CHEM 3311 **HARRINGTON**

Exam 4

1:30 – 4:00 PM May 10, 2017 in CHEM 142

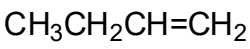
Instructions. No notes, books, laptops, phones, calculators, models, or stencils are allowed.

Periodic Table, Electronegativity Chart, Eclipsing and Gauche Strain Energy Tables, 1,3-Diaxial Strain Energy Table, and Table of pK_a Values are provided.

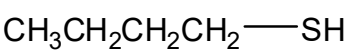
NAME: KEY

	Points Possible	Score
1	20	
2	20	
3	20	
4	20	
5	20	
6	20	
7	20	
8	20	
9	20	
10	20	
Exam 4 Total Raw Score	200	
Exam 4 Curve		
Exam 4 Curved Score		
Exam 4 Letter Grade		
Exam Score Replaced	#	
Quiz Points	50	
Total Points	550	
Final Letter Grade		

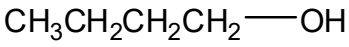
1(**20 points**) Functional groups are the organizational theme for many organic chemistry textbooks, including *Organic Chemistry, 6th Edition*, by Loudon and Parise. Name the functional group in each molecule below. 2 points each



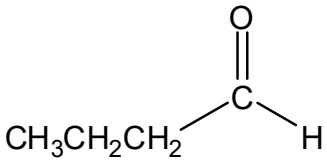
alkene



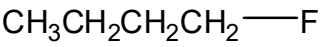
thiol/mercaptan/mercapto



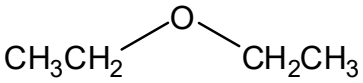
alcohol/hydroxyl



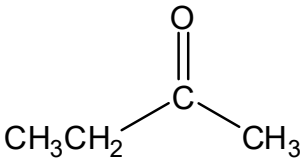
aldehyde



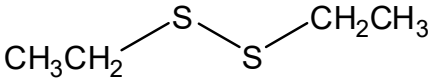
alkyl halide/alkyl fluoride



