

# WJEC (Eduqas) Chemistry A-level

## Core Topic 3.2 - Hydrocarbons

### Flashcards

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What are the only products when a hydrocarbon fuel undergoes complete combustion?



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Water ( $\text{H}_2\text{O}$ ) and carbon dioxide ( $\text{CO}_2$ ).



Write a balanced chemical equation for the complete combustion of ethane



Write a balanced chemical equation for the complete combustion of ethane



When does incomplete combustion occur? What is required to ensure complete combustion occurs?



When does incomplete combustion occur? What is required to ensure complete combustion occurs?

Incomplete combustion occurs when there is an insufficient supply of oxygen.

To ensure complete combustion occurs, the reaction should be carried out with excess oxygen.



# What are the products of incomplete combustion?





# What are the products of incomplete combustion?

Carbon particulates - soot (C)

Carbon dioxide ( $\text{CO}_2$ )

Carbon monoxide (CO)

Water ( $\text{H}_2\text{O}$ )



Write a balanced symbol equation for the incomplete combustion of methane to form carbon monoxide and water



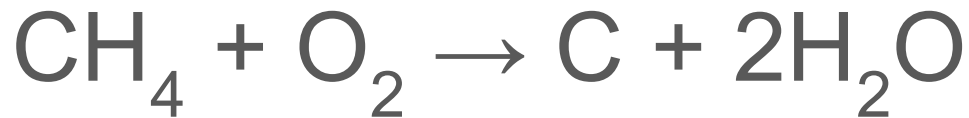
Write a balanced symbol equation for the incomplete combustion of methane to form carbon monoxide and water



Write a balanced symbol equation for the incomplete combustion of methane to form carbon particulates and water



Write a balanced symbol equation for the incomplete combustion of methane to form carbon particulates and water



What are the benefits and drawbacks related to the burning of fossil fuels for energy?



# What are the benefits and drawbacks related to the burning of fossil fuels for energy?

## Benefits:

- Produces large amounts of energy.
- Currently relatively easily available.

## Drawbacks:

- Uses finite resources
- Produces carbon dioxide which contributes to global warming.
- Produces carbon monoxide which is toxic.
- Produces acidic gases which form acid rain.



What type of bonds are the C-C and C-H bonds in alkanes?





What type of bonds are the C-C and C-H bonds in alkanes?

$\sigma$ -bond

(Sigma bond)



Give an example of a type of reaction  
that uses a radical substitution  
mechanism?



Give an example of a type of reaction that uses a radical substitution mechanism?

Photochlorination of alkanes



# What is a photochlorination reaction?



# What is a photochlorination reaction?

A photochlorination reaction is when one of the hydrogen atoms on an alkane is replaced by a chlorine atom. The reaction is initiated by light.



# Compare the difference in reactivity of alkanes and alkenes



# Compare the difference in reactivity of alkanes and alkenes

Alkenes have a high electron density in the carbon-carbon double bond,  $C=C$ . this makes them more susceptible to attacks from electrophiles, compared to alkanes, and so alkenes are more reactive.



Describe the C=C bond in alkenes in terms of the types of covalent bonds present



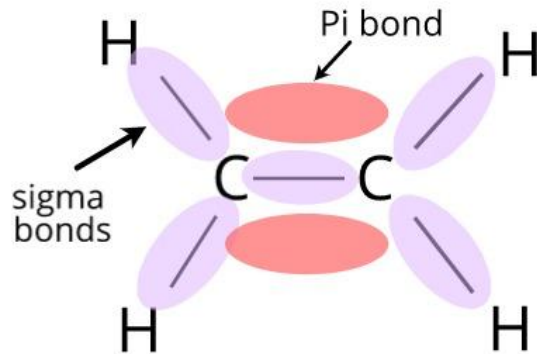


Describe the C=C bond in alkenes in terms of the types of covalent bonds present

The C=C has a normal  $\sigma$ -bond as well as a  $\pi$ -bond located above and below the  $\sigma$ -bond.

