Pearson Edexcel

Examiners' Report
June 2019

IGCSE Chemistry 4CH1 1C

ResultsPlus

Introduction

This is the first time the new specification for International GCSE has been examined. Taking this into account candidates generally performed well on this paper. The first four questions were answered well by the majority of candidates, but the later questions proved more challenging. The calculation questions, however, were well answered by many candidates, which showed that they had been well prepared for the extra maths content of the new specification. Areas which proved difficult for the candidates included the questions on structure and bonding and questions related to practical chemistry. Candidates need plenty of experience in doing chemistry experiments in order to help them answer questions which are related to the practical aspects of chemistry.

These are the differences between the old and new 1C paper:

- The paper is now worth 110 marks as opposed to 120 marks but candidates are still given 2 hours to complete the paper.

- The grading system has changed from G to A* to 1 to 9. 1 is equivalent to a G grade, 4 a C grade and 7 an A grade.

- There is more emphasis on mathematical skills on this paper as there has to be at least 20% maths content. There are also more likely to be a greater number of extended writing questions of between 4 and 6 marks.

- Topics now in the 1C paper, which were previously only in the 2C paper, include: structures and properties of diamond and graphite and percentage yield calculations.

- Topics which are no longer tested on the 1C paper include: metallic bonding, electrolysis and structure of metals, titrations and calulations of molar concentration, preparation of insoluble salts, energy level diagrams, equilibria and the effect of temperature and pressure on equilibria. These topics will now be tested on the 2C paper.

- Topics which are now in neither paper include: the laboratory preparation of oxygen and carbon dioxide and the Haber process.

Question 2 (b)

This question was well answered by the majority of candidates. Those who did not score here often just stated that the elements were in the same group, which was just a repeat of the stem of the question and is, therefore, not creditworthy.

Question 2 (c)

This question was well answered by the majority of candidates. Some lost marks by talking about electrons and electron shells rather than protons.

(c) An atom of element Q has 31 protons.

Use this information to explain how you can determine the number of protons in an atom of element R.

(2)

Element R is two places to the ~~m~~ right of of Q so it will have 31 + 2 protons Element R has 33 protons

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Examiner Comments

This is a clear concise answer with a clear explanation as to why R has 33 protons so can be awarded both marks.

ResultsPlus
Examiner Tip

This is an 'explain' question so an explanation needs to be given as to why R has 33 protons.

(c) An atom of element Q has 31 protons.

Use this information to explain how you can determine the number of protons in an atom of element R.

(2)

Group 3
~~period 3 so~~ 3 so 3 outer electrons. R will have 5 outer electron shells. 31 protons means 31 electrons. Both are in the same period ~~so~~ will also have the same number of electron shells.

ResultsPlus Examiner Comments

This candidate has not answered the question. They have not given the number of protons in R and they have gone on to talk about electrons which is not relevant here, so no marks can be awarded.

ResultsPlus Examiner Tip

Candidates need to read the question carefully and make sure they are answering what is asked.

Question 3 (a) - (c)

Most candidates knew that lithium produces a red flame, but many of these did not gain a mark for part (a) as they just wrote 'lithium' or 'Li' rather than giving the formula of the ion. Another common error was to think the cation was Ca^{2+} which gives an orange-red or brick red flame, not just a red one.

Again the majority knew that the cream precipitate showed that a bromide was present but rather than writing 'silver bromide' many just wrote 'bromide', 'bromine' or sometimes 'bromine nitrate'.

Those who knew that the results of the tests were for lithium and bromide ions usually scored the mark in part (c).

Question 3 (d) (i)

In order to score the mark here candidates need to mention impurities etc. which may be on the wire **and** state that this would affect the colour of the flame or the results of the test.

(d) The student uses a clean metal wire in the flame test.

(i) State why the wire should be clean when used in the flame test.

(1)

To remove any ions which can affect the colour of the flame test.

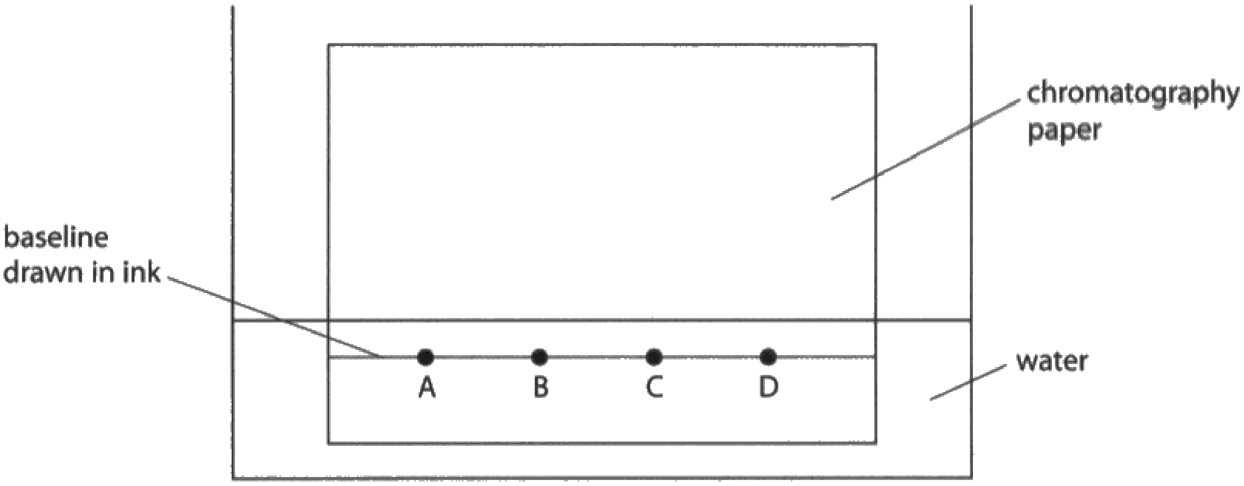
ResultsPlus
Examiner Comments

A good answer which states clearly why the wire should be clean.

Question 4 (a)

This question requires candidates to identify two mistakes and to explain why they are mistakes. Both drawing the baseline in ink and submerging the ink spots in water are very obvious mistakes which would stop the chromatography from working effectively. Any other possible suggestions such as putting a lid on the chromatography tank or changing the solvent are not essential changes and would not stop the chromatography from working, so these answers are not creditworthy.

4 A student uses this apparatus to investigate the colours in four different inks, A, B, C and D.



(a) Explain two mistakes the student made when setting up his experiment.

(4)

1 the base line is drawn in ink. It is wrong because colours in the ink may rise up the chromatography paper with water.

2 Base line is below the solvent level. It is wrong because inks may disolve before the solvent rising up the paper.

ResultsPlus Examiner Comments

This is a good answer. The candidate has identified the two mistakes correctly and has given a clear and concise explanation as to why they are mistakes. All 4 marks can be awarded here.

(a) Explain two mistakes the student made when setting up his experiment.

(4)

1 The water is over the baseline. It should be below the baseline so that the ink can move through the paper

2 The water needs to be a solution. Just water will not work.

ResultsPlus
Examiner Comments

This candidate has identified one mistake correctly by stating that the water is over the baseline. The explanation, however, is not sufficient. There needs to be some indication that the inks will mix with the water (therefore, preventing them from moving through the paper).

The second mistake is not creditworthy as water is a suitable solvent as long as the inks used are water soluble, which can be assumed here.

Just 1 mark is awarded here.

ResultsPlus
Examiner Tip

When identifying mistakes in a practical situation candidates should look for the most obvious ones and explain clearly why they are mistakes.

Question 4 (b) (iii)

This question was well answered by a large majority of candidates, who identified C correctly and gave a good explanation as to why this ink is insoluble. Those who were not awarded the explanation mark often said that C did not separate into different colours. This does not mean the ink is insoluble as it could just be made up of a single dye. There has to be some indication that the ink did not move from the baseline for the second marking point to be awarded.

Question 5 (b)

This question was not particularly well answered. Many candidates wrote about either hydrogen or helium but not both which limited them to 1 mark. A significant number thought helium was less dense than hydrogen, so failed to score.

(b) Explain why helium is now used in airships instead of hydrogen.

(2)

Helium is now used in airships instead of hydrogen, because helium is inert meaning it will not react while hydrogen will react explosively. ~~Plus the~~

ResultsPlus
Examiner Comments

This is a good answer. The candidate has stated that helium is inert and that hydrogen will react explosively so both marks can be awarded.

Hydrogen is extremely flammable, and could lead to massive explosions and fires if it came into contact with a spark. This is dangerous to have on an airship.

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Examiner Comments

This candidate has given a good explanation as to why hydrogen is not used in airships, but there is no reference to helium. The question asks for an explanation as to why helium is used instead of hydrogen so this answer does not fully address the question, so only 1 mark can be awarded.

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Examiner Tip

When answering a question of this nature both the substances mentioned in the question must be referred to in the answer.

This is because Helium has a lower density than hydrogen which allows airships to go higher for longer.

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Examiner Comments

This answer is incorrect as helium is actually more dense than hydrogen so no marks can be awarded.

Question 5 (c) (i)

This question was not particularly well answered with less than half of the candidates writing a fully correct equation here. For those who came close to writing a correct equation, a common error was to not recognise that nitrogen is diatomic and to write 2N instead of N_2

Question 5 (c) (ii)

This question was well answered by the majority of candidates that knew a catalyst is used to speed up a reaction.

Question 6 (b) (i)

A surprising number of candidates thought that Y was copper, not realising that copper does not react with dilute sulfuric acid.

Question 6 (b) (ii)

A surprising number of candidates thought that Z was magnesium, thinking that magnesium reacts quickly with water.

Question 6 (c)

This question was very poorly answered showing that the majority of candidates are not good at recalling observations of displacement reactions.

(c) A displacement reaction can also be used to decide the order of reactivity of two metals.

State two observations made when an excess of magnesium powder is added to an aqueous solution of copper(II) sulfate.

(2)

1 the ~~Solution~~ Solution will go colourless

2 a brown Solid will form.

ResultsPlus
Examiner Comments

This is a good mark scheme answer and both marks can be awarded.

(c) A displacement reaction can also be used to decide the order of reactivity of two metals.

State two observations made when an excess of magnesium powder is added to an aqueous solution of copper(II) sulfate.

(2)

1 Bubbles of gas produced

2 Magnesium dissapeares

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Examiner Comments

This is a common incorrect response to this question.

There is no gas produced in this reaction and magnesium does not disappear as the question states that excess magnesium was used.

No marks can be awarded here.

(c) A displacement reaction can also be used to decide the order of reactivity of two metals.

State two observations made when an excess of magnesium powder is added to an aqueous solution of copper(II) sulfate.

(2)

1 The magnesium displaces the copper because it is more reactive

2 This happen The form magnesium sulfate + copper

ResultsPlus
Examiner Comments

This candidate has not answered the question. Instead of observations the candidate has given an explanation as to why copper is displaced and has given the products of the reaction. These are not observations so no marks can be awarded.

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Examiner Tip

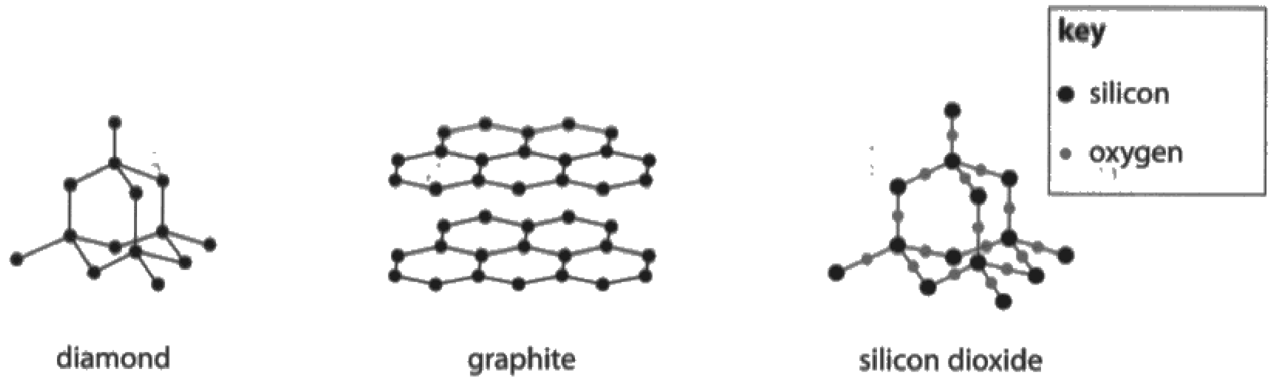
When asked for observations the answer requires a description as to what is **seen** in the reaction and not a theoretical explanation as to why the reaction occurs or the names of the products formed.

Question 7 (a)

This question was not particularly well answered. Many candidates wrote about intermolecular forces which automatically lost them both marks.

7 Diamond, graphite and silicon dioxide all have giant covalent structures.

The diagram shows the structures of these three substances.



(a) Explain why silicon dioxide has a high melting point.

(2)

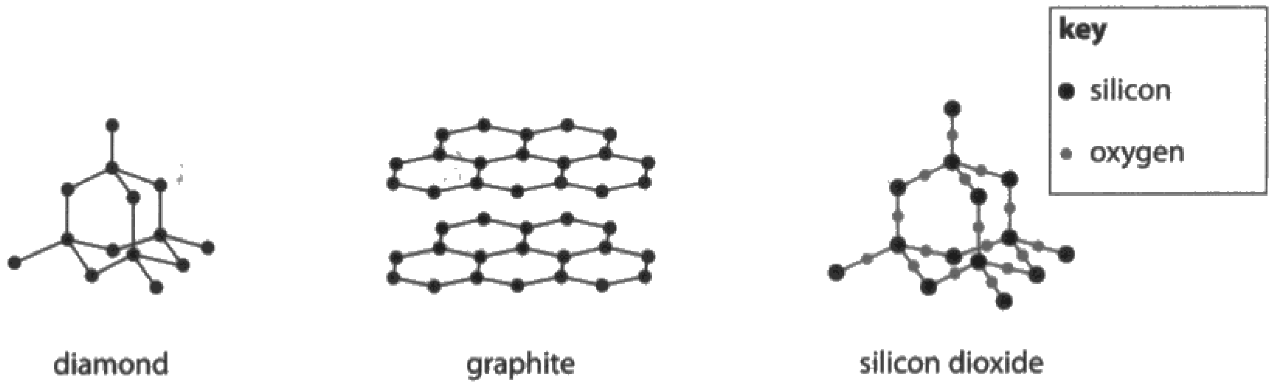
Silicon dioxide has a giant covalent structure which are held by strong covalent bonds that needs alot of energy to break the bonds

ResultsPlus
Examiner Comments

This is a good mark scheme answer and both marks can be awarded.

7 Diamond, graphite and silicon dioxide all have giant covalent structures.

The diagram shows the structures of these three substances.



(a) Explain why silicon dioxide has a high melting point.

(2)

Silicon dioxide has a high melting point because the intermolectular forces between molecules are very strong

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ResultsPlus
Examiner Comments

This candidate has referred to strong intermolecular forces in their answer. This immediately means that no marks can be awarded as there are no intermolecular forces in giant covalent structures.

ResultsPlus
Examiner Tip

Candidates need to realise that intermolecular forces **only** exist in simple molecular substances. Any mention of intermolecular forces in giant covalent structures, metallic structures or ionic structures is going to lose them marks.

Question 7 (b)

The majority of candidates understand that it is the delocalised electrons that cause it to conduct electricity. However many candidates failed to state that these electrons move. Candidates need to be aware that references to electrons carrying charge or current are not creditworthy statements.

(b) Explain why graphite conducts electricity.

(2)

graphite has ~~free~~ delocalised electrons, ~~allowing~~ which allows for electrons to flow through it, which means that it can conduct electricity

ResultsPlus
Examiner Comments

A good mark scheme answer which scores both marks.

Question 7 (c)

Only a minority of candidates scored both marks here. Many candidates knew that graphite has layers that slide over each other but fewer could give an acceptable explanation as to why diamond is hard. Some candidates lost a mark again by talking about intermolecular forces in diamond. Others stated that the carbon atoms in diamond have four bonds, but this was insufficient without reference to every carbon atom being bonded to four others. Also just stating that diamond has strong bonds is insufficient here as there are also strong bonds in graphite.

(c) State why diamond is hard but graphite is soft.

(2)

Diamond has a giant, tetrahedral sctructure and each carbon atom is bonded to four others. Graphite is made up of layers which slide over eachother which makes it a lubricant.

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Examiner Comments

This is a good answer which gives both the explanation of each carbon atom being bonded to four others in diamond as well as the allowable answer of diamond having a tetrahedral structure. The explanation for graphite is also correct, so both marks can be awarded.

Question 8 (b)

This question was answered well by the majority of candidates. When asked to state what is meant by a term, no credit will be given for reusing the words given in bold in the stem of the question, i.e. an answer such as 'using thermal energy to decompose a compound' would not score the mark here. Some candidates confused this with exothermic reactions, stating that it is 'a reaction which gives out heat' which is incorrect as thermal decompositions are endothermic reactions.

Question 8 (c) (i)

This question was answered correctly by most candidates. The clue was in the question here as the molecule drawn shows a double bond. The few candidates who did not score the mark here either said something along the lines of 'more hydrogen can be added' or 'it does not contain only single bonds'. These statements may be true but are not creditworthy.

Question 8 (c) (ii)

When describing a test, both the reagent needed and the result of the test must be given to score full marks.

(ii) Describe a test to show that chloroethene is unsaturated.

(2)

Add Chloroethene to a bromine water Solution. If the Solution turns Colorless, it is unsaturated.

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Examiner Comments

This is a clear and concise answer which gives both the reagent and the result of the test, so both marks can be awarded.

bromine

place chloroethene in a test tube and mix with ~~xxxxxxx~~.

If it turns from orange to colourless then the test

shows a unsaturated chloroethene.

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Examiner Comments

This candidate has added bromine to the chloroethene. In order to score the first marking point either bromine **water** or bromine **solution** is required. Although liquid bromine may work here it is not the usual test and would be unsafe to do in the laboratory.

Although the first marking point is not scored the candidate can be awarded the second marking point here for the correct colour change.

If a totally incorrect reagent was used, e.g. chlorine, then the second marking point would not have been awarded.

Question 8 (d)

A surprising number of candidates answered this incorrectly. All that is required is to write 'poly' in front of 'chloroethene' to give the name of the polymer.

Common incorrect answers included 'polychloroeth**a**ne' and 'polyethene'. Some candidates gave the name of a substance that wasn't even a polymer, e.g. 'chloroethane' or 'chlorine'.

Question 9 (a)

This question was well answered by the majority of candidates, although some lost a mark by not showing the second step in the calculation. Only a small number lost both marks for either doing an 'upside down' calculation or by dividing by atomic numbers.

Halon 1301 has the percentage composition by mass of

C 8.05%   Br 53.69%   F 38.26%

(a) Show, by calculation, that the empirical formula of this compound is $CBrF_3$

(2)

	C	Br	F
# moles =	$\frac{8.05}{12}$	$\frac{53.69}{80}$	$\frac{38.26}{19}$
=	$\frac{0.67}{0.67}$	$\frac{0.67}{0.67}$	$\frac{2.01}{0.67}$
=	1	1	3 → $CBrF_3$

ResultsPlus
Examiner Comments

This is a well constructed answer which shows clearly how the ratio 1:1:3 is obtained, so both marks can be awarded.

Halon 1301 has the percentage composition by mass of

C 8.05%   Br 53.69%   F 38.26%

(a) Show, by calculation, that the empirical formula of this compound is $CBrF_3$

(2)

$\frac{8.05}{12}$ | $\frac{53.69}{80}$ | $\frac{38.26}{19}$ → 1 : 1 : 3 ratio

↓ ↓ ↓

0.67 : 0.67 : 2 ∴ C : Br : F_3 ($CBrF_3$)

ResultsPlus
Examiner Comments

This candidate has shown the first part of the calculation correctly and so can be awarded the first marking point. However, there is no indication of how they have obtained the ratio 1:1:3 from 0.67:0.67:2 so the second marking point is not awarded here.

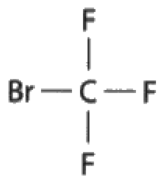
ResultsPlus
Examiner Tip

When a question starts 'show, by calculation' **all** working must be shown for all the marks to be awarded.

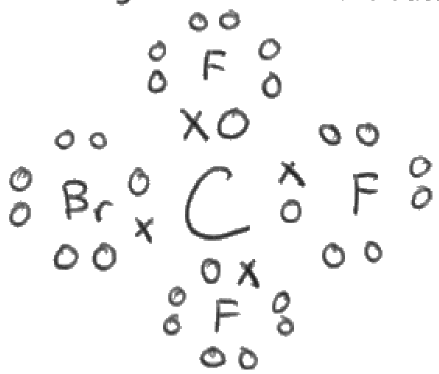
Question 9 (b)

The majority of candidates drew a correct dot and cross diagram and gained both marks, although some diagrams were messy and difficult to mark. A common error was to omit the lone pairs of electrons on the Br and sometimes on the F atoms as well.

(b) The diagram shows the displayed formula of a molecule of Halon 1301.



Draw a dot-and-cross diagram to show all the outer electrons in this molecule. **(2)**



ResultsPlus
Examiner Comments

This is a clearly drawn dot-and-cross diagram and can be awarded both marks.

ResultsPlus
Examiner Tip

It is not neessary to draw circles around the atoms when drawing a dot-and-cross diagram. Start by drawing the shared electron pairs and then draw the rest of the electrons in pairs around the atoms ensuring there are eight electrons in total around each atom.

Question 9 (c)

Many candidates failed to score on this question as they thought that covalent bonds were broken when a simple molecular substance such as Halon boils. Those who did realise that it was the weak intermolecular forces that were broken usually went on to score both marks.

(c) The boiling point of Halon 1301 is −58 °C.

Explain why Halon 1301 has a low boiling point.

(2)

This is because Halon 1301 has weak intermolecular forces of attraction between its molecules, thus only a small amount of energy is needed to overcome the forces of attraction

ResultsPlus
Examiner Comments

This is a clear and concise mark scheme answer which can be awarded both marks.

(c) The boiling point of Halon 1301 is –58 °C.

Explain why Halon 1301 has a low boiling point.

(2)

Halon 1301 has a low boiling point because the bonds between F, C and Br are not very strong. The attraction between the elements are weak so they break easily. The elements have more shells, so the electrons are further away from the nucleus.

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Examiner Comments

This answer is clearly referring to the covalent bonds between the atoms in the molecule and not the intermolecular forces. Covalent bonds are not weak and do not break when a substance boils so no marks can be awarded here. The reference to shells of electrons is irrelevant here.

ResultsPlus
Examiner Tip

When a simple molecular substance boils, it is the weak forces between the molecules that are broken not the covalent bonds, e.g. water does not produce hydrogen and oxygen when it boils!

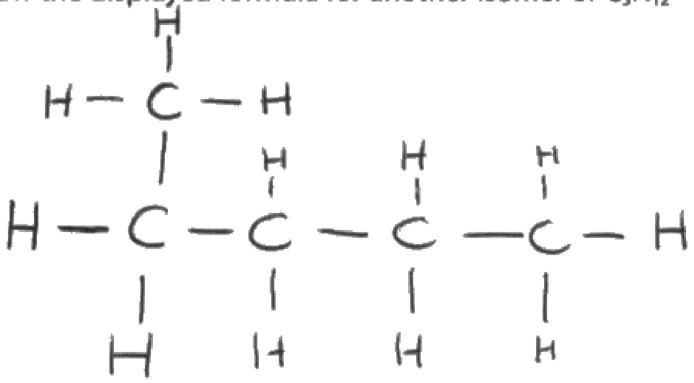
Question 10 (a) (i)

This question was answered well by the majority of candidates. Some lost a mark by use of the wrong terminology, e.g. reference to the 'same chemical formula' rather than 'the same molecular formula'. A small minority confused isomers with isotopes and talked about the same number of protons but different numbers of neutrons.

Question 10 (a) (ii)

Most candidates either scored 0 or 2 here, with a very small minority scoring 1 mark for missing off an H atom or including a CH_3 group, meaning the formula was not a fully displayed one. All bonds must be shown when a displayed formula is asked for.

(ii) Draw the displayed formula for another isomer of C_5H_{12} **(2)**



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Examiner Comments

This candidate has just drawn pentane again with the first C-C bond drawn vertically instead of horizontally. As this is an alternative way of drawing pentane it is not a different isomer so no marks can be awarded.

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Examiner Tip

When drawing an isomer of a straight chain alkane the end carbon atom must be moved and attached to one of the carbon atoms which is already attached to two other carbon atoms. Also make sure there are four bonds to each carbon atom.

Question 10 (b) (i)

Many candidates scored both marks here. A common answer seen was $C_5H_{10}Br_2 + H_2$ which scored 1 mark for the correct substituted alkane.

Question 10 (b) (ii)

Many candidates knew that this was a substitution reaction. A common incorrect answer was 'displacement'. 'Addition' was also seen occasionally.

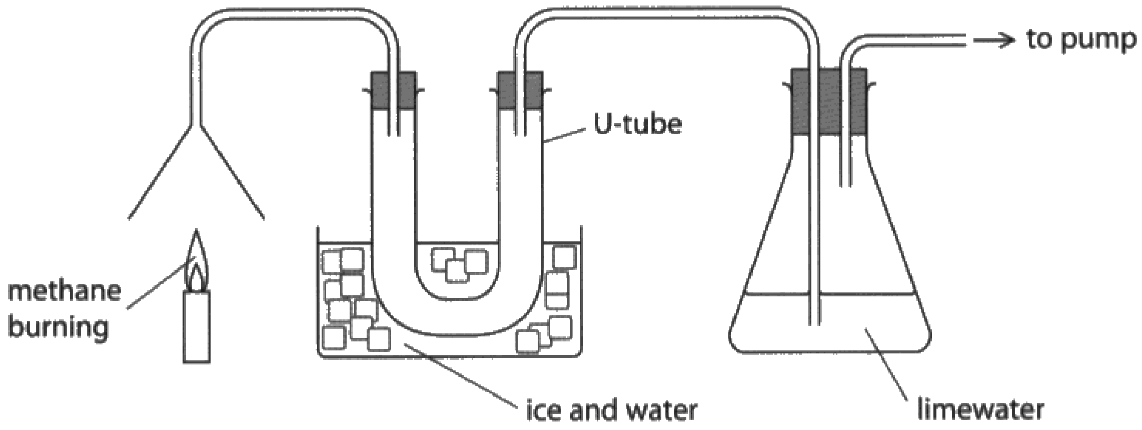
Question 11 (a)

Most candidates scored the first mark for calculating the moles of methane, but many of these failed to realise that it was a 1:2 ratio and multiplied 32 by 2 giving an answer of 64g as opposed to multiplying 32 by 4 giving the correct answer of 128g

Question 11 (b) (i)

This question was not particularly well answered with many candidates scoring zero. Those who gained 1 mark usually did so by mentioning the fact that the ice was cold but stated that 'water condenses' rather than water vapour. As water is already a liquid the first marking point was not awarded.

(b) The diagram shows methane burning in air. It also shows how the two gases formed are collected and tested.



(i) Explain why water collects in the U-tube.

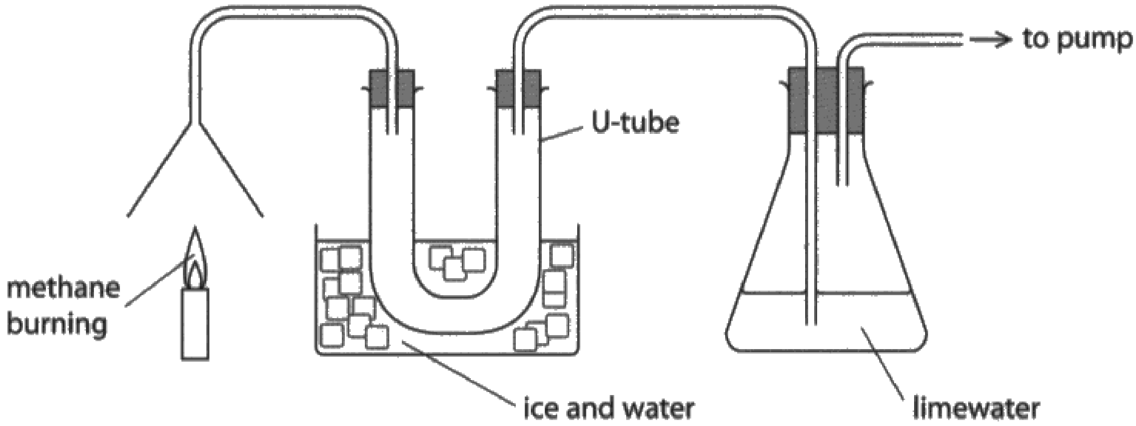
(2)

Because the watervapor will condense Since the tube is cold and water vapour will become water

ResultsPlus
Examiner Comments

This is a clear and concise answer which states that water vapour condenses since the tube is cold, so both marks can be awarded.

(b) The diagram shows methane burning in air. It also shows how the two gases formed are collected and tested.



(i) Explain why water collects in the U-tube.

(2)

Its condensing the ~~tho~~ H_2O back into water because of the ice dropping the temperature below its boiling point

ResultsPlus
Examiner Comments

The first marking point is not awarded here as the candidate has not stated that the water is in the form of a vapour initially.

However, the second marking point can be awarded for the statement that the ice drops the temperature below the boiling point of water.

Question 11 (b) (ii)

This question was answered well by the majority of candidates. Some only scored 1 mark as they failed to mention the initial colour of the anhydrous copper(II) sulfate. A small minority gave the colour change the wrong way round and so failed to score.

Question 11 (b) (iii)

The majority of candidates scored 2 marks for this question for stating that the carbon dioxide produced turned the limewater cloudy. Only a small minority explained that calcium carbonate caused the cloudiness.

(iii) Explain the change in appearance of the limewater.

(3)

The lime water will go from being colourless, ~~to~~ to being white and cloudy as the carbon dioxide produced in the experiment passes through it. This is because the carbon dioxide will react with the limewater producing a white calcium carbonate precipitate.

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Examiner Comments

This is a good mark scheme answer and all 3 marks can be awarded.

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Examiner Tip

When an explanation is worth 3 marks, three different points need to be given. Just stating that the limewater goes cloudy because carbon dioxide is produced is not sufficient to score all of the marks. Some further explanation of why the cloudiness occurs is required.

(iii) Explain the change in appearance of the limewater.

(3)

The limewater will go from cleare to cloudy due to the fact of there being carbon in the air which reacts to change the limewaters appecerance

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Examiner Comments

This candidate can be awarded 1 mark for stating that the limewater goes cloudy. They have, however, said that this is due to 'carbon in the air' rather than carbon dioxide and there is no mention of calcium carbonate or an insoluble substance being formed so no other marks can be awarded.

Question 12 (a)

The majority of candidates realised that the reaction was endothermic and most often explained why they had come to that conclusion with reference to the decrease in temperature, and so scored both marks. Note that for the second marking point just a mention of the reaction taking in energy is not sufficient for the mark; there must be some reference to heat or thermal energy for this mark to be awarded. Quite a few candidates thought that the reaction was exothermic which showed a lack of understanding and so they lost both marks.

Question 12 (b) - (c)

Most candidates scored all 3 marks in (b) but often lost marks in (c) for not including a sign in their answer or giving an incorrect sign and/or not converting the answer from J/mol to kJ/mol.

(b) Show that the heat energy change, Q, is about 2400 J.

[mass of 1.00 cm^3 of solution = 1.00 g]

[for the solution, c = 4.18 J/g/°C]

(3)

$Q = mc\Delta T$

$\Delta T = 20 - 14.2 = 5.8$

$m = 1 \times 100 = 100g$

↓

$100 \times 4.18 \times 5.8 = 2,424.4$

Q = 2,420 J

(c) Use your answer to part (b) to calculate the enthalpy change, ΔH, in kilojoules per mole of ammonium nitrate.

[M_r of ammonium nitrate = 80.0]

Include a sign in your answer.

(4)

$\Delta H = \frac{2420/1000}{n}$

$n = \frac{8}{80} = 0.1$

$2420/1000 = 2.42$

$\frac{2.42}{0.1} = 24.2$

ΔH = +24.2 kJ/mol

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Examiner Comments

This is a good mark scheme answer. Working is clearly shown in both parts and the correct answers given to an appropriate number of significant figures are shown on the answer lines, so full marks can be awarded for both parts.

ResultsPlus
Examiner Tip

In a 'show that' question, calculation working must be clearly shown to make sure all available marks can be awarded.

If a candidate is not able to do the calculation in the first part of the calculation full marks can be awarded for the second part by using the value, in this case 2400J, given in the first part.

(b) Show that the heat energy change, Q, is about 2400 J.

[mass of 1.00 cm^3 of solution = 1.00 g]

[for the solution, c = 4.18 J/g/°C]

(3)

$Q = mc\Delta t$

$Q = 4.18 \times 100 \times 5.8$

Q = 2424.4 J

(c) Use your answer to part (b) to calculate the enthalpy change, ΔH, in kilojoules per mole of ammonium nitrate.

[M_r of ammonium nitrate = 80.0]

Include a sign in your answer.

(4)

Mole of ammonium nitrate $= \frac{8}{80}$

$= 0.1$ mol

$\Delta H = \frac{\text{Heat energy change}}{\text{~~per~~ mole}}$

$= \frac{2424.4}{0.1}$

ΔH = 24244 kJ/mol

ResultsPlus
Examiner Comments

This candidate has shown their working in part (b) and written their answer on the answer line so all 3 marks can be awarded.

In part (c) they have calculated the moles (n) correctly and then divided Q by n to obtain an answer in Joules, so the first 2 marks can be awarded. However there is no conversion to kJ and no sign included, so the third and fourth marking points are not awarded.

ResultsPlus
Examiner Tip

When a question asks for a sign to be included in an answer, even if the answer is a positive number, the + sign must be included or full marks will not be awarded.

(b) Show that the heat energy change, Q, is about 2400 J.

[mass of 1.00 cm³ of solution = 1.00 g]

[for the solution, c = 4.18 J/g/°C]

Q = m × c × ΔT

(3)

Q = 1 × 4.18 × 5.8

20 − 14.2 = 5.8

= 24.244 kJ = ~~240~~ 24240 J

24,244 J

Q = ~~24244 J~~ J

(c) Use your answer to part (b) to calculate the enthalpy change, ΔH, in kilojoules per mole of ammonium nitrate.

[M_r of ammonium nitrate = 80.0]

Include a sign in your answer.

Q/n × 1000

(4)

n = 8/80

24244 kJ / 0.1 × 100

ΔH = 242.44 kJ/mol

ResultsPlus
Examiner Comments

This candidate has found the temperature change correctly, so can be awarded the first marking point in part (b). They have then used 1 instead of 100 for the mass and so the second marking point is not awarded. Thinking their answer is in kJ they have multiplied by 1000. They have not shown that Q is about 2400J as their answer is a factor of 10 out, so the third marking point is not awarded.

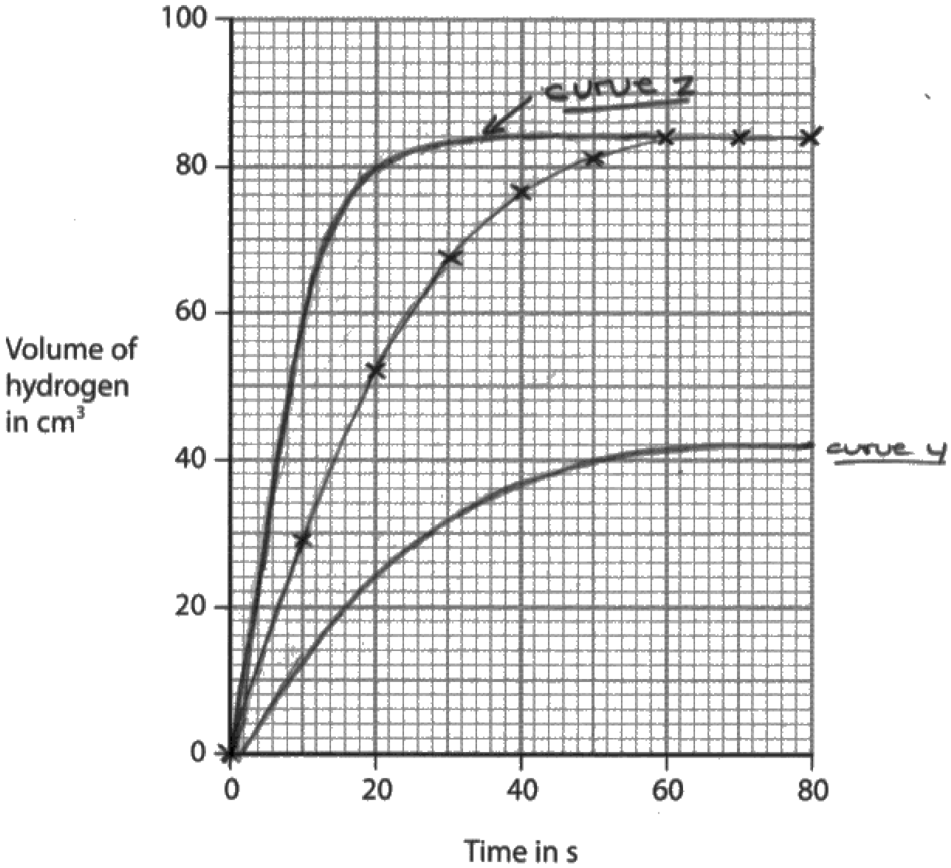
The candidate has gone on to use their answer to (b) in part (c), so error carried forward marks can be awarded for correct working. They have shown that the moles is 8 ÷ 80, which does not need to be evaluated to score the first marking point. They have then gone on to find Q ÷ n and this has been converted to kJ/mol on the answer line, so the second and third marking points can be awarded. The fourth marking point is not awarded as they have not included a sign in their answer.

ResultsPlus
Examiner Tip

In a 'show that' question if the answer obtained is not close to the value given the candidate should check over their working as they have obviously made a mistake somewhere. However, if they are unable to come up with the correct answer they can use their answer in the next part of the question giving them the opportunity to gain full marks for this next part. Alternatively they can use the value given in the first part of the question to answer the second part.

Question 13 (a) - (b)

The majority of candidates scored both the plotting mark and the line of best fit mark, although many graphs could have been drawn more neatly. Fewer candidates scored full marks for the Y and Z curves.



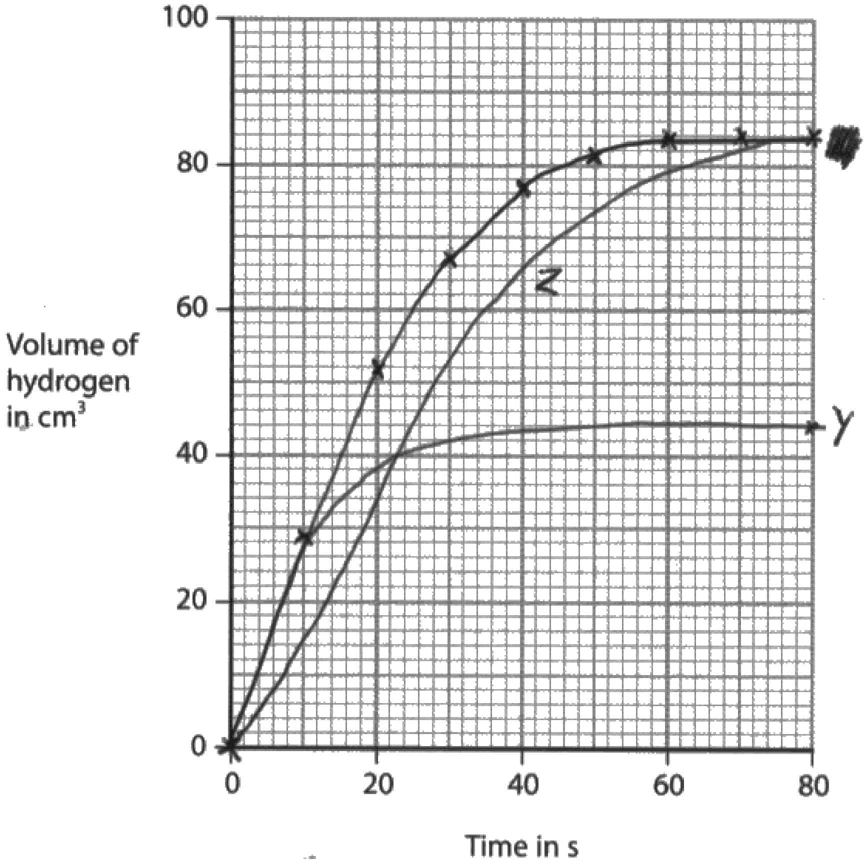
ResultsPlus
Examiner Comments

This is a good example of a response which scores all 6 marks.

All points have been plotted accurately and are clearly visible. The line of best fit is a smooth curve drawn through the points.

Curve Y is below the original curve and levels off at the right place.

Curve Z is above the original curve and levels off at the same place as the original curve.



ResultsPlus
Examiner Comments

The points are plotted correctly and the line of best fit is acceptable so both marks can be awarded for part (a).

Curve Y is not awarded any marks because it is not underneath the original curve for the first 10s and levels off a bit too high.

Curve Z is not awarded the first marking point as it is underneath the original curve, but the second marking point can be awarded as the curve levels off at the same point as the original curve.

Question 13 (c)

This question was poorly answered by the majority of candidates. Many said that gas escapes or is lost, but very few of these went on to say why it escapes, so this was insufficient to be awarded the mark. Mention of the magnesium being impure was rarely seen. Some said that the magnesium didn't fully react which was not creditworthy because as the acid is in excess there is no reason why the magnesium would stop reacting.

Question 13 (d)

This question was not particularly well answered. Many talked about an accurate measurement not being required but failed to mention that this was because the acid was in excess. As the second marking point was dependent on the first, answers such as these could not be awarded any marks.

Question 13 (e)

This question was poorly answered with the majority of candidates scoring 0 or 1 mark. The first marking point referring to the concentation of the hydrochloric acid was rarely seen. A few more mentioned the surface area of magnesium decreasing, but these were also few and far between. Even though candidates were asked to refer to particle collision theory in their answer, quite a few failed to do so.

(e) The ionic equation for the reaction between magnesium and hydrochloric acid is

$$Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$$

Use the information in this equation, and the particle collision theory, to explain why the rate of reaction decreases during each of the experiments.

(3)

It's because when ~~conte~~ reaction continues concentration of ~~particles~~ acid reduce and amount of magnesium will be reduced ~~so at~~ so there will be less particle for reaction to occur ~~so~~ according to collision theory when ~~no of~~ amount of particles reduce ~~no of~~ number of successful collisions in unit time reduce which reduce the rate of reaction.

ResultsPlus Examiner Comments

This is a good answer which scores all 3 marking points.

(e) The ionic equation for the reaction between magnesium and hydrochloric acid is

$$Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$$

Use the information in this equation, and the particle collision theory, to explain why the rate of reaction decreases during each of the experiments.

(3)

As the reaction takes place it starts very vigorously but slowly the rate of reaction decreases because there are less and less particles reacting with each other so there aren't as many collisions taking place, so therefore less energy is being produced.

ResultsPlus
Examiner Comments

This candidate can be awarded 1 mark for saying the rate of reaction decreases because there are not as many collisions taking place. Just saying there are less particles is not enough for the first marking point and there is no mention of unit time or frequency of collisions, so the third marking point can not be awarded. Reference to particles losing energy limits any answer to a maximum of 1 mark.

ResultsPlus
Examiner Tip

Candidates need to realise that there is no increase or decrease in the kinetic energy of the particles when concentration or surface area is changing. Kinetic energy should only be referred to when discussing changes in temperature. Mentioning it in other situations puts candidates in danger of losing marks.

Question 14 (a)

The majority of candidates knew that the mixture was warmed to speed up the reaction. Some lost the mark by saying that it was to help the copper(II) oxide dissolve or increase its solubiloity which was rejected as it showed a lack of understanding.

Question 14 (b)

This was generally well answered with most candidates referring to the solid copper(II) oxide settling at the bottom of the beaker.

Question 14 (c)

Most candidates knew that the mixture was filtered to remove the excess copper(II) oxide. Some candidates who did not score the mark thought that the mixture was filtered to remove impurities and some thought that it was filtered to obtain the copper(II) sulfate crystals.

Question 14 (d)

Most candidates knew that the colour of copper(II) sulfate solution is blue. Some, however, need to realise that blue-green is not an acceptable answer here.

Question 14 (e)

The majority of candidates knew that the solution needed to be heated to evaporate some of the water. A few only gained 1 mark as they evaporated the solution to dryness. Many went on to allow the solution to crystallise. The filtering stage was often omitted but most went on to dry the crystals using a suitable method.

(e) Describe how the student could obtain a pure, dry sample of hydrated copper(II) sulfate crystals from the filtrate in stage 6.

(5)

Heat filtrate of copper(II) sulfate solution in evaporating basin to evaporate some water, using ~~bas~~ bunsen burner. ~~W.~~ Heat until saturated solution forms. Test this with a glass rod, dip it into solution, if crystals form it is saturated. Turn ~~off~~ off heat and allow to cool. Pour off / filter out crystals from remaining solution. Leave to dry in a warm place / oven or blot with paper towel to dry.

ResultsPlus
Examiner Comments

This is a clear concise description of how to prepare pure dry crystals from the copper(II) sulfate solution. All 5 marks can be awarded here.

They could filter it twice to make sure all of the excess copper(II) oxide are gone. They can then put it in a clean sterile dish and make sure no other chemicals or particle are in dish to keep solution pure. They would then put it in a warm sheltered/sterile area to dry and crystilise. He would put it in a warm, dry area to allow it to crystalise faster and leave it for a couple of days to allow all of the solution to fully crystalise. The are would be sheltered/sterile to prevent anything from getting in or mixing with the solution.

ResultsPlus
Examiner Comments

This candidate has started by filtering again to remove the copper(II) oxide. This is not necessary as it was already filtered in stage five. The candidate then leaves the solution to crystallise. There is no mention of heating to crystallisation point, so the first two marking points cannot be awarded. There is no mention of filtering off the crystals and no mention of how to dry the crystals so marking points four and five cannot be awarded. Just 1 mark is awarded here for leaving the solution to crystallise.

ResultsPlus
Examiner Tip

Candidates need to realise that in a 5 mark question when asked to prepare pure dry crystals, just leaving a solution for the water to evaporate is not going to score them many marks. This type of question is asked quite often, so candidates need to learn the steps involved in preparing pure dry crystals from a solution.

Question 14 (f)

The majority of candidates were able to do the first part of this calculation correctly, but most of these lost the third marking point for not giving their answer to three significant figures. The percentage yield calculation was well done by the majority of candidates.

(f) The overall equation for the formation of hydrated copper(II) sulfate crystals from copper(II) oxide is

9.54g → $CuO(s) + H_2SO_4(aq) + 4H_2O(l) \rightarrow CuSO_4.5H_2O(s)$

(i) In an experiment, a student completely reacts 9.54 g copper(II) oxide.

Show that the maximum possible mass of $CuSO_4.5H_2O$ crystals that can be obtained is about 30 g.

[M_r of CuO = 79.5 M_r of $CuSO_4.5H_2O$ = 249.5]

Give your answer to an appropriate number of significant figures.

(3)

$$N = \frac{M}{M_r} = \frac{9.54}{79.5} = 0.12$$

$$M = N \times M_r$$

$$M = 0.12 \times 249.5 = 29.94$$

mass = 29.9 g

(ii) In this experiment, the actual yield of $CuSO_4.5H_2O$ crystals is 23.92 g.

Calculate the percentage yield of $CuSO_4.5H_2O$

(2)

$$\% = \frac{\text{Actual}}{\text{theoretical}} = \frac{23.92}{29.94} \times 100 = 79.89$$

$$= 80\%$$

percentage yield = 80 %

ResultsPlus
Examiner Comments

This is a fully correct answer and all working is clearly shown, so all 5 marks can be awarded. In (i) the question asks for the answer to be given to an appropriate number of significant figures, which this candidate has done.

ResultsPlus
Examiner Tip

When asked to give an answer to an appropriate number of significant figures, candidates need to look at the data given in the question and give their answer to the same number of significant figures. In this example the answer needs to be given to three significant figures.

(f) The overall equation for the formation of hydrated copper(II) sulfate crystals from copper(II) oxide is

$$CuO(s) + H_2SO_4(aq) + 4H_2O(l) \rightarrow CuSO_4.5H_2O(s)$$

(i) In an experiment, a student completely reacts 9.54 g copper(II) oxide.

Show that the maximum possible mass of $CuSO_4.5H_2O$ crystals that can be obtained is about 30 g.

[M_r of CuO = 79.5 M_r of $CuSO_4.5H_2O$ = 249.5]

Give your answer to an appropriate number of significant figures.

(3)

M / m · Mr

249.5 ÷ 79.5 = 3.13836478

9.54 · 3.13 = 29.86

mass = 29.86 g

(ii) In this experiment, the actual yield of $CuSO_4.5H_2O$ crystals is 23.92 g.

Calculate the percentage yield of $CuSO_4.5H_2O$

(2)

30 / 23.92 × 100 = 125.4180602

percentage yield = 125.4 %

ResultsPlus
Examiner Comments

This candidate has used the second mark scheme method for finding the mass of hydrated copper(II) sulfate. Unfortunately, they have incorrectly rounded the answer to 249.5 ÷ 79.5 giving a final answer of 29.86 instead of 29.94. The final answer is not given to three significant figures so only 1 mark is awarded for (i).

In (ii) the percentage yield calculation is upside down and so no marks can be awarded here.

ResultsPlus
Examiner Tip

As (i) is a 'show that' calculation, if a candidate is unable to come up with an answer they can use the value given in the first part of the question in the second part, in this case 30g.

When doing a percentage yield calculation an answer of over 100 is obviously incorrect as percentage yields cannot be over 100%. If a candidate obtains an answer greater than 100 they need to go back and check their working as they have obviously made a mistake.

Question 15 (a)

The majority of candidates gained the third marking point by giving the correct colour change of the universal indicator paper. A fair number knew that a white precipitate was formed with acidified barium chloride. The colour of the precipitate with sodium hydroxide solution was less well known. Some said a green precipitate formed confusing Fe^{2+} and Fe^{3+} ions. Some lost marks by giving the correct colours for the first two marking points but failed to mention that they were precipitates.

Question 15 (b)

Many fully correct answers were seen for this question. The majority gave the correct values for (i) and (ii) and many of these went on to use these values correctly in (iii). Sometimes error carried forward marks were awarded in (iii) for incorrect answers in (i) and (ii).

The table shows the student's results.

mass of empty test tube in g	22.04
mass of test tube and $(NH_4)_2SO_4.Fe_2(SO_4)_3.xH_2O$ in g	34.09
mass of test tube and $(NH_4)_2SO_4.Fe_2(SO_4)_3$ in g	28.69

(i) Calculate the mass of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ produced by heating.

(1)

$28.69 - 22.04 = 6.65$

mass of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ = 6.65 g

(ii) Calculate the mass of water produced.

(1)

$34.09 - 28.69 = 5.4$

mass of water = 5.4 g

(iii) Calculate the value of x.

[M_r of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ = 532 and M_r of H_2O = 18]

Give your answer to the nearest whole number.

(4)

n of $(NH_4)_2SO_4 \cdot Fe_2(SO_4)_3 = \frac{m}{M_r} = \frac{6.65}{532} = 0.0125$

nof $H_2O = \frac{m}{M_r} = \frac{5.4}{18} = 0.3$

$0.3 \div 0.0125 = 24$

value of x = 24

ResultsPlus
Examiner Comments

A fully correct answer with clear working shown, so all 6 marks can be awarded.

The table shows the student's results.

mass of empty test tube in g	22.04
mass of test tube and $(NH_4)_2SO_4.Fe_2(SO_4)_3.xH_2O$ in g	34.09
mass of test tube and $(NH_4)_2SO_4.Fe_2(SO_4)_3$ in g	28.69

(i) Calculate the mass of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ produced by heating.

(1)

28.69 − 22.04 = 6.65

mass of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ = 6.65 g

(ii) Calculate the mass of water produced.

(1)

34.09 − 28.69 = 5.4

6.65 − 5.4 = 1.25

mass of water = 1.25 g

(iii) Calculate the value of x.

[M_r of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ = 532 and M_r of H_2O = 18]

Give your answer to the nearest whole number.

(4)

mole = mass / mr

6.65 / 532 = 0.0125

1.25 / 18 = 0.0694

1 0.0125

? 0.0694

5.5 ≃ 6

value of x = 5.5

ResultsPlus
Examiner Comments

This candidate has the correct answer for (i) and an incorrect answer for (ii) so just 1 mark is awarded for (i).

However, the candidate has gone on to use their values in (iii) correctly so three error carried forward marks can be awarded. The fourth marking point is not awarded as the answer on the answer line is not a whole number. If the candidate had written 6 on the answer line all 4 marks could have been awarded.

Paper Summary

Based on their performance on this paper, candidates should:

- make sure they show all their working in calculations, particularly in 'show that' questions;
- draw clear dot-and-cross diagrams;
- make sure when plotting graphs to mark the points clearly and draw smooth clear lines of best fit;
- learn which molecules are diatomic so as to help in writing correct chemical equations;
- avoid writing about intermolecular forces when referring to giant covalent, metallic or ionic structures;
- remember that covalent bonds are **strong** and that it is the forces between molecules that are weak in simple molecular structures;
- write clear concise answers when answering extended writing questions and avoid adding irrelevant information;
- place more emphasis on revision of practical procedures and expected observations in chemistry experiments.