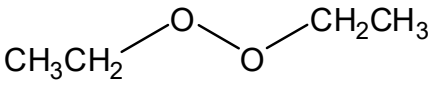
ether



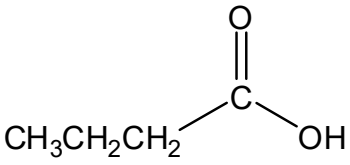
ketone



disulfide

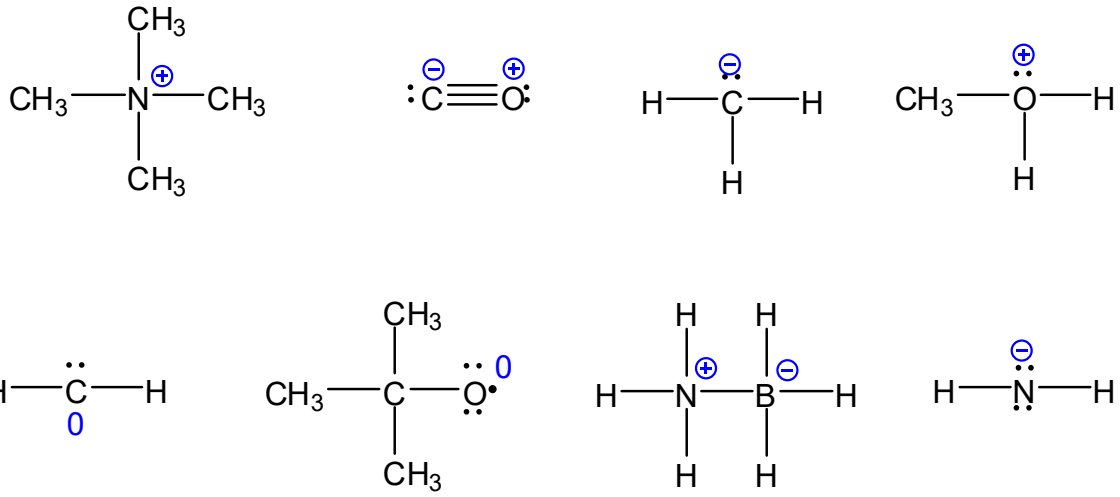


peroxide



carboxylic acid 2
acid 1

2. (**20 points**) Assign the appropriate formal charge to each atom. Atoms with formal charge not assigned will be assumed to have a formal charge of 0 (zero). 2 points each



3. (**20 points**) Circle the compound which has: 2 points each

HIGHER BOILING POINT

chloromethane	or	octane
1-hexanol	or	1-methoxypentane
1-chloropentane	or	1-chloro-3-methylbutane
fluoroethane	or	iodoethane

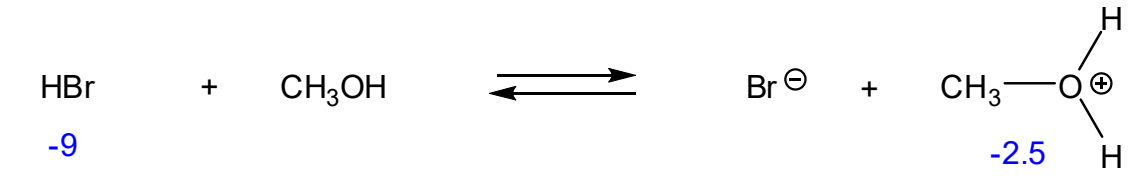
HIGHER MELTING POINT

heptane	or	2-methylhexane
octane	or	2,2,3,3-tetramethylbutane

HIGHER WATER SOLUBILITY

2-propanol	or	cyclohexanol
1-butanol	or	1-fluorobutane
1-pentanol	or	1,5-pentanediol
diethyl ether	or	tetrahydrofuran (THF)

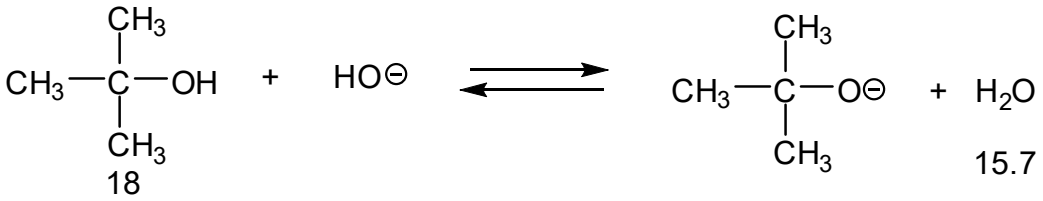
4. (**20 points**) Indicate (**circle**) whether each proton transfer reaction below favors products, reactants, or neither at equilibrium. Estimate the ratio of products-to-reactants.

A. 

-9 -2.5

reactants neither products 3

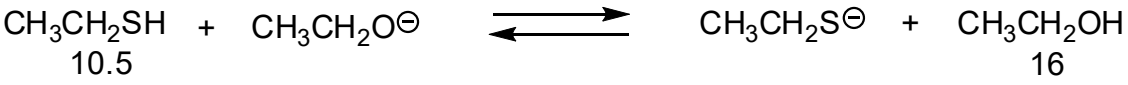
products:reactants ~ 10^6 - 10^7 or 1,000,000:1 2

B. 

