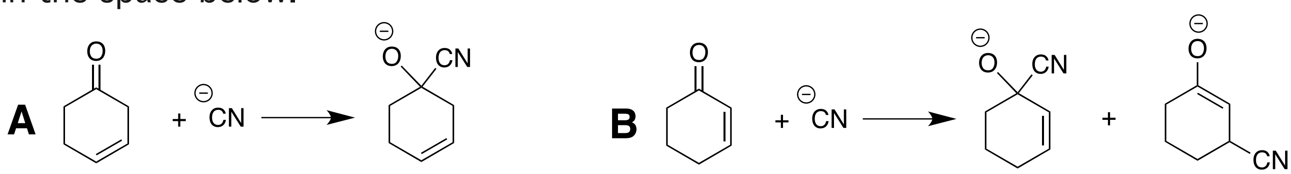
C. Write a logical arrow-pushing mechanism for the following reaction. Be sure that your mechanism accounts for all products shown.



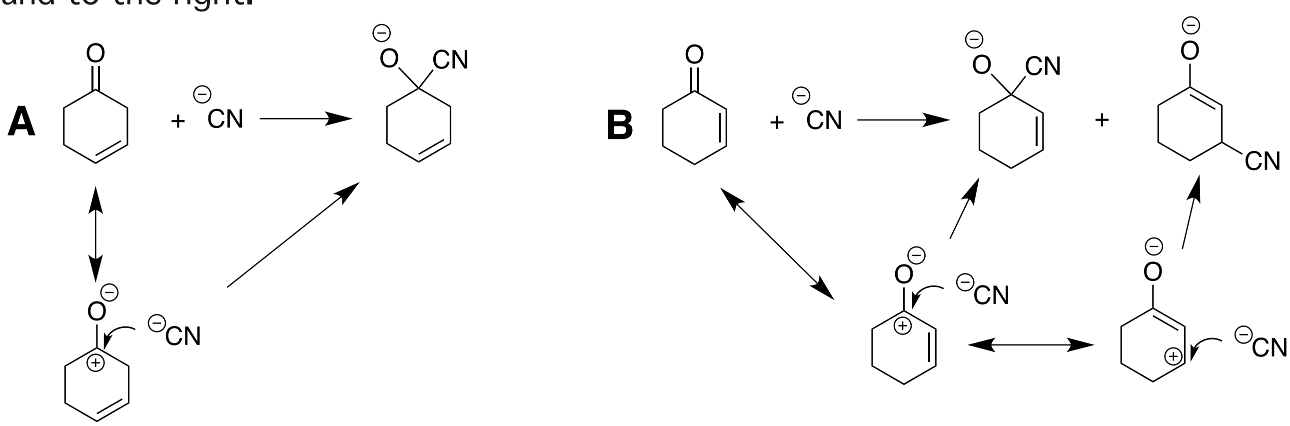
Hint: Note that only one of two possible alkenes is formed in this reaction. In addition to arrow-pushing, you must show the correct conformation of the starting material that leads to this product.



8. The only difference between the two ketones in equations A and B below is the placement of the carbon-carbon double bond. However, in equation A, reaction with cyanide ion leads to only one product whereas in equation B two products are formed. Explain these results using drawings and words. Your answer must be kept in the space below.



In equation A, the compound has only one reasonable and valid resonance structure, which indicates why the cyanide ion reacts where it does. In equation B, the compound has two reasonable and valid resonances structures as shown below and to the right.



9. (14 points)

Match the name with the structure. Write the letter corresponding to the correct structure next to the name in each box (all the structures are on the next page). There are more structures than names and no structure can be used twice. This question is asking you to take information you are aware of from lecture and apply it to the names of commercial products and naturally occurring compounds. In some cases you will be required to extrapolate based on that knowledge.

- Nerol is a diastereomer of geraniol, an important natural product used in the fragrance industry. The IUPAC name of geraniol is (E)-3,7-dimethyl-2,6-octadien-1-ol.

  Nerol: L

- The active ingredient in many snail baits is 2,4,6,8-tetramethyl-1,3,5,7-tetraoxacyclooctane (this is actually the name provided on many brands of snail poison).

  2,4,6,8-tetramethyl-1,3,5,7-tetraoxacyclooctane: A

- Although I have not asked you to know any acronyms for this class, the use of acronyms both by chemists and the general public is pervasive. The compound MTBE was once used as a gasoline additive due to the presence of its single ether oxygen. If you can name simple ethers using common nomenclature, then you can ascertain what the acronym means.

