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Examiners' Report
June 2024

GCSE Chemistry 1CH0 1F

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June 2024

Publications Code 1CH0_1F_2406_ER

Introduction

The examination paper was based on the 9-1 Chemistry specification that was first assessed in 2018. The paper consisted of ten questions, six of which were common with the 1SC0_1CF Combined Science (Chemistry) paper and much of questions Q08, Q09 and the whole of question Q10 was common with the 1CH0_1H Chemistry (Higher) tier paper. As with the other examination papers that have assessed the current specification, a wide variety of question types were used that were suitable for this level, which included multiple choice, short open response, linking lines, interpreting diagrams of apparatus, plotting a line graph and calculations appropriate for the Foundation tier. This examination paper also assessed writing word and simple balanced equations and writing open-ended answers in the 4 – and 6-mark questions. To make the calculations more accessible, appropriate equations were given to help the students complete the calculations; some were more successful than others.

This examination paper targeted grades 1 – 5 with about half the marks targeting grades 4 and 5. It was also noted that there were many blank responses on the open-ended questions as well as where practical knowledge was being tested.

Question 1 (a)

This was a very straightforward introduction to the paper. Most of the candidates knew that the particles had to have some of regular arrangement and should be close together. Markers did give some latitude concerning how regular the arrangement was drawn, if there was at least three rows or columns of particles shown.

1 Figure 1 shows a test tube being heated in a beaker of water.

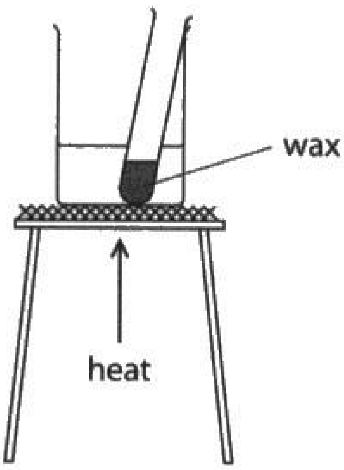


Figure 1

The test tube contains solid wax.

As the test tube was heated, the solid wax changed to liquid wax.

After heating, the wax was allowed to cool to room temperature.

(a) Figure 2 shows the arrangement of particles in liquid wax.

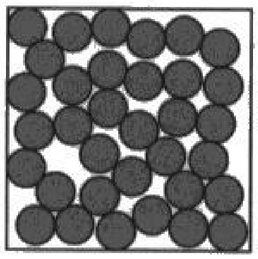


Figure 2

Draw the arrangement of particles in solid wax in the box in Figure 3.

(1)

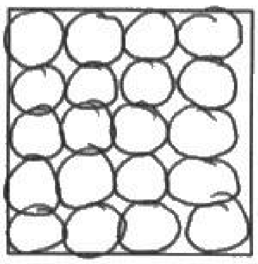


Figure 3

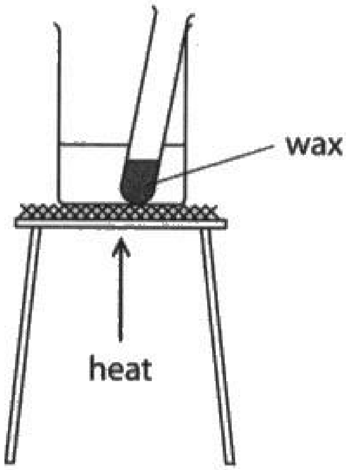
ResultsPlus
Examiner Comments

This scored 1 mark for the regular, close-packed arrangement of the particles depicting a solid.

ResultsPlus
Examiner Tip

Know the typical arrangements of particles to be found in the three states: solid, liquid and gas.

1 Figure 1 shows a test tube being heated in a beaker of water.



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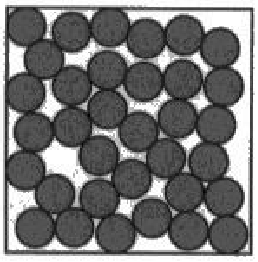


Figure 2

Draw the arrangement of particles in solid wax in the box in Figure 3.

(1)

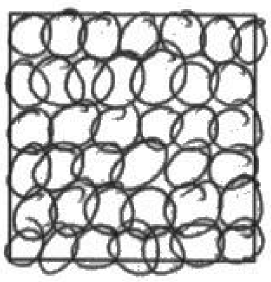


Figure 3

ResultsPlus
Examiner Comments

This scored the mark even though the circles were shown as overlapping – it still showed a regular, close-packed arrangement of particles.

Question 1 (b)(ii)

Only a relatively small proportion of candidates could explain why the change from a liquid to solid was a physical change. Many used statements such as 'a change in appearance' which would apply to both physical and chemical changes; these did not score. Only a small proportion had the idea that a physical change was reversible.

(ii) Explain why the change from a liquid to a solid is a physical change rather than a chemical change.

(2)

It is a Physical change because it is Changing to a Solid by its Self without any chemicals So the liquid Changes to Soild by freezing.

ResultsPlus
Examiner Comments

0 marks

This candidate seems to know what a physical change is but couldn't express it properly.

ResultsPlus
Examiner Tip

Learn the characteristics of physical and chemical changes. Learn the differences between physical and chemical changes.

(ii) Explain why the change from a liquid to a solid is a physical change rather than a chemical change.

(2)

it is a Physical change because it happens without any chemical reactions involved

ResultsPlus
Examiner Comments

1 mark

This scored for stating that there was no chemical reaction taking place.

(ii) Explain why the change from a liquid to a solid is a physical change rather than a chemical change.

(2)

its a physical change because it can be reversed whereas with a chemical change it can't be undone.

ResultsPlus
Examiner Comments

1 mark

This scored for stating that a physical change is reversible.

Question 1 (c)(ii)

For this item, there did need to be a comparison made or implied for the mark to be awarded. Simply saying 'the boiling point of wax is high' was not enough; there had to be a comparison with the boiling point of water. So, the statement 'the boiling point of wax is higher' had the implicit comparison with the boiling point of water; this scored the mark. The mark could also be obtained if candidates suggested that the temperature did not reach the boiling point of wax.

(ii) Suggest why the wax did **not** change into a gas when the test tube was heated in the beaker of water.

(1)

because it wasn't hot enough and it wasn't under the heat long enough

ResultsPlus
Examiner Comments

1 mark

This scored for stating that the wax was not hot enough. The rest of the answer was ignored since there was no indication in the question as to how long the wax was being heated in the beaker of hot water.

(ii) Suggest why the wax did **not** change into a gas when the test tube was heated in the beaker of water.

(1)

Because its at a low temperature and if it was to it would have to be over boiling point in °C.

(Total for Question 1 = 6 marks)

ResultsPlus
Examiner Comments

1 mark

The candidate has understood that the temperature of the wax was below its boiling point so was unable to evaporate.

(ii) Suggest why the wax did **not** change into a gas when the test tube was heated in the beaker of water.

(1)

~~Wax need a~~ Wax cannot ~~ex~~ evapourate so it does not ~~ta~~ turn into a gas.

(Total for Question 1 = 6 marks)

ResultsPlus
Examiner Comments

0 marks

This was an incorrect statement, since if the wax was hot enough then it would evaporate like any other substance at its boiling point.

(ii) Suggest why the wax did **not** change into a gas when the test tube was heated in the beaker of water.

(1)

Because the wax wasn't hot enough for it to change into a gas. And wax can't turn into a gas

ResultsPlus
Examiner Comments

0 marks

If the candidate had stopped after the first sentence, this would have scored the mark, but the second sentence is incorrect.

Question 2 (a)(i)

A variety of symbols used to denote a reversible reaction scored here. However, examiners did not credit the symbol « .

2 (a) Nitrogen reacts with hydrogen to form ammonia.

The reaction is reversible.

(i) Complete the word equation for the reaction by adding the **symbol** to show that the reaction is reversible.

(1)

nitrogen + hydrogen ⟷ ammonia

ResultsPlus Examiner Comments

0 marks

Not a correct symbol to show a reversible reaction.

2 (a) Nitrogen reacts with hydrogen to form ammonia.

The reaction is reversible.

(i) Complete the word equation for the reaction by adding the **symbol** to show that the reaction is reversible.

(1)

nitrogen + hydrogen $\rightleftharpoons$ ammonia

ResultsPlus Examiner Comments

1 mark

This version of the normal symbol was acceptable.

2 (a) Nitrogen reacts with hydrogen to form ammonia.

The reaction is reversible.

(i) Complete the word equation for the reaction by adding the **symbol** to show that the reaction is reversible.

(1)

nitrogen + hydrogen ...... $\rightleftharpoons$ ...... ammonia

ResultsPlus
Examiner Comments

1 mark

This symbol showing two arrows in opposite directions was acceptable for a reversible reaction.

Question 2 (a)(ii)

The dot and cross diagram for hydrogen seemed to be quite well known, but there were a variety of errors seen. The common errors included having one electron on each hydrogen atom, but with none in the overlapping part between the nuclei; having more than two electrons between the two nuclei; and oddly, having several more electrons shown on the electron shells in addition to the bonding pair.

(ii) Figure 4 shows the electronic configuration of an atom of hydrogen.

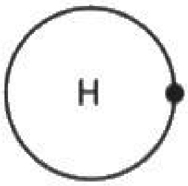
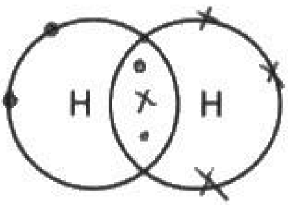


Figure 4

Complete the dot and cross diagram for a molecule of hydrogen, H_2.

(1)



ResultsPlus Examiner Comments

0 marks

A covalent bond is not made up of three electrons as well as having other electrons in the electron for both hydrogen atoms.

ResultsPlus Examiner Tip

Learn how to draw the dot and cross diagrams for the molecules listed in the specification.

(ii) Figure 4 shows the electronic configuration of an atom of hydrogen.

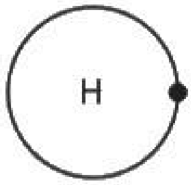
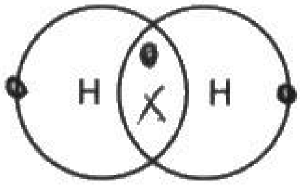


Figure 4

Complete the dot and cross diagram for a molecule of hydrogen, H_2.

(1)



ResultsPlus
Examiner Comments

0 marks

The covalent bond consisting of two electrons in the overlap area is correct, but the other electrons on the hydrogen atoms makes this answer incorrect.

Question 2 (b)(i)

Most candidates could assemble the word equation given the information and the structure it should have. However, common errors seen included just using 'sulfuric' in place of 'sulfuric acid', attempting to write a balanced equation (without success), having incorrect endings of 'ammonia' and 'ammonium' and introducing other substances into the equation.

(b) Ammonia reacts with sulfuric acid to form ammonium sulfate.

(i) Write the word equation for this reaction.

(2)

Ammonium + Sulfur → Ammoium Sulfate

ResultsPlus
Examiner Comments

1 mark

The right hand side – ammonium sulfate – is correct and scored a mark. However, on the left hand side, both reactants are incorrect.

ResultsPlus
Examiner Tip

Practise writing word equations from descriptions of reactions.

(b) Ammonia reacts with sulfuric acid to form ammonium sulfate.

(i) Write the word equation for this reaction.

(2)

~~Nitrogen~~ NH_2 + SO → NH_2SO

ResultsPlus Examiner Comments

0 marks

The candidate attempted to write a balanced equation. The question asked for a word equation. In these situations, the candidate has disadvanged themsleves as they now have to have everything correct to score the two marks.

ResultsPlus Examiner Tip

If a question asks for a word equation, write a word equation.

If a question asks for a balanced equation, write a balanced equation, not a word equation.

(b) Ammonia reacts with sulfuric acid to form ammonium sulfate.

(i) Write the word equation for this reaction.

(2)

Ammonia + sulfuric acid → ammonia sulfate

ResultsPlus Examiner Comments

1 mark

This scored for the left hand side. However, the right hand side is incorrrect: 'ammoni**a** sulfate'.

(b) Ammonia reacts with sulfuric acid to form ammonium sulfate.

(i) Write the word equation for this reaction.

(2)

~~M~~ Ammonia + ~~Sulfate~~ Sulfuric → ammonium sulfate

ResultsPlus
Examiner Comments

1 mark

The right hand side scored the mark. 'Acid' was missed after 'sulfuric' which made the left hand side incorrect.

Question 2 (b)(iii)

Most candidates tended to score for either 'fertiliser' or for a statement about improved growth or improved yield. The major misconception is that such compounds act as insecticides or help to stop insects or birds from eating the plants.

(iii) Explain why some farmers spread ammonium sulfate on their fields. **(2)**

Because it acts as ~~an~~ a fertalizer to increase the yield of their crops.

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Examiner Comments

2 marks

This contained both marking points: the point about it being a fertiliser and because it increases crop yield.

(iii) Explain why some farmers spread ammonium sulfate on their fields. **(2)**

it helps ~~kill and~~ destroy and prevent any animals, creature from wanting to eat their crops. It also helps the crops to grow.

(Total for Question 2 = 7 marks)

ResultsPlus
Examiner Comments

0 marks

It's a common misconception among many students that fertilisers acts also as pesticides – this is not so.

(iii) Explain why some farmers spread ammonium sulfate on their fields.

(2)

Ammonium sulphate is a fertiliser and helps crops grow also it kills pests and insects.

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Examiner Comments

1 mark

This scored just for stating that ammonium sulfate is a fertiliser. Even though the answer did include 'helps crops grow', but the answer also included 'it kills pest and insects' which was rejected.

Question 3 (a)

The marks awarded here were almost equally split between, 2, 1 and 0, so having the three steps in the correct for 2 marks, being able identify either the first or the last step for 1 mark. However, the majority of candidates scored at least one mark.

3 Water treatment is needed to make most sources of water suitable for drinking.

(a) Water treatment includes the processes of **chlorination**, **filtration** and **sedimentation**.

Place these processes in the order that they take place during water treatment.

(2)

first		last
Chlorination	Filtration	Sedimentation

ResultsPlus
Examiner Comments

0 marks

This was totally the wrong order.

3 Water treatment is needed to make most sources of water suitable for drinking.

(a) Water treatment includes the processes of **chlorination**, **filtration** and **sedimentation**.

Place these processes in the order that they take place during water treatment.

(2)

first		last
Sedimentation	filtration	chlorination

ResultsPlus
Examiner Comments

2 marks

The correct order – many candidates correctly placed the processes in the correct order.

3 Water treatment is needed to make most sources of water suitable for drinking.

(a) Water treatment includes the processes of **chlorination**, **filtration** and **sedimentation**.

Place these processes in the order that they take place during water treatment.

(2)

first		last
Sedimentation	chlorination	filtration

ResultsPlus
Examiner Comments

1 mark

Sedimentation was correctly placed and scored 1 mark; the other two processes were the wrong way round.