18 15.7

reactants 3 neither products

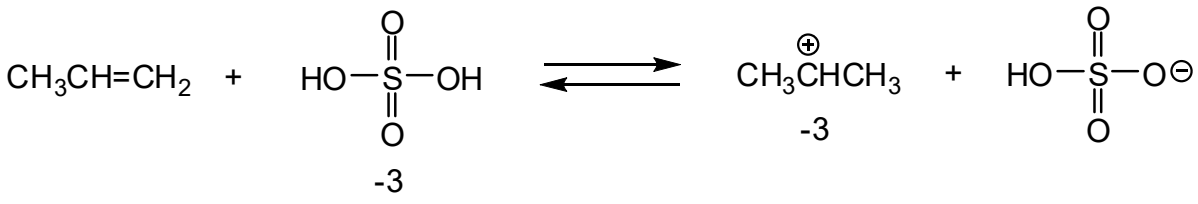
products:reactants ~ $1/10^2$ - 10^3 or 0.01 to 0.001 2

C. 

10.5 16

reactants neither products 3

products:reactants ~ 10^5 - 10^6 or 100,000 - 1,000,000:1 2

D. 

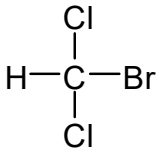
-3 -3

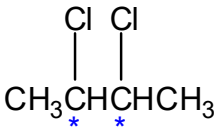
reactants neither 3 products

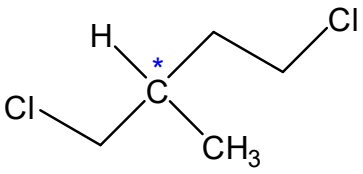
products:reactants ~ 1:1 2

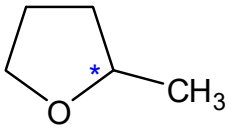
5. (**20 points**) Identify (with *) all of the asymmetric carbon atoms (if any) in each of the following structures. (CH6 Practice Problems 6.4 and 6.28)

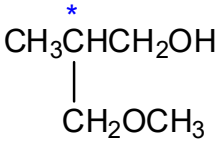
1 point each Identify each missing * when grading each incorrect C* -1

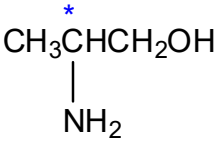


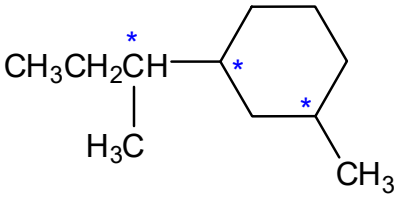


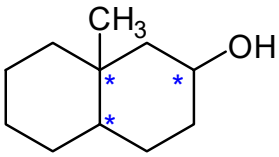


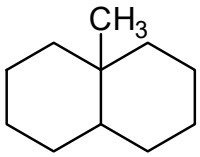


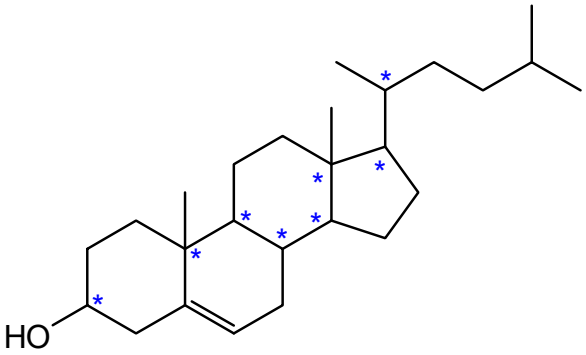






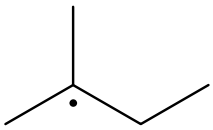




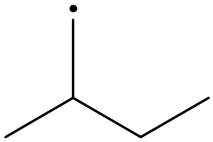


6. (**20 points**) Label the **most stable** and **least stable** member of each group. 2 points each

