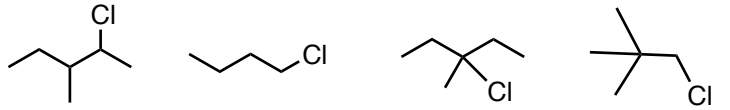
Organic Chemistry for Life Sciences: CHM 223 Section A

Problem Set Chapter 7

Name_____

DUE in class: Monday November 15 @ 8am

1. Rank the following substrates according to their exected rate of reaction with a nucleophile in an **S_N2 reaction** from fastest >>> slowest.

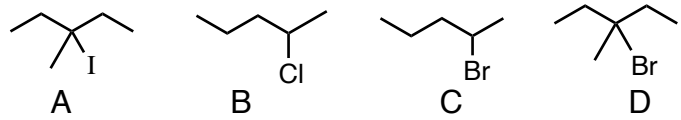


A — 2° substrate
B — 1° substrate
C — 3° substrate
D — 1° substrate

- generally, order of reactivity towards S_N2 = methyl > 1° > 2° >>> 3° (essentially unreactive)
- so, B and D (both 1°) should have a greater reaction rate than A (2°) which will be much much faster than C (3°)
- D is 1°, but has much greater steric hindrance adjacent to the carbon that is being attacked than AB The greater steric hindrance will slow the rate relative to B.

B > D > A >>> C

2. Rank the following substrates according to their exected rate of reaction with a nucleophile in an **S_N1 reaction** from fastest >>> slowest.

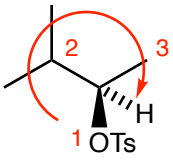


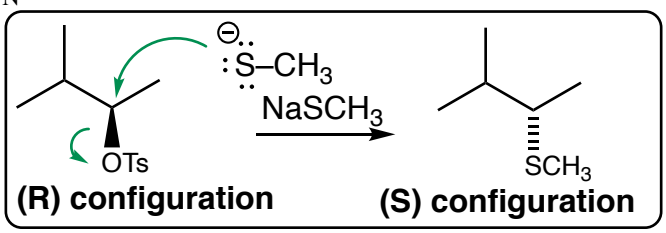
A — • I leaving group • 3° substrate
B — • Cl leaving group • 2° substrate
C — • Br leaving group • 2° substrate
D — • Br leaving group • 3° substrate

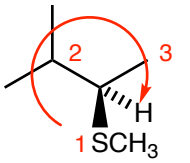
- generally, the order of reactivity towards S_N1 = 3° > 2 ° >>> 1 ° and methyl (both of which are essentially unreactive)
- So A and D (both 3°) will be have a greater rate than B and C (both 2°)
- I is a better leaving group than Br which will result in a faster reaction (i.e., A > D)
- Between the two 2° substrates, Br is a better leaving group than Cl (i.e., C > B)

A > D > C > B

3. Draw the product and determine the configuration (R or S) for the starting material AND the product resulting from the S_N2 reaction below:





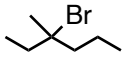


(R)

enantiomer!

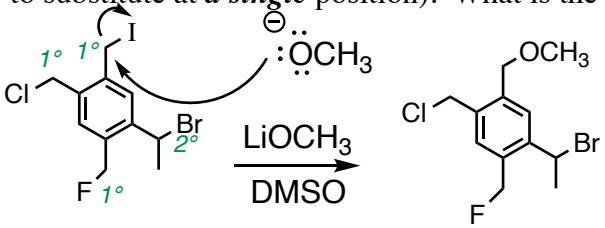
4. Which one of the following statements is true about the substrate 3-bromo-3-methylhexane?

A. It can react via both the S_N1 and S_N2 substitution reaction mechanisms
B. It can react by neither the $S_N1$nor S_N2 substitution reaction mechanisms
C. It can react via the S_N1 but not the S_N2 substitution reaction mechanism
D. It can react via the S_N2 but not the S_N1 substitution reaction mechanism



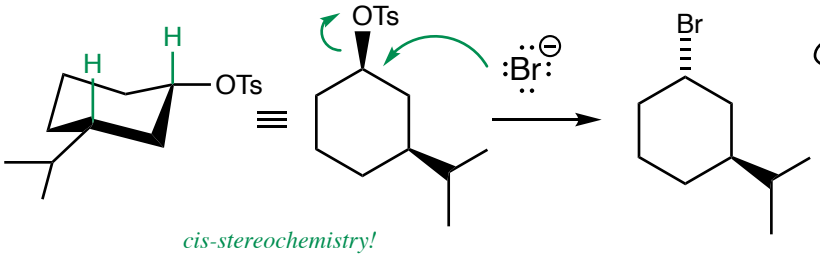
3° alkyl bromide substrate

5. The S_N2 reaction below was conducted with only ONE equivalent of $LiOCH_3$ (i.e. only sufficient $LiOCH_3$ to substitute at ***a single*** position). What is the predicted major product?



