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Examiners' Report
June 2019

GCSE Combined Science 1SC0 1CF

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Introduction

The examination paper was part of the second series of the new 9-1 Combined Science specification, graded 9-1. The paper consisted of 6 questions and all these questions were common with the 1CH0_1F paper – Foundation Tier GCSE Chemistry. Much of the last two questions were common with the 1SC0_1CH paper – Combined Science Chemistry paper. This paper made use of a wide variety of question types that were suitable for this level. This included multiple choice, short open response, linking lines, interpreting a bar chart and a graph, sentence completion, calculations, extended open response and as would be expected on a chemistry paper, use of chemical formulae. The paper targeted grades 5 to 1 with about half the marks targeted for grades 4 and 5.

Similar to last year were the significant number of blank responses seen, and the poor response to the assessment of mathematical and practical skills. It was also disappointing to see that the candidates' knowledge of some basic areas was not particularly strong.

Question 1 (b) (i)

Just under half the candidates could identify from the graph the point at which the gas first started to form a liquid. Many thought it started at point C on the graph, that is at 6 minutes and others thought it was the difference in time between points B and C, that is 4 minutes.

(b) A gas was left to cool to form a liquid.

Figure 1 shows how the temperature of the substance changed with time.

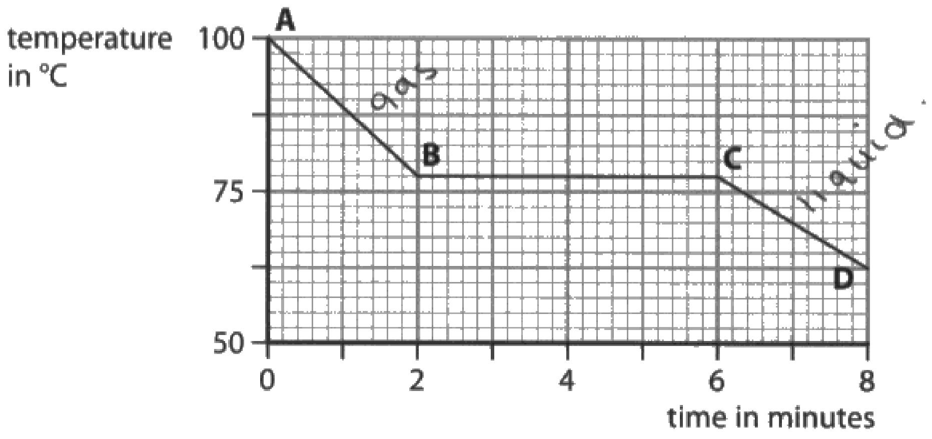


Figure 1

From **A** to **B** the substance is a gas.

From **C** to **D** the substance is a liquid.

(i) State the time when the gas first started to form a liquid.

(1)

2 minutes

ResultsPlus
Examiner Comments

This candidate, like many, was undecided between 2 and 6 minutes and fortunately the candidate made the right decision and scored the mark.

ResultsPlus
Examiner Tip

Know how to interpret the heating and cooling of substances with time shown by graphs.

Question 1 (b) (ii)

This should have been a straightforward question, but most candidates were unsure how to answer this. Many thought it was the total time until point C was reached, that is 6 minutes. Some thought it was the total time until point D, that is 8 minutes, and some thought it was the interval of time from C to D, that is 2 minutes.

(ii) Calculate the number of minutes it took from the gas first starting to form a liquid until the substance was completely liquid.

(1)

8 - 2 = 6

6 minutes

ResultsPlus
Examiner Comments

This candidate had another interpretation of the answer. This scored 0.

(ii) Calculate the number of minutes it took from the gas first starting to form a liquid until the substance was completely liquid.

(1)

~~2~~ 6 - 2 = 4

4 minutes

ResultsPlus
Examiner Comments

Only about a quarter of the candidates produced the correct answer to this question.

Question 1 (c) (i)

Under half the candidates could interpret the data to state which substance was a solid at 20 ^{o}C. The most frequesnt answer seen was X which has a boilng point of -34 ^{o}C.

Question 1 (c) (ii)

Here, over half the candidates obtained the correct answer. The most frequent incorrect answer seen was substance Z with a melting point well above the 50 ^{o}C temperature given in the question.

Question 1 (d)

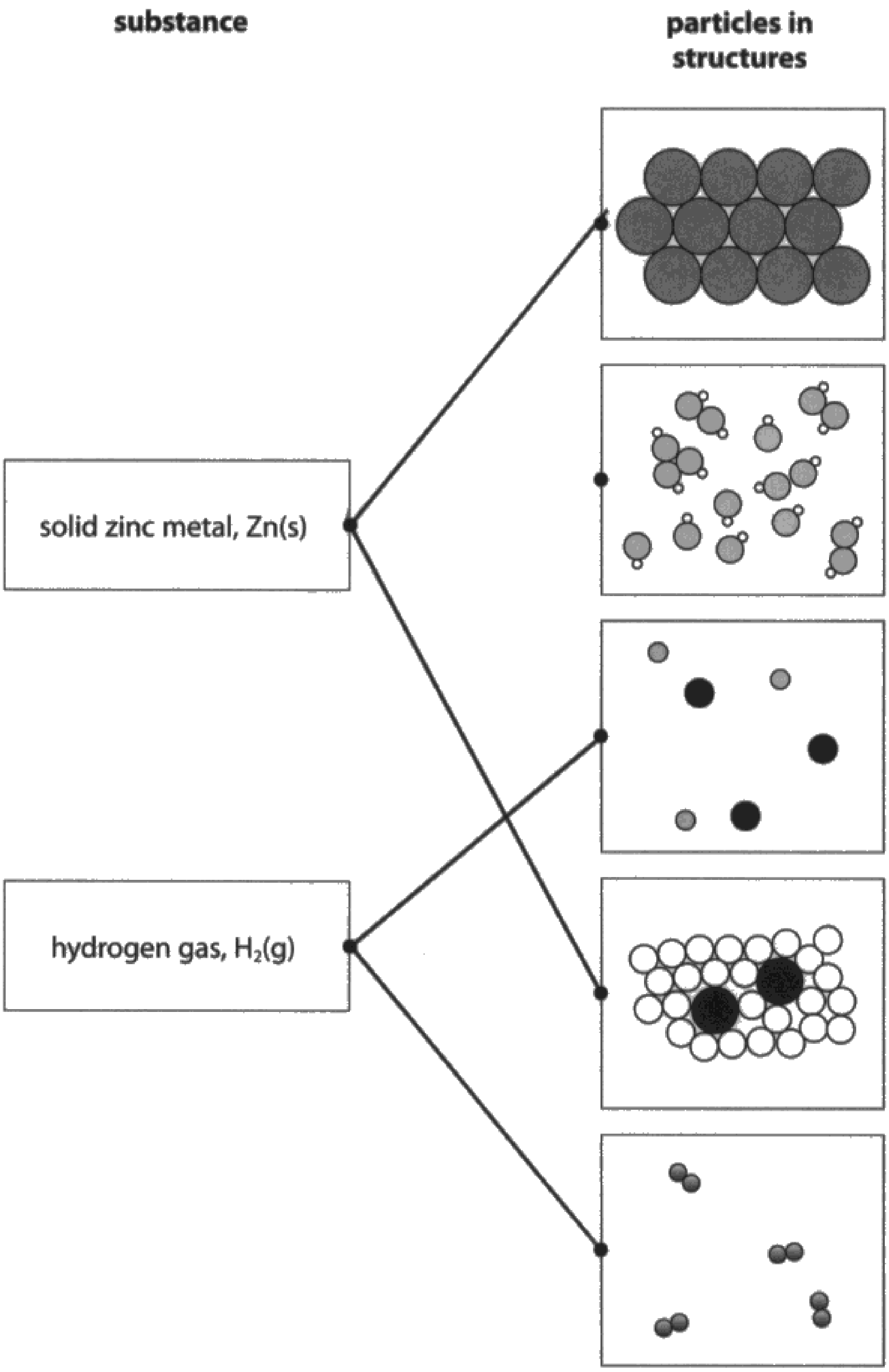
Most candidates followed the instructions of drawing one straight line from each substance to its structure, with most of these scoring both marks. However, a considerable number lost marks by drawing more than one line from a substance on the left. The most common 1-mark answer was scored for the correct linkage to the structure of zinc, with hydrogen gas being linked to the middle structure – that of a mixture of monatomic gases.

