AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.2.5

Polymers

Past-paper questions

Tier	**Foundation**
Question groups	**69**
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.

4.2.2.5 Polymers

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

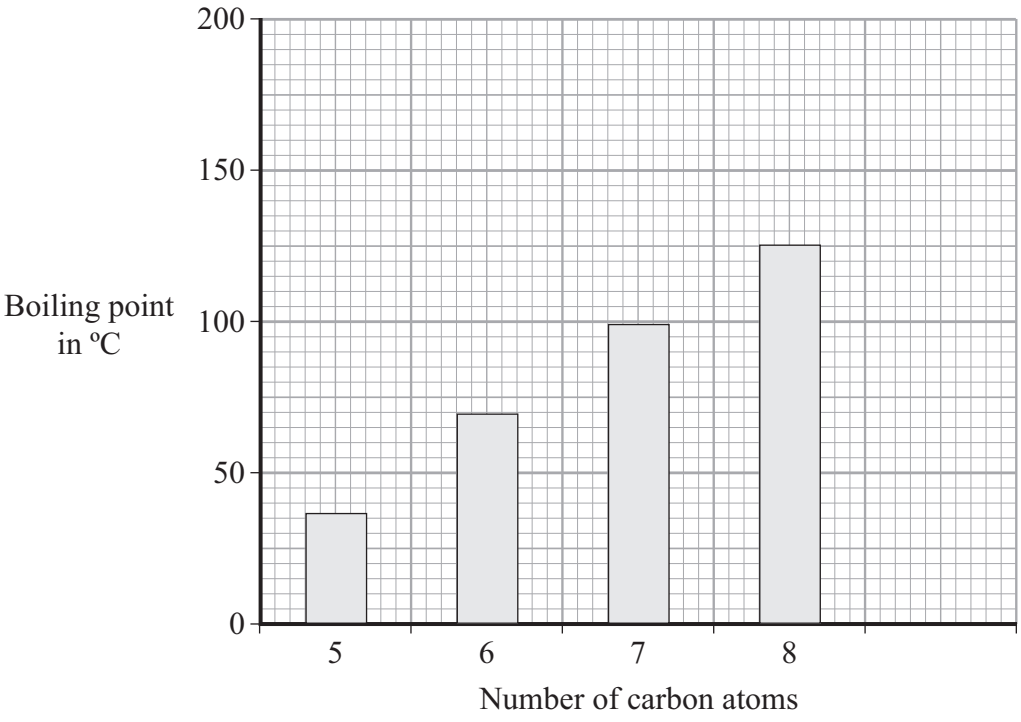
Question 01 · continued

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(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)

4.2.2.5 Polymers

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

4.2.2.5 Polymers

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.

4.2.2.5 Polymers

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}

4.2.2.5 Polymers

Question 04

June 2007 | CHY1F | Original Q1 | Legacy

1 Helium is used to fill party balloons.



(a) Tick **two** properties that make helium suitable for filling party balloons.

Property	Suitable (✓)
Colourless	
Low density	
Small atoms	
Unreactive	

(2 marks)

(b) Complete the sentence by drawing a ring around the correct line in the box.

The material used to make balloons is

a metal
a polymer
an element

.

(1 mark)

(c) One environmental problem is that balloons are non-biodegradable.

What does *non-biodegradable* mean?

.....

.....

(1 mark)

4

4.2.2.5 Polymers

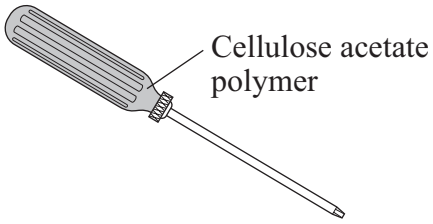
Question 05

November 2007 | CHY1B | Original Q2 | Legacy

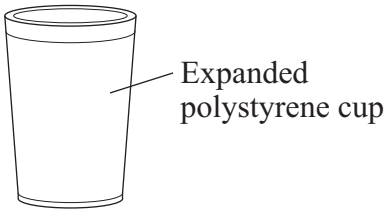
QUESTION TWO

This question is about the properties of polymers and their uses.

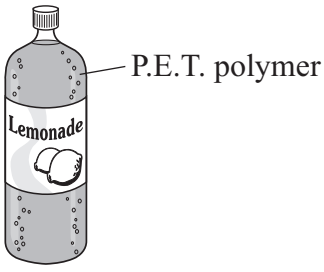
The drawings show four different objects. Each is made using a different polymer.



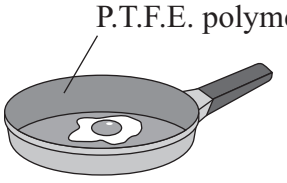
A Screwdriver



B Disposable coffee cup



C Bottle for soft drinks



D Frying pan

The table below shows some properties of four different polymers.

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

	Properties of the polymer
1	It forms a non-stick surface that can be strongly heated.
2	It is strong but light, transparent and can be recycled.
3	It is strong, rigid and a good electrical insulator.
4	It is a good heat insulator, very light and cheap to make.

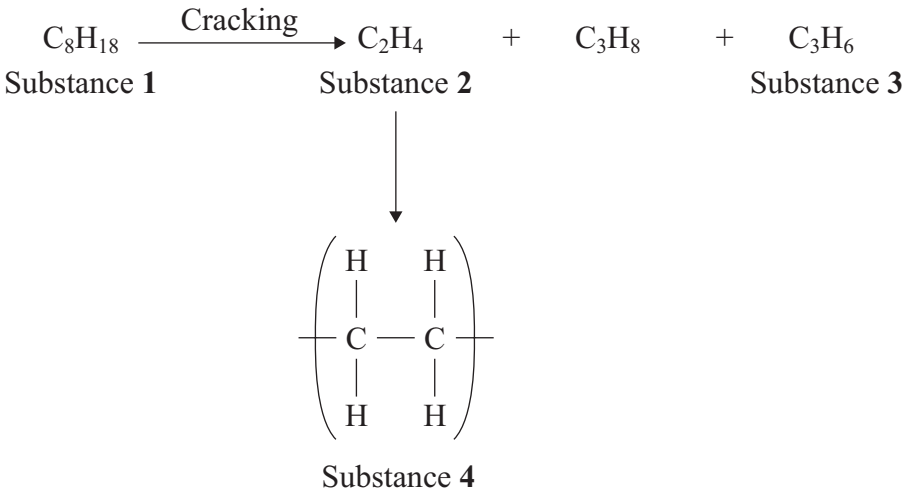
4.2.2.5 Polymers

Question 06

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

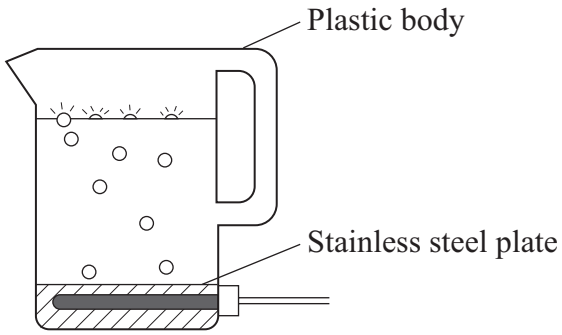
D polymer

4.2.2.5 Polymers

Question 07

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)

4.2.2.5 Polymers

Question 07 · 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

4.2.2.5 Polymers

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** . . . .

4.2.2.5 Polymers

Question 09

March 2008 | CHY1BP | Original Q5 | Legacy

QUESTION FIVE

The table shows some of the properties of four polymers.

	Polymer	Properties
A	Polystyrene	brittle, cheap
B	PTFE	withstands high temperatures, non-stick
C	Perspex	rigid, transparent
D	Acrilan	strong, can be stretched into fibres

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

	How the polymer could be used
1	It could be used as a substitute for glass.
2	It could be used as a substitute for wool.
3	It could be used to make throw-away packaging.
4	It could be used as a coating on cooking pans.

4.2.2.5 Polymers

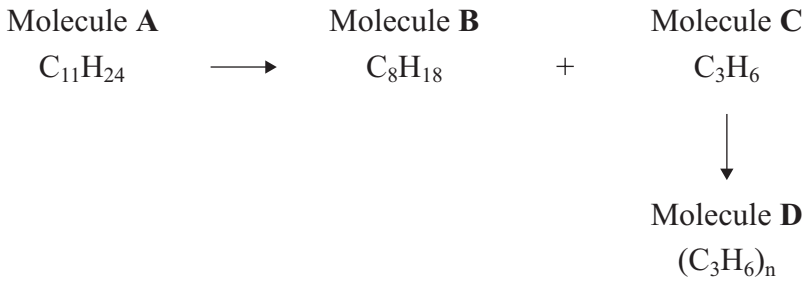
Question 10

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.

4.2.2.5 Polymers

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** . . . .

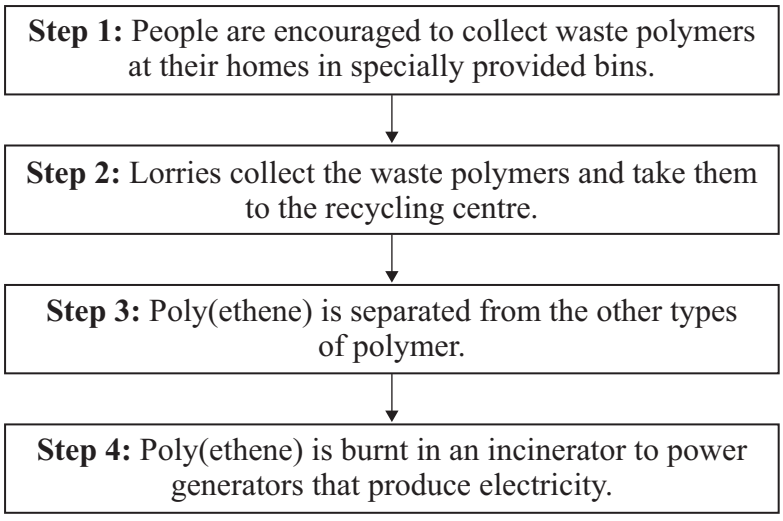
4.2.2.5 Polymers

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.

4.2.2.5 Polymers

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.

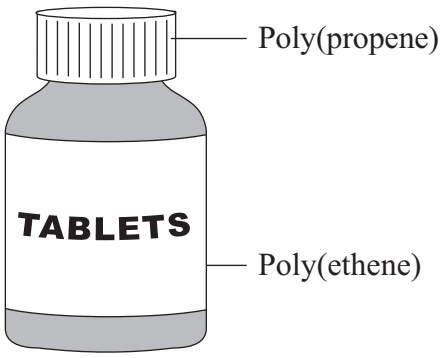
Turn over for the next question

4.2.2.5 Polymers

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.

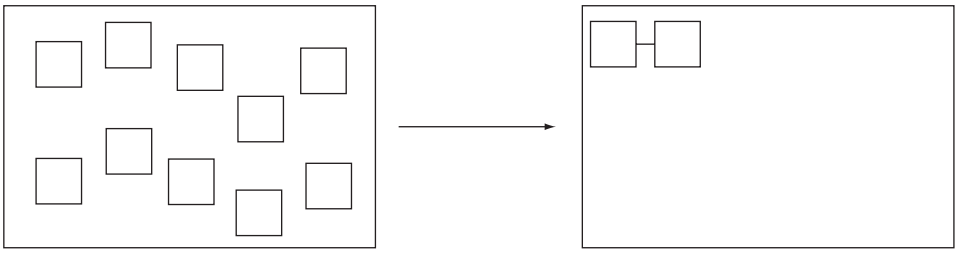
Ethene and propene are called hydrocarbons because they are made up of carbon and ..... atoms only.

(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)

4.2.2.5 Polymers

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

4.2.2.5 Polymers

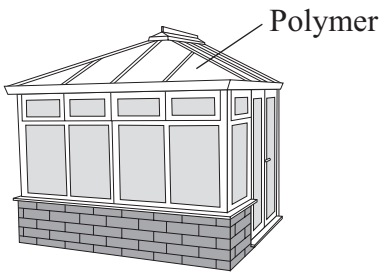
Question 14

March 2009 | CHY1BP | Original Q2 | Legacy

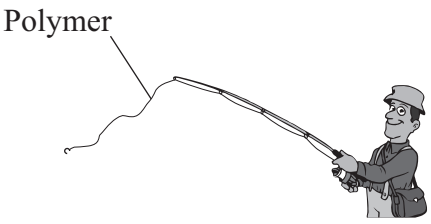
QUESTION TWO

The drawings show four different uses for polymers.

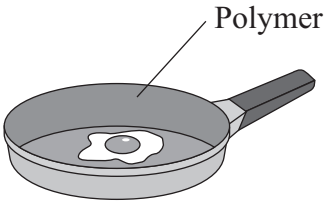
Use A



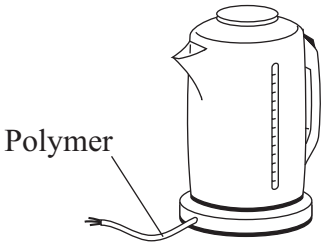
Use B



Use C



Use D



The table shows some of the properties of four different polymers.

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

	Properties of the polymer
1	strong, does not rot and can be pulled into fine threads
2	tough, slippery and can be heated strongly
3	flexible, can be coloured and is a good electrical insulator
4	rigid, transparent and can easily be cut into any shape

4.2.2.5 Polymers

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

4.2.2.5 Polymers

Question 16

June 2009 | CHY1BP | Original Q2 | Legacy

QUESTION TWO

The table shows the properties of four polymers **A**, **B**, **C** and **D**.

	Polymer	Properties
A	PTFE	can withstand high temperatures and is non-stick
B	Nylon	strong, does not rot and can be pulled into fibres
C	Polystyrene	makes a very light, solid foam which is a good heat insulator
D	PET	strong, light, waterproof and can be recycled

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

	How the polymer could be used
1	to make disposable cups for hot drinks
2	to make the coating on frying pans
3	to make string and ropes
4	to make bottles for soft drinks

4.2.2.5 Polymers

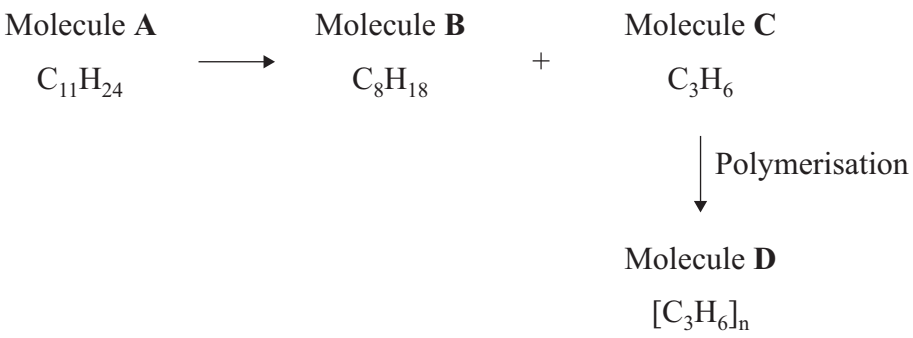
Question 17

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** . . . .

4.2.2.5 Polymers

Question 18

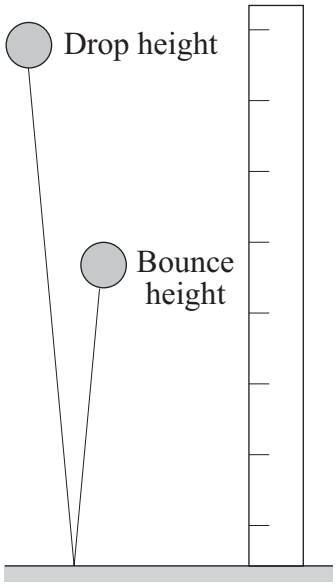
June 2009 | CHY1BP | Original Q6 | Legacy

QUESTION SIX

A student tested two balls; one ball was made from natural rubber and the other from a new polymer.

