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OCR
Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE COMBINED SCIENCE B

J260

For first teaching in 2016

J260/06 Summer 2022 series

Version 1

ocr.org.uk/science

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 answers are 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 OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

Paper 6 series overview

J260/06 is the higher tier paper for the chemistry unit for the GCSE (9-1) Combined Science B (Twenty First Century Science). The paper covers all of the chemistry content of the specification. To do well on this paper candidates need to have a good factual knowledge and to be able to apply it. They need to:

- be able to structure their responses to text based questions.
- have experienced a range of practical techniques and have an understanding of when such techniques are applied.
- have a range of basic mathematical skills.

This was the first paper to be sat by candidates following a two-year disruption to candidates' education. Candidates were given advanced notice of specification topics to be covered. Most candidates were able to complete all the questions and there was no evidence of issues with time management. Candidates had been well prepared and very few candidates omitted any but the most challenging responses. Many candidates rose to the challenges caused by the disruption to their education and there were some excellent responses. Evidence of the disruption was seen in knowledge of practical work, factual recall and examination technique.

Assessment for learning

Many candidates struggled with longer response questions. They should be encouraged to break down such questions before they start writing to make sure they cover the points required, paying particular attention to the command word used which should guide them to what is required.

Assessment for learning

Candidates should be reminded that, although a correct final answer for a calculation with no working shown will always be given full credit, an incorrect answer with no working shown cannot be given partial credit. Writing down their working will also remind candidates what they have calculated which will lead to greater success in multi-step calculations.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• were able to structure responses to longer answers such as Questions 3 (b) (ii), 3 (c) (ii), 6 (b), 8 (a) (i) and 8 (a) (ii) • had a good knowledge of properties of allotropes of carbon • change units and rearrange formulae in mole calculations, e.g. Questions 4 (d) (i) and 4 (d) (iii) • successfully took readings from a rate of reaction graph and used them to calculate average rate • had a good basic knowledge applied it to different contexts.	• struggled with calculations, e.g. in Questions 2 (a) (iii), 4 (c) (i) (percentages) and 4 (d) (multi-step mole calculations) • either lacked knowledge or found it difficult to apply in questions such as Questions 3 (b) (i), 3 (b) (ii), 3 (c) (ii), 3 (d) (properties of metals and non-metals) and 8 (a) (properties of carbon allotropes) • found it difficult to recall facts in Questions 3 (a), 5 (c) (i) (formation of pollutants), 6 (a) (ii) (meaning of dynamic equilibria), 7 (b) (theory of neutralisation) • lacked practical knowledge in Questions 4 (b) (tests for gases) and 4 (c) (ii) (titration technique)

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
	• did not use command word to identify what was required in a response.

Question 1 (a) (i)

1 The table gives information about some of the compounds present in crude oil.

Number of carbon atoms	Molecular formula	Empirical formula	Melting point (°C)	Boiling point (°C)	State at room temperature
4	C_4H_{10}	C_2H_5	–138	0	Gas
5	....	C_5H_{12}	–130	36	
6	C_6H_{14}	C_3H_7	–95	69	Liquid
7	C_7H_{16}	C_7H_{16}	–90		Liquid
8	C_8H_{18}	....	–57	126	Liquid

(a) (i) Complete the table to show the missing molecular formula and empirical formula. **[2]**

Candidates generally showed a good understanding of the difference between a molecular formula and an empirical formula. Some assumed that the molecular formula is always double the empirical formula and so gave the molecular formula as $C_{10}H_{24}$ even though it was clearly labelled as containing 5 carbons.

Question 1 (a) (ii)

(ii) Predict the boiling point for the compound with 7 carbon atoms.

Boiling point = ... °C **[1]**

Most candidates were able to use the data from the table to predict an appropriate boiling point for heptane.

Question 1 (a) (iii)

(iii) Predict the state of the 5 carbon compound at room temperature (20 °C).

Explain your answer.

State ....

Explanation ....

....

.... **[2]**

Most candidates correctly identified the state of this compound to be a liquid and connected it to the melting and boiling points. Some just quoted the values of the melting point and boiling point without explaining the relevance and others just said that it was below the boiling point without including that it was also above the melting point.

Question 1 (b) (i)

(b) All the compounds in the table are in the same homologous series.

All members of a homologous series have the same general formula.

(i) Give **two** other characteristics of a homologous series that are shown in the table.

1 ....

