Chemistry C11 – Polymers

1: The Monomer and the Repeat Unit

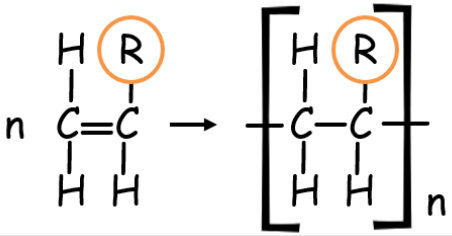
The monomer is only draw once, the letter n in front shows us that we have many of them, the repeat unit always has brackets around it and an n after.

2: Addition polymerisation

Many monomers **add** together to make a polymer. The monomers are the same alkene (a carbon to carbon double bond). The polymer has the **same number of atoms** as the alkene had, no atoms are added or removed.

Drawing the reaction: The monomer must have a double bond between two carbon atoms. The n represents how many monomers there are (e.g. millions). The R in a circle represents any atom or group of atoms (e.g. H, Cl or CH_3). The polymer will now have a single bond between the same two carbon atoms. It must have the same total number of atoms as the monomer. It must have brackets around the repeat unit which must be the size of one monomer and the bond lines must cross the brackets. A small n must be written at the bottom right of the bracket.

R group : monomer name
H = ethene
Cl = chloroethene
CH_3 = propene

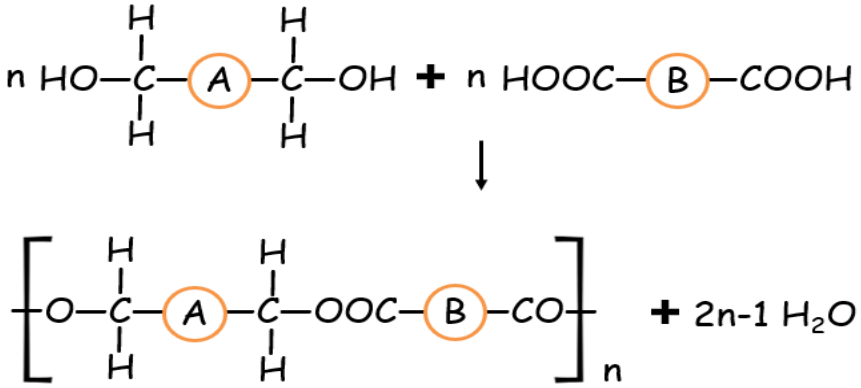


3: Condensation polymerisation

These polymerisation reactions produce a by-product (usually) of water, hence condensation. They occur when an diol (double ended alcohol 2 x C-OH) group reacts with a dicarboxylic acid (2 x COOH) group.

Drawing the reaction: There are two monomers – the diol and the dicarboxylic acid. These combine in a 1:1 ratio, so the polymer must have one of each. The letters A and B represent any length of carbon chain and can also be represented as a shape, such as a square, triangle or diamond. For every **one diol** and **one dicarboxylic acid two water** molecules are produced.

The **diol** loses the hydrogen atoms at each end that are attached to oxygen.	The **dicarboxylic acid** loses the OH from each end of the molecule.



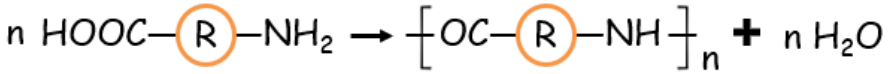
Instead of A and B, the exam might just show a rectangle as the length of the carbon chain between the functional group is not important.

How to check…count up all the atoms you can see in the diol (10) and the dicarboxylate (8) and add together (18). Now count the atoms in the polymer you have drawn (12) then add on the atoms in two water molecules (6) to give a total (18). Both totals should be the same. Your most likely mistake will be the oxygen atoms, so go back and total both sides for these first.

4: Amino Acids

Amino acids are a range of biological molecules that have a carboxylic acid group (COOH) at one end and an amino group (NH_2) at the other. Because the ends are different, they can undergo condensation polymerisation with just one type of monomer. For every one amino acid, one water molecule is produced

Drawing the reaction: n number of amino acids join together to form a polypeptide with n repeat units and n water molecules. The OH is lost from the COOH and one H from the NH_2. R can be one of many different groups.



R group : amino acid name
CH_2 = glycine

The monomer is the amino acid. When the monomers join together they form a polypeptide. Polypeptides have up to 50 amino acid monomers. When many polypeptides with different amino acids join together, they form a protein.

5: Natural polymers

DNA (deoxy-ribo-nucleic acid) is a large molecule essential for life. It is made from four monomers called nucleotides. Two polymer chains (polynucleotides) form the double helix structure of DNA. Starch and cellulose are other natural polymers, made from simple sugar monomers called monosaccharides.