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Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

GATEWAY SCIENCE COMBINED SCIENCE A

J250

For first teaching in 2016

J250/03 Summer 2024 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 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 OCR.

Paper 3 series overview

J250/03 is the first of two Foundation Tier papers for the Chemistry content of Gateway Science Combined Science A. It is designed to assess the content from topics C1-C3 and CS7. Questions 9, 10 and 17 overlap with the Higher Tier paper.

To do well on this paper, candidates need to demonstrate knowledge and understanding of scientific ideas, techniques and procedures across all four topics. They need to be able to apply their knowledge and understanding to unfamiliar contexts as well as displaying the ability to analyse information and ideas. Candidates also need to be familiar with a range of experimental procedures and scientific equipment.

There was no evidence that candidates did not have enough time to complete the paper, but the final (overlap) question proved very challenging with several parts omitted by some candidates.

Candidates need to understand the command words to make sure they are answering the question that has been asked. For example, in Question 13 (b) (ii), candidates were asked to describe *how* changing the mass of salt changes the melting point. However, many attempted to describe *why* changing the mass changed the melting point, which meant they could not access the mark for that question.

Exam practice would help candidates to understand how to answer different types of questions and make sure they are reading the whole question carefully. Some candidates were not clear how to answer a question where they had to link properties with the correct explanation (Question 12 (a) (iv)) so a significant number drew two lines from each property. Others appeared not to have seen the instruction to draw a bar chart (Question 13 (b) (i)) so did not answer.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• correctly balanced a chemical equation (**Question 17 (d)**) • read the whole question carefully and used all the information given (**Question 15**) • used their own knowledge of structure and bonding to explain some properties of sodium chloride (**Question 15**) • calculated R_f value (**Question 14 (d)**), relative formula/atomic masses (**Question 16**) and percentages (**Question 17 (g) (i)**) correctly, showing their working clearly • rounded numerical answers correctly to the required number of significant figures (**Question 14 (d)**) • could recall facts and interpret data relating to both the historical (**Question 11**) and modern Periodic Tables (**Question 17 (a)**).	• were unable to balance a simple chemical equation (**Question 17 (d)**) • used only the data provided as their answer to the Level of Response question (**Question 15**) so could not access the higher levels • lost marks by giving just a final answer instead of showing their working in calculations (**Questions 14 (d), 16 and 17 (g) (i)**) • were unable to round numbers correctly to give the required number of significant figures (**Question 14 (d)**) • confused the term mass number with relative atomic mass (**Question 17 (f)**) • did not attempt all of the questions.

Section A overview

Section A contains 10 multiple choice questions, with Questions 9 and 10 overlapping with the Higher Tier paper. These questions focus on Assessment Objectives 1 and 2 (AO1 and AO2).

Almost all candidates attempted every question.

Candidates may find it helpful to underline key words in the question and to show any calculations next to the relevant question. They can write on the paper as they attempt to eliminate the distractors and remove those that they decide are incorrect.

Candidates are also reminded to write the answer letter clearly, as B and D can be confused if writing is unclear. If candidates change their mind about an answer, they must remember to cross it out clearly and write the new answer next to the answer box, rather than overwriting the old answer.

Question 1

1 When iron reacts with dilute hydrochloric acid, bubbles of hydrogen are produced.

Which state symbol describes these bubbles?

A aq

B g

C l

D s

Your answer ☐ **[1]**

Around half of candidates knew that bubbles were a gas; a common wrong answer was aqueous.

Question 2

2 Magnesium reacts with oxygen to make magnesium oxide.

magnesium + oxygen ⟶ magnesium oxide

Which type of reaction is shown by the equation?

A Displacement

B Electrolysis

C Neutralisation

D Oxidation

Your answer ☐ **[1]**

Most candidates knew that this was oxidation; the most common wrong answer was neutralisation.

Question 3

3 Which gas turns limewater cloudy?

A Carbon dioxide

B Chlorine

C Hydrogen

D Oxygen

Your answer ☐ **[1]**

Some candidates knew that this was carbon dioxide, but more thought it was chlorine.

Question 4

4 Zinc chloride is an ionic compound made from Zn^{2+} and Cl^{-} ions.

What is made at the **negative** electrode during the electrolysis of molten zinc chloride?

A Chlorine

B Hydrogen

C Oxygen

D Zinc

Your answer ☐ **[1]**

Some candidates knew that this was zinc; the majority chose chlorine and a few selected hydrogen.

Question 5

5 The table shows the colours of an indicator at different pH values.

1	2	3	4	5	6	7	8	9	10	11	12
Pink			Orange			Purple			Green		

Which colour is this indicator in a **neutral** solution?

A Green

B Orange

C Pink

D Purple

Your answer ☐ **[1]**

Around half of candidates correctly selected purple; the most common wrong answer was green, followed by orange.

Question 6

6 The energy change in a reaction is 30 000 J.

What is the energy change in **kJ**?

A 3

B 30

C 300

D 3000

Your answer ☐ **[1]**

Many candidates calculated the correct answer, especially those that showed their working. Incorrect answers were mainly A and C.

Question 7

7 Which row describes a **formulation**?

	Description	Amount of chemicals
A	compound	exact
B	mixture	exact
C	compound	random
D	mixture	random

Your answer ☐ **[1]**

The definition of a formulation was not well known, with a range of answers seen.