  MTBE: I

- One component in the synthesis of banana oil is isopentyl alcohol. This compound is also found in the expensive and sought after black truffle. Use what you know about the common names of branched side chains to decipher the structure of this compound.

  isopentyl alcohol: G

- Adamantane is the name of a compound that has a structural feature related to that of diamond, that is, it is made up of six-membered rings of carbon existing in chair conformations. By the way, the name diamond is derived from the latin term diamas, which itself is derived from the term adamas, meaning “invincible”.

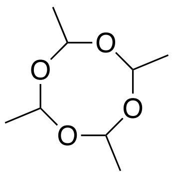
  Adamantane: C

- Sometimes names do not seem to be representative of their elemental composition. For example, the compound theobromine has no bromine in it. The name comes from the genus name *Theobroma,* or cacao tree (from which chocolate beans are harvested). Theobromine is a highly unsaturated alkaloids found in chocolate (it has 6 degrees of unsaturation).

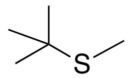
  Theobromine: M

- Sometimes a common chemical name states the obvious. Cubane is one of those names.

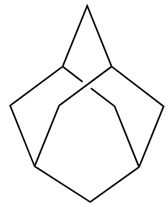
  Cubane: E



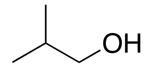
A



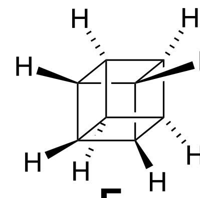
B



C



D



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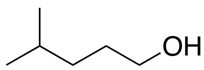

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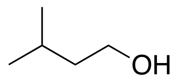

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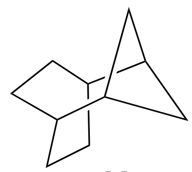

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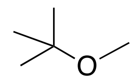

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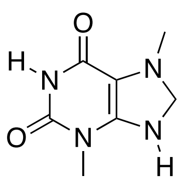

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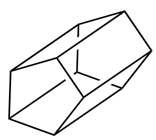

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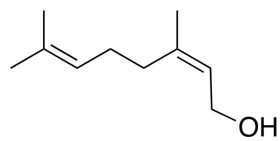

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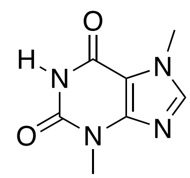

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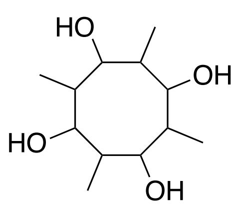

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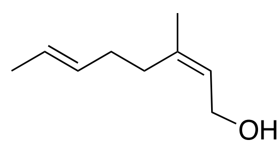
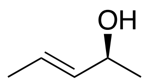


O

The Basics

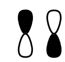
10. (21 points)

A. How many possible stereoisomers are there for the compound shown below (your number should **include** the compound shown). Place your answer in the box.



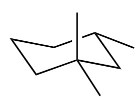
Maximum number of stereoisomers including the one shown. ***4***

B. Draw the Lowest Unoccupied Molecular Orbital of 1-pentene.

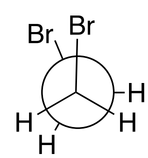


C. Provide a REAL example of an S_N2 reaction where there is no possibility of an E2 reaction occurring. You must show all starting materials and products.

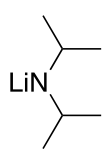
D. Draw the structure of 1,1,3-trimethylcyclohexane in its MOST stable chair conformation.



E. Draw a Newman projection of the LEAST stable conformation of 1,2-dibromoethane looking down the CC bond.

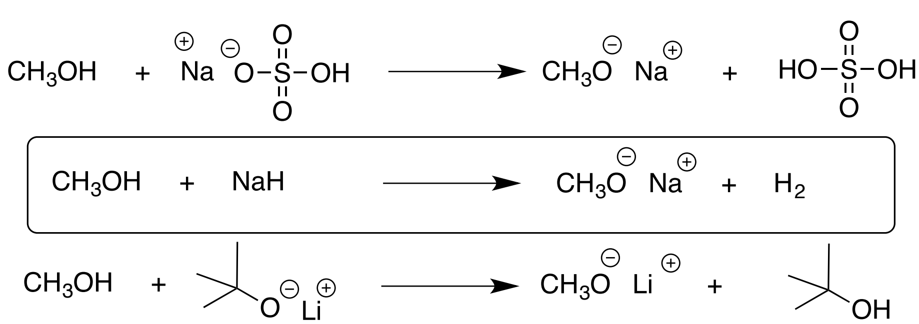


F. Lithium diisopropylamide (shown below) is best described as a: circle one term



a steric acid   a steric base   a steric alkoxide

G. Circle the equation with the largest positive $K_{equilibrium}$.



HAVE A GREAT WINTER BREAK!!