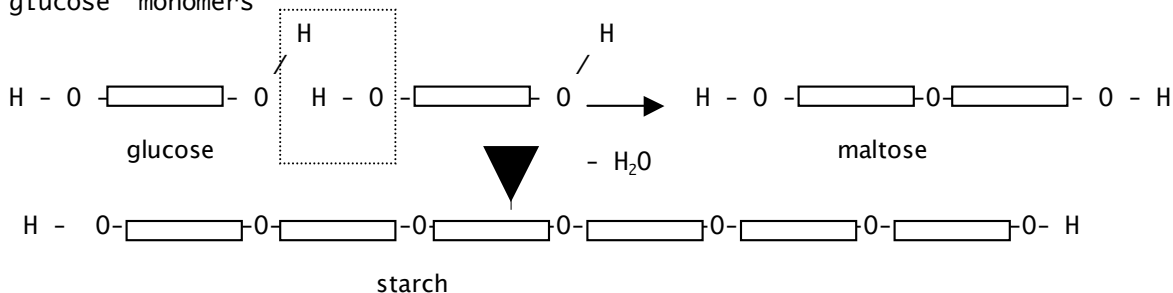


## CONDENSATION POLYMERISATION. 8.1

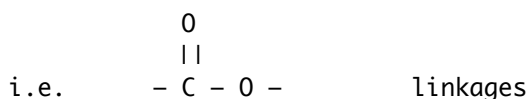
Condensation polymers are made from monomer molecules with two functional groups per molecule. The monomers join together with the loss of a small molecule usually but not always water.

**Starch**

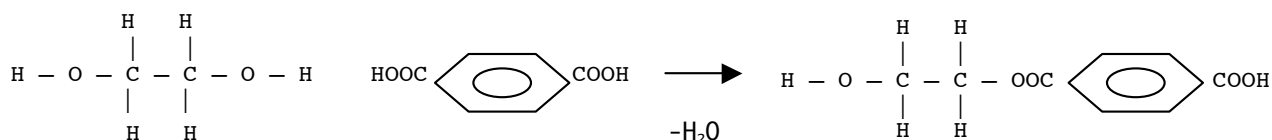
Is an example of a natural condensation polymer. Glucose molecules join together to form maltose and continues to form large chains of starch which can contain 10,000 glucose 'monomers'

**POLYESTERS**

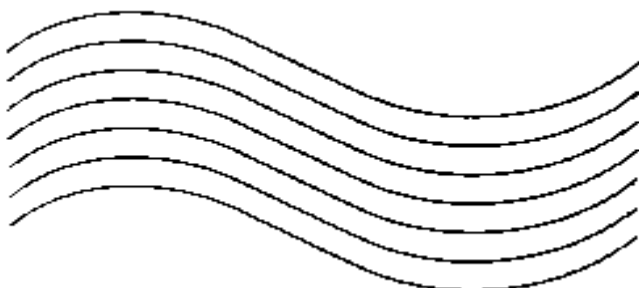
Polyesters are synthetic fibres used as substitutes for cotton and wool, under such trade names as "Terylene". As the name 'polyester' suggests, they are polymers joined by an ester linkage.



By far the most important polyester is "Terylene" made by esterification of ethane-1,2-diol (a dihydric alcohol), with benzene-1,4-dicarboxylic acid (a dicarboxylic acid)



Another molecule of ethane-1,2-diol could react with the RHS of this whilst another molecule of benzene-1,4-dicarboxylic acid could react with the LHS. It can be seen that having two OH groups on the alcohol and two COOH groups on the acid makes possible the formation of the polymer. This type of polymerisation, involving the elimination of a small molecule (water) is called condensation polymerisation.

