



100% sheet

Year 11

Organic chemistry
Combined science

Crude oil, hydrocarbons and alkanes

Display formula for first four alkanes

$$\begin{array}{c} \text{H} \\ | \\ \text{H}-\text{C}-\text{H} \\ | \\ \text{H} \end{array}$$

Methane (CH₄)

$$\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H}-\text{C}-\text{C}-\text{H} \\ | \quad | \\ \text{H} \quad \text{H} \end{array}$$

Ethane (C₂H₆)

$$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ | \quad | \quad | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$$

Propane (C₃H₈)

$$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ | \quad | \quad | \quad | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ | \quad | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array}$$

Butane (C₄H₁₀)

Fractions	<i>The hydrocarbons in crude oil can be split into fractions</i>	Each fraction contains molecules with a similar number of carbon atoms in them. The process used to do this is called fractional distillation.
Using fractions	<i>Fractions can be processed to produce fuels and feedstock for petrochemical industry</i>	We depend on many of these fuels; petrol, diesel and kerosene. Many useful materials are made by the petrochemical industry; solvents, lubricants and polymers.

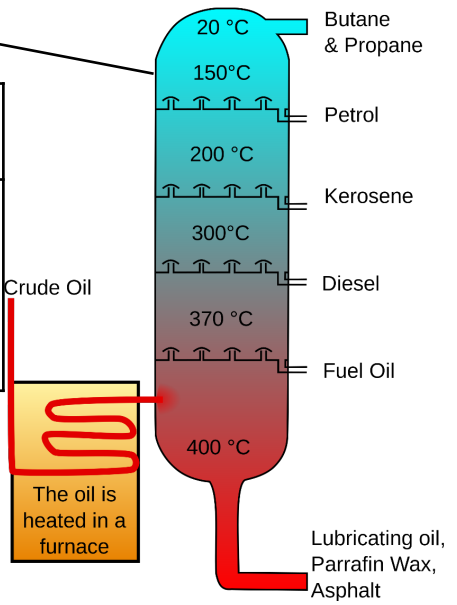
Carbon compounds as fuels and feedstock

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Carbon compounds as fuels and feedstock

Fractional distillation and petrochemicals

Hydrocarbon chains	In oil	Hydrocarbon chains in crude oil come in lots of different lengths.
	Boiling points	The boiling point of the chain depends on its length. During fractional distillation, they boil and separate at different temperatures due to this.



Crude oil	<i>A finite resource</i>	Consisting mainly of plankton that was buried in the mud, crude oil is the remains of ancient biomass.
Hydrocarbons	<i>These make up the majority of the compounds in crude oil</i>	Most of these hydrocarbons are called alkanes.
General formula for alkanes	C_nH_{2n+2}	For example: C ₂ H ₆ C ₆ H ₁₄

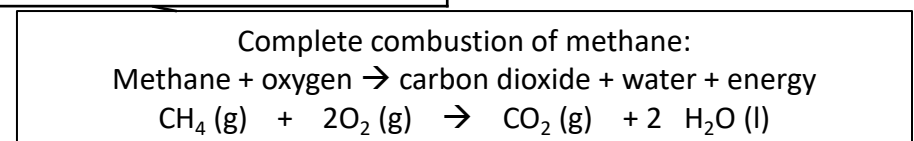
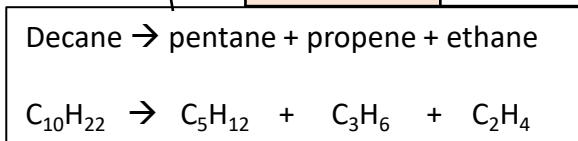
Alkanes to alkenes	<i>Long chain alkanes are cracked into short chain alkenes.</i>
Alkenes	<i>Alkenes are hydrocarbons with a double bond (some are formed during the cracking process).</i>
Properties of alkenes	<i>Alkenes are more reactive than alkanes and react with bromine water. Bromine water changes from orange to colourless in the presence of alkenes.</i>

Cracking and alkenes

Properties of hydrocarbons

Combustion	During the complete combustion of hydrocarbons, the carbon and hydrogen in the fuels are oxidised, releasing carbon dioxide, water and energy.
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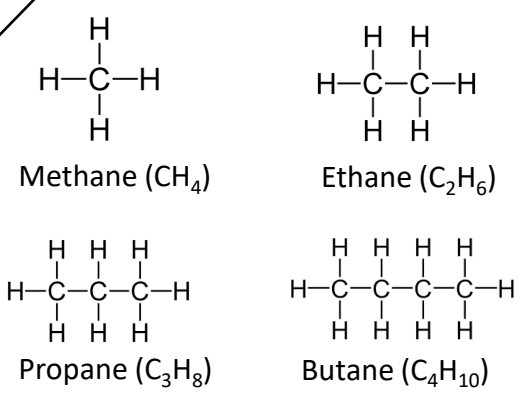
Cracking	<i>The breaking down of long chain hydrocarbons into smaller chains</i>	The smaller chains are more useful. Cracking can be done by various methods including catalytic cracking and steam cracking.
Catalytic cracking	<i>The heavy fraction is heated until vaporised</i>	After vaporisation, the vapour is passed over a hot catalyst forming smaller, more useful hydrocarbons.
Steam cracking	<i>The heavy fraction is heated until vaporised</i>	After vaporisation, the vapour is mixed with steam and heated to a very high temperature forming smaller, more useful hydrocarbons.



