Qualification Accredited

Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE CHEMISTRY B

J258
For first teaching in 2016

J258/04 Summer 2018 series

Version 1

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. 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 can be downloaded from OCR.

Paper J258/04 series overview

J258 04 is the higher tier paper of two papers for the new revised GCSE examination for Chemistry B. This paper is designed to test the depth of candidate's knowledge. As such, candidates are expected to show that they can develop ideas within a question, often over a narrow range of linked specification statements from a single topic. Some questions further test their ability to further make links or to contrast learning from different specification areas.

The question style is short answer, often using stems of information for candidates to process and use in their answers. There are also two longer Level of Response questions, where candidates need to organise their ideas to make reasoned arguments to present their views based on provided information. The Science for the Twenty First Century suite of specifications include integral Ideas about Science, which are also assessed through the contextualised and issue based question style, where candidates are expected to process unfamiliar information, make informed decisions and solve problems.

The new specification also includes mathematics in line with national requirements for the mathematical content of GCSE question papers. Some candidates were well prepared to tackle these new requirements. For others, more focus on the newer mathematical content may support their preparation for the examination, for example by ensuring that they are conversant with numbers given in standard form, rearranging equations, working through multi stage calculations and handling data in different formats.

Candidate performance

Candidates who did well on this paper generally did the following:

- Read and assimilated information given in question stems and applied this when answering the questions (lower ability candidates often copy out information without explaining how it applies to the question).
- Thought about command words and approached questions accordingly, for example by approaching 'Describe how…..' and 'Explain why…' questions differently.
- Answered longer two and three mark questions by considering the number of clear points necessary and ensuring that their marks matched the mark allocations.
- Answered succinctly and clearly.
- Came to the examination prepared for the mathematical demands listed in the specification, for example by using or interpreting standard form, algebra and mathematical symbols within the context of the questions.
- Considered the information in the Level of Response questions before starting to write to ensure that they used all available information.
- Considered the instructions carefully for the Level of Response questions and made sure to answer all aspects of the question.

Candidates who did less well on this paper generally did the following:

- Repeated information in the question stems or in tables without applying it to answer the problem or question asked.
- Gave partial answers to longer questions so that the available number of marks were not all addressed.
- Gave unstructured, lengthy and rambling answers, some of which went beyond the available space onto additional sheets, which did not make points clearly or contradicted correct statements due to confused statements. This issue led to lower marks for some candidates in the Level of Response questions.
- Did not always read the question carefully so that the answer given did not always match the instructions in the question. In the Level of Response questions some candidates only answered one aspect of the question, limiting them to the lower mark ranges.

There was no evidence that any time constraints had led to a candidate underperforming and scripts. Candidates typically answered all questions with few gaps.

Question 1(a)

1 Kai works in a research laboratory for a company that produces organic carbon compounds.

(a) Kai has three unlabelled samples of different compounds. All are colourless liquids.

Kai thinks that one of the compounds might be an alkene.
He thinks that another of the compounds might be a carboxylic acid.
He thinks the third compound is neither an alkene nor a carboxylic acid.

Describe some simple experiments that Kai could use to find out which compound is which.

Include **two** tests and the expected results in your answer.

....

....

....

....

.... **[3]**

This question asked for candidates to distinguish between an alkene and a carboxylic acid. Many candidates knew that bromine water and an indicator could be used. Higher ability candidates wrote clear responses to link each test to the correct compound. Candidates generally could have earned more marks by planning their answer carefully; many answers linked the reagents to the wrong compound, for example by implying that bromine was a test for an acid. Few mentioned that the third compound has a negative result for both. The idea of a negative result for a test is important in analysis to exclude it as an 'unknown'. For the third mark, the result for both tests (the correct colour change) needed to be given. This question had a relatively high omit rate (candidates left it unattempted) compared to other questions on the paper.

Exemplar 1

1 Kai works in a research laboratory for a company that produces organic carbon compounds.

(a) Kai has three unlabelled samples of different compounds. All are colourless liquids.

Kai thinks that one of the compounds might be an alkene.
He thinks that another of the compounds might be a carboxylic acid.
He thinks the third compound is neither an alkene nor a carboxylic acid.

Describe some simple experiments that Kai could use to find out which compound is which.

Include **two** tests and the expected results in your answer.

Kai could add universal indicator to each of the liquids. If there is a carboxylic acid, it will appear more yellow ~~red~~, orange or red.

[3]

This answer clearly links a test (adding Universal Indicator) to the correct compound (the carboxylic acid). 1 mark.

Exemplar 2

An experiment Kai could use to find out which compound is an alkene would be using a universal indicator such as phenophathein as this would cause one of the compounds to change colour as before it was colourless, making it easier to identify. Another experiment he could do would be to react one of the compounds because if it produces hydrogen ions then it is an acid, carboxulic acid. **[3]**

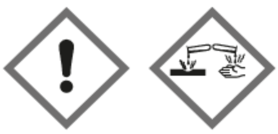
This answer identifies the use of an indicator (phenolphthalein) but links this with the incorrect compound, stating that this would identify the alkene. This therefore does not gain a mark.

Question 1(b)(i)

(b) Hazard symbols are used to give safety information.

Kai uses ethanoic acid.

The table shows the hazard symbols for ethanoic acid at different concentrations.

Concentration (mol/dm^3)	Hazard symbol
< 1.7	none
$\geqslant 1.7$ and < 4.0	
$\geqslant 4.0$	
very concentrated	

(i) At what concentrations is ethanoic acid harmful, but not corrosive?

....

....

.... **[2]**

This question tests the new mathematical content. Candidates are required to interpret the symbols for comparing amounts. Almost all candidates identified the correct range of concentrations. Higher ability candidates made it very clear that they understood the symbols by clearly stating in words 'equal to or greater than 1.7 but less than 4.0'

Question 1(b)(iii)

(iii) Kai adds very concentrated ethanoic acid to ethanol and heats the mixture.

Suggest some safety procedures for Kai to use to make sure that he is safe during this experiment.

....

....

....

....

