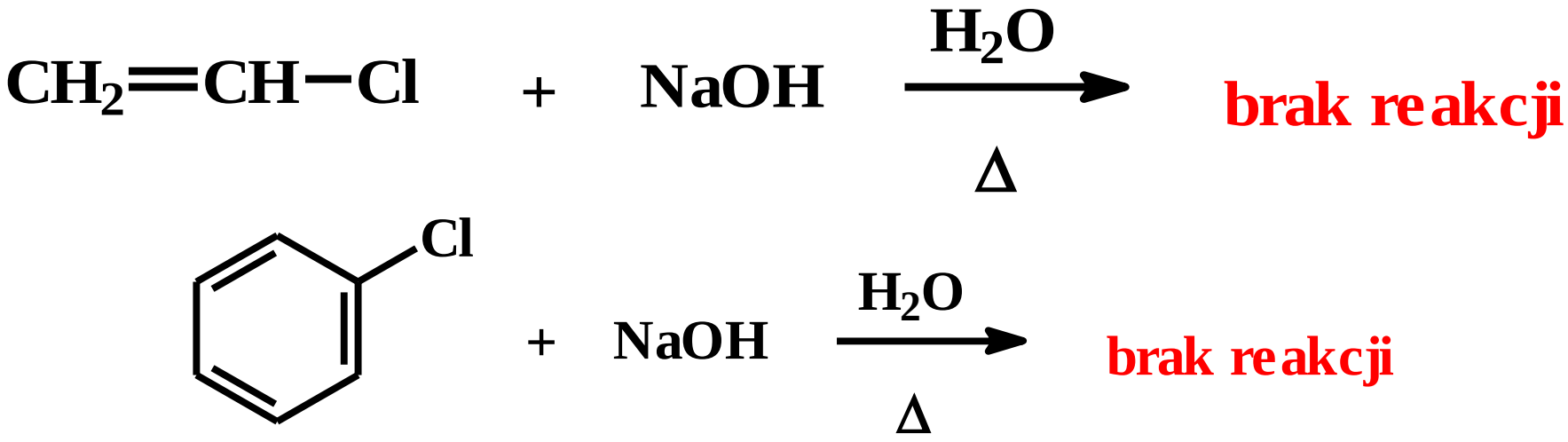
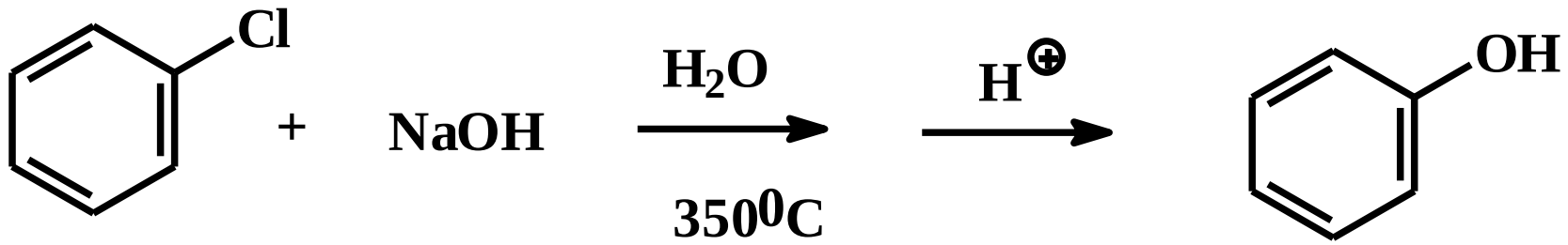
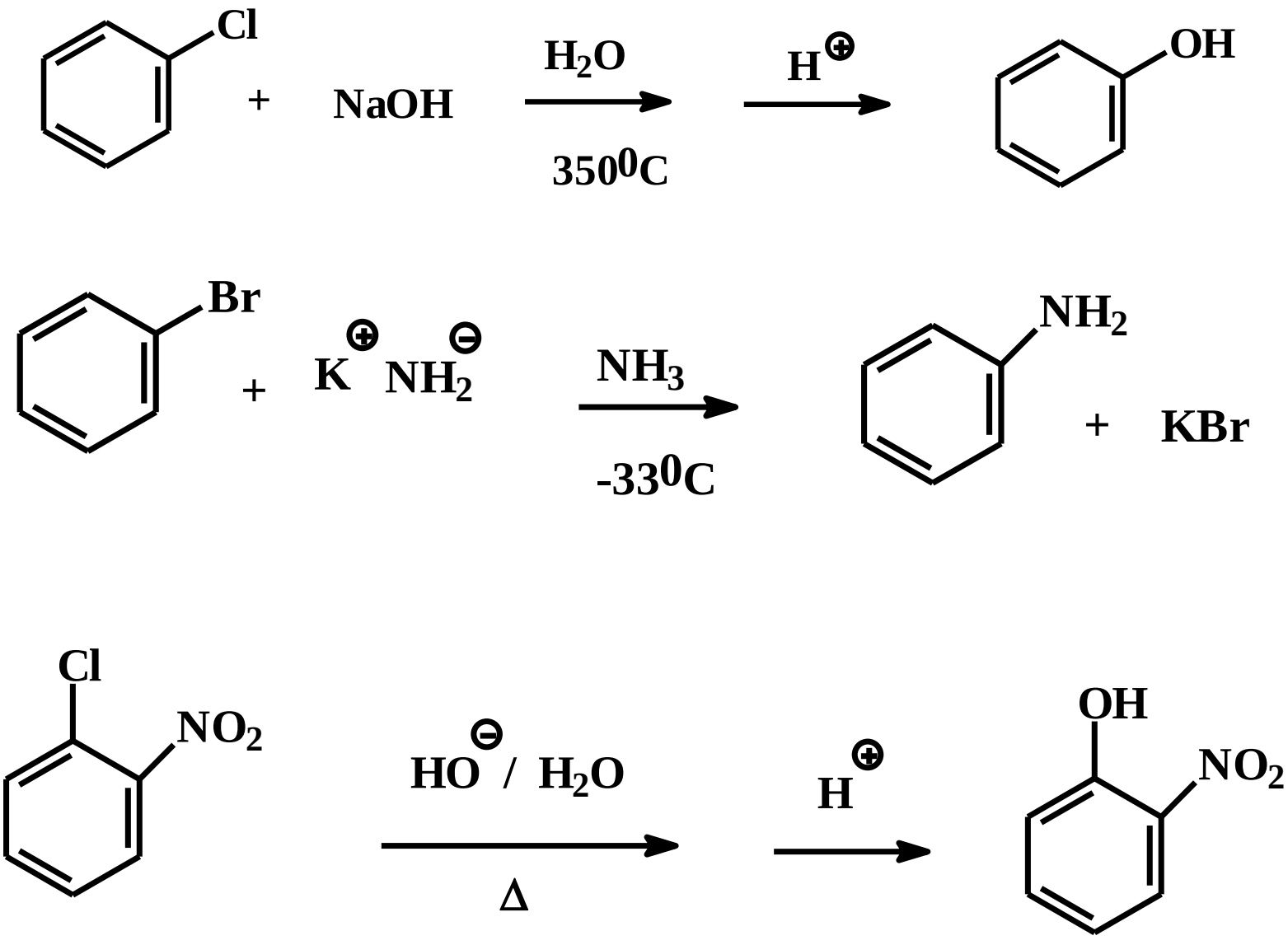
