



Examiners' Report

June 2023

GCSE Chemistry 1CH0 1F

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications come from Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk.

Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.



Giving you insight to inform next steps

ResultsPlus is Pearson's free online service giving instant and detailed analysis of your students' exam results.

- See students' scores for every exam question.
- Understand how your students' performance compares with class and national averages.
- Identify potential topics, skills and types of question where students may need to develop their learning further.

For more information on ResultsPlus, or to log in, visit www.edexcel.com/resultsplus. Your exams officer will be able to set up your ResultsPlus account in minutes via Edexcel Online.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk.

June 2023

Publications Code 1CH0_1F_2306_ER

All the material in this publication is copyright

© Pearson Education Ltd 2023

Introduction

Paper 1F is the first of the two papers for GCSE Chemistry at Foundation tier.

Six of the questions in this paper form one of the GCSE Combined Science Foundation tier papers. The final questions in this paper are also found in the equivalent Higher tier papers and the paper contains ten questions in total.

This paper is targeted at grades up to and including Grade 5, with no advance information being provided this year. Ofqual rules stated that the grade boundaries should be set in order to bring a return close to the standards seen in 2019.

Most candidates made a good attempt at the majority of questions on the paper with the most able candidates showing a good range of chemistry and practical knowledge alongside maths skills. Some candidates were not able to use scientific vocabulary to express their answers clearly, and could not link ideas together to form an explanation.

It was also noted that the separate science questions performed less well than those that also appeared on the Combined Science paper.

Question 1 (a)(iii)

This question was about chromatography and required candidates to calculate an R_f value to 2 decimal places.

Overall, the question was well answered with most candidates scoring full marks. As the equation was given in the question, then very few candidates performed the incorrect calculation and where marks were lost, it was most commonly due to incorrect or no rounding.

This is an example of a response that scored full marks.

(iii) The R_f value of a dye can be calculated using the equation

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

At the end of the chromatography one dye had moved 3.60 cm and the solvent front had moved 9.20 cm.

Calculate the R_f value for this dye.

Give your answer to 2 decimal places.

(2)

$$\frac{3.60}{9.20}$$

$$0.391304347$$

$$R_f = 0.39$$



The working out is clearly shown and the answer is correctly rounded to two decimal places.

This response was awarded 1 mark.

(iii) The R_f value of a dye can be calculated using the equation

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

At the end of the chromatography one dye had moved 3.60 cm and the solvent front had moved 9.20 cm.

Calculate the R_f value for this dye.

Give your answer to 2 decimal places.

(2)

$$\frac{3.60}{9.20} =$$

$$R_f = 0.391$$



ResultsPlus
Examiner Comments

The calculation has been correctly evaluated to 3 decimal places, rather than the 2 decimal places asked for in the question.

This response scored 1 mark.

(iii) The R_f value of a dye can be calculated using the equation

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

At the end of the chromatography one dye had moved 3.60 cm and the solvent front had moved 9.20 cm.

Calculate the R_f value for this dye.

Give your answer to 2 decimal places.

(2)

$$\frac{3.60}{9.20} = 0.39 \rightarrow 0.40$$

$$R_f = 0.40$$



ResultsPlus
Examiner Comments

The final answer of 0.40 is to 2 decimal places, but the evaluation of the calculation has been incorrectly rounded to this number.

Question 1 (b)(i)

Many candidates scored a mark for this response by giving some variation of evaporation, boiling or vapourisation. The most common incorrect answer was condensation.

Question 1 (b)(ii)

Again, this question was well answered by many candidates with most correctly reading 56°C from the graph. The most common incorrect response was 55°C.

Question 1 (b)(iii)

This part of the question was not as well answered as the previous parts of the question, with only about half of the candidates identifying point C on the graph as being this point. The most common incorrect response was 8 minutes.

The fact that this was less well answered suggests that a lot of candidates don't fully understand how to read and interpret graphs showing changes of state.

Question 1 (b)(iv)

Most candidates were able to correctly read the temperature at point D and subtract 25 to get the correct answer. Where candidates did not score here, it was usually by simply stating the temperature at 8 minutes – however a few incorrectly read the final temperature as 72°C.

Question 2 (a)

This question required candidates to describe the relationship shown by a graph, and it was very well answered overall. Most candidates correctly stated that the higher the number of carats, the higher the percentage of gold. Answers linking the purity of gold to its percentage were also accepted, as were answers stating that there was a positive correlation between the variables.

Responses that did not mention the percentage of gold at all, but linked the purity of gold to the number of carats did not score.

This response scored a mark.

- 2 (a) Most of the gold used in jewellery is not pure gold but alloys of gold.

The purity of gold is measured in carats.

Figure 3 shows how the percentage of gold is related to the purity of gold measured in carats.

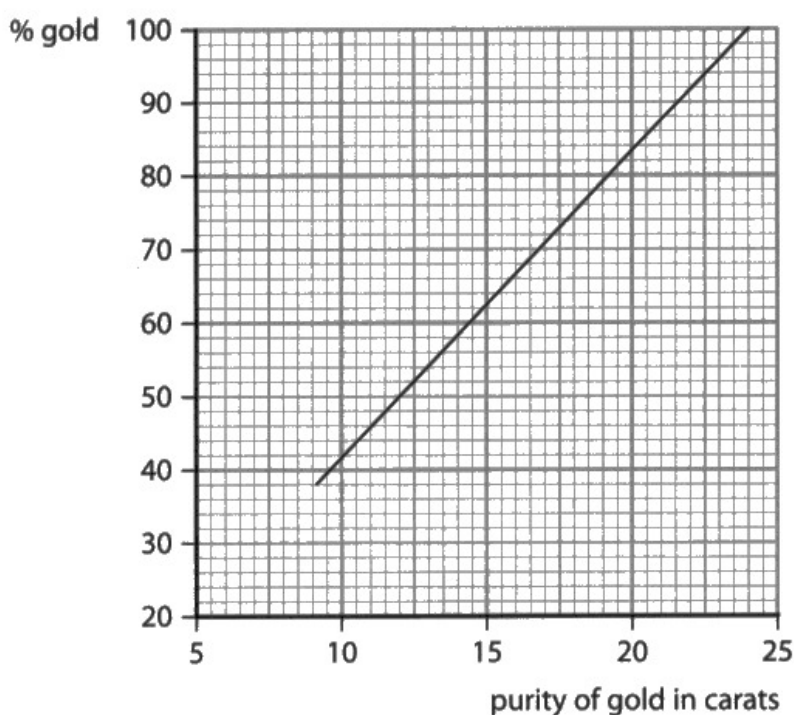


Figure 3

State the relationship between the percentage of gold and the number of carats.

(1)

The higher the carats of Gold, the higher the percentage of Gold.



This response gives a good answer to the question being asked, clearly stating the relationship between the percentage of gold and the number of carats.

This response scored a mark.

2 (a) Most of the gold used in jewellery is not pure gold but alloys of gold.

The purity of gold is measured in carats.

Figure 3 shows how the percentage of gold is related to the purity of gold measured in carats.

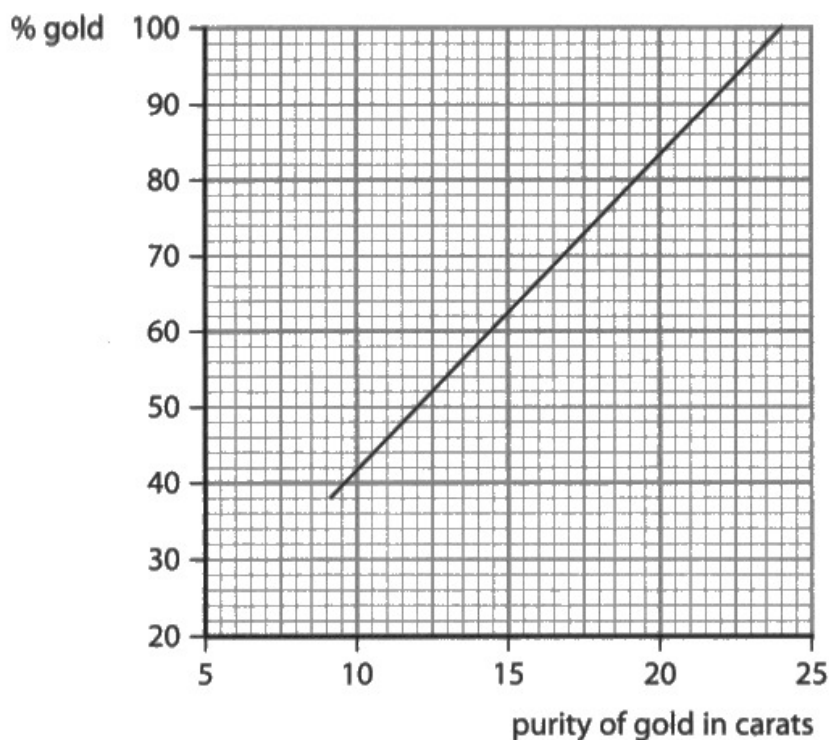


Figure 3

State the relationship between the percentage of gold and the number of carats.

(1)

Positive Correlation. as the purity of gold in carats is getting higher the percentage is getting higher



ResultsPlus
Examiner Comments

Either sentence would have been awarded the mark, but the second sentence shows a greater understanding of what the question is asking by linking the variables rather than just describing the line on the chart.

This response did not score.

2 (a) Most of the gold used in jewellery is not pure gold but alloys of gold.

The purity of gold is measured in carats.

Figure 3 shows how the percentage of gold is related to the purity of gold measured in carats.

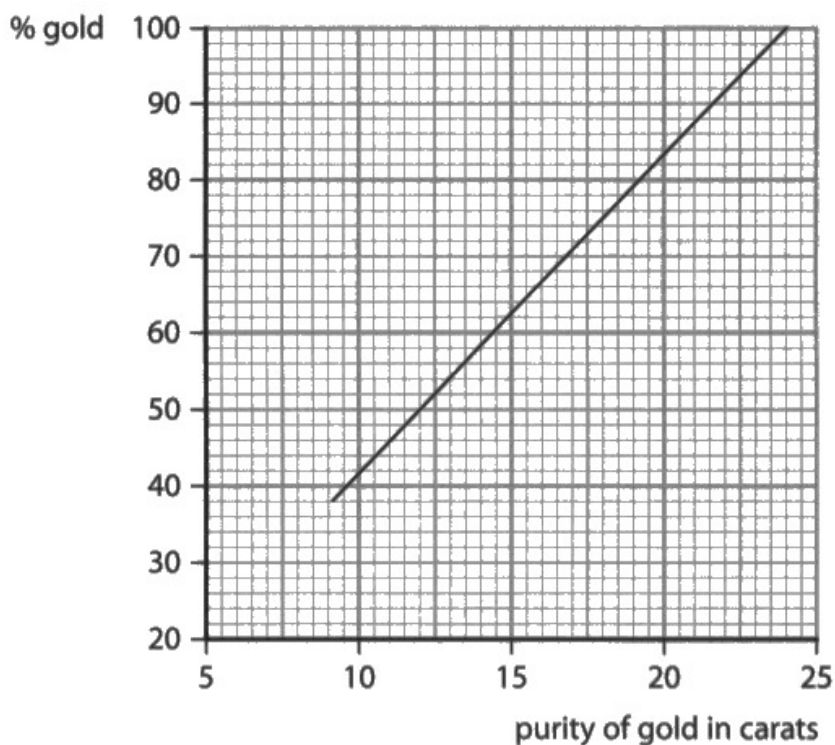


Figure 3

State the relationship between the percentage of gold and the number of carats.