The student dropped the rubber ball from a measured height and recorded the height to which it bounced. The student did the experiment using different drop heights.

The student repeated the whole experiment using the polymer ball.



The results are shown in the table.

Drop height in cm	Rubber ball bounce height in cm	Polymer ball bounce height in cm
20	14	18
40	28	36
60	42	54
80	67	71
100	70	90

6A To improve the reliability of the results, the student could have . . .

1 repeated the test with balls made of different polymers.

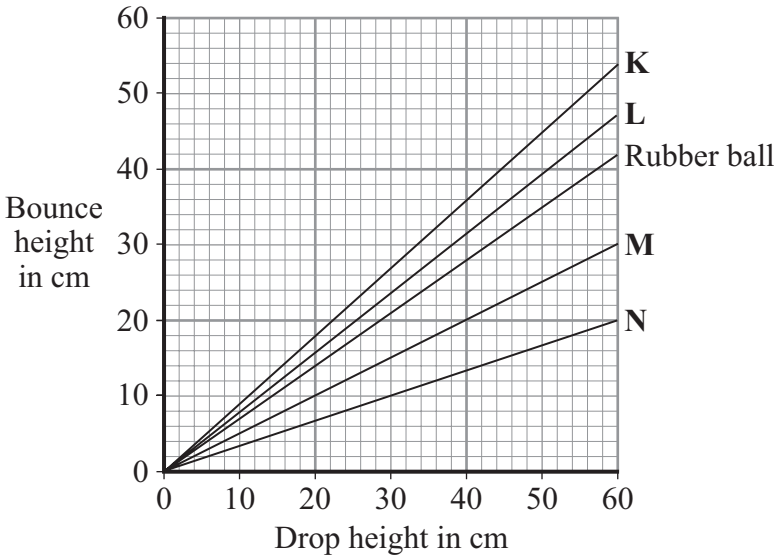
2 repeated the experiment for each drop height several times.

3 used a longer measuring instrument.

4 dropped the ball onto a harder surface.

Question 18 · continued June 2009 | CHY1BP | Original Q6 | Legacy

6B Which of the lines, **K**, **L**, **M** or **N**, on the graph, represents the polymer ball?



1 **K**

2 **L**

3 **M**

4 **N**

6C Which one of the following values **in the table** for the bounce height is clearly anomalous?

1 28 cm for the rubber ball

2 67 cm for the rubber ball

3 36 cm for the polymer ball

4 71 cm for the polymer ball

6D The results show that for each drop height . . .

1 the rubber ball will bounce higher than the polymer ball.

2 the polymer ball will bounce higher than the rubber ball.

3 the rubber ball will bounce higher as it warms up.

4 the rubber ball becomes less bouncy the more it is used.

4.2.2.5 Polymers

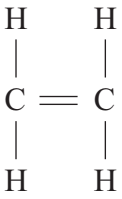
Question 19

November 2009 | CHY1BP | Original Q9 | Legacy

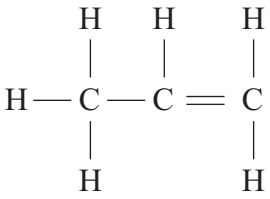
QUESTION NINE

The diagram shows three compounds.

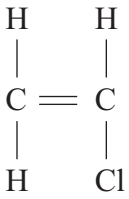
Compound W



Compound X



Compound Y



9A Which of the compounds are hydrocarbons?

1 **W** and **X**

2 **W** and **Y**

3 **X** and **Y**

4 **W**, **X** and **Y**

9B Which row in the table correctly describes the bonding in Compound **X**?

	Number of bonds to each carbon atom	Number of bonds to each hydrogen atom
1	1	1
2	1	4
3	4	1
4	4	4

9C All three compounds can form polymers because . . .

1 they have saturated molecules.

2 their molecules contain two or more carbon atoms.

3 their molecules have a double carbon carbon bond.

4 they have small molecules.

4.2.2.5 Polymers

Question 19 · continued

9D Disposal of polymer waste can be a problem.

The main reason that it causes problems in a landfill site is that . . .

1 it is very light.

2 it is not easily broken down by microorganisms.

3 it is difficult to bury.

4 it burns easily, releasing toxic gases.

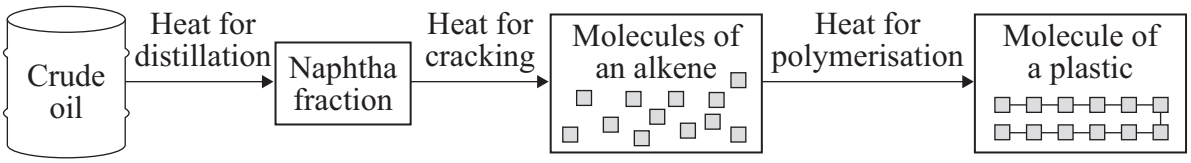
END OF TEST

4.2.2.5 Polymers

Question 20

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)

4.2.2.5 Polymers

Question 20 · 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

4.2.2.5 Polymers

Question 21

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

4.2.2.5 Polymers

Question 22

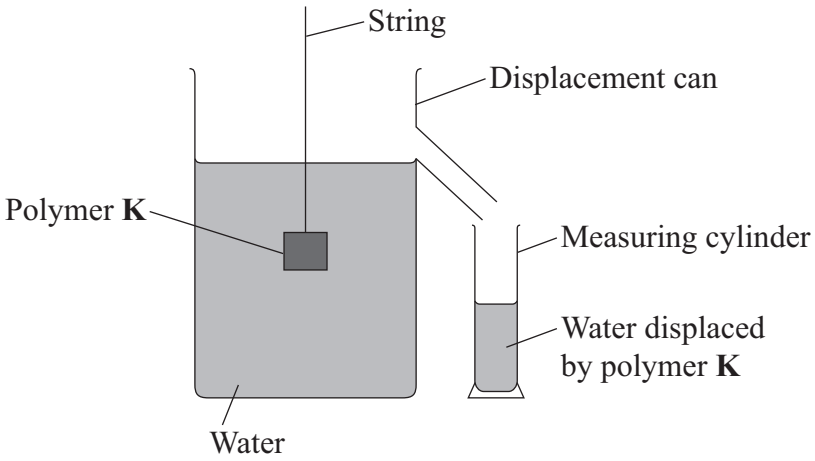
March 2010 | CHY1BP | Original Q6 | Legacy

QUESTION SIX

Some polymers can be used for tooth fillings. A good polymer should not shrink in the tooth cavity.

A scientist tested a polymer, **K**, to see how much it shrinks when it sets.

- He made a sample of the polymer in a container with a volume of 10 cm^3 exactly.
- He allowed the polymer to set hard.
- He removed the polymer from the container and measured its volume again, using the apparatus shown.
- He repeated the test three times.



The scientist then tested three different polymers, **L**, **M** and **N**, in exactly the same way.

The results are shown in the table.

Polymer	Volume of water displaced in cm^3			
	Test 1	Test 2	Test 3	Test 4
K	9.6	9.8	9.7	9.8
L	7.8	8.2	8.9	10.2
M	9.2	9.5	9.6	10.0
N	9.2	9.6	8.5	9.7

4.2.2.5 Polymers

Question 22 · continued

6A Which statement about the results is correct?

1 All four polymers would be equally good as dental fillings.

2 Polymer **K** shows the most consistent results.

3 Polymer **L** is the best for dental fillings because it gives the highest values.

4 If the third test is ignored, polymer **N** is the best polymer for dental fillings.

6B Which one of the following could be the reason for the reading of 10.2 cm^3 for polymer **L**, **Test 4**?

1 The piece of string was too long.

2 The polymer was dropped into the water in the displacement can.

3 At the start, the water was below the level of the spout.

4 Some water had evaporated.

6C One of the tests on polymer **M** gives a volume of 10.0 cm^3.

Does this mean it is the best polymer?

1 Yes, because it has given the volume needed.

2 No, because a single result should not be relied upon.

3 Yes, because it would be the highest value that could be obtained.

4 No, because the first test is always the most accurate.

6D Any polymer used for dental fillings should **not** be biodegradable because it would . . .

1 cost too much to make.

2 be poisonous.

3 shrink too much.

4 break down after it has been put in place.

4.2.2.5 Polymers

Question 23

June 2010 | CHY1BP | Original Q3 | Legacy

QUESTION THREE

The following table lists some properties of four different polymers, **A**, **B**, **C** and **D**.

Polymer	Maximum working temperature in °C	Appearance	Flexibility	Breaking strength
A	250	Grey	Medium	High
B	80	White	High	High
C	70	Transparent	Low	High
D	110	Transparent	High	Low

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

	Most suitable polymer for
1	non-stick coating for cooking pans
2	spectacle lenses
3	cling film (for covering food)
4	toothbrush bristles

4.2.2.5 Polymers

Question 24

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.

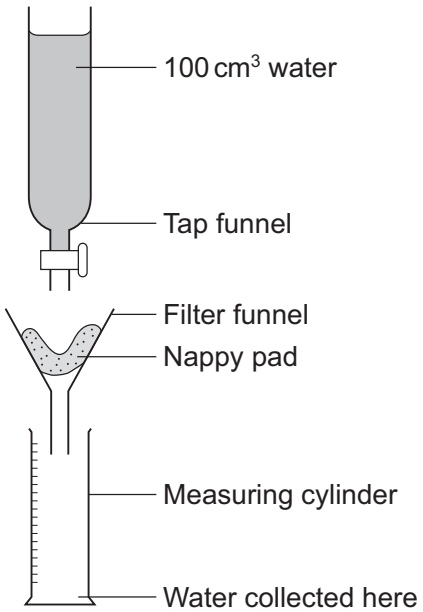
4.2.2.5 Polymers

Question 25

June 2019 | CHY1F | Original Q5 | Legacy

5 Disposable nappies for babies need to absorb as much water as possible.
Disposable nappies have a pad containing a special polymer called a hydrogel.
Hydrogels absorb water.

A company called Aqanaps compared the water absorption of its nappy pads with nappy pads made by other companies.



- A scientist from Aqanaps poured 100 cm^3 of water onto the pad of one of its nappies.
- He measured the volume of water that passed through.
- He did the test three times using a new nappy pad for each test.
- The scientist then repeated the procedure using the nappy pads from three other companies, **A**, **B** and **C**.

The results are shown in the table.

Company	Volume of water collected in cm^3		
	Pad 1	Pad 2	Pad 3
Aqanaps	55	57	55
A	47	46	39
B	65	63	64
C	38	39	38

4.2.2.5 Polymers

Question 25 · continued

5 (a) (i) Choose **one** result in the table that should be tested again.

Result: Company ..... Pad .....

Explain why you chose this result.

.....

.....

.....

(2 marks)

5 (a) (ii) Suggest **one** variable that should be controlled in this investigation.

.....

.....

(1 mark)

5 (a) (iii) Suggest **one** possible cause of error in this investigation.

.....

.....

(1 mark)

5 (b) (i) The Aqanaps company studied the results. The company concluded that it should increase the amount of hydrogel used in its nappy pads.

Give **two** reasons why the company decided to increase the amount of hydrogel used in its nappy pads.

1 .....

.....

2 .....

.....

(2 marks)

5 (b) (ii) Suggest **one** disadvantage for the company if it increases the amount of hydrogel used in its nappy pads.

.....

.....

(1 mark)

7

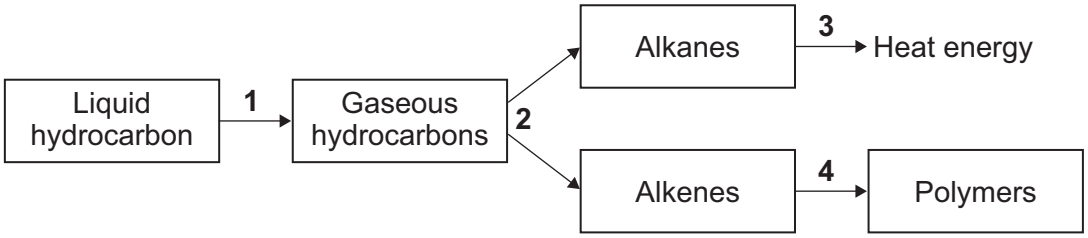
4.2.2.5 Polymers

Question 26

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

4.2.2.5 Polymers

Question 27

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

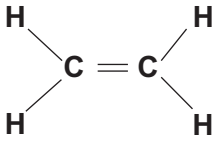
4.2.2.5 Polymers

Question 28

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

4.2.2.5 Polymers

Question 29

January 2011 | CHY3F | Original Q3 | Legacy

3 This label was on a bottle of vinegar.



Vinegar contains ethanoic acid, which is a *weak* acid.

3 (a) Draw a ring around the correct answer to complete the sentences.

3 (a) (i) Ethanoic acid is an acid because it contains [hydrogen / hydroxide / oxide] ions.

(1 mark)

3 (a) (ii) Ethanoic acid is a *weak* acid because it is [completely / not / partially] ionised in water.

(1 mark)

3 (b) Magnesium ribbon can be used in a test to show that ethanoic acid is a weaker acid than hydrochloric acid.

3 (b) (i) State **one** way of making this test fair.

.....

.....

(1 mark)

3 (b) (ii) Give the results of this test.

.....

.....

.....

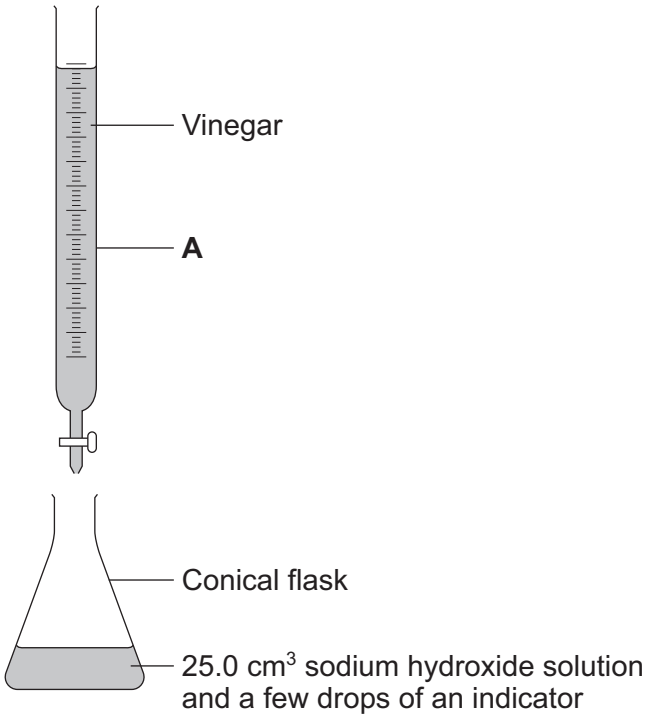
.....

(2 marks)

4.2.2.5 Polymers

Question 29 · continued

3 (c) The diagram shows the apparatus a student used to find the volume of vinegar that reacts with 25.0 cm^3 of sodium hydroxide solution.



3 (c) (i) Choose the correct word from the box to complete the sentence.

filtration	**polymerisation**	**titration**

The name of this method is ..... .

(1 mark)

3 (c) (ii) Which **one** of the following is the correct name for apparatus **A**?

Draw a ring around **one** answer.

burette **measuring cylinder** **pipette**

(1 mark)

3 (c) (iii) State how the student knew when enough vinegar had been added.

.....

.....

(1 mark)

8

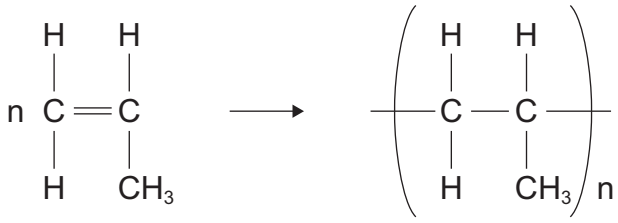
4.2.2.5 Polymers

Question 30

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.

