

A Report on Directing Effects on Organic Chemistry

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BRIEFNOTE

Effects of direction substituents on the benzene ring influence the region-chemistry of the reaction in addition to affecting the reaction speed. That is, they have complete control over the placement of the new substitute in the product substituents on the benzene ring influence the region-chemistry of the reaction in addition to affecting the reaction speed. That is, they have complete control over the placement of the new substitute in the product.

This direction is known as the directional or orientation effect, and it is determined by the type of the first substituent. The already existent substituent can raise or reduce the rate of subsequent substitution, i.e., it can activate or deactivate the benzene ring's ability to undergo further substitution. In 1890, Henry Armstrong of Imperial College was the first to classify benzene ring substituents (R') according to their effect on the ring's electrophilic substitution processes. He attributed this to a polarizable substance he dubbed a "affinity," which functioned at a distance over the entire ring and vary in character depending on the type of the substituents, despite the fact that the electron had yet to be identified.

Remember that a new substituent can bind to the benzene ring in three different positions relative to the previous substituent. Substitution can happen in five different places around the ring, although two of them are linked by symmetry. Numbering the substituents (1,2-, etc.) or the relationships ortho-, meta-, and para- can be used to define isomerism in di-substituted benzenes. There are two places ortho- and two positions meta- to the first substituent.

You'll see that there are two groups of substituents in the table. One group interacts to produce ortho- and para-product combinations. There may be modest amounts of meta- and varied ratios of ortho- to para-, but don't get caught up in the intricacies. Concentrate on the big picture. Some organisations

act as "ortho-/para-directors."

The other group reacts to compounds that are predominantly meta-substituted. There may be minor levels of ortho and para-products present, but don't be concerned. Concentrate on the big picture. Some organizations serve as "meta-directors." These region-chemical effects are extremely similar to the activating and directing effects that we've observed so far. We need to think about things like -donation, -acceptance, inductive effects, and cation stability if we want to interpret this data.

AR5.1: Show resonance structures for the cationic intermediate formed during toluene nitration (methylbenzene). Explain why there is a mix of ortho- and para-substitution.

AR5.2: Show resonance structures for the cationic intermediate formed during chlorobenzene nitration. Explain why there is a mix of ortho- and para-substitution.

AR5.3: Draw resonance structures for the cationic intermediate formed during aceto-phenone nitration ($C_6H_5COCH_3$). Explain why meta-substitution is the most common consequence.

AR5.4. Display the resonance structures of the cationic intermediate formed during the nitration of acetanilide ($C_6H_5NH(CO)CH_3$). Explain why there is a mix of ortho and para-substitution.

These substituents can be divided into three classes in general:

- π -Meta-directors are -acceptors.
- π -Ortho-/para-directors are -donors.
- Ortho-/para-directors are alkyls.

It's worth noting that one substituent, such as a halogen, can have two competing effects. Although the overall effect in halogens is to slow down the reaction, the weak -donation is still enough to tip the product balance in favour of ortho- and para- replacement.

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