Question 3 (b)(i)

The most common misconception here was that to form a chloride ion, electrons had to be lost, and there were some answers that involved chlorine atoms sharing electrons. Other less frequent errors involved chlorine atoms losing protons to leave a negative charge or that chlorine atoms had to gain a neutron to form the chloride ion. So, of those that scored marks, some missed out on a second mark because they did not specify how many electrons the chlorine atom gained. But a good number scored full marks here.

(b) Some tap water contains chloride ions.

(i) Explain, in terms of electrons, how a chlorine atom, Cl, forms a chloride ion, Cl^-.

(2)

the chlorine atom would have gained electrons to make it negitive because electrons have a negitive charge.

ResultsPlus Examiner Comments

1 mark

Gaining electrons scored the first mark. The second could not be awarded as an unknown number of electrons appeared to be gained by the chlorine atom.

(b) Some tap water contains chloride ions.

(i) Explain, in terms of electrons, how a chlorine atom, Cl, forms a chloride ion, Cl^-.

(2)

the chlorine atom is in group 7 so it need 1 more electron to fill its outer shell to make it more Stable.

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Examiner Comments

2 marks

Electrons gained scored 1 mark; correct number of electrons gained scored the second mark.

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Examiner Tip

Know that to form negative ions, electrons are gained.

To form a positive ion, electrons are lost.

The size of the charge gives the number of electrons gained or lost – so a single negative charge means just the one electron gained and similarly a single positive charge means just the one electron lost to form the ion.

(b) Some tap water contains chloride ions.

(i) Explain, in terms of electrons, how a chlorine atom, Cl, forms a chloride ion, Cl^-.

(2)

It gains enough electrons to form an ion

ResultsPlus
Examiner Comments

1 mark

Just the one mark for gaining electrons.

(b) Some tap water contains chloride ions.

(i) Explain, in terms of electrons, how a chlorine atom, Cl, forms a chloride ion, Cl^-.

(2)

chlorine either gains ~~of~~ or loses an electron.
therefore becomes an ion

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Examiner Comments

0 marks

Electrons are gained by atoms to form negative ions. 'gains or loses' contradicts so no mark given.

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Examiner Tip

Remember to form a negative ion, atoms gain electrons.

To form a positive ion, atoms lose electons.

Question 3 (b)(iii)

Many candidates understood what the question was about and stated that tap water wasn't used because it was impure, it contains substances that could somehow interfere with the analysis. Some were vague using answers such as 'tap water contains chemicals' – they did need to be a little more precise than that by naming a relevant substance such chloride ions. It was noticeable that several candidates had misread the question and were answering why tap water **is** used in analysis, so showing that candidates do need to be a little more careful when reading the questions.

(iii) State why tap water is not suitable for use in chemical analysis.

(1)

Tap water contains impurities and bacteria in in it

ResultsPlus Examiner Comments

1 mark

Contains impurities is another way of saying that the water is impure.

(iii) State why tap water is not suitable for use in chemical analysis.

(1)

It has added chemicals to make it potable.

ResultsPlus Examiner Comments

0 marks

'Chemicals' here is too vague to be credited with a mark.

(iii) State why tap water is not suitable for use in chemical analysis.

(1)

Because tap water has been purified

ResultsPlus
Examiner Comments

0 marks

Several candidates misunderstood the question as seen by this example. This seemed to be answering the question about why tap water could be used instead.

Question 3 (c)(i)

Judging by the answers, most candidates had not spotted that the delivery tube was sitting **in** the tap water inside the conical flask and the way to solve the problem was to raise the delivery tube out of the water. Most of the answers seen fell into largely three groups – putting some form of stopper to the top of the test tube to prevent loss of water vapour, include some form of condenser as part of the delivery tube or to remove the beaker of iced-water – of course, none of these would work. Consequently only about a fifth of the candidates scored marks here.

(c) A student was asked to distil a sample of tap water.
Figure 5 shows the apparatus the student used.

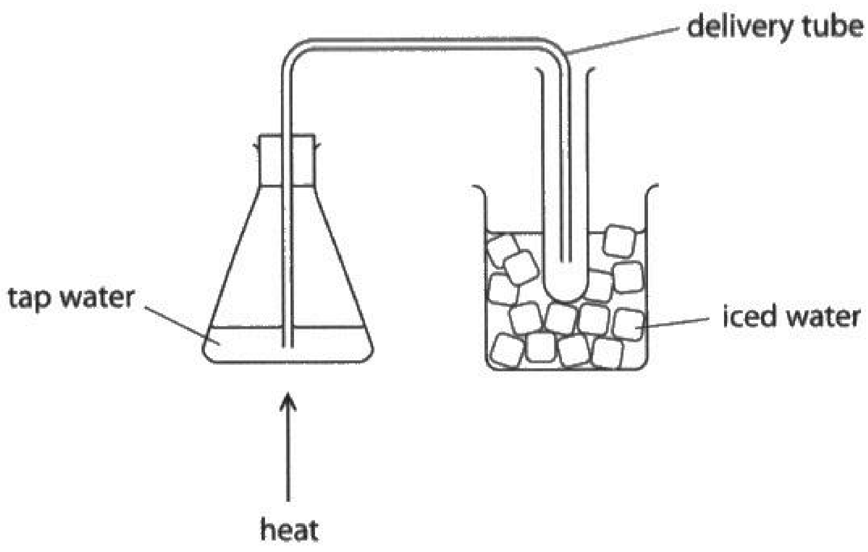

Figure 5

(i) The student made an error when setting up the apparatus in Figure 5.

This error meant that pure water could **not** be collected in the test tube.

Explain what the student needs to change so that pure water can be collected in the test tube.

(2)

The delivery tube needs to be above the tap water, not in it. Because the tap water will evaporate and needs to go into the tube. If it is in the water, evaporated water particle will go onto the sides.

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2 marks

This was a very good answer. The candidate had identified the problem, stated how the apparatus should be changed with a reason for carrying out that change.

(c) A student was asked to distil a sample of tap water.
Figure 5 shows the apparatus the student used.

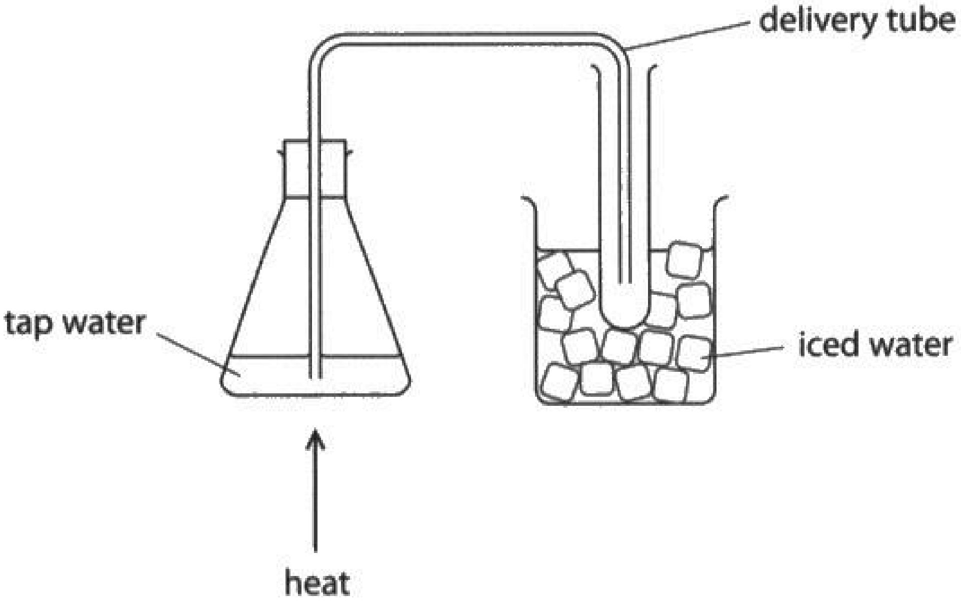

Figure 5

(i) The student made an error when setting up the apparatus in Figure 5.

This error meant that pure water could **not** be collected in the test tube.

Explain what the student needs to change so that pure water can be collected in the test tube.

(2)

The delivery tube was too low so the water ~~ot~~ couldnt go through it. It needs to be higher.

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1 mark

The candidate had idenfied the problem and suggested what to be done, but did give reason for making the change.

Question 3 (c)(ii)

By far, the overwhelming correct response here was a Bunsen burner. However, where candidates mentioned more than one type of heat source, for example 'Bunsen burner or water bath', as the water bath is incorrect, this stopped the mark from being given for Bunsen burner.

(ii) State what the student should use to heat the water.

(1)

~~Bunsen Burner~~ Water bath

ResultsPlus
Examiner Comments

0 marks

Unfortunately the candidate crossed out the correct answer and substituted it with an incorrect one.

(ii) State what the student should use to heat the water.

(1)

a bunsen burner or a candle

ResultsPlus
Examiner Comments

0 marks

Alternatives were given and the candidate is wanting the examiner to choose the correct answer. That's not how it works. The incorrect answer stops the mark from being given.

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Examiner Tip

Giving alternative answers is not a good idea.

(ii) State what the student should use to heat the water.

(1)

a heater

ResultsPlus
Examiner Comments

0 marks

This was too vague to be given a mark.

(ii) State what the student should use to heat the water.

(1)

water bath

ResultsPlus
Examiner Comments

0 marks

A water bath would not heat the contents of the flask sufficiently to cause the tap water to boil and distill. Hot water baths can only used to heat something up to temperatures below the boiling point of water.

Question 4 (a)(ii)

In order to score a mark, the candidates had to mention a suitable piece of apparatus that would deliver exactly 25.0 cm^3 of the acid. The second was for some form of technique linked with that piece of apparatus to help with the delivery of exactly 25.0 cm^3. A few candidates mentioned using a syringe, but added nothing in the way of technique. Sadly, very few candidates mentioned using a pipette, and the number who scored a second mark for technique here was very limited. The use of a burette, though not ideal, seemed to the more popular choice of apparatus capable of delivering the exact volume, but not many added anything about technique. The most popular answer, which was incorrect, was to use a measuring cylinder.

(ii) Describe how the student should measure the 25.0 cm^3 of dilute hydrochloric acid accurately into the conical flask.

(2)

~~- Fill the pipette~~

- Fill a pipette with hydrochloric acid, using a pipette filler.

- Read from the bottom of the minuscus and be at eye level to aviod acid in eyes and to get an accurate reading from the pipette.

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2 marks

Use of a pipette scored the first mark. The second mark was scored where the candidate mentioned reading from the bottom of the meniscus.

Few candidates chose to use a pipette to measure out 25.0 cm^3 of the dilute hydrochloric acid.

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Examiner Tip

Learn the technique of carrying out a titration. It is a core practical.

(ii) Describe how the student should measure the 25.0 cm^3 of dilute hydrochloric acid accurately into the conical flask.

(2)

pour it in ~~at~~ a beaker and use the burette to accurately measure the dilute hydrochloric acid

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1 mark

The use of a burette was allowed as a means of measuring 25.0 cm^3 of dilute hydrochloric acid. However, the preferred way is to use a (volumetric) pipette.

Question 4 (b)(i)

Most candidates produced a correct answer to this straightforward calculation. A few added the initial and final readings and these formed part of the group of candidates who did not look at the rest of the table to see how the volume in question was calculated.

(b) Figure 7 shows the results of the student's titrations.

	rough titration	**accurate titration 1**	**accurate titration 2**	**accurate titration 3**
final reading on **X** in cm^3	29.15	28.20	27.30	27.60
initial reading on **X** in cm^3	1.50	3.50	2.50	3.00
volume of lithium hydroxide solution added in cm^3		24.70	24.80	24.60

Figure 7

(i) Calculate the volume of lithium hydroxide solution added in the **rough** titration.

(1)

$29.15 \div 1.50 = 19.4\dot{3}$

$29.15 \times 1.50 =$

volume of lithium hydroxide solution = 43.725 cm^3

ResultsPlus
Examiner Comments

0 marks

This candidate did not look at the rest of the table to see how to calculate the volume of the rough titration.

(b) Figure 7 shows the results of the student's titrations.

	rough titration	accurate titration 1	accurate titration 2	accurate titration 3
final reading on **X** in cm^3	29.15	28.20	27.30	27.60
initial reading on **X** in cm^3	1.50	3.50	2.50	3.00
volume of lithium hydroxide solution added in cm^3		24.70	24.80	24.60

Figure 7

(i) Calculate the volume of lithium hydroxide solution added in the **rough** titration.

(1)

29.15 − 1.50 = ~~1~~ 27.65

volume of lithium hydroxide solution = 27.65 cm^3

ResultsPlus
Examiner Comments

1 mark

A correct calculation.

(b) Figure 7 shows the results of the student's titrations.

	rough titration	accurate titration 1	accurate titration 2	accurate titration 3
final reading on **X** in cm^3	29.15	28.20	27.30	27.60
initial reading on **X** in cm^3	1.50	3.50	2.50	3.00
volume of lithium hydroxide solution added in cm^3		24.70	24.80	24.60

Figure 7

(i) Calculate the volume of lithium hydroxide solution added in the **rough** titration.

(1)

24.80 − 0.3 = ~~25~~ 24.50

volume of lithium hydroxide solution = 24.50 cm^3

ResultsPlus
Examiner Comments

0 marks

It wasn't clear why the candidate chose to use the numbers in this calculation.

Question 4 (b)(ii)

Most of the candidates were able to calculate the mean volume used in the accurate titrations. A few incorrectly rounded the final answer to 24 cm^3 and lost the second mark. Another group of candidates added up all the accurate volumes of acid along with the rough titration volume, and then obtained the mean by dividing by 4, evaluated correctly gave them one mark. However, some added the three volumes: final + initial + volume delivered for one of the accurate titrations and divided by 3; this scored 0.

(ii) Calculate the mean volume of lithium hydroxide solution used in the **accurate** titrations.

(2)

24.70 + 24.80 + 24.60

24.70
24.80
24.60
74.10

mean volume of lithium hydroxide solution = 74.10 cm^3

ResultsPlus
Examiner Comments

1 mark

The candidate had added together the values of the three accurate titres which scored the first mark of the calculation, but didn't go on to find the mean by dividing by three.

(ii) Calculate the mean volume of lithium hydroxide solution used in the **accurate** titrations.

(2)

~~24.70+24.80+24.60=~~

24.70 + 24.80 + 24.60 = 74.10

74.1 ÷ 3 = 24.70

mean volume of lithium hydroxide solution = 24.70 cm^3

ResultsPlus Examiner Comments

2 marks

This candidate executed the calculation precisely to obtain the correct result.

(ii) Calculate the mean volume of lithium hydroxide solution used in the **accurate** titrations.

(2)

27.65 + 24.70 + 24.80 + 24.60

$= \frac{101.75}{4} = 25.4375$

mean volume of lithium hydroxide solution = 24.4375 cm^3

ResultsPlus Examiner Comments

0 marks

The candidate made the error of adding together the values of all three accurate titres along with the volume from the rough titration. This step therefore did not score the first mark.

The candidate divided the total of the four titrations by four to obtain a mean and calculated that correctly (25.4375 cm^3), but lost the mark by writing down the incorrect value (24.4375 cm^3) on the answer line.

