AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.7.2.1

Structure and formulae of alkenes

Past-paper questions

Tier	**Foundation**
Question groups	**61**
Available paper years	**2007–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.7.2.1 Structure and formulae of alkenes

Question 01

January 2007 | CHY1F | Original Q5 | Legacy

5 Polymers are used to make many materials that people need.

(a) Plastic bags are used to carry, protect and store food. Plastic bags are made from polymers.



Plastic bag made from a polymer

(i) Ethene is the small molecule (the monomer) used to make the polymer for this plastic bag.

Name the polymer that is made from ethene.

.....

(1 mark)

(ii) Use the correct word from the box to complete the sentence about ethene.

condensing	**corroding**	**cracking**

Ethene is made by breaking down large hydrocarbon molecules into smaller hydrocarbon molecules by a process called ..... .

(1 mark)

(iii) The hydrocarbon ethene has the formula C_2H_4

Complete the sentence about ethene.

Ethene is a hydrocarbon made up of carbon and ..... atoms.

(1 mark)

Question 5 continues on the next page

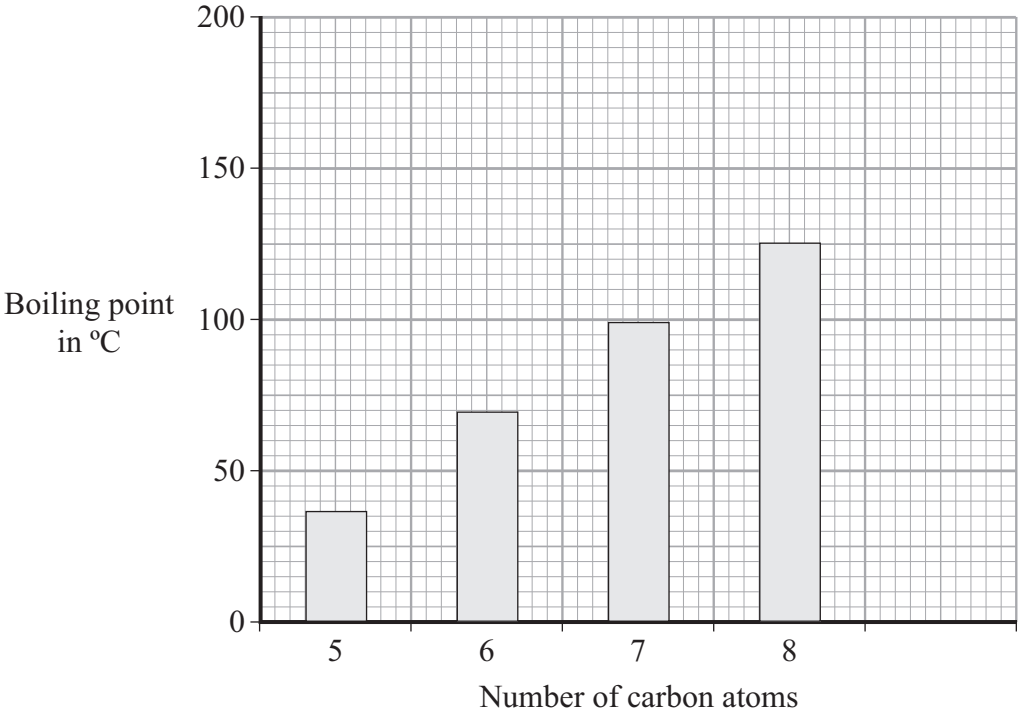
Question 01 · continued

BLANK

(b) The hydrocarbons used to make ethene come from crude oil.
The properties of hydrocarbons are linked to the number of carbon atoms in their molecules.

Number of carbon atoms	5	6	7	8	9
Boiling point in °C	36	69	99	125	151

(i) Use the data in the table to complete the bar chart.



(2 marks)

(ii) What happens to the boiling point of a hydrocarbon as the number of carbon atoms increases?

.....

(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 01 · continued

BLANK

(iii) All the hydrocarbons in the table are found in petrol. Petrol is one of the fractions separated from crude oil.

Describe how the fractions are separated from crude oil.

.....

.....

.....

.....

.....

(2 marks)

(c) Most plastic bags that are made of hydrocarbons are not biodegradable.

Used plastic bags can be:

- dumped into large holes, which is called landfill
- burned to give out heat energy, which would produce large amounts of gases.

Would burning used plastic bags be better for the environment than dumping them in landfill?

Explain your answer.

.....

.....

.....

.....

(2 marks)

10

4.7.2.1 Structure and formulae of alkenes

Question 02

March 2007 | CHY1B | Original Q1 | Legacy

QUESTION ONE

This question is about hydrocarbons.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A alkanes

B fuels

C monomers

D polymers

Hydrocarbons are cracked to produce smaller molecules.

Some of the products of cracking can be used in cars as . . . **1** . . . .

The products of cracking include alkenes and saturated hydrocarbons called . . . **2** . . . .

Alkenes can be used in reactions to make . . . **3** . . . such as poly(ethene) and poly(propene).

In these reactions, many small molecules known as . . . **4** . . . join together to form very large molecules.

4.7.2.1 Structure and formulae of alkenes

Question 03

March 2007 | CHY1B | Original Q3 | Legacy

QUESTION THREE

This question is about four chemical substances.

Match substances, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A ethanol

B ethene

C helium

D poly(propene)

	What we can say about the substance
1	It is an unreactive gas.
2	It is produced when an alkene reacts with steam.
3	It is a polymer.
4	It belongs to a group of hydrocarbons with the general formula C_nH_{2n}

4.7.2.1 Structure and formulae of alkenes

Question 04

June 2007 | CHY1B | Original Q6 | Legacy

QUESTION SIX

The table shows some information about four vegetable oils.

	Type of oil	Average mass of oil extracted from 100 kg of seeds in g	Energy provided by 100 g of the oil in kJ	Approximate melting point in °C	Smoke point in °C	Iodine number
A	Corn	6	3700	–15	229–268	120
B	Olive	40	3378	–12	204–210	60
C	Rapeseed	35	3696	5	230–240	100
D	Sunflower	32	3700	–18	229–252	130

A high iodine number indicates a large number of double bonds in a molecule of the oil.

The smoke point is the temperature at which an oil begins to give off smoke when heated.

Match oils, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

	What we can say about the oil
1	It does not begin to give off smoke until heated to 265 °C.
2	It would be the first to solidify if the oils were cooled from 20 °C.
3	It would need the largest volume of bromine water to react completely.
4	It would provide the most energy from 100 kg of seeds.

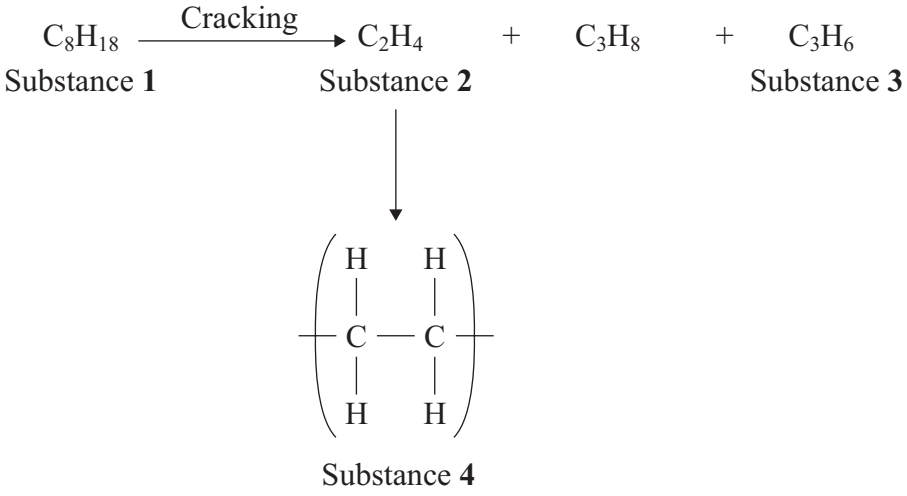
4.7.2.1 Structure and formulae of alkenes

Question 05

November 2007 | CHY1B | Original Q5 | Legacy

QUESTION FIVE

The flow diagram shows an example of cracking and how one of the products is used.



Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow diagram.

A alkene with the smallest molecules

B alkene with the largest molecules

C alkane

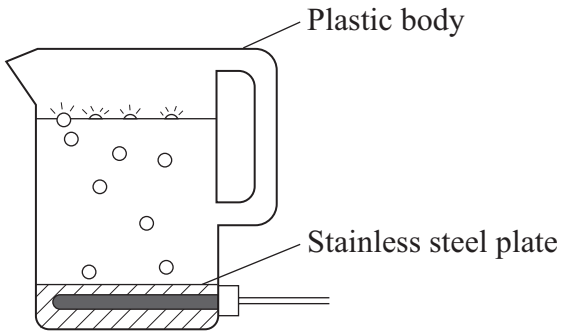
D polymer

4.7.2.1 Structure and formulae of alkenes

Question 06

January 2008 | CHY1F | Original Q4 | Legacy

4 Plastics are used to make many everyday items, such as the body of the kettle.



(a) Complete the sentences by drawing a ring around the correct words.

(i) The plastic is made from many small molecules called

catalysts
monomers
polymers

.

(1 mark)

(ii) Propene is produced by cracking some of the fractions that are

separated from

crude oil
limestone
metal ores

.

(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 06 · continued

BLANK

(b) After a few years the kettle no longer worked.

- Some parts of the kettle are made of plastic.
- Some parts of the kettle are made of stainless steel.
- The owner of the kettle disposed of it in a landfill site.

Consider these statements.

Suggest **three** reasons why the kettle should **not** be disposed of in a landfill site.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

5

4.7.2.1 Structure and formulae of alkenes

Question 07

January 2008 | CHY2F | Original Q4 | Legacy

4 The electrolysis of sodium chloride solution produces useful substances.

(a) (i) Choose a word from the box to complete the sentence.

covalent	**ionic**	**non-metallic**

Electrolysis takes place when electricity passes through ..... compounds when they are molten or in solution.

(1 mark)

(ii) Choose a word from the box to complete the sentence.

alkenes	**elements**	**salts**

During electrolysis the compound is broken down to form ..... .

(1 mark)

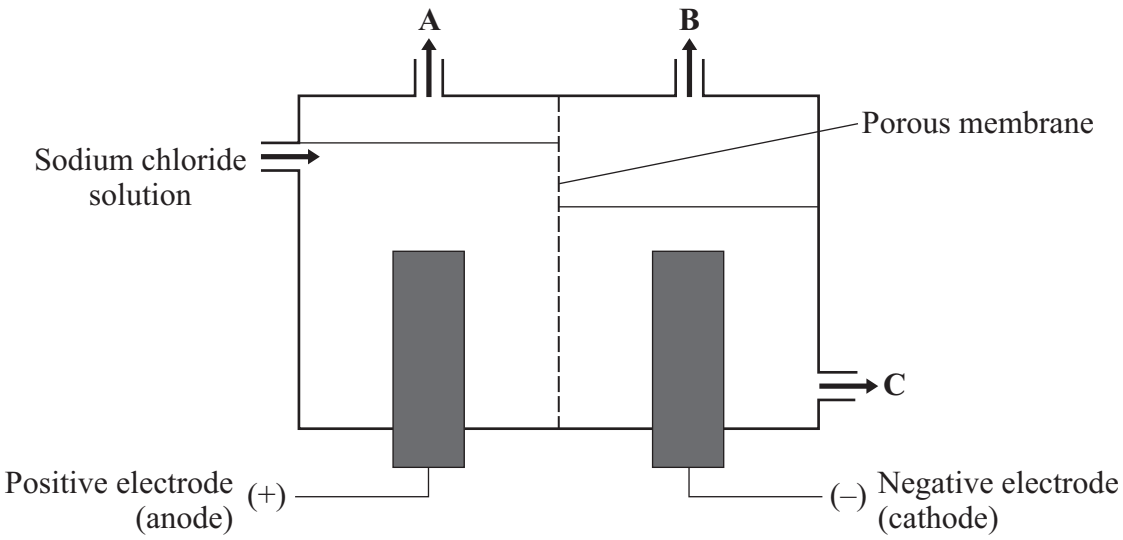
4.7.2.1 Structure and formulae of alkenes

Question 07 · continued

BLANK

(b) The table of ions on the Data Sheet may help you to answer this question.

The diagram shows an apparatus used for the electrolysis of sodium chloride solution.



Identify the products **A**, **B** and **C** on the diagram using substances from the box.

chlorine gas	**hydrogen gas**	**oxygen gas**
sodium hydroxide solution		**sodium metal**

(i) **A** is ..... .

(1 mark)

(ii) **B** is ..... .

(1 mark)

(iii) **C** is ..... .

(1 mark)

5

4.7.2.1 Structure and formulae of alkenes

Question 08

March 2008 | CHY1BP | Original Q4 | Legacy

QUESTION FOUR

This question is about the cracking of hydrocarbons.

Match substances, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A alkanes

B alkenes

C catalysts

D polymers

Cracking hydrocarbons produces unsaturated hydrocarbons called . . . **1** . . . .

It also produces saturated hydrocarbons called . . . **2** . . . .

Molecules of unsaturated hydrocarbons can be joined together to form . . . **3** . . . .

These reactions can often be speeded up by using . . . **4** . . . .

4.7.2.1 Structure and formulae of alkenes

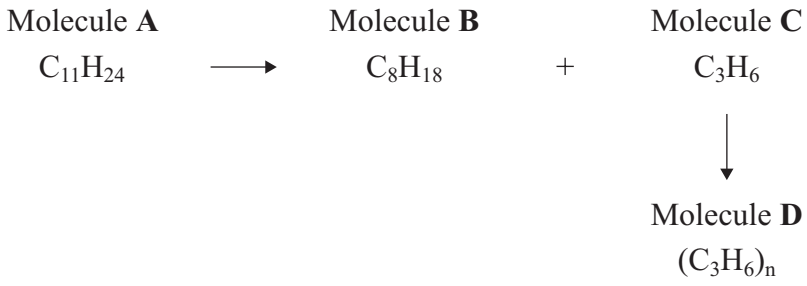
Question 09

March 2008 | CHY1BP | Original Q6 | Legacy

QUESTION SIX

This question is about cracking.

Match molecules, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.



Molecule . . . **1** . . . has been cracked.

Molecule . . . **2** . . . is an alkene.

Molecule . . . **3** . . . is a polymer.

Molecule . . . **4** . . . is the smallest alkane in the reaction.

4.7.2.1 Structure and formulae of alkenes

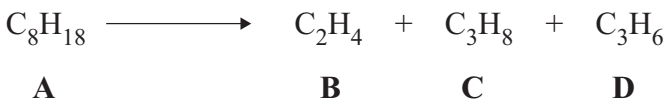
Question 10

June 2008 | CHY1BP | Original Q5 | Legacy

QUESTION FIVE

Large hydrocarbon molecules can be broken down to produce smaller molecules.

An example is shown below.



Match substances, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

1	It is the molecule which contains 11 atoms.
2	It is ethene.
3	It is the monomer from which poly(propene) can be made.
4	It is the alkane with the largest molecules.

4.7.2.1 Structure and formulae of alkenes

Question 11

June 2008 | CHY1BP | Original Q6 | Legacy

QUESTION SIX

This question is about unsaturated hydrocarbons.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A catalysis

B polymerisation

C combustion

D thermal decomposition

Heating large hydrocarbon molecules so that they break down into smaller molecules, such as ethene, is an example of . . . **1** . . . .

Ethanol is formed when ethene reacts with steam. The reaction is speeded up using phosphoric acid. This reaction is an example of . . . **2** . . . .

Individual ethene molecules can be made to link together to form very long chains in a process called . . . **3** . . . .

Ethene reacts with oxygen to produce carbon dioxide and water. This reaction is an example of . . . **4** . . . .

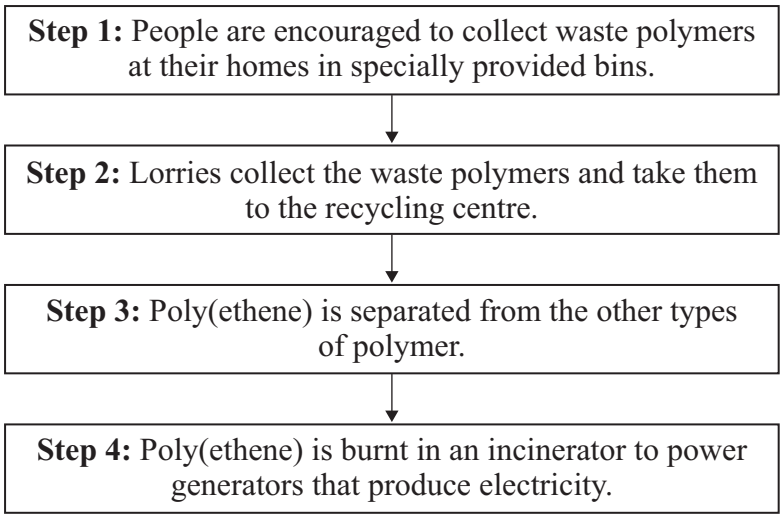
4.7.2.1 Structure and formulae of alkenes

Question 12

June 2008 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

The flow chart shows how the waste poly(ethene) from our homes can be used.



8A One problem associated with **Step 1** is that . . .

1 some people do **not** put their waste polymers in the special bins.

2 people prefer to burn their waste polymers.

3 poly(ethene) is toxic.

4 waste polymers rot and begin to smell.

8B One problem associated with **Step 2** is that . . .

1 burning diesel fuel in lorries can increase global warming.

2 people do **not** know where the recycling centres are.

3 the bins of waste polymers are very heavy.

4 the lorries are hard to recognise.

8C One problem associated with **Step 3** is that . . .

1 all polymers are the same colour.

2 polymers **cannot** be melted down.

3 polymers are magnetic.

4 separating polymers costs money.

8D One reason why all waste polymers are **not** burned in **Step 4** is that . . .

1 burning polymers can produce toxic gases.

2 polymers are poor conductors of electricity.

3 some polymers melt before burning.

4 burning polymers produces too much heat.

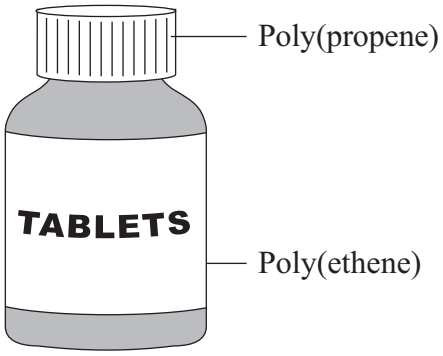
Turn over for the next question

4.7.2.1 Structure and formulae of alkenes

Question 13

June 2008 | CHY1F | Original Q5 | Legacy

5 Tablet containers are often made from two different polymers.



5 (a) Ethene, C_2H_4, and propene, C_3H_6, can be made from crude oil.