Alkenes and uses as polymers	<i>Used to produce polymers. They are also used as the starting materials of many other chemicals, such as alcohol, plastics and detergents.</i>	Boiling point (temperature at which liquid boils)	<i>As the hydrocarbon chain length increases, boiling point increases.</i>
Why do we crack long chains?	<i>Without cracking, many of the long hydrocarbons would be wasted as there is not much demand for these as for the shorter chains.</i>	Viscosity (how easily it flows)	<i>As the hydrocarbon chain length increases, viscosity increases.</i>
		Flammability (how easily it burns)	<i>As the hydrocarbon chain length increases, flammability decreases.</i>

Crude oil, hydrocarbons and alkanes

Display formula for first four alkanes



The hydrocarbons in crude oil can be split into fractions

Each fraction contains molecules with a similar number of carbon atoms in them. The process used to do this is called fractional distillation.

Fractions can be processed to produce fuels and feedstock for petrochemical industry

We depend on many of these fuels; petrol, diesel and kerosene.

Many useful materials are made by the petrochemical industry; solvents, lubricants and polymers.

Carbon compounds as fuels and feedstock

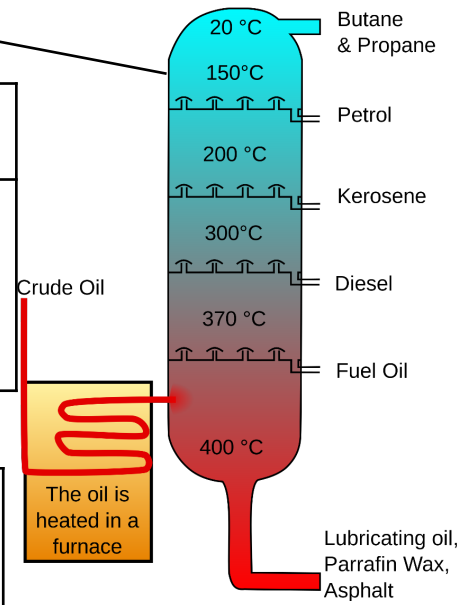
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Carbon compounds as fuels and feedstock

Fractional distillation and petrochemicals

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C_nH_{2n+2}	For example: C ₂ H ₆ C ₆ H ₁₄

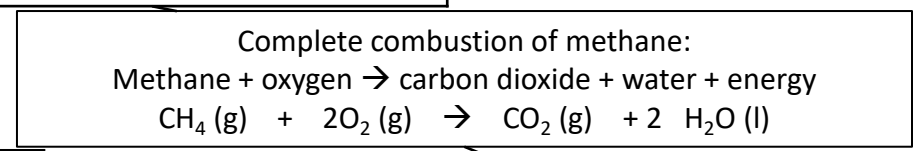
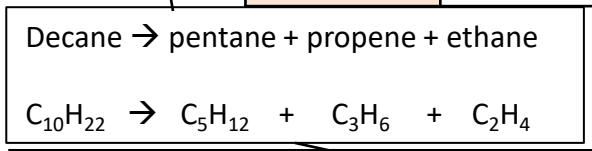
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Cracking and alkenes

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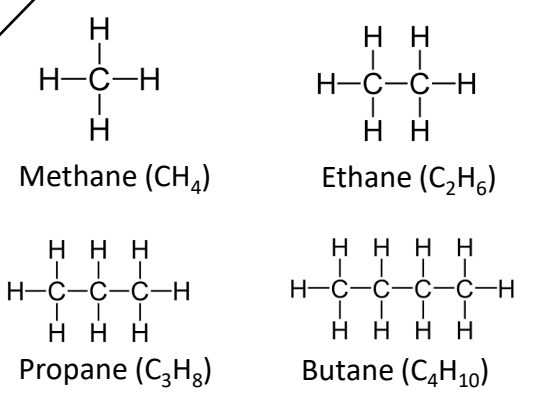


<i>Used to produce polymers. They are also used as the starting materials of many other chemicals, such as alcohol, plastics and detergents.</i>
<i>Without cracking, many of the long hydrocarbons would be wasted as there is not much demand for these as for the shorter chains.</i>

<i>As the hydrocarbon chain length increases, boiling point increases.</i>
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Crude oil, hydrocarbons and alkanes