There was a significant number of candidates who did not follow the instructions for this question and used more than one line as in this example.

(d) The diagrams below show particles in five different structures.
The different circles show different particles.

Draw one straight line from each substance to its structure.

(2)



ResultsPlus
Examiner Comments

The candidate has identified the structure of a solid and linked to zinc and those of a gas to hydrogen but had realised that the lower structure of a solid was one containing two different atoms and upper structure of a gas contained two different sets of atoms. This answer scored 0 marks.

ResultsPlus
Examiner Tip

Follow the instructions given in the question. Here it was 'draw one straight line from each substance to its structure'.

Question 2 (b) (i)

The candidates found this difficult to answer, with only a minority scoring the mark. Few candidates showed any understanding of what the thermometer was supposed to be measuring. Many thought the thermometer blocked the steam where shown on the diagram or would be affected by the heat below. Also, many candidates thought it should be moved 'to get a more accurate boiling point of the ink'. From the answers, it seemed that many found the distillation process difficult to understand, with few answers mentioning steam, water vapour or gas or that the temperature is recorded or measured as this passes into the side arm or is collected.

(b) Figure 3 shows the apparatus that a student set up to obtain pure water from ink.

There are three mistakes in the way the apparatus has been set up.

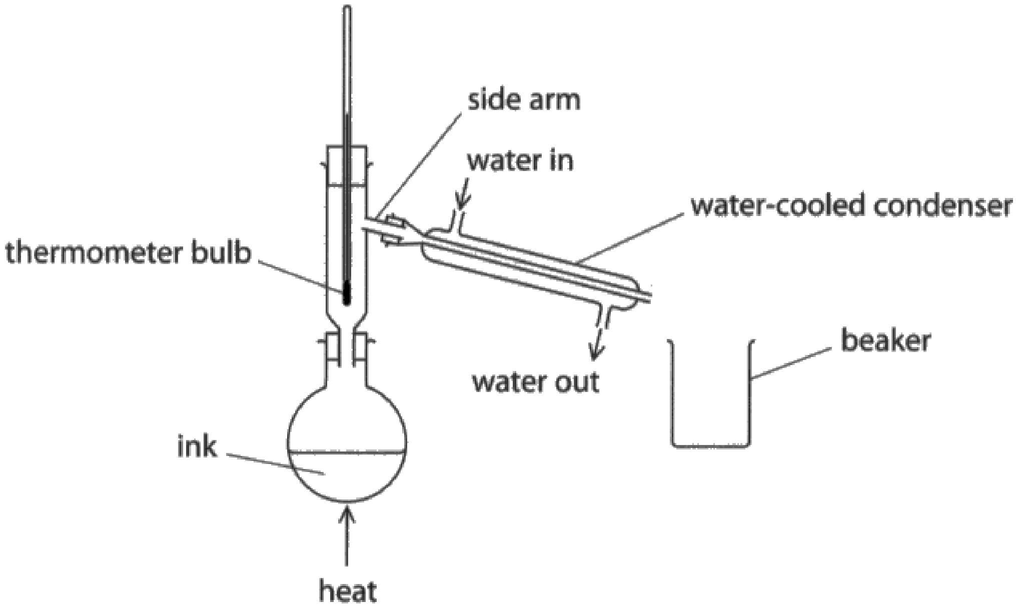


Figure 3

(i) One mistake is that the bulb of the thermometer is too low.

The bulb of the thermometer should be level with the side arm.

Give a reason why the bulb of the thermometer should be level with the side arm.

(1)

Inorder for it tobe in contact with the gas that is given out before condensation. So that way the temperature can be recorded properly

ResultsPlus
Examiner Comments

This scored the mark as the candidate understood the need to record the temperature before the water vapour (or gas here) moved into the condenser.

(b) Figure 3 shows the apparatus that a student set up to obtain pure water from ink.

There are three mistakes in the way the apparatus has been set up.

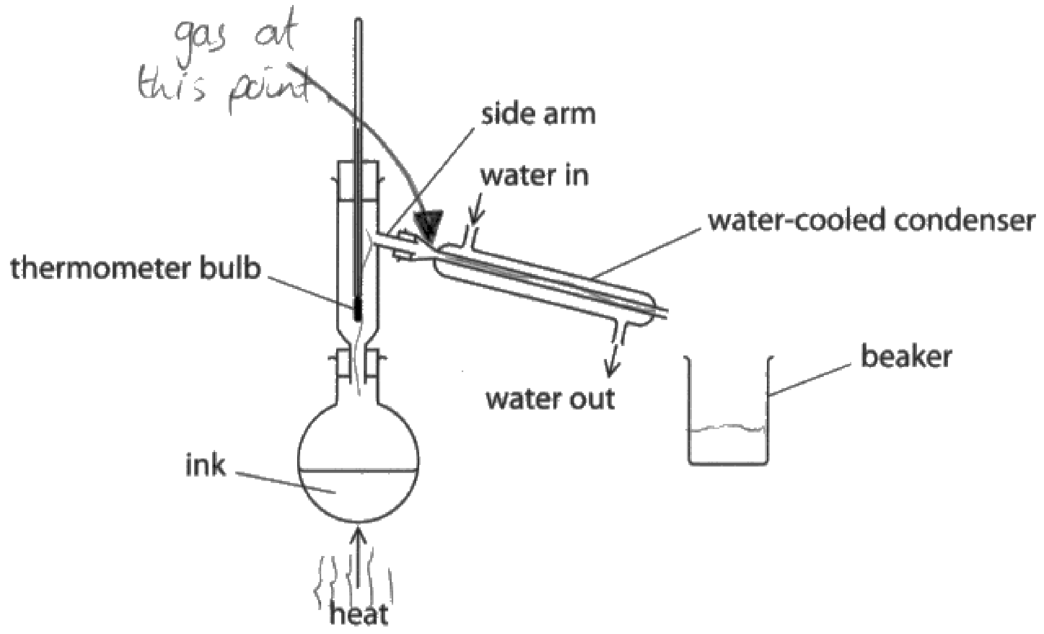


Figure 3

(i) One mistake is that the bulb of the thermometer is too low.

The bulb of the thermometer should be level with the side arm.

Give a reason why the bulb of the thermometer should be level with the side arm.

(1)

to get the exact tempreture of the ink before it goes into the side ~~arm~~ arm.

ResultsPlus
Examiner Comments

This did not score as it was not ink that would be passing into the side arm of the distillation apparatus.

Give a reason why the bulb of the thermometer should be level with the side arm.

(1)

So it can measure the heat accurately at the level when it goes down the side arm.

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Examiner Comments

The candidate made the error of using 'heat' rather than 'temperature' and so did not score.

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Examiner Tip

Know the difference between heat and temperature.

Give a reason why the bulb of the thermometer should be level with the side arm.
(1)

Because the gas would not be able to go into the condenser.

ResultsPlus
Examiner Comments

This was a common incorrect answer seen.

ResultsPlus
Examiner Tip

For each of the separation processes you are taught, make sure you understand how it works.

Question 2 (b) (ii)

Although the majority of the candidates scored the mark, for many of these it was for benefit of doubt as their expression left it uncertain about their meaning. Most of those who did not score the mark stated that the beaker should be under 'water out'. From this it was clear they were referring to the coolant water flow in the condenser, which was incorrect. Those who wrote that the beaker should be under 'where the water comes out' scored the mark. It was this response that was given the benefit of doubt since the condensed water would come out of the end of the condenser. Some scored with the response that 'a tube should connect the condenser with the beaker' or that 'the beaker was too far away' or similar. The majority overlooked the incorrect water flow, but several candidates scored marks for indicating this was an error. Candidates should be made aware that heat as shown represents a Bunsen flame or other source and clamps and stands do not need to be shown on diagrams. These answers did not score any marks.

