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Examiners' Report
June 2022

GCSE Combined Science 1SC0 1CF

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June 2022

Publications Code 1SC0_1CF_2206_ER

Introduction

Paper 1CF is the first of two Chemistry papers in the suite of six papers for Combined Science. The six questions in this paper are six of the ten questions in GCSE Chemistry Foundation Tier Paper 1. The final question(s) in this paper are also found in the equivalent Higher Tier papers.

This is the first set of GCSEs sat under normal conditions since summer 2019. The papers were set and marked as usual, although an Advance Notice was issued giving some information about the topics that would and would not appear in the paper. The setting of grade boundaries was adjusted under Ofqual rules so that the standards are midway between 2019 and 2021.

Question 1 (a)

The candidates generally understood this question, although they did not always clearly distinguish between solids and liquids. A key to scoring well on this question was to reference **particles** in the answer (rather than the bulk material). Some candidates used bullet points which helped them to give a clear, concise response. In the arrangement of particles, some candidates had a lack of detail, but better candidates described particles being in a regular lattice (although this word did not need to be used – they described this in terms of rows of particles, fixed positions, for example). Weaker candidates talked about compactness and density which was not clear. Some candidates mentioned solid particles vibrating – but unfortunately also said that liquid particles vibrated. There is distinct confusion between solid particles not moving (from place to place, there is no net movement when vibration occurs) and them vibrating, with candidates saying 'solids don't move very much'. Some candidates contradicted themselves when discussing movement, so they had gained the marks in the first section then lost them later. Weaker candidates misread the question and talked about what had happened to the three substances in the experiment. Occasionally candidates drew diagrams and, when they did, these usually helped them to secure some of the marks. A significant number of candidates did not acknowledge the differences between the arrangement subsection and motion subsection which was intended to help the candidates organise their answer.

(a) Describe the differences in the arrangement and movement of the particles in a solid and in a liquid.

(2)

difference in arrangement of particles

the Solids vibrate in a fixed compact position whereas the Liquid particles are allways moving and are Spread wider appart

difference in movement of particles

the Solid particles dont move but instaid vibrate in a fixed Position. Liquids particles are allways moving

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Examiner Comments

This answer mentions some useful points in the first paragraph:

- (particles in a) solid vibrate
- liquid particles are moving
- liquid particles are further apart

In the second paragraph:

- solid particles don't move but vibrate
- particles in a fixed position in a solid
- liquid particles are moving

There is plenty of correct information here to score 2 marks.

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Examiner Tip

The headings of arrangement and movement are given here to help organize the answer. This answer does not organize the information in this way. Use headings where they are given.

(a) Describe the differences in the arrangement and movement of the particles in a solid and in a liquid.

(2)

difference in arrangement of particles

Solid are closely compacted toghether and ~~[illegible]~~ liquid is near eachother but not touching

difference in movement of particles

~~[illegible]~~ Solid the particles have a slight vibration liquid have more of a quicker vibration

ResultsPlus
Examiner Comments

In a solid the particles VIBRATE.

In a liquid the particles do not vibrate, but MOVE from place to place.

Question 1 (c)

This question was well answered, although sometimes candidates were vague (metals are 'hard to melt' did not score). Some even said that metals cannot melt (some justifying this by saying that metals conducted the heat (or even electricity) instead). Some latched on to irrelevant properties, such as conductivity, whilst others did not score because they talked about boiling point. Better candidates simply said that the melting point was too high, or higher than chocolate, or that it was not hot enough, or that there was not enough heat or energy.

(c) Give a reason why the metal spoon has not changed state during the experiment.

(1)

the metal spoon is metal so it will have a really high melting point.

ResultsPlus
Examiner Comments

This answer has chosen the correct property that explains why the metal does not change state.

(c) Give a reason why the metal spoon has not changed state during the experiment.

(1)

It's boiling point is higher than the chocolate and egg white as it's made of metal.

ResultsPlus
Examiner Comments

Read questions very carefully – this one is about melting, so an answer about boiling points will not score.

Question 1 (d)

Many candidates got the mark for the change in the egg white (often by just noting that the egg white goes solid), but not so many referenced the lack of change back indicating a chemical change (using the word 'irreversible' was a helpful way to gain the second mark). Some incorrect answers for this included: food is a chemical and that's why it's a chemical change; it's being put over heat that makes it a chemical change; the egg cooked in the heat; egg white has a liquid that is a chemical; it's a physical change because its look hasn't changed; chemical reactions need chemicals; physical reactions change the shape or size. Some candidates did not read the question carefully and justified why this was a physical change. Candidates should look, in a 2 mark question, to say 2 different things.

(d) Explain how we know the change to the egg white is a chemical change rather than a physical change.

(2)

This is because it went from a liquid to a solid when usualy it gose from a solid to a liquid when being heated.

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Examiner Comments

This answer has correctly stated that the egg white turns solid (which was given in the table). Chemical changes are usually not reversible, and physical changes are easily reversible. Unfortunately, this answer has not noted this so only scores 1.

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Examiner Tip

For an explain question, give the information and then a scientific reason.

In this question:

Information – egg white goes solid and stays solid.

Reason – It is a chemical change because the change is not reversible.

Question 2 (a)(ii)

A majority of candidates knew that chlorine was added to kill bacteria, although a number used other terms such as germs, disease, microbes and microorganisms and some used the term toxins. Whilst some of these were allowed and some not, candidates are advised that bacteria is always looked for. Others went off on a track that was not specific enough: to clean the water or make it safe to drink (how?). Others gave an answer linked to pH and neutralisation.

(ii) State the reason why chlorine is added during the water treatment.

