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Examiners' Report
June 2022

International GCSE Chemistry Science Double Award 4SD0 1CR

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Introduction

The paper contained a range of questions with a mixture of question styles and varying levels of demand, ranging from some designed to be accessible for all candidates, to others meant to be challenging for even the most able. There were opportunities for candidates to show their knowledge, understanding and experience of a wide range of topics including practical work they have carried out as part of their course.

The paper seemed to allow all candidates to show their ability and there was no evidence of any candidates having any time issues.

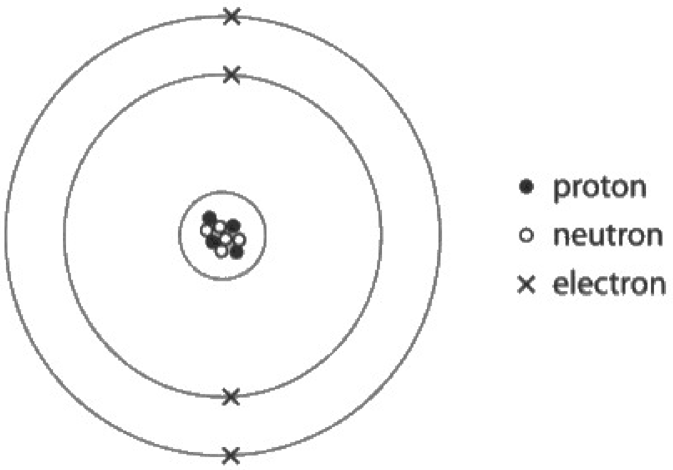
A general comment worth making is that candidates should read all the questions carefully, as they often contain information such as formulae, and other advice to help them in their answers.

This report gives examples of typical responses to questions and some comments on them.

Question 1 (a)

Most candidates were able to give the correct atomic number and mass number of the atom with many also giving the correct period number. The last part, requiring the number of electrons in the 2+ ion formed from the atom proved the most challenging.

1 (a) The diagram represents an atom of an element.



Use numbers from the box to complete the table.

You may use each number once, more than once or not at all.

2	4	5	9	10

(4)

Atomic number of this atom	4
Mass number of this atom	9
Period number of this element	2
Number of electrons in the 2+ ion formed from this atom	4

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Examiner Comments

This answer gains three marks as it has the first three numbers correct but then gives the number of electrons in the atom instead of in the 2+ ion formed from the atom.

Question 1 (b)

This question asking for a similarity and a difference in isotopes of the same element was generally well answered, although some candidates did not answer in terms of sub-atomic particles as was required.

(b) In terms of sub-atomic particles, state a similarity and a difference for isotopes of the same element.

(2)

similarity

~~Same chemical properties~~ Same proton number

difference

Different mass number

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Examiner Comments

This answer scores one mark for the similarity.

(b) In terms of sub-atomic particles, state a similarity and a difference for isotopes of the same element.

(2)

similarity

~~Same~~ They have same atomic number.

difference

They have different mass number.

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Examiner Comments

The question asked for answers in terms of sub-atomic particles. This candidate has not done this but as they have given a correct similarity and difference the answer was awarded one mark.

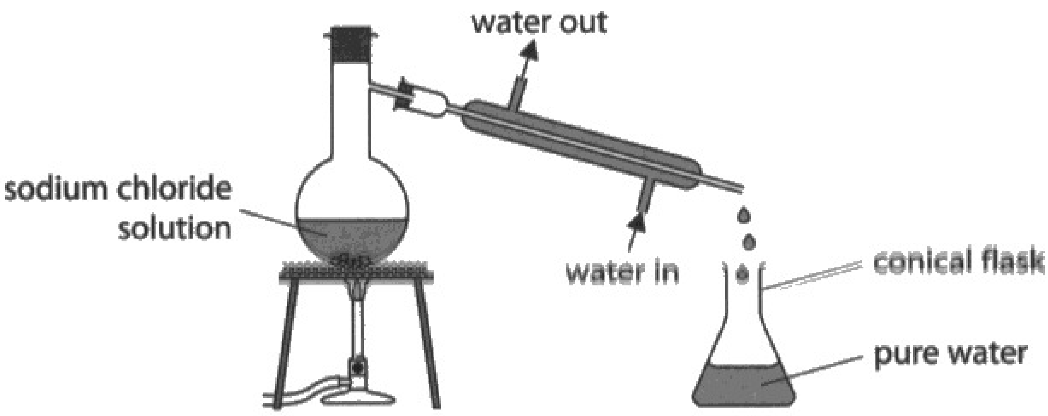
Question 2 (a)

Although this question was often well answered, it was surprising how many candidates could not recognise or give the correct name of a gas syringe.

Question 2 (b)(i)

Good answers were not as common as expected. A lot of candidates showed a lack of clarity or confusion about the process with some thinking sodium chloride solution or even pure sodium chloride passed through the condenser. Other candidates gave vague answers involving impurities.

(b) The diagram shows apparatus used to obtain pure water from sodium chloride solution by simple distillation.



(i) Explain why it is necessary for water to flow continuously in and out of the apparatus.

(2)

to cool down the hot steam of ~~solution~~ water and make it condense in the condenser

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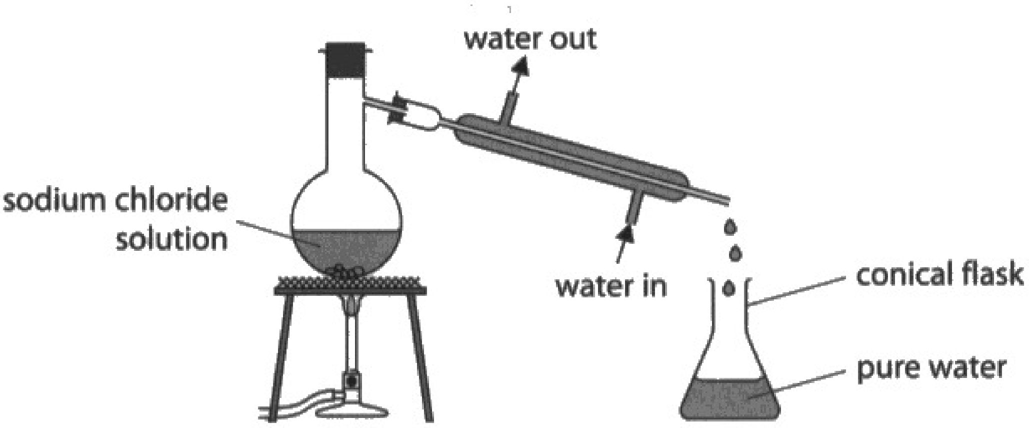
Examiner Comments

This is a good answer covering both points on the mark scheme and scores two marks.

(b) The diagram shows apparatus used to obtain pure water from sodium chloride solution by simple distillation.



(i) Explain why it is necessary for water to flow continuously in and out of the apparatus.