....

2 ....

.... **[2]**

More successful responses were able to apply their knowledge of the characteristics of a homologous series, such as trends in physical properties, and so select relevant information from the table. Many candidates just gave information from the table which was not a characteristic of a homologous series, such as all melting points are negative, all boiling points are positive.

Misconception

A significant number of candidates thought that a large negative melting point was higher than a small negative melting point.

Question 1 (b) (ii)

(ii) Complete the sentences to describe the compounds present in crude oil that are shown in the table.

Put a ring around each correct answer.

Crude oil is a mixture of **hydrocarbons / polymers / salts**.

The compounds are from the homologous series **allotropes / alkanes / alkenes**.

They all have the general formula C_nH_{2n} / C_nH_{2n+1} / C_nH_{2n+2}.

[3]

More successful responses were able to describe the properties of compounds present in crude oil. Only less successful responses did not identify that they were hydrocarbons and chose polymers instead.

Question 2 (a) (i)

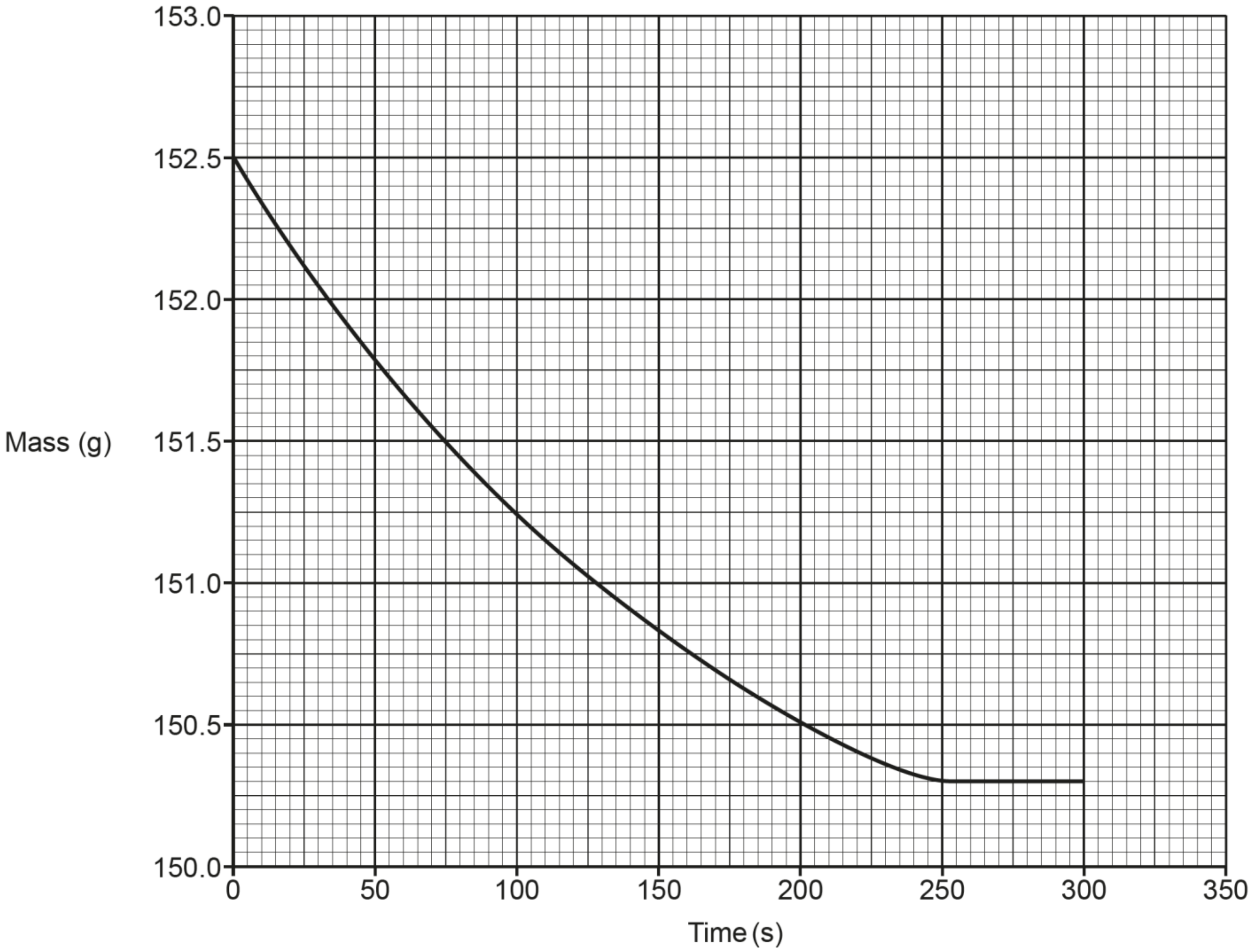
2 Solid calcium carbonate reacts with dilute hydrochloric acid to form calcium chloride, carbon dioxide and water.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

(a) Jane investigates the rate of this reaction. She measures the change in mass during the reaction over five minutes.