Question 4 (d)(i)

Writing the balanced equation correctly for this neutralisation reaction was seen by about half the candidates. The errors seen were mostly through incorrect balancing or by writing incorrect formulae eg $LiCl_2$, which had an impact on the marks awarded.

(d) During the titration, lithium hydroxide solution, LiOH, reacts with dilute hydrochloric acid, HCl, to form lithium chloride, LiCl, and water.

(i) Write the balanced equation for the reaction.

(2)

LiO_2H + H_2Cl → $LiCl_4$ + H_2O

ResultsPlus
Examiner Comments

0 marks

The formulae of the reactants were incorrect, so did not score the first mark; the formulae of the products were also incorrect and so did not score the second mark either.

ResultsPlus
Examiner Tip

Practice writing and balancing equations. With practice comes confidence in tackling these questions.

(d) During the titration, lithium hydroxide solution, LiOH, reacts with dilute hydrochloric acid, HCl, to form lithium chloride, LiCl, and water.

(i) Write the balanced equation for the reaction.

(2)

$2LiOH$ + $2HCl$ → $2LiCl$ + $2H_2O$

ResultsPlus
Examiner Comments

2 marks

The formulae of both the reactants of the products were correct. However, the candidate had erroneously used multiples thoughout but the the equation still balanced. Full marks were given.

(d) During the titration, lithium hydroxide solution, LiOH, reacts with dilute hydrochloric acid, HCl, to form lithium chloride, LiCl, and water.

(i) Write the balanced equation for the reaction.

(2)

hydrogen + chloride → lithiumchlorid + water

ResultsPlus
Examiner Comments

0 marks

The question asked for a balanced equation. Writing a word equation in its place does not score any marks.

Question 4 (d)(ii)

Disappointingly, the majority of candidates could not give a correct name to the type of reaction shown when the lithium hydroxide solution reacted with dilute hydrochloric acid. The term 'neutralisation' only seemed to be understood by about a quarter of the candidates. Probably the most common incorrect answer was 'chemical reaction' but others such as 'endothermic', 'titration' as well as a variety of names of separating processes were also seen.

(ii) State the name of this type of reaction.

(1)

Displacement

ResultsPlus Examiner Comments

0 marks

A surprisingly large number of candidates gave this incorrect answer.

(ii) State the name of this type of reaction.

(1)

Chemical

ResultsPlus Examiner Comments

0 marks

The correct answer of 'neutralisation' was only given by about a fifth of the candidates. 'Chemical' was another frequently written incorrect answer.

(ii) State the name of this type of reaction.

(1)

Endo thermic

ResultsPlus
Examiner Comments

0 marks

This candidate had named a type of energy change in a reaction, unfortunately for this candidate, neutralisation reactions are exothermic, which would have scored in place of neutralisation.

Question 5 (a)

Using the information about the chlorine atom, nearly half of the candidates could give the correct number of protons, neutrons and electrons in a chlorine atom. The frequent errors seen were getting the number of protons and neutrons the wrong way round – candidates could still score a mark if they gave the actual number of electrons present, or the number they quoted was the same as the number of protons. The number 35 shown on Figure 8 sometimes ended up as the number of neutrons, and some candidates split that number – 17.5 and 17.5 – for the numbers of neutrons and electrons.

5 (a) Figure 8 shows some information about an atom of chlorine.

$$^{35}_{17}\mathrm{Cl}$$

Figure 8

State the number of protons, neutrons and electrons in this atom.

(3)

$\overset{2\ 1}{35} - 17 = 18$

number of protons = 17

number of neutrons = 17

number of electrons = 18

ResultsPlus
Examiner Comments

1 mark

This scored for the number of protons. It is clear that the candidate knew that the mass number was made up of two sub-atomic particles but incorrectly identified which two particles had the same number.

ResultsPlus
Examiner Tip

Remember:

- the mass number is made up of protons and neutrons
- the atomic number is the number of protons
- the number of protons and the number of elctrons in a neutral atom are the same

5 (a) Figure 8 shows some information about an atom of chlorine.

$$^{35}_{17}Cl$$

Figure 8

State the number of protons, neutrons and electrons in this atom.

(3)

number of protons = 17

number of neutrons = 17

number of electrons = 35

ResultsPlus
Examiner Comments

1 mark

This just scored for the number of protons.

5 (a) Figure 8 shows some information about an atom of chlorine.

$$^{35}_{17}Cl$$

Figure 8

State the number of protons, neutrons and electrons in this atom.

(3)

number of protons = 17

number of neutrons = 35

number of electrons = 17

ResultsPlus
Examiner Comments

2 marks

This scored for the correct number of protons and electrons.

ResultsPlus
Examiner Tip

Know how to work out the number of protons, neutrons and electrons from the atomic number and mass number for the first 20 elements.

As a challenge, extend that to some of the other elements further down the periodic table such as iodine and caesium.

5 (a) Figure 8 shows some information about an atom of chlorine.

$$^{35}_{17}Cl$$

Figure 8

State the number of protons, neutrons and electrons in this atom.

(3)

number of protons = 17

number of neutrons = 18

number of electrons = 35

ResultsPlus Examiner Comments

2 marks

This scored for the correct number of protons and neutrons.

Question 5 (b)

Unfortunately, about two-thirds did not score on this question; for those that made some attempt, it was common to see the mass of the element multiplied by the relative atomic mass. This approach was not going to score.

So, about a third of the candidates divided one number by another. Those that divided the mass of the element by its relative atomic mass, invariably ended up with the correct empirical formula having gone through the intermediate of finding the simplest whole number ratio. A frequent error seen by markers was where the candidate gave the 'inverted fraction' – ie relative atomic mass divided by the mass of the element which did not score, but if the candidate then produced the simplest whole number ratio from that along with the 'empirical formula' of Si_4Cl, 2 marks were given for the second and third steps.

Just as a side note here, candidates were required to show their working using the information given to score any marks even for a correct empirical formula.

(b) Chlorine reacts with silicon to form silicon chloride.

A sample of silicon chloride contains 1.4 g of silicon atoms and 7.1 g of chlorine atoms.

Calculate the empirical formula of this sample of silicon chloride.

(relative atomic masses: Si = 28, Cl = 35.5)

(3)

$\frac{28}{1.4} = \frac{20}{5} = 4$ $\frac{35.5}{7.1} = \frac{5}{5} = 1$ $\frac{7.1}{35.5} = 0.2$

$\frac{1.4}{28} = 0.05$

Empirical formul Si_4Cl

empirical formula = Si_4Cl

ResultsPlus Examiner Comments

2 marks

The candidate had reversed the fraction for each element – this did not score the first marking point.

The simplest whole number ratio of 4:1 was correctly determined from the fractions and scored the second marking point.

The empirical formula Si_4Cl was correctly written based on the simplest whole ratio and scored the third marking point.

ResultsPlus Examiner Tip

When calculating the empirical formula of a compound, the steps are

1. For each element, calculate the mass of element divided by relative atomic mass

2. Work out the simplest whole number ratio

3. Write the formula using the numbers in the simplest whole number ratio

(b) Chlorine reacts with silicon to form silicon chloride.

A sample of silicon chloride contains [redacted] of silicon atoms and [redacted] of chlorine atoms.

Calculate the empirical formula of this sample of silicon chloride.

(relative atomic masses: Si = 28, Cl = 35.5)

(3)

Si	Cl
$\frac{1.4g}{28}$	$\frac{7.1g}{35.5}$
$\frac{0.05}{0.05}$	$\frac{0.2}{0.05}$
1	4

empirical formula = 1 : 4

ResultsPlus
Examiner Comments

2 marks

The candidate had correctly set up the fractions for each element and evaluated them – this scored the first marking point.

The second marking point was scored for determining the simplest whole number ratio of 1:4.

The final step to obtain the empirical formula unfortunately was missing.

(b) Chlorine reacts with silicon to form silicon chloride.

A sample of silicon chloride contains 1.4 g of silicon atoms and 7.1 g of chlorine atoms.

Calculate the empirical formula of this sample of silicon chloride.

(relative atomic masses: Si = 28, Cl = 35.5)

(3)

$\frac{28}{1.4} = 20$ $\frac{35.5}{7.1} = 5$

Si : Cl

20 : 5

÷5 4 : 1 ÷5

empirical formula = 4 : 1

ResultsPlus
Examiner Comments

1 mark

This scored just for the simplest whole ratio obtained from the inverse fractions.

If the ratio had been left as 20:5, this would not score as it's not the simplest whole number ratio.

ResultsPlus
Examiner Tip

Practise calculations to determine empirical formulae of compounds using data about the masses of each element present and remember to set your work out clearly.

(b) Chlorine reacts with silicon to form silicon chloride.

A sample of silicon chloride contains 1.4 g of silicon atoms and 7.1 g of chlorine atoms.

Calculate the empirical formula of this sample of silicon chloride.

(relative atomic masses: Si = 28, Cl = 35.5)

(3)

$\frac{1.4}{28}$ $\frac{7.1}{35.5}$ $\frac{0.05}{0.05}$ $\frac{0.20}{0.05}$

1 1

÷ 0.05 0.2 = 1 = 4

1 : 4 $SiCl_4$

empirical formula = $SiCl_4$

ResultsPlus
Examiner Comments

3 marks

A well executed calculation leading to the correct empirical formula.

Question 5 (c)

About half the candidates could identify the correct group and period for silicon in the periodic table. Of the rest of the candidates, most were able to identify the correct group for 1 mark but were identifying period 2 rather than period 3; this looks very much like they had forgotten that hydrogen and helium forms the first period in the periodic table. Relatively few could not identify either, and the majority of those that scored zero, left the answers blank.

(c) The modern periodic table is organised into groups and periods.

State in which group and in which period of the periodic table silicon is found.

You should use the periodic table to help you answer this question.

(2)

group = non metals

period = 4

ResultsPlus
Examiner Comments

This scored 0 marks.

The candidate has linked the position of silicon with the group of non-metals and has identified the vertical column of elements as 'period' rather than group.

ResultsPlus
Examiner Tip

Know how how to interpret the periodic table and know the difference between the terms 'group' and 'period'.

(c) The modern periodic table is organised into groups and periods.

State in which group and in which period of the periodic table silicon is found.

You should use the periodic table to help you answer this question.

(2)

group = 3

period = 4

ResultsPlus
Examiner Comments

0 marks

It is evident that the candidate has confused the two.

ResultsPlus
Examiner Tip

Remember that the horizontal rows are periods; the vertical columns are groups.

Question 5 (d)

A wide range of answers were seen to this question. Most correct answers involved Mendeleev leaving gaps in his periodic table and that there were fewer elements. Correct statements about the modern periodic table included that it is ordered by atomic number and that group 0 is now included. The misconception most often seen was where candidates thought that Mendeleev's periodic table was not ordered into groups. Overall, candidates performed quite well on this question.

(d) Describe **two** differences between Mendeleev's periodic table and the modern periodic table.

(2)

1 There are more elements

2 There are amounts of electrons.

ResultsPlus
Examiner Comments

0 marks

The first difference given is not clear as to which form of the periodic table has the greater number of elements.

The second diffrence did not score.

(d) Describe **two** differences between Mendeleev's periodic table and the modern periodic table.

(2)

1 mendeleevs one had gaps in but the modern ~~to~~ one ~~dosnt~~ dont

2 the modern day one has groups and periods but ~~tt~~ mendleeves one dont

(Total for Question 5 = 10 marks)

ResultsPlus
Examiner Comments

1 mark

The first difference about Mendeleev's periodic table having gaps scored a mark.

The second difference given did not score as Mendeleev's periodic table also had the elements arranged in groups.

(d) Describe **two** differences between Mendeleev's periodic table and the modern periodic table.

(2)

1 mendeleeves was orderd in increasing relative atomic mass but now its in order of atomic number

2 mendeleeve had missing elements in the periodic table but the modern one is full.

ResultsPlus
Examiner Comments

2 marks

Both differences given are correct.

Question 6 (a)

A reasonably good number of candidates used the information to produce a correct answer. However, about half the candidates scored just one mark usually for dividing the mass of copper sulfate by the volume without having converted the units from cm ^{3} to dm ^{3} . Often seen also, was the incorrect conversion of units.

These calculations are fairly straightforward and candidates at this level should be capable of performing this type of calculation.

6 (a) A 250 cm^3 solution of copper sulfate contains 6.52 g of dissolved solid.

Calculate the concentration of this copper sulfate solution in g dm^{-3}.

$$\text{concentration (g dm}^{-3}) = \frac{\text{mass of solid (g)}}{\text{volume of solution (dm}^3)}$$

(2)

$\frac{250}{1000} = 0.25$ $\frac{6.52}{0.25} = 26.08$

concentration = 26.08 g dm^{-3}

ResultsPlus
Examiner Comments

2 marks

There are several different ways to calculate the concentration in g dm^{-3}

- change the volume from cm^3 to dm^3
- divide the mass by the volume to give the concentration in g dm^{-3}

Many candidates made an error when converting units – several divided by 100 rather than by 1000.

ResultsPlus
Examiner Tip

Know how to convert from cm^3 to dm^3

6 (a) A 250 cm^3 solution of copper sulfate contains 6.52 g of dissolved solid.

Calculate the concentration of this copper sulfate solution in $g\,dm^{-3}$.

$$\text{concentration } (g\,dm^{-3}) = \frac{\text{mass of solid (g)}}{\text{volume of solution } (dm^3)}$$

(2)

~~250~~ ~~$\frac{6.25}{250000}$~~ $\frac{6.25}{0.25}$

250 ÷ 1000 = 0.25 ~~2.5x10E~~ = 25 250 x1000 = 250000

concentration = 25 $g\,dm^{-3}$

ResultsPlus
Examiner Comments

1 mark

The volume was correctly converted from cm^3 to dm^3 and this scored one mark.

However, the candidate had incorrectly written the mass as 6.25 g rather than 6.52 g and so lost the second mark.

ResultsPlus
Examiner Tip

Take care with reading the numbers given in the question that you need to use. Several candidates made the same error as here using an incorrect mass of the copper sulfate.

6 (a) A 250 cm^3 solution of copper sulfate contains 6.52 g of dissolved solid.

Calculate the concentration of this copper sulfate solution in $g\,dm^{-3}$.

$$\text{concentration } (g\,dm^{-3}) = \frac{\text{mass of solid (g)}}{\text{volume of solution } (dm^3)}$$

(2)

$\frac{250cm^3}{6.25} = 38.34355828220859$

concentration = 38.3̇ $g\,dm^{-3}$

ResultsPlus

Examiner Comments

0 marks

Despite having the equation to calculate the concentration of the solution, the candidate not only used the inverse of the fraction but also did not convert the units of the volume, so scored no marks.

6 (a) A 250 cm^3 solution of copper sulfate contains 6.52 g of dissolved solid.

