AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.2.4

Properties of small molecules

Past-paper questions

Tier	**Foundation**
Question groups	**19**
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.

4.2.2.4 Properties of small molecules

Question 01

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

4.2.2.4 Properties of small molecules

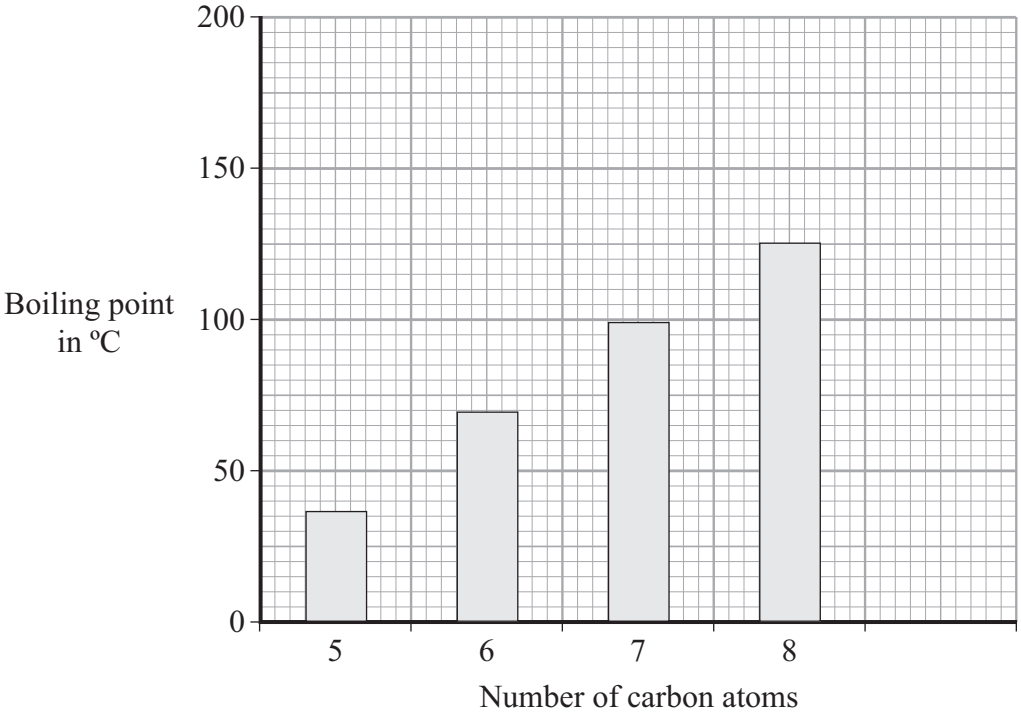
Question 01 · continued

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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)

4.2.2.4 Properties of small molecules

Question 01 · continued

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(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

4.2.2.4 Properties of small molecules

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).

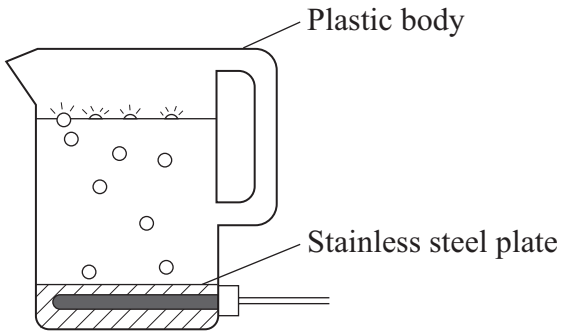
In these reactions, many small molecules known as . . . **4** . . . join together to form very large molecules.

4.2.2.4 Properties of small molecules

Question 03

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)

4.2.2.4 Properties of small molecules

Question 03 · continued

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(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

4.2.2.4 Properties of small molecules

Question 04

June 2008 | CHY1AP | Original Q9 | Legacy

QUESTION NINE

Scientists are researching new catalysts to convert compounds in coal into small hydrocarbon molecules.

These small molecules can be used to make liquid fuels such as petrol.

9A Scientists are trying to develop processes that convert coal into liquid fuels, such as petrol, because . . .

1 they have found new supplies of catalysts.

2 oil reserves are running out quickly.

3 there is no alternative to using coal.

4 catalysts are being used up.

9B Petrol is made from small molecules and **not** large molecules because hydrocarbons with small molecules . . .

1 have a higher boiling point.

2 are more viscous.

3 are darker in colour.

4 ignite more easily.

9C Both petrol and coal produce carbon dioxide when burned.

To compare the volume of the gas produced by a sample of coal with the volume of gas produced by a sample of petrol, a control variable would be . . .

1 how much carbon dioxide is produced.

2 the amount of coal and petrol used.

3 the speed at which each fuel is set alight.

4 the time taken to burn all the fuel.

4.2.2.4 Properties of small molecules

9D Ethanol, made from plant material, is another liquid fuel used in cars.

Ethanol and petrol produce similar amounts of carbon dioxide when they burn.

Burning ethanol made from plant material, in cars, is thought to be less of an environmental problem than burning petrol.