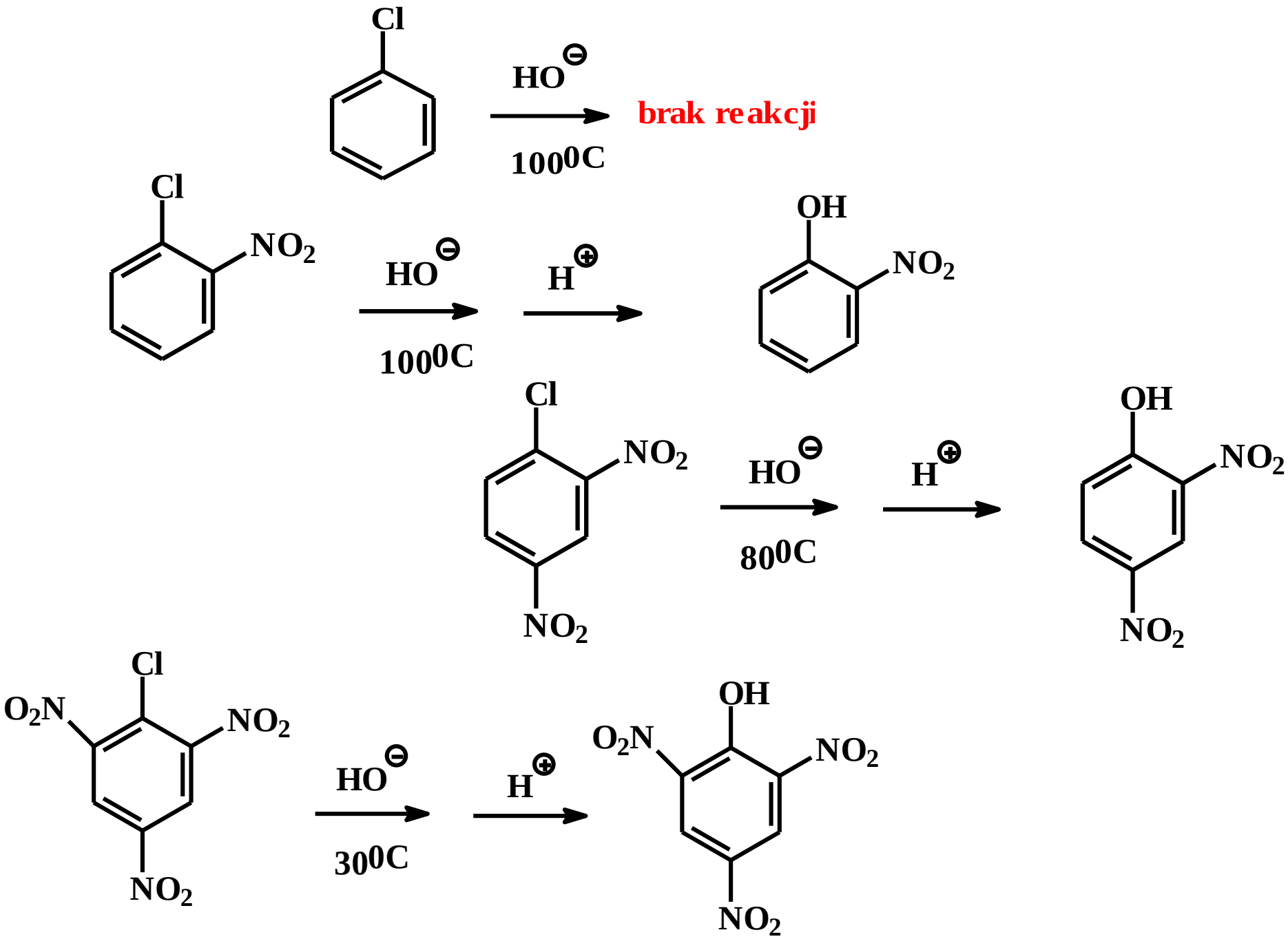
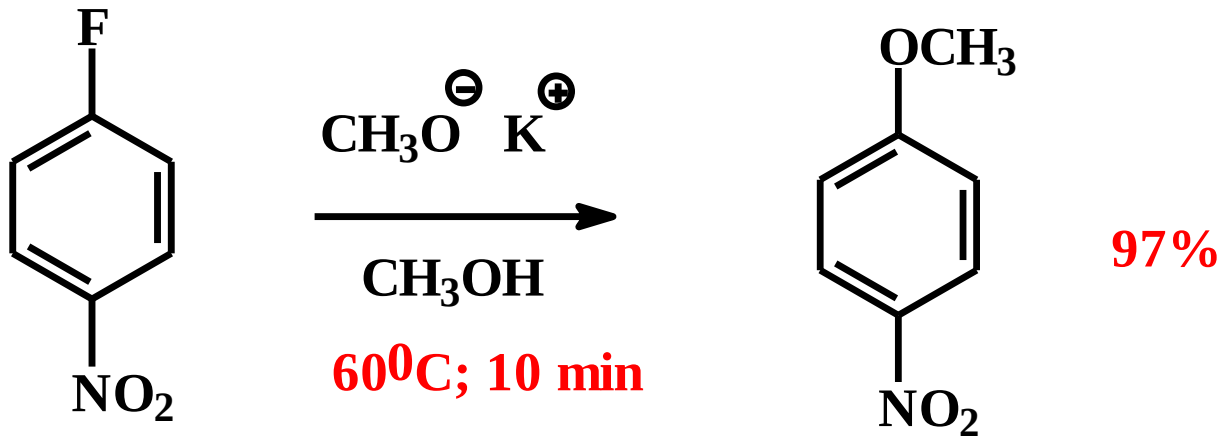
# Reakcje substytucji nukleofilowej w układach aromatycznych