(ii) State **one** other mistake in Figure 3.

(1)

Theres no Stand holding it up

ResultsPlus
Examiner Comments

This was not an error in a the diagram. The water flow was in the wrong direction and the beaker was not under the end of the condenser to collect the distilled water.

ResultsPlus
Examiner Tip

Diagrams of this type do not show clamps & stands, or Bunsen burners. The heat source is just shown as an arrow (as in the diagram for this question) with the word heat below it. Also tubes connecting a Liebig condenser to a water tap are not shown in these diagrams.

instead Of water in it Should be water out

ResultsPlus
Examiner Comments

The candidate had identified an error in the diagram and scored the mark for this answer.

The beaker ~~is~~ ~~at~~ should be where it says water out.

ResultsPlus
Examiner Comments

This was a common mistake made by candidates thinking that something should be there to collect the cooling water coming out of the condenser.

This scored 0 marks.

Question 2 (c) (i)

Most candidates were familiar with the process of carrying out paper chromatography and scored both marks for putting the steps of the procedure into the correct order. A few scored 1 mark for having a step in the wrong place, the most common error observed was mixing up steps 6 and 4.

(c) Paper chromatography is used to separate the substances in five different food colourings, **P**, **Q**, **R**, **S** and **T**.

Figure 4 shows the chromatogram at the end of the experiment.

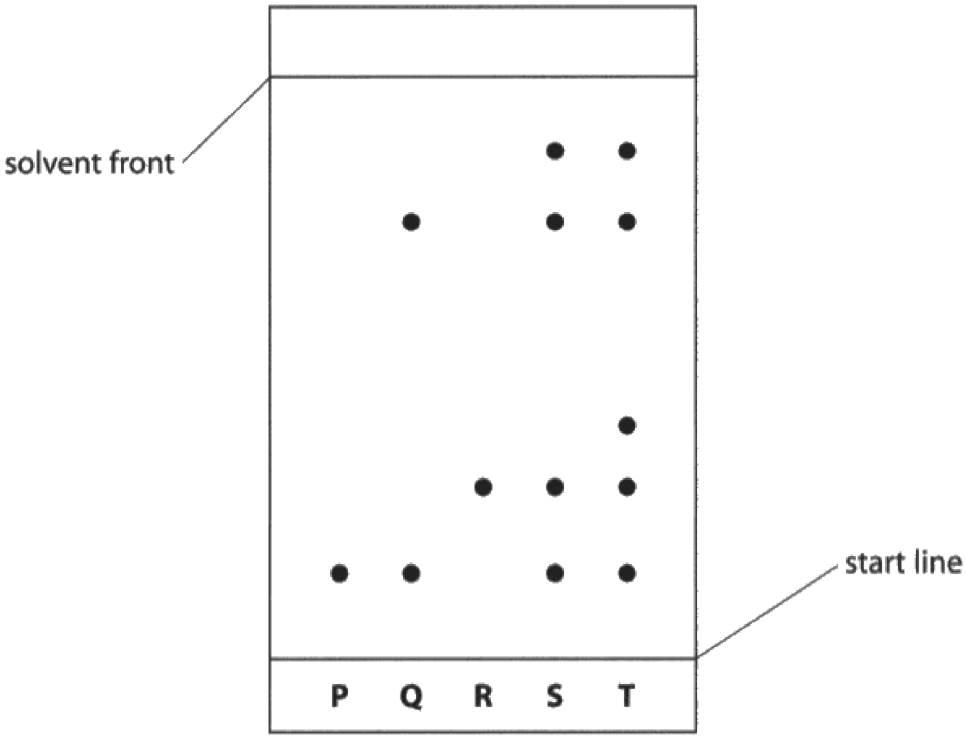

Figure 4

(i) The steps needed to carry out the chromatography experiment are listed below. They are not in the correct order.

1 leave the solvent to rise up the paper
2 put solvent in the beaker
3 draw a start line on the piece of paper
4 place the paper in the beaker
5 remove the paper when the solvent is near the top
6 put small spots of the food colourings on the start line

List the steps in the correct order.

The first two steps have been done for you.

(2)

2	**3**	4	6	1	5

ResultsPlus
Examiner Comments

One of the many candidates who mixed up steps 4 and 6.

2	3	4	1	5	6

ResultsPlus
Examiner Comments

Some candidates thought putting the spots of food colouring on the start line should be last step of the procedure.

ResultsPlus
Examiner Tip

Read all the steps carefully before putting them into logical order.

Question 2 (c) (ii)

The majority of candidates scored marks for stating that T had the greatest number of, or 5 spots, however many lost the second mark through repeating the question 'T had the greatest number of coloured substances' or by not stating how they used the evidence to reason why T contained the greatest number of coloured substances. Only a few went for any of the other substances and did not score either mark.

(ii) Explain, using Figure 4, which food colouring contains the greatest number of coloured substances.

(2)

substance T because it traveled up the paper more than the other substances showing that it contains the greatest number of coloured substance.

ResultsPlus
Examiner Comments

This scored just for identifying food colouring T. The component of T that moved the furthest was also present in food colouring S, so that argument does not score.

ResultsPlus
Examiner Tip

Understand how to interpret chromatograms.

(ii) Explain, using Figure 4, which food colouring contains the greatest number of coloured substances.

(2)

T contains the greatest amount of coloured substance as it contains 5 different Substances.

ResultsPlus
Examiner Comments

This scored 2 marks - 1 for identifying T and 1 for stating that it contained 5 different substances as was shown on the chromatogram.

ResultsPlus
Examiner Tip

Make use of information in the question to help you explain an answer.

Question 2 (c) (iii)

About a quarter of the candidates had the correct sum: dividing the distance moved by food colouring R by the distance moved by the solvent front. Of these about a third lost the second mark by not giving their answer to 2 significant figures. From their answers, some missed that instruction, but some made an incorrect rounding, going from 0.2875 to 0.28 rather than 0.29. Many candidates were not sure how to calculate the R_f value using the data.

Many candidates had the reverse division: dividing the distance moved by the solvent front by the distance moved by food colouring R. This gave the answer of 3.4783 and when rounded to 2 significant figures gave 3.5 for which candidates scored the second mark for the correct approximation to 2 significant figures. It was reported that a few candidates gave the answer of 3.5 without showing any calculation and for this they did not score the second mark. The second mark was specifically for showing the rounding of a calculated answer to 2 significant figures.

In answering this question, most candidates realised that they had to combine 8.00 and 2.30 mathematically in some way. While many opted for division than the use of the other operators, all were seen at some time, sometimes even in the same answer with candidates trying several possibilities and then opting for the one which looked best. The fraction was seen the wrong way up as often as the correct way up. Other misconceptions were seen where candidates used other manipulations of the numbers such as addition or subtraction, so 5.70 was frequently seen.

(iii) During chromatography of the food colourings, the solvent front moved 8.00 cm and the food colouring **R** moved 2.30 cm.

Calculate the R_f value for food colouring **R**.
Give your answer to two significant figures.

(2)

2.30 cm ÷ 8.00 = 0.2875

R_f value = 0.2875

ResultsPlus
Examiner Comments

The division 2.30 ÷ 8.00 scored the first mark.

The answer was not given to 2 significant figures. This was seen quite often by examiners where candidates either missed that instruction or did not know how to round the answer to a set number of significant figures.

2.30 ÷ 8.00 = 0.28|75

R_f value = 0.28

ResultsPlus
Examiner Comments

Correct division but incorrect rounding to 2 significant figures. This scored 1 mark only.

$\frac{8.00}{2.30} = 3.47$

R_f value = 3.5

ResultsPlus
Examiner Comments

An incorrect division, but a correct rounding to 2 significant figures. This answer scored the second mark only. This reverse division was frequently by examiners.