4.2.2.5 Polymers

Question 30 · 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

4.2.2.5 Polymers

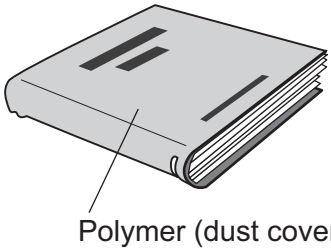
Question 31

June 2011 | CHY1BP | Original Q1 | Legacy

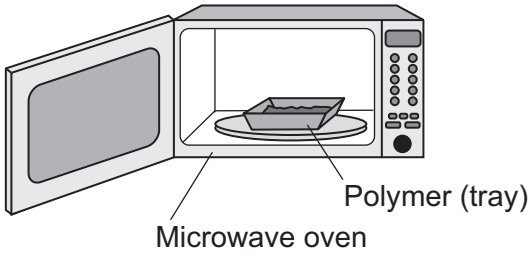
QUESTION ONE

The drawings show four different ways in which polymers are used.

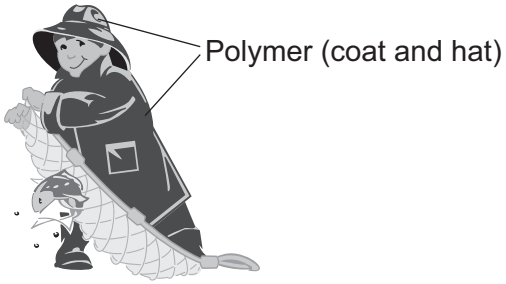
A



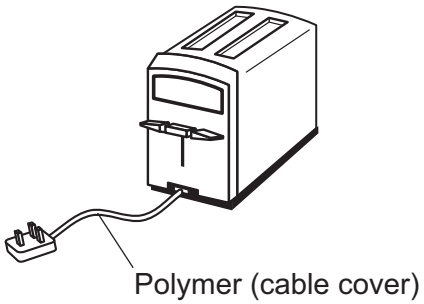
B



C



D



For each of the uses shown, the polymer must have particular properties.

4.2.2.5 Polymers

Question 31 · continued

The table shows the properties of four different polymers.

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

	Properties of the polymer
1	flexible, and must be a good electrical insulator
2	heat resistant and resistant to chemical attack
3	transparent, hard wearing and flexible
4	waterproof, breathable, flexible and can be coloured

Turn over for the next question

4.2.2.5 Polymers

Question 32

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** . . . .

4.2.2.5 Polymers

Question 33

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.

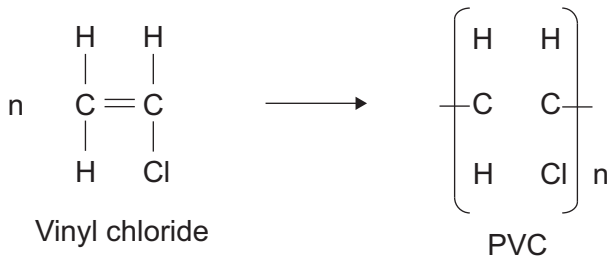
Complete the chemical equation by writing in the formula of the product vinyl chloride.

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

(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)

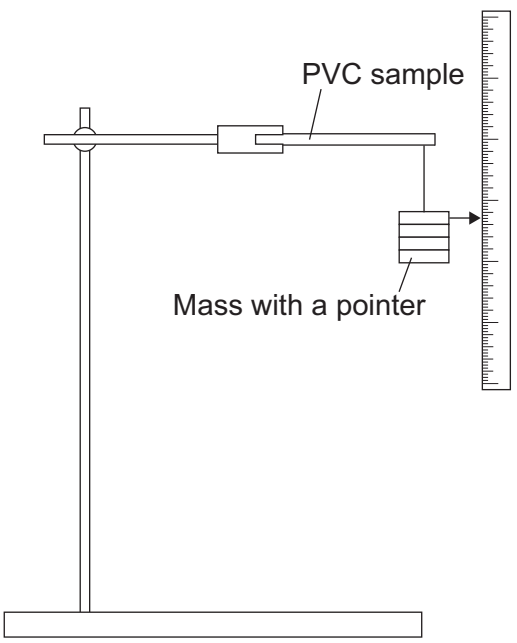
Question 7 continues on the next page

4.2.2.5 Polymers

Question 33 · 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)

4.2.2.5 Polymers

Question 33 · 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

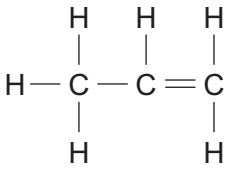
4.2.2.5 Polymers

Question 34

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)

4.2.2.5 Polymers

Question 34 · 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

4.2.2.5 Polymers

Question 35

November 2011 | CHY1BP | Original Q2 | Legacy

QUESTION TWO

Different polymers have different properties.

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

A can withstand high temperatures and is non-stick

B can be stretched into fibres

C makes a very light, solid foam which is a good heat insulator

D strong, rigid and a good electrical insulator

	Uses
1	to make disposable cups for hot drinks
2	to make the coating on frying pans
3	to make shirts and trousers
4	to make the handles of tools

4.2.2.5 Polymers

Question 36

November 2011 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

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

An example is shown below.

Hydrocarbon **K** (large molecule) $\rightarrow$ C_6H_{12} + C_3H_6 + C_3H_8

9A What are the conditions needed for this reaction to take place most successfully?

1 heat hydrocarbon **K** vapour over a hot catalyst

2 heat hydrocarbon **K** vapour with hydrogen

3 heat hydrocarbon **K** with a dilute acid

4 heat hydrocarbon **K** at 40 °C

9B The formula for hydrocarbon **K** is . . .

1 C_9H_{18}

2 $C_{12}H_{24}$

3 $C_{12}H_{26}$

4 $C_{26}H_{12}$

9C Which row in the table shows the products that react with bromine water and the colour change seen when they react?

	Product(s)	Colour change
1	C_6H_{12} and C_3H_6	from yellow-brown to colourless
2	C_3H_6 and C_3H_8	from yellow-brown to colourless
3	C_6H_{12} and C_3H_6	from colourless to yellow-brown
4	C_3H_8 only	from yellow-brown to colourless

4.2.2.5 Polymers

Question 36 · continued

9D Two of the products can form polymers because . . .

1 they are obtained from crude oil by fractional distillation.

2 they are saturated compounds.

3 their molecules have a double carbon carbon bond.

4 they vaporise at temperatures below 20 °C.

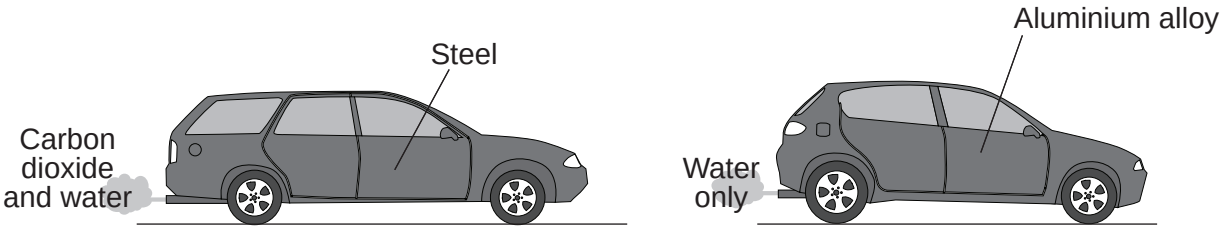
END OF TEST

4.2.2.5 Polymers

Question 37

June 2012 | CH1FP | Original Q3 | Legacy

3 The picture shows two different cars.



3 (a) Some properties of aluminium are given below.

Tick (✓) **two** reasons why aluminium is better than steel for car bodies.

Reason	Tick (✓)
Aluminium is not a transition metal.	
Aluminium has a low density.	
Aluminium is expensive to extract.	
Aluminium is resistant to corrosion.	

(2 marks)

3 (b) Each car body is made from an *alloy*.

3 (b) (i) What is an *alloy*?

.....

.....

(1 mark)

3 (b) (ii) An alloy is used to make a car body. A pure metal is **not** used to make a car body.

Suggest why.

.....

.....

(1 mark)

4.2.2.5 Polymers

Question 37 · continued

3 (c) The car with a steel body uses petrol for fuel.

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

3 (c) (i) Petrol is made from

air.
crude oil.
metal ores.

(1 mark)

3 (c) (ii) Petrol is a mixture of

carbonates
hydrocarbons
polymers

including C_8H_{18}

(1 mark)

3 (c) (iii) In the car engine petrol reacts with

argon
nitrogen
oxygen

to produce carbon dioxide and water.

(1 mark)

3 (d) Look at the substances coming out of each car's exhaust.

3 (d) (i) Suggest the name of the fuel used in the car with the aluminium alloy body.

Name of fuel .....

(1 mark)

3 (d) (ii) Why is the fuel burned in the car with the aluminium alloy body better for the environment than petrol?

.....

.....

(1 mark)

9

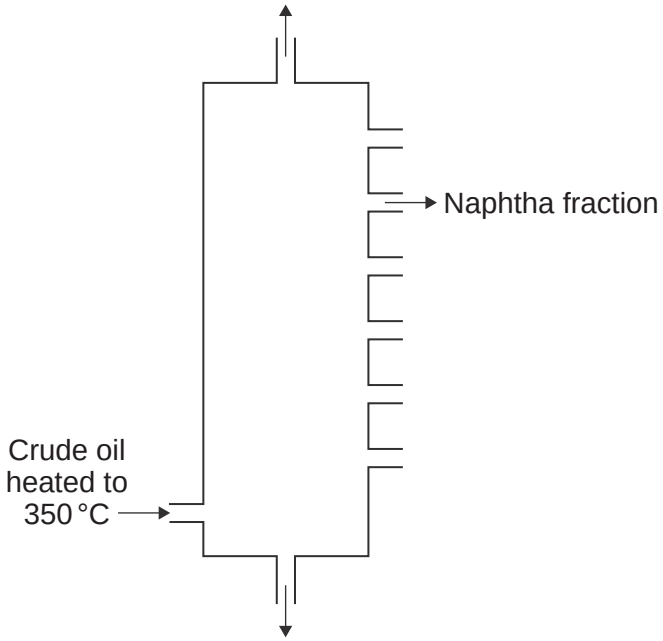
4.2.2.5 Polymers

Question 38

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)

4.2.2.5 Polymers

Question 38 · 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).

.....

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.....

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(6 marks)

10

4.2.2.5 Polymers

Question 39

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)

4.2.2.5 Polymers

Question 39 · 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.

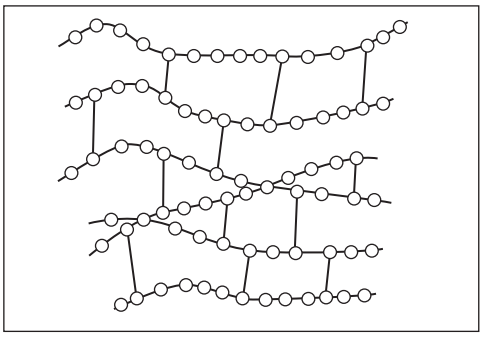
solidify.

(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

4.2.2.5 Polymers

Question 40

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

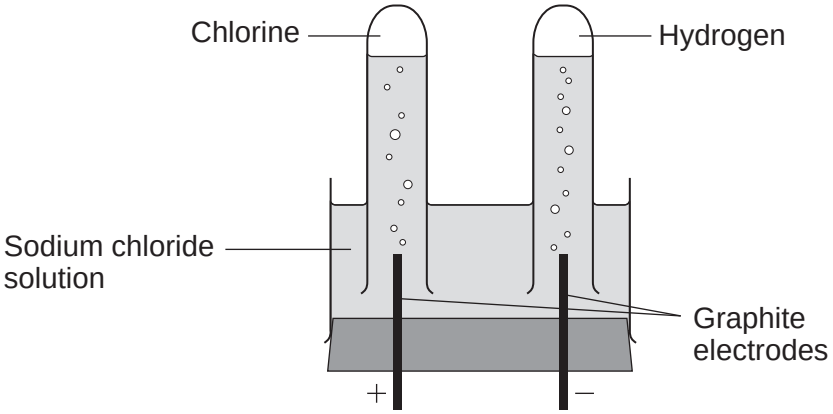
4.2.2.5 Polymers

Question 41

January 2013 | CH2FP | Original Q8 | Legacy

8 The electrolysis of sodium chloride solution is an industrial process.

The diagram shows the apparatus used in a school experiment.



8 (a) One of the products of the electrolysis of sodium chloride solution is hydrogen.

8 (a) (i) Why do hydrogen ions move to the negative electrode?

.....

.....

(1 mark)

8 (a) (ii) How does a hydrogen ion change into a hydrogen atom?

.....

.....

(1 mark)

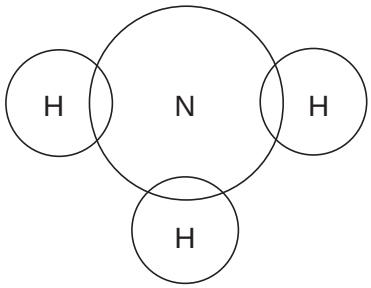
Question 41 · continued

8 (b) Hydrogen is used to make ammonia (NH_3).

Complete the diagram to show the bonding in ammonia.

Use dots (●) and crosses (x) to show electrons.

Show only outer shell electrons.



(2 marks)

8 (c) The table shows the ions in sodium chloride solution.

Positive ions	Negative ions
hydrogen	chloride
sodium	hydroxide

In industry, some of the waste from the electrolysis of sodium chloride solution is alkaline and has to be neutralised.

8 (c) (i) Which ion makes the waste alkaline?

.....

(1 mark)

8 (c) (ii) This waste must be neutralised.

Write the ionic equation for the neutralisation reaction.

.....

(1 mark)

Question 8 continues on the next page

4.2.2.5 Polymers

Question 41 · continued

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

The electrolysis of sodium chloride solution also produces chlorine and sodium hydroxide.

In industry, the electrolysis of sodium chloride solution can be done in several types of electrolysis cell.

Some information about two different types of electrolysis cell is given below.

	Mercury cell	**Membrane cell**
Cost of construction	Expensive	Relatively cheap
Additional substances used	Mercury, which is recycled. Mercury is toxic so any traces of mercury must be removed from the waste.	Membrane, which is made of a polymer. The membrane must be replaced every 3 years.
Amount of electricity used for each tonne of chlorine produced in kWh	3400	2950
Quality of chlorine produced	Pure	Needs to be liquefied and distilled to make it pure.
Quality of sodium hydroxide solution produced	50% concentration. Steam is used to concentrate the sodium hydroxide solution produced.	30% concentration. Steam is used to concentrate the sodium hydroxide solution produced.

Use the information and your knowledge and understanding to compare the environmental and economic advantages and disadvantages of these **two** types of electrolysis cell.

