Qualification Accredited

Oxford Cambridge and RSA

GCSE (9–1)

Examiners' report

GATEWAY SCIENCE CHEMISTRY A

J248

For first teaching in 2016

J248/03 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.

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Paper 3 series overview

J248/03 is the first of two examination units for candidates entered for the Higher Tier of the GCSE examination for Gateway Science Chemistry A. This unit assesses teaching topics C1, C2 and C3 and is 50% of the total GCSE. To do well on this paper, candidates need to demonstrate knowledge and understanding of scientific ideas, techniques and procedures across all three topics. They need to be able to apply their knowledge and understanding to unfamiliar contexts as well as displaying the ability to analyse information. Candidates also need to be familiar with a range of experimental procedures and be able to think about how an experimental method could be improved.

J248/03 has an equal emphasis on knowledge and understanding of the assessment outcomes from the specification and application of this knowledge. There are less questions which assess analysis of information and ideas.

Centres had clearly worked hard to prepare candidates for this examination, and this was reflected in the low question omit rate.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• Constructed and balanced symbol and half equations for familiar and unfamiliar reactions: Questions 17 (b) (ii), 18 (c) and 22 (b) (i). • Performed standard and novel calculations following the required rubric (e.g. clear working, units and, where needed, significant figures) relating relative formula mass to number of atoms in a formula: Question 16 (d), % yield: Question 17 (b) (i), R_f value: Question 20 (a) (i), moles, reacting mass and limiting reactants: Question 21 (a), mass of atoms: Question 22 (a). • Produced a clear, concise and well-structured answer for the Level of Response Question 18 (a). • Applied knowledge and understanding to questions set in a novel context.	• Found it difficult to apply what they had learnt to unfamiliar situations. • Found it difficult to construct and balance ionic and half equations reactions: Question 17 (b) (ii), 18 (c) and 22 (b) (i). • Found it difficult to analyse data and then make a judgement, or draw a conclusion, in relation to the data, e.g. Questions 18 (a), 20 (a) (ii) and 21 (b). • Found it difficult to analyse information to develop experimental procedures or to describe improvements to a specific procedure, e.g. Questions 17 (a) (iii), 19 (c) and 20(c). • Showed imprecise use of scientific terminology, e.g. Questions 16 (c), 17 (a) (iii), 19 (b), 21 (b) (ii) and (iii), and 22 (b) (ii).

When answering multiple choice questions, centres should encourage candidates who wish to change an answer to cross through their answer and write their new response to the right of the answer box, rather than trying to overwrite their original answer. The latter can result in examiners being unable to decipher their answer.

Centres should also encourage candidates to set out their working to calculations clearly. 'Signposting' of calculations was often poor, with numbers written at random in the answer space. This makes it difficult for the examiner to seek out credit-worthy points and/or award marks for errors carried forward. Equally, for candidates, it often leads to them getting 'lost' going through the calculation.

When answering 1 mark questions candidates should be guided to only write one response. Multiple responses, even if one response is correct, will result in the candidate being given 0 marks.

Where a question suggests that candidates can include a labelled diagram in their answer, centres should encourage candidates to do so. For example, in Question 17 (a) (iii) candidates who drew a clear, labelled diagram were able to gain full marks from their diagram and a short description.

The clarity of handwriting is an issue for some candidates, as is poor use of English and/or scientific terminology when explaining their answers.

There was no evidence that time constraints had led to underperforming. Very few questions were left blank by candidates.

Section A overview

Questions 2, 3, 5, 9, 10 and 15 in this section proved to be good discriminators with many higher attaining candidates answering correctly. Questions 1, 4, 6, 7, 12, 13 and 14 were answered well by candidates with many correct answers. All of the MCQs in Section A were attempted by all candidates.

Question 2

2 The radius of a helium atom is 0.14 nm.

What is the radius of a helium atom in metres?

A 0.14×10^{-10} m

B 1.4×10^{-10} m

C 1.4×10^{-9} m

D 14×10^{-9} m

Your answer ☐ **[1]**

Misconception

C was a common misconception in this question. Candidates had clearly appreciated the connection between nm and 10^{-9}, and possibly knew that a number in standard form has to have a value ≥ 1 but < 10 before the power of 10, rather than multiplying 0.14 by 1 x 10^{-9}.

Question 3

3 A Group 1 element reacts with a Group 7 element, so that both elements have a full outer shell of electrons. The table shows what happens to both elements during the reaction.