She uses 10 g of calcium carbonate lumps and 50 cm^3 of dilute hydrochloric acid.

The graph shows Jane's results.



(i) What was the time taken for the reaction to finish?

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

Most candidates understood that the reaction had finished when the graph first levelled off. A significant number thought that it finished when the line stopped and so gave 300s instead of 250s.

Question 2 (a) (ii)

(ii) What was the total mass lost during the reaction?

Total mass lost = ... g **[2]**

Most candidates read the starting and finishing masses correctly from the graph and then subtracted correctly to find the total loss in mass. Many more gained 1 mark for a correct subtraction of an incorrect reading for the final mass. Some did not show their working so could not be given partial credit.

Question 2 (a) (iii)

(iii) Calculate the average rate of the reaction.

Rate of reaction = ... g/s **[2]**

More successful responses were able to use the total mass lost and time taken to find the average rate of the reaction. Some used the initial mass instead of the mass lost and others found the rate at a particular time, instead of the average rate, by finding the gradient of a tangent.

Question 2 (b)

(b) Jane repeats the experiment with 10 g of calcium carbonate **powder** instead of 10 g of lumps. She keeps everything else the same.

Sketch a line on the graph to show the results she should expect. **[2]**

Most candidates gained at least 1 mark for their sketched line, understanding that the powder would be faster, giving a steeper curve, and that it would level off at the same volume. Less successful responses started at a different initial mass, levelled off at a different mass or just drew a single straight line.

Question 2 (c)

(c) Complete the sentences to explain why the rate of reaction changes when powdered calcium carbonate is used instead of lumps.

Put a (ring) around each correct answer.

The surface area of 10 g of powdered calcium carbonate is **larger than / smaller than / the same as** 10 g of lumps.

The total volume of 10 g of powdered calcium carbonate is **larger than / smaller than / the same as** 10 g of lumps.

[2]

Most candidates scored at least one mark here with many gaining both. The most common error was to say that a powder will have a smaller volume than the same mass of lumps.

Question 3 (a)

3 Calcium is a metal in Group 2 of the Periodic Table.
Chlorine is a non-metal in Group 17(7) of the Periodic Table.

Table 3.1 shows some properties of calcium and chlorine.

Property	**Calcium**	**Chlorine**
Type of ions formed	positive	negative
Electrical conductivity	good	none
Boiling point (°C)	1484	–35

Table 3.1

(a) Describe **one** other property, not shown in **Table 3.1**, which is different for metals and non-metals.

....

.... **[1]**

Most candidates could identify a property that is different for metals and non-metals but many did not go on to describe the difference, with simple statements such as 'melting point' being common. Others chose properties that were used in the table despite being told not to.

OCR support

Our [Twenty First Century Quizzes] can be used to reinforce and support with retrieval of common concepts. You will need access to interchange to download this resource.

Assessment for learning

The command word of describe shows that candidates need to do more than just state a property.

Question 3 (b) (i)

(b) The difference in properties of metals and non-metals is caused by their electronic structures.

(i) Give the electronic structures of calcium and chlorine.

Calcium ....

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

Higher achieving candidates understood what was meant by electronic structure and were able to gain both marks. Some made slips with the number of shells or gave incomplete descriptions. Most candidates ignored 'electronic' and described structures such as metallic, covalent, ionic, etc.

Question 3 (b) (ii)

(ii) Explain why calcium and chlorine form different types of ions.

....

....

....

....

....

.... **[3]**

Many candidates understood that positive ions are formed by loss of electrons and negative ions are formed by gain of electrons. Higher achieving candidates explained this by relating it to the number of electrons in the outer shell. Some just referred to metals and non-metals or to Group numbers without explaining the relevance.