(2)

to cool the sodium chloride solution, so it doesn't affect the reaction with the pure water

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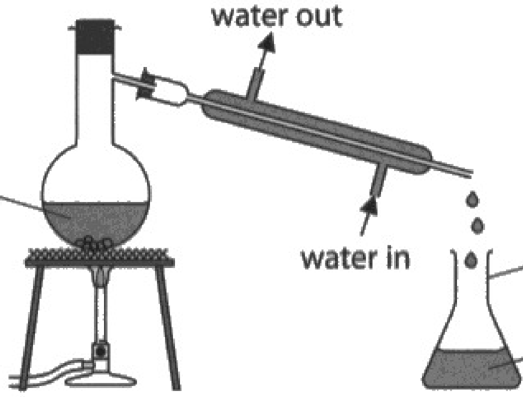
Examiner Comments

This answer contains quite a common error. The candidate incorrectly seems to think that sodium chloride solution is passing through the condenser. The answer gains no marks.

(b) The diagram shows apparatus used to obtain pure water from sodium chloride solution by simple distillation.



(i) Explain why it is necessary for water to flow continuously in and out of the apparatus.

(2)

The water is used for cooling the steam.
It is necessary for water to go in and leave out due to filling with cold water in water jacket.

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Examiner Comments

This answer scores one mark for a correct reference to cooling the steam but does not refer to the steam condensing so does not gain the second mark.

Question 2 (b)(ii)

Although many good answers were seen, it was surprising how many gave the test for chlorine gas instead of chloride ions.

(ii) Describe a chemical test to show that the sodium chloride solution contains chloride ions.

(2)

Bleaches ~~blue~~ damp litmus paper red

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Examiner Comments

This is an example of a candidate confusing the test for chlorine gas with the test for chloride ions. It scores no marks.

(ii) Describe a chemical test to show that the sodium chloride solution contains chloride ions.

(2)

~~NaCl → chlorine turns damp blue litmus paper white (bleaches it)~~

Add Dilute nitric acid + silver nitrate

↳ chloride gives white colour.

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Examiner Comments

This answer scores one mark for the silver nitrate but white colour is insufficient for the second mark – white precipitate is required.

(ii) Describe a chemical test to show that the sodium chloride solution contains chloride ions.

(2)

First add dilute ~~HCl~~ hydrochloric acid and then silver nitrate solution. ~~If a~~ A white precipitate would form.

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Examiner Comments

As the candidate has added hydrochloric acid, the mark for silver nitrate is not awarded. However the mark for white precipitate is given.

Question 2 (b)(iii)

The majority of candidates gave a correct description of a physical test for pure water in terms of either measuring its boiling point or freezing point. However some candidates described a test for the presence of water involving anhydrous copper sulfate or made suggestions involving pH measurement or filtering.

(iii) Describe a physical test to show that the liquid in the conical flask is pure water.

(2)

Boil the liquid in the conical flask, iF ~~and~~ it boils at the fixed boiling point 100 °C that means ~~wate~~ liquid is pure water iF not then it contains impurities and is not pure.

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Examiner Comments

This is an example of a good answer worth two marks.

(iii) Describe a physical test to show that the liquid in the conical flask is pure water.

(2)

we can use filtration method to collect pure water from the conical flask. The impurities will remain on the filter paper and the pure water will be left.

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Examiner Comments

A surprising number of candidates such as this one, despite being told the liquid is pure water, unfortunately seemed under the impression it contains impurities that can be removed by filtration.

Question 3 (a)(i)

As expected, most candidates correctly identified the food colouring containing three different food dyes.

Question 3 (a)(ii)

As expected, most candidates correctly identified the two food colourings containing the same dye.

Question 3 (a)(iii)

Many candidates followed the instruction in the question and were able to correctly calculate the R_f value. However, many did not use the scale as instructed but obviously used a ruler to make their own measurements to use in their calculation. If they did so correctly, they were able to score one mark.

(iii) Using the scale on the diagram, determine the R_f value of the dye in food colouring C.

(2)

C = 2 solvent front = 8

$R_f = \frac{2}{8} = 0.25$

R_f = 0.25

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Examiner Comments

This candidate has correctly answered the question using the scale as instructed and scores both the marks.

(iii) Using the scale on the diagram, determine the R_f value of the dye in food colouring C.

(2)

$\frac{1.5}{6.1} = 0.2459$

R_f = 0.25

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Examiner Comments

This candidate has not used the scale as instructed but has made their own measurements. However, the measurements are within the tolerance in the mark scheme and are used correctly and so the candidate is able to gain one mark.

Question 3 (a)(iv)

Most candidates correctly appreciated that the dye was the most soluble.

(iv) Give a reason why the dye in food colouring D moves the furthest from the start line.

(1)

it is ~~Soluble~~ dissolved in the Solvent. It is very Soluble in the Solvent.

ResultsPlus Examiner Comments

It is insufficient to say very soluble in the solvent – it must be the most soluble.

Question 3 (b)

Most candidates made a reasonable attempt at describing how to obtain a similar chromatogram. However, some answers lacked specific details such as not using a pencil for the start line, not stating that the samples should be placed on the start line or not making clear where the paper should be in relation to the depth of the solvent.

(b) Describe how a student could obtain a chromatogram similar to the one shown in the diagram.

(4)

Draw a base line near the bottom of the filter ~~fotts~~ paper with pencil, dot the food dyes along ~~onto~~ the base line. place the filter paper in a beaker of water, the base line must be above the level of water. ~~wat~~ Leave the paper in the beaker until the solvent level travels near the top of the paper, then take the paper ~~it~~ out.

ResultsPlus
Examiner Comments

This answer gained four marks.

Question 4 (a)(i)

Most candidates correctly selected the symbol of a metal from the diagram.

Question 4 (a)(ii)

Many candidates correctly selected the symbol of an element that forms an acidic oxide with S being the most common answer.

Question 4 (b)

Most candidates correctly stated that Al and In have the same number or three electrons in their outer shell. The most common reason for failing to gain the mark was just stating they are both in the same group or not referring to the outer shell.

(b) Give a similarity in the electron configurations of Al and In.

(1)

They are both in group 3.

ResultsPlus
Examiner Comments

This answer does not score the mark as it does not refer to the electron configuration as required.

Question 4 (c)

Most candidates correctly identified Xe but some omitted to give an explanation in terms of the outer shell.

(c) Explain which element in the diagram is unreactive.

(2)

gold is unreactive because its below hydrogen in terms of reactivity series and because its earth ~~metal~~ metals.

ResultsPlus
Examiner Comments

This could not gain a mark as gold was not in the diagram given.

(c) Explain which element in the diagram is unreactive.

(2)

Xe is unreactive as it is part of the Halogen group in group 7.

ResultsPlus
Examiner Comments

This candidate gains one mark for Xe but, along with a surprising number of others, incorrectly thinks it is in Group 7.

Question 4 (d)(i)

There were many fully correct answers but some candidates thought the sodium hydroxide solution is acidic. Other candidates gave colours which suggested they might have been thinking of other indicators.

(d) A teacher adds a small piece of sodium to a glass trough containing water and universal indicator.

The universal indicator changes colour.

The equation for the reaction is

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$

(i) Explain the final colour of the universal indicator.

(2)

The universal indicator would change its colour from colourless to blue.

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Examiner Comments

The initial colour of the indicator is ignored so one mark is awarded for blue but there is no explanation given so it cannot gain a second mark.

Question 4 (d)(ii)

Most candidates gave a correct similarity and the most common difference was the lilac flame with potassium, although some candidates just stated that potassium is more reactive without giving an observation.

(ii) The teacher repeats the experiment with potassium instead of sodium.

Give one similarity and one difference observed with potassium.