ResultsPlus
Examiner Tip

Learn how to calculate the R_f value of a substance from the distance by that substance on a chromatogram and the distance moved by the solvent using:

R_f = distance moved by substance

distance moved by solvent

Also learn how to round answers correctly to a given number of significant figures.

Question 3 (a) (ii)

Most of the responses suggested that either the temperature or the concentration of the dilute hydrochloric acid should be controlled. Many candidates used the term ‘strength’ rather than concentration here and this was allowed. Of those that were credited with using the same volume of acid, most used the term ‘amount’ rather than volume and again this was allowed. The least frequently seen creditable answer was same size of metal pieces. Instead, many gave the answer of ‘same amount of metal’ which was given in the question and was not credited.

Most of the other incorrect answers involved keeping the metals in the acid for the same time or the same size test tube or beaker.

(ii) State **two** variables, apart from the mass of the metals, that should be controlled in this investigation.

(2)

1 Amount of dilute hydrochloric used

2 The amount of metal.

ResultsPlus
Examiner Comments

At this level, the 'amount' of acid was an alternative to volume of acid. But the 'amount' of metal was a repeat of the question, so scored only 1 mark.

(ii) State **two** variables, apart from the mass of the metals, that should be controlled in this investigation.

(2)

1 Amount of time left in hydrochloric acid

2 concentration of hydrochloric acid

ResultsPlus
Examiner Comments

Controlling the time would not affect the difference in the amount of effervesence produced, but controlling the concentration of the acid would. This scored just for the second variable.

ResultsPlus
Examiner Tip

Think about variables that would affect the outcome of a reaction - the main factors that affect a reaction are concentration and temperature of a solution and surface area or particle size of a solid.

Question 3 (a) (iii)

Just under half the candidates gave a correct answer of copper being unreactive, or there's no reaction (with the acid) or copper is low in the reactivity series. Many of the incorrect answers included 'not as reactive as magnesium' or 'less reactive than magnesium'. Many tried to link this unreactivity with 'copper has a full outer shell of electrons'. It is surprising to see how many thought copper is a non-metal.

(iii) Magnesium produces the most vigorous effervescence.
Copper does not produce any effervescence.

Give the reason why copper does not produce any effervescence.

(1)

Because it is a conductor of electricity.

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Examiner Comments

Several candidates gave a true property of copper, but this did not explain its behaviour when placed in dilute hydrochloric acid, so did not score.

Because copper is non metal and non reactive

ResultsPlus
Examiner Comments

A significant number of candidates thought copper was a non-metal which surprised the examiners.

(iii) Magnesium produces the most vigorous effervescence.
Copper does not produce any effervescence.

Give the reason why copper does not produce any effervescence.

(1)

It is less reative than hydrogen

ResultsPlus
Examiner Comments

This answer scored as the reactivity of copper was compared to that of hydrogen, so hydrogen would not be displaced.

ResultsPlus
Examiner Tip

Know how to use the reactivity of metals to explain metal reaction behaviour.

Question 3 (a) (iv)

State symbols remain a challenge for many candidates with almost half not scoring for either (aq) or (g). Less than a quarter of the candidates scored for two correct state symbols. Just under a third scored one mark which was usually for the gas state symbol. Many are not sure what to put in the brackets, even though those for the reactants were given. Some candidates wrote the words 'solution' and 'gas', others inserted a chemical symbol and some inserted numbers into the spaces.

(iv) The magnesium reacts with dilute hydrochloric acid to form magnesium chloride solution and hydrogen gas.

The equation for the reaction is

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(H_2O) + H_2(Cl)$$

Fill in the missing state symbols in the spaces provided.

(2)

ResultsPlus
Examiner Comments

An example of a candidate who does not know how to use state symbols.

ResultsPlus
Examiner Tip

Learn the state symbols for use in chemical equations:

(s) - solid

(l) - liquid

(g) - gas

(aq) - in solution

Question 3 (b) (i)

The correct answer was only written by a small number of candidates. Most could not balance the charges to give the correct formula for potassium sulfate. The most frequent answer seen was probably KSO_4 along with variations such as KSO_4^- and $K^+SO_4^{2-}$. Some came close with $2KSO_4$ showing the 2 before the potassium rather than as a subscript following the symbol for potassium. In spite of being given the formulae of the two ions, P for potassium and SO for sulfate were seen, as a cavalier approach to the use of super- and sub-scripts. Many candidates did not attempt to write an answer.

(b) Potassium carbonate reacts with dilute sulfuric acid to form potassium sulfate.

(i) Potassium sulfate contains potassium ions, K^+, and sulfate ions, SO_4^{2-}.

Write the formula of potassium sulfate.

(1)

$K^{+1} + SO_4^{-2} \rightarrow K_2SO_4$

ResultsPlus
Examiner Comments

One of the few correct answers seen for this question.

Write the formula of potassium sulfate.

(1)

$K^{+} + SO_4^{2-} \rightarrow KSO_4^{-1}$

ResultsPlus
Examiner Comments

This was probably the most frequent error seen. The candidate has worked out the charge correctly, but this is not the formula of potassium sulfate.

ResultsPlus
Examiner Tip

Using a list of common ions, practice writing the formulae of a variety of compounds. Adjust the number of ions to balance up the charges.

Question 3 (b) (ii)

Just over half the candidates were able to calculate the mean value of the masses given and then approximate to 2 decimal places. About half the remaining candidates could calculate the mean, but missed the approximation, or carried out an incorrect calculation and then made a correct rounding to 2 decimal places. The most common incorrect calculation was just the addition of the three values missing out the division by 3. This gave the answer of 15.67 which by default gave them the second mark. However, several candidates then approximated this value to 2 significant figures (15.67 became 16) and so lost that mark. The second was for showing the approximation of a calculated answer to 2 decimal places and this was not given for writing any number alone to 2 decimal places.

It was surprising to see that even at this level many candidates did not know how to calculate the mean of three numbers as seen by the blank responses as well the incorrect methods being used. These included taking the middle value (5.24) and dividing by 3. It was also disappointing to see that a number of candidates do not know how to use a calculator correctly, a frequently seen answer being 12.20, obtained by failing to input an equals before the divide by 3.

(ii) Equal volumes of a solution of potassium carbonate were reacted separately with an excess of dilute sulfuric acid solution.
Pure dry samples of potassium sulfate were obtained from the resulting solutions.

The experiment was repeated three times using the same conditions.

The masses of potassium sulfate obtained were

experiment 1 = 5.22 g
experiment 2 = 5.24 g
experiment 3 = 5.21 g

Calculate the mean mass of potassium sulfate obtained, giving your answer to two decimal places.

(2)

5.22g + 5.24g + 5.21g = 15.67g

15.67g ÷ 3 = 5.22333

mean mass of potassium sulfate = ~~5.20~~ 5.2 g

ResultsPlus
Examiner Comments

Correct calculation but the answer was rounded to 2 significant figures rather than to 2 decimal places. This scored 1 mark oly.

Calculate the mean mass of potassium sulfate obtained, giving your answer to two decimal places.

(2)

5.24 $\quad$ 15.67 ÷ 3 = 5.223

5.22

5.21

15.67

mean mass of potassium sulfate = 5.223 g

ResultsPlus
Examiner Comments

The calculation was correct and scored 1 mark, but the answer was not rounded to 2 decimal places.

ResultsPlus
Examiner Tip

Learn how to round the answer of a calulation to a set number of decimal places.

Question 4 (b) (i)

It was somewhat disappointing to see that only about a third of the candidates could produce a correct word equation from the information given about the reaction between zinc oxide and carbon. Most of the errors seen included the equation being written the wrong way around, carbon dioxide shown as a reactant as well as a product, the introduction of substances not listed such zinc carbonate or oxygen. Some tried to write a balanced equation, rarely successfully, while some mixed words and formulae, which was not accepted. A significant number made no attempt to answer the question.