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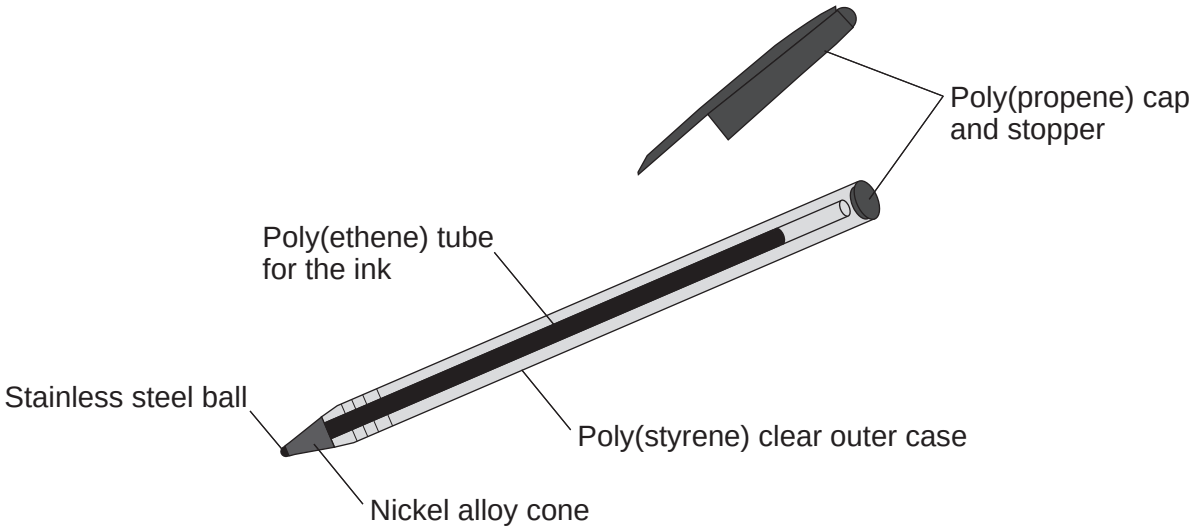
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4.2.2.5 Polymers

Question 42

June 2013 | CH1FP | Original Q5 | Legacy

5 The diagram shows a ballpoint pen.



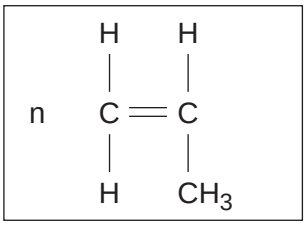
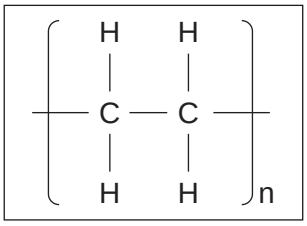
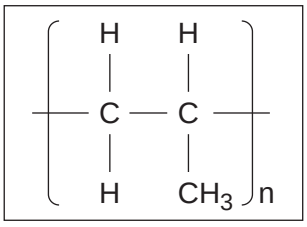
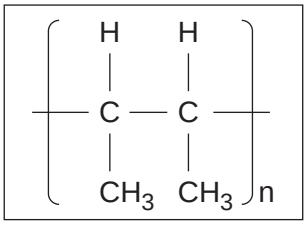
5 (a) Polymers are used to make the ballpoint pen.

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).

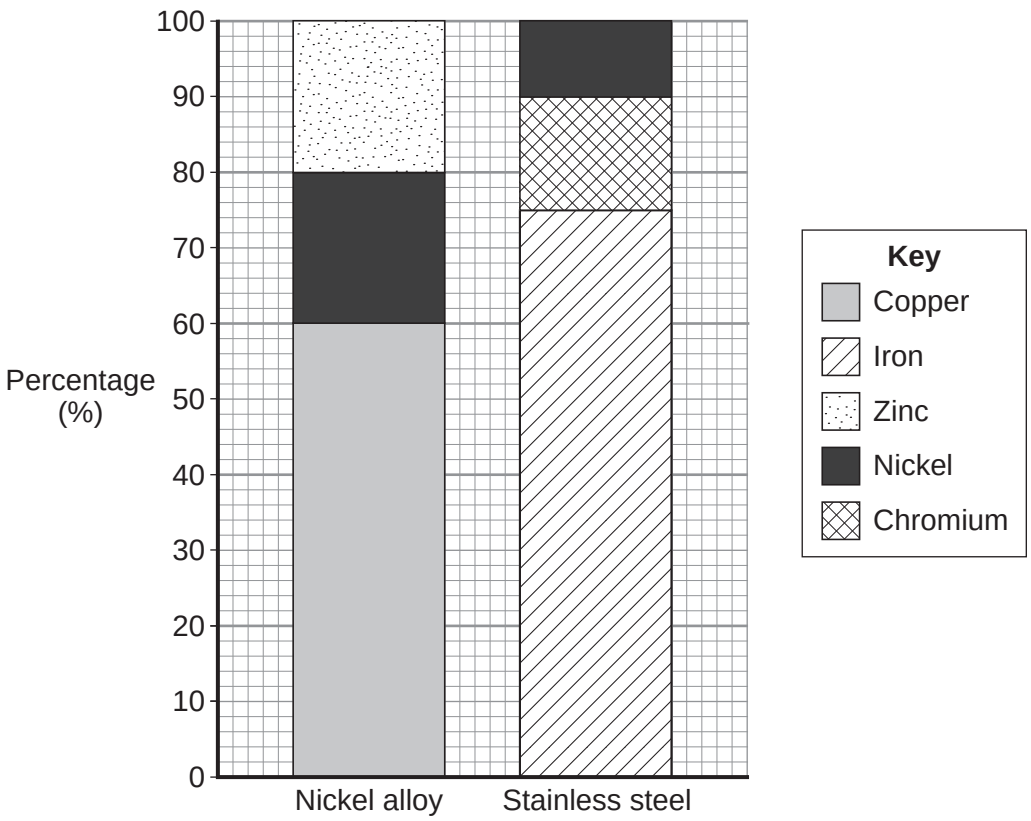
Monomer	Polymer
	
	
	

(1 mark)

4.2.2.5 Polymers

Question 42 · 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)

4.2.2.5 Polymers

Question 42 · 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

4.2.2.5 Polymers

Question 43

June 2013 | CH2FP | Original Q2 | Legacy

2 This question is about salts of ammonia and salts of lead.

2 (a) Ammonia dissolves in water to make an alkaline solution.

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

The pH of a solution of ammonia is

2.
7.
11.

(1 mark)

2 (b) Ammonia can be reacted with an acid to produce the salt ammonium nitrate.

2 (b) (i) Name the acid used to produce ammonium nitrate.

.....

(1 mark)

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

The reaction of ammonia with an acid is a

neutralisation
polymerisation
reduction

reaction.

(1 mark)

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

.....

.....

(1 mark)

4.2.2.5 Polymers

Question 43 · continued

2 (d) Lead iodide is a salt that can be produced without using an acid.

2 (d) (i) Lead iodide is produced by mixing two solutions.

Complete the word equation.

lead ..... + potassium ..... ⟶ lead iodide + potassium nitrate

(2 marks)

2 (d) (ii) The lead iodide is produced as a solid.

Complete the sentence.

A solid that is produced when two solutions are mixed is called a ..... .

(1 mark)

2 (d) (iii) How could the solid lead iodide be separated from the solution?

.....

(1 mark)

2 (d) (iv) A student mixed two solutions to make sodium chloride.

The equation for the reaction the student used is:

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

How could the student obtain solid sodium chloride from the solution?

.....

(1 mark)

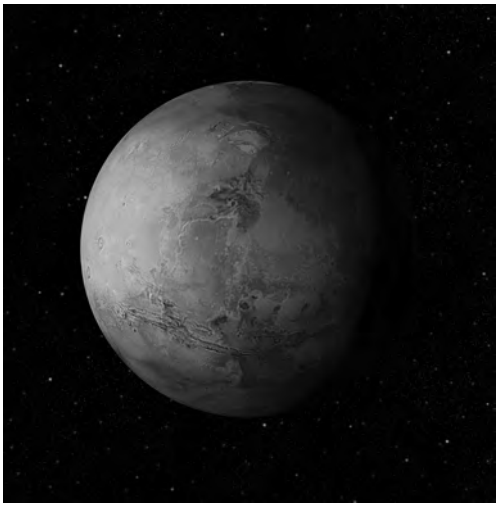
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4.2.2.5 Polymers

Question 44

June 2013 | CH2FP | Original Q5 | Legacy

5 This question is about the planet Mars.



5 (a) Mars is a red colour in the sky at night.

The red colour of Mars is because of iron oxide.

Iron oxide is an ionic compound.

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

Ionic compounds are made of

- giant lattices.
- polymer chains.
- simple molecules.

(1 mark)

5 (b) Many spacecraft have been sent to Mars. Parts of these spacecraft are made from polymers.

5 (b) (i) Polymers that behave like shape memory alloys are used in spacecraft.

The shape memory polymers are cooled and compressed. These polymers are stored on the spacecraft until needed.

Suggest how the polymers could be made to return to their original shape.

.....

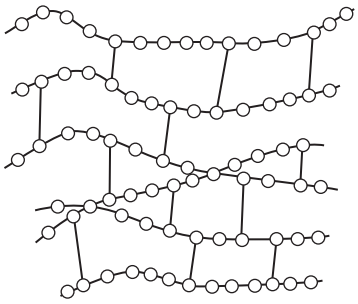
(1 mark)

4.2.2.5 Polymers

Question 44 · continued

5 (b) (ii) Thermosetting polymers are used for the tiles on the outside of spacecraft.

The diagram shows the structure of a thermosetting polymer.



Explain, in terms of structure, why some polymers are thermosetting.

.....

.....

.....

.....

(2 marks)

5 (c) Instrumental methods such as GC–MS are used to analyse substances found on Mars.

In GC–MS, gas chromatography columns are linked to mass spectrometers.

5 (c) (i) What does gas chromatography do to the substances?

.....

.....

(1 mark)

5 (c) (ii) Give **two** reasons for using instrumental methods for analysis.

1 .....

.....

2 .....

.....

(2 marks)

7

4.2.2.5 Polymers

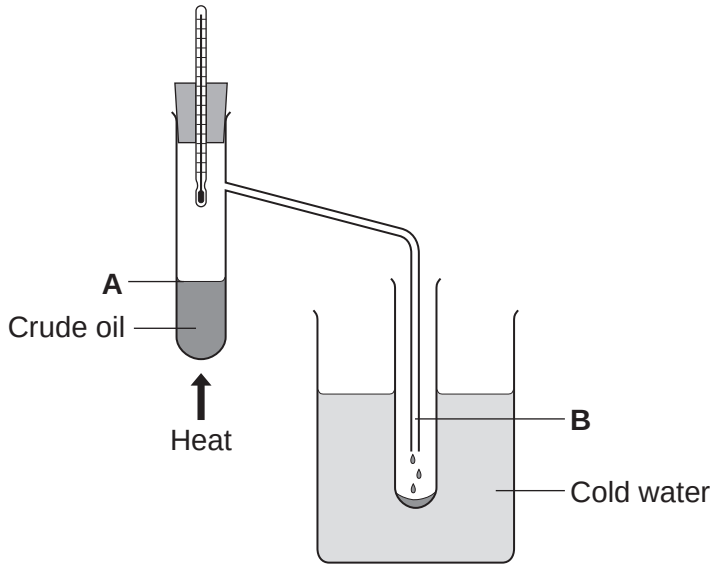
Question 45

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 ..... .

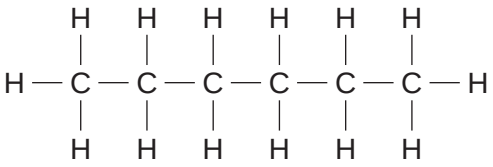
[1 mark]

4.2.2.5 Polymers

Question 45 · 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

4.2.2.5 Polymers

Question 46

June 2014 | CH1FP | Original Q5 | Legacy

5 Where copper ore has been mined there are areas of land that contain very low percentages of copper compounds.

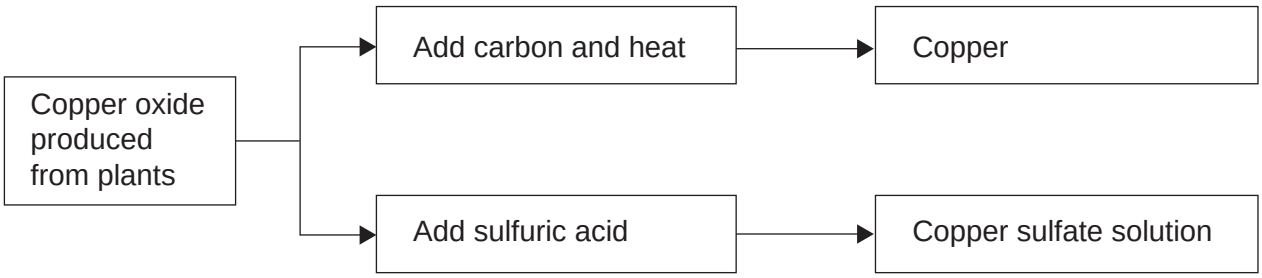
One way to extract the copper is to grow plants on the land.

The plants absorb copper compounds through their roots.

The plants are burned to produce copper oxide.

The copper oxide produced from plants can be reacted to produce copper or copper sulfate solution, as shown in **Figure 6**.

Figure 6



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

5 (a) (i) Copper ores contain enough copper to make extraction of the metal

carbon neutral.

economical.

reversible.

[1 mark]

5 (a) (ii) Using plants to extract metals is called

photosynthesis.

phytomining.

polymerisation.

[1 mark]

5 (a) (iii) Copper oxide reacts with carbon to produce copper and

carbon dioxide.

oxygen.

sulfur dioxide.

[1 mark]

4.2.2.5 Polymers

Question 46 · continued

5 (b) Copper is produced from copper sulfate solution by displacement using iron or by electrolysis.

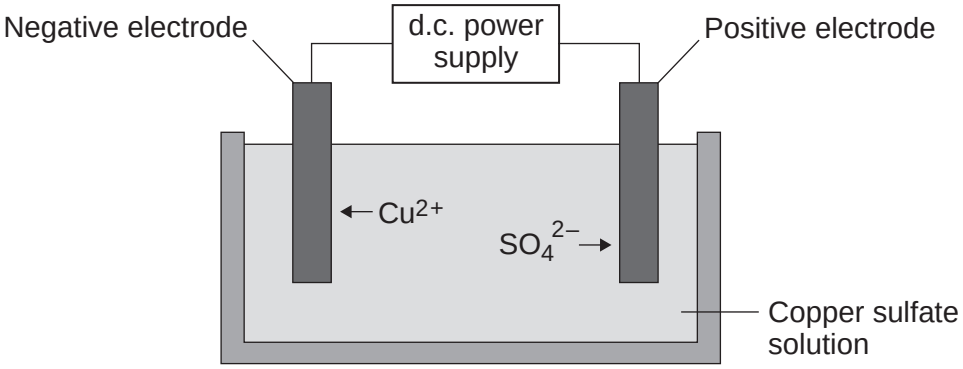
5 (b) (i) Complete the word equation.

[2 marks]

copper sulfate + iron ⟶ ..... + ...

5 (b) (ii) **Figure 7** shows the electrolysis of copper sulfate solution.

Figure 7



Why do copper ions go to the negative electrode?

[1 mark]

.....

.....

5 (c) Suggest **two** reasons why copper should **not** be disposed of in landfill sites.

[2 marks]

.....

.....

.....

.....

8

4.2.2.5 Polymers

Question 47

June 2014 | CH2FP | Original Q2 | Legacy

2 Dental braces are made from nitinol wires. Nitinol is a mixture of metals.



2 (a) Nitinol can return to its original shape after being deformed.

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

[1 mark]

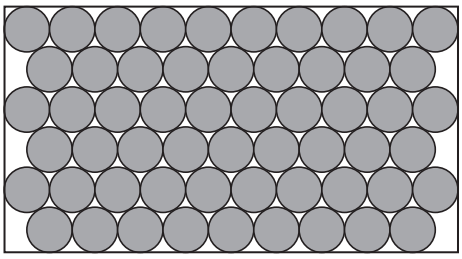
Nitinol is a shape memory

alloy.
catalyst.
polymer.

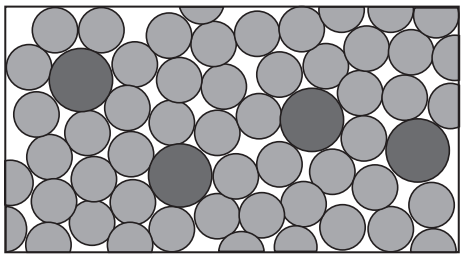
2 (b) **Figure 2** shows the arrangement of atoms in a pure metal and in a mixture of metals.