Question 8

8 What is the ionic equation for an aqueous neutralisation reaction?

A $H^+ + OH^+ \longrightarrow H_2O$

B $H^+ + OH^- \longrightarrow H_2O$

C $H^- + OH^+ \longrightarrow H_2O$

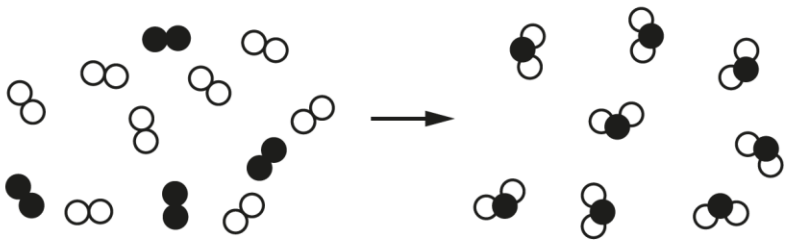
D $H^- + OH^- \longrightarrow H_2O$

Your answer ☐ **[1]**

Around half of candidates were able to identify the correct equation but many got the charges on the ions the wrong way round so selected C.

Question 9

9 The diagram represents the particle model for a change in the arrangement of some particles.



Which row describes this change?

	Type of change	Explanation
A	chemical	The particles break up and then join together in a different way.
B	chemical	The particles stay the same but are arranged in a different way.
C	physical	The particles break up and then join together in a different way.
D	physical	The particles stay the same but are arranged in a different way.

Your answer ☐ **[1]**

Most candidates understood that during a chemical reaction the particles break up and then join together in a different way. However, many incorrectly identified this as a physical change rather than a chemical change.

Question 10

10 Which element in the table is a **non-metal**?

	Appearance at room temperature	Melting point (°C)	Electrical conductivity
A	silver liquid	–39	high
B	orange-red solid	1083	high
C	yellow solid	113	low
D	silvery-white solid	3422	high

Your answer ☐ **[1]**

Many candidates answered correctly. However, some were distracted by the low melting point of A or the orange-red colour of B and didn't realise that low electrical conductivity was a key indicator of a non-metal.

Section B overview

It was good to see that the majority of candidates attempted all the questions. Candidates found Questions 16 and 17 very challenging; Question 17 was an overlap question with the Higher Tier paper. More candidates omitted parts of these questions, particularly parts 16 (c), 17 (c) and 17 (d), than any others.

It was pleasing to see more candidates attempting the Level of Response question (Question 15), than have done so in previous years.

Some handwriting was very difficult to read and candidates may benefit from assistance. A number of candidates chose not to use their assigned scribe and this often resulted in a loss of marks when their answers could not be read. Candidates who use the extra answer spaces at the back of the booklet must make sure they label their additional answers clearly with the correct question number.

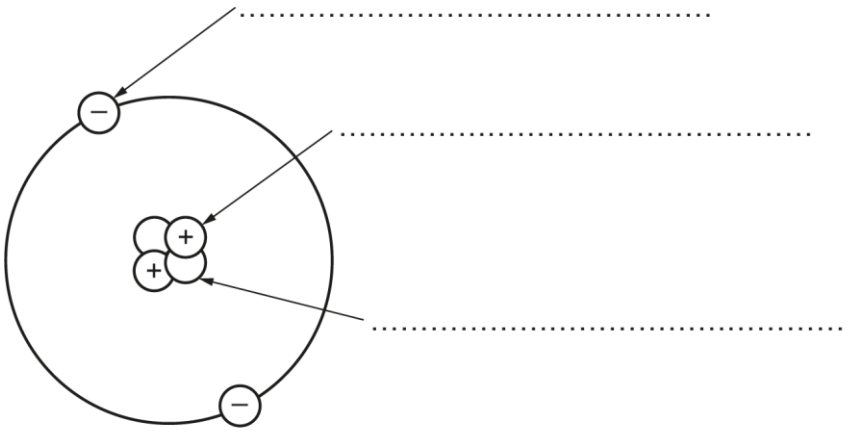
Question 11 (a) (i)

11 Elements in the Periodic Table are made from atoms.

(a) Atoms are made from three particles called **protons**, **neutrons** and **electrons**.

The diagram shows an atom.

(i) Label the names of the three particles on the diagram.



[2]

This question was a good discriminator with many candidates getting all three correct, to score both marks. Candidates should be reminded that they should only choose their answers from the three particles given in the question, as some alternatives were seen, e.g. nucleus or ion.

Question 11 (a) (ii)

(ii) Complete the sentence about the atom.

Put a (ring) around the correct option.

The particle with the lowest relative mass is the **proton / neutron / electron**. **[1]**

Around half of candidates knew that this was the electron, but both proton and neutron were selected by some.

Question 11 (a) (iii)

(iii) The **first** of these three particles to be discovered was by J.J. Thomson.

Complete the sentence about the particles.

Put a (ring) around the correct option.

The particle that was discovered first was the **proton / neutron / electron**. **[1]**

Fewer candidates selected the correct answer compared to Question 11 (a) (ii), with both proton and neutron being chosen fairly equally.