	Group 1 element	**Group 7 element**
A	gains 1 electron	loses 1 electron
B	gains 2 electrons	loses 2 electrons
C	loses 1 electron	gains 1 electron
D	loses 2 electrons	gains 2 electrons

Which row is correct?

Your answer [1]

Misconception

A was a common misconception in this question. Candidates often think that because Group 1 elements form positive ions, they gain electrons and vice versa for Group 7 and centres should be aware of this frequent error.

Question 9

9 One mole of hydrogen gas, H_2, fills a volume of 24 dm^3.

How much volume does 2.0 g of hydrogen gas fill?

A 12 dm^3

B 24 dm^3

C 36 dm^3

D 48 dm^3

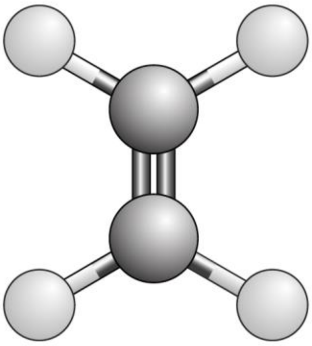
Your answer [1]

Many candidates incorrectly answered D as they did not make the link between 2g hydrogen and the number of moles, instead just multiplying 2g by 24 dm^3.

Section B

Question 16 (a)

16 The diagram shows a ball and stick model for ethene, C_2H_4.



(a) Which statements about this ball and stick model of ethene are correct?

Tick (✓) **two** boxes.

The model shows how many electrons the carbon atoms have. ☐

The model shows how many electrons the hydrogen atoms have. ☐

The model shows how much space each atom fills. ☐

The model shows that the carbon atoms are bigger than the hydrogen atoms. ☐

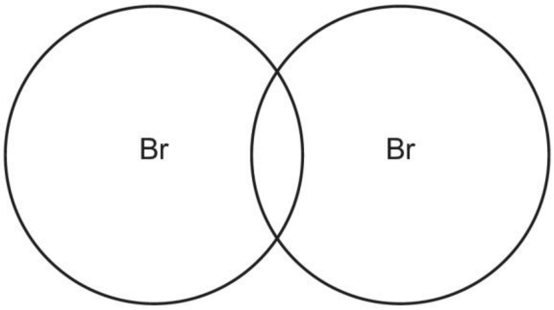
The model shows the difference between double bonds and single bonds. ☐

[2]

Most candidates were aware of the limitations of particular representations and models and gained both marks. When candidates did not gain 2 marks it was usually because they selected the top box instead of one of the last two.

Question 16 (b)

(b) Molecules can be drawn using dot and cross diagrams.



Complete the dot and cross diagram for bromine, Br_2.

Show the electrons in the outer shells only.

[2]

This question required candidates to draw a correct 'dot and cross' diagram. Many excellent diagrams were seen by examiners. Others lost marks as they only drew the shared pair of electrons, omitting the rest of the electrons in the outer shell of each Br atom. Less successful responses tended to draw diagrams showing 7 outer shell electrons in each Br atom in addition to the shared pair of electrons. Some drew a double covalent bond.

Question 16 (c)

(c) At room temperature, ethene is a gas and bromine is a liquid.

Use the particle model to describe **two** differences between the movement or arrangement of the particles in ethene and the particles in bromine.

1 ....

....

2 ....

.... **[2]**

Many candidates, even higher attaining candidates, did not gain marks on this question usually because they did not give direct comparisons, choosing instead to make general statements. Common responses which did not gain marks referred to ethene particles flowing around, particles in a gas being able to take the shape of the container, and liquid particles moving over each other without mention of distance or force between particles.

Exemplar 1

1 ethene particles have more energy and so move around faster in all directions.

2 ethene particles have weaker intermolecular forces and so are spaced further apart. **[2]**

This exemplar demonstrates a well written response to this question in which the candidate has compared the movement and arrangement of the particles in ethene to those in bromine.

Question 16 (d)

(d) Ethene reacts with bromine to make a product.

The relative formula mass of the product is 187.8.

There are **2** carbon atoms and **4** hydrogen atoms in the product.

Calculate how many bromine atoms are in the product.

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

Most candidates correctly calculated the number of bromine atoms.

Question 17 (a) (i)

17 A student has a sample of a **liquid**.

(a) (i) State a method the student uses to find out if the sample is **pure**.