(1)

the increase in number of carats means
increase of purity in gold



This type of response, linking the purity of gold to the number of carats, was a common incorrect response. It does not answer the question being asked as it does not consider the percentage of gold at all.

Question 2 (b)

This question asked candidates to explain why alloys of gold are stronger than pure gold. It was surprisingly poorly answered with only a very few candidates scoring full marks, and many responses scoring no marks at all.

Where marks were scored, it was usually for the idea that atoms are in a regular arrangement of rows or layers for a pure metal with better responses noting that the disruption to the layers in the alloy prevented the easy movement of the atoms over each other.

Many candidates looked at the diagram very literally and came to the conclusion that the alloy contained more atoms than the pure metal and so would be stronger. Not many noted the fact that the alloy contains different sized atoms (or that the pure gold doesn't).

Correct answers were awarded whether the argument related to the pure metal, the alloy or both – as long as the points did not contradict each other.

This is a rare example of a 3-mark response.

(b) Figure 4 shows the arrangement of atoms in pure gold and in an alloy of gold.

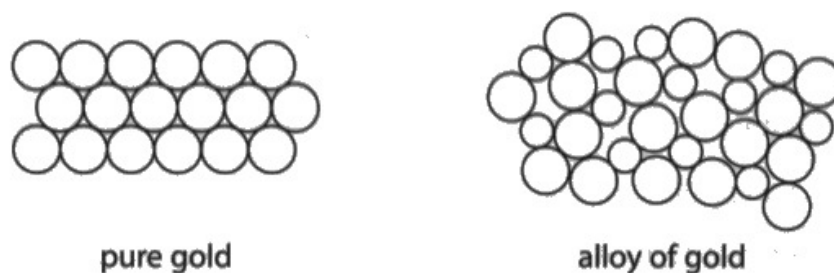


Figure 4

Using Figure 4, explain why alloys of gold are stronger than pure gold.

(3)

They have an irregular arrangement of atoms and have atoms with different sizes making it harder for the atoms to slide over each other and the alloy to break which makes it harder for the alloy to break



ResultsPlus
Examiner Comments

Although the response starts with the word 'they' rather than 'the alloy', it becomes clear later in the response that the candidate is referring to the alloy throughout.

The response gives a clear explanation including all of the marking points: different sized atoms, irregular arrangement and the difficulty for the atoms to slide over each other.

This response scored 2 marks.

(b) Figure 4 shows the arrangement of atoms in pure gold and in an alloy of gold.

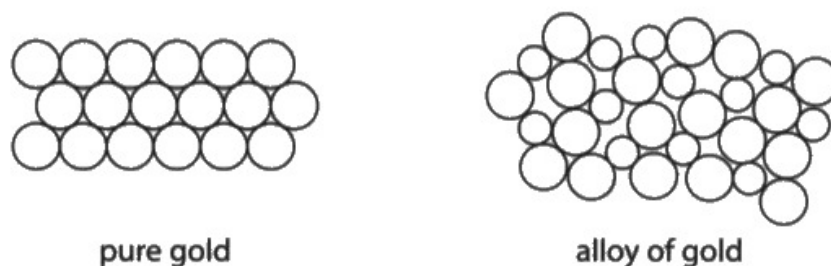


Figure 4

Using Figure 4, explain why alloys of gold are stronger than pure gold.

(3)

pure gold is arranged in a way when the atoms are pulled apart it will be easier as they are in neat rows and are all the same size, the alloy is all different sizes and is not in neat rows making it harder to pull apart.



This response scored the first two marking points for noting the same sized atoms and rows in the pure metal. The reverse argument for the alloy is then given, but the candidate failed to mention the movement of the atoms over each other in either the pure metal or the alloy, and so did not get the third mark.

This response scored 1 mark.

(b) Figure 4 shows the arrangement of atoms in pure gold and in an alloy of gold.

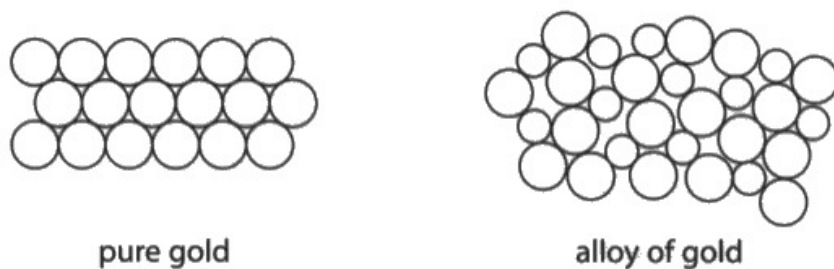


Figure 4

Using Figure 4, explain why alloys of gold are stronger than pure gold.

(3)

The atoms are random meaning that it is harder to break as it would be malleable. Different sized atoms meaning that it is stronger.



The mark is given for different sized atoms. If the response had linked 'random' to the arrangement of the atoms rather than the actual atoms, then a second mark could have been awarded. The candidate also seems to be confused by the meaning of malleable in this response.

This response did not score.

(b) Figure 4 shows the arrangement of atoms in pure gold and in an alloy of gold.

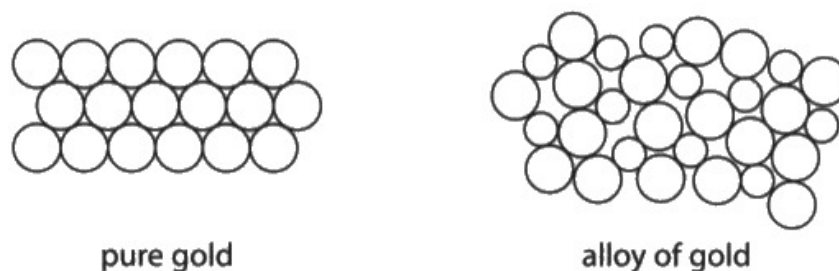


Figure 4

Using Figure 4, explain why alloys of gold are stronger than pure gold.

(3)

there are more atoms that are tightly
arranged in an alloy compared to pure
gold



ResultsPlus
Examiner Comments

This response gives a literal description of the diagram, without mentioning the different sized atoms. It states that the alloy has more atoms and more tightly arranged.

There is no explanation at all.



ResultsPlus
Examiner Tip

The command word 'explain' requires more than a description of any information that has been given in the question.

Question 2 (c)

This question was surprisingly poorly answered. Many candidates seemed to assume that this was a comparison of the alloy to pure gold rather than explaining actual properties of the alloy. This led to the frequently seen response of alloys being cheaper than pure gold. Some candidates gave the response of alloys being stronger, indicating that they hadn't read the question properly.

The most common scoring points were related to either malleability or the appearance of gold, but many did not then go on to explain why these are useful properties. A significant number of candidates also attempted to explain that gold is unreactive, but described this in terms of rusting which is not creditworthy. Some candidates were also confused between the words 'corrosion' and 'corrosive' in their answers.

Some responses did not give properties of gold that were useful in relation to jewellery and discussed conductivity of heat and electricity.

This response scored 2 marks.

(c) Explain **one** property of alloys of gold, other than their strength, that makes them suitable for use in jewellery.

(2)

They are shiny which is suitable
for jewellery as it looks nice
to wear.



The most able candidates gave a suitable property and then linked this back to why this is good for jewellery.



Questions that start with the word 'explain' always have at least two parts to the answer.

This answer scored 2 marks.

(c) Explain **one** property of alloys of gold, other than their strength, that makes them suitable for use in jewellery.

(2)

Unreactive, won't damage the human body.
Will not corrode easily



ResultsPlus
Examiner Comments

Many candidates found it challenging to link the fact that gold is unreactive to why this would be suitable for jewellery. This response gives two correct reasons relating both to the metal itself and any potential reactions with the body.



ResultsPlus
Examiner Tip

'Corrosion' and 'corrosive' have different meanings.

This response did not score.

(c) Explain **one** property of alloys of gold, other than their strength, that makes them suitable for use in jewellery.

(2)

~~was~~ ~~likely~~ ~~to~~ ~~be~~ ~~more~~ ~~expensive~~ as
gold is an expensive resource
turning it into an alloy



This response has not answered the question asked, but compared the properties of gold with gold alloys.



Cost arguments are not usually creditworthy answers.

This response did not score.

(c) Explain **one** property of alloys of gold, other than their strength, that makes them suitable for use in jewellery.

Does not conduct electricity meaning if ⁽²⁾
people wear it they won't get an
electric shock.



ResultsPlus
Examiner Comments

A number of candidates gave responses referring to properties of metals that are not relevant to the use of gold alloys in jewellery.



ResultsPlus
Examiner Tip

Make sure that the properties discussed are relevant to the stated use of the material.

Question 3 (b)(i)

This question was about electrolysis and labelling a diagram.

Most candidates scored at least one mark for this question, for correctly identifying the electrolyte.

Where candidates did not score both marks, it was usually due to the anode and cathode being labelled the wrong way round.

Question 3 (b)(ii)

This question required candidates to identify the products of electrolysis.

The majority of candidates scored at least 1 mark for this question, and many correctly identified both products correctly to gain 2 marks. It was a common error to see hydrogen given as the gas product, but there were a notable number of responses that gave carbon as a gas product and hydrogen as the solid product.

Question 3 (b)(iii)

Questions that ask about the conductivity of ionic compounds are frequently asked in exams and are usually poorly answered. This question was no exception and most candidates scored no marks.

There is a common misconception that in order to conduct electricity that there needs to be a flow of electrons, and this was regularly seen in the responses to this question. A lot of responses also simply repeated the question stem, or variations of it.

Where marks were scored, it was usually due to candidates correctly identifying that no current flows through the solid. It was very unusual to see mention of ions at all.

This response scored 0 marks.

(iii) The experiment is repeated using powdered solid copper chloride instead of copper chloride solution.

Nothing happens and no products are formed.

Explain why nothing happens and no products are formed.

(2)

The powdered solid copper chloride would just dissolve and not mixed in ~~to~~ with the electrolyte so nothing would happen.



Responses like this were common and indicated that candidates were unfamiliar with the idea of what an electrolyte is.

This response scored 0 marks.

- (iii) The experiment is repeated using powdered solid copper chloride instead of copper chloride solution.

Nothing happens and no products are formed.

Explain why nothing happens and no products are formed.

(2)

Nothing happens and no products are formed due to there being nothing to transfer the electricity through. The electrons cannot travel through the powder.



Answers referring to the movement of electrons were also common.



In electrolysis, the current is due to the movement of ions in the electrolyte.

There were a number of ways that a single mark could be scored including the fact that the solid does not conduct electricity, the ions are in a fixed position or that the copper chloride needed to be dissolved.

(iii) The experiment is repeated using powdered solid copper chloride instead of copper chloride solution.

Nothing happens and no products are formed.

Explain why nothing happens and no products are formed.

(2)

The powdered copper chloride has no free moving ions so no reaction happens



ResultsPlus
Examiner Comments

This example referred to the fact that the ions are in a fixed position in solids.

This response scored 2 marks.

- (iii) The experiment is repeated using powdered solid copper chloride instead of copper chloride solution.

Nothing happens and no products are formed.

Explain why nothing happens and no products are formed.

(2)

Because it is a solid so the ions are not free to move which means it does not conduct electricity and as a result it is not an electrolyte.



ResultsPlus
Examiner Comments

A very rare example of a 2-mark response that linked conductivity to the movement of the ions.

This candidate has demonstrated a clear understanding of what an electrolyte is and how electrolysis works.

Question 4 (b)

A majority of candidates were able to correctly calculate the relative formula mass of iron (III) chloride, showing that they were able to interpret a chemical formula and then carry out the calculation correctly.

Where candidates did not score marks, this was often down to multiplying numbers together rather than adding them.

An example of a fully correct response.

