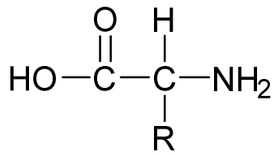
RC1 - Amino Acids and Proteins – Chemistry Revision

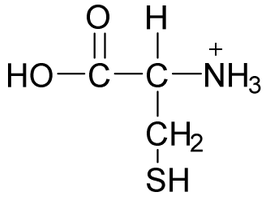
Draw the general structure of an amino acid:



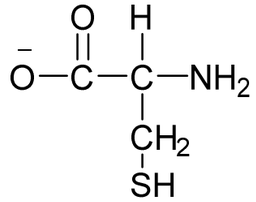
Define the term ‘zwitterion’:
An amino acid which has a negatively charged **COO^-** group, and a positively charged **NH_3^+** group. The two charges balance each other out and there is **no overall charge** on the molecule. This occurs in **neutral solution**.

Draw the amino acid cysteine (R-CH_2SH), at:

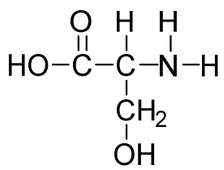
pH 2

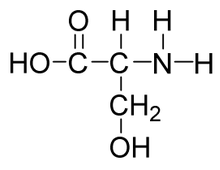


pH 10



Draw the products which form when this dipeptide is hydrolysed:





What is the reverse reaction called?
A **condensation** reaction – as H_2O is produced.

Explain why thin-layer chromatography is able to separate amino acids:

Different amino acids have **different side chains**. These side chains affect the **polarity** of each molecule, as well as its general properties. This means that each amino acid will act differently when subjected to TLC, as each will **interact slightly differently with each solvent and TLC plate**. This allows the amino acids to be separated, based on their **affinities** to the solvent (**mobile phase**), and plate (**stationary phase**).

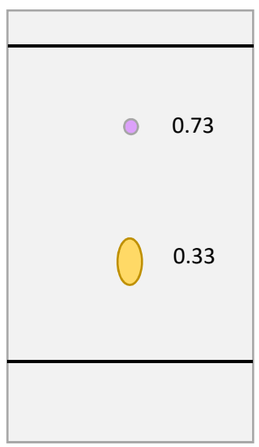
Give two ways which can be used to view invisible amino acids on a chromatogram:

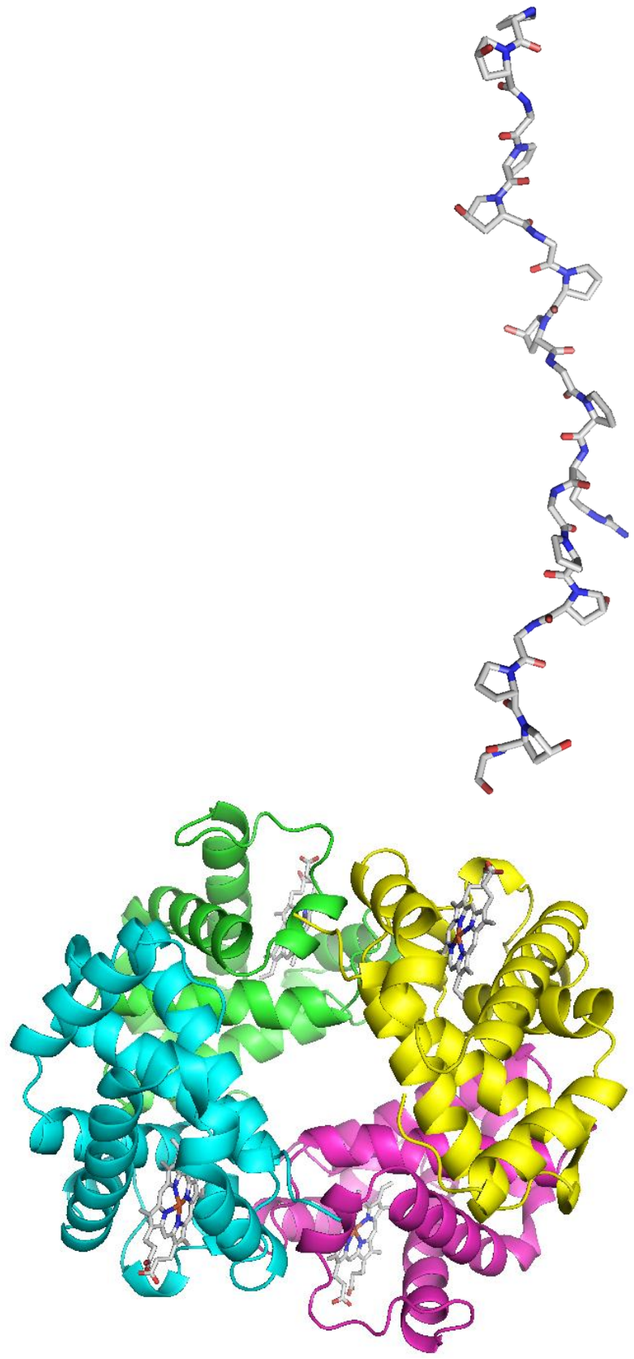
- **UV** radiation
- Staining agent (**Ninhydrin** or Iodine)

Finish the equation:

$$R_f = \frac{\textbf{Distance travelled by spot}}{\textbf{Distance travelled by solvent}}$$

Calculate the R_f value of each of the two spots:





Define the following terms:
Protein: Structures consisting of **one or more polypeptide chains**.

Primary structure: The **sequence of amino acids** in a polypeptide chain.

Secondary structure – include 2 examples: The **local arrangements** of a polypeptide chain into commonly seen structures, such as **α-helices** and **β-sheets**.

Tertiary structure: The **overall 3D structure** of a **single polypeptide chain**. This takes into account the arrangement of the polypeptide, and the secondary structure in it.

Quaternary structure: The overall structure of a protein which forms when **multiple polypeptide chains are combined and interact**.

Conjugated protein: A structure made from **a protein joined to a non-polypeptide unit**, such as another molecule or ion.

Explain why hydrogen bonding is important to the overall structure of a protein:
Hydrogen bonding creates the **secondary structure** on the protein, such as **α-helices and β-sheets**. It also affects the **tertiary structure**, as polypeptide chains interact with themselves, folding into a **specific shape**. Lastly it can create **quaternary structures** when **multiple polypeptide chains** hydrogen bond together.

Explain how disulfide bonding affects the tertiary structure of a protein:
Disulfide bonding occurs between cysteine residues. It forces the polypeptide chain to adopt a very **specific 3D shape** to allow the disulfide bonds to form. This gives the protein a **specific, overall 3D structure**.

Produced by Adam Stubbs at Newcastle University as part of a summer outreach project.