5 (a) (i) Complete the following sentence.

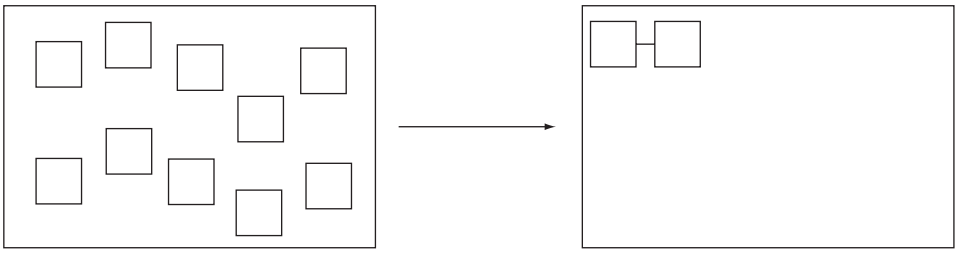
Ethene and propene are called hydrocarbons because they are made up of carbon and ..... atoms only.

(1 mark)

5 (a) (ii) Ethene molecules are used to form poly(ethene) molecules.

Complete the diagram to show the poly(ethene) molecule.

Ethene molecules **Poly(ethene) molecule**



(2 marks)

5 (b) The tablet containers could be disposed of in a landfill site or could be recycled.

5 (b) (i) Suggest **two** reasons why disposing of the tablet containers in a landfill site could cause problems.

1 .....

.....

2 .....

.....

(2 marks)

4.7.2.1 Structure and formulae of alkenes

Question 13 · continued

for mark

5 (b) (ii) Suggest **one** reason why recycling the tablet containers would be difficult.

.....

.....

(1 mark)

6

Turn over for the next question

4.7.2.1 Structure and formulae of alkenes

Question 14

November 2008 | CHY1BP | Original Q3 | Legacy

QUESTION THREE

This question is about four substances.

Match substances, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A argon

B bromine

C ethanol

D nickel

1	It is an unreactive gas.
2	It is produced when ethene reacts with steam.
3	It will be turned from red-brown to colourless by unsaturated oils.
4	It acts as a catalyst in the reaction to hydrogenate unsaturated oils.

4.7.2.1 Structure and formulae of alkenes

Question 15

March 2009 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

Scientists have developed a process to convert plastics such as nylon back to their original monomers.

9A What is the monomer used to make the polymer called poly(chloroethene)?

1 ethene

2 ethane

3 chloroethene

4 chloroethane

9B Which of the following is **not** an advantage of returning a polymer back to its monomer?

1 reduces the amount of plastic going into landfill sites

2 oil reserves will last longer

3 uses up excess supplies of monomers

4 avoids recycling of plastics

9C Plastics that can be broken down by microorganisms are described as . . .

1 unsaturated.

2 thermosetting.

3 thermoplastic.

4 biodegradable.

9D At a supermarket, customers can get vouchers for school equipment when they use their own bags for shopping.

The advantage of this scheme is that . . .

1 the supermarket can order more bags.

2 less plastic has to be manufactured.

3 queues will be shorter.

4 the plastic will be easier to recycle.

END OF TEST

4.7.2.1 Structure and formulae of alkenes

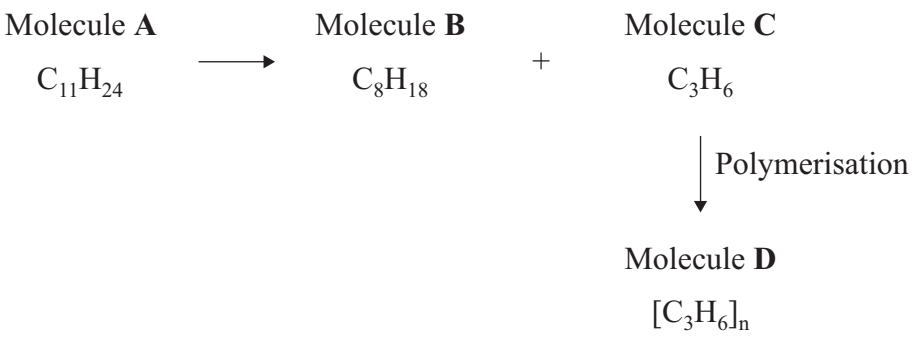
Question 16

June 2009 | CHY1BP | Original Q5 | Legacy

QUESTION FIVE

This question is about reactions of some hydrocarbon molecules.

Match molecules, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.



The molecule that has been cracked is . . . **1** . . . .

The molecule that is an alkene is . . . **2** . . . .

The molecule that is a plastic is . . . **3** . . . .

The molecule that is the smallest alkane in these reactions is . . . **4** . . . .

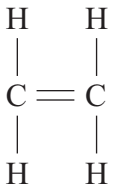
4.7.2.1 Structure and formulae of alkenes

Question 17

June 2009 | CHY1F | Original Q5 | Legacy

5 Crude oil is used to make useful substances such as alkenes and plastics.

5 (a) The alkene shown is ethene.



5 (a) (i) Tick (✓) the correct formula for ethene.

Formula	(✓)
CH_4	
C_2H_4	
C_2H_6	

(1 mark)

5 (a) (ii) Tick (✓) the name of the plastic formed when many ethene molecules join together.

Name of plastic	(✓)
Poly(ethene)	
Poly(ethanol)	
Poly(propene)	

(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 17 · continued

for mark

5 (b) Read the article about plastics and then answer the questions.

THE PROBLEM WITH PLASTIC WASTE

The UK produces about 3 million tonnes of plastics from crude oil every year.
Most of the litter found on UK beaches is plastic waste.
80% of the plastics produced end up in landfill sites.
The UK recycles only 7% of plastic waste.

5 (b) (i) Draw a ring around the correct answer in the box to complete the sentence.

Litter that is plastic waste needs to be removed from beaches

because it

- decomposes.
- is flammable.
- is not biodegradable.

(1 mark)

5 (b) (ii) Suggest a problem caused by 80% of the plastics going to landfill sites.

.....

.....

(1 mark)

5 (b) (iii) The UK government has set a target to recycle 30% of plastic waste.

How are resources saved by recycling more plastics?

.....

.....

(1 mark)

5

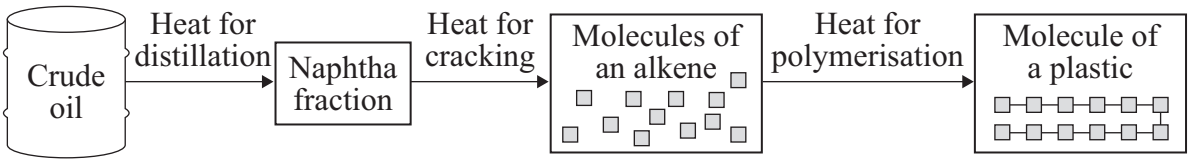
4.7.2.1 Structure and formulae of alkenes

Question 18

January 2019 | CHY1F | Original Q5 | Legacy

5 Crude oil is used to make plastics.

5 (a) To make a plastic from crude oil involves many processes.



5 (a) (i) How do alkene molecules form a molecule of a plastic?

.....

.....

(1 mark)

5 (a) (ii) Suggest **one** of the main costs of making a plastic from crude oil.

.....

.....

(1 mark)

5 (a) (iii) Suggest **two** problems caused by the disposal of plastics in landfill sites.

1 .....

.....

2 .....

.....

(2 marks)

4.7.2.1 Structure and formulae of alkenes

Question 18 · continued

for mark

5 (b) Some companies are using bio-plastics made from plants such as corn.
Less fossil fuel is used to make bio-plastics than is used to make plastics from crude oil.

Plastics made from plants would be more environmentally friendly than plastics made from crude oil.

Explain why.

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

4.7.2.1 Structure and formulae of alkenes

Question 19

March 2010 | CHY1BP | Original Q4 | Legacy

QUESTION FOUR

The table below shows the masses of some gases given off when one gram of each of the polymers, **A**, **B**, **C** and **D**, are burnt in air.

		Combustion products in mg						
	Polymer name	**C_2H_4**	**CH_4**	**CO_2**	**CO***	**NO_2***	**HCN***	**NH_3***
A	Kevlar	–	–	1850	50	10	14	0.5
B	Acrylic	5	17	1300	170	45	40	3.0
C	66 Nylon	50	25	1200	250	20	30	–
D	Polyester	6	10	1000	350	–	–	–

Toxic gases are marked with *.

Match polymers, **A**, **B**, **C** and **D**, with the numbers **1–4** below.

1 the polymer that produces the most HCN

2 the polymer that produces the most ethene

3 the polymer that produces no hydrocarbons

4 the polymer that produces the largest total mass of toxic gases

4.7.2.1 Structure and formulae of alkenes

Question 20

March 2010 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

The two equations below show reactions involving hydrocarbons.

$$C_{11}H_{24} \rightarrow C_2H_4 + C_4H_8 + C_5H_{12}$$

$$C_4H_{10} \rightarrow 2C_2H_4 + H_2$$

8A The reactions are examples of . . .

1 condensation.

2 polymerisation.

3 cracking.

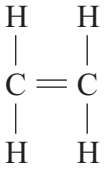
4 hydrogenation.

8B The hydrocarbon C_2H_4 can be represented by . . .

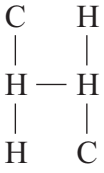
1



2



3



4



8C In the equations, the two hydrocarbons that are alkenes are . . .

1 C_2H_4 and C_4H_8

2 C_2H_4 and C_4H_{10}

3 C_2H_4 and C_5H_{12}

4 $C_{11}H_{24}$ and C_4H_{10}

4.7.2.1 Structure and formulae of alkenes

Question 20 · continued

8D Which of the hydrocarbons is used to make poly(ethene)?

1 C_2H_4

2 C_4H_8

3 C_4H_{10}

4 C_5H_{12}

Turn over for the next question

4.7.2.1 Structure and formulae of alkenes

Question 21

June 2010 | CHY1BP | Original Q4 | Legacy

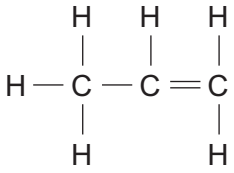
QUESTION FOUR

Large hydrocarbon molecules can be broken down to produce smaller molecules.

An example is shown below.

$$\underset{\textbf{A}}{C_{10}H_{22}} \longrightarrow \underset{\textbf{B}}{C_2H_4} + \underset{\textbf{C}}{C_5H_{12}} + \underset{\textbf{D}}{C_3H_6}$$

Match hydrocarbons, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

1	It has molecules with 17 atoms.
2	It is ethene.
3	It can be represented by 
4	It is the alkane with the largest molecules.

4.7.2.1 Structure and formulae of alkenes

Question 22

June 2010 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

This equation shows the thermal decomposition of a hydrocarbon.

$$C_8H_{18} \longrightarrow \text{an alkane} + \text{an alkene}$$

8A What is the name of this process?

1 polymerisation

2 cracking

3 combustion

4 hydrogenation

8B In this decomposition, . . .

1 the hydrocarbon vapour is heated with iodine.

2 the hydrocarbon is mixed with hydrogen and heated.

3 the hydrocarbon vapour is passed over a hot catalyst.

4 the hydrocarbon is liquefied, then passed over a catalyst.

8C The alkene produced . . .

1 is an unsaturated compound.

2 has molecules in which each carbon atom has two bonds.

3 is unreactive.

4 will burn to produce carbon dioxide and hydrogen.

8D Poly(ethene) is a polymer that is made from an alkene.

The polymer is . . .

1 produced by thermal decomposition.

2 a thermosoftening polymer.

3 produced by cracking.

4 biodegradable.

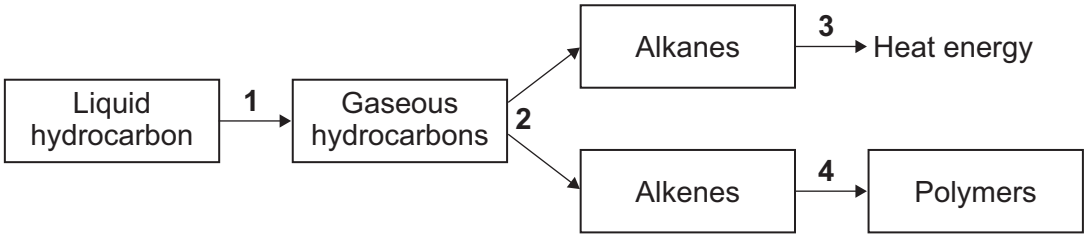
4.7.2.1 Structure and formulae of alkenes

Question 23

November 2010 | CHY1BP | Original Q1 | Legacy

QUESTION ONE

The flow chart is about hydrocarbons.



Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart.

A Crack

B Evaporate

C Polymerise

D Burn

4.7.2.1 Structure and formulae of alkenes

Question 24

November 2010 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

The equation shows the thermal decomposition of a hydrocarbon.

$$C_6H_{14} \longrightarrow \underset{\text{Ethene}}{C_2H_4} + \text{Substance } \mathbf{K}$$

9A What is the formula for substance **K**?

1 CH_4

2 C_2H_6

3 C_4H_{10}

4 C_8H_{18}

9B Ethene, C_2H_4 is . . .

1 an alkane.

2 an alkene.

3 a saturated hydrocarbon.

4 a polymer.

9C Ethene, C_2H_4 can form polymers because . . .

1 it contains both carbon atoms and hydrogen atoms.

2 it contains twice as many carbon atoms as hydrogen atoms.

3 the carbon atoms and hydrogen atoms are linked by single bonds.

4 there is a double bond between the carbon atoms.

9D Poly(ethene) is used to make shopping bags.

A problem with poly(ethene) is that . . .

1 it is not waterproof.

2 it cannot be coloured.

3 it is not broken down by microorganisms.

4 it is a thermosetting polymer.

END OF TEST

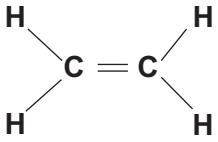
4.7.2.1 Structure and formulae of alkenes

Question 25

January 2011 | CHY1F | Original Q4 | Legacy

4 Supermarkets in the UK have been advised by the Government to stop giving plastic bags to customers.
Plastic bags are made from a polymer.
The polymer is made from ethene.

The structural formula of ethene is shown.



Ethene is made by cracking hydrocarbons.
These hydrocarbons come from crude oil.

4 (a) Complete these sentences about ethene.

4 (a) (i) Ethene is a hydrocarbon because it contains only ..... and

..... .

(2 marks)

4 (a) (ii) Ethene is unsaturated because it has a ..... bond.

(1 mark)

4 (b) Tick (✓) the name of the polymer formed when many ethene molecules join together.

Name of polymer	Tick (✓)
poly(chloroprene)	
poly(ethene)	
poly(propene)	

(1 mark)

4 (c) Suggest **two** reasons why supermarkets should stop giving plastic bags to customers.

1 .....

.....

2 .....

.....

(2 marks)

6

4.7.2.1 Structure and formulae of alkenes

Question 26

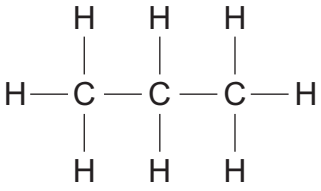
March 2011 | CHY1BP | Original Q5 | Legacy

QUESTION FIVE

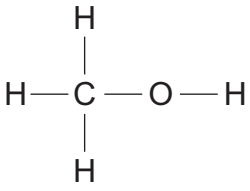
This question is about the formulae of four compounds.

Match formulae, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

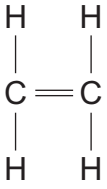
A



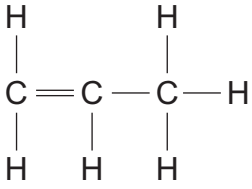
B



C



D



1	It is the alkene used to make ethanol.
2	It is a saturated hydrocarbon useful as a fuel.
3	It is not a hydrocarbon but burns to produce carbon dioxide and water vapour.
4	It belongs to the group with the general formula C_nH_{2n} where n = 3.

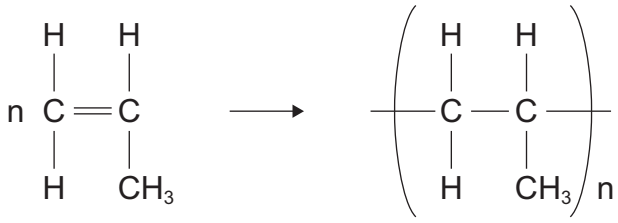
4.7.2.1 Structure and formulae of alkenes

Question 27

March 2011 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

The equation shows a chemical reaction.



Small molecules of hydrocarbon **X**

Large molecule of hydrocarbon **Y**

9A Hydrocarbon **X** is . . .

1 an alkane.

2 a polymer.

3 an alkene.

4 a catalyst.

9B Hydrocarbon **Y** is . . .

1 an unsaturated compound.

2 a polymer.

3 an alkene.

4 a monomer.

9C Poly(propene) is a thermosoftening polymer so it **cannot** be used to make . . .

1 buckets.

2 food containers.

3 non-stick coating for frying pans.

4 washing-up bowls.

4.7.2.1 Structure and formulae of alkenes

Question 27 · continued

March 2011 | CHY1BP | Original Q9 | Legacy

9D Putting poly(propene) and other polymer waste into landfill creates a problem because this type of waste . . .

1 is very lightweight and blows about.

2 is not biodegradable.

3 does not dissolve in water.

4 is very dense and sinks deep underground.

END OF TEST

4.7.2.1 Structure and formulae of alkenes

Question 28

June 2011 | CHY1BP | Original Q4 | Legacy

QUESTION FOUR

This question is about hydrocarbons.

Match words **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A alkenes

B polymers

C monomers

D alkanes

Hydrocarbons are cracked to produce both saturated and unsaturated hydrocarbons.

The saturated hydrocarbons that are used as fuels are called . . . **1** . . . .

The unsaturated hydrocarbons are called . . . **2** . . . .

Compounds, such as poly(ethene) and poly(propene), that have very long chain molecules are called . . . **3** . . . .

Long chain molecules are made when many small molecules join together. These small molecules are called . . . **4** . . . .

4.7.2.1 Structure and formulae of alkenes

Question 29

June 2011 | CHY1F | Original Q7 | Legacy

7 The raw materials used to make the polymer polyvinyl chloride (PVC) are crude oil and sea salt (sodium chloride).

7 (a) There are three main stages in the production of PVC.

7 (a) (i) **Stage 1** Cracking of hydrocarbons from crude oil produces ethene, C_2H_4

$$C_{10}H_{22} \longrightarrow C_8H_{18} + C_2H_4$$

How are hydrocarbons cracked?

.....

.....

.....

.....