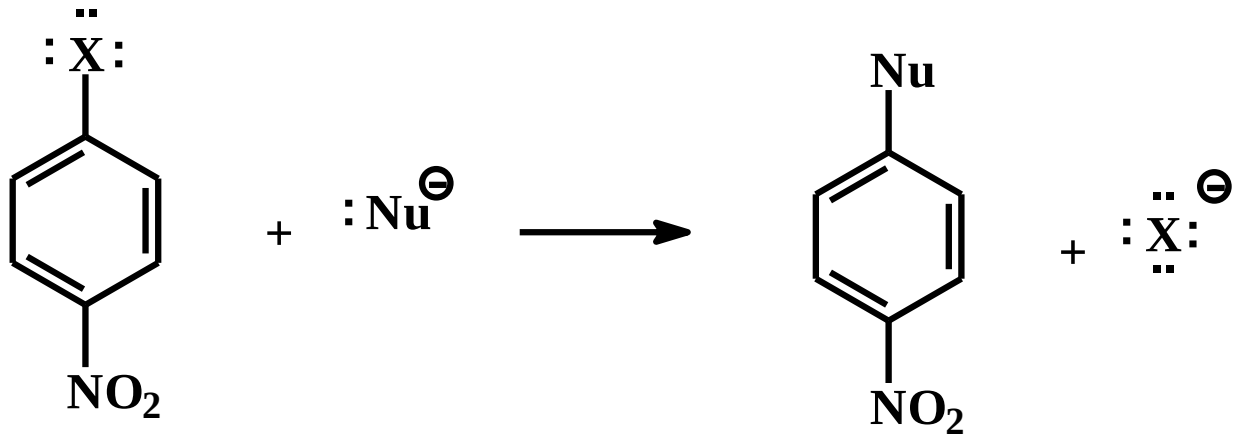




Cl
+
NaOH
H2O
350 0C
H⊕
OH
Br
+
K⊕ NH2⊖
NH3
-33 0C
NH2
+
KBr
Cl
NO2
HO⊖ / H2O
Δ
H⊕
OH
NO2


Cl
HO⊖
100⁰C
brak reakcji
Cl
NO2
HO⊖
100⁰C
H⊕
OH
NO2
Cl
NO2
NO2
HO⊖
80⁰C
H⊕
OH
NO2
NO2
Cl
O2N
NO2
NO2
HO⊖
30⁰C
H⊕
OH
O2N
NO2
NO2




**p-fluorobenzen** **p-nitroanizol**




$$v = k[\text{aryl-X}][\text{nukleofil}]$$

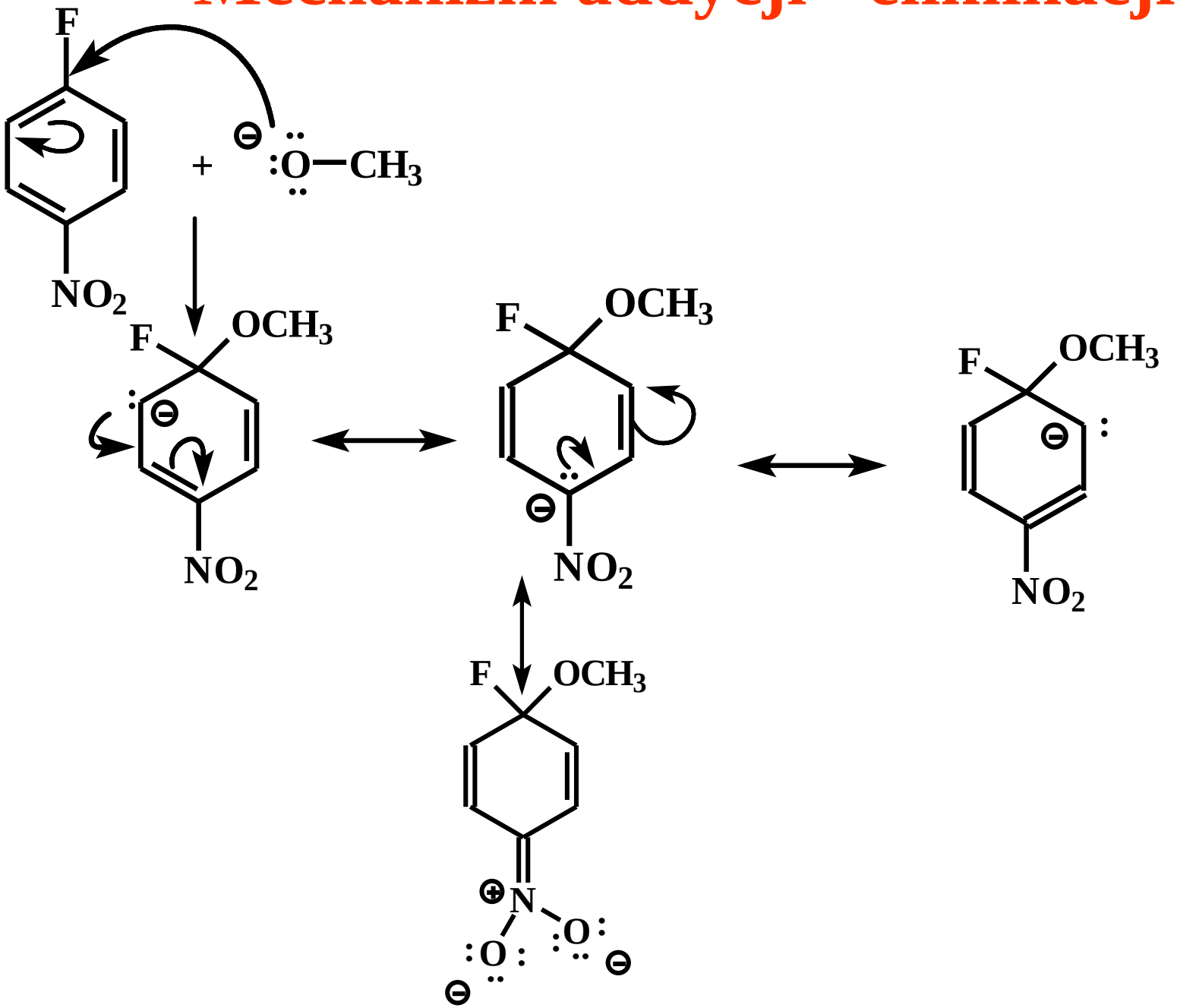
**Szereg szybkości reakcji substytucji nitrowych pochodnych aromatycznych**