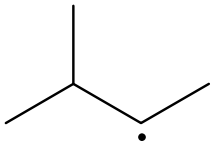
Group 1



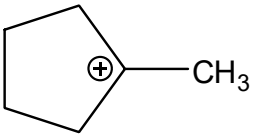
most



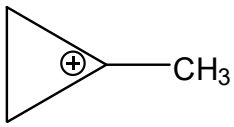
least



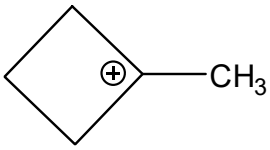
Group 2



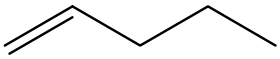
most



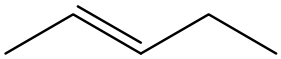
least



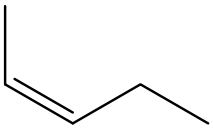
Group 3



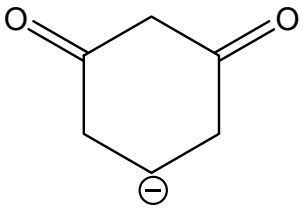
least



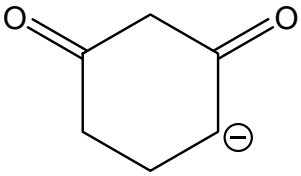
most

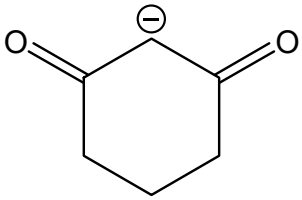


Group 4



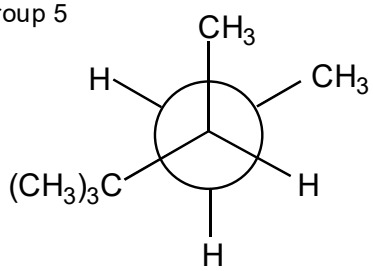
least



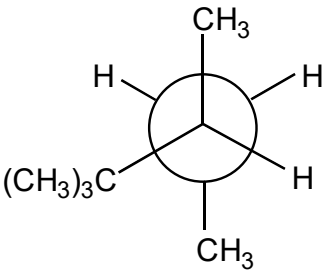


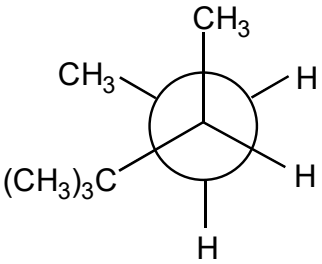