.... **[3]**

This question was an 'overlap' question and so also appeared on the foundation tier. This means that it was designed to be accessible to candidates at standard demand (grades 4/5). Therefore, general safety precautions were accepted as correct for a single mark. This meant that almost all candidates earned at least one mark for stating that the use of gloves/goggles were needed. Fewer candidates processed the provided information to identify that the hazards of the mixture are that it is both flammable and corrosive. Candidates should avoid the use of 'burn' for corrosive, as there is a confusion between this and a description of flammability. Higher ability candidates used the correct terminology so that there was no ambiguity in their answers.

Question 2(a)

2 About 150 years ago, Dimitri Mendeleev developed an early version of the Periodic Table. His Periodic Table had eight groups. He put elements with similar properties into the same group.

The table shows some of the elements that Mendeleev grouped together.

Mendeleev's groups							
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Li Na K Cu	Be Mg Zn	B Al	C Si	N P	O S Cr	F Cl Br	Fe Co Ni

(a) Some of Mendeleev's groups contain similar elements to groups in the modern Periodic Table.

Which group in Mendeleev's table contains the elements now found in Group 14 of the modern Periodic Table?

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

Question 2(b)

(b) None of the elements from Group 18 of the modern Periodic Table are shown on Mendeleev's table.

Suggest a reason why.

....

.... **[1]**

Both of these part questions were very well answered. Candidates interpreted the information well and applied it to the context.

Question 2(c)

(c) Mendeleev put some of the transition metals into his Group 8.

He put some other transition metals into the other groups.

Give the symbols for **three** transition metals in Mendeleev's table that he did **not** put in Group 8.

1 ....

2 ....

3 ....

[2]

Most earned at least one mark for identifying one transition metal correctly. Others either included non-transition metals in the list or used their periodic table to find examples of transition metals that were not from Mendeleev's table. It is important that candidates read the question carefully to ensure that they follow the instructions.

Question 2(e)(i)

(e) Transition metal salts are acidic.

Sundip does an experiment to test the acidity of some solutions of transition metal salts.
She uses Universal Indicator and a colour chart to find the pH of each salt.

These are Sundip's results.

Name of salt	**pH**
copper sulfate	3
iron sulfate	3
zinc sulfate	4
nickel sulfate	4

(i) Describe how Sundip uses Universal Indicator to test the pH of the solutions of the salts.

....

....

.... **[2]**

Candidates know how to test for acidity. This question gives information that Sundip uses Universal Indicator and a colour chart to find pH. In this type of question, it is important to avoid repeating the information given. 'Sundip adds Universal Indicator and uses a chart to find the pH' does not add any information to that already given in the question and so would not be worthy of credit. Higher ability candidates explained that adding the indicator makes the acid change colour. This colour should then be matched to the colour on the chart to find the pH.

Question 2(e)(ii)

(ii) Sundip thinks her results do not show the difference in pH between the salts.
She thinks she needs to improve the precision of her pH results.

Explain why she needs to improve her precision and suggest how she can change her experiment to do this.

....

....

.... **[2]**

There are two parts to this question. Candidates did not always answer both parts. Some omitted to say why she needs to improve her precision (because the pH results are all close together). The specification includes the measurement of pH using a pH meter, which would differentiate between pH values that are close. Higher ability candidates suggested this. Answers which did not gain marks included ideas of 'doing repeats' or 'matching colours more carefully'.

Question 3(a)(i)

3 Mauritius is a country of small islands surrounded by sea.
There is almost no fresh water in Mauritius.

Seawater cannot be used as drinking water because it contains a large amount of salt.

(a) The flowchart shows the stages in a process which produces drinking water from seawater.

Seawater → **Stage 1** **Filtration** → **Stage 2** **Distillation** → **Stage 3** **Chlorination** → Drinking water to homes

(i) Which stage removes the salt from the seawater?

Explain your answer.

Stage ....

Explanation ....

.... **[3]**

This question was well answered. Some candidates chose 'filtration' believing that this would filter out the salt, but most identified distillation correctly. Similarly the explanation of distillation was well understood, most stating that water evaporates and salt is left behind.

Question 3(a)(ii)

(ii) Explain why there are no harmful bacteria in the water **after stage 2**.

....

....

.... **[2]**

Again, this was well answered with most candidates recognising that the high temperatures used kill any bacteria, earning two marks. Some went on further to correctly state that any bacteria would remain behind with the salt and would not be collected in the water.

Question 3(a)(iii)

(iii) Explain why **stage 3** is needed.

....

.... **[1]**

This question was interesting because it is different to the usual water treatment in the UK. In this case at stage 3 the water is already bacteria free. Candidates did not always engage fully with the context to realise this. 'Chlorine kills bacteria' was accepted as correct, but candidates who understood the process gave higher level answers than this, for example by pointing out that the chlorine is a precautionary measure to ensure that any bacteria entering the water during distribution are killed.

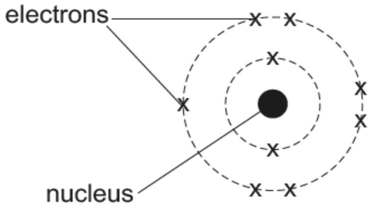
AfL 'Chlorine removes bacteria' is not enough to gain any marks. To be technical, the bacteria are still in the water, but they are dead. It is important that candidates learn that 'chlorine kills bacteria' in water.

Key

AfL Guidance to offer for future teaching and learning practice.

Question 4(a)

4 The diagram shows the arrangement of electrons in an atom of an element, **element X.**



element X

(a) Use the diagram and the Periodic Table to identify the element and to complete the missing information in the table.

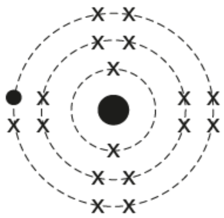
Name of element	
Number of electrons	9
Number of protons	
Number of neutrons	
Periodic Table Group	

[3]

This question was well answered. Almost all candidates correctly identified both the group and the element. Some put the numbers of protons and neutrons in the wrong order.

Question 4(b)(i)

(b) The diagram below shows the arrangement of electrons in **an ion** of another element from the same group, **element Y**.



ion of element Y

(i) What is the charge on the ion?

Explain your answer.

Charge ....

