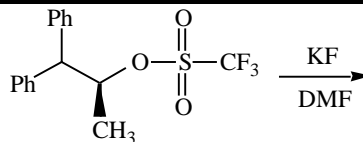


Questions 1 – 9 refer to this  $S_N2$  reaction:  
(Ph = benzene ring)



1. (6 points) Draw the complete mechanism for the reaction including the product and all transition states.
2. (6 points) Draw an energy profile for this reaction. Label all the major features. Assume the reaction is exothermic.
3. (4 points): Triflate ( $\text{CF}_3\text{SO}_3^-$ ) is a good leaving group. Give two one-sentence reasons for this fact.  
  
Reason #1:  
  
Reason #2:
4. (1 points) Does this  $S_N2$  reaction proceed at a reasonable rate (circle one): Yes No
5. (6 points) Very briefly explain your answer to the previous question.

6. (8 points) This  $S_N2$  reaction is slower in  $(CH_3)_3COH$  than in DMF. Briefly explain two reasons for this. Drawings may be used to clarify your explanations, but are not necessary.

Reason #1:

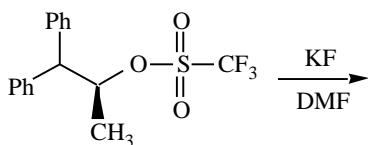
Reason #2:

7. (3 points) By adding, subtracting or otherwise changing at most four atoms of the electrophile rewrite the reaction to make it obviously faster. Include products but not the mechanism.
8. (3 points) By adding, subtracting or otherwise changing at most four atoms of the electrophile rewrite the reaction to make it obviously slower. Include products but not the mechanism.
9. (4 points) List two significant ways in which this reaction would be different if it proceeded by an  $S_N1$  mechanism. Drawings may be used to clarify your explanations, but are not necessary.

Difference #1:

Difference #2:

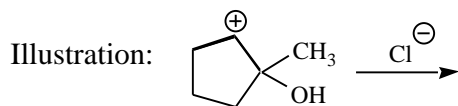
10. (13 points) When the reaction shown below proceeds via the  $S_N1$  mechanism, three products are formed. Write the three most reasonable  $S_N1$  products and provide the complete mechanisms for their formation. Do not include any transition states.



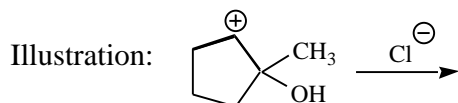
11. (2 points) Circle the best nucleophile in DMF:  $\text{CH}_3\text{O}^-$     $\text{CH}_3\text{S}^-$     $\text{CH}_3\text{CO}_2^-$     $\text{CH}_3\text{OH}$
12. (2 points) Circle the best nucleophile in  $\text{CH}_3\text{OH}$ :  $\text{F}^-$     $\text{Cl}^-$     $\text{Br}^-$     $\text{I}^-$
13. (4 points) Draw the structure of a nonpolar, protic solvent. Label but do not explain the structural features that make it nonpolar and protic.

14. (9 points) Name the three fundamental carbocation fates as discussed in lecture. Illustrate each using  $\text{Cl}^-$  and the cation shown below as the only reactants in each case. Include curved arrows in each case. If a given carbocation fate can occur in more than one way, illustrate only the most favorable pathway.

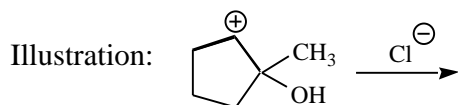
Name of fate #1: \_\_\_\_\_



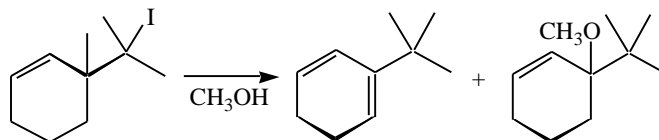
Name of fate #2: \_\_\_\_\_



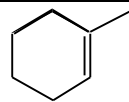
Name of fate #3: \_\_\_\_\_



15. (10 points) Provide a complete mechanism for this reaction. Do not include transition states.



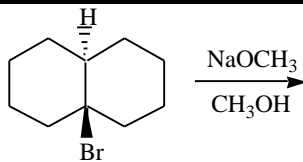
Questions 16 and 17 refer to this alkene:



16. (3 points) Draw an alkene with the same chemical formula that is obviously **more** stable.

17. (3 points) Draw an alkene with the same chemical formula that is obviously **less** stable.

Questions 18 – 20 refer to this reaction:



18. (3 points) In the space above write the major product of this reaction.

19. (2 points) Circle the most probable mechanism for this reaction:  $S_N2$   $S_N1$  E2 E1

20. (8 points) Briefly explain your answer to the previous question.