(b) Zinc can be extracted by heating zinc oxide with carbon.

The products are zinc and carbon dioxide.

(i) Write the word equation for this reaction.

(2)

$ZnO_2 + C \rightarrow Zn + CO_2$

ResultsPlus
Examiner Comments

Although a correctly balanced equation would score both both marks, an incorrect formula of zinc oxide was used and so no marks were given.

ResultsPlus
Examiner Tip

If a word equation is asked for, go with that rather than trying to write a balanced equation.

(b) Zinc can be extracted by heating zinc oxide with carbon.

The products are zinc and carbon dioxide.

(i) Write the word equation for this reaction.

(2)

~~[illegible]~~ Zinc oxide + carbon →

zinc + ~~[illegible]~~ carbonate.

ResultsPlus
Examiner Comments

The candidate had underlined all the relevant substances that would go into the writing of the word equation, but somehow wrote zinc carbonate as the product.

This scored 1 mark for the left side : zinc oxide + carbon →

ResultsPlus
Examiner Tip

Practice writing word equations using a decription fo the reaction. As shown here, underline the substances that will appear in the word equation, remembering a '+' sign between the reactants or between the products and '→' between the left side and the right side.

(i) Write the word equation for this reaction.

(2)

~~Zinc oxide~~ ~~zinc oxide + carbon → zinc~~

zinc + carbon dioxide → zinc oxide + carbon

ResultsPlus
Examiner Comments

This candidate had the correct substances but the word equation was the wrong way round.

Question 4 (b) (ii)

Only a small number candidates identified the reaction correctly as being reduction. The answer seen most often was oxidation, followed by 'chemical reaction'. Other incorrect answers often seen included 'extraction' and 'de-oxidation'. However, many blank responses were seen.

(ii) In this reaction zinc oxide loses oxygen.

State the type of reaction taking place when an oxide loses oxygen.

(1)

Chemical reaction

ResultsPlus
Examiner Comments

This was one the many varieties of responses seen. Only a small number gave the correct answer of 'reduction'.

ResultsPlus
Examiner Tip

Learn the different types of reaction and how to identify them.

Question 4 (c) (i)

Just over half the candidates gave the correct number of ions in the formula of Al_2O_3 as 5. Some thought it was two, but there were many other incorrect answers given where it was difficult to see how those were achieved eg 7 or 11.

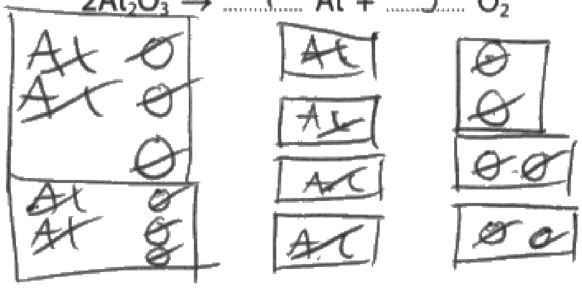
Question 4 (c) (ii)

Only about half the candidates could balance at least one of the products in the given equation with less than a quarter able to balance both products. Frequently incorrect answers included 2Al + $4O_2$ – presumably using the 2 in front of the Al_2O_3 on the reactant side and then 2x2 to give the 4. Again, there were many blank responses to this question.

(ii) Complete the balanced equation for the overall reaction by putting numbers in the spaces.

(2)

$2Al_2O_3 \rightarrow$ ....4.... Al + ...3.... O_2



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Examiner Comments

Two marks given for the correct balancing of the equation.

ResultsPlus
Examiner Tip

If you find balancing equations difficult, look at how this candidate worked out the answer. The two boxes on the left each contains 2 Al and 3 O as in the formula of the aluminium oxide. So 4 Al needed on the right. Each O_2 contains 2 O atoms, so 3 O_2 needed on the right.

(ii) Complete the balanced equation for the overall reaction by putting numbers in the spaces.

(2)

$2Al_2O_3 \rightarrow$ ....1.... Al + ...3.... O_2

ResultsPlus
Examiner Comments

1 mark was given for the balancing of the oxygen on the right side.

ResultsPlus
Examiner Tip

Practice balancing equations given the formulae of only the substances that appear in the left and right sides of the equation.

Question 4 (d) (i)

Over half the candidates could put the stages of a life-cycle assessment into the correct order, and about a third had one stage in the wrong part of the sequence. It was surprising to see that many candidates thought disposal of the product (step **A**) came before using the product (step **D**).

(d) (i) The environmental impact of a product is assessed in a life-cycle assessment.

The stages in this assessment are given below.
They are not in the correct order.

A ~~disposal of the product~~
B ~~manufacturing the product~~
C ~~obtaining and processing the raw materials~~
D ~~using the product~~

List the stages of the life-cycle assessment, using letters **A**, **B**, **C**, **D**, in the correct order from start to finish.

(2)

C	B	A	D

ResultsPlus
Examiner Comments

A candidate who thought that disposal happened before using the product.

List the stages of the life-cycle assessment, using letters **A**, **B**, **C**, **D**, in the correct order from start to finish.

(2)

B	A	D	C

ResultsPlus
Examiner Comments

One of the few sequence of letters that scored 0.

ResultsPlus

Examiner Tip

Know the different stages of the life-cycle assessment of a product.

Question 4 (d) (ii)

Only a very small number of candidates had success with this question. There were many responses of the 'cheaper', 'quicker' variety without justification which will not be credited on a Chemistry paper. Equally, there were many vague answers of 'better for the environment', 'less pollution' and 'less waste' without qualification. Many thought that mining would produce harmful gases and for some that went on 'to cause global warming' or similar. Some thought that that there was little aluminium left in the ground. Examiners reported that there were a significant number of blank responses seen here. Generally, if a candidate scored a mark it was either about using less energy in the recycling of waste aluminium or about conserving supplies of aluminium ore.

(ii) Aluminium can be obtained by recycling aluminium waste.

Give **two** advantages of obtaining aluminium by recycling aluminium waste rather than mining the raw material and extracting aluminium from that raw material.

(2)

1 It saves energy

2 It doesn't take up space in land fill

ResultsPlus
Examiner Comments

This scored for both points. The answer was brief but it was to the point.

1 It is better for the environment

2 We are recycling and not mining more which cuts down on pollution

ResultsPlus
Examiner Comments

Both these points needed qualification in some way in order to score. Candidates need to justify why it is better for the environment such as less damage to the landscape. Less pollution also needed qulifying in some way such as less noise pollution.

ResultsPlus
Examiner Tip

Avoid using vague terms such as 'eco-friendly or 'less-pollution'. They need to be qualified to score marks.

Question 5 (a) (i)

Most candidates could identify which of the featured elements of the periodic table were non-metals. G and X were the most popular ones chosen by the candidates, so most candidates knew of the division between metals and non-metals in the periodic table. However, some chose to name non-metals that were outside the elements under consideration in the question; these did not score. Some chose to use the periodic table to 'translate' the lettered elements in the question, so two of B, O and Ar also scored, but use of the element names was not credited.

Question 5 (a) (ii)

Less than a quarter of the candidates could give the letters of the featured elements that were in period 2 – that is two of A, E and G or 'translated' as Li, B or O . The most common errors were giving the letters J and X which were in period 3, or using the periodic table at the back to identify two elements in group 2 – usually Mg and Ca. So here there was confusion about which is period 2 and confusion between the meaning of the terms period and group when associated with the periodic table.

Question 5 (a) (iii)

Just under half the candidates could give the letter of an element that normally forms an ion with a charge of +1 – A or J, or 'translated' as Li or Na. The most frequent incorrect choices were Z followed by G. Again, several candidates did not follow the instructions and several named elements such as hydrogen or potassium which were not the elements under consideration in the question.

Question 5 (b) (i)

Very few candidates were clear about isotopes, confusing them with ions, ionic bonding, covalent bonding and other terms they clearly did not understand. The most common error was referring to elements, although the best answers clearly stated that it is the same element. Some confused atomic number and atomic mass.

