Qualification Accredited

OCR
Oxford Cambridge and RSA

GCSE (9–1)

Examiners' report

GATEWAY SCIENCE CHEMISTRY A

J248

For first teaching in 2016

J248/01 Summer 2024 series

Version 1

ocr.org.uk/science

Contents

Introduction 5
Paper 1 series overview 6
Section A overview 7
Question 1 7
Question 2 7
Question 3 8
Question 4 8
Question 6 9
Question 7 9
Question 8 10
Question 9 11
Question 10 12
Question 11 12
Question 12 13
Question 13 14
Question 14 15
Question 15 16
Section B overview 17
Question 16 (b) (i) 17
Question 16 (b) (ii) 17
Question 16 (b) (iii) 18
Question 16 (c) 18
Question 16 (d) 19
Question 17 (b) 20
Question 17 (c) 22
Question 17 (d) 23
Question 17 (e) 23
Question 18 (a) 24
Question 18 (b) (i) 25
Question 18 (b) (ii) 25
Question 18 (c) 26
Question 18 (d) (i) 27
Question 18 (d) (ii) 27
Question 19 (a) (i) 28

Question 19 (a) (ii) 28
Question 19 (a) (iii) 29
Question 19 (b) (ii) 29
Question 19 (b) (iv) 30
Question 20 (a)* 31
Question 20 (b) 33
Question 20 (c) 33
Question 21 (a) 34
Question 21 (b) 34
Question 21 (c) 35
Question 21 (d) (i) 36
Question 21 (d) (ii) 36
Question 22 (a) (i) 37
Question 22 (a) (ii) 37
Question 22 (a) (iii) 38
Question 22 (b) (i) 38
Question 22 (b) (ii) 39
Question 23 (a) 40
Question 23 (b) (i) 41
Question 23 (b) (ii) 41
Question 23 (c) 42
Question 23 (d) 42

Introduction

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

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

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

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

Paper 1 series overview

Candidates were well prepared for this examination. Many of the more difficult questions were omitted by a small but significant number of candidates.

In calculations it is imperative for candidates to show their working out, so that where a final answer is incorrect, it may be possible for working and error carried forward marks to be given.

It is advised that candidates check their responses against the questions in the question paper to make sure that they have answered all of what is being asked, e.g. that numerical answers are given to an appropriate number of significant figures or decimal places and that written responses cover all aspects of the question.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• produced a clear, concise and well-structured response for the Level of Response question, Question 20 (a) • used atomic structure theory: Questions 1, 16 (b) (i) and 16 (b) (ii) and particle model Question 16 (a) • performed calculations relating to mean volume Question 17 (c), mass Question 18 (a), orders of magnitude Question 21 (a), ratio Question 22 (a), R_f value Question 22 (b) (ii) and relative atomic mass Question 23 (d) • used data appropriately: Questions 16 (b) (i), (ii) and (iii), 19 (b) (i), (ii) and (iii), 21 (d) and 22 (a) (iii) • derived a relationship from data • applied knowledge of acids and alkalis: Question 17 (b) • named apparatus and experimental techniques: Questions 5, 17 (b), 21 (d) (i) and 23 (a) • plotting graphs Questions 19 (b) (i), (ii) and (iii) • knowledge of the Periodic Table: Question 20 (b).	• gave answers to calculations with no working steps shown • found bonding challenging: Questions 4, 9, 18 (b) and 21 (c) • had difficulty with significant figures, decimal places and standard form difficult: Questions 17 (c) and 21 (b) • found electrolysis tricky: Questions 14 and 15 • found properties of polymers difficult: Question 18 (b) (ii) • found locating agents and R_f value complex: Questions 22 (b) (i) and (b) (ii) • found drawing and changes to experimental apparatus a challenge: Questions 19 (a) (iii) and 22 (b) (i) • found identifying products of reactions difficult: Questions 18 (c) and 22 (a) (ii) • showed imprecise use of scientific terminology.

Section A overview

Only a very small number of candidates omitted any of the multiple choice questions.

Questions on atomic structure (1), chemical changes (2) and separating and purifying (5) were particularly well answered.

Questions on bonding (4), Niels Bohr (6), formulations (7) and electrolysis (14 and 15) proved to be more challenging for candidates.

Question 1

1 Which part of an atom is **negatively** charged?

A Electron

B Neutron

C Nucleus

D Proton

Your answer ☐ **[1]**

Atomic structure was well known. Proton was a popular incorrect response.

Question 2

2 Which of these changes is a **chemical** change?

A Ice melting

B Shaping hot metal with a hammer

C Water condensing

D Wood burning

Your answer ☐ **[1]**

C was the most popular incorrect response with A being the next most popular.

Question 3

3 Which group of elements on the Periodic Table has a full outer shell of electrons?

A 0

B 1

C 2

D 7

Your answer ☐ **[1]**

Some candidates appreciated the organisation of the Periodic Table in terms of electrons. D was a popular incorrect response.

Question 4

4 Sodium chloride, NaCl, is an ionic compound.

How are the ions held together in sodium chloride?

A Covalent bonds

B Delocalised electrons

C Electrostatic forces

D Intermolecular forces

Your answer ☐ **[1]**

Candidates found bonding very challenging. All responses were seen with D being the slightly more popular incorrect response

Question 6

6 Which scientist suggested the idea that electrons exist in electron shells?

A Bohr

B Dalton

C Rutherford

D Thomson

Your answer ☐ **[1]**

Some candidates recalled the work of Niels Bohr. C and D were popular responses.

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 majority of candidates thought a formulation to be a compound hence A and C were the more popular responses. Of those who appreciated that a formulation is a mixture (D), was the more popular response.

