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Examiners' report

GCSE

TWENTY FIRST CENTURY SCIENCE CHEMISTRY B

OCR Level 1/Level 2 GCSE (9-1) in Chemistry B (Twenty First Century Science)

J258

For first teaching in 2016

J258/01 Summer 2025 series

Version 1

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Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate responses is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from Teach Cambridge.

Paper 1 series overview

Candidates were comfortable with the time allocation and were able to work their way through to the end of the paper. Candidates consistently showed an ability to interact meaningfully with the questions, where even wrong answers were clearly related to the topic in question.

Examiners were conscious that this year more candidates seemed to be having communication problems, either in expressing their ideas in writing or in making that writing legible enough to be understood. Examiners are very sympathetic to candidates' communication problems, but handwriting was sometimes an issue.

High scoring candidates were more than willing to apply their scientific knowledge and understanding to unfamiliar looking situations and scored well.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• took enough time to work out what the question was asking • saw unfamiliar contexts as an opportunity to apply their scientific knowledge and understanding • internalised information from graphs and charts, seeing them as more than sets of numbers but as giving information about the real world • attempted questions even when uncertain of the answer • showed their working for mathematical questions.	• experienced problems in expressing their thoughts in writing • read questions hastily due to the pressure of the examination, so missed part of what the question wanted • gave an answer to mathematical questions but no working.

Question 1 (a) (i)

1 Greenhouse gases absorb energy emitted by the Earth.

(a) Carbon dioxide is a greenhouse gas.

(i) Which of these gases is another greenhouse gas?

Tick (✓) **one** box.

Methane ☐

Nitrogen ☐

Oxygen ☐

[1]

This question was very well answered, with nitrogen as the most common incorrect option.

Question 1 (a) (ii)

(ii) Which **two** statements describe the possible effects of increased levels of greenhouse gases?

Tick (✓) **two** boxes.

Decreased algae growth in water. ☐

Flooding of low land. ☐

Increased oxygen in the atmosphere. ☐

Melting of polar ice caps. ☐

[2]

This question was very well answered, especially for the melting of the polar ice caps. Decreased algal growth was the most common incorrect suggestion.

Question 1 (a) (iii)

(iii) Suggest **two** ways the amount of carbon dioxide in the environment can be reduced.

1 .....

.....

2 .....

.....

[2]

Most candidates suggested two different ways of reducing carbon dioxide. Low scoring candidates gave one-word answers such as 'forests' or 'deforestation' but didn't say whether they should be increased or reduced.

Question 1 (b) (i)

(b) The concentration of carbon dioxide in the atmosphere has increased over time.

Fig. 1.1 shows the concentration of carbon dioxide in the atmosphere over a 50-year period.

Fig. 1.1

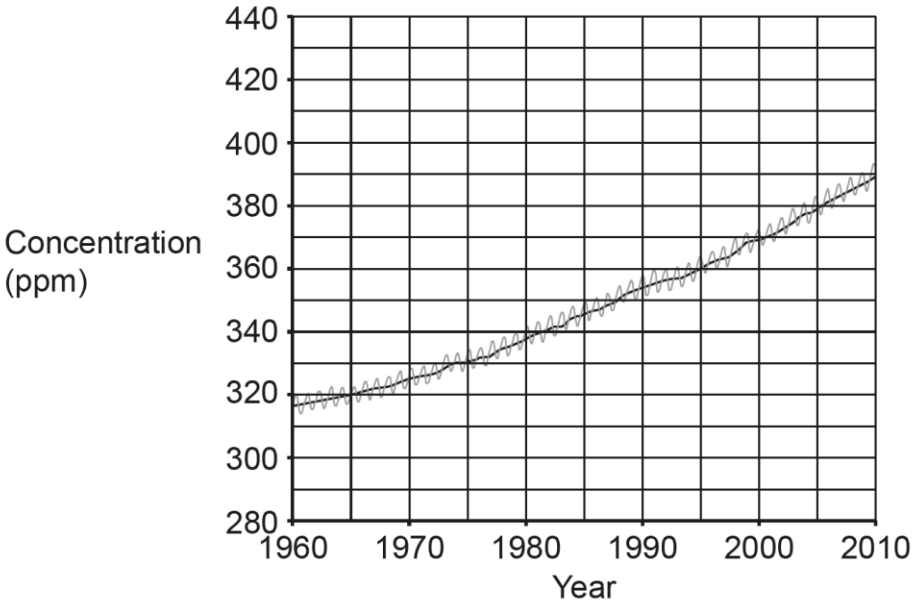
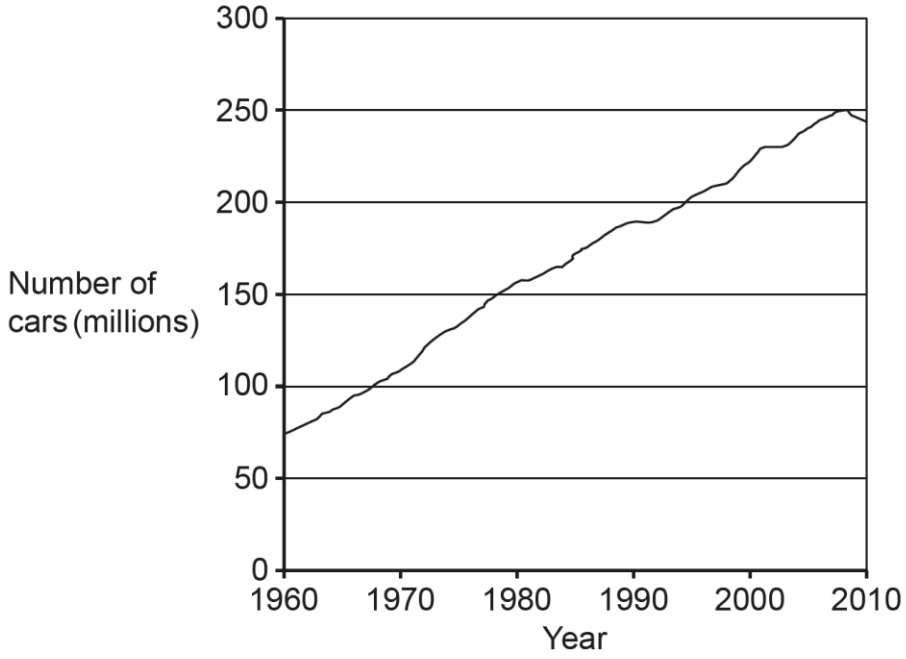


Fig. 1.2 shows the number of cars being used in the USA over the same 50-year period.

