PROTEINS

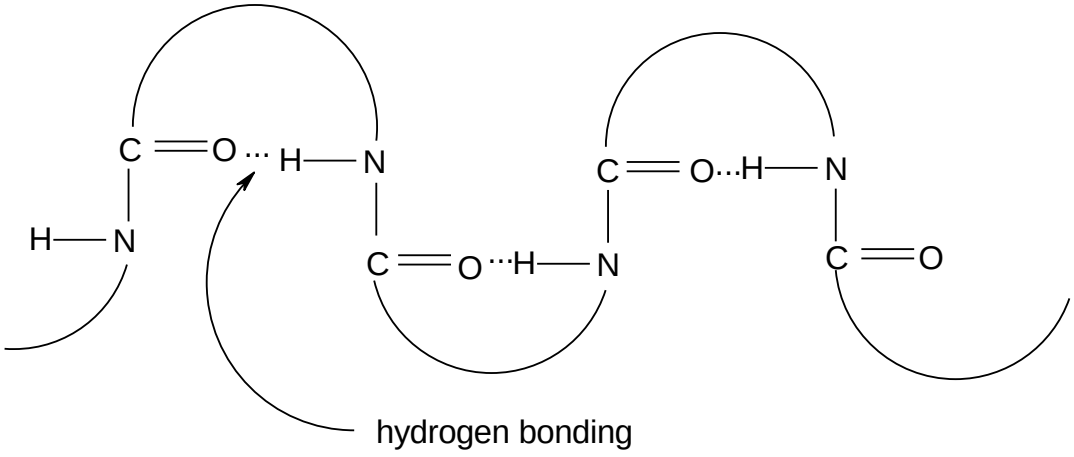
Proteins are naturally occurring polyamides formed by the condensation of many amino acid molecules under carefully controlled conditions around the DNA backbone.

i) structure

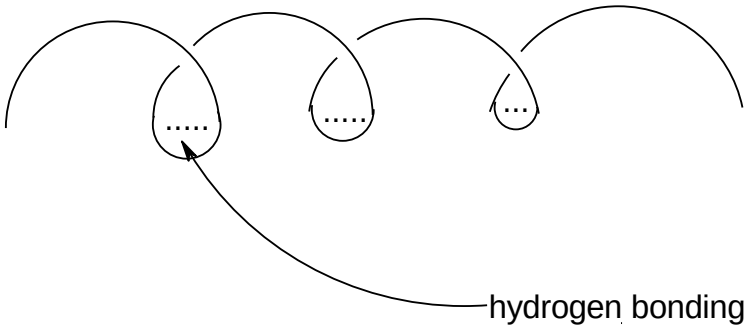
The sequence of amino acids in a protein is known as the **primary** structure of the protein. It varies from protein to protein, depending on the function that the protein needs to perform.

Eg: gly – ala – leu – iso – gln
(each of these three–letter symbols is the code for an amino acid)
A protein can have several thousand amino acids, all arranged in a specific order.

Protein molecules are not straight as there is hydrogen bonding within the molecule; the hydrogen atom on one peptide link can form a hydrogen bond with the nitrogen or oxygen atoms on another peptide link; causing the structure to coil up:



The result of this coiling is a helical structure known as the **secondary** structure of the protein.:

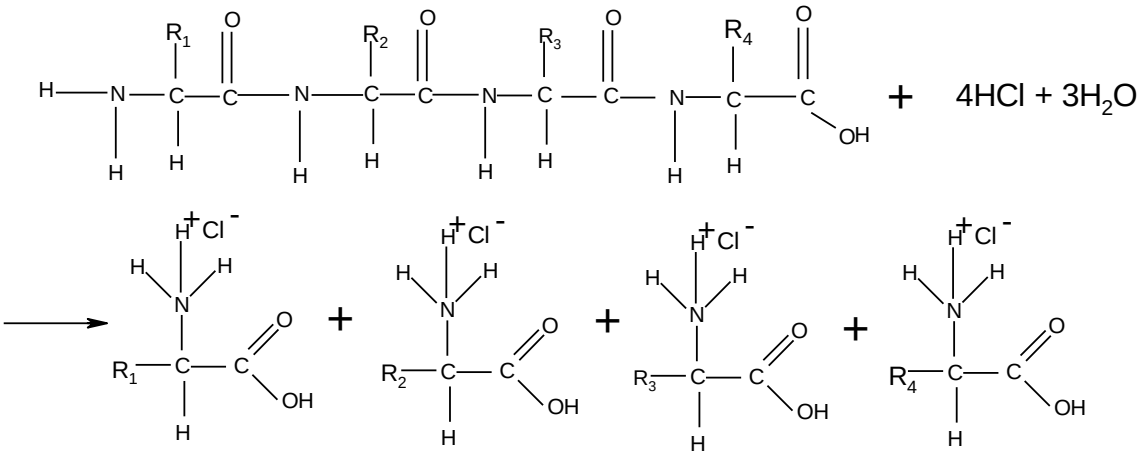


ii) hydrolysis

The peptide link in proteins is the same as the peptide link in N-substituted amides. As a result it can be broken by heating in strong acid or strong alkali.

Proteins can thus be broken down into their constituent amino acids by heating in strong acid or strong alkali; in practice 6 $moldm^{-3}$ HCl is generally used.

This reaction is an example of a hydrolysis reaction. In acidic conditions the amino acids are produced in cationic form:



This hydrolysis reaction enables chemists to deduce which amino acids are present in a sample of protein. The different amino acids can be identified by chromatography.

If a sample of the amino acid mixture is placed onto chromatography paper and allowed to separate, it is possible to identify the different amino acids present in the sample by comparing their R_f values (the distance each amino acid moves up the paper compared to the solvent) with those of known amino acids.

Type of reaction	**Mechanism**
1. **acid-base reactions of amino acids** a) with acids reagents: HCl conditions: room temperature equation: $R\text{-}CH(NH_2)\text{-}COOH + HCl \rightarrow R\text{-}CH(NH_3^+Cl^-)\text{-}COOH$ b) with alkalis reagents: NaOH conditions: room temperature equation: $R\text{-}CH(NH_2)\text{-}COOH + NaOH \rightarrow R\text{-}CH(NH_2)\text{-}COO^-Na^+ + H_2O$ 2. **condensation reactions of amino acids** conditions: DNA equation: $n\ R\text{-}CH(NH_2)\text{-}COOH \rightarrow H\text{-}(NHCRHCO)_n\text{-}OH + (n\text{-}1)\ H_2O$ 3. **hydrolysis of proteins** reagents: 6 $moldm^{-3}$ HCl conditions: heat, reflux equation: $H\text{-}(NHCRHCO)_n\text{-}OH + (n\text{-}1)\ H_2O + n\ HCl \rightarrow n\ R\text{-}CH(NH_3^+Cl^-)\text{-}COOH$	Nucleophilic addition-elimination (not required)