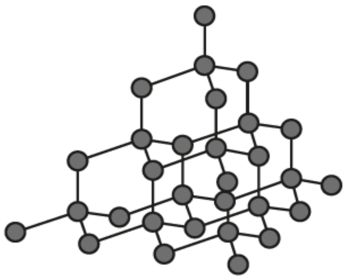
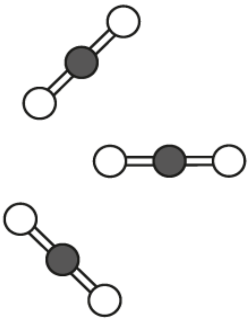
Explanation ....

.... **[2]**

Most knew that the atom had gained an electron. When giving a charge on an ion, 'negative' is not enough, a negative ion could have a range of charges. Best answered stated clearly that the charge is '-1'.

Question 5(a)

5 The table shows some information about diamond and carbon dioxide.

	Diamond	**Carbon dioxide**
Diagram of structure		
Type of structure	giant	simple
State at room temperature and pressure	solid	gas

(a) The structures of diamond and carbon dioxide are different, but the bonds are similar.

Write down some similarities between the bonds in diamond and carbon dioxide.

....

....

....

.... **[2]**

This whole question is a typical 'depth' question. Through the question, candidates are asked to compare and contrast diamond and carbon dioxide. Question (a) is about the bonding; (b) is about the state of each (linked to ideas about structure) and (c) is about allotropes.

Candidates who scored high marks in this question read each question carefully, considered what it was asking about and answered clearly. Candidates who did less well typically wrote long responses which sometimes included contradictions (for example confusion between bonds and intermolecular forces) and did not clearly address the question (for example by discussing structure or state when asked about bonding).

In part (a) the mark scheme allowed a range of similarities. A relatively common shortcoming was to only give one. Some candidates stated that the bonds were 'all single' or 'all double' in both, which is incorrect.

Exemplar 3

Both diamond and carbon dioxide have covalent bonds which means they have non-metallic atoms. They both have bonds between carbon atoms **[2]**

This answer is succinct and clear. It answers the question by stating that both bonds are covalent. 1 mark. As only one similarity is stated, a second mark cannot be given.

Exemplar 4

They both have covalent bonds so electrons are shared between the atoms. For diamond it's between carbon atoms and for carbon dioxide it's between carbon and oxygen atoms. **[2]**

Another clear answer. Notice in this case the candidate has stated two similarities (bonds are covalent and electrons are shared) leading to two marks.

Question 5(b)

(b) Explain why diamond is a solid and carbon dioxide is a gas at room temperature and pressure.

....

....

....

....

.... **[3]**

There are three marks to be earned. Firstly, candidates need to identify that diamond has a giant structure and that carbon dioxide has a simple structure. Either of these, clearly stated earns marking point 1 on the mark scheme. The next important point is that when diamond changes state bonds must break (and these are very strong) whereas when carbon dioxide changes state only (weaker) intermolecular forces break (the bonds do not). These last two ideas proved challenging for all but the most able candidates. There was a great deal of confusion between bonds and intermolecular forces across most of the answers seen.

?

Misconception A very common misconception is that 'intermolecular forces' is a term that can be used interchangeably with 'bonds'. It was common to see 'strong intermolecular forces in diamond'. It was also common to see candidates talking about 'breaking bonds' in carbon dioxide (without any mention of intermolecular). The explanation for the change of state in giant and simple covalent structures is not well understood.

Exemplar 5

Diamond is a giant covalent structure so has a very high melting / boiling point as it has so strong covalent bonds. Carbon dioxide, however is a simple covalent molecule with strong covalent bonds between atoms but weak **[3]**
intermolecular bonds which don't require much energy to be overcome.

This is another very good example of a fully scoring answer.3 marks. Notice how clear and unambiguously the candidate has described the structure of each and correctly explained its effect on the state of each.

Exemplar 6

Diamond is a giant covalent structure with strong intermolecular bonds therefore great amounts of energy are needed to break the bonds however carbon dioxide is simple covalent therefore doesn't require much energy to break the bonds changing the **[3]**
state making it a gas at room temperature and diamond a solid at room temperature.

This candidate has stated correctly that diamond has a giant covalent structure and that carbon dioxide has simple structure (one mark). However notice the contradiction; the candidate has gone on to confuse bonding with intermolecular forces in diamond. Intermolecular forces have not been mentioned at all in relation to carbon dioxide.

Exemplar 7

There is less intermolecular force in carbon dioxide than there is in diamond.

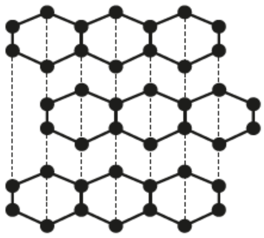
[3]

This candidate earned no marks. The misconceptions discussed above are evident in this response. The answer states that intermolecular forces are broken in both.

Question 5(c)

(c) Diamond is an allotrope of carbon.

Graphite is another allotrope of carbon.



Graphite

Carbon dioxide is not an allotrope of carbon.

Explain why diamond and graphite are allotropes but carbon dioxide is not.

....

....

.... **[2]**

Almost all candidates identified the pertinent point that carbon dioxide is a compound of carbon and oxygen. The question also asks why diamond and graphite are allotropes. Some missed out this part and so did not state that they contain atoms which are all of the same element (carbon).

Question 6(a)

6 The table shows the names and chemical formulae of some alkanes and alkenes.

Number of carbon atoms (n)	Alkanes		Alkenes	
1	methane	CH_4		
2	ethane	C_2H_6	ethene	C_2H_4
3	propane	C_3H_8	propene	C_3H_6
4	butane	C_4H_{10}	butene	C_4H_8

(a) An alkene called 'methene' cannot exist.

Explain why.

....

.... **[2]**

This question was well answered, with most candidates earning at least one mark either for identifying that 'methene' would only have one carbon atom or for stating that alkenes have a double bond (hence methene cannot have one). Candidates need to check that the mark allocation matches the number of points that they make to make sure that where a question has a two mark allocation, their answer addresses two separate, clear points.

Question 6(b)(ii)

(ii) How do the formulae of the alkanes and alkenes show that they are from different homologous series'?

....

....

