PEARSON EDEXCEL GCSE CHEMISTRY · 1CH0

CHEMISTRY



MARK SCHEME

TOPIC 1: KEY CONCEPTS IN CHEMISTRY (PACK 4)

SCORE	PERCENTAGE
/90	%

STEMUP

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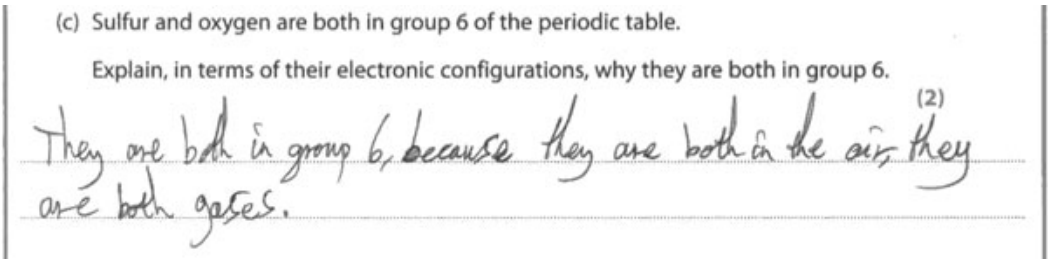
Q2.

This question was very well answered, with the majority of candidates mentioning between four and six of the marking points in their answers by identifying and naming the subatomic particles. Many candidates also discussed the existence of isotopes, and some mentioned the idea of a nucleus within the atom. The responses that did not score simply stated the reverse argument to the points stated within the question – that atoms were made up of smaller particles and that there are differences between them.

Q3.

This question was answered generally well, with many scoring 2 marks. Of the correct answer the majority were of the type stating that both oxygen and sulfur were in group 6 because their atoms had 6 electrons in the outer shell and the minority were of the type where their atoms both needed two more electrons to fill the outer shell.

Common errors included references to them being in group 6 as they were both gases or noble/Nobel [sic] gases. There was frequent reference to the atomic number and mass number e.g. those of sulfur being double that of oxygen: 8 → 16 or 16 → 32. Often a reference was made to oxygen and sulfur having same properties, qualities or reactivity or to them both being non-metals, gases or non-conductors. In these instances, the candidates were not answering the question as given.



(c) Sulfur and oxygen are both in group 6 of the periodic table.

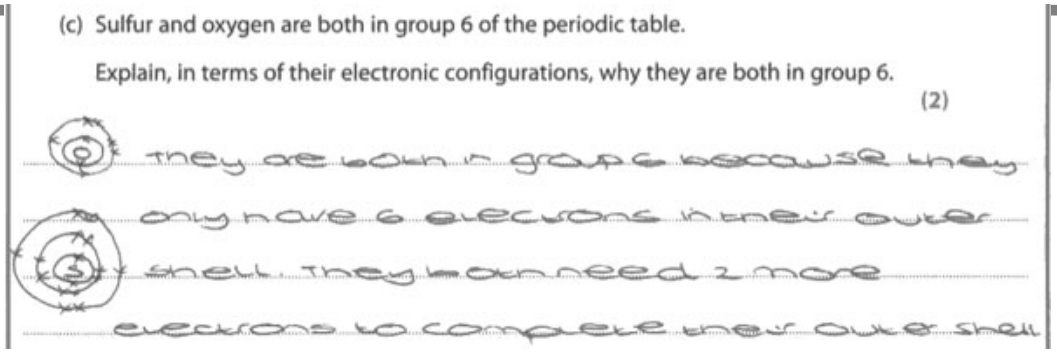
Explain, in terms of their electronic configurations, why they are both in group 6.

(2)

They are both in group 6, because they are both in the air, they are both gases.

Results Plus: Examiner Comments

This did not answer the question and scored 0 marks.



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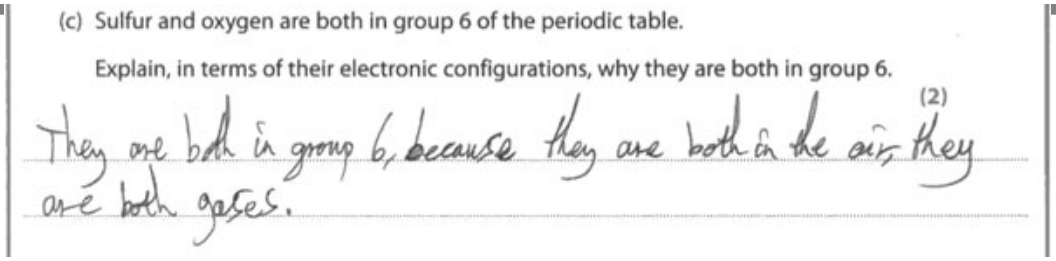
Explain, in terms of their electronic configurations, why they are both in group 6.

(2)

they are both in group 6 because they only have 6 electrons in their outer shell. They both need 2 more electrons to complete their outer shell

Results Plus: Examiner Comments

This was a very good answer scoring 2 marks.


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One of a number of common errors seen in the marking of this question. 0 marks given.

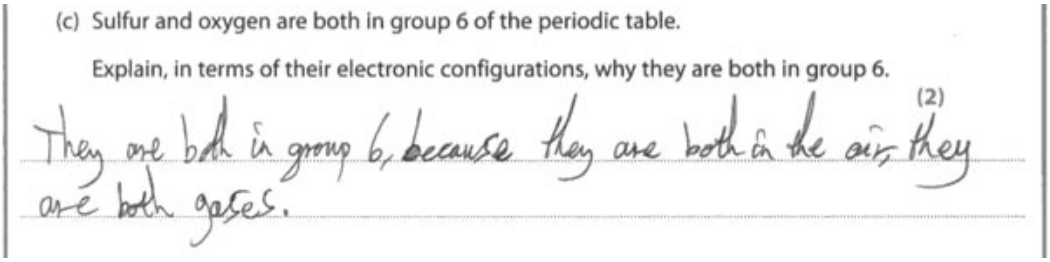
Results Plus: Examiner Tip

Understand how the electronic configuration of an atom of an element is related to the position of that element in the periodic table.

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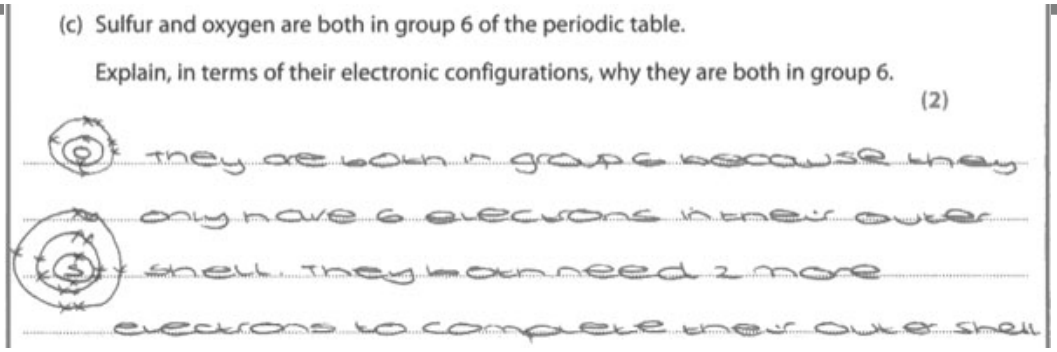
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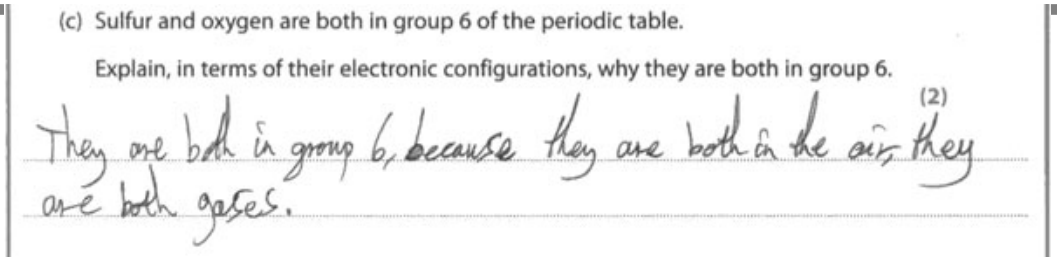
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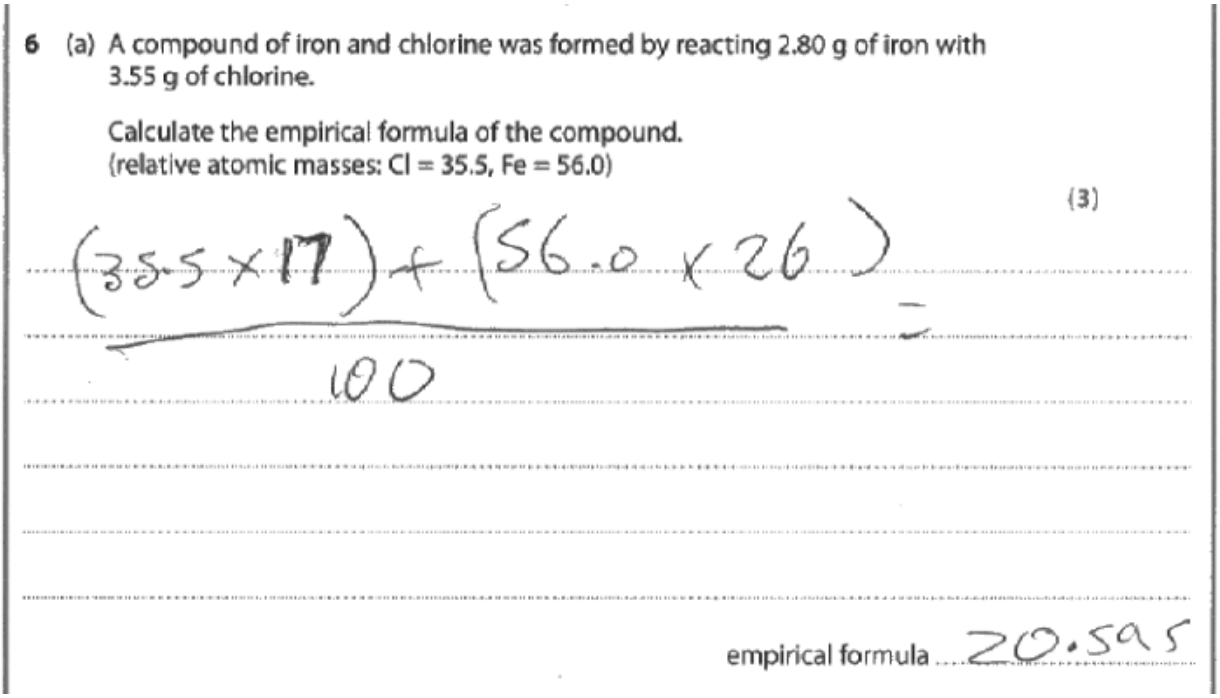
Understand how the electronic configuration of an atom of an element is related to the position of that element in the periodic table.

Q5.

(a)

Candidates found this empirical formula calculation challenging and so it proved to be a good discriminator with about a third gaining full marks.

A significant number of students confused the empirical formula calculation with relative atomic mass type calculations. Some students were able to correctly calculate the simplest whole number ratio but then mixed up the numbers with the elements so gave the incorrect formula Fe_2Cl. Another common error was to divide the mass by the wrong relative atomic mass e.g. 2.8/35.5



6 (a) A compound of iron and chlorine was formed by reacting 2.80 g of iron with 3.55 g of chlorine.

Calculate the empirical formula of the compound.
(relative atomic masses: Cl = 35.5, Fe = 56.0)

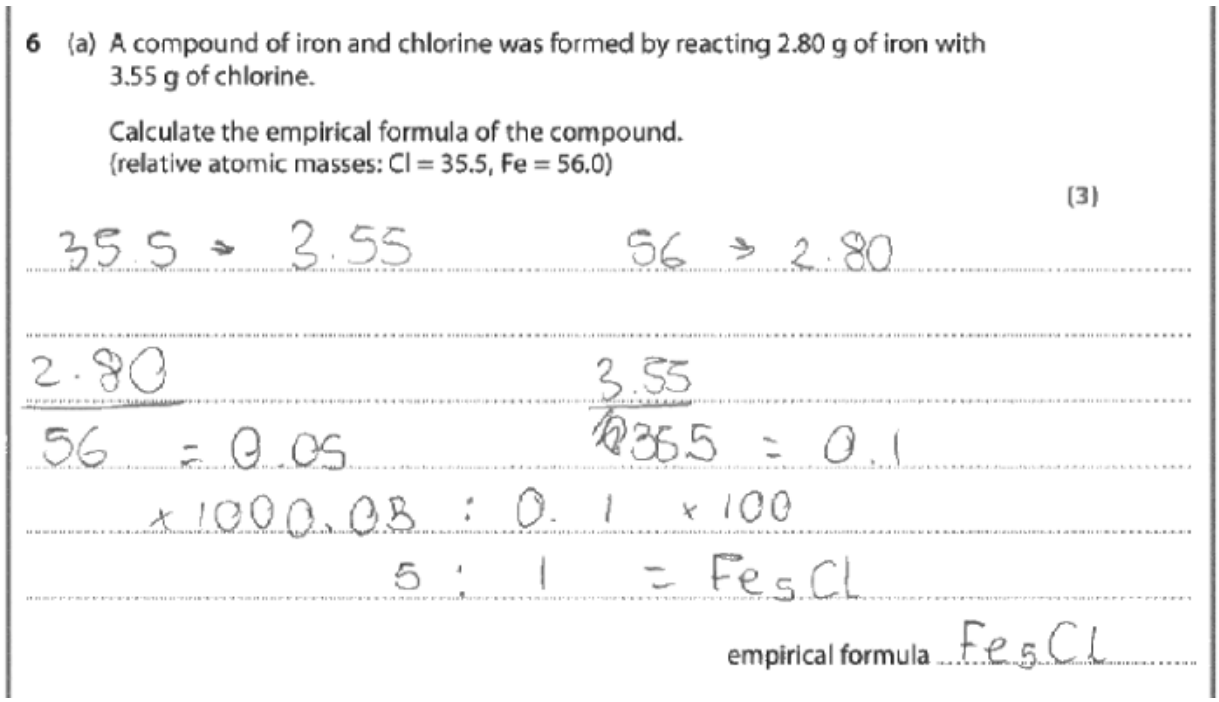
(3)

$\frac{(35.5 \times 17) + (56.0 \times 26)}{100} =$

empirical formula 20.595

Results Plus: Examiner Comments

Quite a number of candidates seemed to confuse empirical formula with a relative atomic mass type calculation.



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Calculate the empirical formula of the compound.
(relative atomic masses: Cl = 35.5, Fe = 56.0)

(3)

35.5 → 3.55 56 → 2.80

$\frac{2.80}{56} = 0.05$ $\frac{3.55}{35.5} = 0.1$

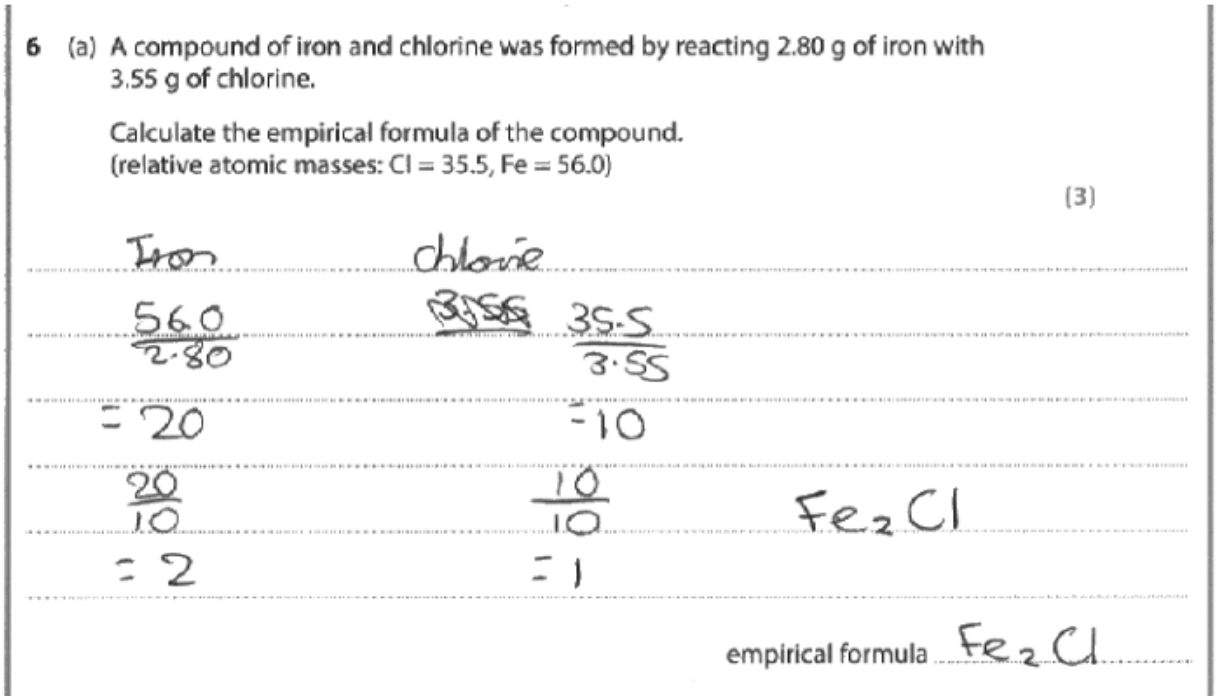
× 1000, 0.05 : 0.1 × 100

5 : 1 = Fe_5Cl

empirical formula Fe_5Cl

Results Plus: Examiner Comments

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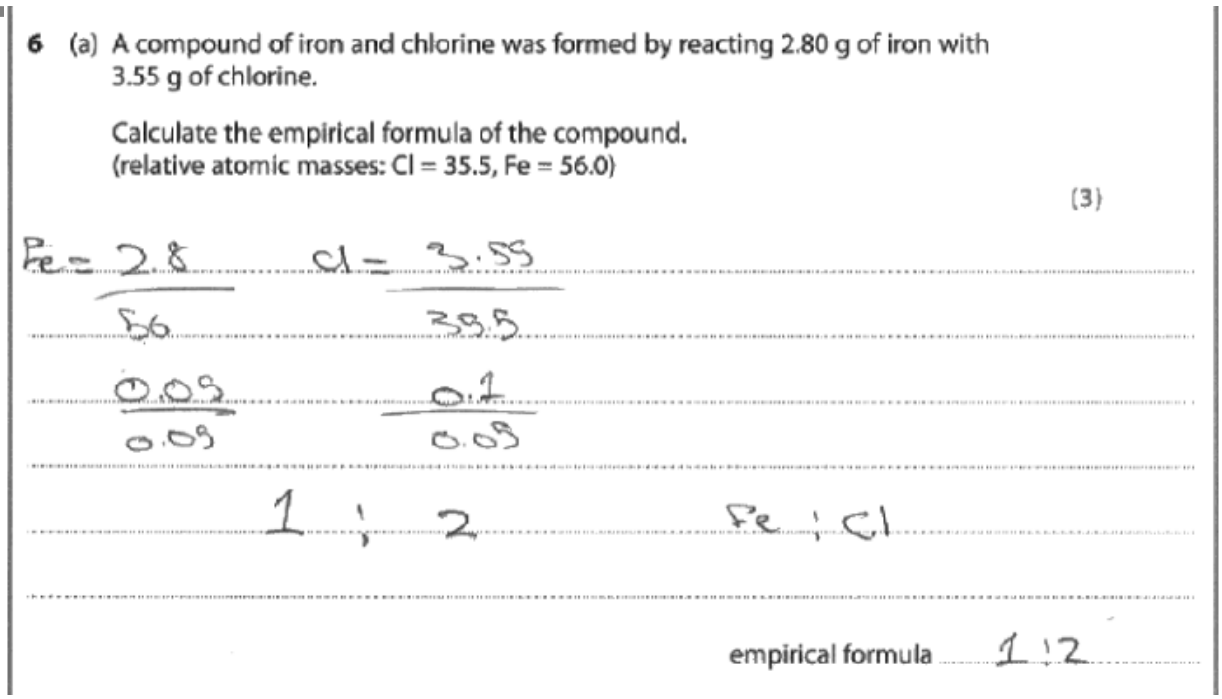
56.0 / 2.80 = 20 — 35.5 / 3.55 = 10

20/10 = 2 — 10/10 = 1 — Fe_2Cl

empirical formula Fe_2Cl

Results Plus: Examiner Comments

Some used the numbers "upside down" as in this example but were still credited with two marks.



6 (a) A compound of iron and chlorine was formed by reacting 2.80 g of iron with 3.55 g of chlorine.

Calculate the empirical formula of the compound.
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(3)

Fe = 2.8 / 56 = 0.05 / 0.05 = 1 — Cl = 3.55 / 35.5 = 0.1 / 0.05 = 2

1 : 2 — Fe : Cl

empirical formula 1 : 2

Results Plus: Examiner Comments

In this example the candidate performs the first two steps correctly but does not give a final empirical formula.

(b) Sodium reacts with chlorine to form sodium chloride.

$2Na + Cl_2 \rightarrow 2NaCl$

Calculate the maximum mass of sodium chloride that could be formed by reacting 9.20 g of sodium with excess chlorine.
(relative atomic masses: Na = 23.0, Cl = 35.5)

(3)

$2Na + Cl \longrightarrow 2NaCl$

$(23 \times 2) + (35.5) \rightarrow 2(23 + 35.5)$

$46 + 35.5 \rightarrow 81.5$

Na	NaCl
46	81.5
9.2	x

$81.5 \times 9.2 = \frac{749.8}{46}$

$= 16.3$

mass of sodium chloride 16.3 g

Results Plus: Examiner Comments

This candidate has made just one error when they incorrectly calculated 2(23+35.5) to give 81.5 instead of 117. It was awarded two marks.

(c)

This question caused a great deal of confusion and many examiners wondered whether candidates had actually seen, or better still carried out the relevant practical work. Some did include descriptions of the halogens but in their pure elemental form – this is not what is seen when this is carried out using halogen and halide solutions.

Some candidates were correctly able to state the order of reactivity of the halogens, but then went on to try to describe experiments in which reaction rates were to be measured.

Good numbers were able to suggest a suitable method of reacting correct combinations of the given solutions, and also a correct explanation or order of reactivity to achieve Level 2. However it was disappointing to see the number who did not know the correct order of reactivity.

Word equations were often helpful in answers as were tables of showing results of experiments. There was the usual confusion about the use of □ide and □ine e.g. "potassium bromine is formed". Those who attempted formulae equations very often gave incorrect formulae such as KCl2 and monatomic halogens. A reversal of the order of reactivity was also fairly often given.

*(c) Chlorine, bromine and iodine are in group 7 of the periodic table.

The order of reactivity of these three elements can be shown by carrying out displacement experiments.

You are provided with

potassium bromide solution
potassium chloride solution
potassium iodide solution
bromine solution
chlorine solution
iodine solution

Describe how these solutions could be used to carry out experiments to show the order of reactivity of bromine, chlorine and iodine, explaining how the results would show the order of reactivity.
You may use equations if you wish.

(6)

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By putting the potassium bromide Solution with the bromine Solution chloride with chlorine etc.

this would be the fastest way to sort out results but you could draw a table and use all the top three solutions with all the three bottom Solution @ naturally to get an overall test.

Results Plus: Examiner Comments

This is an example where quite a lot has been written but unfortunately nothing of credit.

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- 3 chlorine solution
- 1 iodine solution

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(6)

In a displacement reaction, the more reactive ~~element~~ substance displaces a less reactive substance from the compound. In group 7, there are the halogens which are ordered in increasing reactivity (the reactivity increases as you go down the group.) Therefore, iodine is the most reactive, followed by bromine and then chlorine as the least reactive from the three. A displacement reaction can be carried between Potassium bromide and the iodine solution to form potassium iodide and Bromine so iodine displaces the bromine as it is more reactive so it is clear that iodine is more reactive than Bromine. Another displacement reaction can happen between Potassium chloride and the bromine solution to form potassium bromine and Chlorine. So the bromine displaces the Chlorine to show that bromine is more reactive than Chlorine. ~~Furthermore there can be another displacement reaction between~~

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Potassium iodide and the chlorine solution to form potassium chloride and iodine. So the chlorine displaces the iodine As a result by using these reactions, these halogen can be put into order of reactivity.

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

Results Plus: Examiner Comments

The addition of a halogen solution to a halide solution has been made (even though with incorrect results) but there is a wrong order of reactivity. It was awarded Level 1.

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(6)

If potassium bromide solution was reacted with ~~potassium~~ ~~chloride~~ chlorine solution: $2KBr + Cl_2 \rightarrow 2KCl + Br_2$ this equation shows that Chlorine would replace Bromine (a displacement reaction). This is because Chlorine is more reactive than bromine, as Chlorine is higher than bromine in the reactivity series. However, if potassium bromide solution was reacted with iodine solution, than bromine would still remain with potassium as bromine is higher than iodine in the reactivity series. So no change would occur; $KBr + I_2 \rightarrow KBr + I_2$. If potassium iodide solution was reacted with chlorine solution; $2KI + Cl_2 \rightarrow 2KCl + I_2$. Chlorine would replace Iodine as it is ~~still higher~~ higher than iodine in the reactivity series. If potassium bromide solution reacts with bromine solution, no reaction will happen, because it's the same, so no displacement reaction occurs. Displacement only happens if the halide is high in the reactivity series if it isn't nothing changes.

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

Results Plus: Examiner Comments

This is an excellent response with correct descriptions of suitable experiments with correct explanations and balanced equations. It was given Level 3 and 6 marks.

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The order of reactivity of these three elements can be shown by carrying out displacement experiments.

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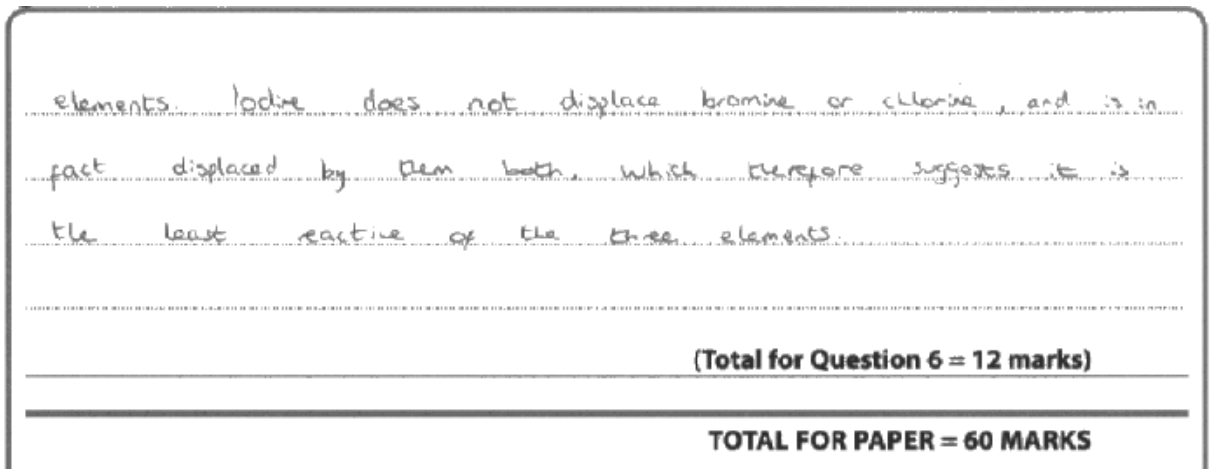
- potassium bromide solution
- potassium chloride solution
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- bromine solution
- chlorine solution
- iodine solution

Cl
Br
I

Describe how these solutions could be used to carry out experiments to show the order of reactivity of bromine, chlorine and iodine, explaining how the results would show the order of reactivity.
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(6)

Firstly we could start with potassium chloride solution. If we add bromine solution to potassium chloride solution, no reaction will take place. Similarly if we add iodine solution, no reaction will take place. Next we could use potassium bromide solution. If we add chlorine solution to potassium bromide solution, a displacement reaction will take place and we would be left with potassium chloride and bromine. However if we add iodine solution to potassium bromide solution, no reaction will take place. Finally we would use potassium iodide solution. If we add chlorine solution to potassium iodide solution, a displacement reaction will take place and we will be left with potassium chloride and iodine. Similarly, if we add bromine solution to potassium iodide a displacement reaction will take place and we will be left with potassium ~~chloride~~ bromide and iodine. The fact chlorine displaces both bromine and iodine suggests that it is the most reactive of the three elements. Bromine displaces iodine, but not chlorine, which suggests it is the second most reactive of the three


elements iodine does not displace bromine or chlorine, and is in fact displaced by them both, which therefore suggests it is the least reactive of the three elements.

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

Results Plus: Examiner Comments

Suitable experiments have been suggested and correct explanations and order of reactivity given. However it was limited to Level 2 and 4 marks as there was no mention of correct observations or balanced equations.

Q6.

(a)

Candidates found this empirical formula calculation challenging and so it proved to be a good discriminator with about a third gaining full marks.

A significant number of students confused the empirical formula calculation with relative atomic mass type calculations. Some students were able to correctly calculate the simplest whole number ratio but then mixed up the numbers with the elements so gave the incorrect formula Fe_2Cl. Another common error was to divide the mass by the wrong relative atomic mass e.g. 2.8/35.5

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Calculate the empirical formula of the compound.
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Iron chlorie

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= 2 = 1

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In this example the candidate performs the first two steps correctly but does not give a final empirical formula.

(b) Sodium reacts with chlorine to form sodium chloride.

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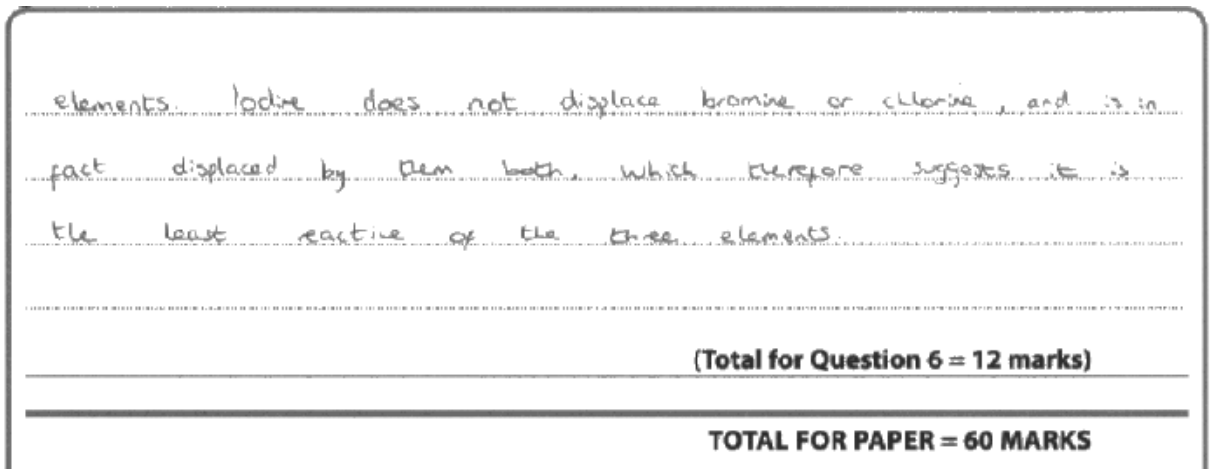
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Cl
Br
I

Describe how these solutions could be used to carry out experiments to show the order of reactivity of bromine, chlorine and iodine, explaining how the results would show the order of reactivity.
You may use equations if you wish.

(6)

Firstly we could start with potassium chloride solution. If we add bromine solution to potassium chloride solution, no reaction will take place. Similarly if we add iodine solution, no reaction will take place. Next we could use potassium bromide solution. If we add chlorine solution to potassium bromide solution, a displacement reaction will take place and we would be left with potassium chloride and bromine. However if we add iodine solution to potassium bromide solution, no reaction will take place. Finally we would use potassium iodide solution. If we add chlorine solution to potassium iodide solution, a displacement reaction will take place and we will be left with potassium chloride and iodine. Similarly, if we add bromine solution to potassium iodide a displacement reaction will take place and we will be left with potassium ~~chloride~~ bromide and iodine. The fact chlorine displaces both bromine and iodine suggests that it is the most reactive of the three elements. Bromine displaces iodine, but not chlorine, which suggests it is the second most reactive of the three


elements iodine does not displace bromine or chlorine, and is in fact displaced by them both, which therefore suggests it is the least reactive of the three elements.

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

Results Plus: Examiner Comments

Suitable experiments have been suggested and correct explanations and order of reactivity given. However it was limited to Level 2 and 4 marks as there was no mention of correct observations or balanced equations.

Q7.

(c) (i) (1)

Although the majority of the candidates could offer suitable values for the density of argon, a blank space was the usual cause for the mark not being awarded.

(c) (i) (2)

A large majority of the candidates scored the mark here, and invariably an incorrect answer was down to giving the symbol of krypton incorrectly as 'KR' or as 'kr'.

(c) (i) (3)

Again a large majority of the candidates followed the pattern of reactivity correctly and gave a correct answer of 'no reaction'; of the remainder quite a few blank spaces were seen and several answers of 'reaction' were given.

(c) (ii)

Many candidates scored at 1 mark, usually for mentioning something about lack of reactivity, but only a small percentage of candidates were able to explain this lack reactivity to score the second mark. Many answers included irrelevant properties such as density or electrical conductivity. It was clear that many candidates did not understand the role of argon in a light bulb. Several thought that the argon was reacting with the metal filament and giving out light as a result. Some thought that using argon made the lighter brighter than if air had been used. Overall, almost half of the candidates scored at least 1 mark.

Explain why argon, instead of air, is used inside these light bulbs.

(2)

Because Argon is unreactive so it will not react with anything ~~Heat~~ which makes the light bulb safer. It's density is greater than air's.

Results Plus: Examiner Comments

This answer indicated that argon was so unreactive that it did not react with anything - for this, 1 mark was awarded.

Explain why argon, instead of air, is used inside these light bulbs.

(2)

Because argon is a non-reactant metal and a good conductor of heat to prevent the light ~~bo~~ bulb from blowing up or catching fire, its a good light sauce which helps the light bulb look brighter and work

Results Plus: Examiner Comments

The candidate thought that argon was a metal and did not understand the purpose of its presence in a light bulb. There was nothing here to credit.

Explain why argon, instead of air, is used inside these light bulbs.

(2)

Argon is used instead of air because it is thinner, making the light shine brighter from the bulb.

Results Plus: Examiner Comments

Several answers of this type were seen where candidates thought that the argon made the light shine brighter. No marks were awarded here.

Results Plus: Examiner Tip

Learn the simple properties of the group 0 elements and be able to explain the lack reactivity in terms of full shells of electrons.

(d)

It was disappointing to see the number of candidates who could not match up the properties of the elements with the correct element, with only about half the candidates scoring at least one mark on this question. Often iodine was matched with the yellow solid and copper matched with the grey solid.

Q8.

(c) (i) (1)

Although the majority of the candidates could offer suitable values for the density of argon, a blank space was the usual cause for the mark not being awarded.

(c) (i) (2)

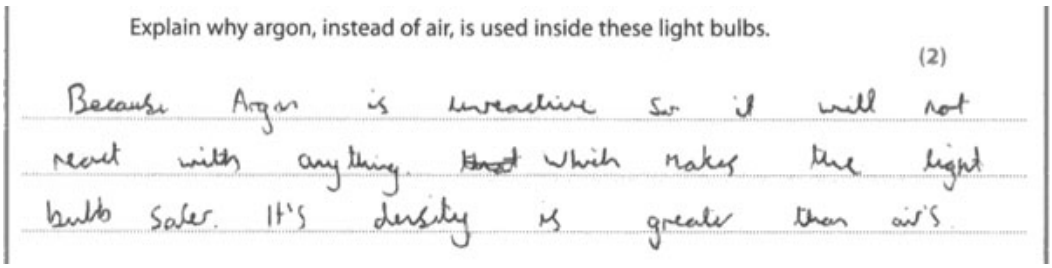
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Results Plus: Examiner Comments

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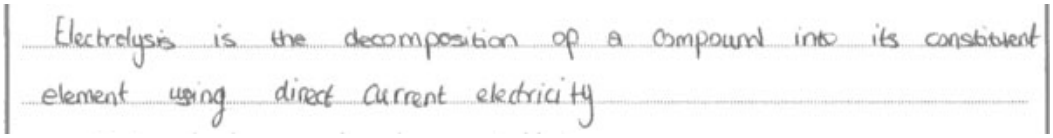
Q9. No Examiner's Report available for this question

Q10. No Examiner's Report available for this question

Q11.

ai

Candidates seem to have a good understanding of what is meant by electrolysis. The majority of candidates knew that it is a process that requires electricity and some knew that a d.c. supply was used. However many candidates are still stating that it is the process of separating compounds, which is not sufficient as a response and does not score the second marking point.



Results Plus: Examiner Comments

A perfect answer including the decomposition of a compound and using direct current.



Results Plus: Examiner Comments

Many candidates are still stating that it is the process of separating compounds, which is not sufficient as a response and does not score the first marking point.

Results Plus: Examiner Tip

When thinking about electrolysis remember

electro– electricity

lysis– splitting.

aii

This question was answered well by the majority of candidates with most being able to state that litmus paper bleaches. Although many candidates are not stating that the litmus is blue and that it is best when damp, marks were not lost for omitting these details.

It will turn damp litmus paper red, then bleech white. (2)

Results Plus: Examiner Comments

Whilst this candidate has not stated to use blue litmus the first marking point is still scored for litmus, they then state that the litmus turns red and is then bleached, so is awarded full marks overall.

~~Chlorine~~ If damp blue litmus paper turns red and then bleaches white it shows chlorine is present.

Results Plus: Examiner Comments

A perfect answer, fully describing how damp blue litmus paper turns red then is bleached white.

using a damp litmus paper should change colour

Results Plus: Examiner Comments

This candidate knows that damp litmus should be used so gains the first marking point. However, they have then not given sufficient detail of the colour change to be able to gain the second marking point.

Results Plus: Examiner Tip

If a colour change is occurring that you need to describe, always give the starting colour and the end colour of whatever substance is used.

aiii

Candidates found this question very difficult and only the best candidates scored the mark here.

Chlorine

Results Plus: Examiner Comments

This candidate has not given the complete name of the compound, just the name of one of the atoms that is present.



Results Plus: Examiner Comments

This candidate has recognised that a polymer is present but has not given the correct name of the compound.

Results Plus: Examiner Tip

When naming a compound ensure that all parts of the structure are accounted for

poly– to show that it is a polymer

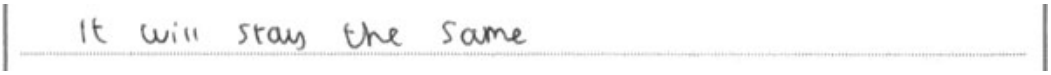
chloro– it contains chlorine

eth– from ethane

ene– as it formed a polymer from its double bond.

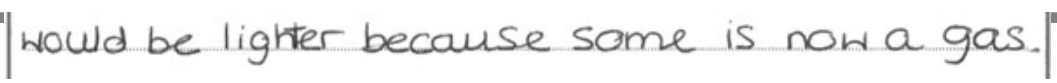
bii

Many candidates did not score here. Candidates that did not get the mark, did so as they thought that a gas was produced and so the mass decreased. They did not read the question fully and did not take on board that no gases were produced in the reaction and that a bung was in the top of the apparatus. There was also evidence of some fundamental misunderstandings such as the magnesium oxide condensing or water vapour being produced, condensed and therefore increasing the water level.



Results Plus: Examiner Comments

Fine, scores one mark.



Results Plus: Examiner Comments

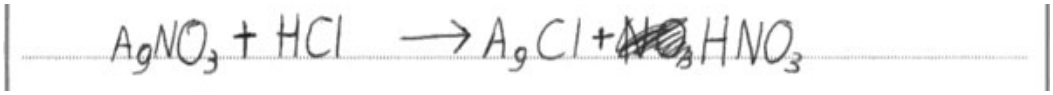
The candidate has not read the question and realised that no gas has been made or seen that there was a bung on top of the conical flask.

Results Plus: Examiner Tip

Check that you read the question fully. When practicals are being discussed ensure that you are clear as to what the reactants and the products are.

biii

Candidates showed that they could write equations and many scored here. However candidates that had not learnt the formulae of the common laboratory acids did not score here.



Results Plus: Examiner Comments

Fine, 2 marks awarded.



Results Plus: Examiner Comments

Whilst the reactants side of the equation was correct for one mark, this candidate could not recall the formulae of nitric acid, the only other product in the reaction.

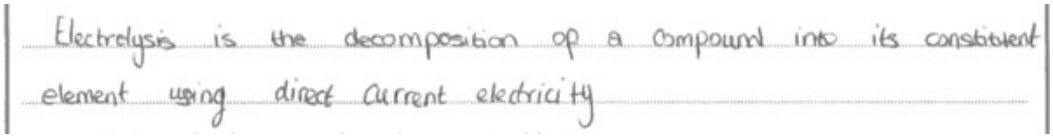
Results Plus: Examiner Tip

It is important that candidates can recall the formulae of common laboratory compounds used in the specification such as hydrochloric acid and nitric acid.

Q12.

ai

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Results Plus: Examiner Comments

A perfect answer including the decomposition of a compound and using direct current.



Results Plus: Examiner Comments

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Results Plus: Examiner Tip

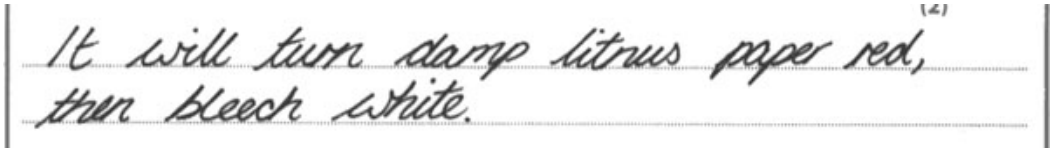
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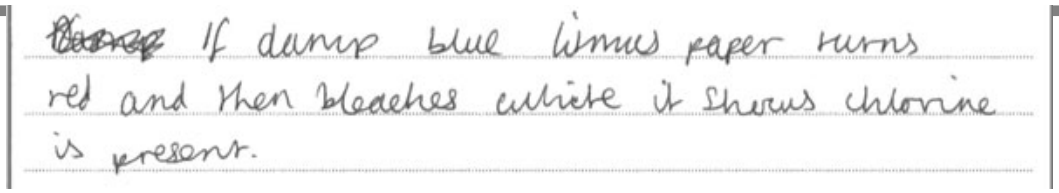
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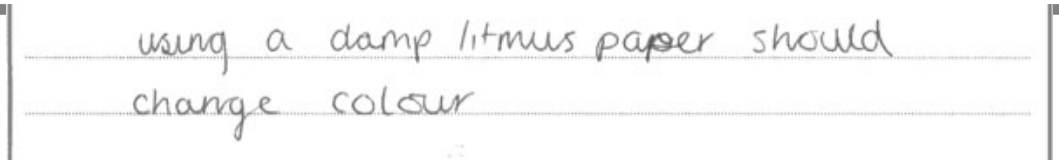
Results Plus: Examiner Comments

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Results Plus: Examiner Comments

A perfect answer, fully describing how damp blue litmus paper turns red then is bleached white.



Results Plus: Examiner Comments

This candidate knows that damp litmus should be used so gains the first marking point. However, they have then not given sufficient detail of the colour change to be able to gain the second marking point.

Results Plus: Examiner Tip

If a colour change is occurring that you need to describe, always give the starting colour and the end colour of whatever substance is used.

aiii

Candidates found this question very difficult and only the best candidates scored the mark here.



Results Plus: Examiner Comments

This candidate has not given the complete name of the compound, just the name of one of the atoms that is present.



Results Plus: Examiner Comments

This candidate has recognised that a polymer is present but has not given the correct name of the compound.

Results Plus: Examiner Tip

When naming a compound ensure that all parts of the structure are accounted for

poly– to show that it is a polymer

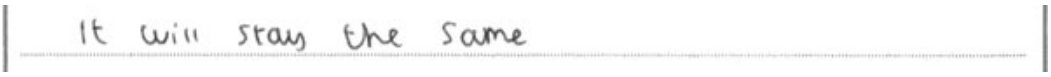
chloro– it contains chlorine

eth– from ethane

ene– as it formed a polymer from its double bond.

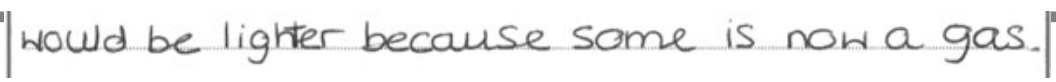
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Results Plus: Examiner Comments

Fine, scores one mark.



Results Plus: Examiner Comments

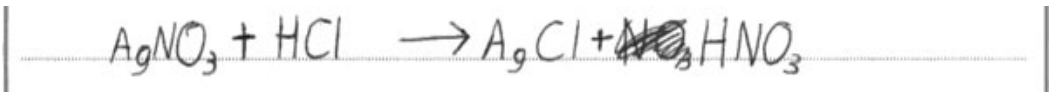
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Results Plus: Examiner Tip

Check that you read the question fully. When practicals are being discussed ensure that you are clear as to what the reactants and the products are.

biii

Candidates showed that they could write equations and many scored here. However candidates that had not learnt the formulae of the common laboratory acids did not score here.



Results Plus: Examiner Comments

Fine, 2 marks awarded.



Results Plus: Examiner Comments

Whilst the reactants side of the equation was correct for one mark, this candidate could not recall the formulae of nitric acid, the only other product in the reaction.

Results Plus: Examiner Tip

It is important that candidates can recall the formulae of common laboratory compounds used in the specification such as hydrochloric acid and nitric acid.

Q13. No Examiner's Report available for this question

Q14. No Examiner's Report available for this question

Q15. No Examiner's Report available for this question

Q16. No Examiner's Report available for this question

Q17. No Examiner's Report available for this question

Q18. No Examiner's Report available for this question

Q19. No Examiner's Report available for this question

Q20. No Examiner's Report available for this question

Q21. No Examiner's Report available for this question

Q22. No Examiner's Report available for this question

Q23.

The vast majority of candidates identified with a reason magnesium, usually from its colour, and sodium hydroxide, using from the pH of the solution. However, a very significant number mixed up copper oxide and copper carbonate. Those that answered fully could identify copper oxide because it reacts with sulfuric acid to form blue copper sulfate solution and water, but unlike the carbonate no carbon dioxide is produced, and similarly giving the correct identification of the carbonate using its production of carbon dioxide, when explaining the effervescence in acid.

Other high scoring answers, where candidates were able to identify all four solids, recognised the colour of each substance. Magnesium was often recognised by the formation of bubbles in water and less often through the formation of hydrogen gas in acid when effervescence takes place.

Some candidates failed to read the question properly and did not realise that they had been given the names of the solids.

* Some properties of four solids, **A**, **B**, **C** and **D**, are shown in Figure 6.

The solids, in no particular order, are copper carbonate, copper oxide, magnesium metal and sodium hydroxide.

	A	B	C	D
colour of solid	black	silver	white	green
observation when solid is added to water	black solid remains	a few bubbles appear on surface of solid	solid dissolves and forms colourless solution	green solid remains
pH of mixture of solid added to water	7	8	13	7
observation when solid is added to dilute sulfuric acid	on warming, solid disappears to form blue solution	effervescence solid disappears to form colourless solution	solid disappears to form colourless solution	effervescence solid disappears to form blue solution

Figure 6

Identify the solids **A**, **B**, **C** and **D**, explaining how the information in Figure 6 supports the identification of each solid.

(6)

Magnesium metal is B. This is because it is silver in colour when magnesium is. It also reacts with water and acid when only magnesium and metals above it in the reactivity series can do. It reacts with them but only slowly and not violently. Sodium hydroxide is C. This is because it has a very high pH of 13 and all hydroxides are alkali. Sodium metal is also white, metals hydroxides for a salt when reacting with water and they dissolves leaving the solution colourless.

Copper oxide is A. This is because it is black when it is solid and it is insolable in water

it oxide are insoluble. When it reacts with the sulfuric acid it produces blue copper sulfate solution. Copper carbonate is D. As it is always a green solid and it remains solid when put water as nearly all carbonates are insoluble in water. It also forms a copper sulfate which is a blue solution. The effervescence for a copper oxide is the oxygen being released while for the copper carbonate it is the carbon dioxide being give off.

Results Plus: Examiner Comments

There are some errors in this answer, but the candidate has made a good attempt to use the data to identify the four solids. This achieved Level 3.

* Some properties of four solids, **A**, **B**, **C** and **D**, are shown in Figure 6.

The solids, in no particular order, are copper carbonate, copper oxide, magnesium metal and sodium hydroxide.

copper oxide sodium hydroxide magnesium copper carbonate

	A	B	C	D
colour of solid	black	silver	white	green
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Figure 6

Identify the solids **A**, **B**, **C** and **D**, explaining how the information in Figure 6 supports the identification of each solid.

(6)

Solid C is magnesium because solid C has the characteristics of a pure metal like magnesium. It dissolves in water and magnesium is a very reactive metal that reacts violently with water. Solid A is copper oxide because it doesn't react with water which is understandable as copper is a metal with low reactivity, which is a bit resistant to oxidation and water. Also it forms blue solution and dissapears in sulfuric acid does and forms a blue solution known as copper sulfate hences it's copper oxide

Solid B is sodium hydroxide because it reacts a bit with water forming bubbles as expected by sodium. and it disappears in sulfuric acid. Solid D is ~~copper~~ copper carbonate as it also unreactive with water as copper is a metal with low reactivity and it dissapears in sulfuric acid to form copper sulfate.

Results Plus: Examiner Comments

In this answer, only two of the solids are identified. Unfortunately, the reasons given, which whilst partially correct, are not enough to uniquely identify the substances. [Both copper oxide and copper carbonate react with acid; the answer does not state that only the carbonate effervesces]. This is a Level 1 answer.

Q24.

Part (ii) was well answered with many candidates scoring two or three marks. A good proportion of candidates appeared to understand the practical well with many being able to describe lifting the lid from time to time and needing to find the mass after heating. The best candidates correctly described heating to a constant mass.

Q25.

(ii)

Many candidates scored at least one mark here for comparing the relative strength of the metals. However, many had the misconception that aluminium does not conduct electricity which is why steel had to be added. Many thought that aluminium surrounded steel as a protective layer, showing a misconception that steel would rust.

Explain why the power lines are made of aluminium with a steel core rather than pure aluminium.

(2)

because the steel can take more electricity than aluminium so most of the electrical current will go through the steel rather than going through the whole of a pure aluminium powerline, it has more electricity held inside of the powerline

Results Plus: Examiner Comments

Some candidates had the misconception that aluminium does not conduct electricity or does not conduct electricity as well as steel which is why the steel had to be added.

Explain why the power lines are made of aluminium with a steel core rather than pure aluminium.

(2)

Steel core has a higher strength than aluminium so the power lines are made of aluminium with a steel core to make the power lines stronger.

Results Plus: Examiner Comments

This example is a good answer that received both marks.

Q26.

(iii)

Candidates found this question quite difficult, with the minority being able to explain how the sodium ion was formed from the sodium atom, in terms of electrons. Some candidates scored 1 mark as they understood that the sodium atom lost electrons, or that just 1 electron was involved, but few were able to explain fully to score both marks. This was another case where it appeared that candidates did not know where to start with the question and simply left it blank. In some cases candidates tried to explain in terms of the atomic structure and charges present on different particles, often incorrectly, which did not gain credit.

(iii) Explain, in terms of electrons, how a sodium atom, Na, forms a sodium ion, Na^+.

(2)

The electrons are shared about So it becomes an ion

Results Plus: Examiner Comments

In some cases candidates thought that the atom shared electrons. These responses gained zero marks.

(iii) Explain, in terms of electrons, how a sodium atom, Na, forms a sodium ion, Na^+.

(2)

it's formed into an ion, Na^+ because

It has lost an electron

Results Plus: Examiner Comments

This answer scored 2 marks for showing the understanding that an electron is lost from the atom.

Q27.

There were a few blank responses here, but most candidates achieved at least one mark as they made an attempt at deciding which reaction took place based on the results given. There was a variety of ways that the candidates carried out the calculation; these are detailed in the mark scheme. Consequently, there was good number that scored full marks. Many worked out the mass of chlorine that had combined with the iron, but some then made errors in calculating the number of moles of atoms. Several went down the route of calculating the formula mass of $FeCl_2$, which was fine, but again some made errors in calculating the number of moles of atoms. It would help greatly if candidates could state their steps in a calculation eg 'mass of chlorine = ...'. This helps the candidate to clarify their thoughts and it enables the marker to understand the candidate's process of calculation rather trying to interpret often random numbers.

Q28. No Examiner's Report available for this question

Q29.

(a) (ii)

The high melting point of sodium chloride was well explained by large numbers of candidates with many scoring full marks. The majority of incorrect answers were in terms of molecules, or intermolecular forces. Marks were usually achieved by reference to strong (ionic) bonds and a lot of energy being needed to break them. However even strong candidates rarely mentioned the attraction between oppositely charged ions.

(ii) Sodium chloride has a melting point of 801 °C.

Explain why the melting point of sodium chloride is high.

(2)

Sodium chloride is an ionic compound which means a lot of energy ('heat') is needed to break the strong ionic bonds

Results Plus: Examiner Comments

A typical way in which both marks were gained.

(ii) Sodium chloride has a melting point of 801 °C.

Explain why the melting point of sodium chloride is high.

(2)

Sodium chloride has a high melting point due to its strong Lattice structure where there are strong electrostatic forces of attraction

Results Plus: Examiner Comments

Candidate gains one mark for correctly mentioning the strong electrostatic forces of attraction but like many others did not refer to them being between oppositely charged ions and so did not gain the second mark.

(a) (iii)

Strong candidates knew this test and gave a perfect answer. A few lost the first mark for failing to add nitric acid or adding hydrochloric acid instead. Some added the nitric acid and failed to mention silver nitrate so also lost out on the precipitate mark. Some candidates attempted an alternative method of determining if a chloride was present. Of these some gained a mark for mentioning electrolysis but then took it no further. Surprisingly, many candidates thought you could test for chloride ions using a flame test.

(iii) Describe how you would test for the presence of chloride ions in a solution of sodium chloride.

(3)

flame test would show chloride ions as lilac.

Results Plus: Examiner Comments

This sort of answer was surprisingly seen quite often.

(iii) Describe how you would test for the presence of chloride ions in a solution of sodium chloride.

(3)

To test for chloride ions, a few drops of dilute hydrochloric acid is added to the sodium chloride solution and is shaken. Then a few drops of silver nitrate solution is added. If a white precipitate of silver chloride forms, chloride ions are present.

Results Plus: Examiner Comments

Like quite a few others, this candidate incorrectly used hydrochloric acid (others simply said use an acid) but was able to score the other marks available.

(b)

It was pleasing to see good attempts being made in this free response question with over half of the candidates producing an answer worthy of level 2 or 3. A good understanding of the formation of magnesium oxide was demonstrated by many candidates with the transfer of electrons from magnesium to oxygen being well described, though fewer candidates could provide the correct formulae of the two ions formed. Surprisingly, significant numbers tried to explain the formation of magnesium oxide in terms of covalent bonding even though they were told in the question that magnesium oxide was an ionic compound. The structure of solid magnesium oxide often received scant treatment, and this was the major reason for not achieving level 3. Some candidates did refer to a lattice structure but often did not mention electrostatic attraction between the oppositely charged ions. Some candidates correctly described properties of magnesium oxide but such answers were not answering the question and so did not gain credit.

*(b) Magnesium has an electronic configuration of 2.8.2.
Oxygen has an electronic configuration of 2.6.

Explain, in terms of their electronic configurations, how magnesium and oxygen atoms react to form the ionic compound magnesium oxide, MgO, and include a description of the structure of solid magnesium oxide.

(6)

Magnesium has 3 shells of electrons with ~~two~~ electrons on the outer most shell. Oxygen has 2 shells of electrons and has ~~6 which~~ six electrons on the outer most shell. To make each element stable there needs to be a complete shell of eight electrons on the outer most shell. So magnesium gives out two electrons while oxygen gains two electrons. The two free electrons on the outer most shell of magnesium breaks away and joins the oxygen atom. So now ~~better~~ both elements ~~are~~ have complete outer shells of eight and are combined together creating a solid compound of Magnesium Oxide. Magnesium has an ionic charge of +2 as it gives out electrons and oxygen has an ionic charge of -2 as it takes electrons.

$Mg + O \rightarrow MgO_{(s)}$

$Mg^{2+} + O^{2-} \rightarrow MgO_{(s)}$

Results Plus: Examiner Comments

A decent description of the formation of the ions and the charges on them are shown but no reference to the structure of magnesium oxide so this was a level 2 answer and given four marks.

*(b) Magnesium has an electronic configuration of 2.8.2.
Oxygen has an electronic configuration of 2.6.

Explain, in terms of their electronic configurations, how magnesium and oxygen atoms react to form the ionic compound magnesium oxide, MgO, and include a description of the structure of solid magnesium oxide.

(6)

Magnesium ~~has~~ has an atomic mass of 24 and an atomic number of 12. This means that the electronic configeration for this is 2, 8, 2. This also means that it has 12 ~~protons~~ electrons ~~and~~, protons, and neutrons. Oxygen has the atomic mass of 16 and the atomic number for it is 8. This means that the eleerronic configeration for it is 2, 6 and it has 8 electrons, 8 protons and 8 neutrons. These two react to form the ionic compound magnesium oxide. The structure of this simple molecular covalent. ~~It has a low melting and boiling~~ It has a low melting and boiling point and the electrons ~~are~~ are, quite far away from eachother and has weak forces of attraction between them.

Results Plus: Examiner Comments

Regrettably even though the candidate has written quite a lot they have not described the ion formation and despite saying it is an ionic compound have then contradicted themself by saying the structure is simple molecular covalent. Hence there is nothing creditworthy here.

Q30.

(a) (ii)

The high melting point of sodium chloride was well explained by large numbers of candidates with many scoring full marks. The majority of incorrect answers were in terms of molecules, or intermolecular forces. Marks were usually achieved by reference to strong (ionic) bonds and a lot of energy being needed to break them. However even strong candidates rarely mentioned the attraction between oppositely charged ions.

(ii) Sodium chloride has a melting point of 801 °C.

Explain why the melting point of sodium chloride is high.

(2)

Sodium chloride is an ionic compound which means a lot of energy ('heat') is needed to break the strong ionic bonds

Results Plus: Examiner Comments

A typical way in which both marks were gained.

(ii) Sodium chloride has a melting point of 801 °C.

Explain why the melting point of sodium chloride is high.

(2)

Sodium chloride has a high melting point due to its strong Lattice structure where there are strong electrostatic forces of attraction

Results Plus: Examiner Comments

Candidate gains one mark for correctly mentioning the strong electrostatic forces of attraction but like many others did not refer to them being between oppositely charged ions and so did not gain the second mark.

(a) (iii)

Strong candidates knew this test and gave a perfect answer. A few lost the first mark for failing to add nitric acid or adding hydrochloric acid instead. Some added the nitric acid and failed to mention silver nitrate so also lost out on the precipitate mark. Some candidates attempted an alternative method of determining if a chloride was present. Of these some gained a mark for mentioning electrolysis but then took it no further. Surprisingly, many candidates thought you could test for chloride ions using a flame test.

(iii) Describe how you would test for the presence of chloride ions in a solution of sodium chloride.

(3)

flame test would show chloride ions as lilac.

Results Plus: Examiner Comments

This sort of answer was surprisingly seen quite often.

(iii) Describe how you would test for the presence of chloride ions in a solution of sodium chloride.

(3)

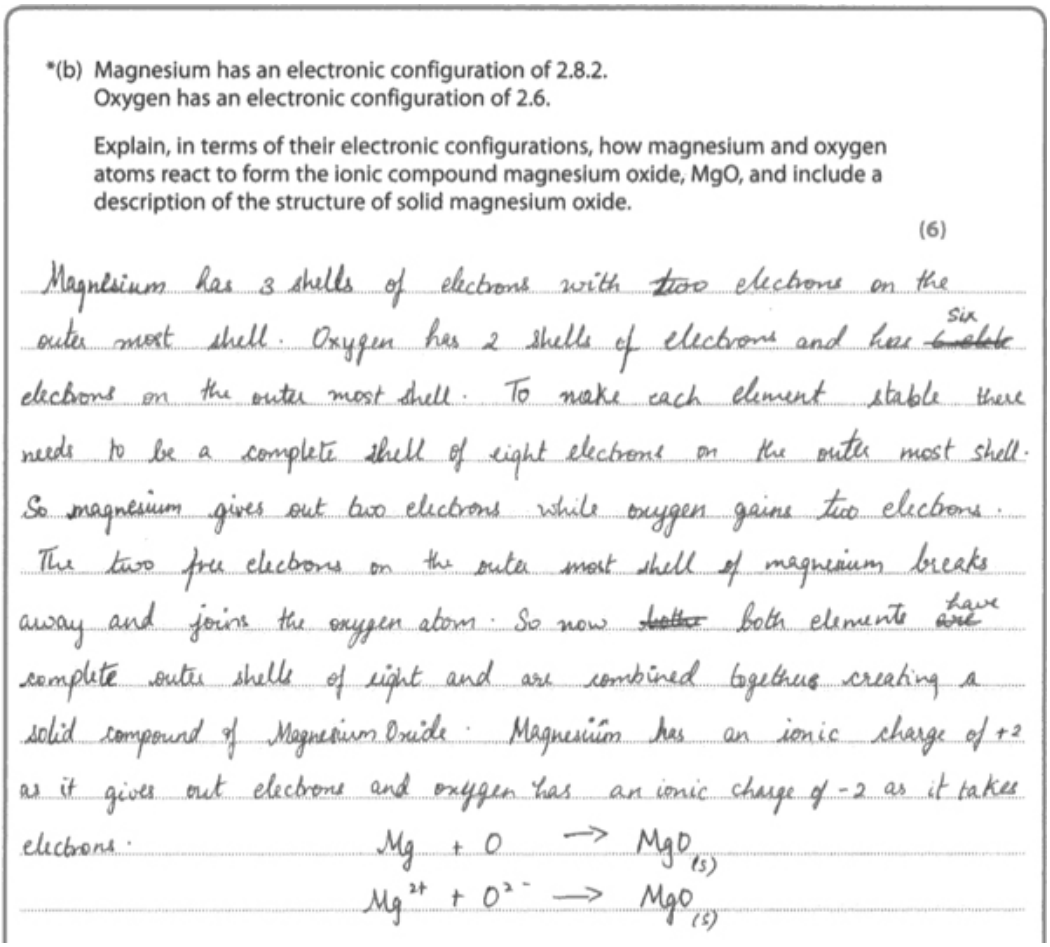
To test for chloride ions, a few drops of dilute hydrochloric acid is added to the sodium chloride solution and is shaken. Then a few drops of silver nitrate solution is added. If a white precipitate of silver chloride forms, chloride ions are present.

Results Plus: Examiner Comments

Like quite a few others, this candidate incorrectly used hydrochloric acid (others simply said use an acid) but was able to score the other marks available.

(b)

It was pleasing to see good attempts being made in this free response question with over half of the candidates producing an answer worthy of level 2 or 3. A good understanding of the formation of magnesium oxide was demonstrated by many candidates with the transfer of electrons from magnesium to oxygen being well described, though fewer candidates could provide the correct formulae of the two ions formed. Surprisingly, significant numbers tried to explain the formation of magnesium oxide in terms of covalent bonding even though they were told in the question that magnesium oxide was an ionic compound. The structure of solid magnesium oxide often received scant treatment, and this was the major reason for not achieving level 3. Some candidates did refer to a lattice structure but often did not mention electrostatic attraction between the oppositely charged ions. Some candidates correctly described properties of magnesium oxide but such answers were not answering the question and so did not gain credit.



*(b) Magnesium has an electronic configuration of 2.8.2.
Oxygen has an electronic configuration of 2.6.

Explain, in terms of their electronic configurations, how magnesium and oxygen atoms react to form the ionic compound magnesium oxide, MgO, and include a description of the structure of solid magnesium oxide.

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A decent description of the formation of the ions and the charges on them are shown but no reference to the structure of magnesium oxide so this was a level 2 answer and given four marks.

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Results Plus: Examiner Comments

Regrettably even though the candidate has written quite a lot they have not described the ion formation and despite saying it is an ionic compound have then contradicted themself by saying the structure is simple molecular covalent. Hence there is nothing creditworthy here.

Q31.

(a)

Good answers were seen but unfortunately many began by correctly describing the movement of electron but later contradicted themselves by stating that the atoms share electrons, although still calling this ionic bonding. Some gave an incorrect direction of electron transfer whilst others vaguely referred to the 'joining of the electrons' in the outer shells to make eight.

(d) Magnesium oxide is an ionic compound.

The electronic configuration of magnesium is 2.8.2.
The electronic configuration of oxygen is 2.6.

Describe, in terms of electrons, how a magnesium atom and an oxygen atom form ions in magnesium oxide, MgO.

(3)

A Magnesium atom and an oxygen atom form ions in magnesium is due to the transfer of electrons. Also they ~~w~~ are two compounds from different groups and contain two compound/ each.

Results Plus: Examiner Comments

This answer was awarded one mark for correctly stating transfer of electrons in the first sentence. The rest of the answer was ignored.

(d) Magnesium oxide is an ionic compound.

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Describe, in terms of electrons, how a magnesium atom and an oxygen atom form ions in magnesium oxide, MgO.

(3)

magnesium atoms ~~to~~ lose electrons to gain positive charge and an oxygen atom ~~to~~ gains electron to lose a charge, ~~So when both~~ ~~to~~ to form ions.

Results Plus: Examiner Comments

This answer has the idea of electron transfer and in the correct direction but has not mentioned the number of electrons transferred so scores two marks.

(b)

It was possibly a little surprising that only just over half of candidates gave a correct answer. Significant numbers of candidates multiplied the relative atomic masses whilst others decided to subtract or divide them. Others obtained the correct answer but then carried out extra operations on it, often involving 100.

(e) Calculate the relative formula mass of magnesium oxide, MgO.
(relative atomic masses: O = 16; Mg = 24)

(1)

16 × 24

relative formula mass = 384

(Total for Question 3 = 11 marks)

Results Plus: Examiner Comments

This was a common incorrect response.

(e) Calculate the relative formula mass of magnesium oxide, MgO.
(relative atomic masses: O = 16; Mg = 24)

(1)

24 - 16 = 1.5 x 100

relative formula mass = 150

(Total for Question 3 = 11 marks)

Results Plus: Examiner Comments

Two incorrect operations given here.

Q32.

(a)

Good answers were seen but unfortunately many began by correctly describing the movement of electron but later contradicted themselves by stating that the atoms share electrons, although still calling this ionic bonding. Some gave an incorrect direction of electron transfer whilst others vaguely referred to the 'joining of the electrons' in the outer shells to make eight.

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The electronic configuration of magnesium is 2.8.2.
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Describe, in terms of electrons, how a magnesium atom and an oxygen atom form ions in magnesium oxide, MgO.

(3)

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(3)

magnesium atoms ~~to~~ lose electrons to gain positive charge and an oxygen atom ~~to~~ gains electron to lose a charge, ~~So when both~~ ~~to~~ to form ions.

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relative formula mass = 150

(Total for Question 3 = 11 marks)

Results Plus: Examiner Comments

Two incorrect operations given here.

Q33. No Examiner's Report available for this question

Q34. No Examiner's Report available for this question

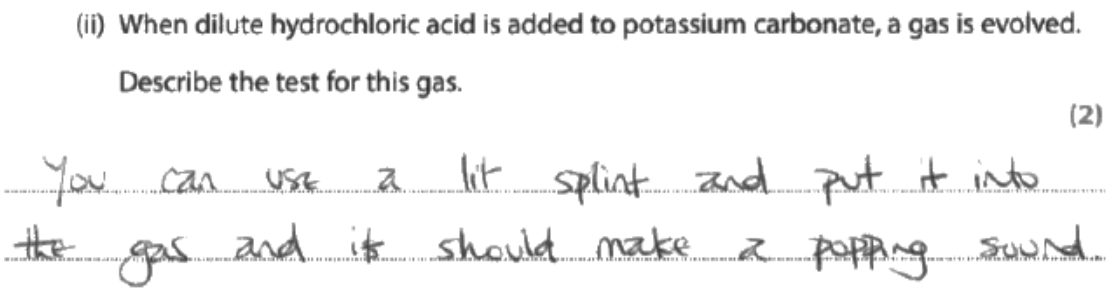
Q35.

(b) (ii)

The majority of candidates did not appreciate that carbon dioxide is produced when dilute hydrochloric acid is added to potassium carbonate. Most students therefore described the test for hydrogen and occasionally the test for oxygen.

Of those who did identify the gas as being carbon dioxide a significant number described a lit

splint being extinguished as a viable test for carbon dioxide.


(ii) When dilute hydrochloric acid is added to potassium carbonate, a gas is evolved.

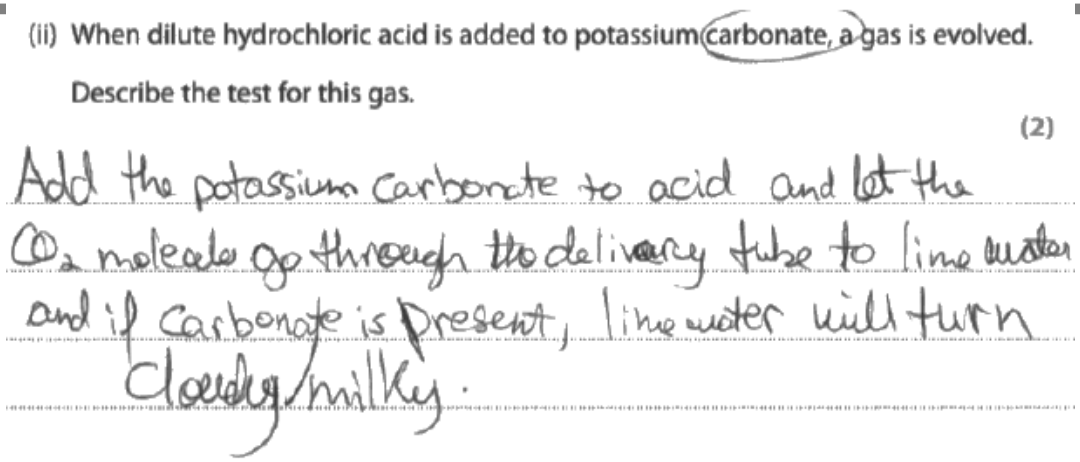
Describe the test for this gas.

(2)

You can use a lit splint and put it into the gas and it should make a popping sound.

Results Plus: Examiner Comments

An all too common answer suggesting a test for hydrogen.


(ii) When dilute hydrochloric acid is added to potassium carbonate, a gas is evolved.

Describe the test for this gas.

(2)

Add the potassium carbonate to acid and let the CO_2 molecule go through the delivery tube to lime water and if carbonate is present, lime water will turn cloudy/milky.

Results Plus: Examiner Comments

An example of a very good response.

Q36.

(b) (ii)

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(2)

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An all too common answer suggesting a test for hydrogen.

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(2)

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Results Plus: Examiner Comments

An example of a very good response.

Q37. No Examiner's Report available for this question

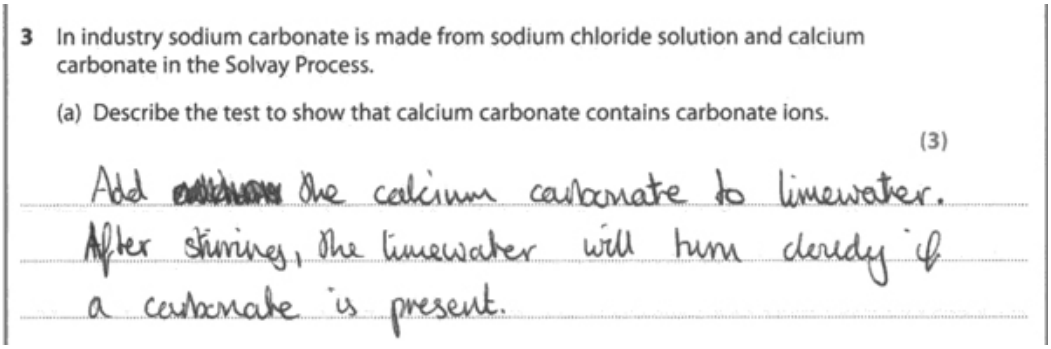
Q38. No Examiner's Report available for this question

Q39.

(a)

Candidates often scored 2 marks for mentioning carbon dioxide and describing a correct limewater test. However the need to add acid to the calcium carbonate or to heat it to produce the carbon dioxide was often omitted with a large number of candidates suggesting that the calcium carbonate should be added directly to the limewater. Some candidates described a

flame test approach to identify calcium ions rather than the carbonate in calcium carbonate and so gained no credit.



3 In industry sodium carbonate is made from sodium chloride solution and calcium carbonate in the Solvay Process.

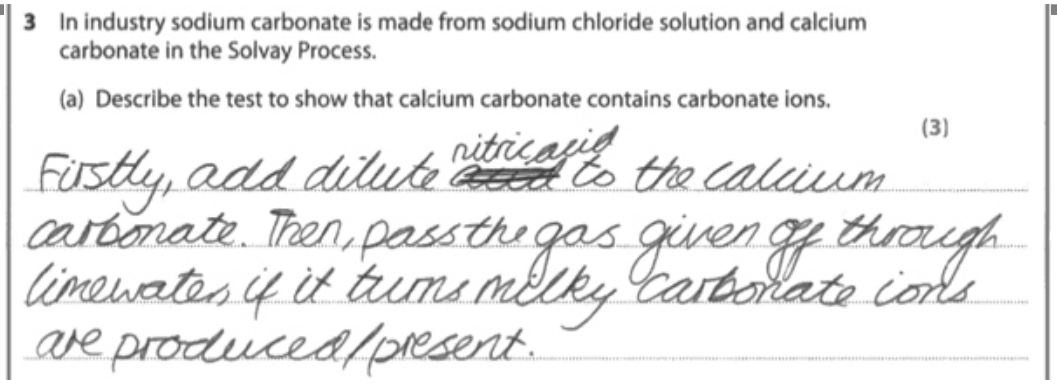
(a) Describe the test to show that calcium carbonate contains carbonate ions.

(3)

Add the calcium carbonate to limewater. After stirring, the limewater will turn cloudy if a carbonate is present.

Results Plus: Examiner Comments

Quite a common answer which was awarded one mark for the result of a limewater test.



3 In industry sodium carbonate is made from sodium chloride solution and calcium carbonate in the Solvay Process.

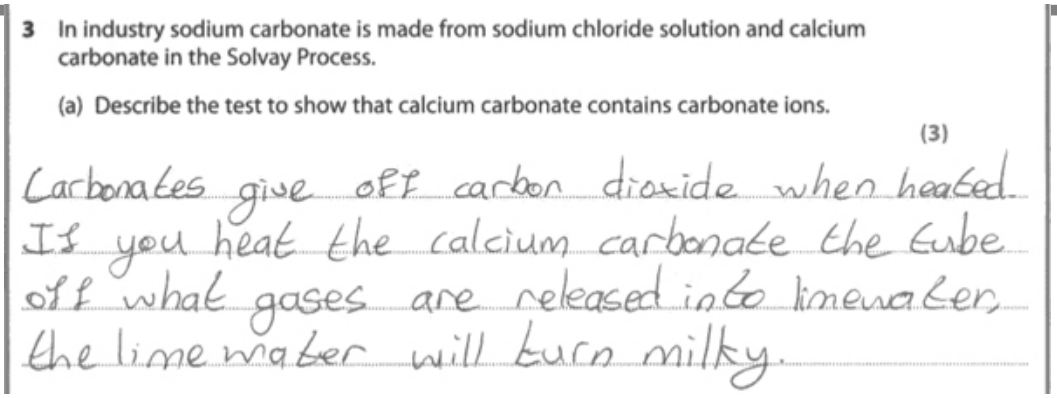
(a) Describe the test to show that calcium carbonate contains carbonate ions.

(3)

Firstly, add dilute nitric acid to the calcium carbonate. Then, pass the gas given off through limewater, if it turns milky carbonate ions are produced/present.

Results Plus: Examiner Comments

A good answer worth all three marks.



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(3)

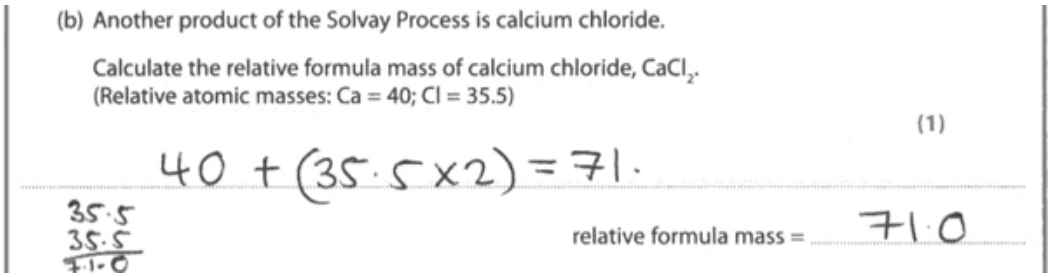
Carbonates give off carbon dioxide when heated. If you heat the calcium carbonate the tube off what gases are released into limewater, the lime water will turn milky.

Results Plus: Examiner Comments

An acceptable method of heating the calcium carbonate to produce the carbon dioxide and then correctly testing for it and so worth 3 marks.

(b)

The majority of candidates got this correct although there were the occasional addition errors, and a few candidates forgot to multiply 35.5 by 2. Some were awarded the mark (which was for the working) for doing the correct calculation but giving the answer as 110. Some weaker candidates gained no marks for incorrect calculations or did not attempt the question.


(b) Another product of the Solvay Process is calcium chloride.

Calculate the relative formula mass of calcium chloride, $CaCl_2$.
(Relative atomic masses: Ca = 40; Cl = 35.5)

(1)

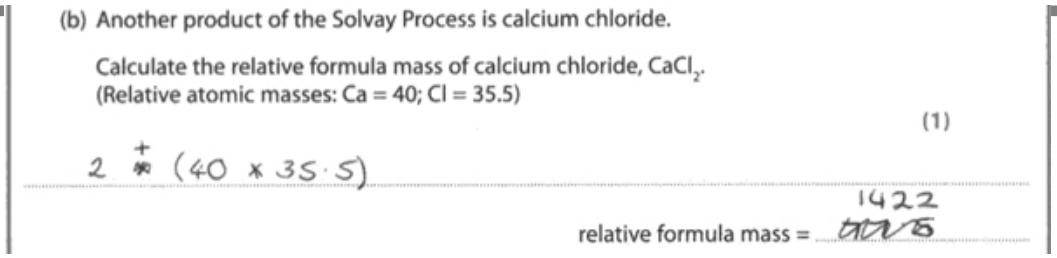
40 + (35.5 x 2) = 71.

35.5
35.5
71.0

relative formula mass = 71.0

Results Plus: Examiner Comments

This gained the mark as it was given for showing the correct working despite the careless error in evaluating the answer.


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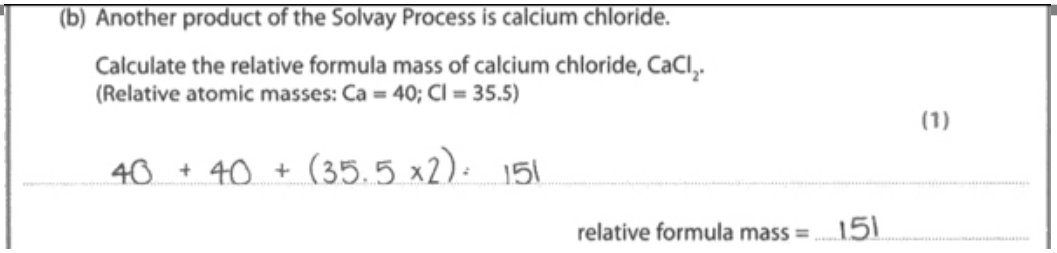
2 + (40 x 35.5)

1422

relative formula mass =

Results Plus: Examiner Comments

It was surprising what some candidates did with the relative atomic masses.


(b) Another product of the Solvay Process is calcium chloride.

Calculate the relative formula mass of calcium chloride, $CaCl_2$.
(Relative atomic masses: Ca = 40; Cl = 35.5)

(1)

40 + 40 + (35.5 x 2) = 151

relative formula mass = 151

Results Plus: Examiner Comments

Some multiplied the Ar of calcium by two as well.

(c)

Stronger candidates answered this reacting mass calculation very well. Less confident candidates mixed up the numbers in the calculation e.g. (100x40)/106, but others did not seem

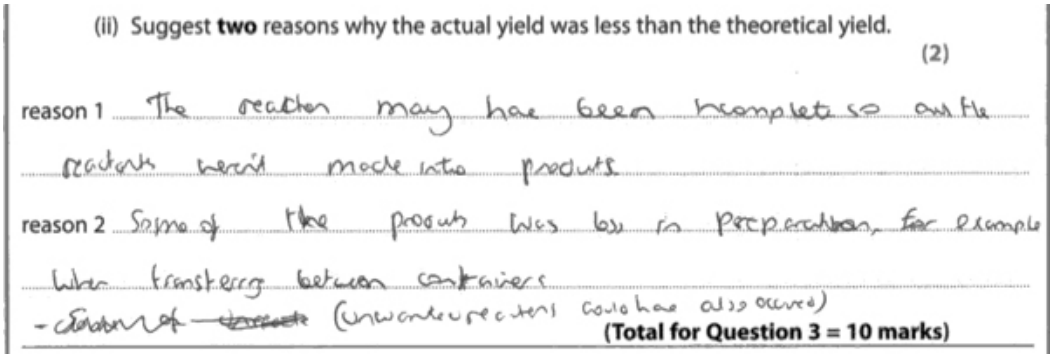
to know how to approach it and performed random calculations with the numbers given. Others simply did not attempt it.

(d) (i)

The majority of candidates answered this correctly. Many were awarded one mark for showing 10.4/15.0 but were not awarded the second mark as they had not multiplied by 100. The most common error was made by those who got the calculation the wrong way round and divided 15.0 by 10.4. They seemingly failed to realise that 144% was not a sensible answer for a percentage yield.

(d) (ii)

Many students seem to have been well trained in their answers to this question. However a range of non-creditworthy answers were suggested. Some of these involved giving definitions of theoretical yield or referred to the difference between theoretical and actual yield or stated that yield calculations are simply inherently faulty. Others made vague suggestions such as "human error" or errors due to parallax and the need to measure solutions at eye level.



(ii) Suggest **two** reasons why the actual yield was less than the theoretical yield.

(2)

reason 1 The reaction may have been incomplete so not all the reactants were made into products

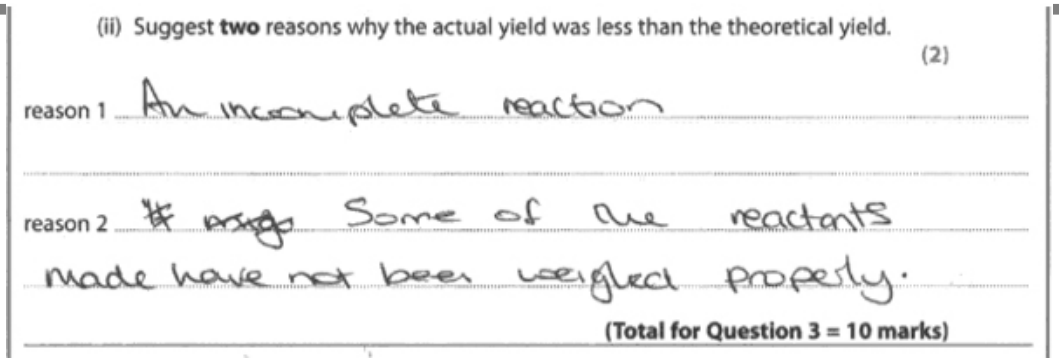
reason 2 Some of the product was lost in preparation, for example when transferring between containers

- Side reactions (unwanted reactions could have also occurred)

(Total for Question 3 = 10 marks)

Results Plus: Examiner Comments

An answer worth both marks.



(ii) Suggest **two** reasons why the actual yield was less than the theoretical yield.

(2)

reason 1 An incomplete reaction

reason 2 Some of the reactants made have not been weighed properly.

(Total for Question 3 = 10 marks)

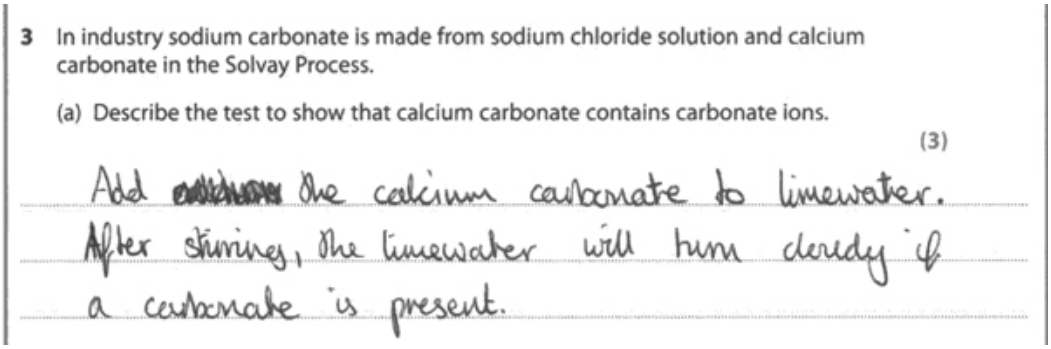
Results Plus: Examiner Comments

The first reason is correct but errors in weighing were not acceptable.

Q40.

(a)

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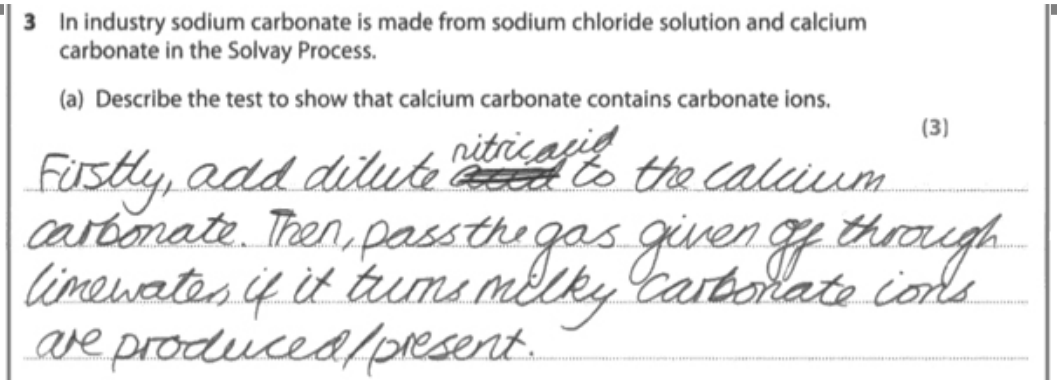
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1422

relative formula mass =

Results Plus: Examiner Comments

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(2)

reason 1 The reaction may have been incomplete so not the reactants would made into products

reason 2 Some of the products was lost in preparation, for example when transferring between containers

- ~~Solution of reactants~~ (unwanted reactions could have also occured)

(Total for Question 3 = 10 marks)

Results Plus: Examiner Comments

An answer worth both marks.

(ii) Suggest **two** reasons why the actual yield was less than the theoretical yield.

(2)

reason 1 An incomplete reaction

reason 2 Some of the reactants made have not been weighed properly.

(Total for Question 3 = 10 marks)

Results Plus: Examiner Comments

The first reason is correct but errors in weighing were not acceptable.

Q41.

(ii)

Candidates found it quite hard to name barium sulfate as the precipitate formed.

(ii) Give the name of the white precipitate formed by the reaction of barium chloride solution with dilute sulfuric acid.

(1)

barium sulphate precipitate

Results Plus: Examiner Comments

The correct answer that scored the mark.

(ii) Give the name of the white precipitate formed by the reaction of barium chloride solution with dilute sulfuric acid.

(1)

barium

Results Plus: Examiner Comments

A common error seen was to simply state barium as the white precipitate formed.

(ii) Give the name of the white precipitate formed by the reaction of barium chloride solution with dilute sulfuric acid.

(1)

Barium Sulgide

Results Plus: Examiner Comments

In some cases candidates gave 'barium sulfide' or were too vague with their answer and just stated salt.

Q42.

(i)

The vast majority of candidates scored the 1 mark available by giving the answer of 35, but some thought they could simply use the value given on the periodic table, but this is the **relative atomic mass** of 35.5 and not the **mass number** of that particular atom. A few candidates chose to add together the numbers of all sub-atomic particles, but this was rarely seen.

(ii)

The vast majority of candidates scored with the correct answer of 2.8.7, but in a very few cases, either had an extra shell of electrons or a different set of numbers that added up to 17.

Q43. No Examiner's Report available for this question

Q44.

(i)

Candidates found it quite hard to state the mass number of this chlorine atom.

A common error was to give the atomic number instead or to use the periodic table at the back rather than the information given in the stem of the question and give an answer of 35.5.

(ii)

More candidates scored in (ii) compared to (i), and were able to correctly give the electronic configuration at the atom.

In some cases, the question was not read correctly, and the number of electrons were given rather than the electronic configuration.

Some candidates drew diagrams, which were accepted.

Q45. No Examiner's Report available for this question

Q46.

This question was generally well answered on the whole with two thirds of candidates gaining at least 1 of the 2 marks available.

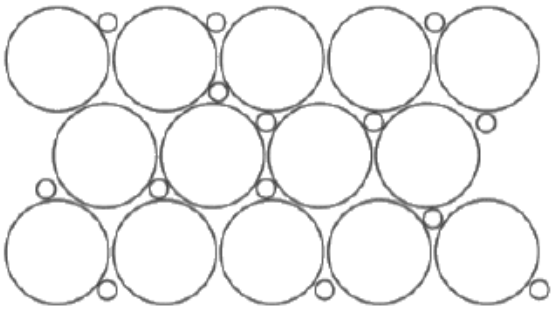
Most candidates were able to link atomic number and mass number to their respective definitions.

In very few cases, candidates drew more than one line from each of the two substances, despite clear instructions in the question and this being a tried and established question style in this and in many of the previous examination series.

Q47.

This proved to be a much more difficult free response question. There were some good responses but many others were very weak. It seemed that some candidates were not familiar with the diagram of a metal structure which was given to help them.

*(c) The diagram shows the structure of a metal.



Use the diagram to describe the structure of a metal and to explain why metals are malleable and conduct electricity.

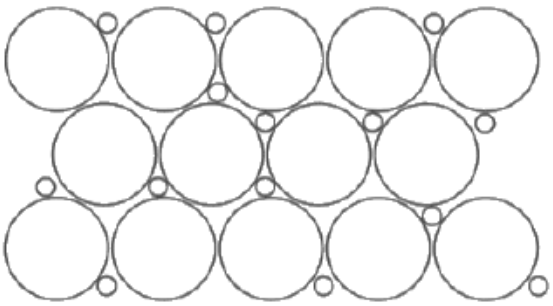
(6)

Metals have many different properties such as they are hard, shiny and are malleable which means they can be hammered into shape, the are also good conductors of electricity and heat, which is why copper is used in wires as it conducts electricity.
The structure shows big particles with small particles inbetween making the metal strong and compact but also allowing movement meaning the metal is malvable and can be hammered into shape with the use of heat.

Results Plus: Examiner Comments

The candidate has explained malleable but no other creditworthy information so level 1 with 2 marks.

*(c) The diagram shows the structure of a metal.



Use the diagram to describe the structure of a metal and to explain why metals are malleable and conduct electricity.

(6)

Metals have layers, which means that they can slip over eachother, meaning that they can be bent into a shape; this is what makes them malleable.

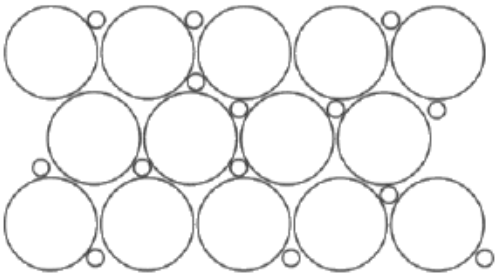
Metals have a delocalised sea of electrons. The electrons within metal are positive meaning that they're able to conduct electricity.

There is also small spaces within metals, allowing electricity to pass

Results Plus: Examiner Comments

This candidate has made two valid points about malleability. Another valid point is delocalised electrons (despite them being positive!) Level 2 and 4 marks.

*(c) The diagram shows the structure of a metal.



Use the diagram to describe the structure of a metal and to explain why metals are malleable and conduct electricity.

(6)

Metals have medium to high melting points and are solids at room temperature except for mercury. Metals can conduct electricity because positive ions are held together by sea of ~~delocia~~ delocalised electrons. Some metals have stronger bonds than others. Metals are malleable because they have layers of ions that can easily slide over one and another. Electrons can move freely in metals ~~meaning~~ so electricity can easily flow through it. As metals are malleable they can be easily bent into shapes and hampered into place/shape.

Results Plus: Examiner Comments

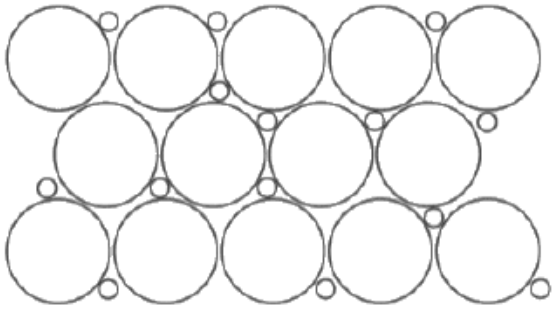
This response includes good references to all three aspects including positive ions and delocalised electrons, explanation of meaning of malleability also with layers of ions being able to slide over one another, electrons being able to move enabling electricity to flow. Level 3 and 6 marks.

Q48.

This proved to be a much more difficult free response question. There were some good responses but many others were very weak. It seemed that some candidates were not familiar

with the diagram of a metal structure which was given to help them.

*(c) The diagram shows the structure of a metal.



Use the diagram to describe the structure of a metal and to explain why metals are malleable and conduct electricity.

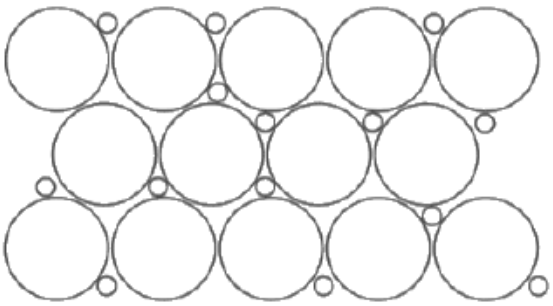
(6)

Metals have many different properties such as they are hard, shiny and are malleable which means they can be hammered into shape, the are also good conductors of electricity and heat, which is why copper is used in wires as it conducts electricity.
The structure shows big particles with small particles inbetween making the metal strong and compact but also allowing movement meaning the metal is malvable and can be hammered into shape with the use of heat.

Results Plus: Examiner Comments

The candidate has explained malleable but no other creditworthy information so level 1 with 2 marks.

*(c) The diagram shows the structure of a metal.



Use the diagram to describe the structure of a metal and to explain why metals are malleable and conduct electricity.

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Metals have layers, which means that they can slip over eachother, meaning that they can be bent into a shape; this is what makes them malleable.

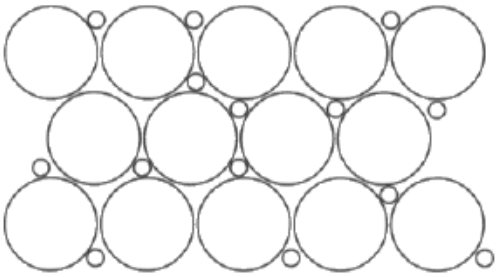
Metals have a delocalised sea of electrons. The electrons within metal are positive meaning that they're able to conduct electricity.

There is also small spaces within metals, allowing electricity to pass

Results Plus: Examiner Comments

This candidate has made two valid points about malleability. Another valid point is delocalised electrons (despite them being positive!) Level 2 and 4 marks.

*(c) The diagram shows the structure of a metal.



Use the diagram to describe the structure of a metal and to explain why metals are malleable and conduct electricity.

(6)

Metals have medium to high melting points and are solids at room temperature except for mercury. Metals can conduct electricity because positive ions are held together by sea of ~~delocia~~ delocalised electrons. Some metals have stronger bonds than others. Metals are malleable because they have layers of ions that can easily slide over one and another. Electrons can move freely in metals ~~meaning~~ so electricity can easily flow through it. As metals are malleable they can be easily bent into shapes and hampered into place/shape.

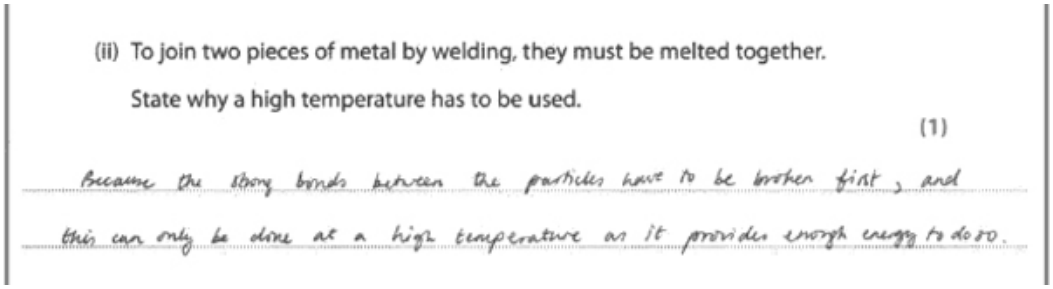
Results Plus: Examiner Comments

This response includes good references to all three aspects including positive ions and delocalised electrons, explanation of meaning of malleability also with layers of ions being able to slide over one another, electrons being able to move enabling electricity to flow. Level 3 and 6 marks.

Q49.

(a) (ii)

Many candidates gave the expected answer of high melting point but others answered in terms of energy required to break bonds and many of these answers were correct. However some incorrectly made references to ionic or covalent or intermolecular bonds. A small minority of the candidates discussed a high boiling point while others effectively just repeated the question.



(ii) To join two pieces of metal by welding, they must be melted together.

State why a high temperature has to be used.

(1)

Because the strong bonds between the particles have to be broken first, and this can only be done at a high temperature as it provides enough energy to do so.

Results Plus: Examiner Comments

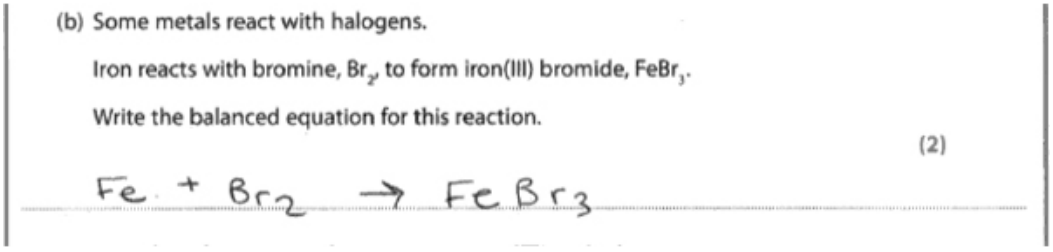
An acceptable way of answering the question worth the mark.

(a) (iii)

Many candidates gained one mark by correctly stating that argon is inert or unreactive or a noble gas. Some candidates then went on to gain a second mark by explaining this idea using the idea of the full outer shell and some others explained that oxygen would react with the metal. However, a significant number of candidates did not gain a second mark as they answered in terms of argon not reacting with oxygen or not being flammable and a surprising number thought argon was a catalyst.

(b)

Many candidates who gave correct symbols and formulae could also balance the equation. Some lost a mark by using the wrong case letters and others gave the wrong formula for $FeBr_3$ and/or Br_2 which should not have happened as these were given in the question. Other errors included putting charges or oxidation states on the iron or trying to balance the equation by putting a number in the middle of the formula, e.g. Fe2Br3.



(b) Some metals react with halogens.

Iron reacts with bromine, Br_2, to form iron(III) bromide, $FeBr_3$.

Write the balanced equation for this reaction.

(2)

$Fe + Br_2 \rightarrow FeBr_3$

Results Plus: Examiner Comments

Correct formulae but not balanced so worth 1 mark.

(d)

The majority of candidates seemed to know the order of the reactivity of the halogens. However there was a good deal of confusion as to when to use the name of the halogen and when to use

the name of the halide ion e.g. candidates referred to bromide and iodide being displaced. Some failed to score marks as they referred to the order of reactivity of the halide ions instead of the halogens. Some weaker candidates thought chlorine was the least reactive giving the reason that chloride would not react with any of the halogens.

Use the information in the table to explain the order of reactivity of the three halogens.

(2)

Chlorine is the most reactive as it displaces the other two halogens. Bromine is ~~the~~ not as reactive as chlorine but more reactive that iodine as it displaces it. Iodine is the least reactive as it doesn't displace any of the above halogens, this shows us the reactivity decreases as you go down the group.

(Total for Question 1 = 9 marks)

Results Plus: Examiner Comments

An answer worth two marks.

Use the information in the table to explain the order of reactivity of the three halogens.

(2)

Chlorine is the highest in reactivity order because it reacts with bromide ion and iodide ion, second is bromine which reacts with iodide ion, and third is iodine which reacts with none of the halide ions.

Results Plus: Examiner Comments

A good answer for two marks.

Use the information in the table to explain the order of reactivity of the three halogens.

(2)

the most reactive halogen out of these three is chlorine as it causes a displacement reaction with a bromide and iodide ion, Bromine is the second most reactive as it is below Chlorine in the periodic table, Iodine is the least reactive as it doesn't cause any displacement reactions, Iodine is below Bromine in the periodic table.

Results Plus: Examiner Comments

A good answer for 2 marks.

Q50.

(a) (ii)

Many candidates gave the expected answer of high melting point but others answered in terms of energy required to break bonds and many of these answers were correct. However some incorrectly made references to ionic or covalent or intermolecular bonds. A small minority of the candidates discussed a high boiling point while others effectively just repeated the question.

(ii) To join two pieces of metal by welding, they must be melted together.

State why a high temperature has to be used.

(1)

Because the strong bonds between the particles have to be broken first, and this can only be done at a high temperature as it provides enough energy to do so.

Results Plus: Examiner Comments

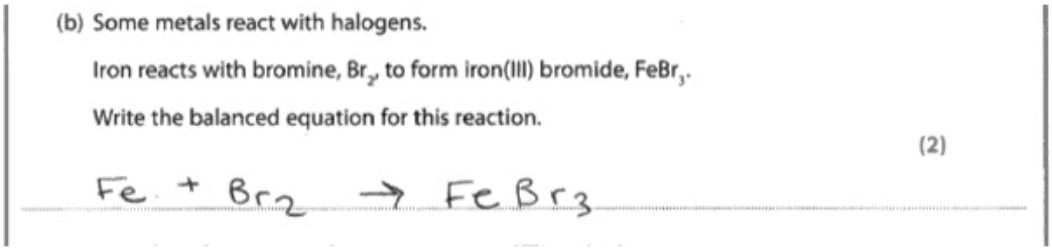
An acceptable way of answering the question worth the mark.

(a) (iii)

Many candidates gained one mark by correctly stating that argon is inert or unreactive or a noble gas. Some candidates then went on to gain a second mark by explaining this idea using the idea of the full outer shell and some others explained that oxygen would react with the metal. However, a significant number of candidates did not gain a second mark as they answered in terms of argon not reacting with oxygen or not being flammable and a surprising number thought argon was a catalyst.

(b)

Many candidates who gave correct symbols and formulae could also balance the equation. Some lost a mark by using the wrong case letters and others gave the wrong formula for $FeBr_3$ and/or Br_2 which should not have happened as these were given in the question. Other errors included putting charges or oxidation states on the iron or trying to balance the equation by putting a number in the middle of the formula, e.g. Fe2Br3.



(b) Some metals react with halogens.

Iron reacts with bromine, Br_2, to form iron(III) bromide, $FeBr_3$.

Write the balanced equation for this reaction.

(2)

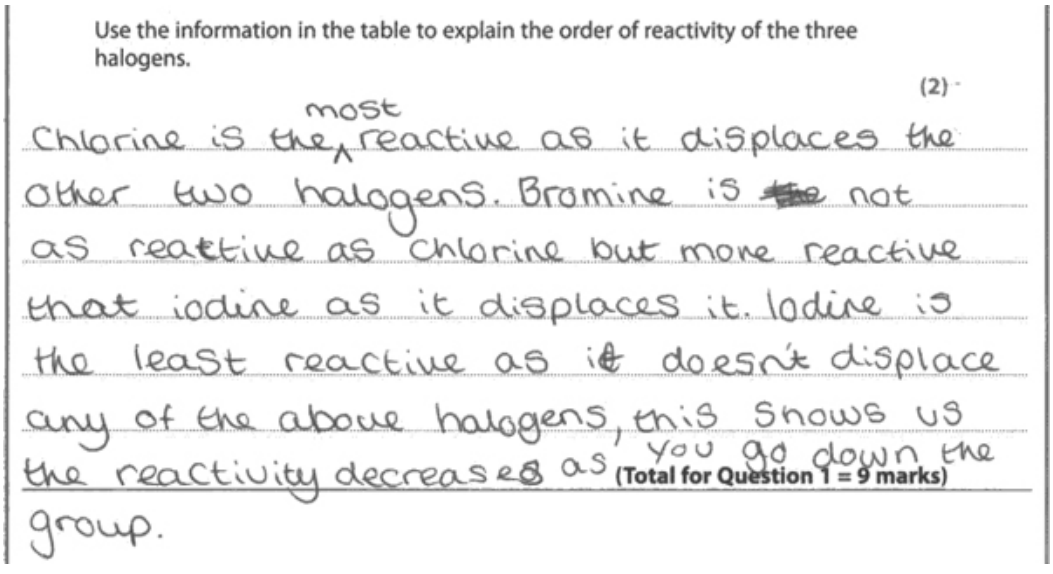
$Fe + Br_2 \rightarrow FeBr_3$

Results Plus: Examiner Comments

Correct formulae but not balanced so worth 1 mark.

(d)

The majority of candidates seemed to know the order of the reactivity of the halogens. However there was a good deal of confusion as to when to use the name of the halogen and when to use the name of the halide ion e.g. candidates referred to bromide and iodide being displaced. Some failed to score marks as they referred to the order of reactivity of the halide ions instead of the halogens. Some weaker candidates thought chlorine was the least reactive giving the reason that chloride would not react with any of the halogens.



Use the information in the table to explain the order of reactivity of the three halogens.

(2)

Chlorine is the most reactive as it displaces the other two halogens. Bromine is ~~the~~ not as reattive as chlorine but more reactive that iodine as it displaces it. Iodine is the least reactive as it doesn't displace any of the above halogens, this shows us the reactivity decreases as you go down the group.

(Total for Question 1 = 9 marks)

Results Plus: Examiner Comments

An answer worth two marks.

Use the information in the table to explain the order of reactivity of the three halogens.

(2)

chlorine is the highest in reactivity order because it reacts with bromide ion and iodide ion, second is bromine which reacts with iodide ion, and third is iodine which reacts with none of the halide ions.

Results Plus: Examiner Comments

A good answer for two marks.

Use the information in the table to explain the order of reactivity of the three halogens.

(2)

the most reactive halogen out of these three is chlorine as it causes A displacement reaction with a bromide and iodide ion, Bromine is the second most reactive as it is below Chlorine in the periodic table, Iodine is the least reactive as it doesn't cause any displacement reactions, Iodine is below Bromine in the periodic table.

Results Plus: Examiner Comments

A good answer for 2 marks.

Q51.

(a)

As anticipated this opening question on protons, neutrons and electrons provided a good start for most candidates with over 90% gaining 2 or more marks. The most common error was in the mass of the electron whilst some others included charges on the relative mass.

1 (a) Atoms contain protons, neutrons and electrons.

Complete the table to show the relative mass and relative charge of each particle and its position in an atom.

(3)

	relative mass	relative charge	position in atom
proton	1	+1	shells
neutron	1	0	in nucleus
electron	0	-1	shells

Results Plus: Examiner Comments

The relative mass of the electron was the most common incorrect aspect but this was a surprising incorrect answer. Also the position of the proton was incorrect but four correct responses earned 2 marks.

Results Plus: Examiner Tip

This is obviously just a matter of factual recall and should always be a good source of marks.

(c)(i)

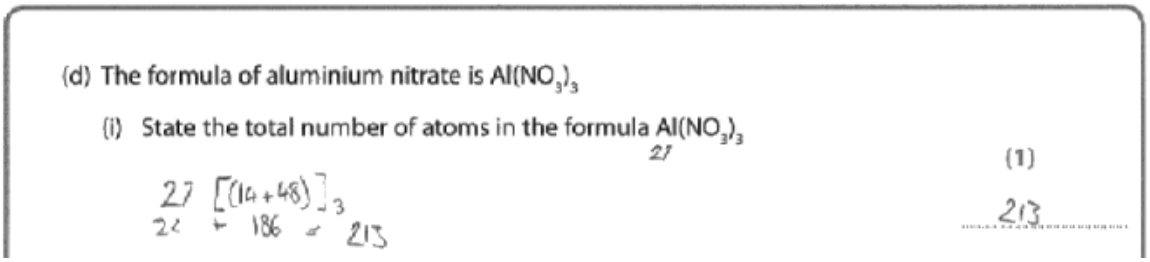
Most candidates gave the correct answer of Ca but a few did not follow the instructions and gave the name rather than the symbol.

(c)(ii)

Over a third of candidates gave incorrect answers showing a lack of knowledge of the connection between groups and the charge on ions. Instead of the correct answer of O it was common to see K and Cl, with Ne also sometimes being given.

(d)(i)

Many candidates seemed generally confused about different types of atoms and the total number of atoms. There were a wide range of incorrect answers – 3, 9, 10 and 12 all seemed popular. Some even went into the hundreds, perhaps multiplying rather than adding, whilst others were obviously working out a value of the relative formula mass.


(d) The formula of aluminium nitrate is $Al(NO_3)_3$

(i) State the total number of atoms in the formula $Al(NO_3)_3$

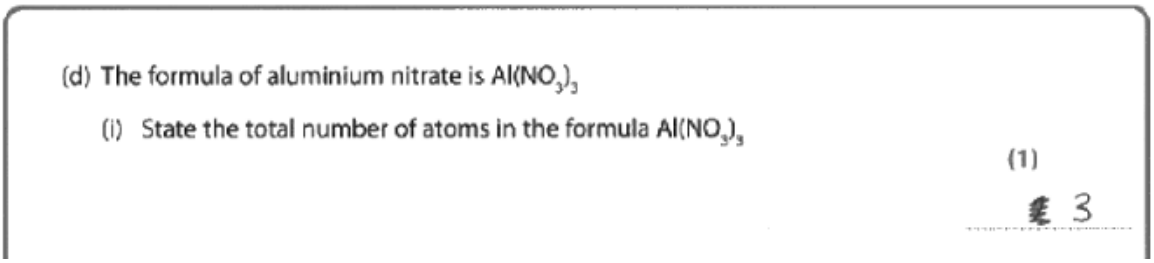
(1)

27 [(14+48)]3
27 + 186 = 213

213

Results Plus: Examiner Comments

This candidate was one of quite a few who tried to work out a relative formula mass.


(d) The formula of aluminium nitrate is $Al(NO_3)_3$

(i) State the total number of atoms in the formula $Al(NO_3)_3$

(1)

3

Results Plus: Examiner Comments

Many, as this candidate did, gave the number of different elements present.

Mark Scheme

Q1.

Question number	Answer	Additional guidance	Mark
	Any two from (in modern model) • atoms are formed of sub-atomic particles (1) • atoms have a nucleus (1) • atoms contain protons (1) • atoms contain neutrons (1) • atoms contain (shells of) **electrons** (1) • atoms of same element can have different numbers of neutrons / isotopes exist (1)	allow (for Dalton's model) atoms are indivisible ignore statements that are simply the negative of those in the question reject each comparison with 'plum pudding model'	**(2)** **AO1**

Q2.

Question number	Answer	Additional guidance	Mark
	Any two from (in modern model) • atoms are formed of sub-atomic particles (1) • atoms have a nucleus (1) • atoms contain protons (1) • atoms contain neutrons (1) • atoms contain (shells of) electrons (1) • atoms of same element can have different numbers of neutrons / isotopes exist (1)	allow (for Dalton's model) atoms are indivisible ignore statements that are simply the negative of those in the question reject each comparison with 'plum pudding model'	(2) AO1

Q3.

	Answer	Acceptable answers	Mark
	Explanation linking • (both have) same number (of electrons) in outer shell(1) • 6 (electrons in outer shell) (consequent on first point) (1)	correct electronic configurations or diagrams alone max 1 'they both have 6 in the outer shell' scores both marks allow 'both need 2 (more) (electrons) to fill outer shell' for both marks	**(2)**

Q4.

	Answer	Acceptable answers	Mark
	Explanation linking • (both have) same number (of electrons) in outer shell(1) • 6 (electrons in outer shell) (consequent on first point) (1)	correct electronic configurations or diagrams alone max 1 'they both have 6 in the outer shell' scores both marks allow 'both need 2 (more) (electrons) to fill outer shell' for both marks	**(2)**

Q5.

Question Number	Answer	Acceptable answers	Mark
(a)	Fe Cl 2.8/56 3.55/35.5 (1) 0.05 0.1 or 1 2 (1) $FeCl_2$ (1)	Cl_2Fe $FeCl_2$ with no working (3) Consequential errors: if "upside down" ie 56 / 2.8 and 35.5 / 3.55 ratio 20 : 10 or 2 : 1 (1) empirical formula Fe_2Cl (1) allow 3 marks for 2.8 / 56 and 3.55 / 71 ratio 0.05: 0.05 or 1 : 1 empirical formula $FeCl_2$ allow 2 marks for 2.8 / 56 and 3.55 / 71 ratio 0.05: 0.05 or 1 : 1 empirical formula FeCl allow 2 marks for Fe Cl 2.8/56 3.55/35.5 (1) 0.5 0.1 (0) Fe_5Cl (1) - ECF	**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)	**EITHER** 2x23 (1) g Na makes 2x58.5 (1) g NaCl 9.2 g Na makes $\frac{2\times58.5\times9.2}{46}$ g NaCl (1) (= 23.4 g) **OR** 23 g Na makes 58.5 (1) g NaCl 9.2 g Na makes $\frac{58.5\times9.2(1)}{23(1)}$ g NaCl (1) (= 23.4 g) mark consequentially eg 46 (1) g Na makes (2x23+35.5) (0) g NaCl 9.2 g Na makes $\frac{2\times23+35.5\times9.2}{46}$ (1) g NaCl (= 16.3 g)	23.4 g with no working (3) 23.4 g from any method (3) do not accept 23(.0) mol Na used = 9.2/23 (1) (= 0.4) mol NaCl = 0.4 (1) mass NaCl = 0.4 x 58.5 (1) (= 23.4 g) Ignore units throughout unless incorrect mark consequentially awarding 2 marks for 46.8 g,11.7 g and 16.3 g (see last example opposite).	**(3)**

Question Number	Indicative Content	Mark
* **(c)**	A description, comparison and explanation including some of the following points Order of reactivity: chlorine > bromine > iodine Experiment • add (aqueous) chlorine to a solution of potassium bromide • the solution turns orange/yellow • bromine is produced Conclusion/Explanation and equation: (so) chlorine is more reactive than / displaces bromine $Cl_2 + 2KBr \rightarrow Br_2 + 2KCl$ / $Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$ Experiment • add (aqueous) bromine to a solution of potassium iodide • the solution turns brown • iodine is produced Conclusion/Explanation and equation: (so) bromine is more reactive than / displaces iodine $Br_2 + 2KI \rightarrow I_2 + 2KBr$ / $Br_2 + 2I^- \rightarrow I_2 + 2Br^-$	

		Experiment • add (aqueous) bromine to a solution of potassium iodide • the solution turns brown • iodine is produced Conclusion/Explanation and equation: (so) bromine is more reactive than / displaces iodine $Br_2 + 2KI \rightarrow I_2 + 2KBr$ / $Br_2 + 2I^- \rightarrow I_2 + 2Br^-$ Experiment • add (aqueous) chlorine to a solution of potassium iodide • the solution turns brown • iodine is produced Conclusion/Explanation and equation: (so) chlorine is more reactive than / displaces iodine $Cl_2 + 2KI \rightarrow I_2 + 2KCl$ / $Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$ ▪ Allow use of organic solvents to identify halogens ▪ Allow use of suggested reactions which do not produce a displacement reaction eg add (aqueous) bromine to a solution of a potassium chloride with suitable conclusion/explanation ▪ Allow use of table of suggested experiments	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited description of at least one experiment in which any halogen solution is added to any halide solution (not of the same halogen) **OR** describes order of reactivity as Cl > Br > I • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	• a simple description of at least two displacement experiments AND • EITHER at least one correct explanation/conclusion OR • at least one correct observation of a displacement reaction that works/balanced equation. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	• a detailed description of at least two displacement experiments **AND** • (a total of) at least two correct explanations/conclusions **AND** • at least one correct observation of a displacement reaction that works/ balanced equation • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q6.

Question Number	Answer	Acceptable answers	Mark
(a)	Fe Cl 2.8/56 3.55/35.5 (1) 0.05 0.1 or 1 2 (1) $FeCl_2$ (1)	Cl_2Fe $FeCl_2$ with no working (3) Consequential errors: if "upside down" ie 56 / 2.8 and 35.5 / 3.55 ratio 20 : 10 or 2 : 1 (1) empirical formula Fe_2Cl (1) allow 3 marks for 2.8 / 56 and 3.55 / 71 ratio 0.05: 0.05 or 1 : 1 empirical formula $FeCl_2$ allow 2 marks for 2.8 / 56 and 3.55 / 71 ratio 0.05: 0.05 or 1 : 1 empirical formula FeCl allow 2 marks for Fe Cl 2.8/56 3.55/35.5 (1) 0.5 0.1 (0) Fe_5Cl (1) - ECF	**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)	**EITHER** 2x23 (1) g Na makes 2x58.5 (1) g NaCl 9.2 g Na makes $\frac{(2\times58.5)\times9.2}{46}$ g NaCl (1) (= 23.4 g) **OR** 23 g Na makes 58.5 (1) g NaCl 9.2 g Na makes $\frac{(58.5)\times9.2(1)}{23(1)}$ g NaCl (1) (= 23.4 g) mark consequentially eg 46 (1) g Na makes (2x23+35.5) (0) g NaCl 9.2 g Na makes $\frac{(2\times23+35.5)\times9.2}{46}$ (1) g NaCl (= 16.3 g)	23.4 g with no working (3) 23.4 g from any method (3) do not accept 23(.0) mol Na used = 9.2/23 (1) (= 0.4) mol NaCl = 0.4 (1) mass NaCl = 0.4 x 58.5 (1) (= 23.4 g) Ignore units throughout unless incorrect mark consequentially awarding 2 marks for 46.8 g,11.7 g and 16.3 g (see last example opposite).	**(3)**

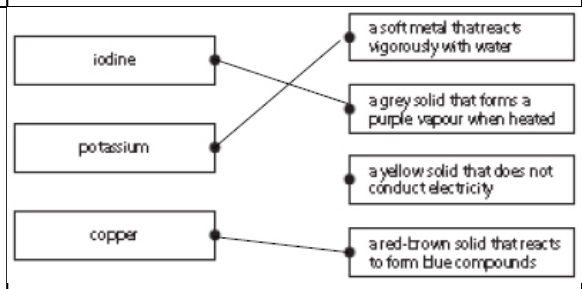
Question Number		Indicative Content	Mark
	* **(c)**	A description, comparison and explanation including some of the following points Order of reactivity: chlorine > bromine > iodine Experiment • add (aqueous) chlorine to a solution of potassium bromide • the solution turns orange/yellow • bromine is produced Conclusion/Explanation and equation: (so) chlorine is more reactive than / displaces bromine $Cl_2 + 2KBr \rightarrow Br_2 + 2KCl$ / $Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$ Experiment • add (aqueous) bromine to a solution of potassium iodide • the solution turns brown • iodine is produced Conclusion/Explanation and equation: (so) bromine is more reactive than / displaces iodine $Br_2 + 2KI \rightarrow I_2 + 2KBr$ / $Br_2 + 2I^- \rightarrow I_2 + 2Br^-$	

		Experiment • add (aqueous) bromine to a solution of potassium iodide • the solution turns brown • iodine is produced Conclusion/Explanation and equation: (so) bromine is more reactive than / displaces iodine $Br_2 + 2KI \rightarrow I_2 + 2KBr$ / $Br_2 + 2I^- \rightarrow I_2 + 2Br^-$ Experiment • add (aqueous) chlorine to a solution of potassium iodide • the solution turns brown • iodine is produced Conclusion/Explanation and equation: (so) chlorine is more reactive than / displaces iodine $Cl_2 + 2KI \rightarrow I_2 + 2KCl$ / $Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$ ▪ Allow use of organic solvents to identify halogens ▪ Allow use of suggested reactions which do not produce a displacement reaction eg add (aqueous) bromine to a solution of a potassium chloride with suitable conclusion/explanation ▪ Allow use of table of suggested experiments	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited description of at least one experiment in which any halogen solution is added to any halide solution (not of the same halogen) **OR** describes order of reactivity as Cl > Br > I • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	• a simple description of at least two displacement experiments AND • EITHER at least one correct explanation/conclusion OR • at least one correct observation of a displacement reaction that works/balanced equation. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	• a detailed description of at least two displacement experiments **AND** • (a total of) at least two correct explanations/conclusions **AND** • at least one correct observation of a displacement reaction that works/ balanced equation • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

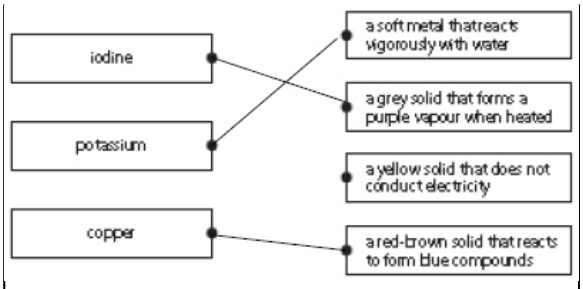
Q7.

	Answer	Acceptable answers	Mark
(a)	B elements		**(1)**
(b)	D alkali metals		**(1)**
(c)(i) 1	any value in range 1.45 to 2.99	any answer which, to 1 sf, is in the range	**(1)**
(c)(i) 2	Kr	Reject KR, kr	**(1)**
(c)(i) 3	no reaction	'nothing'	**(1)**
(c)(ii)	An explanation linking any two of: • argon is {inert / unreactive} (1) • argon does not react with {metal/filament}/{metal/ filament} would react with air or oxygen / ORA (1)	ignore noble gas doesn't react with anything argon does not corrode the metal ignore references to electrical conductivity	**(2)**

	• atom has {eight electrons in outer shell / full (outer) shell} (1)		
(d)	 all 3 correct – 2 marks any two correct – 1 mark one correct – 0 marks	if two answer lines from one element, then ignore	**(2)**

Q8.

	Answer	Acceptable answers	Mark
(a)	B elements		**(1)**
(b)	D alkali metals		**(1)**
(c)(i) 1	any value in range 1.45 to 2.99	any answer which, to 1 sf, is in the range	**(1)**
(c)(i) 2	Kr	Reject KR, kr	**(1)**
(c)(i) 3	no reaction	'nothing'	**(1)**
(c)(ii)	An explanation linking any two of: • argon is {inert / unreactive} (1) • argon does not react with {metal/filament}/{metal/ filament} would react with air or oxygen / ORA (1) • atom has {eight electrons in outer shell / full (outer) shell} (1)	ignore noble gas doesn't react with anything argon does not corrode the metal ignore references to electrical conductivity	**(2)**
(d)		if two answer lines from one element, then ignore	**(2)**



all 3 correct – 2 marks
any two correct – 1 mark
one correct – 0 marks

Q9.

Question Number	Indicative content	Mark
*	An explanation that combines identification - knowledge (3 marks) and reasoning/justification - understanding (3 marks) • each magnesium atom loses electrons • two (electrons) • to form magnesium cation / Mg^{2+} • $Mg \rightarrow Mg^{2+} + 2e^{(-)}$ • electrons transferred from magnesium atoms to oxygen atoms • each oxygen atom gains electrons • two (electrons) • to form oxide anion / O^{2-} • $O + 2e^{(-)} \rightarrow O^{2-}$ • ionic bonds form • (ionic bonds form) between oppositely charged ions • strong electrostatic forces • between oppositely charged ions • regular arrangement of ions / lattice structure • require large amounts of energy to separate (hence high melting point)	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Q10.

Question Number	Answer	Mark
	element on left hand side of periodic table (1)	**(1)**

Q11.

	Answer	Acceptable answers	Mark
(a)(i)	an explanation linking the following • decomposition (of compound/substance /electrolyte)(1) • using (direct) current (1)	 splitting up/breaking down/breaking up ignore separating reject splitting of atoms/elements/molecules for M1 using {electrical energy /electricity} reject alternating current/ac	(2)
(a)(ii)	• (damp blue) litmus (paper) (1) • (turns red then) {bleaches / goes white} (1)		(2)

		allow bleaches indicator for 1 mark ignore indicator goes lighter ignore smells of chlorine/swimming pools ignore any incorrect middle colour mentioned use of suitable named indicator with correct result e.g. (damp) universal indicator paper (1) (turns red then) bleaches (1) starch-iodide paper(1) turns blue-black(1)	
(a) (iii)	poly(chloroethene)	PVC/polyvinylchloride/ polychloroethene/poly(chlorethene)	(1)
(b)(i)	D AgCl(s)		(1)
(b)(ii)	same/no change		(1)
(b)(iii)	$HCl + AgNO_3 \rightarrow AgCl + HNO_3$ • reactant formulae (1) • product formulae (1)	$Ag^+ + Cl^- \rightarrow AgCl$ max 1 if any incorrect attempt to balance reject incorrect use of cases and non-subscripts	(2)

Q12.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	an explanation linking the following • decomposition (of compound/substance /electrolyte)(1) • using (direct) current (1)	 splitting up/breaking down/breaking up ignore separating reject splitting of atoms/elements/molecules for M1 using {electrical energy /electricity} reject alternating current/ac	(2)
(a)(ii)	• (damp blue) litmus (paper) (1) • (turns red then) {bleaches / goes white} (1)	 allow bleaches indicator for 1 mark	(2)

		ignore indicator goes lighter ignore smells of chlorine/swimming pools ignore any incorrect middle colour mentioned use of suitable named indicator with correct result e.g. (damp) universal indicator paper (1) (turns red then) bleaches (1) starch-iodide paper(1) turns blue-black(1)	
(a) (iii)	poly(chloroethene)	PVC/polyvinylchloride/ polychloroethene/poly(chlorethene)	(1)
(b)(i)	D AgCl(s)		(1)
(b)(ii)	same/no change		(1)
(b)(iii)	$HCl + AgNO_3 \rightarrow AgCl + HNO_3$ • reactant formulae (1) • product formulae (1)	$Ag^+ + Cl^- \rightarrow AgCl$ max 1 if any incorrect attempt to balance reject incorrect use of cases and non-subscripts	(2)

Q13.

Question number	Answer	Mark
(i)	**C** 2.8.7 **A, B, D** do not represent electronic configurations	(1)

Question number	Answer	Additional guidance	Mark
(ii)	An explanation linking • in {outer / 3rd} shell (1) • seven electrons (1) or • number of electrons in outer shell (1) • is the same as group number (1)	 allow last shell / outer ring MP2 depends on MP1 allow 7 is the last number of the electronic configuration / OWTTE (1)	(2)

Q14.

Question number	Answer	Mark
	C	(1)

Q15.

Question number	Answer	Mark
	C	(1)

Q16.

Question number	Answer	Mark
	D SO_4^{2-}	(1) comp

Q17.

Question number	Answer	Mark
	D 12 protons, 12 neutrons, 10 electrons	(1) comp

Q18.

Question number	Answer	Mark
	D 11 12 10	**(1)**

Q19.

Question number	Answer	Mark
	D 11, 12, 10	**(1)**

Q20.

Question number	Answer	Mark
	D 3 3 is the only correct answer. **A** is incorrect as the metal is in group 3 **B** is incorrect as the metal is in group 3, period 3 **C** is incorrect as the metal is in period 3	**(1)**

Q21.

Question number	Answer	Mark
	B 13 14 10 is the only correct answer **A** is incorrect because it is the numbers of subatomic particles in the atom not the ion **C** is incorrect because it would be an isotope of silicon with a +4 charge to it **D** is incorrect because it would be another isotope of silicon but with a 3- charge to it.	**(1)**

Q22.

Question number	Answer	Mark
	B 13 14 10 is the only correct answer **A** is incorrect because it is the numbers of subatomic particles in the atom not the ion **C** is incorrect because it would be an isotope of silicon with a +4 charge to it **D** is incorrect because it would be another isotope of silicon but with a 3- charge to it.	**(1)**

Q23.

Question number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO3 (6 marks)** • **A** is copper oxide • copper oxide is black • copper oxide reacts with sulfuric acid to make {copper sulfate / blue solution} but no gas • **B** is magnesium • magnesium is silver coloured • magnesium reacts/ bubbles with water • magnesium reacts with sulfuric acid to give hydrogen / equation • **C** is sodium hydroxide • sodium hydroxide is white • sodium hydroxide solution is colourless • sodium hydroxide reacts with sulfuric acid to form a colourless solution / equation • sodium hydroxide solution is alkaline • sodium hydroxide has hydroxide ions • **D** is copper carbonate • copper carbonate is green • carbonates are insoluble • copper carbonate reacts with sulfuric acid to form copper sulfate and {gas / carbon dioxide} • copper carbonate reacts with sulfuric acid to form carbon dioxide / equation • copper sulfate (solution) is blue	**(6)**

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Deconstructs scientific information but understanding and connections are flawed. An unbalanced or incomplete argument that provides limited synthesis of understanding. • Judgements are supported by limited evidence. (AO3)
Level 2	3-4	• Deconstructs scientific information and provides some logical connections between scientific concepts. An imbalanced argument that synthesises mostly relevant understanding, but not entirely coherently. • Judgements are supported by evidence occasionally. (AO3)
Level 3	5-6	• Deconstructs scientific information and provide logical connections between scientific concepts throughout. A balanced, well-developed argument that synthesises relevant understanding coherently. • Judgements are supported by evidence throughout. (AO3)

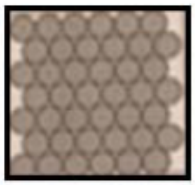
Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then: No solids are correctly identified/ One solid is identified but no reason is given
Level 1	1–2	Additional Guidance **Three solids are correctly identified** but only one or none have valid reasoning (2) **Two solids are correctly identified** and one has valid reasoning (2) **Two solids are correctly identified** but neither has valid reasoning (1) **One solid is correctly identified** with a valid reason (1)	Possible candidate response A is copper oxide. D is copper carbonate because carbonates fizz with acid. – 2 correctly identified, one has a sufficient reason (2)
Level 2	3–4	Additional Guidance **All four solids are correctly identified** but only one or none have valid reasoning -No solid has valid reasoning (3) -One solid has valid reasoning (4) **Three solids are correctly identified** and at least two have valid reasoning -Three have valid reasoning (4) -Two have valid reasoning (3) **Two solids are correctly identified** and both have valid reasoning (3)	Possible candidate response A is copper oxide because it has pH 7, B is magnesium because metals are silver coloured, C is sodium hydroxide because it reacts with acid, D is copper carbonate because it has pH 7. – 4 correctly identified, only 1 has a sufficient reason (magnesium is silver) (4)
Level 3	5–6	Additional Guidance **All four solids are correctly identified** and at least two have valid reasoning. -Two or three solids have valid reasoning (5) -All four have valid reasoning (6)	Possible candidate response A is copper oxide because it is the only black solid. B is magnesium because metals are silver coloured. C is sodium hydroxide because it dissolves to form an alkaline solution. D is copper carbonate because it forms copper sulfate which is blue in the reaction with acid and fizzes. 4 correctly identified, 4 with sufficient reasons (6)

Q24.

Question number	Answer	Additional guidance	Mark
(i)	**D** oxidation Answers **A** and **B** are physical processes rather than chemical reactions. **C** is wrong because it is not neutralisation.		**(1)**

Question number	Answer	Additional guidance	Mark
(ii)	A description linking any three from: • lift lid from time to time/ leave small gap between crucible and lid (1) • find mass (of crucible, lid and product) (1) • {repeat / heat} to constant mass (1) • final mass – start mass = mass of oxygen (1)	 allow 'weigh' allow find the change in mass	**(3)**

Q25.

Question number	Answer	Mark
(i)	 B	**(1)**

Question number	Answer	Additional guidance	Mark
(ii)	An explanation that combines identification via a judgment of relevant information (1 mark) to reach a conclusion via justification/reasoning (1 mark): aluminium has a low strength / steel has {high strength/is strong} (1) steel is added to make the powerline strong(er) (1)	ignore references to cost ignore references to electrical conduction	(2)

Q26.

Question number	Answer	Additional guidance	Mark
(i)	**B** high melting point		(1) comp

Question number	Answer	Mark
(ii)	D SO_4^{2-}	(1) comp

Question number	Answer	Additional guidance	Mark
(iii)	An explanation that combines identification - knowledge (1 mark) and reasoning/justification - understanding (1 mark): • loses electron(s) (1) • (loses) {one/an} (electron) (1)	allow transfers for loses mention of covalent bonding/sharing electrons = 0 ignore any reference to molecules.	(2)

Q27.

Question number	Answer	Additional guidance	Mark
	mass of chlorine = 19.05 – 8.40 (1) (= 10.65 g) **EITHER** moles iron = $\frac{8.40}{56}$ and moles chlorine (= 0.15) = $\frac{10.65}{35.5 \times 2}$ (1) (= 0.15) ratio 1:1 so equation **A** represents reaction (1) **OR** moles iron = $\frac{8.40}{56}$ and moles chlorine (=0.15) atoms = $\frac{10.65\ (1)}{35.5}$ (=0.30) **OR** formula mass $FeCl_2$ = 56 + 2x35.5 (=127) (1) moles Fe = $\frac{8.4}{56}$ and moles (=0.15) $FeCl_2$ = $\frac{19.05}{127}$ (1) (=0.15) ratio 1:1 so equation **A** represents reaction (1)	allow not finding mass of chlorine initially: moles iron = $\frac{8.40}{56}$ (=0.15) and moles chlorine atoms = $\frac{19.05}{35.5}$ (=0.537) (1) simplest ratio: $\frac{0.15}{0.15}$: $\frac{0.537}{0.15}$ or 1 : 3.58 allow: mass of chlorine = 19.05 – 8.40 (1) (= 10.65 g) for reaction A, mass of chlorine needed $\frac{2x35.5}{56}$ x 8.4 = 10.65 (g) (1) mass of chlorine needed = mass of chlorine reacted,so equation **A** represents reaction (1) accept calculations based on expected mass of $FeCl_2$ or mass of $FeCl_3$ to show which reaction is taking place	**(3)** **AO3**

Q28.

Question number	Answer	Mark
	D they are malleable	**(1)**

Q29.

	Answer	Acceptable answers	Mark
(a)(i)	B lead chloride		**(1)**
(a)(ii)	An explanation linking two of • strong (electrostatic) forces of attraction • between oppositely charged ions • so requires lot of heat/energy to overcome forces/break bonds	Any reference to molecules/molecular/intermolecular/covalent scores 0 marks strong (ionic) bonds positive and negative ions reject charged atoms for this mark ignore hard to melt/high temperature needed	**(2)**
(a)(iii)	A description including • M1 add (dilute) nitric acid • M2 add silver nitrate (solution) • M3 forms white ppt/solid	Accept correct formulae If use any other acid can score M2 and M3 dependent on use of silver nitrate Alternative method: Electrolyse (1) Chlorine formed (1) Bleaches litmus/pH paper (1) Ignore smell	**(3)**

		Indicative Content	
QWC	***(b)**	A description including some of the following points **ion formation** • magnesium atoms lose electrons • each magnesium atom loses two electrons • to acquire full outer shell • magnesium (configuration) becomes 2.8 • forms Mg^{2+} ion • electrons transferred to oxygen atoms • oxygen atoms gain electrons • each oxygen atom gains two electrons • oxygen (configuration) becomes 2.8 • to acquire full outer shell • forms O^{2-} ion **structure** • magnesium ions attract oxide ions	

		• due to opposite charges • ions pack close together • ratio of ions 1: 1 • ions arranged in lattice • giant (ionic) (structure) diagram can be credited for any points	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. magnesium atoms lose electrons and oxygen atoms gain electrons e.g. magnesium oxide is a giant structure • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. magnesium atoms lose two electrons to form positive ions and oxygen atoms gain two electrons to form negative ions • e.g. magnesium atoms lose electrons and oxygen atoms gain electrons and magnesium oxide is a giant structure • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description e.g. each magnesium atom transfers two electrons to an oxygen atom and the opposite charged ions (Mg^{2+} /O^{2-}) formed attract each other to form a giant (ionic) lattice • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q30.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	B lead chloride		**(1)**
(a)(ii)	An explanation linking two of • strong (electrostatic) forces of attraction • between oppositely charged ions • so requires lot of heat/energy to overcome forces/break bonds	Any reference to molecules/molecular/intermolecular/covalent scores 0 marks strong (ionic) bonds positive and negative ions reject charged atoms for this mark ignore hard to melt/high temperature needed	**(2)**
(a)(iii)	A description including • M1 add (dilute) nitric acid • M2 add silver nitrate (solution)	Accept correct formulae If use any other acid can score M2 and M3	**(3)**

	• M3 forms white ppt/solid	dependent on use of silver nitrate Alternative method: Electrolyse (1) Chlorine formed (1) Bleaches litmus/pH paper (1) Ignore smell	

		Indicative Content	
QWC	***(b)**	A description including some of the following points **ion formation** • magnesium atoms lose electrons • each magnesium atom loses two electrons • to acquire full outer shell • magnesium (configuration) becomes 2.8 • forms Mg^{2+} ion • electrons transferred to oxygen atoms • oxygen atoms gain electrons • each oxygen atom gains two electrons • oxygen (configuration) becomes 2.8 • to acquire full outer shell • forms O^{2-} ion **structure** • magnesium ions attract oxide ions • due to opposite charges • ions pack close together • ratio of ions 1: 1 • ions arranged in lattice • giant (ionic) (structure) diagram can be credited for any points	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. magnesium atoms lose electrons and oxygen atoms gain electrons e.g. magnesium oxide is a giant structure • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. magnesium atoms lose two electrons to form positive ions and oxygen atoms gain two electrons to form negative ions • e.g. magnesium atoms lose electrons and oxygen atoms gain electrons and magnesium oxide is a giant structure • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description e.g. each magnesium atom transfers two electrons to an oxygen atom and the opposite charged ions (Mg^{2+} /O	

		$^{2-}$) formed attract each other to form a giant (ionic) lattice • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q31.

Question Number	Answer	Acceptable answers	Mark
(a)	An explanation linking **transfer of electrons (1)** **correct direction of transfer (1)** **two** electrons (transferred) **(1)**	Marks can be scored from diagrams If any reference to electrons shared **0/3** If any reference to covalent bonds MAX 2 transfer of atoms/ions in place of electrons MAX 2 if transfer of electrons to/from ions MAX 2 Ignore charges on ions	**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)	(24 + 16) (1) (= 40)	40 (with no working)	**(1)**

Q32.

Question Number	Answer	Acceptable answers	Mark
(a)	An explanation linking **transfer of electrons (1)** **correct direction of transfer (1)** **two** electrons (transferred) **(1)**	Marks can be scored from diagrams If any reference to electrons shared **0/3** If any reference to covalent bonds MAX 2 transfer of atoms/ions in place of electrons MAX 2 if transfer of electrons to/from ions MAX 2 Ignore charges on ions	**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)	(24 + 16) (1) (= 40)	40 (with no working)	**(1)**

Q33.

	Answer	**Acceptable answers**	**Mark**
	D have high melting points		**(1)**

Q34.

	Answer	**Acceptable answers**	**Mark**
	D have high melting points		**(1)**

Q35.

Question Number	Answer	Acceptable answers	Mark
(a)	B Na^+		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	C K_2CO_3		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	A description linking M1 (bubble gas through) limewater/calcium hydroxide solution (1) M2 turns cloudy/milky/white precipitate (1)	 if limewater added directly to the solution/mixture then only M1 can be awarded .white ppt second mark dependent on use of limewater if mention any gas other than carbon dioxide or make reference to any other gas test/result then max 1	**(2)**

Q36.

Question Number	Answer	Acceptable answers	Mark
(a)	B Na^+		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	C K_2CO_3		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	A description linking M1 (bubble gas through) limewater/calcium hydroxide solution (1) M2 turns cloudy/milky/white precipitate (1)	 if limewater added directly to the solution/mixture then only M1 can be awarded .white ppt second mark dependent on use of limewater if mention any gas other than carbon dioxide or make reference to any other gas test/result then max 1	**(2)**

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Q37.

Question Number	Answer	Mark
	A -6 low **1. The only correct answer is A** ***B** is not correct because bpt is too high and solubility not high* ***C** is not correct because solubility not high* ***D** is not correct because bot is too high*	**(1)** AO 3 2b

Q38.

Question Number	Answer	Mark
(i)	An explanation that combines identification - knowledge (1 mark) and reasoning/justification - understanding (1 mark) • allow air/oxygen to enter (1) • (so) more magnesium reacts (1)	**(2)**

Question Number	Answer	Mark
(ii)	**C** 0.36 0.56 0.20	**(1)**

Question Number	Answer	Mark
(iii)	An explanation that combines identification - improvement of the experimental procedure (1 mark) and justification/reasoning which must be linked to the improvement (1 mark) • reheat the crucible and contents (1) • redetermine the mass / mass is constant (1)	**(2)**

Q39.

	Answer	Acceptable answers	Mark
(a)	A description including: • add (dilute) (hydrochloric) acid (1) • gas/carbon dioxide (passed into/tested) with limewater (1) • limewater goes milky / cloudy / white ppt (1)	correct formulae heat/thermally decompose bubbled through limewater dependent on use of limewater	**(3)**
(b)	40 +[2 × 35.5] (=111)	111 alone	**(1)**
(c)	• 100 (kg) (calcium carbonate) → 106 (kg) (sodium carbonate) (1) $\frac{106 \times 40}{100}$ (1) (=42.4)	OR alternative 106÷100 40000÷100 /40÷100 (moles approach) Only 42.4 with no working worth 2 marks 42400**g** worth 2 marks	**(2)**
(d)(i)	• 10.4/15.0 **(1)** • (10.4/15.0) ×100**(1)** (= 69.3)	69.3 alone worth 2 marks If no/incomplete working shown answer to 2 or more sf scores 2 marks Ignore any units	**(2)**
(d)(ii)	Two suggestions from • reaction incomplete (1) • impure reactants (1) • other unwanted/side reaction(s) occur (1) • product lost during experiment/practical (1)	reversible ignore by-products form could be an example eg some products left in apparatus ignore generic experimental errors eg measuring/weighing errors/human error/spillage	**(2)**

Q40.

	Answer	Acceptable answers	Mark
(a)	A description including:		**(3)**

	• add (dilute) (hydrochloric) acid (1) • gas/carbon dioxide (passed into/tested) with limewater (1) • limewater goes milky / cloudy / white ppt (1)	correct formulae heat/thermally decompose bubbled through limewater dependent on use of limewater	
(b)	40 +[2 × 35.5] (=111)	111 alone	**(1)**
(c)	• 100 (kg) (calcium carbonate) → 106 (kg) (sodium carbonate) (1) $\frac{106 \times 40}{100}$ (1) (=42.4)	OR alternative 106÷100 40000÷100 /40÷100 (moles approach) Only 42.4 with no working worth 2 marks 42400**g** worth 2 marks	**(2)**
(d)(i)	• 10.4/15.0 **(1)** • (10.4/15.0) ×100**(1)** (= 69.3)	69.3 alone worth 2 marks If no/incomplete working shown answer to 2 or more sf scores 2 marks Ignore any units	**(2)**
(d)(ii)	Two suggestions from • reaction incomplete (1) • impure reactants (1) • other unwanted/side reaction(s) occur (1) • product lost during experiment/practical (1)	reversible ignore by-products form could be an example eg some products left in apparatus ignore generic experimental errors eg measuring/weighing errors/human error/spillage	**(2)**

Q41.

Question Number	Answer	Additional guidance	Mark
(i)	25.7 (g)	do not allow 25 answer may be written on the lower diagram	**(1)** AO 2 1

Question Number	Answer	Additional guidance	Mark
(ii)	barium sulfate	do not allow barium sulfide	**(1)** AO 1 2

Q42.

Question Number	Answer	Additional guidance	Mark
(i)	35	reject 35.5	**(1)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	2.8.7	allow any separator including gaps *e.g.* 2 8 7	**(1)** AO 1 1

Q43.

	Answer	Acceptable answers	Mark
	C smaller than the mass of a proton		**(1)**

Q44.

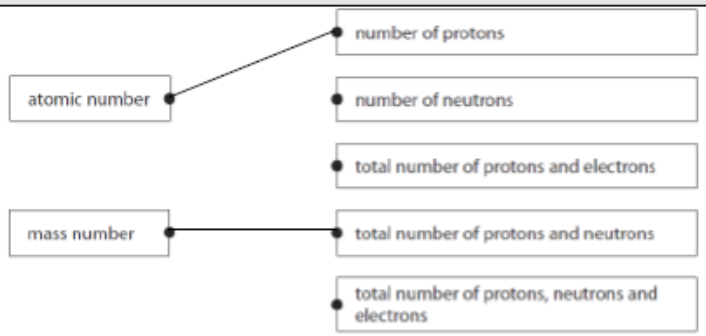
Question Number	Answer	Additional guidance	Mark
(i)	35	reject 35.5	**(1)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(ii)	2.8.7	allow any separator including gaps e.g. 2 8 7 send to review any diagrams	**(1)** AO 1 1

Q45.

	Answer	Acceptable answers	Mark
	C smaller than the mass of a proton		**(1)**

Q46.

Question number	Answer	Additional guidance	Mark
	 1 mark for each line	Each line 1 mark Do not award mark if more than one line joins the left hand boxes with those on the right	**(2)**

Q47.

Question Number		Indicative Content	Mark
QWC	*	A description / explanation including some of the following points **CREDIT CAN BE GIVEN FOR LABELS/ANNOTATIONS ON DIAGRAM** **Structure of a metal** • positive ions/cations/atoms • in regular arrangement/lattice • delocalised/sea of electrons **Metals are malleable** • malleable means can be bent/hammered into shape because • rows/sheets/layers of ions/ atoms • slide over each other • electrons fill spaces **Metals conduct electricity** • free electrons • (electrons) can move/flow • through structure • (electrons) transfer charge	**(6)**

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description eg a limited description of one of structure, malleability, and conduction • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• a simple description eg a limited description of **two** from structure, malleability and conduction **OR** an explanation of **one** of structure, malleability and conduction • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed description eg a description of all three of structure, malleability, and conduction **OR** a detailed explanation of one of them and a limited description of another • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q48.

Question Number		Indicative Content	Mark
QWC	*	A description / explanation including some of the following points **CREDIT CAN BE GIVEN FOR LABELS/ANNOTATIONS ON DIAGRAM** **Structure of a metal** • positive ions/cations/atoms • in regular arrangement/lattice • delocalised/sea of electrons **Metals are malleable** • malleable means can be bent/hammered into shape because • rows/sheets/layers of ions/ atoms • slide over each other • electrons fill spaces **Metals conduct electricity** • free electrons • (electrons) can move/flow • through structure • (electrons) transfer charge	**(6)**

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description eg a limited description of one of structure, malleability, and conduction • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• a simple description eg a limited description of **two** from structure, malleability and conduction **OR** an explanation of **one** of structure, malleability and conduction • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed description eg a description of all three of structure, malleability, and conduction **OR** a detailed explanation of one of them and a limited description of another • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q49.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	C cations in a sea of electrons		**(1)**
(a)(ii)	(metals have) high melting <u>point</u>	a lot of energy needed to break/overcome (metallic) bonds	**(1)**

		energy needed to break/overcome strong (metallic) bonds Ignore references to boiling point Reject reference to intermolecular forces/covalent (bonds) /attraction between ions/breaking ionic bonds/ breaking covalent bonds	
(a)(iii)	An explanation including two of the following points • argon is inert/does not react/is unreactive (1) • because it has 8 electrons in its outer shell (1) • metals would react in/with air/oxygen (1) • argon will exclude air from welding point (1)	Ignore argon is in group 0/8 argon is a noble gas Ignore argon does not burn does not {gain/lose/share} electrons has a full outer shell (of electrons) has a stable electron configuration form (metal) oxide prevents oxidation	**(2)**
(b)	$2\ Fe + 3\ Br_2 \rightarrow 2\ FeBr_3$ M1 Correct symbol/formulae (1) M2 balancing of correct symbol/formulae (1)	Reject incorrect use of upper/lower case / subscripts for M1 but allow ECF for M2	**(2)**
(c)	C – grey solid		**(1)**
(d)	A explanation including M1 order of reactivity chlorine > bromine > iodine (1) and M2 one of the following points • chlorine displaces bromine (from bromide) AND chlorine displaces iodine (from iodide) (1) • bromine displaces iodine (from iodide) AND bromine does not	For M1 reject reference to reactivity of halide ions eg chlorine more reactive than bromide halogens/they decrease in reactivity down the group/table chlorine is most reactive <u>and</u> iodine is least reactive Ignore reference to displacement of halide ions eg chlorine displaces bromide Ignore "replaces" chlorine reacts with bromide AND iodide chlorine takes part in two	**(2)**

	displace chlorine (from chloride) (1) • iodine does not displace chlorine(from chloride) AND iodine does not displace bromine (from bromide) (1)	(displacement) reactions bromine reacts with iodide AND does not react with chloride bromine takes part in one (displacement) reactions iodine does not react with chloride or bromide iodine does not take part in any (displacement) reactions	

Q50.

	Answer	Acceptable answers	Mark
(a)(i)	C cations in a sea of electrons		**(1)**
(a)(ii)	(metals have) high melting <u>point</u>	a lot of energy needed to break/overcome (metallic) bonds energy needed to break/overcome strong (metallic) bonds Ignore references to boiling point Reject reference to intermolecular forces/covalent (bonds) /attraction between ions/breaking ionic bonds/ breaking covalent bonds	**(1)**
(a)(iii)	An explanation including two of the following points • argon is inert/does not react/is unreactive (1) • because it has 8 electrons in its outer shell (1) • metals would react in/with air/oxygen (1) • argon will exclude air from welding point (1)	Ignore argon is in group 0/8 argon is a noble gas Ignore argon does not burn does not {gain/lose/share} electrons has a full outer shell (of electrons) has a stable electron configuration form (metal) oxide prevents oxidation	**(2)**

(b)	$2\ Fe + 3\ Br_2 \rightarrow 2\ FeBr_3$ M1 Correct symbol/formulae (1) M2 balancing of correct symbol/formulae (1)	 Reject incorrect use of upper/lower case / subscripts for M1 but allow ECF for M2	**(2)**
(c)	C – grey solid		**(1)**
(d)	A explanation including M1 order of reactivity chlorine > bromine > iodine (1) and M2 one of the following points • chlorine displaces bromine (from bromide) AND chlorine displaces iodine (from iodide) (1) • bromine displaces iodine (from iodide) AND bromine does not displace chlorine (from chloride) (1) • iodine does not displace chlorine(from chloride) AND iodine does not displace bromine (from bromide) (1)	For M1 reject reference to reactivity of halide ions eg chlorine more reactive than bromide halogens/they decrease in reactivity down the group/table chlorine is most reactive <u>and</u> iodine is least reactive Ignore reference to displacement of halide ions eg chlorine displaces bromide Ignore "replaces" chlorine reacts with bromide AND iodide chlorine takes part in two (displacement) reactions bromine reacts with iodide AND does not react with chloride bromine takes part in one (displacement) reactions iodine does not react with chloride or bromide iodine does not take part in any (displacement) reactions	**(2)**

Q51.

Question Number	Answers	Acceptable Answers	Mark
(a)	<table><tr><th></th><th>relative mass</th><th>relative charge</th><th>position in atom</th></tr><tr><td>proton</td><td>1</td><td>(+1)</td><td>in nucleus</td></tr><tr><td>neutron</td><td>(1)</td><td>0</td><td>(in nucleus)</td></tr><tr><td>electron</td><td>1/1837</td><td>-1</td><td>in shells</td></tr></table> all 6 correct (3) 4 or 5 correct (2) 2 or 3 correct (1)	ignore units reject relative mass of proton: +1/1+ for relative mass of electron: anything smaller than 1/1500/0.00067 (almost) 0/negligible/very small for relative charge on neutron: none/no charge/neutral for position of electron in an atom: in orbits / orbitals / energy levels / around the nucleus /outside the nucleus ignore rings ignore inner/outer	**(3)**

Question Number	Answers	Acceptable Answers	Mark
(b)	D equal numbers of protons and electrons		**(1)**

Question Number	Answers	Acceptable Answers	Mark
(c)(i)	Ca	Reject CA / ca /cA ignore calcium	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(c)(ii)	O	ignore any negative charge on the O ignore oxygen reject: oxide/O_2	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(d)(i)	13	Allow correct working even if wrong answer	**(1)**

Question Number	Answers	Acceptable Answers	Mark
(d)(ii)	**D** AlN		**(1)**