(b) Rust can be removed from steel by treating it with dilute hydrochloric acid.

One product formed in this reaction is iron chloride, FeCl_3 .

Calculate the relative formula mass of this iron chloride.

(relative atomic masses: Fe = 56.0, Cl = 35.5)

(2)

$$- \quad 35.5 \times 3 = 106.5$$

$$- \quad 106.5 + 56 = 162.5$$



relative formula mass = 162.5



ResultsPlus
Examiner Comments

The candidate has clearly shown and explained their calculation.

This response scored 1 mark.

(b) Rust can be removed from steel by treating it with dilute hydrochloric acid.

One product formed in this reaction is iron chloride, FeCl_3 .

Calculate the relative formula mass of this iron chloride.

(relative atomic masses: Fe = 56.0, Cl = 35.5)

(2)

$$56 + 35.5 = 91.5$$

relative formula mass = 91.5



ResultsPlus
Examiner Comments

There were very few 1-mark responses, but some candidates were not able to interpret the chemical formula and simply added the two numbers together.

Question 4 (c)(i)

Surprisingly few candidates were able to identify carbon as the only non-metal in the table, with nickel and chromium being common incorrect responses to this question.

Candidates should be encouraged to refer to the Periodic Table on the back of the paper to help them determine whether elements are metals or non-metals.

Question 4 (c)(ii)

This question was marginally better answered than the previous item, even though it required interpretation of the data rather than just extracting data from the table.

A greater number of candidates recognised that there was a larger quantity of chromium in stainless steel, although a significant minority gave the answer of iron here.

Question 4 (c)(iii)

This question required candidates to explain a method to prevent rusting and was not very well answered overall.

Many candidates were able to give a method of preventing rusting, but only a few could go on to explain how rusting would be prevented using their method. Paint and oil were the most common answers given, with only a few candidates suggesting galvanising or sacrificial protection as an option.

Some responses suggested simply keeping items covered or dry, but this is not practical for items that are to be used. These responses were also often not clear enough to score the second marking point about excluding oxygen or water, but indicated some knowledge as to what causes rusting.

This response scored 0 marks.

(iii) Explain **one** other way that corrosion of steel can be prevented.

(2)

By ~~diluting~~ treating it with dilute acids



ResultsPlus
Examiner Comments

Some candidates used information from the previous part of the question and gave the answer of treating the steel with acid. However, this is not a method of preventing corrosion but a method of removing rust once it has formed.

(iii) Explain **one** other way that corrosion of steel can be prevented.

(2)

place a cover to stop the rain reaching with it



ResultsPlus
Examiner Comments

Generic responses about covering the steel or putting it somewhere where it wouldn't get wet were not detailed enough to score any marks.

(iii) Explain **one** other way that corrosion of steel can be prevented.

(2)

Painting over the steel to create a shield / barrier
to the steel reaching and corroding.



This response scored a mark for stating a way that corrosion could be prevented, but did not go on to explain that this would prevent the steel reacting with oxygen or water.

(iii) Explain **one** other way that corrosion of steel can be prevented.

(2)

• Layer it with a thick layer
of oil or wax, etc
• This will stop the oxygen or water
from reacting with the steel



The candidate gives two specific materials to cover the steel with, and then goes on to state that it will prevent both oxygen and water from reacting with the steel.

This is a good response that gives more than enough detail to score both of the marks.

A more uncommon example of a fully correct answer.

(iii) Explain **one** other way that corrosion of steel can be prevented.

(2)

Sacrificial protection, where a substance such as magnesium can be wrapped around the steel and be corroded first before the corrosion can meet the steel.



The candidate has stated that a more reactive metal will corrode first and then gives a correct example of magnesium as a more reactive metal.

Question 4 (d)

This question required candidates to give detail of a simple experiment to determine which steel would corrode most quickly.

Most candidates had a good attempt at this question with the vast majority scoring 1 or 2 marks for putting the nails into water and waiting for a period of time. Only a few candidates scored the third mark, which required them to state how they would know which nail had corroded more quickly. Many simply repeated the stem of the question by suggesting 'see which corrodes faster'. In order to score the third mark, candidates were required to give a comparison of the nails – either which showed signs of corrosion first, or the one that had corroded the most after a period of time.

Candidates did not score the first mark if they introduced additional variables to the experiment such as adding acid to one tube or covering the surface of one tube with oil.

This response scored 1 mark.

(d) A student is given **two** nails of the same size but made of different types of steel.

They are also given two boiling tubes and some distilled water.

Devise an experiment to show which nail corrodes more quickly.

(3)

- Cover one nail in nail polish the other with nothing.
- Put them in a boiling tube with distilled water
- Wait for a couple minutes and you should see the nail without anything on has corroded.



This response lost the first mark because the candidate has introduced another variable by covering one nail in nail polish, but does score a mark for leaving the nails in water for a period of time. Although 'a couple minutes' is not actually long enough for corrosion to happen, the mark has been awarded for the idea of leaving the nails for a period of time.

(d) A student is given **two** nails of the same size but made of different types of steel.

They are also given two boiling tubes and some distilled water.

Devise an experiment to show which nail corrodes more quickly.

(3)

They could put the distilled water in ~~the~~ both of the boiling tubes and put each nail in each boiling tube and see which difference there is from each nail and write down what happened for each nail.



Most candidates scored 1 mark for adding the nails to water. This response does not mention waiting for any amount of time, or seeing which nail corrodes first and so does not score any more marks.

This response scored 2 marks.

- (d) A student is given **two** nails of the same size but made of different types of steel. They are also given two boiling tubes and some distilled water. Devise an experiment to show which nail corrodes more quickly.

(3)

put the distilled water in the two boiling tubes and put the two different types of nails in the two different boiling tubes. leave the boiling tubes for a set long amount of time and then you will be able to see what one corrodes more quickly.



ResultsPlus
Examiner Comments

This is an example of the most common response that was seen. The candidate has correctly stated to add the nails to the water and leave them for a (long) period of time.

The third mark was not awarded because the candidate has repeated information about seeing which nail corrodes more quickly.



ResultsPlus
Examiner Tip

Be careful not to simply repeat the information from the question in your answer.

This response scored 3 marks.

(d) A student is given **two** nails of the same size but made of different types of steel.

They are also given two boiling tubes and some distilled water.

Devise an experiment to show which nail corrodes more quickly.

(3)

Place the nails in each of the boiling tubes and add the distilled water to both. Leave and keep watching to see which one corrodes first



This response scored full marks for a clear and concise method. In this case, the candidate explains how they will know which nail corrodes most quickly by looking for the one that corrodes first.

(d) A student is given **two** nails of the same size but made of different types of steel.

They are also given two boiling tubes and some distilled water.

Devise an experiment to show which nail corrodes more quickly.

(3)

To show which nail corrodes more quickly, firstly place a nail in each boiling tube, within a ~~boiling~~ test tube rack. Pour in equal amounts of distilled water. Leave both of the nails in the boiling tube for around 24 hours. When you return, both nails may be corroded ~~to~~ however one will be more than the other. This will show you which type of steel corrodes faster, ~~and~~ only using an easy experiment.



ResultsPlus
Examiner Comments

This response states to add the nails to water and leave for a fixed period of time (24 hours).

It then clearly states that one nail will corrode more than the other and so scores full marks.

Question 5 (a)(i)

Quite often, word equations will name some or all of the products and reactants in the question, as was the case for this question. Most candidates scored the mark for this question.

Question 5 (b)(i)

The selection of appropriate equipment for use in practical work is an essential skill and it is commonly asked about. However, a large number of candidates are still unable to identify appropriate laboratory equipment. Whilst the majority of candidates correctly stated that a measuring cylinder, burette or pipette would work here there are still lots of measuring jugs, rulers and thermometers being suggested.

Question 5 (b)(ii)

This question required candidates to calculate the mean of three numbers and was well answered overall with most responses scoring both marks.

While it was clear that candidates knew how to calculate the mean of the numbers, there were sometimes errors in calculations that led to marks being lost.

(ii) The student repeated the experiment.

The results are shown in Figure 8.

experiment	height of precipitate in cm
1	2.4
2	2.7
3	2.4

Figure 8

Use the data in Figure 8 to calculate the mean height of the precipitate.

(2)

$$2.4 + 2.7 + 2.4 = 7.5$$

$$\cancel{\times 3} \quad 7.5 \times 3 = 22.5$$

mean height of precipitate = 22.5 cm



ResultsPlus
Examiner Comments

This response scored 1 mark for correctly adding the three values together and obtaining the answer of 7.5.

The candidate then multiplied this answer by 3 rather than dividing and so the second mark could not be awarded.

(ii) The student repeated the experiment.

The results are shown in Figure 8.

experiment	height of precipitate in cm
1	2.4
2	2.7
3	2.4

Figure 8

Use the data in Figure 8 to calculate the mean height of the precipitate.

$$2.4 + 2.4 + 2.7 \div 3 = 5.7 \quad (2)$$

mean height of precipitate = 5.7 cm



ResultsPlus
Examiner Comments

The incorrect answer of 5.7 (or 5.9) to the correct sum was a commonly seen mistake.

These numbers are obtained by putting the sum into a calculator as it has been written and without considering BIDMAS rules, so could score only 1 mark maximum.



ResultsPlus
Examiner Tip

Remember that calculators follow BIDMAS rules, and double check the answers to calculations.

(ii) The student repeated the experiment.

The results are shown in Figure 8.

experiment	height of precipitate in cm
1	2.4
2	2.7
3	2.4

Figure 8

Use the data in Figure 8 to calculate the mean height of the precipitate.

(2)

$$2.4 + 2.7 + 2.4 = 7.5 \quad 7.5 \div 3 = 2.5$$

mean height of precipitate = 2.5 cm



ResultsPlus
Examiner Comments

This response clearly shows the calculation along with working out, and the answer is correct.



ResultsPlus
Examiner Tip

Remember to show working out for calculations.

Question 5 (b)(iii)

This question asked for a method for obtaining a pure, dry precipitate from a mixture.

Many candidates gave the method for crystallisation by simply heating the mixture until some, or all, of the solution evaporated. Whilst this would obtain an impure sample of the precipitate for this reaction, many other precipitates would decompose under heating with a Bunsen burner.

Of those candidates that identified the correct method (filtration), very few mentioned washing the precipitate before drying, or that the precipitate would be left behind in the filter paper. Sometimes responses suggested that the filtrate should be left to dry, suggesting a lack of understanding about what a precipitate is.

Only a very few responses scored all three marks for this question.

(iii) Describe how a pure, dry sample of the precipitate could be obtained from the mixture in the test tube.

(3)

gently heat the test tube until the
water evaporates and leave to
cool



ResultsPlus
Examiner Comments

Responses that indicated crystallisation or simply heating the solution scored a maximum of 1 mark. However, this type of response was commonly seen.



ResultsPlus
Examiner Tip

Make sure you are familiar with different separating techniques for different types of mixture.

This response scored 2 marks.

(iii) Describe how a pure, dry sample of the precipitate could be obtained from the mixture in the test tube.

(3)

get a beaker, put a funnel in it, put a filter into the funnel and pour the precipitate and solution into the funnel, the solution will seep through and the precipitate will be in the filter paper.



The candidate has identified the correct method for obtaining the precipitate and then stated that the precipitate would be left behind in the filter paper.

(iii) Describe how a pure, dry sample of the precipitate could be obtained from the mixture in the test tube.

(3)

filter the mixture then wash precipitate with distilled water and place into an oven until dry.



3-mark responses were rarely seen, but this response gives a concise description of all of the steps required for obtaining the pure, dry precipitate.