Assessment for learning

Care needs to be taken to look at the command word, such as 'explain', when candidates are planning their answers.

Question 3 (c) (i)

(c) **(i)** The boiling points of calcium and chlorine are different because of the forces of attraction between particles.

Draw lines to connect each **element** to the **forces of attraction** between its particles.

Element	**Forces of attraction**
	between atoms
Calcium	
	between ions
	between molecules
Chlorine	
	between positive ions and delocalised electrons

[2]

Most candidates were able to select the forces of attraction between the particles in one of the elements although only the higher achieving candidates got both correct, recognising that calcium had metallic bonding and that the particles in chlorine are molecules. A significant number drew two lines from each element.

Question 3 (c) (ii)

(ii) Explain why the boiling points of calcium and chlorine are different.

Use your answer to **(i)** to support your answer.

....

....

....

.... **[2]**

Some high achieving candidates were able to compare the forces between particles and the reason why this affects boiling point with others. Some understood the idea but referred to weak forces between incorrect particles such as atoms or ions. Some referred to the forces between particles without comparing their strengths and others referred to the ability to lose or gain electrons.

Assessment for learning

Differences in boiling points is a concept that many candidates find difficult to explain. It may help to remember that a higher boiling point means more energy needed to separate the particles and so must mean stronger forces between the particles. This should help candidates achieve some marks even if they cannot remember what the particles are.

Exemplar 1

Calcium has strong electrostatic forces between the positive ions and sea of negative electrons. meaning that it takes a lot of energy to overcome these forces, while ~~ca~~ chlorine only has weak ~~[illegible]~~ intermolecular forces which are easy to overcome, thus it has a lower ~~p~~ boiling point than calcium. **[2]**

This response shows a logical progression from forces between particles to energy needed to separate them to comparison of boiling points. 2 marks clearly achieved.

Question 3 (d)

(d) Metals and non-metals react together to form ionic compounds.

Table 3.2 shows some information about three ionic compounds.

Ionic Compound	Ions	Formula
Sodium chloride	Na^+ and Cl^-	$NaCl$
Potassium oxide	....	K_2O
Aluminium oxide	Al^{3+} and O^{2-}	....

Table 3.2

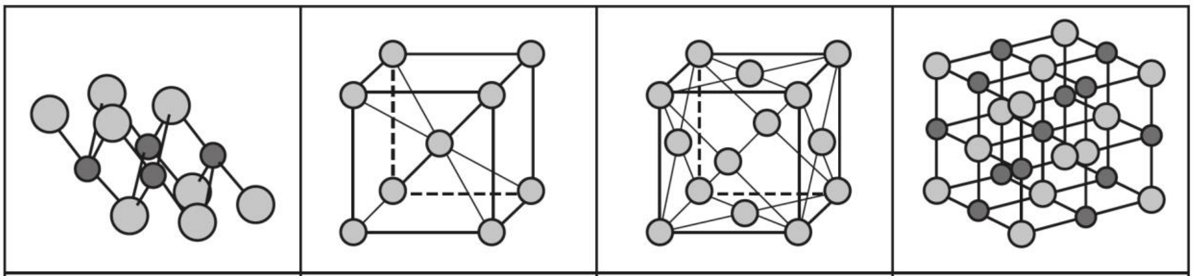
Complete the table to show the ions in potassium oxide and the formula of aluminium oxide. **[2]**

High achieving candidates could identify ions from a given formula and write a formula from given ions. Many candidates could do neither. The most common errors were K^{2+}, O^- (even though correct ion was given elsewhere in the table) and Al_3O_2.

Question 3 (e) (i)

(e) Metals and ionic compounds can form lattices.

The diagram shows four different lattice structures.



A	B	C	D

(i) Which **two** structures are the lattice of a metal?

Structures .... and .... **[1]**

High achieving candidates correctly identified the two structures with only one type of particle as being metals. D was the most common incorrect choice.

Question 3 (e) (ii)

(ii) Which structure is the lattice of potassium oxide (K_2O)?

Explain your answer.

Structure ....

Explanation ....

....**[2]**

High achieving candidates realised that the model should have particles to match the formula and correctly chose A, giving that as their explanation. Some realised that they were looking for a 2:1 ratio but thought that it was present in D.

OCR support

Support with teaching about ionic compounds can be found for teachers via our Ionic compounds teacher instructions and can be used alongside these worksheets to reinforce key concepts with candidates in and out of the classroom.