(2)

similarity

there will be effervesence and the sodium and potassium will get smaller and disappear/dissolve

difference

there will be a small lilac flame coming off the potassium

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Examiner Comments

This was a typical answer worth two marks with reference to a lilac flame with potassium.

Question 4 (d)(iii)

Although weaker candidates understandably found this calculation difficult, there were many good attempts. The main reasons for losing marks amongst those who were able to attempt it were failing to divide by the correct M_r or not giving the answer to two significant figures as required.

(iii) The reaction with sodium produces 0.036 g of hydrogen gas.

One mole of hydrogen gas contains 6.0×10^{23} molecules.

Calculate the number of molecules of hydrogen gas produced in the reaction with sodium.

Give your answer to two significant figures.

(3)

$$mol = \frac{mass}{mr} = \frac{0.036}{1} = 0.036 \text{ mol}$$

$$1 \times 0.036 = 0.036$$

$$6.0 \times 10^{23} \times 0.036 = 2.16 \times 10^{22}$$

number of molecules of hydrogen gas = 2.16×10^{22}

ResultsPlus
Examiner Comments

This candidate uses an incorrect M_r value but then gains MP2 on the mark scheme with ECF (error carried forward) being applied. However the final answer is not given to two significant figures so MP3 cannot be awarded.

(iii) The reaction with sodium produces 0.036 g of hydrogen gas.

One mole of hydrogen gas contains 6.0×10^{23} molecules.

Calculate the number of molecules of hydrogen gas produced in the reaction with sodium.

Give your answer to two significant figures.

(3)

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

$$= \frac{0.036}{2(1)}$$

$$= \frac{0.036}{2} = 0.018$$

$$0.018 \times (6 \times 10^{23})$$

$$= 1.08 \times 10^{22}$$

number of molecules of hydrogen gas = 1.08×10^{22}

ResultsPlus
Examiner Comments

This candidate has correctly attempted the calculation but has not given the final answer to two significant figures so scores two marks.

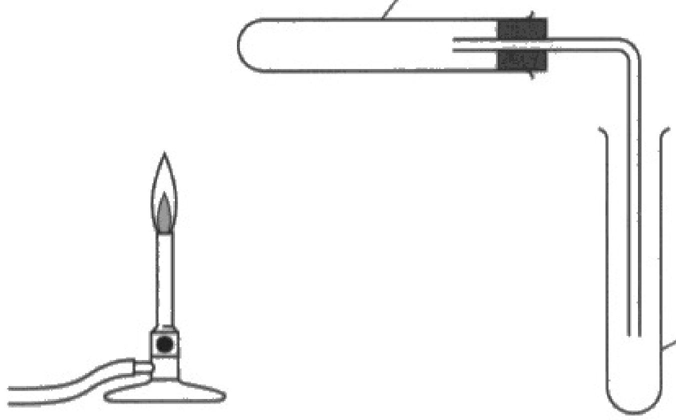
Question 5 (a)

As expected, a wide range of quality answers was seen, possibly indicative of the amount of practical experience of the candidates. Good candidates often scored three marks but only the best scored MP3 on the mark scheme, usually by referring to using the same mass of metal carbonate each time. Weaker answers involved descriptions of counting bubbles in the limewater or even suggested putting both the metal carbonate and limewater in the same tube.

5 This question is about metal carbonates.

When heated, some metal carbonates decompose to form a metal oxide and carbon dioxide gas.

(a) A student is given three solid metal carbonates, a timer, some limewater and this apparatus.



Describe a method the student can use to find out which metal carbonate decomposes fastest when heated.

(4)

~~The student could use a gas syringe to test for which metal carbonate decomposes fastest. This is because when a metal carbonate~~

First, take one of the metal carbonates and place it in the ~~bot~~ boiling tube. Then add ~~the lime~~ some of the lime water into the test tube. Place the bunsen burner under the boiling tube and start the timer. Record how long it takes for ~~each~~ the limewater to turn cloudy. This is because carbon dioxide is a product of metal carbonates thermal decomposition. Repeat the experiment with the two other metal carbonates and compare the results. The metal carbonate that took the least time for lime water to change decomposes the quickest.

ResultsPlus
Examiner Comments

This answer scores three marks but the candidate, like many others, does not score MP3 on the mark scheme by failing to mention some way of making it a fair test.

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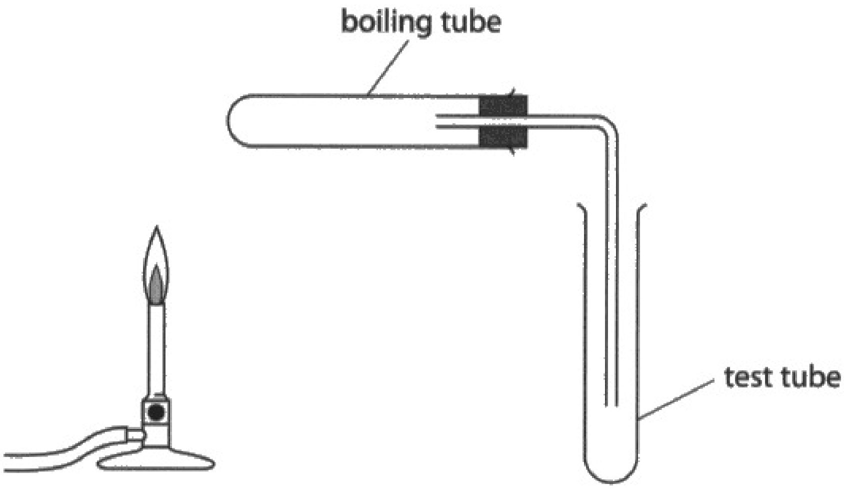

Describe a method the student can use to find out which metal carbonate decomposes fastest when heated.

(4)

Place the lime water in the test tube. The place one metal ~~oxide~~ carbonates in the boiling tube. ~~Then~~ After that heat the boiling tube and start the timer at the same time. Stop the timer once the lime water has turned cloudy. This will mean carbon dioxide is given off. Repeat this experiment with the diffrent metal carbonates but make sure you are using the same mass.

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Examiner Comments

This answer scores three marks but does not score MP4 on the mark scheme.

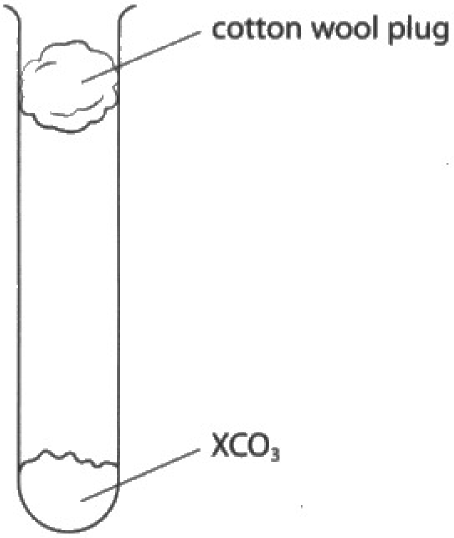
Question 5 (b)(i)

This question was not generally well answered. Many candidates thought the cotton wool was to prevent gas escaping or suggested it was to prevent acid spitting out, although there was no acid involved in the question.

(b) A student is given a solid metal carbonate with the formula XCO_3

X represents the symbol of a Group 2 metal.

A student uses this apparatus to heat a sample of XCO_3 until it all decomposes.