Question 11 (b)

(b) Write the **symbol** of the element made from atoms with nine protons.

Use the Periodic Table on the Data Sheet.

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

Over half of candidates correctly identified the element as fluorine. However, many confused proton/atomic number and mass number so chose beryllium. Although the question asked for the element symbol, candidates were given credit for writing the name of the element instead (which many candidates did).

Question 11 (c) (i)

(c) The table shows part of Mendeleev's Periodic Table published in 1871.

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K Cu	Ca Zn		Ti	V As	Cr Se	Mn Br	Fe Co Ni
Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	I	Ru Rh Pd

(i) Which property did Mendeleev use to arrange the elements in his Periodic Table?

Tick (✓) **one** box.

Atomic number ☐

Atomic size ☐

Atomic weight ☐

[1]

Very few candidates identified atomic weight as the property used to arrange the elements in Mendeleev's Periodic Table. Most remembered that our modern Periodic Table is arranged in order of atomic number so opted for this instead.

Question 11 (c) (ii)

(ii) Give **one** reason why Mendeleev left gaps in his Periodic Table.

.....

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

Most candidates included the word 'undiscovered' in their answer, with the majority scoring the mark. Some did not gain a mark as they did not mention elements, but they had the concept of something yet to be discovered, e.g. properties, atomic number or size. Very few answered with the idea that elements with similar properties were being placed in the same group.

Question 11 (c) (iii)

(iii) Elements from which Group(s) are present in **both** Mendeleev's Periodic Table and the modern Periodic Table?

Use the Periodic Table on the Data Sheet.

Tick (✓) **one**, **two** or **three** boxes.

Group 1 ☐

Group 7 ☐

Group 0 ☐

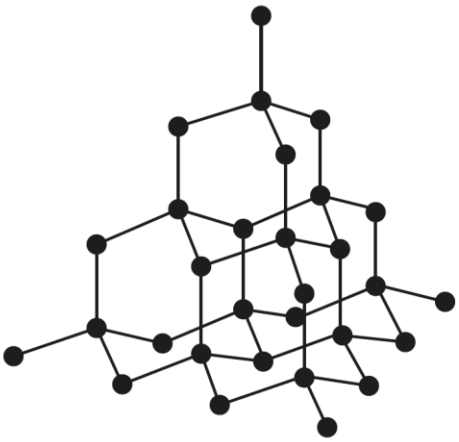
[1]

Around half of candidates scored this mark; those who didn't mostly only ticked one box instead of both Group 1 and Group 7.

Question 12 (a) (i)

12 This question is about diamond and graphite.

(a) The diagram shows the structure of diamond.



(i) Which element is diamond made from?

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

Although many candidates answered correctly, a wide range of alternative elements were seen. A few did not understand the question so suggested answers that were not elements, including covalent bonds, diamond, graphite, atoms and metals.

Question 12 (a) (ii)

(ii) What is the maximum number of covalent bonds that each atom in diamond can form?

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

Few candidates realised what was required, so a wide range of suggestions were made – from 1 to over 100. Some candidates attempted to count the bonds in the whole diagram.

Question 12 (a) (iii)

(iii) The atoms in diamond have a diameter of 0.000000000154 m.

What is the diameter of the atoms in standard form?

Tick (✓) **one** box.

1.54×10^{-13} m ☐

1.54×10^{-10} m ☐

1.54×10^{-3} m ☐

[1]

The majority of candidates answered correctly, and it was good to see that many showed their working. Some, however, may have simply recalled the size of an atom.

Question 12 (a) (iv)

(iv) The properties of diamond can be explained in terms of its structure and bonding.

Draw lines to connect each **property** with its correct **explanation**.

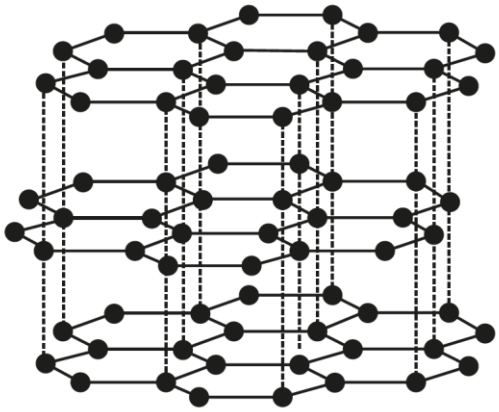
Property	Explanation
	It has many strong covalent bonds.
High melting point	It has no free electrons.
Does not conduct electricity	It is a simple molecule.
	It is made from ions.

[2]

Around half of candidates gained both marks, with the majority scoring at least 1 mark. A significant number thought they had to link all the boxes so drew two lines from each property. This meant they could not access any marks. Exam practice with this kind of question would be beneficial.

Question 12 (b)

(b) This diagram shows the structure of graphite.



Which statements about the properties of graphite are **true** and which are **false**?

Tick (✓) **one** box in each row.

Properties of graphite	True	False
It conducts electricity.		
It is as hard as diamond.		
It has a high melting point.		