This is because . . .

1 ethanol does **not** produce water when it burns.

2 using ethanol made from plants as a fuel does **not** change the amount of carbon dioxide in the atmosphere.

3 ethanol will burn without using oxygen.

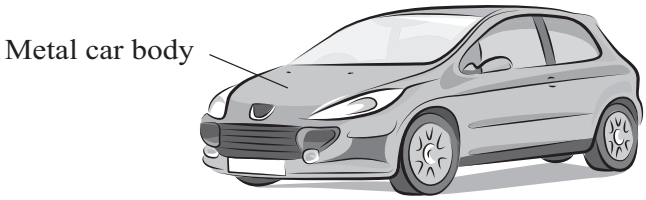
4 in the car engine, only partial combustion of the ethanol occurs.

END OF TEST

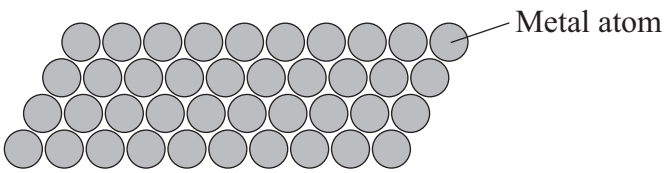
4.2.2.4 Properties of small molecules

Question 05

1 Metal is bent and shaped to make a car body.



The diagram below represents how atoms are arranged in a metal.



Which **two** statements in the table best explain why the metal can be bent and shaped?

Tick (✓) the **two** statements.

Statement	Tick (✓)
The atoms are in layers.	
The metal is shiny.	
The atoms can slide over each other.	
All the atoms are linked by strong covalent bonds.	

(2 marks)

2

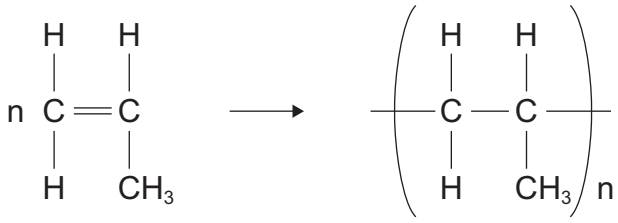
4.2.2.4 Properties of small molecules

Question 06

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.

4.2.2.4 Properties of small molecules

Question 06 · continued

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

4.2.2.4 Properties of small molecules

Question 07

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** . . . .

4.2.2.4 Properties of small molecules

Question 08

June 2012 | CH2FP | Original Q1 | Legacy

1 (a) The symbol equation for the decomposition of hydrogen peroxide is:

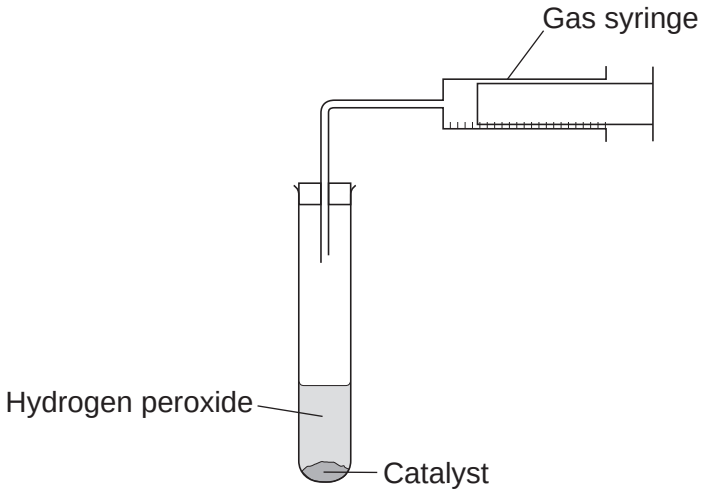
$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Complete the word equation for the decomposition of hydrogen peroxide.

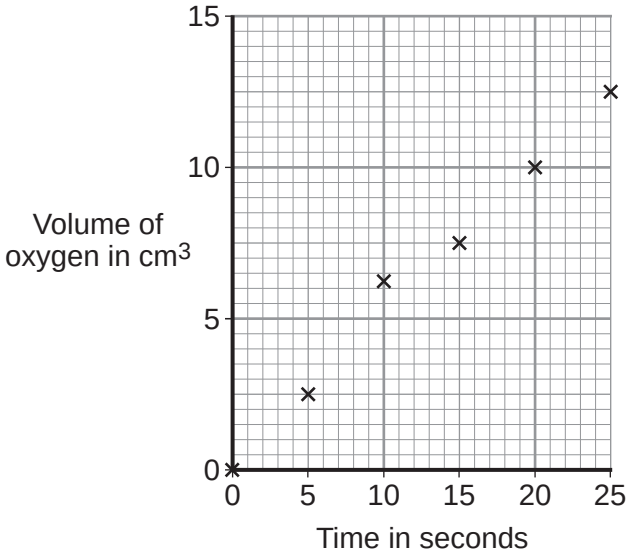
Hydrogen peroxide → ..... + ...