Question 4 (a) (i)

4 Ovenshine is used as an oven cleaner.

The label gives information about the product.

OVENSHINE

Contents:

5 to <12% sodium hydroxide

Hazards:

corrosive

Avoid contact with aluminium

(a) (i) Complete the **balanced symbol** equation for the reaction of aluminium with sodium hydroxide.

..............Al + 2NaOH + ...H_2O → ....$NaAlO_2$ + ...H_2 **[1]**

Balancing the equation was done successfully by higher achieving candidates. The most common error was incorrectly balancing the hydrogen molecule, with many candidates giving 2 instead of 3.

OCR support

Our Balancing equations – let's balance! and accompanying worksheets can provide extra support in the classroom for candidates to practice this skill.

Question 4 (a) (ii)

(ii) How does the equation show that contact with aluminium surfaces is a hazard?

....

....

....

.... **[2]**

Most candidates based their answer on information shown on the label instead of using the equation as asked in the question. Of those that looked at the equation, many just named both products instead of picking out the hydrogen. Very few of those that picked hydrogen went on to describe why it was a hazard.

Question 4 (b)

(b) Tests can be used to identify gases produced in a reaction.

Complete the table to show the method and the result for the tests for the three gases.

Gas	Method	Result
hydrogen	....	....
carbon dioxide	....	....
oxygen	....	....

[3]

Most candidates were able to score at least 1 mark for tests of gases. Marks were most commonly lost by giving correct results with no method, e.g. hydrogen would give squeaky pop with no mention of lit splint, oxygen relighting splint with no mention of glowing. Lower achieving did not know the tests at all and made guesses such as testing with litmus.

Question 4 (c) (i)

(c) Sam does a titration to find the amount of sodium hydroxide in the oven cleaner.

This is the method:

- Measure out 3.00 g of the cleaner into a conical flask
- Add a few drops of indicator
- Add 0.25 mol/dm^3 hydrochloric acid until all of the sodium hydroxide has reacted.

The equation shows the reaction of sodium hydroxide with hydrochloric acid.

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

(i) Calculate the range of the mass of sodium hydroxide expected in 3 g of oven cleaner.

Use information from the label.

Mass of sodium hydroxide is from .... g to < .... g **[3]**

The highest achieving candidates understood that the range given on the label was the percentage of sodium hydroxide in the oven cleaner. They were then able to use these percentages to find the range of mass of sodium hydroxide in 3g. Many divided 3 by the relative formula mass of sodium hydroxide as part of their answer. Others used the concentration of the hydrochloric acid.

Question 4 (c) (ii)

(ii) How does Sam know when all the sodium hydroxide has reacted?

....

.... **[1]**

Good responses showed a knowledge of titrations to identify a colour change as the way to know when all the sodium hydroxide was used up. Many used other types of reaction and referred to changes in mass or fizzing. Some were very vague and just said 'when the reaction has stopped'.

Question 4 (c) (iii)

(iii) Sam wants to measure the exact volume of acid needed for all of the sodium hydroxide to react.

Describe **one** thing Sam should do so that the titration result is accurate.

....

.... **[1]**

Most candidates described repeating of results as the best way of getting an accurate volume of acid added. The most commonly recalled correct method was adding the acid drop by drop. Use of a burette to measure the acid was also seen.

Question 4 (d) (i), (ii) and (iii)

(d) Sam finds that 24.8 cm^3 of 0.25 mol / dm^3 hydrochloric acid is needed to react with the sodium hydroxide in 3.00 g of oven cleaner.

(i) Calculate the number of moles of hydrochloric acid in 24.8 cm^3 of 0.25 mol / dm^3.

Use the formula: $\text{concentration (mol/dm}^3) = \dfrac{\text{number of moles of solute}}{\text{volume (dm}^3)}$

Number of moles of acid = ... **[3]**

(ii) Find out how many moles of sodium hydroxide react with this amount of acid.

Use the symbol equation: $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

Number of moles of sodium hydroxide = ... **[1]**

(iii) Calculate the mass of sodium hydroxide (NaOH) reacting with the acid.

Use the formula and the relative atomic masses given.

$\text{number of moles} = \dfrac{\text{mass of substance (g)}}{\text{relative formula mass (g)}}$

Relative atomic masses: Na = 23.0, O = 16.0, H = 1.0

Mass of sodium hydroxide = ... (g) **[3]**

In (d) (i), most candidates were able to successfully rearrange the formula to multiply the concentration by the volume. Many did not change the units and so gained 2 marks instead of 3. Less successful responses did random calculations using the quantities given in the stem, including the mass of sodium hydroxide.