(2 marks)

7 (a) (ii) **Stage 2** Electrolysis of sodium chloride solution produces chlorine.
Ethene from **Stage 1** is then reacted with this chlorine.
One of the hydrogen atoms in each ethene molecule is replaced by a chlorine atom to produce vinyl chloride.

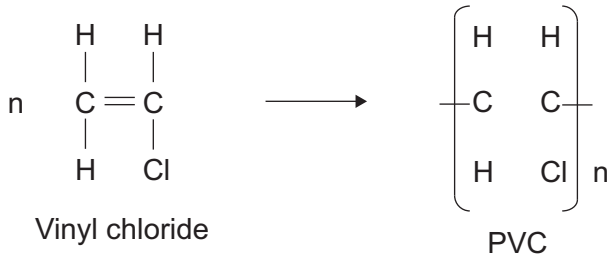
Complete the chemical equation by writing in the formula of the product vinyl chloride.

$$C_2H_4 + Cl_2 \longrightarrow \text{.....} + HCl$$

(1 mark)

7 (a) (iii) **Stage 3** Polymerisation of vinyl chloride produces polyvinyl chloride (PVC).

Complete the chemical equation by drawing in the missing bonds of the product, PVC.



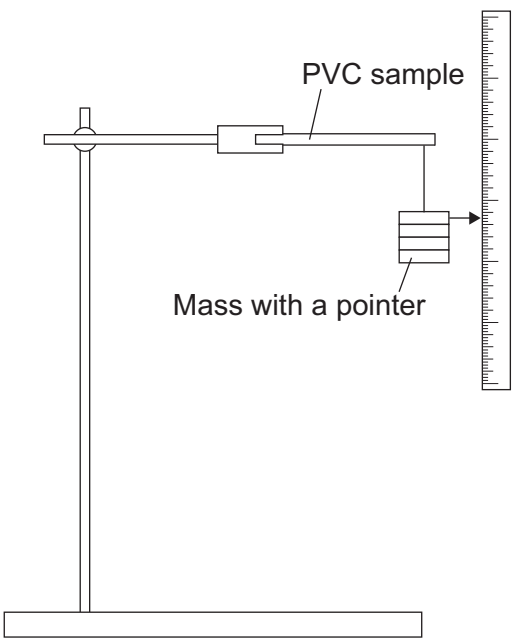
(1 mark)

Question 7 continues on the next page

Question 29 · continued

7 (b) Unplasticised polyvinyl chloride (uPVC) is used to make door and window frames.
PVC with a plasticiser added is used to make cling film for wrapping food.
A plasticiser is a chemical compound.

A student investigated how the percentage of plasticiser added to PVC affected its flexibility.
The student measured the bending of PVC samples when a mass was added.



The student's results are shown in the table.

Sample of PVC	Percentage (%) of plasticiser added	Bending of PVC sample in mm				
		Test 1	Test 2	Test 3	Test 4	Mean
A	**0**	2	3	3	4	3
B	**5**	22	15	23	24	
C	**10**	27	27	29	29	28
D	**15**	34	35	35	36	35

7 (b) (i) Each PVC sample should be the same size to make it a fair test.
Explain why.

.....

.....

(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 29 · continued

7 (b) (ii) The student repeated the test four times for each sample.
Explain why.

.....

.....

(1 mark)

7 (b) (iii) Calculate the mean value for sample **B**.

.....

.....

.....

.....

(2 marks)

7 (b) (iv) Each of the samples bent the most in test **4**.
Suggest a possible reason for this.

.....

.....

(1 mark)

7 (c) Suggest why unplasticised polyvinyl chloride (uPVC) is used to make door and window frames.

.....

.....

(1 mark)

10

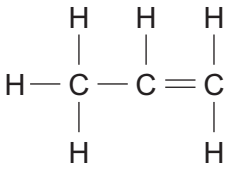
4.7.2.1 Structure and formulae of alkenes

Question 30

June 2011 | CHY3F | Original Q4 | Legacy

4 Propene (C_3H_6) is an *unsaturated* hydrocarbon used to make polymers.

The structure of a propene molecule is shown below.



Bromine water can be used to show that propene is *unsaturated*.

4 (a) Draw a ring around the correct answer to complete each sentence.

4 (a) (i) Bromine water is

blue.

green.

orange.

(1 mark)

4 (a) (ii) Bromine water reacts with propene and turns

colourless.

purple.

red.

(1 mark)

4 (a) (iii) Propene is *unsaturated* because it contains

a carbon carbon double bond.

a carbon carbon single bond.

carbon hydrogen single bonds.

(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 30 · continued

4 (b) Hydrocarbons are often used as fuels.

Some information about three fuels is given in the table.

Fuel	Mass of fuel burned in g	Heat released in kJ	Price of fuel in pence per g	Combustion products	
				CO_2	H_2O
A	1	30	3p	Yes	Yes
B	1	20	1p	Yes	Yes
C	1	40	5p	No	Yes

4 (b) (i) Which fuel, **A**, **B** or **C**, releases the most heat per gram? ☐

(1 mark)

4 (b) (ii) Which fuel, **A**, **B** or **C**, releases the most heat per penny? ☐

(1 mark)

4 (b) (iii) Suggest why fuel **C** is the most environmentally friendly.

.....

.....

(1 mark)

6

4.7.2.1 Structure and formulae of alkenes

Question 31

November 2011 | CHY1BP | Original Q7 | Legacy

QUESTION SEVEN

Scientists working for a plastics company tested three different types of poly(ethene) to see how much they would stretch before tearing.

7A The scientists used identical apparatus, equal-sized pieces of poly(ethene), and carried out all the tests at the same temperature.

They did this so that . . .

1 all the variables were kept the same.

2 it was easier and cheaper to carry out the tests.

3 all the measurements would be accurate.

4 only the independent variable would affect the results.

7B Cling film, a very thin sheet of poly(ethene), is used to wrap sandwiches.

Which row in the table shows two properties of poly(ethene) that make it suitable for use as cling film?

	Property 1	Property 2
1	tears when stretched	is easily coloured and printed
2	is easily coloured and printed	is transparent
3	is transparent	is airtight
4	is airtight	easily melts when heated

7C Sandwiches could be wrapped in paper and packed in paper bags.

Paper is made from wood. When a tree is cut down, another tree can be planted to replace it.

An advantage of using paper instead of cling film is that . . .

1 the use of paper bags is sustainable.

2 paper is non-biodegradable.

3 paper has been used for hundreds of years.

4 paper does not blow about in the wind like plastic.

4.7.2.1 Structure and formulae of alkenes

7D Poly(ethene) can be recycled.

A problem that has to be overcome at the recycling centre is that poly(ethene) . . .

1 is mixed with other polymers.

2 is difficult to melt down.

3 is a poor conductor of electricity.

4 is not biodegradable.

Turn over for the next question

4.7.2.1 Structure and formulae of alkenes

Question 32

June 2012 | CH1FP | Original Q6 | Legacy

6 Ethanol (C_2H_5OH) can be made from ethene or from sugar.

6 (a) Complete the table which shows the number of atoms of each element in the formula of ethanol.

Use the Chemistry Data Sheet to help you to complete the table.

Element	Symbol	Number of atoms in the formula C_2H_5OH
Carbon	C	2
Hydrogen	H	.....
.....	O	1

(2 marks)

6 (b) Ethene (C_2H_4) is produced when hydrocarbons are cracked.

6 (b) (i) Tick (✓) **two** conditions needed to crack a hydrocarbon.

Condition	Tick (✓)
The presence of an emulsifier.	
Heating the hydrocarbon to a high temperature.	
Adding oxygen to the hydrocarbon.	
The presence of a catalyst.	

(2 marks)

6 (b) (ii) Draw the missing bonds to complete the displayed structure of ethene.

H H

C C

H H

(1 mark)

6 (b) (iii) Name the substance added to ethene (C_2H_4) to produce ethanol (C_2H_5OH).

.....

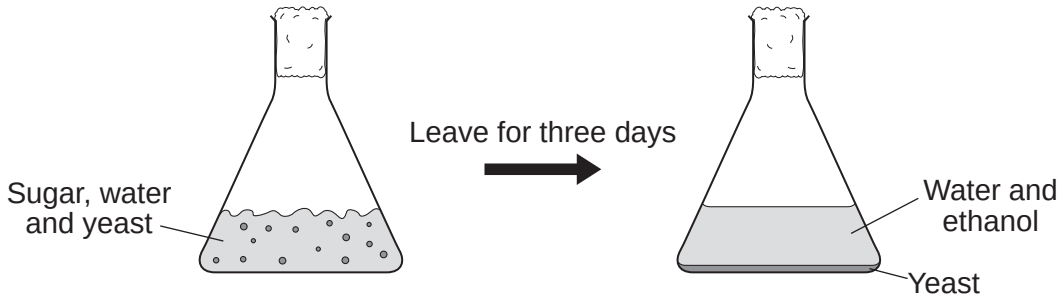
(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 32 · continued

6 (c) The diagram shows how a solution of ethanol is made from sugar dissolved in water.

The boiling point of ethanol is 78°C and the boiling point of water is 100°C.



6 (c) (i) Name the gas produced during this reaction.

.....

(1 mark)

6 (c) (ii) What are the main steps needed to obtain pure ethanol from the mixture produced after three days?

.....

.....

.....

.....

(2 marks)

9

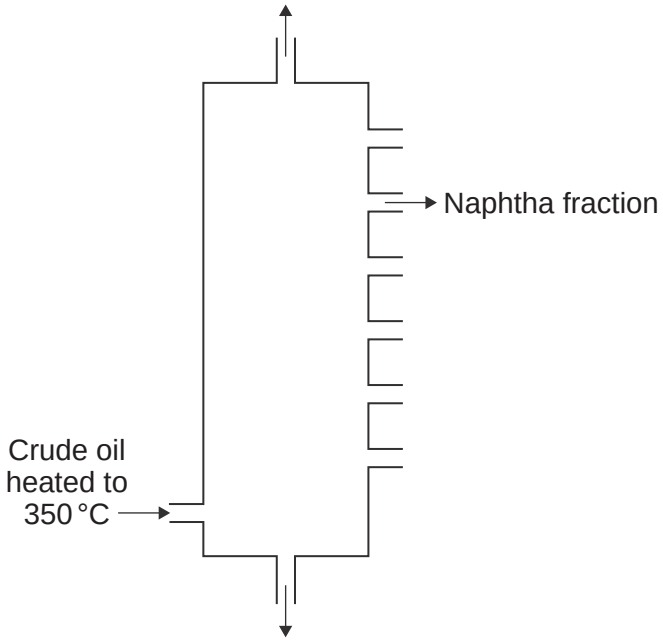
4.7.2.1 Structure and formulae of alkenes

Question 33

June 2012 | CH1FP | Original Q8 | Legacy

8 Crude oil is used to produce poly(ethene).

8 (a) Fractional distillation is used to separate crude oil into fractions.



8 (a) (i) Write a number, **2**, **3**, **4** or **5**, next to each stage so that the description of fractional distillation is in the correct order. Numbers **1** and **6** have been done for you.

Number	Stage
1	The crude oil is heated to 350 °C.
	When a fraction in the vapours cools to its boiling point, the fraction condenses.
	Any liquids flow down to the bottom of the column and the hot vapours rise up the column.
6	The condensed fraction is separated and flows out through a pipe.
	When the hot vapours rise up the column, the vapours cool.
	Most of the compounds in the crude oil evaporate.

(2 marks)

8 (a) (ii) The naphtha fraction is cracked to produce ethene (C_2H_4).
Ethene is used to make the polymer called poly(ethene).

Name **two** substances produced when poly(ethene) burns in air.

1 .....

2 .....

(2 marks)

4.7.2.1 Structure and formulae of alkenes

Question 33 · continued

8 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Each year in the UK, billions of plastic bags are given free to shoppers. These bags are made from poly(ethene) and are often used only once.
After being used many of these plastic bags are either thrown away as litter or buried in landfill sites.

In 2006 over 10 billion of these plastic bags were given free to shoppers.
In 2009 the number of plastic bags given to shoppers had decreased to 6.1 billion.
One reason for the decrease was because some supermarkets made people pay for their plastic bags.

From 2011 a new type of plastic shopping bag made mainly from poly(ethene) had a use-by date of only one year printed on the bag.

Use the information above and your knowledge and understanding to describe advantages and disadvantages of using plastic shopping bags made from poly(ethene).

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

10

4.7.2.1 Structure and formulae of alkenes

Question 34

June 2012 | CH2FP | Original Q2 | Legacy

2 Gold and gold ions are used as catalysts.

2 (a) An atom of gold is represented as:

$$^{197}_{79}Au$$

Complete the sentences.

The atomic number of gold is ..... .

The number of electrons in an atom of gold is ..... .

(2 marks)

2 (b) Scientists have found that gold nanoparticles are very good catalysts.

Draw a ring around the correct answer to complete the sentence.

A gold nanoparticle contains a few | hundred / thousand / million | atoms.

(1 mark)

2 (c) The formation of a gold ion (Au^{3+}) from a gold atom (Au) is shown in the symbol equation.

$$Au \rightarrow Au^{3+} + 3e^-$$

2 (c) (i) Complete the sentence.

The particles lost when a gold atom becomes a gold ion

are called ..... .

(1 mark)

2 (c) (ii) Draw a ring around the correct answer to complete the sentence.

The number of these particles lost when a gold atom becomes a gold ion is | one. / two. / three. |

(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 34 · continued

2 (d) Gold ions are used as a catalyst in the reaction to make chloroethene.

How does a catalyst help a reaction?

.....

(1 mark)

2 (e) Chloroethene can react to make a thermosoftening polymer.

2 (e) (i) Draw a ring around the correct answer to complete the sentence.

When heated, a thermosoftening polymer will

dissolve.

melt.

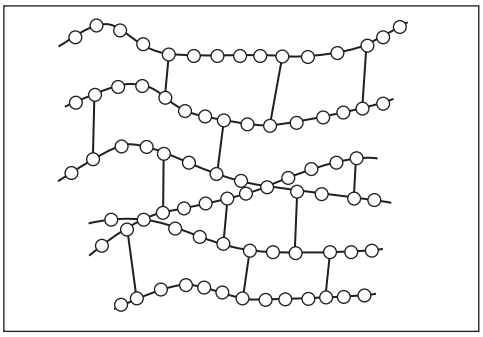
solidify.

(1 mark)

2 (e) (ii) Polymer **B** is a different type of polymer.

The diagram shows the structure of polymer **B**.

Polymer B



How can you tell from the diagram that polymer **B** is **not** thermosoftening?

.....

.....

(1 mark)

8

4.7.2.1 Structure and formulae of alkenes

Question 35

January 2013 | CH1FP | Original Q5 | Legacy

5 This question is about compounds produced from crude oil.

The table below shows four of these compounds.

Compound	Melting point in °C	Boiling point in °C
methane (CH_4)	–183	–164
ethene (C_2H_4)	–169	–104
decane ($C_{10}H_{22}$)	–30	+174
icosane ($C_{20}H_{42}$)	+37	+343

5 (a) Tick (✓) **two** correct statements about the four compounds.

Statement	Tick (✓)
Methane has the lowest melting point and icosane has the highest boiling point.	
Ethene and methane are alkanes.	
Methane and decane are gases at room temperature (20 °C).	
Decane and icosane are liquid at 100 °C.	

(2 marks)

5 (b) Petrol contains a mixture of compounds, including octane (C_8H_{18}).

Complete the word equation for the complete combustion of octane.

octane + oxygen → ..... + ...

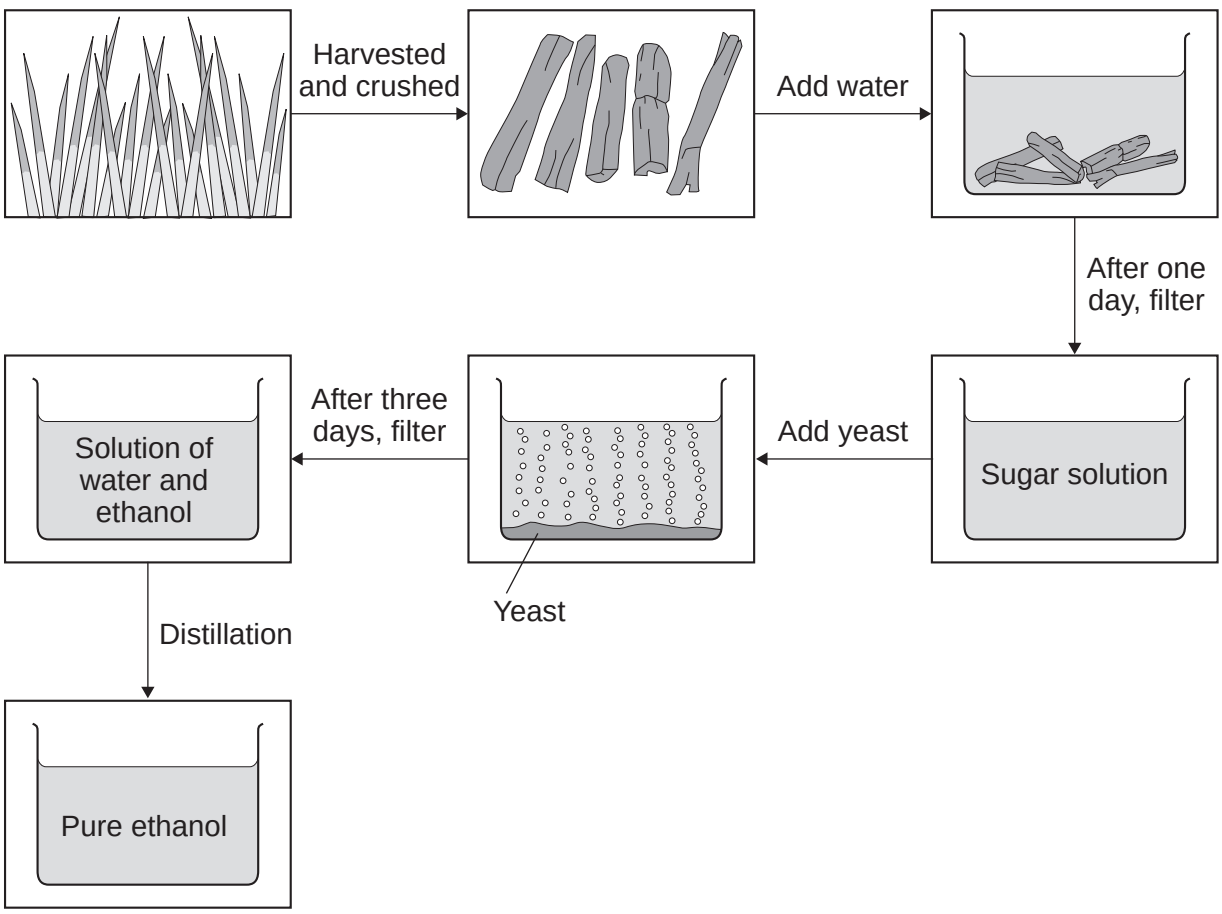
(2 marks)

Question 5 continues on the next page

4.7.2.1 Structure and formulae of alkenes

Question 35 · continued

5 (c) Most petrol used in cars contains about 5% ethanol (C_2H_5OH).
Ethanol can be produced from sugar cane.



