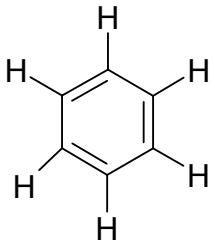
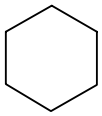
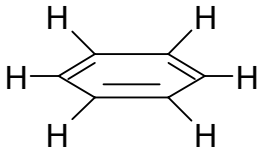
Aromatische Verbindungen



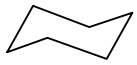
Benzol C_6H_6

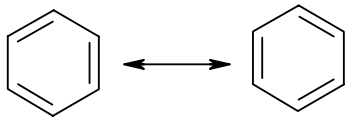


Cyclohexan C_6H_{12}



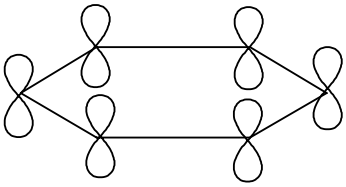
planar
139pm

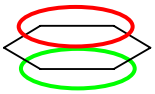


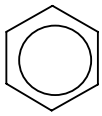


Resonanzstrukturen

Mesomerie im Benzol: C-C 139pm







Benzol
· farblose Flüssigkeit
· Siedepunkt: 88°C; Schmelzpunkt: 5,5°C
· aromatischer Geruch und Geschmack

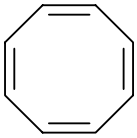
Kriterien für Aromatizität
⇨ planare, cyclisches System
⇨ cyclisch konjugiert
⇨ (4n+2) π-Elektronen (Hückel-Regel)

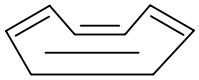
Antiaromat 4n π-Elektronen

lang → 

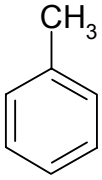
kurz ↑

instabil

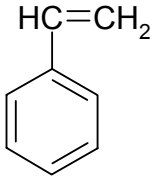




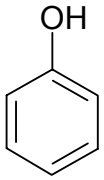
Cyclooctatetraen



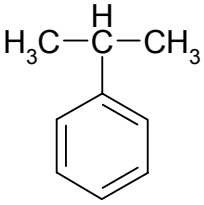
Toluol
(Methylbenzol)



