

# CAIE Chemistry A-level

## Topic 15 - Halogen Compounds

### Flashcards

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# What are halogenoalkanes?



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Halogenoalkanes are organic compounds where the hydrogen atom on an alkane has been replaced by a halogen atom.



How does bromoethane undergo hydrolysis reactions?



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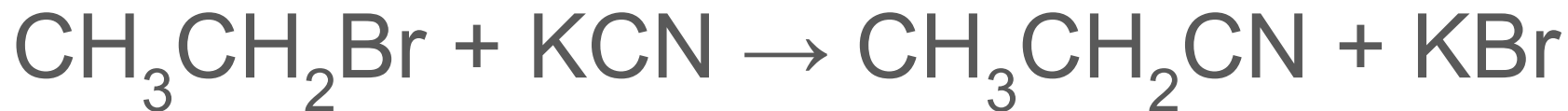
- Reaction is fairly slow.
- Resulting solution can be tested with  $\text{AgNO}_3$  to determine the halogen present.



How does bromoethane undergo a nucleophilic substitution reaction to form a nitrile?



How does bromoethane undergo a nucleophilic substitution reaction to form a nitrile?



- Heat under reflux.
- Ethanol is used as the solvent.



How does bromoethane react with ammonia to form a primary amine?





# How does bromoethane react with ammonia to form a primary amine?

First, bromoethane reacts with ammonia to form an alkyl ammonium salt:



If the ammonia is in excess, the salt reacts to form a primary amine:



How does 2-bromopropane react to form an alkene?



How does 2-bromopropane react to form an alkene?

Elimination reaction:

Reflux with KOH in ethanol (or conc. NaOH solution).



# Describe the $S_N1$ nucleophilic substitution mechanism



# Describe the $S_N1$ nucleophilic substitution mechanism



In the first stage, the halogenoalkane ionises to form the carbocation intermediate  $(\text{CH}_3)_3\text{C}^+$  and  $\text{Cl}^-$ .

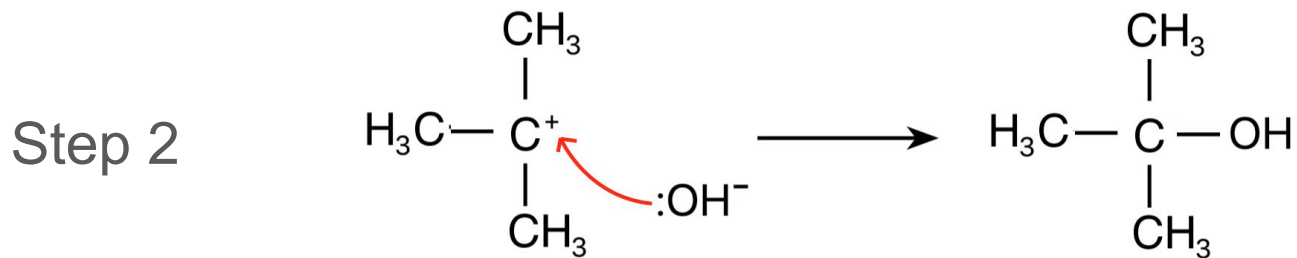
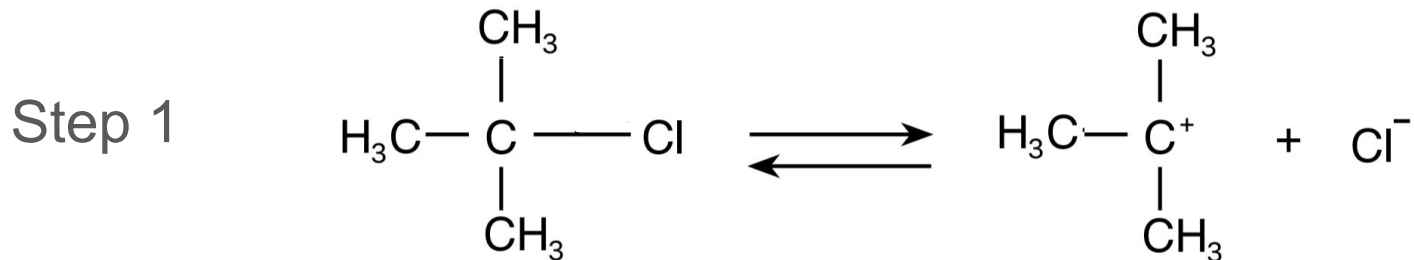
The  $(\text{CH}_3)_3\text{C}^+$  intermediate then immediately reacts with the hydroxide ion to form the product.