Fig. 1.2



(i) Explain how the graphs shown in **Fig. 1.1** and **Fig. 1.2** show that there is a correlation between the number of cars being used and the concentration of carbon dioxide in the atmosphere.

.....

..... **[1]**

While it wasn't always clear that candidates understood the meaning of the word 'correlation', they showed an excellent intuitive understanding of what was needed. Some discussed causality only and did not mention any correlation.

Some low scoring candidates understood the context of the question but did not seem to realise what it was actually asking, so gave one-word answers such as 'pollution' or 'greenhouse gas'.

Assessment for learning

Candidates should distinguish between a correlation and a cause-effect link (IaS3).

Question 1 (b) (ii)

(ii) Calculate the increase in concentration of carbon dioxide in the atmosphere between 1960 and 2010.

Use **Fig. 1.1**.

Increase in concentration of carbon dioxide = ... ppm **[2]**

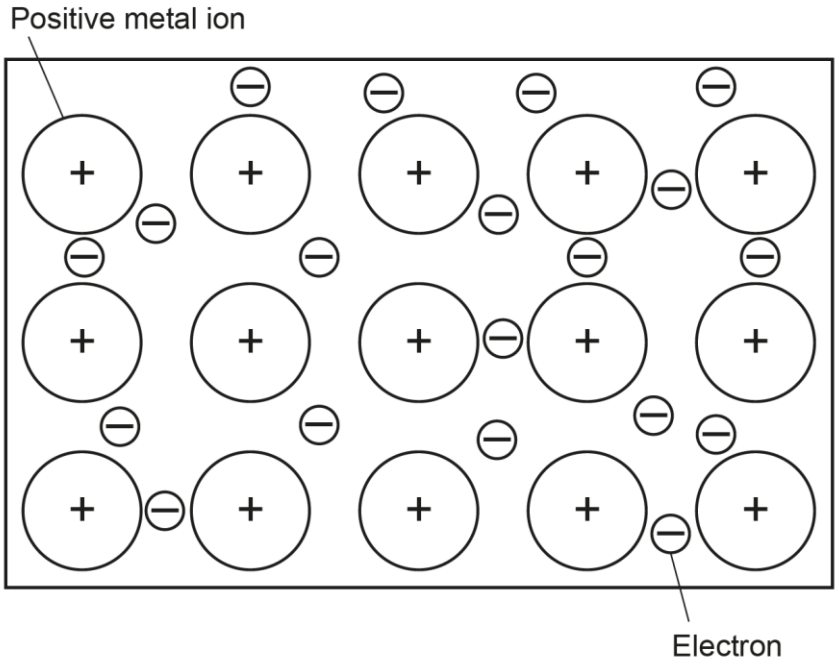
While most candidates scored well, two areas of difficulty did show up. One group of candidates knew to deduct one value from the other, but at least one value was out of tolerance. A smaller group were uncertain how to calculate the increase, so either added the values or carried out a division calculation.

Question 2 (a) (i)

2 A student investigates the reactivity of metals.

(a) The diagram shows a model of a metallic structure.

The positive metal ions are shown as spheres, packed closely together in a regular pattern.



(i) What type of structure do metal atoms form?

Tick (✓) **one** box.

Covalent ☐

Giant ☐

Simple ☐

[1]

Most candidates, even the highest scoring, thought that metals had a covalent structure.

Assessment for learning

Candidates should realise that metallic bonding is neither covalent nor ionic, but a separate category (C3.1).

Question 2 (a) (ii)

(ii) Draw lines to connect each **metal property** with its correct **explanation**.

Metal Property	Explanation
Conducts electricity	Electrons are free to move.
High melting point	Layers of ions are in fixed positions.
Malleable	Layers of ions can slide over each other.
	Strong electrostatic attraction.

[3]

Candidates successfully linked 'malleable' to 'layers of ions can slide'. While most candidates incorrectly linked 'conducts electricity' to 'strong electrostatic interaction', higher scoring candidates often successfully tied it to 'electrons are free to move'.

The high melting point box sometimes had two lines drawn from it.

Question 2 (b) (i)

(b) Metals are placed in order of reactivity by observing their reactions.

A student adds three metals to water and dilute hydrochloric acid and observes the reactions.

The table shows their results.

Metal	Reaction with water	Reaction with dilute hydrochloric acid
Potassium	Reacts violently	Reacts violently
Zinc	No reaction	Slow reaction
Silver	No reaction	No reaction

(i) Which of the metals in the table is the **least** reactive?

Explain your answer.

Least reactive metal .....

Explanation .....

.....

.....

[2]

This question was well answered by almost all candidates. A few even realised that the only important reaction here is that with acid. The most common incorrect choice was Zinc.

Question 2 (b) (ii)

(ii) What happens to metal atoms when they lose electrons?

Tick (✓) **one** box.

They form double bonds. ☐

They form negative ions. ☐

They form positive ions. ☐

They form protons. ☐

[1]

This question was well answered by a good number of candidates. 'Negative ions' was the most common incorrect choice.

Question 2 (b) (iii)

(iii) Complete the **word** equation for the reaction of potassium with dilute hydrochloric acid.

potassium + hydrochloric acid → hydrogen + ...

[1]

This question provided very strong differentiation between candidates who scored high marks in general, who did very well here, and those scoring low marks in general, who found predicting the product to be very difficult. The most common incorrect suggestions were 'water', 'oxygen', and 'potassium acid'.

Question 3 (a)

3 The properties of elements in the same group of the Periodic Table show trends.

(a) **Table 3.1** shows information about some Group 7 elements.