The equation for the decomposition of XCO_3 is

$$XCO_3 \rightarrow XO + CO_2$$

The student records the mass of XCO_3 and the mass of carbon dioxide that escapes through the cotton wool plug.

These are the student's results.

mass of XCO_3 = 7.40 g

mass of CO_2 = 2.20 g

(i) Give a reason why the student uses a cotton wool plug.

(1)

To prevent spitting out /escape of metal oxide and only allow the carbon dioxide to leave.

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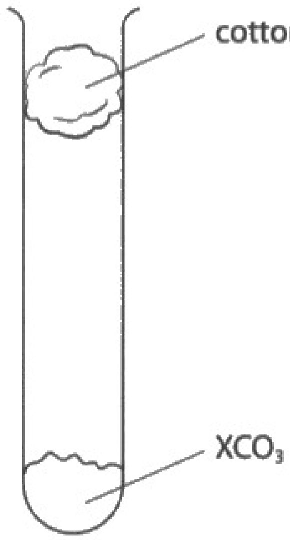
Examiner Comments

This is a very good response with two acceptable answers given.

(b) A student is given a solid metal carbonate with the formula XCO_3

X represents the symbol of a Group 2 metal.

A student uses this apparatus to heat a sample of XCO_3 until it all decomposes.



The equation for the decomposition of XCO_3 is

$$XCO_3 \rightarrow XO + CO_2$$

The student records the mass of XCO_3 and the mass of carbon dioxide that escapes through the cotton wool plug.

These are the student's results.

mass of XCO_3 = 7.40 g

mass of CO_2 = 2.20 g

(i) Give a reason why the student uses a cotton wool plug.

(1)

To prevent the gas from escaping which coult effect the results

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Examiner Comments

This was a common incorrect suggestion.

Question 5 (b)(ii-v)

Strong candidates scored well in this calculation but occasionally, having gotten all the way to an answer of 88 in part (b)(v) they then looked at the atomic number on the Periodic Table and gave radium as the metal instead of strontium. Weak candidates often only scored the mark in part (b)(ii).

(ii) Calculate the amount, in mol, of carbon dioxide produced.

[for carbon dioxide M_r = 44]

(1)

moles = $\frac{mass}{mm}$ = $\frac{2.20}{44}$ = 0.05 mol

amount of carbon dioxide = 0.05 mol

(iii) Use the equation to determine the amount, in mol, of XCO_3 that decomposed.

(1)

amount of XCO_3 = 0.05 mol

(iv) Use the mass of XCO_3 and your answer to (b)(iii) to calculate the relative formula mass (M_r) of XCO_3

(2)

moles = $\frac{m}{mm}$

mm = $\frac{mass}{moles}$ = $\frac{7.40}{0.05}$ = 148

M_r of XCO_3 = 148

(v) Use your answer to (b)(iv) and the Periodic Table on page 2 to determine the identity of the Group 2 metal X.

Show your working.

(2)

CO_3 = 12 + (16×3) = 60

X = 148 − 60 = 88 = Strontium (Sr)

identity of X = Strontium

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Examiner Comments

This a well presented, fully correct answer from a strong candidate.

(ii) Calculate the amount, in mol, of carbon dioxide produced. CO_2.

[for carbon dioxide $M_r = 44$]

(1)

$$n = \frac{m}{M}$$
$$= \frac{2.2}{44} = 0.05 \text{ mol}$$

amount of carbon dioxide = 0.05 mol

(iii) Use the equation to determine the amount, in mol, of XCO_3 that decomposed.

(1)

amount of XCO_3 = 0.05 mol

(iv) Use the mass of XCO_3 and your answer to (b)(iii) to calculate the relative formula mass (M_r) of XCO_3

(2)

$$n = \frac{m}{M}.$$
$$0.05 = \frac{7.4}{M}.$$
$$0.05M = 7.4$$
$$M = 148$$

M_r of XCO_3 = 148

(v) Use your answer to (b)(iv) and the Periodic Table on page 2 to determine the identity of the Group 2 metal X.

Show your working.

(2)

$$X + 12 + 16 \times 3 = 148.$$
$$X + 60 = 148$$
$$X = 88$$

identity of X = Ra

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Examiner Comments

This candidate is obviously confident in their calculation but unfortunately in part (b)(v) having correctly calculated 88 they then identified the wrong metal by looking at the atomic number on the Periodic Table instead of the relative atomic mass.

(ii) Calculate the amount, in mol, of carbon dioxide produced.

[for carbon dioxide $M_r = 44$]

(1)

moles = $\frac{\text{mass}}{\text{molar mass}}$ $\frac{2.2}{44}$ = 0.05 mol

amount of carbon dioxide = 0.05 mol

(iii) Use the equation to determine the amount, in mol, of XCO_3 that decomposed.

(1)

7.4

amount of XCO_3 = ... mol

(iv) Use the mass of XCO_3 and your answer to (b)(iii) to calculate the relative formula mass (M_r) of XCO_3

(2)

M_r of XCO_3 = ...

(v) Use your answer to (b)(iv) and the Periodic Table on page 2 to determine the identity of the Group 2 metal X.

Show your working.

(2)

identity of X = ...

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Examiner Comments

Many weaker candidates gained the mark in part (b)(ii) but were unable to progress further.

Question 6 (a)

6 Silicon hydride (SiH_4) and silicon dioxide (SiO_2) both contain covalent bonds but they have different structures.

(a) Describe the forces of attraction in a covalent bond.

(2)

Electrostatic attraction between shared pair of electrons [between atoms] and nuclei of both atoms that make up the bond.

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A well-constructed description worth two marks.

6 Silicon hydride (SiH_4) and silicon dioxide (SiO_2) both contain covalent bonds but they have different structures.

(a) Describe the forces of attraction in a covalent bond.

(2)

there is [an electrostatic] force of attraction between the postive nucleus and the shared negative electrons

ResultsPlus Examiner Comments

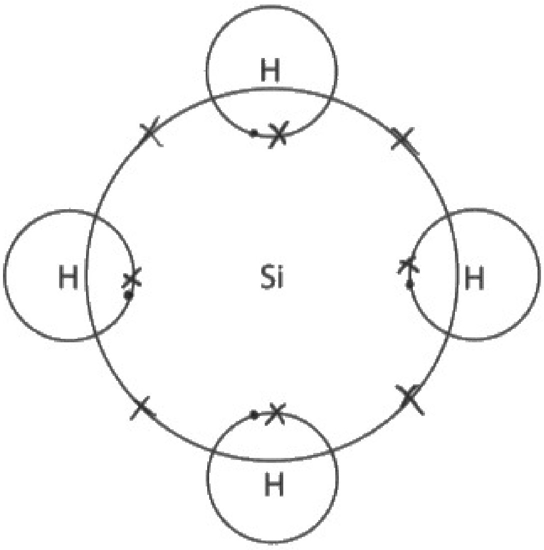
This answer unfortunately does not mention **nuclei** or shared **pair** of electrons so does not gain any marks.

Question 6 (b)

The majority of candidates were able to complete the diagram of the molecule of silicon hydride correctly.

(b) Complete the diagram to show the outer shell electrons in a molecule of silicon hydride (SiH_4).