5 (c) (i) Draw a ring around the correct answer to complete the sentence.

The reaction to produce ethanol from sugar solution is

combustion.

displacement.

fermentation.

(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 35 · continued

5 (c) (ii) Some people say that increasing the production of ethanol from sugar cane will be **good** for the environment.

Suggest **two** reasons why.

1 .....

.....

.....

2 .....

.....

.....

(2 marks)

5 (c) (iii) Other people say that increasing the production of ethanol from sugar cane will be **bad** for the environment.

Suggest **two** reasons why.

1 .....

.....

.....

2 .....

.....

.....

(2 marks)

9

4.7.2.1 Structure and formulae of alkenes

Question 36

January 2013 | CH2FP | Original Q4 | Legacy

4 Thermosoftening polymers can be used to make plastic bottles and food packaging.

4 (a) Why are thermosoftening polymers **not** suitable for storing very hot food?

.....

.....

(1 mark)

4 (b) The reaction to produce the polymers uses a catalyst.

Why are catalysts used in chemical reactions?

.....

.....

(1 mark)

4 (c) Compounds from food packaging must not get into food.

Gas chromatography can be used to separate compounds in food.

The output from the gas chromatography column can be linked to an instrument which can identify the compounds.

4 (c) (i) Name the instrument used to identify the compounds.

.....

.....

(1 mark)

4 (c) (ii) Give **one** reason why instrumental methods of analysis are used to identify the compounds.

.....

.....

(1 mark)

4 (d) Poly(ethene) is a thermosoftening polymer.

Poly(ethene) can be made with different properties. The properties depend on the conditions used when poly(ethene) is made.

Suggest **two** conditions which could be changed when poly(ethene) is made.

.....

.....

(2 marks)

6

4.7.2.1 Structure and formulae of alkenes

Question 37

June 2013 | CH1FP | Original Q2 | Legacy

2 Barbecues are heated by burning charcoal or burning hydrocarbons.



2 (a) Use the Chemistry Data Sheet to help you to answer this question.

The chemical equation for charcoal burning is:

$$C + O_2 \longrightarrow CO_2$$

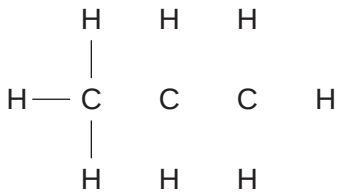
Complete the word equation for this reaction.

carbon + ... ⟶ carbon dioxide

(1 mark)

2 (b) Propane is a hydrocarbon.

2 (b) (i) Complete the displayed structure of propane. Draw in the missing bonds.



(1 mark)

2 (b) (ii) Write the chemical formula of propane. .....

(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 37 · continued

2 (b) (iii) Draw a ring around the correct answer to complete the sentence.

Propane burns in air to produce carbon dioxide and

hydrogen.

hydroxide.

water.

(1 mark)

2 (c) The table shows information about six hydrocarbons.

Hydrocarbon	State at room temperature (20 °C)	Boiling point in °C
Ethane (C_2H_6)	gas	–89
Ethene (C_2H_4)	gas	–104
Butane (C_4H_{10})	gas	–1
Butene (C_4H_8)	gas	–6
Hexane (C_6H_{14})	liquid	+69
Hexene (C_6H_{12})	liquid	+64

Tick (✓) **two** correct statements about the six hydrocarbons.

Statement	Tick (✓)
Ethane and butane boil at temperatures less than 20 °C.	
Hexene and butene are alkanes.	
Butane and hexane are liquid at 0°C.	
Ethene and hexene each have a carbon-carbon double bond.	

(2 marks)

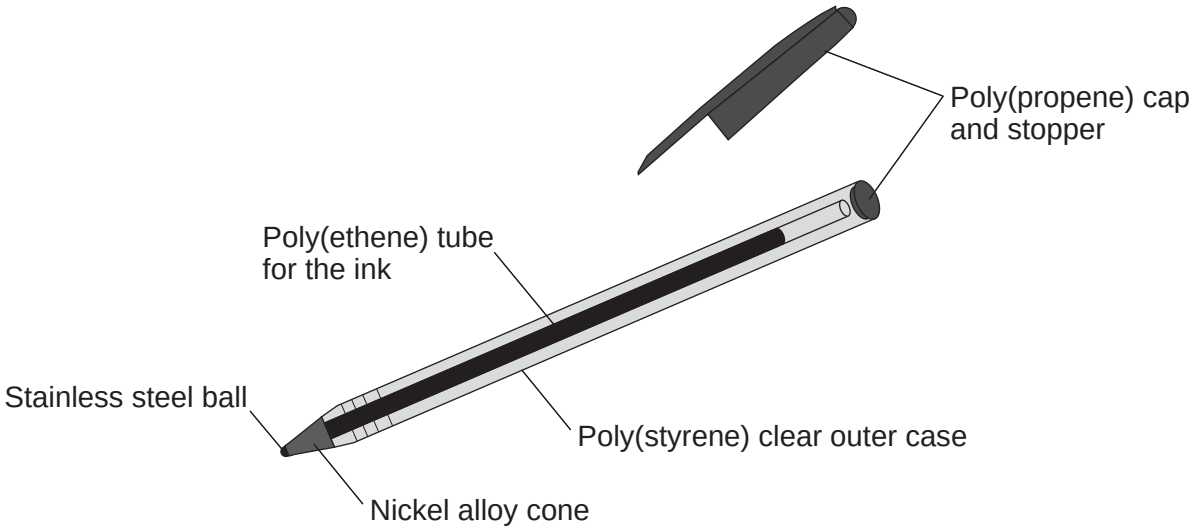
6

4.7.2.1 Structure and formulae of alkenes

Question 38

June 2013 | CH1FP | Original Q5 | Legacy

5 The diagram shows a ballpoint pen.



5 (a) Polymers are used to make the ballpoint pen.

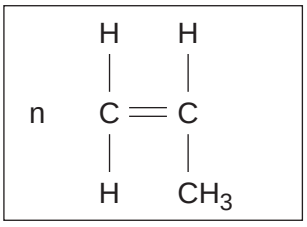
5 (a) (i) Name the monomer used to make poly(ethene).

.....

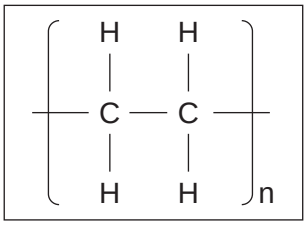
(1 mark)

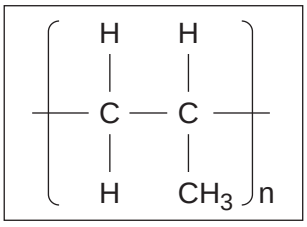
5 (a) (ii) Draw **one** line from the monomer propene to its polymer poly(propene).

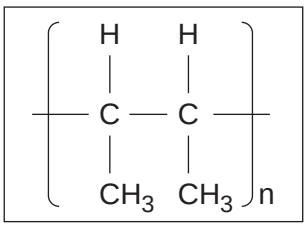
Monomer



Polymer





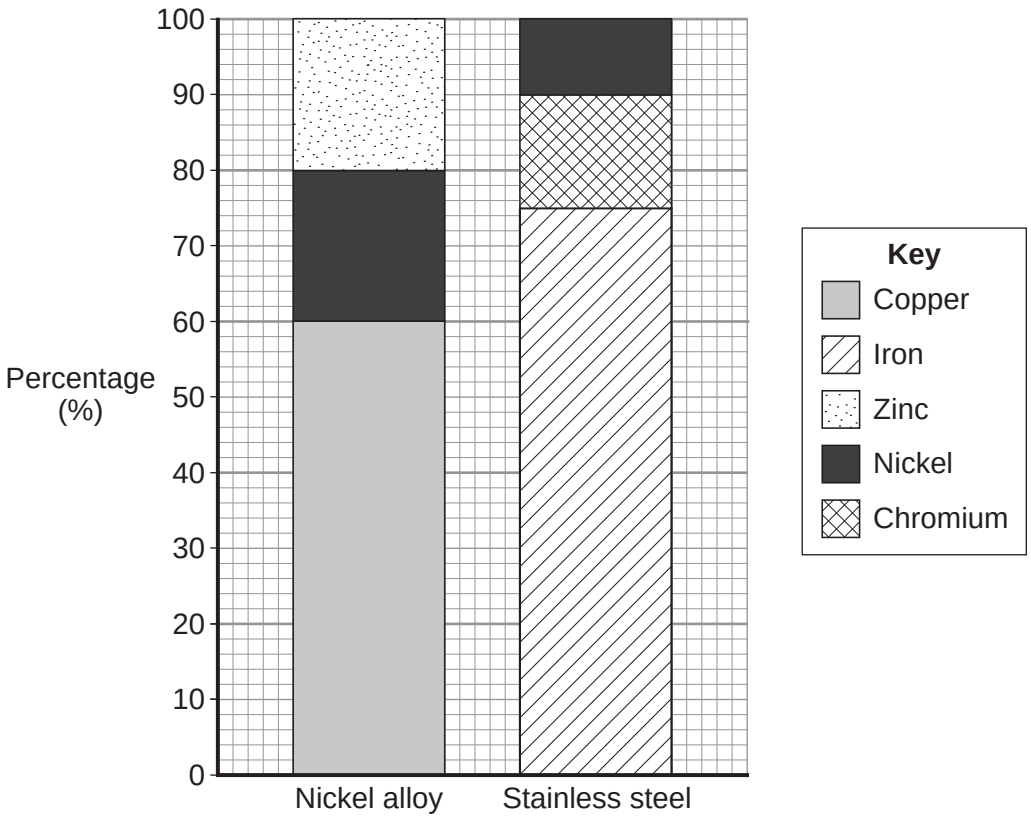


(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 38 · continued

5 (b) Two alloys are used to make the ballpoint pen.



Use the bar chart to answer these questions.

5 (b) (i) Which metal is in both of these alloys? .....

(1 mark)

5 (b) (ii) What is the percentage of iron in the stainless steel? ..... %

(1 mark)

4.7.2.1 Structure and formulae of alkenes

Question 38 · continued

5 (b) (iii) The alloy stainless steel is used instead of pure iron for the ball of the pen.
Give **two** reasons why.

.....

.....

.....

.....

(2 marks)

5 (c) Tick (✓) **one** advantage and tick (✓) **one** disadvantage of **recycling** this type of ballpoint pen.

	Advantage Tick (✓)	Disadvantage Tick (✓)
Can be refilled and reused		
Conserves resources of crude oil and ores		
High cost of separating materials		
Polymers and alloys are not expensive		

(2 marks)

8

4.7.2.1 Structure and formulae of alkenes

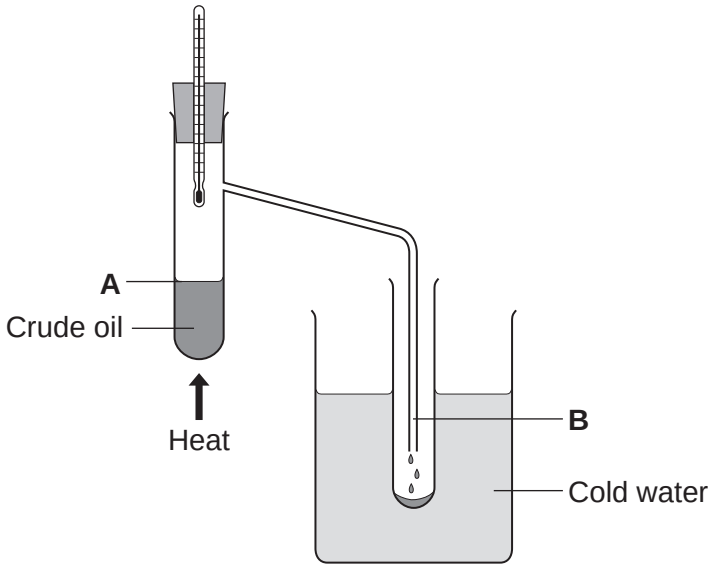
Question 39

June 2014 | CH1FP | Original Q4 | Legacy

4 Crude oil is a mixture of a very large number of compounds.

Figure 4 shows a laboratory experiment to separate crude oil.

Figure 4



4 (a) Complete the sentence.

[1 mark]

The name for compounds that contain only hydrogen and carbon is ..... .

4 (b) Use the correct word from the box to complete each sentence.

condensation	**decomposition**	**distillation**
evaporation	**reduction**	

4 (b) (i) The process of separating crude oil is fractional ..... .

[1 mark]

4 (b) (ii) The process taking place at **A** is ..... .

[1 mark]

4 (b) (iii) The process taking place at **B** is ..... .

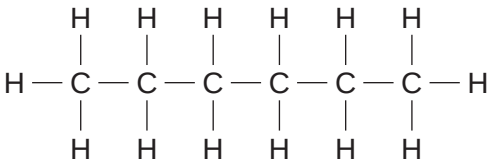
[1 mark]

4.7.2.1 Structure and formulae of alkenes

Question 39 · continued

4 (c) One of the compounds in crude oil is hexane. The displayed structure of hexane is shown in **Figure 5**.

Figure 5



Complete the sentences.

4 (c) (i) Each line between the atoms in hexane represents a covalent ..... .

[1 mark]

4 (c) (ii) Complete the chemical formula for hexane.

[1 mark]

C_6H.....

4 (c) (iii) Hexane can be broken down into smaller molecules by a process called ..... .

[1 mark]

4 (d) Small molecules, called alkenes, are used to make polymers.

4 (d) (i) Name the polymer made from butene.

[1 mark]

.....

4 (d) (ii) Incinerators are used to burn waste polymers, such as plastic bags.

Tick (✓) **one** advantage and tick (✓) **one** disadvantage of burning plastic bags.

[2 marks]

	Advantage Tick (✓)	Disadvantage Tick (✓)
Energy is released.		
More recycling is needed.		
Carbon dioxide is produced.		

10

4.7.2.1 Structure and formulae of alkenes

Question 40

June 2014 | CH1FP | Original Q7 | Legacy

7 Ethanol and vegetable oil are used as fuels.

7 (a) There are two different ways to produce ethanol:

- using ethene from crude oil
- using sugar from plants.

7 (a) (i) Ethanol is produced from ethene by **hydration** in the presence of a catalyst.

What is **hydration**?

[1 mark]

.....

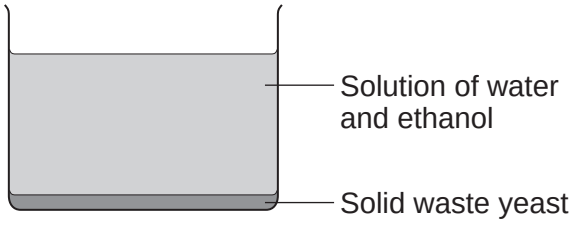
.....

7 (a) (ii) Fermentation is used to produce ethanol from sugar by:

- dissolving the sugar in water
- adding yeast to the sugar solution
- leaving the mixture for three days.

Figure 8 shows the substances after three days.

Figure 8



Suggest:

- how the solid waste yeast is removed
- how ethanol is obtained from the solution.

[2 marks]

.....

.....

.....

.....

4.7.2.1 Structure and formulae of alkenes

Question 40 · continued

7 (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Crude oil is separated to produce the fraction petroleum diesel.

Worries about low supplies of crude oil have led to the growing of large areas of crops to produce vegetable oil.

Vegetable oils are used to produce biodiesel.

There are economic, ethical and environmental issues about the use of biodiesel.

Biodiesel and petroleum diesel are used as a fuel for cars. In a car engine the fuel burns and releases waste products through the car exhaust system.

Table 4 shows the amount of waste products formed by biodiesel compared with the amount of waste products formed by petroleum diesel.

(Note that ppm is parts per million.)

Table 4

	Carbon dioxide in ppm	Nitrogen oxides in ppm	Sulfur dioxide in ppm	Particulates in g per m^3
Biodiesel	20 000	760	0	0.3
Petroleum diesel	80 000	700	300	0.6

Use this information and your knowledge and understanding to give advantages and disadvantages of using biodiesel instead of petroleum diesel.

[6 marks]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

4.7.2.1 Structure and formulae of alkenes

Question 41

June 2015 | CH1FP | Original Q3 | Legacy

3 Crude oil is a fossil fuel.

3 (a) To make crude oil more useful it is separated into fractions.

Use the correct word from the box to complete each sentence.

boiling	**compound**	**decomposition**	**distillation**
filtration	**mixture**	**molecule**	

3 (a) (i) Crude oil is a ..... of different substances.

[1 mark]

3 (a) (ii) The substances in crude oil have different ..... points.

[1 mark]

3 (a) (iii) Crude oil is separated by fractional ..... .

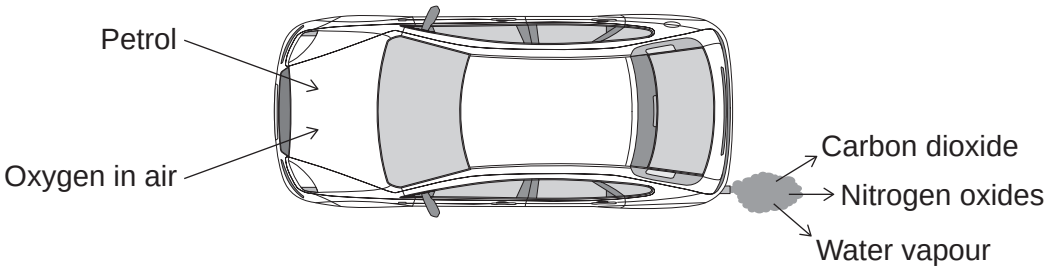
[1 mark]

3 (b) Petrol is one of the fractions produced from crude oil.

Car engines use a mixture of petrol and air.

Figure 5 shows some of the gases produced.

Figure 5



4.7.2.1 Structure and formulae of alkenes

Question 41 · continued

3 (b) (i) What type of reaction happens to petrol in a car engine?

[1 mark]

Tick (✓) **one** box.

combustion ☐

decomposition ☐

neutralisation ☐

3 (b) (ii) Petrol contains octane (C_8H_{18}).

Complete the word equation for the reaction of octane with oxygen.

[2 marks]

octane + ... ⟶ ..... + ...

3 (b) (iii) Cars use sulfur-free petrol as a fuel.

Describe why sulfur should be removed from petrol.

[2 marks]

.....

.....

.....

.....

Question 3 continues on the next page

4.7.2.1 Structure and formulae of alkenes

Question 41 · continued

3 (c) Some fractions from crude oil contain large hydrocarbon molecules.

