

ALKENES

ADDITION TO UNSYMMETRICAL ALKENES

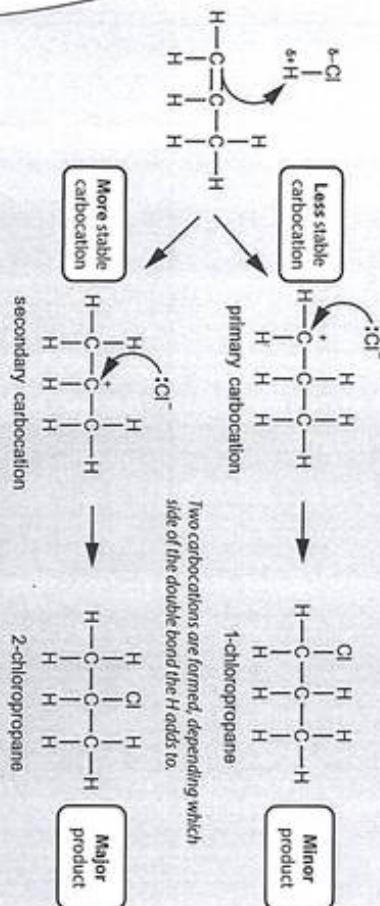
TYPES OF CARBOCATION

Primary	Secondary	Tertiary
$\text{H}-\text{C}^+-\text{CH}_3$	$\text{H}-\text{C}^+-\text{CH}_2-\text{CH}_3$	$\text{H}_3\text{C}-\text{C}^+-\text{CH}_3$

INCREASING STABILITY →

In an addition reaction between water or a hydrogen halide and an unsymmetrical alkene such as propene, there are two possible products. One of these products is more likely than the other.

The reason for this is that some carbocations are more stable than others.



ADDITION POLYMERS

Addition polymers are large molecules with a repeating structure. The structure of the polymer depends on the structure of the monomer.

When an addition polymer is formed from its monomers:

- the double bond breaks
- C-C single bonds form between monomers
- carbon chain forms



The lines on the polymer section below break the polymer up into repeat units. In an addition polymer, repeat units always have two carbons in the middle, with the groups coming off. Notice in this example that the monomer is not always the same way round.



EXAM TIP

In your exam you may be asked to find the alkene which a polymer was made from or vice versa. Practise this skill!

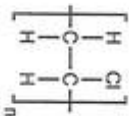
The continuous carbon chain is hard to break, so addition polymers are unreactive.

There is a continuous carbon chain, so this polymer must have been formed by addition polymerisation.

PVC

Poly(chloroethene) or PVC is a rigid plastic which can be used for pipes and window frames.

Adding a plasticiser to PVC makes the plastic less brittle and more flexible. Plasticised PVC is used for electrical cable insulation and fake leather.



ELECTROPHILIC ADDITION

ELECTROPHILE

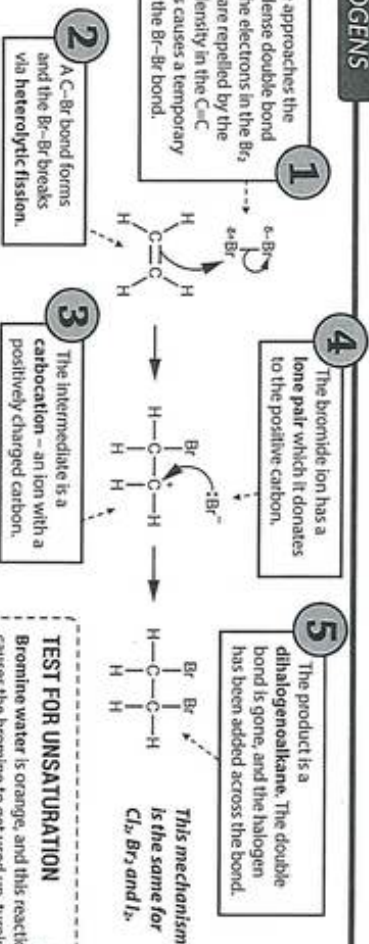
Electrophiles are 'electron pair acceptors'. The double bond in alkenes is an area of high electron density, and so electrophiles are attracted to the double bond.

ELECTROPHILIC ADDITION CONDITIONS

Alkenes can react with electrophiles via an electrophilic addition mechanism. Here are the three key reactions you need to know.

Electrophile	Conditions	Product
Halogen e.g. Br ₂		Dihalogenoalkane
Hydrogen halide e.g. HBr		Halogenoalkane
H ₂ O	Steam, H ₂ SO ₄ or H ₃ PO ₄ catalyst	Alcohol

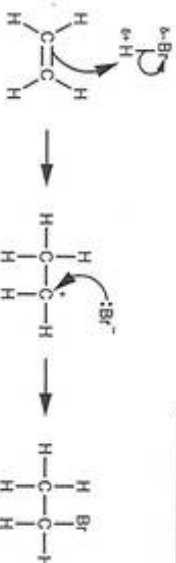
HALOGENS



TEST FOR UNSATURATION

Bromine water is orange, and this reaction causes the bromine to get used up, turning the bromine water solution colourless. This is commonly used as a test for unsaturation (the presence of a C=C bond).

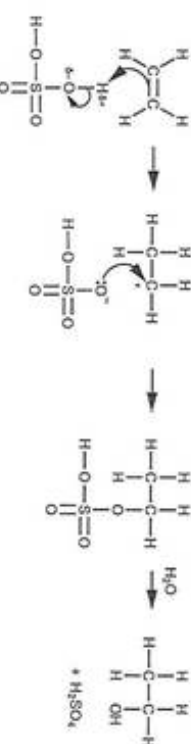
HYDROGEN HALIDES



SULFURIC ACID

HBr has a permanent dipole. This makes the more positive H atom attracted to the electron-rich double bond.

The rest of this mechanism is the same as the one above.



Addition polymers often have long chains, so have large induced dipole-dipole forces between polymer chains, meaning they are solid at room temperature.

To name a polymer, put the name of the monomer in brackets and put 'poly' in front. e.g. poly(ethene).