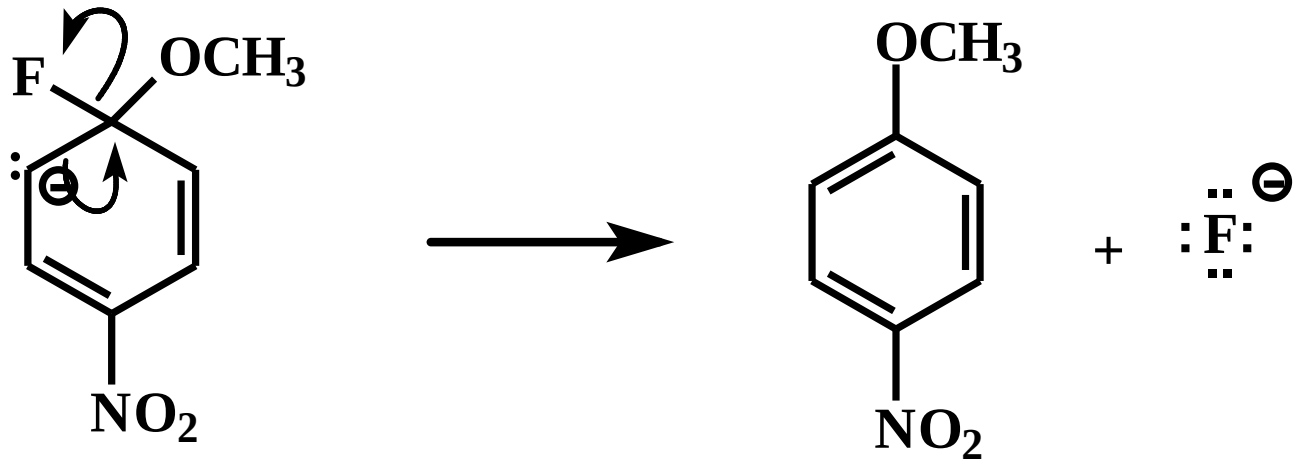
**Ar-F >> Ar-Cl > Ar-Br > Ar-I**

**Szereg szybkości reakcji substytucji nukleofilowej $S_N2$ na węglu $sp^3$**

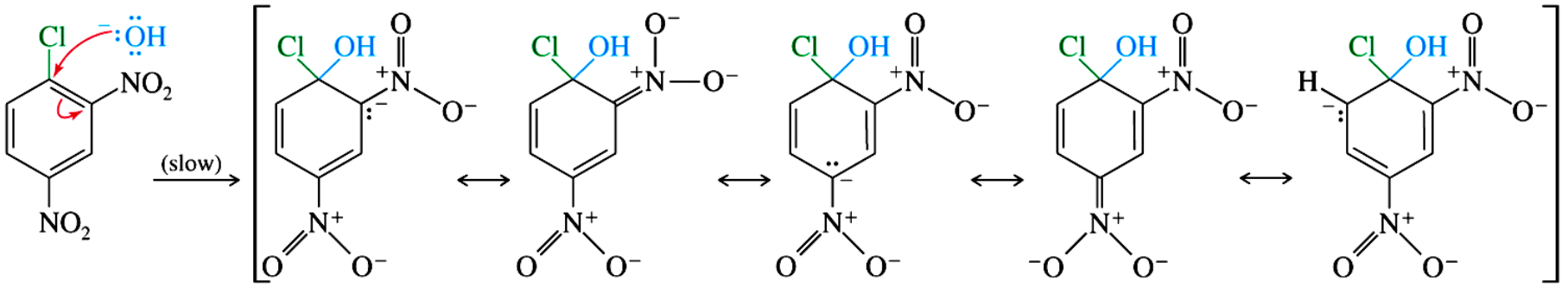
**R-I >> R-Br > R-Cl >> R-F**

# Mechanizm addycji - eliminacji



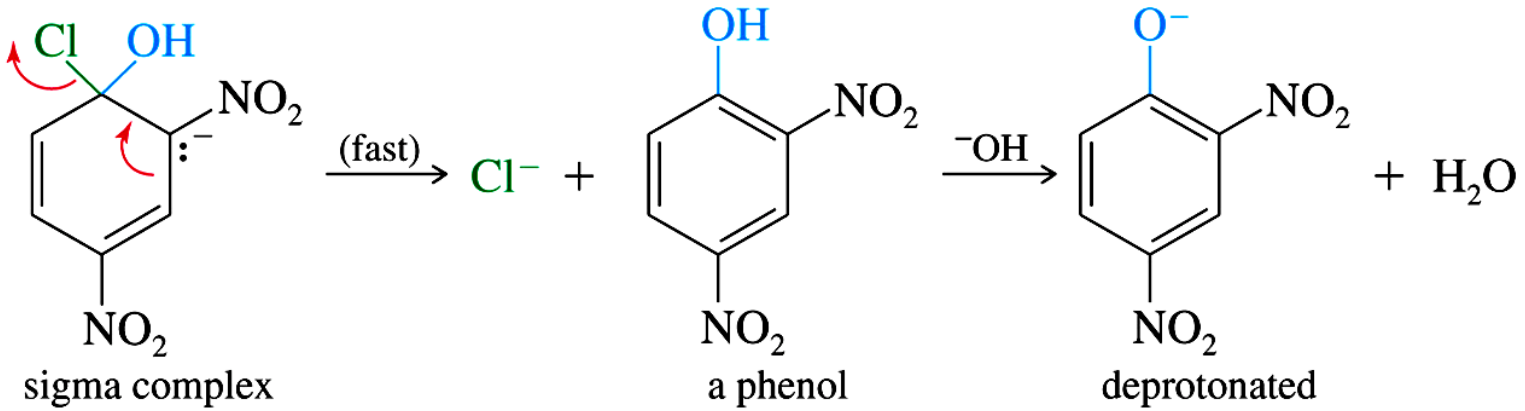

F
OCH3
NO2
OCH3
NO2
+
F

Etap 1. przyłączenie grupy hydroksylowej i utworzenie kompleksu sigma




Etap 2. odejście anionu $Cl^-$

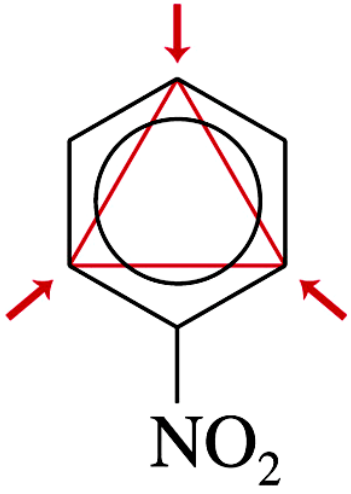
