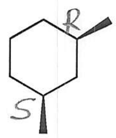
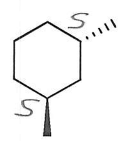
Key - Exam 3 3311
Summer 2011

Select the single best answer to each multiple choice question (1-18) and bubble it in on your Scantron. (~~3~~ 4 pts each)

For questions 1-5, identify the correct relationship between the two molecules shown using one of the following choices:

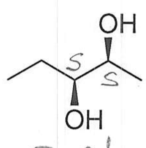
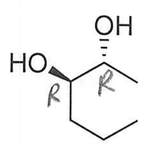
a. identical
b. constitutional isomers
c. diastereomers
d. enantiomers
e. none of these choices

1.

 and 

C - diastereomers

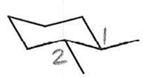
2.

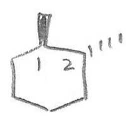
 and 

E - none of these

5 C's   6 C's

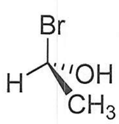
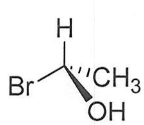
3.

 and 

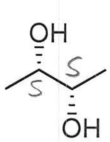
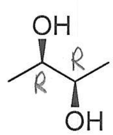
A- identical

4.

 and 

A - identical

5.

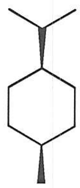
 and 

D - enantiomers

For questions 6-10, choose the term from the following list that correctly describes the structure:

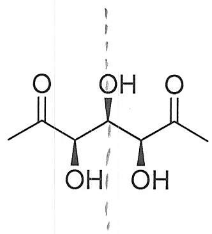
a. chiral
b. achiral
c. achiral and meso

6.



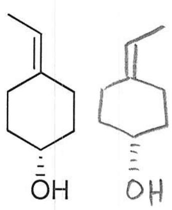
B – achiral
plane of symmetry, no asymmetric C's

7.



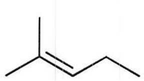
C – achiral & meso
plane of symmetry
2 asymmetric C's

8.



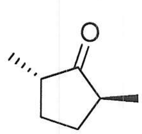
A – chiral
no plane of symmetry
non superimposable mirror image

9.



B – achiral
plane of symmetry (in page)
Superimposable mirror image

10.

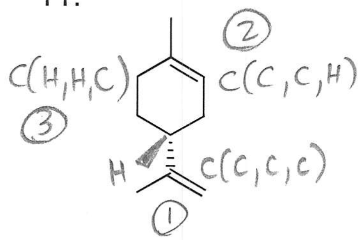


A – chiral
no plane of symmetry
non superimposable mirror image

For questions 11 and 12, indicate whether the absolute configuration at the asymmetric carbon is *R* or *S* by choosing the correct option:

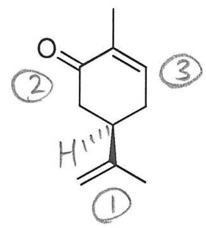
a. *R*
b. *S*

11.



R
(A)

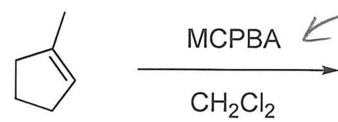
12.



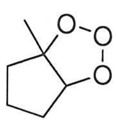
R
(A)

B

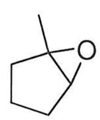
13. What is the major organic product of this reaction?



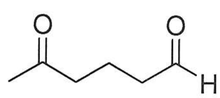
forms epoxide



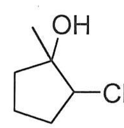
A



B



C



D

None of these is the major organic product

E

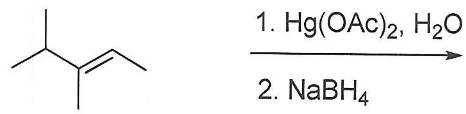
C

14. You have seen a number of addition reactions that can be classified as either "Markovnikov" or "anti-Markovnikov". Which of the following reagents is *not* involved in creating an anti-Markovnikov product from an alkene?

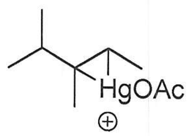
a. BH_3-THF - hydroboration-oxidation → Markovnikov alcohol*
b. CH_3OOCH_3 – "peroxide effect" when used with HBr
c. $Hg(OAc)_2$ – oxymercuration-reduction generates Markovnikov ROH
d. H_2O_2 - hydroboration-oxidation (see a)
e. All of these reagents are involved in anti-Markovnikov processes.

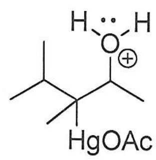
* hydroboration itself is anti-Markovnikov

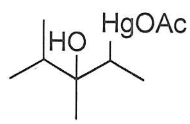
15. Which of the following is *not* a mechanistic intermediate in this reaction?



