AQA Chemistry A-level

3.3.4: Alkenes

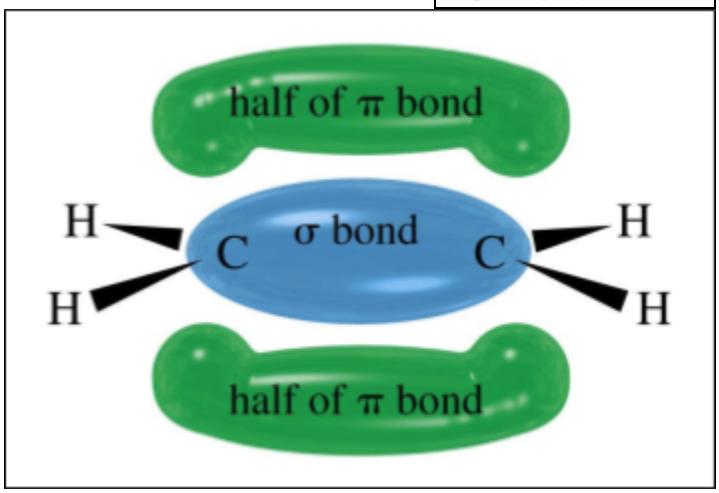
Detailed Notes

3.3.4.1 - Structure and Reactivity

Alkenes are **unsaturated hydrocarbons** meaning they contain a carbon-carbon double bond. This is an area of **high electron density** making it susceptible to attack from electrophiles (species that are attracted to ∂- areas). It consists of a normal covalent bond and a **π bond**.

Example:

Image courtesy of wps.prenhall.com



Bromine water is used to identify this double bond and other unsaturated compounds. It turns the solution from **orange-brown to colourless** if a double bond is present in the substance.

3.3.4.2 - Electrophilic Addition

Alkenes undergo electrophilic addition about the double bond.

Electrophiles

These are **electron acceptors** and are attracted to areas of high electron density. Some of the most common electrophiles are:

- HBr
- Br_2
- H_2SO_4

They can be used to form **alkyl hydrogensulphates or halogenoalkanes** from alkenes.

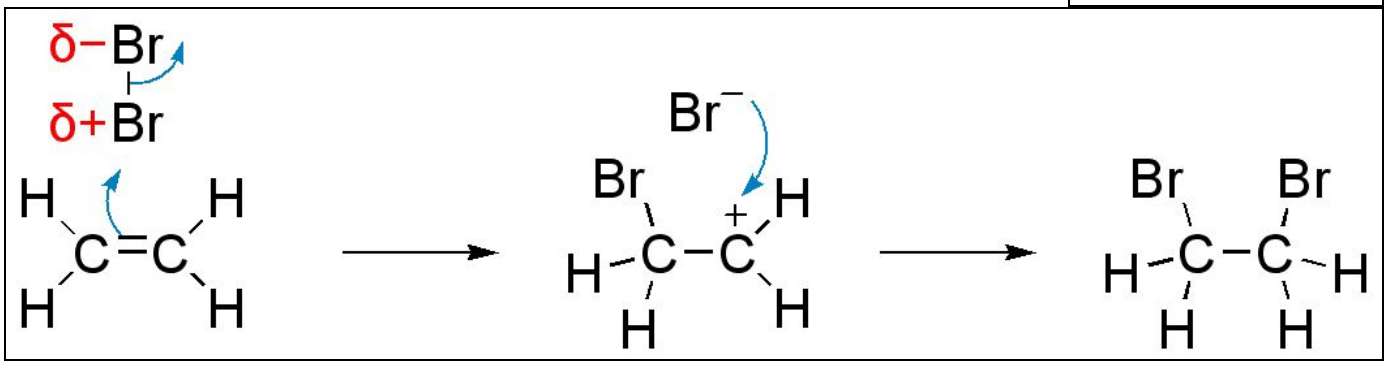
Electrophilic Addition

This is the reaction mechanism that shows how electrophiles attack the double bond in alkenes. When the double bond is broken, a **carbocation** forms. This is a carbon atom with only **three bonds**, meaning it has a **positive** charge.

Carbocations can have **varying stability**, with tertiary being the most stable and primary the least. The **more stable** the carbocation, the **more likely** it is to form. Therefore in an addition reaction, multiple products can form but the **major product** will always be the **most stable** possible.