.... **[2]**

In common with question 5, this question is a typical 'depth' question where candidates need to develop their thinking across multiple question parts within a narrow specification area. In this case, candidates need to carefully consider their answers to make sure that they do not merely repeat a statement across multiple part questions, but instead make sure that they make clear points relevant to each part.

In this case, a common correct answer to (b) (i) was 'they have the same general formula' (there are other alternative correct answers given on the mark scheme).

For (b) (ii) candidates who only said 'they have different general formula' gained only one mark. Better answers looked at the mark allocation and gave more detail, or gave two separate points, for example by contrasting the ratio of carbon to hydrogen in terms of numbers. A few made comments about differences which were not shown by the formulae (as the question asks), for example by commenting on their effects on bromine water. Although such answers are correct statements, they do not answer the question and so earned no marks.

Question 6(c)

(c) The general formula for an alkane is $C_nH_{(2n+2)}$.

Use this general formula to predict the chemical formula for an alkane which contains 50 carbon atoms.

.... **[1]**

Almost all candidates correctly used the general formula to predict the formula of the alkane, showing good understanding of this specification area.

Question 6(d)(i)

(d) The general formula for an alkene is C_nH_{2n}.

A **general equation** for the complete combustion of alkenes uses the number of carbon atoms in the alkene to balance the equation.

general equation C_nH_{2n} + $\mathbf{1.5n}O_2$ → $\mathbf{n}CO_2$ + $\mathbf{n}H_2O$

(i) Use the general equation to write a balanced equation for the combustion of butene, C_4H_8.

Explain your reasoning for each part of the equation.

Equation ....

Reasons ....

.... **[3]**

Many candidates successfully wrote and balanced the equation correctly. Many showed clearly how they had used algebra (as expected in the mathematical requirements) to produce the equation. In giving reasons, however, some candidates explained how they would normally balance the equation (referring to numbers of atoms of each element on each side) rather than explaining in terms of the general equation they had been given.

Question 6(d)(ii)

(ii) This general equation can be used to balance equations for the complete combustion of alkenes, but does **not** work for alkanes.

Give **one** reason why the equation does **not** work for alkanes.

....

....

.... **[1]**

In common with part (b) candidates need to take care not to repeat again answers that they have given for earlier questions. 'They have a different general formula' is a true statement but does not fully explain why this leads to the general equation failing to work. Better answers contrasted the number of hydrogen atoms and water molecules on each side of the equation when alkanes undergo combustion.

Question 7

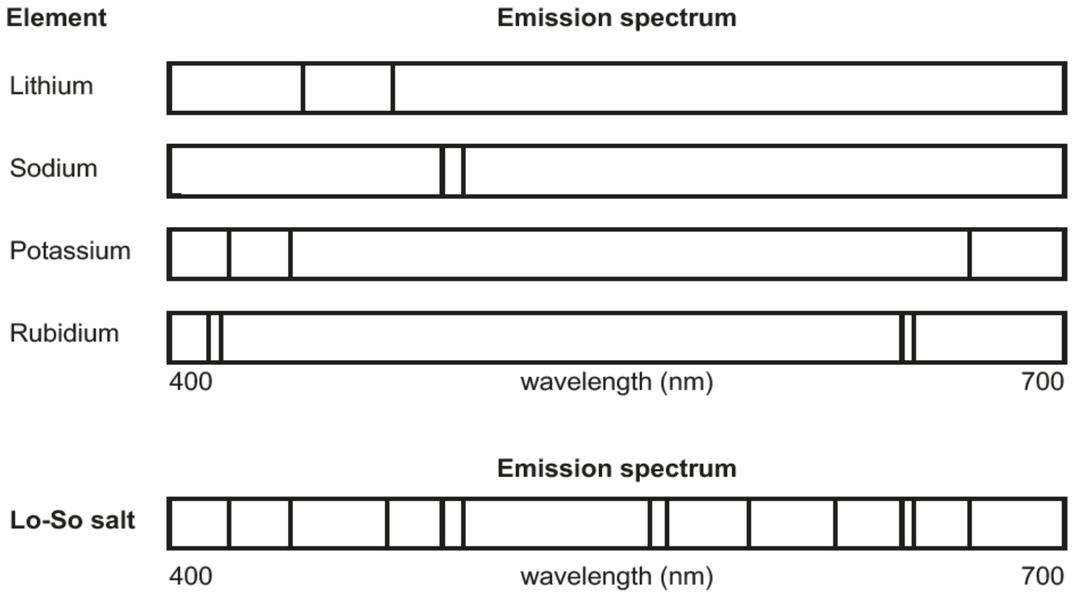
7 A new type of salt for using on food is called 'Lo-So salt'.

Nina wants to find out what elements 'Lo-So salt' contains.

She does some experiments to find the emission spectra of some compounds of Group 1 elements. She also does an experiment to find the emission spectrum of 'Lo-So salt'.

She puts small samples of each element and the salt in a spectroscopy machine and looks at the print-out of results.

Here are Nina's results.



(a)* Nina says that she thinks she needs to do further experiments to identify all the elements in 'Lo-So salt'.

State which elements 'Lo-So salt' does and does not contain, giving your reasons, and describe what further experiments Nina needs to do to identify all the elements in 'Lo-So salt'.

.... **[6]**

This question has two parts to it. Firstly, candidates need to identify which elements are and are not present. Secondly they have to describe further experiments to show this. As this is a higher demand question, the spectrum was not straightforward. The lines in the spectrum were similar, but not identical to those in lithium. The spectrum had some, but not all of the lines present in rubidium.

Most able candidates fully addressed the question, taking care to analyse the spectrum carefully to list the elements present (sodium and potassium) and those absent (lithium and rubidium). They then went on to develop the second part of the task by stating that there are extra, unidentified lines. To identify these elements it would be necessary to do further spectra of known elements to look for a match. Credit was given to candidates who described chemical ion tests rather than using spectroscopy to identify the unknown elements.

Candidates who did not reach Level 3 omitted parts of their answer or misinterpreted the spectrum. Some did not describe further experiment. Some did not match the spectra carefully, leading to a statement that either or both lithium and rubidium were present. A relatively common error was to say that, as only some of the lines for lithium and rubidium match, this indicates only small amounts of these elements in the mixture.