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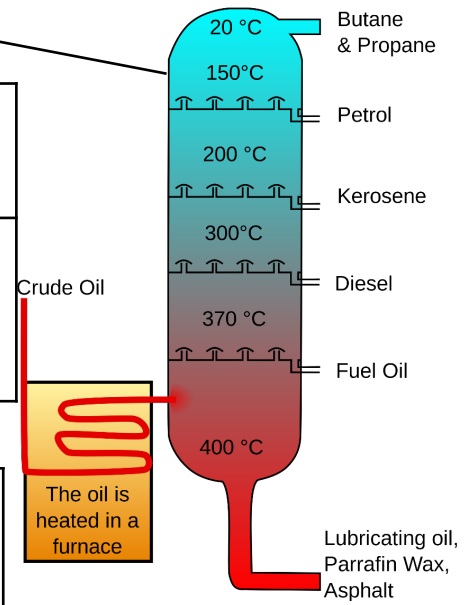
Carbon compounds as fuels and feedstock

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Carbon compounds as fuels and feedstock

Fractional distillation and petrochemicals

Hydrocarbon chains	In oil	
	Boiling points	



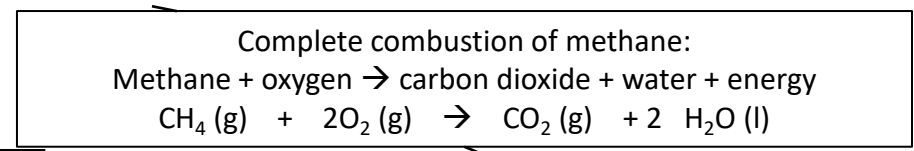
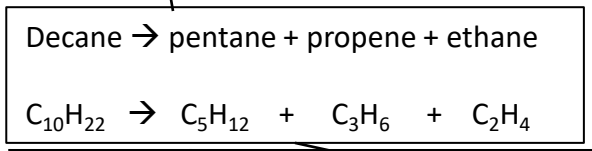
Alkanes to alkenes	
Alkenes	
Properties of alkenes	

Cracking and alkenes

Properties of hydrocarbons

Combustion	
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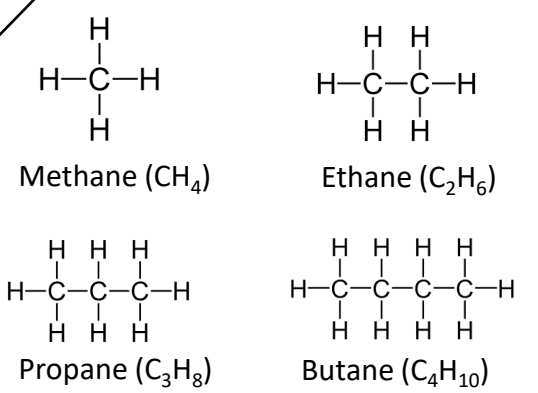


Alkenes and uses as polymers	
Why do we crack long chains?	

Boiling point (temperature at which liquid boils)	
Viscosity (how easily it flows)	
Flammability (how easily it burns)	

Crude oil, hydrocarbons and alkanes

Display formula for first four alkanes



Fractions		
Using fractions		

Crude oil		
Hydrocarbons		
General formula for alkanes		For example:

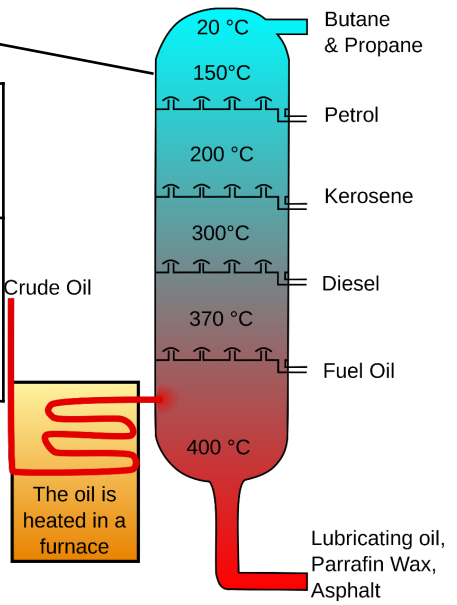
Carbon compounds as fuels and feedstock

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Carbon compounds as fuels and feedstock

Fractional distillation and petrochemicals

Hydrocarbon chains	<i>In oil</i>	
	<i>Boiling points</i>	

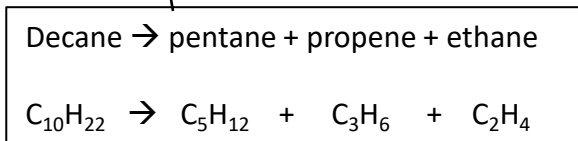


Alkanes to alkenes	
Alkenes	
Properties of alkenes	

Cracking and alkenes

Properties of hydrocarbons

Combustion



Complete combustion of methane:
 Word equation:
 Symbol equation:

Cracking		
Catalytic cracking		
Steam cracking		

Alkenes and uses as polymers	
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