Many candidates did not read the question completely and missed the important phrase 'in terms of subatomic particles'. So, for these candidates if the answer was given as 'same atomic number but a different mass number', it was clear they knew what isotopes were and so were given a mark. There were also many 1-mark answers as candidates were only referring to one subatomic particle not both, usually by stating that they had different numbers of neutrons, but often this was reversed with the definition having different numbers of protons but the same number of neutrons. Overall about three quarter of the candidates did not show sufficient knowledge to score a mark on this question.

(b) Element **E** has an atomic number of 5.
In a sample of **E** there are two isotopes. One isotope has a mass number of 10 and the other isotope has a mass number of 11.

(i) Explain, in terms of subatomic particles, what is meant by the term **isotopes**.

(2)

Isotopes have the same atomic number but diffrent Atomic mass they have the same number of Protons and electrons.

ResultsPlus
Examiner Comments

This response scored for isotopes having the same number of protons, the number of electrons was ignored. If there had been no mention of sub-atomic particles, 1 mark would have been allowed for isotopes having the same atomic number but different atomic mass.

ResultsPlus
Examiner Tip

Subatomic particles include protons, neutrons and electrons.

(i) Explain, in terms of subatomic particles, what is meant by the term **isotopes**.

(2)

Isotopes have different number of neutrons but the same atomic number.

ResultsPlus

Examiner Comments

This was given 1 mark for isotopes having different numbers of neutrons only.

(i) Explain, in terms of subatomic particles, what is meant by the term **isotopes**.

(2)

Isotopes are different versions of an element that have different mass numbers

ResultsPlus

Examiner Comments

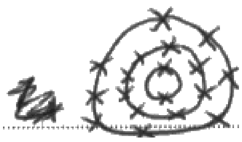
No marks were given here as the subatomic particles protons and neutrons were not mentioned.

Question 5 (c)

About half the candidates could give the electronic configuration as 2.8.8. A minority of these drew a diagram instead of writing it. The common errors included writing (or drawing) it as 8.8.2, 18 and 40. And again there were many blank responses seen.

(c) Element **X** has an atomic number of 18.

State the electronic configuration of an atom of element **X**.

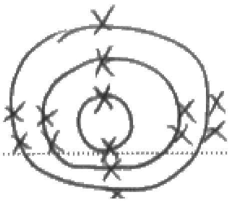


(1)

ResultsPlus
Examiner Comments

This candidate could have saved time by writing 2.8.8, but this representation was still correct and was given the mark.

State the electronic configuration of an atom of element **X**.



(1)

ResultsPlus
Examiner Comments

Incorrect 2nd and 3rd shells stopped the awarding of the mark here.

ResultsPlus
Examiner Tip

Practise writing the electronic configurations for all element with a maximum atomic number of 20.

(c) Element **X** has an atomic number of 18.

2, 8, 8

State the electronic configuration of an atom of element **X**.

(1)

-3

ResultsPlus
Examiner Comments

The candidate wrote the correct answer but then put an incorrect one on the answer line, so the mark wasn't given.

ResultsPlus
Examiner Tip

Examiner's don't 'pick' the best answer. What is written on the answer line is the final answer and is incorrect for this 1-mark question.

State the electronic configuration of an atom of element **X**.

(1)

~~6, 6, 6~~ 2, 6, 6, 4

ResultsPlus
Examiner Comments

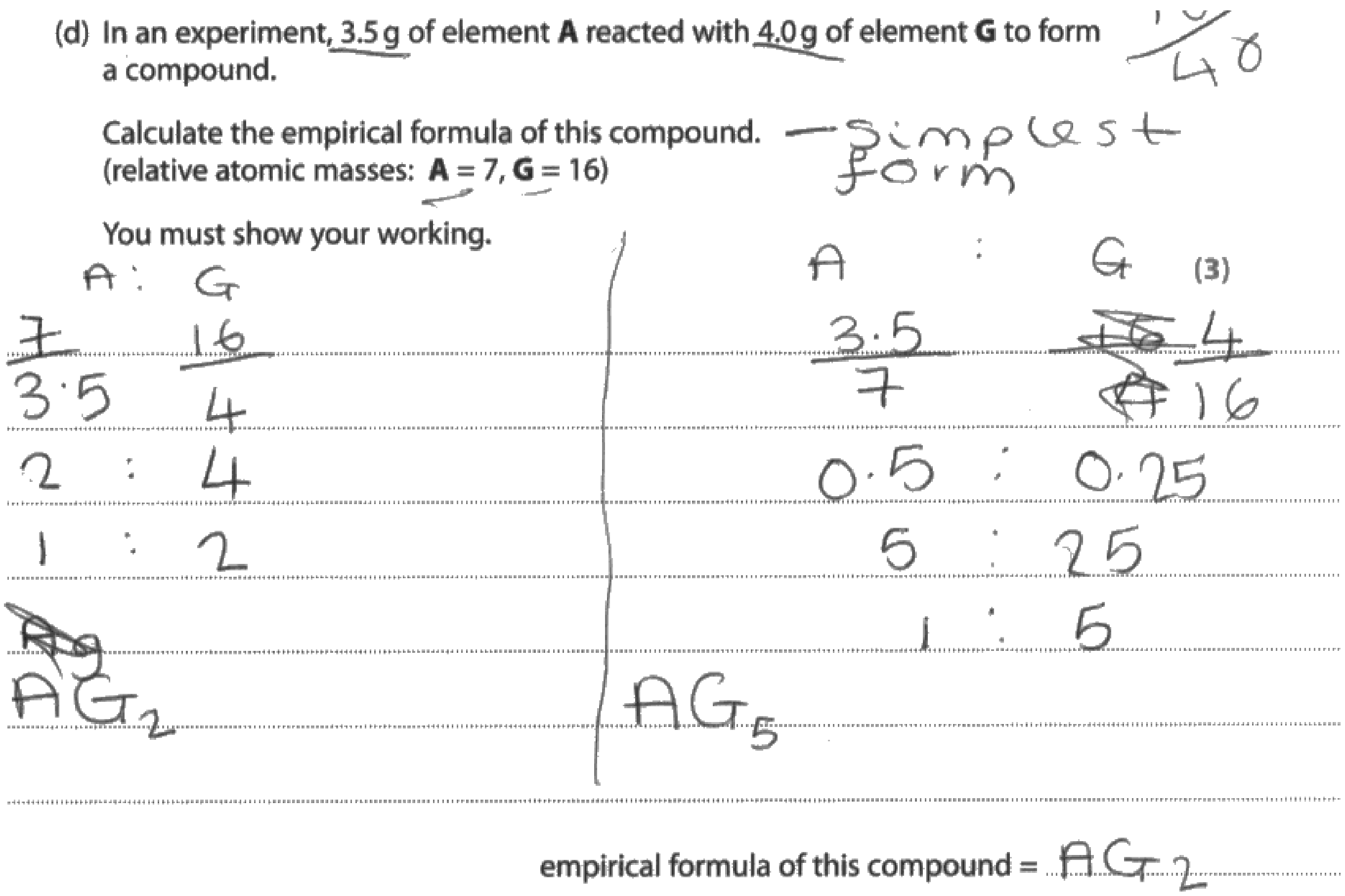
An incorrect representation.

ResultsPlus
Examiner Tip

Not only does the total number of electrons have to equal the atomic number, but maximum number of electrons in the shells also has to fit.

Question 5 (d)

Most candidates found this calculation to be a challenge. Even though empirical formulae determinations is often set, it is surprising that candidates appear not to be better prepared. Most made an attempt, but few moved along a correct path to obtain an answer. In the first step, candidates needed to divided the mass of the element by its relative atomic mass: there were more who had the wrong fraction than those had the correct fraction. Many candidates multiplied the masses by the relative atomic mass and then added the two answers to get 88.5; a very common answer. Some candidates did the hard work and obtained the correct ratio and then did not know how to write an empirical formula. Some candidates, usually correctly, gave their answers in terms of Li and O. It was evident that the greater majority did not understand the term 'empirical formula'.