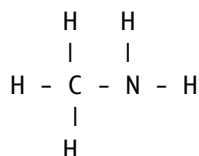


Polymers with only two active groups give rise to linear polymers, which are usually fairly flexible. **Polyesters have great tensile strength (strong when pulled).**

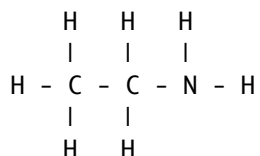


## Amines

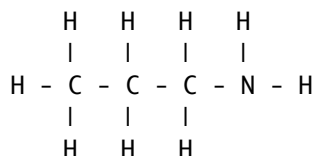
Amines are a homologous series of compounds with the General Formula  $C_nH_{2n+1}NH_2$ .



methylamine

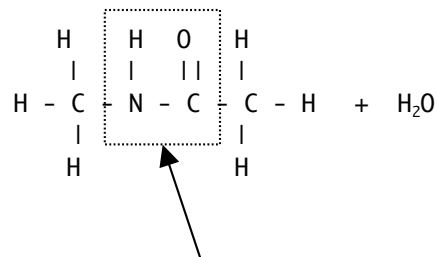
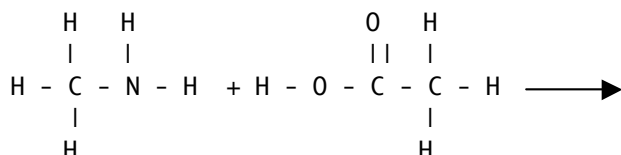


ethylamine



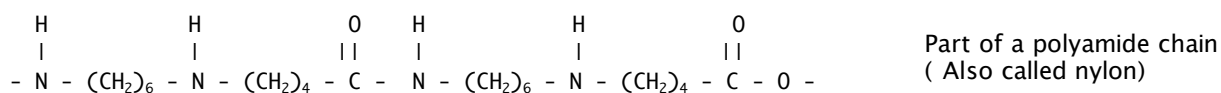
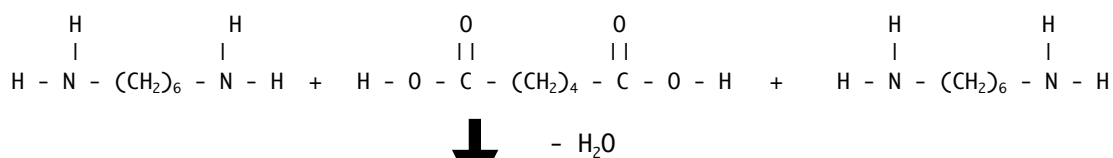
propylamine

## Amines & alkanolic acids

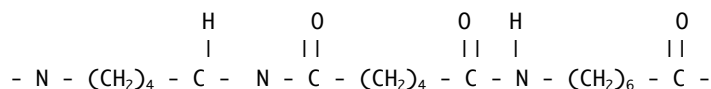
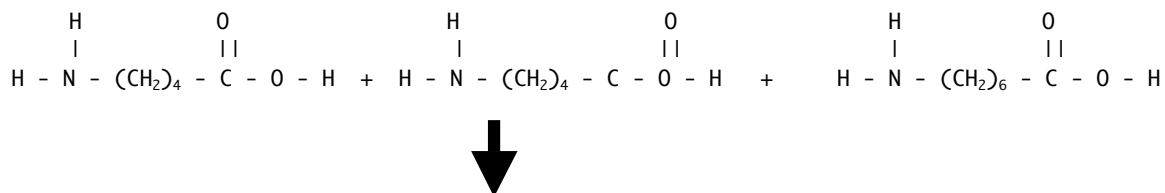


