AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.3.1.4

Chemical measurements

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**11**
Available paper years	**2018–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

5.3.1.4 Chemical measurements

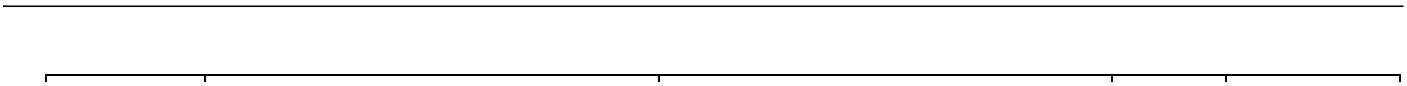
Answer 01 · Mark scheme June 2018 | 8464/C/1F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	chlorine		1	AO2 5.4.3.4
05.2	copper is less reactive than hydrogen		1	AO2 5.4.3.4
05.3	1.8 (mg)	allow an answer in range 1.7–1.9	1	AO3 5.4.3.4
05.4	$\frac{3.02 + 3.01 + x}{3} = 3.06$ 3.15 (mg)	an answer of 3.15 (mg) scores **2** marks allow any other suitable method if no other mark awarded allow 9.18 for **1** mark	1 1	AO2 5.4.3.4
05.5	$\frac{50}{1000}$ **or** $\frac{1}{20}$ **or** 0.05 (0.05) × 300 15 (g) **or** $\frac{300}{1000}$ **or** $\frac{3}{10}$ **or** 0.03 (1) (0.3) × 50 (1) 15 (g) (1)	an answer of 15 (g) scores **3** marks the second mark is dependent on the first mark being scored the second mark is dependent on the first mark being scored if no other mark awarded allow 150 **or** 15 000 for **1** mark	1 1 1	AO2 5.3.2.5
Total			**8**	

5.3.1.4 Chemical measurements

Answer 01 · Mark scheme

June 2018 | 8464/C/1F | Original Q5



5.3.1.4 Chemical measurements

Answer 02 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	watch glass		1	AO1 5.10.1.2
03.2	identify 0.29 as anomaly	an answer of 0.14 (g) scores **3** marks	1	AO3 5.10.1.2
	$\frac{0.12 + 0.14 + 0.15}{3}$ **or** $\frac{0.41}{3}$	allow $\frac{0.12 + 0.29 + 0.14 + 0.15}{4}$ **or** $\frac{0.70}{4}$	1	AO2 5.10.1.2
	(=) 0.14 (g)	allow 0.18 (g) if first marking point not awarded	1	AO2 5.10.1.2
03.3	evaporating **or** vaporisation	allow from liquid to vapour / gas do **not** accept boiling	1	AO1 5.1.1.2 5.2.2.1
03.4	pure **or** no salt	allow converse answers relating to seawater allow not a mixture allow desalinated do **not** accept less salt do **not** accept filtered	1	AO1 5.1.1.2 5.10.1.2
03.5	uses (a lot of) energy	allow needs heating allow needs electricity allow needs fuel **or** any suitable fuel ignore references to equipment ignore references to time	1	AO1 5.10.1.2

5.3.1.4 Chemical measurements

Answer 02 · Mark scheme

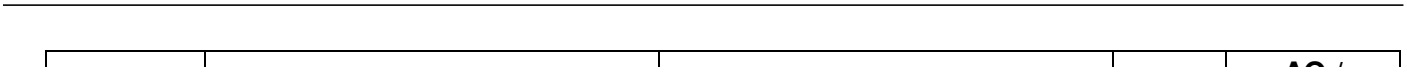
June 2018 | 8464/C/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	filtering removes particles	allow solids **or** suitable named solids	1	AO1 5.10.1.2
	sterilising kills bacteria / microbes	allow destroys viruses allow kills viruses	1	
Total			**9**	

5.3.1.4 Chemical measurements

Answer 02 · Mark scheme

June 2018 | 8464/C/2F | Original Q3



5.3.1.4 Chemical measurements

Answer 03 · Mark scheme June 2018 | 8464/C/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	lines from: • independent to size of marble chips • control to volume of acid	ignore arrowheads do **not** accept if more than one line from one box	 1 1	AO2 AO3 5.6.1.2
05.2	calcium chloride carbon dioxide water	all three needed for **2** marks allow **1** mark if two correct do **not** accept carbon oxide do **not** accept hydrogen oxide	2	AO2 5.1.1.1 5.3.1.3
05.3	stops loss of acid	allow stops loss of water / liquid allow to ensure that only the gas escapes do **not** accept stops acid evaporating do **not** accept stops gas / CO_2 / water vapour escaping	1	AO3 5.6.1
05.4	0.053	allow 0.05 allow 0.053333… do **not** accept 0.052 ignore units	1	AO2 5.6.1.1
05.5	g/s		1	AO1 5.6.1.1