AfL

Candidates should be advised to look carefully at the information given. For a higher tier Level of Response differences in information are likely to be subtle and need careful consideration.

Secondly, candidates should take great care to answer all parts of the task for a Level of Response question.

Exemplar 8

Lo-So salt contains Potassium and Sodium. This is because all the stationary lines match with the lines of the Lo-So salt. However, Lithium and Rubidium are not in the Lo-So salt because not all the stationary lines are not in the salt. Nina needs to do further experiments ~~of~~ using the spectroscopy machine but with different elements. This is because not all the stationary lines were matched. This means that Lo-So Salt is combined of more than ~~2~~ Sodium and Potassium. [6]

phase

L3

This answer fully addresses both parts of the question. Although not a 'perfect' answer, (more explanation about how to compare the unknown lines with known spectra could have been added) notice how succinctly and clearly the candidate has addressed the points. 6 marks.

Exemplar 9

'Lo-so salt' has the elements Potassium, lithium and sodium. This can be seen because it's emission spectrum has the same wavelengths that these elements' emission spectrum shows. [6]

potassium

L1

This answer only answers one part of the question (elements present). No elements are identified as absent and no further experiments are described. Also notice the error in identifying lithium as present. However, two elements are correctly identified. This is not a secure match to the Level 1 description; 1 marks.

Question 7(b)

(b) The label for 'Lo-So salt' claims that it is 'low in sodium'.

Nina says that she cannot use spectroscopy to check this claim because spectroscopy is a qualitative, not a quantitative technique.

Explain why Nina is right.

....

....

.... **[2]**

Many candidates earned at least one mark for explaining the meaning of one of the terms (quantitative and qualitative). Some described both. Although most candidates had an instinctive understanding of quantitative and qualitative tests, sometimes the expressions used could not gain marks. For example, some candidates repeated the wording 'quantitative tests can tell you if it is low in sodium but qualitative cannot'. Others knew that quantitative 'involves numbers' but did not clearly state that the amounts of substances are measured.

Question 8(a)

8 Alex does some experiments to make some salts.

(a) In his first experiment, he uses 0.2 moles of magnesium oxide. He works out the mass of magnesium oxide in 0.2 moles.

He uses this equation: number of moles = mass of substance (g) ÷ relative formula mass (g)

Use the equation and the Periodic Table to work out the mass of magnesium oxide in 0.2 moles.

Give your answer to **1** decimal place.

Mass = ... g **[3]**

This question was well answered, with many candidates gaining all three marks. Candidates confidently rearranged the equation and solved for mass. Some made small errors in the calculation of relative atomic mass, but Error Carried Forward was allowed. Some forgot to round to one decimal place on the final answer line.

Question 8(b)

(b) In another experiment, Alex reacts 4.0 g copper oxide with hydrochloric acid to make copper chloride. This is an equation for the reaction.

copper oxide + hydrochloric acid → copper chloride + water

$$CuO + 2HCl \rightarrow CuCl_2 + H_2O$$

Alex works out the mass of copper chloride he can make in the experiment.

He uses these relative formula masses.

Name of compound	Formula	Relative formula mass
copper oxide	CuO	79.5
copper chloride	$CuCl_2$	134.5

What mass of copper chloride can be made from 4.0 g of copper oxide?

Use the relative formula masses and the equation to help you.

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

Mass = ... g **[4]**

Again, this question was well answered by many candidates, who used the equation and the masses to correctly calculate the mass and rounded it correctly to two decimal places. Despite the instruction to 'use the relative formula masses' given, some candidates attempted to calculate their own masses and made simple errors in doing so. This highlights the importance of studying the information given and the instructions in the question before starting to answer calculation type questions.

AfL In calculations, candidates need to watch out for instructions such as 'Give your answer to 1/2 decimal place(s)'. Some candidates who correctly completed their calculation forgot to round to the necessary number of decimal places on the answer line for both parts (a) and (b).

Question 8(c)(i)

(c) Alex adds 4.0 g of solid copper oxide to 25.0 cm^3 dilute hydrochloric acid.

At the end of the experiment, Alex sees that there is a problem because he has some unreacted solid left.

(i) How will this problem affect his actual yield?

....

.... **[1]**

Most candidates knew that Alex's yield would be lower. Some did not express this very well, however, by saying 'the actual yield will be lower than the theoretical yield'. As this statement is always true, whether or not there is unreacted solid, this answer did not gain any credit.

Question 8(c)(ii)

(ii) How could Alex change his experiment to solve this problem?

....

.... **[1]**

Most made sensible suggestions, such as changing the concentration or volume of the acid. The most common answer which did not gain credit was to state that Alex should 'leave the experiment for longer'.

Question 9(a)(i)

9 Eve measures the volume of gas given off when solid calcium carbonate reacts with a dilute acid.

Fig. 9.1 shows a graph of her results.

She draws a tangent at the start of her graph.

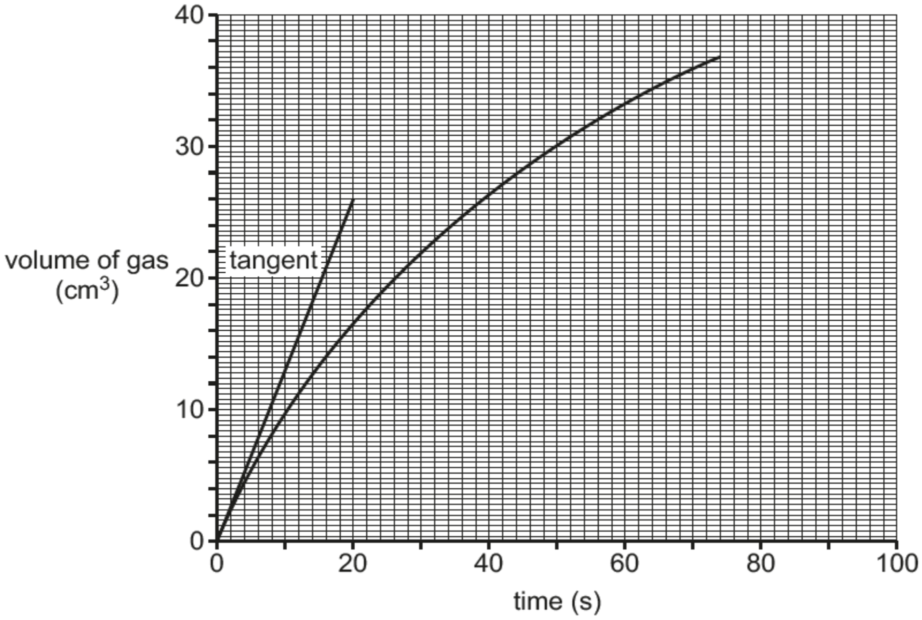


Fig. 9.1

(a) (i) Calculate the rate of reaction at the start by calculating the gradient of the tangent.