$\sigma$ -bond: sigma bond

$\pi$ -bond: pi bond



# 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*-?

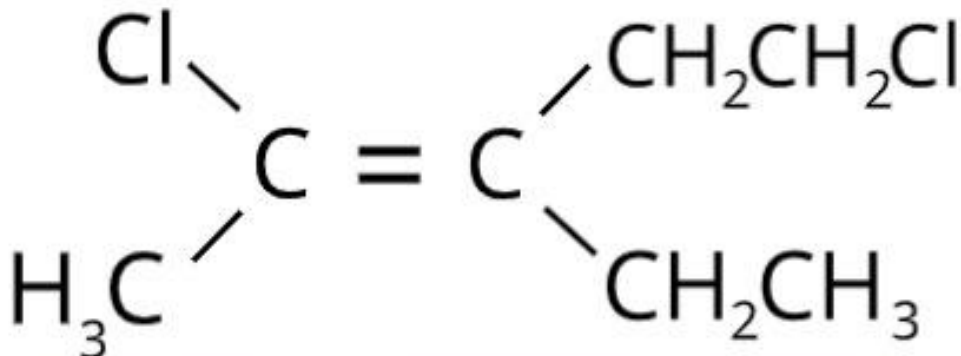


# How do you determine whether an isomer is *E*- or *Z*-?

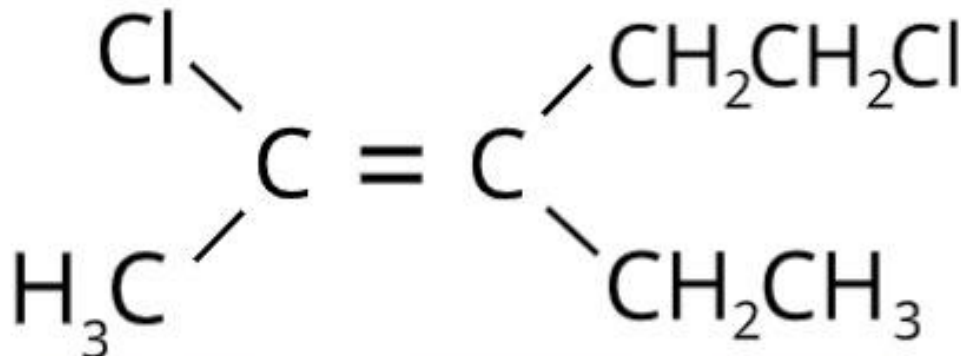
- In *E*- isomers, high priority groups are on opposite sides of the  $C=C$ .
- In *Z*- isomers, high priority groups are on the same side of the  $C=C$ .



Name the compound below



Name the compound below



Z-2,5-dichloro-3-ethylpent-2-ene



# Why can alkenes undergo electrophilic addition?





# Why can alkenes undergo electrophilic addition?

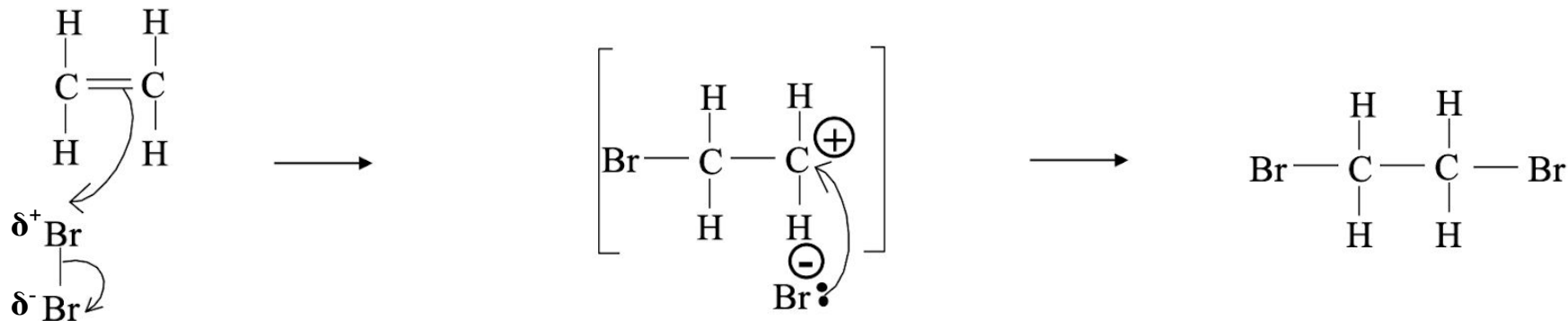
Alkenes are susceptible to attack from electrophiles because of the high electron density in the  $C=C$  double bond.



