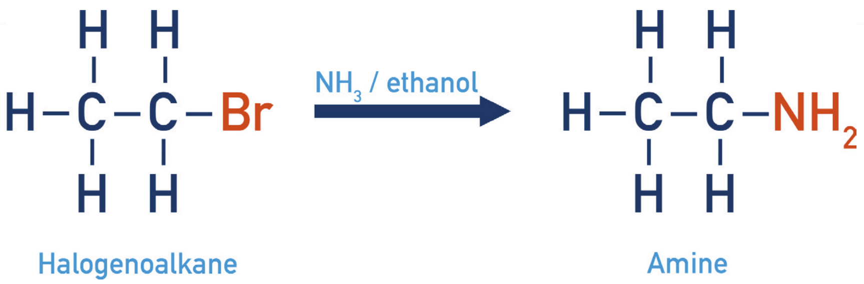
Organic Chemistry Revision Sheets
Halogenoalkanes | Nucleophilic Substitution (with NH_3)

Reaction

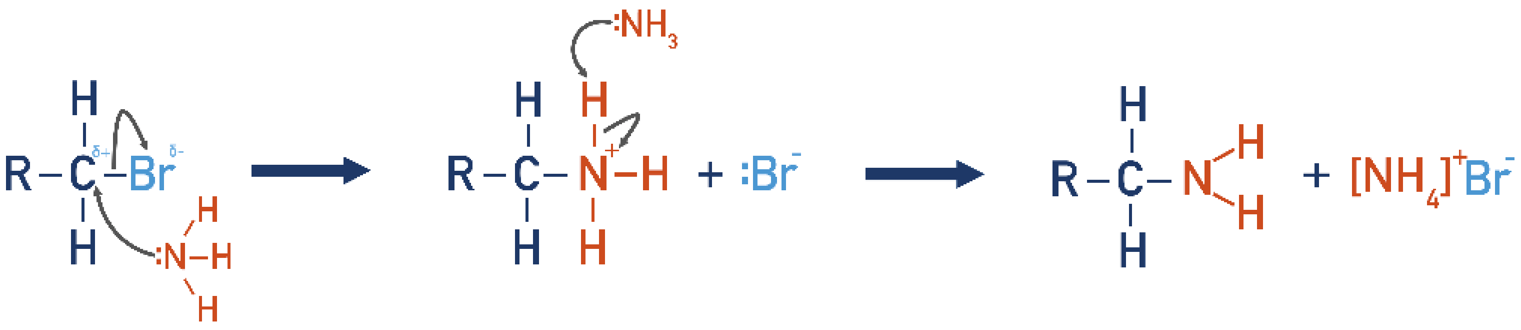
REACTANTS: Halogenoalkane and Ammonia (NH_3)
CONDITIONS: Heat*, Ethanolic conditions
PRODUCT(S): Amine and Ammonium Halide Salt
REACTION TYPE: Nucleophilic Substitution

REACTION:
(example of bromoethane)



Mechanism

Ammonia (NH_3) acts as a nucleophile, due to its lone pair of electrons on the nitrogen atom and attacks the partially positive carbon atom in the carbon-halogen bond. The carbon-halogen bond breaks, forming an (aliphatic) amine and ammonium halide salt. NH_2 group is **substituted** for the halogen group.



Notes:

- Reaction must be carried out in **ethanolic conditions (in ethanol, no water present), otherwise an alcohol is likely to form** rather than the nitrile.
- *A sealed container containing reactants is heated (otherwise ammonia would escape due its high volatility).
- The amine formed in the reaction is actually a stronger base than ammonia, so an ammonium-alkyl salt may be formed. The amine can be obtained by adding sodium hydroxide to the mixture - forcing the amine group to 'release' a H^+ ion and become a neutral molecule.
- The strength of the carbon-halogen bond (bond enthalpy) determines the speed of the reaction. The stronger the bond, the slower the nucleophilic substitution reaction. *C-F bond is strongest, giving the slowest reaction; C-I bond is weakest, giving the fastest reaction.*