(1)

to kill bacteria

ResultsPlus
Examiner Comments

This answer gives all that is necessary for the mark.

ResultsPlus
Examiner Tip

In a state question, all that is needed is the answer with no further explanation.

(ii) State the reason why chlorine is added during the water treatment.

(1)

So it can make the water clean

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Examiner Comments

Chlorine is added to water to make it potable, and specifically to kill bacteria. Making the water clean does not give this specific information and does not score.

Question 2 (a)(iii)

Few students had properly learned – or could not express themselves if they had – the process of sedimentation. There was plenty of confusion between the filtration of larger pieces, and the sedimentation of fine particles, as well as a significant number of blanks. Some knew what a sediment was but could not link this to water purification. Many answers referred to all sort of possible steps: removing larger objects (by filtering), distillation, chlorination (or sterilising, cleaning), heating (to evaporate), screening, desalination. Those candidates who scored marks often described particles sinking to the bottom, but unfortunately many referred to larger pieces such as sand, rocks or stones. Occasionally there was (incorrect) reference to sedimentary rocks.

(iii) Describe how sedimentation is carried out.

(2)

you would filter the water to take any ~~things~~ lumps or objects out so that you just have smooth water making it easier to become potable.

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Examiner Comments

This answer is talking about filtration, which removes large pieces (that do not pass through the filtration apparatus). Sedimentation is a process to remove very fine particles.

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Examiner Tip

Learn carefully the stages in water purification: filtration, sedimentation and chlorination. In particular know the difference between filtration and sedimentation.

Question 2 (a)(iv)

Many candidates had the correct idea here, but often used vague or contradictory language. As a result, they failed to explain clearly that pure water contains ONLY water molecules while portable water contains water molecules and a mixture of ions. Some knew what 'pure' meant but did not always express this suitably scientifically – it has nothing added – or, perhaps influenced by advertising – it comes from mountains/rivers/streams/lakes. They seemingly did not realise that bottled water/ drinking water was not pure water. Quite a few indicated that there would be *less* ions (or even more) in pure water (or even that less are added to it) – rather than none. Some stated that the concentrations in the table were the wrong amount for pure water. Candidates that scored indicated that ions from the table were present in potable water but not in pure water. Some perhaps had this idea but referred to potable water having, for example, 'elements' in it – the incorrect use of terminology when ions was wanted was not uncommon. The key advice here is to use the table that was in the question. Other candidates linked purity to pH levels or to water that had been chlorinated, and some were talking about portable water (ideal for picnics).

A summary of some common errors:

- Pure water contains less ions, rather than **no** ions.
- Pure water is drinking water

A pure substance only contains one element.

Question 2 (b)(i)

A delivery tube was infrequently seen here, with most stating a tube. Incorrect responses included evaporation tube, distillation tube, condenser or condensation tube, filtration tube, pipe or even funnel.

(b) A student wanted to distil a sample of potable water.
Figure 4 shows apparatus the student used.

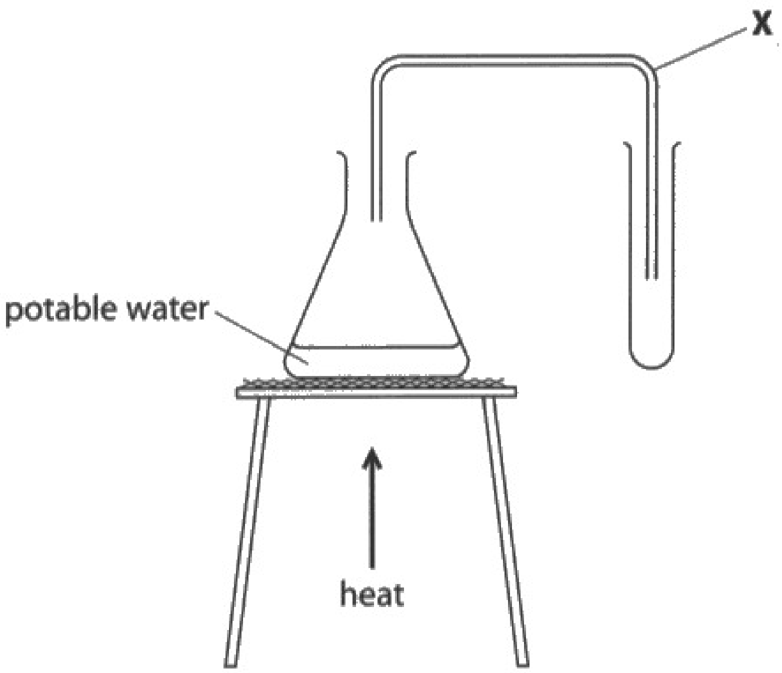

Figure 4

(i) Name the piece of equipment labelled **X** in Figure 4.

(1)

~~Thabe~~ Trans portation tube

ResultsPlus
Examiner Comments

It is important to learn properly the names of common laboratory apparatus – especially those pieces used in the practicals in the specification.

Question 2 (b)(ii)

Some candidates failed to appreciate the flaw in the diagram, or if they did their ability to name a bung/cork (and stopper was allowed), was not good. Common errors included: lower the equipment further into the water in the flask/ add more water to the flask to raise the level so that it went into the tube, turn the delivery tube the other way round, completely seal the whole apparatus. Some who did understand the need for a bung went on to explain how the water vapour would then not escape, although some failed to use the correct term for the water vapour (for example talking about condensation). Many incorrect terms for bung were seen, including lid, cap, cover or just more generally make it airtight or seal. If this was incorrect the examiners allowed one mark for adding a condenser which some candidates scored with.