In (d) (ii), few candidates used the equation to understand that the moles of sodium hydroxide would be the same as the moles of acid calculated in the first part. Some used the mass and/or the relative formula mass of sodium hydroxide in a variety of ways.

In (d) (iii), most candidates calculated the relative formula mass of sodium hydroxide correctly. The highest achieving candidates were able to go on to use their answer for number of moles and the given

formula to find the mass of sodium hydroxide. Many did not know what value to use for number of moles with the mass of oven cleaner being commonly used,

Assessment for learning

In multi-step calculations like this, candidates need to pause after each part remind themselves what they have calculated in order to use this correctly in subsequent parts. For example, in this calculation, reminding themselves that they have calculated the moles of acid in part (i) will help them to use the equation to find the moles of sodium hydroxide. Then reminding themselves that they have found moles of sodium hydroxide in part (ii) will help them use the formula in part (iii) correctly.

Question 5 (a)

5 (a) **Table 5.1** shows information about some pollutants in the air over 100 days in 2020.

Year	Particulates (µg/m^3)	NO (µg/m^3)	NO_2 (µg/m^3)
	Change from five year average	**Change from five year average**	**Change from five year average**
2020	–1.60	–7.52	–9.71

Table 5.1

Calculate the orders of magnitude for the change in each pollutant in 2020.

Particulates .... µg/m^3

NO .... µg/m^3

NO_2 .... µg/m^3

[3]

Candidates struggled with order of magnitude calculations and few correct answers were seen. Most just repeated the values shown in the table.

Assessment for learning

Order of magnitude calculations are a specified part of the maths skills and can be tested on any paper.

Question 5 (b)

(b) **Table 5.2** shows information about the same pollutants in the air over a 100-day period in 5 years from 2015–2019.

Year	Particulates (μg/m^3)	NO (μg/m^3)	NO_2 (μg/m^3)
	Change from five year average	Change from five year average	Change from five year average
2015	–1.38	+0.78	–0.13
2016	–0.91	+2.17	+1.26
2017	+0.71	–0.10	–1.02
2018	+1.16	–0.99	–0.50
2019	+0.43	–1.84	–1.28

Table 5.2

Sundip looks at the data in **Table 5.1** and **Table 5.2** and says:
'The changes in these pollutants during 2020 are not significant. They go up and down each year.'

Explain why she is only partially correct.

Use data from **Table 5.1** and **Table 5.2** to support your answer.

....

....

....

.... **[2]**

Candidates were asked why the statement was only partially correct and so should have been looking for one way it was correct and one way that it was not. Many realised that the changes do go up and down. Fewer were also able to comment that the changes in the nitrogen oxides in 2020 were significantly bigger than in any previous year.

Misconception

? Many candidates did not understand the significance of the + and – signs, thinking that the pollutants increased in 2020.

Question 5 (c) (i)

(c) These pollutants are all emitted from car exhausts.
Particulates are tiny carbon particles and NO and NO_2 are oxides of nitrogen.

(i) Describe how particulates and oxides of nitrogen are produced by car engines.

Particulates ....

....

....

....

Oxides of nitrogen ....

....

....

....
[4]

Very few candidates could recall how these pollutants are formed. Some remembered that particulates are formed by incomplete combustion but did not specify from a fossil fuel. Many thought the nitrogen oxides were formed in the catalytic converter or produced to help propel the car. Others thought that the nitrogen reacting with the oxygen came from the fuel.

Question 6 (a) (i), (ii) and (iii)

6 Ammonia is manufactured from nitrogen and hydrogen. When nitrogen and hydrogen gases are mixed, they come to a dynamic equilibrium.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(a) (i) What is meant by the $\rightleftharpoons$ symbol?

....

.... **[1]**

(ii) What is happening to the rates of the forward and reverse reactions when it is at **dynamic equilibrium**?

....

.... **[1]**

(iii) Why is the yield of the reaction **not** 100%?

....

....

....

.... **[2]**

Most candidates identified the symbol as meaning the reaction is reversible. Many also knew that in a dynamic equilibrium the rates of reaction in both directions were equal. Some said that the rates stayed the same (i.e., were constant) rather than they were the same (i.e. were equal). Candidates struggled to explain why there is never a 100% yield when there is a dynamic equilibrium. Many thought it was due to losses to the surroundings rather than ammonia reacting back to reactants as fast as it is formed.

