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Examiners' Report
June 2023

GCSE Combined Science 1SC0 1CF

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Introduction

This examination paper was part of the continuing series of the 9-1 Combined Science specification. The paper consisted of 6 questions and all the questions were common with the 1CH0_1F paper – Foundation Tier GCSE Chemistry. Much of the last two questions (Qs 5 and 6) were common with the 1SC0_1CH paper (Qs 1 and 2 – Combined Science Chemistry paper.) A variety of question styles was used to test the specification including multiple-choice, short open response, linking lines, interpreting a graph of pH, calculations, extended open response and, as would be expected on a Combined Science (Chemistry) paper, use of chemical formulae. The paper targeted grades 5 to 1 with about half the marks targeted for grades 4 and 5.

This year saw a further move in cumulative percentages at each grade to pre-pandemic levels.

As in previous years, there were the significant number of blank responses seen, as well as the poor response to the assessment of mathematical and practical skills. Equally disappointing was seeing that the candidates' knowledge of some basic areas was not particularly strong.

Question 1 (a)(iii)

Overall, this seemed to be quite well answered with a good proportion evaluating the R_f value and then approximating the value to 2dp. Inevitably, there were those that had the fraction the wrong round but with correct rounding to a value of 2.56; they scored the second marking point. It was pleasing to see that most candidates showed their calculation, ie the fraction 3.60/9.20, so it was clear to see how the evaluation took place. There were some who just wrote an answer without calculation and only the final answer of 0.39 and in this situation, this scored the full marks. The most common error seen was in the approximation: some gave the answer to 3dp (0.391) and others to just 1dp (0.4). Centres should note that there were some candidates who did not have access to a calculator and so had difficulty accessing the marks for this question.

(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)

$\frac{3.60}{9.20} = 0.3913043478 = 0.39$

R_f = 0.398

ResultsPlus
Examiner Comments

This scored 1 mark.

The candidate has carried out the calculation correctly, rounded it to 2 decimal places correctly but then written an incorrect answer on the answer line. The calculation scored 1, but because the answer on the answer line was incorrect, the second mark was not scored.

ResultsPlus
Examiner Tip

The answer you give on the answer line is the answer that counts.

(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)

~~2.55~~ 3.60 ÷ 9.20 = 0.391

R_f = 0.391

ResultsPlus Examiner Comments

This scored 1 mark.

A correct calculation but it was not given to the required number of decimal places.

(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)

$\frac{3.60}{9.20} = 0.3913043478260$

2dp ↓

0.40

$R_f =$ 0.40

ResultsPlus
Examiner Comments

This scored 1 mark.

The calculation was correct and scored the first mark, but the answer was incorrectly rounded to 0.40 and so did not score the second 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)

9.20 ÷ 3.60 = 2.55

R_f = 2.55

ResultsPlus
Examiner Comments

This scored 0 marks.

The candidate has given the inverse fraction:

9.20/3.60 = 2.5555...

This did not score the first mark, but had it been rounded correctly to 2 decimal places, 2.56, then the second mark would have been scored.

ResultsPlus
Examiner Tip

Rounding an answer to 2 decimal places does not mean just use the first two numbers after the decimal point.

Question 1 (b)(i)

Mostly candidates were able to name the change that takes place from a liquid to a gas. Evaporation, boiling and vaporisation were terms that were seen by examiners.

The most common error seen was 'condensation'.

Question 1 (b)(ii)

Most candidates could read the correct temperature of 56 °C. The grid was quite clear with the horizontal line on the graph from B to C at exactly 56 °C so no tolerance on this figure was given.

The main error seen here was with the candidates giving an answer of 55 °C.

Question 1 (b)(iii)

About half the candidates realised that point C showed that all the liquid had turned into a gas and gave the answer of 6 minutes.

The most common error here was candidates giving the answer as 8 minutes.

Question 1 (b)(iv)

About three-quarters of the candidates gave a correct answer here. Most showed their working as 75 – 25 = 50, but there was a tolerance given in this question as the line at point A and at point D wasn't exactly at 25 and 75 respectively, so answers between 74 and 76 were allowed.

Question 2 (b)(i)

The overwhelming majority of the candidates obtained marks on this question, of whom about half were able to label the diagram correctly, while half obtained just 1 mark mostly for mixing up the labels for cathode and anode.

Question 2 (b)(ii)

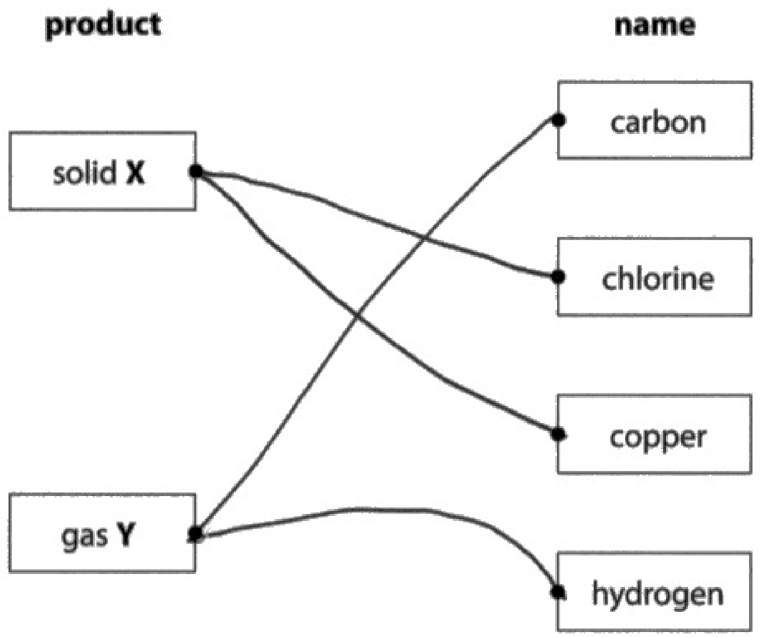
Although the majority of candidates scored marks on this question, there were quite a few who did not follow instructions and linked a product to more than one name. This did not score a mark.