Question 8

8 The table shows information about some atoms and ions.

Which two are **isotopes**?

Atom or ion	Number of protons	Number of neutrons	Number of electrons
1	17	18	17
2	17	18	18
3	17	20	17
4	18	20	18

A 1 and 2

B 1 and 3

C 2 and 4

D 3 and 4

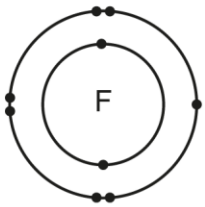
Your answer ☐ **[1]**

Some candidates used their knowledge of isotopes to choose from the species correctly. Many thought the number of neutrons or electrons needed to be equal, hence responses C and D were popular.

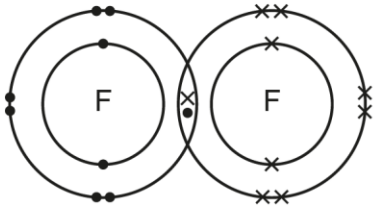
Question 9

9 Which dot and cross diagram shows the structure of a fluorine molecule, F_2?

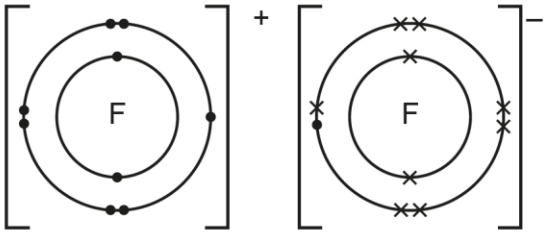
A



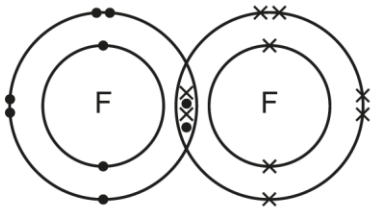
B



C



D



Your answer ☐ **[1]**

Some candidates recognised the single covalent bonding in a molecule of fluorine. Most appreciated that the bonding was not ionic, hence responses A and D were popular incorrect responses.

Question 10

10 What is the balanced symbol equation for the reaction of methane with oxygen?

A $CH_4 + O_2 \rightarrow CO_2 + H_2O$

B $CH_4 + O_2 \rightarrow CO_2 + 2H_2O$

C $CH_4 + 2O_2 \rightarrow CO_2 + H_2O$

D $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Your answer ☐ **[1]**

Candidates found balancing the equation challenging. C was the most popular incorrect response.

Question 11

11 11.0 g of aluminium reacts with 43.4 g of chlorine to make 54.4 g of aluminium chloride.

$2Al + 3Cl_2 \rightarrow 2AlCl_3$

How much **aluminium** is required to make 217.6 g of aluminium chloride?

A 22.0 g

B 44.0 g

C 86.8 g

D 173.6 g

Your answer ☐ **[1]**

Some candidates calculated the mass of chlorine required hence D was a popular response. C was also quite popular.

Question 12

12 The table shows the start and end temperatures of four reactions.

Which reaction is endothermic?

	Temperature at start (°C)	Temperature at end (°C)
A	19.0	19.0
B	19.0	15.2
C	20.0	23.2
D	20.0	21.0

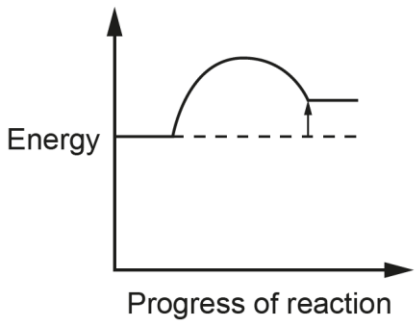
Your answer ☐ **[1]**

Many candidates chose the most exothermic change, C.

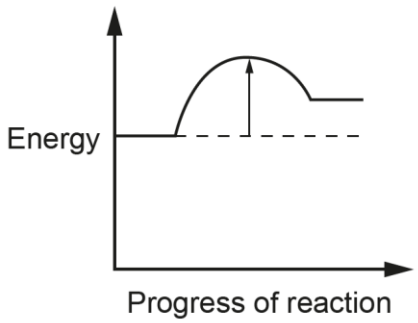
Question 13

13 Which reaction profile shows an **exothermic** reaction with the arrow marking the activation energy?

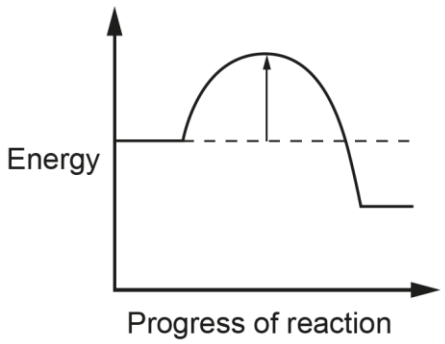
A



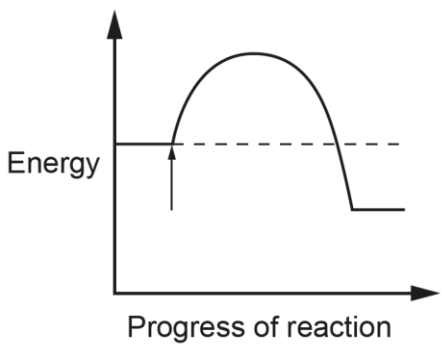
B



C



D



Your answer ☐ **[1]**

While many candidates recognised that for an exothermic change the energy of the products is lower than the energy of the reactants, and that the placement of the activation energy was incorrect. This however lead many to choose D as the most popular incorrect response. Some appreciated that activation energy is shown by an upwards arrow and chose B.