most

Group 5



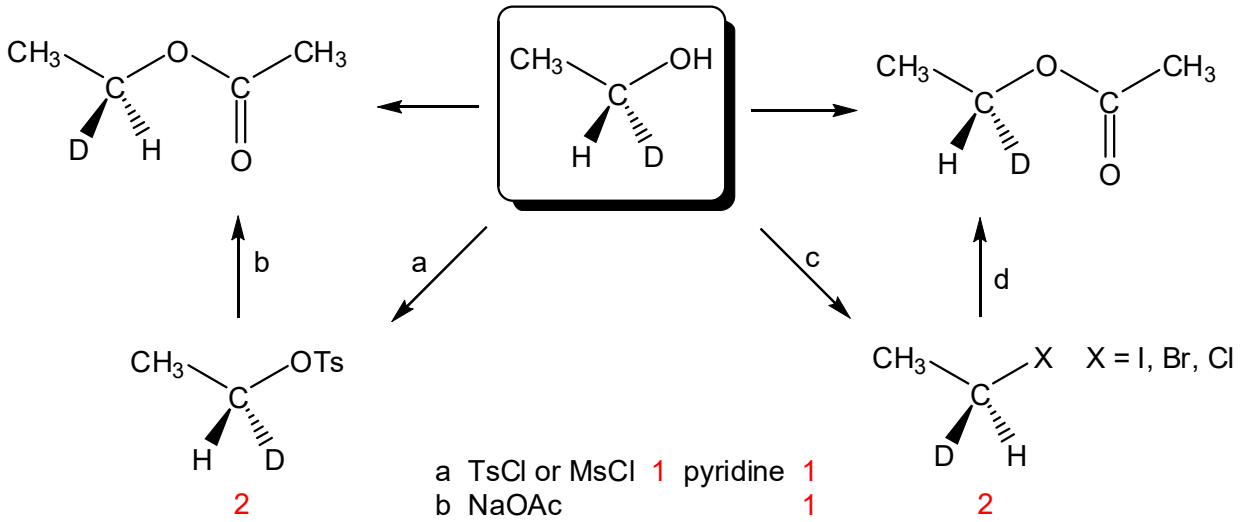
most





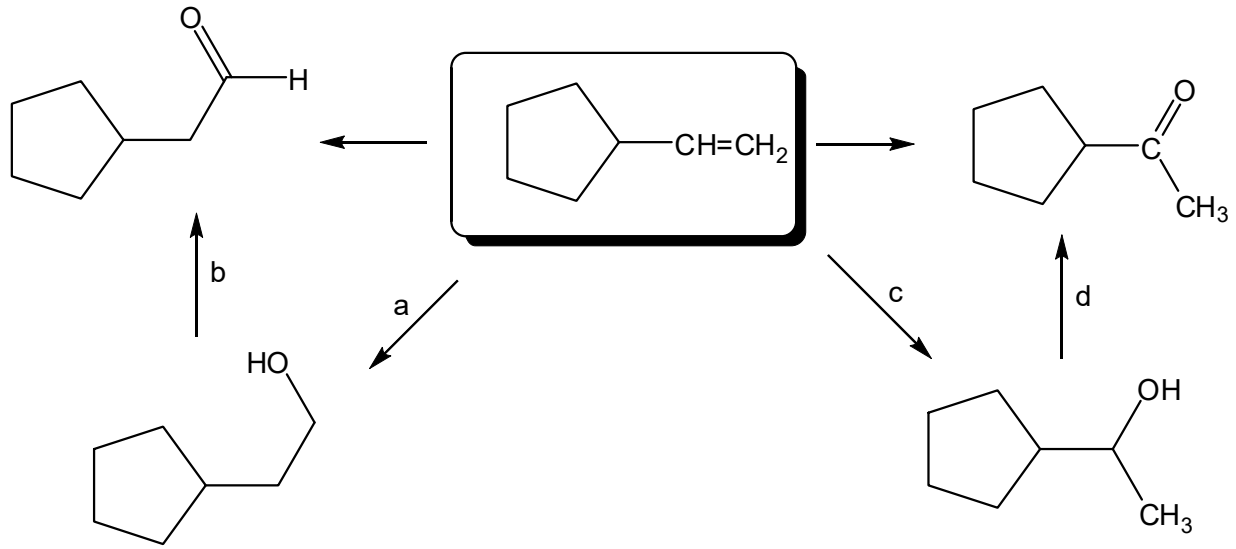
least

7. (**20 points**) Design a synthesis for each product from the given starting material. List any inorganic and organic reagents needed for each step. Draw structures for the products of each step. (*Hint*: More than one step is probably required.)



2 2

a TsCl or MsCl 1 pyridine 1
b NaOAc 1
c HI or HBr or HCl, $ZnCl_2$
or $SOCl_2$ or PBr_3 or Br_2-PPh_3 2
d NaOAc 1



2 2

a 1) BH_3THF 1 2) H_2O_2, NaOH 1
b CrO_3, pyridine or PCC 1
c 1) $Hg(OAc)_2$ 1 2) $NaBH_4$, NaOH 1
d CrO_3, pyridine or CrO_3, H_2SO_4 or PCC 1