Figure 2

Pure metal



Mixture of metals



The mixture of metals is harder than the pure metal.

Use **Figure 2** to explain why.

[2 marks]

.....

.....

.....

.....

4.2.2.5 Polymers

Question 47 · continued

2 (c) Gold and stainless steel are also used for dental braces.

Suggest **two** factors to consider when choosing which metal to use for dental braces.

[2 marks]

.....

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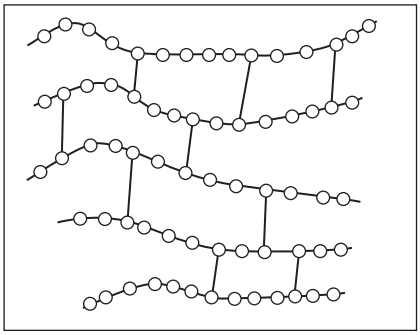
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2 (d) A thermosetting polymer is used to hold dental braces on the teeth.

Figure 3 shows the structure of a thermosetting polymer.

Figure 3

Thermosetting polymer



How can you tell from **Figure 3** that the polymer is thermosetting?

[1 mark]

.....

.....

6

4.2.2.5 Polymers

Question 48

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]

.....

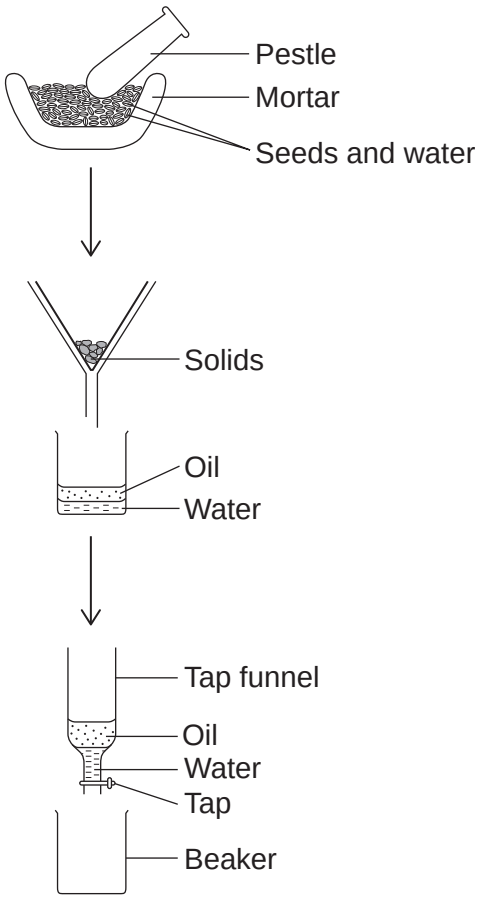
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4.2.2.5 Polymers

Question 48 · 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]

.....

.....

.....

.....

4.2.2.5 Polymers

Question 48 · 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

4.2.2.5 Polymers

Question 49

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]

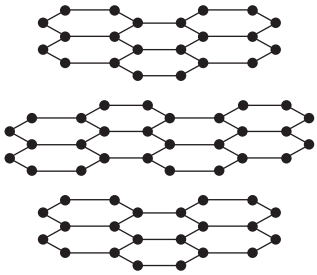
hundred	**million**	**thousand**

Nanoparticles contain a few _____ atoms.

2 (b) Graphite is made of carbon atoms.

Figure 4 shows the structure of graphite.

Figure 4



4.2.2.5 Polymers

Question 49 · 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

4.2.2.5 Polymers

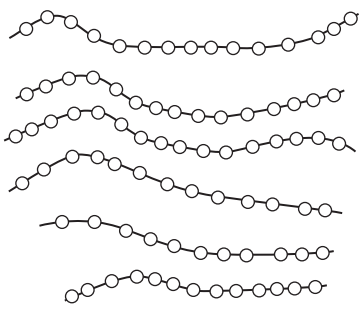
Question 49 · continued

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 _____

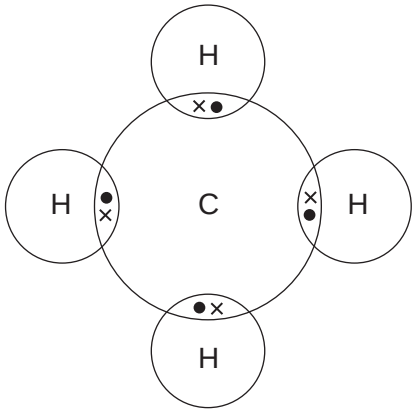
2 _____

4.2.2.5 Polymers

Question 49 · 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

4.2.2.5 Polymers

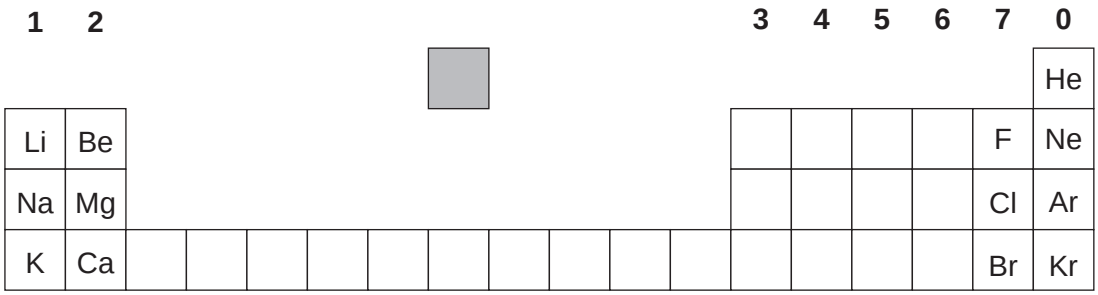
Question 50

June 2017 | CH1FP | Original Q2 | Legacy

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

Figure 2 shows part of the periodic table.

Figure 2



2 (a) Give the name of the element that should be in the shaded box.

[1 mark]

2 (b) How many different elements are there in the complete periodic table?

[1 mark]

Tick (✓) **one** box.

About 36 ☐

About 100 ☐

About 500 ☐

4.2.2.5 Polymers

Question 50 · continued

2 (c) What are **two** reasons why lithium, sodium and potassium are in the same group of the periodic table?

[2 marks]

Tick (✓) **two** boxes.

- Low melting points ☐
- Same number of electrons in the outer shell ☐
- Similar atomic (proton) numbers ☐
- Similar chemical reactions ☐
- Two electrons in the innermost shell ☐

2 (d) Complete each sentence.

[2 marks]

The elements in Group 0 are called _____ gases.

The elements in the central block are known as _____ metals.

2 (e) Use the correct word from the box to complete each sentence.

[2 marks]

alloys	ions	molecules	polymers	protons

Atoms of fluorine gain electrons to form fluoride _____ .

Atoms of fluorine share electrons to form fluorine _____ .

8

4.2.2.5 Polymers

Question 51

June 2017 | CH2FP | Original Q2 | Legacy

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

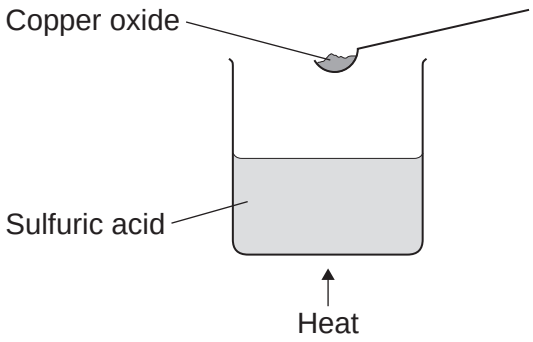
2 (a) A student added copper oxide to sulfuric acid to make copper sulfate.

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

4.2.2.5 Polymers

Question 51 · 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.

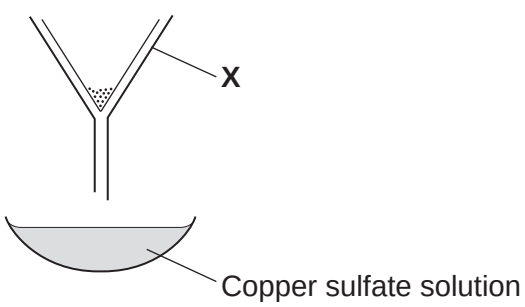
To make bigger copper sulfate crystals. ☐

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



4.2.2.5 Polymers

Question 51 · 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]

_____

4.2.2.5 Polymers

Question 51 · 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

4.2.2.5 Polymers

Question 52

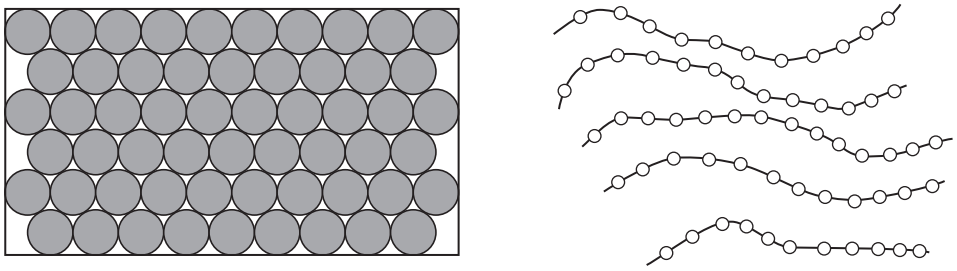
June 2017 | CH2FP | Original Q6 | Legacy

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

Metals and thermosoftening polymers have different properties.

Figure 12 shows structures of a metal and a thermosoftening polymer.

Figure 12



Explain how the properties of a metal and a thermosoftening polymer relate to their structures.

In your answer you should describe the structures of a metal and a thermosoftening polymer.

[6 marks]

4.2.2.5 Polymers

Question 53

June 2018 | 8462/1F | Original Q6

0 6 A student investigated the temperature change in displacement reactions between metals and copper sulfate solution.

This is the method used.

1. Measure 50 cm^3 of the copper sulfate solution into a polystyrene cup.
2. Record the starting temperature of the copper sulfate solution.
3. Add the metal and stir the solution.
4. Record the highest temperature the mixture reaches.
5. Calculate the temperature increase for the reaction.
6. Repeat steps 1-5 with different metals.

0 6 . 1 Draw **one** line from each type of variable to the name of the variable in the investigation.

[2 marks]

Type of variable	Name of variable in the investigation
	Concentration of solution
Dependent variable	Particle size of solid
	Temperature change
Independent variable	Type of metal
	Volume of solution

4.2.2.5 Polymers

Question 53 · continued

0 6 . 2 The student used a polystyrene cup and **not** a glass beaker.

Why did this make the investigation more accurate?

[1 mark]

Tick **one** box.

- Glass is breakable ☐
- Glass is transparent ☐
- Polystyrene is a better insulator ☐
- Polystyrene is less dense ☐

Question 6 continues on the next page

Question 53 · continued

Table 5 shows the student's results.

Table 5

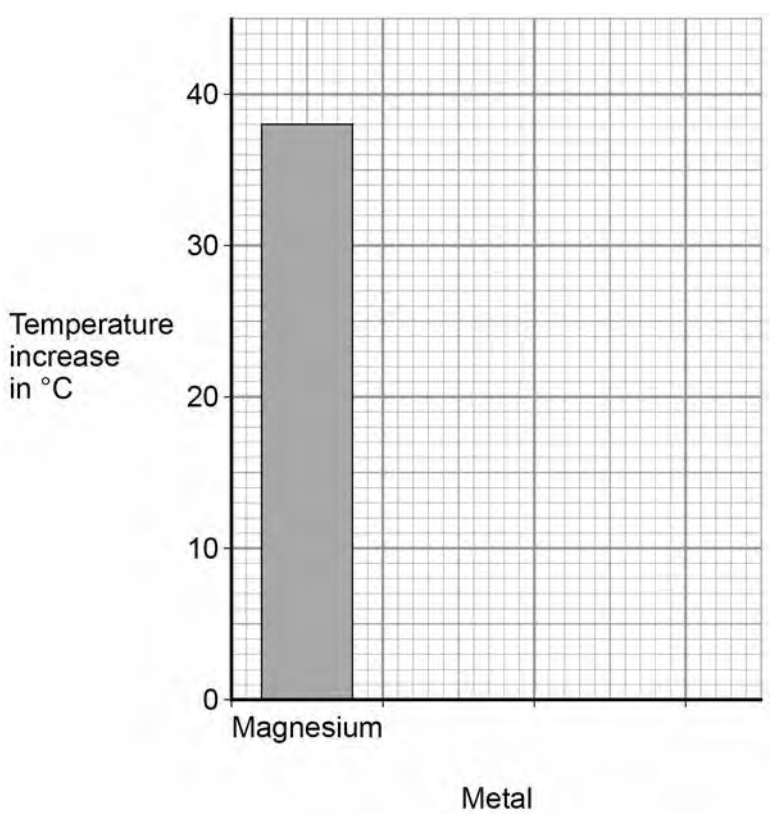
Metal	Temperature increase in °C
Magnesium	38
Nickel	8
Zinc	16

0 6 . 3 Complete **Figure 9**.

Use data from **Table 5**.

[2 marks]

Figure 9



4.2.2.5 Polymers

Question 53 · continued

0 6 . 4 The student concluded that the reactions between the metals and copper sulfate solution are endothermic.

Give **one** reason why this conclusion is **not** correct.

[1 mark]

0 6 . 5 The temperature increase depends on the reactivity of the metal.

Write the metals magnesium, nickel and zinc in order of reactivity.

Use **Table 5**.

[1 mark]

Most reactive _____

_____

Least reactive _____

0 6 . 6 **Y** is an unknown metal.

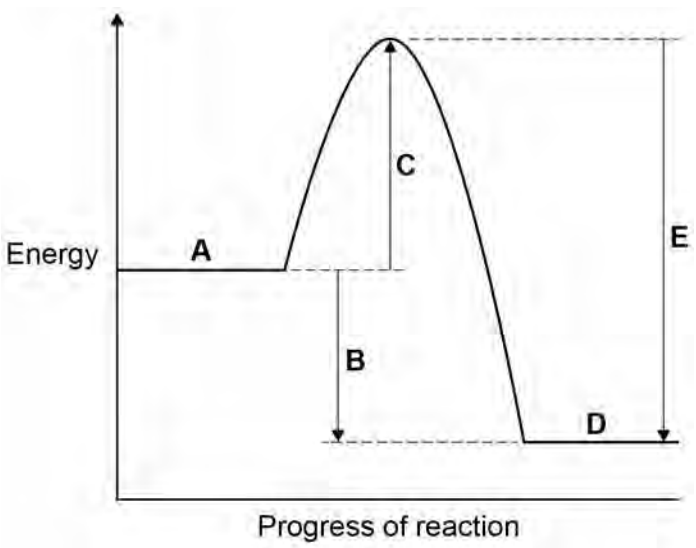
Describe a method to find the position of **Y** in the reactivity series in Question **06.5**

[3 marks]

Question 53 · continued

Figure 10 shows the reaction profile for the reaction between zinc and copper sulfate solution.

Figure 10



0 6 . 7 Which letter represents the products of the reaction?

[1 mark]

Tick **one** box.

A		B		C		D		E	

0 6 . 8 Which letter represents the activation energy?

[1 mark]

Tick **one** box.

A		B		C		D		E	

12

4.2.2.5 Polymers

Question 54

June 2018 | 8462/2F | Original Q3

0 3 Polymers are used to make fabrics.

Table 1 shows some properties of two polymers.

Table 1

Property	Polymer J	Polymer K
Density in g/cm^3	0.9	1.4
Melting point in °C	165	260
Flame resistance	Poor	Good
Water absorption	Low	High

0 3 . 1 Polymer fabrics are used to make firefighter uniforms.