(ii) The student made an error when setting up the equipment in Figure 4.
This error meant no water could be collected in the test tube.

Explain what the student needs to do so water can be collected.

(2)

The Student should swap the condensor the other way round and lower it, so that the potable water can be collected and passed through the tube.

(Total for Question 2 = 9 marks)

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Examiner Comments

It was a very common error to think that the water in the flask needed to reach the delivery tube (X).

(ii) The student made an error when setting up the equipment in Figure 4.
This error meant no water could be collected in the test tube.

Explain what the student needs to do so water can be collected.

(2)

The student needs to use a condenser to cool down the evaporated water so that it can be condensed and released as a liquid into the test tube

ResultsPlus
Examiner Comments

The use of a condenser was not the way to solve the problem in the apparatus, but it was awarded 1 mark as a reasonable idea.

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Examiner Tip

Know well the core practicals, the apparatus in them and how they work.

Question 3 (a)

In most cases the number of electrons was correct, but the numbers of protons and neutrons were less often so, sometimes transposed. Some gave 27 as one of these numbers.

Question 3 (b)

It was a pity that on this routine calculation there were a lot of blank responses. Those that did tackle the question often scored all of the marks, the best answers showing their working out very clearly in a table or grid format (with or without lines). A small number inverted the fractions but could score 2 if they followed this through correctly to Al_3Br. It was a pity that some gave up part way through – calculating mass/Ar but not then getting a whole number ratio, or getting the ratio and not converting to a formula. There were occasional mistakes in generating the simplest ratio from the correct numbers of moles so from 0.05 and 0.15 to an incorrect whole number ratio.

Common errors included:

- Inverting the fractions with conversion to Al_3Br
- Doing the first correct division, but failing to divide by lowest number
- Multiplication by atomic mass
- Conversion of ratio to whole number ratio
- Failure to convert whole number ratio to a formula

Adding both numbers after working out the correct fractions.

(b) Aluminium reacts with bromine to form aluminium bromide.
A sample of aluminium bromide contains 1.35 g of aluminium atoms and 12.00 g of bromine atoms.

Calculate the empirical formula of this sample of aluminium bromide.

(relative atomic masses: Al = 27.0, Br = 80.0)

(3)

Al	Br
$\frac{1.35}{27}$	$\frac{12}{80}$
$\frac{0.05}{0.05}$	$\frac{0.15}{0.05}$
1	3

empirical formula = $AlBr_3$

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Examiner Comments

In this calculation the working has been set out very clearly. This makes it easy for the examiner to award marks.

Question 3 (c)(i)

In this question the group was most often correct. The period was less often so, regularly stated as period 3.

Question 3 (c)(ii)

This question was poorly attempted by many candidates. They could often get one mark for explaining that Mendeleev compared gallium to elements which were in the same group or period, or elements on either side of gallium. They very often did not go on to speak about a trend or pattern or averaging process being used to arrive at a value for gallium. Weaker answers were beset by vagueness: 'Mendeleev looked at gallium and predicted the properties'; 'gallium is compared to other elements with similar properties' (without referring to groups/periods); 'gallium is compared to other metals'; 'gallium is compared to other atoms'; 'Mendeleev guessed' (without saying how, or even that 'he was smart'). There was some poor terminology – for example, comparing gallium to other substances (rather than referring to elements). Some even talked about measuring or testing gallium's properties even though the question stated that it had not yet been discovered.

Common errors included:

- A failure to recognise that gallium was not yet discovered, with many responses stating that the properties of gallium could be measured
- Not using the word element or metal
- Not saying that the elements he already knew were those neighbouring gallium
- Using atomic mass and the number or protons/neutrons or electrons to identify the properties
- He made patterns or arranged elements that he already knew and then left gaps and made predictions, but without saying how

(ii) Gallium had not been discovered when Mendeleev created his first periodic table.

Figure 5 shows some properties of gallium that Mendeleev predicted and some of the actual properties of gallium.

property	predicted property	actual property
relative atomic mass	about 68	70
density in g/cm^3	about 6.0	5.9
melting point	lower than 40 °C	29.8 °C
density of oxide in g/cm^3	about 5.5	5.9

Figure 5

Describe how Mendeleev predicted these properties of gallium.

(2)

Because he had the other elements of Group 7 and as we go down ~~the~~ group 7 becomes less reactive. Therefore he can predict the ~~[illegible]~~ atomic mass and other properties

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Examiner Comments

This candidate has the idea of looking at elements in the same group, but unfortunately has the wrong group. Reactivity is irrelevant (it is not a property in the table).

ResultsPlus
Examiner Tip

There is always a periodic table on the back of the question paper to help.

(ii) Gallium had not been discovered when Mendeleev created his first periodic table.

Figure 5 shows some properties of gallium that Mendeleev predicted and some of the actual properties of gallium.

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relative atomic mass	about 68	70
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melting point	lower than 40 °C	29.8 °C
density of oxide in g/cm^3	about 5.5	5.9

Figure 5

Describe how Mendeleev predicted these properties of gallium.

(2)

He looked at what elements he had and fit Gallium into the gaps based off of what the other elements around it were to make an estimate.

ResultsPlus
Examiner Comments

This answer has the idea of looking at elements around Gallium – but does not say how the properties would have been predicted.

Question 4 (a)

The majority of candidates calculated 3.14/250 = 0.01256, losing one mark for not converting the volume to dm^3. Others tried to convert the volume but used factors of 100 or 10 rather than 1000. Candidates were allowed many ways of making one single error and getting one mark, but it has to be clear to the examiner how this was done and answers must be worked out correctly and if rounded, rounded correctly. Weaker candidates were confused by cm^3 and calculated 3.14/ 250^3. Others ignored the index given on their calculator.