Table 3.1

Element	Formula	State at room temperature and pressure	Colour at room temperature and pressure	Colour in the gas state
Chlorine	Cl_2	Gas	Yellow-green	.....
Bromine	Br_2	.....	Deep-red	Red-brown
Iodine	.....	Solid	Grey	Purple

Complete **Table 3.1**. **[3]**

Most candidates successfully wrote the formula as I_2, and many went on to identify bromine as a liquid. The highest scoring realised that chlorine was yellow-green or green. Common incorrect colours were blue, cloudy, colourless and red-brown.

Exemplar 1

Element	Formula	State at room temperature and pressure	Colour at room temperature and pressure	Colour in the gas state
Chlorine	Cl_2	Gas	Yellow-green	Green
Bromine	Br_2	Liquid	Deep-red	Red-brown
Iodine	I	Solid	Grey	Purple

Candidates do need to take care over formula. Here the first mark was lost because of a simple slip-up.

Question 3 (b) (i)

(b) **Table 3.2** shows the atomic number, melting point and boiling point of some Group 7 elements.

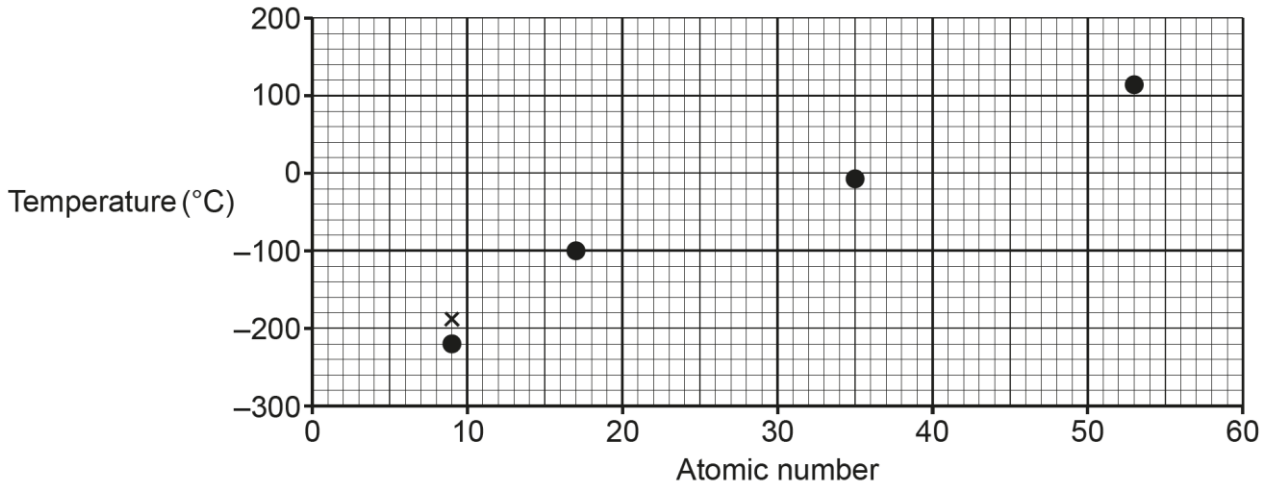
Table 3.2

Name	Atomic number	Melting point (°C)	Boiling point (°C)
Fluorine	9	–220	–188
Chlorine	17	–102	**–35**
Bromine	35	–7	**59**
Iodine	53	114	**184**

The graph shows the melting point data from **Table 3.2**.

Key

● Melting point
× Boiling point



(i) Plot the boiling point data from **Table 3.2** on the graph.

The boiling point of fluorine has been done for you. **[2]**

The points were well plotted by all except low scoring candidates, and even then they were not that far out.

Question 3 (b) (ii)

(ii) Find whether iodine is a solid, liquid or gas at 100 °C.

Tick (✓) **one** box.

Solid ☐

Liquid ☐

Gas ☐

[1]

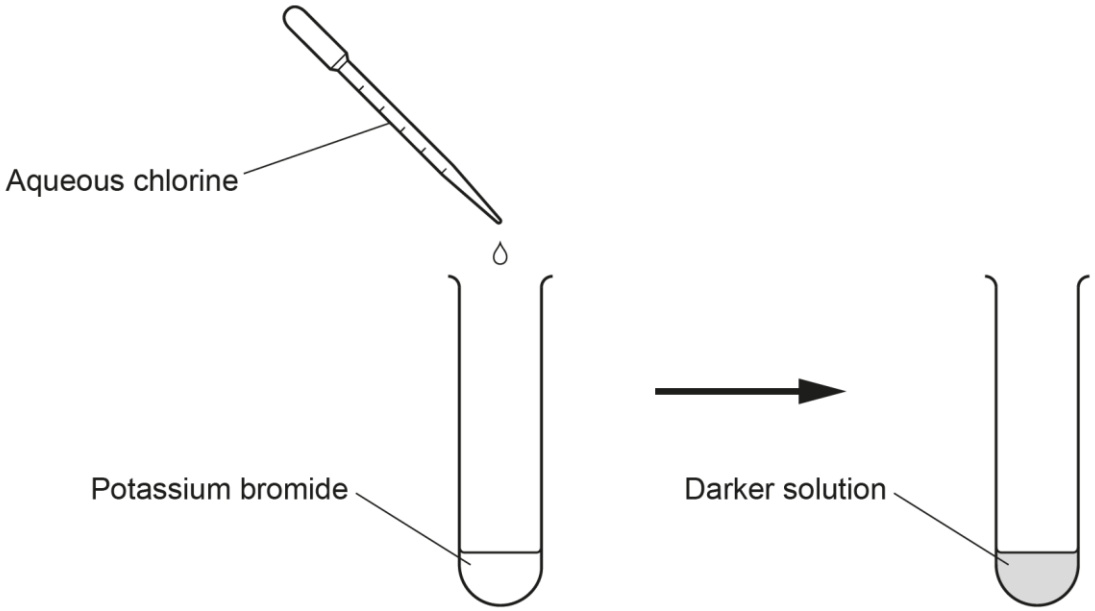
This was generally well answered with 'liquid' as the most common incorrect choice.

Question 3 (c) (i)

(c) A student investigates the reactivity of chlorine and bromine.