(1 mark)

1 (b) A student did an experiment to see how quickly hydrogen peroxide decomposes.
The student used the apparatus shown below to measure the volume of oxygen.



1 (b) (i) Draw a straight line of best fit to complete the graph.



(1 mark)

4.2.2.4 Properties of small molecules

Question 08 · continued

1 (b) (ii) Draw a circle around the anomalous point on the graph.

(1 mark)

1 (b) (iii) What is the volume of oxygen given off after 15 seconds? ..... cm^3

(1 mark)

1 (b) (iv) How did the volume of oxygen change between 0 and 25 seconds?

.....

(1 mark)

1 (c) The student wanted to make the reaction faster.

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

1 (c) (i) To make the reaction faster, the temperature should be

higher.

lower.

the same.

(1 mark)

1 (c) (ii) To make the reaction faster, the hydrogen peroxide should be

more dilute.

more concentrated.

the same.

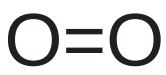
(1 mark)

Question 1 continues on the next page

4.2.2.4 Properties of small molecules

Question 08 · continued June 2012 | CH2FP | Original Q1 | Legacy

1 (d) The diagram represents the bonding in oxygen.



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

1 (d) (i) When two oxygen atoms bond, the atoms [share / transfer / delocalise] electrons.

(1 mark)

1 (d) (ii) The oxygen atoms are joined by [ionic / metallic / covalent] bonds.

(1 mark)

1 (d) (iii) Oxygen is made of [simple molecules. / a giant lattice. / macromolecules.]

(1 mark)

1 (e) When hydrogen peroxide decomposes water is produced.
Which **two** statements in the table explain why water is a liquid at room temperature?

Tick (✓) the **two** statements.

Statement	Tick (✓)
Water has a boiling point of 100 °C.	
Water is made of ions.	
Water has a melting point lower than room temperature.	
Water has a giant covalent structure.	

(2 marks)

12

4.2.2.4 Properties of small molecules

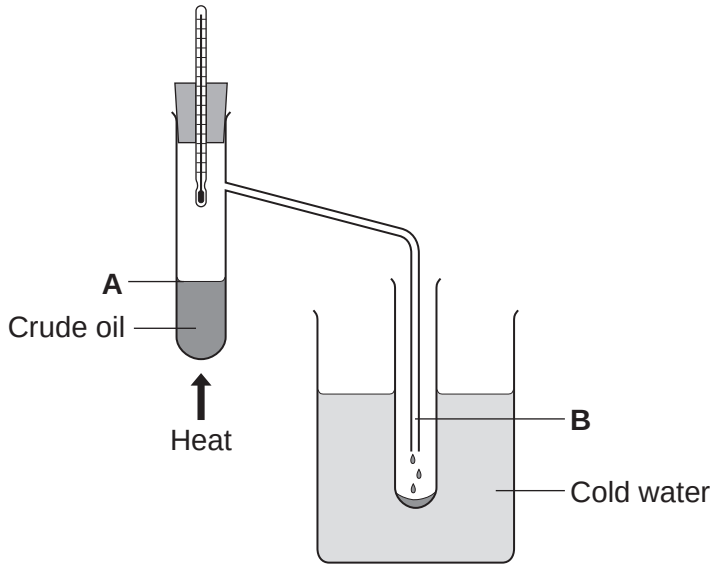
Question 09

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 ..... .

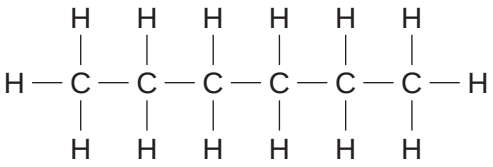
[1 mark]

4.2.2.4 Properties of small molecules

Question 09 · continued June 2014 | CH1FP | Original Q4 | Legacy

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

4.2.2.4 Properties of small molecules

Question 10

June 2015 | CH2FP | Original Q2 | Legacy

2 This question is about salts.

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

Sodium chloride is produced by reacting sodium with chlorine.

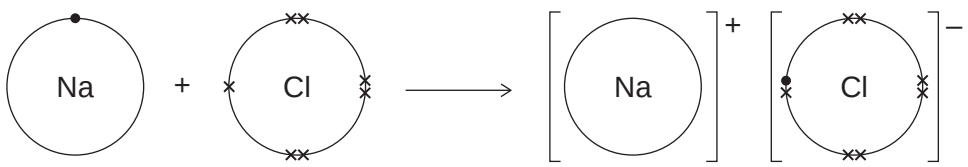
sodium + chlorine ⟶ sodium chloride

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

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

Only the outer electrons are shown.

Figure 2



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

[3 marks]

.....

.....

.....

.....

.....

.....

Question 2 continues on the next page

4.2.2.4 Properties of small molecules

Question 10 · continued June 2015 | CH2FP | Original Q2 | Legacy

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

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

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

What is a property of substances that have simple molecules?