Question 4 (b)(i)

Many candidates did not know what precipitate meant, although the majority who scored mentioned going cloudy. A few candidates recognised this as a displacement reaction but could not describe what they would see. The ever-popular observation of fizzing/bubbling was seen often, as was a colour change or even a flame. The fact that the solution goes colourless was, perhaps unsurprisingly, almost never seen.

(b) Sodium hydroxide solution was added to a solution of copper sulfate.
A precipitate of copper hydroxide and a solution of sodium sulfate were formed.

(i) State what would be **seen** in the reaction.

(1)

A change in colour

ResultsPlus Examiner Comments

It is correct that many precipitates are coloured, but to answer this question it is necessary to identify that a precipitate is a solid. This could either be by stating that a solid, or form of a solid, is seen, or that the mixture turns cloudy (cloudiness is caused by small solid pieces).

(b) Sodium hydroxide solution was added to a solution of copper sulfate.
A precipitate of copper hydroxide and a solution of sodium sulfate were formed.

(i) State what would be **seen** in the reaction.

(1)

fizzing of solution

ResultsPlus Examiner Comments

Fizzing is a very common response to questions like this. Fizzing only happens when a gas is produced. In this case, a precipitate is a solid so there is no fizzing.

Question 4 (b)(ii)

A reasonable number of candidates got this part correct; although some could not resist adding numbers in other places than the space indicated.

(ii) Complete the balanced equation for the reaction by adding a number in front of NaOH.

1 : Cu 6 : O 2 : H **(1)**

$$2\ NaOH + CuSO_4 \rightarrow Cu(OH)_2 + Na_2SO_4$$

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Examiner Comments

The dotted line shows that only one number is needed.

This answer is fully correct.

(ii) Complete the balanced equation for the reaction by adding a number in front of NaOH.

(1)

$$\text{....4....}NaOH + CuSO_4 \rightarrow Cu(OH)_2 + Na_2SO_4$$

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Examiner Comments

4 is not correct.

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Examiner Tip

To answer this question, the number added has to make the same number of atoms of each element appear on both sides of the equation.

If you choose Na, there are two on the right hand side, so you need a 2 before NaOH to give two Na on the left hand side.

The same argument applies to H.

Choosing O makes this much more difficult, because oxygen is in all four substances.

Question 4 (b)(iii)

The practical description of obtaining salts is very often poorly described and this was no exception. Candidates do not distinguish between the different procedures and seemingly cannot apply any knowledge they have to a real example. The key here was that many candidates did not seem to realise that to obtain the solid precipitate the mixture had to be filtered. Many of them heated with a Bunsen burner without any filtration. Some having not realised that an insoluble salt had been formed carried on suggesting that crystallisation/heating to dryness should be done to separate the salt from a solution, some even after filtering (where the copper hydroxide was the filtrate). Those that did filter did not score a mark for washing the residue. Those that went on to dry the salt were often too vague – not saying how this would be done – most candidates completing a practical like this would have used a windowsill to dry their product and this was an acceptable answer. Some perhaps recognizing copper sulfate had a go at electrolysis.

(iii) Describe how to obtain a pure, dry sample of the precipitate of copper hydroxide from the reaction mixture.

(3)

to Obtain a pure , dry sample of the precipitate Or copper hydroxide from the reaction mixture you will need to use the process Or heating the mixture up sothat the liquid can evaporate ~~ea~~ and you are just left with the dry Sample Of the precipitate.

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Examiner Comments

The reaction mixture contains two products (and any unused reactants) so just heating will evaporate the water but leave both of the products mixed together. Filtration has to happen first, to separate the precipitate.

(iii) Describe how to obtain a pure, dry sample of the precipitate of copper hydroxide from the reaction mixture.

(3)

The way to obtain a pure dry sample of the precipitate of copper hydroxide is to use filter paper to filter any excess and it will dry the sample and make it pure.

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Examiner Comments

This candidate has mentioned filtration, but then has not described clearly what will happen. The precipitate is a solid so would not go through the filter paper. The solid in the filter paper then has to be washed and dried.

Question 4 (c)(i)

A common misconception here was circling both negative ions. A common error was circling only one positive ion.

(c) Figure 6 shows the equipment used to electrolyse a sample of sodium sulfate solution.

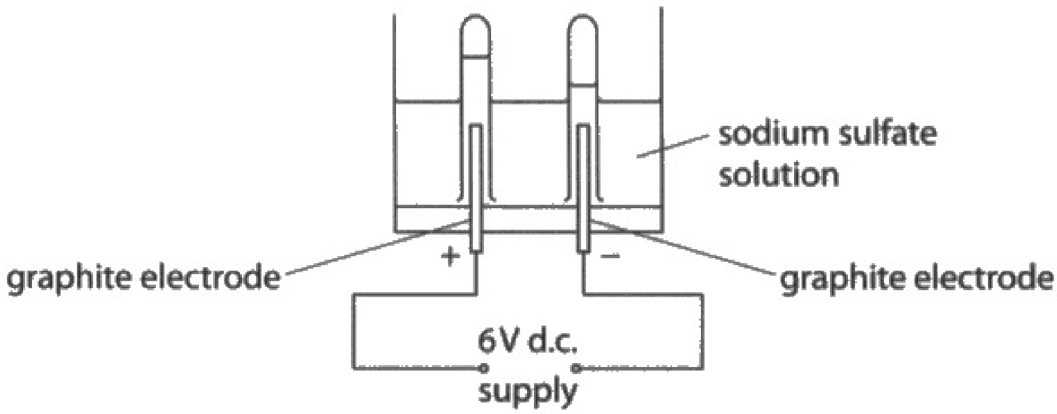

Figure 6

Graphite electrodes are used in the electrolysis of sodium sulfate solution. Graphite is used because it is inert and conducts electricity.