5.3.1.4 Chemical measurements

Answer 03 · Mark scheme

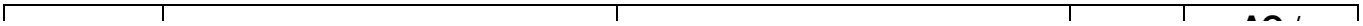
June 2018 | 8464/C/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	all points correctly plotted	allow **1** mark for 5 points correctly plotted allow ± ½ a small square	2	AO2 5.6.1.1
	line of best fit	should be a curve nearer to (10,0.8) than the anomaly (20, 0.6) and through all other points if plotting incorrect allow **1** mark for appropriate line of best fit through student's points	1	AO3 5.6.1.1
05.7	the eight small marble chips have a larger surface area, so more frequent collisions		1	AO3 5.6.1.2 5.6.1.3
Total			**11**	

5.3.1.4 Chemical measurements

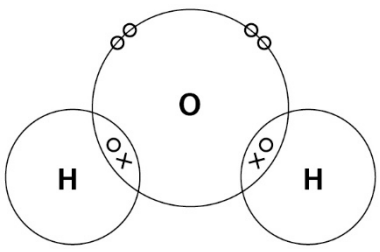
Answer 03 · Mark scheme

June 2018 | 8464/C/2F | Original Q5



5.3.1.4 Chemical measurements

Answer 04 · Mark scheme June 2019 | 8464/C/1F | Original Q5

05.1	(g)	allow g ignore formulae	1	AO1 5.2.2.2
05.2	40 (%)		1	AO2 5.1.1.1
05.3		an answer of 3.94 (g) scores **3** marks		AO2 5.3.1.3
	$\frac{3.76 + 3.98 + 4.09}{3}$ **or** $\frac{11.83}{3}$		1	
	= 3.943(333333333333333)		1	
	= 3.94 (g)	allow a correctly written answer to 3 significant figures from an incorrectly calculated mean	1	
05.4		allow combination of circles, dots, crosses or $e^{(-)}$		AO1 5.2.1.4
	one shared pair in each overlap	do **not** accept extra electron(s) on outer shell of hydrogen	1	
	4 non-bonding electrons in outer shell of oxygen		1	
		ignore any inner shell electrons		
				
		diagram scores 2 marks		

5.3.1.4 Chemical measurements

Answer 04 · Mark scheme

June 2019 | 8464/C/1F | Original Q5

05.5	covalent		1	AO1 5.2.2.1 5.2.2.4

05.6	higher (than) stronger (than between oxygen molecules)		1 1	AO2 5.2.2.4

Total			**10**

5.3.1.4 Chemical measurements

Answer 04 · Mark scheme

June 2019 | 8464/C/1F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.3.1.4 Chemical measurements

Answer 05 · Mark scheme November 2020 | 8464/C/1F | Original Q2

02.1	21.1 (°C) 14.4 (°C)	 allow correct use of an incorrect start temperature	1 1	AO2 5.4.1.2 5.5.1.1 RPA 10

02.2	any **two** from: • surface area of metal • 25 cm^3 / volume of copper sulfate solution • concentration of copper sulfate solution • mass / 1 g of metal	 ignore amount ignore temperature ignore stirring	2	AO2 5.4.1.2 5.5.1.1 RPA 10

02.3	$\frac{9.2 + 9.5 + 9.2}{3}$ **or** $\frac{27.9}{3}$ = 9.3 (°C)	 if no other mark awarded allow **1** mark for 8.8 (°C)	1 1	AO3 AO2 5.4.1.2 5.5.1.1 RPA 10

Answer 05 · Mark scheme

November 2020 | 8464/C/1F | Original Q2

02.4	(metal **A** / zinc) is less reactive (than magnesium) **or** (metal **A** / zinc) is lower in reactivity series **or** change in temperature is lower (with metal **A** / zinc)	allow converse	1	AO3 5.4.1.2 5.5.1.1 RPA 10
02.5	stays the same		1	AO3 5.4.1.2 5.5.1.1 RPA 10
02.6	too dangerous **or** too reactive	allow potassium would react with water	1	AO2 5.1.2.5 5.4.1.2 5.5.1.1 (RPA 10)
02.7	$\frac{25}{100} \times 1.8$ **or** $\frac{1}{4} \times 1.8$ = 0.45 (g)		1 1	AO2 5.3.2.5 RPA 10
Total			**11**	

5.3.1.4 Chemical measurements

Answer 05 · Mark scheme

November 2020 | 8464/C/1F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.3.1.4 Chemical measurements