.... **[1]**

Good responses to this question suggested the use of chromatography or testing the boiling point of the liquid. The most common incorrect answer was distillation.

Question 17 (a) (ii)

(ii) The student finds out that the sample is **impure**.

The sample contains hexane, C_6H_{14}, and cyclohexane, C_6H_{12}.

What is the **empirical formula** of hexane?

.... **[1]**

Most candidates were able to correctly determine the empirical formula.

Question 17 (a) (iii)

(iii) The boiling point of hexane is lower than the boiling point of cyclohexane.

Describe a method the student could use to obtain a sample of **pure** hexane from the mixture of cyclohexane and hexane.

You can include a labelled diagram in your answer.

....

....

....

....

....

.... **[4]**

More successful responses to this question described the use of distillation to obtain a sample of pure hexane.

Assessment for learning

Candidates should be encouraged to use correct terminology.

In this question credit was given for a description of liquid hexane boiling and then condensing. Many candidates, however, wrote about hexane evaporating rather than boiling when heated.

Many candidates referred to the condenser incorrectly as a condensing tube.

Question 17 (b) (i)

(b) (i) The student obtains 12.0 g of hexane from 15.2 g of the mixture of hexane and cyclohexane.

Calculate the percentage of hexane obtained.

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

Percentage of hexane = ... % **[2]**

Candidates were familiar with percentage yield calculations.

Assessment for learning

Centres should stress to candidates that if they are asked to give their answer to a specific number of significant figures, they can only gain full marks by doing so.

Question 17 (b) (ii)

(ii) Hexane reacts with oxygen in a combustion reaction.

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

$$\mathbf{2}\ C_6H_{14} + \ldots\ldots\ldots O_2 \rightarrow \ldots\ldots\ldots CO_2 + \ldots\ldots\ldots H_2O$$

[1]

Many candidates were able to balance this combustion equation. Lower achieving candidates were not able to balance the oxygen atoms.

OCR support

Our Lesson Element: Balancing Equations – Let's Balance provides activities, answers and extra guidance to teachers to support all candidates to improve their balancing equation skills.

Question 18 (a)*

18 A scientist investigates three solutions, **A**, **B** and **C**. They want to find out if the solutions are acids or alkalis. They don't have any universal indicator or a pH probe.

- In test 1, they try to neutralise the solutions by adding 25 cm^3 of dilute hydrochloric acid to 25 cm^3 of each solution.
- In test 2, they add 1.0 g of magnesium carbonate to 25 cm^3 of each solution.

The table shows the scientist's observations.

	Observation after test 1	**Observation after test 2**
solution **A**	salt formed	no change
solution **B**	no salt formed	vigorous bubbling
solution **C**	no salt formed	bubbling

(a)* Use the observations from both test 1 and test 2 to state which solutions are acids and which solutions are alkalis.

Explain your answer.

....

....

....

....

....

.... **[6]**

This 6 mark, Level of Response, question assessed AO1 and AO3. At Level 3 (5 – 6 marks) candidates needed to analyse the scientist's observations to identify all three solutions and explain the reasoning behind their deductions. Most candidates attempted this question and many of the responses were excellent, with clear explanations of the reactions of acids with alkalis and acids with metal carbonates, including correct word equations. The answers of lower attaining candidates reasoned that, as a salt was not mentioned as an observation from test 1 with solutions B and C, they were therefore not acids, which led them to state that A was an acid. A common error was that the bubbling in the reaction with magnesium carbonate was due to hydrogen gas.

Exemplar 2

Solution A is an alkali. Alkalis react with acid to make a salt and water. Since there was no reaction with magnesium carbonate, the acid neutralised the alkali solution. Solution B is an acid, because no salt was formed when an acid was added, so neutralisation didn't occur. The magnesium carbonate caused vigorous bubbling. This may have been carbon dioxide. Acid + metal carbonate → salt + water + carbon dioxide. It's a strong, concentrated acid. Solution C is also an acid as no salt was formed after test 1. The less vigorous bubbling when magnesium carbonate was added shows that it was a weaker, less concentrated acid.

