

Edexcel IAL Chemistry

A-Level

Topic 5 - Alkenes

Flashcards

This work by [PMT Education](https://www.pmt.education) is licensed under [CC BY-NC-ND 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/)



What is an alkene?



What is an alkene?

An unsaturated hydrocarbon with the general formula C_nH_{2n} .



What does unsaturated mean?



What does unsaturated mean?

An organic compound that contains at least one carbon-carbon double bond, $C=C$.



What is a carbon-carbon double bond?



What is a carbon-carbon double bond?

- Consists of a σ bond and a π bond.
- A σ bond is formed from the end-on-end overlap of orbitals.
- A π bond is formed from the sideways overlap of p-orbitals above and below the carbon atoms.



What is stereoisomerism (in terms of E-Z isomerism)?



What is stereoisomerism (in terms of E-Z isomerism)?

Stereoisomerism occurs when isomers have the same structural formula but a different arrangements of atoms in space due to the limited rotation around the carbon-carbon double bond.

Isomers are normally referred to as *E*- or *Z*- isomers.



How do you determine whether an isomer is *E*- or *Z*-?



How do you determine whether an isomer is *E*- or *Z*-?

- In *E*- isomers, high priority groups are on opposite sides of the C=C.
- In *Z*- isomers, high priority groups are on the same side of the C=C.



What is a 'high priority' group?



What is a 'high priority' group?

- For molecules where only single atoms are attached to the carbons in the C=C: The high priority group is the atom with the highest atomic mass.
- For non-complex small groups such as $-\text{CH}_3$, look at the atomic mass of the atom attached directly to the C=C (in $-\text{CH}_3$ this would be the carbon atom - ignore the hydrogen atoms). The one with the greatest atomic mass is the high priority group.
- For more complex groups (i.e. $\text{CH}_2\text{CH}_2\text{Cl}$ vs. CH_2CH_3), where multiple groups have the same atom directly attached to the C=C, compare the atomic masses of the atoms/groups attached to that atom.

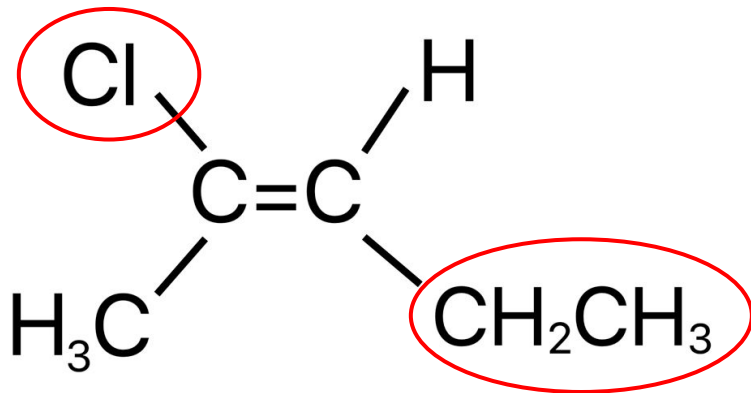


Give an example of E/Z isomerism?



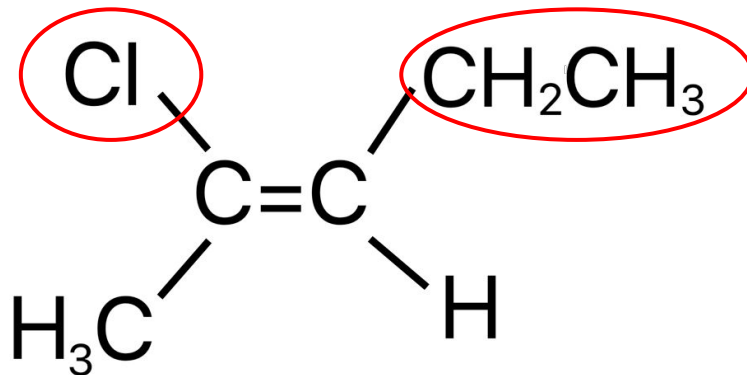
Give an example of E/Z isomerism?