Question 5 (b)(iv)

Questions relating to practical work remain challenging, with about half of the candidates correctly identifying a control variable. The most common correct answer was the same volume or amount of potassium carbonate, while the most common incorrect answer was the volume of calcium nitrate. As this was identified in the question as the independent variable, this suggests that a significant number of candidates are not familiar with different types of variable.

- (iv) The student investigated whether increasing the volume of calcium nitrate solution increased the height of the precipitate formed.

They repeated the experiment using different volumes of calcium nitrate.

State **one** variable that should be controlled in this investigation.

(1)

Volume should be the same.



ResultsPlus
Examiner Comments

Unfortunately, this response could not score as it did not state which volume needed to be the same.

- (iv) The student investigated whether increasing the volume of calcium nitrate solution increased the height of the precipitate formed.

They repeated the experiment using different volumes of calcium nitrate.

State **one** variable that should be controlled in this investigation.

(1)

The volume of calcium nitrate

should be the same.

(Total for Question 5 = 9 marks)



ResultsPlus
Examiner Comments

The question states that the volume of calcium nitrate is to be changed and therefore it cannot be a control variable.

(iv) The student investigated whether increasing the volume of calcium nitrate solution increased the height of the precipitate formed.

They repeated the experiment using different volumes of calcium nitrate.

State **one** variable that should be controlled in this investigation.

(1)

volume of potassium carbonate solution



ResultsPlus
Examiner Comments

This was the most commonly seen correct response.

Question 6 (a)(i)

This question required candidates to state a property of magnesium and proved more challenging than expected for some candidates, with less than half of the responses scoring.

The most common correct responses were shiny or malleable, whilst common incorrect responses included solid, hard and dense.

6 (a) Magnesium is a metal.

(i) State **one** physical property of magnesium.

(1)

reactive.



Reactivity is a chemical property and so this response did not score.

6 (a) Magnesium is a metal.

(i) State **one** physical property of magnesium.

(1)

Shiny



The most common correct response.

6 (a) Magnesium is a metal.

(i) State **one** physical property of magnesium.

(1)

Magnesium is a solid / strong



ResultsPlus
Examiner Comments

Some candidates gave responses such as strong or dense, which are not relevant to magnesium.

This response also states solid which is not creditworthy as magnesium can be melted.



ResultsPlus
Examiner Tip

Do not give lists of possible answers.

Question 6 (b)(i)

Most candidates were successfully able to complete the electron configuration for magnesium, having been given the first part of it in the question.

Question 6 (b)(ii)

This question asked candidates to link the electron configuration of chlorine to its period in the periodic table, and it was very poorly answered. The vast majority of responses made the link between electron configuration and group, suggesting that candidates are unaware of the differences between periods and groups, or are not reading the question properly.

The responses that correctly identified period 3 usually went on to score both marks.

This response scored 0 marks.

(ii) The electronic configuration of a chlorine atom is 2.8.7

Explain how the electronic configuration of chlorine is linked to its period in the periodic table.

(2)

Chlorine is in group 7 of the
periodic table so will have 7
electrons on the outer shell



ResultsPlus
Examiner Comments

An example of the most commonly seen response. Whilst the information in the response is correct, it does not answer the question that was asked.



ResultsPlus
Examiner Tip

Make sure you know the difference between groups and periods in the periodic table.

This response scored 1 mark.

(ii) The electronic configuration of a chlorine atom is 2.8.7

Explain how the electronic configuration of chlorine is linked to its period in the periodic table.

period 3 group 7

(2)

chlorine has 7 electrons

on its outer shell as it is in group 7

and it has 3 outer shells as its

in period 3.



ResultsPlus
Examiner Comments

This response almost scored full marks, but lost a mark for mentioning that chlorine has three outer shells, rather than three shells altogether.



ResultsPlus
Examiner Tip

There is only one outer shell on any atom.

This response scored 2 marks.

(ii) The electronic configuration of a chlorine atom is 2.8.7

Explain how the electronic configuration of chlorine is linked to its period in the periodic table.

(2)

* Chlorine is in period 3
periods tell us how many shells there
are.



This response scored both marks for stating that chlorine is in period 3 and then linking this to the number of electron shells.

Question 6 (c)

Empirical formula questions appear regularly, but are usually poorly answered. Fewer than half of the candidates scored any marks on this question.

Where marks were scored, it was disappointing to see that candidates were carrying out the calculation correctly but then not giving any formula at the end and so not being able to score full marks.

This response scored 1 mark.

- (c) 1.20 g of magnesium reacts completely with 3.55 g of chlorine to form magnesium chloride.

Calculate the empirical formula of the magnesium chloride.

(relative atomic masses: Mg = 24.0, Cl = 35.5)

You must show your working.

(3)

$$\text{Mg } 1.2 \div 24 = 0.05$$

$$\text{Cl } 3.55 \div 35.5 = 0.1$$



empirical formula = $2:1$



ResultsPlus
Examiner Comments

Although the candidate has carried out the correct calculation at the beginning, the final ratio given on the answer line is different to that which was calculated.

This response would have scored another mark had the incorrect ratio then been expressed as a chemical formula.



ResultsPlus
Examiner Tip

Make sure the final answer is a chemical formula rather than a ratio.

This response scored 2 marks.

- (c) 1.20 g of magnesium reacts completely with 3.55 g of chlorine to form magnesium chloride.

Calculate the empirical formula of the magnesium chloride.

(relative atomic masses: Mg = 24.0, Cl = 35.5)

You must show your working.

$$\begin{array}{r} \text{Mg} \\ \hline 24.0 \\ 1.20 \\ \hline 20 \\ \hline 5.10 \\ \hline 2 \end{array}$$

$$\begin{array}{r} \text{Cl} \\ \hline 35.5 \\ 3.55 \\ \hline 10 \\ \hline 1 \end{array}$$

(3)



empirical formula = Mg_2Cl



ResultsPlus
Examiner Comments

One common error is that the initial division is done upside down. This initial error is then carried through the rest of the calculation correctly and so the rest of the marks are awarded.

(c) 1.20 g of magnesium reacts completely with 3.55 g of chlorine to form magnesium chloride.

Calculate the empirical formula of the magnesium chloride.

(relative atomic masses: Mg = 24.0, Cl = 35.5)

$$\frac{\text{mass}}{\text{Mr} \times \text{moles}}$$

You must show your working.

(3)

$$\text{Magnesium} = \frac{1.20}{24.0}$$

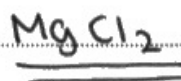
$$= 0.05$$

$$\frac{0.05}{0.05} = 1$$

$$\text{chlorine} = \frac{3.55}{35.5}$$

$$= 0.1$$

$$\frac{0.1}{0.05} = 2$$



empirical formula = MgCl_2



ResultsPlus
Examiner Comments

A fully correct response, clearly laid out, with all working shown and a correct formula on the answer line.

Question 6 (d)

This question required candidates to describe differences between ionic and covalent bonds. Most candidates managed to score some marks here, but it was rare to see any more than 2 marks awarded and very few candidates scored all of the marks.

Responses were often poorly expressed, referring to the differences between ionic and covalent compounds, or were contradictory mentioning both sharing and exchange of electrons for one type of bond.

For the higher scoring responses, it was much more common to see covalent bonds correctly defined as a shared pair of electrons rather than an ionic bond defined as an electrostatic force between oppositely charged ions.

(d) Sodium reacts with chlorine to form sodium chloride, which contains ionic bonds.

Hydrogen reacts with chlorine to form hydrogen chloride, which contains covalent bonds.

Figure 9 shows dot and cross diagrams of these compounds.

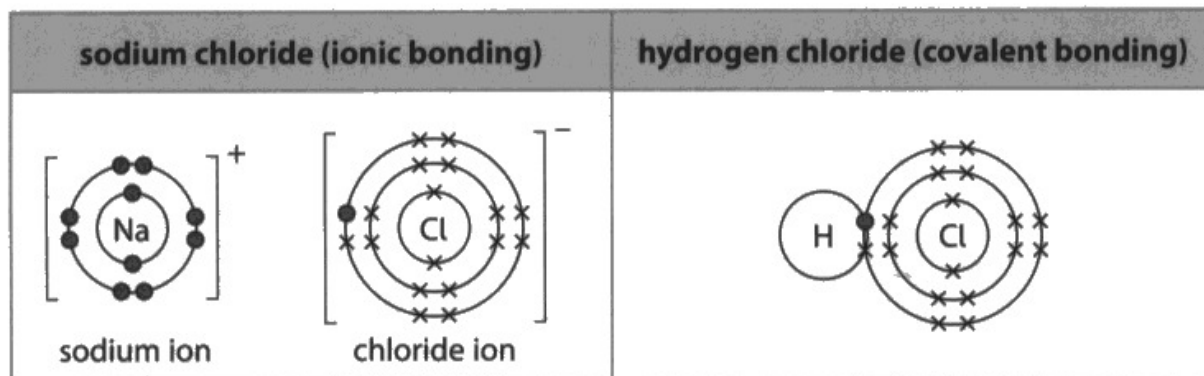


Figure 9

Describe the differences between an ionic bond and a covalent bond.

(4)

An ionic bond is where electrons are shared between a non-metal atom and a metal atom. Whereas covalent bonds are where electrons are shared between two non-metals.

ionic - atoms transfer electrons to other to get full outer shells; atoms still separate

covalent - atoms bond together, share the electron.



Responses like this, containing contradictory information, were quite common. The response mentions both sharing of electrons and electron transfer for ionic bonds, and so no marks could be awarded. A mark has been awarded for the mention of covalent bonds being shared electrons without any contradiction.

(d) Sodium reacts with chlorine to form sodium chloride, which contains ionic bonds.

Hydrogen reacts with chlorine to form hydrogen chloride, which contains covalent bonds.

Figure 9 shows dot and cross diagrams of these compounds.

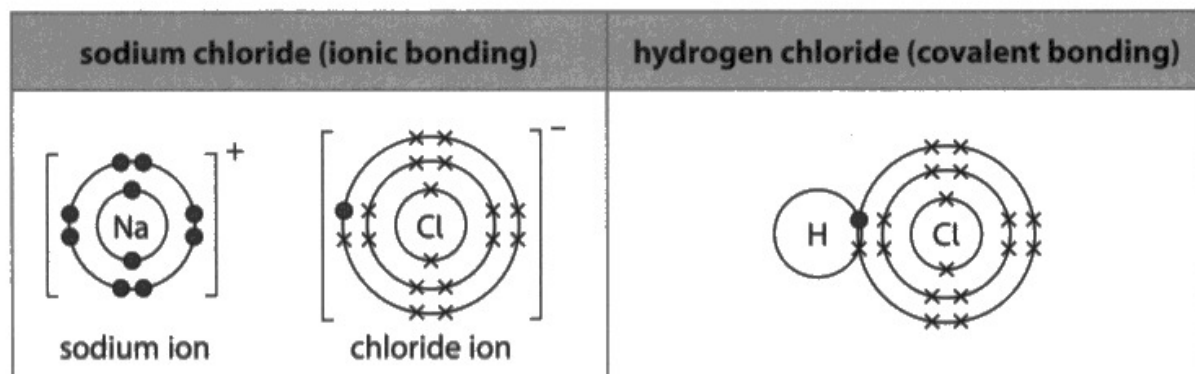


Figure 9

Describe the differences between an ionic bond and a covalent bond.

(4)

Ionic bonding is the transfer of electrons causing positive sodium^{ion} and negatively charged and stable chloride ion.

Covalent bonding is sharing electrons to form hydrogen chloride. Hydrogen sharing it's 1 electron with chlorine to form a full outer shell and stabilize them both.