They add aqueous chlorine to aqueous potassium bromide.

A colour change is seen.



(i) Which of these is a **product** of the reaction?

Tick (✓) **one** box.

Bromine ☐

Chlorine ☐

Potassium ☐

[1]

While chlorine was the most common incorrect choice, potassium was also frequently chosen.

Question 3 (c) (ii)

(ii) What is the name for this type of reaction?

Tick (✓) **one** box.

- Combustion ☐
- Displacement ☐
- Neutralisation ☐
- Titration ☐

[1]

High scoring candidates knew that this is a displacement reaction, with titration as the most common incorrect choice.

Question 4 (a) (i)

4 Many useful products contain mixtures.

(a) Cement is a product used in the construction industry.

It contains substances mixed together in definite proportions.

(i) What is the name of this type of mixture?

Tick (✓) **one** box.

- Compound ☐
- Element ☐
- Formulation ☐
- Pure ☐

[1]

The word 'formulation' was not well known, but the many who did not know it very sensibly went for 'compound'.

Question 4 (a) (ii)

(ii) The table shows the percentage of each substance used in one type of cement.

Substance	Percentage (%)
Calcium oxide	91.5
Magnesium oxide	3.5
Water	

Calculate the percentage of water in this cement.

Percentage of water = ... % **[1]**

This question was very well answered.

Question 4 (a) (iii)

(iii) Cement can be harmful to skin and eyes.

State **one** safety precaution that must be taken when using cement.

..... **[1]**

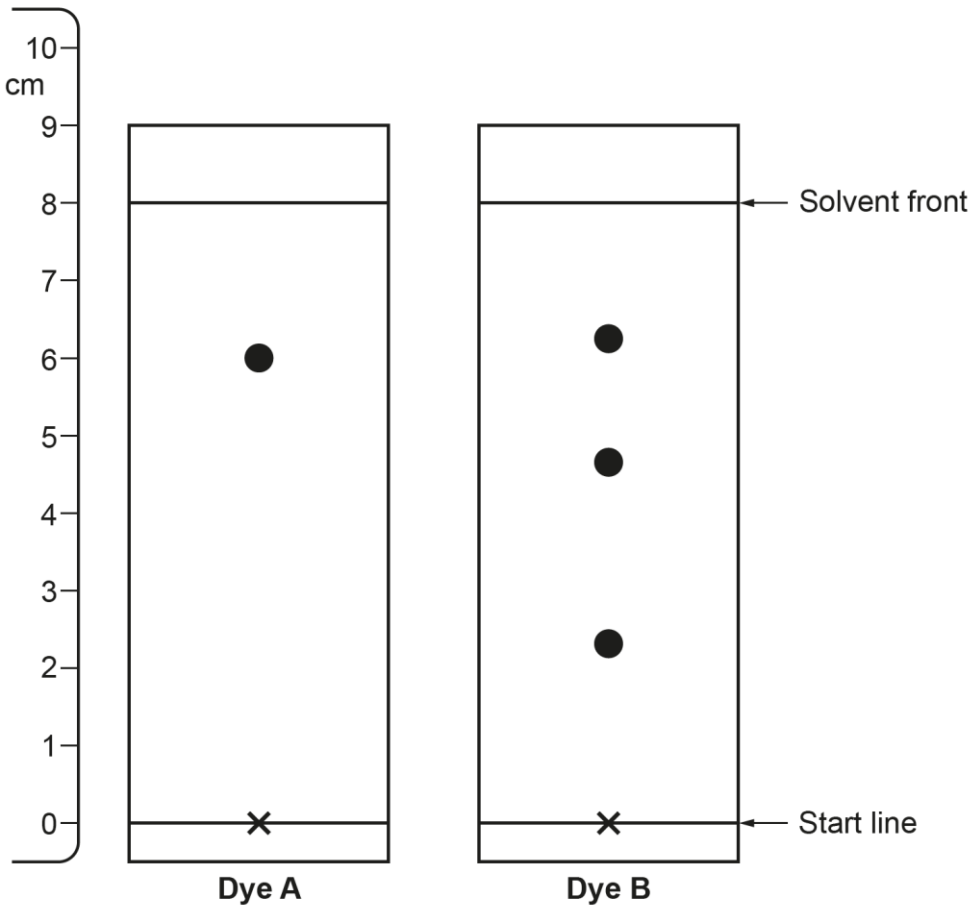
Almost all candidates showed a good understanding of safety precautions, although the few responses along the lines of 'use protection' needed to be more specific in order to gain credit.

Question 4 (b) (i)

(b) A scientist uses paper chromatography to separate the colours in two dyes.

Fig. 4.1 shows the results.

Fig. 4.1



(i) The scientist thinks that dye B is a mixture.

Explain how the results show that dye B is a mixture.

.....

..... **[1]**

This question was well understood, although candidates often had difficulty articulating their answers.

Question 4 (b) (ii)

(ii) Calculate the R_f value for the colour used in dye A.

Use the formula: $R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$

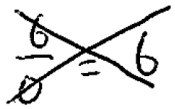
R_f = ... **[2]**

Both high and medium scoring candidates correctly identified the two distances needed to calculate the R_f value, with the main mistake being to use 6 and 2 as the two values. Some did not gain the second mark because they calculated 8/6 instead of 6/8.

In this question, a significant number of candidates who gave an incorrect answer could have gained one of the marks if they had shown their working.

Exemplar 2

Use the formula: $R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$



$\frac{6}{8} = 0.75$

R_f = 0.75 ..... **[2]**

Despite getting the wrong answer, the candidate has scored the first mark for the working.

Question 4 (b) (iii)

(iii) Paper chromatography uses two phases.

The **mobile** phase is the solvent.

What is the name of the **other** phase?

Tick (✓) **one** box.

Separation ☐

Solute ☐

Stationary ☐

[1]

The stationary phase was well recognised, with 'solute' as the most frequent alternative.

Question 5 (a)

5 Some substances have a covalent structure.

(a) Which **two** statements about covalent bonds are **true**?

Tick (✓) **two** boxes.

