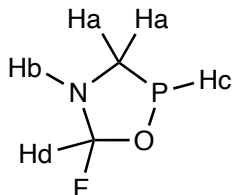


Organic Chemistry I for the Life Sciences
CHM 223
Test 3
Chapters 3, 6-8

Name _____

1. Which of the indicated hydrogen atoms (Ha, Hb, Hc or Hd) in the compound below is MOST acidic and LEAST acidic?



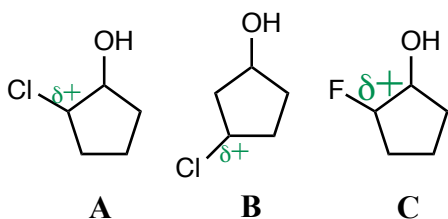
most acidic: Hc

least acidic: Ha

• of the types of CH bonds possible, CH, NH and PH, the P-H bond will be most acidic due to the atom effect. The conjugate base places a negative charge on the large phosphorous atom

• of the types of CH bonds possible, CH, NH and PH, one of the C-H bonds will be least acidic due to the atom effect. The C-H bond attached to the C with the fluorine will be more acidic than Ha due to the inductive effect of the F atom

2. The structures of three alcohols are provided below. Which of the following ranks their acidities correctly from most acidic >> least acidic)?



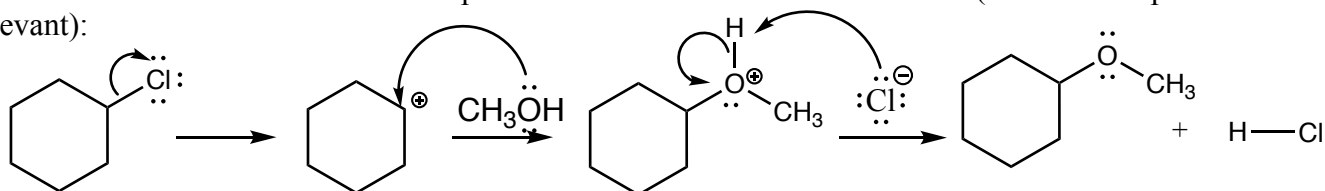
- A. A > B > C
 B. A > C > B
 C. B > A > C
 D. B > C > A
 E. C > B > A
 F. C > A > B

• in each case removal of the more acidic OH bond will take place to form the -O^-

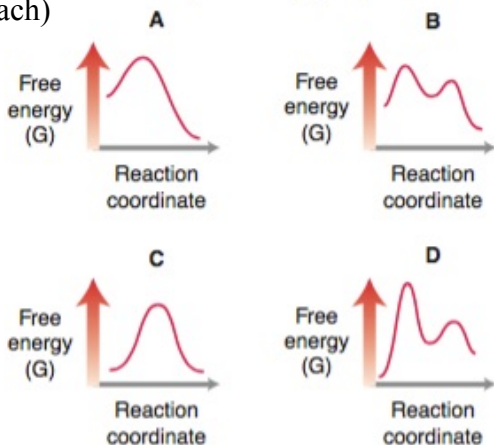
• the δ^+ provided by the F at the 2-position will stabilize the conjugate base more so than the smaller δ^+ provided by the Cl atom. This is the inductive effect. Therefore, C > A

• the δ^+ of B will be further from the charged oxygen upon deprotonation relative to A and have a weakened inductive effect.

3. Draw the curved arrows that accomplish each of the transformations below (include lone pairs where relevant):



4. Answer the following questions based on the reaction coordinates below (may be more than one answer for each)



i. Which reaction coordinate(s) describe a concerted reaction?

A B C D

ii. For reaction coordinate B, which step is the rate-determining step (circle one):

step 1 step 2 step 3

iii. Which describe overall endothermic reactions?

A B C D

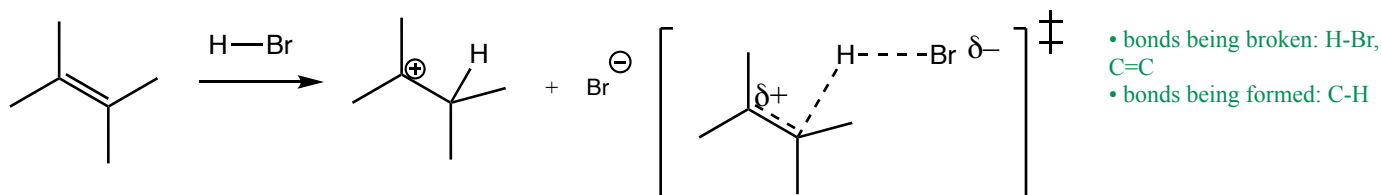
5. In addition to requiring a collision between reactants with proper orientation, what is the third condition that must be met for a reaction step to be successful?

