Halogenoalkanes Summary Map

Cambridge International AS & A Level Chemistry · Topic 15 Halogen compounds

1 Names, classes, nucleophiles

13.1.4, 13.2.1, 15.1.2

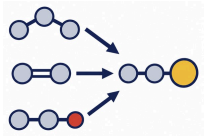
- Halogen as a **prefix**: 2-bromobutane
- Carbons on C–X: **1° 2° 3°**
- **Nucleophile**: electron-pair donor
- Polar C–X: δ+ C attracts nucleophiles



2 Making them

15.1.1

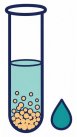
- Alkane + X_2, **UV**: radical substitution
- Alkene + **HX** or X_2: addition
- Alcohol + **$SOCl_2$**, PCl_5 or PCl_3 + heat
- Alcohol + **KBr + H_2SO_4** (or H_3PO_4)

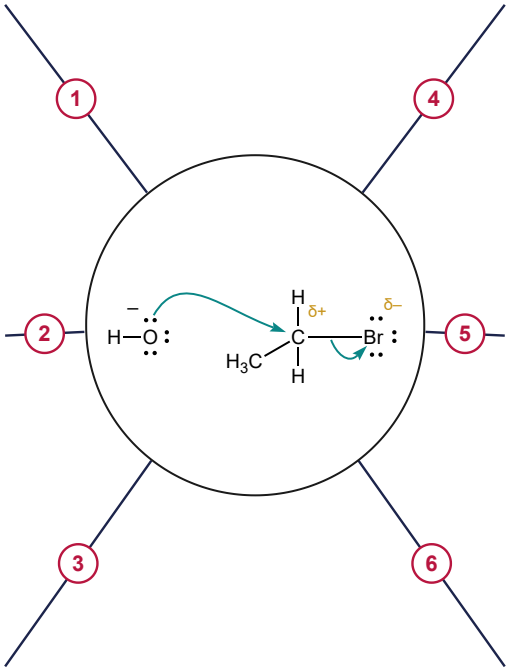


3 Nucleophilic substitution

15.1.3

- **NaOH(aq)**, heat: alcohol
- **NH_3 in ethanol**, pressure: amine
- **KCN in ethanol**, heat: nitrile
- $AgNO_3$ in ethanol: AgX precipitate

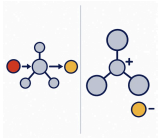




4 SN1 and SN2

15.1.5, 15.1.6

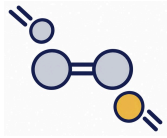
- Primary: **SN2**, one step
- Tertiary: **SN1**, via a **carbocation**
- Alkyl groups stabilise C^+
- Crowding blocks attack from behind



5 Elimination

15.1.4

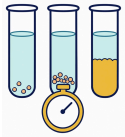
- **NaOH in ethanol**, heat: alkene
- OH^- acts as a **base**: takes H^+
- H and X from neighbouring carbons
- Several alkenes: check E/Z



6 Rates of hydrolysis

15.1.3(d), 15.1.7

- Time to the precipitate: rate ∝ 1/t
- C–I weakest: **iodo fastest**
- Bond energy, not polarity
- **Tertiary > secondary > primary**



One halogenoalkane, five products

bromoethane, CH_3CH_2Br; NaOH aqueous for substitution, ethanolic for elimination

Reagent	Conditions	Product	OH^-, NH_3 or CN^- acts as
NaOH(aq)	heat, reflux	ethanol	nucleophile
H_2O ($AgNO_3$)	ethanol, warm	ethanol + AgBr	nucleophile (water)
NH_3 (excess)	ethanol, heat, pressure	ethylamine	nucleophile, then base
KCN	ethanol, heat	propanenitrile	nucleophile
NaOH in ethanol	heat	ethene	base

Worked examples

Name and class

- $(CH_3)_3CBr$
- 2-bromo-2-methylpropane
- C–Br carbon has 3 C: **tertiary**

Three alkenes

- 2-bromobutane, NaOH in ethanol
- but-1-ene
- **E** and **Z** but-2-ene

Which is faster?

- 1-iodo- or 1-chloropropane
- C–I 240, C–Cl 340 kJ mol^{-1}
- **iodo**: weaker bond

Halogenoalkanes link alkanes and alkenes (Topic 14) to alcohols (Topic 16), amines and nitriles (Topic 19); they are key intermediates in organic synthesis (Topic 21).

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