Question 14

14 The electrolysis of molten copper chloride makes copper metal and chlorine gas.

Which row describes what happens to the inert electrodes during the electrolysis of molten copper chloride?

A Mass of both electrodes decreases

B Mass of both electrodes increases

C Mass of one electrode increases, mass of one electrode decreases

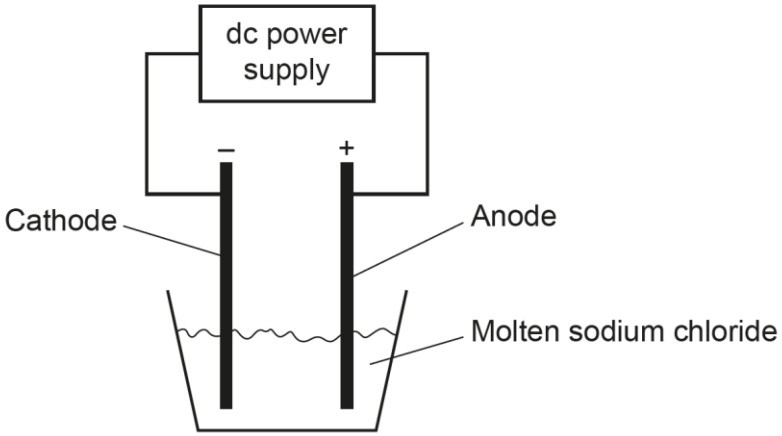
D Mass of one electrode increases, mass of one electrode stays the same

Your answer ☐ **[1]**

The highest achieving candidates appreciated that inert electrodes do not take part in the electrolysis reactions. Many confused the outcome using copper electrodes, hence C was the most popular response.

Question 15

15 The diagram shows the electrolysis of molten sodium chloride.



Which products are made in the electrolysis of molten sodium chloride?

	Product at anode	Product at cathode
A	chlorine	hydrogen
B	chlorine	sodium
C	hydrogen	chlorine
D	sodium	chlorine

Your answer ☐ **[1]**

Many candidates reversed the products, hence D was a popular incorrect response. However, electrolysis was generally not well understood and so all responses were seen.

Section B overview

Questions on the particle model (16 (a) (i)), atomic structure (16 (b) (i)), measuring apparatus (17 (a)), calculating mean volume (17 (c)), calculating mass (18 (a)), plotting a graph (19 (b) (i) and (b) (iii)), the Periodic Table and Mendeleev (20 (b)), calculating a ratio (22 (a) (i)) and separating mixtures (23 (a)) were particularly well answered.

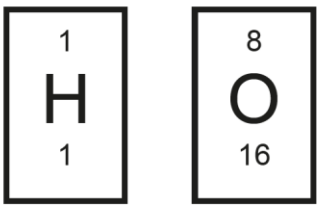
Questions on atomic structure (16 (b) (ii)), covalent bonding (18 (b) (i)), differences in polymers (18 (b) (ii)), empirical formula (18 (d) (ii)), balancing equations (19 (a) (i)), drawing experimental set up including a syringe (19 (a) (iii)), standard form (21 (b)), locating agents (22 (b) (i)), structure of diamond (21 (c)), Question 22, changes to apparatus (23 (b) (i) and (b) (ii)) proved to be the most challenging for candidates.

A significant number of candidates omitted the more challenging questions, particularly Questions 18 (b) (i), 18 (b) (ii), 18 (d) (i), 18 (d) (ii), 19 (a) (i),19 (a) (ii),19 (a) (iii), 21 (b), 21 (c), 22, 23 (b) (i), 23 (b) (ii) and 23 (d).

There was no evidence that candidates did not have enough time to complete the paper.

Question 16 (b) (i)

(b) Water, H_2O, contains hydrogen and oxygen atoms.



(i) How many protons does an oxygen atom have?

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

Atomic structure was well known. A small number reversed the atomic number and mass number and gave the response 16. A very small number halved the atomic number and gave the response 4.

Question 16 (b) (ii)

(ii) How many neutrons does a hydrogen atom have?

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

Most candidates thought that one of the two numbers on the symbol referred to the number of neutrons, hence 1 was the most popular response. Some thought the atomic number referred to the number of neutrons and so 8 was also quite popular.

Question 16 (b) (iii)

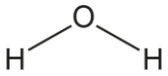
(iii) What is the relative charge of a proton?

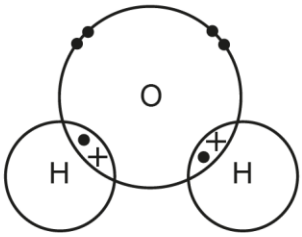
..... **[1]**

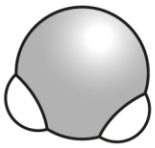
Almost all candidates appreciated that the proton is positively charged. However, many omitted to give the magnitude of the relative charge as 1.

Question 16 (c)

(c) A water molecule can be represented with different models.







Model 1 **Model 2** **Model 3**

Which model would you use to show the **volume** of a water molecule?

Explain your answer.

Model .....

Reason .....

.....

[2]

Some candidates appreciated that Model 3 should be chosen and many of these explained the model was 3D. Non-creditworthy reasons included showing the size or showing the volume. Many candidates chose Model 2 as it showed where the electrons were or Model 1 as it showed the bonds.

Question 16 (d)

(d) Water is formed from the reaction of hydrogen, H_2, and oxygen, O_2.

$2H_2 + O_2 \rightarrow 2H_2O$

Hydrogen is **oxidised** in the reaction.

Explain how you can tell from the equation.

.....

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

A small number of candidates appreciated that they needed to use the equation in order to answer the question and so discussed hydrogen gaining oxygen. Non-creditworthy responses included the equation being balanced, water as a product, equation has oxygen, oxygen is lost and the 2 being removed from the oxygen. Many discussed electron movement, which is not shown in the equation and often the movement was reversed.