(1)



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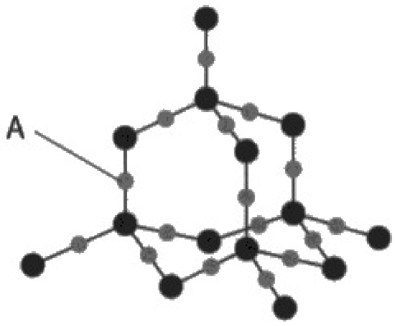
Examiner Comments

This candidate has too many electrons in the outer shell of silicon.

Question 6 (c)(i)

Although good numbers of correct answers were seen, many candidates stated that every one silicon was joined to two oxygen atoms as the formula was given as SiO_2.

(c) The diagram represents part of the structure of silicon dioxide (SiO_2).



(i) State how the diagram shows that the atom labelled A is oxygen, not silicon.

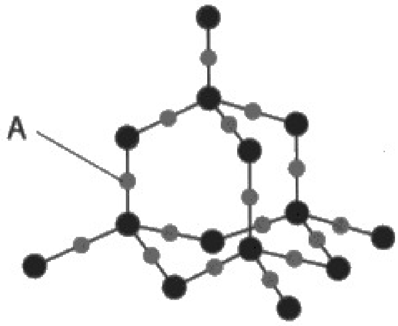
(1)

~~O is a~~ Oxygen atom is ~~has a~~ smaller ~~atom~~ than silicon atom

ResultsPlus
Examiner Comments

This is an acceptable answer.

(c) The diagram represents part of the structure of silicon dioxide (SiO_2).



(i) State how the diagram shows that the atom labelled A is oxygen, not silicon. **(1)**

The ~~ox~~ oxygen atom has two bonds.

ResultsPlus Examiner Comments

This is another acceptable answer.

Question 6 (c)(ii)

As in the past, this question showed confusion in some candidates about what type of bonds or forces exist in different structures that need to be broken or overcome in melting. Many candidates thought that both covalent bonds and intermolecular forces are present in silicon dioxide. Many others thought that covalent bonds were broken in melting silicon hydride. As often happens, candidates start by giving correct answers but then spoil it by either contradicting themselves or giving extra but incorrect information.

The best answers were clearly presented, talking about the structure and bonding of silicon dioxide as one separate paragraph and then silicon hydride as another.

(ii) Silicon hydride has a simple molecular structure.

Silicon dioxide has the same type of structure as diamond.

Explain why silicon dioxide has a much higher melting point than silicon hydride.

Refer to structure and bonding in your answer.

(4)

Silicon dioxide has a giant covalent lattice structure meaning it has very strong covalent bonds and many of them that need to be overcome so it requires a large amount of energy to break these many, strong covalent bonds; silicon hydride has a simple molecular structure so the intermolecular forces between the molecules aren't that strong; they're weak. So it requires less energy to be overcome.

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Examiner Comments

This answer scores four marks.

(ii) Silicon hydride has a simple molecular structure.

Silicon dioxide has the same type of structure as diamond.

Explain why silicon dioxide has a much higher melting point than silicon hydride.

Refer to structure and bonding in your answer.

(4)

Silicon dioxide has a ~~[illegible]~~ giant covalent structure where each silicon is ~~bonded with 2~~ ~~ox~~ strongly covalently bonded with 2 oxygen atom. To break this ~~ener~~ bond a huge amount of energy is needed which makes it have higher melting point.

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Examiner Comments

This answer is worth two marks for referring to silicon dioxide being a giant (covalent) structure (MP1 on the mark scheme) and for the reference to strong covalent bonds (MP2).

Question 6 (d)

It was disappointing to sometimes see incorrect formulae of silicon dioxide or silicon hydride as both were given in the question. A more common error was in balancing the equation.

(d) Silicon hydride reacts with oxygen to form silicon dioxide and water.

Write a chemical equation for the reaction between silicon hydride and oxygen.

(1)

$2SiH_4 + 4O_2 \longrightarrow 2SiO_2 + 4H_2O$

ResultsPlus
Examiner Comments

This equation, although a multiple of what normally is seen, is balanced and so is acceptable.

(d) Silicon hydride reacts with oxygen to form silicon dioxide and water.

Write a chemical equation for the reaction between silicon hydride and oxygen.

(1)

$SiH_2 + O_2 \rightarrow SiO_2 + 2H_2O$

ResultsPlus
Examiner Comments

This candidate has not used the correct formula for silicon hydride, SiH_4, which was given in the question.

Question 7 (a)

As expected, this question produced a full range of marks. Most candidates were able to gain one or two of the first three marks with capable candidates able to score a total of four or five.

(a) Describe how kerosene is produced from crude oil in process 1.

(5)

Crude oil goes through a process called fractional distillation. The crude oil is heated to its different componants that have different boiling points. ~~#~~ As crude oil breaks down, ~~#~~ one of these components is kerosene, it has a low boiling point, which is why it's dense and dark.

ResultsPlus Examiner Comments

This candidate scores the first two marks on the mark scheme.

(a) Describe how kerosene is produced from crude oil in process 1.

(5)

It is found by fractional Distillation.

ResultsPlus Examiner Comments

This brief answer gains just the first mark.

(a) Describe how kerosene is produced from crude oil in process 1.

(5)

- Crude oil is heated
- vapours enter the fractionating column
- Inside the fractionating column, there is a temperature gradient — Higher temperatures at the bottom, and lower temperatures at the top
- Vapours of kerosene rise to the top, until it reaches the temperature which is cooler than its boiling point, so it can be condensed to form a liquid kerosene
- Kerosene can be tapped out from the fractionating column where it can be collected.

ResultsPlus
Examiner Comments

This answer gains MP2, MP3, MP4 and MP6 on the mark scheme.

(a) Describe how kerosene is produced from crude oil in process 1.

(5)

* Fractional distillation is used

* The crude oil is heated until it turns into vapour.

* the vapour moves through the fractioning coloumn which has a temperature gradient (~~Hott~~ cooler at the top & hotter at the bottom)

* kerosene is ~~the~~ the third fraction in crude oil & so has the third shortest chain & the third lowest boiling point. ~~4~~

* When the temp of the coloumn is below kerosenes boiling point it condenses & drains off at that part of the fractioning coloumn.

* The bubble caps stop the condensed part of the mixture from mixing.

ResultsPlus
Examiner Comments

This is an example of an answer worth five marks.

Question 7 (b)(i)

This was often answered correctly although some candidates had obviously not read that **one** molecule of another hydrocarbon was produced.

(b) $C_{12}H_{26}$ is present in kerosene.

In process 2, $C_{12}H_{26}$ is cracked to produce two molecules of ethene and one molecule of another hydrocarbon.

(i) Complete the equation for the cracking of $C_{12}H_{26}$

(1)

$C_{12}H_{26} \rightarrow 2C_2H_4 +$ ~~C_2H_4~~ $2C_4H_9$

ResultsPlus
Examiner Comments

This was quite a common incorrect answer.

Question 7 (b)(ii)

The idea that shorter chain hydrocarbons are more in demand than longer chain hydrocarbons was well understood. Many candidates also stated that cracking changes longer chain hydrocarbons into shorter chain ones. Disappointingly, although some did refer to short chain hydrocarbons being more flammable or their use as fuels, only very good candidates discussed the formation of alkenes in cracking and their use in making polymers.

(ii) Explain why cracking is a useful process in the oil industry.