E-2-Chloropent-2-ene



The high priority groups are on opposite sides of C=C.

Z-2-chloropent-2-ene



The high priority groups are on the same side of C=C.



What is cis-trans isomerism?



What is cis-trans isomerism?

- Cis-trans isomerism is a type of *E-Z* isomerism.
- It occurs when each carbon has a group in common (usually hydrogen) but the other group attached to the carbon is different.



How do you work out which isomers are
cis- or *trans-*?



How do you work out which isomers are *cis*- or *trans*-?

- The *E*- isomer is the *trans*- isomer
- The *Z*- isomer is the *cis*- isomer

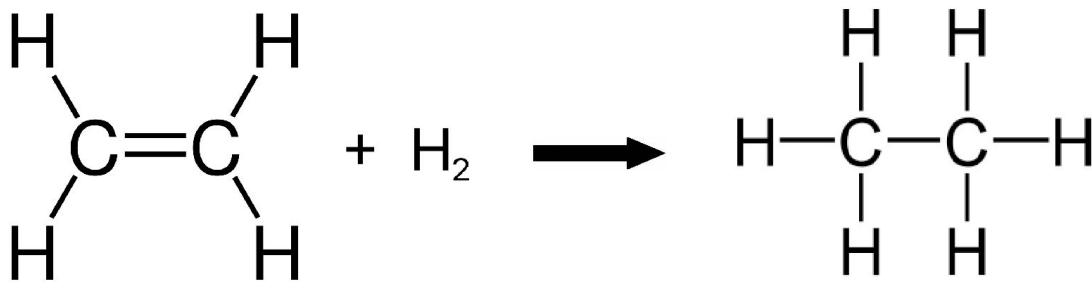


What reaction does an alkene undergo to form an alkane? Name the reagents and conditions required.



What reaction does an alkene undergo to form an alkane? Name the reagents and conditions required.

- Reaction type: Hydrogenation
- Reagents: Hydrogen gas, H_2
- Conditions: Nickel catalyst, $150^\circ C$

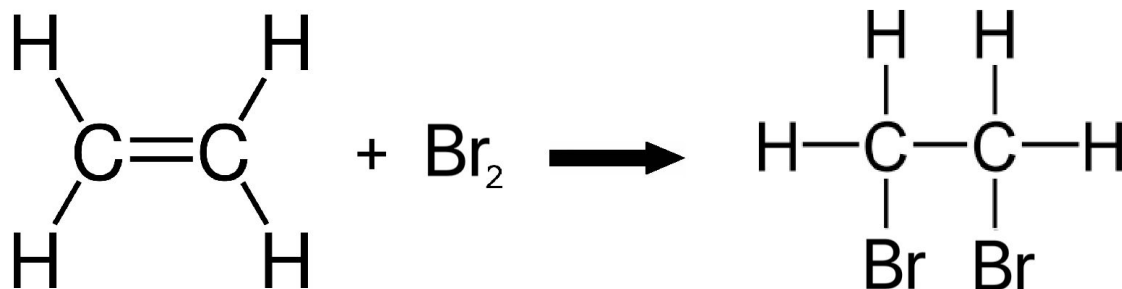


What reaction does an alkene undergo to form a dihaloalkane?



What reaction does an alkene undergo to form a dihaloalkane?