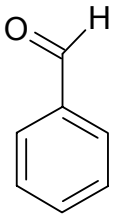
Styrol



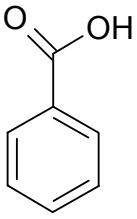
Phenol



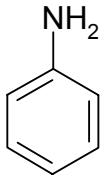
Cumol



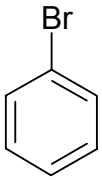
Benzaldehyd



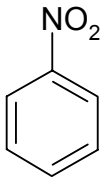
Benzoesäure



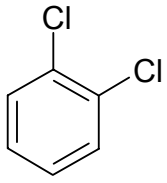
Anilin



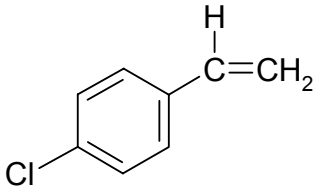
Brombenzol



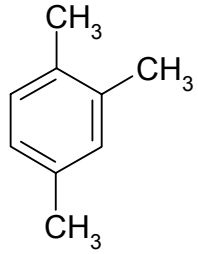
Nitrobenzol



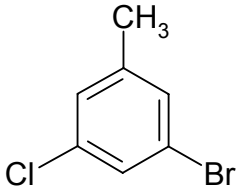
ortho-Dichlorbenzol



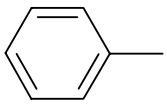
para-Chlorstyrol



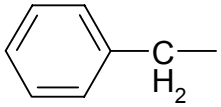
1,2,4-Trimethylbenzol



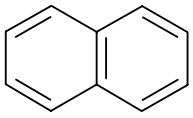
3-Brom-5-Chlortoluol



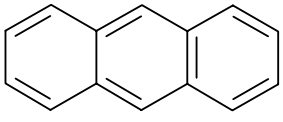
Phenyl



Benzyl



Naphtalin

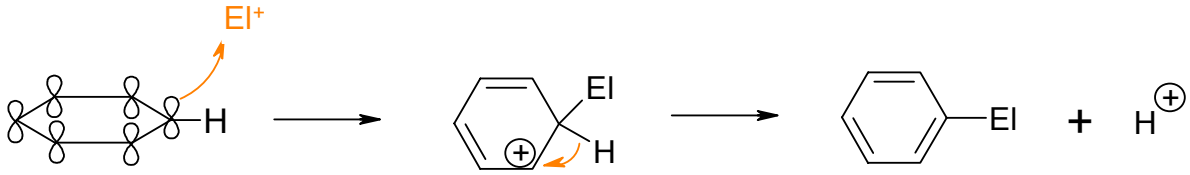


Anthracen

10π e^- n = 2

14π e^- ⇨ n = 3

Elektrophile aromatische Substitution



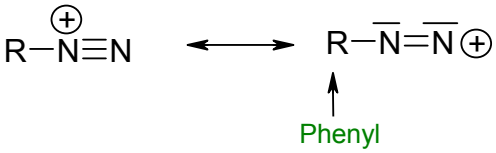
$Br_2 + FeBr_3 \rightarrow$ „ $Br^{\oplus}$ “ + $FeBr_4^{\ominus}$

$AlBr_3 \rightarrow$ „ $Br^{\oplus}$ “ + $AlBr_4^{\ominus}$

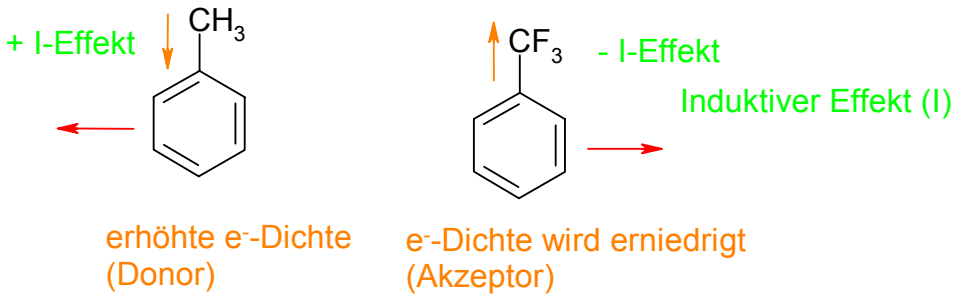
$HNO_3 + H^{\oplus} \rightarrow H_2O + NO_2^{\oplus}$

abb Energiediagramm reaktion

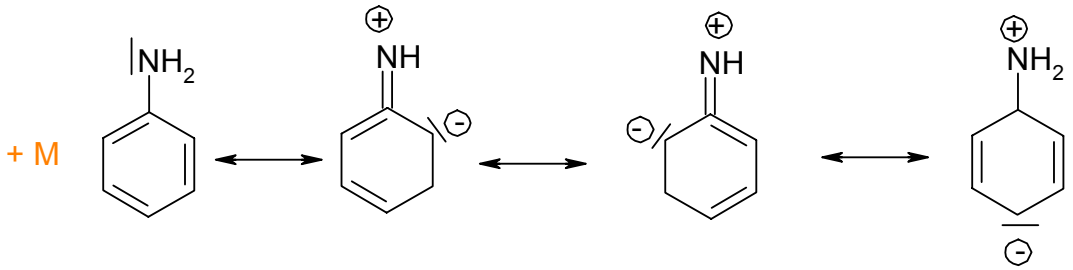
El⊕: $Br^{\oplus}$, $Cl^{\oplus}$
SO_3, $SO_3H^{\oplus}$
$NO_2^{\oplus}$, $NO^{\oplus}$,