(i) Figure 7 shows the ions in the sodium sulfate solution.

Draw a circle around each of the ions in Figure 7 that are attracted to the negative graphite electrode during the electrolysis.

(1)

Figure 7

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Examiner Comments

Ions from the dissolved compound and the water will go to the electrodes.

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Examiner Tip

Only positive ions are attracted to a negative electrode.

Question 4 (c)(ii)

Many candidates did not understand the term 'inert' – although some did describe the unreactivity and scored. Many referred to inert relating to the ability to conduct electricity. Some were too vague and described the structure of graphite or gave answers such as ‘so the experiment/ graphite would work’. Of those who did answer correctly, most said that the electrodes do not react with the sodium sulfate solution.

(ii) State why it is important that the electrodes are inert.

(1)

So they are able to conduct electricity

ResultsPlus
Examiner Comments

This is a correct property of graphite, but it is not described using the term 'inert'.

(ii) State why it is important that the electrodes are inert.

(1)

So that the electrodes do not react with anything

ResultsPlus
Examiner Comments

This answer correctly describes the term inert.

Question 4 (c)(iii)

There were some good answers to this question, and many candidates were awarded a mark for the recognition that electrons played a role in electrical conductivity, although some wrote all they knew about graphite and its structure without identifying the key information. Several talked about carbon forming three bonds but not linking this to delocalised electrons/ free electrons/ sea of electrons.

Much knowledge of the layered structure was seen, but not always linked to the delocalised electrons. Most students did not know the difference between ions and electrons, especially when to use them. As a result, they struggled with scoring full marks in this question. Some candidates thought that graphite was a metal.

(iii) Explain, in terms of its structure, how graphite conducts electricity.

(2)

it has lose electrons and the electrons move about very fast as they are delocalised electrons.

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Examiner Comments

'lose' electrons (loose electrons) does give an idea but is not the correct scientific term – the answer does then use the correct term – delocalised electrons.

Question 5 (b)(i)

This was often left blank. Errors included scales, balance, measuring cylinder, beaker, jug, test tube with markings and assorted non-laboratory equipment.

Question 5 (b)(ii)

Many candidates answered this question well with many describing the possible colour changes in UI paper, usually correctly linking them to acid/alkali. However, some went on to say how the colour was linked to a pH value with a colour chart/scale.

(ii) Describe how the pH of the mixture is determined when a drop of it is placed on the universal indicator paper.

(2)

The colour will change between Red-Green-Blue to determine the pH, whether it's acid neutral or alkali.

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Examiner Comments

The answer has identified a colour change, and has said this determines the pH, but not how this is done (by using a pH colour chart).

Question 5 (b)(iii)

This question proved much more difficult than the previous part. Often only single colours for litmus were given and the answer missed the point that litmus can only tell you if a solution is acid or alkaline and not how acidic or alkaline. However, better answers explained that litmus could not accurately measure pH or that litmus only went red and blue. Some errors seen included: litmus would react with the solution and invalidate the results, litmus paper was too thin and would disintegrate in acid, litmus does not change colour in acid. Incorrect links were made by some to testing for chlorine or use in chromatography.

(iii) In the method, universal indicator paper is used to determine the pH.

Explain why litmus paper would not be a suitable indicator to use in this experiment.

(2)

Because the litmus paper will not change colour. ~~It it both~~ therefore it will not give us a ph

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Examiner Comments

Litmus will change colour in acid and in alkali.

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Examiner Tip

Know the colours for litmus, Universal Indicator, phenolphthalein and methyl orange.

(iii) In the method, universal indicator paper is used to determine the pH.

Explain why litmus paper would not be a suitable indicator to use in this experiment.

(2)

Litmus Paper isnt made for PH level testing.

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The answer does not make clear why litmus paper cannot be used.

Question 5 (b)(iv)

Many candidates drew a good graph with sensible scales, mostly scoring 3 marks. The best answers had linear scales which filled the grid and clearly plotted points. Weaker graphs (although often scoring some marks) had a graph not covering half of the grid, having a thick line added so that points plotted could not be seen, drawing a bar chart or using non-linear scale(s) [either skipping a value seemingly in error, or just using the values from the table], or not numbering the axes so that plotting marks could not be scored. It would be a good idea for candidates to use (sharp, dark) pencil and not pen when setting up their initial axes so that they can rub out any errors – there were lots of axes which had been changed and it could be difficult to read some of them. This would also allow them to correct plotting errors. Some of the linear scales chosen by candidates were more complicated than necessary on the x axis. This then led to points being plotted incorrectly because they were difficult to do so on the chosen scale. It is also advisable to use crosses rather than dots so that plotted points can easily be discerned. Some candidates reversed the axes even though they were labelled. It is worth noting that candidates can use the edge of the graph paper in the exam rather than starting the axes one block in.

(iv) Figure 8 shows the student's results.

