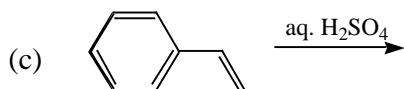
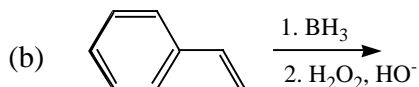
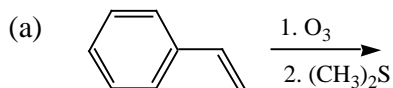


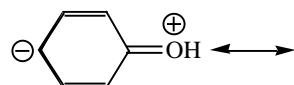
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1. (9 points) Suggest the organic product(s) for each reaction. Pay careful attention to stereochemistry. If more than one product is formed, indicate which product is major, if possible. If no reaction occurs write "NR." Do not include any mechanism details.



2. (3 points) Draw *one* molecule that includes a ketone, an alkyne and an amide, but *does not include* any other functional groups. If this is not possible, write "not possible" and briefly explain why.

3. (3 points) Draw the most significant resonance contributor for this molecule, including all lone pairs and formal charges.

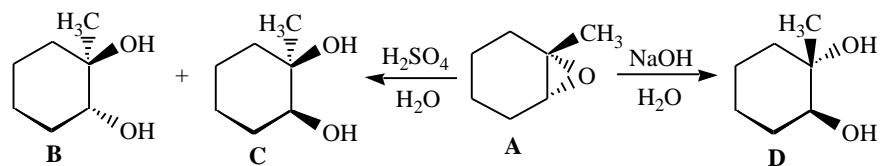


4. (5 points) Draw *one molecule* that includes *all* of these features: sp² carbon, a bond angle of approximately 120°, an sp³ nitrogen, an atom with exactly one lone pair but no formal charge, and a π bond. Label each of these features in your molecule.

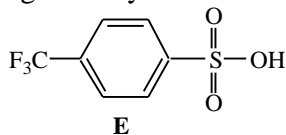
5. (3 points) In 1874, LeBel and van't Hoff proposed a radical idea that was considered lunacy at the time but soon became a very fundamental concept of stereochemistry. In one sentence or less, describe this idea.

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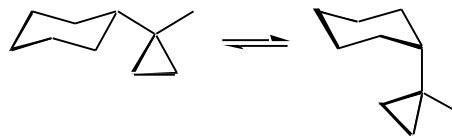
An ether that forms a three-membered ring is called an epoxide. Questions 6 - 8 refer to these reactions of epoxide **A**:



6. (2 points) List two distinctly different types of strain caused by the epoxide of **A**.
7. (6 points) Write the letter(s) or draw the structure(s) of molecule(s) in the reaction that meet the stated requirements. If none of the structures in the reaction answers the question write "none."
- (a) An achiral molecule.
 - (b) A meso compound.
 - (c) Two molecules that are diastereomers.
 - (d) Two molecules that are enantiomers.
 - (e) An optically inactive molecule.
 - (f) A trans-diol.
8. (6 points) The $\text{p}K_a$ of molecule **E** is approximately 0. Briefly discuss the structural features that account for this high acidity.



9. (9 points) Consider this equilibrium:

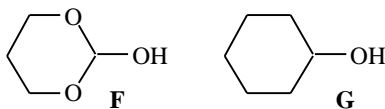


(a) The least favored side of this equilibrium is (circle one): Left Right Neither

(b) Explain your reasoning for the position of the equilibrium. Your answer *must include* one or more Newman projections that clearly illustrate your explanation.

(c) By adding, subtracting or otherwise changing no more than four atoms rewrite the equilibrium so the disfavored side is disfavored to an even greater extent.

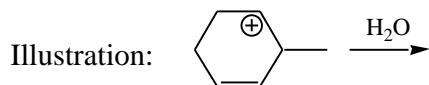
10. (6 points) On a previous exam, students were asked to compare the acidity of alcohols **F** and **G**. Many students wrote that **F** is more acidic due to resonance. If this statement is true, briefly explain how resonance causes the higher acidity. If the statement is not true then explain why it is false.



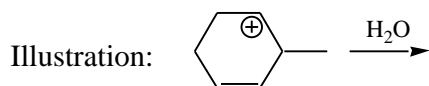
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11. (9 points) Using the carbocation shown below and water as the only reactants in each case, name and illustrate the three common mechanism fates of a carbocation. If a fate may occur in more than one way, illustrate the most favorable outcome. Show mechanism step products and curved arrows in each case.

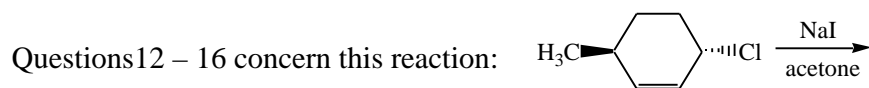
Name of carbocation fate #1: _____



Name of carbocation fate #2: _____



Name of carbocation fate #3: _____

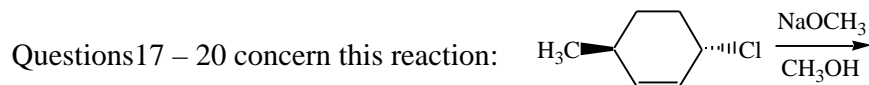


12. (3 points) In the space above write the major product(s) of this reaction.
13. (1 point) The most likely mechanism for this reaction is (circle one): S_N2 S_N1
14. (6 points) Briefly explain your choice of reaction mechanism.

15. (4 points) Provide a complete mechanism for the reaction including transition states for all steps.

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16. (3 points) By adding, subtracting or otherwise changing no more than four atoms rewrite the reaction so that it obviously proceeds by the mechanism that you did not select in question 13.



17. (3 points) In the space above write the major product(s) of this reaction.
18. (1 point) The most likely mechanism for this reaction is (circle one): E2 E1
19. (3 points) Write a complete mechanism for this reaction but do not include any transition states.
20. (3 points) By adding, subtracting or otherwise changing no more than four atoms rewrite the reaction so that it obviously proceeds by the mechanism that you did not select in question 18.

21. (1 point) Circle the best leaving group: CF_3SO_3^- CH_3SO_3^- $\text{CF}_3\text{CH}_2\text{O}^-$ Br^-

22. (1 point) Circle the best nucleophile: CF_3SO_3^- CH_3SO_3^- $\text{CF}_3\text{CH}_2\text{O}^-$ Br^-

23. (10 points) Provide a complete mechanism for this reaction. Clearly label these features of the mechanism: chain reaction, initiation step.