Calculate the concentration of this copper sulfate solution in $g\,dm^{-3}$.

$$\text{concentration } (g\,dm^{-3}) = \frac{\text{mass of solid (g)}}{\text{volume of solution } (dm^3)}$$

(2)

250 × 1000 = ~~250000dm³~~

~~250000~~ $\frac{6.52}{250000}$ = ~~2.61~~ 2.608×10^{-5}

concentration = 2.608×10^{-5} $g\,dm^{-3}$

ResultsPlus
Examiner Comments

1 mark

The candidate made an error in converting the units by multiplying the volume by 1000 rather dividing by 1000. This error was then carried forward and the fraction was correctly evaluated for 1 mark.

6 (a) A 250 cm^3 solution of copper sulfate contains 6.52 g of dissolved solid.

Calculate the concentration of this copper sulfate solution in $g\,dm^{-3}$.

$$\text{concentration } (g\,dm^{-3}) = \frac{\text{mass of solid (g)}}{\text{volume of solution } (dm^3)}$$

(2)

6.52/2.5 = 2.608 = 2.61

250/100 = 2.5

concentration = 2.61 $g\,dm^{-3}$

ResultsPlus
Examiner Comments

1 mark

The volume had not been converted, but the candidate had correctly evaluated the fraction and rounded suitably to 3 significant figures to give the answer of 2.61 g dm^{-3} and so scored 1 mark. If the answer had been rounded incorrectly as 2.60, then the mark would not have been given.

Question 6 (b)

Most candidates found this question difficult. The greater majority did not know how to go about separating the mixture of a precipitate mixed with a solution. A large number of candidates did not attempt this question; many just tried with any separation technique they could think of. Chromatography, distillation, electrolysis and even titration were all suggested, but these methods, of course, would not work. Several candidates had the idea of using filtration to remove the copper hydroxide, but only a few then went on to wash or even dry it. Some candidates who had filtered off the copper hydroxide did suggest to separate the sodium sulfate 'by crystallisation'; again only very few went on to dry the solid in some way.

(b) Sodium hydroxide solution and copper sulfate solution were reacted together completely.

The result was a mixture of a precipitate of copper hydroxide in a solution of sodium sulfate.

Describe how to obtain

- a pure sample of solid copper hydroxide from the mixture
- a pure sample of solid sodium sulfate from the mixture.

(4)

Put the Solid copper hydroxide and the solid sodium sulfate in a boiling tube. Then put said boiling tube in a water bath to completly heat up the mixture. After heating it up porr the hot mixture into filter paper to separate it.

ResultsPlus
Examiner Comments

1 mark

Only the filtration step described in the final sentence scored here as that was needed to separate the solid copper hydroxide from the sodium sulfate solution.

ResultsPlus
Examiner Tip

Learn how to carry out various methods of separating substances and how to obtain a soluble salt from a solution.

(b) Sodium hydroxide solution and copper sulfate solution were reacted together completely.

The result was a mixture of a precipitate of copper hydroxide in a solution of sodium sulfate.

Describe how to obtain

- a pure sample of solid copper hydroxide from the mixture
- a pure sample of solid sodium sulfate from the mixture.

(4)

You can obtain a pure sample of solid copper hydroxide from the mixture by ~~[illegible]~~ using fitrate paper and collect the substances filtered. You can obtain a pure sample of solid sodium sulfate from the mixture by using crystalisation.

ResultsPlus
Examiner Comments

2 marks

In this answer the candidate scored a mark for filtration to remove the copper hydroxide and for 'crystallisation' to obtain the sodium sulfate crystals. Unfortunately the candidate had not decribed how to wash the copper hydroxide nor how to dry the two compounds.

Question 6 (c)(i)

Over half the candidates could give at least one correct reason why graphite was a suitable material for the electrodes. This was mostly to do with conductivity, the second most popular reason given was that it was unreactive. It was surprising to see the number of candidates who thought that suitable properties of graphite included strong, flexible, cheap and insoluble. It was also disappointing to see the number who did not attempt this question.

(c) Figure 9 shows the equipment used to electrolyse a sample of sodium sulfate solution.

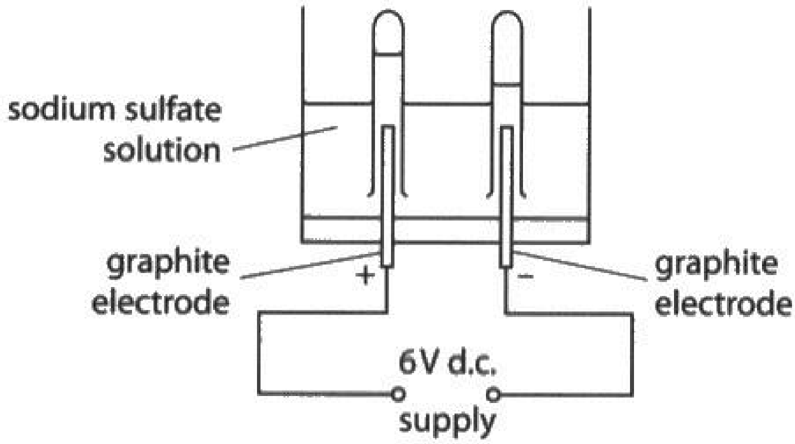


Figure 9

Graphite electrodes are used in the electrolysis.

(i) Give **two** reasons why graphite is a suitable material for the electrodes.

(2)

1 graphite conducts electricity

2 graphite is unreactive

ResultsPlus
Examiner Comments

2 marks

The candidate had given two correct reasons why graphite would be a suitable material for the electrodes.

(c) Figure 9 shows the equipment used to electrolyse a sample of sodium sulfate solution.

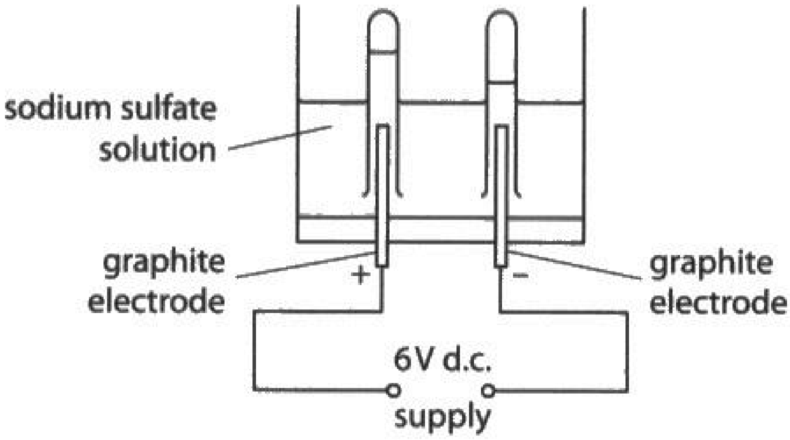


Figure 9

Graphite electrodes are used in the electrolysis.

(i) Give **two** reasons why graphite is a suitable material for the electrodes.

(2)

1 good conductor of electricity

2 soluble

ResultsPlus
Examiner Comments

1 mark

Graphite is a good conductor of electricity but is not soluble, so only 1 mark scored.

It was surprising to see how many had given soluble a reason for graphite to be used for the electrodes.

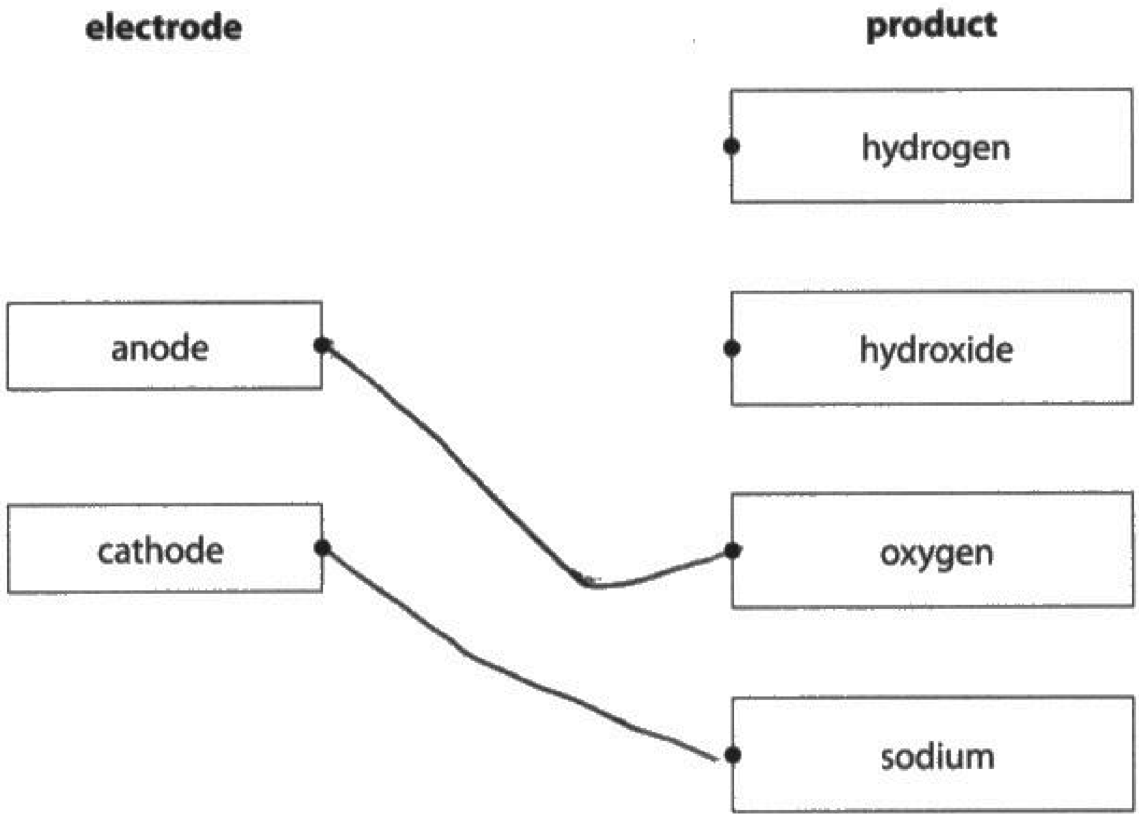
Question 6 (c)(iii)

Only about a quarter of the candidates could identify one of the correct products of electrolysis. It was disappointing to see so many with the wrong answers. Only a few could correctly identify both. Candidates do find the topic of electrolysis difficult.

This style of question has been used in many Foundation tier Chemistry papers, so it is quite surprising to see that several candidates still do not read the instructions and draw two or more lines to connect a box on the left with those on the right.

(iii) Draw **one** straight line from each electrode to the product formed at that electrode during the electrolysis of sodium sulfate solution.

(2)



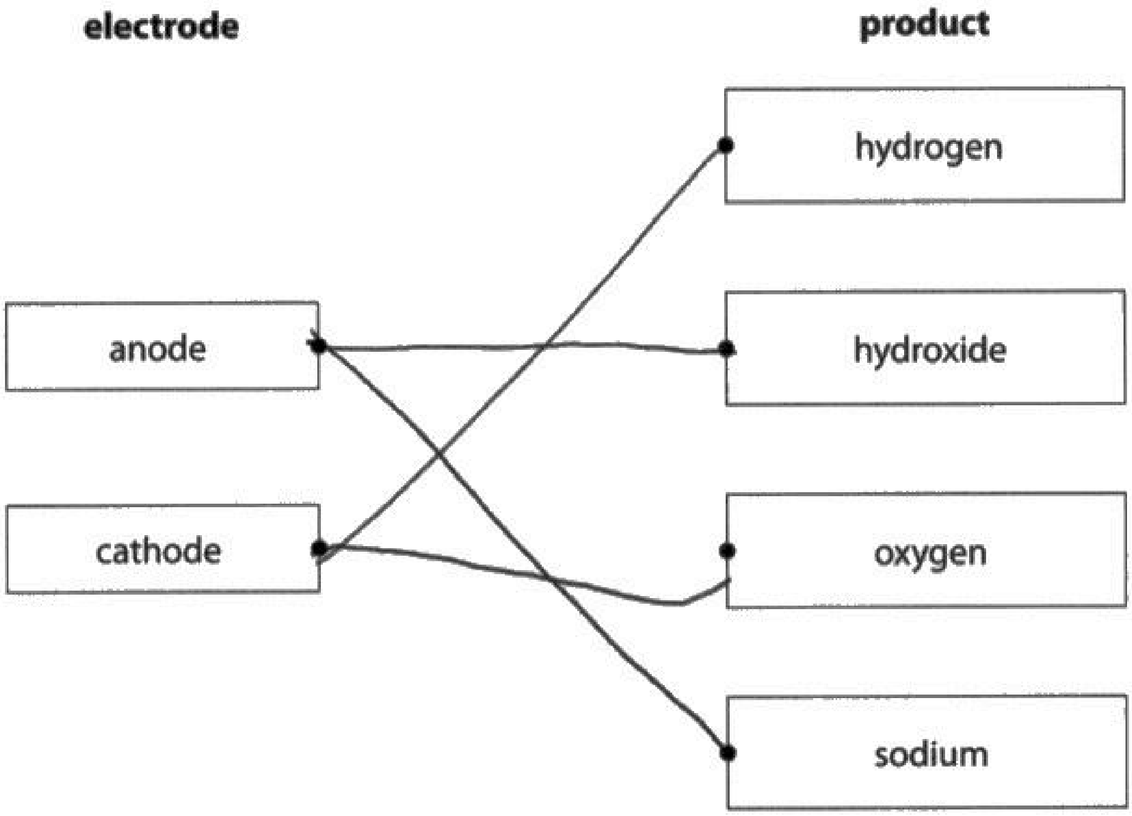
ResultsPlus
Examiner Comments

1 mark

One mark was scored for identifying oxygen as the product at the anode.

(iii) Draw **one** straight line from each electrode to the product formed at that electrode during the electrolysis of sodium sulfate solution.

(2)



ResultsPlus
Examiner Comments

0 marks

Candidates score no marks for drawing multiple lines when the instruction at the top is for drawing ONE line from each electrode to the product formed at that electrode.

Question 7 (a)(i)

This proved to be a very straightforward calculation with the greater majority of candidates scoring the three marks. The main error seen was largely not calculating the change in mass and simply dividing the final mass of the rod by the mass of the rod which gave the answer of 108% – this scored 2 marks.

7 (a) A student investigated the rusting of iron rods using the following method.

step 1 find the mass of two identical iron rods

step 2 wrap magnesium ribbon around one of the iron rods

step 3 place each rod in separate boiling tubes containing 10 cm^3 of water

step 4 leave the iron rods for one week

step 5 find the new mass of the iron rods.

Figure 10 shows the apparatus used.