A covalent bond always forms between electrons in the shell closest to the nucleus. ☐

A covalent bond forms between two non-metals. ☐

A covalent bond forms from a shared pair of electrons. ☐

A covalent bond is very weak. ☐

[2]

Most candidates knew that a covalent bond forms from a shared pair of electrons, and the higher scoring also knew that it formed between non-metals. The most common incorrect choice was to think the bonding was between electron shells closest to the nucleus.

Misconception

Candidates should be aware that covalent bonding takes place when atoms come close together, and therefore only involves the outer electrons.

Question 5 (b) (i)

(b) Ammonia has a simple covalent structure.

(i) Ammonia has a low boiling point.

Complete the sentences to explain the low boiling point of ammonia.

Use words from the list.

atoms	**bonds**	**ions**	**molecules**

Ammonia molecules have covalent bonds joining the ..... within the molecule.

To boil ammonia, energy is transferred to it.

A small amount of energy is needed because of the weak forces of attraction between

the ..... .

[2]

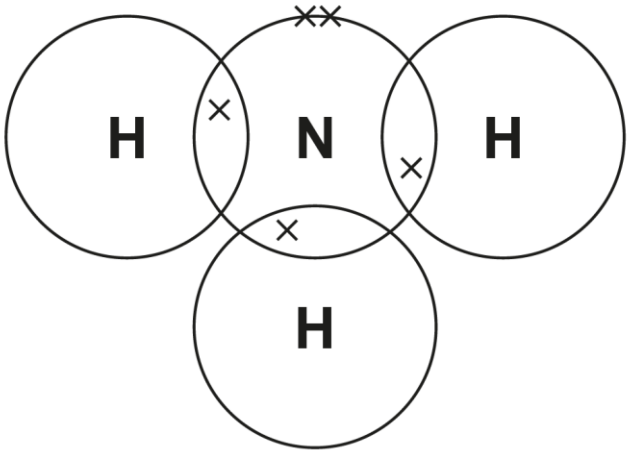
The difference between covalent bonds and weaker intermolecular forces was not well understood by most candidates. The most frequent choices were 'ions' for the first part and either 'bonds' or 'atoms' for the second part.

Question 5 (b) (ii)

(ii) **Complete** the dot and cross diagram for ammonia.

Hydrogen has 1 electron.

The electrons for nitrogen have been done for you.



[2]

This question provided very strong differentiation between high scoring candidates, who did very well here, and lower scoring candidates, who found dot and cross diagrams very difficult. Some low scoring candidates put an octet of electrons round each hydrogen, and while it did not gain credit it did show a level of good interaction with the question.

Question 5 (c) (i)

(c) Diamond is a covalent structure.

Diamond is a naturally occurring material containing only carbon.

(i) State the number of covalent bonds that carbon forms.

..... **[1]**

High scoring candidates tended to correctly state '4', while elsewhere examiners saw a range of numbers with '12', '6', '3' and '2' being the most frequent.

Question 5 (c) (ii)

(ii) Diamond is a pure substance.

Explain what is meant by a pure substance.

.....

..... **[1]**

Many candidates struggled to express themselves clearly, but they showed definite understanding and so gained credit. There were a few answers along the lines of 'it's natural' or 'it's from the earth'.

Question 5 (c) (iii)

(iii) State **one** property of diamond.

..... **[1]**

Most candidates were able to give a property of diamond, albeit using non-scientific terminology. A small minority of candidates appeared to be unfamiliar with the term 'property'.

Question 5 (c) (iv)

(iv) Which statements about the nature and arrangement of bonds in diamond are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	False
Diamond contains delocalised electrons.		
Diamond has a 2D arrangement of atoms.		
Diamond has a giant structure.		
Diamond is an allotrope of carbon.		

[3]

Most candidates knew that diamond has a giant structure and also that it is not two dimensional, so gained at least one of the marks

Question 6 (a) (i)

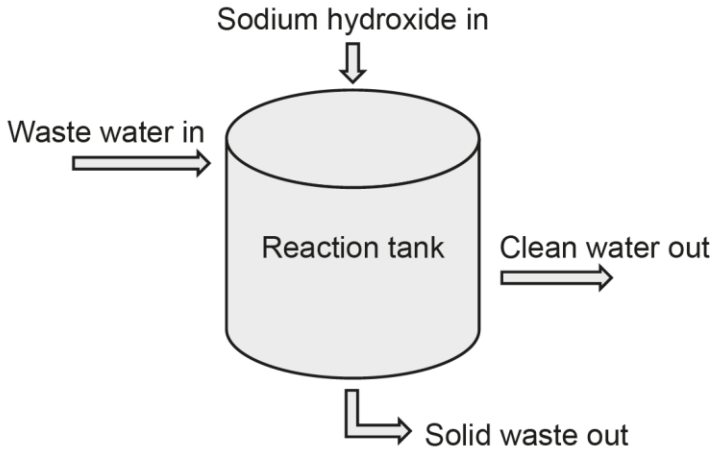
6 Waste water is treated to remove impurities before it is released into rivers.

Waste water from a factory contains aqueous copper chloride as an impurity.

The copper chloride is removed in a reaction with aqueous sodium hydroxide.

Fig. 6.1 shows the reaction tank where copper chloride is removed.

Fig. 6.1



(a) The word equation for the reaction is:

copper chloride + sodium hydroxide → copper hydroxide + sodium chloride

(i) Complete the **balanced symbol** equation for the reaction.

$$CuCl_2(aq) + ...NaOH(aq) \rightarrow Cu(OH)_2(s) + 2.....(aq)$$

[2]

The need for 2NaOH was well understood, and higher scoring candidates realised that NaCl would be produced. The most common error was $NaCl_2$, although NaOH was also occasionally seen. Not everybody recognised the symbol for sodium, so some candidates put SoCl for sodium chloride.

Question 6 (a) (ii)

(ii) The copper hydroxide produced in the reaction is **insoluble** in water.

Name the process used to remove the copper hydroxide from the water.

..... **[1]**

Filtration was often correctly chosen, even if there was a wide range of spellings. Titration and distillation were the two main alternatives, with occasional mention of the Haber Process.