Exemplar 2

Because the products are always turning back into reactants, and the reactants are always turning back into products, so it is never possible to stop, and reach 100%. **[2]**

This response gains both marks as clearly shows an understanding of the idea that, once equilibrium is reached, any new product formed will be balanced by product turning back into reactants and so the reaction cannot reach completion.

Question 6 (b)*

(b)* The yield of ammonia is affected by changing the conditions of the reaction vessel.

Table 6.1 shows the percentage yield at different temperatures and pressures.

	Percentage yield of ammonia at equilibrium (%)			
Pressure (atm)	**200 °C**	**300 °C**	**400 °C**	**500 °C**
10	51	15	4	1
25	64	27	9	3
50	74	40	15	6
100	82	53	25	11
200	89	67	39	18
400	95	80	55	32

Table 6.1

Chemical companies choose the most effective conditions for the manufacture of ammonia.

Table 6.2 shows the conditions chosen by one company.

Temperature (°C)	400–450
Pressure (atm)	150–300
Catalyst	iron

Table 6.2

Describe the effect of changing the conditions of the reaction vessel on the yield of ammonia shown in **Table 6.1** and explain why the chemical company chose the conditions shown in **Table 6.2**.

Use ideas about yield, rate, energy use and safety in your answer.

....

....

....

....

....

.... **[6]**

The most successful responses discussed the effects of temperature and pressure on yield and then showed that the conditions chosen for temperature and pressure were a compromise between yield, rate, energy use and safety. These answers also understood that the catalyst improves the rate allowing lower temperatures to be used successfully.

Some thought that a high yield of ammonia would be too dangerous rather than safety being an issue with the equipment at high pressures and temperatures, as outlined in the specification. Answers tended to be scattergun comments about rate, yield and safety without the significance of these factors being made clear.

Many candidates did not take the time to address the question and plan their answers. Many did not address Table 6.1 at all and so did not discuss the effect of temperature and pressure on yield, in spite of it being specifically asked for in the question.

OCR support

We have recommended a number of resources to support teachers and candidates to prepare for questions about C6.3 What factors affect the yield of chemical reactions chapter. These can be accessed through the online delivery guide.

Question 7 (a)

7 Neutralisation is when an acid reacts with an alkali to form a salt and water. Neutralisation can also be described in terms of ions.

(a) Complete the word and balanced symbol equations for the reaction between nitric acid and sodium hydroxide.

nitric acid + sodium hydroxide → .... + water

.... + ... → $NaNO_3$ + H_2O

[3]

Many candidates were able to name the product, either from predicting the product from the reaction or from the given formula, sodium nitroxide was a common error. Higher achieving candidates knew the formula for sodium hydroxide, although some added a minus sign and so lost the mark. Few either knew or were able to work out the formula for nitric acid with various oxides of nitrogen being the most common error.

Question 7 (b)

(b) Identify the **two** ions involved in a neutralisation reaction **and** state where they come from.

1 ....

2 ....

[2]

More successful responses could recall the ions involved in neutralisation and their source. Most candidates just guessed from possible ions, e.g. sodium, oxygen.

Question 7 (c) (i)

(c) The pH scale is a measure of the H^+ concentration of a solution.

It is used to measure the relative acidity or alkalinity of a solution.

pH	1	3	5	7	9	11	13
H^+ concentration (mol/dm^3)	1×10^{-1}	1×10^{-3}	1×10^{-5}		1×10^{-9}	1×10^{-11}	1×10^{-13}

(i) Describe the change in H^+ concentration and the relative acidity and alkalinity of a solution as the pH number changes.

H^+ concentration ....

....

acidity and alkalinity of the solution ....

....
[2]

Most candidates described the changes without linking to the change in pH number, just referring to a decrease/increase in concentration without linking to pH increasing or decreasing. More successful responses linked both acidity and alkalinity to changes in pH number. Many only referred to acidity or linked with hydrogen ion concentration instead of pH number.

