Substitution and elimination

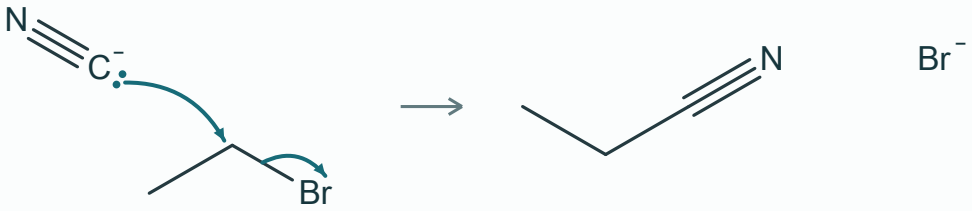
Chapter 5 cheat sheet · 10 mechanism steps to practice

Start at a lone pair or bond; the arrowhead shows where the electron pair goes.

01 / REACTION

SN2 builds C-C

The carbon end of cyanide attacks as bromide leaves. NaCN in DMSO.



Key idea Cyanide adds a carbon when its carbon end attacks.

Propanenitrile + Br^-. The chain gains one carbon.

02 / REACTION

Neutral Nu: attack

Ammonia donates its lone pair while C-Br breaks.



Key idea A neutral nitrogen becomes positive when it makes its fourth bond.

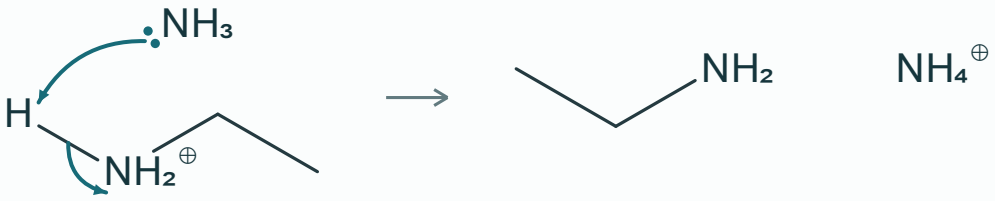
Ethylammonium + Br^-. Nitrogen has four bonds and +1.

FREE SAMPLE

03 / REACTION

Neutral Nu: finish

Another ammonia takes H from the ammonium product.



Key idea Another base removes the extra proton to release the amine.

Ethylamine + NH_4^+. Further alkylation can compete.

↔ Resonance contributors. → Reaction step. Dots show moving lone pairs. Unchanged spectators omitted.

Aromatic reactions

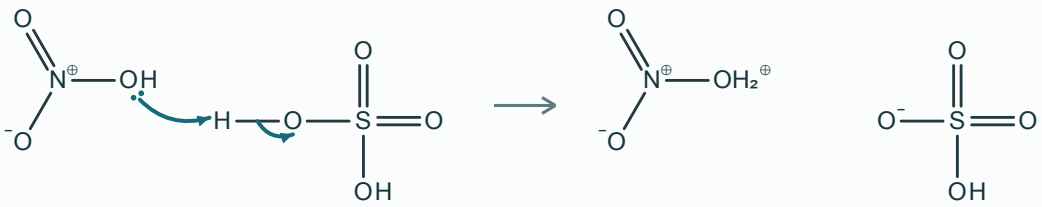
Chapter 13 cheat sheet · 22 mechanism steps to practice

Start at a lone pair or bond; the arrowhead shows where the electron pair goes.

01 / REACTION

Nitration: protonate nitric acid

The OH oxygen of HNO_3 takes H from H_2SO_4.



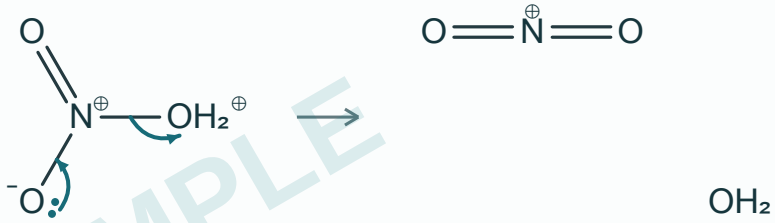
Key idea An OH group leaves much more easily once it's been turned into water.

The protonated OH becomes a water leaving group; HSO_4^- is the counterion.

02 / REACTION

Nitration: make NO_2^+

O^- supplies the second N=O bond as water leaves.



Key idea Water leaves as the second N=O bond forms, so nitrogen keeps its octet.

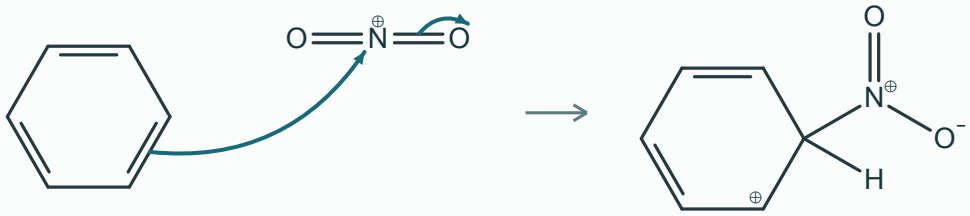
Linear $O=N^+=O$ is the electrophile. Nitrogen keeps its octet throughout.

FREE SAMPLE

03 / REACTION

Nitration: attack NO_2^+

A ring π pair attacks N; one N=O pair moves to O.



Key idea The ring spends its aromaticity to make a bond, giving a delocalized σ cation.

The sp^3 carbon bears H and NO_2. Ring + is shared by the two ortho and the para carbons; one contributor is shown.

↔ Resonance contributors. → Reaction step. Dots show moving lone pairs. Unchanged spectators omitted.