Question 6 (a) (iii)

(iii) Scientists use analysis to calculate the mass of copper chloride in the waste water.

What is the name for this type of analysis?

Tick (✓) **one** box.

Experimental ☐

Instrumental ☐

Qualitative ☐

Quantitative ☐

[1]

Quantitative was often correctly chosen by higher scoring candidates, with incorrect answers fairly evenly distributed across the distracters.

Question 6 (b) (i)

(b) A scientist wants to identify the metal ions contained in four different samples of waste water.

The scientist uses dilute sodium hydroxide to test each of the four samples.

The table shows their results.

Sample	Observation
A	light blue precipitate
B	green precipitate
C	white precipitate
D	white precipitate

(i) Complete the method for the tests.

1. Place four test tubes in a test tube holder.
2. .....

.....

3. .....

.....

4. Record results.

[2]

Most candidates appreciated what needed doing but had difficulty in expressing their ideas. Many assumed the water samples were already in the test tubes and so step 3 was waiting for a colour change.

Question 6 (b) (ii)

(ii) Which water sample, **A**, **B**, **C** or **D** contains copper ions?

..... **[1]**

Most candidates thought that sample B with its green precipitate was the one that contained copper. Interestingly, those who chose A were widely spread across the candidates.

Question 7 (a) (i)

7 Crude oil is a mixture of hydrocarbons.

(a) Crude oil is separated into fractions by fractional distillation.

(i) Modern life is dependent on crude oil.

Which statements about crude oil are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	False
Crude oil contains substances that combust.		
Crude oil is a feedstock for the petrochemical industry.		
Crude oil is a renewable resource.		
Crude oil is a source of coal.		

[3]

Most candidates knew that crude oil contains substances that combust, and also knew that it is not a source of coal. Higher achieving candidates also knew that it is a feedstock. A sizeable minority thought that crude oil is a source of coal.

Question 7 (a) (ii)

(ii) Complete the sentences to describe fractional distillation.

Use words from the list.

different	**equal**	**gases**
solids	**strongest**	**weakest**

In fractional distillation, the hydrocarbons are separated because their boiling points are

..... .

The smallest hydrocarbon molecules have the ..... intermolecular forces so

leave the column as ..... .

[3]

The link between weakest intermolecular forces and gases seemed to be better understood than the idea of differences in boiling point. While there were still frequent examples of 'strongest' and 'solid' for last two answers, at least they had an internal consistency.

Question 7 (a) (iii)

(iii) Name the process in which long chain hydrocarbon molecules are broken down into smaller, more useful hydrocarbon molecules.

..... **[1]**

'Cracking' was not well known as a term. However, the many suggestions of 'fractional distillation' showed good interaction with the question.

Question 7 (b) (i)

(b) Crude oil contains hydrocarbons from the alkane homologous series.

Table 7.1 shows information about the first five alkanes in the series.

Table 7.1

Alkane	Molecular formula	Boiling point (°C)
Methane	CH_4	–162
Ethane	C_2H_6	–89
Propane	C_3H_8	–42
Butane	C_4H_{10}	–1
Pentane	C_5H_{12}	

(i) Find the empirical formula of butane.

Empirical formula = ... **[1]**

High scoring candidates could often give the empirical formula, while most other candidates attempted to manipulate the formula in some meaningful way

Question 7 (b) (ii)

(ii) Predict the boiling point of pentane.

Explain your answer using information from **Table 7.1**.

Boiling Point ..... °C

Explanation .....

.....

.....

[2]

Most candidates appreciated that the decrease in value of each negative value represented an increase in boiling point, even if they had trouble expressing that understanding. A lot of candidates took the trouble to calculate incremental changes in order to produce a realistic estimate.

Question 8 (a)

8 PET is the plastic most commonly used to make plastic bottles.

About 13 billion of these bottles are produced in the UK each year.

(a) Life cycle assessments are used to consider the overall impact of plastic bottles.

Complete the sentences to describe the basic principles of a life cycle assessment.

Use words from the list.

disposal	**environment**	**information**
use	**water**	

A life cycle assessment involves collecting data from each stage in the life cycle of a product.

Manufacturers can assess the use of raw materials, energy and ..... from manufacture to ..... of the product.

A life cycle assessment considers the impact on the ..... of each of the stages.

[3]

Environment was the most frequent correct choice.

Question 8 (b)

(b) Explain the difference between the terms **reuse** and **recycle**.

.....

.....

.....

..... **[2]**

This question was well attempted, although some candidates assumed that to recycle meant to throw the object into a recycling bin.

Question 8 (c) (i)

(c) Disposal of the products is an important step to consider when conducting a life cycle assessment of PET bottles.

The table shows some information about the incineration, landfill and recycling of PET bottles.

	Incineration	**Landfill**	**Recycling**
Cost (per tonne of bottles disposed)	£250	£25	£300
Greenhouse gas released	Carbon dioxide	Carbon dioxide	None
Energy generated	Electricity	None	None
Raw material recovered (%)	0	0	80

(i) State **one** advantage and **one** disadvantage of the disposal of PET bottles by incineration.

Use the table to help you answer.

Advantage .....

.....

Disadvantage .....

.....

[2]

This question provided very strong differentiation between high scoring candidates, who did very well here, and those scoring low marks, who had difficulty in both understanding what the question was asking and then putting their answer into words.

Common misunderstandings were either to suggest that incineration ***needs*** electricity, ***uses*** carbon dioxide and no raw material recovered or thinking the question was about recycling rather than incineration

Question 8 (c) (ii)

(ii) Explain how the data in the table supports this statement:

'Recycling of PET bottles has a less negative impact on the environment than incineration and landfill of them.'

.....

.....

.....