- Reaction type: Halogenation
- Reagents: Halogen i.e. Br₂

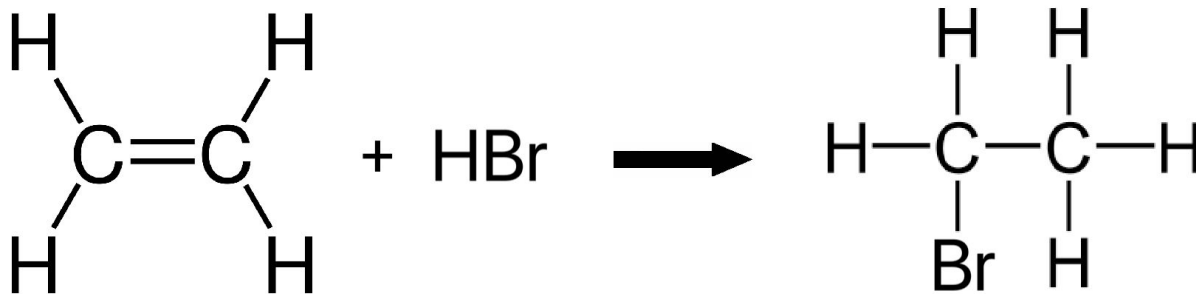


What reaction does an alkene undergo to form a mono-substituted haloalkane?



What reaction does an alkene undergo to form a mono-substituted haloalkane?

- Reaction type: Addition of hydrogen halide/halogenation.
- Reagents: Hydrogen halide, for example HBr.

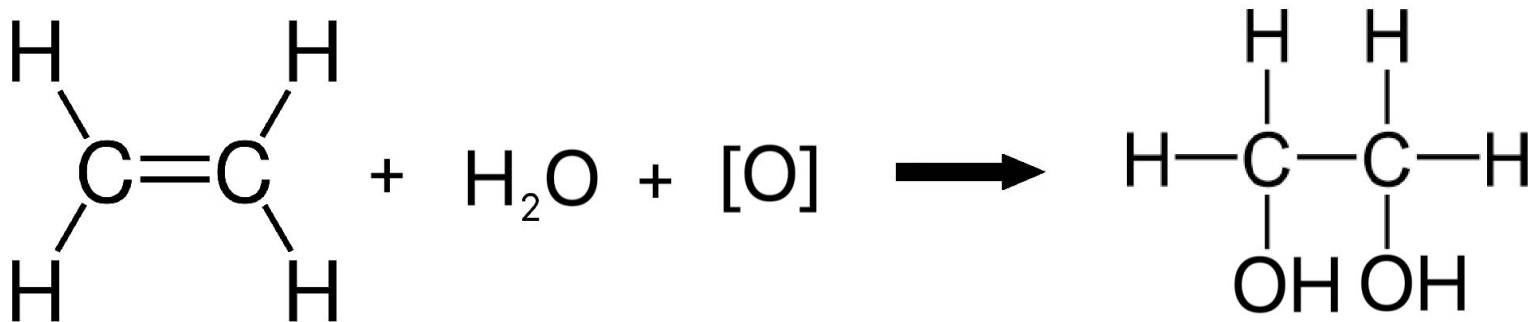


What reaction does an alkene undergo to form a diol?



What reaction does an alkene undergo to form a diol?

- Reaction: Oxidation of alkene (addition of steam).
- Reagents: $\text{KMnO}_{4(\text{aq})}$ - strong oxidising agent.



What qualitative test can be carried out to test for alkenes?



What qualitative test can be carried out to test for alkenes?

Add bromine water.

