

# Edexcel IAL Chemistry

## A-Level

### Topic 19 - Organic Nitrogen Compounds: Amines, Amides, Amino acids and Proteins

#### Flashcards

This work by [PMT Education](https://www.pmt.education) is licensed under [CC BY-NC-ND 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/)



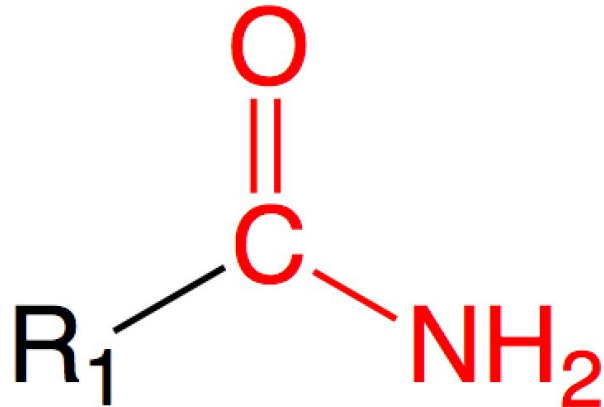
# What is an amide?



## What is an amide?

An amide is a derivative of a carboxylic acid where the alcohol group on the  $\text{-COOH}$  is replaced by  $\text{-NH}_2$ .

General formula:  $\text{R}_1\text{-CONH}_2$



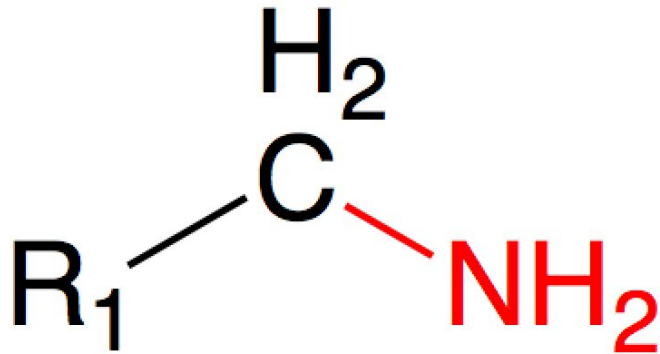
# What is an amine?



## What is an amine?

An amine is a compound derived from ammonia, where at least one of the hydrogen atoms have been replaced by an alkyl group.

General formula:  $R_1-NH_2$



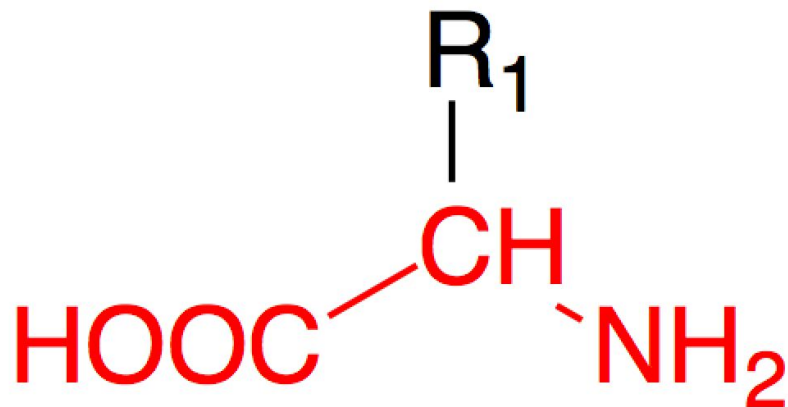
# What is an amino acid?



# What is an amino acid?

An amino acid has a carboxyl group as well as an amino group.

General formula:



How does butylamine react with water to form an alkaline solution?





## How does butylamine react with water to form an alkaline solution?

The nitrogen on butylamine can bond to a hydrogen atom on water by forming a dative coordinate bond. This leaves an  $\text{OH}^-$  ion, so the resulting solution is alkaline.



What is produced when an amine reacts with an acid?



What is produced when an amine reacts with an acid?

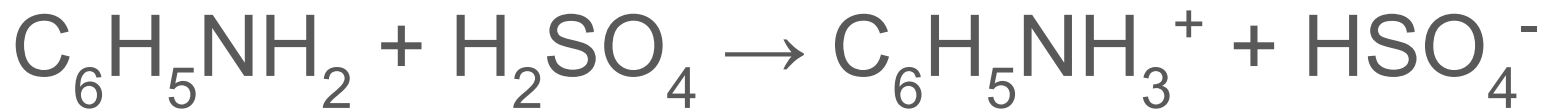
An amine acts as a base and forms a salt when reacted with an acid.



