AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.5.1.2

Reaction profiles

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**6**
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.

5.5.1.2 Reaction profiles

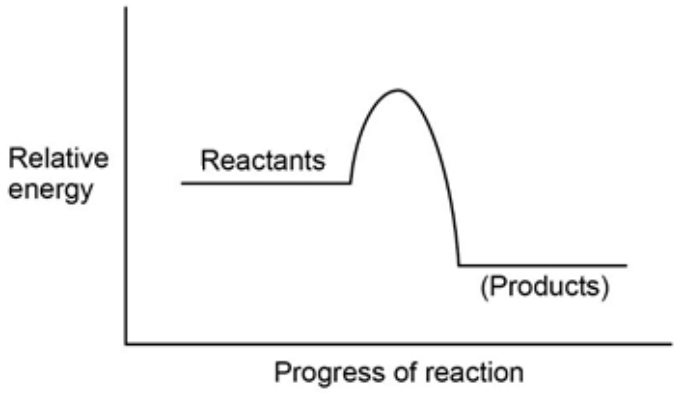
Answer 01 · Mark scheme June 2018 | 8464/C/1F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(difference) sodium has one and chlorine has seven electrons in outer level / shell **or** number of electrons	number of electrons must be correct if quoted	1	AO2 5.1.1.7 5.1.2.1
	(similarity) both have three / same number of levels / shells **or** have electrons in third level / shell **or** both have incomplete (outer) levels / shells	allow both have 2 electrons in inner shell **or** both have 8 electrons in second shell **or** both are one electron away from full outer level / shell	1	
06.2		allow marks from suitable diagram(s)		AO1 5.2.1.2
	sodium (atom) loses	allow moves / transfers for loses do **not** accept sodium ion loses	1	
	one (outer shell electron)		1	
	chlorine (atom) gains	do **not** accept chloride	1	
	one (electron)		1	
		transfer of 1 electron from chlorine to sodium **max 2** marks		
		reference to sharing **or** covalent bonding **max 3** marks		

5.5.1.2 Reaction profiles

Answer 01 · Mark scheme

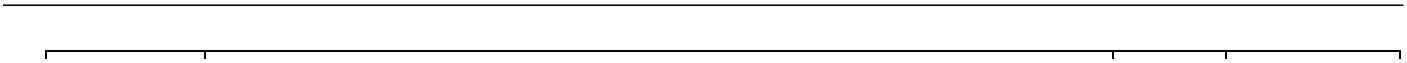
June 2018 | 8464/C/1F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3		ignore labels any curve / line going up and then down products line below reactants allow curve to start / finish anywhere along reactant / product lines	1 1	AO1 5.5.1.2
Total			**8**	

5.5.1.2 Reaction profiles

Answer 01 · Mark scheme

June 2018 | 8464/C/1F | Original Q6



5.5.1.2 Reaction profiles

Answer 02 · Mark scheme June 2019 | 8464/C/1F | Original Q1

01.1	sports injury pack		1	AO1 5.5.1.1
01.2	B		1	AO1 5.5.1.2
01.3	C		1	AO1 5.5.1.2
01.4	lower than		1	AO1 5.5.1.2
01.5	thermometer		1	AO1 5.5.1.2
01.6	27.4 (°C) (27.4–14.3 =) 13.1 (°C)	allow values in the range 27.2–27.5 (°C) allow correct subtraction of incorrect temperature reading	1 1	AO2 5.5.1.1
Total			**7**	

5.5.1.2 Reaction profiles

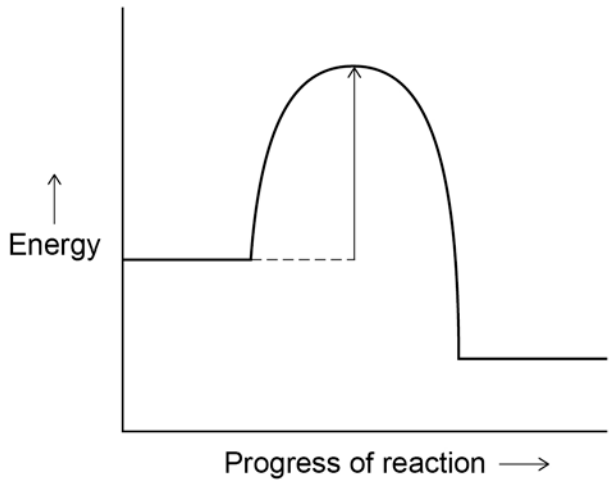
Answer 02 · Mark scheme

June 2019 | 8464/C/1F | Original Q1

Question	Answers	Extra information	Mark	AO / Spec.