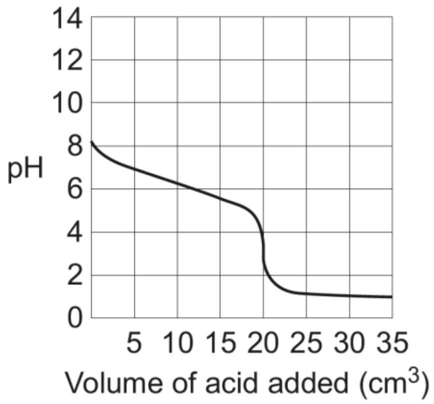
This is a Level 3 (6 mark response) which has correctly identified all three solutions as acidic or alkaline. The candidate has used their knowledge and understanding to describe the reactions of acids with alkalis and acids with metal carbonates. They also appreciate that solution B is a stronger or more concentrated acid that solution C.

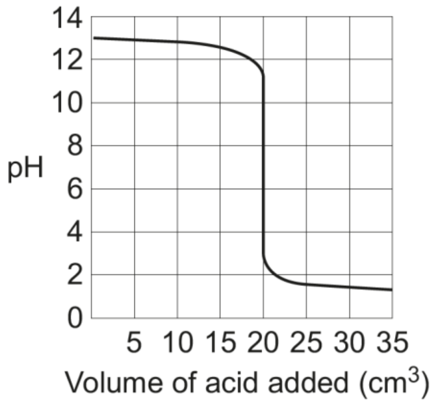
Question 18 (b)

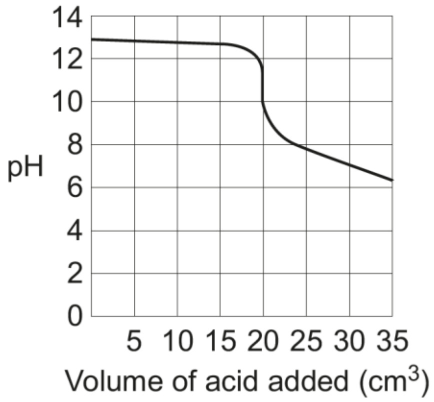
(b) The graphs show the titration curves for three different experiments.

Draw **three** lines to connect each **titration curve** with its correct **description**.

Titration curve







Description

- Strong acid added to strong alkali
- Weak acid added to strong alkali
- Strong acid added to weak alkali
- Weak acid added to weak alkali

[3]

The most common incorrect link was to connect the top titration curve to 'weak acid added to weak alkali'.

Question 18 (c)

(c) Write the **ionic symbol** equation for a neutralisation reaction.

Include state symbols.