What is the chemical equation for the reaction of phenylamine with sulfuric acid?



What is the chemical equation for the reaction of phenylamine with sulfuric acid?



How does ethylamine react with excess bromoethane?



## How does ethylamine react with excess bromoethane?

Ethylamine undergoes nucleophilic substitution with bromoethane. If the bromoethane is in excess, the secondary amine produced will react again to produce a tertiary amine, which will undergo another nucleophilic substitution reaction to form a quaternary ammonium salt.



What is produced when ethanoyl chloride reacts with an amine?





What is produced when ethanoyl chloride reacts with an amine?

Amines reacts with ethanoyl chloride to produce an amide and hydrogen chloride. The hydrogen chloride reacts further with the amine to form an ammonium salt.



What is the chemical equation for the reaction between propylamine and ethanoyl chloride?



What is the chemical equation for the reaction between propylamine and ethanoyl chloride?

Step 1:



Step 2:



How does methylamine react with copper(II) ions?



How does methylamine react with copper(II) ions?



With excess methylamine:



In the first reaction a blue precipitate is formed which dissolves to form a dark blue solution in excess methylamine.



# Why are amines miscible in water?



## Why are amines miscible in water?

Amines are soluble in water because they are able to form hydrogen bonds with water molecules. This is possible because in the amine functional group, the hydrogen atom is bonded to a very electronegative nitrogen atom.



What is the trend in basicity between ammonia, primary aliphatic amines and primary aromatic amines?





What is the trend in basicity between ammonia, primary aliphatic amines and primary aromatic amines?

Primary aliphatic amine > ammonia > primary aromatic amine.

Primary aliphatic amines are the most basic whereas primary aromatic amines are the least basic.



Explain the trend in basicity between ammonia, primary aliphatic amines and primary aromatic amines



# Explain the trend in basicity between ammonia, primary aliphatic amines and primary aromatic amines

The alkyl groups on the primary aliphatic amine have a positive inductive effect and 'push' electrons away from themselves. Therefore the primary aliphatic amine has a more negative nitrogen atom so it reacts with a hydrogen ion more easily. The ion formed from a primary aliphatic amine is more stable than the ion formed from ammonia. Aromatic amines are weaker bases than ammonia. This is because the lone pair on nitrogen is delocalised into the benzene ring so it is no longer fully available to react with hydrogen ions.



How can primary aliphatic amines be produced from halogenoalkanes?



How can primary aliphatic amines be produced from halogenoalkanes?

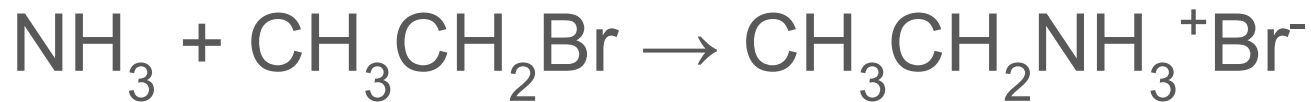
When a halogenoalkane is reacted with ammonia, an ammonium salt is produced. This ammonium salt then reacts further with the halogenoalkane to form a primary aliphatic amine.



What is the equation for the reaction between bromoethane and ammonia to form ethylamine?



What is the equation for the reaction between bromoethane and ammonia to form ethylamine?



How can an amine be produced from a nitrile?





How can an amine be produced from a nitrile?

Nitriles can be reduced, using the reducing agent  $\text{LiAlH}_4$ , to form primary amines.



What is the chemical equation for the reduction of ethanenitrile?



What is the chemical equation for the reduction of ethanenitrile?



How can aromatic amines be produced from aromatic nitro-compounds?



How can aromatic amines be produced from aromatic nitro-compounds?

Aromatic nitro-compounds can be reduced to aromatic amines. Nitrobenzene is reacted with concentrated HCl in the presence of a tin catalyst.