About half the candidates scored a mark for linking solid X with copper. The most common error was to link gas Y with hydrogen rather than chlorine.

(ii) The products of the electrolysis shown in Figure 3 are solid **X** and gas **Y**.

Draw **one** straight line from each product to its name.

(2)



ResultsPlus
Examiner Comments

This scored 0 marks.

The question was asking for one straight line to join each product with its name. More than one line, as here, results in no mark being given.

Question 2 (b)(iii)

The greater majority of the candidates found this question difficult. Only a few scored full marks on this question. Of those that scored 1 mark, this was mostly for stating that the solid compound did not conduct electricity. There seemed to be appreciation that conductivity of ionic solids depended on the movement of ions as few mentioned ions in their answer. There were some who were confused about the copper chloride being a powder. Electrolysis is the area of the specification that is probably least understood by the candidates who are entered for this examination.

(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)

Solids have no ions that can freely move to let electricity flow but the copper chloride solution has ions thats can freely move

ResultsPlus
Examiner Comments

This scored 2 marks.

Essentially this answer scored both marking points in the first line. The candidate backed up their reason by comparing the inability of the solid to conduct with that of the copper chloride solution where ions could move freely. An excellent answer.

(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)

This is because in a solid no ions can move because they are titly fixed together whereas in a solution (liquid) there is some space for the ions to move

(Total for Question 2 = 7 marks)

ResultsPlus
Examiner Comments

This scored 1 mark.

This answer focussed on the inability of ions not being able to move in a solid, but are free to move in a solution and scored the second marking point only.

(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)

no products are formed because they are using a powder the atoms are not moving like in a solution.

ResultsPlus Examiner Comments

This scored 0 marks.

Unfortunately, this candidate referred to atoms as not being able to move in the powder, which meant that the second mark could not be given.

Candidates did need to refer to **ions** in their answer to score the second mark. 'Ions' is in bold on the mark scheme.

(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 in a solid ionic compound the ions are not free to move and are unable to conduct electricity and carry a charge

ResultsPlus
Examiner Comments

This scored 2 marks.

Both marking points were clear and unambiguous in this very good answer:

- unable to conduct electricity
- ions not free to move.

There were not many answers of this calibre.

Question 3 (a)(i)

In most cases, candidates were able to drop the names of the missing substances directly into the spaces provided in the work equation. The most common errors seen were:

- Attempting to use chemical formulae which was not necessary.
- Spelling 'chloride' as 'chlorine' and 'nitrate' as 'nitrite'.

3 (a) **When lead nitrate solution and potassium chloride solution are mixed, potassium nitrate and a precipitate of lead chloride are formed.**

(i) **Complete the word equation for this reaction.**

(1)

lead nitrate + Potassium C → Potassium N + lead chloride

ResultsPlus
Examiner Comments

This scored 0 marks.

Abbreviations like this are not acceptable.

ResultsPlus
Examiner Tip

In word equations, use the full name of the substance. Also, when writing **word** equations, chemical formulae are **not** needed.

3 (a) When lead nitrate solution and potassium chloride solution are mixed, potassium nitrate and a precipitate of lead chloride are formed.

(i) Complete the word equation for this reaction.

(1)

lead nitrate + Potassium + chlorine → Potassium+ nitrate + lead chloride

ResultsPlus
Examiner Comments

This scored 0 marks.

This candidate used 'potassium + chlorine' on the left and 'potassium + nitrate' on the right which are not alternatives for the correct names of the missing substances.

3 (a) When lead nitrate solution and potassium chloride solution are mixed, potassium nitrate and a precipitate of lead chloride are formed.

(i) Complete the word equation for this reaction.

(1)

lead nitrate + Potassium carbonate solution → Calcium Nitrate Solution + lead chloride

ResultsPlus
Examiner Comments

This scored 0 marks.

The incorrect names of substances were used by this candidate despite them appearing at the start of the question.

ResultsPlus
Examiner Tip

Read the question carefully so that you can identify all the relevant information.

Question 3 (b)(i)

Many candidates could identify the correct piece of apparatus to find the volume of the potassium carbonate solution. The common incorrect answers seen included 'measuring jug', 'measuring beaker' and 'measuring flask'.

Question 3 (b)(ii)

Although many candidates could, using the data in Figure 5, calculate the mean height of precipitate, there were several who had difficulty in performing the calculation. Errors were seen in both the addition of the values and dividing the total by the correct number of values used. Some determined the mode of the 3 values, whilst others ruled out the 2.7 as an anomaly and then obtained an average value of the remaining two – this we allowed for 1 mark. Another reasonably frequent error was using the calculator and ignoring the hierarchy of mathematical functions to obtain 2.4 + 2.7 + 2.4 ¸ 3 = 5.9 – again here we allowed 1 mark as only 1 error had been made. Overall, the greater majority scored well on this question.

Should use a beaker

(ii) The student repeated the experiment.

The results are shown in Figure 5.

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

4.8

9.6

= 2.4
= 5.4
= 7.2
15

Figure 5

Use the data in Figure 5 to calculate the mean height of the precipitate.

(2)

1 x 2.4 = 2.4, 2 x 2.7 = 5.4, 3 x 2.4 = 7.2 and

2.4 + 5.4 + 7.2 = 15. 15 ÷ 3 = 5cm

mean height of precipitate = 5 cm

ResultsPlus
Examiner Comments

This scored 1 mark.

This response was an interesting find. The candidate has erroneously multiplied the experiment number by the height of precipitate for each experiment, then added them together. So far, 0 marks. However, the second marking point was scored for finding the mean value of those three by dividing by the number of experiments, 3.

(ii) The student repeated the experiment.

The results are shown in Figure 5.

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

Figure 5

Use the data in Figure 5 to calculate the mean height of the precipitate.

(2)

2.4cm came up the most. out of the 3 experiments.

mean height of precipitate = 2.4 cm

ResultsPlus
Examiner Comments

This scored 0 marks.

This candidate made the error of finding the mode of the 3 values rather than the mean, so could not score any marks.

(ii) The student repeated the experiment.

The results are shown in Figure 5.

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

Figure 5

Use the data in Figure 5 to calculate the mean height of the precipitate.

(2)

2.4 + 2.7 + 2.4 = 7.5 7.5 ÷ 2 = 3.75

mean height of precipitate = 3.75 cm

ResultsPlus
Examiner Comments

This scored 1 mark.

The candidate had added the 3 values together correctly, which scored the first mark, but then divided the total by 2 rather than by 3, so could not score the second mark. By showing their working, it was easy for the examiner to identify creditable material within the candidate's answer. An answer of 2.75 here without any working showing would result in 0 marks being given.

ResultsPlus
Examiner Tip

Remember to show your working in any calculation – it may provide evidence for marks to be awarded even if your final answer is incorrect.

Question 3 (b)(iii)

This question proved difficult for most candidates as demonstrated by their answers. Only a very small proportion appreciated the idea of filter – wash – dry as the steps involved in producing a pure dry sample of the precipitate from the mixture. About a third scored a mark for the first step – filtration. Here, some candidates wrote at great length about the process of carrying out the filtration and omitted the next steps of washing the solid and then drying it. Many examiners reported seeing several instances of sieving, decanting and draining, but these did not gain credit. The most frequent mark awarded was for drying the solid in a suitable way such as 'leave to dry', 'placing on a windowsill' or 'pat dry between filter papers'. Very few washed the precipitate.

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

(3)

Use filtration to seperate the precipitate from the liquid. Then leave the precipitate to dry.

ResultsPlus Examiner Comments

This scored 2 marks.

Filtration followed by leaving the precipitate to dry scored 2 out of the 3 marks available. Most candidates omitted washing the precipitate to remove the soluble compounds.

ResultsPlus Examiner Tip

Remember the 3 steps for obtaining a pure dry sample of an insoluble salt:

- Filter – to separate the insoluble salt.
- Wash – to remove the soluble compounds to leave a pure salt.
- Dry – to remove the water after washing.

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

(3)

Firstly, you would place a funnel over a beaker and place filter paper in it, then you can pour the mixture through the funnel and you should be left with your precipitate, this is filtration

ResultsPlus
Examiner Comments

This scored 1 mark.

The candidate used all the available space to describe filtration rather than being a little more succinct and fitting in at least another step to produce the pure, dry sample.

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

(3)

Filtration - mix both together then filter the solutions and seperatate the mixtures.

ResultsPlus
Examiner Comments

This scored 1 mark.

This candidate only included the step of filtration within their answer and so only scored the first mark.

Question 3 (b)(iv)

A substantial number of candidates could give a suitable variable that need to be controlled. A wide latitude was given to terms used when controlling the potassium carbonate solution, however, 'time' was ignored as that alone was quite vague as time allowed for the settling of the precipitate was being looked for. Many candidates just opted for 'volume of calcium nitrate' probably because it was mentioned in the question, but they overlooked the fact that the volume of this reagent was changed each time. A small number of candidates did try giving the answer of 'size of test tube', but this was not creditable as it was more important to control the diameter of the test tube in order to measure the height of the precipitate. Errors were seen regularly of potassium carbonate or calcium nitrate unqualified.

(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)

temperature

ResultsPlus
Examiner Comments

This scored 1 mark.

Temperature was creditable since the solubility of most compounds depends on the temperature.

(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 amount of Potassium carbonate solution

ResultsPlus
Examiner Comments

This scored 1 mark.

Candidates often use 'amount' to mean volume rather than quantity at this level. This was an acceptable answer.

(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)

Same concentration each time

ResultsPlus
Examiner Comments

This scored 0 marks.

It was not clear from this answer which concentration of which solution was being kept the same each time.

Question 4 (a)(i)

A good range of physical properties were offered by the candidates with ‘shiny’ and ‘malleable’ being the two most frequent correct answers. Several candidates seemed not to understand the term ‘physical property’ as they gave answers such as ‘it has an atomic mass of 24’, ‘it is very reactive’. However, it was disappointing to see the number of candidates who could not suggest a suitable physical property of magnesium.

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

(1)

has a high melting point

ResultsPlus Examiner Comments

This scored 1 mark.

An acceptable physical property of most metals.

ResultsPlus Examiner Tip

Make sure you know the difference between 'physical properties' and 'chemical properties'.

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

(1)

Silver in colour

ResultsPlus Examiner Comments

This scored 1 mark.

Fortunately, the candidate added '**in colour**' after 'silver'. 'Magnesium is silver in colour' is correct, but 'magnesium is silver' is not correct.

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

(1)

malleable

ResultsPlus
Examiner Comments

This scored 1 mark.

'Malleable' was a common correct answer.

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

(1)

~~it's~~ ~~hard~~ highly ~~corrosive~~ reactive

ResultsPlus
Examiner Comments

This scored 0 marks.

Reactivity is not a physical property, so did not score the mark.

Question 4 (b)(i)

Most candidates completed the electronic configuration of a magnesium atom with '2'.

The most common error seen was '12'.

Question 4 (b)(ii)

A great many candidates answered a different question; many gave the answer that chlorine was in group 7 because it has 7 electrons in the outer shell. Relatively few candidates had read the question carefully enough to generate a completely correct answer. There were some that had ignored hydrogen and helium as forming the 1st period of the periodic table and said that magnesium was in the 2nd period as shown by the '2' in the electronic configuration. Some had mentioned 3 shells, as taken from the electronic configuration, but had not linked that to the period number. Unfortunately, some wrote about the electronic configuration as having '3 outer shells'. This lost them the first 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.

(2)

The ~~third~~ first number of Chlorine atom is ~~3~~ 2 ~~each~~ ~~3~~ which is also the ~~3~~ period of the Chlorine atom.

ResultsPlus
Examiner Comments

This scored 0 marks.

This was another misconception seen among candidates' answers – thinking that the number of electrons in the first shell indicates the period number.

(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)

It has 3 shells so it's in the 3rd Period.

ResultsPlus Examiner Comments

This scored 2 marks.

A completely correct answer which was a bit of a rarity for this question.

(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)

Periods are linked to the amount of electrons in the outer shell from the elements meaning chlorine is in period 7 because it has 7 electrons left on the outer shell.

ResultsPlus Examiner Comments

This scored 0 marks.

This candidate, just as most of the candidates who wrote an answer, was answering a completely different question. This question was not assessing the idea of the link between the electronic configuration and the group of the periodic table. So, no credit could be given.

(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 linked to its period in the periodic table because it has 3 outershells meaning its in period 3.

ResultsPlus
Examiner Comments

This scored 1 mark.

'3 outershells' was not allowed, so only the point that chlorine is in period 3 scored the mark.

ResultsPlus
Examiner Tip

There is only 1 outer shell.

An atom with 3 electron shells has 2 inner shells and 1 outer shell.

Question 4 (c)

There seemed to be as many candidates dividing mass by relative formula mass as there were setting up the fractions the other way round. For many with the correct fractions, most went onto producing a correct ratio and a correct empirical formula for magnesium chloride. Those with the inverted fraction lost that first mark but having followed that through to give a ratio and a consequential empirical formula of Mg_2Cl, 2 marks were awarded. Examiners said the successful answers were where the candidates had used a grid to lay out their calculations – not only did it provide a logical sequence for the candidate to follow, but it also made the marking much easier.

However, the majority of candidates had no idea how to use the information to determine the empirical formula or even understand the term.

(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)

mg $\frac{1.20}{24.0}$ = 0.05 Cl $\frac{3.55}{35.5}$ = 0.1

$\frac{0.05}{0.1}$ = 0.5 $\frac{0.1}{0.1}$ 1

empirical formula = Mg_5Cl_1

ResultsPlus
Examiner Comments

This scored 2 marks.

The first line of the calculation is correct – mass/relative atomic mass for both elements and with the correct ratio showing as 0.05 : 0.1 scores the first two marks.

Unfortunately, on the next line, division by the larger number (0.1) then gave the ratio 0.5 : 1, from which the candidate wrote the empirical formula as Mg_5Cl which did not score.

ResultsPlus
Examiner Tip

To find the whole number ratio, always divide by the smaller number.

(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)

	Mg	Cl
m	1.20g	3.55
a	24.0	35.5
d	1.20 ÷ 24.0 = 0.05	3.55 ÷ 35.5 = 0.1
ratio	0.05 ÷ 0.05 = 1	0.1 ÷ 0.05 = 2
	1 : 2	

empirical formula = 1 : 2

ResultsPlus
Examiner Comments

This scored 2 marks.

The first two steps of the calculation are correct and scores the two marks.

However, the candidate did not produce an empirical formula from the ratio.

ResultsPlus
Examiner Tip

The simplest ratio is not the empirical formula of a compound.

(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)

Mg

$\frac{1.2}{24.0} = 0.05$

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

Cl

smallest

$\frac{3.55}{35.5} = 0.1$

$\frac{0.01}{0.01} = 1$

Mg_2Cl

empirical formula = Mg_2Cl

ResultsPlus
Examiner Comments

This scored 2 marks.

The candidate had set up the fraction of mass / relative atomic mass for both Mg and Cl, which scored the first mark. However, the second line shows that the simplest ratio was incorrectly calculated so the second mark was lost. The third mark was given for producing the chemical formula of Mg_2Cl from the incorrect simplest ratio.

ResultsPlus
Examiner Tip

Practise these type of calculations to ensure marks are not lost.

Question 4 (d)

Many candidates understood that covalent bonding resulted from a sharing of electrons, but most missed the point that it was a pair of electrons. For ionic bonding, many knew that had been a transference of electrons; some even mentioned that ions had been formed. However, there were just a tiny number who knew that the ionic bond resulted from the attractive force between ions. Most of the candidates who gained marks on this question made the comparison that ionic bonds formed when a metal reacted with a non-metal and a covalent bond formed between non-metal atoms.

This question highlighted many misconceptions/lack of knowledge of names for sub-atomic particles. Candidates referred to IONS giving away atoms/electrons or atoms giving away ions, sharing ions for covalent compounds etc.

Many contradicted themselves by talking about "sharing" the electrons and then talking about transfer.

(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 6 shows dot and cross diagrams of these compounds.

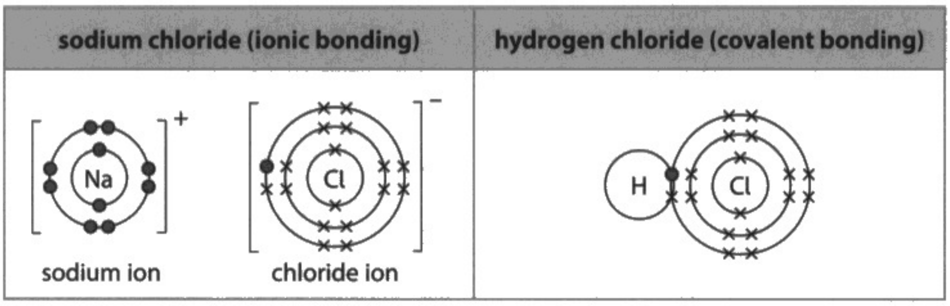


Figure 6

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

(4)

Ionic bonds are formed ~~when~~ by ~~elect~~ strong electrostatic forces of attraction between oppositley charged ions. An ion that loses an electron is called a cation because it gains a positive charge and an ion that gains an electron is an anion because it has a negative charge. This happens in order for each ion to gain a full outer shell. Covalent bonds are formed between two non-metal elements. They also need to gain ~~elec~~ a full outer shell, however they ~~shar~~ share ~~a~~ their pair of ~~of~~ electrons to do this.

(Total for Question 4 = 12 marks)

ResultsPlus
Examiner Comments

This scored 4 marks.

Ionic bonding was excellently described in terms of the electrostatic attraction between oppositely charged ions as well as how those ions are formed. Covalent bonding was also extremely well described in terms of both atoms sharing a pair of electrons.

This answer was exceptional at this level.

(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 6 shows dot and cross diagrams of these compounds.

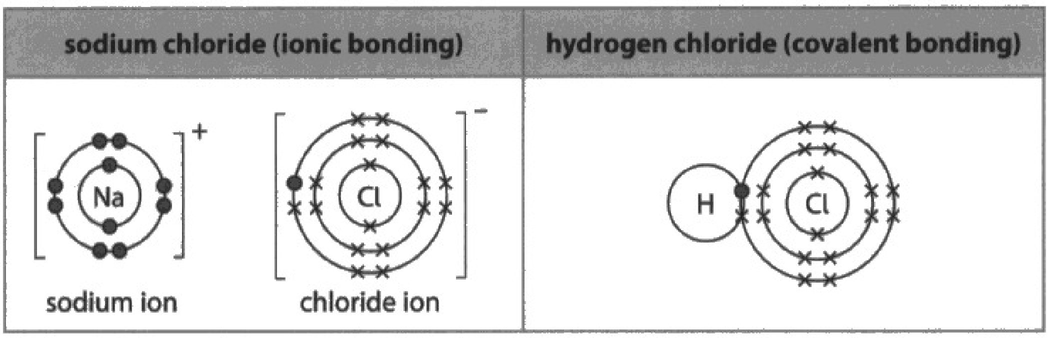


Figure 6

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

(4)

The difference between an ionic bond and a covalent bond is that a in covalent bonds the bonds are together but in ~~tio~~ Ionic bonds they share their ions/electrons.

ResultsPlus
Examiner Comments

This scored 0 marks.

There was nothing to credit here. Little was said about covalent bonding and ionic bonding was described in terms of ions being shared.

(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 6 shows dot and cross diagrams of these compounds.

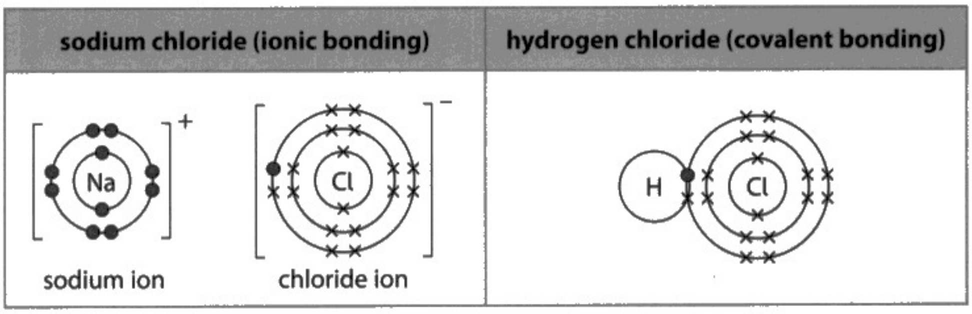


Figure 6

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

(4)

Ionic bonding is metals and non-metals whereas covalent bonding is just metals. Covalent bonding has a bigger compound's on the left. ionic bonds have significantly more dots. ~~(compounds).~~

(Total for Question 4 = 12 marks)

ResultsPlus
Examiner Comments

This scored 1 mark.

The only creditable content here was ionic bonding being between metals and non-metal. The candidate did not recognise that covalent bonding occurred between atoms of non-metals.

(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 6 shows dot and cross diagrams of these compounds.

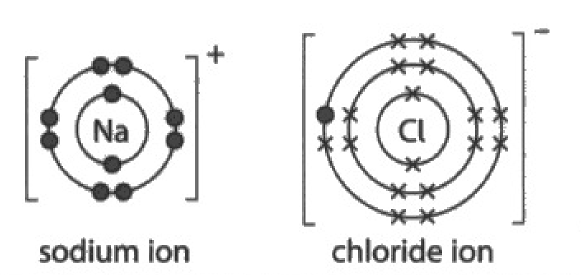
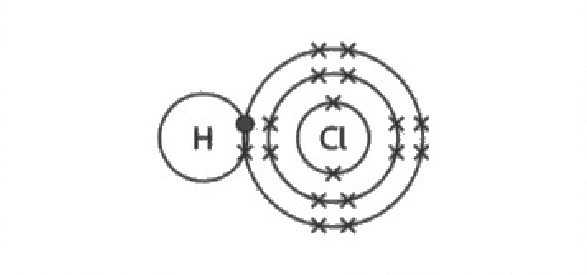
sodium chloride (ionic bonding)	hydrogen chloride (covalent bonding)
	

Figure 6

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

(4)

-Ionic bond is between a metal and non-metal

-Covalent bond is between two non-metals

-Ionic bonds between two ions remain separated

-Covalent bonds between atoms join together

ResultsPlus
Examiner Comments

This scored 2 marks.

This answer was a typical of most candidates who scored marks.

Ionic bonding formed between atoms of metals and non-metals.

Covalent bonding formed between atoms of non-metals.

Question 5 (a)

Of those who scored the mark here, the majority said that the beaker should be stirred. An error frequently seen was when candidates didn't understand what the question was after and made the mistake that step 3 followed step 2 and copied 'find the pH of the mixture' from step 3. Other incorrect responses seen included wait, give it time, add excess.

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

(1)

find the pH level of the mixture

ResultsPlus
Examiner Comments

This scored 0 marks.

Some candidates didn't quite understand what was being asked and just copied the instruction for step 3.

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

(1)

Stir the mixture or heat it up.

ResultsPlus
Examiner Comments

This scored 1 mark.

Both suggestions were acceptable.

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

(1)

~~mix the~~ lightly shaking the beaker to mix the solution.

ResultsPlus Examiner Comments

This scored 1 mark.

Shaking the beaker was an acceptable answer.

Question 5 (b)

Only the more able candidates could complete the word equation with the two correct products – calcium chloride and water. There were a sizeable amount of candidates who gave water as one product or calcium chloride as the only product; these answers scored one mark. However, many answered this with somewhat unusual names of substances such as 'calcium hydroxychloride acid', which, of course, did not score. Other common incorrect responses – hydrogen instead of water, calcium hydrogen chloride, calcium hydroxide (or variations of this), salt instead of calcium chloride, or too many products. Inevitably, at this part of the paper, there were many blank spaces.

(b) Complete the word equation for the reaction.

(2)

calcium hydroxide + hydrochloric acid → calcium chlorine + hydrogen

ResultsPlus
Examiner Comments

This scored 0 marks.

The product 'calcium **chlorine**' is not an acceptable alternative to calcium chloride.

ResultsPlus
Examiner Tip

Take care with spellings of chemical names. 1 letter difference can make a huge difference.

(b) Complete the word equation for the reaction.

(2)

calcium hydroxide + hydrochloric acid → Calcium chloride + hydrogen

ResultsPlus
Examiner Comments

This scored 1 mark.

Calcium chloride was correct, hydrogen was not.

ResultsPlus
Examiner Tip

Learn the general equations of acids. For this case it is:

acid + base/alkali ® salt + water.

(b) Complete the word equation for the reaction.

(2)

calcium hydroxide + hydrochloric acid → water + calcium chloride

ResultsPlus
Examiner Comments

This scored 2 marks.

A completely correct answer.

ResultsPlus
Examiner Tip

Practise writing word equations. Remember in word equations, chemical formulae are not required.

Question 5 (d)(i)

Most candidates gave the correct reading of the pH from the graph as 1. pH values of 0.9 and 1.1 were also accepted.

Question 5 (d)(ii)

The mass of calcium hydroxide required to make a neutral solution from the graph was 0.74 g. This answer was given by fewer than half of the candidates with many giving the mass as 0.75 or 0.7 or 0.8 g; these did not score as the vertical section of the graph passing through pH7 was exactly on 0.74 g.

Question 5 (d)(iii)

Candidates generally found this question very difficult. Most of those who answered this question generally gave a description of what they could see rather than an explanation of what it showed. Few started their answer by stating that the graph showed the pH and showed that it was acidic to begin with. It was rare to have an answer that indicated neutralisation occurred or that the calcium hydroxide reacted with the acid. Finally, few gave answers to indicate that the calcium hydroxide was a base or an alkali.

Frequent incorrect responses included:

- Low pH is alkali(ne) and high is acid – often with this one a good response was written and would have been 2 marks if not given the wrong way around.
- pH goes up because more reactions are happening.
- Statements of what pH is or the colour of it.

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

(3)

Because as you put in more powdered calcium hydroxide to neutralise the reaction you put in more and more and it gains some mass.

ResultsPlus
Examiner Comments

This scored 1 mark.

The mark was scored for 'calcium hydroxide to neutralise the reaction (mixture)'.

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

(3)

~~Ca~~ Calcium hydroxide is ~~an~~ an alkali Solution and ~~the~~ when it is placed in the hydrochloric acid, ~~f~~ it neutralises ~~its~~ it and Slowly turns ~~in~~ it into an alkali

ResultsPlus Examiner Comments

This scored 2 marks.

Marks were given for calcium hydroxide is an alkali and for stating that it neutralises the hydrochloric acid.

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

(3)

as the calcium hydroxide was added then the pH level would have increased because the calcium hydroxide is getting more reactive

ResultsPlus Examiner Comments

This scored 0 marks.

There was nothing to credit in this answer as there was no explanation as to why the pH increased on addition of the calcium hydroxide.

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

(3)

at the start it starts at a low value because there isn't much of mass of calcium hydroxide added in gram but towards the end it reached it's optimum mass of calcium hydroxide added in grams so the pH has rised rapidly.

ResultsPlus
Examiner Comments

This scored 0 marks.

The answer described what happened to the pH during the reaction (starts low ... rises rapidly), but gave no explanation as to why that happened.

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

(3)

It starts of as an acid and then neutralises when 0.7 g of calcium hydroxide is added but then it rises ~~to~~ up to a pH of 12, making it a alkali.

ResultsPlus
Examiner Comments

This scored 2 marks.

Starting as an acid scored the first marking point. The addition of the calcium hydroxide causing neutralisation to occur scored the second mark. However, even though the answer does mention 'making it a alkali' at the end wasn't indicating that calcium hydroxide is a base/alkali which was the 3rd marking point.

Question 5 (e)

About a third of the candidates could state a method of how to measure the pH of a mixture: universal indicator was the most common one seen. However, many candidates lost the mark for ‘indicator’ unqualified.

Other common incorrect answers included pH scale, litmus paper and other named indicators such as methyl orange.

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

(1)

universal indicator paper

ResultsPlus
Examiner Comments

This scored 1 mark.

Universal indicator paper was one of the more popular choices, however, many gave their answer as 'litmus paper' which cannot be used to determine the pH value.

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

(1)

the PH Scale

ResultsPlus
Examiner Comments

This scored 0 marks.

The pH scale is the means of interpreting the colour of universal indicator rather than actually measuring the pH of the solution. Many candidates gave this answer.

Question 5 (f)

It was pleasing to see that the greater majority could describe a safety precaution given the information about calcium hydroxide. Overwhelmingly, the answer most frequently seen was 'goggles' / 'safety goggles' but the equally valid answer of 'gloves' was seen in about a quarter of the answers. It would come as no surprise these days to see that several candidates gave the answer as 'googles' – this we did allow as a spelling slip! However, we did consider that 'glasses' alone was not acceptable given the corrosive nature of calcium hydroxide.

(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)

wear a pair of saftey gaggles

ResultsPlus
Examiner Comments

This scored 1 mark.

This alternative spelling of goggles was acceptable.

(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)

wear gloves and protective/saftey goggles

ResultsPlus
Examiner Comments

This scored 1 mark.

This answer would have scored for either gloves or protective /safety goggles.

(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)

were Safety Equipment ~~am~~ and be carefel

ResultsPlus

Examiner Comments

This scored 0 marks.

This answer was considered to be too vague. A specific safety precaution was needed for the mark.

Question 6 (b)(i)

The aim of this question was for candidates to analyse the information given about the reactivity of two metals in dilute hydrochloric acid then predict the reactivity of two familiar metals – magnesium and iron. A good proportion of the candidates were able to make a sensible prediction about both metals, usually in terms of rate of bubbles produced. Where just 1 mark was scored, this was invariably for predicting the rate of bubbling for magnesium rather than for iron. There was also a sizeable number of candidates who offered interpretations rather than observations by commenting on reactivity – for example, 'magnesium is much more reactive'. But as this was late on the paper, the weaker candidates often struggled with this question and missed out on marks by either not attempting this questions or by giving a response that did not fit in as an observation.

(i) **Use the information in Figure 8 and in Figure 9 to predict the observations for the reactions of magnesium and of iron with dilute hydrochloric acid.**

(2)

magnesium

Will have the most reaction out of the metals that have been obsened. Bubbles will be produced rapidly.

iron

Will fizz and move around in the dilute hydrochloric acid. ~~Bubbles produced~~.

ResultsPlus
Examiner Comments

This scored 1 mark.

The mark given was for 'bubbles will be produced rapidly' for magnesium.

The observation for iron was incorrect.

(i) Use the information in Figure 8 and in Figure 9 to predict the observations for the reactions of magnesium and of iron with dilute hydrochloric acid.

(2)

magnesium

feeling warm, Bubbles produced fast sizzing sound

iron

Bubbles produced at a slow rate

ResultsPlus
Examiner Comments

This scored 2 marks.

The observations for both magnesium and iron were correct.

(i) Use the information in Figure 8 and in Figure 9 to predict the observations for the reactions of magnesium and of iron with dilute hydrochloric acid.

(2)

magnesium

Most likely to have a big reactant as acid would be added to metal.

iron

Not that much of a reaction.

ResultsPlus
Examiner Comments

This scored 0 marks.

Candidates were asked to predict the observations; neither metal contained an actual observation.

(i) Use the information in Figure 8 and in Figure 9 to predict the observations for the reactions of magnesium and of iron with dilute hydrochloric acid.

(2)

magnesium

bubbles produced
test tube really warm

iron

A bit of bubbles but not
much reaction.

ResultsPlus
Examiner Comments

This scored 2 marks.

The observations for both metals fitted in with the pattern provided by the other two metals.

ResultsPlus
Examiner Tip

In questions like this, use the information already given to make predictions. This question was about observations and not about explaining the results.

Question 6 (b)(ii)

It was quite disappointing to see that only about a third of the candidates could describe the test for hydrogen at this level. A few did describe what to do (eg use a lighted splint) but then either did not complete the description or gave an incorrect result (eg the splint went out). Examiners reported that some candidates erroneously described the complete test for a different gas (eg bubble the gas through limewater and it turns cloudy). A significant just answered with 'Squeaky pop test' which did not score: for any gas test, candidates need to describe the test (in the case the use of the lighted splint) and then give the positive result. The more able candidates were quite succinct in their answers here: 'Put a lighted splint into the gas and it gives a squeaky pop.'

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

Describe the test to show that the gas is hydrogen.

(2)

You would put a lit spint in the end of the test tube.

ResultsPlus
Examiner Comments

This scored 1 mark.

The test to show what gas is present also required the result of the test. This scores the first mark for the correct test.

ResultsPlus
Examiner Tip

Learn both how to test for a gas **and** the positive result of that test.

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

Describe the test to show that the gas is hydrogen.

(2)

the squeaky pop test

ResultsPlus Examiner Comments

This scored 0 marks.

The test has not been described, so does not score any marks.

ResultsPlus Examiner Tip

'Squeaky pop test' alone will not score any marks.

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

Describe the test to show that the gas is hydrogen.

(2)

re-lighting a splint test

ResultsPlus Examiner Comments

This scored 0 marks.

From this, the test must have been 'a splint', which does not score.

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

Describe the test to show that the gas is hydrogen.

(2)

Squeaky pop test.
Use a upside-down test tube filled with hydrogen gas
Put a lit splint underneath and if hydrogen gas is
present a loud popping sound should be heard.

ResultsPlus
Examiner Comments

This score 2 marks.

The first line did not score, but the candidate then went on to describe the complete test and the positive result for hydrogen.

ResultsPlus
Examiner Tip

The tests and results for the gases hydrogen and carbon dioxide can be asked in questions on the first chemistry paper.

Question 6 (b)(iii)

Disappointingly, only about half the candidates scored marks on this question. The main error seen was an incorrect formula of hydrogen, and where candidates completed this, they invariably wrote 2H rather than H_2. The balancing mark in front of the HCl was usually correct, though.

(iii) When magnesium reacts with hydrochloric acid, magnesium chloride and hydrogen are formed.

Complete the balanced equation for the reaction.

(2)

Mg + hydrochloric acid HCl → $MgCl_2$ + hydrogen

ResultsPlus
Examiner Comments

This scored 0 marks.

Hydrogen is the correct product, but the formula of hydrogen was needed here for the mark.

ResultsPlus
Examiner Tip

Practise writing simple balanced equations.

(iii) When magnesium reacts with hydrochloric acid, magnesium chloride and hydrogen are formed.

Complete the balanced equation for the reaction.

(2)

$$Mg + \ldots 2 \ldots HCl \rightarrow MgCl_2 + \ldots 2 \ldots H$$

ResultsPlus
Examiner Comments

This scored 1 mark.

The balancing of the HCl is correct, but 2H is not accepted as the formula for hydrogen.

Question 6 (c)

This question was fairly accessible for the candidates sitting this paper. There will always be those who will make no attempt to answer it, but of those who did, most candidates found they could write enough to give a reasonably good account of explaining which methods were used to extract the metals aluminium, gold, iron and silver. Unfortunately, few scored the top marks of 5 or 6 because they limited their explanations to just a link to the position of the metals in the reactivity series. Most candidates could identify how to extract at least 2 metals and why that method was appropriate. Just identifying how to extract 1 metal and why that method was used gave them a mark of 2 – eg ‘gold is found as the pure metal as it is very low in the reactivity series’.

To reach the top marks, there needed to be other indicative points present within the answer in addition to the links made with the reactivity series. These included points about aluminium being too reactive to be extracted by heating with carbon, gold/silver were very unreactive and so a reduction reaction was not necessary.

Some candidates extended the range of metals to include copper and zinc, but these were ignored as they were beyond the scope of the question.

Common errors seen in answers included:

- Reverse the order of extraction with regards to the metal’s reactivity. For instance, Al was recognised as reactive, but the method of extraction would then be to mine the metal as it was incorrectly assumed that the metal would react with carbon or was too dangerous to electrolyse.
- Few responses recognised the energy intensity required for electrolysis.
- Picking one extraction method for all metals rather than choosing the best extraction method for each metal separately.
- Reactivity was often quoted with no method.
- The ‘depth of metal in earth's crust’ as a factor in extraction.

*(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 8 to state and explain the method chosen to obtain each of these four metals.

(6)

~~The first method we would be using is electrolysis.~~

Step 1

↳ in electrolysis, we would have an anode and a cathode these obtain positive and negative ions

Step 2

↳ ~~They~~ The electrodes are made out of graphite this is because it is inert, which means its unreactive to the solutions.

Step 3

↳ when the ~~+~~ negative ions go to the positive electrode and this ~~xx~~ would cause in increase in mass for the metal ore

ResultsPlus Examiner Comments

This scored 0 marks.

The candidate here has said something about electrolysis and not related this process with the extraction of any of the metals.

*(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 8 to state and explain the method chosen to obtain each of these four metals.

(6)

To mine aluminium, you would electrolyse the metal ore. This is because aluminium is more reactive, so you will get better results using this method.

To mine gold, you would mine the pure metal, this is because it is a less reactive metal, if at all, so you would get no reaction using the other methods.

To mine iron, you would heat it with carbon. This is because it is slightly reactive, but not enough to use electrolysis.

To mine silver, you would mine the pure metal. This is because, while it is slightly reactive, it is not reactive enough to use any of the other methods.

ResultsPlus Examiner Comments

This scored 4 marks.

The candidate has correctly identified how each of the 4 metals is extracted from the Earth's crust, linking each of the metals to the reactivity series. So, this was a Level 2 answer (see Marker Guidance in the mark scheme).

*(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 8 to state and explain the method chosen to obtain each of these four metals.

(6)

· Aluminium = ~~mine~~ mine the metal ore and electrolyse the molten compound
· Gold = mine the ore and heat it with carbon
· Iron = mine the pure metal
· Silver = mine the metal ore and electrolyse the molten compound

ResultsPlus
Examiner Comments

This scored 1 mark.

The candidate used all 4 metals in their answer, but only the method for aluminium was correct. There was no link with the reactivity series. This was a basic Level 1 answer.

*(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 8 to state and explain the method chosen to obtain each of these four metals.

(6)

Alluminium
carbon
Iron
Silver
gold

The method used to obtain gold and silver would be to mine the ~~pure~~ pure metals as they ~~are~~ are found uncombined and unreactive in the earths crust.

The method used for iron would be to mine the mineral ore and heat it with carbon. This is because iron is less reactive than carbon so a displacement reaction would take place and the carbon would take the place of iron in the ~~ore~~ ore's compound leaving iron on its own. Iron could be electrolysed but isnt as it used too much energy if another method could be used such as using carbon.

The method used for aluminium would be to mine the metal ore ~~for~~ and electolyse the moltan compound. This would be used as ~~aluminium~~ aluminium is more reactive than carbon so no reaction would take place using the carbon method. This leaves electrolysis as the only option as it is the only method that would work ~~and~~.

For ~~I~~ iron and aluminium just mining the pure metals would not work as they are not found as pure metals and are only found as compounds in ores.

ResultsPlus Examiner Comments

This scored 6 marks.

The methods used to extract each of the four metals have been identified and each linked to their reactivity. Further details have been given for each of the metals particularly for iron and aluminium. This level of detail clearly put this answer as a Level 3.

Paper Summary

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

- Read all of the question and understand what the command words such as 'describe' and 'explain' mean.
- Be familiar with the practical techniques included in the specification such as the preparation of salts, both soluble and insoluble and how to obtain a pure, dry sample of those salts.
- Ensure that you revise the core practicals thoroughly and can explain what has happened in each experiment.
- Know how to write word equations given a description of a reaction.
- Know how to balance a chemical equation, know the state symbols to be used and know how to write chemical formulae using the correct conventions.
- Learn and understand the meaning of key terms such as reduction, solubility, electrolyte.
- Understand the basics of electrolysis.
- Practise calculations of the type seen in this examination paper and know how to round to a set number of decimal places or significant figures.

To help with the above, centres are encouraged to make use of the past GCSE questions using Exam Wizard to target particular topics and assessment objectives.

Grade boundaries

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

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

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