Etap 3. nadmiar zasady odrywa proton



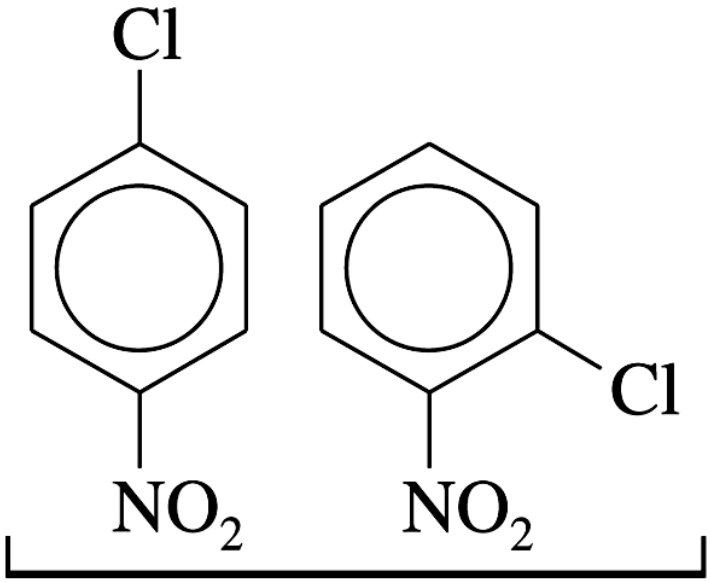

sigma complex

a phenol

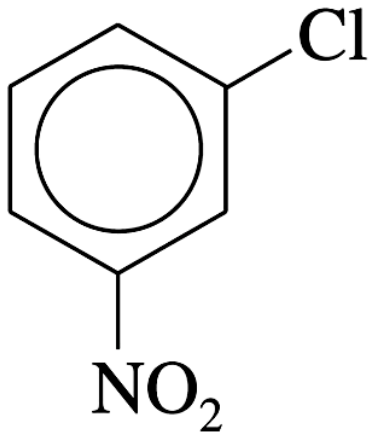
deprotonated




aktywne pozycje
orto i para

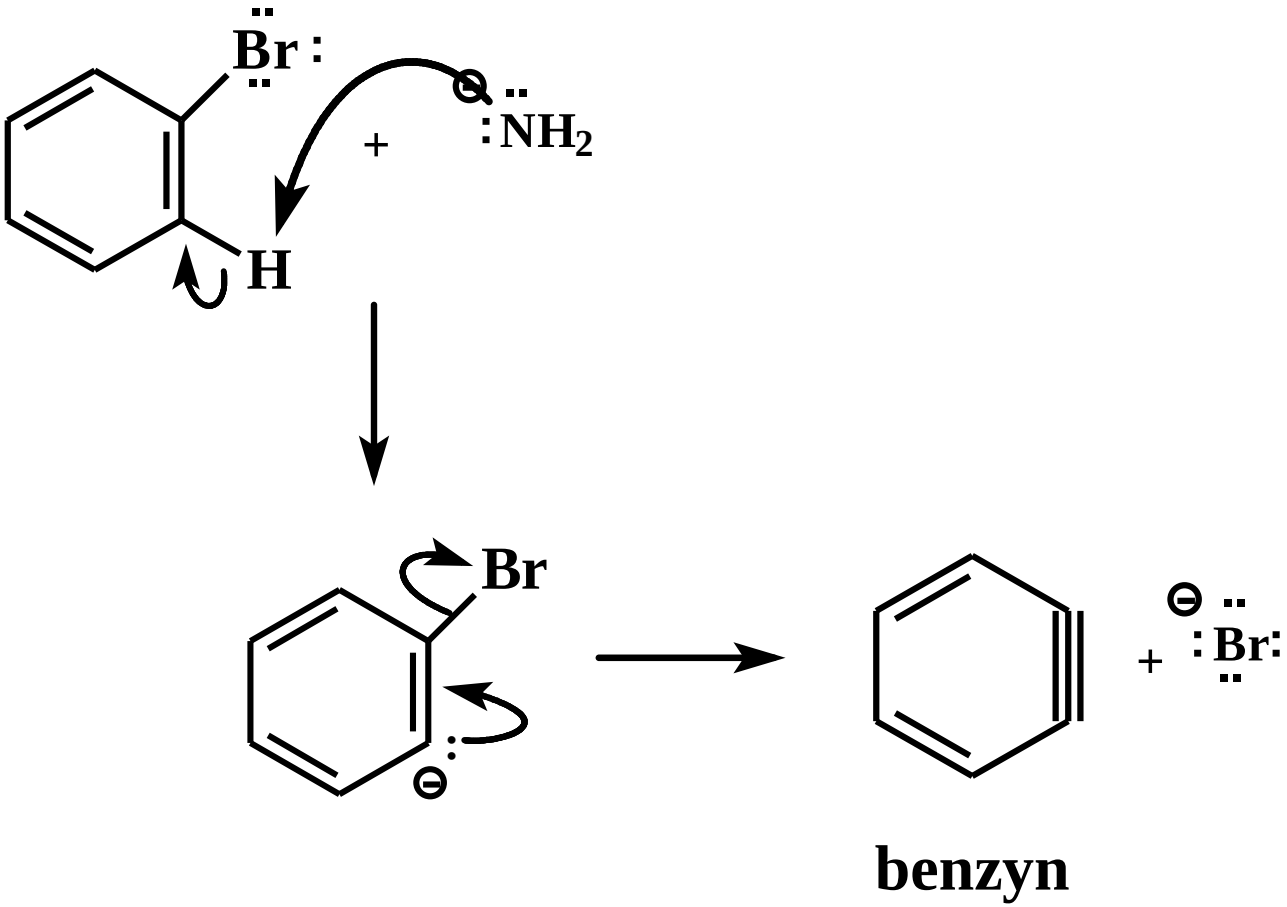