[1 mark]

Tick (✓) **one** box.

Have no overall electric charge ☐

Have high boiling points ☐

Have giant covalent structures ☐

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

[2 marks]

Tick (✓) **one** box.

How much sodium chloride is in food? ☐

What harm does a lack of iodine do? ☐

Should iodine be added to salt in food? ☐

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

.....

.....

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

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

[1 mark]

.....

4.2.2.4 Properties of small molecules

Question 10 · continued

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

[1 mark]

an acid	an alkali	a salt

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

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

Complete the sentence.

[1 mark]

The solution added is an ..... .

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

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

[1 mark]

Tick (✓) **one** box.

Crystallisation ☐

Decomposition ☐

Electrolysis ☐

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

[1 mark]

.....

.....

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

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

[1 mark]

.....

.....

12

4.2.2.4 Properties of small molecules

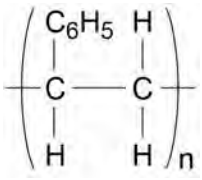
Question 11

June 2018 | 8462/2F | Original Q6

0 6 Disposable cups are made from coated paper or poly(styrene).

Figure 4 represents the structure of poly(styrene).

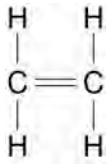
Figure 4



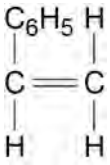
0 6 . 1 Which small molecule is used to produce poly(styrene)?

[1 mark]

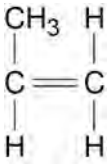
Tick **one** box.



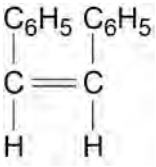
☐



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4.2.2.4 Properties of small molecules

Question 11 · continued

0 6 . 2 Which process is used to make poly(styrene) from small molecules?

[1 mark]

Tick **one** box.

- Cracking ☐
- Distillation ☐
- Fermentation ☐
- Polymerisation ☐

0 6 . 3 Complete the sentences.

Choose answers from the box.

[3 marks]

ceramics	**composites**	**four**	**many**
monomers	**polymers**	**two**	

Poly(styrene) is produced from small molecules called _____.

When poly(styrene) is made, _____ styrene molecules join to form large molecules.

These large molecules are called _____.

Question 6 continues on the next page

4.2.2.4 Properties of small molecules

Question 11 · continued

0 6 . 4 **Table 4** gives some information about disposable cups.

Table 4

	Coated paper cups	Poly(styrene) cups
Source of raw materials	Wood	Crude oil
Energy to make 1 cup in arbitrary units	550	200
Biodegradable	Yes	No
Recyclable	No	Yes

Compare the advantages and disadvantages of using coated paper and poly(styrene) to make disposable cups.

Use **Table 4** and your knowledge and understanding of life cycle assessments (LCAs).

[4 marks]

4.2.2.4 Properties of small molecules

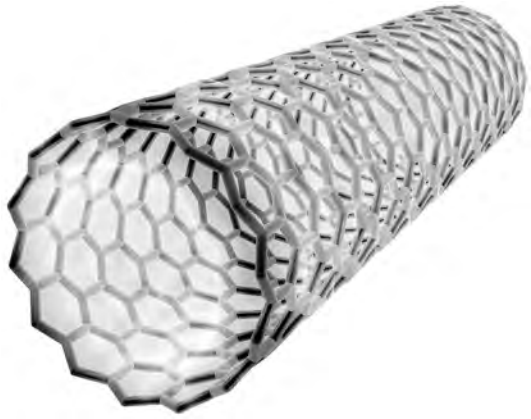
Question 12

June 2019 | 8462/1F | Original Q10

1 0 This question is about materials and their properties.

1 0 . 1 **Figure 13** shows a carbon nanotube.

Figure 13



The structure and bonding in a carbon nanotube are similar to graphene.

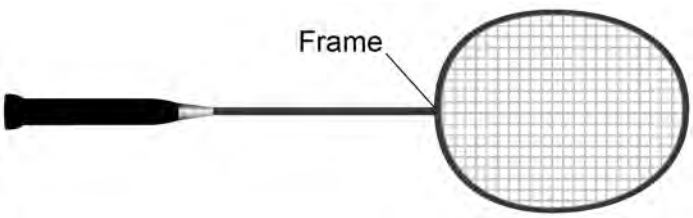
Carbon nanotubes are used in electronics because they conduct electricity.

Explain why carbon nanotubes conduct electricity.

[2 marks]

1 0 . 2 **Figure 14** shows a badminton racket.

Figure 14



4.2.2.4 Properties of small molecules

Question 12 · continued

June 2019 | 8462/1F | Original Q10

Table 4 shows some properties of materials.

The materials could be used to make badminton racket frames.

Table 4

Material	Density in g/cm^3	Relative strength	Relative stiffness
Aluminium	2.7	0.3	69
Carbon nanotube	1.5	60	1000
Wood	0.71	0.1	10

Evaluate the use of the materials to make badminton racket frames.