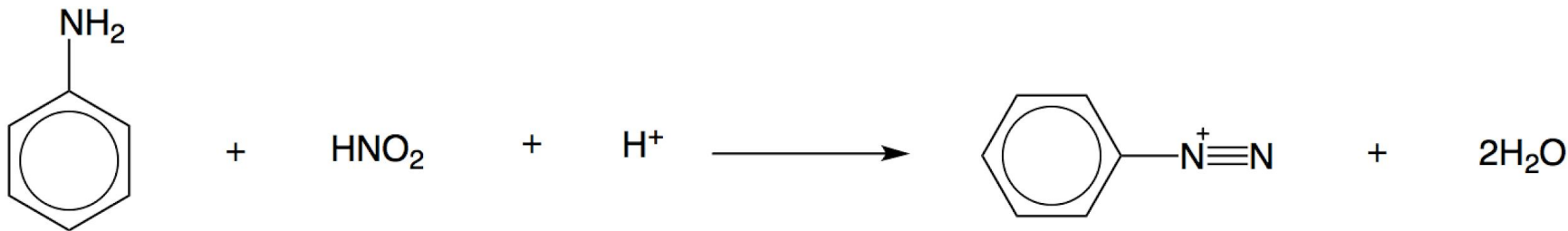


How is a benzenediazonium ion formed from phenylamine?



How is a benzenediazonium ion formed from phenylamine?

The phenylamine is reacted with nitrous acid:



What is the equation for the coupling of benzenediazonium and phenol?





What is the equation for the coupling of benzenediazonium and phenol?

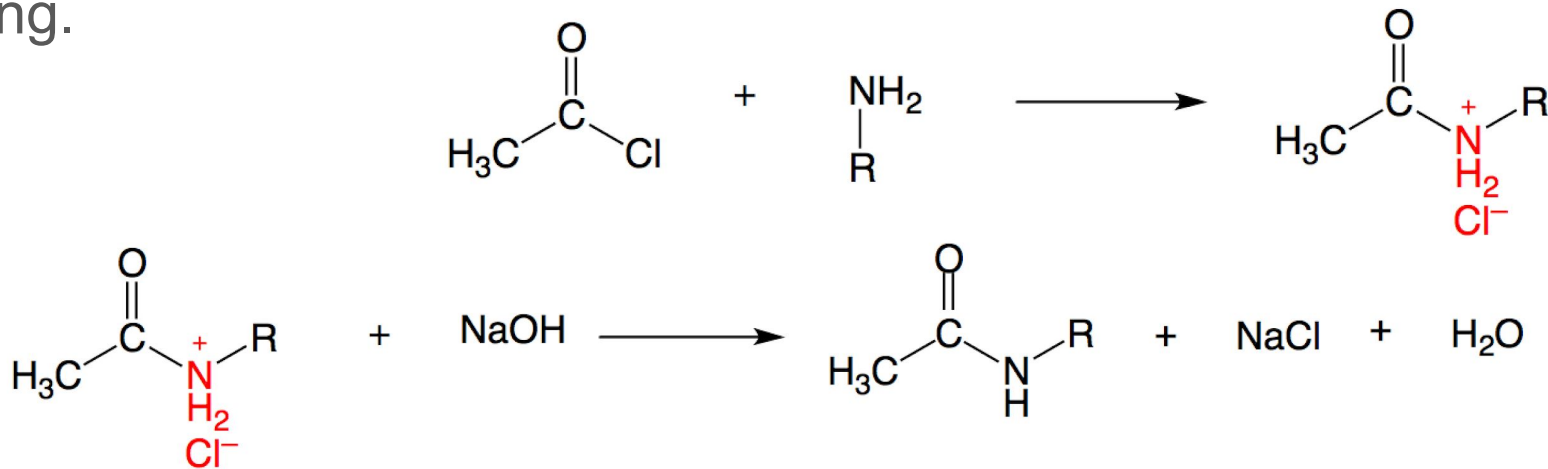


How is an amide produced from an acyl chloride?



# How is an amide produced from an acyl chloride?

An acyl chloride is reacted with ammonia or a primary or secondary amine. It is then treated with NaOH solution to stop the amide salt forming.



# What is condensation polymerisation?



## What is condensation polymerisation?

Condensation polymerisation is a type of polymerisation which forms a polymer by reacting compounds containing two different functional groups. A small molecule such as water is produced as well as the polymer.



What type of polymer is nylon?



What type of polymer is nylon?

Polyamide



# What process is used to form nylon?





What process is used to form nylon?

Condensation polymerisation



# How is a polyamide formed?



## How is a polyamide formed?

Two types of monomers react. One monomer contains two carboxylic acid groups and the other contains two amine groups. Water is also produced.



# How is a polyester formed?



## How is a polyester formed?

Two types of monomers react. One monomer contains two carboxylic acid groups and the other contains two alcohol groups. Water is also produced.