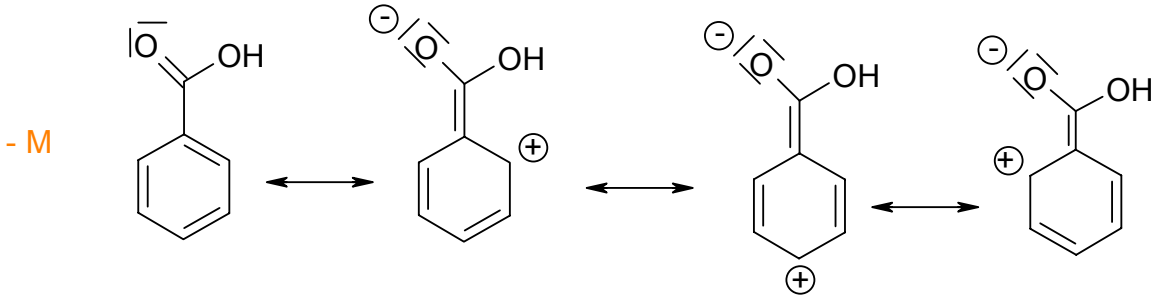
Der Einfluss von Substituenten



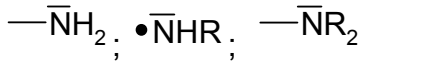
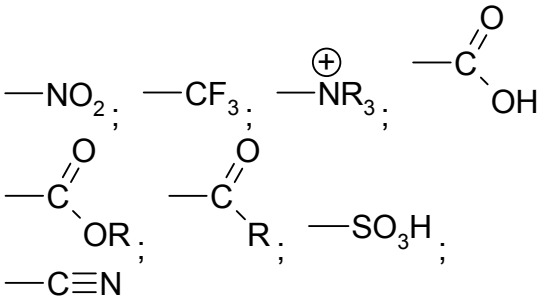
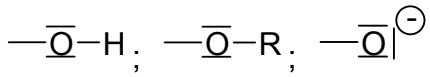
Der mesomere (M-) Effekt

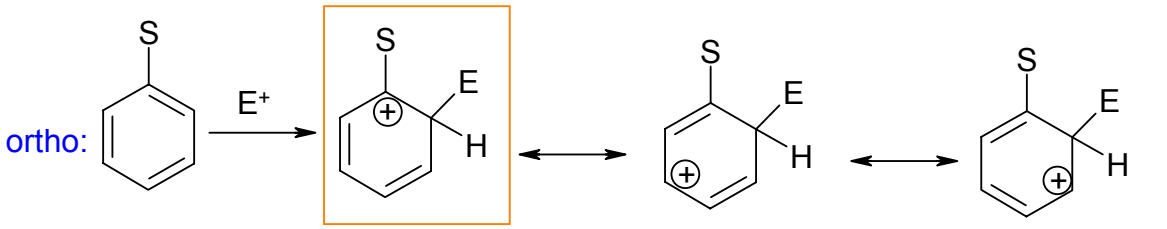


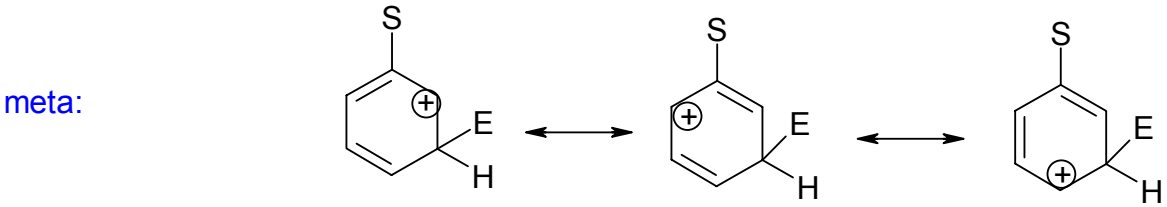
Elektronendichte wird erhöht ⇨ schnelle Reaktion