Use **Table 4**.

[4 marks]

Question 10 continues on the next page

4.2.2.4 Properties of small molecules

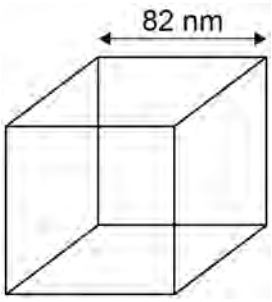
Question 12 · continued

Zinc oxide can be produced as nanoparticles and as fine particles.

1 0 . 3 A nanoparticle of zinc oxide is a cube of side 82 nm

Figure 15 represents a nanoparticle of zinc oxide.

Figure 15



Calculate the surface area of a nanoparticle of zinc oxide.

Give your answer in standard form.

[3 marks]

Surface area = _____ nm^2

1 0 . 4 Some suncreams contain zinc oxide as nanoparticles or as fine particles.

Suggest **one** reason why it costs less to use nanoparticles rather than fine particles in suncreams.

[1 mark]

4.2.2.4 Properties of small molecules

Question 13

November 2020 | 8462/1F | Original Q1

0 1 This question is about the elements in Group 7 of the periodic table.

Table 1 shows the melting points and boiling points of some of the elements.

Table 1

Element	Melting point in °C	Boiling point in °C
Fluorine	–220	–188
Chlorine	–101	–35
Bromine	–7	59

0 1 . 1 What is the state of bromine at 100 °C?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

Gas ☐

Liquid ☐

Solid ☐

4.2.2.4 Properties of small molecules

Question 13 · continued

0 1 . 2 What temperature does chlorine gas condense at to form a liquid?

Use **Table 1**.

[1 mark]

Temperature = _____ °C

0 1 . 3 Complete the sentences.

[2 marks]

Going down Group 7 the melting points _____.

This is because the size of the molecules increases so the

intermolecular forces _____.

Question 1 continues on the next page

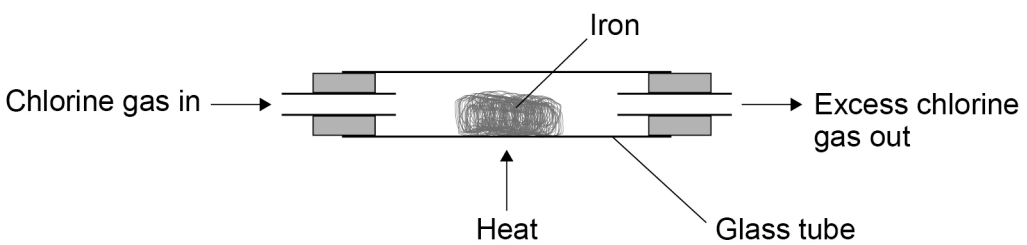
4.2.2.4 Properties of small molecules

Question 13 · continued

A teacher investigated the reaction of iron with chlorine.

Figure 1 shows the apparatus used.

Figure 1



0 1 . 4 Why did the teacher do the investigation in a fume cupboard?

[1 mark]

Tick (✓) **one** box.

Chlorine gas is coloured. ☐

Chlorine gas is flammable. ☐

Chlorine gas is toxic. ☐

4.2.2.4 Properties of small molecules

Question 13 · continued

0 1 . 5 The word equation for the reaction is:

iron + chlorine → iron chloride

Iron chloride is a solid.

The teacher weighed the glass tube and contents:

- before the reaction
- after the reaction.

What happened to the mass of the glass tube and contents during the reaction?

Give **one** reason for your answer.

[2 marks]

The mass of the glass tube and contents _____.

Reason _____

_____

Question 1 continues on the next page

Question 13 · continued

The teacher repeated the investigation with bromine gas and with iodine gas.

Table 2 shows the results.

Table 2

Element	Observation
Chlorine	Iron burns vigorously with an orange glow
Bromine	Iron burns with an orange glow
Iodine	Iron slowly turns darker

0 1 . 6 Fluorine is above chlorine in Group 7.

Predict what you would observe when fluorine gas reacts with iron.

Use **Table 2**.

[1 mark]

0 1 . 7 Balance the equation for the reaction between iron and bromine.

[1 mark]

$$2Fe + _____ Br_2 \rightarrow 2FeBr_3$$

0 1 . 8 Calculate the relative formula mass (M_r) of $FeBr_3$

Relative atomic masses (A_r): Fe = 56 Br = 80

[2 marks]

Relative formula mass (M_r) = _____

11

4.2.2.4 Properties of small molecules

Question 14

November 2020 | 8462/1F | Original Q5

0 5 This question is about aluminium.

0 5 . 1 Aluminium is a metal.

Draw **one** line from each property of aluminium to the correct reason for that property.

[2 marks]

Property	Reason
	Aluminium has delocalised electrons
Conducts electricity	Aluminium has layers of atoms which can slide
	Aluminium has strong metallic bonds
High melting point	Aluminium has weak intermolecular forces
	Aluminium has a random arrangement of atoms

0 5 . 2 Aluminium can be used to make alloys.