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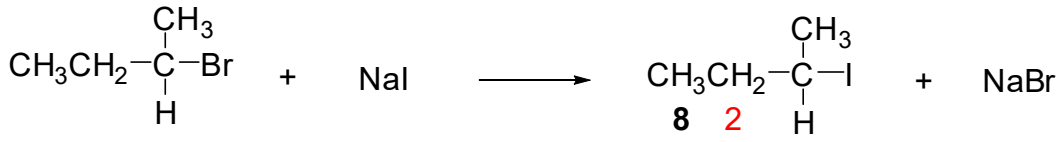
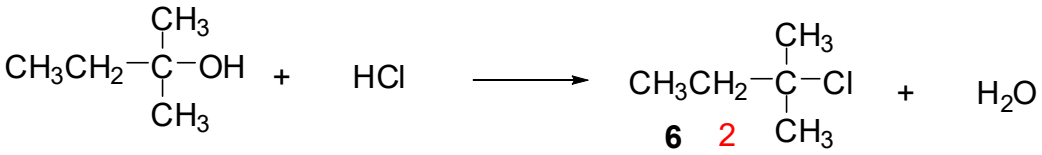
8. (**20 points**) Match each of the reactions to the correct reaction coordinate-energy diagram. Draw structures for the species present at each location (**1** – **8**) on the diagrams. Label each structure with the location number.



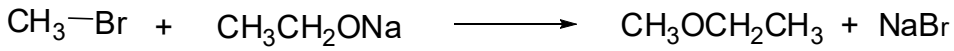
8 2

Diagram **D** 1



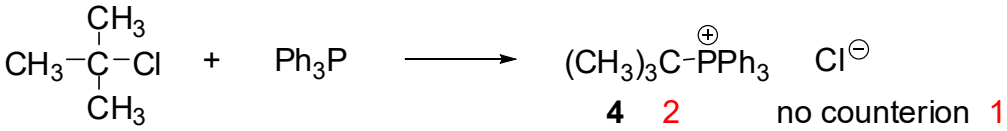
6 2

Diagram **C** 1



2 2

Diagram **A** 1



4 2 no counterion 1

Diagram **B** 1

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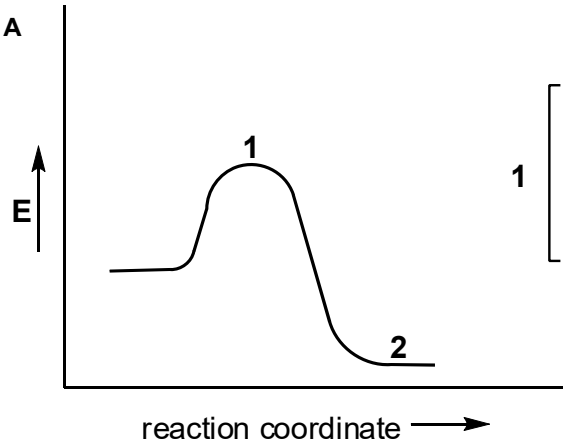
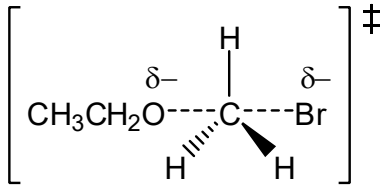
8. **Reaction Coordinate-Energy Diagrams**