Complete **Table 2** by deciding for each property whether polymer **J** or polymer **K** is **best** for firefighter uniforms.

Use **Table 1**.

Density has been completed for you.

[2 marks]

Tick **three** boxes.

Table 2

Property	Polymer J	Polymer K
Density in g/cm^3	✓	
Melting point in °C		
Flame resistance		
Water absorption		

4.2.2.5 Polymers

Question 54 · continued

0 3 . 2 A firefighter uniform made from polymer **J** has a mass of 6.0 kg

Calculate the mass of a uniform of the same size made from polymer **K**.

Use **Table 1** and the equation:

$$\text{mass of uniform made from polymer K} = \frac{\text{density of polymer K}}{\text{density of polymer J}} \times 6.0$$

[2 marks]

Mass of uniform made from polymer **K** = _____ kg

0 3 . 3 Polymers **J** and **K** are both thermosoftening polymers.

Polymer **L** is a thermosetting polymer.

Why would polymer **L** be better than polymers **J** and **K** for firefighter uniforms?

[1 mark]

Tick **one** box.

- Polymer **L** burns easily ☐
- Polymer **L** does not biodegrade ☐
- Polymer **L** will not melt ☐

Question 3 continues on the next page

4.2.2.5 Polymers

Question 54 · continued

June 2018 | 8462/2F | Original Q3

Polymers **J** and **K** are made from crude oil.

In the past, firefighter uniforms were made from wool.

Wool is obtained from sheep.

0 3 . 4 Why are many fabrics made from polymers instead of wool?

[1 mark]

Tick **one** box.

- Polymers are man-made ☐
- Polymers are more hard-wearing ☐
- Wool is more easily available ☐
- Wool is more flame resistant ☐

0 3 . 5 Why is wool more sustainable than polymers **J** and **K** for making firefighter uniforms?

[2 marks]

4.2.2.5 Polymers

Question 54 · continued

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

4.2.2.5 Polymers

Question 55

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 ☐

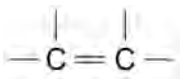
4.2.2.5 Polymers

Question 55 · continued

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

[1 mark]

Tick (✓) **one** box.



☐

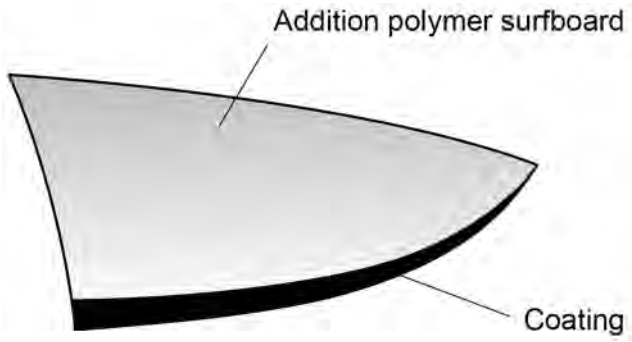
—COOH ☐

—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 55 · 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

4.2.2.5 Polymers

Question 55 · 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

4.2.2.5 Polymers

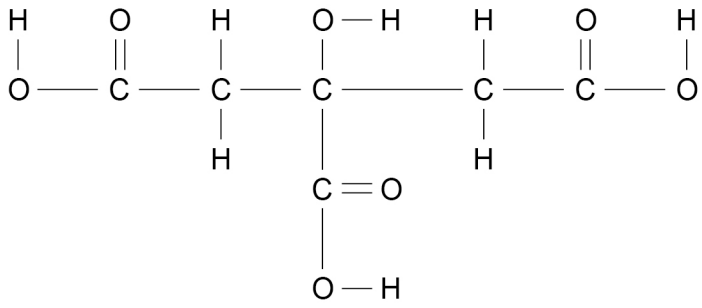
Question 56

November 2020 | 8462/1F | Original Q6

0 6 This question is about citric acid.

Figure 7 represents one molecule of citric acid.

Figure 7



0 6 . 1 Complete the molecular formula of citric acid.

Use **Figure 7**.

[1 mark]

C_6H __ O __

0 6 . 2 What type of bonding is shown in **Figure 7**?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

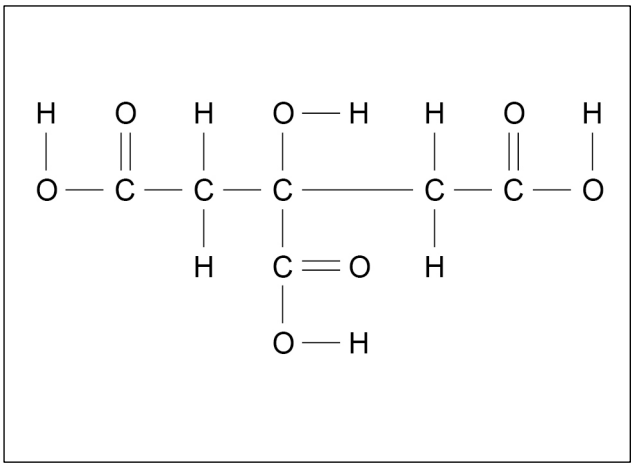
4.2.2.5 Polymers

Question 56 · continued

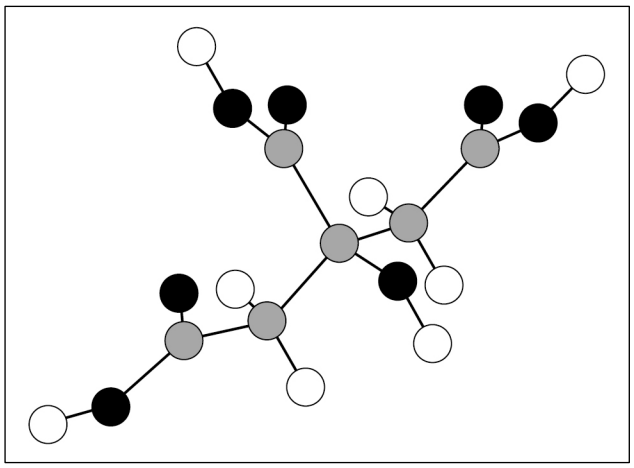
0 6 . 3 **Figure 8** shows two representations of one molecule of citric acid, **A** and **B**.

Figure 8

A



B



Give **two** advantages of representation **A** compared with representation **B**.

[2 marks]

Advantages of **A**:

1 _____

_____

2 _____

_____

Question 56 · continued

A student investigated the temperature change during the reaction between citric acid and sodium hydrogencarbonate solution.

Citric acid is a solid.

This is the method used.

1. Pour 25 cm^3 of sodium hydrogencarbonate solution into a polystyrene cup.
2. Measure the temperature of the sodium hydrogencarbonate solution.
3. Add 0.25 g of citric acid to the cup.
4. Stir the solution.
5. Measure the temperature of the solution.
6. Repeat steps 3 to 5 until a total of 2.00 g of citric acid has been added.

Table 4 shows some of the student's results.

Table 4

Mass of citric acid added in g	Temperature of solution in °C
0.00	22.6
0.25	22.2
0.50	21.8
0.75	21.4
1.00	21.0
1.25	20.6

0 6 . 4 How do the results in **Table 4** show that the reaction is endothermic?

[1 mark]

Question 56 · continued

0 6 . 5 Three of the student's results are plotted on **Figure 9**.

A line of best fit for these points is drawn.

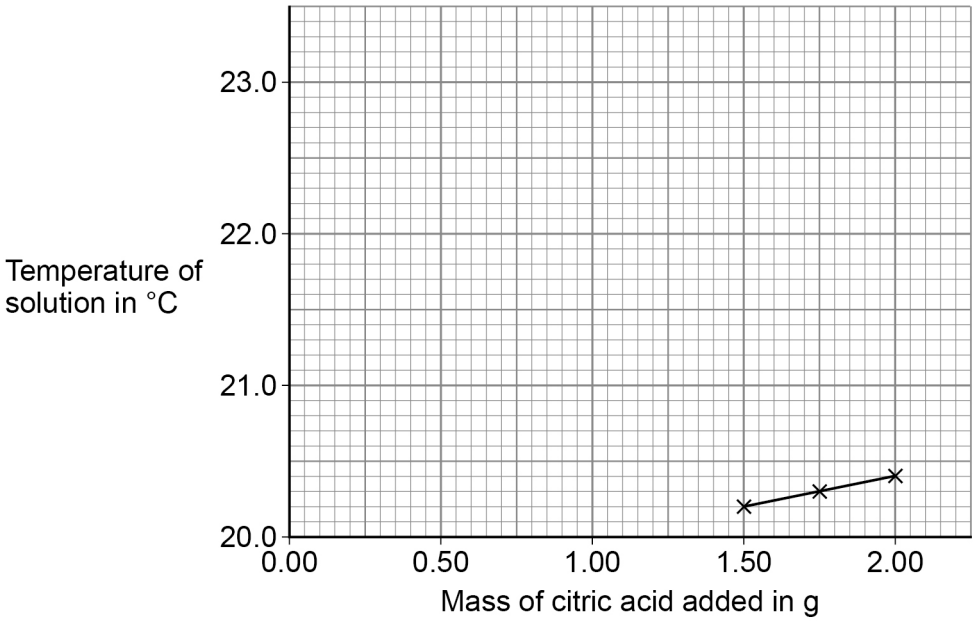
Complete **Figure 9**.

You should:

- plot the data from **Table 4** on **Figure 9**
- draw a line of best fit through the points you have plotted
- extend your line of best fit to meet the line of best fit already drawn on **Figure 9**.

[4 marks]

Figure 9



0 6 . 6 Determine the overall temperature change for the reaction.

Use **Figure 9**.

[2 marks]

Overall temperature change = _____ °C

4.2.2.5 Polymers

Question 56 · continued

November 2020 | 8462/1F | Original Q6

0 6 . 7 What is the dependent variable in this investigation?

[1 mark]

Tick (✓) **one** box.

- Mass of citric acid ☐
- Temperature of solution ☐
- Volume of solution ☐

12

4.2.2.5 Polymers

Question 57

November 2020 | 8462/1F | Original Q8

0 8 This question is about structure and bonding.

0 8 . 1 Which **two** substances have intermolecular forces between particles?

[2 marks]

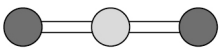
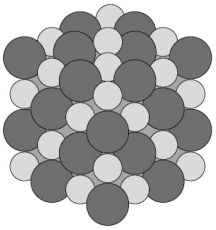
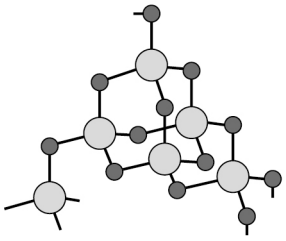
Tick (✓) **two** boxes.

- Diamond ☐
- Magnesium ☐
- Poly(ethene) ☐
- Sodium chloride ☐
- Water ☐

0 8 . 2 **Table 5** shows the structures of three compounds.

Table 5

Diagrams not to scale

Compound	Structure
Carbon dioxide	
Magnesium oxide	
Silicon dioxide	

4.2.2.5 Polymers

Question 57 · continued

Compare the structure and bonding of the three compounds:

- carbon dioxide
- magnesium oxide
- silicon dioxide.

[6 marks]

8

4.2.2.5 Polymers

Question 58

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 ☐

Question 58 · 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 ☐

4.2.2.5 Polymers

Question 58 · 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

4.2.2.5 Polymers

Question 59

November 2021 | 8462/1F | Original Q4

0 4 A student investigated the reactivity of metals with hydrochloric acid.

This is the method used.

1. Measure 50 cm^3 of hydrochloric acid into a polystyrene cup.
2. Measure the temperature of the hydrochloric acid.
3. Add one spatula of metal powder to the hydrochloric acid and stir.
4. Measure the highest temperature the mixture reaches.
5. Calculate the temperature increase for the reaction.
6. Repeat steps 1 to 5 three more times.
7. Repeat steps 1 to 6 with different metals.

Table 4 shows the student's results.

Table 4

Metal	Temperature increase in °C				Mean temperature increase in °C
	Trial 1	Trial 2	Trial 3	Trial 4	
Cobalt	6	7	5	9	7
Magnesium	54	50	37	55	**X**
Zinc	18	16	18	20	18

0 4 . 1 Calculate the mean temperature increase **X** for magnesium in **Table 4**.

Do **not** include the anomalous result in your calculation.

[2 marks]

X = _____ °C

4.2.2.5 Polymers

Question 59 · continued

0 4 . 2 Determine the order of reactivity for the metals cobalt, magnesium and zinc.

Use **Table 4**.

[1 mark]

Most reactive _____

_____

Least reactive _____

0 4 . 3 The range of measurements either side of the mean shows the uncertainty in the mean temperature increase.

Complete the sentence.

Use **Table 4**.

[1 mark]

The mean temperature increase for zinc is 18 ± _____ °C

0 4 . 4 What type of variable is the volume of hydrochloric acid in this investigation?

[1 mark]

Tick (✓) **one** box.

Control ☐

Dependent ☐

Independent ☐

0 4 . 5 Suggest **one** way of improving **step 3** in the method to give results which are more repeatable.

[1 mark]

_____

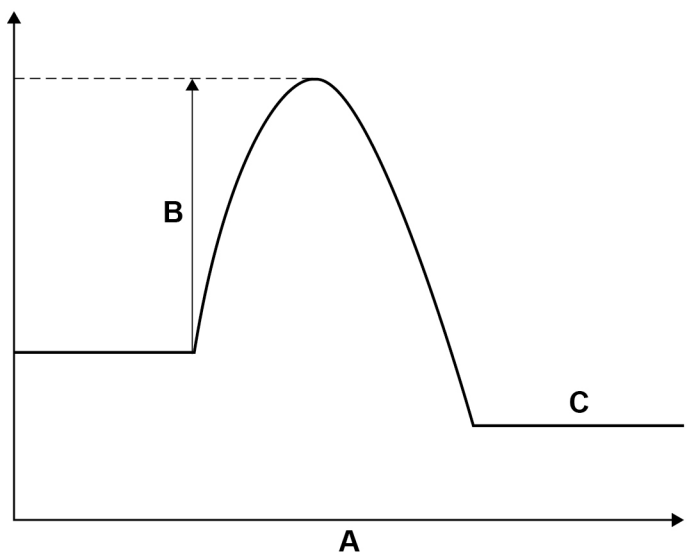
_____

_____

Question 59 · continued

0 4 . 6 **Figure 6** shows a reaction profile for the reaction of magnesium with hydrochloric acid.

Figure 6



What do labels **A**, **B** and **C** represent on **Figure 6**?

Choose answers from the box.

[3 marks]

activation energy	**energy**	**overall energy change**
products	**progress of reaction**	**reactants**

A _____

B _____

C _____

9

4.2.2.5 Polymers

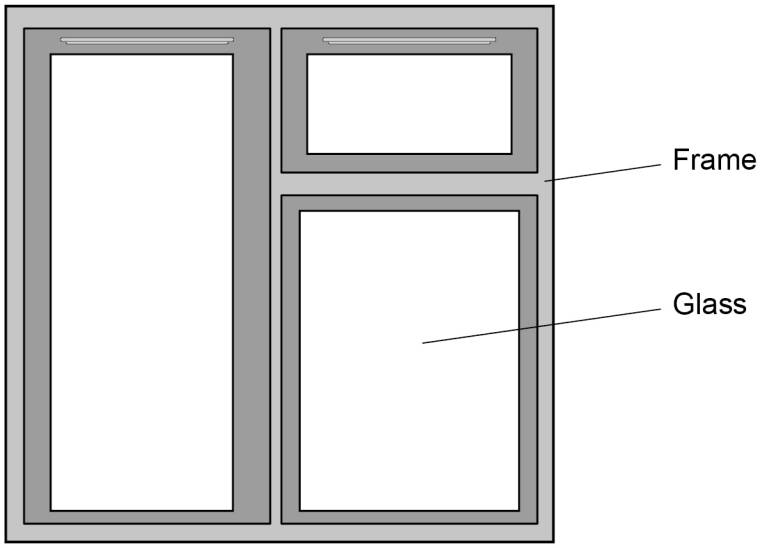
Question 60

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 ☐

Question 60 · 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 _____

_____

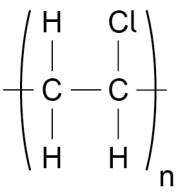
Reason _____

_____

Question 60 · continued

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

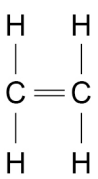
Figure 3

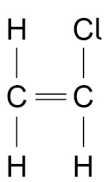


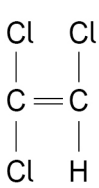
Which monomer is used to make poly(chloroethene)?

