Cambridge (CIE) A Level Chemistry

Your notes

Amides

Contents

Your notes

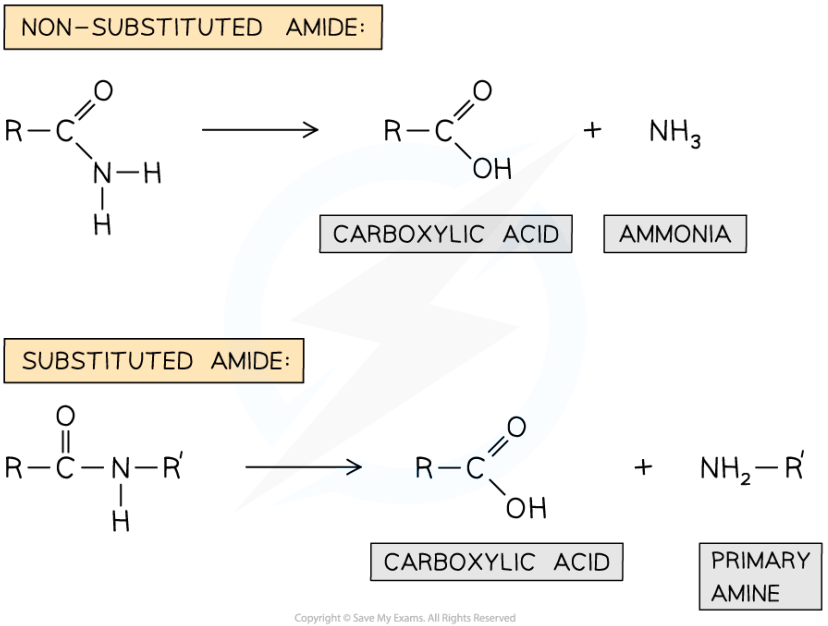
Reactions of Amides

- **Amides** are formed from the **condensation reaction** of **carboxylic acids or acyl chlorides** with **ammonia or amines**
- The amide group ($CONR_2$) in these compounds can undergo reactions including
  - **Hydrolysis** with **aqueous alkali** or **aqueous acid**
  - **Reduction** with **$LiAlH_4$**

Hydrolysis of amides

- The -CON- group in **substituted amides** links two hydrocarbon sections of their molecules together
- This amide link can be broken down by **hydrolysis** by **refluxing** it with an **acid** or **alkali**
- The products of a **non-substituted amide** are:
  - Carboxylic acid
  - Ammonia
- The products of a **substituted amide** are:
  - Carboxylic acid
  - Primary amine

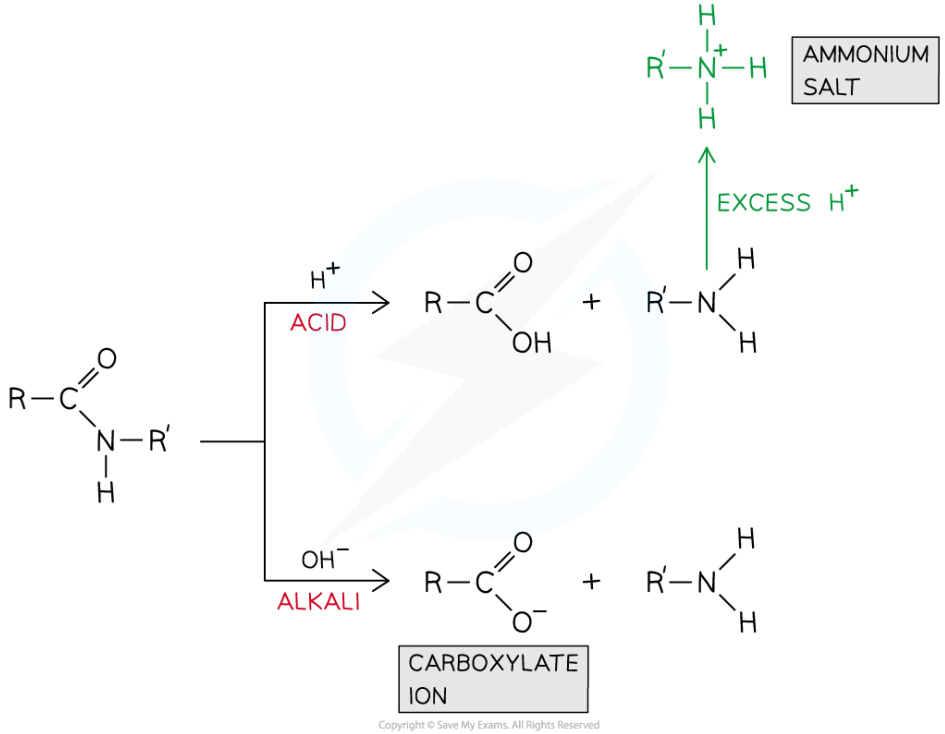
Hydrolysis of substituted and non-substituted amides