Many responses scored 2 marks for correctly describing the formation of ionic and covalent bonds, but then did not score further as there was not enough detail about the actual bond given in the responses.

This response scored 3 marks.

(d) Sodium reacts with chlorine to form sodium chloride, which contains ionic bonds.

Hydrogen reacts with chlorine to form hydrogen chloride, which contains covalent bonds.

Figure 9 shows dot and cross diagrams of these compounds.

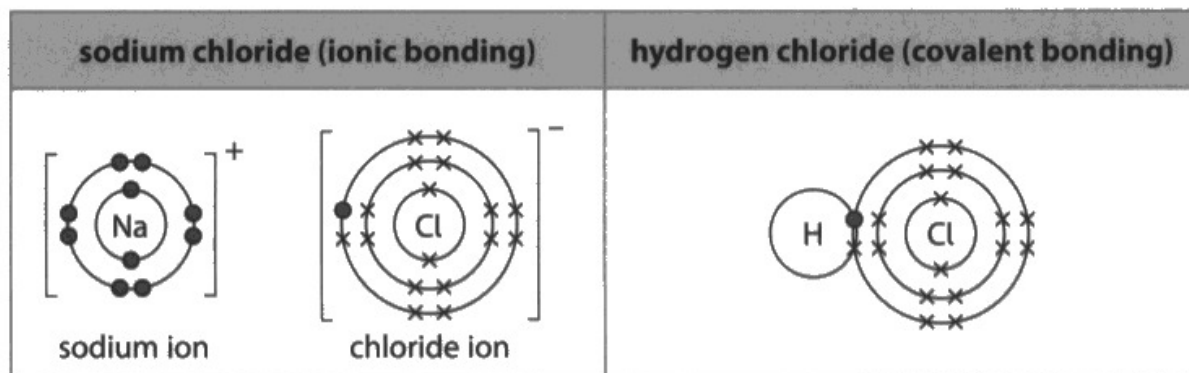


Figure 9

Describe the differences between an ionic bond and a covalent bond.

(4)

A covalent bond is a shared pair of electrons between two non-metals. An ionic bond is where atoms gain or lose electrons, depending on how many electrons they have on their outer shells.



ResultsPlus
Examiner Comments

Where responses scored more than 2 marks, it was most common to see that covalent bonds are shared **pairs** of electrons.

This response scored 4 marks.

(d) Sodium reacts with chlorine to form sodium chloride, which contains ionic bonds.

Hydrogen reacts with chlorine to form hydrogen chloride, which contains covalent bonds.

Figure 9 shows dot and cross diagrams of these compounds.

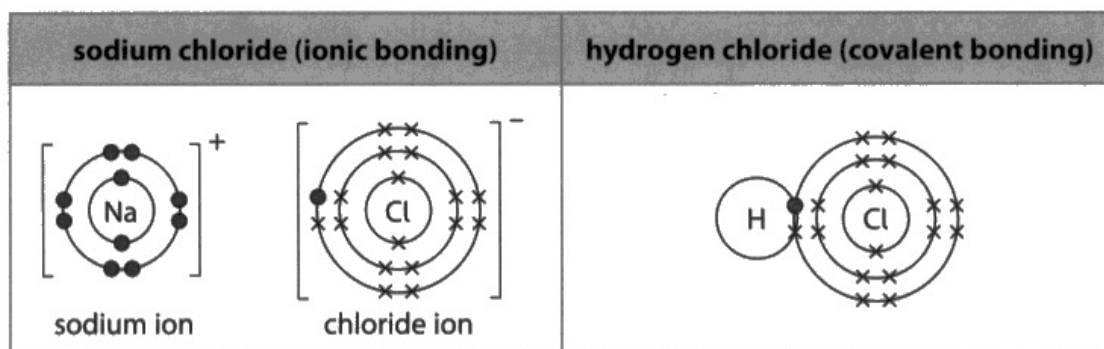


Figure 9

Describe the differences between an ionic bond and a covalent bond.

(4)

ionic bond is an electrostatic force of attraction between two oppositely charged ions

covalent bond is a shared pair of electrons

ionic bonding is between a metal and a non metal

covalent bonding is between two non metals



ResultsPlus
Examiner Comments

It was very rare to see 4-mark responses and this is an example of a good response to the question being asked. The candidate clearly defines both an ionic and a covalent bond in the first two sentences, and this alone is worth 4 marks.

Question 7 (a)(i)

This question asked about elements commonly used in fertilisers and required the use of information from a table. It was expected that candidates would select phosphorus as the correct answer to the question but only a very small minority did so. The most commonly seen response was phosphorus oxide – copied directly from the table.

This indicates that most candidates did not know the difference between an element and a compound.

Question 7 (a)(iii)

A surprising number of candidates were unaware that fertilisers are used to increase plant growth and therefore crop yield. Fewer than half of candidates scored this mark, with many suggesting that fertilisers are used as some sort of pesticide.

(iii) State why farmers spread fertilisers on their fields.

(1)

stop pests as it is toxic
and kills them



Candidates commonly seemed to think that fertilisers are used as a form of pest control.

(iii) State why farmers spread fertilisers on their fields.

(1)

so that crops grow faster and insects don't eat them.



This response correctly identifies that fertilisers aid with crop growth. However, this correct response is negated by the rest of the sentence about keeping insects away and so this candidate scored 0 here.

(iii) State why farmers spread fertilisers on their fields.

(1)

to provide the crops with more nutrients so
the crops will grow larger and faster.



This response shows almost all of the creditworthy points and is not negated by any incorrect points, therefore the mark is awarded.

Question 7 (b)(i)

The word equation for the reaction between ammonia solution and sulfuric acid was well answered overall. Most candidates scored at least 1 mark, and many scored 2 marks.

Where errors were made, it was usually due to mixing up ammonia and ammonium or adding extra products into the equation such as water, oxygen or carbon dioxide.

This response scored 1 mark.

(b) Ammonium sulfate is a fertiliser and is produced on a large scale in industry.

In this process, ammonia reacts with sulfuric acid.

(i) Write the word equation for the reaction between ammonia and sulfuric acid.

(2)



The candidate has correctly named both of the reactants before the arrow and so scores 1 mark here. However, hydrogen has been incorrectly added as an additional product of the reaction, and the other product has been incorrectly named as ammonia sulfate.

This response scored 1 mark.

(b) Ammonium sulfate is a fertiliser and is produced on a large scale in industry.

In this process, ammonia reacts with sulfuric acid.

(i) Write the word equation for the reaction between ammonia and sulfuric acid.

(2)

ammonium + sulfuric acid → Ammonium sulfate.



ResultsPlus
Examiner Comments

The candidate has correctly identified the product and written this after the reaction arrow. However, they have incorrectly named one of the reactants as ammonium.



ResultsPlus
Examiner Tip

Ammonia and ammonium are not the same thing.

(b) Ammonium sulfate is a fertiliser and is produced on a large scale in industry.

In this process, ammonia reacts with sulfuric acid.

(i) Write the word equation for the reaction between ammonia and sulfuric acid.

(2)

ammonia + sulfuric acid → ammonium sulfate



ResultsPlus
Examiner Comments

This is an example of a fully correct response, scoring 2 marks.

Question 7 (b)(ii)

The responses given here suggested that many candidates were unaware of the differences between the two methods of making ammonium sulfate, and although most candidates attempted this question, only about half scored the mark.

The most common correct response was related to how long the processes took, which was an accepted answer as this linked to the desired response of the smaller quantities made in the laboratory.

- (ii) Ammonium sulfate can also be made in the laboratory by titrating ammonia solution with dilute sulfuric acid.

Give **one disadvantage** of using this laboratory method to produce ammonium sulfate as a fertiliser compared with an industrial method.

(1)

It is more expensive to make in a lab.



Arguments relating to the cost of processes are common, and rarely creditworthy. This response did not score.

- (ii) Ammonium sulfate can also be made in the laboratory by titrating ammonia solution with dilute sulfuric acid.

Give **one disadvantage** of using this laboratory method to produce ammonium sulfate as a fertiliser compared with an industrial method.

(1)

could be more harmful to the plants



A significant number of incorrect responses seemed to suggest that ammonium sulfate made in the laboratory would be in some way more harmful than that made industrially.

- (ii) Ammonium sulfate can also be made in the laboratory by titrating ammonia solution with dilute sulfuric acid.

Give **one disadvantage** of using this laboratory method to produce ammonium sulfate as a fertiliser compared with an industrial method.

(1)

..... in laboratory it's made in small amounts.....



This is an example of a fully correct response – that the laboratory method makes small quantities of ammonium sulfate compared to methods used in industry.

Question 7 (c)

The first of the 6-mark questions required candidates to describe how to obtain a sample of pure ammonium sulfate crystals using titration. Candidates were required firstly to describe how to carry out a titration and then the process of crystallisation.

There was a wide range of responses across the paper including a large proportion left completely empty. Of those candidates that had attempted to answer the question, there were a full range of responses from 0 to 6 marks. Lower scoring responses were those that gave some basic, correct information about how to carry out a titration or a crystallisation. Some basic information about both processes was enough to get into Level 2, while a detailed description of one (only) of the processes scored at the top of this level. Level 3 responses required some description of both processes with a good level of detail for at least one of them.

The majority of candidates were able to give some details about crystallisation that were creditworthy and therefore scored some marks. Most candidates also attempted to describe a titration, but there was far more variation in the quality of responses here. Some candidates could not name the equipment or what it was used for, with a common suggestion being that a volumetric pipette is used to add indicator to either an acid or an alkali. Only the most able candidates were able to give a correct, detailed description of how to carry out a titration including using a white tile, swirling the mixture or drop-by-drop addition from the burette near the end point.

Titration is a neutralisation reaction that requires a high level of accuracy and has many steps to follow in order to obtain this level of accuracy. It was clear that candidates are not able to recall these steps and why they are carried out. Rinsing the burette and pipette with the chemicals to be used, filling the jet of the pipette and repeating the titration without indicator were rarely or never seen.

*c) In the laboratory, ammonium sulfate crystals can be made using ammonia solution and dilute sulfuric acid.

The volume of ammonia solution required to neutralise 25 cm³ of dilute sulfuric acid is found by titration using an indicator.

The results of the titration can be used to prepare a solution of ammonium sulfate.

Pure, dry ammonium sulfate crystals can be made from this solution.

Figure 11 shows some of the equipment that may be used in the experiment.

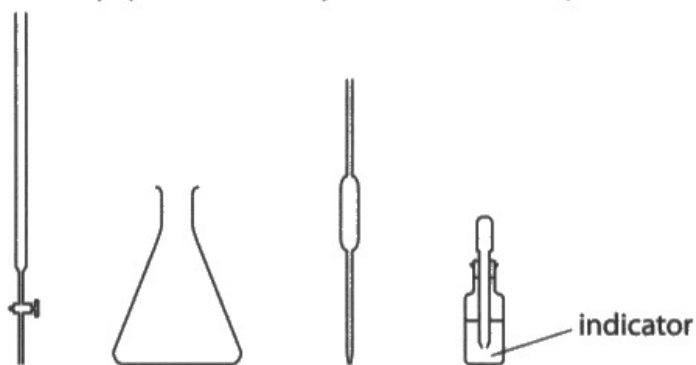


Figure 11

Write a detailed method to make ammonium sulfate crystals starting with ammonia solution and dilute sulfuric acid.

(6)

- Pour the ammonia solution into the flask.
- Add ~~the~~ drops of the indicator until the solution begins to change colour.
- Filter out the solution onto a petri dish.
- Leave the solution for 24 hours.
- The solution will have dried to form ammonium sulfate crystals.
- Record the amount of indicator needed for the reaction to take place.