What does the  $S_N1$  mechanism look like?



# What does the S<sub>N</sub>1 mechanism look like?



# Describe the $S_N2$ nucleophilic substitution mechanism





# Describe the S<sub>N</sub>2 nucleophilic substitution mechanism



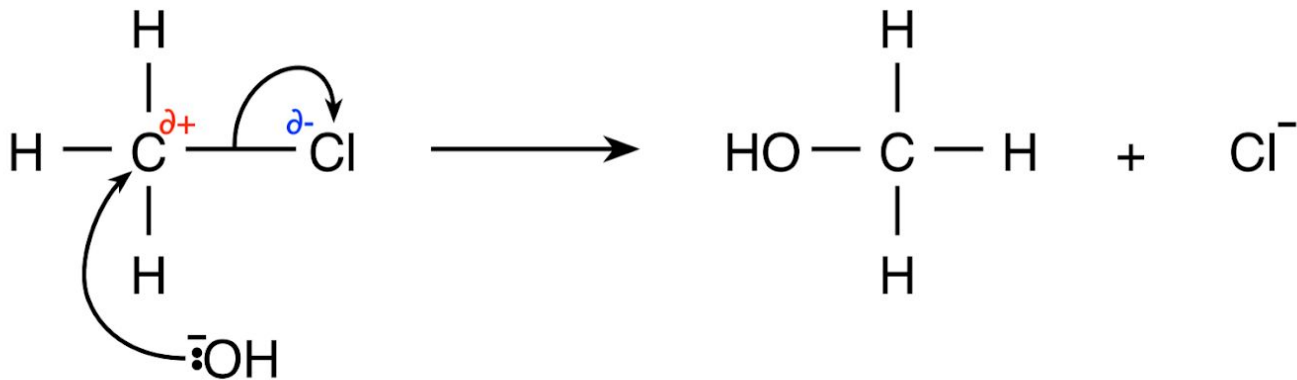
- These reactions are a one step mechanism.
- The nucleophile attacks the substrate at the same time as the leaving group leaves the substrate.
- The nucleophile attacks the carbon atom from the back side, causing an inversion of the groups in the product. The nucleophile attacks from the backside because the large halogen atom prevents the attack from the other direction.



What does a  $S_N2$  mechanism look like?



# What does a S<sub>N</sub>2 mechanism look like?



What are the inductive effects of alkyl groups?



# What are the inductive effects of alkyl groups?

Alkyl groups are electron-donating groups.

They push electrons towards the carbon that the group is bonded to, making the alkyl group have a slight positive charge and the carbon it is bonded with to have a slight negative charge. This is called the positive inductive effect.



What mechanism ( $S_N1$  or  $S_N2$ ) do primary, secondary and tertiary haloalkanes react via?



What mechanism ( $S_N1$  or  $S_N2$ ) do primary, secondary and tertiary haloalkanes react via?

- Primary halogenoalkanes tend to react via the  $S_N2$  mechanism.
- Tertiary halogenoalkanes tend to react via the  $S_N1$  mechanism
- Secondary halogenoalkanes react via a mixture of the two, depending on the structure.



What are the relative strengths of carbon-halogen bonds?





What are the relative strengths of carbon-halogen bonds?

As you go down Group 7, the carbon-halogen bond strength decreases.



What is the trend in the rate of hydrolysis of carbon-halogen bonds?



What is the trend in the rate of hydrolysis of carbon-halogen bonds?

As you go down the group, the rate of hydrolysis of carbon-halogen bonds increases as less energy is required to break the bond, since bond strength weakens down the group.



What are the uses of fluoroalkanes and fluorohalogenoalkanes?



What are the uses of fluoroalkanes and fluorohalogenoalkanes?

- Refrigerants.
- Used in aerosols.
- Used in making foamed plastics.

They are chemically inert and will not react with anything.