Answer 06 · Mark scheme

November 2020 | 8464/C/2F | Original Q7

Question	Answers	Mark	AO / Spec. Ref.
07.1	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO3 5.6.1.2
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content: • use a measuring cylinder / pipette / burette to measure 50 cm^3 of sodium thiosulfate • use a different measuring cylinder / pipette / burette to measure 10 cm^3 of hydrochloric acid • start the timer when the acid is added • record the temperature of the solution after the acid is added • stop the timer when the cross is no longer visible • record the temperature of the solution at the end of the reaction • calculate the mean temperature of the reaction • repeat the experiment at different temperatures • use the same concentration of sodium thiosulfate and same concentration of hydrochloric acid • use the same volume of sodium thiosulfate and the same volume of hydrochloric acid • describe how to heat the thiosulfate / acid solutions		

5.3.1.4 Chemical measurements

Answer 06 · Mark scheme

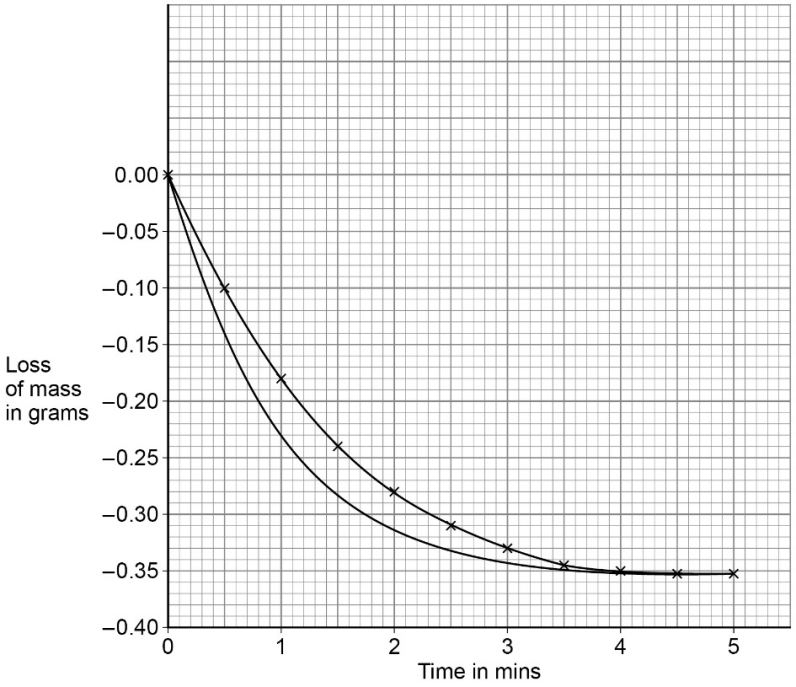
November 2020 | 8464/C/2F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(change in mass of gas =) 0.15 **and** (time =) 2	ignore signs	1	AO2 5.6.1.1 5.6.1.4
	(rate of reaction =) $\frac{0.15}{2}$	allow correct use of incorrectly determined values for mass and / or time	1	
	0.075 (g/min)		1	

5.3.1.4 Chemical measurements

Answer 06 · Mark scheme

November 2020 | 8464/C/2F | Original Q7

07.3	curve starts at same point, to the left and steeper line levels at −0.35 g the curve below can be awarded 2 marks  	1 1	AO2 5.6.1.1 5.6.1.2 5.6.1.4

Total			**11**

5.3.1.4 Chemical measurements

Answer 07 · Mark scheme

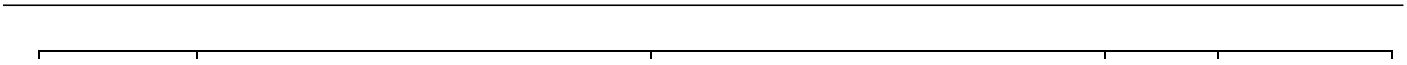
November 2021 | 8464/C/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	a metal and a non-metal		1	AO1 5.1.2.1 5.1.2.3 5.3.1.1
01.2	magnesium + chlorine → magnesium chloride	allow Mg for magnesium allow Cl_2 for chlorine allow $MgCl_2$ for magnesium chloride	1	AO2 5.1.1.1 5.1.2.6
01.3	balance		1	AO1 5.3.1.3
01.4	more than 1.0 g		1	AO3 5.3.1.3 5.4.1.1
01.5	(% =) $\frac{24}{40} \times 100$ = 60 (%)		1 1	AO2 5.3.1.2
01.6	the student heated the magnesium carbonate for less than ten minutes		1	AO3 5.3.1.3
01.7	$\frac{0.97 + 0.91 + 0.95}{3}$ **or** $\frac{2.83}{3}$ = 0.943333 (g) = 0.94 (g)	allow for **1** mark $\frac{0.97 + 0.91 + 0.50 + 0.95}{4}$ **or** $\frac{3.33}{4}$ = 0.8325 (g) allow an answer correctly rounded to 2 significant figures using values from the table	1 1 1	AO3 AO2 AO2 5.3.1.3
Total			**10**	