ResultsPlus
Examiner Comments

This is an example of a response that scored 1 mark, in this case for adding an indicator to ammonia. There is nothing else creditworthy as no titration is carried out, filtration is not required, and the crystallisation is not using ammonium sulfate.

This response scored 2 marks.

*(c) In the laboratory, ammonium sulfate crystals can be made using ammonia solution and dilute sulfuric acid.

The volume of ammonia solution required to neutralise 25 cm^3 of dilute sulfuric acid is found by titration using an indicator.

The results of the titration can be used to prepare a solution of ammonium sulfate.

Pure, dry ammonium sulfate crystals can be made from this solution.

Figure 11 shows some of the equipment that may be used in the experiment.

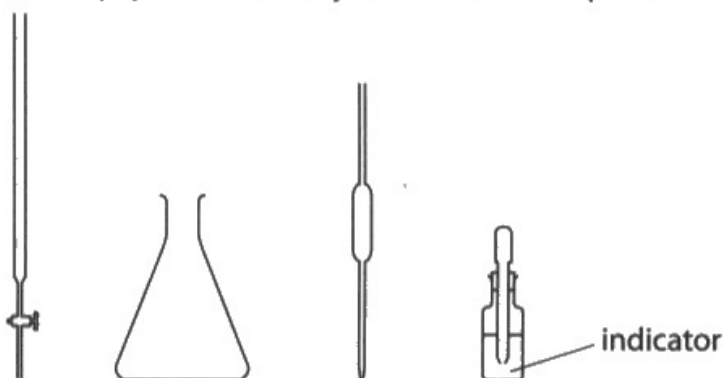
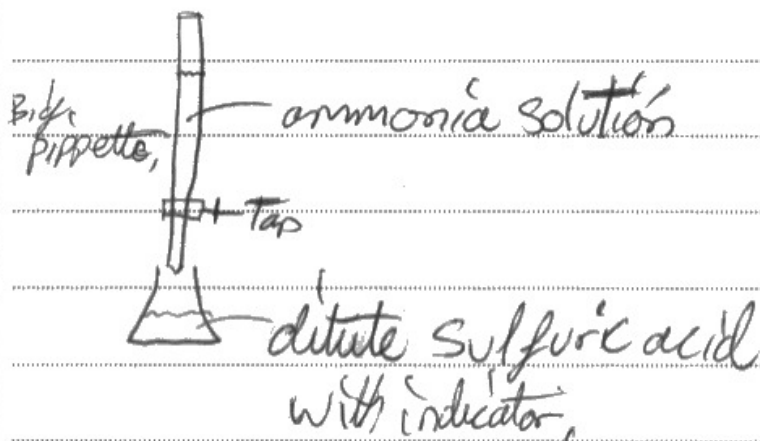


Figure 11

Write a detailed method to make ammonium sulfate crystals starting with ammonia solution and dilute sulfuric acid.

(6)





Information presented as a diagram (or table or bullet points) is always considered, and there was enough detail in this response to get 2 marks. The candidate correctly shows sulfuric acid in the conical flask with indicator added, and ammonia solution in the (incorrectly labelled) burette, ready to be added to the sulfuric acid.

It was common to see incorrectly named equipment, including conical flasks regularly identified as beakers.



Learn the names of the different pieces of equipment used in practical work.

*(c) In the laboratory, ammonium sulfate crystals can be made using ammonia solution and dilute sulfuric acid.

The volume of ammonia solution required to neutralise 25 cm^3 of dilute sulfuric acid is found by titration using an indicator.

The results of the titration can be used to prepare a solution of ammonium sulfate.

Pure, dry ammonium sulfate crystals can be made from this solution.

Figure 11 shows some of the equipment that may be used in the experiment.

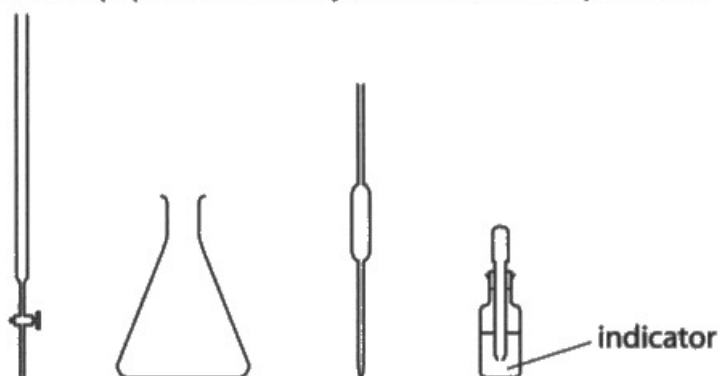


Figure 11

Write a detailed method to make ammonium sulfate crystals starting with ammonia solution and dilute sulfuric acid.

(6)

to find the volume of ammonia required to neutralise 25 cm^3 of dilute sulfuric acid, you fill a beaker with 25 cm^3 of dilute sulfuric acid and add a few drops of phenolphthalein, this is clear when in acid and turns a pink colour when an alkali is present. you next fill the titration

dropper tube with ammonia solution, making sure to note the amount in the tube. ~~You should have~~ now you very slowly start adding a few drops at a time into the beaker and swirling the beaker to mix it until you see a very slight colour change, if it goes bright pink then you know you have added too much, you should have the beaker on a white tile so you can see the colour change. You want it to be a very pale pink colour, keep repeating the experiment until you've got a pale pink colour and then look at the amount of ammonia solution left in the dropper tube and take this away from the amount that was in there at the start, this will tell you how much ammonia solution is required to neutralise 25cm^3 of dilute sulfuric acid.



This is an example of a Level 2 response.

The candidate describes how to carry out a titration with a good level of detail including: named indicator with an almost correct colour change, adding the ammonia drop by drop, using a white tile and swirling the beaker. There are some issues with naming equipment correctly, and a few details are missing but this is enough for the top of Level 2.

Had the candidate given anything related to crystallisation in their response then this would have been enough to get into Level 3.

*c) In the laboratory, ammonium sulfate crystals can be made using ammonia solution and dilute sulfuric acid.

The volume of ammonia solution required to neutralise 25 cm³ of dilute sulfuric acid is found by titration using an indicator.

The results of the titration can be used to prepare a solution of ammonium sulfate.

Pure, dry ammonium sulfate crystals can be made from this solution.

Figure 11 shows some of the equipment that may be used in the experiment.

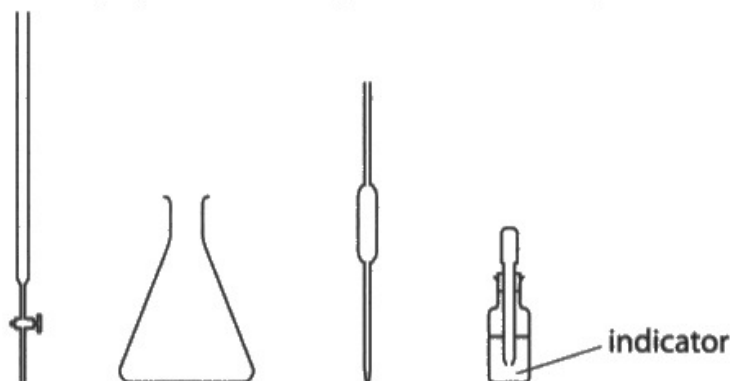


Figure 11

Write a detailed method to make ammonium sulfate crystals starting with ammonia solution and dilute sulfuric acid.

First you would place ^{25cm³} ~~25cm³~~ the ⁽⁶⁾ dilute sulphuric ~~acid~~ acid into a conical flask with a few drops of an indicator, such as ~~methyl orange~~ phenolphthalein. Use a burette to slowly ~~mix~~ add ammonia solution to the conical flask. Continue to swirl the flask until

The solution turns colourless.

Once it turns colourless stop adding ammoniac solution. Read from the burette the amount of solution it took to neutralise the acid.

Next, repeat these exact steps but ~~with~~ without the indicator.

Pour the new, pure solution into an evaporating dish and, using a Bunsen burner, evaporate the solution until the mass has ~~been~~ halved. Then leave to

cool for a day or two on a windowsill, and finally, collect your crystals.



ResultsPlus
Examiner Comments

This candidate has given a detailed description of both titration and crystallisation and scored 6 marks.



Although the description of the titration is brief it includes a named indicator, correctly named equipment and adding the ammonia to the acid as well as detail about swirling the flask and repeating the titration without indicator.

There is a good description of crystallisation, including evaporating half of the water from the solution before leaving it to cool and crystallise.

There is enough detail in this response to score full marks.

Question 8 (a)

This was the first of the overlap questions and was about the neutralisation of hydrochloric acid with calcium hydroxide.

This question required candidates to know that the reactants should be mixed before the pH of the mixture was measured and approximately half of the candidates correctly identified this.

Common incorrect answers included adding the calcium hydroxide to excess, measuring pH (even though this was the next step given) and timing how long the reaction took.

- 8** In an experiment, powdered calcium hydroxide was added to dilute hydrochloric acid and the pH was measured.

The method used was

step 1 measure 200 cm³ dilute hydrochloric acid into a beaker

step 2 add 0.1 g of powdered calcium hydroxide to the beaker

step 3 find the pH of the mixture

step 4 repeat steps 2 and 3 until the pH stops changing.

- (a) State what should be done after **step 2** to make sure that any reaction is complete.

(1)

results table



ResultsPlus
Examiner Comments

This response did not score. There were numerous different incorrect or irrelevant suggestions.

- 8 In an experiment, powdered calcium hydroxide was added to dilute hydrochloric acid and the pH was measured.

The method used was

step 1 measure 200 cm³ dilute hydrochloric acid into a beaker

step 2 add 0.1 g of powdered calcium hydroxide to the beaker

step 3 find the pH of the mixture

step 4 repeat steps 2 and 3 until the pH stops changing.

- (a) State what should be done after **step 2** to make sure that any reaction is complete.

(1)

Stir and mix the solutions



The candidate has suggested both stir and mix, but either on its own would have been enough to score the mark.

Question 8 (b)

This question required the identification of the products of neutralisation and completing the word equation for the reaction, and proved to be a challenge for candidates at this level with many responses scoring 0 marks.

Some candidates made a good attempt at the question and correctly identified one or both of the products, however correct responses were sometimes negated by the inclusion of additional products such as hydrogen or carbon dioxide. In some instances, candidates gave the generic response of salt + water and therefore scored a mark for identifying water as a product.

Naming salts was particularly challenging for candidates with variations including calcium hydrochloride, calcium hydrochloric acid and calcium hydro-oxide.

(b) Complete the word equation for the reaction.

(2)

calcium hydroxide + hydrochloric acid → calcium chloride



ResultsPlus
Examiner Comments

This response scored 1 mark for correctly naming calcium chloride. There is no mention of water, so the second mark is not awarded.

(b) Complete the word equation for the reaction.

(2)

calcium hydroxide + hydrochloric acid → calcium hydrochloride



ResultsPlus
Examiner Comments

There were a number of incorrect attempts at naming calcium chloride.

(b) Complete the word equation for the reaction.

(2)

calcium hydroxide + hydrochloric acid → calcium chloride + water



ResultsPlus
Examiner Comments

This response scored 2 marks for correctly identifying both products with no additional products.

Question 8 (d)(i)

A large majority of candidates were able to correctly read the initial pH of 1 from the graph.

Question 8 (d)(ii)

This question did not perform as well as the previous one, even though it was another question that required the reading of information from the same graph.

Many candidates rounded their answer down to 0.7 even though the correct response was clearly marked at 0.74.

Question 8 (d)(iii)

This question was very challenging for candidates and poorly answered overall, with most scoring either 0 or 1 mark.