What is meant by an 'alloy'?

[1 mark]

4.2.2.4 Properties of small molecules

Question 14 · continued

Aluminium is extracted from bauxite.

Bauxite is a mixture which contains aluminium oxide.

0 5 . 3 Bauxite contains between 15% and 25% aluminium.

Aluminium oxide always contains 53% aluminium.

How does this show that bauxite is a mixture and **not** a compound?

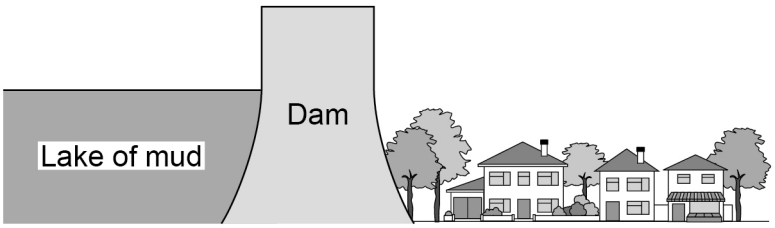
[1 mark]

0 5 . 4 The waste material from the bauxite is stored in lakes of mud.

The lakes of mud are held in place by dams.

Figure 6 shows one of these lakes.

Figure 6



Suggest **two** possible problems with storing the waste material in lakes of mud.

[2 marks]

1

2

4.2.2.4 Properties of small molecules

Question 14 · continued

Aluminium is extracted by electrolysis.

The aluminium oxide is mixed with cryolite and melted.

The mixture is then electrolysed.

0 5 . 5 The formula of cryolite is Na_3AlF_6

Give the total number of atoms in the formula.

[1 mark]

Number of atoms = _____

0 5 . 6 What is the reason for adding cryolite to the aluminium oxide?

[1 mark]

Tick (✓) **one** box.

- To increase the amount of aluminium extracted ☐
- To lower the melting point of the mixture ☐
- To reduce the amount of aluminium oxide needed ☐

4.2.2.4 Properties of small molecules

Question 14 · continued

0 5 . 7 Complete the sentences.

Choose answers from the box.

[2 marks]

aluminium	**carbon**	**fluorine**
oxygen	**sodium**	

When the molten aluminium oxide and cryolite mixture is electrolysed the product at the positive electrode is _____.

This product reacts with the positive electrode because the positive electrode is made of _____.

0 5 . 8 A sample of bauxite contains 25% aluminium.

Calculate the maximum mass of aluminium that can be extracted from 300 000 kg of the sample of bauxite.

Give your answer in standard form.

[3 marks]

Maximum mass (in standard form) = _____ kg

13

4.2.2.4 Properties of small molecules

Question 15

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]

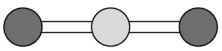
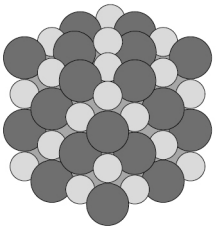
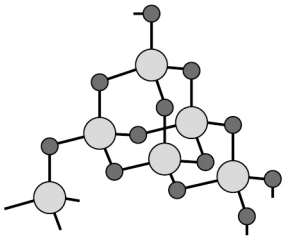
Tick (✓) **two** boxes.

- 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	

4.2.2.4 Properties of small molecules

Question 15 · continued

Compare the structure and bonding of the three compounds:

- carbon dioxide
- magnesium oxide
- silicon dioxide.

[6 marks]

8

4.2.2.4 Properties of small molecules

Question 16

November 2021 | 8462/1F | Original Q8

0 8 This question is about carbon and its compounds.

Fullerenes are molecules of carbon atoms.

The first fullerene to be discovered was Buckminsterfullerene (C_{60}).

0 8 . 1 What shape is a Buckminsterfullerene molecule?

[1 mark]

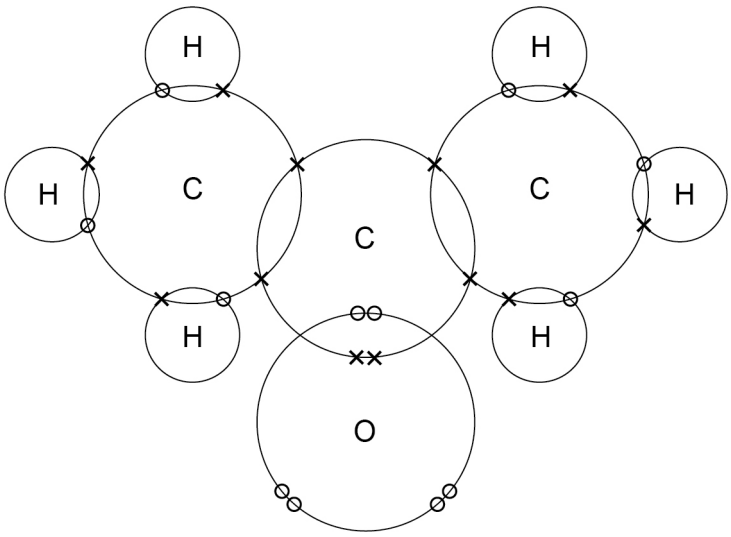
0 8 . 2 Give **one** use of a fullerene.