(4)

There is a high demand on Short chain hydrocarbon as
they are more flammable & reactive & there're used widely as
fuels but there is more supply of long chain hydrocarbon
So it a usefull process as it allow long Chain hydrocarbon
to be broken to small ones & as there is more demand
or short chains

ResultsPlus
Examiner Comments

This is a fairly typical three mark answer. It does not score more marks as there is no mention of cracking producing alkenes.

(ii) Explain why cracking is a useful process in the oil industry.

(4)

We have a large supply of long-chain hydrocarbons. However, there is a large demand of short-chain hydrocarbons. So we use the process of cracking to break longer-chain hydrocarbons into shorter-chain hydrocarbons. Shorter chain hydrocarbons are more useful and easily burnt we can also use the alkenes produced by the process of cracking to make polymers.

ResultsPlus
Examiner Comments

This candidate has given enough information to be awarded four marks.

(ii) Explain why cracking is a useful process in the oil industry.

(4)

Cracking is useful in the oil industry because it produces short chain hydrocarbons from long chain hydrocarbons. Although there is a larger abundance of long chain hydrocarbons there is a higher demand for short chain hydrocarbons making cracking extremly useful.

ResultsPlus Examiner Comments

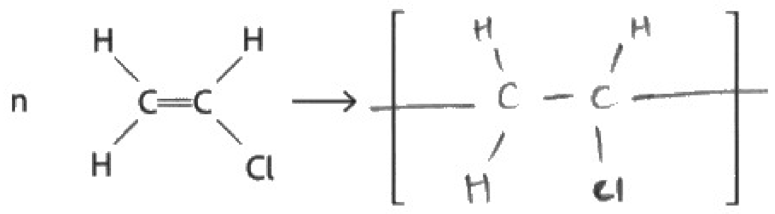
This answer is worth two marks.

Question 7 (d)(i)

There were many correct answers although it was common to see structures with the n in the wrong place or the continuation bonds missing. The weakest candidates retained the double bond in the structure.

(d) (i) Complete the equation for the polymerisation of chloroethene in process 4.

(2)

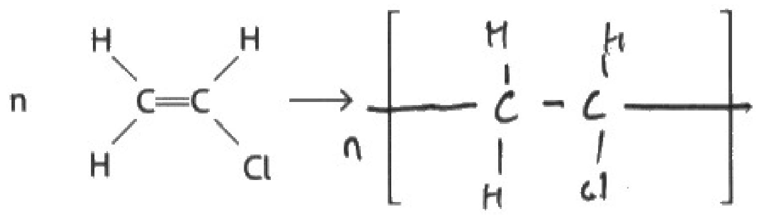


ResultsPlus
Examiner Comments

This scores one mark but is missing the n after the brackets so does not gain the second mark.

(d) (i) Complete the equation for the polymerisation of chloroethene in process 4.

(2)

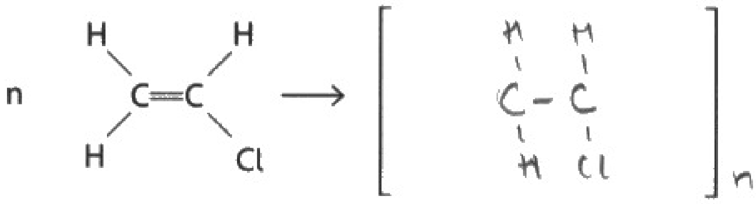


ResultsPlus
Examiner Comments

This scores one mark but the n is in front of the brackets so does not gain the second mark.

(d) (i) Complete the equation for the polymerisation of chloroethene in process 4.

(2)



ResultsPlus
Examiner Comments

This scores one mark but is missing the extension bonds so does not gain the second mark.

Question 7 (d)(ii)

The most popular way to score two marks was by explaining that disposal by burning polymers such as poly(chloroethene) produces toxic fumes.

(ii) Explain why the disposal of polymers such as poly(chloroethene) is difficult. **(2)**

Polymers such as poly(chloroethene) is not biodegradable and inert. If they are discarded in landfills, they will stay there indefinitely, causing land pollution. Burning of polymers by incineration emits toxic gas and greenhouse gases which cause air pollution and global warming.

ResultsPlus
Examiner Comments

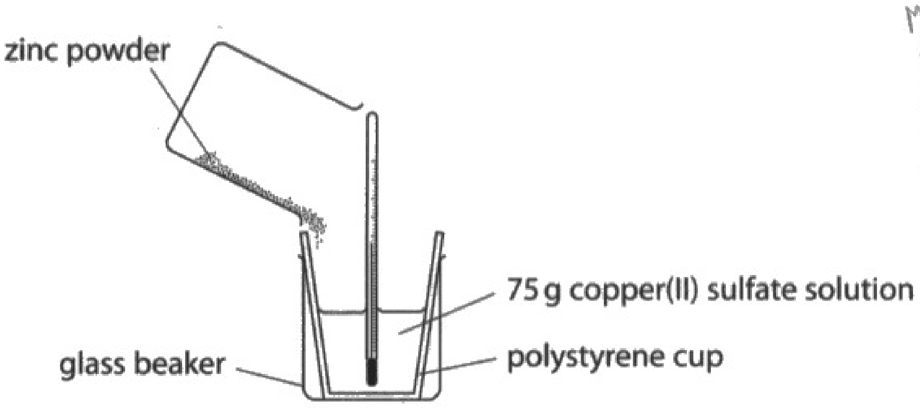
This answer contains more than enough information to be awarded two marks.

Question 8 (a)(i)

As expected, most candidates were able to complete the word equation.

8 This question is about exothermic reactions.

(a) A student uses this apparatus to measure the temperature increase when an excess of zinc powder is added to copper(II) sulfate solution.



(i) Complete the word equation for the reaction.

(1)

zinc + copper(II) sulfate → Zinc sulfate + Copper (II)

ResultsPlus
Examiner Comments

This was a common error suggesting copper(II) as the product.

Question 8 (a)(ii)

Most candidates correctly referred to polystyrene being an insulator.

Question 8 (a)(iii)

Most candidates correctly stated that zinc is more reactive than copper.

(iii) State why zinc reacts with copper(II) sulfate solution.

(1)

because zinc is more reactive than sulfate.

ResultsPlus Examiner Comments

This answer is not worth the mark.

Question 8 (a)(iv)

The majority of candidates knew how to do the heat energy change calculation although some lost a mark by using an incorrect temperature rise.

(iv) The temperature at the start of the reaction is 19.7 °C.

The temperature at the end of the reaction is 48.3 °C.

Calculate the heat energy change, in joules, for the reaction.

[for the mixture, c = 4.2 J/g/°C]

(2)

$q = mc\Delta T$

$q = 4.2 \times 28.6$

$q = 120.12$

$\Delta T = 48.3 - 19.7$

$\Delta T = 28.6$

heat energy change = 120.12 J

ResultsPlus
Examiner Comments

This candidate forgot to use the mass in their calculation but was given one mark for the correct temperature rise.

Question 8 (b)(i)

This molar enthalpy calculation proved quite challenging with some candidates either not attempting it at all or trying to use the heat energy change equation again. Some candidates who could demonstrate how to do the calculation then forgot to add the negative sign for the exothermic reaction as required in the question.

(b) (i) The reaction between zinc and silver nitrate solution is exothermic.

A mass of 0.65 g of zinc is added to excess silver nitrate solution.

The heat energy change is 800 J.

Calculate the molar enthalpy change, ΔH, in kJ/mol.