Question 17 (b)

(b) The student adds universal indicator to the acid.

The student predicts the colour change they think will happen when they add the alkali to the acid.

Colour of indicator before alkali is added	Red
Colour of indicator when solution is neutral	Green
Colour of indicator when too much alkali has been added	Yellow

Do you agree with the student?

Tick (✓) **one** box.

The student is completely correct. ☐

The student is partly correct. ☐

The student is completely incorrect. ☐

Explain your answer.

.....

.....

.....

[3]

Many candidates chose partially correct and correctly described the colour of the indicator when too much alkali is added. Far fewer explained that the other two observations were correct. Incorrect observations included neutral being clear or white and acid and alkali colours being reversed.

Exemplar 4

The student is completely correct. ☐

The student is partly correct. ☑

The student is completely incorrect. ☐

Explain your answer.

the student is partly correct because when too much alkali has been added it will turn blue or purple, however when a solution is neutral it turns green so is correct. [3]

The candidate has ticked the correct box, partly correct. They have identified the incorrect part of the student's prediction - that the colour when too much alkali is added would be blue/purple (not yellow). To gain full marks the candidate would need to identify which parts of the student's prediction were correct, i.e. the colour in acid being red and the colour when neutral being green.

Question 17 (c)

(c) The table shows the volume of alkali the student adds in each experiment.

Experiment	Volume of alkali added (cm^3)
1	24.2
2	24.4
3	23.9
4	24.0

Calculate the mean volume of alkali added.

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

Mean volume of alkali added = ... cm^3 **[3]**

The majority of candidates calculated the mean correctly and most of these gave their value to three significant figures. Where no working is shown a possible correct method containing a mathematical error cannot be credited.

Calculations

It is really important that candidates show their working in calculations, otherwise it is impossible to award partial marks for responses where only one step is incorrect.

Question 17 (d)

(d) Complete the **word** equation for a neutralisation reaction.

acid + alkali → ..... + ...

[2]

Some candidates knew at least one of the products of the equation. Incorrect responses included hydrogen, oxygen, base, alkali, carbon dioxide, alkane, alkene and acid. A significantly large number omitted the question.

Question 17 (e)

(e) Which **two** ions react together in neutralisation reactions to form H_2O?

Put a ring around **two** ions.

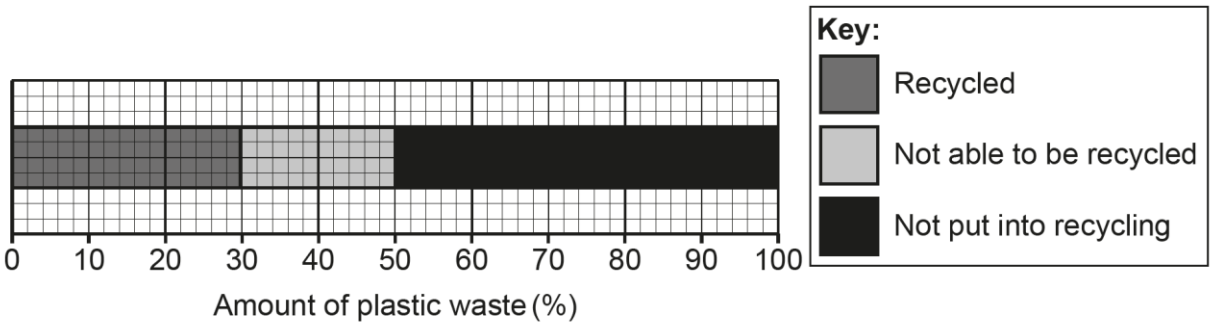
Cl^+ Cl^- H^+ H^- OH^+ OH^- **[1]**

Some candidates chose the two correct ions. All ions were seen in responses with H^- and OH^+ being the most common.

Question 18 (a)

18

(a) The diagram shows how a town is recycling plastic waste.



The town generates a total of 45 000 kg of plastic waste in a year.

Calculate the mass of plastic waste that is **not able to be recycled** in the town.

Mass of plastic waste not able to be recycled = ... kg **[3]**

Many candidates appreciated that 20% of the plastic waste was not able to be recycled. Some found calculating this percentage challenging, often dividing 45,000 by 20. A small number thought 30% was not able to be recycled and were able to score error carried forward marks by showing their working.

OCR support

Exambuilder can be used to isolate mathematical skills questions from our bank of exam papers to specifically assess skills like order of magnitude. These could be used in conjunction with our Mathematical skills handbook and Mathematical skills check in resources.

Question 18 (b) (i)

(b) Plastics are polymers. Polymers have covalent bonds between the atoms.

(i) Explain what a **covalent bond** is in terms of electrons.

.....

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

Candidates found this very challenging with few appreciating the sharing of a pair of electrons. Many thought electrons would be swapped or that metallic bonds were formed. A significant number omitted the question.

Question 18 (b) (ii)

(ii) Describe **two** differences between a polymer used to make a plastic bag and a polymer used to make a plastic bottle.

1 .....

.....

2 .....

.....

[2]

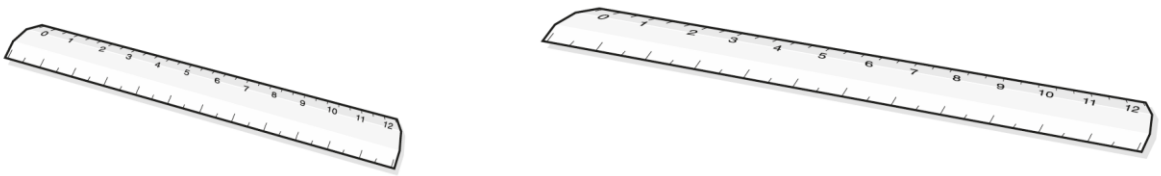
Highly successful candidates usually discussed strength or flexibility of the polymers and rarely both. The many incorrect responses included: thickness and thinness, strong and weak bonds, transparent and not, more and less polymers used, lighter and heavier, moving and not moving freely, larger and smaller polymers, hard to make and easy to make and recycled and not recycled.