[2]

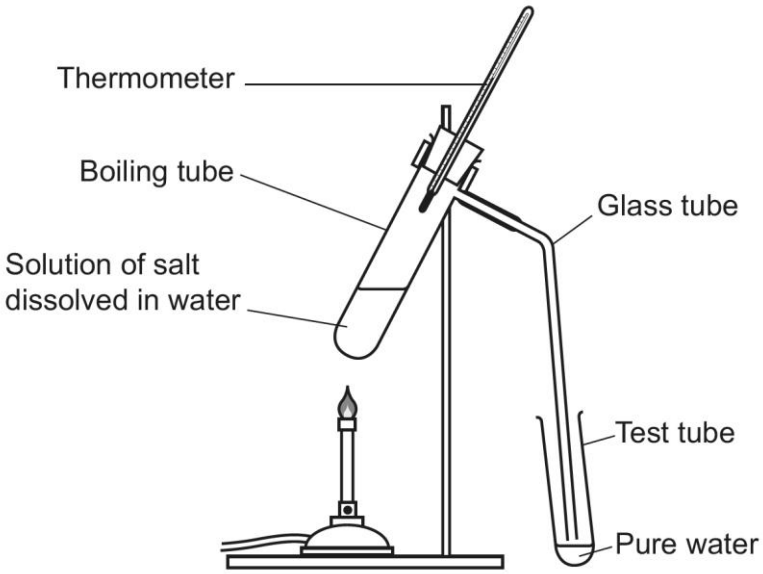
Many candidates scored 2 marks on this question. Almost all scored at least 1 mark by giving one or two correct responses. Some candidates were not aware that graphite conducts electricity.

Question 13 (a) (i)

13 A student investigates mixtures of salt and water.

(a) The student has a solution of salt dissolved in water.

The diagram shows how they separate pure water from the solution.



(i) What name is given to this method of separation?

Tick (✓) **one** box.

Crystallisation ☐ Distillation ☐ Filtration ☐

[1]

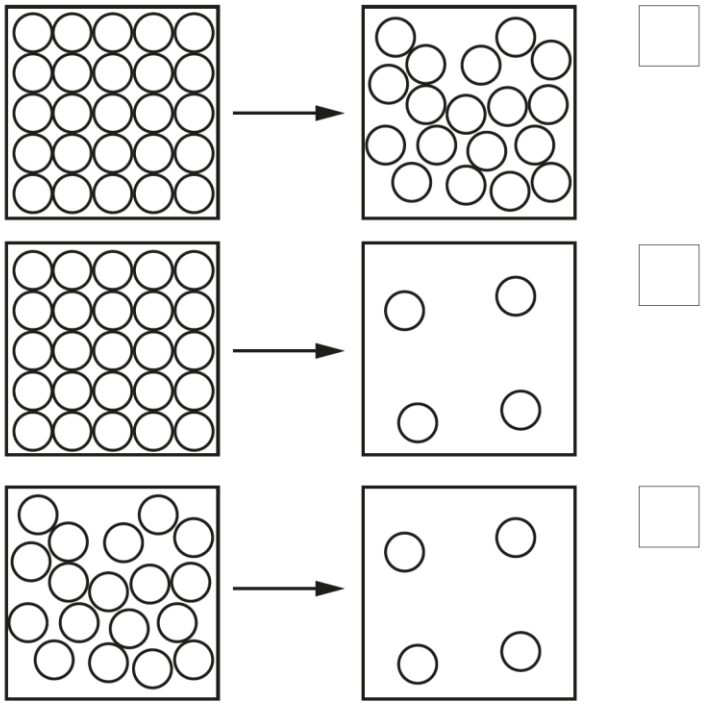
Many candidates recognised that this apparatus was performing distillation, but filtration and crystallisation were both chosen by others.

Question 13 (a) (ii)

(ii) The particle diagrams represent changes of state.

Which diagram represents what happens in the boiling tube?

Tick (✓) **one** box.



[1]

The majority of candidates selected the correct particle diagram.

Question 13 (a) (iii)

(iii) After several minutes the glass tube becomes hot, and no more water is collected in the test tube.

Give **one** reason why the glass tube becomes hot.

.....

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

Most candidates did not understand that they were being asked why the glass delivery tube got hot. Many believed that the glass tube referred to in the question was the boiling tube, so the most common answer was that it was being heated by the Bunsen burner. A minority of candidates discussed heat conduction in glass and a few wrote about an exothermic reaction heating the glass.

Very few candidates mentioned the steam or water vapour as the carrier of heat energy. A few wrote about boiling water or hot gas which did not gain a mark. A significant number omitted this question.

Question 13 (a) (iv)

(iv) The student wants the experiment to work for longer.

What other piece of equipment can they use instead of the glass tube?

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

Very few candidates understood what was being asked, so a wide range of items were suggested – not all of it laboratory equipment. Many did not attempt to answer. The most common responses were beaker and metal tube; others included flask, gas syringe, straw, bowl, plastic pipe, etc.

Of those that identified that a condenser was required, some did not know the correct name and called it a (fractional) distillation tube or cylinder; a few drew a sketch of a condenser to clarify what they meant.