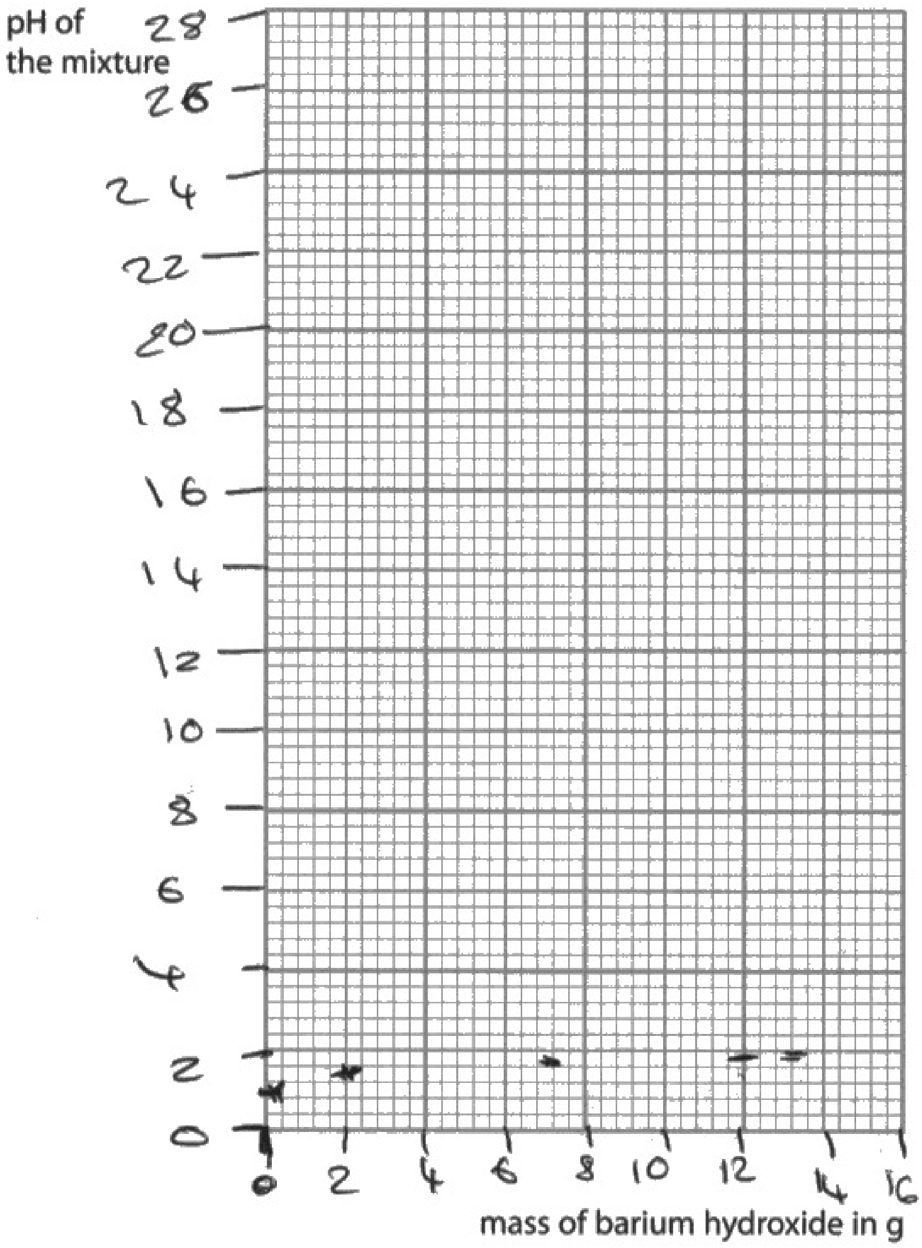
mass of barium hydroxide in g	pH of mixture
0.0	1
0.2	1
0.4	1
0.6	1
0.8	2
1.0	7
1.2	12
1.4	13
1.6	13

Figure 8

On the grid opposite:

- Add suitable scales to the vertical and horizontal axes.
- Plot a graph of the pH of the mixture against the mass of barium hydroxide.

(3)



ResultsPlus
Examiner Comments

The scales on a graph should be chosen to spread out the data. The choice of y axis scale on this answer has squashed together all of the points too closely. This makes the data hard to plot and the graph hard to use.

ResultsPlus
Examiner Tip

Choose an even scale that makes the points spread out over at least half of the grid.

(iv) Figure 8 shows the student's results.