5.3.1.4 Chemical measurements

Answer 07 · Mark scheme

November 2021 | 8464/C/1F | Original Q1



Answer 08 · Mark scheme

June 2022 | 8464/C/1F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	K_2SO_4		1	AO2 5.1.1.1 5.4.3.4 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(volume of hydrogen) 30 (cm^3) **and** (volume of oxygen) 15 (cm^3)		1	AO2 5.4.3.4 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(because) the ratio of volume of hydrogen : oxygen is 2 : 1 (and this is the) **same** as the ratio of hydrogen (atoms) : oxygen (atoms) in (formula of) H_2O **OR** (because) the ratio of volume of hydrogen : oxygen is **not** 2 : 1 (1) (and this is) **different** to the ratio of hydrogen (atoms) : oxygen (atoms) in (formula of) H_2O (1)	**must** relate to the volumes given in question **06.2**	1 1	AO3 5.4.3.4 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	9 ± 3 cm^3		1	AO2 5.3.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	(conversion) ($\frac{25}{1000}$ =) 0.025 (dm^3)		1	AO2 5.3.2.5 5.4.3.4
	(concentration =) $\frac{0.86}{0.025}$	allow correct use of incorrect / no conversion	1	
	= 34.4 (g per dm^3)	allow 34 (g per dm^3)	1	
	OR (conversion) $\frac{1000}{25}$ (1) = 40 (1) (40 × 0.86) = 34.4 (g per dm^3) (1)	allow correct use of incorrect / no conversion allow 34 (g per dm^3)		
	OR (concentration =) $\frac{0.86}{25}$ (1) = 0.0344 (1) (conversion) (0.0344 × 1000) = 34.4 (g per dm^3) (1)	allow 34 (g per dm^3)		

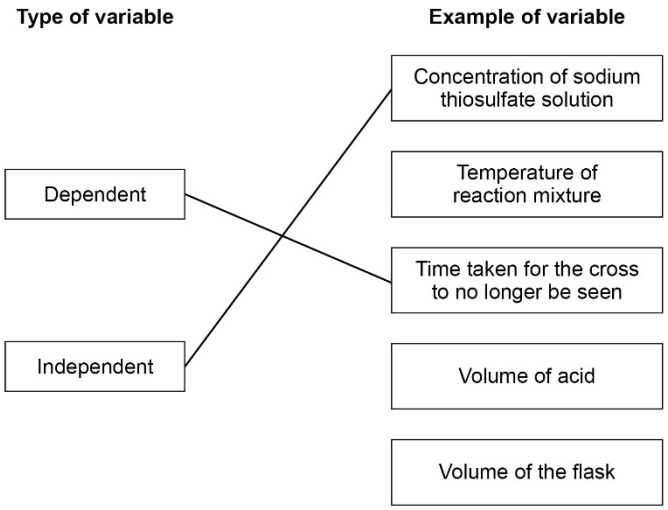
Total Question 6		8

5.3.1.4 Chemical measurements

Answer 09 · Mark scheme

June 2022 | 8464/C/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	 do **not** accept more than one line from a box on the left		1 1	AO2 5.6.1.1 RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	19.5 (°C)		1	AO2 5.6.1.2 RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	all points correctly plotted line of best fit	allow a tolerance of ± ½ a small square allow **1** mark for 3 / 4 / 5 points correctly plotted	2 1	AO2 5.6.1.1 RPA11

Answer 09 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	7 (s)	allow ecf from question **04.3** allow a tolerance of ± ½ a small square	1	AO3 5.6.1.1 RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	decreases		1	AO2 5.6.1.1 RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(mean =) $\frac{0.725}{20}$ = 0.03625	 ignore units	1 1	AO2 5.6.1.1 RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	g/s		1	AO1 5.6.1.1 RPA11

5.3.1.4 Chemical measurements

Answer 09 · Mark scheme

June 2022 | 8464/C/2F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.8	(mean =) $\frac{60.5 + 63.2 + 65.7}{3}$ = 63.13333 (s)	allow for **1** mark $\frac{60.5 + 63.2 + 65.7 + 82.3}{4} = 67.925$	1 1	AO3 AO2
	= 63.1 (s)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses the values in the question	1	AO2 5.6.1.1 RPA11

Total Question 4		**14**

Answer 10 · Mark scheme

June 2024 | 8464/C/1F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	independent		1	AO1 5.4.1.2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	zinc sulfate	allow $ZnSO_4$	1	AO2 5.4.1.2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3		ignore references to temperature / fizzing		AO2 5.4.1.2 5.5.1.1 RPA10
	solution becomes colourless	allow solution changes colour	1	
	(brown / orange) solid produced	allow zinc changes colour	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(highest temperature =) 36 (°C)		1	AO2 5.4.1.2 5.5.1.1 RPA10
	(temperature increase = 36 – 21 =) 15 (°C)	allow correct use of an incorrectly determined value for highest temperature ignore minus sign	1	