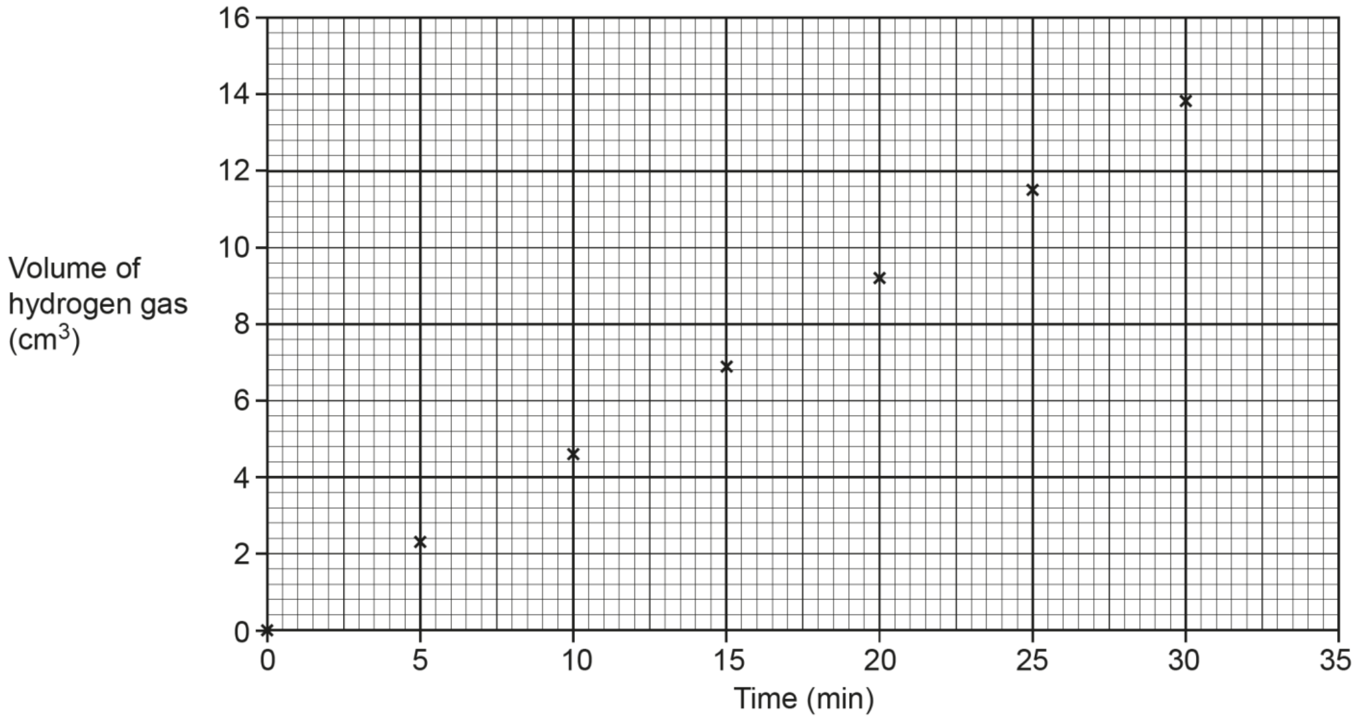
.... **[2]**

Many candidates were able to write the correct ionic symbol equation, but often did not gain the mark for the correct state symbols. The most common errors were H^+(g) and/or OH^-(g).

Question 19 (a) (i)

19 A teacher sets up an experiment to investigate the electrolysis of aqueous sodium chloride, NaC*l*. The teacher measures the volume of hydrogen gas given off.

The teacher plots the results on a graph.



(a) **(i)** Draw a line of best fit on the graph. **[1]**

When candidates did not gain this mark, it was usually because they did not include the point at the origin in their line of best fit.

OCR support

Our GCSE (9-1) Science Exam hints for Students is a useful resource to provide candidates with when revising to help them avoid common mistakes like this when drawing lines of best fit. They can also be downloaded as an A3 version to display in classrooms.

Question 19 (a) (ii)

(ii) What is the volume of hydrogen gas given off after 23 minutes?

Volume of hydrogen gas = ... cm^3 **[1]**

Many candidates correctly read the volume of hydrogen gas from the graph. The most common error was not reading the x-axis scale correctly and taking the reading at 21.5 minutes instead of at 23 minutes.

OCR support

Topic Check in 4 -Graphs might be a useful resource to use in the classroom to improve graph reading skills. The answers and support with how to use the resource can be found in the Mathematicals Skills Handbook.

Question 19 (a) (iii)

(iii) Which electrode is hydrogen gas given off at?

.... **[1]**

Most candidates knew that hydrogen gas is given off at the cathode. Understandably, anode was the most common incorrect answer.

Question 19 (a) (iv)

(iv) State the name of the product made at the other electrode.

.... **[1]**

The most common incorrect answers were chloride and sodium.

Question 19 (b)

(b) A student repeats the teacher's experiment with aqueous copper sulfate, $CuSO_4$.
The student finds that **no** hydrogen gas is given off.

Explain why hydrogen gas is given off in the electrolysis of aqueous NaCl, but **not** in the electrolysis of aqueous $CuSO_4$.

....

....

....

....

....

.... **[3]**

Good responses to this question described that discharge is based on the reactivity series and that less reactive ions are discharged in preference. Many candidates appreciated that hydrogen is less reactive than sodium and copper is less reactive than hydrogen. Lower attaining candidates compared the reactivity of chlorine and hydrogen to explain why hydrogen is given off.

Misconception

? Common misconceptions were that no hydrogen gas is given off in the electrolysis of $CuSO_4$ because $CuSO_4$ does not contain any hydrogen or that one ion displaces the other, possibly muddling up the terms discharge and displace.

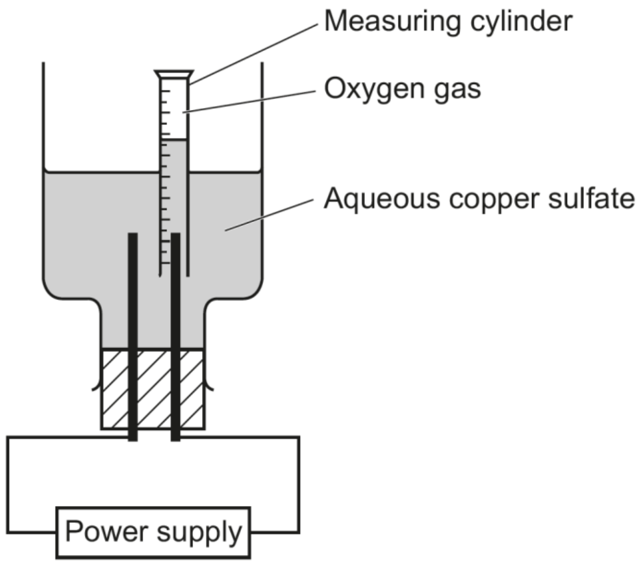
OCR support

i The Electrolysis Topic exploration pack could be used to develop understanding for this here by providing extra teacher guidance and a range of activities to use in the classroom.