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

Question 9(a)(ii)

(ii) Draw a new tangent on the graph at time = 60 s. **[1]**

In (a) (i), although most candidates knew how to calculate the gradient (and did so correctly), not all used the largest values of y and x possible from the line given (26 and 20). Some took readings at 10 or even 5s. In this case, these calculations usually still gave the correct answer, but candidates may consider for the future that the most accurate gradient will be calculated from the largest available values of y and x.

In (a) (ii) most knew what a tangent should look like, but the lines drawn did not always touch the curve at 60s and did not always appear to be tangential. Commonly, lines were drawn which appeared to be tangential at a lower time value and were away from the line at 60s.

Exemplar 10

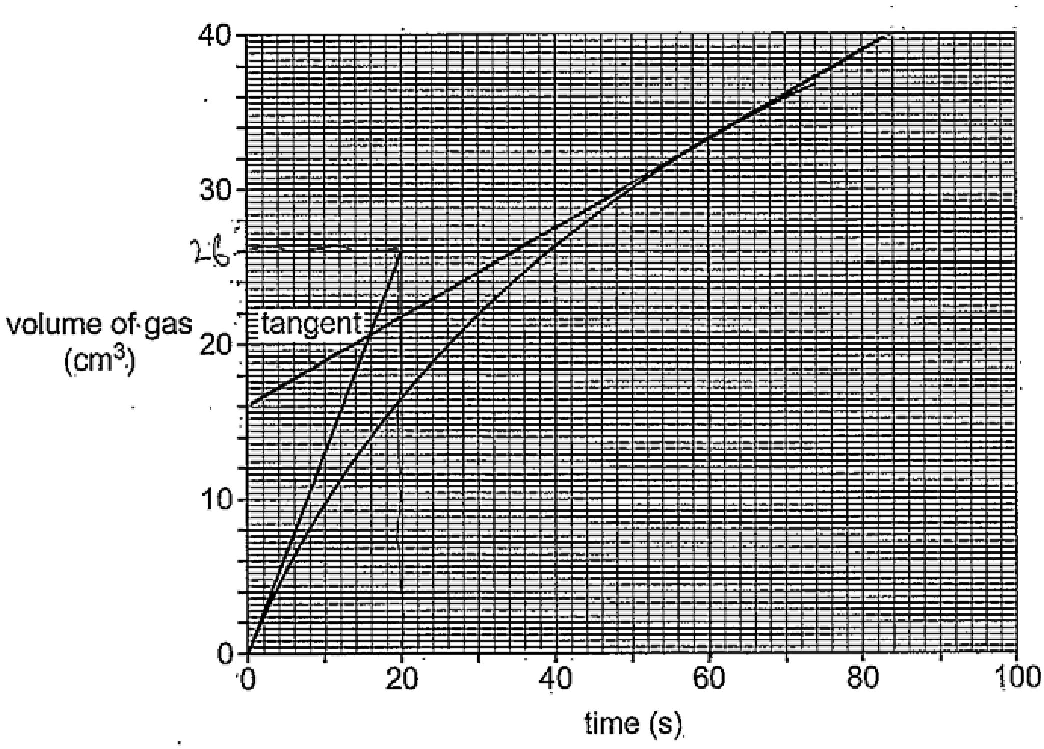


Fig. 9.1

This tangent is well drawn with the centre of the line clearly in contact with the curve at 60s. 1 mark.

Exemplar 11

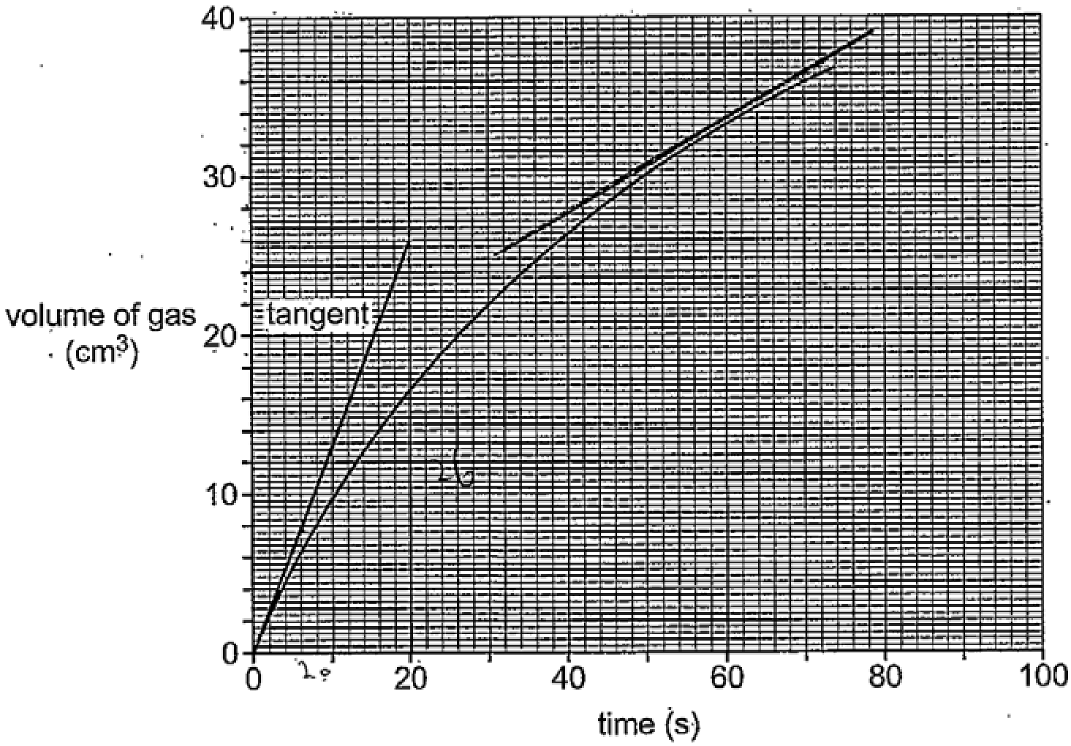


Fig. 9.1

Although this candidate clearly understands what to do, this tangent does not touch the curve. 0 marks.