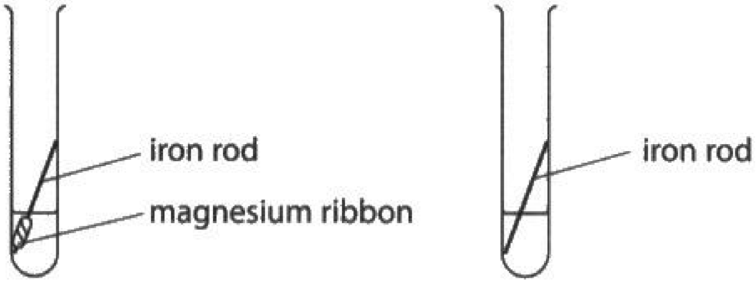


Figure 10

Figure 11 shows the results of the investigation.

	initial mass of iron rod in g	final mass of iron rod in g	change in mass in g
boiling tube **A**	7.00	7.00	0.00
boiling tube **B**	7.00	7.56	

Figure 11

(i) Use the results in Figure 11 to calculate the percentage increase in the mass of the iron rod in boiling tube **B**.

$$\% \text{ increase} = \frac{\text{change in mass}}{\text{initial mass}} \times 100$$

(3)

7.56 - 7 = 0.56

$\frac{0.56}{7.56} \times 100 = 7.407$

percentage increase in mass of iron rod = 7.407

ResultsPlus
Examiner Comments

2 marks

The candidate had correctly calculated the difference in mass (0.56 g) but divided by the final mass instead of the initial mass. So this scored for the increase in mass (marking point 1) and calculation and evaluation of the percentage (marking point 3).

7 (a) A student investigated the rusting of iron rods using the following method.

step 1 find the mass of two identical iron rods

step 2 wrap magnesium ribbon around one of the iron rods

step 3 place each rod in separate boiling tubes containing 10 cm³ of water

step 4 leave the iron rods for one week

step 5 find the new mass of the iron rods.

Figure 10 shows the apparatus used.

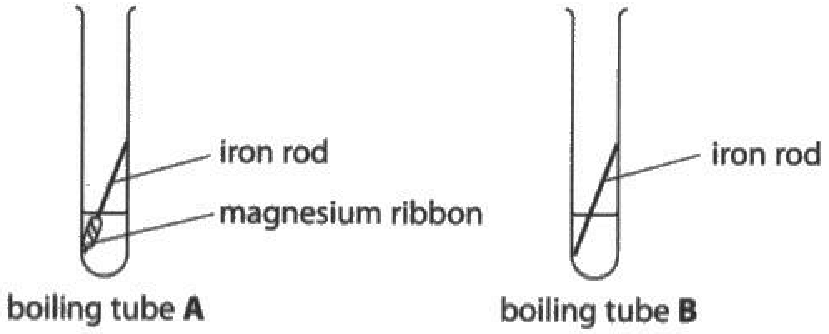


Figure 10

Figure 11 shows the results of the investigation.

	initial mass of iron rod in g	final mass of iron rod in g	change in mass in g
boiling tube **A**	7.00	7.00	0.00
boiling tube **B**	7.00	7.56	

Figure 11

(i) Use the results in Figure 11 to calculate the percentage increase in the mass of the iron rod in boiling tube **B**.

$$\% \text{ increase} = \frac{\text{change in mass}}{\text{initial mass}} \times 100$$

(3)

$\frac{7.56}{7.00} \times 100 = 108\%$

percentage increase in mass of iron rod = 108%

ResultsPlus
Examiner Comments

2 marks

This candidate had missed the first step of calculating the change in mass, however the subsequent calculation with that error carried forward was correct to give 108%.

7 (a) A student investigated the rusting of iron rods using the following method.

step 1 find the mass of two identical iron rods

step 2 wrap magnesium ribbon around one of the iron rods

step 3 place each rod in separate boiling tubes containing 10 cm^3 of water

step 4 leave the iron rods for one week

step 5 find the new mass of the iron rods.

Figure 10 shows the apparatus used.

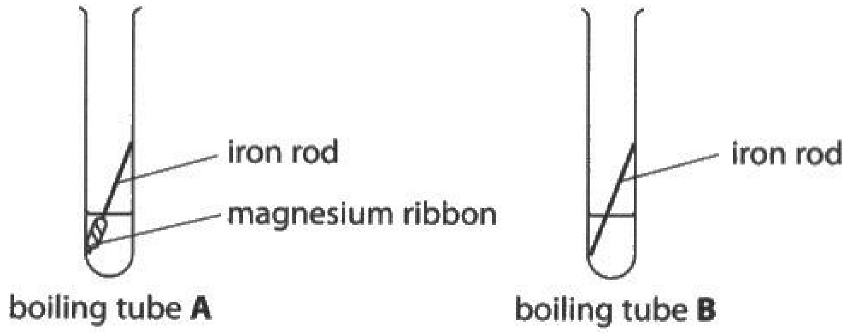


Figure 10

Figure 11 shows the results of the investigation.

	initial mass of iron rod in g	final mass of iron rod in g	change in mass in g
boiling tube **A**	7.00	7.00	0.00
boiling tube **B**	7.00	7.56	

Figure 11

(i) Use the results in Figure 11 to calculate the percentage increase in the mass of the iron rod in [redacted].

$$\% \text{ increase} = \frac{\text{change in mass}}{\text{initial mass}} \times 100$$

(3)

$\frac{0.56}{7} \times 100$

percentage increase in mass of iron rod = 8·

ResultsPlus
Examiner Comments

3 marks

A correct calculation succinctly written out.

Question 7 (a)(iii)

Although many candidates had the right idea when answering this question very few gave a real explanation. Many answers just consisted of the iron nail being protected by the magnesium but not say how – magnesium reacts rather than iron, or that magnesium reacts with oxygen instead but not said why – magnesium is more reactive than iron. There were, however, a large number of candidates who thought the magnesium being wrapped around the nail formed a physical barrier preventing oxygen and water getting through to the nail, rather than a chemical explanation of sacrificial protection.

(iii) The iron rod did not rust in boiling tube **A**.

Explain why.

(2)

The magnesium ribbon meant that the rod will not corrode as magnesium is reactive than iron
more

ResultsPlus
Examiner Comments

1 mark

This answer made a correct statement about the difference in reactivity of the two metals.

(iii) The iron rod did not rust in boiling tube **A**.

Explain why.

(2)

Because it was wrapped in magnesium ribbon to prevent the iron rod from coming in contact with the water or gas from the air

ResultsPlus
Examiner Comments

0 marks

The idea of magnesium forming a physical barrier did not score.

(iii) The iron rod did not rust in boiling tube **A**.

Explain why.

(2)

As the magnesium ribbon used as scarificial protection so the magnesium reacts as it has a higher reactiving so water and oxygen does not come in contact with iron does not corrode.

ResultsPlus
Examiner Comments

2 marks

The marks were given for 'magnesium ... used as sacrificial protection' and '(magnesium) has a higher reactivity (than iron)'.

(iii) The iron rod did not rust in boiling tube **A**.

Explain why.

(2)

Because the magnesium ribbon acts as a barrier and prevents rusting by adding a protective layer and absorbing the oxygen.

ResultsPlus
Examiner Comments

1 mark

This answer scored for magnesium providing a protective layer, but nearly scored 2 marks if instead of the last 4 words the candidate had written 'by reacting with oxygen'

Question 7 (b)

As an extended open response question, this worked really well on this paper. The question allowed candidates to firstly identify uses of copper from the photographs and then provide reasons based on copper's properties why it was used in those situations.

A good proportion of candidates produced very good quality answers, scoring 5 or 6 marks, identifying a range of copper's properties for at least two of the uses; the two uses that attracted most properties were to make wires and to make pipes.

The majority of candidates identified the uses and for each could give a related property for that use or they could identify one use and link that use to a range of properties. So for those who scored 3 or 4 marks, there was a variety of ways that mark could be achieved.

Those who scored 1 mark resulted from just being able to identify a use or a property of copper while those who scored 2 marks could identify all 4 uses of copper shown in the photographs or could a property to a use of copper.

Overall, this question did allow candidates to shown what they did know about uses of copper and how the properties of copper were related to its uses.

*(b) Figure 12 shows some uses of copper metal.

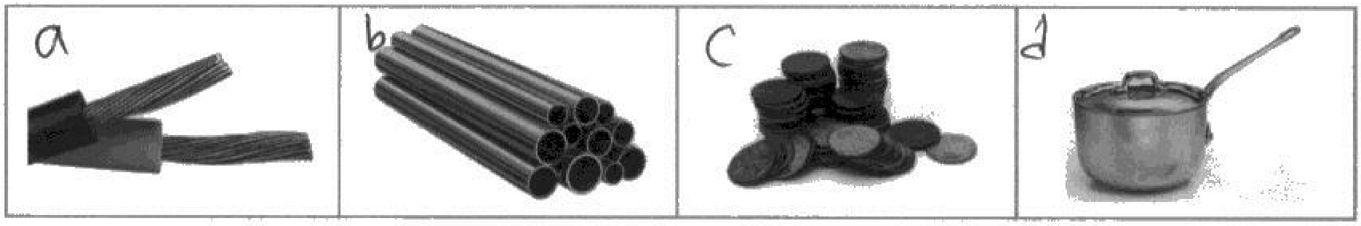


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Figure 12

Describe how the properties of copper metal make it a suitable material for the uses shown.

Your answer should include

- uses of copper metal shown in the photographs
- properties of copper metal including:
  - chemical reactivity
  - electrical conductivity
  - malleability
  - thermal conductivity

(6)

The use of copper A is to make electricity pass through it.

D is good at thermal conductivity because it is good at retaning heat.

ResultsPlus
Examiner Comments

This was a level 1 answer scoring 1 mark, The candidate just made observation of a property of copper relevant to its use in cookware.

*(b) Figure 12 shows some uses of copper metal.

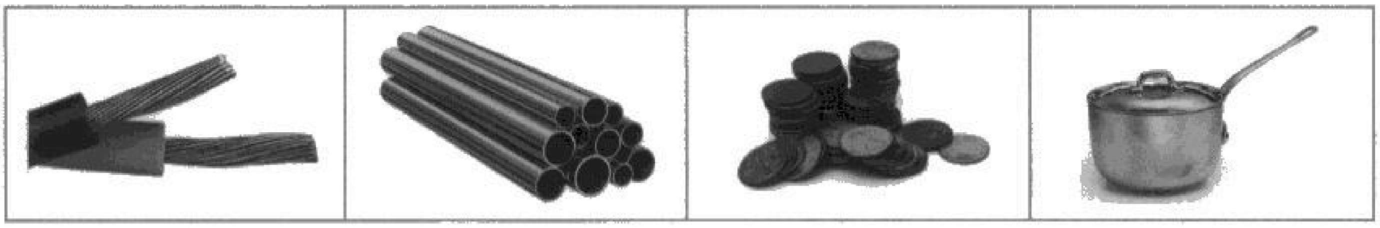

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Figure 12

Describe how the properties of copper metal make it a suitable material for the uses shown.

Your answer should include

- uses of copper metal shown in the photographs
- properties of copper metal including:
  - chemical reactivity
  - electrical conductivity
  - malleability
  - thermal conductivity

(6)

Copper can be used in eletrical wiring. Its suitable for this, as it does not conduct electricity. Another use of copper is in pots/pans. It is suitable for this because it has a high melting point, so a high thermal conductivity

ResultsPlus
Examiner Comments

A level 2 answer scoring 3 marks. The candidate had correctly identified two of the uses of copper but had given an incorrect statement about electrical conductivity. However, a correct property was given – high thermal conductivity – for use of copper in cookware.

*(b) Figure 12 shows some uses of copper metal.

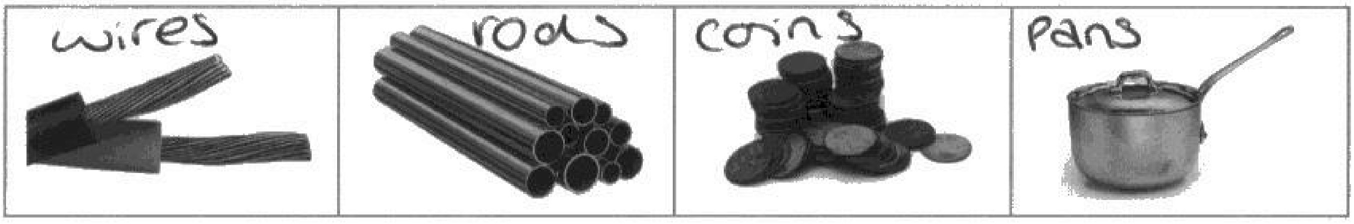

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Figure 12

Describe how the properties of copper metal make it a suitable material for the uses shown.

Your answer should include

- uses of copper metal shown in the photographs
- properties of copper metal including:
  - chemical reactivity
  - electrical conductivity
  - malleability
  - thermal conductivity

(6)

· Copper metal is used in wires as it is a good electrical and thermal conducter, as well as being malleable, however it is not very reactive which makes it good for long lasting wires.

Copper metal is used in tubing rods as its ~~[illegible]~~ ~~[illegible]~~ low rate of chemical reactivity means it ~~[illegible]~~ will take a longer time to rust, it is not too malleable which means it can be used for solid tubing.

copper metal is used for coins as it doesn't react to quickly to chemicals which allows for ~~thes~~ coins to last for long periods of time. It is also not incredibly malleable so it doesn't bend easily and can last for a long time.

copper metal is used for cooking equipment as it is a good thermal conductor and transfers the heat energy into the food/water being cooked or boiled.

ResultsPlus
Examiner Comments

A level 3 answer; this was awarded 6 marks.

All four uses had been identified with relevant properties associated. There were sufficient properties given for two uses which made this a level 3 answer. Overall, a very good answer for Foundation Tier.

Question 8 (a)(i)

The greater majority of the candidates could balance the equation by adding the correct number in front of the formula for hydrochloric acid. Several showed how they arrived at the answer by listing and totalling the number of atoms of element on either side of the equation. There were some who doubled everything, giving the equation as $2Ba(OH)_2 + 4HCl \rightarrow 2BaCl_2 + 4H_2O$, which was fine, but those forgot to change then number in front of H_2O from 2 to 4 lost the mark.

Question 8 (a)(ii)

Very few candidates gave an answer that scored a mark. Many incorrect answers seen which included the go-to observations such as 'bubbling' (or similar – but the equation in part (i) did not have a gas being evolved), 'change of colour' and 'a reaction occurs' (as in 'reacting to form barium chloride and water').

In questions such as this, we are looking for an observation, so anything similar to the barium hydroxide dissolving or it disappears, or the mixture becomes clear would have scored.

(ii) State what you would **see** during the reaction.

(1)

the Barium hydroxide dissolving

ResultsPlus
Examiner Comments

1 mark

This was an acceptable answer for the barium hydroxide disappearing as it reacts with the hydrochloric acid.

(ii) State what you would **see** during the reaction.

(1)

bubbles

ResultsPlus
Examiner Comments

0 marks

This was one of the most popular answers seen, but it was not correct. Many candidates had not looked at the information given and in particular the equation for the reaction which showed no gas being produced.

ResultsPlus
Examiner Tip

Make use of all the information given to you when answering questions about unfamiliar reactions.

Question 8 (b)(i)

Only about a quarter of the candidates could give a correct answer to this question. Answers that did score included naming another indicator such as litmus or methyl orange, anything with pH in it such as pH measurer or pH scale and surprisingly a significant number identified a piece of equipment such as burette or pipette as a means of measuring the pH more accurately.

(i) Name a piece of equipment that could be used to measure the pH of a substance more accurately than universal indicator paper.