Question 18 (c)

(c) A scientist wants to choose a polymer that is suitable for making a plastic ruler.

The scientist says that a polymer that stretches will **not** be suitable for making a ruler.

The diagram shows the ruler before and after stretching.



Before stretching

After stretching

Explain why the scientist is **correct**.

.....

.....

.....

[2]

Many candidates understood that the measurements on the stretched ruler would be inaccurate and the most competent added that the stretching moved the graduations apart. Incorrect responses included the rulers going back to their original length after stretching, their strength being reduced, becoming easy to break and being flimsy.

Question 18 (d) (i)

(d) The properties of four different polymer samples are shown in the table.

Polymer	Melting point of sample (°C)	Distance the sample stretches before breaking (cm)
PET	260	0.0
PVC	110	12.5
PS	240	0.1
PE	125	10.4

(i) Describe the relationship between the melting point of the sample and the distance the sample stretches before breaking.

.....

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

The relationship was described by many candidates. Some described them as being harder or easier to stretch or discussed boiling point.

Question 18 (d) (ii)

(ii) The molecular formula of the monomer used to make PET is $C_{10}H_{10}O_5$.

State the **empirical** formula of the monomer used to make PET.

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

Empirical formula was understood by the same candidates. Common incorrect responses included CHO, C_5H_5O and $C_{10}H_{10}O_5$. A large number omitted the question.

Misconception

Many candidates thought the empirical formula was either the molecular formula or the atoms in the molecule (e.g. CHO) rather than it being the simplest whole number ratio of the atoms in a molecule.

Question 19 (a) (i)

19

(a) A student investigates the reaction between sodium carbonate, Na_2CO_3, and sulfuric acid, H_2SO_4.

Sodium sulfate, water and carbon dioxide are made.

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

$Na_2CO_3(s) + H_2SO_4(aq) \rightarrow$ ..... $(aq) + H_2O(l) + CO_2(g)$ **[1]**

Many incorrect responses for Na_2SO_4 included NaS, $NaSO_4$, NaSO, Na_2S, $NaCO_3$, Na_2CO_3 and H_2O. A large number omitted the question.

Question 19 (a) (ii)

(ii) Sulfuric acid has the state symbol (aq).

What does (aq) mean?

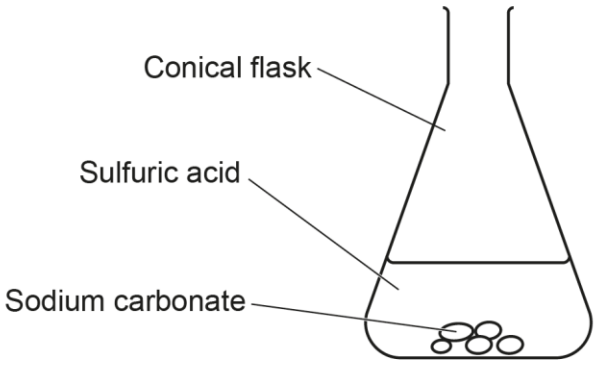
..... **[1]**

Aqueous was well known. Some candidates qualified this incorrectly with liquid. Aqua was a common non-creditworthy response. A significant number omitted the question.

Question 19 (a) (iii)

(iii) One of the products is a gas. The student wants to collect the gas formed.

Complete the diagram to show how they can collect and measure the volume of gas.



[2]

This proved to be very challenging for all but the most practised candidates. Common incorrect diagrams included: distillation apparatus, collecting the gas in an open beaker or conical flask or sealed test-tube or sealed measuring cylinder or only drawing a stopper in the conical flask. A large number omitted the question.

Question 19 (b) (ii)

(ii) Draw a curve of best fit. **[1]**

Drawing the curve proved challenging for many candidates. There were many feathery or multiple lines, lines which were too far away from the plotted points, lines which went point-to-point using a ruler and a small number of straight lines.

Question 19 (b) (iv)

(iv) The student collects 5.1 cm^3 of gas.

The student wants to collect more gas.

How does the student change the experiment so that more gas is collected?

Tick (✓) **one** box.

- Use a larger conical flask ☐
- Use less sodium carbonate ☐
- Use less sulfuric acid ☐
- Use more sulfuric acid ☐

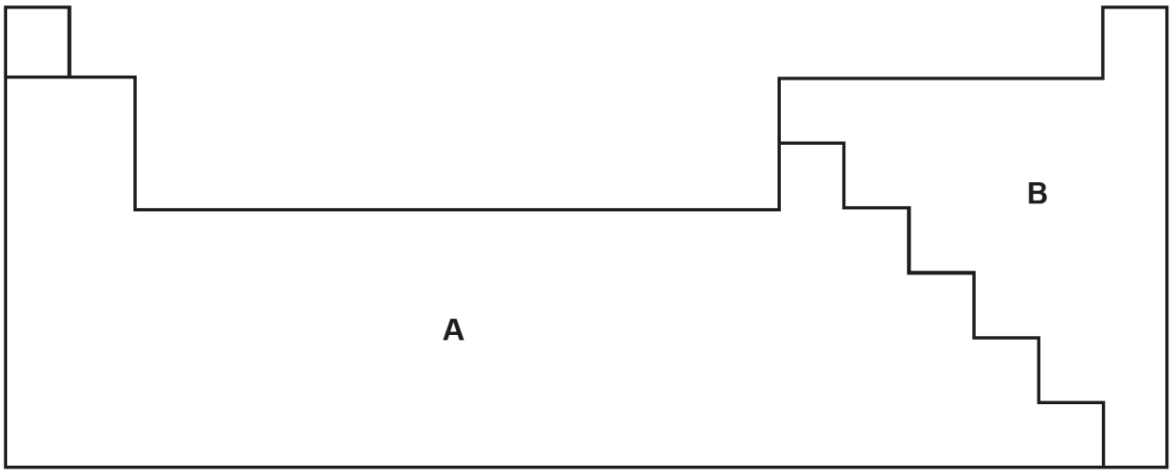
[1]