B







Neither B nor C are intermediates in this reaction

None of these structures are intermediates in this reaction

A B C D E

H_2O attacks more substituted side of mercurinium ion.

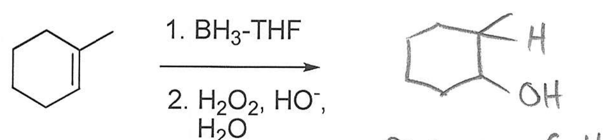
16. Which of the following terms or phrases does *not* describe meso compounds?

E

T a. They have asymmetric carbons
T b. They are achiral
T c. They have an internal (i.e., within the molecule) symmetry plane
T d. They are related to other compounds as diastereomers
e. All of these statements properly describe meso compounds

17. Is this reaction an oxidation, a reduction, or neither?

C

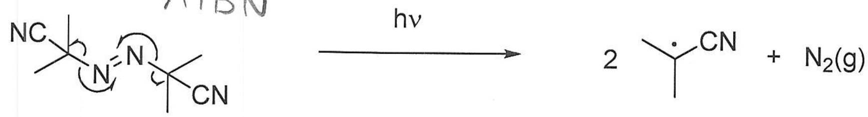


One new C-H
one new C-O

a. oxidation
b. reduction
c. neither oxidation nor reduction

18. What type of mechanistic step is shown here?

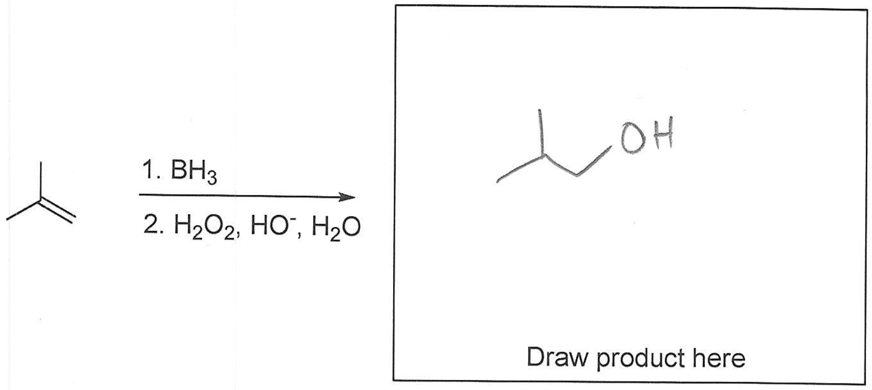
AIBN



A

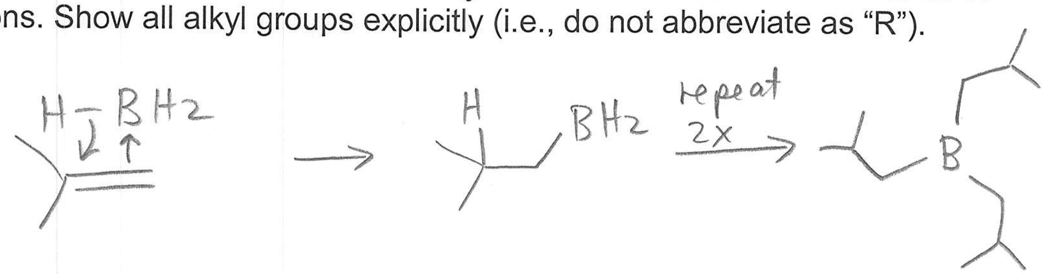
a. initiation
b. propagation
c. termination
d. substitution
e. chain reaction

19. Predict the major organic product of the following conditions and draw mechanisms as instructed below. In your mechanisms, show all necessary electrons (both lone pairs and unpaired electrons), non-zero formal charges, bonds, and curved arrows to receive full credit. (12 pts)



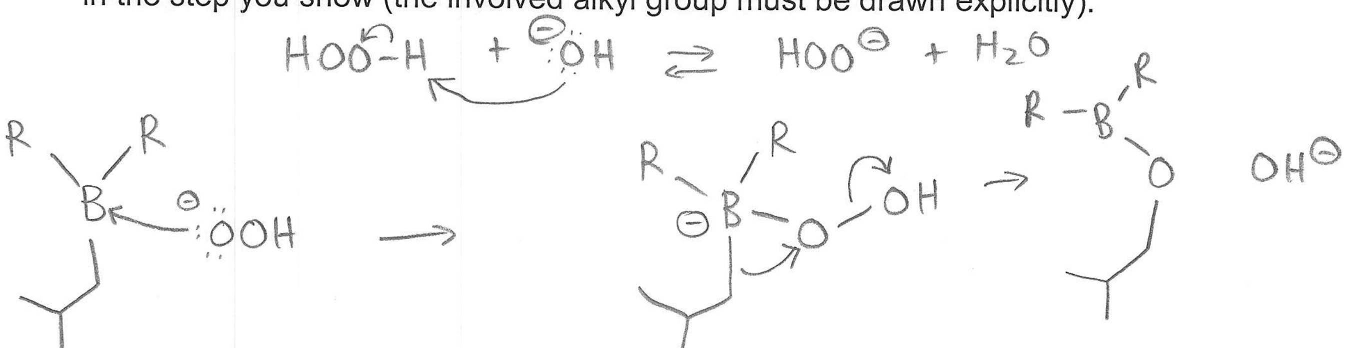
(a) Draw the major organic product in the box to the right of the reaction arrow.