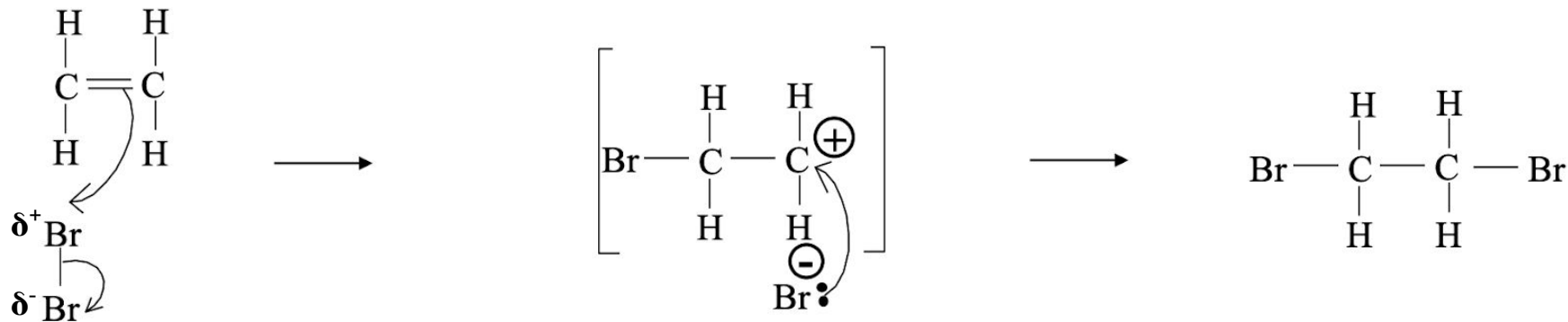
The orange colour decolourises to form a colourless solution if the alkene $C=C$ bond is present.



Describe the electrophilic addition of bromine to ethene, including mechanisms.



Describe the electrophilic addition of bromine to ethene, including mechanisms.



The electron dense $\text{C}=\text{C}$ induces a dipole in Br_2 . This causes the π bond to break and form a bond with the slightly positive bromine atom, breaking the $\text{Br}-\text{Br}$ bond.

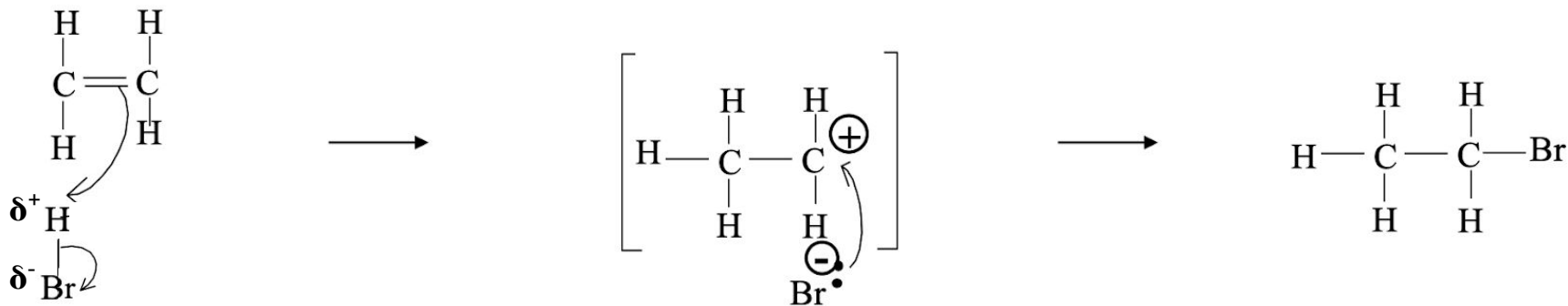
This forms a positive carbocation intermediate which is attracted to the negative bromide ion and so forms a bond with it.



Describe the electrophilic addition of hydrogen bromide to ethene, including mechanisms.



Describe the electrophilic addition of hydrogen bromide to ethene, including diagrams.



Bromine is more electronegative than hydrogen so HBr is a polar molecule. The electron dense $\text{C}=\text{C}$ is attracted to the slightly positive hydrogen, causing carbon to form a bond with it, breaking the H-Br bond in the process. This produces a positive carbocation intermediate, which is attracted to the negative bromide ion.



What is Markovnikov's rule?



What is Markovnikov's rule?

When a hydrogen halide is reacted with an unsymmetrical alkene, the hydrogen will attach itself to the carbon atom with the most hydrogen substituents. (The halide group will bond to the carbon with more alkyl groups).