Question 13 (b) (i)

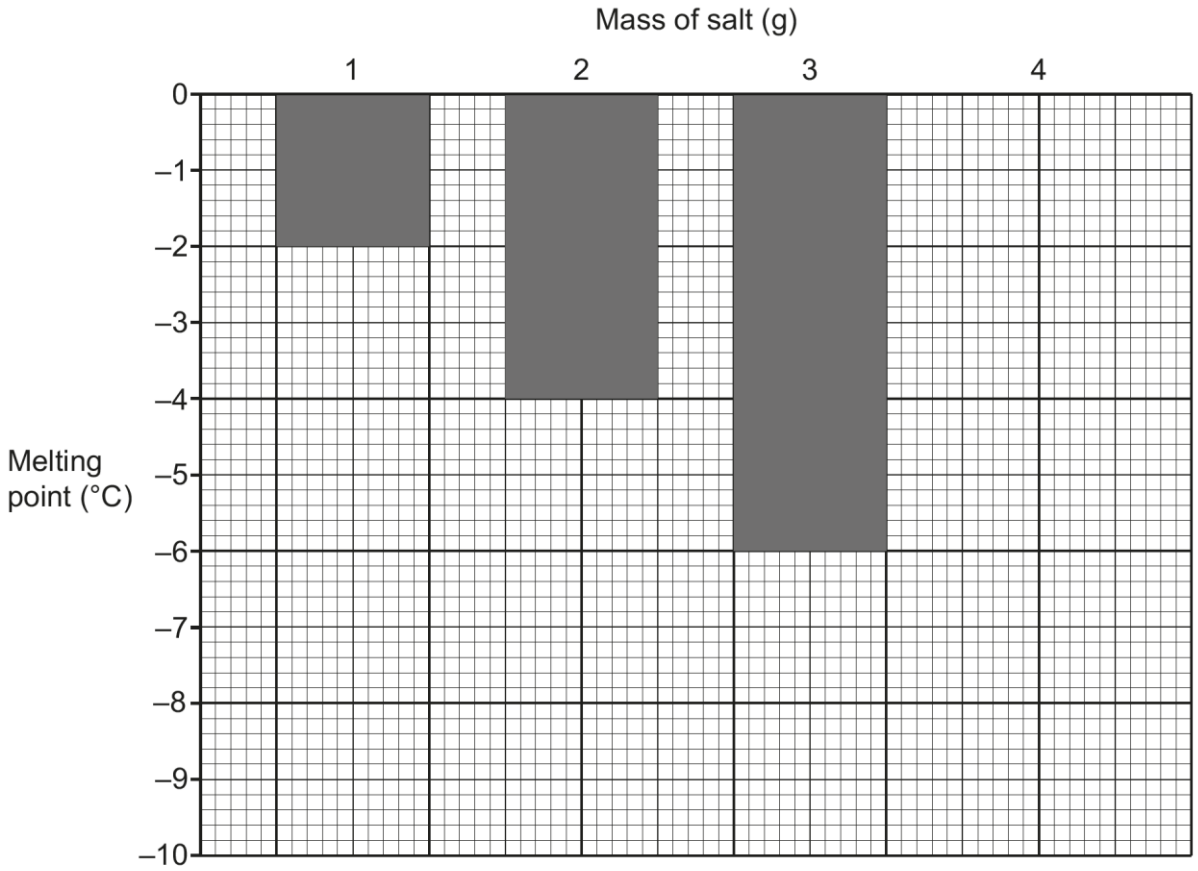
(b) The student also investigates how adding salt to ice changes the melting point of the ice.

The table shows their results.

Mass of salt (g)	Melting point (°C)
1	–2
2	–4
3	–6
4	–8

(i) The student draws a bar chart of the results.

Draw a bar on the bar chart for the results when 4 g of salt are added to the ice.



[1]

It was good to see that almost all the candidates who attempted this question drew a neat and accurate bar on the chart. However, there was a high omit rate and it appears that many candidates simply did not notice the instruction in the question asking them to draw the bar.

Question 13 (b) (ii)

(ii) Describe how changing the mass of salt changes the melting point.

.....

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

Higher achieving candidates were mostly able to link an increase in the amount of salt added to a decrease in melting point. A common error was to say that the melting point increased as the mass of salt increased. Vague responses such as 'adding salt affects the melting point', or changing rather than increasing the mass of salt were not credited.

A number of candidates attempted to explain *why* adding salt changed the melting point, rather than *how* it affected it. Others focused on the rate of melting rather than the melting temperature. Some referred to boiling point rather than melting point in their answer, so needed to read the question more carefully.

Misconception

This is a 'describe how' not a 'describe why' question. Candidates needed to describe what happened to the melting point when the mass of salt added was changed. They did not need to explain why this happened.

Exemplar 1

When mass increases theres less surface area a ice to start melting from the outside so melting po higher. **[1]**

This candidate has attempted to describe *why* the melting point changes, as well as *how* it changes. They have not scored the mark as they state that as mass (of salt) increases, the melting point is higher. They may be attempting to link the melting point change to their explanation, without considering the data. Alternatively, they may have misinterpreted the data and not understood that the melting point is getting more negative, not more positive. Some candidates appear to have been confused by the negative numbers.

Question 13 (b) (iii)

(iii) The student thinks the results show that pure ice will have a melting point of 0 °C.

Explain why the student is **correct**.

.....

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

This question was not well answered. Candidates clearly knew that the melting point of ice is 0°C so many simply stated this; they didn't realise that they needed to use the data in the table and bar chart.