[1 mark]

Propanone is a compound of carbon, hydrogen and oxygen.

Figure 13 shows the dot and cross diagram for a propanone molecule.

Figure 13



Question 16 · continued

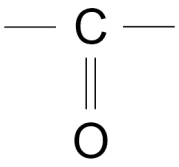
0 8 . 3 Complete **Figure 14** to show a propanone molecule.

Use a line to represent each single bond.

Use **Figure 13**.

[1 mark]

Figure 14



0 8 . 4 Determine the molecular formula of propanone.

Use **Figure 13**.

[1 mark]

Molecular formula = _____

0 8 . 5 Propanone is a liquid with a low boiling point.

Why does propanone have a low boiling point?

[1 mark]

Tick (✓) **one** box.

The covalent bonds are strong. ☐

The covalent bonds are weak. ☐

The intermolecular forces are strong. ☐

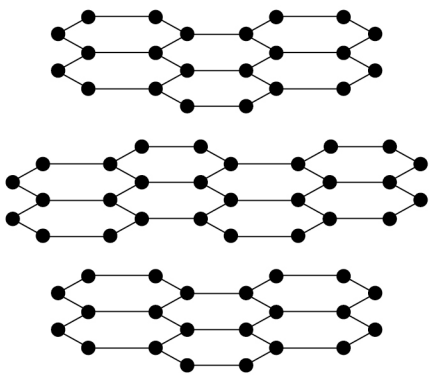
The intermolecular forces are weak. ☐

4.2.2.4 Properties of small molecules

Question 16 · continued

0 8 . 6 **Figure 15** represents the structure of graphite.

Figure 15



Explain why graphite is:

- a good electrical conductor
- soft and slippery.

You should answer in terms of structure and bonding.

[6 marks]

11

4.2.2.4 Properties of small molecules

Question 17

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 ☐

4.2.2.4 Properties of small molecules

Question 17 · 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. ☐

4.2.2.4 Properties of small molecules

Question 17 · 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

4.2.2.4 Properties of small molecules

Question 18

June 2024 | 8462/1F | Original Q5

0 5 This question is about carbon and carbon compounds.

An atom of carbon is represented as:

(Mass number) 13
(Atomic number) 6 C

0 5 . 1 What is the number of protons in this atom of carbon?

Tick (✓) **one** box.

[1 mark]

1 ☐ 6 ☐ 7 ☐ 13 ☐

0 5 . 2 What is the number of neutrons in this atom of carbon?

Tick (✓) **one** box.

[1 mark]

1 ☐ 6 ☐ 7 ☐ 13 ☐

0 5 . 3 What is the number of electrons in this atom of carbon?

Tick (✓) **one** box.

[1 mark]

1 ☐ 6 ☐ 7 ☐ 13 ☐

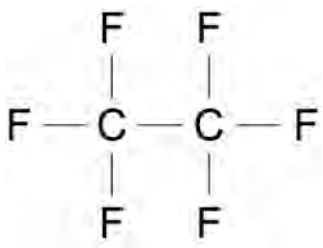
Question 5 continues on the next page

4.2.2.4 Properties of small molecules

Question 18 · continued

0 5 . 4 **Figure 10** shows the structure of a carbon compound.

Figure 10



Complete the formula of the carbon compound.

[1 mark]

C__ F__

0 5 . 5 Methane:

- is a carbon compound
- exists as small molecules
- has a low boiling point.

What is the reason for the low boiling point of methane?

[1 mark]

Tick (✓) **one** box.

Covalent bonds **and** intermolecular forces are weak. ☐

Only covalent bonds are weak. ☐

Only intermolecular forces are weak. ☐

4.2.2.4 Properties of small molecules

Question 18 · continued

0 5 . 6 Buckminsterfullerene (C_{60}) is a form of carbon.

Buckminsterfullerene was the first fullerene to be discovered.

What is the shape of a buckminsterfullerene molecule?

[1 mark]

Tick (✓) **one** box.

Cubic ☐

Cylindrical ☐

Spherical ☐

Question 5 continues on the next page

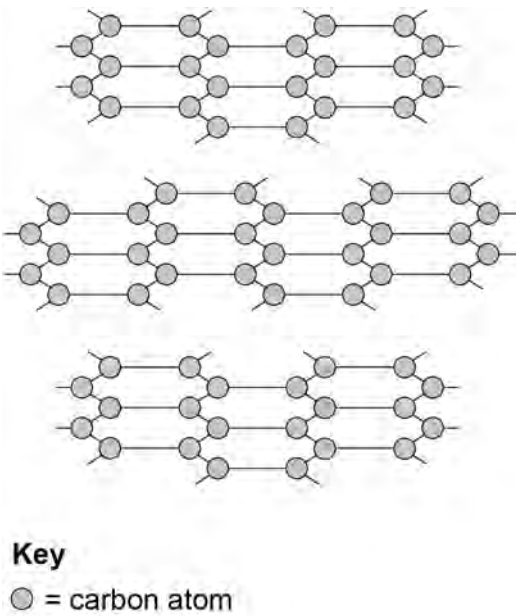
4.2.2.4 Properties of small molecules

Question 18 · continued

0 5 . 7 Graphite is a form of carbon.