The change to the experiment was well known. All responses were seen so no single misconception can be isolated from the incorrect responses.

Question 20 (a)*

20

(a)* A Periodic Table is shown with two sections, **A** and **B**.



An element, **X**, is shiny and conducts electricity.

State and explain if element **X** is found in section **A** or **B**.

In your answer, describe the differences in the **physical** properties of elements in sections **A** and **B**.

.....

.....

.....

.....

.....

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

Level 1 required a description of the basic properties of Section A or Section B. Level 2 required a clear description of the properties and correctly assigning them to Section A/metals and Section B/non-metals. Level 3 required a detailed description of the properties of metals assigning them to Section A and non-metals assigning them to Section B which included properties in addition to those of X and also assigning X to section A/metals.

Most candidates assigned X to metals/Section A. Some assigned the properties of X to A and B and the strongest candidates discussed properties in excess of shiny and conduction of electricity.

Some reversed metals and non-metals or Sections A and B. The non-metals were often considered to be either gases (often halogens or noble gases) or liquids. Many discussed the properties of metals without including any properties of non-metals.

Exemplar 1

element X would be found in Section B, As Section B contains only metals while Section A only contains non metals: Section B contains metals that have a high tactile Strength, can conduct electricity and is Shiny as well as potentially malleable depending on the metal. While in Section A, the elements which are non metal, are dull looking have a low tactile Strength, cannot conduct electricity and are malleable. this is crucial as element X is Shiny and conducts electricity which are two common facts of metals found Section B.

The candidate discusses the properties of metals in the question and two other properties of metals. They also discuss the properties of non-metals and two other properties of non-metals.

However, they have reversed Sections A and B and have X in Section B. This is Level 2, 4 marks.

OCR support

Our Candidate Exemplars, produced for every series, will provide even more ways to see how our team of examiners apply the mark scheme and help you with marking via their detailed commentary. We produce four varieties: Level of Response, Maths skills, Practical activity and short answer. They are all available on Teach Cambridge.

Question 20 (b)

(b) In his Periodic Table, Mendeleev noticed that when elements were arranged in order of atomic mass, some elements seemed to be in the wrong place.

Complete the sentences about Mendeleev's Periodic Table.

Use words from the list.

had the wrong mass	**left gaps for**	**neutrons**	**properties**
reweighed	**were undiscovered**		

Mendeleev grouped the elements according to their ..... .

He predicted that some elements ..... .

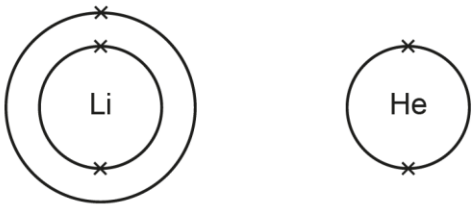
He ..... these elements.

[3]

The work of Mendeleev was well known. Neutrons was quite a popular response for the first gap. Those that chose the wrong mass for gap two usually also had reweighed for gap three.

Question 20 (c)

(c) Lithium is in Group 1 of the Periodic Table and helium is in Group 0.



Explain why Group 1 elements are reactive, but Group 0 elements are unreactive.

.....

.....

.....

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

Some candidates appreciated that Group 0 have a filled outer shell of electrons hence are stable. While many appreciated that Group 1 have 1 electron in their outer shell and lose it, few explained why they lost this electron. Many discussed filled shells of electrons with no reference to outer shell, thought Group 0 had no outer shell or discussed trends down the groups.

Question 21 (a)

21 A carbon atom is 1.7×10^{-10} m wide.

A diamond is 4.0×10^{-3} m wide.

(a) How many **orders of magnitude** larger is the diamond than the carbon atom?

Tick (✓) **one** box.

Two ☐ Four ☐ Seven ☐ **[1]**

Many candidates calculated the order of magnitude correctly. The most popular incorrect response was four.

Question 21 (b)

(b) Calculate the number of carbon atoms that fit in the width of the diamond.

Give your answer in **standard form** to **1** decimal place.

Number of carbon atoms = ... **[3]**

Candidates found this very challenging. Many reversed the division, multiplied the numbers or subtracted them. The most competent candidates gave the correct standard form and to one decimal place. Often the answer to the inverted division was given as 4.25 x 10^{-8}.

Many candidates gave an answer with no working out shown, so error carried forward marks could not be given.

Many omitted the question.

Exemplar 6

(b) Calculate the number of carbon atoms that fit in the width of the diamond.

Give your answer in **standard form** to **1** decimal place.