## Polyamides

When diacids react with diamines, polyamides are formed



## Nylon from aminoacids [nylon 6]



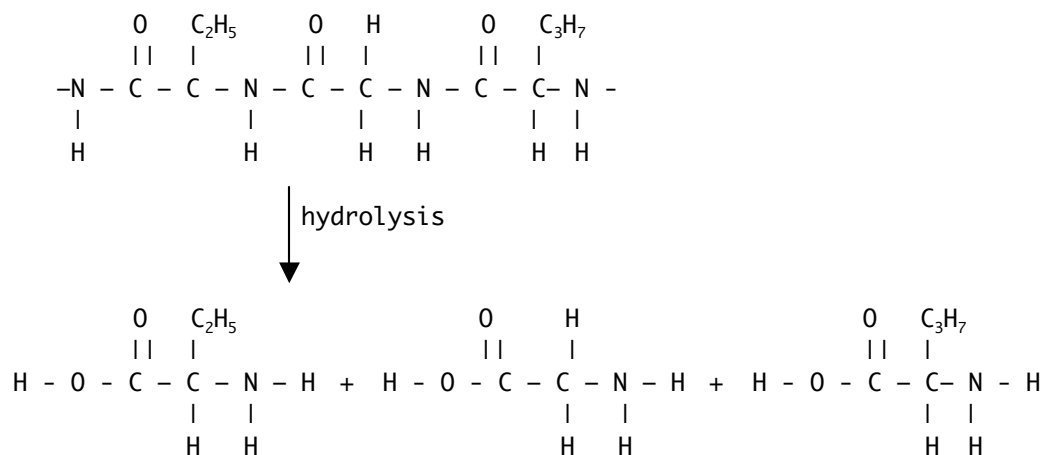


Since the body cannot make all of the amino acids necessary for the formation of body proteins we are **dependent on proteins in our diet** for the supply of the amino acids our body cannot make for itself. The amino acids, which we have to obtain from dietary protein, are known as **essential** amino acids.

**DIGESTION.**

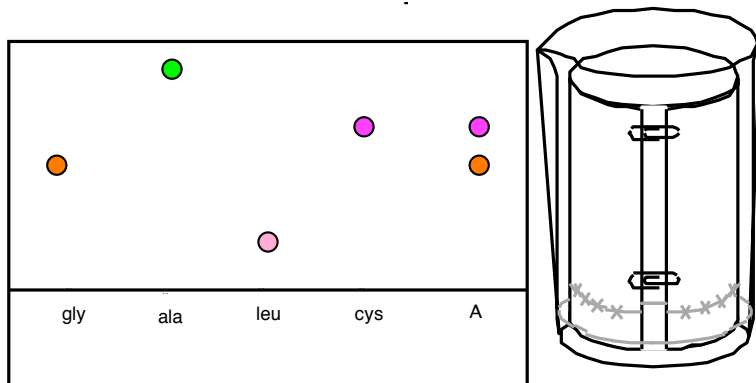
During the digestion process **enzymes**, such as **pepsin** and **trypsin**, bring about the hydrolysis of proteins in food producing amino acids. These amino acids formed on hydrolysis are small enough to pass into the bloodstream and so can be transported all round the body to wherever they are needed to be reformed into body proteins.

Consider the diagram below, which shows part of a protein chain, showing three amino acid units, linked together.



**Analysing amino acids from proteins**

Paper chromatography uses paper as the material on which to separate the mixture. A small spot of the mixture (A) from the hydrolysed protein is placed upon the paper. Tiny spots of known aminoacids are also placed on the paper. The solvent washes the different aminoacids up the paper at different rates and so separates them. By comparing the positions of the spots it is possible to identify the unknown aminoacids.



Different amino acids travel different distances.

This technique can be used to determine the amino acids present in a mixture - the number of spots tells us the number of amino acids in the mixture and the distances they travel can be matched to known amino acids spotted on the same paper.

A The hydrolysed protein contain the aminoacids  
 ----- and -----

## Protein Structures 8.4

Proteins fall into two main groups - **fibrous** and **globular** proteins.

Fibrous proteins are long parallel polypeptide chains with very occasional cross links making up fibres. Fibrous proteins are insoluble in water and are very tough - this makes them ideally suited for their uses in the body such as connective tissue in tendons, muscle tissue and the keratin in nails and hair.

Globular proteins are folded into complex, spherical (globular) shapes. Globular proteins are involved in the maintenance and regulation of life processes, the three-dimensional shape is crucial to the chemical functioning of globular proteins. Important functional groups from different parts of the chain are brought together to form an "active site" a position where a particular chemical reaction can occur globular proteins make up the haemoglobin in the blood. They also form enzymes and some hormones (e.g. insulin). Globular proteins are water-soluble.

