

Nucleophilic Substitution

Reading: Most of the general texts carry decent sections on this work but probably the best are Clayden et al. "Organic Chemistry", Wothers and Warren "Chemical Structure and Reactivity", Peter Sykes, "A Guidebook to Mechanism in Organic Chemistry", and Eames & Peach "Stereochemistry at a Glance".

Notes and Questions

a) Summary on not more than 6 sides. This should outline the possible mechanisms and the evidence on which they are based, in particular the evidence for inversion during S_N2 reactions. Consider the effects of changes in solvent, nucleophile, leaving group as well as in substrate structure – include a range of nearby functional groups, such as α-haloketones and α-haloethers. Discuss stereochemical effects and rate differences etc. Include neighbouring group effects with examples.

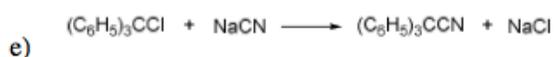
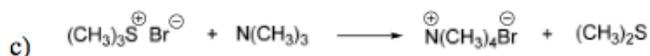
b) Check that you can do the easy problems on this subject in Hornby and Peach 'Foundations of Organic Chemistry: worked examples', OUP Primer no. 87, chapter 4, Q 1-7.

c) Learn the general chemistry of alcohols, alkyl halides, vinyl halides etc. See Meakins, Functional Groups: characteristics and interconversions.

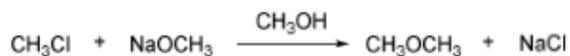
d) Do the problems attached. These are particularly important. For additional problems with answers and explanations, see Chapter 2 of Stereochemistry at a glance.

Problems

1. For each of the reactions below:
 - i) Identify the nucleophilic atom and the electrophilic atom (mark then n and e);
 - ii) Identify the leaving group (Le);
 - iii) State the functional group(s) of the product(s);
 - iv) Draw a curly arrow mechanism;
 - v) Predict whether the reaction rate will be increased by a change to a more polar solvent and give your reasoning.

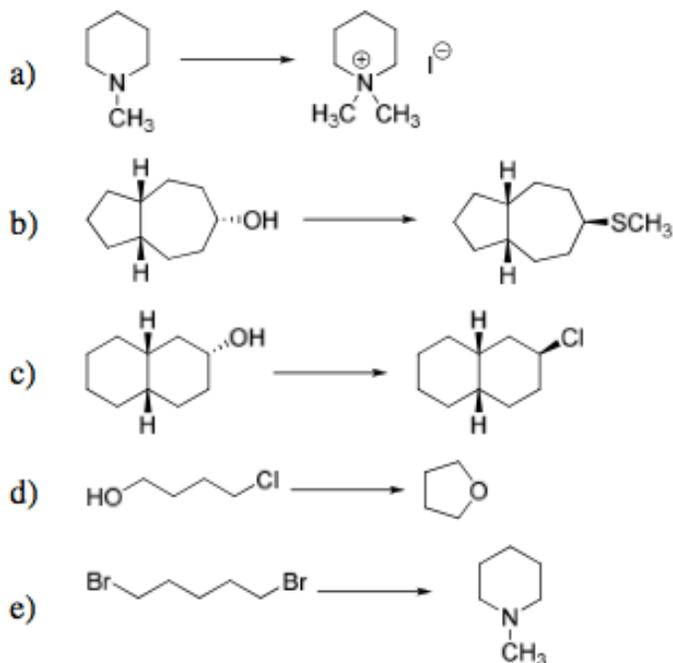


2. For the reaction:

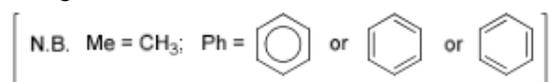


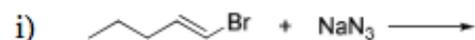
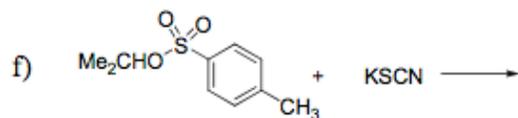
predict the effect on the rate by changing the: i) substrate to $(\text{CH}_3)_2\text{CHCl}$ iii) substrate to CH_3I
 iii) nucleophile to CH_3SNa iv) solvent to $(\text{CH}_3)_2\text{SO}$ (dimethyl sulfoxide)
 Explain your answers!

3. Suggest reagents for the following and write mechanisms for the reactions.



4. Draw the structures of the products (if any) of the following reactions: show your reasons by considering mechanisms.

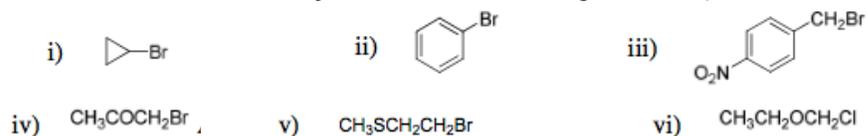




If there is no reaction, explain why!

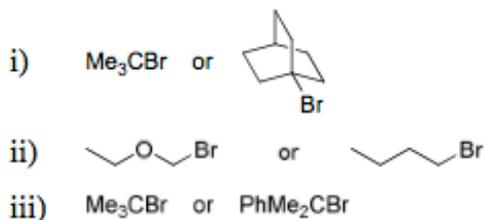
And now some Prelim questions...

5. How can the structure of the alkyl halide influence its reactivity in $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions? Comment on the reactivity of all of the following in nucleophilic substitution reactions. [25]



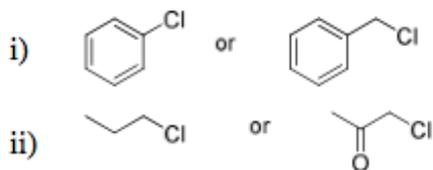
6. Predict, giving reasons, which member of the following pairs in both Part A and Part B will react faster under the conditions indicated.

A. Solvolysis in aqueous formic acid (HCO_2H)



[3 x 3]

B. With NaI in acetone (CH_3COCH_3)



[2 x 3]

Any reasoning involving electron delocalisation must be supported by drawing resonance structures. This applies to any question.

7. Rationalise (i.e. explain what is happening and draw mechanisms) the following observations:

