

AQA Chemistry A-Level

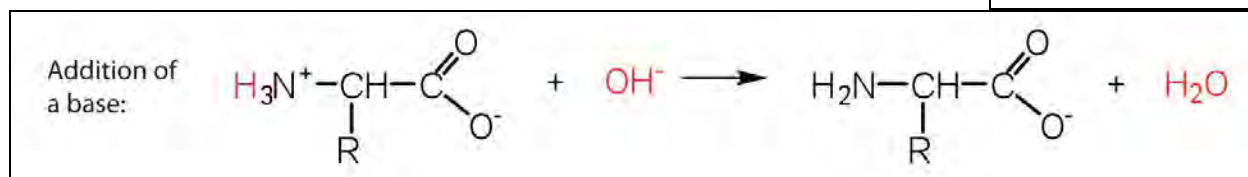
3.3.13: Amino Acids, Proteins and DNA Detailed Notes





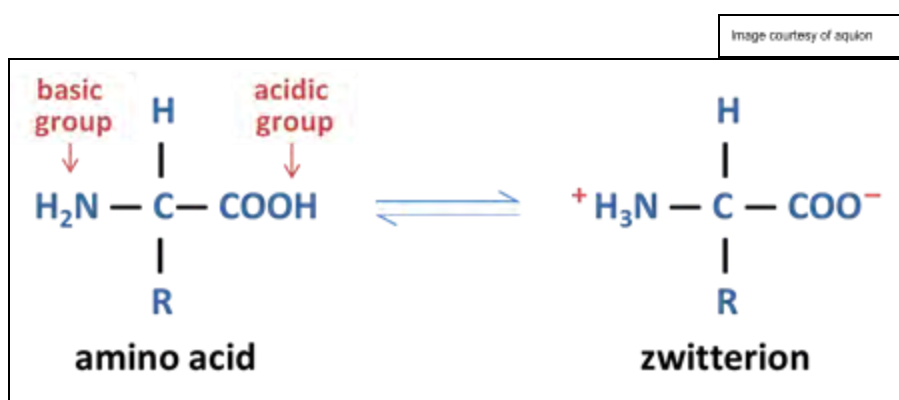
In **basic conditions (high pH)**, the hydrogen atom on the -OH group is more likely to be lost, producing a **negative (basic) end** to the molecule.

Example:



A **zwitterion** forms when the overall pH of the molecule is **zero**, known as the **isoelectric point**.

Example:

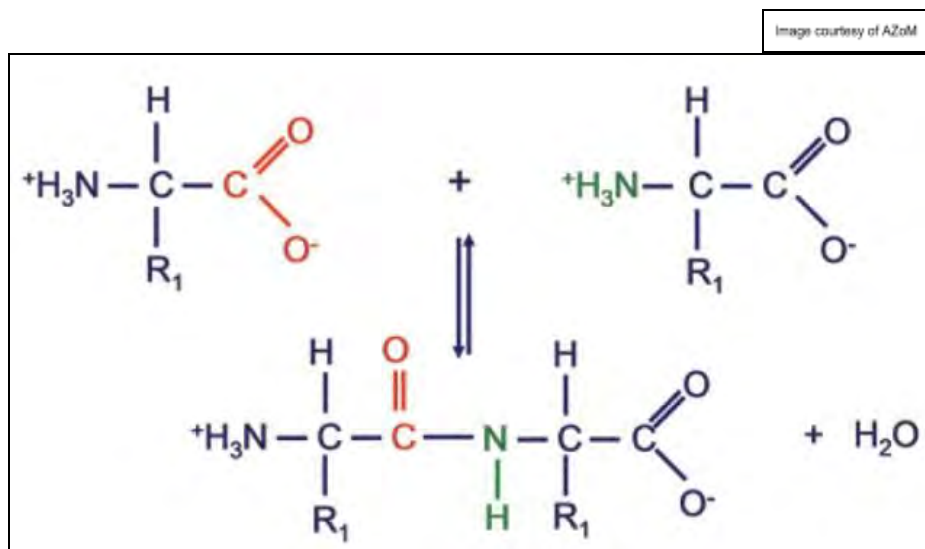


Thin-layer chromatography can be used to identify unknown amino acids using UV light to view the traces on the silica plate.

3.3.13.2 - Proteins

Proteins are sequences of amino acids joined together by **peptide links**.

Example:



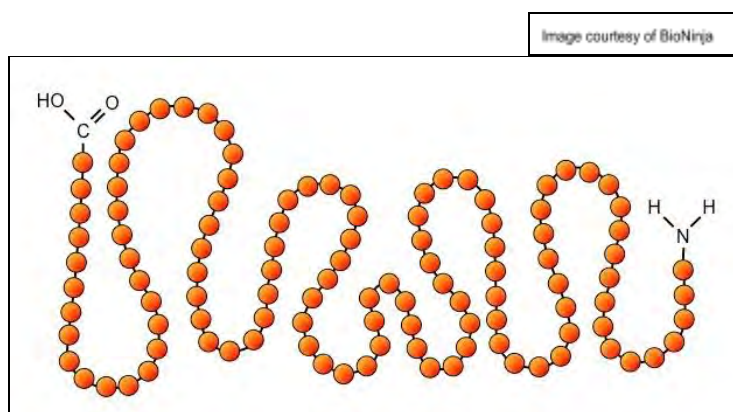


This reaction can be reversed by boiling the protein in **6.0 mol dm⁻³ HCl for 24 hours** in a process called **hydrolysis**. In nature, this process is carried out by **enzymes** so such harsh conditions are not required.

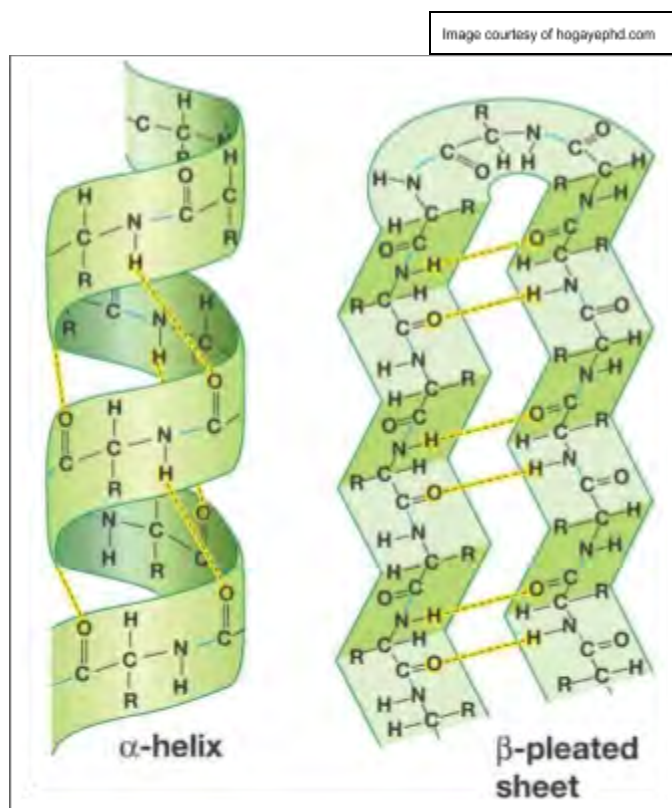
Structures

Proteins have complex structure which are held together with **hydrogen bonds, van der waals forces and sulfur-sulfur bonds**.

Primary Structure - a single polypeptide chain of amino acids.

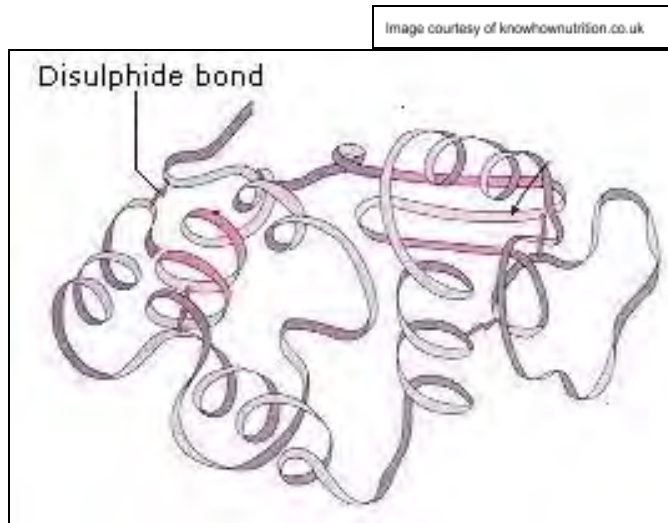


Secondary Structure - an α -helix or β -pleated sheet held with hydrogen bonds.





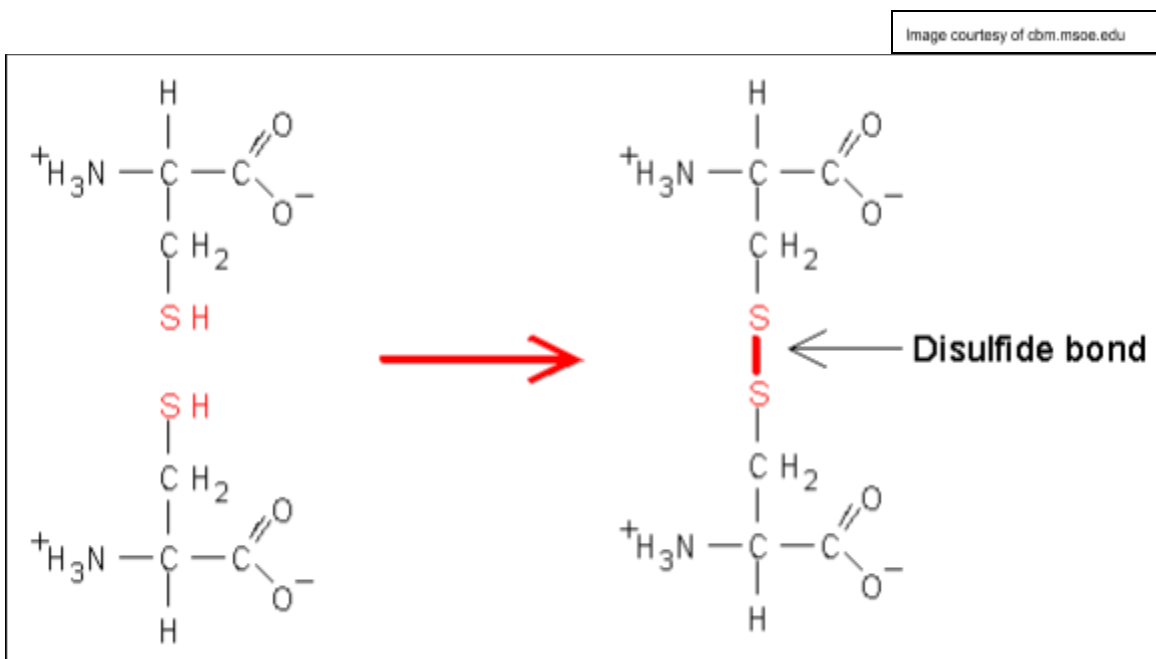
Tertiary Structure - chains folded into a 3D coil with hydrogen and disulfide bonding.



Disulfide Bonding

The sulfur-sulfur bonds that hold together tertiary structures are known as a **disulfide bridge**. They keep the protein structure **stable** by losing two hydrogen ions.

