Substitución Electrofílica Aromática \((S_E \text{Ar})\)
Mecanismo general

In the first step, the aromatic ring functions as a nucleophile and attacks \( \text{E}^+ \), forming the intermediate sigma complex.

In the second step, the sigma complex is deprotonated, restoring aromaticity.

Sigma complex
Pheniramine

Chlorpheniramine

Brompheniramine
R-\text{phenyl} + \text{N≡N⁻} \rightarrow \text{R-phenyl-N=N-phenyl}

(R = \text{OH or NH}_2)
The reaction of benzene with nitric acid and sulfuric acid results in the formation of three isomers:

- **ortho-Nitrotoluene (63%)**
- **meta-Nitrotoluene (3%)**
- **para-Nitrotoluene (34%)**

The product distribution is shown in the histogram below.
The diagram shows the reaction of a methyl ether with HNO₃ in H₂SO₄, leading to the formation of three isomers: ortho-, meta-, and para-nitroanisoles.

- **Ortho-nitroanisole (31%)**
- **Meta-nitroanisole (2%)**
- **Para-nitroanisole (67%)**

A bar chart below the diagram illustrates the product distribution, with ortho-nitroanisole being the dominant product, followed by para-nitroanisole and then meta-nitroanisole.
9.10

Product distribution for the nitration of benzenediazonium salt.

- ortho (6%)
- meta (93%)
- para (1%)
Ortho attack

Meta attack

Para attack
Los halógenos son la excepción
Strong activators are characterized by the presence of a lone pair immediately adjacent to the aromatic ring.
Moderate activators exhibit a lone pair that is already delocalized outside of the ring.
Alkyl groups are weak activators.
desactivadores
débiles

\[
\begin{align*}
\text{F} & \quad \text{Cl} & \quad \text{Br} & \quad \text{I} \\
\end{align*}
\]
moderados
fuertes

\[
\begin{align*}
\text{NO}_2 & \quad \text{R} \quad \text{X} \\
\text{C} & \quad \text{R} \quad \text{R}
\end{align*}
\]

(X = Halogen)
<table>
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<tr>
<th>Activators</th>
<th>Strong</th>
<th>Moderate</th>
<th>Weak</th>
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<td>(\text{OH})</td>
<td>(\text{O}^-)</td>
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<td>Deactivators</td>
<td>Weak</td>
<td>Moderate</td>
<td>Strong</td>
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- **Weak**: 
  - $R \text{CO}_2 \text{H}$
  - $R \text{CO}_2 \text{OH}$

- **Moderate**: 
  - $R \text{CO}_2 \text{H}_2 \text{NH}$
  - $\text{SO}_2 \text{R}$
  - $R \text{C}_3 \text{N}_2$

- **Strong**: 
  - $\text{NO}_2$
  - $R \text{C}_2 \text{NO}_2$
  - $X_2 \text{C}_2 \text{X}_2$
Determine si el anillo está activado o desactivado y clasifique al substituyente
¿Cual anillo es más reactiva en una $S_{E}Ar$?
¿Cuál será la posición más reactiva en una $S_{E}Ar$?
19.19 For each compound below, identify which position(s) is/are most likely to undergo an electrophilic aromatic substitution reaction.

(a) \( \text{O}_2\text{N} \quad \text{CH}_3 \quad \text{NO}_2 \)

(b) \( \text{O}_2\text{N} \quad \text{NO}_2 \)

(c) \( \text{CO}_2\text{H} \)

(d) \( \text{CN} \)

(e) \( \text{N} \quad \text{CO} \)

(f) \( \text{Br} \quad \text{OH} \)
19.20 Predict the product(s) for each of the following reactions:

(a) \[ \text{compound} \xrightarrow{\text{HNO}_3/\text{H}_2\text{SO}_4} ? \]

(b) \[ \text{compound} \xrightarrow{\text{Br}_2/\text{FeBr}_3} ? \]

(c) \[ \text{compound} \xrightarrow{\text{Fuming H}_2\text{SO}_4} ? \]
19.22 For each of the following compounds, determine the position that is most likely to be the site of an electrophilic aromatic substitution reaction:

(a) \( \text{HO-} \quad \text{NO}_2 \)

(b) \( \text{O}_2\text{N-} \quad \text{OMe} \quad \text{Br} \)

(c) \( \quad \text{X-} \quad \text{X} \quad \text{X} \)
19.24 When the following compound is treated with Br₂ in the presence of a Lewis acid, one product predominates. Determine the structure of that product.