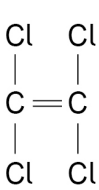
[1 mark]

Tick (✓) **one** box.

 ☐

 ☐

 ☐

 ☐

4.2.2.5 Polymers

Question 60 · 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 60 · 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

4.2.2.5 Polymers

Question 61

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 ☐

4.2.2.5 Polymers

Question 61 · 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. ☐

4.2.2.5 Polymers

Question 61 · 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

4.2.2.5 Polymers

Question 62

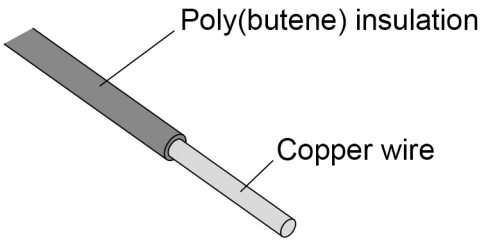
June 2022 | 8462/2F | Original Q8

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

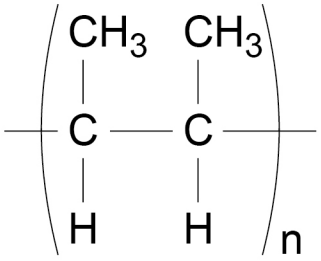
Copper is used to make electrical wires.

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:

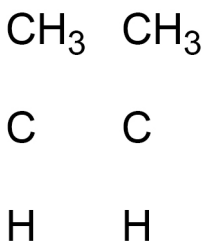


Poly(butene) is produced from the monomer butene.

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

[2 marks]

Figure 10



4.2.2.5 Polymers

Question 62 · 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

4.2.2.5 Polymers

Question 62 · 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

4.2.2.5 Polymers

Question 63

1 0 This question is about life cycle assessments (LCAs).

1 0 . 1 Milk bottles can be made from glass or from a polymer.

Table 10 shows information about milk bottles of equal volume.

Table 10

	Glass	Polymer
Raw materials	Limestone Sand Sodium carbonate	Crude oil
Energy needed to process raw materials in kilojoules	6750	1710
Energy needed to manufacture bottle in kilojoules	750	90
Mass of bottle in grams	200	20
Mean number of times used during lifetime of bottle	25	1
One disposal method at end of useful life	Recycled to make different glass products	Recycled to make different polymer products

Evaluate the use of glass for milk bottles compared with the use of a polymer for milk bottles.

Use features of life cycle assessments (LCAs) in your answer.

Use **Table 10**.

[6 marks]

4.2.2.5 Polymers

Question 63 · continued

10.2 Milk is also sold in cardboard cartons.

A carton is made using 40 cm^3 of cardboard.

The density of the cardboard is 0.40 g/cm^3.

Calculate the mass of the carton.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

[3 marks]

Mass = _____ g

9

4.2.2.5 Polymers

Question 64

June 2023 | 8462/1F | Original Q10

1 0 This question is about temperature changes.

A student investigated the change in temperature of a solution when different masses of ammonium nitrate were dissolved in water.

This is the method used.

1. Measure 200 cm^3 of water into a polystyrene cup.

2. Measure the temperature of the water.

3. Add 4.0 g of ammonium nitrate to the water.

4. Stir the solution until all the ammonium nitrate has dissolved.

5. Measure the lowest temperature reached by the solution.

6. Repeat steps 1 to 5 with different masses of ammonium nitrate.

1 0 . 1 Give the independent variable and the dependent variable in the investigation.

[2 marks]

Independent variable _____

Dependent variable _____

Table 6 shows the results.

Table 6

Mass of ammonium nitrate added in grams	Lowest temperature of solution in °C
4.0	18.2
8.0	16.2
12.0	15.2
16.0	13.6
20.0	12.4
24.0	10.6

Question 64 · continued

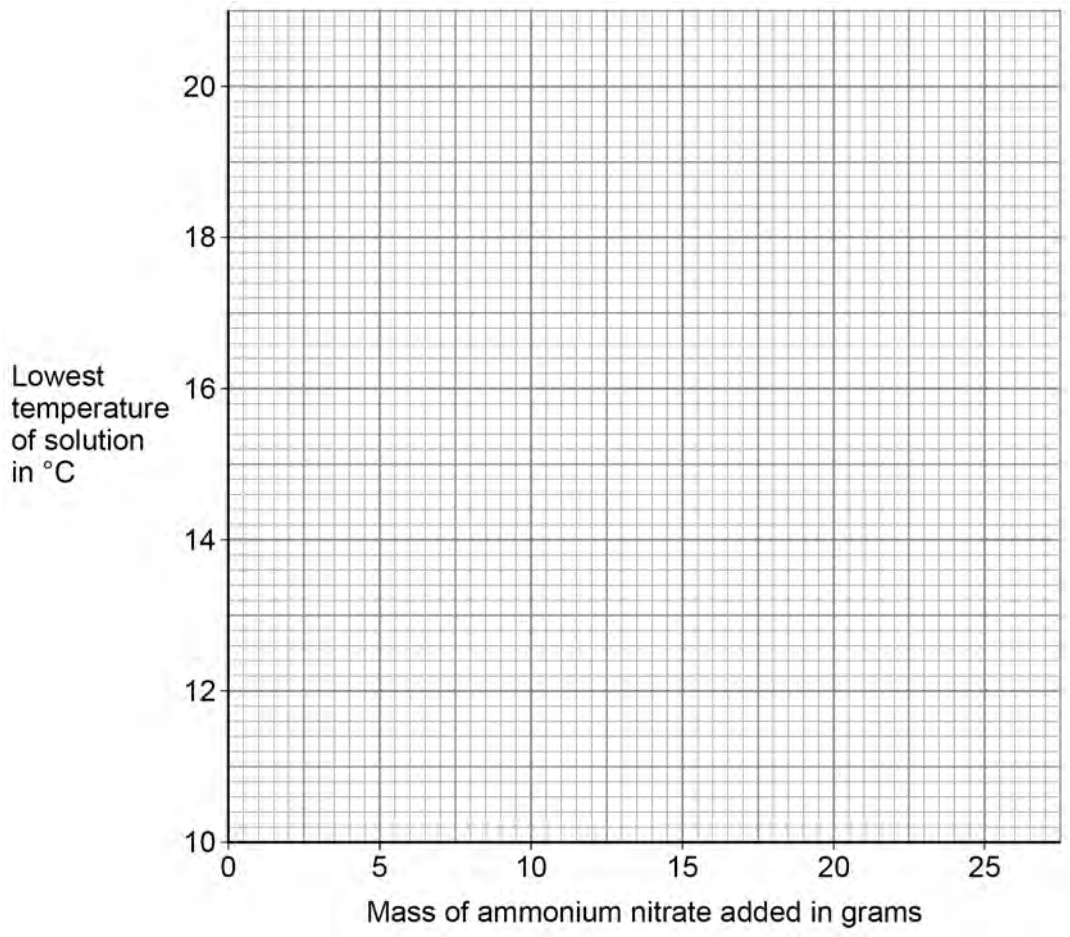
June 2023 | 8462/1F | Original Q10

1 0 . 2 Plot the data from **Table 6** on **Figure 11**.

Draw a line of best fit.

[3 marks]

Figure 11



1 0 . 3 Determine the initial temperature of the water.

You should extend your line of best fit on **Figure 11**.

[2 marks]

Initial temperature of the water = _____ °C

1 0 . 4 How do the results show that dissolving ammonium nitrate in water is endothermic?

[1 mark]

_____

_____

Question 64 · continued

The student repeated the experiment three more times.

Table 7 shows the results for 8.0 g of ammonium nitrate.

Table 7

	Trial 1	Trial 2	Trial 3	Trial 4	Mean
Lowest temperature of solution in ºC	16.2	16.6	16.8	16.4	16.5

10.5 The student recorded the mean lowest temperature of the solution for 8.0 g of ammonium nitrate as 16.5 ± 0.3 ºC.

Explain why the student included ± 0.3 ºC after the mean lowest temperature.

[2 marks]

10.6 What type of error is shown by the results in **Table 7**?

[1 mark]

Tick (✓) **one** box.

Random error ☐

Systematic error ☐

Zero error ☐

11

4.2.2.5 Polymers

Question 65

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]

_____

_____

4.2.2.5 Polymers

Question 65 · continued

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

[1 mark]

Tick (✓) **one** box.

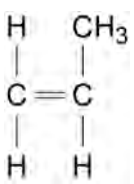
Boron trioxide ☐

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**.

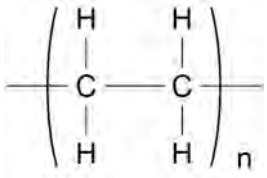
[2 marks]

Question 65 · continued

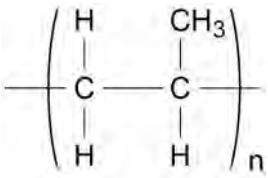
0 2 . 5 Which structure is the repeating unit of poly(propene)?

[1 mark]

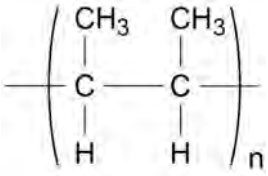
Tick (✓) **one** box.



☐



☐



☐

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 _____.

4.2.2.5 Polymers

Question 65 · 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

4.2.2.5 Polymers

Question 66

June 2024 | 8462/1F | Original Q3

0 3 This question is about energy changes of reactions.

Zinc reacts with copper sulfate solution.

The word equation for the reaction is:

zinc + copper sulfate → zinc sulfate + copper

0 3 . 1 What type of reaction is the reaction between zinc and copper sulfate solution?

[1 mark]

Tick (✓) **one** box.

Combustion ☐

Decomposition ☐

Displacement ☐

0 3 . 2 Calculate the percentage (%) by mass of copper in copper sulfate ($CuSO_4$).

Give your answer to 3 significant figures.

Relative atomic mass (A_r): Cu = 63.5

Relative formula mass (M_r): $CuSO_4$ = 159.5

[3 marks]

Percentage by mass (3 significant figures) = _____ %

4.2.2.5 Polymers

Question 66 · continued

A student investigated the energy change in the reaction between zinc and copper sulfate solution.

This is the method used.

1. Measure 25 cm^3 of copper sulfate solution into a polystyrene cup.
2. Weigh 0.20 g of zinc powder.
3. Add the zinc powder to the copper sulfate solution.
4. Measure the highest temperature reached by the mixture.
5. Repeat steps 1 to 4 using different masses of zinc powder.

0 3 . 3 Control variables are used to make an investigation a fair test.

Which is a control variable in the investigation?

[1 mark]

Tick (✓) **one** box.

- Highest temperature reached by the mixture ☐
- Mass of zinc powder ☐
- Volume of copper sulfate solution ☐

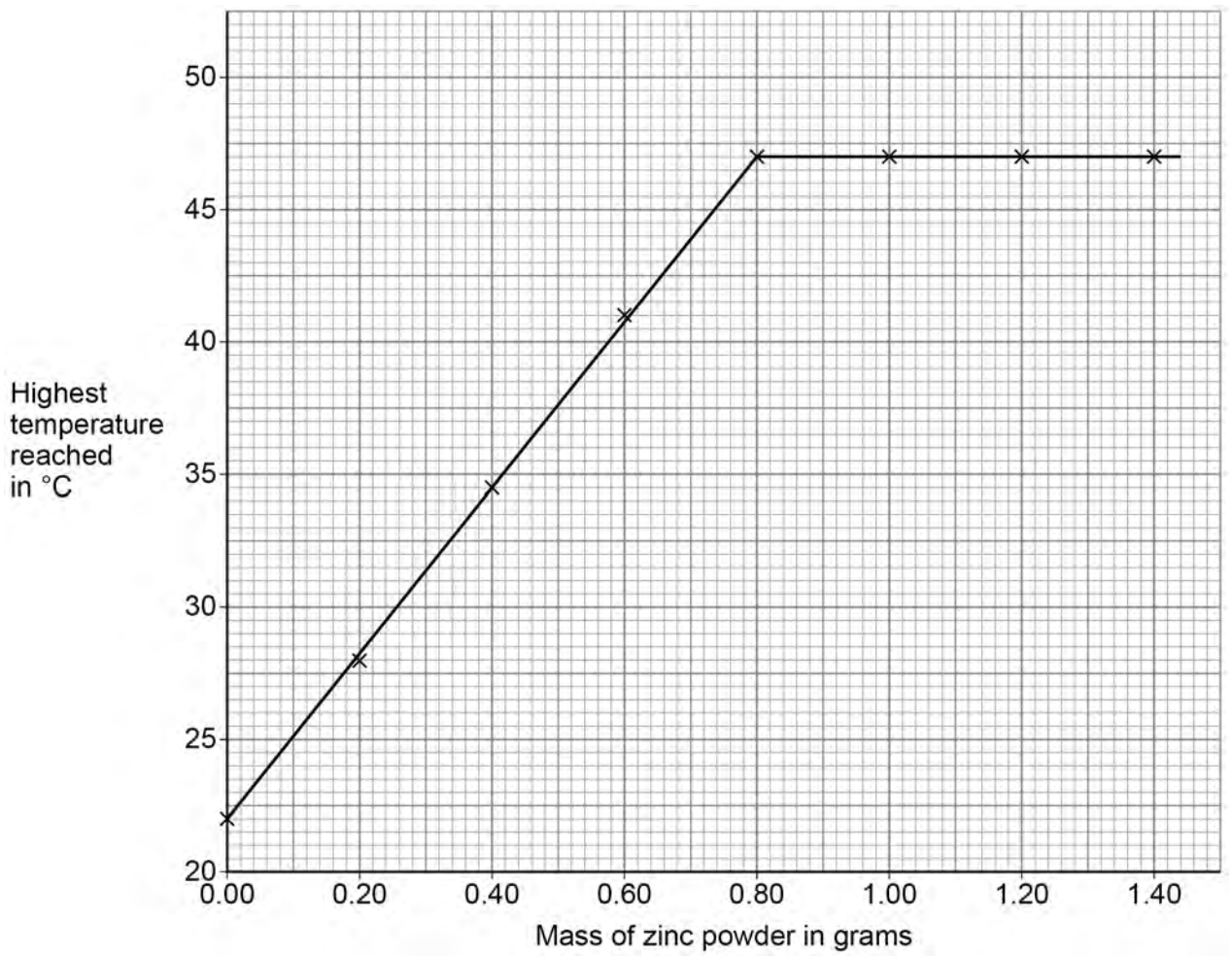
Question 3 continues on the next page

4.2.2.5 Polymers

Question 66 · continued

Figure 6 shows the results.

Figure 6



0 3 . 4 What is the minimum mass of zinc powder needed to react with all the copper sulfate solution?

Use **Figure 6**.

[1 mark]

Minimum mass of zinc powder = _____ g

Question 66 · continued

0 3 . 5 What is the maximum temperature change in the reaction between zinc powder and 25 cm^3 of copper sulfate solution?

Use **Figure 6**.