# Compare the structures of proteins and nylon



## Compare the structures of proteins and nylon

- Both contain amide linkages (-CONH-)
- They have different polymer units

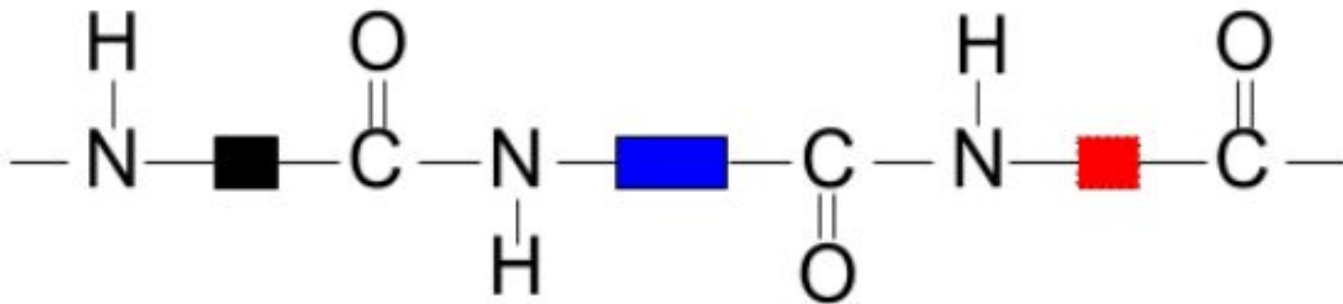


# How can the structure of a protein be represented?





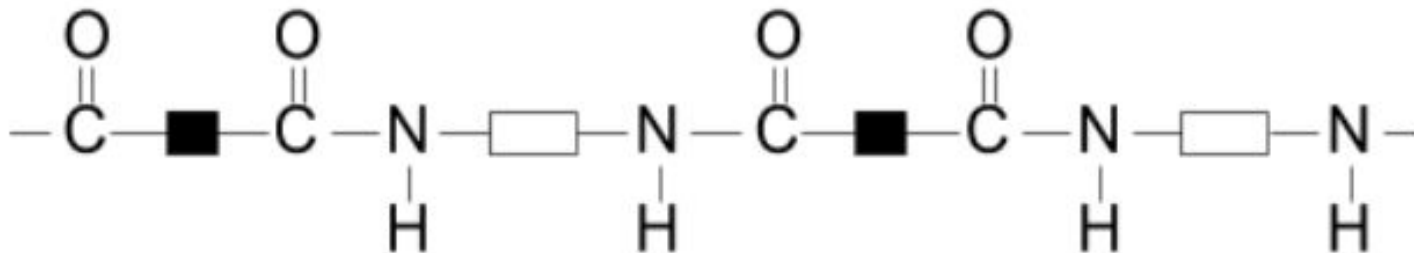
# How can the structure of a protein be represented?



How can the structure of nylon be represented?



# How can the structure of nylon be represented?



# What is addition polymerisation?



## What is addition polymerisation?

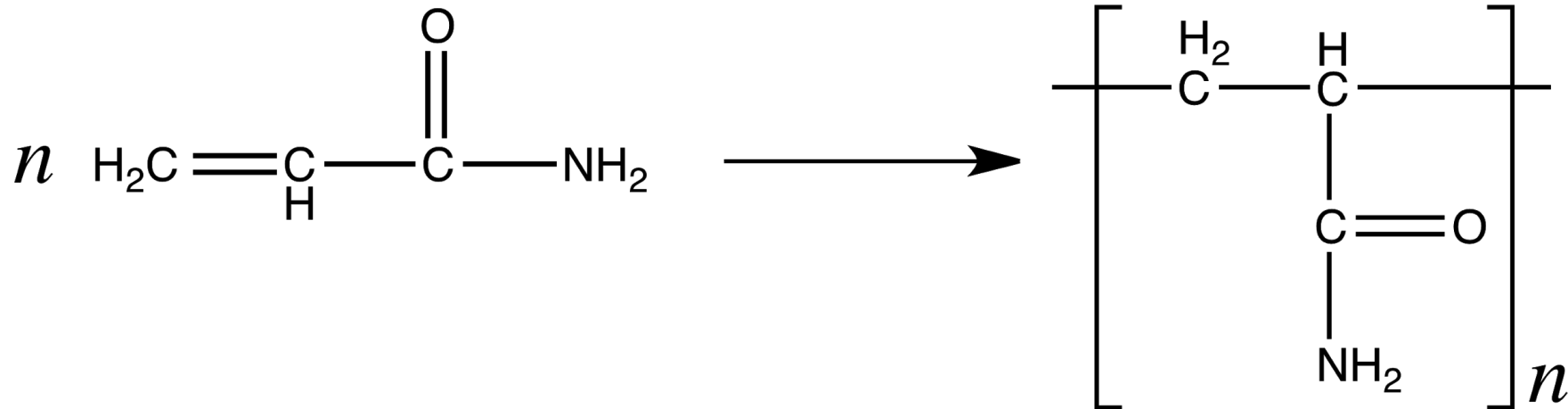
A polymerisation reaction in which the polymer is formed by the 'opening up' of double bonds from an alkene. The polymer is the only product formed, making the atom economy 100%.



