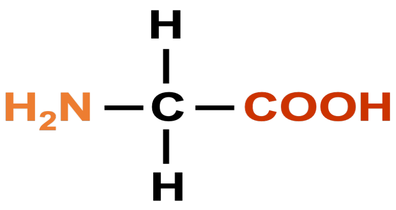
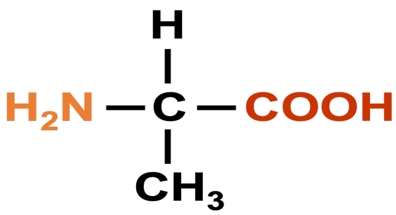
Amino Acids, Amides and Chirality

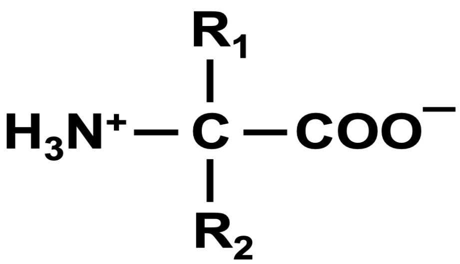
Amino Acids

The general formula for an **α-amino acid** is $RCH(NH_2)COOH$, i.e. the acid and amino groups are bonded to the **same C atom.**

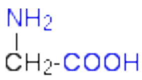




The acid group in an amino acid molecule can donate a proton to the amino group in the **same** molecule, forming an internal salt or **zwitterion**, i.e. amino acids are **ionic.**
An amino acid exists as a zwitterion at a pH value called the isoelectric point.

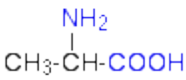


Different R groups in α-amino acids may result in different isoelectric points.
[Recall not necessary: glycine the isoelectric point is pH 6.07; for alanine, 6.11]



2-aminoethanoic acid

glycine



2-aminopropanoic acid

alanine

Acid-base properties:

Basic properties- α-amino acids will react with acids

with H^+ $HOOCCH_2NH_2 + H^+ \longrightarrow HOOCCH_2NH_3^+$

with HCl $HOOCCH_2NH_2 + HCl \longrightarrow HOOCCH_2NH_3^+\ Cl^-$

Structure at low pH

Acidic properties- α-amino acids will react with alkalis

with OH^- $HOOCCH_2NH_2 + OH^- \longrightarrow {}^-OOCCH_2NH_2 + H_2O$

with NaOH $HOOCCH_2NH_2 + NaOH \longrightarrow Na^+\ {}^-OOCCH_2NH_2 + H_2O$

Structure at high pH

At low pH they have a positive charge and at high pH a negative charge.

Formation of esters

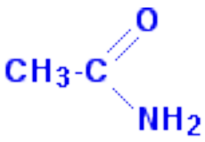
Note that the carboxylic acid group can form esters with alcohols. In the acidic conditions used (conc H_2SO_4), the amine group will be protonated.

$$NH_2\text{-}CH_2 - COOH + CH_3OH \rightleftharpoons {}^{+}NH_3\text{-}CH_2 - COOCH_3 + H_2O$$

Amides

Amides are derived from carboxylic acids. A carboxylic acid contains the -COOH group, and in an amide the -OH part of that group is replaced by an $-NH_2$ group.

The most commonly discussed amide is ethanamide, CH_3CONH_2



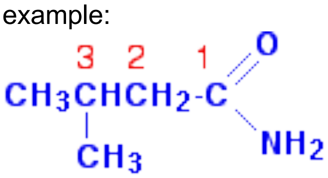
ethanamide

The three simplest amides are:

$HCONH_2$	Methanamide
CH_3CONH_2	ethanamide
$CH_3CH_2CONH_2$	propanamide

Notice that in each case, the name is derived from the acid by replacing the "oic acid" ending by "amide".

If the chain was branched, the carbon in the $-CONH_2$ group counts as the number 1 carbon atom. For example:



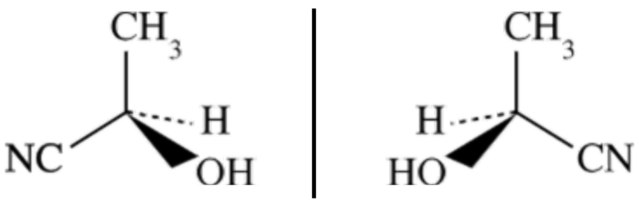
3-methylbutanamide

Primary amides have two H atoms attached to the N atom
Secondary amides have three H atoms attached to the N atom.

Optical Isomers

Optical isomers are non-superimposable mirror images about an organic chiral centre. A **chiral centre is** a carbon atom bonded to four different groups.

They are drawn to show 3D and are mirror images of each other, e.g.



All α-amino acids have a chiral centre (except for glycine, $CH_2(NH_2)COOH$).

Optical isomerism and E/Z isomerism (E/Z isomerism exists because of restricted rotation about a C=C double bond if each carbon atom is bonded to two different groups) are different types of stereoisomerism.