These molecules can be cracked to produce smaller, more useful molecules.

An equation for cracking decane is:

$$\underset{\text{decane}}{C_{10}H_{22}} \longrightarrow \underset{\text{propane}}{C_3H_8} + \underset{\text{ethene}}{C_2H_4} + \underset{\text{pentene}}{C_5H_{10}}$$

3 (c) (i) Why is propane useful?

[1 mark]

Tick (✓) **one** box.

Propane is a polymer. ☐

Propane is an alloy. ☐

Propane is a fuel. ☐

3 (c) (ii) Draw bonds to complete the displayed structure of ethene.

[1 mark]



4.7.2.1 Structure and formulae of alkenes

Question 41 · continued

3 (c) (iii) What is the colour change when bromine water reacts with ethene?

[1 mark]

Tick (✓) **one** box.

Orange to colourless ☐

Orange to green ☐

Orange to red ☐

3 (c) (iv) Complete the sentence.

[1 mark]

Pentene is useful because many pentene molecules can join together to form ..... .

12

4.7.2.1 Structure and formulae of alkenes

Question 42

June 2015 | CH1FP | Original Q4 | Legacy

4 Polymers and fuels can be produced from crude oil and from plants.

4 (a) There are many types of polymer. Each polymer has different properties.

4 (a) (i) Poly(chloroethene) is a polymer produced from crude oil.

Why is poly(chloroethene) used for water pipes?

[2 marks]

Tick (✓) **two** boxes.

- The polymer is not biodegradable. ☐
- The polymer is made from crude oil. ☐
- The polymer decomposes when heated. ☐
- The polymer is waterproof. ☐
- The polymer does not conduct electricity. ☐

4 (a) (ii) Some shopping bags are made from a biopolymer.

Biopolymers are produced from plants.

Suggest **one** advantage of using a biopolymer.

[1 mark]

.....

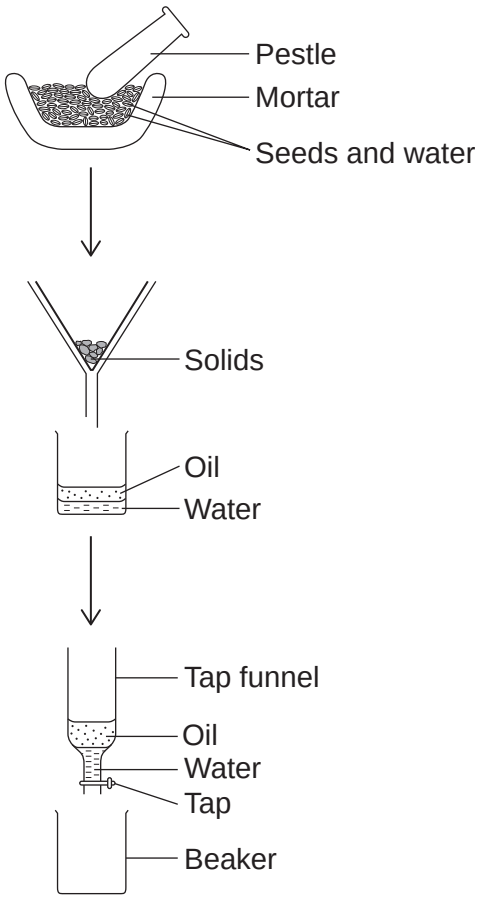
.....

4.7.2.1 Structure and formulae of alkenes

Question 42 · continued

4 (b) Some plants have seeds that contain vegetable oils.
The flow diagram in **Figure 6** shows how the oil can be extracted.

Figure 6



4 (b) (i) Use the correct word from the box to complete each sentence.

[2 marks]

burning	**crushing**	**distilling**	**filtering**

Oil is released from the seeds by..... .

Solids are removed from the oil and water by ..... .

4 (b) (ii) Describe how the tap funnel can be used to separate the oil from the water.

[2 marks]

.....

.....

.....

.....

4.7.2.1 Structure and formulae of alkenes

Question 42 · continued

4 (c) Vegetable oils are used as foods and fuels.

4 (c) (i) Why are vegetable oils important foods and fuels?

[1 mark]

Tick (✓) **one** box.

They are used as emulsifiers. ☐

They have high boiling points. ☐

They provide a lot of energy. ☐

4 (c) (ii) Burning fossil fuels made from crude oil increases the overall percentage of carbon dioxide in the atmosphere.

Burning biofuels made from vegetable oil does **not** increase the overall percentage of carbon dioxide in the atmosphere.

Explain why.

[2 marks]

.....

.....

.....

.....

10

4.7.2.1 Structure and formulae of alkenes

Question 43

June 2015 | CH2FP | Original Q2 | Legacy

2 This question is about salts.

2 (a) Salt (sodium chloride) is added to many types of food.

Sodium chloride is produced by reacting sodium with chlorine.

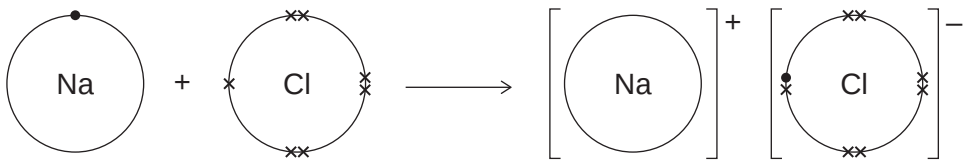
sodium + chlorine ⟶ sodium chloride

Figure 2 shows what happens to atoms of sodium and chlorine in this reaction.

The dots (•) and crosses (×) represent electrons.

Only the outer electrons are shown.

Figure 2



Describe, in terms of electrons, what happens when a sodium atom reacts with a chlorine atom to produce sodium chloride.

[3 marks]

.....

.....

.....

.....

.....

.....

Question 2 continues on the next page

4.7.2.1 Structure and formulae of alkenes

Question 43 · continued

2 (b) Lack of iodine can affect the learning ability of children.

One idea is that salt (sodium chloride) should have iodine added.

2 (b) (i) Iodine consists of simple molecules.

What is a property of substances that have simple molecules?

[1 mark]

Tick (✓) **one** box.

Have no overall electric charge ☐

Have high boiling points ☐

Have giant covalent structures ☐

2 (b) (ii) Which one of the following questions cannot be answered by science alone?

[2 marks]

Tick (✓) **one** box.

How much sodium chloride is in food? ☐

What harm does a lack of iodine do? ☐

Should iodine be added to salt in food? ☐

Give **one** reason why this question cannot be answered by science alone.

.....

.....

2 (c) A student produced the salt ammonium nitrate by adding an acid to ammonia solution.

2 (c) (i) Name the acid used.

[1 mark]

.....

4.7.2.1 Structure and formulae of alkenes

Question 43 · continued

2 (c) (ii) Use the correct answer from the box to complete the sentence.

[1 mark]

an acid	an alkali	a salt

Ammonia solution (ammonium hydroxide) is ..... .

2 (c) (iii) The student added a few drops of a solution which changed colour when the reaction was complete.

Complete the sentence.

[1 mark]

The solution added is an ..... .

2 (d) Farmers buy solid ammonium nitrate in poly(ethene) sacks.

2 (d) (i) How is solid ammonium nitrate made from a solution of ammonium nitrate?

[1 mark]

Tick (✓) **one** box.

Crystallisation ☐

Decomposition ☐

Electrolysis ☐

2 (d) (ii) Why do farmers use ammonium nitrate on their fields?

[1 mark]

.....

.....

2 (d) (iii) The properties of poly(ethene) depend on the reaction conditions when it is made.

State **one** reaction condition that can be changed when making poly(ethene).

[1 mark]

.....

.....

12

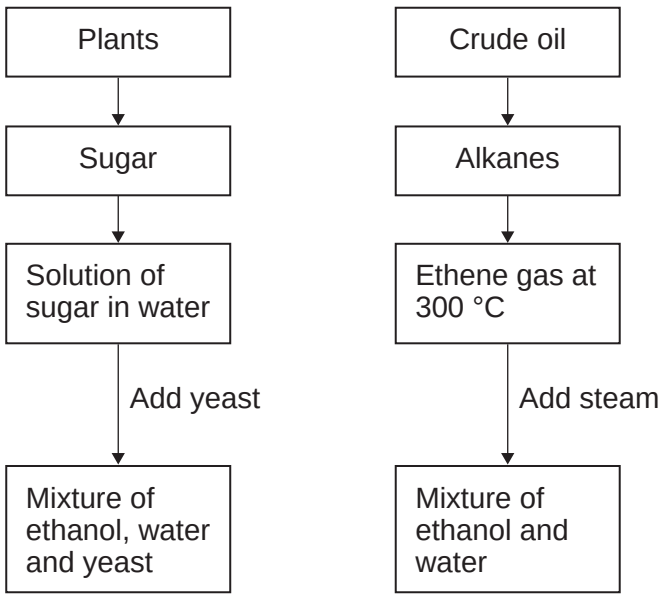
4.7.2.1 Structure and formulae of alkenes

Question 44

June 2016 | CH1FP | Original Q4 | Legacy

4 **Figure 8** shows how ethanol is made from plants and from crude oil.

Figure 8



4 (a) (i) What is the name of the reaction to produce ethanol from sugar?

[1 mark]

Tick (✓) **one** box.

fermentation ☐

polymerisation ☐

reduction ☐

4 (a) (ii) What is the name of the reaction to produce ethanol from ethene?

[1 mark]

Tick (✓) **one** box.

bioleaching ☐

displacement ☐

hydration ☐

4.7.2.1 Structure and formulae of alkenes

Question 44 · continued

4 (a) (iii) A lot of the ethanol produced is used as a fuel for cars.

What are **two** reasons why most of this ethanol is made from plants and **not** from crude oil?

[2 marks]

Tick (✓) **two** boxes.

- Resources of crude oil are non-renewable. ☐
- Ethanol from plants is more flammable. ☐
- Producing ethanol from plants is not sustainable. ☐
- Ethanol from plants has a different formula. ☐
- Producing ethanol from plants uses less energy. ☐

Question 4 continues on the next page

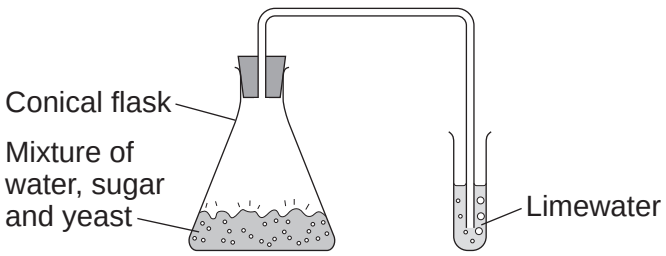
4.7.2.1 Structure and formulae of alkenes

Question 44 · continued

4 (b) A student made ethanol from sugar.

Figure 9 shows the apparatus used.

Figure 9



4 (b) (i) What change is seen in the limewater?

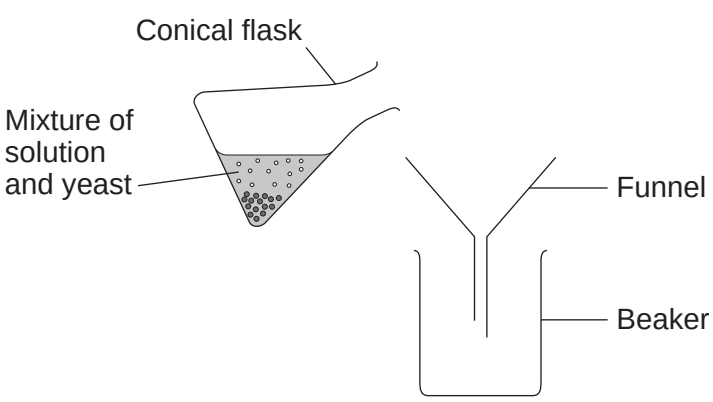
Give a reason for your answer.

[2 marks]

4 (b) (ii) The student wanted to separate the solid yeast from the solution.

Figure 10 shows the apparatus used.

Figure 10



What is missing from the apparatus in **Figure 10**?

[1 mark]

4.7.2.1 Structure and formulae of alkenes

Question 44 · continued

4 (c) Vegetable oils are made from plants.

4 (c) (i) Which statement is correct?

[1 mark]

Tick (✓) **one** box.

Vegetable oils have lower boiling points than water. ☐

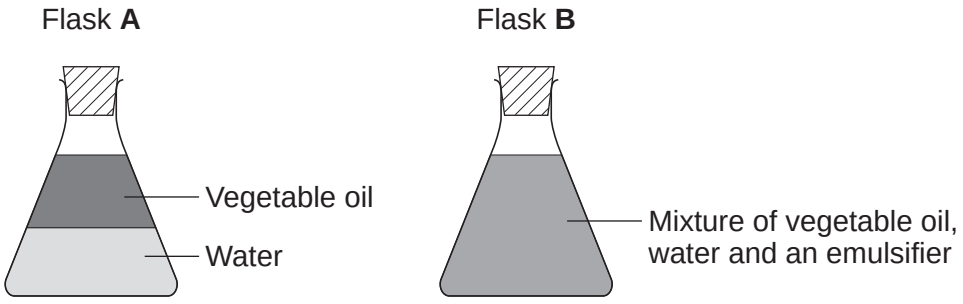
Vegetable oils cook foods at higher temperatures than boiling water. ☐

Cooking in vegetable oils decreases the energy content of the food. ☐

4 (c) (ii) A student puts different mixtures into two flasks, **A** and **B**. The student shakes the flasks.

Figure 11 shows the two flasks after they have been shaken and left to stand for one minute.

Figure 11



Complete the sentences.

[2 marks]

The mixture in flask **A** separates because _____

_____

The mixture in flask **B** does not separate because _____

_____

10

4.7.2.1 Structure and formulae of alkenes

Question 45

June 2016 | CH1FP | Original Q5 | Legacy

5 This question is about hydrocarbons.

5 (a) Most of the hydrocarbons in crude oil are alkanes.

5 (a) (i) Large alkane molecules can be cracked to produce more useful molecules.

The equation shows the cracking of dodecane.

$$\underset{\text{dodecane}}{C_{12}H_{26}} \longrightarrow \underset{\text{butane}}{C_4H_{10}} + \underset{\text{hexene}}{C_6H_{12}} + \underset{\text{ethene}}{C_2H_4}$$

Give **two** conditions used to crack large alkane molecules.

[2 marks]

1 _____

2 _____

5 (a) (ii) The products hexene and ethene are alkenes.

Complete the sentence.

[1 mark]

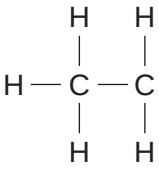
When alkenes react with bromine water the colour changes

from orange to _____ .

5 (a) (iii) Butane (C_4H_{10}) is an alkane.

Complete the displayed structure of butane.

[1 mark]



Question 5 continues on the next page

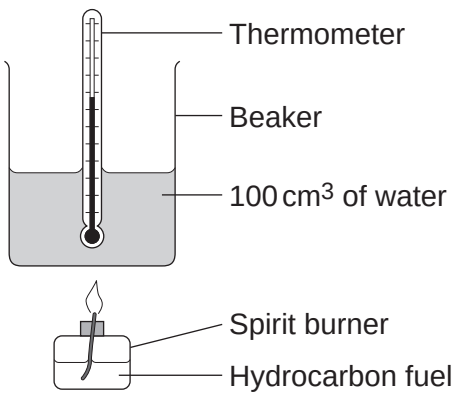
4.7.2.1 Structure and formulae of alkenes

Question 45 · continued

5 (b) A group of students investigated the energy released by the combustion of four hydrocarbon fuels.

Figure 12 shows the apparatus used.

Figure 12



Each hydrocarbon fuel was burned for two minutes.

Table 2 shows the students' results.

Table 2

	After two minutes				
Name and formula of hydrocarbon fuel	**Mass of fuel used in g**	**Temperature increase of water in °C**	**Energy released by fuel in kJ**	**Energy released by 1.0 g of fuel in kJ**	**Relative amount of smoke in the flame**
Hexane, C_6H_{14}	0.81	40	16.80	20.74	very little smoke
Octane, C_8H_{18}	1.10	54	22.68	20.62	some smoke
Decane, $C_{10}H_{22}$	1.20	58	24.36		smoky
Dodecane, $C_{12}H_{26}$	1.41	67	28.14	19.96	very smoky

4.7.2.1 Structure and formulae of alkenes

Question 45 · continued

5 (b) (i) Calculate the energy released by 1.0 g of decane in kJ.

[2 marks]

Energy released = _____ kJ

5 (b) (ii) Suggest **one** improvement to the apparatus, or the use of the apparatus, that would make the temperature increase of the water for each fuel more accurate.

Give a reason why this is an improvement.

[2 marks]

5 (b) (iii) The students noticed that the bottom of the beaker became covered in a black substance when burning these fuels.

Name this black substance.

Suggest why it is produced.

[2 marks]

5 (b) (iv) A student concluded that hexane is the best of the four fuels.

Give **two** reasons why the results in **Table 2** support this conclusion.

[2 marks]

1 _____

2 _____

Question 5 continues on the next page

4.7.2.1 Structure and formulae of alkenes

Question 45 · continued

5 (c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Most car engines use petrol as a fuel.

- Petrol is produced from the fractional distillation of crude oil.
- Crude oil is a mixture of hydrocarbons.
- Sulfur is an impurity in crude oil.

Car engines could be developed to burn hydrogen as a fuel.

- Hydrogen is produced from natural gas.
- Natural gas is mainly methane.

Table 3 shows information about petrol and hydrogen.

Table 3

	Petrol	**Hydrogen**
State of fuel at room temperature	Liquid	Gas
Word equation for combustion of the fuel	petrol + oxygen ⟶ carbon dioxide + water	hydrogen + oxygen ⟶ water
Energy released from combustion of 1 g of the fuel	47 kJ	142 kJ

Describe the **advantages** and **disadvantages** of using hydrogen instead of petrol in car engines.

Use the information given and your knowledge and understanding to answer this question.

[6 marks]

4.7.2.1 Structure and formulae of alkenes

Question 46

June 2016 | CH2FP | Original Q2 | Legacy

2 This question is about substances containing carbon atoms.

2 (a) Diamond is made of carbon atoms.

2 (a) (i) Diamond is used for tips of drills.

Figure 3 shows a drill.

Figure 3



Give **one** reason why diamond is used for tips of drills.

[1 mark]

_____

_____

2 (a) (ii) Diamond nanoparticles can be made.

Use the correct answer from the box to complete the sentence.

[1 mark]

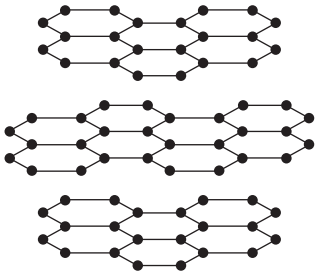
hundred	**million**	**thousand**

Nanoparticles contain a few _____ atoms.

