

Chemistry 30A Exam 2 Solutions

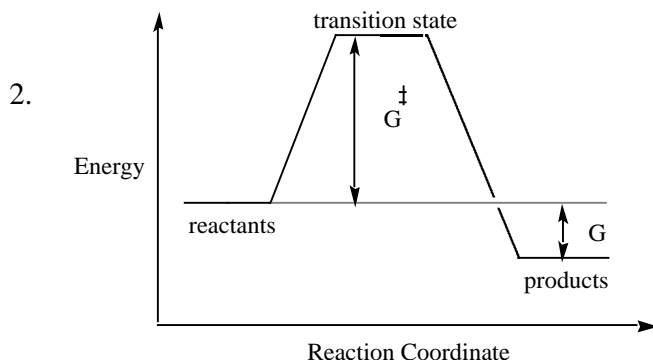
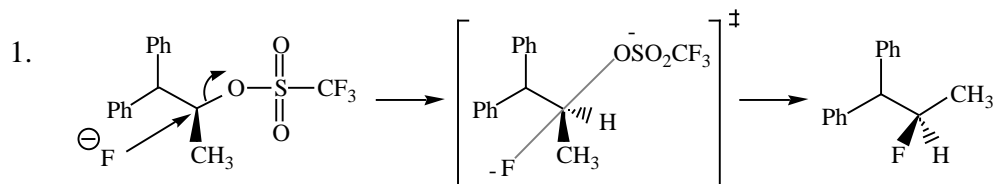
Statistics: High score = 97 Average score = 66.9 Low score = 07

Standard Deviation = irrelevant as it does not control grade distribution in this class.

A note about exam keys: The answers presented here are usually significantly longer than expected from a student taking the exam. An exam key serves not only to reveal what was expected, but to instruct you as well.

Exam key posted 10 AM, Friday May 23, 2003

To see the current course grade cutoffs, consult "If Grades Were Assigned Today" at the Chem 30A Home Page.



3. Reason #1: **Resonance delocalization** of the CF_3SO_3^- negative charge.

Reason #2: An **inductive effect** by the CF_3 group stabilizes the CF_3SO_3^- negative charge.

4. Yes, this $\text{S}_{\text{N}}2$ reaction proceeds at a reasonable rate.

5. The rate of an $\text{S}_{\text{N}}2$ reaction is controlled by the activation energy. If the activation energy is sufficiently low (if the transition state is sufficiently stable) then the reaction proceeds at a reasonable rate. Activation energy is low enough if the reaction has these features.

Good nucleophile: Fluoride ion is a good nucleophile because the atomic radius is small and the negative charge is concentrated.

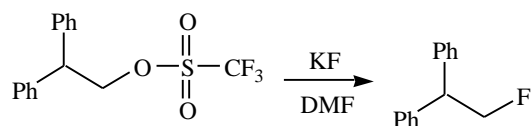
Good leaving group: Triflate ion is a superior leaving group for the reasons described in question 3.

Not tertiary: Steric hindrance at the carbon bearing the leaving group cannot so severe as to prevent the approach of the nucleophile. This carbon cannot be tertiary. In the case under consideration, the carbon is secondary. (The two phenyl groups do provide some steric hindrance but not so much as to completely stop the reaction.)

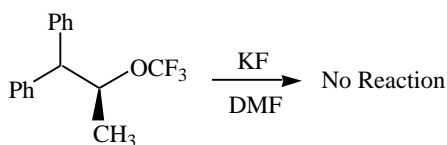
6. **(CH₃)₃COH is protic.** The hydrogen atom of the OH group reduces nucleophilicity of fluoride ion due to hydrogen bonding.

(CH₃)₃COH is of low polarity (low dielectric constant) as it has many more nonpolar bonds (C-C and C-H) than polar bonds (C-O and O-H). Reduced polarity increases the association of fluoride and potassium ions, which decreases the nucleophilicity of fluoride ion.

7. Removing some steric hindrance results in faster reaction.



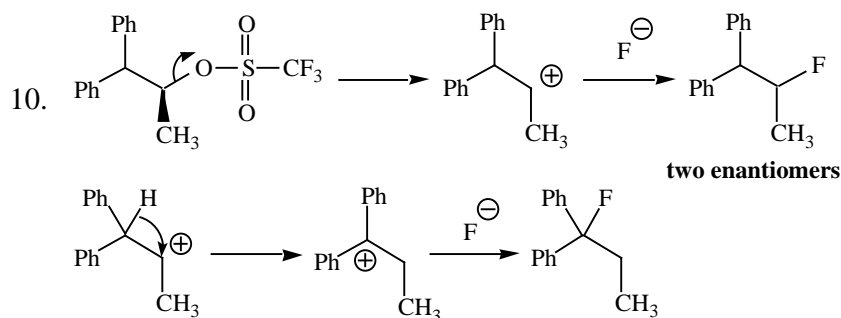
8. Changing triflate to a poorer leaving group results in a slower reaction.