Question 19 (c)

(c) In the electrolysis of aqueous copper sulfate, copper is also made.

The teacher sets up an experiment to measure the volume of oxygen gas made.



Explain how the student could change the experiment to measure the amount of copper formed.

....

....

....

....

.... **[3]**

This question required candidates to describe an adaptation to the experiment. Good responses described weighing the cathode before and after the experiment and calculating the mass increase. Less successful candidates described collecting the copper in the measuring cylinder or using the measuring cylinder to measure the volume of copper. Some responses were vague and talked about measuring the electrodes, rather than weighing them.

OCR support

The Practical Skills Booklet – Student Book could be used by centres to prepare them for questions about practical skills and apparatus. Specifically, the activity for electrolysis invites students to use micro test tubes of syringes to collect the gas.

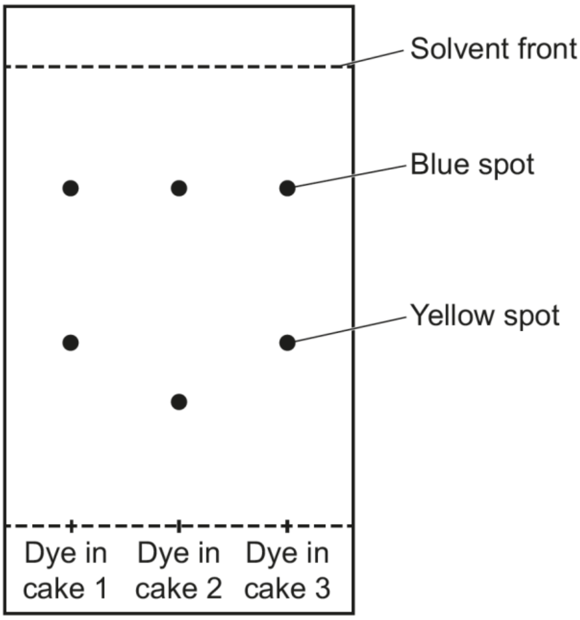
Question 20 (a) (i)

20 Three cakes each contain a different brand of food colouring dye.

- The colour is the same in each cake, but the taste in one is different.
- The cakes' baker thinks it is because of the food colouring dye.

(a) The baker compares the food colouring dyes that were used in the three different cakes using thin layer chromatography. The chromatogram is shown in **Fig. 20.1**.

Fig. 20.1



(i) Calculate the R_f value of the blue spot in the dye in cake 3.

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

R_f value of blue spot in the dye in cake 3 = ... **[3]**

Many candidates gained 3 marks on this question. The most common error was

R_f = distance moved by solvent ÷ distance moved by dye.

Assessment for learning

Centres should remind candidates that they should measure to the centre of the spot on a chromatogram.

Question 20 (a) (ii)

(ii) Which of the cakes would you expect to taste the same?

Explain your answer using data from **Fig. 20.1**.

....

....

.... **[2]**

Good responses identified cake 1 and cake 3, appreciating that the blue and yellow spots in these cakes have the same R_f values.

Question 20 (b) (i)

(b) The baker thinks the dyes are mixtures where the substances are combined in exact amounts.

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

.... **[1]**

The definition or meaning of a formulation was not well known.

Examiners saw a wide range of incorrect responses including, most frequently, compound, alloy, polymer, solution, equal mixture and impure mixture.

Question 20 (b) (ii)

(ii) Brass is also a mixture of different substances combined in exact amounts.

What type of substance is brass?

Tick (✓) **one** box.

