

## In Context

Subject area: Organic chemistry

Level: 14–16 years (Higher)

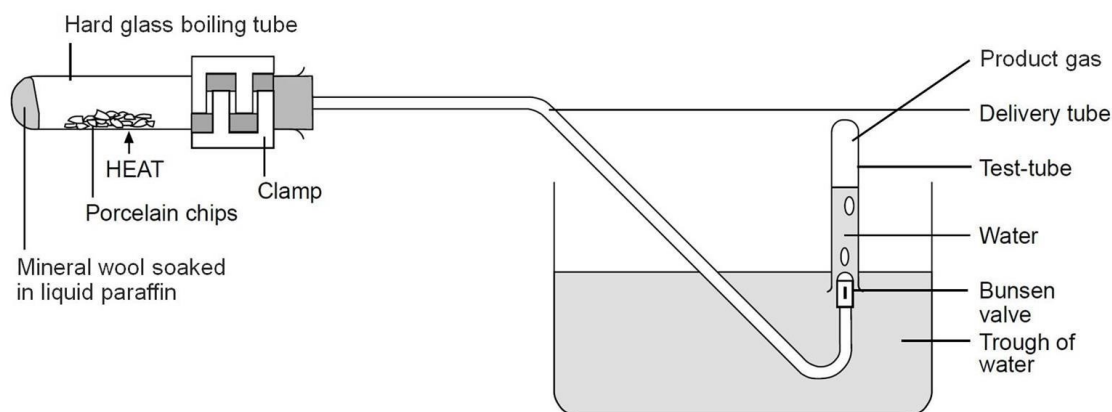
Topic: Cracking hydrocarbons

Source: [rsc.li/2SCxbLL](https://rsc.li/2SCxbLL)

**1. A teacher shows a class an experiment in which liquid paraffin is cracked.**

Watch the video at <https://youtu.be/ZYyKUePdC2Y>

Here is a diagram of the equipment used.



Source: Royal Society of Chemistry

**a) Porcelain chips are used because they catalyse the reaction.**

Define 'catalyse'?

*Answer: To make the reaction take place at a faster rate.*

**b) Using the diagram, what evidence is there that smaller molecules are made in the experiment?**

Explain your answer.

*Answer: A product gas is formed from the liquid paraffin.  
The gas has a lower boiling point than the liquid paraffin.  
This is because the gas contains smaller molecules.*

c) Using the diagram, describe how you think the experiment works.

*Answer: Liquid paraffin and porcelain chips are heated with a Bunsen flame.  
The liquid paraffin boils and turns into a vapour.  
The paraffin molecules break down due to heat and the catalyst.  
The smaller molecules are then collected in the test tube as a gas.*

d) What evidence is there from the diagram that the product gas is insoluble in water?

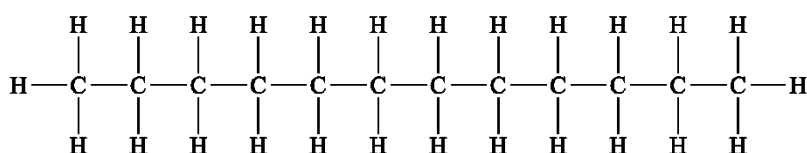
*Answer: The product gas is collected over water, and if it were soluble, it would dissolve.*

e) Suggest why a special valve called a Bunsen valve is used in the experiment.

*Answer: It is a safety feature – if suck-back of water back into the glass equipment occurs, water on very hot glass could cause an accident. The Bunsen valve is supposed to decrease the likelihood of this happening.*

Paraffin is a mixture of large hydrocarbon molecules.

The structure of one of these molecules, called dodecane, is shown below.



f) State the molecular formula of dodecane.

*Answer: C<sub>12</sub>H<sub>26</sub>*

Dodecane is a member of a homologous series.

g) Give two characteristics of molecules in a homologous series.

*Answer: They have the same functional group.  
One member differs from the next by a CH<sub>2</sub> unit.  
When arranged in order, they have a graduation in physical properties.*

h) To which homologous series does dodecane belong?

*Answer: The alkanes.*

i) What is the general formula of the homologous series in part h)?

*Answer:  $C_nH_{(2n+2)}$*

j) Which of these molecules do not belong to the same homologous series as dodecane?

Write 'Yes' or 'No' into the right-hand column in the table.

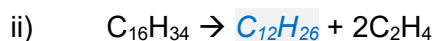
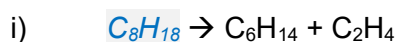
Molecular formula of substance	The same homologous series as dodecane ('Yes' or 'No')
$C_8H_{16}$	<i>Answer: No.</i>
$C_{13}H_{28}$	<i>Answer: Yes.</i>
$C_5H_{12}$	<i>Answer: Yes.</i>
$C_{23}H_{46}$	<i>Answer: No.</i>
$C_{50}H_{102}$	<i>Answer: Yes.</i>

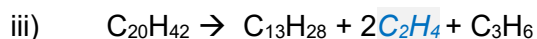
k) Dodecane may be cracked to form smaller alkanes and alkenes.

Write a symbol equation to show dodecane being cracked to form ethene as one of the products, together with a different product.

*Answer:  $C_{12}H_{26} \rightarrow C_{10}H_{22} + C_2H_4$*

l) Complete the symbol equations for the following cracking processes.

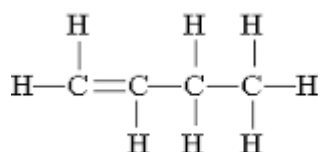




m) State a use for the products formed from a cracking reaction.

Smaller alkanes	<i>Answer: Petrol</i>
Alkenes	<i>Answer: Polymers and solvents.</i>

The molecule shown below can form from a cracking reaction.



n) What is the name of this molecule?

*Answer: Butene or but-1-ene.*

o) State whether this molecule is saturated or unsaturated.

Give a reason for your answer.

*Answer: Unsaturated.  
A carbon double bond is present.*