Most candidates were aware of the pattern in the data but were unable to articulate their answer clearly enough to score the mark. Candidates at Foundation level seem not to understand that when negative numbers increase, the temperature is cooling down.

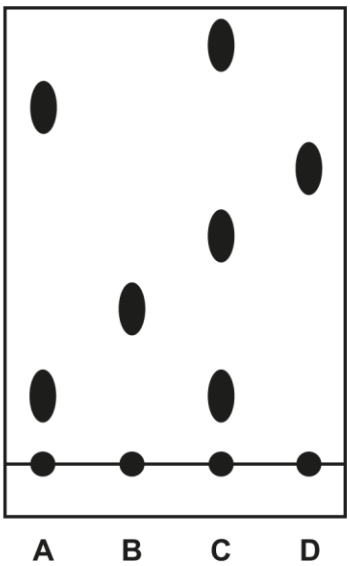
Some candidates seemed focused on the word 'pure' and discussed narrow melting ranges.

Question 14 (a)

14 A teacher uses paper chromatography to show which dyes are in four different food colourings, **A**, **B**, **C** and **D**.

Fig. 14.1 shows the result of their experiment.

Fig. 14.1



(a) Which food colouring contains the most dyes?

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

Almost all candidates correctly identified C.

Question 14 (b)

(b) Which food colourings contain the same dye?

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

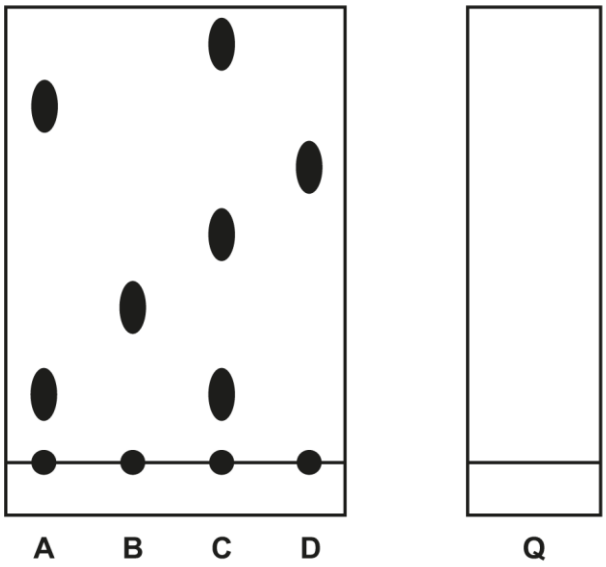
This question was not well answered; many candidates answered B and D instead of A and C. Despite being asked which food colourings (plural) contained the same dye, many only mentioned a single letter.

Question 14 (c)

(c) The teacher repeats the experiment with a new food colouring **Q**. They find it contains the same dyes that are also found in **B** and **D**.

Draw the results for the food colouring **Q** on **Fig. 14.2**.

Fig. 14.2



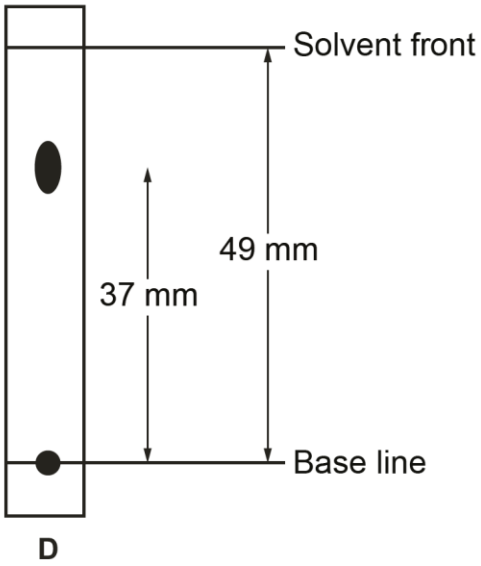
[1]

Less than half of candidates were able to correctly draw the results expected for dye Q. It was good to see some successful responses where candidates used a ruler to draw horizontal lines as guides. However, many single spots were seen, or poorly positioned double spots.

Question 14 (d)

(d) **Fig. 14.3** shows the result for the food colouring **D**.

Fig. 14.3



Calculate the R_f value for the dye in the food colouring.

Give your answer to **2** significant figures.

Use the equation: $R_f = \frac{\text{distance travelled by the ink}}{\text{distance travelled by the solvent}}$

R_f value = ... **[3]**

It was pleasing to see that most candidates attempted this question. However, many chose not to show any working and just wrote 0.75 on the answer line. Since they had rounded their calculator answer of 0.755 incorrectly, they could not access any marks.

Most candidates who showed their working gained a mark for dividing 37 by 49, although some got the fraction upside down. Those who attempted to convert their answer to 2 significant figures at this stage (but without writing the intermediate answer down) sometimes did not round it correctly and so scored no further marks. Candidates should be encouraged to show all stages of their working so that examiners can give marks for correct technique even if the final answer is not correct.

Even if an incorrect answer is calculated, perhaps by dividing the wrong numbers, it is still possible to gain an 'error carried forward' (ECF) mark for correctly rounding to 2 significant figures. However, some candidates had not read the question fully and so had missed the instruction to convert to 2 significant figures.