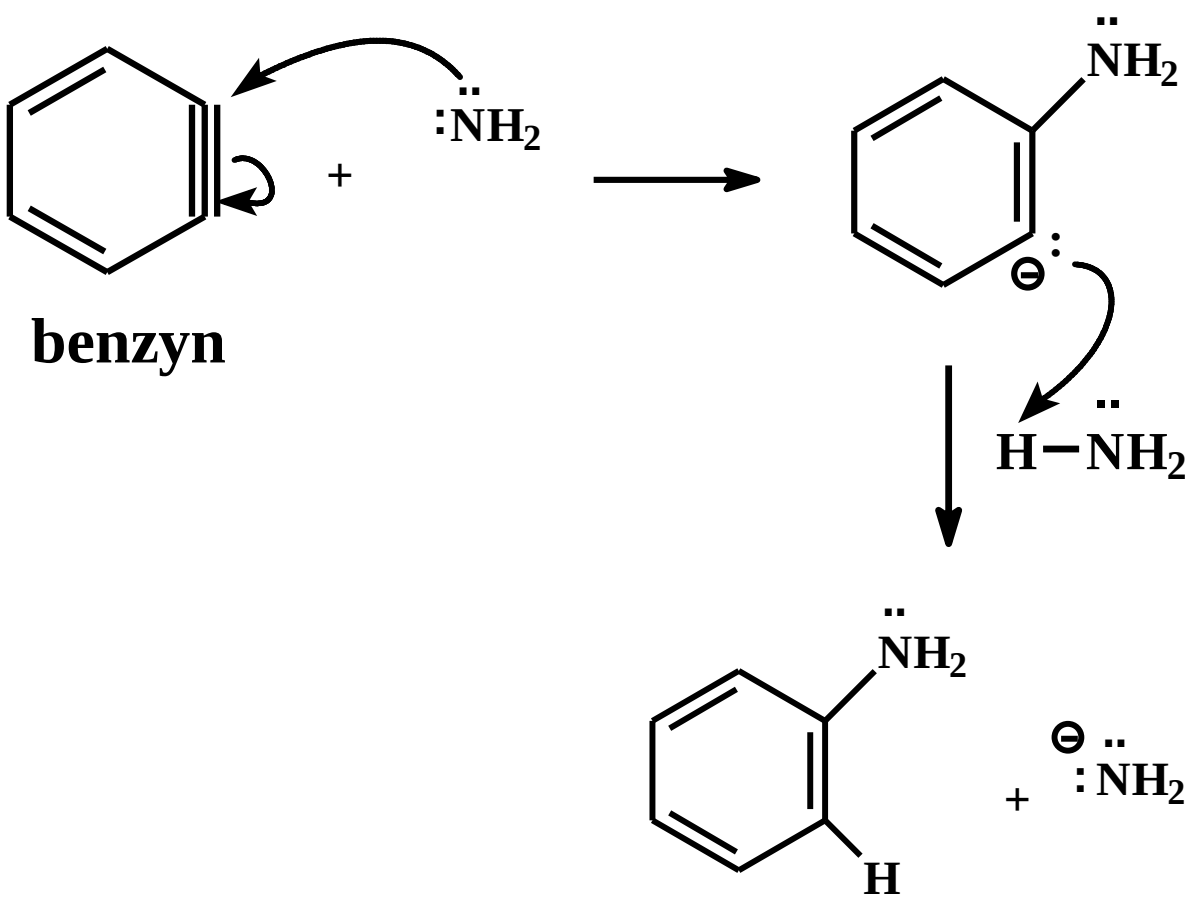

zaktywowane

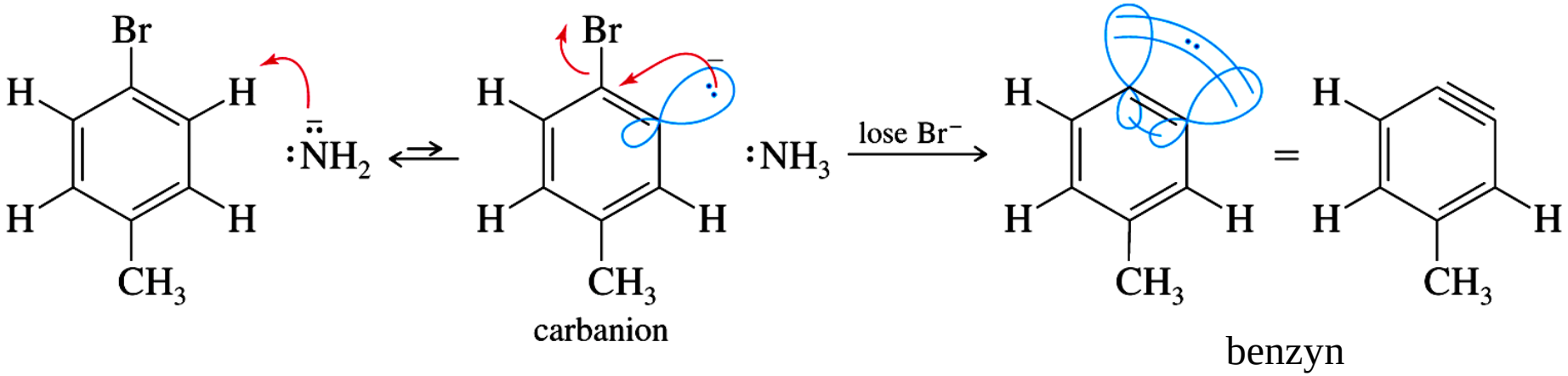



zdezaktywowane

# Benzyn

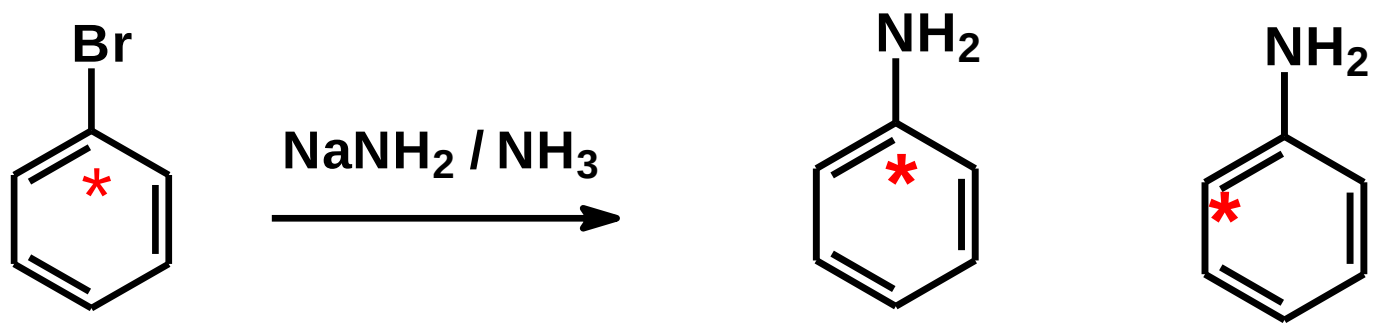


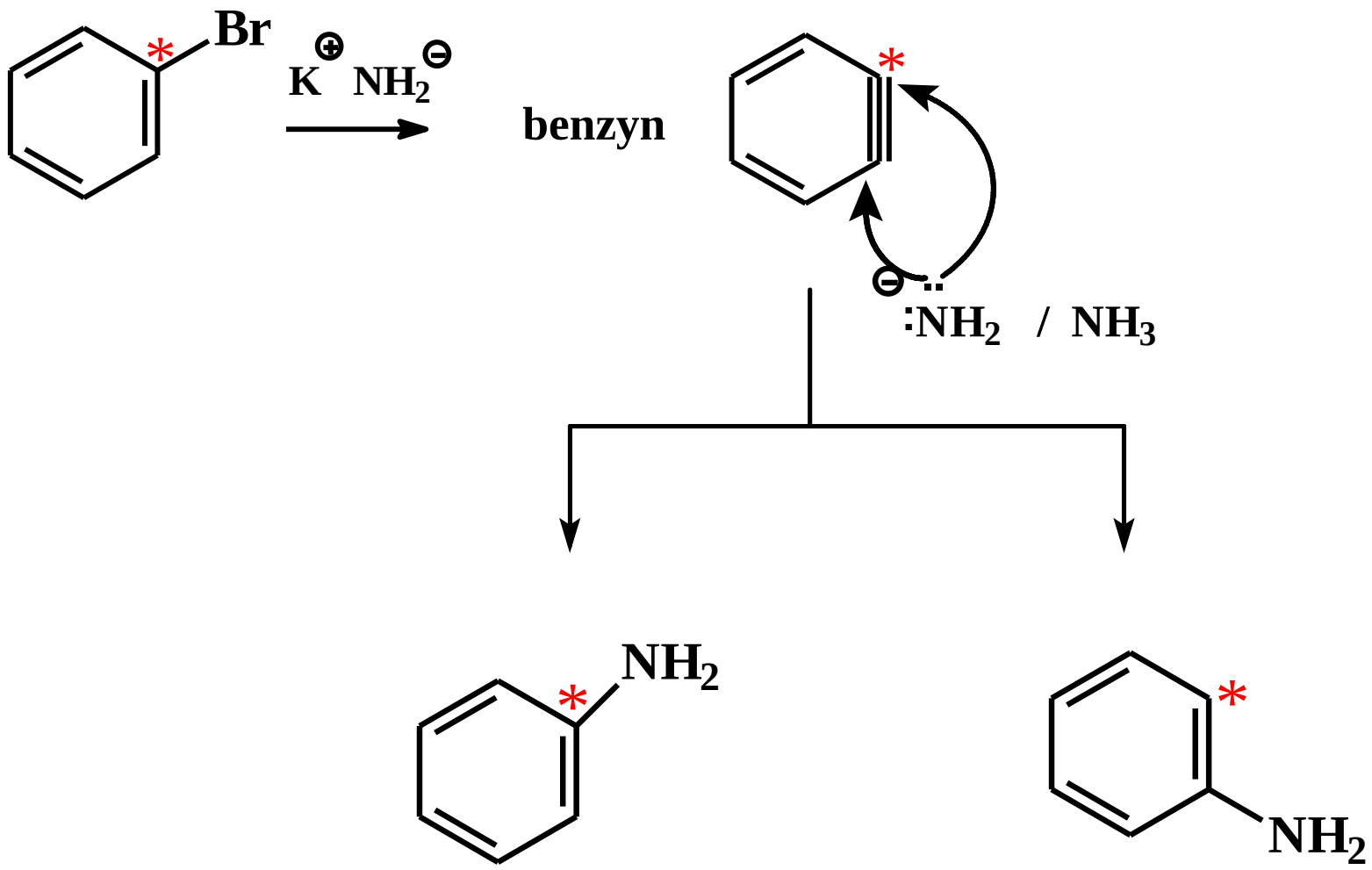

benzyn

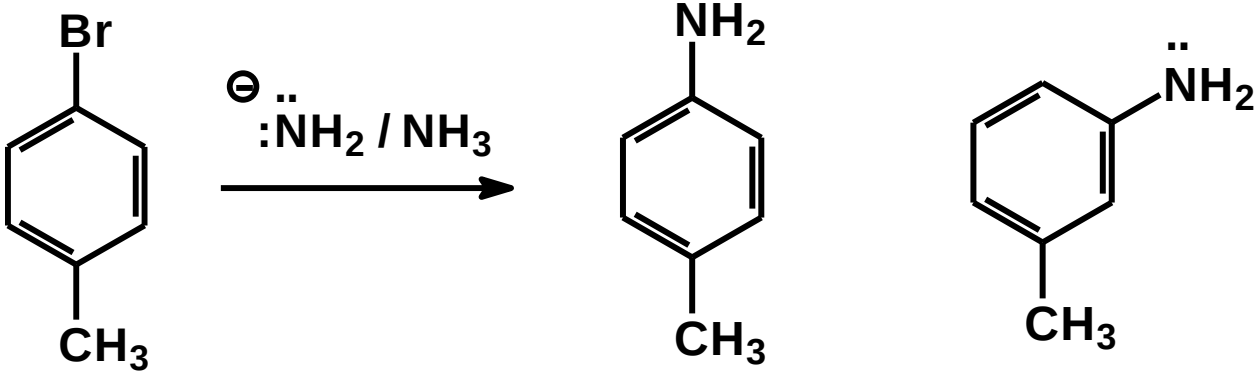