- 1° positions will generally be more reactive than 2° position in an S_N2 reaction
- of the 1° positions, F is unreactive as a leaving group and I is more reactive than Cl

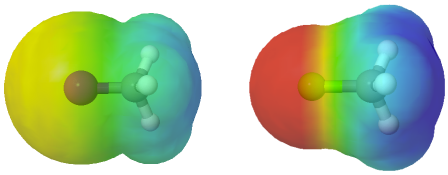
6. The name of the product formed from the following S_N2 reaction is:



cis-stereochemistry!

A. trans-1-bromo-3-isopropylcyclohexane
B. cis-1-bromo-3-isopropylcyclohexane
C. trans-1-isopropyl-3-bromocyclohexane
D. cis-1-isopropyl-3-bromocyclohexane

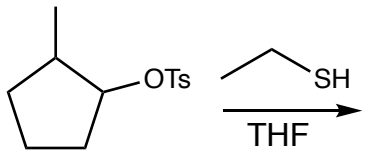
7. The electrostatic potential map for CH_3I (see I, below) shows much less deep red and blue colors than the electrostatic potential map for CH_3F (see II below). This is because:



I II

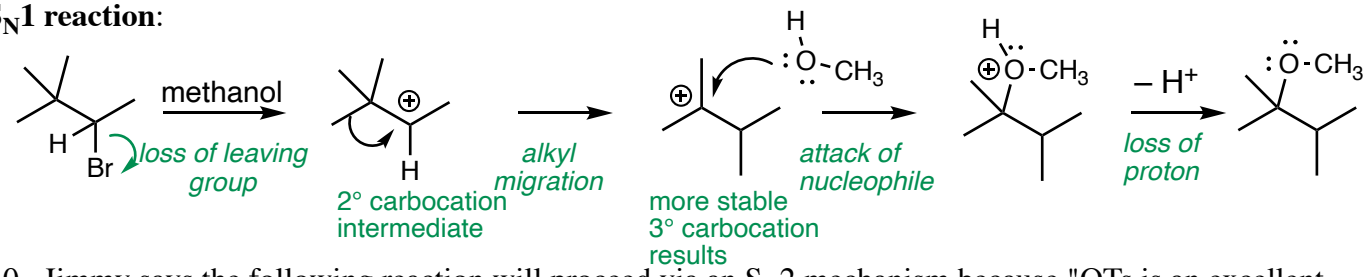
A. The C–I bond is more polar than C–F so there is more δ+ on I and more δ– on C
B. The C–I bond is more polar than C–F so there is more δ– on I and more δ+ on C
C. The C–F bond is more polar than C–I so there is more δ– on F and more δ+ on C
D. The C–F bond is more polar than C–I so there is more δ+ on F and more δ– on C

8. Predict whether the following reaction is likely to proceed by an S_N1 or S_N2 reaction and *justify your answer* (i.e., consider the nature of the nucleophile, nature of the substrate, nature of the leaving group, and the solvent)



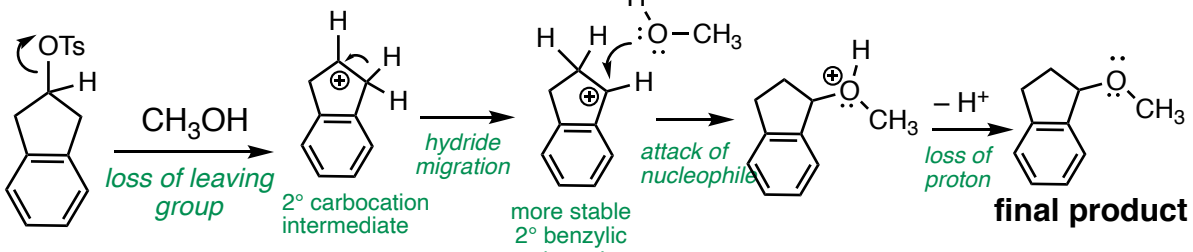
- OTs is a great leaving group for both SN1 and SN2
- 2° substrate can proceed by either SN1 or SN2
- THF is a polar aprotic solvent, which favors SN2
- thiols are strong nucleophiles which favors SN2
- **all of the factors suggest an S_N2 reaction will prevail**

9. Draw the individual steps (including curved arrows!!) for the reaction mechanism to explain the following **S_N1 reaction**:



10. Jimmy says the following reaction will proceed via an S_N2 mechanism because "OTs is an excellent leaving group and CH_3OH is a strong nucleophile". Do you agree with Jimmy? Why or why not? What major final product is expected to form from this reaction (HINT: consider possible rearrangments)?

Jimmy



- CH_3OH is a fairly WEAK nucleophile, Jimmy!
- CH_3OH is acting as both nucleophile *and* solvent, and polar protic solvents favor S_N1 reactions
- **the preferred mechanism would therefore be S_N1 and NOT S_N2. Sorry Jimmy!!**