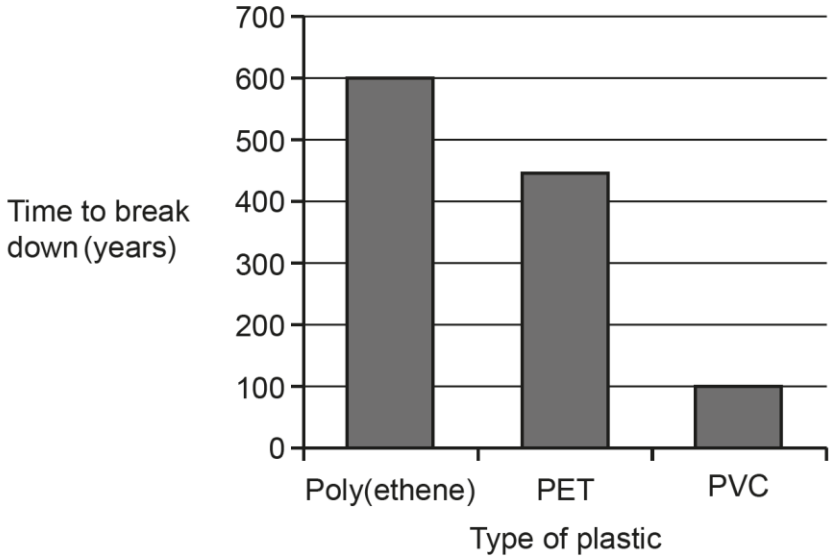
..... **[2]**

This also provided strong differentiation for similar reasons to Question 8 (c) (i), so there were frequent misunderstandings of what constituted a positive impact and some did not seem to realise that the question had changed from incineration to recycling.

Question 8 (d)

(d) PET and other plastics take a very long time to break down in the environment.

The graph shows the time taken for three types of plastics to break down in the environment.



Calculate the mean of the times taken for the three plastics to break down in the environment.

Use information from the graph.

Give your answer to **3** significant figures.

Mean = ... years **[3]**

High and middle scoring candidates were able to both calculate the mean and also then give the answer to three significant figures as required.

Question 9 (a)

9 A student investigates rate of reaction.

(a) The student does three experiments adding limestone to dilute hydrochloric acid.

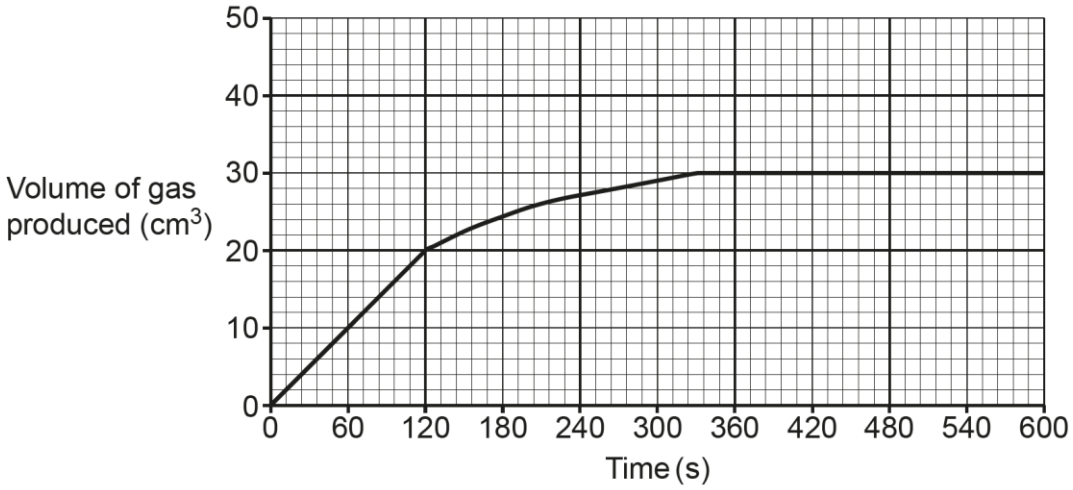
In all three experiments, the student keeps these the same:
- the mass of limestone
- the volume of acid
- the concentration of acid.

In experiment 1 the student adds **one** large piece of limestone to the acid at 20 °C.

The student measures the volume of gas produced every 30 seconds.

Fig. 9.1 shows the results of experiment 1.

Fig. 9.1



Calculate the rate of reaction during the first 120 seconds.

Use **Fig. 9.1**.

Give your answer to **2** decimal places.

Rate of reaction = ... cm^3/s **[3]**

In this question, a significant number of candidates who gave an incorrect answer could have gained one of the marks if they had shown their working.

Question 9 (b) (i)

(b) **Table 9.1** shows the conditions used for all three experiments.

Table 9.1

	Type of limestone	Temperature (°C)
Experiment 1	Large piece	20
Experiment 2	Large piece	40
Experiment 3	Powder	40

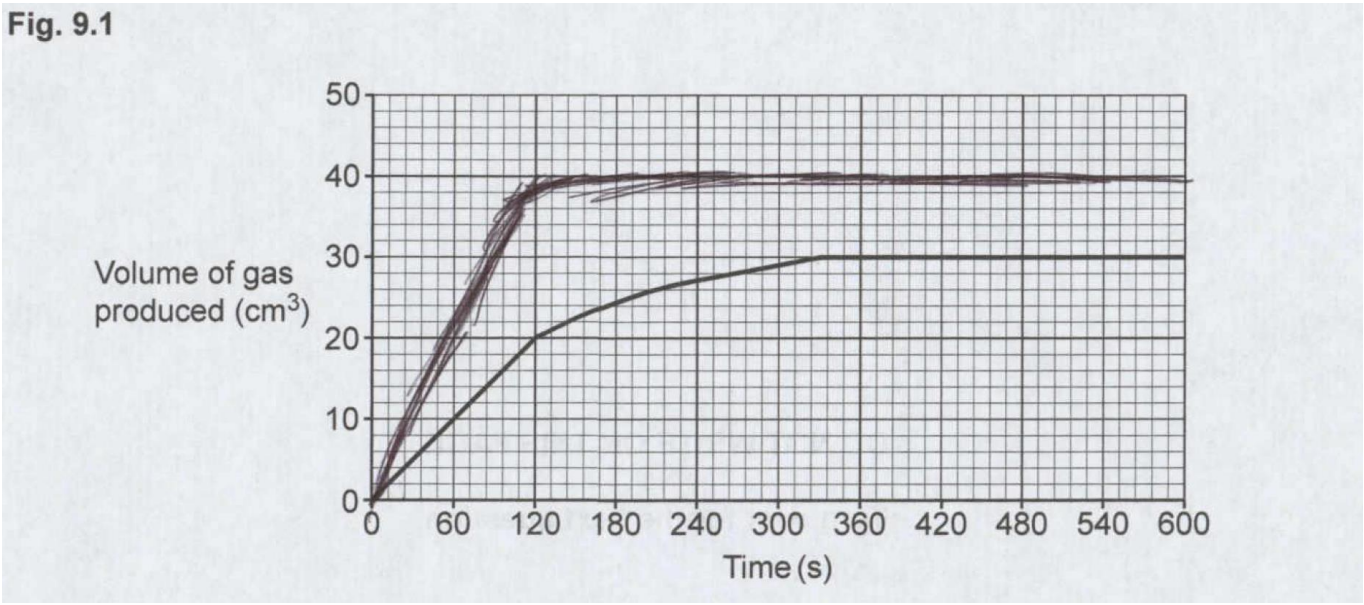
(i) Draw a line on **Fig. 9.1** to show the expected results for experiment 2.

