AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.4.3.2

Electrolysis of molten ionic compounds

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**2**
Available paper years	**2019–2020**

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.

5.4.3.2 Electrolysis of molten ionic compounds

Answer 01 · Mark scheme June 2019 | 8464/C/1H | Original Q5

05.1	metal is too reactive to be extracted using carbon **or** metal reacts with carbon	allow metal is more reactive than carbon	1	AO1 5.4.3.3

05.2		either order		AO1 5.4.3.3
	aluminium oxide	ignore bauxite **or** aluminium ore	1	
	cryolite		1	

05.3		allow multiples		AO2 5.4.3.2 5.4.3.5
	negative electrode: $Cu^{2+} + 2e^- \rightarrow Cu$		1	
	positive electrode: $2Cl^- \rightarrow Cl_2 + 2e^-$	allow $2Cl^- - 2e^- \rightarrow Cl_2$	1	

05.4	any **two** from: • concentration / volume of solution was different • impurities in solution • error in timing • copper falls off (electrode) • copper removed when drying electrode • electrode not dry (when weighed) • voltage / current was different	 allow copper at bottom of beaker ignore power supply ignore recorded mass inaccurately	2	AO3 5.4.3.4

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Answer 01 · Mark scheme

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

05.5		an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 5.4.3.4
	reading of mass at stated time	allow tolerance of ± ½ small square eg at 30 minutes value is 5.4 (mg)	1	
	factor from time to 24 hours	eg 5.4 × 48 $\left(= \frac{24 \text{ hours}}{30 \text{ minutes}}\right)$ allow correct calculation using incorrectly read value for mass at time quoted	1	
	correct evaluation	eg = 259 (mg)	1	
	alternative approach:			
	calculates the gradient (1)	eg (1.8÷10) = 0.18		
	gradient × time in minutes in 24 hours (1)	eg 0.18 × 24 × 60 **or** eg 0.18 × 1440 allow correct use of incorrectly determined gradient		
	correct evaluation (1)	eg = 259 (mg)		

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Answer 01 · Mark scheme

05.6	4.75 (g)	allow values in range 4.7–4.8 (g)	1	AO2 5.4.3.4

05.7		an answer in the range 0.18–0.25 scores **2** marks (**3** marks with correct unit)		AO2 5.4.3.4
	(working) Y increase **and** X increase measured from graph	allow ecf from question **05.6**		
	and substitution into $\frac{\text{Y increase}}{\text{X increase}}$	eg = $\frac{2.0}{10}$	1	
	correct evaluation	eg = 0.2	1	
	(units) g/hour	allow g/h **or** g/hr **or** g per hour	1	

Total			**14**

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.4.3.2 Electrolysis of molten ionic compounds

Answer 02 · Mark scheme November 2020 | 8464/C/1H | Original Q1

01.1	13 14	this order only	1 1	AO2 5.1.1.4 5.1.1.5

01.2	loss of oxygen	allow (Al^{3+}) gain of electrons allow aluminium oxide loses oxygen	1	AO1 5.4.1.1 5.4.1.3

01.3	 (at high temperature) oxygen reacts with carbon / electrode (so the positive) electrode burns / wears away to produce carbon dioxide	allow anode for (positive) electrode $C + O_2 \rightarrow CO_2$ scores MP1 and MP3	 1 1 1	 AO1 5.4.3.1 5.4.3.2 5.4.3.3

01.4	(delocalised) electron(s) ion(s) (delocalised) electron(s)		1 1 1	AO1 AO2 AO1 5.2.2.3 5.2.2.8 5.2.3.2

Total			**9**

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Answer 02 · Mark scheme November 2020 | 8464/C/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.

Answer 01 · Examiner comments June 2019 | 8464/C/1H | Original Q5

Question 5

As well as an increase in demand through each question in the paper, there was a ramping of demand in this question from standard/high demand to high demand.

05.1 A fifth of students were able to give the reason that electrolysis was used when a metal was more reactive than carbon. Many answers were too vague in terms of metals being reactive, rather than including the comparison with carbon. It was very rare to see a response showing that a student knew that some metals might react with carbon.

05.2 Students found this question challenging. Cryolite was usually the answer that gained one mark. Very few students gave two-mark answers. The most common incorrect responses mentioned a wide variety of elements including the products of electrolysis ‘aluminium’ and ‘oxygen’.

05.3 This high demand question discriminated very well. Students should recognise that electrons are negatively charged. To balance ‘charges’, electrons need to be added as a reactant in the first equation and are produced as a product in the second; the negative charge on the electron must be shown. The first equation was more successfully attempted than the second. Symbols should always have the second letter as lower case.

05.4 Many students answered for a standard yield type question without considering the circumstances of the experiment. Common non-creditworthy responses included:

- not all reacted
- some lost as a gas
- unexpected products formed.

Many thought the electrode being made from copper would affect the mass measured. A number questioned the power supply without specifying voltage or current.

05.5 This question was very well answered with more than two-thirds of students scoring all 3 marks. There were 2 common approaches to this question. Many students read the mass and scaled up. A mass of 5.4g at 30 minutes was a common starting point, which resulted in an answer of 259 mg. A tolerance was allowed reading the graph which led to a range of

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Answer 01 · Examiner comments June 2019 | 8464/C/1H | Original Q5

results, which was narrower at longer initial times. Others calculated the gradient (0.18) and then used this value to determine the mass after 24 hours. Students used many variations of both methods to obtain a valid and correct answer. A common error was to misread the graph (e.g. mass of 5.2 g at 30 minutes); 2 of the remaining 3 marks were awarded for a subsequent correct evaluation.

05.6 Over three-quarters of students were able to determine the mass of the electrode from the graph.

05.7 This question was well answered and discriminated well. The increases in Y and X were usually calculated correctly. However, a small number of students then inverted the values when calculating the gradient. Some did not evaluate the calculation giving an answer for the gradient as 1/5 for example. The unit mark was generally correct.