- A. it must be an endothermic reaction step
 B. there must be an acidic hydrogen available for removal
 C. it must be an exothermic reaction step
 D. there must be sufficient energy to reach the transition state
 E. there must be formation of transition states with complete Lewis dot structures

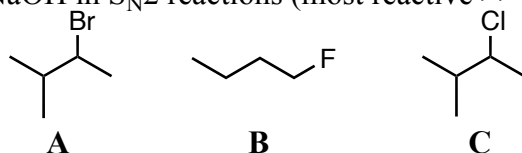
6. Raising the temperature of a reaction increases the rate of a reaction because (may be more than one answer):

- A. raising the temperature converts endothermic reactions into exothermic reactions
- B. raising the temperature increases the proportion of molecules with sufficient energy to surmount the activation barrier of the rate determining step**
- C. raising the temperature increases the likelihood of collisions between molecules
- D. raising the temperature lowers the activation energy for the reaction

7. Predict the transition state for the following reaction step using proper conventions:

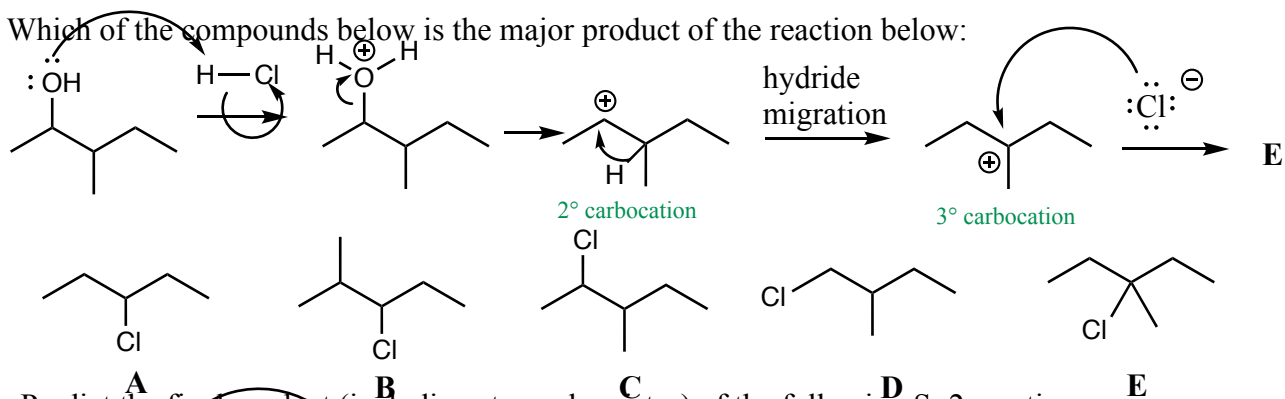


8. Which of the following correctly ranks the alkyl halides below according to their expected rate of reaction with NaOH in S_N2 reactions (most reactive >> least):

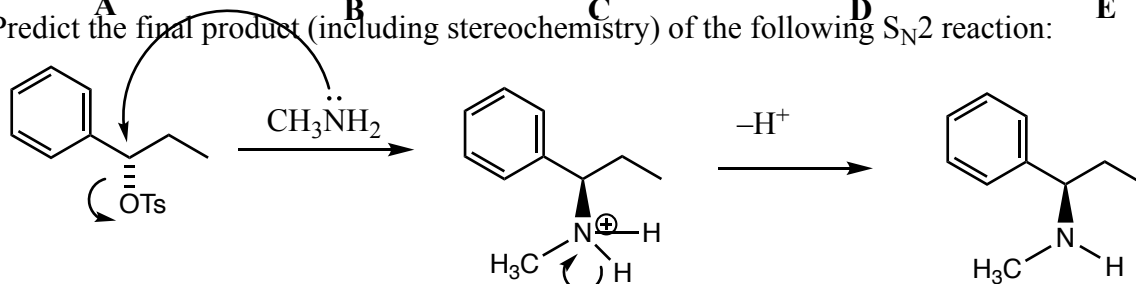


- A. A > B > C
 - B. A > C > B**
 - C. B > A > C
 - D. B > C > A
 - E. C > B > A
 - F. C > A > B
- $2^\circ \text{ Br} > 2^\circ \text{ Cl}$
 • RF unreactive in S_N2

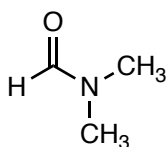
9. Which of the compounds below is the major product of the reaction below:



10. Predict the final product (including stereochemistry) of the following S_N2 reaction:



11. How would the following solvent, named dimethylformamide or DMF, be best characterized?

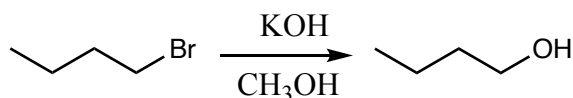


- A. nonpolar
- B. nonpolar aprotic
- C. polar protic
- D. polar aprotic**

12. Jimmy proposes running the following reaction as an S_N2 reaction. As written, however, the reaction is not expected to proceed readily. Identify the major reason why this reaction would NOT proceed via an S_N2 reaction as written, and propose a change that could be made so that it does proceed via the S_N2 mechanism.



