

# AQA Chemistry A-level

## 3.3.4: Alkenes

### Detailed Notes

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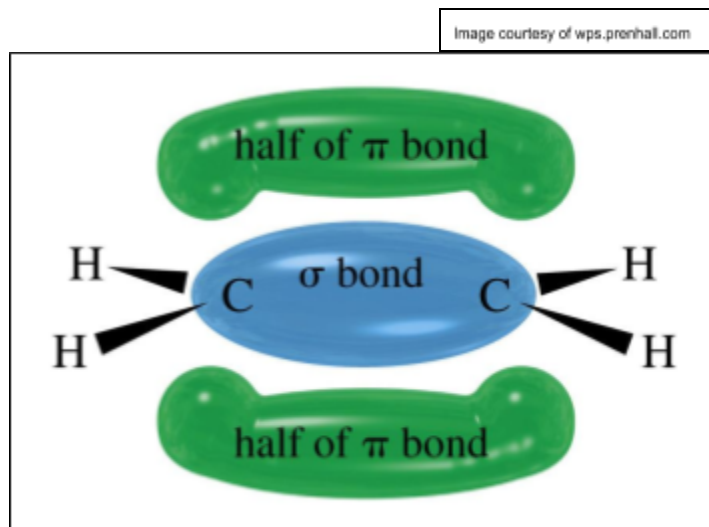




### 3.3.4.1 - Structure and Reactivity

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  $\delta^-$  areas). It consists of a normal covalent bond and a  **$\pi$  bond**.

Example:



**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<sub>2</sub>
- H<sub>2</sub>SO<sub>4</sub>

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





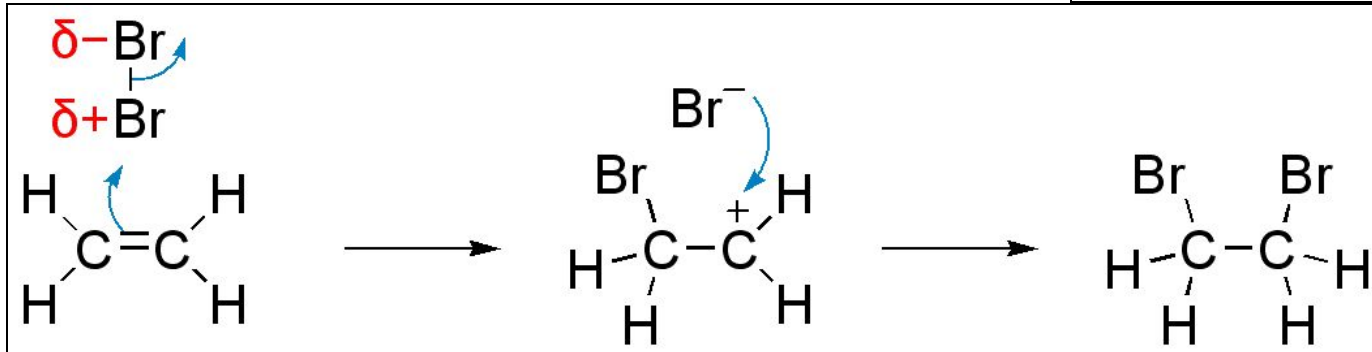
## Electrophilic Addition

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

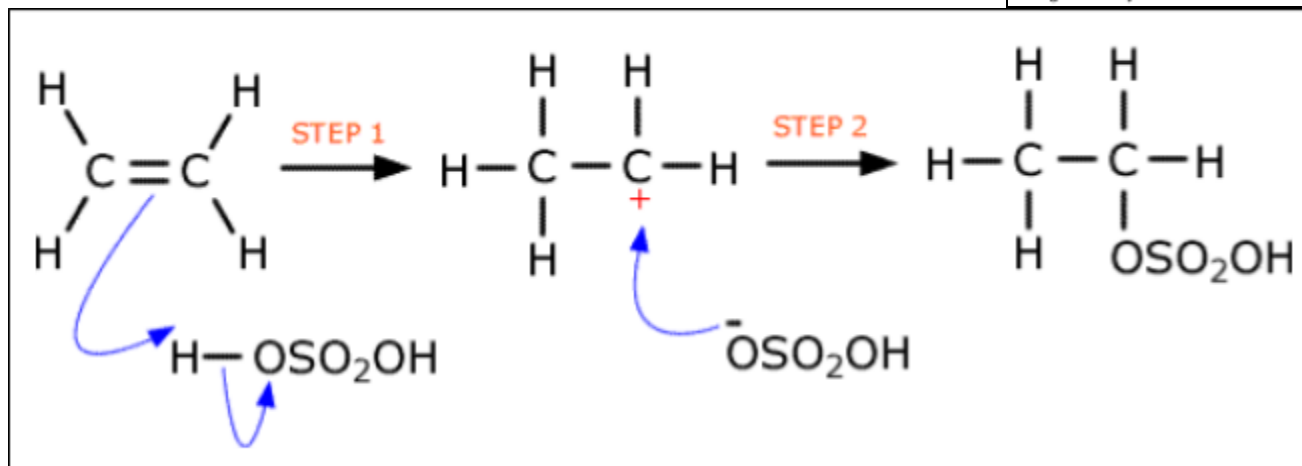
Image courtesy of Wikimedia Commons



*The  $\pi$  bond causes the bromine molecule to gain a temporary dipole so that electrons are transferred.*

### Mechanism - Water

Image courtesy of alevelchem.com



*This product reacts with water to produce alcohols.*

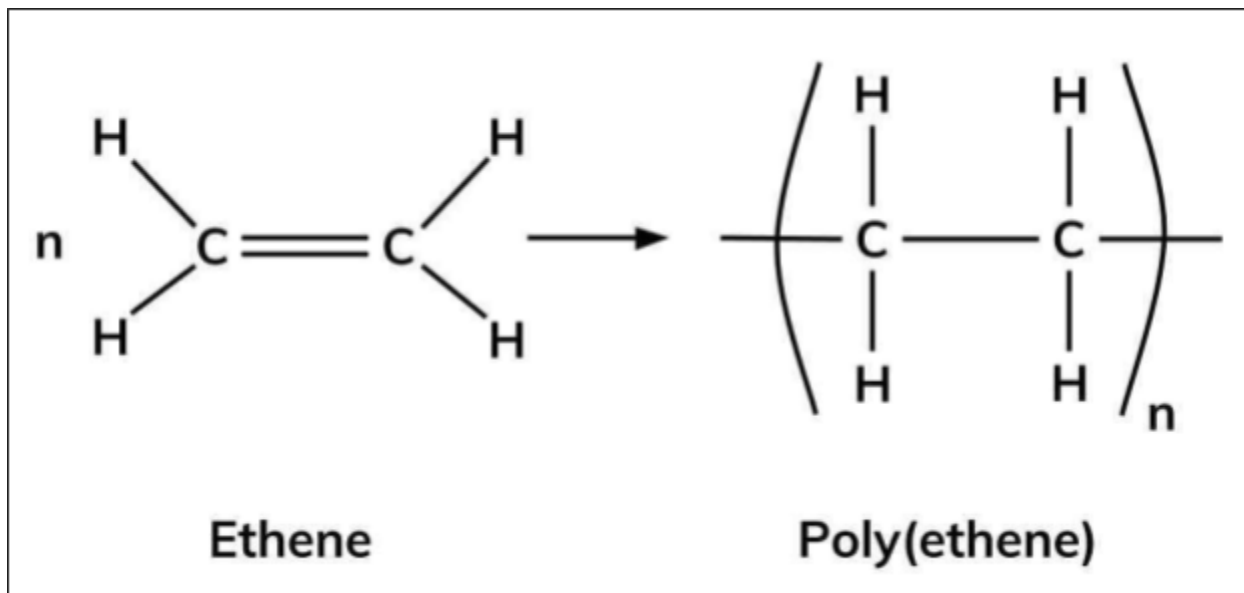




### 3.3.4.3 - Addition Polymers

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.