(b) Draw a mechanism to show the addition of BH_3 across the alkene. You will recall that this process repeats three times. You only need to draw the first addition. Draw the structure of the trialkylborane that results from these three additions. Show all alkyl groups explicitly (i.e., do not abbreviate as "R").



trialkylborane

(c) Draw a mechanism showing the oxidation of the trialkylborane. You will recall that this process also repeats three times. You only need to draw the first oxidation. You may use the abbreviation "R" for alkyl groups not directly involved in the step you show (the involved alkyl group must be drawn explicitly).



then repeats 2x

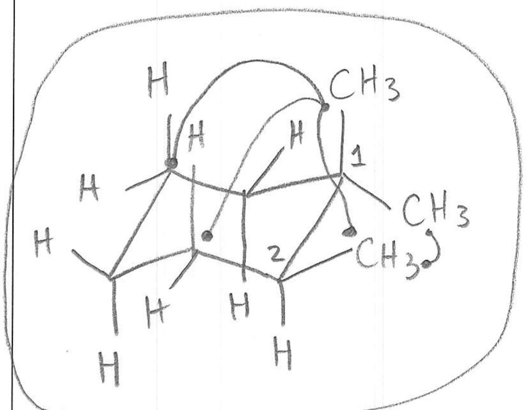
20. READ THE FOLLOWING QUESTION CAREFULLY BEFORE YOU START DRAWING.

(a) Draw the two chair conformations of 1,1,2-trimethylcyclohexane.

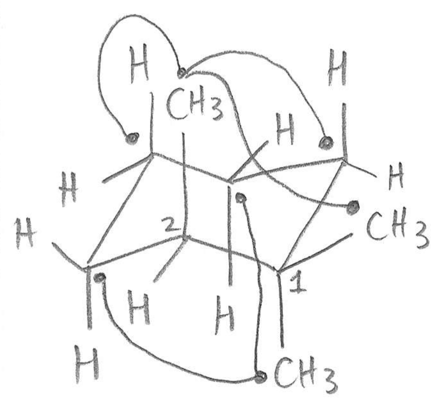
(b) Clearly identify all sources of strain (i.e. gauche butane interactions) in each molecule. Under each chair, list the total number of gauche butane interactions you have identified.

(c) Circle the more stable chair conformation.

Draw your chairs neatly and in accordance with the guidelines set forth in class and in the text. Draw every hydrogen that is attached to the ring. Abbreviate methyl groups as "Me" or "CH_3". Do not draw "bowtie pasta with hair". (12 pts)



more stable chair



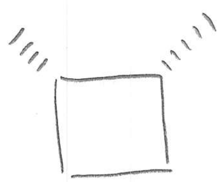
Total number of gauche butanes in this chair = 4

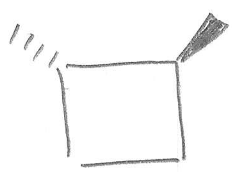
Total number of gauche butanes in this chair = 5

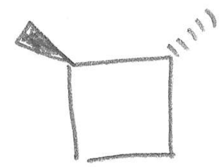
21. Gas chromatography is an analytical technique that separates molecules based on their boiling points. In a typical experiment, a sample of a compound is injected into the chromatograph, where it passes through a column and a detector. Once it passes through the detector, a signal is generated that is recorded as a "peak" on chart paper.

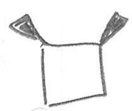
A chemist injects a mixture of all of the stereoisomers of 1,2-dimethylcyclobutane into a gas chromatograph.

(a) Draw all the stereoisomers of 1,2-dimethylcyclobutane and indicate their relationships to each other (enantiomers or diastereomers). Make sure that your drawings and relationships are clearly labeled. (6 pts)


A


B


C

or 

A, B: diastereomers
A, C: diastereomers
B, C: enantiomers

(b) How many peaks did the chemist see once this mixture had been separated? Explain. (6 pts)

Number of peaks = 2

Explanation (one or two sentences will be sufficient):

B and C are enantiomers and thus have the same boiling point, so will not separate.