

# AQA Chemistry A-level

## Topic 3.2 - Alkanes

### Flashcards

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# What is an alkane?



What is an alkane?

A saturated hydrocarbons  
containing C-H bonds only



# What is the general formula of an alkane?



What is the general formula of an alkane?



Are their bonds polar?  
Why/why not?



Are their bonds polar? Why/why not?

Nonpolar- carbon and hydrogen have similar electronegativities



# Which intermolecular forces do they have? Why?





Intermolecular forces? Why?

Only van der Waals forces of  
attraction - bonds are  
non-polar



# Are they soluble in water? why?



# Solubility in water? why?

Insoluble because hydrogen bonds in water are stronger than alkanes' van der Waals forces of attraction



# How reactive are alkanes?



How reactive are alkanes?

Very unreactive



# Which reactions will alkanes undergo?



Which reactions will alkanes undergo?

# Combustion and reaction with halogens



What is crude oil? How is it formed? Is it renewable? Why?





What is crude oil? How is it formed? Is it renewable?  
Why?

Mixture of fractions (hydrocarbons with similar boiling points and properties)

Formed at high temperatures and pressures deep below earth's surface over millions of years  
→ therefore non-renewable



Name the fractions from high to low boiling point.



Name the fractions from high to low boiling point.

Gases - fuel on site

Gasoline/petrol/naphtha - cars

Kerosene/paraffin - jet fuel, lighting

Diesel oil - lorries/taxis

Lubricating oil/waxes - candles, engine oil

Fuel oil - ships, power stations

Tar/bitumen - roads/roofing





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# What is fractional distillation/how does it work?



# What is fractional distillation/how does it work?

Crude oil heated until mostly vapourised

Passed into a fractionating tower that is cooler at the top than the bottom

Liquid fractions are piped off at the bottom

Vapours rise up the column and - via trays and bubble caps - condense when temperature  $<$  their boiling point

Shortest chain hydrocarbons condense at the top as they have the lowest boiling points



# What is fracking and how is it done?



# What is fracking and how is it done?

Natural gas held within shale rock

Drill into shale, force pressurised water and sand into rock to fracture it, Collect gas

HCl and methanol added to break up shale and prevent corrosion



# Pros/cons of fracking?





## Pros/cons of fracking?

Advantages - gas supply for many years, reduces imported gas and electricity

Disadvantages - lots of traffic to local area, concern about amount of water used, chemical additives can pollute water supplies, can cause small earthquakes, combust  $\text{CH}_4 \rightarrow \text{CO}_2 \rightarrow$  global warming



# Why are alkanes cracked?



## Why are alkanes cracked?

To turn a long chain alkane, which is not very economically valuable, into a shorter chain alkane (more economically valuable as it can be used as a fuel) and an alkene (more reactive, starting point for many products)



# What are the conditions for thermal cracking?



# What are the conditions for thermal cracking?

700-1200 K temperature

Up to 7000 kPa pressure



# What is the intermediate for the reaction?



What is the intermediate for the reaction?

Free radicals



# What are the main products of thermal cracking?





What are the main products of thermal cracking?

alkenes



# What are the conditions for catalytic cracking?



# What are the conditions for catalytic cracking?

Lower temp (720K)

Lower pressure (but above atmospheric)

Zeolite catalyst ( $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$ ) with a honeycomb structure to give a large surface area



# What are the main products of catalytic cracking?



What are the main products of catalytic cracking?

Cycloalkanes, aromatic hydrocarbons,  
branched alkanes



Write an equation for the  
combustion of propane





Write an equation for the combustion of propane



# What is a fuel?





# What is a fuel?

Something which releases heat energy when combusted



# What are the five main fuels comprising of alkanes?



What are the five main fuels comprising of alkanes?

Methane, butane, propane, petrol (about C<sub>8</sub>), paraffin (C<sub>10</sub> - C<sub>18</sub>)



What is incomplete combustion and what products are formed in the case of alkanes?



What is incomplete combustion and what products are formed in the case of alkanes?

Combustion in a limited supply of oxygen

CO - carbon monoxide - poisonous

C - carbon - particulates - soot - global dimming



Which type of hydrocarbons are most likely to undergo incomplete combustion?



Which type of hydrocarbons are most likely to undergo incomplete combustion?

Longer chains



# What is the environmental impact of carbon monoxide?





What is the environmental impact of carbon monoxide?

It is toxic/poisonous



# What is the environmental impact of nitrogen oxides?



What is the environmental impact of nitrogen oxides?

form nitric acid → acid rain,  
photochemical smog



# What is the environmental impact of sulfur impurities/sulfur dioxide?



What is the environmental impact of sulfur impurities/  
sulfur dioxide?

form sulphuric acid → acid rain



# What is the environmental impact of soot (carbon)?



What is the environmental impact of soot (carbon)?

asthma, cancer, global dimming



# What is the environmental impact of unburnt hydrocarbons?





What is the environmental impact of unburnt hydrocarbons?