Example:

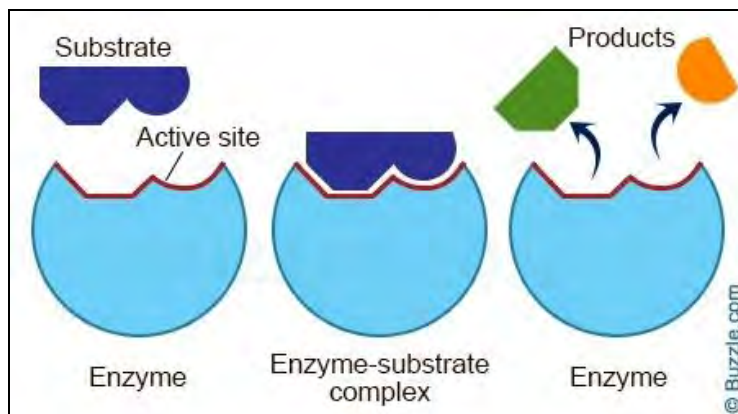




3.3.13.3 - Enzymes

Enzymes are proteins with a **tertiary structure** that act as **biological catalysts**. They contain **active sites** that are specific to a certain molecule that they break down, called a **substrate**.

Example:



Enzymes are **stereospecific**, meaning they can only break down a single enantiomer and will have no effect on the other optical isomer.

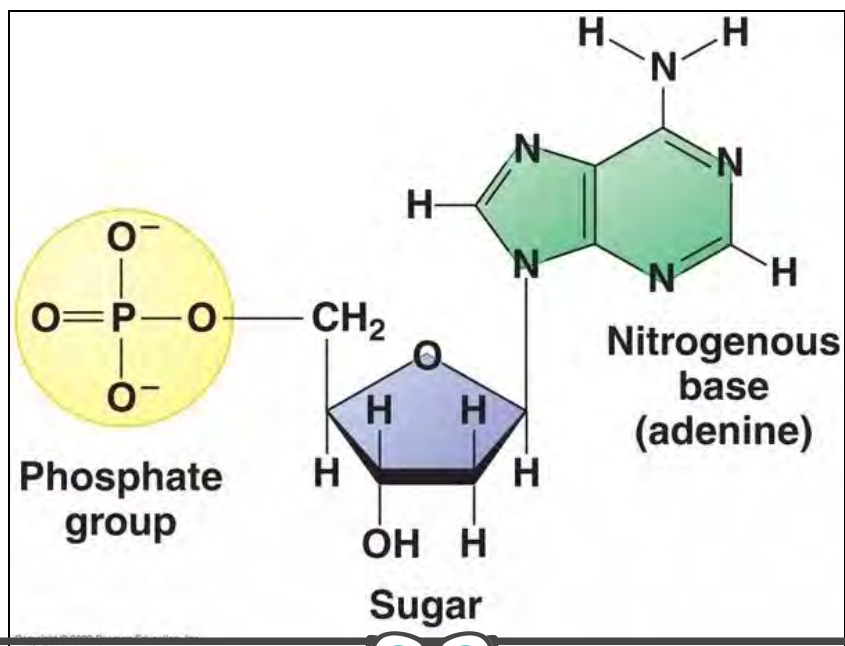
3.3.13.4 - DNA

DNA (deoxyribonucleic acid) is a **condensation polymer** formed from a **sugar, a phosphate and a base**.

Nucleotides

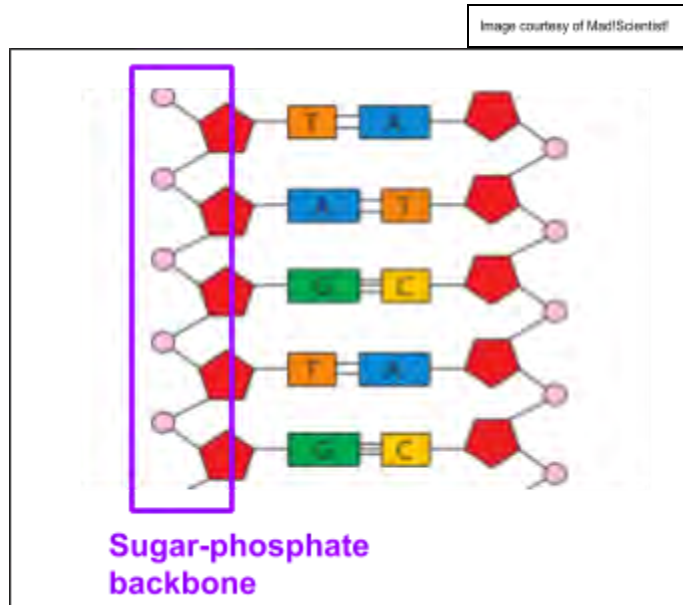
These molecules join together to make form a **nucleotide** which consists of one of each molecule.