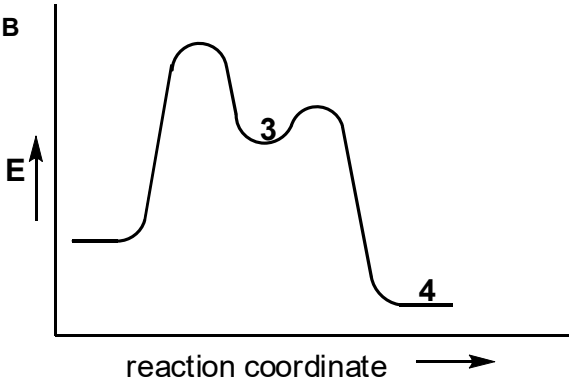
Diagram A

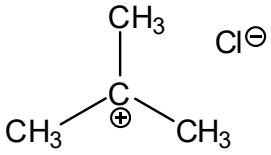


1 

2 no partial charges -1
no linear trajectory -1

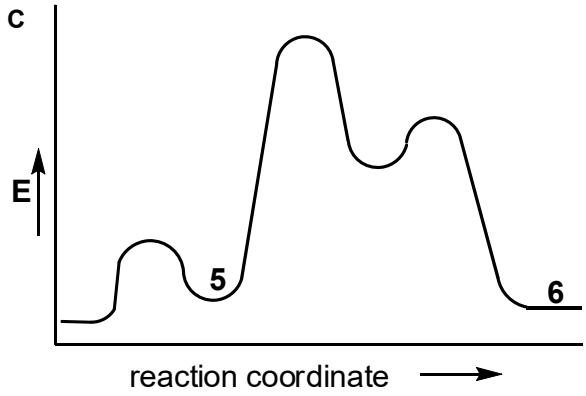
Diagram B

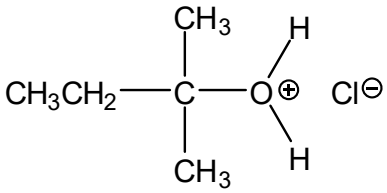


3 

2 missing + charge -1
missing counterion -1

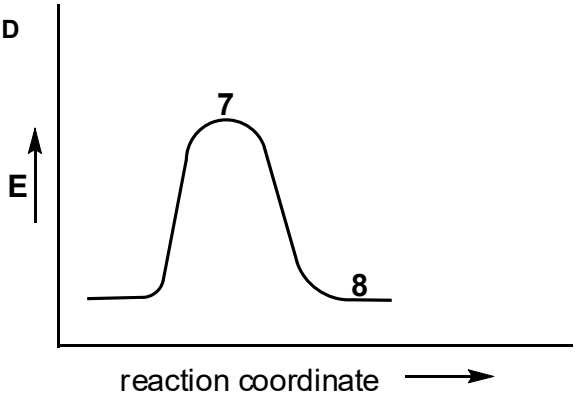
Diagram C

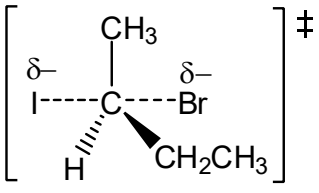


5 

2 missing + charge -1
missing counterion -1

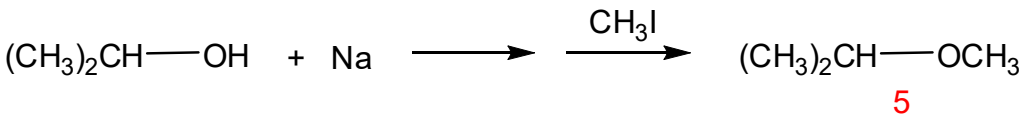
Diagram D



7 

2 no partial charges -1
no linear trajectory -1

9. (**20 points**) Complete the following reactions. If no reaction is likely, explain why.
(Suggested Practice Problem 11.2)



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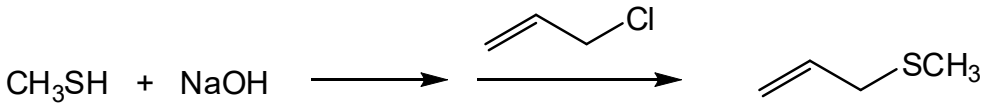

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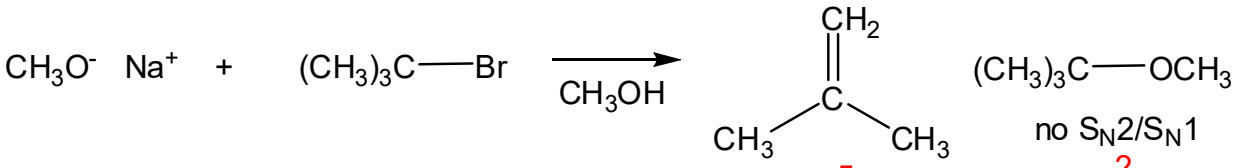
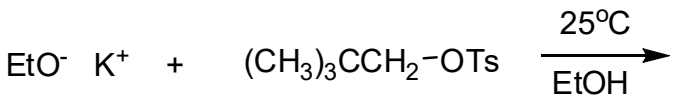