2 (b) Graphite is made of carbon atoms.

Figure 4 shows the structure of graphite.

Figure 4



4.7.2.1 Structure and formulae of alkenes

Question 46 · continued

2 (b) (i) What type of bonding does graphite have?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

2 (b) (ii) How many carbon atoms does each carbon atom bond to in graphite?

[1 mark]

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

2 (b) (iii) What is a property of graphite?

[1 mark]

Tick (✓) **one** box.

Dissolves in water ☐

Has a low melting point ☐

Soft and slippery ☐

Question 2 continues on the next page

4.7.2.1 Structure and formulae of alkenes

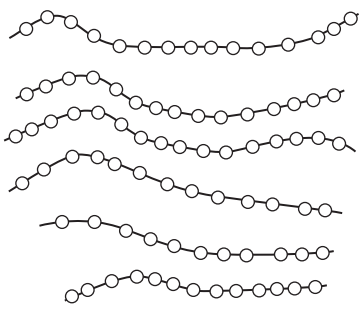
Question 46 · continued

2 (c) Poly(ethene) is made of carbon and hydrogen atoms.

Poly(ethene) is a thermosoftening polymer.

Figure 5 shows the structure of a thermosoftening polymer.

Figure 5



2 (c) (i) Complete the sentence.

[1 mark]

Between the polymer chains in a thermosoftening polymer there

are no _____ .

2 (c) (ii) Use the correct answer from the box to complete the sentence.

[1 mark]

condense	**dissolve**	**melt**

Heating would cause a thermosoftening polymer to _____ .

2 (c) (iii) Many ethene molecules react together to make poly(ethene).

Different types of poly(ethene) can be made by changing the conditions for the reaction. Suggest **two** conditions that could be changed.

[2 marks]

1 _____

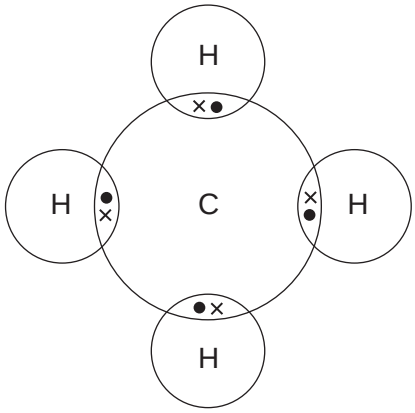
2 _____

4.7.2.1 Structure and formulae of alkenes

Question 46 · continued

2 (d) **Figure 6** shows how the atoms are bonded in methane.

Figure 6



2 (d) (i) What is the formula for methane?

[1 mark]

Tick (✓) **one** box.

C_4H ☐

CH_4 ☐

C_4H_4 ☐

2 (d) (ii) Methane has a low boiling point.

What does methane consist of?

[1 mark]

Tick (✓) **one** box.

Charged ions ☐

A giant lattice ☐

Small molecules ☐

11

4.7.2.1 Structure and formulae of alkenes

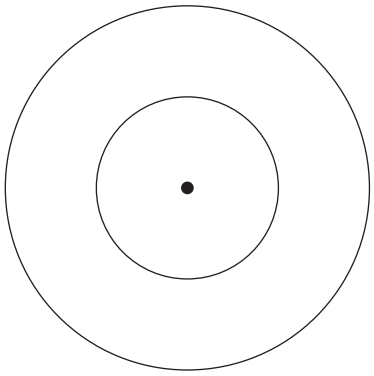
Question 47

June 2017 | CH1FP | Original Q6 | Legacy

6 This question is about compounds of carbon.

6 (a) **Figure 7** shows an atom with two energy levels (shells).

Figure 7



6 (a) (i) A carbon atom has six electrons.

Complete **Figure 7** to show the electronic structure of a carbon atom.

Use **x** to represent an electron.

[1 mark]

6 (a) (ii) Complete the following description about the central part of this carbon atom.

[3 marks]

The central part is made up of six neutrons that have no electrical charge and _____

_____

_____

_____

_____

6 (b) Crude oil is a mixture of compounds. These compounds are mainly hydrocarbons.

What does the term hydrocarbon mean?

[1 mark]

_____

_____

4.7.2.1 Structure and formulae of alkenes

Question 47 · continued

6 (c) Alkanes and alkenes are hydrocarbons.

Table 2 shows the boiling points of some alkanes and alkenes.

Table 2

Alkanes

Name	Formula	Boiling point in °C
Ethane	C_2H_6	−88
Propane	C_3H_8	−42
Butane	C_4H_{10}	0
Pentane	C_5H_{12}	+36
Hexane	C_6H_{14}	+69

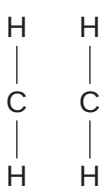
Alkenes

Name	Formula	Boiling point in °C
Ethene	C_2H_4	−104
Propene	C_3H_6	−48
Butene	C_4H_8	−6
Pentene	C_5H_{10}	+30
Hexene	C_6H_{12}	+64

6 (c) (i) Complete the displayed structure of ethane and the displayed structure of ethene.

[2 marks]

Ethane



Ethene



6 (c) (ii) Describe the relationship between the number of carbon atoms in an alkane molecule and the boiling point of the alkane molecule.

[1 mark]

4.7.2.1 Structure and formulae of alkenes

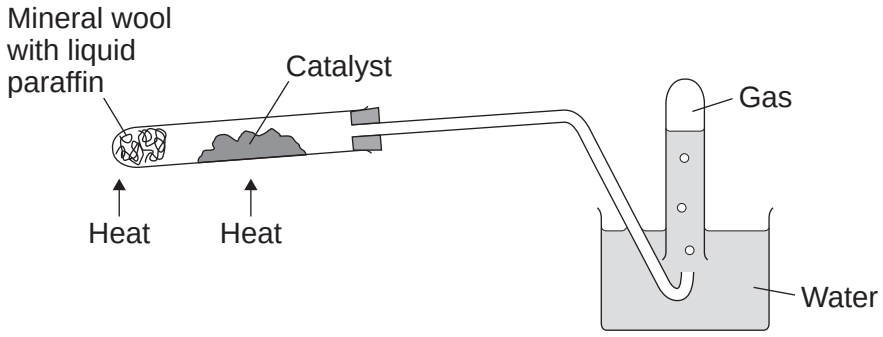
Question 47 · continued

6 (c) (iii) Use the information in **Table 2** to compare the boiling points of alkanes with the boiling points of alkenes.

[2 marks]

6 (d) A student used the apparatus in **Figure 8** to investigate what happens when liquid paraffin is heated to a high temperature.

Figure 8



Liquid paraffin contains alkanes.

Describe what happens to the alkane molecules in this investigation.

[3 marks]

13

4.7.2.1 Structure and formulae of alkenes

Question 48

June 2017 | CH2FP | Original Q2 | Legacy

2 This question is about sulfuric acid, copper sulfate and ethene.

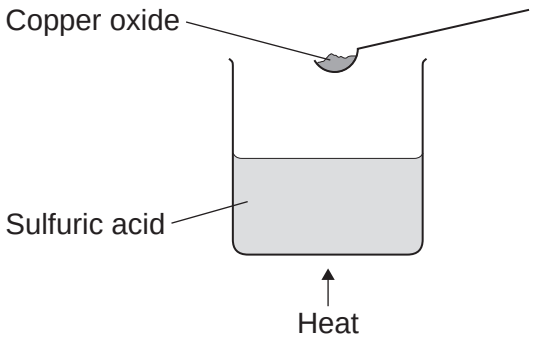
2 (a) A student added copper oxide to sulfuric acid to make copper sulfate.

The word equation for the reaction is:

sulfuric acid + copper oxide ⟶ copper sulfate + water

Figure 4 shows the first stage of the student's method.

Figure 4



2 (a) (i) The state symbol for CuO is missing from the equation below.

Use the correct answer from the box to complete the equation.

[1 mark]

aq	g	l	s

H_2SO_4 (aq) + CuO (___) ⟶ $CuSO_4$ (aq) + H_2O (l)

2 (a) (ii) Why is the sulfuric acid heated?

[1 mark]

_____

_____

Question 2 continues on the next page

Question 48 · continued

2 (a) (iii) Which of these values could be the pH of sulfuric acid?

[1 mark]

Tick (✓) **one** box.

1 ☐

7 ☐

11 ☐

14 ☐

2 (a) (iv) Why does the student continue to add copper oxide until some is left at the end of the reaction?

[1 mark]

Tick (✓) **one** box.

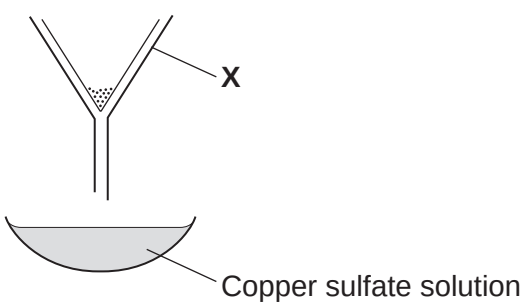
To make bigger copper sulfate crystals. ☐

To make sure all the copper oxide has reacted. ☐

To make sure all the sulfuric acid has reacted. ☐

2 (b) **Figure 5** shows the second stage of the student's method.

Figure 5



4.7.2.1 Structure and formulae of alkenes

Question 48 · continued

2 (b) (i) Name the apparatus labelled **X** on **Figure 5**.

[1 mark]

_____

2 (b) (ii) What could the student do to the copper sulfate solution to get copper sulfate crystals?

[1 mark]

_____

_____

2 (c) The student weighed the copper sulfate crystals.

Why was the mass of the copper sulfate crystals less than the student expected?

[1 mark]

Tick (✓) **one** box.

The student added too much copper oxide. ☐

The student left some copper sulfate crystals in the apparatus. ☐

The student weighed the copper sulfate crystals when they were wet. ☐

2 (d) The equation shows the reaction when blue hydrated copper sulfate crystals are heated.

hydrated copper sulfate $\rightleftharpoons$ anhydrous copper sulfate + water

2 (d) (i) What colour is anhydrous copper sulfate?

[1 mark]

_____

2 (d) (ii) What would you see if water is added to anhydrous copper sulfate?

[1 mark]

_____

4.7.2.1 Structure and formulae of alkenes

Question 48 · continued

2 (e) Ethene and sulfuric acid are used to make many substances.

Table 1 shows data about wealth of countries, ethene production and sulfuric acid production.

Table 1

Country	Wealth of country in billions of dollars	Ethene production in kilotonnes	Sulfuric acid production in kilotonnes
A	4000	13 900	36 000
B	1300	4 400	6 600
C	1290	2 700	26 000
D	460	1 500	2 500

2 (e) (i) Use the correct answer from the box to complete the sentence.

[1 mark]

alloys	chlorine	graphite	polymers

Ethene is used to make _____ .

2 (e) (ii) Describe the relationship, if any, between the wealth of a country and the production of ethene.

[1 mark]

_____

_____

2 (e) (iii) Describe the relationship, if any, between the wealth of a country and the production of sulfuric acid.

[1 mark]

_____

_____

12

4.7.2.1 Structure and formulae of alkenes

Question 49

June 2019 | 8462/2F | Original Q4

0 4 Titan is a moon of the planet Saturn.

Table 2 shows the percentages of some gases in the atmosphere of Titan and in the atmosphere of the Earth.

Table 2

Gas	Percentage of gas in atmosphere (%)	
	Titan	Earth
Nitrogen	98	78
Oxygen	Zero	21
Methane	1.4	0.0002
Argon	0.14	0.9
Carbon dioxide	0.0001	0.04

0 4 . 1 Which **two** gases are present in smaller percentages on the Earth than on Titan?

[1 mark]

_____ and _____

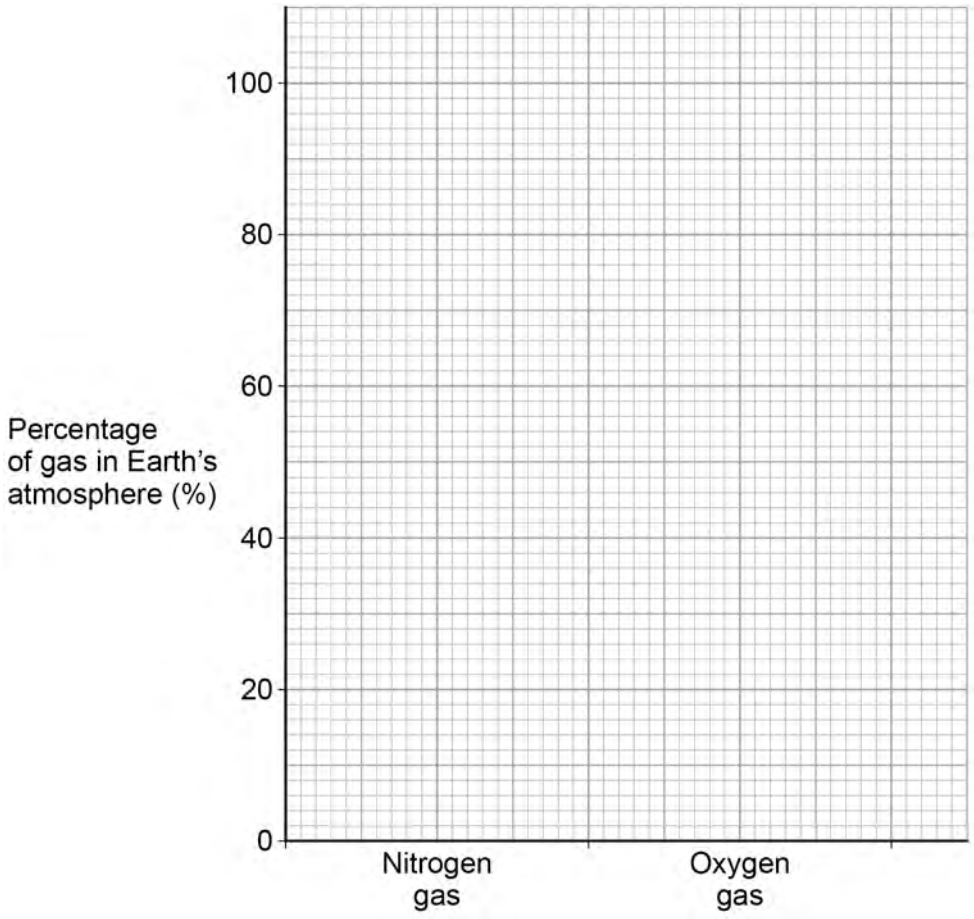
4.7.2.1 Structure and formulae of alkenes

Question 49 · continued

0 4 . 2 Complete the bar chart in **Figure 2** to show the percentages of nitrogen gas and oxygen gas in the Earth's atmosphere.

[2 marks]

Figure 2



0 4 . 3 Why are algae less likely to photosynthesise on Titan than Earth?

Use **Table 2**.

[1 mark]

Tick (✓) **one** box.

- Titan's atmosphere contains too little argon. ☐
- Titan's atmosphere contains too little carbon dioxide. ☐
- Titan's atmosphere contains too little methane. ☐
- Titan's atmosphere contains too little nitrogen. ☐

4.7.2.1 Structure and formulae of alkenes

Question 49 · continued

0 4 . 4 Titan is warmer than the other moons of Saturn because of the greenhouse effect.

How do greenhouse gases trap energy from the sun?

[1 mark]

Tick (✓) **one** box.

All wavelengths of radiation are reflected back to the surface of Titan. ☐

Long wavelength radiation is reflected back to the surface of Titan. ☐

Short wavelength radiation is reflected back to the surface of Titan. ☐

As well as methane, the atmosphere of Titan contains small amounts of propene gas. Methane is an alkane and propene is an alkene.

0 4 . 5 Bromine water is an orange solution used to identify alkenes.

Draw **one** line from each gas to its effect on bromine water.

[2 marks]

Gas	Effect on bromine water
	Forms a blue solution
Methane	Forms a colourless solution
	Forms a green solution
Propene	Forms a white precipitate
	No effect

4.7.2.1 Structure and formulae of alkenes

Question 49 · continued

0 4 . 6 Propene reacts with water (steam) to make propanol.

The ratio of the masses of propene and water that react is:

propene : water

7 : 3

Calculate the mass of propene that reacts with 21 g water.

[2 marks]

Mass = _____ g

9

Turn over for the next question

4.7.2.1 Structure and formulae of alkenes

Question 50

June 2019 | 8462/2F | Original Q5

0 5 **Figure 3** shows a surfer on a surfboard.

Figure 3



Some surfboards are made from addition polymers.

Addition polymers are made from small alkene molecules.

0 5 . 1 Which type of bonding is present in small alkene molecules?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

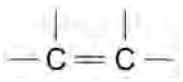
4.7.2.1 Structure and formulae of alkenes

Question 50 · continued

0 5 . 2 What is the functional group in these small alkene molecules?

[1 mark]

Tick (✓) **one** box.



☐

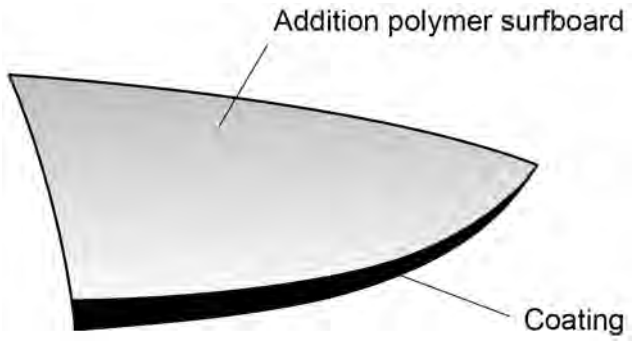
—COOH ☐

—OH ☐

Figure 4 shows the structure of part of an addition polymer surfboard.

The outer surface of the surfboard is coated.

Figure 4



The coating is made from soda-lime glass fibres surrounded by a plastic.

0 5 . 3 What type of material is the coating of the surfboard?

[1 mark]

Tick (✓) **one** box.

Alloy ☐

Ceramic ☐

Composite ☐

Nanotube ☐

Question 50 · continued

0 5 . 4 Complete the sentence.

Choose answers from the box.

[2 marks]

air	**ammonia**	**copper**
limestone	**sand**	

The materials used to make the soda-lime glass fibres are sodium carbonate,

_____ and _____.

0 5 . 5 Suggest **two** reasons why surfboards are coated.

[2 marks]

1 _____

_____

2 _____

_____

Some surfboards are made from wood.

Table 3 contains information about the materials in an addition polymer surfboard and a wooden surfboard.

Table 3

	Addition polymer surfboard	Wooden surfboard
Relative strength	14	38
Cost (£ per m^3)	140	390
Density (kg/m^3)	50	150
Disposal at end of life	Difficult to recycle	Can be used as fuel

4.7.2.1 Structure and formulae of alkenes

Question 50 · continued

0 5 . 6 Suggest **two** advantages and **two** disadvantages of using addition polymers rather than wood to make surfboards.