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



# Describe the electrophilic addition of bromine to ethene, including a mechanism.



The electron dense  $\text{C}=\text{C}$  induces a dipole in  $\text{Br}_2$ . This causes the  $\pi$  bond to break and form a bond with the slightly positive bromine, breaking the  $\text{Br}_2$  molecule.

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



Which qualitative tests can be carried out to test for alkenes?



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

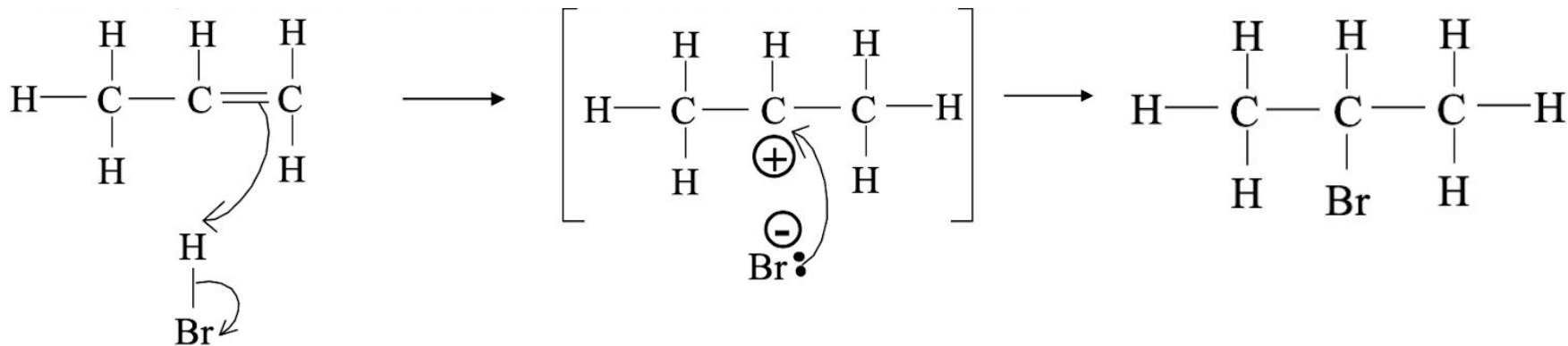
- Add bromine water: The orange colour decolourises to form a colourless solution if the alkene  $C=C$  bond is present.
- Add acidified potassium dichromate: The purple colour decolourises to form a colourless solution if the alkene  $C=C$  bond is present.



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



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



This is the reaction pathway for the formation of the major product, 2-Bromopropane.



Explain why the electrophilic addition of bromine to propene can produce a major and a minor product





# Explain why the electrophilic addition of bromine to propene can produce a major and a minor product

When propene undergoes addition polymerisation, two possible products can be formed: the major and the minor product. This is because two different carbocation intermediates can be formed - the primary and the secondary carbocation. The secondary carbocation is more stable so this produces the major product 2-bromopropene. The primary carbocation forms the minor product 1-bromopropane.

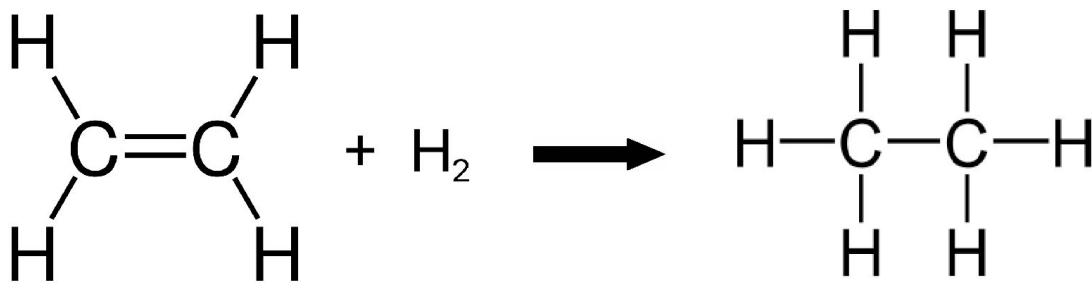


What reaction does an alkene undergo to form an alkane? Name the reagents and conditions



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

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



# What is addition polymerisation?



# What is addition polymerisation?

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

The  $\pi$  bond breaks and the electrons are used to form  $\sigma$  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 deriving from its monomer, the repetition of which would result in the polymer.