carbanion

benzyn


Br
NaNH2 / NH3
NH2
NH2

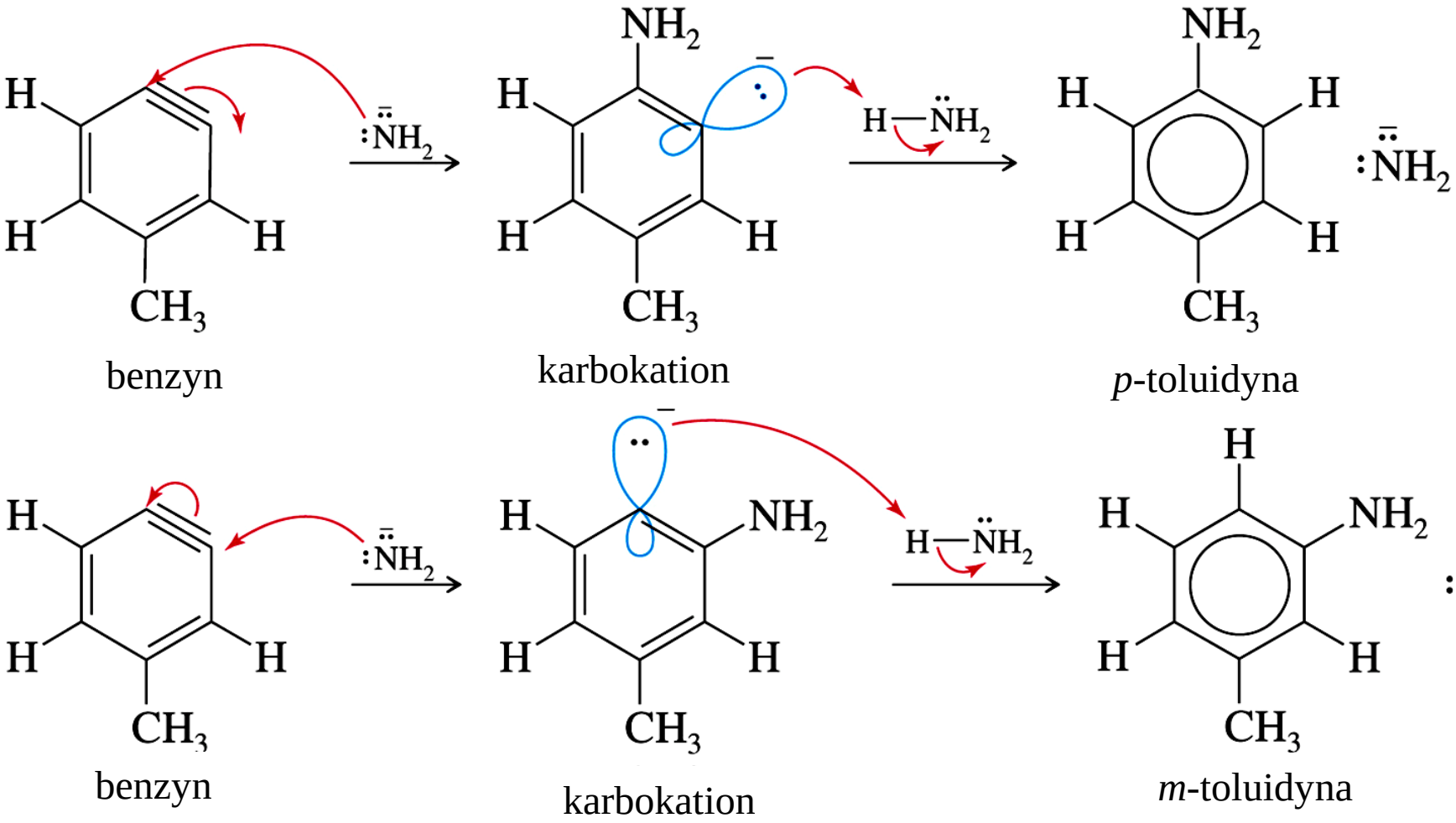

Br
K ⊕
NH2 ⊖
benzyn
:NH2 / NH3
NH2
NH2




**p-bromotoluen**

**p-toluidyna**

**m-toluidyna**


benzyn
karbokation
p-toluidyna
benzyn
karbokation
m-toluidyna