Use **Table 3**.

[4 marks]

Advantages of addition polymers _____

_____

_____

_____

Disadvantages of addition polymers _____

_____

_____

_____

0 5 . 7 Calculate the volume of wood in a wooden surfboard of mass 5.25 kg

Use **Table 3** and the equation:

$$\text{Density in kg/m}^3 = \frac{\text{Mass in kg}}{\text{Volume in m}^3}$$

[3 marks]

_____

_____

_____

_____

Volume = _____ m^3

14

4.7.2.1 Structure and formulae of alkenes

Question 51

November 2020 | 8462/2F | Original Q6

0 6 This question is about materials used to make plates.

Plates are made from ceramics, paper or poly(propene).

0 6 . 1 Paper plates are biodegradable and recyclable.

Which stage of a life cycle assessment (LCA) would contain this information?

[1 mark]

Tick (✓) **one** box.

- Disposal at the end of useful life ☐
- Extracting and processing raw materials ☐
- Manufacturing and packaging ☐
- Use and operation during lifetime ☐

0 6 . 2 Which **two** processes are used to make ceramic plates?

[2 marks]

Tick (✓) **two** boxes.

- Forming a composite ☐
- Galvanising with zinc ☐
- Heating in a furnace ☐
- Melting sand and boron trioxide ☐
- Shaping wet clay ☐

4.7.2.1 Structure and formulae of alkenes

Question 51 · continued

Poly(propene) is produced from an alkene.

0 6 . 3 Complete the sentences.

[2 marks]

The name for very large molecules such as poly(propene) is _____.

The name of the alkene used to produce poly(propene) is _____.

0 6 . 4 The alkene needed to make poly(propene) is produced from crude oil.

Which **two** processes are used to produce this alkene from crude oil?

[2 marks]

Tick (✓) **two** boxes.

- Chromatography ☐
- Cracking ☐
- Fermentation ☐
- Fractional distillation ☐
- Quarrying ☐

0 6 . 5 What type of bond joins the atoms in a molecule of poly(propene)?

[1 mark]

Tick (✓) **one** box.

- Covalent ☐
- Ionic ☐
- Metallic ☐

4.7.2.1 Structure and formulae of alkenes

Question 51 · continued

Table 4 shows information about two polymers used to make plates.

Table 4

Polymer	Effect of heating the polymer
A	does not melt
B	melts at 50 °C

0 6 . 6 What type of polymer is polymer **A**?

Use **Table 4**.

[1 mark]

0 6 . 7 Why does polymer **A** behave differently to polymer **B** when heated?

You should refer to crosslinks in your answer.

[1 mark]

10

4.7.2.1 Structure and formulae of alkenes

Question 52

November 2020 | 8462/2F | Original Q10

1 0 This question is about hydrocarbons.

Hexane and hexene are hydrocarbons containing six carbon atoms in each molecule.

Hexane is an alkane and hexene is an alkene.

1 0 . 1 Draw **one** line from each hydrocarbon to the formula of that hydrocarbon.

[2 marks]

Hydrocarbon	Formula
	C_6H_8
Hexane	C_6H_{10}
	C_6H_{12}
Hexene	C_6H_{14}
	C_6H_{16}

1 0 . 2 Bromine water is added to hexane and to hexene.

What would be observed when bromine water is added to hexane and to hexene?

[2 marks]

Hexane _____

_____

Hexene _____

_____

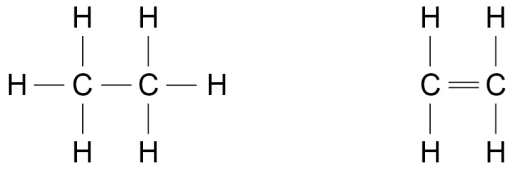
4.7.2.1 Structure and formulae of alkenes

Question 52 · continued

1 0 . 3 Ethane is an alkane and ethene is an alkene.

Figure 8 shows the displayed structural formulae of ethane and of ethene.

Figure 8



Ethane **Ethene**

Compare ethane with ethene.

You should refer to:

- their structure and bonding
- their reactions.

[6 marks]

10

4.7.2.1 Structure and formulae of alkenes

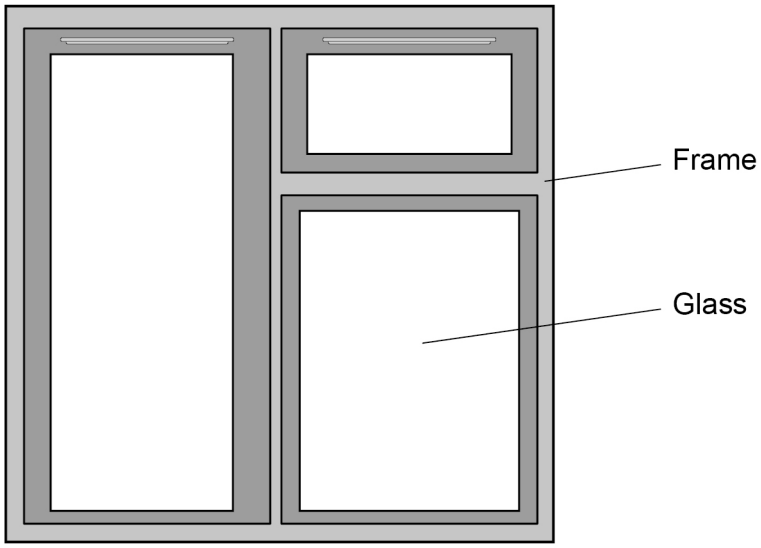
Question 53

November 2021 | 8462/2F | Original Q3

0 3 This question is about substances used to make windows and window frames.

Figure 2 shows a window.

Figure 2



0 3 . 1 Glass is made by heating sand with **two** other materials.

Which **two** other materials are used to make glass?

[2 marks]

Tick (✓) **two** boxes.

- Clay ☐
- Graphite ☐
- Limestone ☐
- Sodium carbonate ☐
- Sodium hydroxide ☐

4.7.2.1 Structure and formulae of alkenes

Question 53 · continued

Window frames need to be:

- easy to install
- resistant to damage.

The polymers poly(chloroethene) and HDPE are used to make window frames.

Table 3 shows information about poly(chloroethene) and HDPE.

Table 3

Property	Poly(chloroethene)	HDPE
Density in g/cm^3	1.4	0.92
Relative strength	72	25

0 3 . 2 Suggest **one** advantage of using poly(chloroethene) compared with HDPE to make window frames.

Give **one** reason for your answer.

Use **Table 3**.

[2 marks]

Advantage _____

_____

Reason _____

_____

0 3 . 3 Suggest **one** advantage of using HDPE compared with poly(chloroethene) to make window frames.

Give **one** reason for your answer.

Use **Table 3**.

[2 marks]

Advantage _____

_____

Reason _____

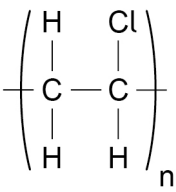
_____

4.7.2.1 Structure and formulae of alkenes

Question 53 · continued

0 3 . 4 **Figure 3** shows the displayed structural formula of poly(chloroethene).

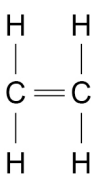
Figure 3

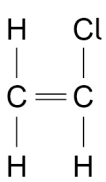


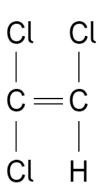
Which monomer is used to make poly(chloroethene)?

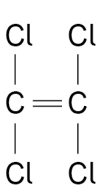
[1 mark]

Tick (✓) **one** box.

 ☐

 ☐

 ☐

 ☐

4.7.2.1 Structure and formulae of alkenes

Question 53 · continued

0 3 . 5 Chlorine gas is used to produce poly(chloroethene).

Describe a test to identify chlorine gas.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 3 . 6 Wood can be used instead of polymers to make window frames.

- Polymers are unreactive.
- Polymers are produced from crude oil.
- Wood breaks down in wet conditions.
- Wood is produced from trees.

Suggest **one** advantage of using polymers and **one** advantage of using wood to make window frames.

[2 marks]

Advantage of polymers _____

_____

Advantage of wood _____

_____

Question 3 continues on the next page

Question 53 · continued

Window frames can also be made from an alloy of aluminium.

0 3 . 7 6.00 kg of the alloy is used to make a window frame.

Table 4 shows the mass of each element in 6.00 kg of the alloy.

Table 4

Element	Mass in kg
Aluminium	5.94
Magnesium	0.04
Silicon	0.02

Calculate the percentage of aluminium in 6.00 kg of the alloy.

[2 marks]

Percentage of aluminium = _____ %

0 3 . 8 Why is an alloy used instead of pure aluminium to make window frames?

[1 mark]

14

4.7.2.1 Structure and formulae of alkenes

Question 54

November 2021 | 8462/2F | Original Q7

0 7 This question is about organic compounds.

0 7 . 1 Butane is an alkane with small molecules.

Complete the sentence.

Choose the answer from the box.

[1 mark]

fertiliser	**formulation**	**fuel**

Butane can be used as a _____.

0 7 . 2 Poly(propene) is a polymer.

What is the name of the monomer used to produce poly(propene)?

[1 mark]

Tick (✓) **one** box.

- Propane ☐
- Propanoic acid ☐
- Propanol ☐
- Propene ☐

4.7.2.1 Structure and formulae of alkenes

Question 54 · continued

Ethene and steam react to produce ethanol.

The equation for the reversible reaction is:

ethene + steam ⇌ ethanol

0 7 . 3 The reaction produces a maximum theoretical mass of 400 kg of ethanol from 243 kg of ethene and 157 kg of steam.

A company produces 380 kg of ethanol from 243 kg of ethene and 157 kg of steam.

The percentage yield of ethanol is less than 100%

Calculate the percentage yield of ethanol.

Use the equation:

$$\text{percentage yield of ethanol} = \frac{\text{mass of ethanol actually made}}{\text{maximum theoretical mass of ethanol}} \times 100$$

[2 marks]

Percentage yield = _____ %

0 7 . 4 What are **two** possible reasons why the percentage yield of ethanol is less than 100%?

[2 marks]

Tick (✓) **two** boxes.

- Ethanol is the only product of the reaction. ☐
- Ethanol is very unreactive. ☐
- Some ethanol changes back into ethene and steam. ☐
- Some ethanol escapes from the apparatus. ☐
- Some ethanol reacts with steam. ☐

Question 54 · continued

0 7 . 5 Ethanol burns in oxygen.

Balance the equation for the reaction.

[1 mark]

$$C_2H_5OH + ___ O_2 \rightarrow 3H_2O + 2CO_2$$

0 7 . 6 Two processes for producing ethanol are:

- fermentation
- hydration (reacting ethene with steam).

Table 5 shows information about the processes.

Table 5

Feature	Process	
	Fermentation	**Hydration**
Raw material	sugar	crude oil
Energy usage	low	high
Rate of reaction	slow	fast
Purity of ethanol	15%	98%

Give **two** advantages and **two** disadvantages of using fermentation to produce ethanol.

[4 marks]

Advantage of fermentation 1 _____

_____

Advantage of fermentation 2 _____

_____

Disadvantage of fermentation 1 _____

_____

Disadvantage of fermentation 2 _____

_____

11

4.7.2.1 Structure and formulae of alkenes

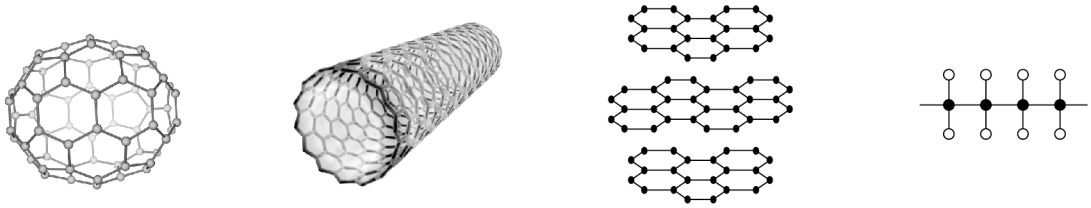
Question 55

June 2022 | 8462/1F | Original Q6

0 6 This question is about carbon and compounds of carbon.

Figure 9 shows diagrams that represent different structures.

Figure 9



A **B** **C** **D**

Use **Figure 9** to answer questions **06.1** and **06.2**.

0 6 . 1 Which diagram represents graphite?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 6 . 2 Which diagram represents poly(ethene)?

[1 mark]

Tick (✓) **one** box.

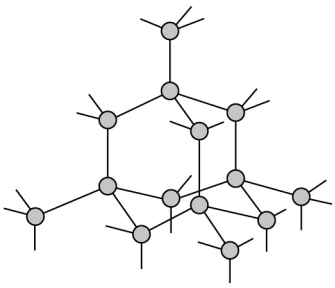
A ☐ **B** ☐ **C** ☐ **D** ☐

4.7.2.1 Structure and formulae of alkenes

Question 55 · continued

Figure 10 represents the structure of diamond.

Figure 10



0 6 . 3 How many covalent bonds does each carbon atom form in diamond?

[1 mark]

0 6 . 4 Which is a property of diamond?

[1 mark]

Tick (✓) **one** box.

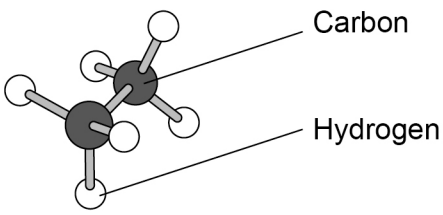
- Conducts electricity ☐
- Low melting point ☐
- Very hard ☐

Question 6 continues on the next page

Question 55 · continued

0 6 . 5 **Figure 11** shows a model of a molecule.

Figure 11



Complete the molecular formula of the molecule.

[1 mark]

Molecular formula = C__ H__

Carbonic acid is a compound of carbon.

The formula of carbonic acid is H_2CO_3

0 6 . 6 Which ion is produced by carbonic acid in aqueous solution?

[1 mark]

Tick (✓) **one** box.

H^+ ☐ OH^- ☐ O^{2-} ☐

0 6 . 7 Calculate the relative formula mass (M_r) of carbonic acid (H_2CO_3).

Relative atomic masses (A_r): H = 1 C = 12 O = 16

[2 marks]

Relative formula mass (M_r) = _____

8

4.7.2.1 Structure and formulae of alkenes

Question 56

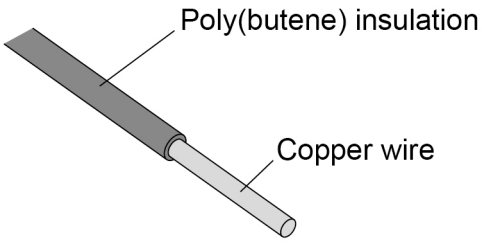
June 2022 | 8462/2F | Original Q8

0 8 This question is about copper wire and copper compounds.

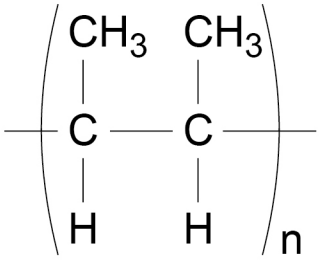
Copper is used to make electrical wires.

Figure 9 shows how copper electrical wire is insulated using an addition polymer called poly(butene).

Figure 9



0 8 . 1 The addition polymer poly(butene) has the displayed structural formula:

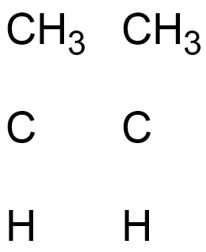


Poly(butene) is produced from the monomer butene.

Complete **Figure 10** to show the displayed structural formula of butene.

[2 marks]

Figure 10



4.7.2.1 Structure and formulae of alkenes

Question 56 · continued

Copper can be obtained by recycling scrap copper wire.

0 8 . 2 Suggest why poly(butene) insulation must be removed from scrap copper wire before the copper is recycled.

[1 mark]

0 8 . 3 Describe how scrap copper wire can be recycled to make new copper water pipes.

[2 marks]

0 8 . 4 Suggest **two** reasons why recycling scrap copper is more sustainable than extracting copper from copper ores.

[2 marks]

1

2

Question 8 continues on the next page

4.7.2.1 Structure and formulae of alkenes

Question 56 · continued

Copper sulfate is a compound of copper.

Copper sulfate solution contains copper(II) ions and sulfate ions.

0 8 . 5 A solution can be added to copper sulfate solution to show the presence of copper(II) ions.

Name the solution added.

Give the result of the test.

[2 marks]

Name of solution added _____

_____

Result _____

_____

0 8 . 6 Describe **one** test to show the presence of sulfate ions in copper sulfate solution.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

11

4.7.2.1 Structure and formulae of alkenes

Question 57

June 2023 | 8462/2F | Original Q2

0 2 This question is about glass and polymers.

Beakers can be made from borosilicate glass or poly(propene).

Table 1 shows information about materials used to make beakers.

Table 1

	Material used to make beakers	
	borosilicate glass	**poly(propene)**
Temperature at which melting begins in °C	850	160
Flammability	does not burn	burns
Resistance to impact	shatters	tough
Cost of 100 cm^3 beaker in £	1.50	2.00

0 2 . 1 Suggest **two** reasons why a Bunsen burner should **not** be used to heat a liquid in a poly(propene) beaker.

Use **Table 1**.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 2 Poly(propene) beakers are more expensive than borosilicate glass beakers.

Suggest **one** reason why using poly(propene) beakers instead of borosilicate glass beakers could save money.

Use **Table 1**.

[1 mark]

_____

_____

4.7.2.1 Structure and formulae of alkenes

Question 57 · continued

0 2 . 3 Which is a raw material used to make borosilicate glass?

[1 mark]

Tick (✓) **one** box.

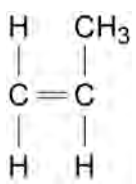
Boron trioxide ☐

Clay ☐

Limestone ☐

Poly(propene) is produced from propene.

The displayed structural formula of propene is:



0 2 . 4 **Table 2** shows some information about the elements in one molecule of propene.

Table 2

Symbol for element	Name of element	Number of atoms of element in one molecule of propene
C		
H		

Complete **Table 2**.

[2 marks]

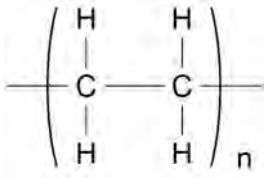
4.7.2.1 Structure and formulae of alkenes

Question 57 · continued

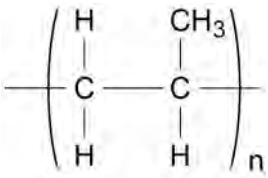
0 2 . 5 Which structure is the repeating unit of poly(propene)?

[1 mark]

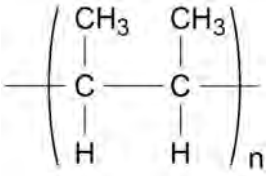
Tick (✓) **one** box.