5.3.1.4 Chemical measurements

Answer 10 · Mark scheme

June 2024 | 8464/C/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	(**B** =) $\frac{7.8 + 7.3 + 7.7}{3}$ **or** $\frac{22.8}{3}$ = 7.6 (°C) **OR** (**B** =) $\frac{7.8 + 7.7}{2}$ **or** $\frac{15.5}{2}$ (1) = 7.75 (°C) (1)	allow 7.8 (°C) if working shown for calculation of the mean using 7.8 and 7.7 (°C)	1 1	AO2 5.4.1.2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	(range =) 13.1 (°C to) 13.8 (°C)	allow (range =) 13.8 (°C to) 13.1 (°C)	1	AO2 5.3.1.4 5.4.1.2 5.5.1.1 RPA10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	(result) 12.9 (°C)	MP2 is dependent on MP1 being awarded allow (result / experiment) 2	1	AO3 5.4.1.2 5.5.1.1 RPA10
	any **one** from: • (the result is) much lower than the other two results • (used) less than 3 g zinc • (used) more than 50 cm^3 of copper sulfate (solution) • the mixture was not stirred	allow (used) incorrect mass of zinc allow (used) incorrect volume of copper sulfate (solution)	1	

Total Question 3	**11**

5.3.1.4 Chemical measurements

Answer 11 · Mark scheme

June 2025 | 8464/C/1F | Original Q3

Question 3

Question	Answers	Mark	AO / Spec. Ref.
03.1	magnesium + oxygen → magnesium oxide allow MgO for magnesium oxide	1	AO2 5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	oxidised		1	AO1 5.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	0.30 (g)	allow 0.3 (g)	1	AO2 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	a solid reacts with a gas to produce a solid		1	AO3 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	ring around point 0.25, 0.35		1	AO3 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	(mean =) $\frac{0.96 + 0.93 + 0.92 + 0.95}{4}$ = 0.94 (g)	allow (mean =) $\frac{3.76}{4}$	1 1	AO2 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	a water bath is not hot enough		1	AO3 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	some of the magnesium did not react	allow the reaction was incomplete allow none of the magnesium reacted allow there was no reaction	1	AO3 5.3.1.3

Total Question 3	**9**

5.3.1.4 Chemical measurements

Answer 01 · Examiner comments

June 2018 | 8464/C/1F | Original Q5

Question 5 (low & standard demand)

05.1 Halogens are produced at the positive electrode if an aqueous solution contains a halide ion. 27% of students correctly selected chlorine as the gas produced.

05.2 Students could have linked their understanding of the reactivity series, with which ion is discharged when an aqueous solution is electrolysed. In this case, the production of copper at the negative electrode informs students that copper is less reactive than hydrogen. 30% of students were able to correctly deduce this.

05.3 Students needed to look at the data and see that the mass produced at three minutes was missing from the table. Experimental errors account for the trend not being exactly directly proportional. 42% of students noticed the relationship and correctly deduced the mass within the allowed range of 1.7 to 1.9 (mg).

05.4 This question discriminated well. 28% of students achieved full marks for this question giving an answer of 3.15 (mg), however, some did so without showing their working. This was not an issue where they obtained the correct answer, but some did not and therefore gained no credit as it was not possible to see how they had obtained their answer. 15% of students did not attempt to answer this question.

05.5 A unit conversion is essential to make progress in this calculation. A conversion between cm^3 and dm^3 requires a division of either 50 by 1000 to convert cm^3 to dm^3 or 300 by 1000 to convert mass per dm^3 to mass per cm^3. 1% of students understood this concept to achieve the maximum three marks for this question. 28% of students did not attempt to answer this question.

5.3.1.4 Chemical measurements

Answer 07 · Examiner comments — November 2021 | 8464/C/1F | Original Q1

Question 1 (low and standard demand)

01.1 Most students knew that magnesium reacting with chlorine is an example of a metal reacting with a non-metal.

01.2 Approximately two thirds of students were able to construct a word equation from the information supplied in the question.

01.3 Approximately two thirds of students knew that a balance is used to measure 1.0 g of magnesium.

01.4 Nearly half of students deduced that more than 1.0 g of magnesium chloride is formed when 1.0 g of magnesium reacts with chlorine.

01.5 Just under one third of students gained two marks for correctly calculating the percentage of magnesium in magnesium oxide.

01.6 More than half of students deduced that the anomalous result is explained when the student heated the magnesium carbonate for less than ten minutes. 'The student used a higher temperature' was a strong distractor.

01.7 Approximately one quarter of students gained three marks for correctly calculating the mean and just under one third of students incorrectly included the anomalous result in their mean. A few did not give their answer to two significant figures.