(1)

~~Universal indicator.~~ Methyl orange

ResultsPlus
Examiner Comments

0 marks

Other indicators would not help to determine the pH of a solution.

(i) Name a piece of equipment that could be used to measure the pH of a substance more accurately than universal indicator paper.

(1)

universal indicator Solution

ResultsPlus
Examiner Comments

0 marks

This was a frequently seen answer. The candidate had missed the first part of the question where it asks to 'Name a piece of equipment ...'

(i) Name a piece of equipment that could be used to measure the pH of a substance more accurately than universal indicator paper.

(1)

PH Metar

ResultsPlus
Examiner Comments

1 mark

A correct answer was only given by about a quarter of the candidates.

Question 8 (b)(ii)

About three-quarters of the candidates scored a mark for indicating that the mixture would be evenly spread, but only a small number scored a second mark for a suitable reason such as to ensure the substances react or to make the reaction faster. The most frequent incorrect answer seen was 'to make it more accurate'.

(ii) Explain why, in step 3, the mixture was stirred after adding the barium hydroxide.

(2)

~~So its mu~~ So it mixes together

ResultsPlus
Examiner Comments

1 mark

This scored for mixing the reactants together which was an allowed response on the markscheme.

(ii) Explain why, in step 3, the mixture was stirred after adding the barium hydroxide.

(2)

to speed up the reaction and make sure all the reactant was used

ResultsPlus
Examiner Comments

1 mark

Unfortunately for the candidate the answer contained two ideas that were the same mark point in the markscheme, which is why 2 marks could not be given.

(ii) Explain why, in step 3, the mixture was stirred after adding the barium hydroxide.

(2)

To ensure the barium hydroxide was fully disolved and distributed evenly before reading the ph again.

ResultsPlus Examiner Comments

2 marks

This scored for both marking points:

- to ensure the barium hydroxide was fully dissolved ... – mark point 2
- ... and distributed evenly – mark point 1

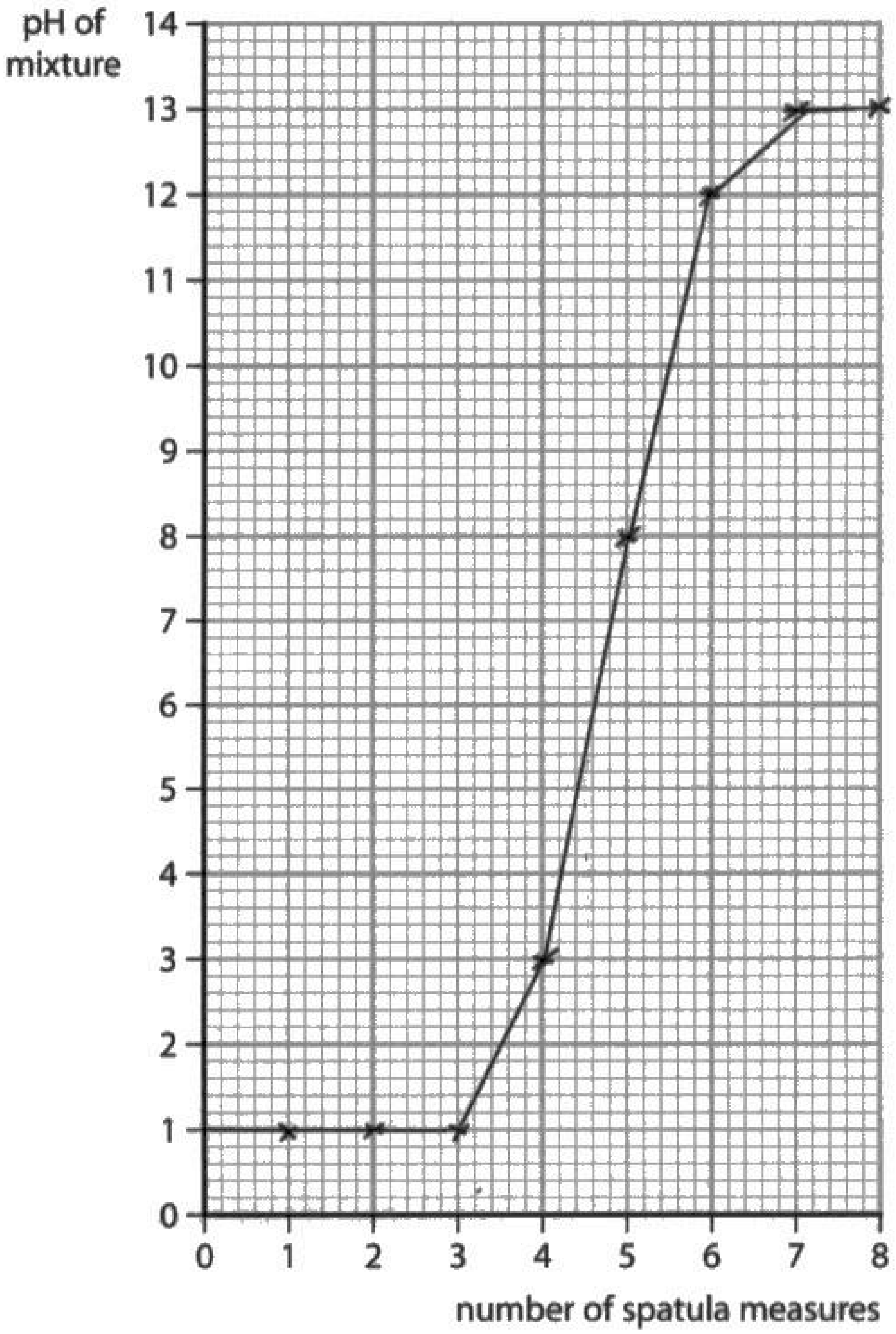
Question 8 (b)(iii-iv)

Plotting of the graph was, in the most part, generally well done but there were a few who missed plotting the point at 0 spatula measures. Successful candidates generally showed their plotted point with ‘x’ which examiners appreciated very much. Most candidates drew a best fit S-shaped curve through the points, however those who drew straight lines from point-to-point were not credited with the mark. In addition, there was a sizeable number of candidates who did not draw a best fit line and missed out on the third mark.

Examiners checked the reading quoted by the candidate with the candidate’s graph. Mostly they matched and the mark was awarded. However, some candidate’s reading of 4.5 spatula measures was not always correct in that some were drawing vertical lines at 4.4 or even 4.6 which made a big difference to the corresponding pH from the graph. Those who did not draw a best fit line to the graph could not be awarded a mark for their value but a few candidates did draw a line from the point for 4 spatula measures to the point at 5 spatula measures and then came up with the reading 4.5 spatula measures and were the mark if the examiner agreed with the reading.

Plot a graph of the pH of the mixture against the number of spatula measures of barium hydroxide.

(3)



(iv) Use the graph to find the pH of the mixture when 4.5 spatula measures of barium hydroxide are added.

(1)

pH of the mixture = 5

ResultsPlus
Examiner Comments

8biii: 2 marks

The points were plotted correctly and this scored 2 marks.

However, the best fit should be a curved around the 3-4 spautla measures and again at the top end going through the points. This line did not score the mark.

8biv: 0 marks

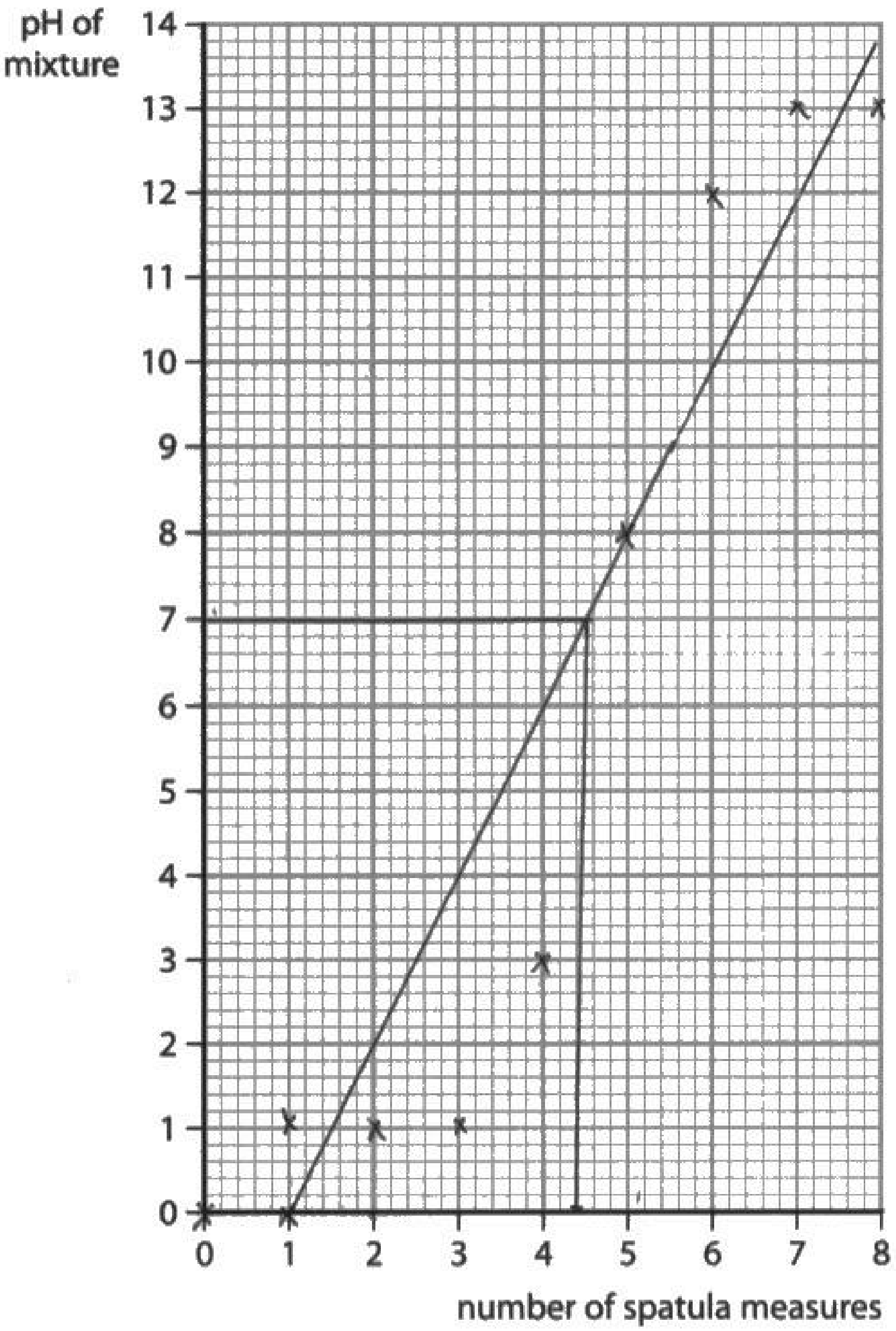
Markers checked the point carefully for accuracy of reading. At 4.5 spatula measures, the candidate's line drawn corresponds to a pH of 5.3 rather 5.

ResultsPlus
Examiner Tip

Practise plotting graphs. Points are best shown on graphs with a small 'x'. If the points look to fall on a straight line, then the best fit line would be a straight line. Otherwise, as in this question, the points form a curve, so the best fit line is curved.

Plot a graph of the pH of the mixture against the number of spatula measures of barium hydroxide.

(3)



(iv) Use the graph to find the pH of the mixture when 4.5 spatula measures of barium hydroxide are added.

(1)

pH of the mixture = ...7......

ResultsPlus
Examiner Comments

8biii: 1 mark

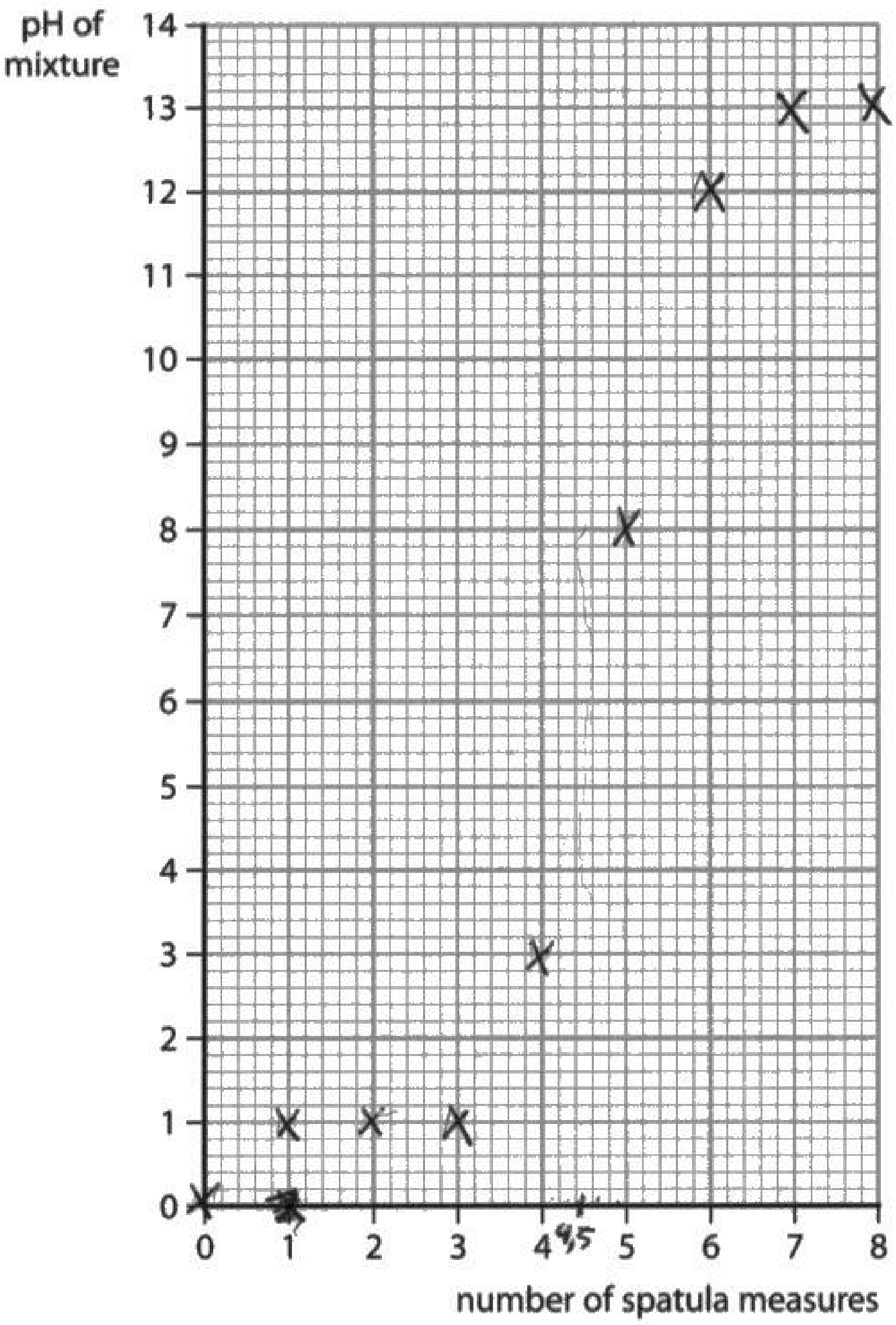
8biv: 1 mark

8biii – Eight points on the graph were plotted correctly to score 1 mark; the first point should have been at pH1 rather than pH 0. The line of best fit did not score.

