AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.3.1.4

Chemical measurements

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**4**
Available paper years	**2018–2022**

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

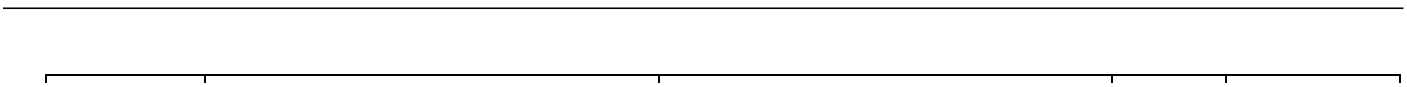
Answer 01 · Mark scheme June 2018 | 8464/C/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	chlorine		1	AO2 5.4.3.4
01.2	copper is less reactive than hydrogen		1	AO2 5.4.3.4
01.3	1.8 (mg)	allow an answer in range 1.7–1.9	1	AO3 5.4.3.4
01.4	$\frac{3.02 + 3.01 + x}{3} = 3.06$ 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
01.5	$\frac{50}{1000}$ **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/1H | Original Q1



5.3.1.4 Chemical measurements

Answer 02 · Mark scheme

November 2020 | 8464/C/2H | Original Q2

Question	Answers	Mark	AO / Spec. Ref.
02.1	**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		

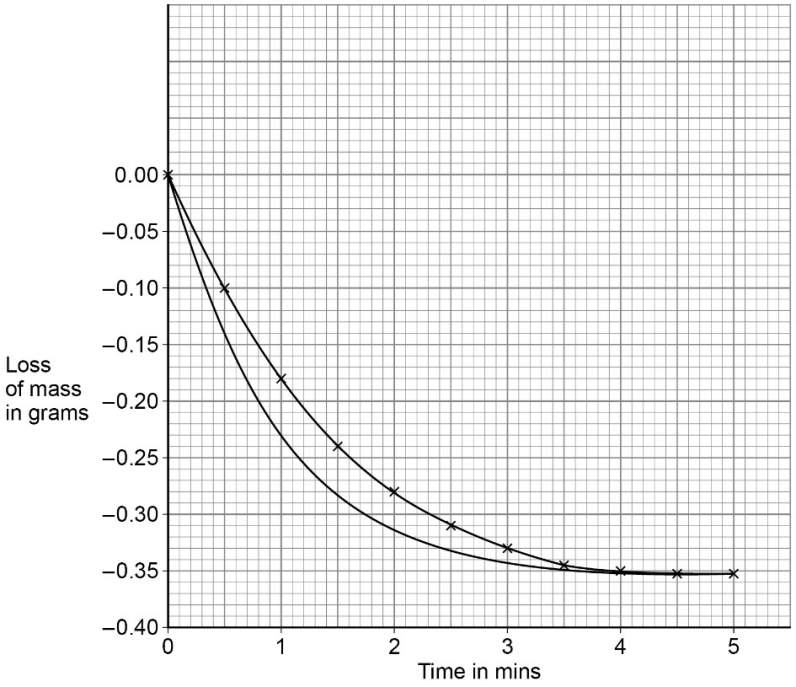
5.3.1.4 Chemical measurements

Answer 02 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(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 02 · Mark scheme

02.3	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 02 · Mark scheme

November 2020 | 8464/C/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.3.1.4 Chemical measurements

Answer 03 · Mark scheme

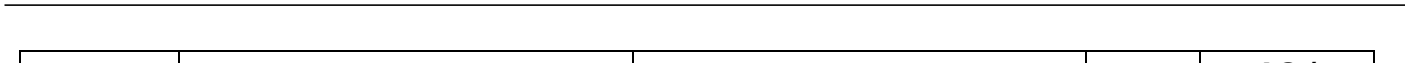
November 2021 | 8464/C/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	at high temperatures (in the engine) nitrogen reacts with oxygen (to produce nitrogen dioxide)		1 1 1	AO1 5.9.3.1
05.2	(**X**=) (33×7) – [(37×3)+35+34+29] = 22 (micrograms per m^3)	allow 33x7 = (37x3)+35+34+29+**X**	1 1	AO2 5.9.3.1
05.3	countryside data has smallest values (so) 2 is a higher proportion / percentage of the value	 allow (so) countryside is ± 2 out of a value between 6 to 8	1 1	AO3 5.9.3.1
05.4	$2\,NO_2 \rightarrow N_2 + 2\,O_2$	allow multiples or halves allow 1 mark for N_2 **and** O_2	2	AO2 5.3.1.1 5.10.1.1
05.5	a resource which will run out	allow a non-sustainable resource	1	AO1 5.10.1.1
05.6	(because carbon dioxide is emitted in) extracting / processing raw materials (and) manufacturing (and) disposal at the end of its useful life		1 1 1	AO2 5.9.2.4 5.10.2.1
Total			**13**	