Answer 08 · Examiner comments — June 2022 | 8464/C/1F | Original Q6

Question 6 (Standard demand)

06.1 Students were given the formula of the potassium and sulfate ions and asked to deduce the formula of potassium sulfate. Just under 40% of students correctly determined the formula as K_2SO_4. The formula $K(SO_4)_2$ proved to be a good distractor.

5.3.1.4 Chemical measurements

Answer 08 · Examiner comments June 2022 | 8464/C/1F | Original Q6

06.2 Just under 15% of students were able to correctly read the volumes of hydrogen and oxygen in the measuring cylinders. Most wrote the volumes of solution left in the measuring cylinder, rather than the gas, stating 20 cm^3 for hydrogen and 35 cm^3 for oxygen.

06.3 Students were given a hypothesis linking the ratio of the volumes of gases collected in an electrolysis experiment with the ratio of hydrogen to oxygen atoms in a water molecule. When students deduced that the volumes of hydrogen gas and oxygen gas collected were 30 cm^3 and 15 cm^3, they were able to simplify this ratio to 2:1 which they recognised as the ratio of hydrogen atoms to oxygen atoms in a water molecule and thus able to confirm the hypothesis. When the ratio of their volumes was not 2:1 many did not then go on to state that the hypothesis was incorrect.

06.4 Just over 30% of students identified that the measure of uncertainty in the 4 experiments was 9 ± 3 cm^3. The mean volume was 9 cm^3 and the range of reading was from 6 to 11 cm^3. The option of 9 ± 2 cm^3 proved a good distractor.

06.5 Just over 10% of students gained 2 of the 3 marks, usually following method 3 for dividing the mass of 0.86 g by the volume of 25 cm^3. Few students then went onto carry out the unit conversion of cm^3 into dm^3 which required multiplying their answer (in g/cm^3) by 1000.

5.3.1.4 Chemical measurements

Answer 09 · Examiner comments

Question 4

The skills tested in this question led to some good responses from students, particularly when reading scales, graph plotting and in guided calculations.

04.1 Identifying variables from a practical procedure is still one of the skills that students find challenging. Only 1 in 5 scored both marks, with a further quarter of these students correctly identifying one of the variables.

04.2 Nearly 95% of students were able to read the thermometer to give the temperature.

04.3 A quarter of students gained all the marks for plotting the graph, including a curved line of best fit. Fewer than 1 in 5 gained no marks. The common error was the line of best fit, with many drawing a straight line. Students need to realise that lines of best fit can be curved or straight and they need to make that judgement.

04.4 A quarter of students were able to successfully extrapolate the graph to find the value requested. Students should be encouraged to extrapolate the lines and read from that line, as opposed to estimating where the line crosses the point.

04.5 Two thirds of students correctly completed the sentence.

04.6 Guided calculations with no manipulation of the equation are well understood by students, and this one was no exception, with nearly 4 in 5 achieving both marks for the calculation. Transposition errors (both written and putting into calculators) accounted for a number of the incorrect responses.

04.7 The units were correctly identified by nearly 80% of students.

04.8 Around 1 in 4 students achieved all three marks for this calculation. The two most frequently seen errors were including the anomalous result and not rounding to 3 significant figures. This is another example where students need to read the whole question, perhaps highlighting the requirements, before embarking on the solution.

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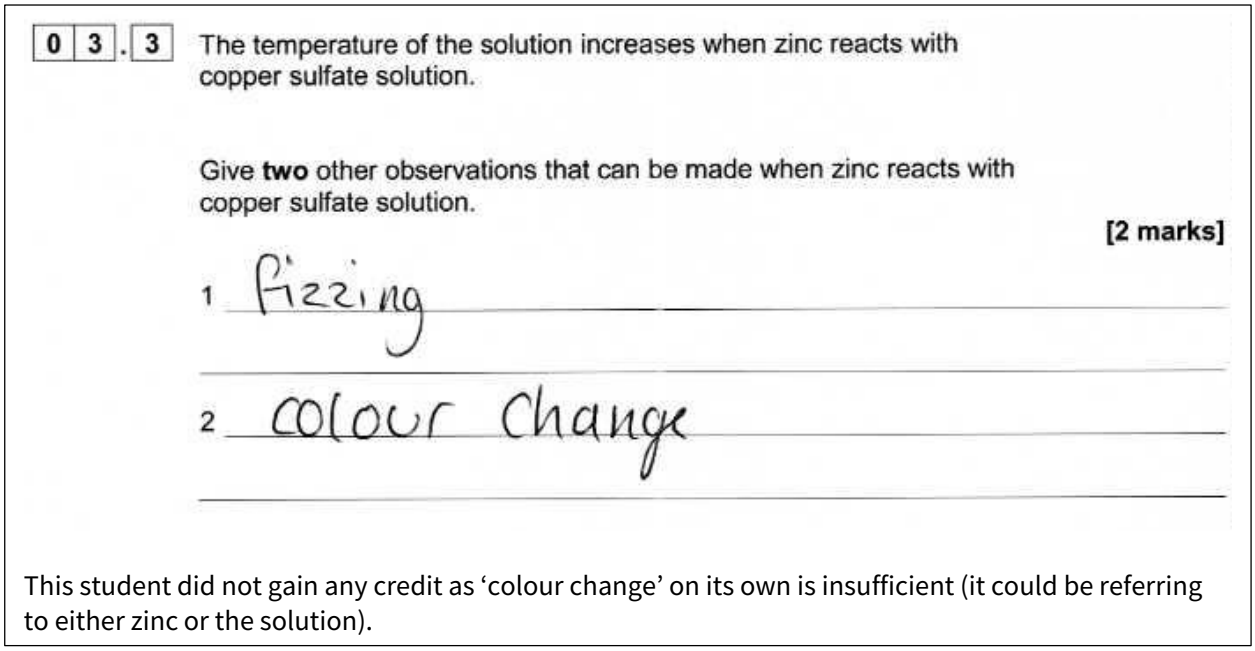
Question 3 (low & standard demand)