8biv – the pH was read correctly for the addition of 4.5 spatula measures of barium hydroxide.

Plot a graph of the pH of the mixture against the number of spatula measures of barium hydroxide.

(3)



(iv) Use the graph to find the pH of the mixture when 4.5 spatula measures of barium hydroxide are added.

(1)

pH of the mixture = 8

ResultsPlus
Examiner Comments

8biii: 1 mark

8biv: 0 marks

8biii – 8 of the points were plotted correctly and so scored 1 mark; the first point was plotted incorrectly. There was no line of best fit.

8biv – as there was no line of best fit, this could not score.

Question 8 (d)

It was quite surprising to see that only about a third of the candidates gave a correct answer to this question by the use of a balance (or similar). Probably the most common misconception seen here was to use a measuring cylinder to find the precise amount even though they were told that the barium hydroxide was shown as a solid earlier in the question. Others suggested using a pipette or burette, probably because they know they are more accurate ways of measuring volumes of liquids. The use of the word 'scale' can cause problems. There are many scales – pH. temperature and of course, weighing. If it's unqualified, then a mark cannot be given since it's not certain as to what type of scale the candidate means. 'Measuring scale' is also a problem because it does not say what is being measured. We do allow 'scales' as a set of scales can be used to find the mass of an object.

(d) The barium hydroxide was measured in spatulas.

State **one** way that the measuring of the barium hydroxide could be improved.

(1)

measuring it in mols

ResultsPlus Examiner Comments

1 mark

Although moles is not on the specification for Foundation Tier candidates, this answer is still correct and so scores the mark.

(d) The barium hydroxide was measured in spatulas.

State **one** way that the measuring of the barium hydroxide could be improved.

(1)

Use a measuring Scale instead

ResultsPlus
Examiner Comments

0 marks

'Measuring scale' is somewhat vague and does not specify what is being measure.

(d) The barium hydroxide was measured in spatulas.

State **one** way that the measuring of the barium hydroxide could be improved.

(1)

It could be measured using a measuring cylinder or a pipette.

ResultsPlus
Examiner Comments

0 marks

Barium hydroxide is a solid, as it was measured out in spatula measures in part (b) as well as shown in the balanced equation in part (a) as having the state symbol for a solid.

(d) The barium hydroxide was measured in spatulas.

State **one** way that the measuring of the barium hydroxide could be improved.

(1)

Use a Scale

ResultsPlus
Examiner Comments

0 marks

A mark would have been scored if the candidate had written 'scales' or 'a set of scales' as these are used to find a substance's mass.

Question 9 (a)(ii)

Only a very small number scored all three marking points on this question. These were the only candidates who made a comment about the structure of an ionic compound to explain why the ions in a solid could not move and therefore not conduct. A small number made a worthwhile statement about the ability of ions to move in a liquid, ions not moving in a solid, or both, to explain the difference in electrical conductivity.

The biggest misconception seen was when candidates wrote about the presence of delocalised electrons able to move in a liquid or not move in a solid. Where candidates tried to use 'charged particles' in place of 'ions', this was only allowed for the first marking point about the structure of the ionic solid as this would too be ambiguous for movement of or lack of movement of them in a liquid or solid.

Some candidates still have the erroneous idea of electricity moving through free space in liquids and not in solids due to the lack of free space.

(ii) Explain why solid sodium carbonate **cannot** conduct electricity but a solution of sodium carbonate **can** conduct electricity.

(3)

Ions themselves are in a fixed ionic lattice So cannot move to Conduct electricity however when dissolved in a Solution the ions are free to move So can Conduct.

ResultsPlus Examiner Comments

3 marks

This was one of the few answers that scored all three marking points:

(ii) Explain why solid sodium carbonate **cannot** conduct electricity but a solution of sodium carbonate **can** conduct electricity.

(3)

Solid sodium carbonate does not have any free ~~ele~~ delocalised electrons to let energy pass through where as a ~~So~~ soultion of sodium carbonate has delocalised electrons to pass electronic currents.

ResultsPlus Examiner Comments

0 marks

Most of the candidates who attempted this question wrote about the need for delocalised electrons for conductivity in the solution of sodium carbonate and the lack of them to explain why the solid sodium carbonate did not conduct electricity.

(ii) Explain why solid sodium carbonate **cannot** conduct electricity but a solution of sodium carbonate **can** conduct electricity.

(3)

The solution ~~hs~~ has free moving ions but a Solid is in a fixed position with a strong structure not letting electricity through. The ~~so~~ Solution has free moving particles.

ResultsPlus
Examiner Comments

1 mark

The mark here was given for the solution having free moving ions. Unfortunately, the candidate did not specify what was in a fixed position in the solid.

Question 9 (b)

Many candidates made a good attempt at answering this question. A correct calculation for the relative formula mass of sodium carbonate was often seen, but many candidates made subsequent errors such as using the combined relative atomic masses of Na+C+O (=51) as the numerator value of the fraction. This gave a frequently seen answer of 48.11%. Rather than using the total relative atomic mass of sodium in sodium carbonate (2 x 23 = 46), a significant number of candidates just used the singular value of 23 and ended up with a value of 21.7% for 2 marks.

(b) Calculate the percentage by mass of sodium in sodium carbonate, Na_2CO_3.

$$\text{percentage by mass of element} = \frac{\text{total relative atomic mass of element}}{\text{relative formula mass of compound}} \times 100$$

(relative atomic masses: C = 12, O = 16, Na = 23)

(3)

Na = 23 x 2 = 46   23 $\frac{51}{106}$ x100 = 48.1...

C = 12 x 1 = 12   12

O = 16 x 3 = 48 +   16 +

106   51

percentage by mass of sodium = 48 %

ResultsPlus
Examiner Comments

1 mark

This is just awarded 1 mark for calculating the correct formula mass (106) of sodium carbonate. The next two steps, as shown on the mark scheme, required the use of the relative atomic of sodium as the numerator in the calculation of the percentage of sodium in the compound.

(b) Calculate the percentage by mass of sodium in sodium carbonate, Na_2CO_3.

$$\text{percentage by mass of element} = \frac{\text{total relative atomic mass of element}}{\text{relative formula mass of compound}} \times 100$$

(relative atomic masses: C = 12, O = 16, Na = 23)

(3)

12 + 48 + 46

$\frac{23}{106} \times 100 = 21.698$

percentage by mass of sodium = 21.698

ResultsPlus
Examiner Comments

2 marks

The candidate had shown how the formula mass of sodium carbonate was calculated: 12 + 48 + 46 and had used that total (106) when calculating the percentage of sodium in the compound. However, the candidate had only used 1 x 23 rather than 2 x 23 for the two sodiums present in the formula. This led to a final answer which was half of the correct answer. This calculation was given by many candidates.

(b) Calculate the percentage by mass of sodium in sodium carbonate, Na_2CO_3.

$$\text{percentage by mass of element} = \frac{\text{total relative atomic mass of element}}{\text{relative formula mass of compound}} \times 100$$

(relative atomic masses: C = 12, O = 16, Na = 23)

(3)

23 × 2 = 46   C = (12 × 1) +

(12 × 1) + (16 × 3) + (23 × 2) = 106.

$\frac{46}{106} \times 100 = 43.4$ (1dp).

percentage by mass of sodium = 43.4%

ResultsPlus Examiner Comments

3 marks

A correct calculation with all the necessary working method of the percentage of sodium in sodium carbonate.

Question 9 (c)

As is often the case with 6-mark questions on Foundation tier, relatively few candidates were answering the actual question in which they were required to explain, using the results given in Figure 15 to identify the 3 solids as being sodium carbonate, powdered zinc or copper oxide.

Those who successfully produced a detailed answer that was considered to be a level 3 (5 or 6 marks) not only had correctly identified A, B and C but also backed that up with explanations such as when a carbonate reacts with an acid, carbon dioxide is given off and this was shown to be produced by substance C where the gas given gave a positive test carbon dioxide using the limewater, and similar for at least one other substance. Some at this level also gave a correct word equation (or two). However, only a small minority of the candidates fell into this category.

There were many who thought they had answered the question, but only really copied the information given in Figure 15. Answers of this type could not receive credit. There were also many candidates who seemed to guess the identity of the 3 solids, sometimes correctly, but many just seemed to guess that solid A was copper oxide, B was powdered zinc and C was sodium carbonate, with little justification other than, for example 'I know A is copper oxide because the gas given off gives no change with limewater and a squeaky pop with a lit splint'. Answers of this type invariably were at the lower end of the scale sometimes being awarded 1 mark for a correct identification. Certainly candidates who were scoring the lower marks, were, in general, tending to shorten the names to just copper or sodium, and that made marking somewhat difficult. The greater majority of the candidates fell into this group, just stating information from the Figure 15 without any explanation.

That left the small group in the middle who produced a level 2 answer. Of this group it seemed that most were scoring for stating that substance C was sodium carbonate because when it reacted it gave off a gas which was found to be carbon dioxide as it turned limewater cloudy. Similar to the other 6-mark question, many candidates just relied on copying information given to them rather than explaining any information that would help back up a decision.

*(c) A student has three solids, **A**, **B** and **C**.

The solids are sodium carbonate, powdered zinc and copper oxide, but the student does not know which solid is which.

The student reacted each solid with dilute sulfuric acid.

Figure 15 shows the student's observations and the results of tests on any gases produced.

	observations and results		
	reaction with dilute sulfuric acid	**gas bubbled through limewater**	**gas tested with a lit splint**
Zinc solid **A**	bubbles seen colourless solution formed	no change	squeaky pop
Copper solid **B**	blue solution formed some black solid remains at bottom of test tube	no gas produced	no gas produced
Sodium solid **C**	bubbles seen colourless solution formed	limewater turned cloudy	puts out lit splint

Figure 15

Use the observations and results in Figure 15 to identify which solid is which.

Your answer should include

- how each test result helps you to identify the solid
- word equations to support your answer.

(6)

Solib B is copper oxide this is because Copper + dilute sulfuric acid turns into copper sulfate which is a blue solution. Also copper oxide does not all disolve with sulfuric acid. Copper oxide doesn't react with lime water so no gas is produced (Copper oxide + limewate → No reaction). Copper oxide also doesn't react with oxygen so it won't light a splint.

Solid A is zinc as when reacting with dilute sulfuric acid it starts bubbiling and a colourless solution is formed this as its on the reactivity scale and in group 0.

Solid C is sodium carbonate as when the gas is bubbled through limewater it turns cloudy. and when tested with oxygen it puts out a lit splint. Also it goes colourless in dilute sulfuric acid.

ResultsPlus
Examiner Comments

Level 2 – 4 marks

This answer started well with a correct identification of solid B (copper oxide) and detailed the reaction of solid B with dilute sulfuric acid naming the blue solution, however much of the rest of the answer showed a misunderstanding about the two gas tests.

The identities of A and C were correct, but were not backed up by the results of the gas tests.

*(c) A student has three solids, **A**, **B** and **C**.

The solids are sodium carbonate, powdered zinc and copper oxide, but the student does not know which solid is which.

The student reacted each solid with dilute sulfuric acid.

Figure 15 shows the student's observations and the results of tests on any gases produced.

	observations and results		
	reaction with dilute sulfuric acid	**gas bubbled through limewater**	**gas tested with a lit splint**
solid **A**	bubbles seen colourless solution formed	no change	squeaky pop
solid **B**	blue solution formed some black solid remains at bottom of test tube	no gas produced	no gas produced
solid **C**	bubbles seen colourless solution formed	limewater turned cloudy	puts out lit splint

Figure 15

Use the observations and results in Figure 15 to identify which solid is which.

Your answer should include

- how each test result helps you to identify the solid
- word equations to support your answer.

(6)

Solid A was tested with ~~[illegible]~~ dilute sulphuric acid and no full reaction was seen so we know that they cant match, it then tried gas bubbled through limewater and there was no change, the last test was it being tested with a lit splint so we know that the solid A is the reaction matched with it being tested with a lit splint and also in the table solid B had no gas produced when it was tested with a lit splint and solid C puts out the ~~lit~~ splint so it cant match to B or C.

The next one to be tested was solid B I know it cant be the test procuced with a lit splint as no gas was produced and it matches to solid A. There was two for it to be out of either reaction with dilute sulfric acid or gas bubbled with limewater, the student tested solid B with the dilute sulfric acid firstly and a reaction was formed of a blue solution so we knew solid B reaction test matches with dilute sulfric acid as once Tested with bubbled through limewater no gas was produced.

finally, solid C was tested and from the results of the other solids I know it wouldnt match with it being tested with a lit splint or dilute sulfuric acid whereas it had a reaction when bubbled through limewater and that was the lime water turned cloudy.

after all the tests I believe solid A is sodium carbonate, solid B is powdered Zinc solid C is Copper oxide.

ResultsPlus
Examiner Comments

This scored 0.

The candidate had copied many of the observations from the table without interpreting them, eg for solid A there was the observation that when the gas was bubbled through limewater there was no change and this was followed stating that the gas was therefore not carbon dioxide. At the end of the answer, the candidate listed the identities of the solids, but these are incorrect and were not backed with relevant justification.

*(c) A student has three solids, **A**, **B** and **C**.

The solids are sodium carbonate, powdered zinc and copper oxide, but the student does not know which solid is which.

metal + acid → salt + hydrogen

The student reacted each solid with dilute sulfuric acid.

Figure 15 shows the student's observations and the results of tests on any gases produced.

	observations and results		
	reaction with dilute sulfuric acid	**gas bubbled through limewater**	**gas tested with a lit splint**
solid **A**	bubbles seen colourless solution formed ~~sodium~~ zinc	no change	squeaky pop
solid **B**	blue solution formed copper some black solid remains at bottom of test tube	no gas produced	no gas produced
solid **C**	bubbles seen ~~zinc~~ sodium colourless solution formed	limewater turned cloudy	puts out lit splint

Figure 15

Use the observations and results in Figure 15 to identify which solid is which.

Your answer should include

- how each test result helps you to identify the solid
- word equations to support your answer.

(6)

Solid A forms bubbles in the presence of the dilute sulfuric acid showing that it is somewhat reactive. There is not much to be told about the limewater test other than the fact that it doesn't contain CO_2, ruling out sodium which we know contains carbon. What is really telling is the squeaky pop produced from the lit splint, meaning that hydrogen is present. Applying the knowledge that a metal reacting with an acid produces salt and hydrogen, it allows us to infer therefore that solid A must be zinc as it is the only metal option. Since solid C turns cloudy in the limewater, we know CO_2 is present, making the only option sodium carbonate, this is further proved by the lit splint test, it's results demonstrating the oxygen putting out the flame. This leaves only solid B which can now be inferred as copper oxide. This can be confirmed throughout such as the black solid remaining in test tube, meaning it is insoluble as well as the fact that no gas was produced from the ~~test~~ lit splint test. Applying the fact that an oxide or hydroxide reacting with acid produce just salt and water and no gasses, it can be confirmed that copper oxide must be solution B.