### Globular Protein



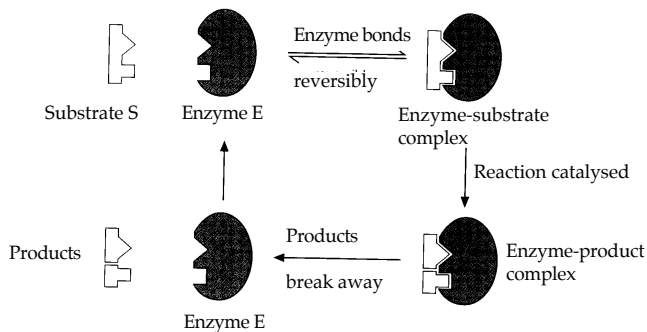
### Fibrous Protein

If the hydrogen bonding takes place between two different chains sheets are formed, when hydrogen bonding takes place in the one chain a helix is formed

### LOCK AND KEY MECHANISM.

Scientists often refer to the action of enzymes as a lock and key mechanism as a particular enzyme has to be the correct shape to catalyse a particular reaction in just the same way that a key has to a precise shape to open a particular lock. The diagram below shows how an enzyme's precise shape allows it to react with a particular molecule - called the substrate.

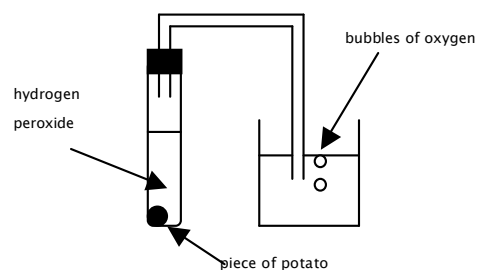
Notice that once the substrate has reacted (broken in two in this case) it breaks away leaving the active site free to react with more substrate.



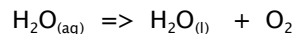
### ENZYME DENATURING.

The bonds, which bind the enzyme to the molecule, the substrate, have to be weak so that the binding can be readily reversed when the products leave the active site after reaction. The bonds are usually hydrogen bonds or interactions between ionic groups. The precise shape of the enzyme can be altered by changes in pH and/or temperature, which alter these weak attractions. When this happens the active sites is destroyed irreversibly and the enzyme is said to be **denatured**.

Enzymes are made from complex protein molecules. Their ability to catalyse particular chemical reactions can be greatly affected by conditions of pH and temperature.

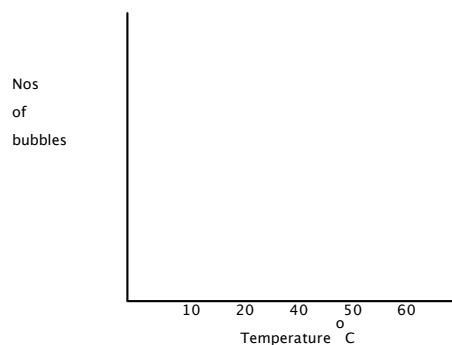


The enzyme catalase can catalyse the decomposition of hydrogen peroxide. The enzyme is found in potatoes.



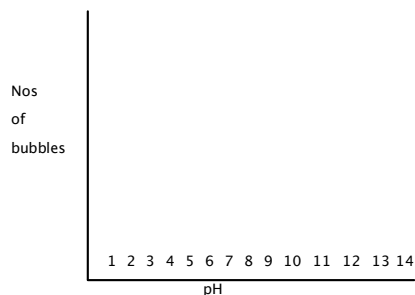
### Effect of Temperature

Keep pH, mass of potato and volume and concentration of hydrogen peroxide constant.



### Effect of pH

Keep temperature, mass of potato and volume and concentration of hydrogen peroxide constant.



### Conclusions

Catalase works best at 37°C

Catalase works best at pH = 7.



When polymer chains have 3 functional groups the polymer can become cross-linked

### **Polyester Resin**

As a result of cross-linking a hard , rigid, heat resistant resin is produced which is used along with glass fibre to repair holes in car bodies and boats.

### **Bakelite**

Bakelite is the name for the phenol - methanal resin used as electrical fittings and rigid insulating foams