A rate of zero is less than a rate of "slow"!

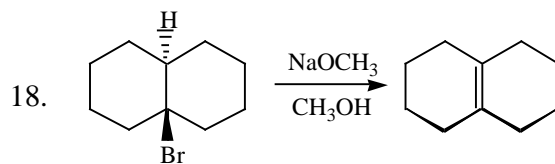
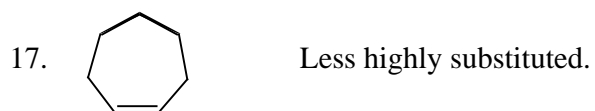
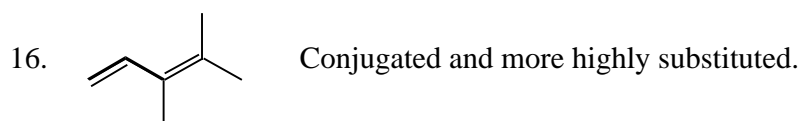
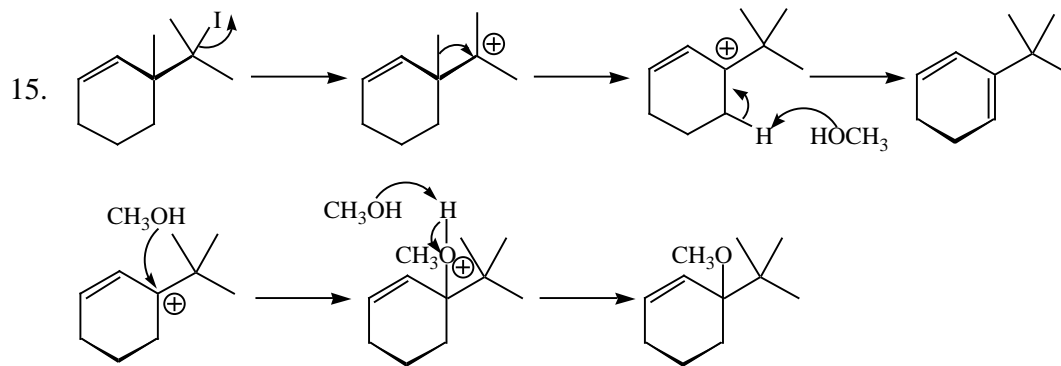
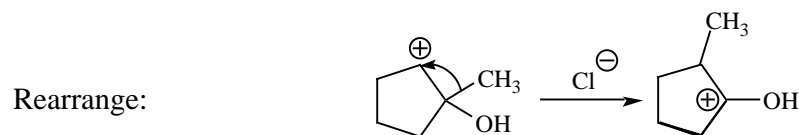
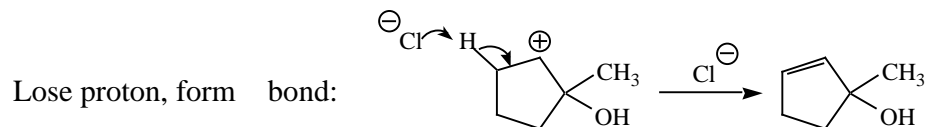
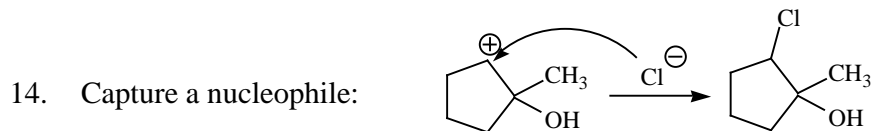
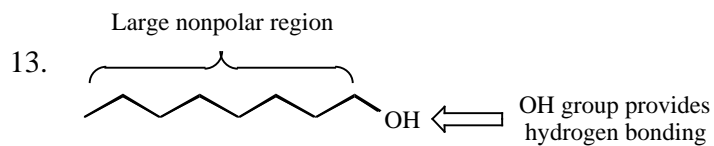
9. Difference #1: An S_N2 reaction proceeds with inversion of stereochemistry whereas an S_N1 reaction leads to a mixture of stereoisomers.

Difference #2: An S_N2 reaction follows bimolecular kinetics (rate [ROTF][F⁻]) whereas an S_N1 reaction follows unimolecular kinetics (rate [ROTF]).



11. CH₃O⁻

12. F



19. The most probable mechanism for this reaction is **E2**.
20. E2 is considered before S_N2 except in the case of primary alkyl halides. An E2 reaction requires strong base (CH₃O⁻ is a strong base), moderate or better leaving group (Br⁻ is a moderate leaving group) and antiperiplanar β-hydrogen (present). The E2 requirements are met, so we predict the reaction mechanism in this case is E2.