[2 marks]

Maximum temperature change = _____ °C

0 3 . 6 25 cm^3 of copper sulfate solution contained 6.75 g of copper sulfate.

Calculate the concentration of the solution in g/dm^3.

You should:

- calculate the volume of the solution in dm^3 (1000 cm^3 = 1 dm^3)
- use the equation:

$$\text{concentration of solution in g/dm}^3 = \frac{\text{mass of copper sulfate in grams}}{\text{volume of solution in dm}^3}$$

[3 marks]

Volume of solution = _____ dm^3

Concentration of solution = _____ g/dm^3

Question 3 continues on the next page

Question 66 · continued

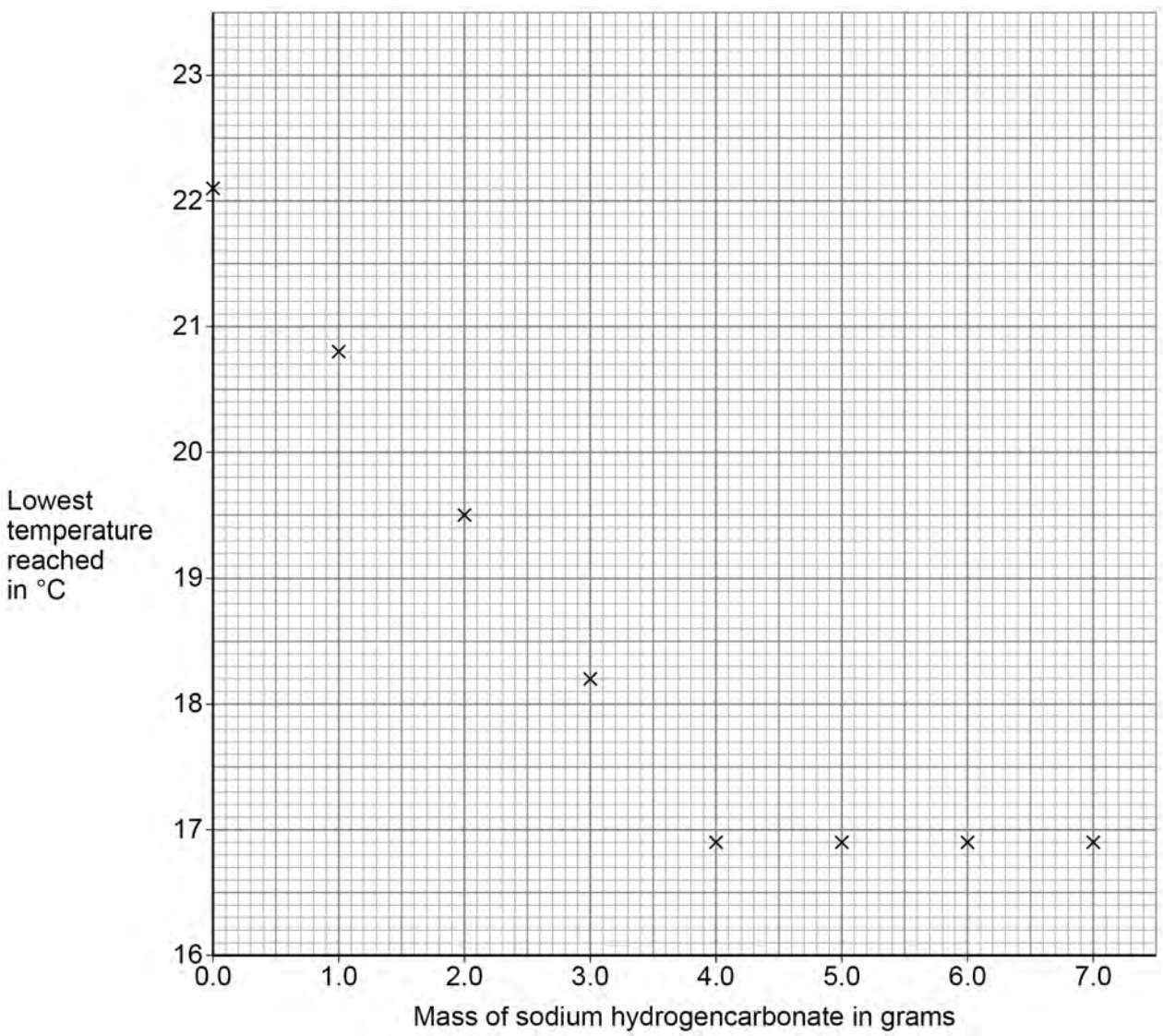
Another student investigated the energy change of the reaction between sodium hydrogencarbonate and hydrochloric acid.

This is the method used.

1. Measure 25 cm^3 of hydrochloric acid.
2. Weigh 1.0 g of sodium hydrogencarbonate.
3. Add the sample of sodium hydrogencarbonate to the hydrochloric acid.
4. Measure the lowest temperature reached by the mixture.
5. Repeat steps 1 to 4 using different masses of sodium hydrogencarbonate.

Figure 7 shows the results.

Figure 7



4.2.2.5 Polymers

Question 66 · continued

0 3 . 7 Draw **two** straight lines of best fit on **Figure 7**.

The lines should cross.

[2 marks]

0 3 . 8 Which statement describes the energy change in the reaction shown in **Figure 7**?

[1 mark]

Tick (✓) **one** box.

Energy is **transferred to** the surroundings so the reaction is **endothermic**. ☐

Energy is **transferred to** the surroundings so the reaction is **exothermic**. ☐

Energy is **taken in from** the surroundings so the reaction is **endothermic**. ☐

Energy is **taken in from** the surroundings so the reaction is **exothermic**. ☐

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4.2.2.5 Polymers

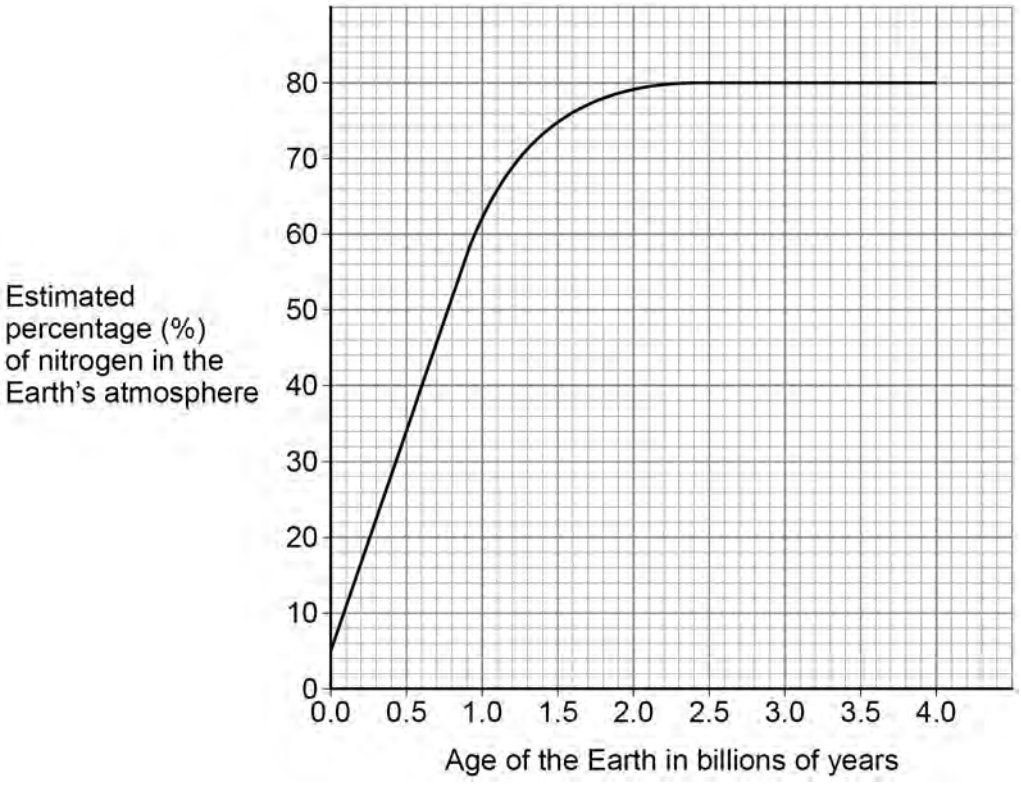
Question 67

June 2024 | 8462/2F | Original Q4

0 4 This question is about the Earth's atmosphere and naturally occurring polymers.

0 4 . 1 **Figure 5** shows how the estimated percentage of nitrogen in the Earth's atmosphere has changed since the Earth was formed.

Figure 5



Describe the trends shown by the graph.

Use data from **Figure 5**.

[3 marks]

Question 4 continues on the next page

Question 67 · continued

The percentage of oxygen in the Earth's atmosphere has increased since the Earth was formed.

This is because of photosynthesis.

The word equation for the photosynthesis reaction is:

carbon dioxide + water → glucose + oxygen

0 4 . 2 What happened to the percentage of carbon dioxide in the atmosphere when photosynthesis began?

[1 mark]

Tick (✓) **one** box.

- The percentage of carbon dioxide decreased. ☐
- The percentage of carbon dioxide stayed the same. ☐
- The percentage of carbon dioxide increased. ☐

0 4 . 3 The photosynthesis reaction takes in energy from the surroundings.

Complete the sentence.

Choose the answer from the box.

[1 mark]

carbon dioxide	**light**	**water**

The source of the energy used in photosynthesis is _____.

4.2.2.5 Polymers

Question 67 · continued

0 4 . 4 Which **two** produce oxygen by photosynthesis?

[2 marks]

Tick (✓) **two** boxes.

- Algae ☐
- Animals ☐
- Plants ☐
- Viruses ☐
- Yeast ☐

0 4 . 5 The glucose produced during photosynthesis can form naturally occurring polymers.

Which **two** are naturally occurring polymers that can be produced from glucose?

[2 marks]

Tick (✓) **two** boxes.

- Cellulose ☐
- DNA ☐
- Poly(propene) ☐
- Protein ☐
- Starch ☐

Question 4 continues on the next page

4.2.2.5 Polymers

Question 67 · continued

DNA molecules contain two polymer chains.

A DNA molecule has a relative formula mass (M_r) of approximately 140 000 000 000

0 4 . 6 What is the approximate relative formula mass (M_r) of the DNA molecule in standard form?

[1 mark]

Tick (✓) **one** box.

- 1.4×10^9 ☐
- 1.4×10^{10} ☐
- 1.4×10^{11} ☐
- 1.4×10^{12} ☐

0 4 . 7 What is the approximate relative formula mass (M_r) of each polymer chain in the DNA molecule?

[1 mark]

Tick (✓) **one** box.

- 70 000 000 000 ☐
- 140 000 000 000 ☐
- 280 000 000 000 ☐
- 560 000 000 000 ☐

0 4 . 8 Complete the sentence.

[1 mark]

The shape of a DNA molecule is a double _____ .

4.2.2.5 Polymers

Question 67 · continued

0 4 . 9 How many different nucleotides are present in a molecule of DNA?

[1 mark]

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

13

Turn over for the next question

4.2.2.5 Polymers

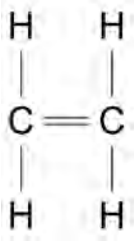
Question 68

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

_____ .

4.2.2.5 Polymers

Question 68 · 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 ☐

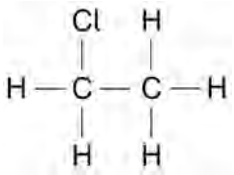
Limewater ☐

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

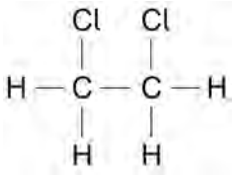
Use **Figure 7**.

[1 mark]

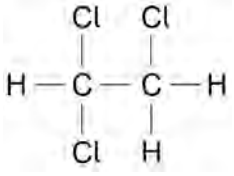
Tick (✓) **one** box.



☐



☐



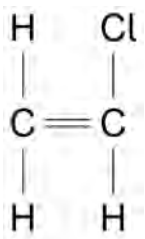
☐

Question 6 continues on the next page

Question 68 · continued

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

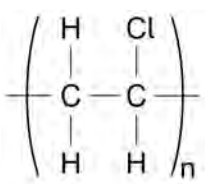
The displayed structural formula of chloroethene is

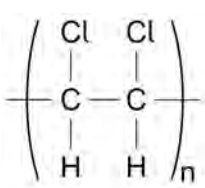


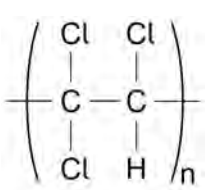
Which represents the structure of poly(chloroethene)?

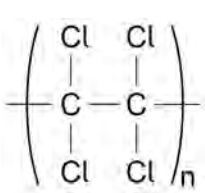
[1 mark]

Tick (✓) **one** box.

 ☐

 ☐

 ☐

 ☐

Question 68 · 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

4.2.2.5 Polymers

Question 69

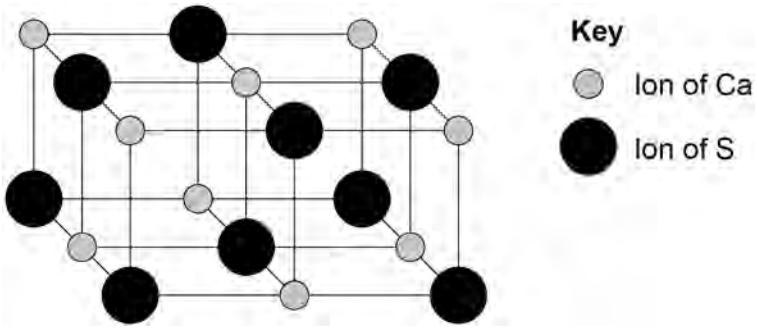
June 2025 | 8462/1F | Original Q9

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

4.2.2.5 Polymers

Question 69 · 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.

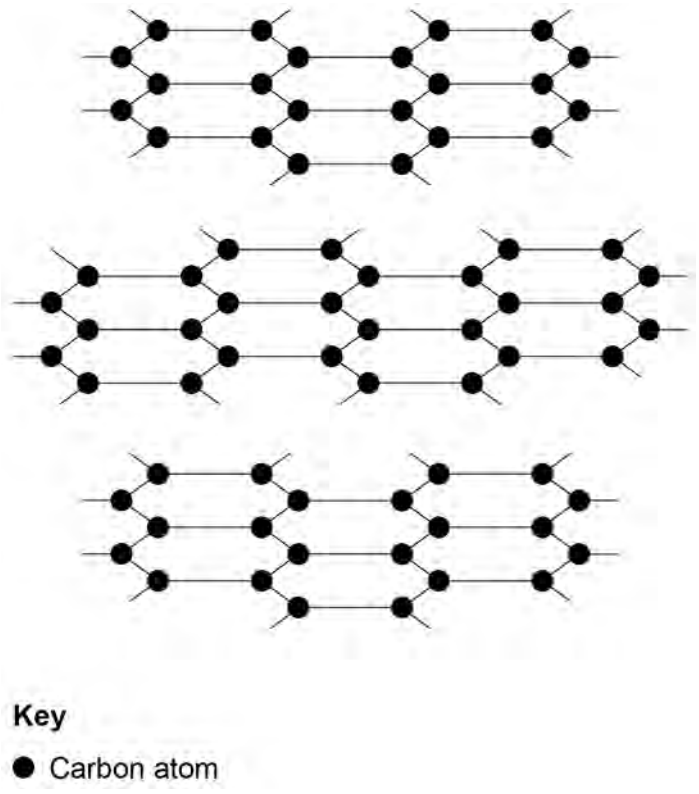
[4 marks]

4.2.2.5 Polymers

Question 69 · continued

Figure 14 shows the structure of graphite.

Figure 14



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

[4 marks]

Extra space

4.2.2.5 Polymers

Question 69 · 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. ☐

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