Question 9(a)(iii)

(iii) How do the tangents show that the rate of reaction has changed from the start to 60 s?

....

....

.... **[2]**

Candidates understood that the tangents represented rate and were able to justify the reduction in rate at 60s by reference to the tangents.

Question 9(b)

(b) Eve does some more experiments.

This time she finds out the rate of reaction at the start when she reacts different concentrations of acid with solid calcium carbonate.

She plots a graph of rate of reaction against concentration, as shown in **Fig. 9.2**.

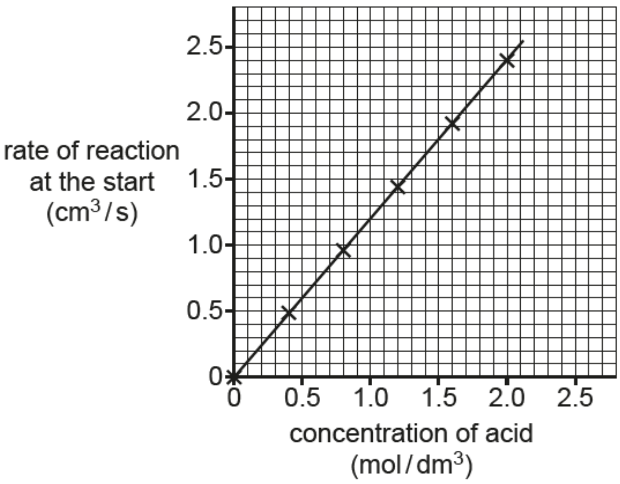


Fig. 9.2

(i) Eve thinks that the relationship between rate and concentration in the **graph** in **Fig. 9.2** can be shown using this equation: rate α concentration

Does the graph in **Fig. 9.2** agree with this equation?
Use the data to explain your reasons.

....

....

.... **[2]**

There were several routes to gaining the two marks here. Some candidates clearly stated that they understood the meaning of the equation by stating 'the rate is proportional to the concentration', gaining a mark. Some went on to say that the graph shows a straight line which goes through the origin. Other used values from the graph to demonstrate the idea of direct proportionality. Any two of these points gained both marks. Some candidates mentioned that the graph was a straight line, but this in itself is not enough to describe direct proportion without clear mention of the line passing through the origin.

Question 9(b)(ii)

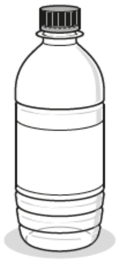
(ii) Using the graph in **Fig. 9.2** estimate the rate of reaction when acid of concentration 3.0 mol / dm^3 is used.

Rate of reaction = ... cm^3 / s **[2]**

In common with (a) (i) some candidates used very small values of y and x from the graph to judge the proportion of the two. Higher ability candidates gave better answers by working out a ratio of y to x at concentrations of either 1.0 or 2.0 mol/dm^3.

Question 10(a)

10 Soft drinks are sold in containers made from PET (a plastic), aluminium and glass.



PET bottle

Aluminium can

Glass bottle

All three containers are non-biodegradable.

Table 10.1 and **Fig. 10.1** show information about the life cycle assessment of containers from two different companies.

Company 1

	Total life cycle energy and waste per 1000 litres of drink			
	Energy use (GJ)	**Emissions**	**Waste produced**	
		CO_2 equivalent emission (kg)	**Mass (kg)**	**Volume (m^3)**
PET bottle	4.1	180	48	0.2
Aluminium can	5.9	440	120	0.3
Glass bottle	9.8	770	730	0.6

Table 10.1

Company 2

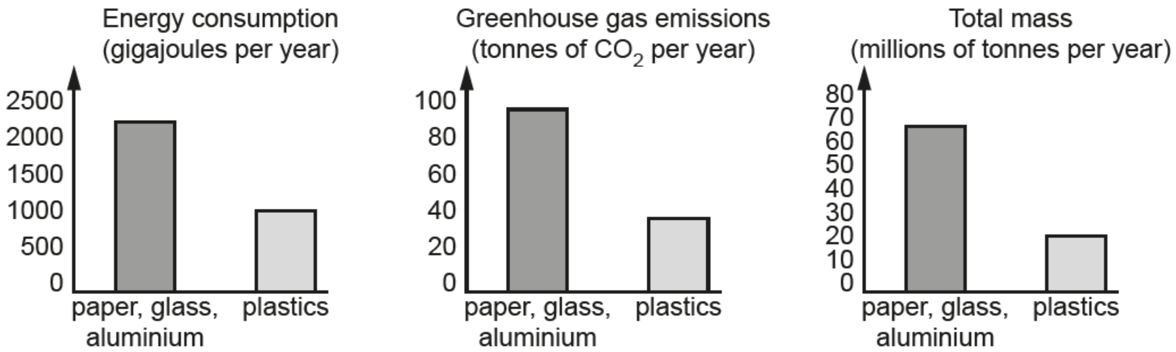


Fig. 10.1

(a)* Both companies show that the same material is likely to cause the least harm to the environment when used for making containers.

Use the information in **Table 10.1** and **Fig. 10.1** to state and explain which material is best to use for containers and identify any differences in the information from the two companies.

....

.... **[6]**

In common with question 7, there are two parts to this Level of Response question. Firstly candidates need to state and explain which material should be chosen, then go on to identify any differences between the two companies. Most candidates used table 10.1 to identify PET as the 'best' material and usually justified this in terms of energy use, emissions and waste produced. The second part of the question proved more challenging. Some candidates omitted this entirely from their answer. Others gave very long answers to the first part of the problem and only gave a small reference at the end of their answer, usually only identifying a single difference.