Exemplar 2

$Rf = \frac{37}{49}$

R_f value = 0.76 [3]

This answer scored 3 marks as the answer was correct, even though the working was not fully shown. A number of candidates did not show any working and just wrote 0.75 on the answer line, having rounded their calculator answer incorrectly.

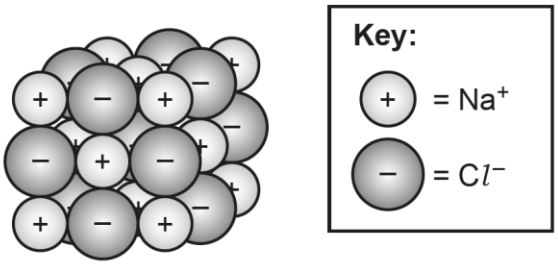
If this candidate had rounded the answer incorrectly they would only have gained 1 mark for dividing 37 by 49. However, if they had written down the calculator answer of 0.7551 they would have gained 2 marks, even though their final answer was incorrect.

Question 15*

15* This question is about the ionic compound sodium chloride, NaCl.

It is made from sodium ions, Na^+, and chloride ions, Cl^- ions.

The diagram shows the structure of sodium chloride.



The table show information about four materials.

Material	Appearance at room temperature	Melting point (°C)	Does it dissolve in water?	Does it conduct heat?	Does it conduct electricity?
A	a flexible white solid	120	no	no	no
B	a shiny silver solid	232	no	yes	yes
C	a white solid	801	yes	no	when melted into a liquid
D	a white solid	1713	no	no	no

Material **C** is sodium chloride.

Describe properties of material **C** that shows it is sodium chloride.

Explain these properties using ideas about the structure and bonding of sodium chloride.

.....

.....

.....

.....

.....

..... **[6]**

The majority of candidates attempted this Level of Response question and gained some marks. The most common mark given for this question was 2. Most candidates appeared to engage with the command word 'describe' but not with the 'explain' section of the question.

Candidates found explaining the properties very challenging. They would have benefited from reading the question more carefully because, although it told them sodium chloride was ionic and showed a diagram of an ionic structure, many candidates wrote about strong covalent bonds.

Common errors included confusing the properties of sodium chloride with those of the elements that make it up, e.g. explaining that sodium chloride dissolves because chlorine dissolves in the water in swimming pools, or that it conducts electricity when melted because sodium is a metal and metals conduct.

Exemplar 3

Material C is ~~a~~ sodium chloride because the melting point is high at 801°C because of the strong electrostatic forces between ionic bonds and the amount of energy needed to break them. It is also C as it dissolves in water which is a chemical property of ionic compounds. C also conducts electricity when melted into liquid, proving it's the ionic compound as, when ionic compounds are in liquid form, their regular lattice structure with alternating ions ~~held~~ closely packed together is no longer their, and the electrons are free to move therefore conducts electricity.

The candidate has used the information supplied to describe three properties of sodium chloride, including identifying melting point as high rather than just stating that it is 801° C. There is one clear explanation: it dissolves in water, which is a property of ionic compounds. The other two explanations are less successful – high melting point is due to the strong attraction between ions, not ionic bonds. The explanation of conductivity when melted is also not successful: it is the ions, not electrons, that are free to move.

They have described and explained properties of material C, but the communication on two of their explanations are incorrect or inadequate. This is a Level 3 response and the candidate scored 5 marks.

OCR support

For more support for teachers and candidates with answering Level of Response (LOR) questions, we produce candidate exemplars yearly for maths skills, short answer questions, practical activities and LORs. The links included here are from the June 2023 series, with this summer's series materials available early in the next academic year.

Question 16 (a)

16 The formula of a compound is **X**$(OH)_2$. **X** is an element found in Group 2 of the Periodic Table.

The relative formula mass of **X**$(OH)_2$ is 74.1.

(a) Calculate the relative formula mass of **one** OH.

Relative atomic mass (A_r): H = 1.0 O = 16.0

Relative formula mass of **one** OH = ... **[1]**

Lower achieving candidates were not familiar with how to calculate relative formula mass. Although almost half of candidates obtained the correct answer, many wrote 16. Frequent errors were to multiply some of the numbers, to divide 74.1 by 16, or to divide 74.1 by 2. A significant number omitted this question.

Question 16 (b)

(b) Use your answer to part **(a)** to calculate the relative atomic mass of **X**.

Relative atomic mass of **X** = ... **[2]**

Few candidates realised they needed to double their answer from Question 16 (a) then subtract it from 74.1. Many who wrote 16 for OH mass did not follow this through in Question 16 (b). Most scored either 2 marks or none, and there was a higher omit rate than with the previous question. Where 1 mark was given, it was for 2 x 17 or 34.

Question 16 (c)

(c) Use your answer to part **(b)** to identify **X**.

Use the Periodic Table on the Data Sheet.

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

Even if their answer to Question 16 (b) was incorrect, many candidates were able to match the appropriate element to their previous answer. However, some did not notice that the question had told them it was a Group 2 element so did not score the mark. A few seemed to have just guessed at 24.3 in Question 16 (b) and gained an ECF mark for magnesium in Question 16 (c).