The question required an explanation of the shape of the curve in terms of neutralisation and ions, however many candidates simply stated the changing pH values from the graph rather than linking this to the reaction that was happening.

Most commonly a mark was awarded for correctly identifying that the pH at the beginning of the solution was acidic. Only a few candidates mentioned that the reaction was a neutralisation and it was very rare to see reference to H^+ or OH^- ions.

A significant number of candidates had the misconception that higher the pH, the more acidic the solution was.

This response scored 0 marks.

(iii) Explain why the pH starts at a low value and ends at a higher value.

(3)

It starts at a low value as the mass of calcium hydroxide is low. As the mass increased the pH slowly increases before taking a large incline in pH once the mass goes above ~~0.7~~ 0.7g which causes the pH to end higher than what it started on.



ResultsPlus
Examiner Comments

It was common to see responses that described the change in pH throughout the neutralisation rather than explaining why the pH changed.

(iii) Explain why the pH starts at a low value and ends at a higher value.

(3)

Calcium hydroxide is acidic meaning the more you add the more acidic the substance becomes.



Some responses suggested that increasing the pH also increased the acidity of the solution.

This response scored 2 marks.

(iii) Explain why the pH starts at a low value and ends at a higher value.

(3)

hydrochloric acid is a strong ~~acid~~ acid so its lower the pH scale but calcium hydroxide is alkali so it changes the pH of the mixture.



The candidate correctly identifies that the low pH at the beginning indicates an acid, and also states that the calcium hydroxide is an alkali. However, there is no mention of a reaction between the two so a third mark could not be awarded.

(iii) Explain why the pH starts at a low value and ends at a higher value.

(3)

pH begins low as it is an acid, the calcium hydroxide is added to neutralise but is alkaline so if too much is added the pH will continue to increase.



ResultsPlus
Examiner Comments

Responses that scored full marks usually looked like this. The low pH is correctly linked to an acid, the calcium hydroxide is identified as alkaline and the candidate also goes on to state that the alkali will neutralise the acid and then continue to increase the pH after neutralisation.



ResultsPlus
Examiner Tip

Acids have a pH below 7.

(iii) Explain why the pH starts at a low value and ends at a higher value.

(3)

Dilute hydrochloric acid has a lot of H^+ ions meaning it will be very acidic so it starts at a pH of 1 but as powdered calcium hydroxide is added it neutralises the H^+ ions and replaces them with OH^- ions.



ResultsPlus
Examiner Comments

A very rare example of an explanation in terms of the ions present during the reaction. The candidate correctly identifies acids as a source of H^+ ions and having a low pH. Although poorly worded, the candidate recognises that the reaction is a neutralisation and that there will be an excess of OH^- ions at the end.

Question 8 (e)

This question asked candidates to name equipment that could be used to measure the pH of a mixture. Most candidates attempted this and many scored the mark for identifying either a pH meter or universal indicator.

The incorrect responses usually referred to just 'indicator' or gave the names of indicators other than universal indicator. Candidates do not seem to recognise that indicators such as phenolphthalein do not give a pH value, but simply identify whether a mixture is acidic or alkaline. Some candidates stated that a pH scale should be used, but did not state that universal indicator needed to be added in order to use the pH scale.

(e) State what should be used to measure the pH of the mixture in this experiment.

(1)

Indicator paper



The only indicator that would give an indication of pH is universal indicator. There are many other indicators that could be used that would not give the pH of the mixture.

(e) State what should be used to measure the pH of the mixture in this experiment.

(1)

blue litmus paper



Blue litmus paper would only indicate if the mixture is acidic or not. There would be no indication of pH.



Most indicators do not give the actual pH of a mixture.

(e) State what should be used to measure the pH of the mixture in this experiment.

(1)

pH scale



A pH scale is the chart used to convert the colour of universal indicator into a pH value and would be of no use without adding universal indicator to the mixture.

(e) State what should be used to measure the pH of the mixture in this experiment.

(1)

a pH meter



A pH meter will give a digital value for the pH of a mixture.

(e) State what should be used to measure the pH of the mixture in this experiment.

(1)

universal indicator.



Universal indicator can be used alongside a pH scale to determine a value for the pH of a mixture.

Question 8 (f)

Most candidates were able to identify goggles or gloves as a suitable safety precaution when working with corrosive or irritant chemicals.

Where candidates did not score the mark, it was usually because the precautions suggested were generic lab safety rules, or the incorrect naming of goggles as glasses.

(f) The calcium hydroxide used is corrosive to the eyes and an irritant to skin.

Using this information, state **one** safety precaution that should be taken during the experiment when using any corrosive substance.

~~Wear lab gloves~~ Wear a lab coat (1)



Responses such as lab coat, stand up, tie hair back and wear PPE are not specific to these hazards and therefore did not score.

(f) The calcium hydroxide used is corrosive to the eyes and an irritant to skin.

Using this information, state **one** safety precaution that should be taken during the experiment when using any corrosive substance.

(1)

Safety glasses



Safety glasses is a suitable alternative for goggles, but glasses alone was not enough to score the mark.

Gloves also scored the mark as a suitable measure of avoiding skin contact with calcium hydroxide.

Question 9 (b)(i)

This question gave candidates part of the reactivity series of metals alongside observations from the reactions of two metals with acids. Candidates were required to use these to predict observations when two different metals were reacted with acid.

In order to score marks, the observations needed to be a comparison with the observations given rather than a repeat of the original observations. Most candidates scored at least one mark, with many scoring both marks for one correct observation for each metal. Where marks were lost, it was usually because candidates gave additional, incorrect observations or they stated that there would be no reaction between iron and acid.

- (i) Use the information in Figure 13 and in Figure 14 to predict the observations for the reactions of magnesium and of iron with dilute hydrochloric acid.

(2)

magnesium

bubbles/fizzes

iron

no reaction



ResultsPlus
Examiner Comments

Responses that didn't score often gave correct observations, but did not go on to compare these with the other metals in order to give an idea of reactivity.

In this case, the observation for magnesium is correct but not compared to zinc. The observation for iron is incorrect.

- (i) Use the information in Figure 13 and in Figure 14 to predict the observations for the reactions of magnesium and of iron with dilute hydrochloric acid.

(2)

magnesium

Starts to bubble more than zinc, and the test tube is warmer

iron

Very small amount of bubbles and the temperature is a tiny bit warmer



ResultsPlus
Examiner Comments

This response scored both marks and has given both correct observations, although only one observation for each metal was needed. The reactivity of magnesium is compared to that of zinc in terms of both bubbles and temperature. Both statements are also correct for iron, although many candidates suggested a cold test tube for iron. This was ignored as it could have been an indication of no temperature change rather than an endothermic reaction.

Question 9 (b)(ii)

Questions asking how to test for different gases are asked regularly.

This question asked how to test for hydrogen gas and was attempted by most candidates. Many could identify the 'squeaky pop' test, but did not always state how to carry out the test and therefore did not score any marks.

Occasionally, candidates gave the test for oxygen or carbon dioxide.

(ii) When metals react with acids, hydrogen gas is produced.

Describe the test to show that the gas is hydrogen.

(2)

you should hear a ~~pop~~ pop sound when realised



Some candidates seemed to indicate that the pop sound came from releasing their thumb or finger from the top of the test tube.

In order to score any marks, a flame of some description had to be identified – usually a lit splint.



Describe what you need to carry out the test as well as what the result of the test will be.

(ii) When metals react with acids, hydrogen gas is produced.

Describe the test to show that the gas is hydrogen.

Squeaky Pop

(2)

put gas into a test tube and put a lit
splint into the tube. IF hydrogen is present,
there will be a squeaky pop sound.



ResultsPlus
Examiner Comments

This candidate has correctly identified the 'squeaky pop' test alongside the question, which would not have been creditworthy on its own.

However, there is a good description of how to carry out the test as well as the result that would be expected for hydrogen.

Question 9 (b)(iii)

The most common score for this question was 1 mark, for correctly adding a 2 to balance the equation. It was far less common to see the correct formula for hydrogen.

A good number of candidates recognised that there would be two hydrogen atoms, but only some of these remembered that hydrogen is diatomic, therefore it was more common to see the formula given as 2H rather than H₂.

Question 9 (c)

The second of the 6-mark questions required candidates to explain the most suitable method for extracting metals, based on their position in the reactivity series.

More than half of candidates attempted to answer the question and the full range of marks was seen across the responses. The most commonly awarded marks were in Level 2 – candidates were often able to identify the correct methods of extracting the metals and then link this to their reactivity, but many of the responses lacked enough detail for more marks. In order to get into Level 3, candidates were required to state why the chosen method was the most suitable one but very few responses discussed this. Lower scoring responses were able to identify correct methods for one or two metals.

One commonly seen misconception was to assume that the most reactive metal would be mined as a pure metal whilst unreactive metals would require electrolysis. Candidates seemed to assume that if a metal was reactive then it would be too dangerous to do anything other than mine the pure metal.

Some responses did not score because they simply discussed the different methods of extracting metals, without linking these to the metals that were asked about in the question.

*c) There are **three** common methods of obtaining metals from the Earth's crust:

- mine the pure metal
- mine the metal ore and heat it with carbon
- mine the metal ore and electrolyse the molten compound.

The method used to obtain a metal is linked to its position in the reactivity series of metals.

Aluminium, gold, iron, and silver are some commonly used metals.

Use the reactivity series in Figure 13 to state and explain the method chosen to obtain each of these four metals.

(6)

gold is extracted from the ground so mining would be best

Aluminium is best for mining and heat with carbon because then it is a very strong alloy making it more useful

Iron is best to mine then electrolyse to again make it more useful for more than one thing.

Silver is best to also heat with carbon as silver being an alloy increases its chances of becoming less fragile and malleable, becomes multi functional.



This is an example of a Level 1 response.

There is some incorrect information about iron and aluminium, but the candidate has identified a correct method of extraction for both gold and silver and therefore scores 2 marks.

*(c) There are **three** common methods of obtaining metals from the Earth's crust:

- mine the pure metal
- mine the metal ore and heat it with carbon
- mine the metal ore and electrolyse the molten compound.

The method used to obtain a metal is linked to its position in the reactivity series of metals.

⁴ Aluminium, ¹ gold, ³ iron, and ² silver are some commonly used metals.

Use the reactivity series in Figure 13 to state and explain the method chosen to obtain each of these four metals.

(6)

You would mine the gold and silver.
Mine the iron and heat it with carbon.
Mine the aluminium and electrolyse the molten compound.



Being able to identify the correct method for all four metals was enough to score 3 marks.

* (c) There are **three** common methods of obtaining metals from the Earth's crust:

- mine the pure metal
- mine the metal ore and heat it with carbon
- mine the metal ore and electrolyse the molten compound.

The method used to obtain a metal is linked to its position in the reactivity series of metals.

Aluminium, gold, iron, and silver are some commonly used metals.

Use the reactivity series in Figure 13 to state and explain the method chosen to obtain each of these four metals.

(6)

Gold and silver can be obtained by mining the pure metal, this is because they are very low in the reactivity ~~series~~ series and isn't dangerous. Aluminium, however is a lot higher in the reactivity series, so likely, would need to be extracted by electrolysis. because it reacts too easily to other things and could be dangerous to humans and other wildlife. Iron is in the middle and would have to be extracted by mining the ore and heating it with carbon.



This is an example of a Level 2 response that scored 4 marks.

The candidate correctly identified the correct method of extraction for all four metals and linked this to their relative reactivity. The further explanations linking extraction to danger are not relevant, but not contradictory and are therefore ignored.

*(c) There are **three** common methods of obtaining metals from the Earth's crust:

- mine the pure metal
- mine the metal ore and heat it with carbon
- mine the metal ore and electrolyse the molten compound.