Allotrope ☐

Alloy ☐

Fullerene ☐

Isotope ☐

Polymer ☐

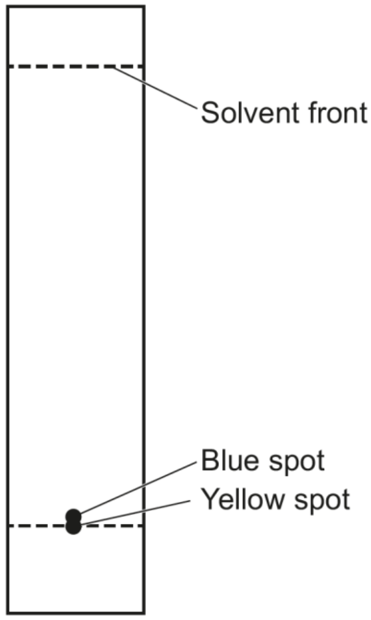
[1]

Most candidates identified brass as an alloy. The most common incorrect response was allotrope

Question 20 (c)

(c) The student tests another dye. The chromatogram is shown in **Fig. 20.2**.

Fig. 20.2



What should the student change in their experiment to separate the blue and yellow spots?

.... **[1]**

Many candidates did not appreciate the need to change the solvent to separate the blue and yellow spots. Common incorrect responses described spreading the blue and yellow spots along the baseline to improve the experiment. Other suggestions included increasing the length of the paper, using more solvent, leaving the experiment for a longer time, or using more dye.

Question 21 (a) (i)

21 Phosphorus can exist as P_4 molecules.

Phosphorus trichloride, PCl_3, is made in the reaction of phosphorus, P_4, and chlorine as shown in the equation.

$$P_4 + 6Cl_2 \rightarrow 4PCl_3$$

(a) (i) A scientist starts the reaction with 2.0 mol of phosphorus, P_4.

Calculate the mass of 2.0 mol of phosphorus.

Mass of phosphorus = ... g **[2]**

Many candidates correctly calculated the relative formula mass of P_4 and then multiplied by 2.0 to calculate the mass of phosphorus. 62 was the most common incorrect answer (from 2 x 31.0).

Question 21 (a) (ii)

(ii) Calculate the maximum mass of phosphorus trichloride, PCl_3, that could be made from 2.0 mol of phosphorus, P_4.

Maximum mass of phosphorus trichloride = ... g **[3]**

Most candidates recognised that they needed to calculate the relative formula mass of PCl_3 so gained at least 1 mark. Fewer candidates looked to state or apply the mole ratio from the equation to gain the remaining 2 marks.

Question 21 (a) (iii)

(iii) The scientist reacts the 2.0 mol of phosphorus, P_4, with 866.2 g of chlorine, Cl_2.

Which is the **limiting reactant**? Explain your answer.

Limiting reactant ....

Explanation ....

....

....

.... **[4]**

Most candidates identified phosphorus as the limiting reactant. Many candidates calculated the moles of chlorine correctly as 12.2 and were able to state it in a ratio with 2 moles of phosphorus. Fewer compared this to the actual ratio of 1:6 (or 2:12), which was the mark most commonly not gained by candidates who gained 3 marks. Less successful candidates stated that phosphorus was the limiting reactant as it has the lower mass, without any attempt at a calculation.

Question 21 (b) (i)

(b) Some information about phosphorus compounds is shown in the table.

Name	Formula	Melting point (°C)	Boiling point (°C)	State at room temperature
Phosphorus trichloride	PCl_3	–94	76	....
Phosphorus pentachloride	PCl_5	161	167	....
Phosphorus trifluoride	PF_3	–152	–102	....

(i) Complete the table. **[2]**

Most candidates correctly interpreted the melting and boiling point data to determine that state at room temperature of the three phosphorus compounds.

Question 21 (b) (ii)

(ii) Put a (ring) around the compound with the weakest intermolecular forces.

Phosphorus trichloride

Phosphorus pentachloride

Phosphorus trifluoride

Explain your answer using information from the table.

....

....

....

.... **[3]**

Most candidates correctly identified phosphorus trifluoride as the compound with the weakest intermolecular forces and realised that the evidence is the low melting point and boiling point. More successful responses then described that the weakest intermolecular forces require the least energy to break and that less energy to break the forces means a lower melting and/or boiling point.

Misconception

A common misconception was to refer to the energy needed to break the bonds rather than the intermolecular forces.

OCR support

Extra support with terminology and challenging common misconceptions with candidates can be found in our Multiple choice topic quizzes. Instructions for setting these self-marking assessments can be found in the Digital MCQ quiz – Instructions resource.

Question 21 (b) (iii)

(iii) The scientist thinks phosphorus trichloride is a **giant covalent** compound.