Photochemical smog



# What is the environmental impact of carbon dioxide?



What is the environmental impact of carbon dioxide?

greenhouse gas → global warming,  
increases global temperatures,  
speeds up climate change



# What is the environmental impact of water vapour?



What is the environmental impact of water vapour?

greenhouse gas → global warming,  
increases global temperatures,  
speeds up climate change



# What are flue gases?



# What are flue gases?

## Gases given out by power stations

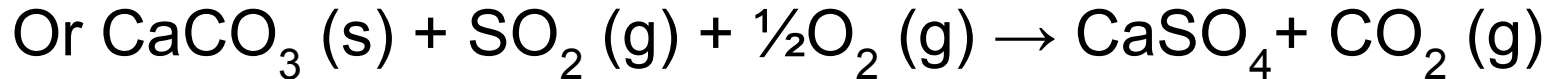
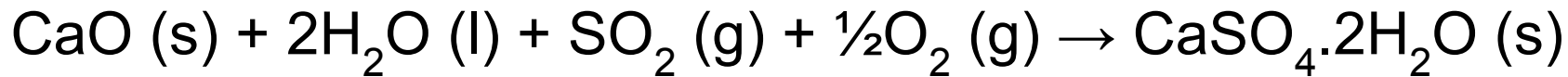


Write two equations for two different ways of desulfurising flue gases.





Write two equations for two different ways of desulfurising flue gases.



# What are catalytic converters made up of?



What are catalytic converters made up of?

Ceramic honeycomb coated with platinum, palladium and rhodium (Pt, Pd and Rh) metals

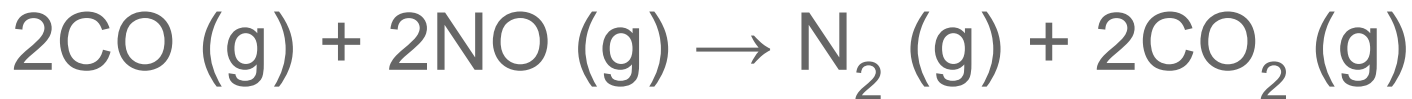


# What do catalytic converters catalyse (equations)?



What do they catalyse (equations)?

They catalyse these reactions of products from car exhausts:



# What are greenhouse gases?



# What are greenhouse gases?

Gases which trap infrared radiation,  
making the earth act like a greenhouse



# What is the greenhouse effect and how does it contribute to global warming?





# What is the greenhouse effect and how does it contribute to global warming?

Greenhouse gases trap infrared radiation in the atmosphere, atmosphere heats up → global warming



# Define carbon neutral activities



# Define carbon neutral activities

Activities that produce no net / overall carbon dioxide emissions



# How are halogenoalkanes formed from alkanes?



# How are halogenoalkanes formed from alkanes?

## Free radical substitution reaction



# What are the three stages of free radical substitution?



# What are the three stages of free radical substitution?

Initiation - breaking halogen bond to form free radicals

Propagation - chain part of the reaction where products are formed but free radical remains

Termination - free radicals removed, stable products formed



What are the conditions needed for the formation of a free radical chlorine atom?





What are the conditions needed for the formation of a free radical chlorine atom?

Presence of UV light



Write equations for the  
reaction of  $\text{CH}_4$  with  $\text{Cl}_2$  to  
form  $\text{CH}_3\text{Cl}$



Write equations for the reaction of  $\text{CH}_4$  with  $\text{Cl}_2$  to form  $\text{CH}_3\text{Cl}$

Initiation:  $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$  (in presence of UV light)

Propagation:  $\text{Cl}\cdot + \text{CH}_4 \rightarrow \text{HCl} + \cdot\text{CH}_3$

$\cdot\text{CH}_3 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{Cl}\cdot$

Termination:

$\cdot\text{CH}_3 + \text{Cl}\cdot \rightarrow \text{CH}_3\text{Cl}$

$2\text{Cl}\cdot \rightarrow \text{Cl}_2$

$\cdot\text{CH}_3 + \cdot\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_3$



# What is the ozone layer's function?



# What is the ozone layer's function?

protects the earth from harmful exposure to too many UV rays



# How do CFCs break the ozone layer down?



# How do CFCs break the ozone layer down?

## Free radical substitution

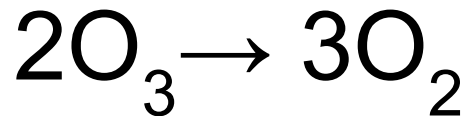


Write an equation for the overall decomposition of ozone into oxygen ( $O_2$ )





Write an equation for the overall decomposition of ozone into oxygen ( $O_2$ )



Write free radical  
substitution equations to  
show how Cl free radicals  
catalyse the break down of  
 $O_3$



Write free radical substitution equations to show how Cl free radicals catalyse the decomposition of  $O_3$