Figure 11 represents the structure of graphite.

Figure 11



How many covalent bonds does each carbon atom form in graphite?

[1 mark]

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

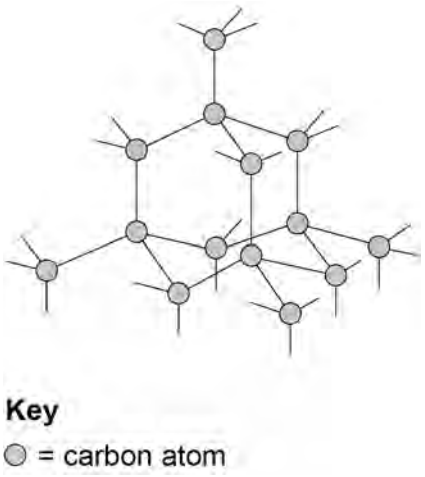
4.2.2.4 Properties of small molecules

Question 18 · continued

0 5 . 8 Diamond is another form of carbon.

Figure 12 represents the structure of diamond.

Figure 12



Describe the structure and bonding in diamond.

[3 marks]

10

4.2.2.4 Properties of small molecules

Question 19

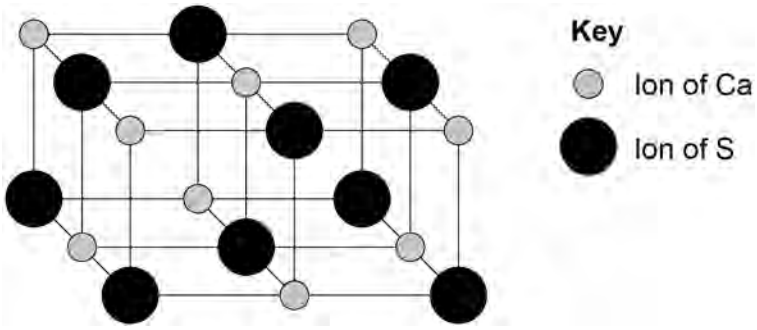
June 2025 | 8462/1F | Original Q9

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

4.2.2.4 Properties of small molecules

Question 19 · 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.

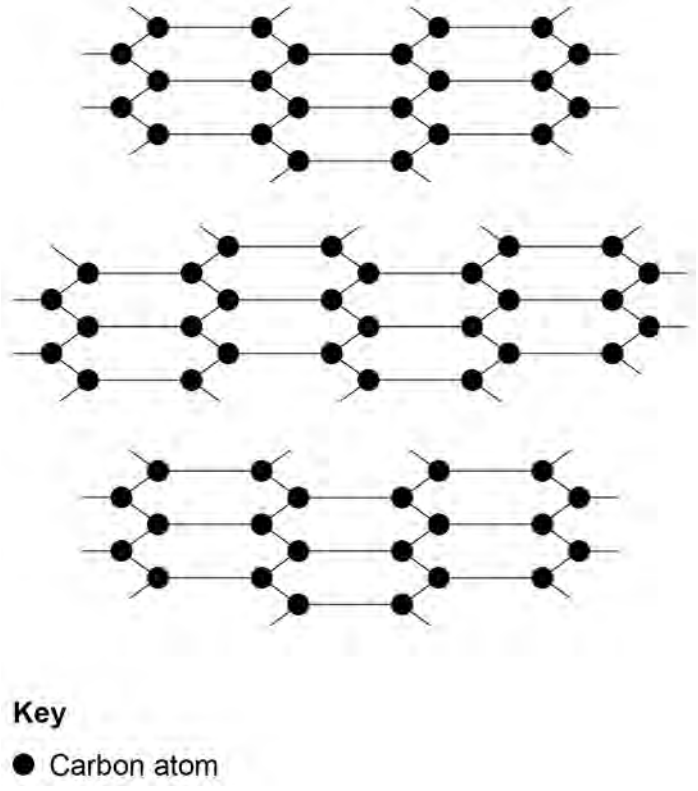
[4 marks]

4.2.2.4 Properties of small molecules

Question 19 · continued

Figure 14 shows the structure of graphite.

Figure 14



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

[4 marks]

Extra space

4.2.2.4 Properties of small molecules

Question 19 · continued June 2025 | 8462/1F | Original Q9

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

Give **one** reason why.

[1 mark]

0 9 . 5 Methane consists of small molecules.

Poly(ethene) is a polymer.

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

[1 mark]

Tick (✓) **one** box.

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

11