What is the equation for the formation of poly(propenamide)?



What is the equation for the formation of poly(propenamide)?

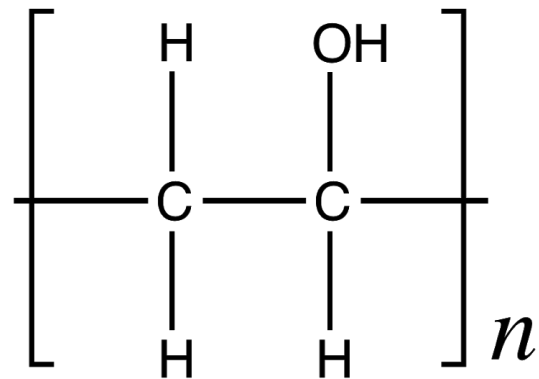
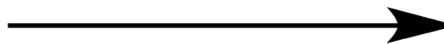
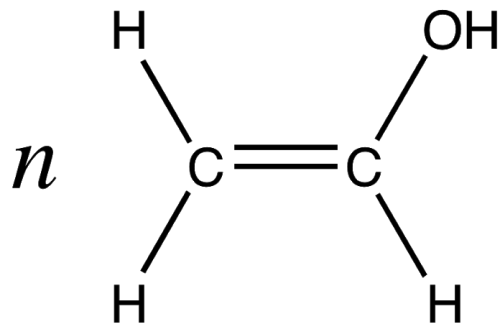


What is the equation for the formation of poly(ethenol)?





What is the equation for the formation of poly(ethenol)?



# Why is poly(ethenol) soluble in water?



# Why is poly(ethenol) soluble in water?

The OH groups in the polymer form hydrogen bonds with water, which makes the polymer soluble and useful for applications such as soluble laundry bags.

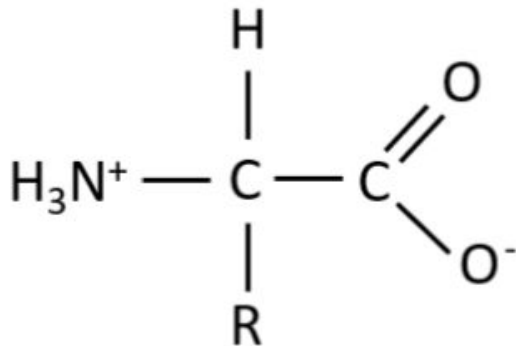


# What is a zwitterion?



# What is a zwitterion?

A zwitterion is a molecule that contains both negatively and positively charged parts. The amino acid zwitterion is formed when the carboxylic acid group donates a proton to the amine group:



What is the isoelectric point of an amino acid?



What is the isoelectric point of an amino acid?

The isoelectric point of an amino acid is the pH at which the molecule becomes a zwitterion.



What happens when an acid is added to an amino acid?





# What happens when an acid is added to an amino acid?

If an acid ( $\text{H}^+$  ions) is added to a solution of an amino acid, the  $\text{COO}^-$  group accepts a hydrogen ion from the solution. The organic compound is no longer a zwitterion as it only contains a positive charge.



What happens when an alkali is added to an amino acid?



What happens when an alkali is added to an amino acid?

If an alkali ( $\text{OH}^-$  ions) is added to a solution of an amino acid, the  $\text{NH}_3^+$  group in the zwitterion donates a hydrogen to the  $\text{OH}^-$  ions to form water. The organic compound is no longer a zwitterion as it only contains a negative charge.



What is a peptide bond and how are they formed?



# What is a peptide bond and how are they formed?

A peptide bond is formed during a condensation reaction between two amino acids. A water molecule is lost. When two amino acids react, a dipeptide is formed.



What effect will amino acids have on  
plane polarised light?



What effect will amino acids have on plane polarised light?

Most amino acids have a chiral centre and therefore are optically active. This means they will rotate plane-polarised monochromatic light.