(d) In an experiment, 3.5 g of element **A** reacted with 4.0 g of element **G** to form a compound.

Calculate the empirical formula of this compound. — simplest form
(relative atomic masses: **A** = 7, **G** = 16)

You must show your working. **(3)**

A : G
$\frac{7}{3.5}$ $\frac{16}{4}$
2 : 4
1 : 2
AG_2

A : G
$\frac{3.5}{7}$ $\frac{4}{16}$
0.5 : 0.25
5 : 25
1 : 5
AG_5

empirical formula of this compound = AG_2

ResultsPlus
Examiner Comments

This candidate tried two ways to obtain the ratios - the correct way on the right and the incorrect way on the left. On the right an error was made obtaining the whole number ratio which led to the formula AG_5. This alone would have scored marking points 1 and 3.

Although the first step on the left was incorrect, the rest of the calculation was correct with the answer of AG_2 on the answer line. This answer scored for marking points 1 and 3 - 2 marks in total.

Calculate the empirical formula of this compound.
(relative atomic masses: **A** = 7, **G** = 16)

You must show your working.

(3)

A : G

3.5 : 4.0

7/3.5 : 16/4.0

2 : 4

~~2A4G~~ A_2G_4

empirical formula of this compound = A_2G_4

ResultsPlus
Examiner Comments

The first step was incorrect, but a whole number ratio was obtained and marking point 2 was given. The final formula of A_2G_4 did not score as a carried forward error as that is not an empirical formula.

7 x 3.5 = 24.5

16 x 4 = 64

$\frac{24.5}{64}$ = 0.3828125

= 0.38

empirical formula of this compound = 0.38

ResultsPlus
Examiner Comments

Probably more candidates started with this multiplication than those with the division. With the answer of 0.38 on the answer line, it can only be assumed that the candidate does not understand what is meant by an empirical formula.

$\frac{3.5}{7}$ $\frac{4.0}{16}$

$= \frac{0.5}{0.5} = 1$ $= \frac{0.25}{0.5} = 1$

1 : 1

empirical formula of this compound = 1 : 1

ResultsPlus
Examiner Comments

A correct first step, but the division in the second step was incorrect. No empirical fromula was given. So this scored for marking point 1 only. If the formula of AG was given on the answer line, this would have scored the 3rd marking for an empirical formula obatined from the whole number ratio.

ResultsPlus
Examiner Tip

Practise calculating the empirical formula for a variety of compounds. The calculation is not difficult but practise helps you remember the steps that are needed. Also, remember that the emprical formula is a formula that contains the simplest whole number ratio of the elements in that compound.

Question 5 (e)

About a third of the candidates produced a correct dot and cross diagram, and a further third scored 1 mark for a correct shared pair of electrons between oxygen and the other hydrogen atom losing the second mark by having too many or too few electrons on the oxygen atom. Some candidates added extra electrons to both hydrogen atoms or added extra hydrogen atoms around the oxygen atom.

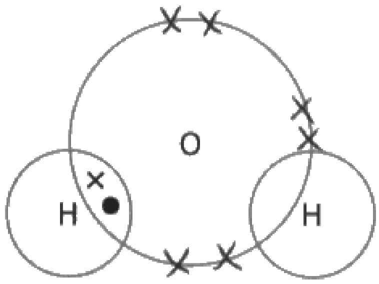
(e) An oxygen atom has six electrons in its outer shell.

A hydrogen atom has one electron in its outer shell.

Complete the dot and cross diagram of a molecule of water, H_2O.

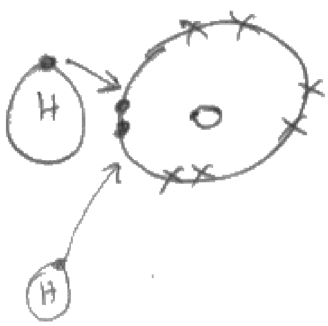
Show outer shell electrons only.

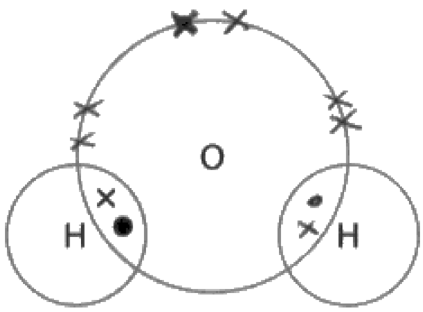
(2)



ResultsPlus
Examiner Comments

The first mark was for a correct shared pair, which is missing here. As the second mark was dependent on a correct shared pair being in place, so this answer scored 0.





ResultsPlus
Examiner Comments

This scored 1 mark for a correct shared pair between the oxygen atom and the other hydrogen atom, but there were too many electrons around the oxygen for the second mark.

ResultsPlus
Examiner Tip

Practicse drawing dot and cross diagrams for a variety of simple covalent compounds. Remember to get the shared pairs in for the bonds first before getting the rest of the molecule correct.

Question 6 (a) (i)

Of all the gas tests, experience has shown that the test for hydrogen is the one that candidates at this level know the best. However, in this case, only half the candidates could give a correct answer to this question. Many read the first line of the question, missed the next two lines and wrote something that had nothing to do with the question being asked. Some appeared not to understand the term 'ignited' and others seemed unable to cope with the question being asked in this way.

6 (a) Water, acidified with sulfuric acid, is decomposed by electrolysis. The water is decomposed to produce hydrogen and oxygen.

(i) A sample of hydrogen is mixed with air and ignited.

State what would happen.

(1)

- A lit Splint would be put in
- Squeeky pop

ResultsPlus
Examiner Comments

This scored the mark for 'squeeky pop'. The candidate had recognised this as the test for hydrogen.

~~[illegible]~~ they would react together and ignite

ResultsPlus
Examiner Comments

0 marks here. It looks likely that the candidate did not recognise this as the test for hydrogen.

ResultsPlus
Examiner Tip

Ensure you learn the tests for the presence of the gases hydrogen, oxygen, carbon dioxide and ammonia.

Question 6 (a) (ii)

Most candidates attempted this item with many scoring one mark. It seemed that they could compare across the table, twice as much hydrogen as oxygen, or down the table, volume of gas increasing, but not both together. Many candidates simply copied numbers from the table which did not score and some simply noted that the volume of oxygen was the same number as the time.

(ii) Throughout the experiment the volume of hydrogen and the volume of oxygen are measured at two-minute intervals.

The results are shown in Figure 6.

time in minutes	volume of hydrogen in cm^3	volume of oxygen in cm^3
0	0	0
2	4	2
4	8	4
6	12	6
8	16	8

Figure 6

Describe, using the data in Figure 6, what the results show about the volumes of hydrogen and of oxygen produced in this experiment.

(2)

when you add volume of hyirogen it doubles in depth and when you add the volume of oxygen it stays the same.

ResultsPlus
Examiner Comments

This did not score as there is no mention about what happened to the volumes of gases as time increased or a direct comparison between the volumes of the two gases.

the volume of hydrogen and oxygen increase even though hydrogen increases more.

ResultsPlus
Examiner Comments

This scored the first marking point only; there was no mention about the volume of hydrogen being double that of oxygen needed for the second marking point.

Hydrogen is always twice the amount of oxygen

ResultsPlus
Examiner Comments

This scored for the second marking point only.

ResultsPlus
Examiner Tip

When making conclusions about data in a table, ensure you use all of the information in some way, but don't just quote values as that will not score the marks.

Question 6 (c)

Another item where there seemed to be more blanks responses than answers. Few candidates seemed to understand the words of the question. Perhaps 'behaves as an electrolyte' was simply too difficult for candidates at this level.

Many looked at the names of the substances, saw that what was different was 'carbon' and 'nitr' and answered in terms of supposed differences between carbon and nitrogen. For those scoring one mark, this was generally writing a correct comment about the difference in solubility, ignoring the rest of the question about movement of ions.