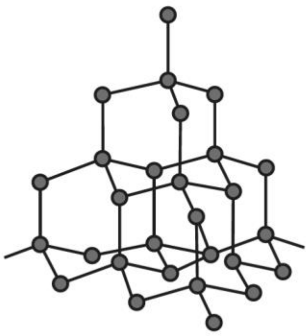
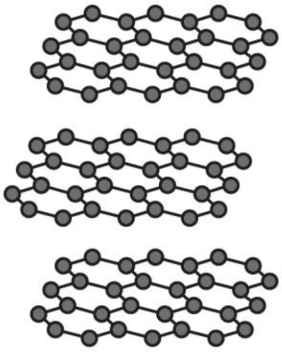
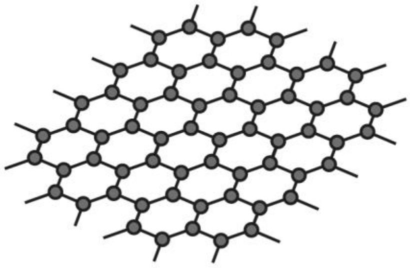
OCR support

Our Lesson Element resource on The pH Scale lists common misconceptions, practical activities and tasks for candidates to practice and improve their knowledge and skills in this topic area.

Question 8 (a) (i)

8 Diamond, graphite and graphene are all allotropes of carbon.

The table shows the structure and some properties for these allotropes.

Diamond	Graphite	Graphene
		
giant covalent structure	giant structure with 2 dimensional covalent layers	single covalent layer
hard	soft	hard
non-conductor of electricity	good conductor of electricity	good conductor of electricity

(a) The properties of these allotropes depend on their structure.

(i) Explain why graphite and graphene are good conductors of electricity but diamond is not.

....

....

....

....

....

.... **[3]**

This was another question where planning an answer before responding led to greater success. More successful responses identified that conducting electricity required a movement in charge which they knew to be electrons in the case of carbon allotropes. They then identified graphite and graphene as the only ones with unbonded/delocalised electrons. The most successful responses then explained, in terms of either structure or bonding, why diamond did not have these electrons but graphite and graphene did.

Exemplar 3

Because diamond uses all four of it's free electrons in bonding, whereas graphite and graphane use only three, so they have a free ~~electron that~~ delocalised electron that can flow and can therefore conduct electicity.

This response demonstrated a clear line of thought from the difference in the number of electrons used in bonding to the movement of electrons which allows current to flow and so gained all three marks.

Question 8 (a) (ii)

(ii) Explain why diamond and graphene are hard but graphite is soft.

Diamond and graphene ....

....

....

Graphite ....

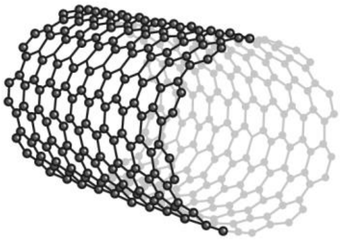
....

.... **[4]**

Again, thinking about what is meant by hardness/softness before attempting the question led to greater success. Many knew that graphite was soft because the layers slide over each other with more successful responses going on to explain this by the presence of weak forces between the layers. More successful responses understood that the hardness of diamond and graphene was due to **all** atoms being linked by strong covalent bonds. Many candidates found it difficult to explain that this meant that the particles were harder to pull apart. Some candidates had the right idea but lost the marks by referring to intermolecular or ionic bonds.

Question 8 (b) (i)

(b) Carbon nanotubes are graphene sheets rolled into a tube.



Graphene and nanotubes are examples of nanoparticles. Nanoparticles have important uses which depend on their structure and properties.

(i) Which **two** statements explain why nanotubes can be used to carry drugs into the body?

Tick (✓) **two** boxes.

They act as molecular sieves.	☐
They are good catalysts.	☐
They are hollow.	☐
They are made of carbon atoms.	☐
They are very small.	☐
They have a large surface area.	☐

[2]

Most candidates correctly identified one of the reasons why nanotubes can be used to carry drugs into the body and high achieving candidates identified both. Some candidates just chose properties that they knew were possessed by nanoparticles with large surface area or molecular sieves being common incorrect responses.

Question 8 (b) (ii)

(ii) Give **one** risk and **one** benefit of using nanoparticles to carry drugs into the body.

Risk ....

....

Benefit ....

....

[2]

More successful responses chose risks and benefits of using nanoparticles to deliver drugs, with the most successful responses highlighting uncertainty about long term effects and the ability to target specific areas by using nanotubes. Less successful responses discussed issues with the drug, such as harmful side effects and curing disease, rather than issues with the nanotubes themselves.

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