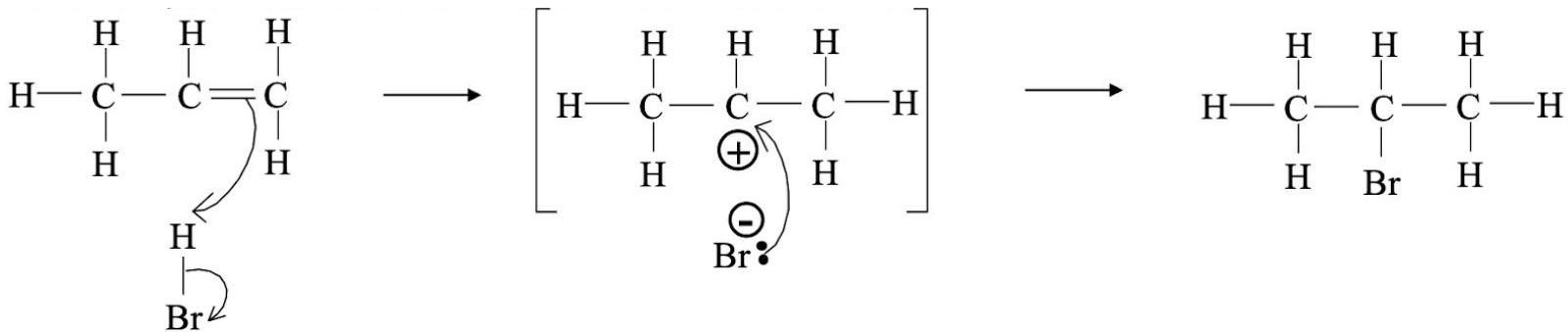
This produces the major product.



Describe the electrophilic addition of hydrogen bromide to propene, including mechanisms.



Describe the electrophilic addition of hydrogen bromide to propene, including diagrams.



This product is the major product; 2-Bromopropane.

This is the major product because the secondary carbocation intermediate is more stable than the primary carbocation that would form in the production of the minor product.



What is addition polymerisation?



What is addition polymerisation?

Occurs when lots of monomers with carbon-carbon double bonds join together to form a long chain polymer.

The π bond breaks and the electrons are used to form σ bonds with other monomers either side of it.

Atom economy is 100%.

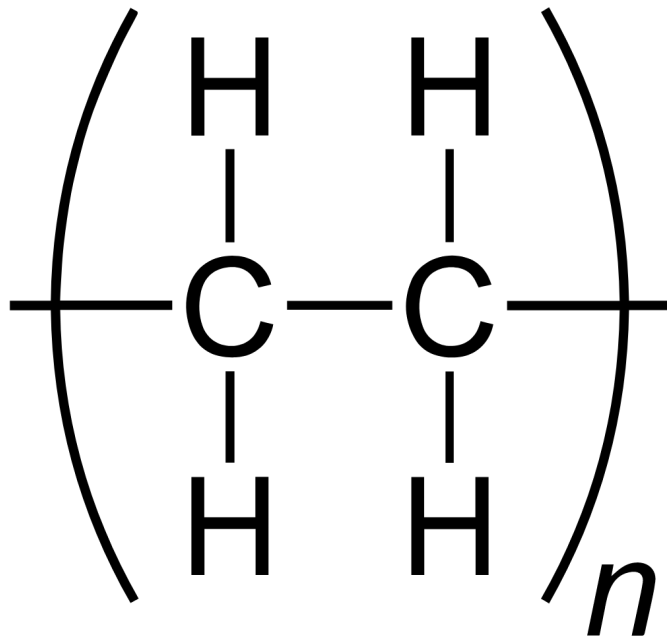


What is a repeat unit?



What is a repeat unit?

A single unit of a polymer derived from its monomer; the repetition of which would result in the polymer.



How can the life cycle of polymers be made more sustainable?



How can the life cycle of polymers be made more sustainable?

- By producing biodegradable polymers instead.
- By recycling old polymers into monomers to be reused again.



How can the problems caused by polymer disposal be limited?



How can the problems caused by polymer disposal be limited?

- Develop biodegradable polymers.
- Remove toxic waste gases produced when polymers undergo incineration.