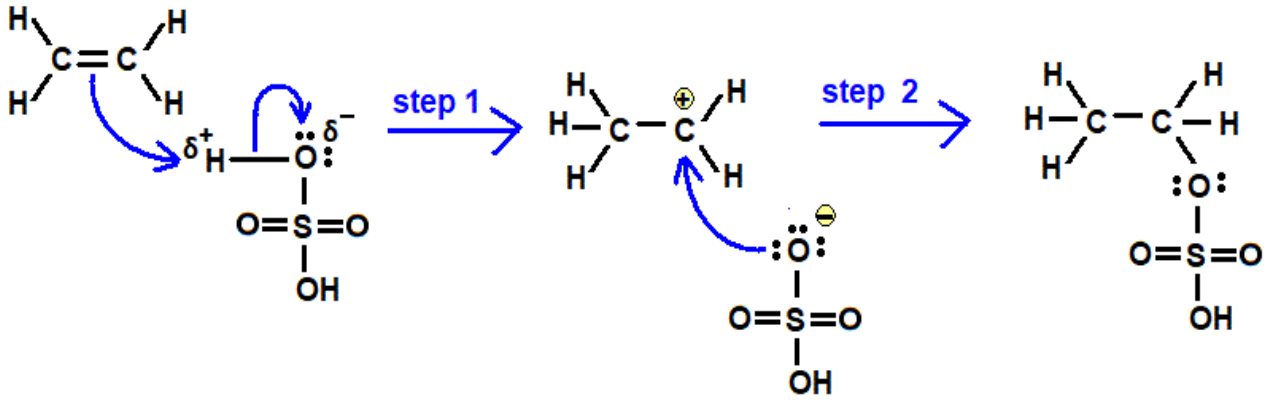
Mechanism - Halogenoalkanes

Image courtesy of Wikimedia Commons



The π bond causes the bromine molecule to gain a temporary dipole so that electrons are transferred.

Mechanism - Sulphuric Acid

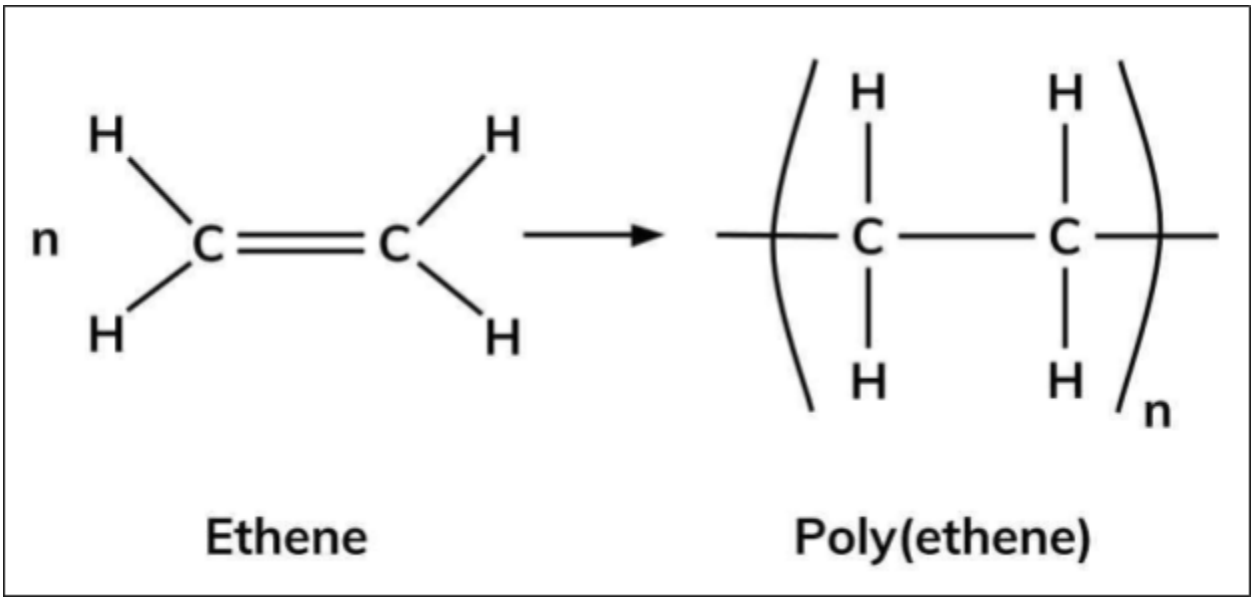


Alkene reacts with sulphuric acid to produce ethyl hydrogensulphate.

3.3.4.3 - Addition Polymers

Addition polymers are produced from **alkenes** where the double bond is broken to form a **repeating unit**.

Example:



The repeating unit must always be shown with **extended bonds through the brackets** showing that it bonds to other repeating units on both sides.

Reaction Conditions

The reaction conditions used in the production of these polymer chains can be altered to give the plastics **produced different properties**.

High pressures and temperatures produce **branched chain** polymers with weak intermolecular forces. Whereas **lower** pressures and temperatures produce **straight chain** polymers with strong intermolecular forces.

Uses of Polymers

Polymers are unreactive hydrocarbon chains with **multiple strong, non-polar covalent bonds**. This makes them useful for manufacturing many everyday plastic products such as **shopping bags (poly(ethene))**.

However, the unreactive nature of the bonds in addition polymers means they are **not biodegradable** and cannot be broken down by species in nature.

PVC

Poly(chloroethene) more commonly known as **PVC** is an addition polymer with **waterproof properties**. It gains these properties by the addition of **plasticisers** during the reaction.