Question 17 (a)

17 Lithium reacts with oxygen to form lithium oxide.

The symbols for lithium and oxygen on the Periodic Table are:

3 **Li** 6.9	8 **O** 16.0

(a) Explain how the positions of lithium and oxygen in the Periodic Table are used to decide that lithium is a metal and oxygen is a non-metal.

Use the Periodic Table on the Data Sheet.

.....

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

Successful candidates mostly scored a mark for the idea that metals are on the left of the Periodic Table and non-metals on the right. Alternatively, that lithium is in Group 1 and oxygen is in Group 6. A common error was to state that metals are in Group 1 and non-metals in Group 6, without any link to lithium or oxygen. However, many found this challenging with some thinking that the mass numbers and atomic numbers were relevant.

Question 17 (b)

(b) Lithium reacts with oxygen to make lithium oxide.

Complete the **balanced symbol** equation for the reaction.

$$.....Li + O_2 \rightarrow .....Li_2O$$

[2]

Although few candidates scored both marks, many scored 1 mark; this was mostly for $2Li_2O$. It was good to see many attempts to show working. A significant number omitted this question, but most of those that attempted it knew that they were required to write numbers, rather than symbols, on the lines.

Question 17 (c)

(c) Write the electron arrangement for an atom of lithium.

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

Most incorrect responses were not an electron configuration. If candidates wrote an electron configuration, it was often correct. Those who attempted to answer in a sentence often gained the mark. Incorrect answers often included 3 or 6.9. Many did not give an answer.

Misconception

Many candidates do not realise that an electron arrangement is a series of numbers which shows how many electrons are on each shell, starting with the innermost shell.

Question 17 (d)

(d) When an atom of lithium reacts with oxygen it forms a lithium ion, Li^+.

Describe how an atom of lithium forms a lithium ion.

.....

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

Some higher achieving candidates were able to score 2 marks; 1 mark was rarely seen, as most of those knew it that just one electron was being lost. Some wrote of 'gaining or losing electrons', sharing electrons or just 'reacting with oxygen'. A few thought that the + sign meant it gained electron(s). However, many had no clear idea of how ions were formed and did not mention electrons. Many omitted this question.

Question 17 (e)

(e) A student thinks that sodium reacts in a similar way to lithium.

Explain why they are **correct**.

Use the Periodic Table on the Data Sheet.

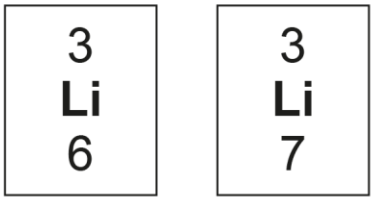
.....

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

Most candidates gained the mark by stating that sodium and lithium were in the same group, often saying Group 1. A few referred to both having one electron in the outer shell, or both losing one electron. Sometimes candidates said they were both (reactive) metals, or they were 'next to each other', which was insufficient.

Question 17 (f)

(f) Lithium can exist as two isotopes.



Explain what **isotope** means.

.....

.....

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

Most candidates found this question very challenging, with few gaining both marks. Many candidates gaining the atomic number mark wrote 'same element'. The majority knew that something was the same and something was different but were not clear about which particles it was.

Common errors involved relative atomic mass, same or different numbers of protons AND neutrons. Electrons were frequently mentioned. Almost no answers were seen referring to the specific numbers of protons and neutrons in each isotope. A few confused isotopes with ions.

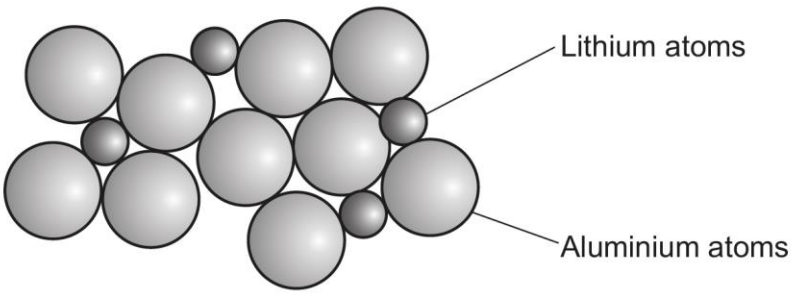
Misconception

Many candidates confused the terms mass number and relative atomic mass, frequently believing they mean the same thing.

Question 17 (g) (i)

(g) Lithium can be added to aluminium to make an alloy. One alloy contains 2% lithium.

A student draws a diagram of the alloy.



(i) Calculate the percentage of lithium atoms in the alloy drawn by the student.

Percentage of lithium atoms in the alloy = ... % **[2]**

Very few candidates successfully calculated the percentage, although it was good to see many including their working. The most common responses were 4% and 8%. A common error was 40% obtained by dividing the number of Li atoms by the number of Al atoms, rather than the total number of atoms. A small number gained 1 mark, either for 4/14, or for the full calculator answer which they incorrectly rounded to 28% instead of 29%.

Question 17 (g) (ii)

(ii) Suggest a reason why the student's diagram is **incorrect**.

.....

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

Few candidates gained marks as most just said the percentage was not 2%. A few thought there were too few Li atoms or too many Al atoms; others referred to the relative sizes of the atoms. A common misconception was that there should be an equal number of Li and Al atoms, or that the atoms in an alloy should be bonded in some way. Many candidates did not attempt an answer.

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