☐



☐



☐

0 2 . 6 Poly(propene) is produced in three stages:

- **Stage 1:** separating large alkane molecules from crude oil
- **Stage 2:** producing propene molecules from large alkane molecules
- **Stage 3:** joining many propene molecules together.

Name **Stage 1**, **Stage 2** and **Stage 3**.

Choose answers from the box.

[3 marks]

cracking	**fermentation**	**fractional distillation**
polymerisation	**reverse osmosis**	

Stage 1 is _____.

Stage 2 is _____.

Stage 3 is _____.

4.7.2.1 Structure and formulae of alkenes

Question 57 · continued

0 2 . 7 A molecule of hexene contains a double carbon–carbon bond.

Many hexene molecules join together to form poly(hexene).

Which **two** words describe a hexene molecule in this process?

[2 marks]

Tick (✓) **two** boxes.

- Alkene ☐
- Catalyst ☐
- Composite ☐
- Element ☐
- Monomer ☐

12

4.7.2.1 Structure and formulae of alkenes

Question 58

June 2023 | 8462/2F | Original Q9

0 9 This question is about alcohols and carboxylic acids.

Alcohols are used as fuels.

A student burned 1.00 g of six alcohols and determined the energy released from each.

Table 8 shows the results.

Table 8

Alcohol	Formula of one molecule of the alcohol	Energy released in kJ/g
Ethanol	C_2H_5OH	29.6
Propanol	C_3H_7OH	33.6
Butanol	C_4H_9OH	36.1
Pentanol	$C_5H_{11}OH$	37.7
Hexanol	$C_6H_{13}OH$	38.9
Heptanol	$C_7H_{15}OH$	39.8

0 9 . 1 Calculate the mass of ethanol that must be burned to release the same amount of energy as burning 1.00 g of heptanol.

[2 marks]

Mass = _____ g

0 9 . 2 The energy released in kJ/g varies with the number of carbon atoms in one molecule of each alcohol.

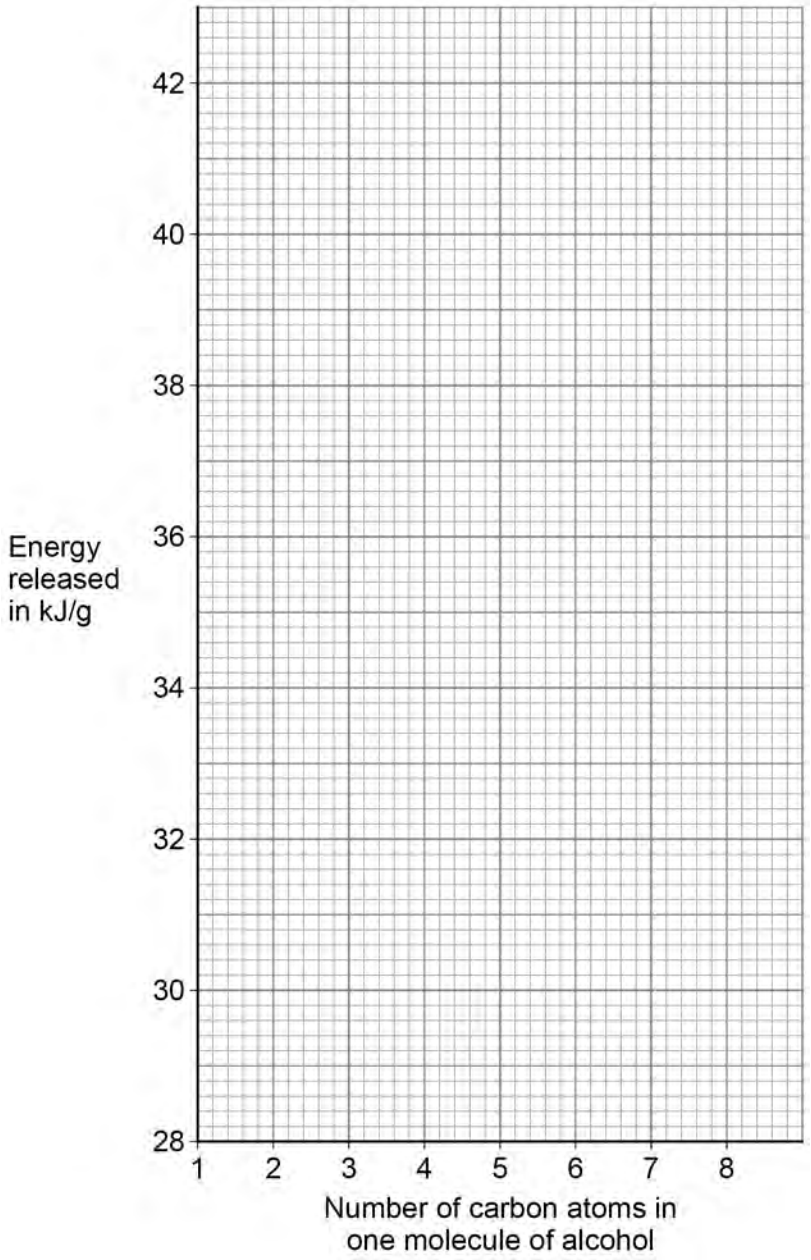
Plot the data from **Table 8** on **Figure 8**.

[2 marks]

4.7.2.1 Structure and formulae of alkenes

Question 58 · continued

Figure 8



0 9 . 3 Estimate the energy released in kJ when 1.00 g of octanol ($C_8H_{17}OH$) is burned.

Use **Figure 8**.

[1 mark]

Energy released = _____ kJ

4.7.2.1 Structure and formulae of alkenes

Question 58 · continued

Carbon dioxide is produced when alcohols are burned.

Carbon dioxide is identified by bubbling the gas through limewater.

0 9 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

calcium chloride	**calcium hydroxide**	**calcium nitrate**	**calcium sulfate**

Limewater is an aqueous solution of _____.

0 9 . 5 Give the result of the test when carbon dioxide is bubbled through limewater.

[1 mark]

_____

_____

4.7.2.1 Structure and formulae of alkenes

Question 58 · continued

Ethanoic acid can be produced from ethanol.

0 9 . 6 What is reacted with ethanol to produce ethanoic acid?

[1 mark]

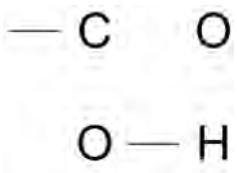
Tick (✓) **one** box.

- A halogen ☐
- An alkali metal ☐
- An oxidising agent ☐
- Water ☐

0 9 . 7 Ethanoic acid contains the functional group –COOH

Complete the displayed structural formula of this functional group.

[1 mark]



Question 9 continues on the next page

4.7.2.1 Structure and formulae of alkenes

Question 58 · continued

0 9 . 8 Ethanoic acid reacts with different compounds.

Draw **one** line from each compound to a product of the reaction of the compound with ethanoic acid.

[2 marks]

Compound	Product of the reaction with ethanoic acid
Ethanol	Carbon dioxide
Sodium carbonate	Ethene
	Ethyl ethanoate
	Hydrogen
	Poly(ethene)

11

4.7.2.1 Structure and formulae of alkenes

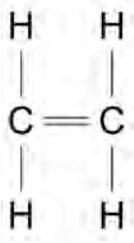
Question 59

June 2024 | 8462/2F | Original Q6

0 6 This question is about addition reactions.

Figure 7 shows the displayed structural formula of ethene.

Figure 7



0 6 . 1 Complete the sentence.

[1 mark]

When bromine water is added to ethene, the bromine water changes from orange to

_____ .

4.7.2.1 Structure and formulae of alkenes

Question 59 · continued

Chlorine reacts with ethene.

0 6 . 2 What is used to identify chlorine?

[1 mark]

Tick (✓) **one** box.

A lighted splint ☐

Damp litmus paper ☐

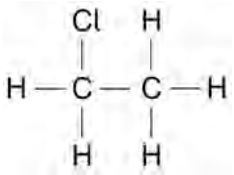
Limewater ☐

0 6 . 3 Which of the following shows the displayed structural formula of the compound produced when chlorine reacts with ethene?

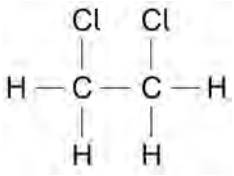
Use **Figure 7**.

[1 mark]

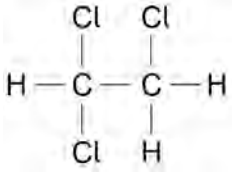
Tick (✓) **one** box.



☐



☐



☐

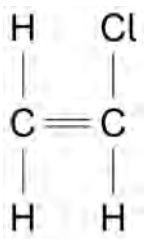
Question 6 continues on the next page

4.7.2.1 Structure and formulae of alkenes

Question 59 · continued

0 6 . 4 Chloroethene can be used to produce a polymer called poly(chloroethene).

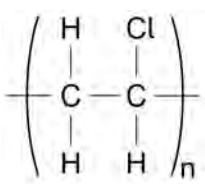
The displayed structural formula of chloroethene is



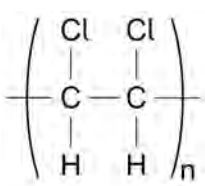
Which represents the structure of poly(chloroethene)?

[1 mark]

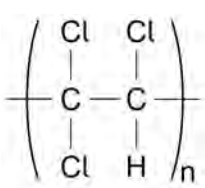
Tick (✓) **one** box.



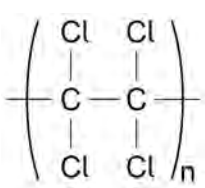
☐



☐



☐



☐

Question 59 · continued

Ethene can be used to produce another polymer called poly(ethene).

Table 3 shows information about poly(chloroethene) and poly(ethene).

Table 3

	Poly(chloroethene)	Poly(ethene)
Density in g/cm^3	1.5	0.9
Temperature at which polymer completely melts in °C	260	120

0 6 . 5 Determine the simplest whole number ratio of the density of poly(chloroethene) : density of poly(ethene).

[3 marks]

Simplest whole number ratio = _____ : _____

0 6 . 6 Poly(ethene) **and** poly(chloroethene) can both be used to make pipes.

Suggest why neither polymer is suitable for pipes carrying steam at a temperature of 300 °C.

Use **Table 3**.

[1 mark]

0 6 . 7 Poly(ethene) and paper can both be used to make shopping bags.

Poly(ethene) is produced from crude oil. Paper is produced from trees.

Suggest **one** reason why paper is more sustainable than poly(ethene) for making shopping bags.

[1 mark]

9

4.7.2.1 Structure and formulae of alkenes

Question 60

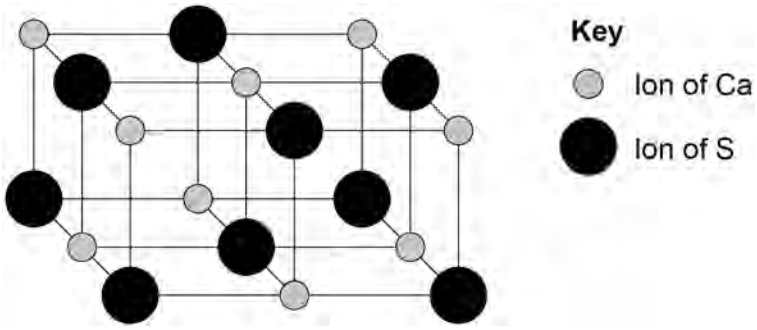
June 2025 | 8462/1F | Original Q9

0 9 This question is about structure and bonding.

Calcium sulfide is an ionic compound.

Figure 13 represents the structure of calcium sulfide.

Figure 13



0 9 . 1 Determine the empirical formula of calcium sulfide.

[1 mark]

Empirical formula _____

Question 9 continues on the next page

4.7.2.1 Structure and formulae of alkenes

Question 60 · continued

0 9 . 2 Calcium is in Group 2 of the periodic table.

Sulfur is in Group 6 of the periodic table.

Describe what happens when a calcium atom reacts with a sulfur atom.

Answer in terms of electrons and ions.

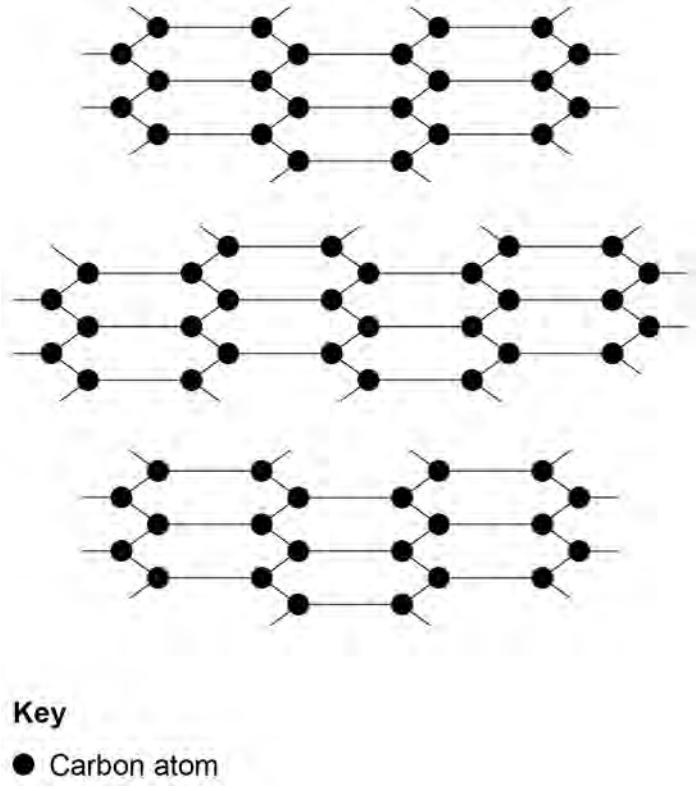
[4 marks]

4.7.2.1 Structure and formulae of alkenes

Question 60 · continued

Figure 14 shows the structure of graphite.

Figure 14



0 9 . 3 Describe the structure and bonding of graphite.

[4 marks]

Extra space

4.7.2.1 Structure and formulae of alkenes

Question 60 · continued

0 9 . 4 Substances that consist of small molecules do **not** conduct electricity.

Give **one** reason why.

[1 mark]

0 9 . 5 Methane consists of small molecules.

Poly(ethene) is a polymer.

Why does poly(ethene) have a higher melting point than methane?

[1 mark]

Tick (✓) **one** box.

- Poly(ethene) has more covalent bonds to break than methane. ☐
- Poly(ethene) has no intermolecular forces to overcome. ☐
- Poly(ethene) has stronger covalent bonds to break than methane. ☐
- Poly(ethene) has stronger intermolecular forces to overcome than methane. ☐

11

4.7.2.1 Structure and formulae of alkenes

Question 61

June 2025 | 8462/2F | Original Q2

0 2 Alkanes and alkenes are hydrocarbons.

Hydrocarbon molecules are made up of hydrogen and carbon atoms only.

An alkene has the formula C_3H_6

0 2 . 1 Which alkene has the formula C_3H_6?

[1 mark]

Tick (✓) **one** box.

Butene ☐

Ethene ☐

Propene ☐

0 2 . 2 How many atoms are there in a molecule of C_3H_6?

[1 mark]

Tick (✓) **one** box.

2 ☐ 3 ☐ 6 ☐ 9 ☐

0 2 . 3 Which is a use of C_3H_6?

[1 mark]

Tick (✓) **one** box.

Making a polymer ☐

Making ammonia ☐

Making glass ☐

Question 61 · continued

0 2 . 4 The percentage (%) by mass of each element in a molecule of C_3H_6 is:

- hydrogen 14%
- carbon 86%.

Figure 1 shows the percentage by mass of hydrogen in a molecule of C_3H_6

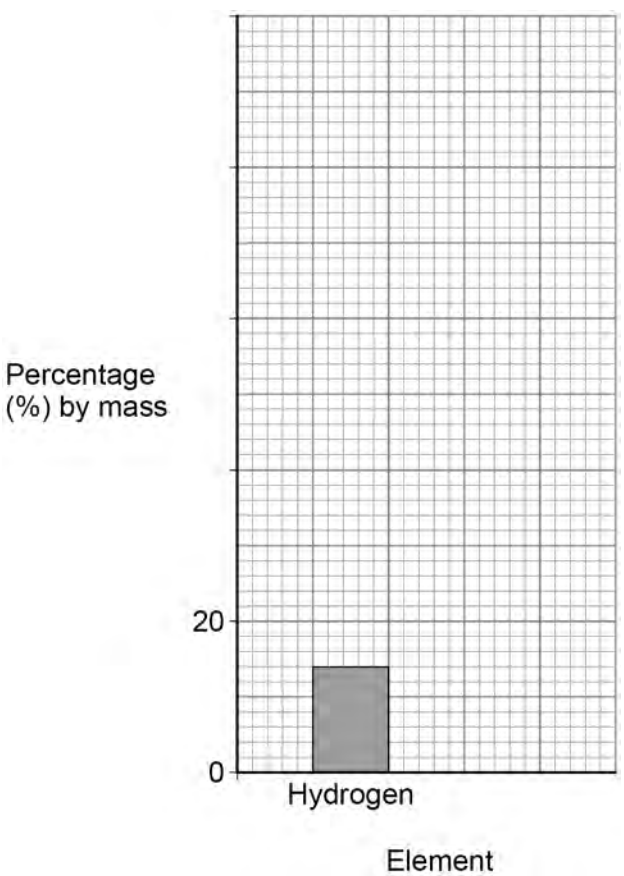
Complete **Figure 1**.

You should:

- complete the *y*-axis scale
- plot the percentage by mass of carbon as a bar
- label the bar plotted for carbon.

[3 marks]

Figure 1



4.7.2.1 Structure and formulae of alkenes

Question 61 · continued

Alkanes can be cracked to produce alkenes and smaller alkane molecules.

0 2 . 5 Describe a test for alkenes.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 2 . 6 $C_{10}H_{22}$ can be cracked to produce C_3H_6 and an alkane.

Complete the equation for the reaction.

[1 mark]

$$C_{10}H_{22} \longrightarrow C_3H_6 + C___H_{16}$$

0 2 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

ceramics	**fertilisers**	**fuels**

Smaller alkanes from cracking are useful as _____.

4.7.2.1 Structure and formulae of alkenes

Question 61 · continued

High temperatures between 450 °C and 750 °C are used in cracking reactions.

0 2 . 8 Which statement describes the molecules at 750 °C compared with the molecules at 450 °C?

[1 mark]

Tick (✓) **one** box.

- The molecules collide more frequently at 750 °C. ☐
- The molecules have less energy at 750 °C. ☐
- The molecules move more slowly at 750 °C. ☐

0 2 . 9 How does the rate of reaction at 750 °C compare with the rate of reaction at 450 °C?

[1 mark]

_____

_____

12