$\frac{4.0 \times 10^{-3}}{1.7 \times 10^{-10}} =$

23529411.76

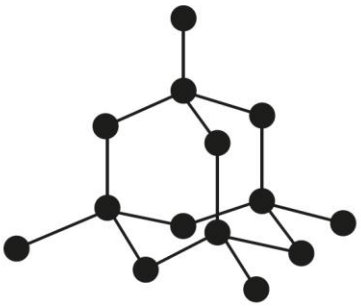
2.4×10^{6}

Number of carbon atoms = 2.4×10^{6} **[3]**

The answer on the answer line is incorrect, while the number is to 1 decimal place the power of 10 is incorrect. If no working had been shown this response would have been given no marks. However, looking at the working, the division is correct and the answer to the division is also correct and so two marks are given.

Question 21 (c)

(c) The diagram shows the structure of diamond.



Explain why diamond **cannot** conduct electricity.

.....

.....

.....

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

The bonding in carbon was described by the most competent candidates, who also discussed the absence of delocalised electrons that could move. Many discussed the structure of graphite or the strength of the covalent bond in diamond. A significant number omitted the question.

Bonding

The bonding in carbon is giant covalent such that each carbon is bonded to 4 others. This means that all of the electrons are used in bonding so there are none available to move to conduct electricity.

Question 21 (d) (i)

(d) Some properties of forms of carbon are shown in the table.

Form of carbon	Conducts electricity?	Conducts heat?	Melting point
X	yes	yes	very high
Y	no	yes	high
Z	no	no	very high

(i) Which form of carbon should you choose to use as an electrode in an electrolysis experiment with a molten electrolyte?

Explain your answer.

Form of carbon .....

Reason .....

.....

[2]

The need for an electrode to conduct electricity was well known and many candidates chose X. Those that chose Y or Z gave the reason as not conducting electricity.

Question 21 (d) (ii)

(ii) All of the melting points in the table are high.

Why is it important that electrodes used in a **molten** electrolyte have a high melting point?

Tick (✓) **one** box.

Electrodes need to remain liquid, and not freeze at low temperatures ☐

Electrodes need to remain liquid, and not melt at high temperatures ☐

Electrodes need to remain solid, and not freeze at low temperatures ☐

Electrodes need to remain solid, and not melt at high temperatures ☐

[1]

The high melting point of electrodes was quite well known. All responses were seen.

Question 22 (a) (i)

22

(a) A scientist investigates dissolving four different tablets in water.

Each tablet has a different surface area.

They add each tablet to 20 cm^3 of water and time how long it takes for the tablet to dissolve.

The table shows their results.

Tablet	Surface area of tablet (cm^2)	Volume of tablet (cm^3)	Surface area to volume ratio	Time taken to dissolve (seconds)
A	2.8	0.3	9.33 : 1	43
B	2.5	0.2	12.5 : 1	27
C	1.5	0.2		62
D	3.0	0.2	15.0 : 1	

(i) Calculate the surface area to volume ratio of tablet C.

Surface area to volume ratio = ... **[2]**

Many candidates calculated the ratio correctly. Quoting the numbers in the question or 13:2 were common responses. A significant number omitted the question.

Question 22 (a) (ii)

(ii) Complete the sentence to describe the relationship between the surface area to volume ratio and the time taken to dissolve.

As the surface area to volume ratio ..... ,

the tablet will take ..... time to dissolve. **[1]**

Many candidates determined the ratio correctly from the information given. The most common incorrect response pair was increase and more. A significant number omitted the question.

Question 22 (a) (iii)

(iii) The scientist thinks that tablet D will dissolve **slowest** in 20 cm^3 of water.

Explain why the scientist is **incorrect**.

.....

.....

.....

[2]

Many candidates used the relationship to correctly describe why D would be the fastest to dissolve rather than the slowest. Some responses were vague discussing surface area or volume rather than the surface area to volume ratio. A significant number omitted the question.

Question 22 (b) (i)

(b) The scientist performs thin layer chromatography on solutions of each of the tablets.

(i) The spots on the chromatogram are **colourless**.

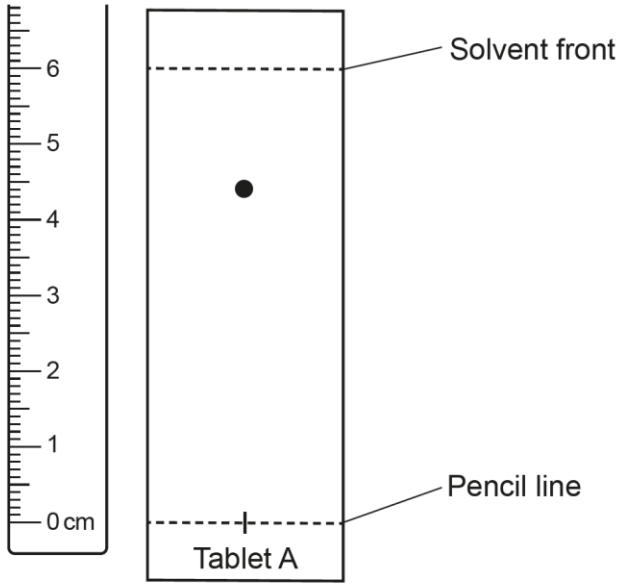
State what the scientist could use to see the spots.

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

Locating agents were not well known. Incorrect responses included ink, pens, indicators and food colouring. A significant number omitted the question.

Question 22 (b) (ii)

(ii) After the scientist uses a method to see the spots, the chromatogram for Tablet A is shown.



Calculate the R_f value for the spot seen from tablet A.

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

R_f value was not well known. Often just the distance the spot moved was given as the response. Many measured the distance the spot travelled as 4.5 cm and those that showed their working gained error carried forward marks. Some inverted the division or gave the denominator of the expression as the distance from the solvent front to the top of the paper. A significant number omitted the question.

R_f value

The R_f value is given by the equation:

$$R_f = \frac{\text{distance moved by the spot}}{\text{distance moved by the solvent front}}$$

Question 23 (a)

23 A student wants to separate a mixture of compounds.

Different separation methods are used depending on the mixture.