Include a sign in your answer.

(3)

(1) $= \frac{800\text{J}}{\text{N of moles}}$

$\frac{0.8\text{ kJ}}{\text{N of mole}}$

(2) $\frac{0.65}{65} = 0.01$

(3) $\frac{0.8}{0.01} = 80$

$\Delta H =$ 80 kJ/mol

ResultsPlus
Examiner Comments

This candidate was one of many who forgot to add the negative sign but did gain two marks.

Question 8 (b)(ii)

Only the strongest candidates scored two marks as many referred to silver being reduced rather than silver **ions**.

(ii) This is the ionic equation for the reaction between zinc and silver nitrate solution.

$$Zn(s) + 2Ag^{+}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$$

Explain, in terms of electrons, why this is a redox reaction.

(2)

- Both oxidation and reduction are taking place at the same time.
- Zinc loses electrons so it gets oxidised.
- Silver gains electrons so it gets reduced.

ResultsPlus
Examiner Comments

This candidate scores one mark. Along with many other candidates they incorrectly state silver gains electrons instead of silver **ions.**

Question 9 (a)(i)

The best catalyst was almost always correctly identified but the explanation was sometimes not sufficient.

9 This question is about rates of reaction.

(a) A student uses this method to investigate the rate of reaction between iron(III) nitrate solution and sodium thiosulfate solution.

- pour 50 cm^3 of iron(III) nitrate solution into a conical flask
- add one drop of catalyst solution
- add 50 cm^3 of sodium thiosulfate solution to the conical flask
- record the time for the mixture to become colourless

The student repeats the method using different catalysts and also with no catalyst.

The table shows the student's results.

Catalyst	Time for mixture to become colourless in s
no catalyst	55
cobalt(II) chloride solution	32
copper(II) sulfate solution	8
iron(II) sulfate solution	27
zinc nitrate solution	75

(i) Explain which is the best catalyst for the reaction.

(2)

~~coppe~~ copper (II) sulfate because a catalyst speeds up a reaction.

ResultsPlus
Examiner Comments

This scores one mark for identifying copper(II) sulfate but no explanation is given.

9 This question is about rates of reaction.

(a) A student uses this method to investigate the rate of reaction between iron(III) nitrate solution and sodium thiosulfate solution.

- pour 50 cm^3 of iron(III) nitrate solution into a conical flask
- add one drop of catalyst solution
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The student repeats the method using different catalysts and also with no catalyst.

The table shows the student's results.

Catalyst	Time for mixture to become colourless in s
no catalyst	55
cobalt(II) chloride solution	32
copper(II) sulfate solution	8
iron(II) sulfate solution	27
zinc nitrate solution	75

(i) Explain which is the best catalyst for the reaction.

(2)

copper(ii)sulfate solution as it decreases the time needed for the mixture to turn colourless by 47 seconds than when there was no catalyst.

ResultsPlus
Examiner Comments

This scores one mark for identifying copper(II) sulfate but the explanation is incomplete as it does not compare the time to the others.

Question 9 (a)(ii)

This was generally answered well although some candidates just described what a catalyst is, rather than how it works. The most common misconception was from those who confused a lowering of activation energy with an increased energy of the particles.

(ii) Explain how a catalyst increases the rate of a reaction.

(2)

Catalysts lower the activation energy without effecting the product

ResultsPlus
Examiner Comments

This answer is worth one mark.

Question 9 (b)(i)

Many good explanations of how increasing the temperature affects the rate of a reaction were seen with candidates often gaining at least three marks. The most common errors were to omit a reference to more collisions per **unit time** or **increased frequency** of collisions. Some candidates also did not mention successful collisions whilst disappointingly, some otherwise very good answers were spoiled by suggestions that the activation energy of the reaction was lowered.

(b) The rate of a reaction can also be altered by changing the temperature or by changing the concentration of solutions.

(i) Explain, using the particle collision theory, how increasing the temperature affects the rate of a reaction.

(4)

As we increase the ~~[illegible]~~ temperature the rate of reaction increases so the particles start to collide more frequently with a higher force.

ResultsPlus
Examiner Comments

This answer is worth two marks, MP1 and MP3 on the mark scheme.

(b) The rate of a reaction can also be altered by changing the temperature or by changing the concentration of solutions.

(i) Explain, using the particle collision theory, how increasing the temperature affects the rate of a reaction.

(4)

Increasing the temperature gives the particles more kinetic energy as they move faster meaning there will be more frequent collisions which will increase the rate of the reaction and since the particles will have more energy, more of them will have enough or more energy meeting the requirements of activation energy and as a result there will be more successful collisions which also increases the rate of the reaction.

ResultsPlus
Examiner Comments

This is a good answer worth four marks.

Question 9 (b)(ii)

Although a lot of good answers were seen many candidates lost a mark by referring to fewer particles without including the idea of per unit volume or similar. Similarly others mentioned fewer collisions but without a reference to a time factor or frequency of collisions.

(ii) Explain why using a solution of a lower concentration decreases the rate of reaction.

(2)

lower concentration makes the particles move slower making it take more time for collision therefore decreasing the rate of reaction.

ResultsPlus
Examiner Comments

The incorrect reference to particles moving slower means that this answer sores no marks.

(ii) Explain why using a solution of a lower concentration decreases the rate of reaction.

(2)

Because there are less particles in a given volume so there are less successful collisions per unit time.

ResultsPlus
Examiner Comments

This is a very good answer worth two marks.

Question 10 (a)(i)

As expected, most candidates gave correct answers.

Question 10 (a)(ii)

The points were usually correctly plotted but some candidates omitted the point at (0.0, 10.0) or the point at (50.0, 0.0).

Question 10 (a)(iii)

Most candidates drew two straight lines of best fit. However some, despite the requirement for a ruler given on the front page, did not use one and others simply joined the dots/crosses.

Question 10 (a)(iv)

Many good answers were seen but sometimes candidates did not link the conductivity to the volume of acid.

(iv) Give the trend shown on the graph for the first 50 cm^3 of acid added.

(1)

as acid is added, ~~electricity~~ electrical conductivity decreases.

ResultsPlus
Examiner Comments

This is an acceptable answer for the mark.

Question 10 (a)(v)

Many candidates just gave vague answers about human error without thinking carefully about whether the anomalous result was too high or too low and then considering a possible mistake to cause it.

(v) Suggest a mistake the student could have made to cause the anomalous result.

(1)

not exact amount of acid is a dded.

ResultsPlus
Examiner Comments

This answer is too vague – it must refer to less acid or lower volume of acid being added.

Question 10 (b)(i)

This proved challenging to many candidates. Often, they did not help themselves by being vague or unclear in their answers. Despite being clearly told to refer to the type of bonding in barium sulfate and in water it was often impossible to tell which substance they were referring to. However it was pleasing to see some very good answers.

(b) This is the equation for the reaction.

$$Ba(OH)_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$$

(i) When 50 cm^3 of dilute sulfuric acid have been added, only barium sulfate and water are present in the mixture.

Explain why this mixture does not conduct electricity.
Refer to the type of bonding in barium sulfate and in water in your answer.

(3)

~~Barium sulfate is has covalent~~

Water has covalent bonds

Barium sulfate has ionic bonds.

ResultsPlus
Examiner Comments

This is a fairly brief answer worth one mark.