Explain why the scientist is incorrect.

....

....

.... **[2]**

This question was well answered with many candidates gaining 2 marks. Candidates needed to discuss both phosphorus trichloride and giant covalent compounds to gain both marks.

Assessment for learning

Candidates should be encouraged to use correct terminology. Examiners frequently saw references to strong intermolecular forces in giant covalent compounds.

Question 22 (a)

22 Compounds that contain the element zinc, Zn, have many uses.

(a) Calculate the mass of one atom of zinc.

The Avogadro constant is 6.02×10^{-23}.

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

Mass of one atom of zinc = ... g **[3]**

Avogadro's constant was incorrectly quoted. Our examiners reviewed the impact and found this did not seem to affect the candidates' approach to this question. However, to ensure no candidate was disadvantaged, full marks were given for answers using either 6.02×10^{23} or 6.02×10^{-23}.

Question 22 (b) (i)

(b) Zinc bromide is an ionic compound made from zinc ions, Zn^{2+}, and bromide ions, Br^{-}.

(i) Construct a **balanced ionic** equation for the formation of zinc bromide.

.... **[2]**

Higher achieving candidates were able to construct the correct balanced ionic equation for the formation of zinc bromide. One mark was given for the correct reactants and products and 1 mark for the correct balancing. The balancing mark was dependent on the correct formulae, but 1 mark was allowed for a balanced equation with a minor error in subscripts or formulae. The most common error was writing the formula of zinc bromide as ZnBr.

OCR support

Teachers might find the Chemical reactions Delivery Guide a useful resource for identifying common misconceptions and approaches to overcome them. In addition our GCSE (9-1) Science Exam hints for candidates is a useful resource to provide candidates with when revising to help them avoid this common issue. They can also be downloaded as an A3 version to display in classrooms.

Question 22 (b) (ii)

(ii) Zinc bromide can conduct electricity when aqueous or molten, but not when solid.

Zinc metal can conduct electricity when solid.

Explain why.

Zinc bromide ....

....

Zinc metal ....

.... **[3]**

Good responses to this question described that zinc metal contain delocalised electrons and that zinc bromide contains ions that can only move when the compound is dissolved in water or molten

Assessment for learning

Candidates should be encouraged to use correct terminology. Many candidates attempted to explain the electrical conductivity of zinc bromide in terms of electrons, while others described molten zinc bromide as containing free electrons or ions, a contradiction which did not gain a mark.

Exemplar 3

Zinc bromide: when melted the Covalent bonds have been broken meaning there are free delocaliSed electons

Zinc metal: metalic bonding alows for delocalised electons to pass the current

This response shows the answer, given 2 marks, which examiners saw most often.

Exemplar 4

Explain why. * is made up of oppositely charged ions.

Zinc bromide* When solid, the ions cannot move. When aqueous or molten, the ions can move and carry a charge

Zinc metal has delocalised electrons that are free to move when solid therefore allowing electricity to be conducted. [3]

This response, however, illustrates correct use of key terminology and was given 3 marks.

Question 22 (c) (i)

(c) Zinc oxide, ZnO, is another compound containing zinc.

The table shows some information about four different zinc oxide particles.

Particle	Size of zinc oxide particles (m)	Cost per gram (£/g)	Purity (%)
A	1.85×10^{-7}	0.05	95.00
B	6.54×10^{-9}	0.31	99.99
C	8.52×10^{-7}	0.87	99.99
D	4.02×10^{-8}	1.84	99.99

(i) Which particles are nanoparticles?

Tick (✓) **two** boxes.

A ☐

B ☐

C ☐

D ☐

[1]

Many candidates correctly identified B and D as nanoparticles. The most common incorrect answer was the combination of A and C. This was possibly because candidates had not learnt the definition of a nanoparticle and simply selected the two values which look similar because they were both values x 10^{-7}.

Question 22 (c) (ii)

(ii) A scientist wants to buy some zinc oxide particles to use in suncream. A large surface area to volume ratio is important.

Which particle, **A**, **B**, **C** or **D**, would be the most suitable for use in suncream?

Explain your answer.

Particle ....

Explanation ....

....

....

.... **[3]**

Good responses correctly identified particle B, stating that B has the largest surface area to volume ratio, is cheap and has a high purity. Less successful candidates did not use the term nanoparticles in their explanation or did not refer to B having the larg**est** surface area to volume ratio. Candidates that didn't choose B usually chose A or C.

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