Jimmy

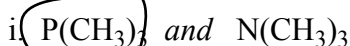


- the leaving group, Br, is good for S_N2
- the 1° alkyl bromide is a good substrate for S_N2
- Hydroxide ion is a strong nucleophile

major reason for failing to proceed via S_N2 : CH_3OH is a polar protic solvent which greatly disfavors an S_N2 reaction.

change that could be made so it DOES proceed via S_N2 : changing the solvent to a polar aprotic solvent such as DMSO

13. From each pair of nucleophiles below, circle the one expected to be most nucleophilic and provide a sufficient rationale for your selection:

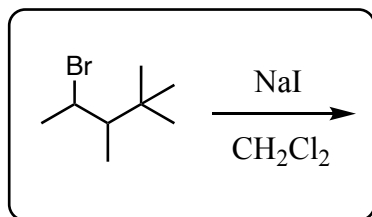


- the nucleophilic atom is a P in one versus a N in the other, otherwise they are identical
- P is less electronegative and more polarizable than the N, increasing its nucleophilicity



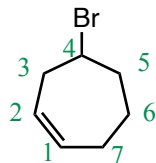
- the nucleophilic atom in each case is identical, a negatively charged S
- The ethyl group is larger than the methyl group, and the larger the group the less nucleophilic

14. Answer the true/false questions below concerning the reaction provided (circle T or F):



- the alkyl bromide substrate can only react via an S_N2 reaction. T **(F)**
 - a 2° substrate can react via S_N2 or S_N1
- the leaving group favors S_N1 reaction over the S_N2 reaction. T **(F)**
 - the Br is a great leaving group for both S_N2 and S_N1
- the nucleophile in the reaction would be considered to be weak. T **(F)**
 - Iodide is a strong nucleophile
- CH_2Cl_2 as solvent for the reaction favors the S_N1 process over S_N2 . T **(F)**
 - CH_2Cl_2 is a polar aprotic solvent, which favors the S_N2 reaction
- overall, this reaction favors the S_N2 process over S_N1 . **(T)** F
 - a 2° substrate, good leaving group, strong nucleophile and polar aprotic solvent favor S_N2

15. Provide the complete IUPAC name for the following compound:



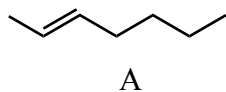
4-bromocycloheptene

16. Which one of the following isomeric alkenes is MOST and LEAST stable?

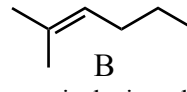
- A. trans-2-heptene B. 2-methyl-2-hexene C. cis-2-heptene D. 2-methyl-1-hexene

MOST stable: B

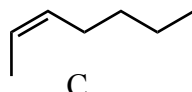
LEAST stable: C



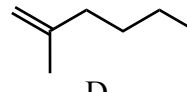
trans disubstituted



trisubstituted

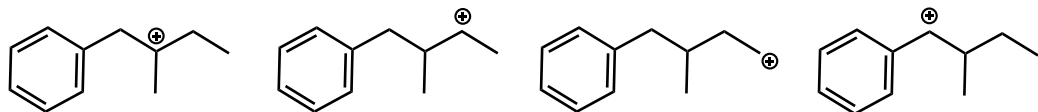


cis disubstituted



gem disubstituted

17. Arrange the following carbocations according to their expected stabilities (most stable >>> least):



A

3°

B

2°

C

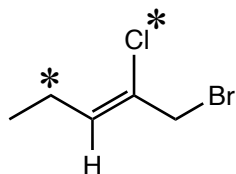
1°

D

2° benzylic

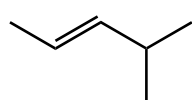
most stable D > A > B > C least stable

18. What is the stereochemistry (E/Z) of the following alkene (indicate how you arrived at your answer by showing which substituents are rank highest):



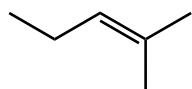
- higher priority substituents on either end are marked with a *
- since the higher priority substituents are on the same side of the C=C bond, **the stereochemistry is Z**

19. The alkenes below are formed from an elimination reaction that abides by Zaitsev's rule. Which of the following orders them according to their expected yields from most >>> least:



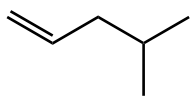
I

trans-disubstituted



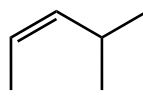
II

trisubstituted



III

monosubstituted



IV

cis-disubstituted

A. I > IV > III > II

B. II > IV > I > III

C. III > I > IV > II

D. I > III > II > IV

E. II > I > IV > III

20. What are the expected products from the following E2 reaction.

