CHEM 3311 **HARRINGTON**

Exam 4

10:30 AM – 1:00 PM December 13, 2016 in MATH 100

Instructions. No notes, books, laptops, phones, calculators, models, or stencils are allowed. Periodic Table, Electronegativity Chart, and Strain Energy Tables are provided.

NAME:

	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		

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1(**20 points**) Draw a **structure** corresponding to each of the following IUPAC names.

a. (2Z,4E)-5-methyl-2,4-octadiene

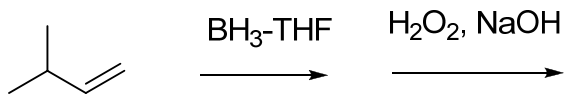
b. (S)-1,4-pentanediol

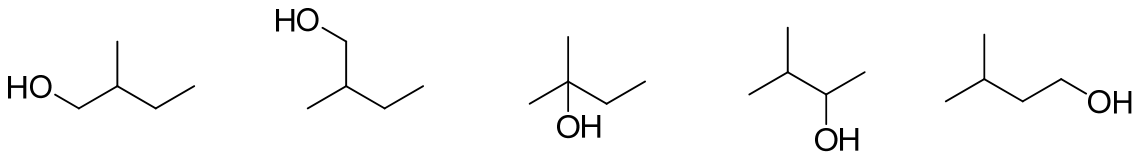
c. 5-ethyl-2-methylheptane

d. 2-ethyl-1-butene

2. (**20 points**)

a. What is the major product of the following reaction? (**Circle the answer.**)

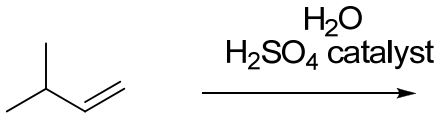


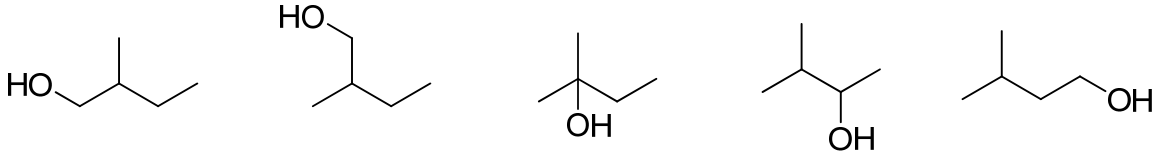


A **B** **C** **D** **E**

Draw the structure of the **first intermediate** in the proposed mechanism for the reaction.

b. What is the major product of the following reaction? (**Circle the answer.**)

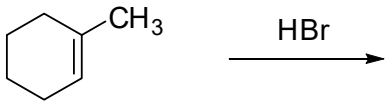


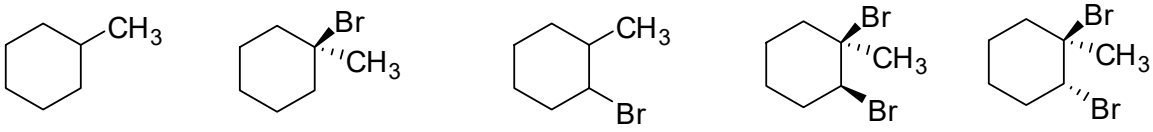


A **B** **C** **D** **E**

Draw the structure of the **first intermediate** in the proposed mechanism for the reaction.

c. What is the major product of the following reaction? (**Circle the answer.**)

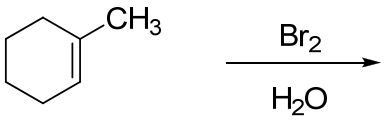


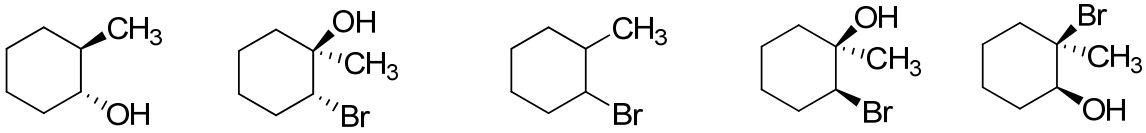


A **B** **C** **D** **E**

Draw the structure of the **first intermediate** in the proposed mechanism for the reaction.

d. What is the major product of the following reaction? (**Circle the answer.**)





A **B** **C** **D** **E**

Draw the structure of the **first intermediate** in the proposed mechanism for the reaction.

3. (**20 points**) Rank each of the three anions in order of nucleophilicity (1 = most nucleophilic, 3 = least nucleophilic). **Explain each ranking in 10 words or less.**

a. Br^- Cl^- F^-

b. CH_3O^- CH_3NH^- $CH_3CH_2^-$

c. Cl^- HO^- HS^-

d. $CF_3CH_2CH_2O^-$ $CF_3CH_2CH_2CH_2O^-$ $CF_3CH_2COO^-$

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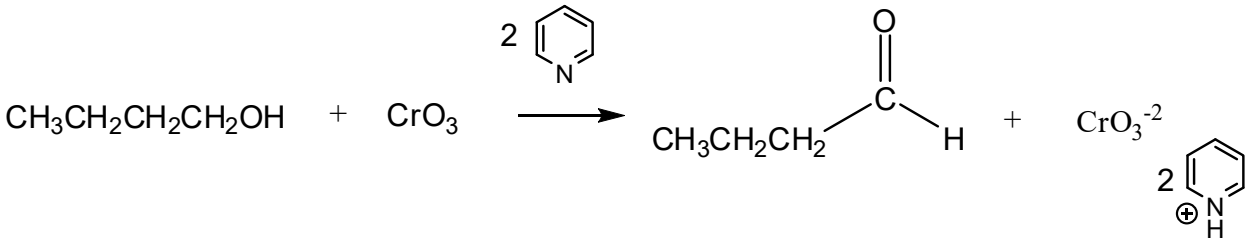
4. (**20 points**) A reaction and a proposed mechanism for the reaction are shown below.

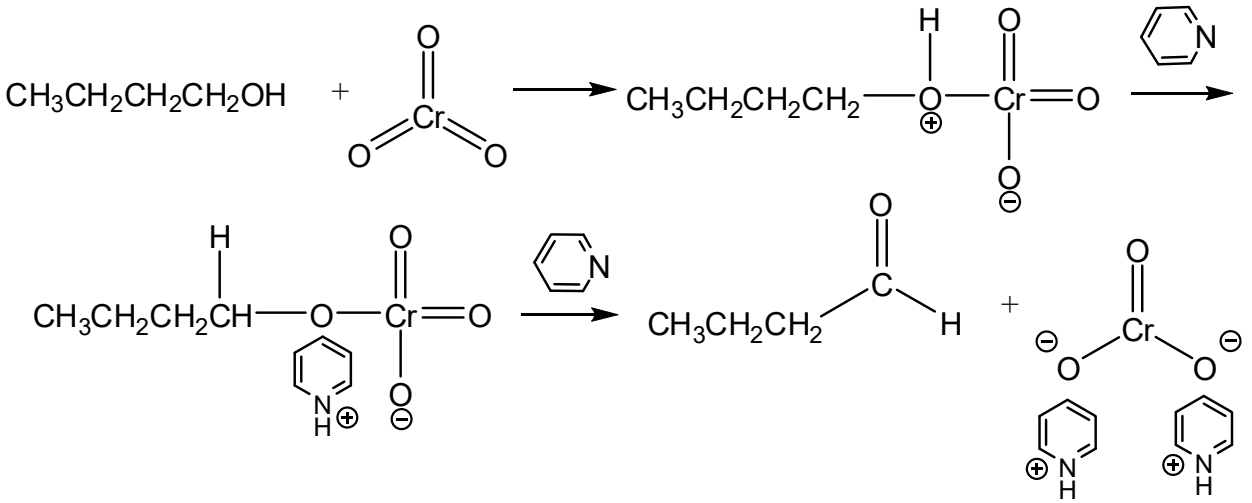
a. Calculate the oxidation numbers for all carbons in the alcohol starting material and in the aldehyde product. Calculate the oxidation number for chromium in the starting material and in the chromium byproduct.

c. Draw the 2-electron curved arrows on each step of the mechanism.

Reaction:



Mechanism:



5. (**20 points**) Draw structures for the products expected from the treatment of each of the following compounds with ozone followed by dimethyl sulfide. Indicate **NR** if there is no reaction.