The hydrolysis products include a carboxylic acid along with ammonia for a non-substituted amide and an amine for a substituted amide

- When hydrolysed by refluxing in **excess acid**, the ammonia or amine produced will form an ammonium salt
- When hydrolysed by refluxing in **excess** base, the carboxylic acid produced will be deprotonated to form a carboxylate ion

Comparing amide hydrolysis in acidic and alkaline conditions



Amides are hydrolysed to carboxylic acids and ammonia or primary amines when refluxed with acid or alkali

Reduction of amides

- The C=O group in amides can be **reduced** by the strong reducing agent $LiAlH_4$ to form an amine
- The products of a **non-substituted amide** are:
  - A primary amine and water
- The products of a **substituted amide** are:
  - A secondary amine and water

Reduction of amides

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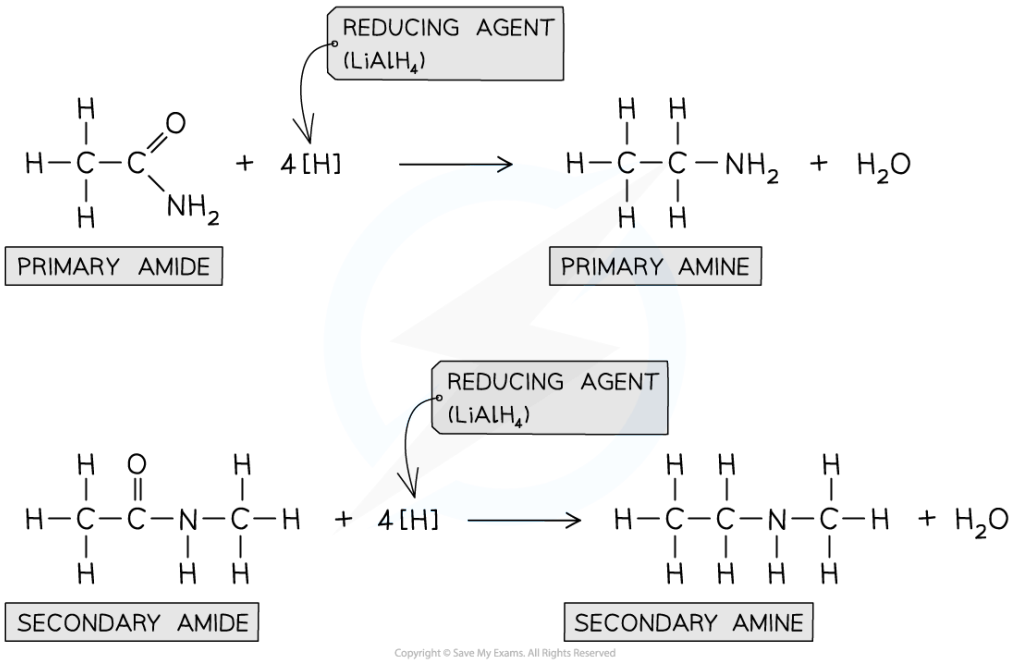

Amides can be reduced to amines using $LiAlH_4$

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Relative Basicity of Amides & Amines

- A **base** is a species that can **donate** its lone pair of electrons to form a **dative covalent bond** with another species
- **Amines** are basic as the **nitrogen** atom has a lone pair of electrons which can form a dative covalent bond with an electron-deficient species (such as an H^+ ion)
- The **basicity** of the amine depends on the availability of this lone pair of electrons
  - The **more readily** available the lone pair of electrons is for dative covalent bonding, the **stronger the base**
  - The **less readily** available the lone pair of electrons is, the **weaker the base**
- **Electron-donating** groups such as alkyl groups **increase** the electron density on the nitrogen atom causing the lone pair to become more available
- **Electron-withdrawing** groups such as aromatic benzene rings, cause **delocalisation** of the lone pair of electrons which become less readily available
- This is why **phenylamine** (which contains an electron-withdrawing benzene ring) is a **weaker base** than **propylamine** (which contains an electron-donating alkyl group)

Basicity of amides

- Amides also contain a nitrogen atom with a lone pair of electrons
- Again, the **basicity** of the amide depends on the availability of this lone pair for dative covalent bonding
- Due to the presence of the **electron-withdrawing** oxygen atom in the amide group, electron density is **removed** from the nitrogen atom
- The lone pair on the nitrogen atom, therefore, becomes **less readily** available and is not available to donate to an electron-deficient species
- Since this electron-withdrawing oxygen is characteristic of amides and is **not** present in amines, amides are **much weaker bases** than amines