The method used to obtain a metal is linked to its position in the reactivity series of metals.

Aluminium, gold, iron, and silver are some commonly used metals.

Use the reactivity series in Figure 13 to state and explain the method chosen to obtain each of these four metals.

(6)

~~Aluminium~~ Gold is extracted as a ~~molten~~ pure metal by getting it straight from the ground. This is because it is inert and doesn't react with other metals. This explains why it is the lowest in the reactivity series. Iron ^{and silver are less} ~~more~~ reactive than carbon, so they are mined by carbon. It is used to displace the metal from its ore. Aluminium is more reactive than carbon, so displacement won't work. This means it is extracted through electrolysis.



This response scored full marks.

The candidate has correctly identified correct methods of extraction for all four metals and then gone on to give detailed explanations for each metal. The explanations show a good level of understanding and explains why each method is chosen.

Question 10 (a)

The final question on the paper covered a lot of the maths content of separate chemistry. Candidates found this question about calculating atom economy particularly challenging and there were a lot of responses that scored 0 marks.

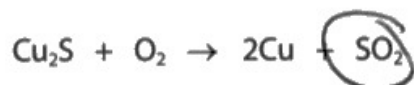
Some candidates correctly calculated the total relative formula mass of the reactants and scored a mark, but it was not uncommon to see candidates calculate the total formula mass of both products and reactants and finish with a number twice as large as expected.

Many candidates were not able to go any further than this, and it was very rare to see a fully correct calculation. There were some 3-mark answers that had lost the final rounding mark and a very few 4-mark answers.

10 There are several stages to the production of sulfuric acid in industry.

(a) Sulfur dioxide is required for the production of sulfuric acid.

Sulfur dioxide can be obtained by heating copper sulfide, Cu_2S , in excess air.



Calculate the atom economy for the production of sulfur dioxide, SO_2 , in this reaction.

(relative atomic mass: $\text{Cu} = 63.5$)

relative formula masses: $\text{O}_2 = 32.0$, $\text{Cu}_2\text{S} = 159.0$, $\text{SO}_2 = 64.0$)

Give your answer to two significant figures.

(4)

$$\begin{array}{r} 159 + 32 \rightarrow 127 + 64 \\ 191 \qquad \qquad \qquad 191 \\ 64 / 382 \times 100 \end{array}$$

atom economy = 17 %



ResultsPlus
Examiner Comments

This example has used the formula mass of both the products and the reactants added together, but then carried on with the correct calculation. The only error is due to the incorrect formula mass used and, because the candidate has clearly shown their working out, this response scored 3 marks.



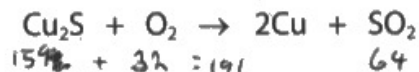
ResultsPlus
Examiner Tip

Make sure that all working out is clearly shown – some marks may still be awarded even with an incorrect final answer.

10 There are several stages to the production of sulfuric acid in industry.

(a) Sulfur dioxide is required for the production of sulfuric acid.

Sulfur dioxide can be obtained by heating copper sulfide, Cu_2S , in excess air.



Calculate the atom economy for the production of sulfur dioxide, SO_2 , in this reaction.

(relative atomic mass: $\text{Cu} = 63.5$)

(relative formula masses: $\text{O}_2 = 32.0$, $\text{Cu}_2\text{S} = 159.0$, $\text{SO}_2 = 64.0$)

Give your answer to two significant figures.

(4)

~~$\frac{191}{64} \times 100 = 298.44$~~ $\frac{64}{191} \times 100 = 33.508$

atom economy = 33 %



ResultsPlus
Examiner Comments

This response has a completely correct calculation shown.

Unfortunately, the candidate has incorrectly rounded their answer and the 2 significant figures here are not correct so the final mark could not be awarded.

10 There are several stages to the production of sulfuric acid in industry.

(a) Sulfur dioxide is required for the production of sulfuric acid.

Sulfur dioxide can be obtained by heating copper sulfide, Cu_2S , in excess air.



Calculate the atom economy for the production of sulfur dioxide, SO_2 , in this reaction.

(relative atomic mass: $\text{Cu} = 63.5$)

(relative formula masses: $\text{O}_2 = 32.0$, $\text{Cu}_2\text{S} = 159.0$, $\text{SO}_2 = 64.0$)

Give your answer to two significant figures.

(4)

total mass of reactants = ~~(63.5×2)~~ + $32 + 159 = 191$

mass of desired product = 64

Atom economy = $\frac{64}{191} \times 100 = 33.5$

atom economy = 34 %



ResultsPlus
Examiner Comments

This response scored 4 marks. All steps are clearly shown and calculated correctly.



ResultsPlus
Examiner Tip

Practise past exam questions on calculations.

Question 10 (c)(i)

Calculations on reacting masses remain challenging for candidates at this level. Many did not attempt this question at all and less than a quarter of candidates scored any marks.

Those responses that did score a mark appeared to be sometimes down to chance rather than knowledge, where candidates correctly divided numbers and then did no more.

(c) The equation shows a reaction forming sulfuric acid.



- (i) Calculate the maximum mass of sulfuric acid that could be produced from 400 tonnes of sulfur trioxide, SO_3 .

(relative formula masses: $\text{SO}_3 = 80$, $\text{H}_2\text{SO}_4 = 98$)

(2)

$$\frac{M}{V} \quad \frac{400 \text{ tonnes}}{80} = 5$$

maximum mass of sulfuric acid = 5 tonnes



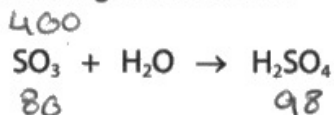
Responses like this, that scored a single mark, were usually down to correctly calculating the number of moles of sulfur trioxide in 400 tonnes.

One mark could also be scored for correctly calculating the mass ratio.



Although knowledge of moles is not required at Foundation level, being able to calculate the number of moles is a good starting point for multiple chemistry calculations.

(c) The equation shows a reaction forming sulfuric acid.



- (i) Calculate the maximum mass of sulfuric acid that could be produced from 400 tonnes of sulfur trioxide, SO_3 .

(relative formula masses: $\text{SO}_3 = 80$, $\text{H}_2\text{SO}_4 = 98$)

(2)

$$\frac{98}{80} = 1.225 \times 400$$

maximum mass of sulfuric acid = 490 tonnes



ResultsPlus
Examiner Comments

A correct calculation showing the calculation of the mass ratio.

(c) The equation shows a reaction forming sulfuric acid.



- (i) Calculate the maximum mass of sulfuric acid that could be produced from 400 tonnes of sulfur trioxide, SO_3 .

(relative formula masses: $\text{SO}_3 = 80$, $\text{H}_2\text{SO}_4 = 98$)

(2)

$$\frac{400}{80} = 5 \quad 98 \times 5 = 490 \text{ tonnes}$$

maximum mass of sulfuric acid = 490 tonnes



ResultsPlus
Examiner Comments

A correct calculation using the number of moles.

Question 10 (c)(ii)

This was the best answered of the three calculation questions – calculating the percentage yield in a reaction. About half of the responses scored full marks here, with a few more scoring 1 mark.

A number of candidates calculated answers that were over 100% and did not consider the fact that the yield of a reaction cannot be over 100%.

- (ii) Using a different amount of sulfur trioxide, it was calculated that 700 tonnes of sulfuric acid could be made.

The actual mass produced was 672 tonnes.

Calculate the percentage yield of sulfuric acid.

(2)

$$\frac{\text{theoretical yield}}{\text{actual yield}} \times 100 = \frac{700}{672} \times 100 = 104$$

percentage yield = 104%



ResultsPlus
Examiner Comments

This response scored 1 mark for clearly showing working out and was credited for calculating a percentage from the candidate's fraction.

Here, the candidate has carried out the division upside down and obtained a yield of 104%.

- (ii) Using a different amount of sulfur trioxide, it was calculated that 700 tonnes of sulfuric acid could be made.

The actual mass produced was 672 tonnes.

Calculate the percentage yield of sulfuric acid.

(2)

$$\frac{672}{700} = 0.96$$

$$\text{percentage yield} = 0.96$$



ResultsPlus
Examiner Comments

The correct calculation has been done, but the candidate has not multiplied their answer by 100 to convert it to a percentage – so only 1 mark scored.

- (ii) Using a different amount of sulfur trioxide, it was calculated that 700 tonnes of sulfuric acid could be made.

The actual mass produced was 672 tonnes.

Calculate the percentage yield of sulfuric acid.

(2)

$$700 - 672 = \cancel{28} \frac{28}{700} \times 100$$

percentage yield = 4%



ResultsPlus
Examiner Comments

This response has incorrectly calculated the percentage of reactants that do not become products.

However, the working out shown, as well as the answer, meant that this response could still score a mark.

- (ii) Using a different amount of sulfur trioxide, it was calculated that 700 tonnes of sulfuric acid could be made.

The actual mass produced was 672 tonnes.

Calculate the percentage yield of sulfuric acid.

(2)

$$\frac{672}{700} \times 100 = 96$$

percentage yield = 96%



ResultsPlus
Examiner Comments

This is an example of a fully correct response.

Question 10 (c)(iii)

The final question on the paper was badly answered overall, and showed that many candidates do not understand what theoretical yield and actual yield are in chemistry. There are a number of misconceptions including that theoretical yield is just a rough guess, and that actual yield is more accurate. There is also some confusion between unwanted side reactions and waste products of the reaction.

Only the most able candidates were able to state some correct reasons why the actual yield would be less than 100%.

(iii) State **two** reasons why the percentage yield is less than 100%.

(2)

- 1 The actual yield was lower than the theoretical yield.
- 2 The theoretical yield was rounded to the nearest 100.



This response did not score.

A significant number of responses showed a lack of understanding as to why the yield would be less than 100%, simply quoting numbers from the question or pointing out that actual yield is lower than theoretical yield.

(iii) State **two** reasons why the percentage yield is less than 100%.

(2)

- 1 Only 672 tonnes were produced out of 700 tonnes
- 2 lost in atmosphere



The first part of this answer is not creditworthy.

Answers referring to the loss of reactants or products were creditworthy, and the second part of the answer was assumed to be referring to some of the chemicals. Answers referring to spillages were not creditworthy.

(iii) State **two** reasons why the percentage yield is less than 100%.

(2)

- 1 Unwanted reactions happened
- 2 Not everything reacted



This response scored 2 marks.

Unwanted reactions were often confused with waste products in candidate responses.

(iii) State **two** reasons why the percentage yield is less than 100%.

(2)

1 because reactants escape into the air.

2 not all the reactants reacted.



The most common 2-mark responses covered the marking points about incomplete reactions and loss of either reactants or products.

A number of candidates were confused between reactants and products and gave answers stating that the products had not finished reacting. These responses did not score.

Paper Summary

Based on the performance in this examination paper candidates should:

- Focus on using and improving their knowledge of scientific literacy. Candidates often struggle to use scientific language correctly and show a poor understanding of some of the key terms used in chemistry.
- Clearly show all working out for calculation questions.
- Practise different calculations used in chemistry, including reacting masses, concentration calculations and empirical formula.
- Ensure that their calculation answers are rounded correctly and given to the correct number of significant figures or decimal places if this is asked for in the question.
- Focus on the difference between the command words 'describe' and 'explain'.
- Learn the names of equipment commonly used in chemistry practicals.
- Choose the most suitable separation methods for different types of mixtures.
- Focus on the periodic table and the information it gives about atoms and elements.
- Learn the difference between the terms atom, element, ion and molecule.
- Make the effort to write clearly and legibly. Some candidates have lost marks because their work cannot be read by examiners.

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>