Example:



The sugar present in the nucleotide is always **2-deoxyribose**. Sugar-phosphate bonds hold together multiple nucleotides into a **polynucleotide strands** called RNA. This is known as a **'sugar-phosphate backbone'**.

Example:

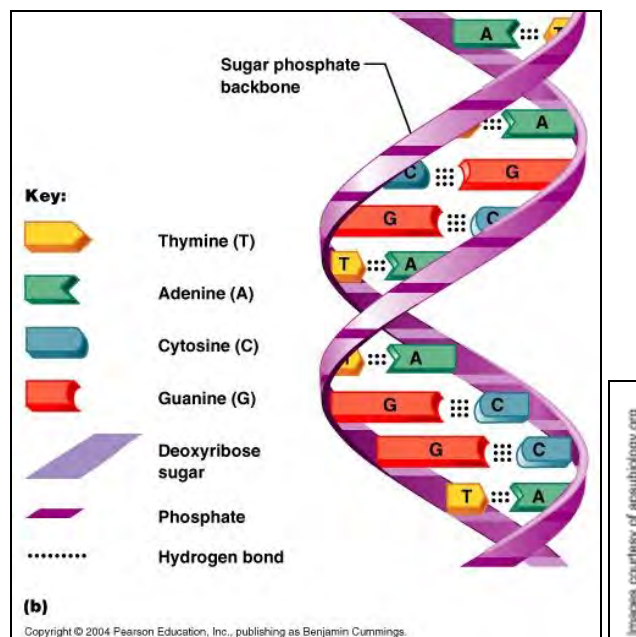


There are four possible bases that could be present in the nucleotide:

- Adenine
- Cytosine
- Thymine
- Guanine

These bases pair up to allow a single strand of DNA, known as RNA, to join with others via **hydrogen bonding** to form a **double helix structure** of DNA.

Example:

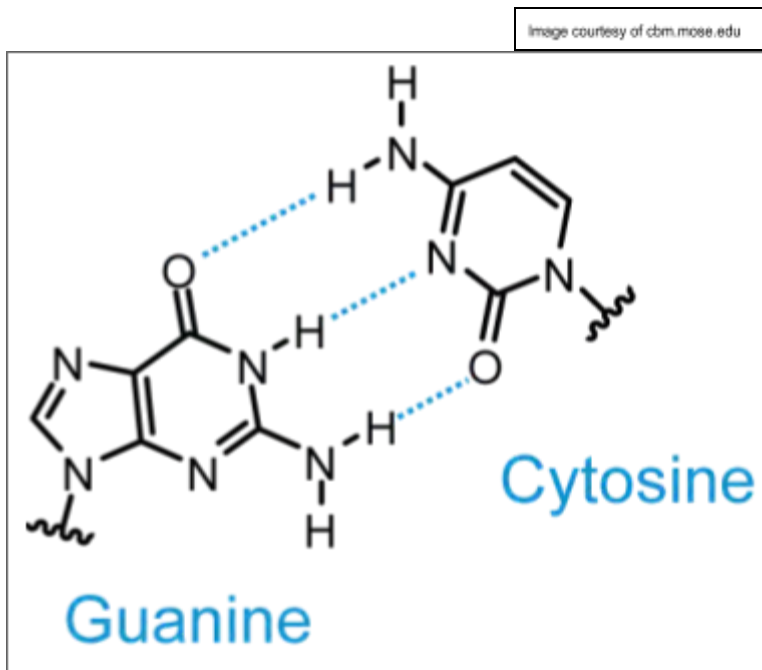




Complementary Bases

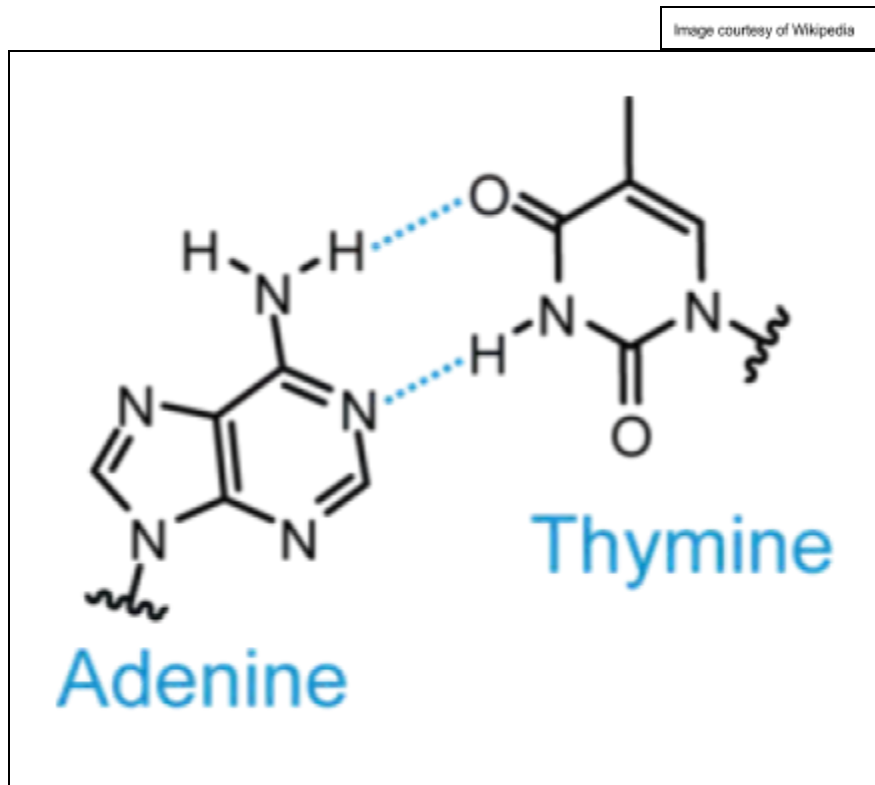
In order to join the protein strands, the bases pair up in specific, **complementary pairs**. **Guanine and Cytosine** are complementary bases that bond with **three** hydrogen bonds.

Example:



Thymine and Adenine are complementary bases that bond with **two** hydrogen bonds.

Example:

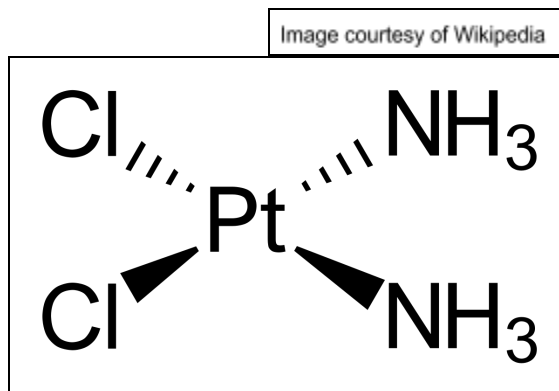




3.3.13.5 - Anticancer Drugs

Cisplatin is used as an anticancer drug. It is the **cis isomer** of a square planar complex of platinum.

Example:



Cells in the natural world are **chiral** so only the Z-isomer of the drug is effective and will be the correct orientation to 'fit' the cells. It has to be able to bond to **two adjacent Guanine bases**. Cancer spreads by replicating 'bad DNA'. Cisplatin bonds to strands of this mutated DNA to prevent it from replicating via **ligand replacement** with guanine.

However, cisplatin can occasionally bond to heated DNA strands causing serious **side effects** such as hair loss. To combat these side effect, the drug has to be administered in **small amounts** to try and reduce these effects.

The long term benefits of using cisplatin and its effectiveness as an anticancer drug means it continues to be used despite the short term side effects.

