

## Organic Chemistry – Exercise 8

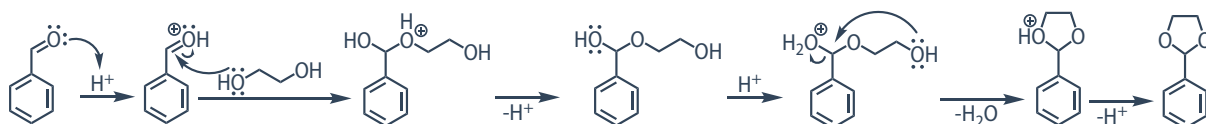
Distribution: November 27, 2025

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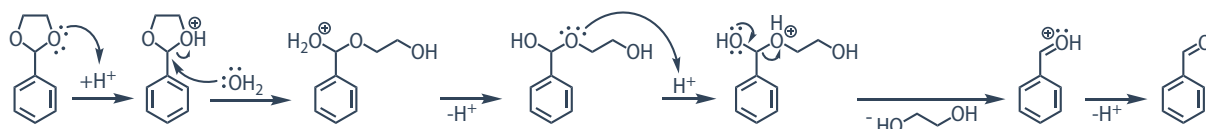
1. In order to avoid the reaction of some functional groups under the certain conditions, they are “protected” in organic syntheses. The protection of a carbonyl group can be done in several ways, but one of the most common ones is converting it to an acetal. The acetal protecting groups are widely used because of the ease of their removal after the desired transformation, which is always done in acidic conditions.

- a. Show the mechanism of the reaction between benzaldehyde and ethylene glycol (1,2-ethanediol) in acidic conditions. Which reagent is reacting as an electrophile and which is reacting as a nucleophile? What is the name of this mechanistic pathway?



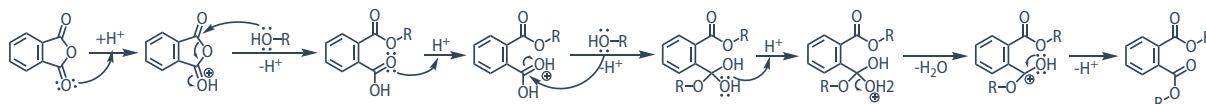
**The carbonyl C atom of benzaldehyde is the electrophile and the O atoms of ethylene glycol are the nucleophiles. This is a nucleophilic addition to a carbonyl group, or A<sub>n</sub>.**

- b. Show the mechanism of the deprotection of the acetal formed in a) via hydrolysis in presence of water in acidic medium.



2. Dioctyl phthalate (DOP) is a common plasticizer for plastics like PVC. Its role is to increase the flexibility and durability of the plastic materials, making them suitable for products such as hoses, electrical wire coatings, or leather imitations. It can be easily synthesized from phthalic anhydride (anhydride of benzene-1,2-dicarboxylic acid) and the corresponding octanol in acidic conditions.

- a. Show the mechanism of the reaction between phthalic anhydride and octanol in acidic conditions (you don't have to show the full structure of the octanol; you may represent it as R-OH). What is the name of this mechanistic pathway?



**This nucleophilic substitution on a carbonyl group via addition-elimination mechanism.**

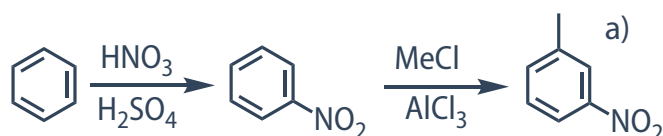
- b. Which step is faster, the substitution with the first or with the second alcohol molecule? Explain your answer.

As the nucleophile is identical in both cases, so the quality of the leaving group will determine the reaction rate. The first substitution is faster, as the carboxylic acid is better leaving group than water.

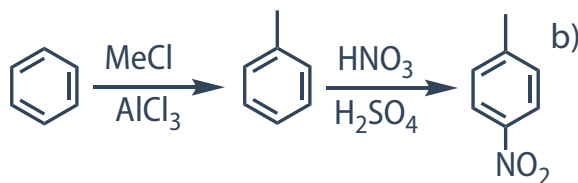
- c. What is the role of the acid in this system?

The role of the acidic catalyst is to protonate the species in order to make better leaving groups – carboxylic acid and water.

3. Propose synthetic sequences for obtaining the following compounds from benzene: a) *m*-methylnitrobenzene and b) *p*-methylnitrobenzene. Give the names of all the reactions that you use in your proposed sequences.



The reactions for synthesis of a) are, respectively, nitration (electrophilic aromatic substitution) and Friedel-Crafts alkylation (electrophilic aromatic substitution).



The reactions for synthesis of b) are, respectively, Friedel-Crafts alkylation (electrophilic aromatic substitution) and nitration (electrophilic aromatic substitution).

*Note:* it is important that the reactions are done in these orders. Methyl group is *ortho* and *para* directing, so if we want to obtain product b) methylation has to be done first. On the other hand, nitro group is *meta* directing, so if we want to obtain product a) the nitration has to be done first.

### Reading Suggestions:

Clayden, Greeves, Warren, *Oxford University Press*, 2012.

Organic Chemistry, John McMurry, *Thomson Brooks/Cole*, 2008.

Chimie Organique, Les Grands Principes, John McMurry, *Dunod Editeur*, 2009.

Chimie Organique, Paul Arnaud, *Dunod Editeur*, 2009.