(a) Draw lines to connect each **separation method** to the correct **mixture**.

Separation method	Mixture
Crystallisation	Insoluble solid and liquid
Filtration	Solution containing a soluble solid dissolved in a liquid
Fractional distillation	Three liquids with different boiling points

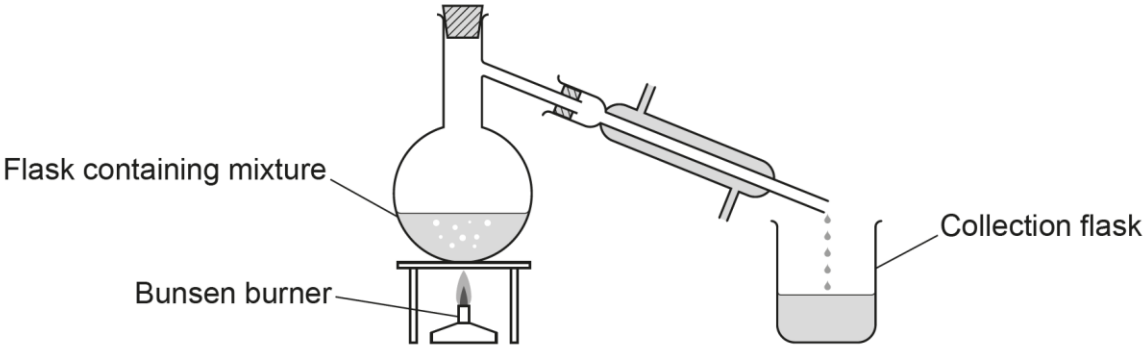
[2]

Separation methods were very well known. A small number of candidates drew three horizontal lines or had the correct line for filtration.

Question 23 (b) (i)

(b) The student decides to use simple distillation to separate a mixture.

They set up the apparatus shown in the diagram.



(i) A liquid in the mixture is **flammable**.

Suggest a change the student could make to the apparatus to make the distillation safer.

.....

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

Candidates found this very challenging. Incorrect responses included, move the Bunsen burner further away, use a non-flammable liquid, use a less hot flame, add a heatproof mat and use a different mixture. A significant number omitted the question.

Question 23 (b) (ii)

(ii) The student wants to record the boiling point of the pure liquid that is collected in the collection flask.

Suggest an improvement the student could make to the apparatus so that they can record the boiling point.

.....

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

Adding a thermometer to measure the temperature was well known. Several candidates added the thermometer to the collection flask which was not creditworthy. A significant number omitted the question.

Question 23 (c)

(c) The pure liquid collected has the molecular formula $(C_2H_5)_2O$ and a boiling point of 35 °C.

Which statements about the pure liquid are **correct**?

Tick (✓) **two** boxes.

The empirical formula is CH_2. ☐

The melting point is lower than 35 °C. ☐

The pure liquid contains two compounds. ☐

The pure liquid is an element. ☐

The pure liquid will be a gas at above 35 °C. ☐

[2]

Many candidates gave the correct two responses. The most common incorrect response was the pure liquid contains two compounds and a significant number ticked only one box.

Question 23 (d)

(d) Calculate the relative formula mass of a $(C_2H_5)_2O$ molecule.

Relative atomic mass (A_r): C = 12.0 H = 1.0 O = 16.0

Relative formula mass = ... **[3]**

Many candidates calculated the relative formula mass correctly. Most appreciated there were 4 carbons and 5 hydrogens and a common error was not to double this. A significant number omitted the question.

Supporting you

Teach Cambridge

Make sure you visit our secure website **Teach Cambridge** to find the full range of resources and support for the subjects you teach. This includes secure materials such as set assignments and exemplars, online and on-demand training.

Don't have access? If your school or college teaches any OCR qualifications, please contact your exams officer. You can forward them this link to help get you started.

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Access to Scripts

We've made it easier for Exams Officers to download copies of your candidates' completed papers or 'scripts'. Your centre can use these scripts to decide whether to request a review of marking and to support teaching and learning.

Our free, on-demand service, Access to Scripts is available via our single sign-on service, My Cambridge. Step-by-step instructions are on our website.

Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular professional development courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses for your subject on **Teach Cambridge**. You'll also find links to our online courses on NEA marking and support.

Signed up for ExamBuilder?

ExamBuilder is a free test-building platform, providing unlimited users exclusively for staff at OCR centres with an Interchange account.

Choose from a large bank of questions to build personalised tests and custom mark schemes, with the option to add custom cover pages to simulate real examinations. You can also edit and download complete past papers.

Find out more.

Active Results

Review students' exam performance with our free online results analysis tool. It is available for all GCSEs, AS and A Levels and Cambridge Nationals (examined units only).

Find out more.

You will need an Interchange account to access our digital products. If you do not have an Interchange account please contact your centre administrator (usually the Exams Officer) to request a username, or nominate an existing Interchange user in your department.

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

Call us on
01223 553998

Alternatively, you can email us on
support@ocr.org.uk

For more information visit
ocr.org.uk/qualifications/resource-finder
ocr.org.uk
facebook.com/ocrexams
twitter.com/ocrexams
instagram.com/ocrexaminations
linkedin.com/company/ocr
youtube.com/ocrexams

We really value your feedback

Click to send us an autogenerated email about this resource. Add comments if you want to. Let us know how we can improve this resource or what else you need. Your email address will not be used or shared for any marketing purposes.

I like this **I dislike this**

Please note – web links are correct at date of publication but other websites may change over time. If you have any problems with a link you may want to navigate to that organisation's website for a direct search.

CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT