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Examiners' Report
June 2019

GCSE Chemistry 1CH0 2H

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June 2019
Publications Code 1CH0_2H_1906_ER

Introduction

This examination paper was the second of this series for the Chemistry Higher tier, graded 9-1. This paper, like all the Separate Science examinations, contains ten questions giving a total of 100 marks. Six of these questions also appear on the Combined Science Chemistry Higher tier paper.

This paper also has Combined Science Chemistry questions in common with the Foundation papers, totaling 16 marks. There are also 11 marks of Separate Chemistry questions in common with the Separate Chemistry Foundation tier paper.

The paper made use of a variety of question types suitable for candidates at this level; multiple choice, calculations and short answer questions being the frequent types. The paper contained two extended open response questions (6-marks). As with the other Chemistry papers, a minimum of 20% of the marks were for maths, a minimum of 15% for testing practical skills and a maximum of 15% on knowledge in isolation (recall) questions.

Question 1 (a) (i)

This first question on the paper was generally well answered with candidates referring to the higher melting point or boiling point of ionic solids.

1 (a) (i) Titanium(IV) oxide is an ionic solid.
Many ionic solids are soluble in water.

Titanium(IV) oxide is not soluble in water.
Its other physical properties are typical of ionic solids.

Predict **one** other physical property of titanium(IV) oxide that would be typical of ionic solids.

(1)

High melting point

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Examiner Comments

The most common correct answer that scored.

Lattice structure (strong electrostatic bonds)

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Examiner Comments

A common mistake which caused candidates not to score was where they did not read the question carefully and talked about the structure of ionic solids rather than its properties.

This example gained no marks.

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Examiner Tip

You should read the question carefully and if you have time at the end re-read through your answers alongside the question to ensure that your answer answers the question set.

Boiling point / melting point

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Examiner Comments

In some cases, candidates were not precise with their answers and just stated boiling point or melting point but did not state whether it was high or low. This therefore did not gain credit.

Question 1 (a) (ii)

Candidates found deducing the charge of the titanium ion quite difficult with the majority not scoring on this question.

Question 1 (b) (ii)

A good proportion of candidates scored in this question, with most gaining 1 mark. Candidates were asked to describe a reason, in most cases, candidates scored just 1 mark as they started to describe two reasons and did not give linked detail for either. Fewer were able to give a complete description of a reason why.

Those that did score both marks often showed a clear understanding of the context and the reason that nanoparticles of titanium(IV)oxide are used in some screens. In some cases, candidates were not specific enough with their answers and just stated that sunlight or light is absorbed rather than the UV light from the sun. This did not score. References to the titanium being insoluble in water and therefore resistant to water were ignored.

(ii) Nanoparticles of titanium(IV) oxide are used in some sunscreens.

Describe a reason why nanoparticles of titanium(IV) oxide are used in some sunscreens.
(2)

~~nanoparticles~~ They block uv light so protect from sunburn and are very small and they cant be seen (colourless) so can easy and unnoticibly be placed on body as they are unseen.

ResultsPlus
Examiner Comments

In this example, the candidate scored 2 marks. They state that the nanoparticles block UV which therefore prevents sunburn this alone would score 2 marks. They go on to give a second 2 mark answer, that the nanoparticles are very small and therefore cannot be seen. Just one of these descriptions would have been sufficient to gain the marks.

Describe a reason why nanoparticles of titanium(IV) oxide are used in some sunscreens.
(2)

They absorb UV rays

ResultsPlus
Examiner Comments

In this example the candidate starts the description that the nanoparticles absorb UV rays but does not complete this by stating that this prevents sunburn.

Question 1 (b) (iii)

The second question about nanoparticles, was again well attempted with a good proportion scoring. The majority gained 1 mark and only the best candidates gained 2 marks for a complete explanation.

(iii) Some people are concerned that there is a risk when sunscreens containing nanoparticles are used.

Explain a possible risk associated with using nanoparticles in sunscreens.
(2)

Because they are so small they may be absorbed unto the skin and because the tecnology is so new scientists don't really know the consequences of this which is why its concerning.

ResultsPlus
Examiner Comments

Where candidates did score full marks, it was often for recognising that nanotechnology is new and so therefore we don't yet know that consequences such as in this answer. Another common fully correct answer was that the nanoparticles might pass into the body and could change or catalyse reactions in the body.

Explain a possible risk associated with using nanoparticles in sunscreens.

(2)

could result in irritations and allergic reactions.

ResultsPlus
Examiner Comments

Where candidates did not score, it was often as their answers were vague, for example that it might harm the body or cause health problems. In some cases candidates stated that the nanoparticles may cause allergic reaction, this was not accepted and gained no marks.

Question 2 (b) (i)

Candidates performed well in question 2bi, with the vast majority being able to state a use for kerosene and a use of diesel to gained both marks.

(b) Crude oil is separated into several fractions by fractional distillation.
Two of these fractions are kerosene and diesel oil.

(i) State a use for each of these fractions.

(2)

kerosene used for fuel in planes.

diesel oil for fuel in large trucks

ResultsPlus
Examiner Comments

A good example that gained both marks.

kerosene fuel for large transport systems (planes, trains)

diesel oil fuel for cars power stations

ResultsPlus
Examiner Comments

Where candidates did not score, it was often where they gave a list of uses that included incorrect answers that contradicted correct answers. As in this case. If the candidates had just stated planes, then a mark could have been awarded, however they then also gave an answer of trains and therefore a mark could not be awarded. Power station did not score for a use for diesel so no marks were scored here.

ResultsPlus
Examiner Tip

When asked to give 'a' or one use, do not give a list, as a contradictory answer will rule out the correct answer.

kerosene Petrol for aircraft

diesel oil fuel for cars and trains

ResultsPlus
Examiner Comments

A common error was to use the term petrol for fuel, which therefore made a nonsensical answer. As in this example where the candidate states that kerosene is petrol for aircraft.

Question 2 (b) (ii)

Again, candidates answered this question well with the majority being able to correctly compare a property of kerosene with that of diesel oil.

(ii) Figure 1 shows where the fractions kerosene and diesel oil are produced in the fractionating column.

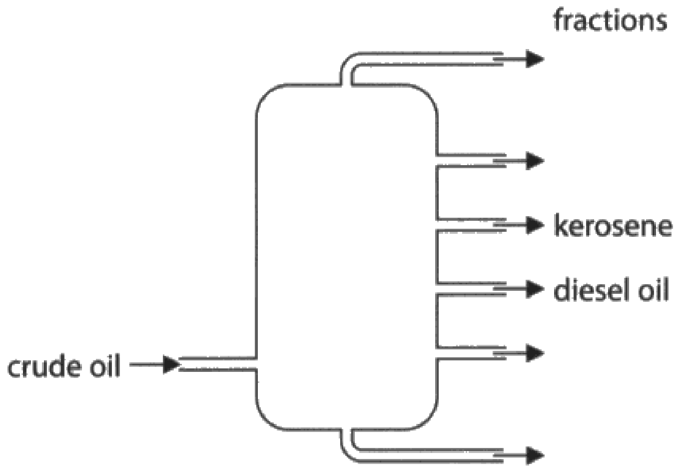

Figure 1

Kerosene is obtained higher up the column than diesel oil.
Kerosene and diesel oil fractions have slightly different properties.

Choose a property.
State how this property for kerosene compares with the property for diesel oil.

(1)

property Viscosity

comparison Diesel is more viscous than kerosene.

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Examiner Comments

The most common correct answer seen was that melting point of kerosene was lower than that of diesel or that the viscosity of kerosene was lower.

Choose a property.
State how this property for kerosene compares with the property for diesel oil.

(1)

property Length of carbon chain

comparison kerosene has a shorter chain length than diesel oil

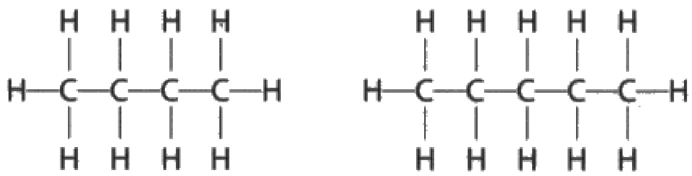
ResultsPlus
Examiner Comments

Where candidates did not score the mark it was often as they had the comparison the wrong way around or that they gave an answer that referred to the length of the carbon change which was ignored.

Question 2 (c) (i)

Many candidates could score at least 1 mark on this question on homologous series for recognising that butane and pentane are in the alkane homologous series and then stated this or the general formula for an alkane to gain the second mark point. Fewer, however, could explain why they are neighbouring members to gain the second mark. Some candidates lost marks as they were not careful with their use of terms and used the term same chemical or same molecular formula rather than same general formula and so therefore did not gain the mark.

(c) Figure 2 shows the formulae of a molecule of butane and of a molecule of pentane.
Butane and pentane are neighbouring members of the same homologous series.



butane pentane

5 12

C_nH_{2n+2}

4 10

Figure 2

(i) Explain, using these formulae, why butane and pentane are neighbouring members of the same homologous series.

(2)

they have similar chemical properties and have the same general formula eg C_nH_{2n+2}. They are both hydrocarbons and they increase by CH_2

ResultsPlus
Examiner Comments

A good answer that gained both marks.

(i) Explain, using these formulae, why butane and pentane are neighbouring members of the same homologous series.

(2)

Butane has 4 carbons. Pentane has 5 carbons. Therefore they are neighbouring members. They are both alkanes and therefore both are part of the alkane homologous series

ResultsPlus
Examiner Comments

In some cases, candidates just re-stated the number of carbons in each of the molecules, rather than describing the difference this was not deemed sufficient to gain the first marking point. A mark was still awarded for the fact that they are both alkanes.

Question 2 (c) (ii)

Calculation of the mass of carbon contained in 100g of butane was generally well answered by candidates with many gaining the full 3 marks available. Where candidates lost marks, it was often as did not read the question carefully and did not give their answer to 3 significant figures.

(ii) Butane has the formula C_4H_{10}.

Ma
Mo RAM

Calculate the mass of carbon in 100 g of butane.

Give your answer to three significant figures.

(relative atomic masses: H = 1.00, C = 12.0;
relative formula mass: C_4H_{10} = 58.0)

You must show your working.

(3)

$C_4 = 12 \times 4 = 48$ | $100 \div 58 = 1.724$

$H_{10} = 1 \times 10 = 10$ | $1.724 \times 48 = 82.75862$

$48 + 10 = 58$

mass of carbon = 82.8 g

ResultsPlus
Examiner Comments

The correct answer given to 3 significant figures gained 3 marks.

You must show your working.

(3)

$\frac{100}{58} = 1.7$

$12.0 \times 1.7 = 20.7$

mass of carbon = 20.7 g

ResultsPlus
Examiner Comments

Another reason that candidates did not score full credit was where candidates had multiplied by 12 rather than 48. Where these answers were written correctly to 3 significant figures, these candidates were still able to score 2 of the 3 marks

ResultsPlus
Examiner Tip

It is important that you show your working on calculations so you can still obtain credit for method marks in the working.

Question 3 (b)

The calculation of the maximum mass of magnesium oxide formed was also well answered with many being able to score the full 3 marks available.

* (b) Magnesium burns in excess oxygen to form magnesium oxide.
The balanced equation for this reaction is

$$2Mg + O_2 \rightarrow 2MgO$$

Starting with 1.35g of magnesium, calculate the maximum mass of magnesium oxide that could be formed in this reaction.
(relative atomic masses: O = 16.0, Mg = 24.0)

You must show your working.

(3)

2Mg → 24 x 2 = 48

2MgO → 48 + (16 x 2) = 80

48 → 80

1.35g

mass of magnesium oxide = ... g

ResultsPlus
Examiner Comments

In some cases, candidates knew that 48g of magnesium forms 80g of magnesium oxide to gain the first marking point, but were not able to take this any further. The presence of the working meant that 1 mark could still be awarded.

Mg : MgO
2 : 2
$\frac{1.35}{24}$ =
0.05625 × (24+16)
0.05625×40 = 2.25

mass of magnesium oxide = 2.25 g

ResultsPlus
Examiner Comments

Many candidates that scored full marks, used the moles method and showed their working clearly and concisely.

Question 3 (c)

Although most candidates could write the formula of hydrochloric acid correctly on the right hand side of the equation, a large number were not able to write the correct formula of one or both of the diatomic molecules on the left hand side, therefore losing the second and the third marking point. On this question candidates were not penalised for letters in the formulae that had been written too small.

(c) Chlorine reacts with hydrogen to form hydrogen chloride.

Write the balanced equation for this reaction.

(3)

$2Cl_2 + H_2 \rightarrow 2HCl_2$

ResultsPlus
Examiner Comments

Another common error was to write the formula of hydrochloric acid as HCl_2 , since the formula on the right hand side was incorrect the balancing mark could not be awarded.

Write the balanced equation for this reaction.

(3)

$Cl_2 + H_2 \rightarrow 2HCl$

ResultsPlus
Examiner Comments

Those that were able to write the correct formula on both sides of the equation were often then able to balance these formula to gain the third mark so few scored a mark of 2.

Write the balanced equation for this reaction.

(3)

$2H^+ + Cl_2^- \rightarrow$ ~~[illegible]~~ $2HCl$

ResultsPlus
Examiner Comments

A noticeable number of candidates wrote the hydrogen and chlorine were written as ions. This was not allowed, however if the formula were otherwise correct the balancing mark could have still be awarded. In this example, just 1 mark was scored.

Question 3 (d)

The vast majority of candidates were able to give the electronic configurations of the ions formed when a sodium reacts with chlorine.

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

The electronic configuration of the sodium atom is 2.8.1 and the electronic configuration of the chlorine atom is 2.8.7.

Give the electronic configurations of the ions formed.

(2)

Na^+ 2.8.0

Cl^- 2.8.8

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Examiner Comments

In some cases, candidates gave the electronic configuration of sodium as 2.8.0, this was accepted and a mark awarded.

Question 4 (a)

Most candidates were able to link the idea of enzymes and yeast and then followed this up with the ideas of the enzymes denaturing.

4 (a) Ethanol is made by fermentation of a carbohydrate dissolved in water, in the presence of yeast.

The reaction is carried out at 30 °C.

Explain why the reaction is carried out at a temperature of 30 °C rather than at a temperature of 80 °C.

(2)

As fermentation uses enzymes, this means that the enzymes will denature at 80°c and not 30°c.

ResultsPlus
Examiner Comments

Candidates that scored 1 mark often did so as they knew that enzymes were denatured by did not link the enzymes to the yeast thus losing the first mark point, as in this example.

Explain why the reaction is carried out at a temperature of 30 °C rather than at a temperature of 80 °C.

(2)

30°C is the optimum temperature for yeast as a catalyst and too high temperatures will denature the enzyme (yeast)

ResultsPlus
Examiner Comments

A good answer that scored both marking points.

Explain why the reaction is carried out at a temperature of 30 °C rather than at a temperature of 80 °C.

(2)

Because the enzymes inside the reaction would denature at a temperature too high. Also alcohol burns easily therefore if the temperate is too high it could begin evaporating.

ResultsPlus
Examiner Comments

The misconception that the alcohol would evaporate was ignored, this answer scored 1 mark.

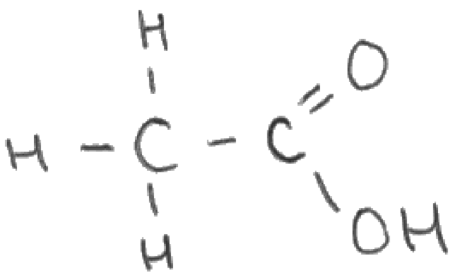
Question 4 (b) (ii)

A good proportion of candidates scored on this question with the majority scoring the full 2 marks.

In some cases, although the majority of the molecule had been drawn correctly, the inclusion of a double bond between the two carbons meant that a maximum of 1 mark could be scored.

(ii) Draw the structure of a molecule of ethanoic acid, CH_3COOH, showing all covalent bonds.

(2)

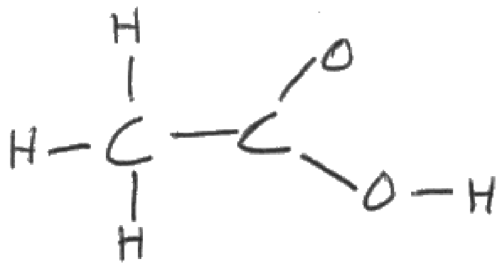


ResultsPlus
Examiner Comments

Although the OH on the carboxylic acid has not been fully displayed, full credit was still awarded.

(ii) Draw the structure of a molecule of ethanoic acid, CH_3COOH, showing all covalent bonds.

(2)



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Examiner Comments

Those that did not score full credit, often lost marks as they did not draw the correct functional group for the carboxylic acid group.

Question 4 (c) (i)

It was pleasing to see that many candidates were familiar with this apparatus and were able to describe the remaining steps of the method needed to determine the mass of ethanol to raise the temperature of the water by 30 ° C.

(c) (i) The apparatus in Figure 3 can be used to investigate the temperature rise produced in a known mass of water when a sample of ethanol is burned.

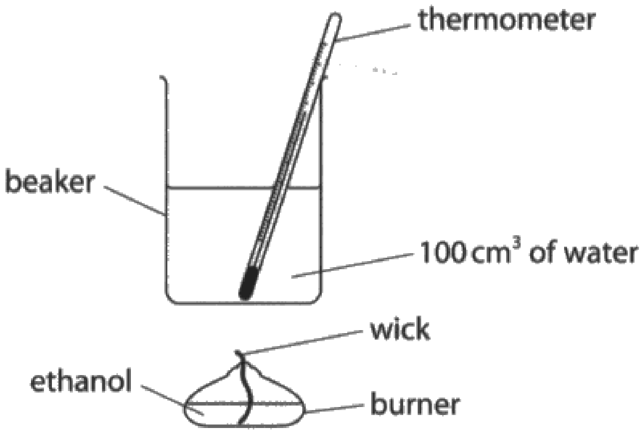

Figure 3

The first steps of the method are

1. put 100 cm³ of water into a beaker
2. determine the mass of the burner containing ethanol
3. measure the initial temperature of the water
4. place the burner under the beaker of water
5. light the wick

6. look at therm – at 30° put out flame

Describe the remaining steps of the method that are needed to determine the mass of ethanol required to raise the temperature of the water by 30 °C.

(3)

6. keep looking at the thermometre until it reaches 30°.
7. Once it reaches 30° extinguish the flame not by blowing it out but by suffocating it.
8. then measure the mass of the burner containing ethanol.
9. Take the new mass away from the initial mass.

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Examiner Comments

Those that did not gain full credit often lost marks as they stated that the flame should be extinguished when the water reaches 30°C rather than when the temperature of the water had been increased by 30°C. In these cases, two marks from the last three marking points could still be credited as in this example.

Question 4 (c) (ii)

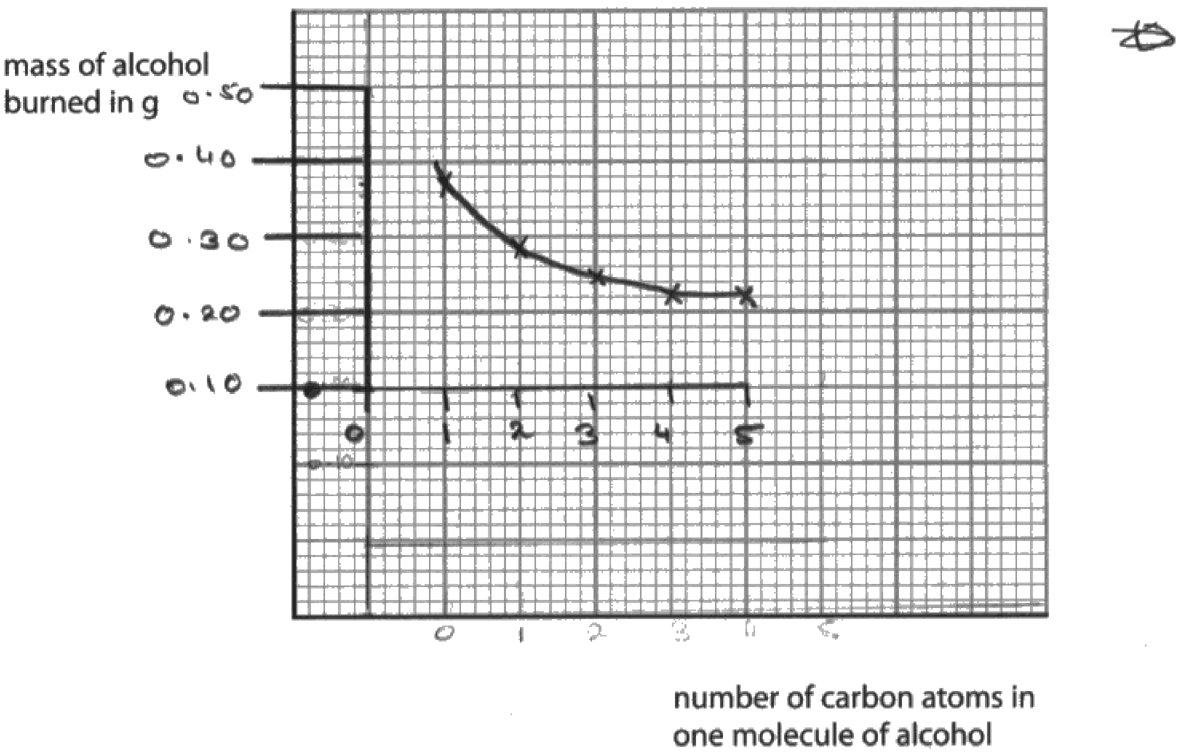
In general, this question was well answered with the majority gaining full marks, Point plotting was generally very good and in the main, good lines of best fit were drawn.

(ii) In a different experiment, separate samples of the alcohols methanol, ethanol, propanol, butanol and pentanol were burned to determine the mass of each alcohol that needs to be burned to raise the temperature of 100 cm^3 water by 10 °C.

alcohol	number of carbon atoms in one molecule of alcohol	mass of alcohol burned in g
methanol	1	0.37 ✓
ethanol	2	0.28 ✓
propanol	3	0.25 ✓
butanol	4	0.23 ✓
pentanol	5	0.22

Draw a graph of the mass of each alcohol required to raise the temperature of 100 cm^3 of water by 10 °C against the number of carbon atoms in one molecule of that alcohol.

(3)



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Examiner Comments

In some cases, candidates lost marks as they drew a non-linear scale or drew a scale that did not take up at least half of the edge of the grid.

Question 5 (a) (ii)

Candidates performed well in this question with many being able to fully explain two factors that cause the percentage of carbon dioxide in today's atmosphere to vary. Candidates that lost marks often did so as they were too vague with their answers, for example simply stating that trees take in carbon dioxide rather than specifying that it is the process of photosynthesis that takes places in trees that causes the carbon dioxide to be absorbed. Weak terms such as breathing in place of respiration were ignored.

(ii) The actual percentage of carbon dioxide in the Earth's atmosphere today varies.

Explain **two** factors that cause the percentage of carbon dioxide in today's atmosphere to vary.

(4)

factor 1 The amount of plants taking in carbon dioxide, if there are lots then the percentage will decrease.

factor 2 The amount of fires /fossil fuels being burnt. The more burning, the more carbon dioxide will be in our atmosphere.

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Examiner Comments

This example gained three marks. Whilst there is no reference to photosynthesis the plants taking in carbon dioxide did score the second of the marking points in the pair. Burning fossil fuels increasing carbon dioxide all gained the marking points.

Question 5 (b)

Candidates found this question quite difficult. The best candidates understood the difference between intermolecular forces and covalent bonds and so answered well. However, many did not show this understanding and gave answers that referred to the weak covalent bonds that needed to be broken.

(b) Carbon dioxide is a simple molecular, covalent compound.

It has a low boiling point of –78.5 °C.

Explain why carbon dioxide has a low boiling point.

(2)

It has weak intermoleculer forces which are ~~easy~~ easily brokend down.

ResultsPlus
Examiner Comments

In this case, the candidate correctly refers to the weak intermolecular forces and stated that these are easily broken, simply stating the forces are easily broken was not sufficient to gain the second mark as there needed to some reference to the amount of heat or energy required. Therefore, this answer scored just 1 mark.

Explain why carbon dioxide has a low boiling point.

(2)

Covalent bonds are weak, so require less energy (thermal here) to break the bonds.

ResultsPlus
Examiner Comments

In this case the reference to the weak covalent bonds means that that this answer was rejected for both mark points and did not score.

Explain why carbon dioxide has a low boiling point.

(2)

Carbon dioxide has a low boiling point because it has weak intermolecular forces that don't require a lot of energy to be overcome.

ResultsPlus
Examiner Comments

A good answer that scored both marking points.

Question 5 (c)

Candidates were able to calculate the number of molecules in 0.11g of carbon dioxide successfully with many gaining 2 or 3 marks.

(c) Calculate the number of molecules in 0.11 g of carbon dioxide.

Give your answer to two significant figures.

(relative formula mass : $CO_2 = 44$
Avogadro constant $= 6.02 \times 10^{23}$)

(3)

moles = $\frac{\text{mass}}{\text{RFM}}$

$= \frac{0.11}{44} \Rightarrow 2.5 \times 10^{-3}$

$2.5 \times 10^{-3} \times 6.02 \times 10^{23}$

$= 1.505 \times 10^{21}$

$= 1.5 \times 10^{21}$ ✓ 2.s.f

number of molecules = 1.5×10^{21}

ResultsPlus
Examiner Comments

A good, clearly laid out answer that gained 3 marks.

$\frac{44}{0.11} = 400 \quad 400 \times 6.02 \times 10^{23} = 2.408 \times 10^{26}$

$= 2.40 \times 10^{26}.$

$= 2.4 \times 10^{26}$

number of molecules = $2.4 \times 10^{26}.$

ResultsPlus
Examiner Comments

In other cases, candidates inverted the fraction to find the number of moles incorrectly. this error was carried forward and so therefore a mark of 2 was still awarded for multiplying by Avogadro's constant and then giving their answer to two significant figures.

$\frac{0.11}{44} = 2.5 \times 10^{-3}$

$2.5 \times 10^{-3} \times (6.02 \times 10^{23}) = 1.505 \times 10^{21}$

number of molecules = 1.505×10^{21}

ResultsPlus
Examiner Comments

A common error, as in this case, is where candidates lost marks because they did not give their answer to 2 significant figures.

Question 6 (b) (i)

Candidates seem familiar with the reactions of the alkali metals and were able to apply their knowledge to rubidium to gain credit.

Most gained credit for stating that there would be an explosion or a flame and that there would be bubbling or effervescence.

(b) Lithium, potassium and rubidium are alkali metals.

(i) Describe what you would see when a small piece of rubidium is dropped on to water.

(2)

Effervegence & extrem fizzing.

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Examiner Comments

Effervescence and fizzing are the same marking point so this answer gained just 1 mark.

ResultsPlus
Examiner Tip

Avoid giving synonyms of the same word as credit will only be awarded once.

(i) Describe what you would see when a small piece of rubidium is dropped on to water.

(2)

Rapid fizzing. The rubidium would appear to be disappearing.

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Examiner Comments

Fizzing and the rubidium appearing to disappear both gain credit and 2 marks were awarded here.

Question 6 (b) (ii)

In this second question on the alkali metals, again candidates performed well with many candidates being able to explain, in terms of their electronic configurations why lithium is less reactive than potassium.

(ii) The electronic configuration of lithium is 2.1
The electronic configuration of potassium is 2.8.8.1
Lithium is less reactive than potassium.

Explain, in terms of their electronic configurations, why lithium is less reactive than potassium.

(3)

Because ~~pot~~ the 1 electron on the outer shell of potassium, is very far away from the ~~nu~~ nucleaus and doesn't have a strong attraction ~~the~~ to the positive nucleaus, so it can loose its outer ~~ele~~ electron very quickly so is ~~and~~ very reactive, whereas The outer shell electon on lithium is very close the nucleaus So is not lost as easily.

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Examiner Comments

A good answer that scored all 3 marks

Explain, in terms of their electronic configurations, why lithium is less reactive than potassium.

(3)

lithium is less reactive as it has less electrons and less outter shells so there are less electrons to react with as they can't move around as much.

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Examiner Comments

Where marks were lost in this question, it was because candidates were not specific with their answers and referred to electrons in general rather than the electron in the outer shell, or where candidates referred to the potassium having more outer shells rather than having more shells.

Question 6 (c)

In general, candidates performed well in this question with the majority being able to score the full 4 marks available for calculating the relative atomic mass of lithium in the sample. Some candidates did not however show this understanding of how to use the data given with different methods of divisions and subtractions seen that did not result in a correct answer. They could still however access mark point 4 for their answer given to 2 decimal places.

(c) Lithium has two naturally occurring isotopes, lithium-6 and lithium-7.

A sample of lithium contains
7.59% of lithium-6
92.41% of lithium-7.

Calculate the relative atomic mass of lithium in this sample.

Give your answer to two decimal places.
You must show your working.

(4)

$$\frac{(7.59 \times 6) + (92.41 \times 7)}{100}$$

$= 6.9241$

relative atomic mass of lithium = 6.9241

ResultsPlus
Examiner Comments

In some cases, candidates lost a mark as they did not give their answer to 2 decimal places.

7239 (% × RFM) + (% × RFM) / No. Moles

(7.59 × 6) + (92.41 × 7) / 100

43.54 + 646.87 / 100 = 6.924

relative atomic mass of lithium = 6.92

ResultsPlus
Examiner Comments

A well laid out answer with the correct answer to 2 decimal places on the answer line to gain full marks.

Question 7 (a)

Candidates found explaining why ethene is unsaturated relatively straightforward with many gaining a mark for this. However, a large proportion of these failed to continue to explain what was meant by hydrocarbon to gain the second of the two marking points.

7 Ethene, C_2H_4, is an unsaturated hydrocarbon.

(a) Explain why ethene is an **unsaturated hydrocarbon**.

(2)

It has a double bond between the carbons.

ResultsPlus
Examiner Comments

The most common answer that addresses the unsaturated nature of the ethene only gains just 1 mark only.

(a) Explain why ethene is an **unsaturated hydrocarbon**.

(2)

ethene is an unsaturated hydrocarbon because it contains a double C=C bond, and consists only of hydrogen and carbon atoms.

ResultsPlus
Examiner Comments

A good answer that explains both parts of the definition.

Question 7 (b)

Candidates performed well in this question with many gaining full marks for the correct balanced equation for the complete combustion of ethene in oxygen.

(b) A sample of ethene is burned completely in oxygen.

Write the balanced equation for this reaction.

(3)

$C_2H_4 + O_2 \rightarrow CH_3COOH$

ResultsPlus
Examiner Comments

Where candidates lost marks, it was often as they gave the formula of oxygen as O rather than O_2. Others lost marks as they were not aware that the products of the complete combustion were carbon dioxide and water with a common misconception being that ethanoic acid would be produced.

Write the balanced equation for this reaction.

(3)

$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

ResultsPlus
Examiner Comments

Those that knew all the formula of the reactants and products were often able to balance these correctly to gain the third marking point and gain 3 marks as in this example.

Question 7 (c)

A good range of marks were seen on this question. The majority of candidates were familiar with the bromine water test. However, not all were able to apply the correct reaction to the correct substance. Some were able to get the correct change but failed to state the original colour of the bromine water. Some candidates are still incorrectly referring to the colour change with ethene as clear rather than colourless. Whilst saying this the most popular mark scored on this paper was the full 3 marks. A large proportion of candidates tried to explain why the bromine water decolourised or otherwise. Candidates would benefit with more guidance as to what is required by different command words so that if asked to describe what they would see, they should not then be trying to explain those observations.

(c) Ethene can be polymerised to form poly(ethene).

Describe what you would **see** when a sample of ethene and a sample of poly(ethene) are shaken with separate, small volumes of bromine water.

(3)

The ethene would turn the bromine water from orange to colourless, The poly(ethene) would do the same thing but faster than the ethene

ResultsPlus
Examiner Comments

A common misconception was that poly(ethene) had many double bonds and therefore the reaction with bromine water would occur much quicker with the poly(ethene) than with the ethene.

Question 7 (d)

Candidates performed well in this question with a large proportion of candidates scoring the full 3 marks available for deducing the molecular formula of the hydrocarbon.

(d) A different hydrocarbon has a relative formula mass of 84.
It has an empirical formula of CH_2. = 14

Deduce the molecular formula of this hydrocarbon. 84 ÷ 14 = 6

You must show your working.

(relative atomic masses : H=1, C=12)

(3)

$CH_2 \times 6 =$ C_6H_{12} $\frac{84}{14} = 6$

(12+(2×1))
$CH_2 = 14$

molecular formula = C_6H_{12}

ResultsPlus
Examiner Comments

A number of different approaches to deducing the formula were used that gained the correct answer, all of which gained full marks.

$(1 \times 2) + (12 \times 1) = 14$ – RAM of CH_4

÷14 (14 : 84) ÷14

1 : 6 $2 \times 6 = 12$

therefore, using the 1:6 ratio, the molecular formula is:

CH_{12}

molecular formula = CH_{12}

ResultsPlus
Examiner Comments

In this example, the candidate has calculated the correct ratio but then incorrectly converted this into the molecular formula and therefore lost the last mark scoring just 2 of the 3 marks.

Question 8 (a)

It was pleasing to see that the majority of candidates were familiar with this experiment and therefore the apparatus that should be required. However, the skill of drawing apparatus was weak. For the first marking point, where candidates lost marks, it was often as they missed key pieces of apparatus for the apparatus to work such as the bung or drawing a bung that clearly left a big gap meaning that the gas would not have been collected in the rest of the apparatus, another common error was where candidates drew a delivery tube that extended down into the dilute hydrochloric acid. For the second mark, the majority keyed into the question and attempted to draw a gas syringe for accuracy rather than an inverted measuring cylinder over water, however both received credit for this part.

8 Calcium carbonate reacts with dilute hydrochloric acid to produce calcium chloride, water and carbon dioxide.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

(a) A student wanted to measure the amount of gas produced in two minutes.

The student suggested that this could be done by counting the number of bubbles formed.
However, the bubbles are produced too quickly to count them.

Figure 4 shows a conical flask in which the calcium carbonate and dilute hydrochloric acid are reacting.

Complete Figure 4 to show the apparatus that could be used to measure accurately the volume of gas given off in two minutes.

(2)

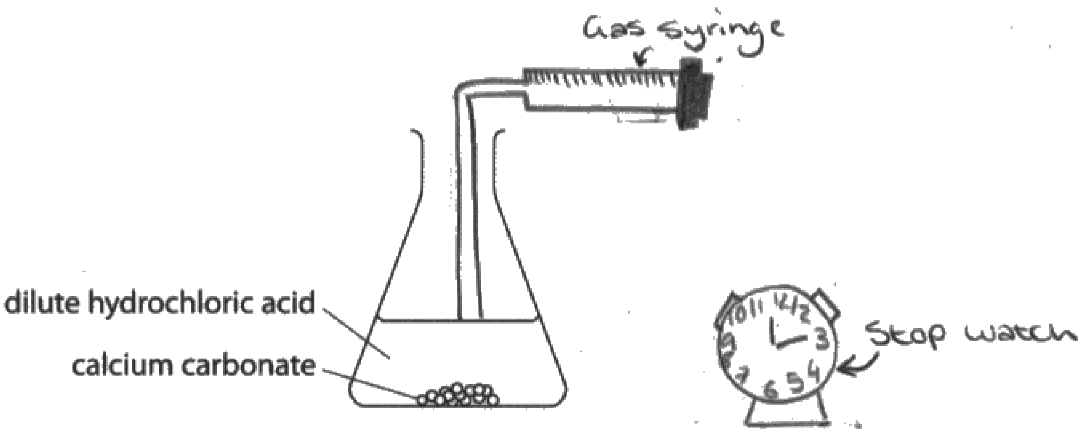

Figure 4

ResultsPlus
Examiner Comments

Where candidates lost marks, it was often as they missed key pieces of apparatus for the apparatus to work such as the bung meaning that the gas would not have been collected in the rest of the apparatus.

ResultsPlus
Examiner Tip

Marks were awarded for reasonably drawn apparatus, more time should be spent on drawing correct and scientifically accurate drawings of apparatus.

Question 8 (b)

Candidates still find the concept of bond making or bond breaking very challenging and bringing the two together to explain an overall change could only be achieved by the best candidates. Marking point 3 was often not attempted or contradicted what has been written elsewhere. Some candidates talked more about the number of bonds breaking rather than comparing the amount of energy taken in or given out. Lack of the correct terminology often let candidates down in this question.

(b) The reaction between calcium carbonate and dilute hydrochloric acid is exothermic.

Explain, in terms of bond breaking and bond making, why some reactions are exothermic.

(3)

When bonds are broken, some of the energy is released into its surroundings, making it exothermic. However, bond making uses some energy from its surroundings to form the bonds, making it endothermic.

ResultsPlus
Examiner Comments

A common incorrect answer that gained no credit.

Question 8 (c)

This question was the first of the two 6 mark levelled response questions based on the effect of changing the concentration of hydrochloric acid and changing the size of lumps of calcium carbonate on the rate of a reaction.

It was pleasing to see that candidates found this question accessible with very few blank responses seen. A good range of marks were seen with the majority scoring marks in level 3. In general, the best answers were often concise with excellent, succinct explanations, using the correct scientific terminology. It was clear that teachers have focused on teaching candidates to use clear terminology with many using the correct scientific terms throughout their answers with many candidates answering using the idea of frequency of collisions to explain their answer. Weaker candidates were confused between the increased frequency of collisions and increased energy of collisions, in these cases the lower mark in the level was awarded.

Those that scored a mark in level 2 rather than level 3, often did so as they only explained one of the factors, albeit it in good detail or if they did not relate their answer to the context of the question and referred to the amount of gas produced in the reactions. In other examples, candidates were able to give a weak explanation of both the effect of the size of the lumps and the concentration of the acid but not in detail which scored them a mark in level 2.

*(c) An investigation was carried out into the rate of reaction of calcium carbonate with dilute hydrochloric acid.

5.0g of small lumps of calcium carbonate were reacted with 50 cm^3 of 0.50 mol dm^{-3} hydrochloric acid.
Another 5.0g of the same sized lumps of calcium carbonate were reacted with 50 cm^3 of 1.0 mol dm^{-3} hydrochloric acid.
The volume of gas collected in two minutes was recorded for each experiment.

The two experiments were then repeated, each using 5.0g of large lumps of calcium carbonate.

Figure 5 shows the results.

concentration of hydrochloric acid in mol dm^{-3}	volume of gas collected in cm^3	
	small lumps of calcium carbonate	large lumps of calcium carbonate
0.50	17.2	3.1
1.0	35.1	5.6

Figure 5

Explain, in terms of collision of particles, how these results show the effect of the size of the lumps of calcium carbonate and the effect of the concentration of the acid on the rate of this reaction.

(6)

• When small lumps were used a higher volume of gas is produced because there is a larger surface area in direct contact with the HCl, meaning more collisions occur, meaning more gas is produced.
• When 1.0 concentration is used there are more H^+ ions which can dissociate. Because there is a higher frequency more collisions with the $CaCO_3$ occur, meaning higher rate of reaction, meaning more gas is produced.

→ The most reactive of the 4 tests was 1.0 HCl and small lumps of HCl because there was both a high concentration of H^+ ions, meaning the likelihood of collision increases, and small lumps, meaning the surface area on which to collide was larger meaning a fast rate of reaction, meaning more gas produced.

→ The next most reactive was the test will small bits and low HCl concentration. This is because the surface area is so ~~[illegible]~~ increased that it is the largest affector, and so the lower concentration decreases collisions slightly, but the rate of reaction still remains high.

→ The 3rd most reactive was the test with 1.0 conc and ~~large~~ small surface area. The 1.0 conc means high frequency of collisions, but the smaller surface area means the likelihood of collisions is decreased.

→ The least reactive was the test with large bits and 0.5 conc because there is a smaller surface area in direct contact with the HCl, which contains less H^+ ions, meaning there is a low frequency of collisions, meaning low rate of reaction, meaning small volume of gas produced.

ResultsPlus
Examiner Comments

In this example, the candidate has fully explained the results in the table explaining the effect of increasing concentration and changing the size of the lumps of calcium carbonate on the amount of gas produced and rate of reaction, giving more than necessary to gain the full 6 marks available in level 3.

In terms of the size of the lumps they affect the rate of reaction because smaller lumps have a larger surface area this will increase the rate of successful collisions because the particles are more likely to collide which increases rate of reaction. If the lumps are larger the chance of successful collisions is lower because the surface area will be smaller. In terms of concentration, if the concentration is higher it means there are more particles in the same volume, this increases chances of successful collisions because of the increased number of particles meaning they're more likely to collide thus increases rate of reaction. The small lumps and higher concentration would have largest results but smallest rate of reaction because there are two factors which speed up rate of reaction.

ResultsPlus
Examiner Comments

In this example, the candidate has discussed the concentration of the hydrochloric acid and the size of the lumps of calcium carbonate but they have not related this to the results in the table and the amount of gas produced and a mark of 4 in level 2 was awarded.

The small lumps of calcium carbonate meant there was a larger surface area and that means more hydrochloric acid will be in contact with the calcium carbonate giving off more bubbles and a greater reaction. The larger lumps have a much smaller surface area because there will be less of them meaning a smaller surface area so less of a reaction.

ResultsPlus
Examiner Comments

In this example, the candidate has only focused on the size of the lumps of calcium carbonate. The explanation is simple and sufficient for level 1 - 2 marks only.

The candidate has given the explanation for the small lumps of calcium carbonate followed by the reverse argument for large lumps. The explanation for the small lumps only was sufficient for the 2 marks and the reverse argument adds no more to the answer.

Question 9 (a)

A good proportion of candidates were able to correctly describe the test for chlorine gas. Of those that knew litmus paper was to be used a large proportion knew the correct result of this test with smaller proportion scoring just 1 mark.

9 Fluorine, chlorine, bromine, iodine and astatine are elements in group 7.

(a) Describe the test to show that a gas is chlorine.

(2)

Add damp litmus paper to a test tube of chlorine gas. In the presence of chlorine the damp litmus paper will be bleached.

ResultsPlus
Examiner Comments

A clear answer that gained both marks.

(a) Describe the test to show that a gas is chlorine.

(2)

Add nitric acid to the solution then adding silver nitrate solution if chlorine is present the solution will turn white.

alkali metal + hydrogen = alkali salt + water

ResultsPlus
Examiner Comments

Some candidates tried to describe the test for chloride ions or carbon dioxide gas rather than the chlorine gas, this gained no credit.

ResultsPlus
Examiner Tip

Candidates should be taught the difference between chloride and chlorine and their tests.

Question 9 (b)

Candidates found stating the name of the solution formed when hydrogen bromide dissolves in water very difficult, with only the best candidates scoring this mark.

(b) Bromine reacts with hydrogen to form hydrogen bromide.
Hydrogen bromide dissolves in water to form a solution.

State the name of the solution formed.

(1)

hydrobromic acid.

ResultsPlus
Examiner Comments

The correct answer gained 1 mark.

~~hydrogen~~ bromine hydroxide

ResultsPlus
Examiner Comments

A very common incorrect answer was that bromine hydroxide was formed.

Question 9 (d)

It appeared that in this question, those candidates that had some experience of carrying out displacement reactions practically were able to answer in a much better way than those that had not and were replying just on their theoretical knowledge. These candidates often gave all five of the marking points in their answer. A common error seen was that the potassium was displacing the halogen from the solution rather than a more reactive halogen displacing a less reactive one. Others thought that iodine was the most reactive as it left a brown solution in all three reactions. Candidates that simply copied information from the stem of the question did not gain credit.

(d) **Bromine, chlorine and iodine are dissolved in water to make aqueous solutions. Potassium iodide solution is added to each of these solutions.**

Figure 6 shows the observations.

halogen	initial colour of aqueous solution	final colour of mixture
bromine	orange	brown
chlorine	pale green	brown
iodine	brown	brown

Figure 6

Explain the observations shown in the table.

(4)

bromine displaces iodide from the solution
because bromine is more reactive.
chlorine displaces the iodide from solution
because chlorine is more reactive so it turns
brown because iodide is brown.
Iodine does not displace it self so
the solution remains brown.

ResultsPlus
Examiner Comments

A good answer that gained all 4 marks.

Question 9 (e)

Candidates gain lost marks in this balanced equation as they did not seem to be aware that fluorine is a diatomic element and therefor gave the formula as F rather than F_2, therefore losing the first mark. As all formula had to be correct for the balancing mark, the second mark was often then lost too.

(e) Fluorine reacts vigorously with iron to produce iron(III) fluoride, FeF_3.

Write the balanced equation for this reaction.

(2)

3f + Fe → fef3

ResultsPlus
Examiner Comments

The most common incorrect answer that scored no marks.

$3F_2 + 2Fe \longrightarrow 2FeF_3$

ResultsPlus
Examiner Comments

A good answer that scored both marks.

Question 10 (a)

The most common score on this question was 0. Candidates found it hard to describe how it could be shown the potassium and sodium ions were present in the sample.

Although it had been stated that a flame test had already been carried out on the sample, many candidates then described how to carry out the flame test.

Of those that knew that a flame photometer should be used, only around half of those then knew how this would show that the two ions were present.

10 (a) A sample of potassium carbonate is contaminated with a small amount of sodium carbonate.
When a flame test is carried out on the sample, a bright yellow flame is seen.

Describe how you could show that potassium and sodium ions are present in this sample.

(2)

Dip a sterilised wire loop into the sample and angle slightly on the bunsenburner to create a coloured flame. If potassium ions are present, it becomes a lilac flame. If sodium ions are present, it produces a yellow flame.

ResultsPlus
Examiner Comments

Although it had been stated that a flame test had already been carried out on the sample, many candidates then described how to carry out the flame test. This gained no credit.

You could use flame photometry to determine whether potassium and sodium ions are present.

ResultsPlus
Examiner Comments

In this example, the candidate understood that a flame photometer should be used, but does not describe how this would show that the potassium and sodium ions were present.

ResultsPlus
Examiner Tip

When describing tests, ensure that you always give the manner to test for a substance and then how you would know that the ion in question is present.

I would use flame photometry to ~~a~~ identify these ions using the range of ~~li~~ light wavelengths produced and comparing ~~thos~~ them with the wavelengths ~~of~~ produced by different ions including sodium and potassium.

ResultsPlus
Examiner Comments

A good answer that gained both marks.

Question 10 (b)

Writing the ionic equation for the reaction between hydrochloric acid and sodium carbonate proved very difficult for candidates.

In many cases it was clear that candidates did not know what an ionic equation was and often repeated the equation from above in the question.

In some cases, candidates gave all the ions and molecules present in the reaction but did not take this further to write the ionic equations.

Where candidates did score, it was often for the right hand side of the equation.

(b) Hydrochloric acid reacts with a solution of sodium carbonate.

$$2HCl(aq) + Na_2CO_3(aq) \rightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$$

Write the ionic equation for this reaction.

(3)

$$2H^+ + CO_3^{2-} \longrightarrow CO_2 + H_2O$$

ResultsPlus
Examiner Comments

Those that gained a mark for the left hand side and the right hand side of the equation very often were able to balance the equation too and so few gained just 2 marks.

$$Cl^-_{(aq)} + Na^+_{(aq)} \longrightarrow NaCl_{(aq)}$$

ResultsPlus
Examiner Comments

A very common incorrect answer that scored no marks.

Question 10 (c)

The second of the two extended answer level based questions was again well attempted with marks awarded equally across the mark range. Candidates appeared to interact well with the question and understood what was required of them to gain the marks. Again, it was clear that many candidates were familiar with the practical and those that had were able answer well.

Knowledge of the tests was good. Candidates found discussing the additional test required to justify the presence of the ammonium ion and the sulfate ions the most difficult.

The more successful candidates structured their answers in a systematic, organised manner discussing each substance in turn. The test for chloride and iron (II) were well known. However, a noticeable proportion of candidates appeared to be confused between ammonium and aluminium ions.

*(c) A student tests solutions of three ionic substances, **K**, **L** and **M**.

The student carries out the same two tests on each of the three solutions.

Test 1 add dilute nitric acid and then silver nitrate solution.

Test 2 add a few drops of sodium hydroxide solution and warm the mixture.

Figure 7 shows the results of the tests and the student's conclusions about the identity of each substance.

ionic substance	test 1	test 2	student's conclusion
K	white precipitate	colourless solution	ammonium chloride ✓
L	white precipitate	white precipitate	aluminium chloride ✓
M	no precipitate	green precipitate	iron(II) ✓ sulfate

Figure 7

None of the student's conclusions are fully justified.

Explain which part of each conclusion is justified and what further work can be carried out to fully justify each conclusion.

(6)

Test 1 - This is a test for Halide ions (anions)

(K) - This produces a white precipitate so yes the 'CHLORIDE' is justifiable ~~[crossed out]~~ but NOT 'AMMONIUM' as we have not tested for that yet.

(L) - This also produces a white precipitate so again, 'CHLORIDE' is justifiable but not yet 'ALUMINIUM' as chloride is meant to produce white precipitat

(M) - Since there is no precipitate we know there are no HALIDE ions present but it is impossible yet to justify 'IRON (II) SULPHATE".

Test 2 - This is a test for Cations.

(K) Since it is colourless, it is possible that the result is 'AMMONIUM' but further tests are required to completely justify this.

(L) - Again, 'ALUMINIUM' is potentially correct but needs further tests to confirm.

(M) - A green precipitate is definitely "Iron (II)" so yes this is justifiable

FURTHER TESTS:

(K) To check it is ammonium, hold up damp red litmus paper to test tube. If it turns blue, 'AMMONIUM CHLORIDE" is correct as AMMONIUM turns red litmus paper blue

(L) To confirm 'ALUMINIUM' is correct, add excess Sodium Hydroxide. If it goes colourless, 'ALUMINIUM CHLORIDE" is correct. Else it is "CALCIUM CHLORIDE".

Ⓜ To verify that "SULPHATE" is correct, Add. dilute hydrochloric acid and then barium chloride. If white precipitate forms, "SULPHATE" ion s are present so "IRON(II) SULPHATE" is correct.

else:

-if sulphates test negative, add dilute HCL and if a gas is given off test gas with limewater. If limewater goes cloudy, CO_2 is given off and carbonates are present. This proves Ⓜ is Iron(II) carbonate.

ResultsPlus
Examiner Comments

In this example, the candidate has gone through the results in the table in a logical way, discussing the results of each test for each substance, this very clear answer gained full credit at level 3.

For substance M the Iron(II) is identified by the green precipitate formed by test two but they havn't identified the sulfate, a different test for sulfer ions would need to be carried out using dilute hydrochloric acid and barium chloride, if a white precipitate forms there are sulfer ions present. In substance K and L the chloride is justified by the first test where a white precipitate forms showing the presense of a halide ion, chlorine.

ResultsPlus
Examiner Comments

In this example, the candidate has fully discussed both ions in substance M and the anions in substances K and L, they have not explained the further work required to justify the ammonium and aluminum in K and L. The answer was sufficient to gain full credit at level 2.

Test 1 ionic substance K and L had white precipitate and the students concluded that it was chloride this justified has they both have the same answer.

ResultsPlus
Examiner Comments

In this example, the candidate has explained why two of the ions in present are justified by the results shown. These partial explanations are sufficient for full credit in level 1.

Paper Summary

Candidates that did well this session were able to do so are they knew formula of common elements. They were able to read and analyse information and new contexts and were able to apply their knowledge of chemistry to these new situations. They were able to carry out calculations well, showing their working clearly and concisely to gain the marks. It was pleasing to see that centres have obviously been taking care to ensure that candidates are prepared for the exam by giving them the time and opportunity to engage with the practical work as there was an increase in candidates ability to response to practical based questions.

Candidates that did less well, did so because they lacked understanding of some of the basic chemistry concepts such as knowledge of which elements are diatomic. This had a big impact on the balanced equations. Knowledge of practical work in the less able was an issue. Candidates could improve by being taught the meaning of different command words such as describe and explain. Many candidates when asked to describe what was seen, often tried to explain. Candidates should be taught to structure their answers, including in the calculations in an organised and in a logical manner, which often leads them to a correct conclusion in a straight forward way.

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