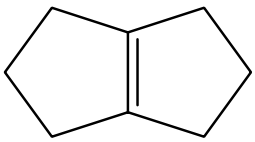
3-methyl-1-pentene

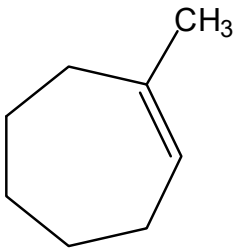
3-methyl-2-pentene

2-ethyl-1-butene

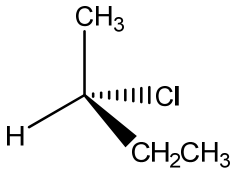
2-methylpentane

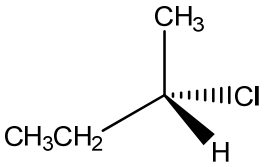
(E)-4-octene

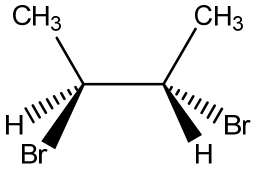


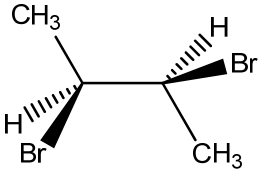


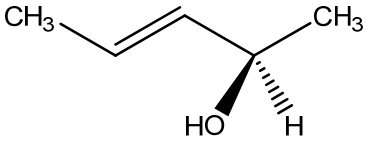
6. (**20 points**) Identify the relationship between each of the following pairs of molecules. The options are: not isomers, constitutional isomers, enantiomers, diastereomers, or same molecule. **No explanation is required.**

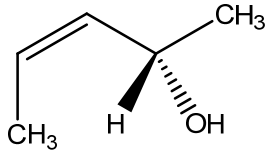


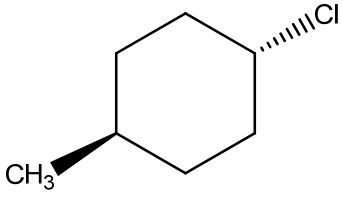


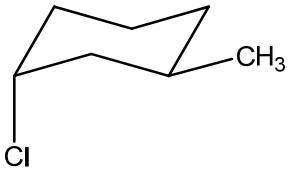


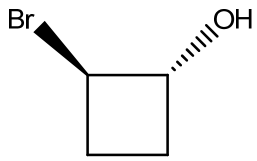


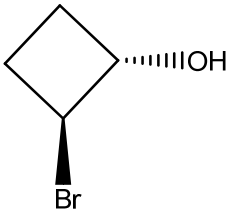












7. (**20 points**)
a. Draw planar-ring (flat-ring) structures corresponding to the IUPAC names
b. Draw the two chair conformations corresponding to each of the flat-ring structures.
c. Use the **Data Table** to calculate the 1,3-diaxial strain for each chair conformation and then indicate which chair conformation is more stable.

*(*1S,3R*)*-1-bromo-3-methylcyclohexane

(1R,2S,3R)-2-chloro-1-ethyl-3-methylcyclohexane

8. (**20 points**) The ***barrier to rotation*** is the difference in energy between the lowest energy conformation and the highest energy conformation. Using data in the **Tables** provided, calculate the barrier to rotation about the C3-C4 bond of 2,2,3-trimethylpentane.

Structure of 2,2,3-trimethylpentane:

Newman projections for the clockwise rotation about the C3-C4 bond in 60° increments:

#1	#2	#3
#4	#5	#6

Strain energy calculations for each Newman projection:

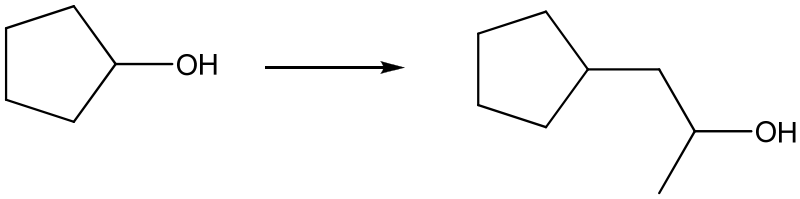
#1	#2	#3	#4	#5	#6

The barrier to rotation is:

#	#	#
#	#	kcal/mol

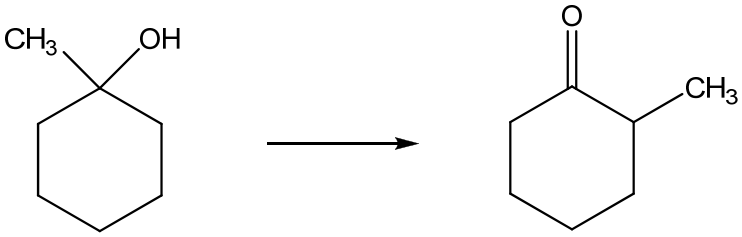
9. (**20 points**) Design a synthesis of each **Target Molecule** from the starting material provided. List the reagent(s) you will need for each step and draw a structure for the product of each step.

a.



Target Molecule

b.



Target Molecule

10. (**20 points**) For each orbital interaction or bond type given below, draw an orbital picture and then describe (20 words or less for each picture/use only the space provded) what the picture tells us (such as stability, bond strengths, bond lengths, bond angles, other ideas).

a. hyperconjugation

b. σ–bond (sigma bond)

c. π-bond (pi-bond)

d. “banana bond”

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