5.3.1.4 Chemical measurements

Answer 03 · Mark scheme

November 2021 | 8464/C/2H | Original Q5



5.3.1.4 Chemical measurements

Answer 04 · Mark scheme

June 2022 | 8464/C/1H | Original Q2

Question 2

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(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.
02.3	(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 **02.2**	1 1	AO3 5.4.3.4 RPA9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	9 ± 3 cm^3		1	AO2 5.3.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	(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 2		8

5.3.1.4 Chemical measurements

Answer 01 · Examiner comments

June 2018 | 8464/C/1H | Original Q1

Question 1 (standard demand)

01.1 Halogens are produced at the positive electrode if the solution contains a halide ion. 51% of students correctly selected chlorine as the gas produced.

01.2 Students could have linked their knowledge 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. 46% of students were able to correctly deduce this.

01.3 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. In this instance 63% of students noticed the relationship and correctly deduced the mass. The mark scheme did allow a small range around the expected answer.

01.4 68% of students achieved full marks for this question giving an answer of 3.15 (mg), however, a significant number did so without showing their working. This was not an issue where they obtained the correct answer, but some didn't and therefore gained no credit as it was not possible to see how they had obtained their answer.

A working mark was available and showing 9.18 (mg) was the most likely way that this was gained by students.

5.3.1.4 Chemical measurements

Answer 01 · Examiner comments June 2018 | 8464/C/1H | Original Q1

01.5 A unit conversion between cm^3 and dm^3 in this question 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

This conversion is essential to make progress in this calculation. 14% of students understood this concept and achieved the maximum three marks for this question.

A significant number either divided 300 by 50 with an answer of 6 or multiplied 300 by 50. The latter led to a compensatory mark for 15 000.

Answer 03 · Examiner comments November 2021 | 8464/C/2H | Original Q5

Question 5 (standard, standard / high and high demand)

The idea that nitrogen and oxygen from the air react together in the engine was not well known. Many students incorrectly stated that nitrogen dioxide was present in the fuel. Heat from the engine was insufficient to gain marking point 1 as there must be an indication of high temperature.

Non-renewable was a common response for a “finite resource” which did not gain credit as marks were awarded for the definition.

Students appeared to have a good understanding of the idea of a carbon footprint. Some excellent answers were seen where carbon emissions were linked to each stage in the life cycle of the car. Some students simply focused on the manufacture of both the car and its raw materials and failed to address the disposal.

5.3.1.4 Chemical measurements

Answer 04 · Examiner comments

June 2022 | 8464/C/1H | Original Q2

Question 2 (Standard demand)

02.1 Students were given the formula of the potassium and sulfate ions and asked to deduce the formula of potassium sulfate. Just over 50% of students correctly determined the formula as K_2SO_4. The formulae KSO_4 and $K(SO_4)_2$ proved to be good distractors.

02.2 Just over 45% of students were able to correctly read the volumes of hydrogen and oxygen in the measuring cylinders. Many 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.

02.3 This question was a good discriminator. A third of students answered this correctly. 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 were thus able to confirm the hypothesis. When the ratio of their volumes was not 2:1 many lacked the confidence to state that the hypothesis was incorrect.

02.4 Just over 40% 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 to be a good distractor.

02.5 A quarter of students gained all 3 marks with a similar number gaining 2 of the 3 marks available. The most common method was to divide the mass of 0.86 g by the volume of 25 cm^3. Some 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.There was still a small minority of students who showed no working at all.