(b) This is the equation for the reaction.

$$Ba(OH)_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$$

50cm³

(i) When 50 cm³ of dilute sulfuric acid have been added, only barium sulfate and water are present in the mixture.

Explain why this mixture does not conduct electricity.
Refer to the type of bonding in barium sulfate and in water in your answer.

(3)

This is because ~~the~~ the water is covalently bonded and so cannot conduct electricity (unless it was graphite). And because Barium sulfate while being ionicly bonded, is a solid, and so ions are not free to move and carry charge, such as if it were molten. Barium sulfate has to be ~~no~~ molten to carry charge, so ions are free to move, ~~water doesn't~~

ResultsPlus
Examiner Comments

This is a very good answer worth three marks.

Question 10 (b)(ii)

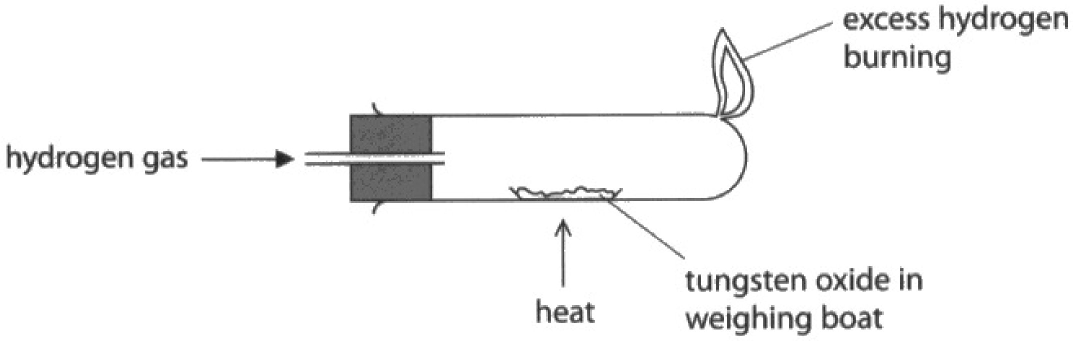
As anticipated, most candidates correctly suggested filtration.

Question 11 (a)(i)

Many candidates were able to give correct state symbols for all the substances although surprisingly a few put chemical formulae or numbers in the brackets.

11 This question is about the reduction of tungsten oxide, WO_3

(a) A teacher uses this apparatus to reduce tungsten oxide.



This is the teacher's method.

- record the mass of a weighing boat
- add tungsten oxide and record the mass again
- heat the weighing boat and tungsten oxide strongly for two minutes and then allow to cool
- record the mass of the weighing boat and its contents

(i) Complete the equation by adding the state symbols.

(2)

$$WO_3(s) + 3H_2(g) \rightarrow W(aq) + 3H_2O(l)$$

ResultsPlus
Examiner Comments

The left hand side is correct and scores one mark. On the right, (g) or (l) was accepted for water but (aq) for tungsten is incorrect.

Question 11 (a)(ii)

Few completely correct answers were seen. Candidates often mentioned reheat or weigh again but not both together as was required. Surprising suggestions included testing for oxygen.

(ii) Give an addition to the method to check that the tungsten oxide has been completely reduced.

(1)

heat again

ResultsPlus
Examiner Comments

This answer was quite common but is insufficient without reference to reweighing the constant mass.

Question 11 (a)(iii)

(iii) The table shows the teacher's results.

	Mass in g
empty weighing boat	14.72
weighing boat and tungsten oxide	17.04
weighing boat and tungsten	16.56

Use the teacher's results to show that the empirical formula of tungsten oxide is WO_3

[for tungsten, A_r = 184 for oxygen, A_r = 16]

(3)

mass of tungsten = 16.56 − 14.72 = 1.84 g

mass of oxygen = 17.04 − 16.56 = 0.48 g

W : O

$\frac{1.84}{184}$: $\frac{0.48}{16}$

0.01/0.01 : 0.03/0.01

1 : 3

WO_3

ResultsPlus
Examiner Comments

This is a well presented answer worth three marks.

Question 11 (a)(iv)

Although gloves was judged insufficient without an additional description such as heat-proof, many correct suggestions were seen.

(iv) The teacher wears eye protection and a lab coat during the experiment.

Give one other safety precaution the teacher should take.

(1)

Use a fume Cupboard.

ResultsPlus Examiner Comments

A sensible safety precaution worth a mark.

(iv) The teacher wears eye protection and a lab coat during the experiment.

Give one other safety precaution the teacher should take.

(1)

Heat resistant gloves

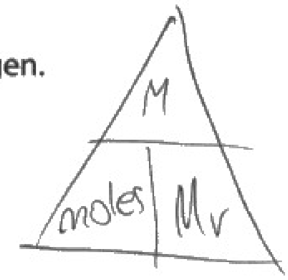
ResultsPlus Examiner Comments

A sensible suggestion of a suitable type of gloves so worth the mark.

Question 11 (b)

As expected, this was only accessible to the strongest candidates and others often did not attempt it. Also some good candidates lost a mark by failing to take into account the information about the percentage yield.

(b) In industry, tungsten oxide is reduced on a large scale using hydrogen.



The percentage yield of tungsten is 73.5%

This is the equation for the reaction.

$$WO_3 + 3H_2 \rightarrow W + 3H_2O$$

Calculate the mass, in tonnes, of tungsten that is produced when 2784 tonnes of tungsten oxide are reacted with an excess of hydrogen.

[1 tonne = 1×10^6 g]

[for tungsten, A_r = 184 for oxygen, A_r = 16]

2784 WO_3 ? W

(3)

$\frac{2784}{(184 + (16 \times 3))}$ = 12

12 : 12

÷ 12

1 : 1

12 × 184 = 2208

mass of tungsten = 2208 tonnes

ResultsPlus
Examiner Comments

A good answer but unfortunately the candidate fails to use the 73.5% percentage yield information so only scores two marks.

(b) In industry, tungsten oxide is reduced on a large scale using hydrogen.

The percentage yield of tungsten is 73.5%

This is the equation for the reaction.

$$WO_3 + 3H_2 \rightarrow W + 3H_2O$$

Calculate the mass, in tonnes, of tungsten that is produced when 2784 tonnes of tungsten oxide are reacted with an excess of hydrogen.

[1 tonne = 1×10^6 g]

[for tungsten, A_r = 184   for oxygen, A_r = 16]

(3)

WO_3 W

2784   x

Mr   184 + 16 = 200   184

Moles $\frac{2784}{200}$ = 13.92

13.92 x 0.735 = 10.2312 x 184 =

mass of tungsten = 1882.5 tonnes

ResultsPlus
Examiner Comments

This candidate has used an incorrect relative formula mass of 200 instead of 232. However the rest of the calculation is correct so the candidate scores two marks using ECF (error carried forward) as indicated in the mark scheme.

Paper Summary

Based on their performance on this paper, candidates should:

- increase their familiarity with pieces of apparatus used in the laboratory and their purpose.
- have as much practical experience as possible to improve understanding of methods used in practical situations.
- read questions carefully to both be clear what is being asked, and to be aware that useful information to help in the answer is sometimes provided.
- learn tests for ions.
- appreciate the difference between testing for the presence of water and showing that a liquid is pure water.
- practise writing formulae and equations.
- practise all types of calculations and show all working.
- be clear which bonds or forces need to be broken or overcome when different types of substances are melted or boiled.

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