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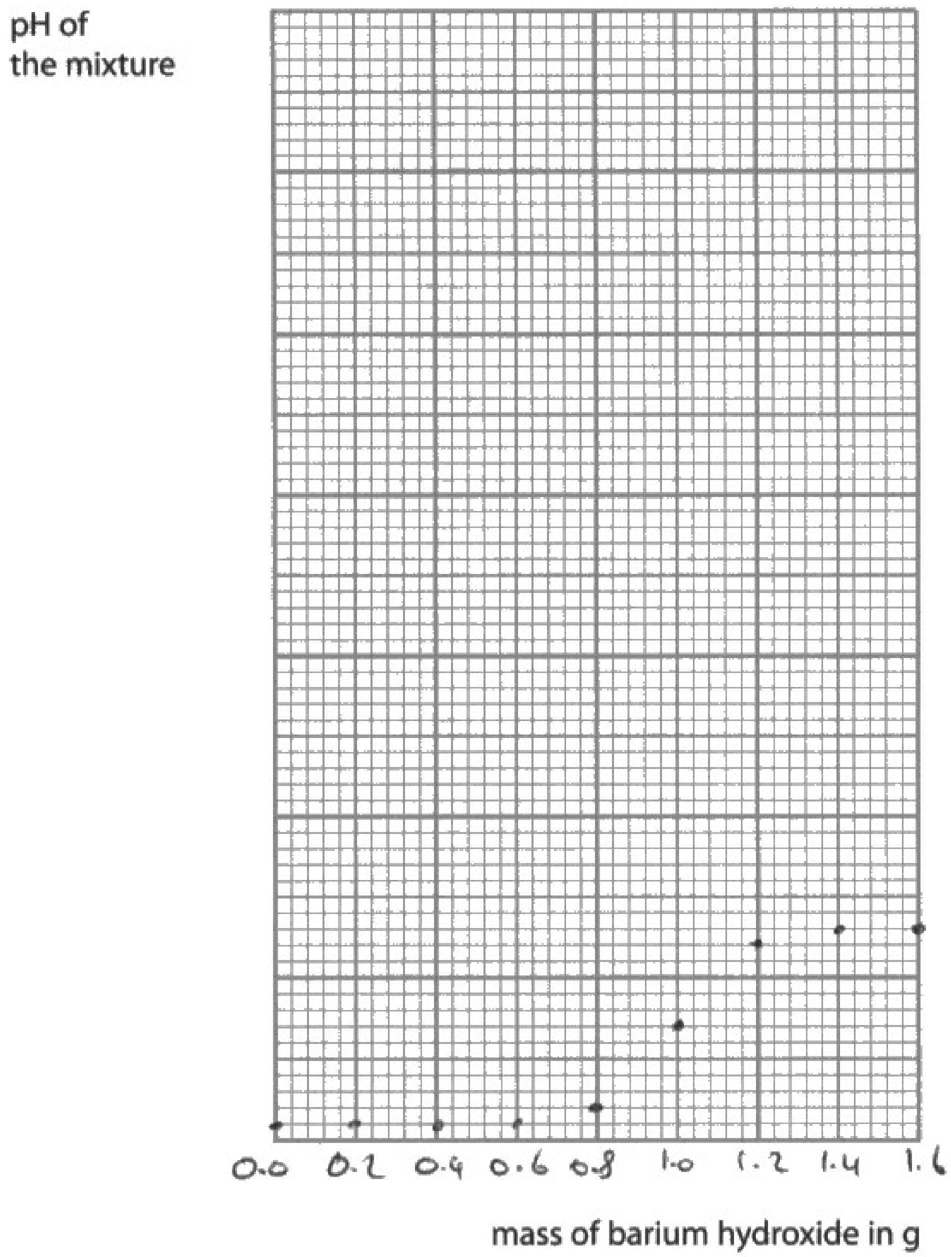

ResultsPlus
Examiner Comments

This y axis has no scale so cannot be awarded any marks.

Question 5 (c)(ii)

Hazards are well known and this question was mostly answered convincingly. However, some were too vague – not relating the precaution specifically to corrosive – and gave answers such as stand well back, tie hair back, do not let it touch the skin, use PPE.

Question 6 (a)(ii)

The identification of the substances as ionic and metallic, and hence the difference in properties, was not well done. When candidates responded including the term electrons, they usually scored well. However, most candidates did not recognise magnesium carbonate as being ionic therefore did not mention ions fixed in a lattice, although some scored here for mentioning that magnesium carbonate did not have delocalised electrons – so using a reverse statement to magnesium which made sense in the context of the wording of this question. Many responses showed a lack of understanding of compounds that was quite fundamental – the presence of carbon in magnesium carbonate prevented it conducting, or the purity of magnesium were the reasons why magnesium carbonate didn't conduct whilst magnesium did. It was more common for candidates to score marks for mentioning free electrons (sometimes delocalised, rarely 'sea of electrons') in magnesium. Some had the idea that these electrons move or flow. Electrons of course have a charge so 'carry a charge' is not allowed as meaning move.

(ii) Explain why solid magnesium carbonate cannot conduct electricity but solid magnesium can.

(3)

Solid magnesium carbonate cannot conduct electricity as the carbon stops the ions from being free to move however when it is just solid magnesium, there is enough space for the delocalised electrons to move which enables it to conduct electricity.

ResultsPlus
Examiner Comments

The answer correctly identifies that ions are fixed in magnesium carbonate, but that delocalised electrons move in magnesium.

However, it incorrectly states that the ions cannot move due to the carbon in magnesium carbonate. It was a common misconception that carbon in magnesium carbonate 'stopped the magnesium conducting'.

Question 6 (b)

Many candidates did not attempt this question. Some scored 1 mark for the Mr = 84 but then could not proceed. Even on this step some candidates fell and gave 52 (MgCO). Where they do make errors examiners try to follow through the calculation to try to award marks, but many did not show (clear) working which meant that giving part marks was difficult. Candidates should be very careful at rounding their final answers as some got this wrong and lost the final mark.

(b) Calculate the percentage by mass of magnesium in magnesium carbonate, $MgCO_3$.

(relative atomic masses: C = 12.0, O = 16.0, Mg = 24.0)

(3)

24+12+48 =84   16×3 =48

$\frac{24}{84}$ ×100 = 28.6

percentage by mass of magnesium = 28.6%

ResultsPlus Examiner Comments

Full marks.

ResultsPlus Examiner Tip

Always show working in calculations – as this answer does.

(b) Calculate the percentage by mass of magnesium in magnesium carbonate, $MgCO_3$.

(relative atomic masses: C = 12.0, O = 16.0, Mg = 24.0)

(3)

24.0 + 12.0 + 16.0 + 16.0 + 16.0

= 84.0

percentage by mass of magnesium = 84%

ResultsPlus
Examiner Comments

1 mark.

ResultsPlus
Examiner Tip

This is not the correct answer, but the candidate has shown where the 84 comes from, so gets 1 mark.