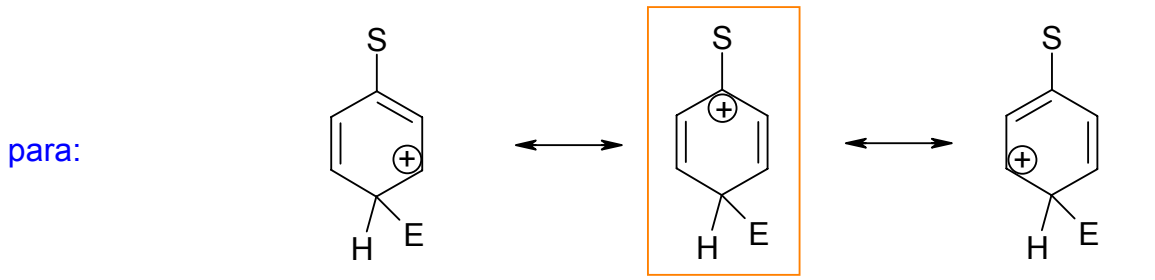


niedrige Elektronendichte ⇨ langsame Reaktion

stark aktivierende Substituenten (Donoren)	stark desaktivierende Substituenten (Akzeptoren)
	
	
schwach aktivierend	**schwach desaktivierend**
Allyl, Phenyl	-F; -Cl, -Br, -I







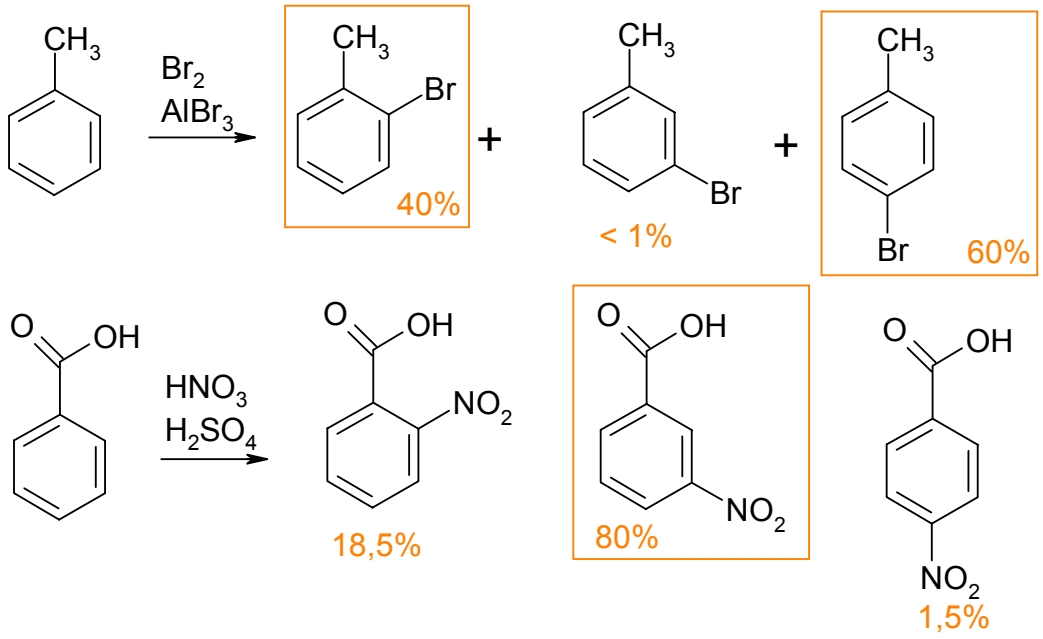
S = Substituent mit +M, +I-Effekt

Donor ➡ Stabilisierung → ortho, para

aktivierende Substituenten und –F, -Cl, -Br, -I

S = Substituent mit -M, -I-Effekt

Akzeptor ➡ Destabilisierung → meta


CH3
Br2
AlBr3
CH3
Br
40%
+
CH3
Br
< 1%
+
CH3
Br
60%
O
OH
HNO3
H2SO4
O
OH
NO2
18,5%
O
OH
NO2
80%
O
OH
NO2
1,5%