03.1 In an investigation the independent variable is the one that is changed, the dependent variable is the one that is measured, and all other variables must be controlled. If a student investigates the temperature change when different masses of zinc are added to copper sulfate solution the independent variable is the mass of zinc and the dependent variable is the temperature change. Just under half of the students answered this correctly. Control (variable) was a slightly more common incorrect response than dependent (variable).

03.2 A word equation was provided to help students identify that the salt zinc sulfate is produced when zinc reacts with copper sulfate solution. A quarter of students gave the correct answer.

03.3 Students found this question challenging. When a question asks for observations students should be encouraged to think 'before', 'during' and 'after'. In the reaction between zinc and copper sulfate solution, zinc is replaced by brown/orange copper solid and the blue colour of the copper sulfate solution fades as colourless zinc sulfate is produced. The colours are not required in the specification, hence the allow statements where there is just reference to the solution/zinc changing colour. 'Colour change' is too vague to gain credit as it does not refer to either the zinc solid or the copper sulfate solution.

The equation for the reaction was provided to help and, although it does not contain any gaseous products, many students gave 'bubbles' or 'fizzing' as an observation.



This student did not gain any credit as 'colour change' on its own is insufficient (it could be referring to either zinc or the solution).

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5.3.1.4 Chemical measurements

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03.4 The temperature shown on the diagram of the thermometer scale showed 36 °C. Most students read this correctly and then subtracted the starting temperature to give a temperature increase of 15 °C. A number of students did not use the temperature scale correctly and did not score marking point 1 but could access marking point 2 for a correct subtraction from their highest temperature.

03.5 The calculation of the mean temperature increase was correctly carried out by nearly three-quarters of students. Most students achieved either 2 or 0 marks.

Table 4

Mass of zinc in grams	Temperature increase in °C			
	Experiment 1	Experiment 2	Experiment 3	Mean
1.0	7.8	7.3	7.7	**B**
2.0	13.1	13.8	13.3	13.4
3.0	20.4	12.9	20.2	20.3

0 3 . 5 Calculate value **B** in **Table 4**.

[2 marks]

7.8 + 7.3 + 7.7 = 17.666666667

B = 17.6 °C

This student did not gain any credit. They divided only the last number (7.7) by 3, then added, rather than dividing the sum of all three numbers (ie 22.8) by 3.

03.6 The range of results is the 'minimum value to the maximum value'. In the data set the lowest value is 13.1 °C and the highest value is 13.8 °C. 60% of students gained this mark.