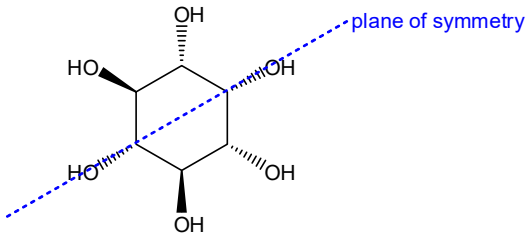
5

no S_N2/S_N1
-2



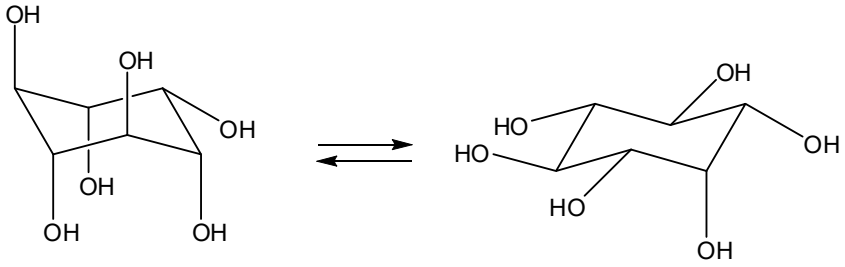
3 explanation 2

10. (**20 points**) myo-Inositol, a natural product found in many foods (oranges and cantaloupes), is the stereoisomer of cyclohexane-1,2,3,4,5,6-hexol shown below. Inositol is a core component of many signaling and secondary messenger molecules involved in a growing list of biological processes (insulin signal transduction, cytoskeleton assembly, gene expression).



myo-inositol

Draw structures for the two chair conformations of myo-inositol. Which chair is more stable?



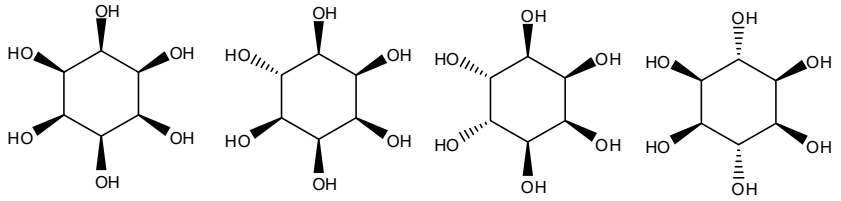
5 axial
4

5 equatorial
4
more stable 2

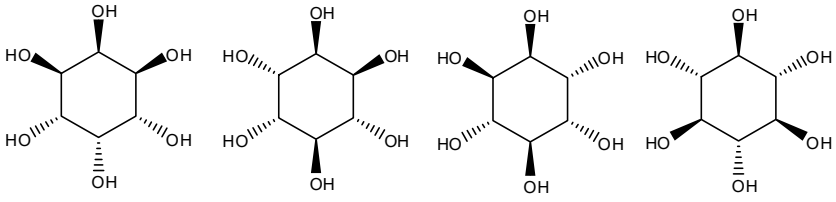
Explain in ten words or less why myo-Inositol (also known as meso-inositol) is **achiral**.

myo-Inositol is achiral because it has a plane of symmetry (shown in flat-ring). 2

myo-Inositol is one of nine naturally occurring stereoisomers of cyclohexane-1,2,3,4,5,6-hexol. Draw flat-ring structures for the other eight stereoisomers and identify each one as chiral or achiral. 1 point each



achiral | achiral | achiral | achiral



achiral | chiral | chiral | achiral