ResultsPlus
Examiner Comments

Level 3 – 6 marks

The candidate had correctly identified each of the 3 substances (allowing copper in place of copper oxide and sodium in place of sodium carbonate for this purpose) and for each substance had backed this up with relevant interpretations of the various tests. This was not a perfect answer, but this was a very good answer for Foundation Tier having identified the 3 substances and backed that up with several pieces of knowledge.

Question 10 (a)(i)

This was a surprisingly straightforward calculation for many candidates. About half the candidates scored all 3 marks; the most common error was not to give the answer to 1 decimal place. Another frequent error seen occurred when the candidate thought the actual yield was obtained by subtracting the mass of titanium produced (45.26 tonnes) from the initial mass of titanium oxide (100 tonnes) (so losing the first mark) and then dividing by the theoretical yield and when rounded to 1 dp, gave an answer of 91.2% to score 2 marks. A question on a previous paper showed that many candidates do not understand the terms 'actual yield' and 'theoretical yield'. Despite being given the equation for how to calculate the percentage yield, a disappointing number did not attempt the calculation.

10 (a) Titanium can be extracted from titanium oxide, TiO_2, by reaction with magnesium.

(i) 100 tonnes of titanium oxide was heated with magnesium.
The titanium formed in the reaction was separated and purified.
The mass of titanium was then determined.

The results are shown in Figure 16.

	mass in tonnes
mass of titanium oxide	100.00
mass of titanium produced	45.26
theoretical mass of titanium formed	60.00

Figure 16

Use the information in Figure 16 to calculate the percentage yield of titanium in this process.

$$\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

Give your answer to 1 decimal place.

(3)

....

....

....

....

percentage yield = 75.4

ResultsPlus
Examiner Comments

3 marks

A correct answer, but a risky move as there was no working method shown.

Note: If the candidate had rounded incorrectly to 75.5, then this would be given 0 marks. The working method as shown in the markscheme shows how the marks are awarded.

ResultsPlus
Examiner Tip

Always show your working method for a calculation question. That way, marks could be awarded for the working method even if the final answer is incorrect.

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	mass in tonnes
mass of titanium oxide	100.00
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Figure 16

Use the information in Figure 16 to calculate the percentage yield of titanium in this process.

$$\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

Give your answer to 1 decimal place.

(3)

45.26 ÷ 60.00 = 0.7543

0.7543 ×100 = 75.43

percentage yield = 75.43 %

ResultsPlus
Examiner Comments

2 marks

The candidate had correctly calculated the percentage but had given the answer to 2 decimal places rather 1.

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Figure 16

Use the information in Figure 16 to calculate the percentage yield of titanium in this process.

$$\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

Give your answer to 1 decimal place.

(3)

Percentage yield = $\frac{54.74}{60.00} \times 100$ = 91.23% → 91.3%

Actual yield = 100 − 45.26 = 54.74

Percentage Yield = 91.3%

percentage yield = 91.3%

ResultsPlus
Examiner Comments

1 mark

The candidate had subtracted the actual yield from 100. The subsequent calculation would then give a final answer of 91.2%, but the candidate had rounded their final answer incorrectly. So only 1 mark could be awarded.

10 (a) Titanium can be extracted from titanium oxide, TiO_2, by reaction with magnesium.

(i) 100 tonnes of titanium oxide was heated with magnesium. -mg
The titanium formed in the reaction was separated and purified.
The mass of titanium was then determined.

The results are shown in Figure 16.

	mass in tonnes
mass of titanium oxide	100.00
mass of titanium produced	45.26
theoretical mass of titanium formed	60.00

Figure 16

Use the information in Figure 16 to calculate the percentage yield of titanium in this process.

$$\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

Give your answer to 1 decimal place.

(3)

100 − 45 = 55 $\frac{55}{60} \times 100$

$\frac{45.26}{60} \times 100$

= 0.7543 × 100 = 75.43 or 91.6

percentage yield = 91.6

ResultsPlus
Examiner Comments

1 mark

Two calculations are shown – 1 correct one leading to the correct answer of 75.43% before any required rounding to 1dp, and in incorrect one leading to the answer as given on the answer line which counted. Two errors were made – rounding the mass of titanium to 45 tonnes and then subtracting this actual yield from 100. Consequently only 1 mark could be awarded.

ResultsPlus
Examiner Tip

Use the numbers as given in the question for any required calculation.

Question 10 (a)(ii)

There was a wide range of answers given for this question, however there were only a few candidates who scored 2 marks. A significant number did not attempt this question. A good number of candidates could give correct reasons such as those given on the markscheme, but there many answers that showed various misconceptions. Some candidates referred to not all products reacted or simply vague comments about titanium was lost in the process – here they needed to refer specifically to the separation or purification of the titanium. Other answers that did not included energy or products lost to the atmosphere and spillages during the process.

(ii) Give **two** reasons why the percentage yield for **this process** is less than 100%.

(2)

1 wrong amount of reactants were used.

2 Chemical reaction wasn't completed fully.

ResultsPlus
Examiner Comments

1 mark

This was given the mark for an incomplete reaction.

(ii) Give **two** reasons why the percentage yield for **this process** is less than 100%.

(2)

1 ~~overestimate~~ ~~overestimate~~ heated with magnesium

2 ~~a~~ not enough titanium oxide

ResultsPlus
Examiner Comments

0 marks

Several candidates did think that not enough titanium oxide was used in the reaction. They weren't told how much magnesium was used, so if there was a shortage of a reactant, it would then be magnesium.

(ii) Give **two** reasons why the percentage yield for **this process** is less than 100%.

(2)

1 Loses Substances in during process

2 You can't get more than 100%

ResultsPlus
Examiner Comments

0 marks

Reason 1 – did not score as we were looking for possible loss of substance during separation or purification rather just a general comment.

Reason 2 – many candidates did offer this as a reason, but were not given credit as it showed a lack of understanding of percentage yield.

(ii) Give **two** reasons why the percentage yield for **this process** is less than 100%.

(2)

1 It couldve lost some in purifaction

2 they might not of let it run long enough

ResultsPlus
Examiner Comments

2 marks

This was given marks for both reasons – loss of product during purification and incomplete reaction.

Question 10 (a)(iii)

Many candidates appeared to have misread the denominator of the provided equation. Instead of reading this as '... all reactants or products', they read as '... all reactants and products' judging from the way in which those candidates had 256 as the denominator. Many made a good start by correctly calculating the total relative formula mass of either the reactants or products, but several used the total relative atomic mass of various combinations of elements rather than just that of titanium. Many missed out on the 3rd marking point by either forgetting to give their answer to 2 significant figures or by incorrect rounding.

(iii) The balanced equation for this process is

1 O   2Mg
1 Ti

$$TiO_2 + 2Mg \rightarrow Ti + 2MgO$$

Calculate the atom economy of this process to produce titanium.

$$\text{atom economy (\%)} = \frac{\text{total formula mass of desired product}}{\text{total formula mass of all reactants or products}} \times 100$$

Give your answer to 2 significant figures.

(relative atomic masses: O = 16, Mg = 24, Ti = 48)

(3)

16+24+24 +48 = 112

48 +

$\frac{112}{128} \times 100 = 88\%$

atom economy = 88 %

ResultsPlus
Examiner Comments

2 marks

The candidate managed to calculate the total formula mass of the reactants as 128 was seen as the denominator in the fraction – this scored the first marking point.

However, the candidate mistakingly tried to calculate the total formula mass of **all the products** (the firgure of 112) rather than the total formula of the **desired product** (Ti = 48), as seen in the fraction, so was not given the second marking point.

The fraction to calculate the percentage was evaluated correctly and given to 2 significant figure, scoring the 3rd marking poin.

ResultsPlus
Examiner Tip

If the question asks for the answer to be rounded to a nunber of significant figures or decimal places, or asked to be given to the nearest whole number, highlight that instruction to remind you before you write your final answer.

(iii) The balanced equation for this process is

$$TiO_2 + 2Mg \rightarrow Ti + 2MgO$$

Calculate the atom economy of this process to produce titanium.

$$\text{atom economy (\%)} = \frac{\text{total formula mass of desired product}}{\text{total formula mass of all reactants or products}} \times 100$$

Give your answer to 2 significant figures.

(relative atomic masses: O = 16, Mg = 24, Ti = 48)

(3)

Ti = 48 + (16 x 2) = 80

Mg = 24 x 2 = 48

80 + 48 =

$\frac{48}{128}$ = 37.5

atom economy = 37.5 %

ResultsPlus
Examiner Comments

2 marks

The first and second marking points were scored by this candidate, but had not given the final answer to 2 significant figures, missing out on the 3rd marking point.

ResultsPlus
Examiner Tip

Practise calculating the atom economy for a variety of reactions, both familiar and unfamiliar, using the balanced equations and the relative atomic masses of the elements.

(iii) The balanced equation for this process is

$$TiO_2 + 2Mg \rightarrow Ti + 2MgO$$

Calculate the atom economy of this process to produce titanium.

$$\text{atom economy (\%)} = \frac{\text{total formula mass of desired product}}{\text{total formula mass of all reactants or products}} \times 100$$

Give your answer to 2 significant figures.

(relative atomic masses: O = 16, Mg = 24, Ti = 48)

(3)

$\frac{48}{112} \times 100$ $48 + (2 \times 24) + 16$

$= 112$

$= 42.9$

atom economy = 42.9 %

ResultsPlus
Examiner Comments

1 mark

The candidate had made an error in calculating the total formula mass of all reactants – their total was 112, so was not given the first mark.

The second mark was given for calculating the percentage 48/112 x 100, with the error carried forward, but was not give the third mark as the evaluated answer was not given to 2 significant figure.

Question 10 (b)(i)

The idea why the atom economy of a reaction to be 100% was not well known among the candidates. Only a small proportion could give a correct answer, with most opting for answers as 'the equation is balanced', 'nothing was lost', 'because the reaction was efficient' or similar.

(b) Ethanol, C_2H_5OH, can be produced by two different methods.

- by the hydration of ethene, C_2H_4

  $C_2H_4 + H_2O \rightarrow C_2H_5OH$ atom economy = 100%

- and by the fermentation of a carbohydrate, e.g. sucrose, $C_{12}H_{22}O_{11}$

  $C_{12}H_{22}O_{11} + H_2O \rightarrow 4C_2H_5OH + 4CO_2$ atom economy = 51.1%

(i) State why the hydration of ethene has an atom economy of 100%.

(1)

The formulea was balanced,

ResultsPlus
Examiner Comments

0 marks

The idea of the reactants and product are balanced was a common misconception suggested by many candidates.

(b) Ethanol, C_2H_5OH, can be produced by two different methods.

- by the hydration of ethene, C_2H_4

  $C_2H_4 + H_2O \rightarrow C_2H_5OH$ atom economy = 100%

- and by the fermentation of a carbohydrate, e.g. sucrose, $C_{12}H_{22}O_{11}$

  $C_{12}H_{22}O_{11} + H_2O \rightarrow 4C_2H_5OH + 4CO_2$ atom economy = 51.1%

(i) State why the hydration of ethene has an atom economy of 100%.

(1)

There is only one product formed

ResultsPlus
Examiner Comments

1 mark

This was a rare correct answer.

(b) Ethanol, C_2H_5OH, can be produced by two different methods.

- by the hydration of ethene, C_2H_4

  $C_2H_4 + H_2O \rightarrow C_2H_5OH$ atom economy = 100%

- and by the fermentation of a carbohydrate, e.g. sucrose, $C_{12}H_{22}O_{11}$

  $C_{12}H_{22}O_{11} + H_2O \rightarrow 4C_2H_5OH + 4CO_2$ atom economy = 51.1%

(i) State why the hydration of ethene has an atom economy of 100%.

(1)

As there is no change in the
total Formula masses

ResultsPlus
Examiner Comments

0 marks

If this had said that the total formula mass of the reactants = formula mass of the desired product (or ethene), then this would have scored.

Question 10 (b)(ii)

Very few candidates scored any marks on this question. A few suggested finding a use for or selling the carbon dioxide but omitted saying that carbon dioxide would then become a useful or desired product.

Many suggested increasing (or decreasing) the amount of reactants or changing the carbohydrate. Many also confused atom economy with percentage yield and suggested changing the conditions to obtain more of the product. There were many who did not understand how the atom economy could be increased simply by using a by-product in a useful way, so it becomes a desired product. And there many who did not attempt this question.

(ii) Explain how the atom economy of the fermentation reaction can be improved.

(2)

Condense the Carbon dioxide and reuse it. Or sell it to companies to use it for fizzy water. This will increase the atom economy as all was used.

(Total for Question 10 = 11 marks)

ResultsPlus
Examiner Comments

2 marks

This scored both marking points:

- finding a use for the carbon dioxide that is also formed – here it was to make fizzy water
- final sentence the answer states the atom economy would increase as all was used.

(ii) Explain how the atom economy of the fermentation reaction can be improved.

(2)

Use the wasted product, which carbon dioxide and use it to make fizzy drink, so it is useful, making it a desired product increasing the atom ~~economy~~ economy to 100%.

ResultsPlus
Examiner Comments

2 marks

The candidate has suggested making use of the waste product, carbon dioxide, to make fizzy drinks and recognised that the carbon dioxide then became a useful product.

(ii) Explain how the atom economy of the fermentation reaction can be improved.

(2)

You could find a use for the carbon dioxide. For example, you could use it to make drinks fizzy.

ResultsPlus
Examiner Comments

1 mark

The candidate suggested finding a use for the carbon dioxide that is formed, but didn't say that the carbon dioxide would then become a useful product, so scored only the first marking point.

(ii) Explain how the atom economy of the fermentation reaction can be improved.

(2)

Ensure all conditions are at their optimum e.g temperature is at its best throughout the reaction.

ResultsPlus
Examiner Comments

0 marks

Many candidates thought that by having the 'optimum conditions' would increase the atom economy. Examiners reported that many candidates had confused atom economy with percentage yield as their answers were trying improve the yield rather than atom economy.

Paper Summary

The candidates who performed well on this paper were those who had read and understood the questions, answered the questions succinctly without repeating the question. They also answered the extended writing questions in a logical manner and set out their calculations in full so it was easy to see how the final answer was obtained.

- Based on this year's performance, candidates are offered the following advice:
- Make use of the past GCSE papers that their teachers can provide.
- Read the whole question to ensure that they know what is needed for the answer.
- Revise the core practical's as these form the basis of many of the questions covering practical work.
- Practice writing word and simple balanced equations.
- Practice answering the types of calculations seen in this examination paper; know how to round a numerical answer to the required number of significant figures or decimal places.
- Learn and understand the different types of reaction eg neutralisation
- Learn the gas tests
- Learn how to separate mixtures of substances

Teachers can help their candidates with their revision by accessing past paper questions targeting particular topics using Exam Wizard or downloading whole papers from the Pearson website.

Grade boundaries

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

https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

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