AfL

Candidates need to consider the information and instructions for Level of Response questions. It is wise to ensure that all aspects of the task are addressed, rather than giving a lot of time and writing space to one aspect at the expense of another. Candidates need to make sure that they answer all aspects rather than concentrate on one only. It is wise to go back and re-check the question before moving on.

Exemplar 12

Both companies ~~agree~~ show that PET (plastics) is the best option for making the containers. This is because its the least likely to cause harm to the environment. On table 10.1 it shows how the ~~PET~~ PET bottle produces the lowest mass and volume of waste compared to the other options meaning less to potentially harm the environment. Also it emits the least amount of CO_2 all while using the least amount of energy. On Fig. 10.1 it shows pretty much the same. The total mass of plastics is less, ~~the~~ ~~even~~ the CO_2 emissions produced are less and the energy used is less than its opposition.

Differences are that table 10.1 talk about emissions and mass in kg, while Fig. 10.1 talk about them in tonnes. [6]
Also table 10.1 is on about it in context to 'Total life cycle energy and waste per 1000 litres of drink' while Fig. 10.1 does it by 'per year'.

L3

This answer is succinct and clear. The candidate chooses PET as the 'best' material, justifies it and then gives two clear differences between the information. 6 marks.

Exemplar 13

The PET bottle is the best, as it uses the lowest amount of energy – 4.1 GJ compared to 5.9 GJ and 9.8 GJ.
L1 It produces ~~less~~ more than half the CO_2 than the aluminium can and over 4 times less than the glass bottle. It also produces the least amount of waste (48 kg or $0.2 m^3$). In Fig. 10.1 it is shown to have over half the energy consumption per year than paper, glass and aluminium.

.... **[6]**

This answer chooses PET and justifies the choice (Level 1, 2 marks). However, the second part of the task is completely omitted, so that Level 2 or higher cannot be earned.

Question 10(b)

(b) The way that plastic bottles are collected for recycling has changed over time.

In the past, people had to sort their waste plastic bottles and take them to bins in towns or supermarket car parks.

Now, over 90% of local authorities collected waste plastic bottles directly from homes.

Suggest how this change affects the life cycle assessment of plastic bottles.

....

....

.... **[1]**

Many candidates stated either that more plastic bottles would be recycled or that the change would reduce in less individual transportation of bottles, both of which would impact positively on the life cycle assessment of the bottles. A well answered question.

Question 10(c)

(c) **Company 1** and **Company 2** both manufacture drinks containers from polymers.

Some people want to ban the use of all non-biodegradable packaging, including polymers.

Explain why these people have different views to the polymer companies about the use of non-biodegradable materials

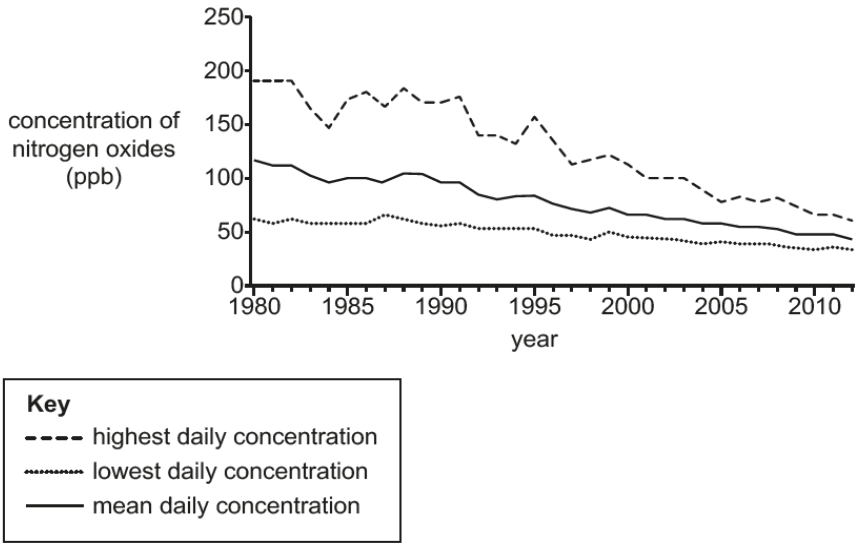
....

.... **[1]**

The best answers focussed on the idea of non-biodegradable materials and explained why people want to see these materials banned, due to the fact that they 'don't break down' or 'take up space in landfill'. Some answers did not reference any science in the answer, making statements about the companies such as 'they only want to make money'.

Question 11(b)(i)

(b) The graph shows information about the concentration in parts per billion (ppb) of nitrogen oxides in the air between 1980 and 2012.



(i) A scientist comments that the daily concentration of nitrogen oxides in 2012 has fallen by more than 50% compared to 1980.

To what extent does the data support this statement?

Use the data to explain your reasoning.

....

....

....

.... **[3]**

In this type of question, it is important that candidates use the data. The best answers looked at the trend for mean, highest and lowest daily concentrations, stated whether each agreed with the statement and then justified this by describing the change in each given on the graph. Some references to the data were either incorrect, such as 'the lowest daily concentration does not change'; or unclear such as 'the mean daily concentration has fallen' without a comparison to the 50% claim. Very few candidates commented on the relevance of the fact that all of the data shows fluctuations.

Question 11(c)

(c) Scientists first collect data about the concentration of nitrogen oxides in the air from a monitoring station near a power station.

They then set up 30 monitoring stations to collect data to work out a mean daily concentration of nitrogen oxide across the whole country.

Suggest some factors the scientists should consider when they choose where to set up these monitoring stations.

....

....

.... **[2]**

Some candidates had a clear idea of how to work out a mean daily concentration. They suggested spreading the monitoring stations randomly or choosing a range of locations such as by roads, in towns, rural locations or near other industry. Others either only gave a single factor to consider (the question is worth 2 marks) or repeated parts of the stem, such as 'measure it across the whole country'.

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Question 7

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Question 10, Charts Company 2

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Question 11b

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