Question 6 (c)

It can be deduced from these answers that the knowledge of the reactions of metals and carbonates with acids is not strong. Candidates are advised to structure their answers (perhaps in this case (a) magnesium carbonate and (b) magnesium) and to try to cover all parts – here observations, gas tests and word equations. Generally, candidates with some knowledge and understanding made a good attempt at making structured answers. Many responses tackled each substance in turn, with structure of observation, products and gas test ordered in each paragraph. For the weaker candidates, at least here many realised that the tubes would bubble.

Some general points:

- Word equations when given were often incomplete, especially in the case for magnesium carbonate where the water was often missing. (Partly correct equations were credited for what they did show of the products.)
- More marks were awarded for the magnesium with acid equation. Many responses also correctly identified magnesium sulfate as a product.
- Some candidates explained all the gas tests they knew but did not **link them** to products formed in the reactions. Candidates must make clear what is relevant and not just write down all gas tests and expect the examiner to pick the correct one.
- There were many references to the test for oxygen and at times this was confused with the test for hydrogen e.g. a glowing splint gives a squeaky pop. There also appeared to be confusion with the test for carbon dioxide referring to observing the reaction appearing as cloudy. Candidates should be reminded to clearly state observations separately to tests.

At Level 1, a vast majority of candidates reported observations such as fizzing and bubbling. Some attempted to name the products, with few mentioning dissolving of the reactants.

At Level 2, some word equations were given although these were not necessarily complete. Normally fizzing was given as an observation, and perhaps the test for hydrogen linked to the magnesium reaction or for carbon dioxide linked to the magnesium carbonate reaction.

At Level 3, a decent attempt at the word equations – or the description of the products in the text – often giving magnesium sulfate. These candidates linked the carbon dioxide gas test to tube 1 and the hydrogen gas test to tube 2.

*(c) A student has two separate test tubes containing sulfuric acid.

The student adds a spatula measure of magnesium carbonate, $MgCO_3$, to the first test tube and a piece of magnesium to the second test tube.

Explain what the student would see in each test tube and the tests that they should carry out to identify the gases produced.

Your answer should include word equations for the reactions that would take place.

(6)

In the first tube of sulfuric acid sulfuric acid + magnesium carbonate → sulfate carbonate would be produced. ~~ba~~ on the other hand, sulfuric acid + magnesium → magnesium sulfate would be produced. They The student should carry out fractional distillation, filtration and ~~[illegible]~~ to ~~extract the~~ identify gases produced. To find hydrogen test use a lighted splint and see if it makes a squeaky pop showing the gas has burned.

ResultsPlus
Examiner Comments

The salt formed from magnesium is identified. The test for hydrogen is also given, but is not linked clearly to the magnesium reaction. Nothing correct is given about magnesium carbonate.

Level 1 answer.

*(c) A student has two separate test tubes containing sulfuric acid.

The student adds a spatula measure of magnesium carbonate, $MgCO_3$, to the first test tube and a piece of magnesium to the second test tube.

Explain what the student would see in each test tube and the tests that they should carry out to identify the gases produced.

Your answer should include word equations for the reactions that would take place.

(6)

The two Separate test tubes wauld show fizzing and bubbling, this is because sulfuric acid is an 'acid' which wauld react agressively with magnesium the word equation for this reaction would be:
sulpuric acid + Magnesium Carbonate → ~~Sulphate acid + Magnesium carbonate~~. Carbon dioxide

The test the student shauld do to determine the gas is lime water they shauld have lime water and blow bubbles into it after adding the gas if the lime water is claudy then the gas ~~produced~~ is carbon dioxide.

ResultsPlus
Examiner Comments

The answer identifies that the magnesium carbonate reaction would bubble due to carbon dioxide, and gives the correct test for this gas.

Unfortunately, there is no detail about the other reaction – only that there is fizzing.

Level 2 answer.

*(c) A student has two separate test tubes containing sulfuric acid.

The student adds a spatula measure of magnesium carbonate, $MgCO_3$, to the first test tube and a piece of magnesium to the second test tube.

Explain what the student would see in each test tube and the tests that they should carry out to identify the gases produced.

Your answer should include word equations for the reactions that would take place.

(6)

• the first test tube you would see bubbling and fizzing

• in the second test tube, you would see fizzing and bubbling

• to test for hydrogen gas, take a lit splint and hold it into the test tube. If it makes a squeaky pop sound, hydrogen is present.

• to test for carbon dioxide gas, use limewater and if the solution turns cloudy, carbondioxide is present.

• to test for oxygen, take a glowing splint and put into the test tube, if it relights, then oxygen is present.

- magnisium carbonate + sulphuric acid → magnisium sulphate + carbon dioxide

- magnisium + sulphuric acid → magnisium sulphate + hydrogen

ResultsPlus
Examiner Comments

Using bullet points is a good way to organize longer answers.

This answer gives some correct observations about both reactions, gives word equations (not fully complete but still identifies the correct salt and gas in each reaction) and gives the correct gas tests.

Level 3 answer.

Paper Summary

Based on their performance in this paper, candidates should:

- Consider all of the practical work you have undertaken, and particularly those mentioned in the specification, and learn the names of the apparatus, and the reasons each step in the procedure is carried out
- Understand how to prepare salts in neutralization reactions, and how to get pure, dry samples of the salt if the salt is soluble and if it is insoluble
- Know the difference between particles vibrating (but not moving from place to place) in solids and moving (but not vibrating) in liquids
- Understand that in compounds, different elements have bonded together and the compound has different properties to the elements from which it is composed
- Know what an ion is, and how ionic compounds can conduct electricity because the ions can move when the substance is melted or dissolved in water; and how, in metals and graphite, delocalized electrons can move to enable these substances to conduct electricity.
- Practise rounding and the use of significant figures in calculations.

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