Use the information in **Table 9.1** to help you. **[2]**

Many candidates drew a line with a steeper initial gradient, but in almost all cases the line flattened out somewhere near the top of the graph. Almost nobody realised that the final volume would be the same as for the previous experiment.

Exemplar 3

Fig. 9.1



This response is typical of a higher scoring candidate. Many others either left it blank or drew the steeper initial gradient only which went to the top of the graph paper

Question 9 (b) (ii)

(ii) Experiment 3 is the **fastest**.

Explain why.

Use the information in **Table 9.1**.

Include ideas about collisions in your answer.

.....

.....

.....

..... **[2]**

High scoring candidates gained credit for stating that the surface area was larger, although almost no-one was able to discuss collisions in any meaningful way. There were some references to 'more collisions' and 'more successful collisions', but examiners were looking for 'more frequent collisions'.

Lower scoring candidates did not mention collisions at all, despite being prompted, and usually explained the reactivity of the powder as due to the fact that the powder was easier to break apart or was already broken down. Many did not even attempt this question.

Question 9 (c) (i)

(c) A scientist investigates the effect of four metals, **A**, **B**, **C** and **D**, on the rate of reaction to make ethane.

The scientist uses 5.0 g of each metal.

Table 9.2 shows their results.

Table 9.2

Metal	Mass of metal at end of reaction (g)	Time taken to make 10 g of ethane (s)
A	2.5	25
B	0.0	30
C	5.0	40
D	5.0	25

(i) Which metal **A**, **B**, **C** or **D** is the best metal to use as a catalyst in this reaction?

Explain your reasoning.

Use the information in **Table 9.2**.

Metal .....

Explanation .....

.....

.....

[2]

This question produced strong discrimination, with high scoring candidates scoring both marks. Others noted that D was the fastest, but did not discuss mass, and low scoring candidates did not understand the table so wrote about the mass 'produced' in the reaction or gave answers such as 'C, because it has the highest numbers'.

Question 9 (c) (ii)

(ii) Which statements about catalysts are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	False
A catalyst changes the overall energy change for a reaction.		
A catalyst lowers the activation energy of a reaction.		
A catalyst provides an alternative route for a reaction.		

[2]

There was a fairly random distribution of errors, although the majority of candidates thought that a catalyst does change the overall energy of a reaction. The most common correct answer was that a catalyst lowers the activation energy.

Misconception

The difference between the overall energy of a reaction and the activation energy was not understood by many candidates.

Question 10 (a)

10 Atoms contain protons, neutrons and electrons.

(a) The table shows the relative masses and relative charges of protons, neutrons and electrons.

Complete the table by filling in the blanks.

Particle	Relative mass	Relative charge
.....	1	.....
.....	.....	0
Electron	0.0005	–1

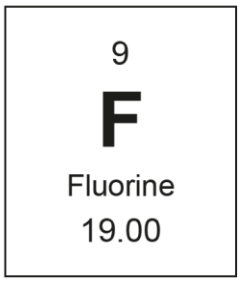
[2]

Proton and neutron were placed correctly by the vast majority of candidates. The second mark was more difficult to score, with many stating that the relative mass of a neutron was zero, or by failing to indicate that the relative charge of a proton was positive

Question 10 (b)

(b) **Fig. 10.1** shows information about fluorine.

Fig. 10.1



Find the number of protons, neutrons and electrons in an atom of fluorine.

Protons = ...

Neutrons = ...

Electrons = ...

[3]

Most candidates scored at least one of the marks, although it was a randomly distributed across the three options. Higher scoring candidates did proportionately better.

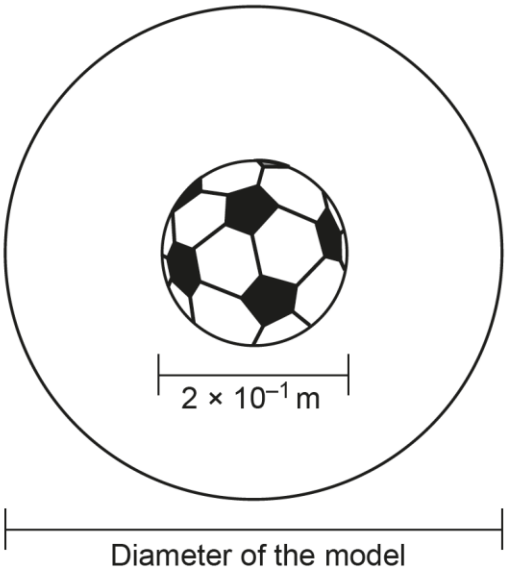
Question 10 (c)

(c) The size and scale of atoms can be compared to objects in the physical world.

A student builds a model of a hydrogen atom using a football to represent the nucleus.

Fig. 10.2 shows their model.

Fig. 10.2



The diameter of the football is 2×10^{-1} m.

The diameter of a hydrogen atom is 5×10^{4} times bigger than its nucleus.

Calculate the diameter of the model of the hydrogen atom.

Give your answer in **standard form** in **metres**.

Diameter = ... m **[2]**

Some candidates subtracted one number from the other.

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