(c) Calcium nitrate and calcium carbonate are both ionic compounds.

Calcium nitrate mixed with water behaves as an electrolyte.
Calcium carbonate mixed with water does not behave as an electrolyte.

Explain, in terms of solubility and movement of ions, this difference in behaviour.

(2)

In calcium nitrate the Ions can move freely whereas in Calcium carbonate the ions can't move as freely therefore it does not behave as an electrolyte.

ResultsPlus
Examiner Comments

This candidate describes ion movement correctly, but there's no mention of solubility, so only scores 1 mark.

(c) Calcium nitrate and calcium carbonate are both ionic compounds.

Calcium nitrate mixed with water behaves as an electrolyte.
Calcium carbonate mixed with water does not behave as an electrolyte.

Explain, in terms of solubility and movement of ions, this difference in behaviour.

(2)

calcium nitrate can be dissolved in water because it's soluble whereas calcium carbonate cannot be dissolved in water because it's insoluble.

ResultsPlus
Examiner Comments

Here solubility of the two compounds is correct, but there's no mention about the movement of ions, so only 1 mark scored.

ResultsPlus
Examiner Tip

Make you deal with all that is asked for in your answer. Here an answer about both solubility and movement of ions was needed for full marks.

Question 6 (d)

This item was extremely poorly answered and merely served to demonstrate candidates' difficulty with electrolysis. Only a small number of candidates were able to produce an answer of more than 2 marks and many blank responses were seen by markers.

Many candidates are unable to identify the correct charges of the electrodes and to recognise which ions will be positive and which negative, even with those writing the 'PANIC' mnemonic at the top of the answer. Some gained credit for saying that both electrodes increased in mass, the thought often being that the cathode gained pure copper while the anode gained impure copper. Many thought that the solid appearing under the anode was copper, often impure copper that had fallen from the electrode. Few identified this solid as impurities from the anode. Almost none correctly described why the solution does not change in colour. It was very clear that very few candidates indeed had any real understanding of what was going on in this process even though this is a core practical. If they had carried it out or seen it carried out, it is clear that few candidates learned something from the experience.

One good aspect often noticed was that a good number of candidates structured their answer into 3 paragraphs dealing with one of the observations in each paragraph.

*(d) Impure copper can be purified using electrolysis.

In this electrolysis
- the anode is made of impure copper
- the cathode is made from pure copper
- the electrolyte is copper sulfate solution.

The apparatus at the start of the experiment is shown in Figure 7.

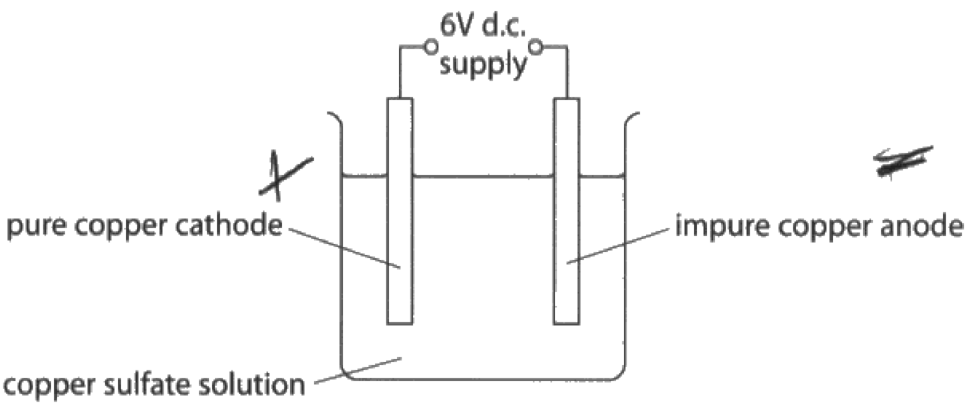


Figure 7

During the electrolysis three observations are made
- the sizes of both the anode and the cathode change
- a solid appears directly beneath the anode
- the colour of the copper sulfate solution does not change.

Explain all three observations.

(6)

In electrolysis the positive ions are attracted ~~the~~ to the anode (negative). ~~where~~ and the negative ions are attracted ~~to~~ to ~~the~~ the ~~po~~ cathode. ~~The~~ Electrolysis therefore separates the ~~[illegible]~~ mixtures. the size of the anode and cathode changes because of the amount of Electricity passing through ~~(electrolyte)~~ the electrolyte.

During the electrolysis three observations are made

- the sizes of both the anode and the cathode change
- a solid appears directly beneath the anode
- the colour of the copper sulfate solution does not change.

Explain all three observations.

(6)

In electrolysis the positive ions are attracted ~~the~~ to the anode (negative). ~~Where~~ and the negative ions are attracted ~~to~~ to ~~the~~ the ~~po~~ cathode. ~~The~~ Electrolysis therefore separates the ~~[illegible]~~ mixtures. The size of the anode and cathode changes because of the amount of electricity passing through ~~(electrolyte)~~ the electrolyte.

ResultsPlus
Examiner Comments

This scored 0.

There were more responses with the ions moving in the wrong direction than those with the ions moving in the correct direction. Concerning the changes of size of the electrodes, most candidates just repeated that without saying how they changed - increased or decreased in size or mass.

Explain all three observations.

(6)

The pure copper cathode will increase in size. This is because Copper ions are attracted to it because they ~~[illegible]~~ are ~~anions~~ cations as they have a ~~negative~~ positive charge which will be attracted to a cathode which has a negative charge. This forms a pure metal which will be seen on the cathode. ~~[illegible]~~ The impure copper anode will decrease in size as the copper ions are being transferred from it to the cathode. The solid which will appear under the anode is the waste products of the realtion which are insoluble, meaning they will not dissolve in the ~~electrolyte~~ copper sulfate solution.

ResultsPlus
Examiner Comments

The size changes of both electrodes were correct as was the explanation for those changes, though not perfect. Similarly, accounting for the solid underneath the anode was good enough even though the term 'impurity' was not mentioned. There was no mention about there being no change to the electrolyte, but overall this answer was a good one for the F tier in what is a difficult topic.

This scored 6 marks.

ResultsPlus
Examiner Tip

Try to address everything that's asked for in your answer. You may not get everything correct but it might be good enough to score at least 3 marks.

Explain all three observations.

(6)

The sizes of both the anode and the cathode change as they start to transfer ions, positive copper ions on the anode move to pure copper cathode which makes the cathode increase in size and the anode to decrease. A solid appears directly beneath the anode as the impurities gather forming a solid underneath the anode, leaving the anode to be pure copper.

The colour of the copper sulfate solution does not change as it is only the electrolyte. and the purification of the copper can't change it.

ResultsPlus
Examiner Comments

The answer showed several flaws in this candidate's understanding. The transfer of the ions from the anode to the cathode was correct as well as the size changes and the impurities underneath the anode, but the candidate thinks there are positive ions already on the anode and that after they have left pure copper remains. The rest of the answer contained nothing of credit.

This response was not good enough to be a level 3 but would be a top level answer 2 answer and was given 4 marks.

Paper Summary

Candidates who performed well on this paper had read the complete question and answered clearly and without repetition of the question. They also tended to set out their calculations in a logical manner that was easy to follow; their 6-mark answer was well structured and contained an appropriate diagram that helped their answer.

Based on the performance of this year's cohort, candidates are offered the following advice:

- Read all of the question and understand what the command words such as 'describe' and 'explain' mean.
- Ensure that you revise the core practicals thoroughly and can explain what has happened each experiment.
- Know how to write word equations given a description of a reaction.
- Know how to balance a chemical equation, know the state symbols to be used and know how to write chemical formulae using the correct conventions.
- Learn and understand the meaning of key terms such as reduction, solubility, electrolyte.
- Understand the basics of electrolysis.
- Practise calculations of the type seen in this examination paper and know how to round to a set number of decimal places or significant figures.
- To help with the above, centres are encouraged to make use of the past GCSE questions using to target particular topics and assessment objectives.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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