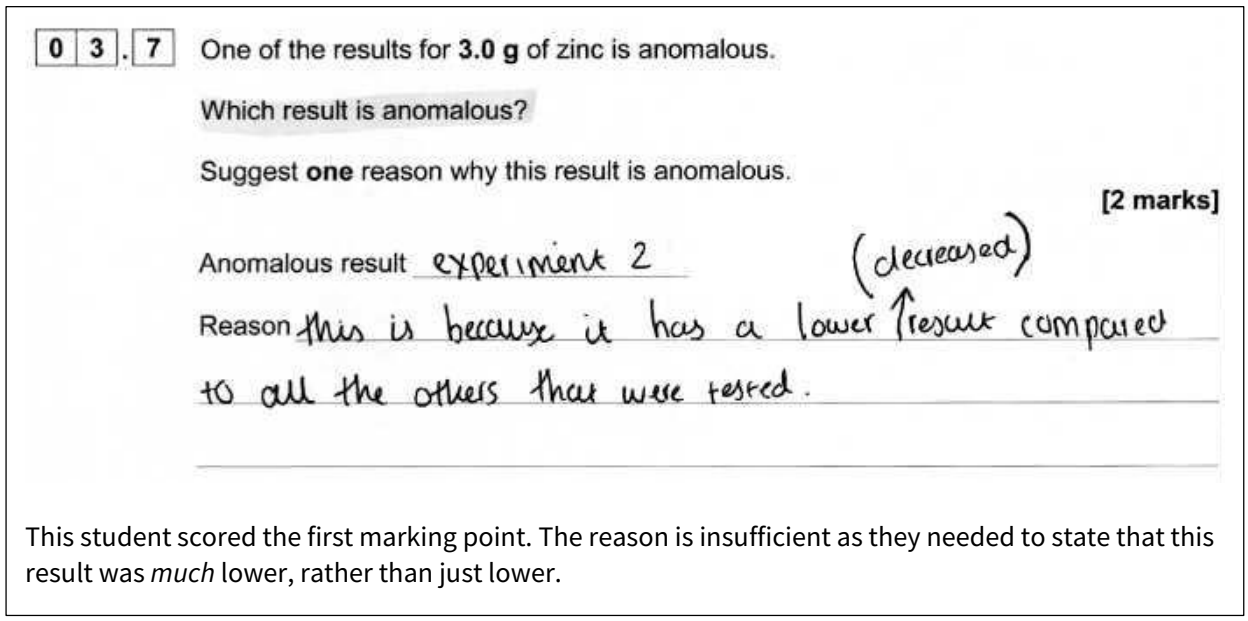
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5.3.1.4 Chemical measurements

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03.7 More than half of students correctly identified the anomalous result as 12.9 °C. Reasons why this result is anomalous were not well expressed, however: this result is *much* lower than the other two results (20.4 °C and 20.2 °C).

Alternative answers giving a reason why the result is anomalous such as 'used less than 3 g zinc', 'used more than 50 cm^3 of copper sulfate (solution)' or 'the mixture was not stirred' were much less common.



0 3 . 7 One of the results for **3.0 g** of zinc is anomalous.

Which result is anomalous?

Suggest **one** reason why this result is anomalous.

[2 marks]

Anomalous result experiment 2 (decreased)

Reason this is because it has a lower result compared to all the others that were tested.

This student scored the first marking point. The reason is insufficient as they needed to state that this result was *much* lower, rather than just lower.

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Question 3 (Low and Standard demand)

03.1 Three quarter of students added magnesium oxide to complete the word equation. Phonetic spellings were credited. Those students who wrote a correct formula were awarded the mark. Water was a common additional product.

03.2 The majority of students were able to select the word from the box to describe the process of magnesium reacting with oxygen as oxidised. Credit was awarded if the student identified the correct answer in the box.

03.3 More than half of students were able to use the data to determine the mass of magnesium in the crucible before heating by subtracting the mass of the empty crucible from the mass of the crucible and magnesium before heating. 0.2 g was the mass of oxygen that reacted, a common answer obtained by subtracting the wrong data.

03.4 Less than a third of students knew that when magnesium is heated with oxygen in a crucible the reaction results in an increase in the mass of the contents of the crucible because a solid reacts with a gas to produce a solid. Just over half the students selected the incorrect response that the reactants have a greater mass than the product.

03.5 The graph had 8 points. A straight line (of best fit) could be drawn through 7 of these with the point at (0.25, 0.35) being anomalous which required a ring to be drawn around it. Students were not expected to draw a line when answering this question although many did. Those who drew a line without a positive identification of the anomalous point were not credited.

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5.3.1.4 Chemical measurements

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03.6 The calculation of the mean mass was correctly carried out by nearly three-quarters of students. Most students achieved either 2 or 0 marks.

0 3 . 6 The student did the experiment using 0.60 g of magnesium four times.

Table 4 shows the results.

Table 4

	Test 1	Test 2	Test 3	Test 4	Mean
Mass of the contents of the crucible after heating in grams	0.96	0.93	0.92	0.95	X

Calculate mean value **X**.

[2 marks]

0·96 + 0·93 + 0·92 + 0·95 ÷ 4 = 3·0475

Mean value **X** = 3·0475 g

This was a common incorrect response. The student has only divided the 4th number by 4 (rather than the total of all four)
i.e. 0.95÷4 (= 0.2375) and adding this to the first 3 numbers (0.96+0.93+0.92 = 2.81)

03.7 Just over half the students knew that a water bath is not hot enough to allow magnesium to react with oxygen. The crucible would dissolve in a water bath was the most popular incorrect distractor.

03.8 Few students were able to give a correct reason for why a student who heated the crucible for 1 minute instead of for 5 minutes obtained different results. The answer was that a reaction has not taken place or that the reaction was incomplete. Common incorrect responses focussed on time (not long enough) or temperature (not high enough).

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