5.5.1.2 Reaction profiles

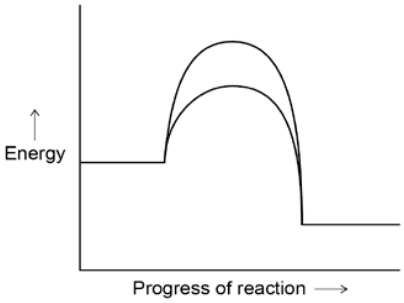
Answer 03 · Mark scheme June 2019 | 8464/C/2F | Original Q5

05.1	3.50 %		1	AO2 5.10.1.1
05.2	correct bar to 2.1 (%)	allow a tolerance of ± ½ a small square	1	AO2 5.10.1.1
05.3	(617 + 258) – 648 **or** 875 – 648 = 227 (kg)	an answer of 227 (kg) scores **2** marks	1 1	AO2 5.3.1.1
05.4	 ignore arrow heads		1	AO1 5.6.1.4

5.5.1.2 Reaction profiles

Answer 03 · Mark scheme

June 2019 | 8464/C/2F | Original Q5

05.5	(curve) starts and ends at same energy levels as existing curve maximum of curve below maximum of existing curve	ignore references to activation energy only award if MP1 correct an answer of  scores **2** marks	1 1	AO1 5.6.1.4

05.6	enzymes		1	AO1 5.6.1.4

Total			**8**

5.5.1.2 Reaction profiles

Answer 03 · Mark scheme

June 2019 | 8464/C/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.5.1.2 Reaction profiles

Answer 04 · Mark scheme

November 2021 | 8464/C/1F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **three** from: • use a (glass) beaker **or** use a polystyrene cup • insulate the metal container • add a lid • measure copper sulfate solution with a pipette • use same volume (of copper sulfate solution) • use a more accurate balance • stir (the mixture) • record the initial **and** the highest temperature • use a digital thermometer **or** use a more accurate thermometer • repeat the experiment **and** calculate the mean (ignoring anomalous results)		3	AO3 5.5.1.1
05.2	72 (cm^3)		1	AO2 5.4.3.1 5.4.3.4 RPA9
05.3	exothermic		1	AO2 5.5.1.2

5.5.1.2 Reaction profiles

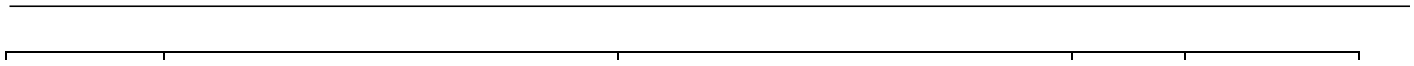
Answer 04 · Mark scheme

05.4	(increase in temperature =) 50 (°C) increase in mass = 6 (g) (gradient =) $\frac{50}{6}$ = 8.33 (°C per g)	 allow a value in the range 5.8 – 6 (g) allow correct use of incorrectly determined value(s) for temperature and/or mass 	1 1 1 1	AO2 5.4.3.1 5.4.3.4 RPA9
05.5	extends line on graph to 10 g of zinc any **one** from: • temperature (change) of 84 (°C) • (so the solution will be) too hot • (so the solution will be) over 100 (°C) • (so the solution will) boil	 allow a temperature (change) over 80 (°C) 	1 1	AO2 AO3 5.4.3.1 5.4.3.4 RPA9
Total			**11**	

5.5.1.2 Reaction profiles

Answer 04 · Mark scheme

November 2021 | 8464/C/1F | Original Q5



5.5.1.2 Reaction profiles

Answer 05 · Mark scheme

June 2022 | 8464/C/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	hydrogen chloride	allow hydrochloric acid	1	AO1 5.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(g)		1	AO1 5.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	⇌	allow reversible sign / arrow	1	AO1 5.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	exothermic		1	AO1 5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	rate		1	AO1 5.6.2.3

5.5.1.2 Reaction profiles

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	C		1	AO1 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	any **one** from: • increases rate of reaction • reduces energy required • lower temperature can be used		1	AO1 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	formulation		1	AO1 5.8.1.2

Total Question 3		**8**

5.5.1.2 Reaction profiles

Answer 06 · Mark scheme

June 2025 | 8464/C/1F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **two** from: • measure the volume of the alkali • repeat **and** calculate a mean • stir / swirl the mixture • use universal indicator solution	ignore references to safety allow use a measuring cylinder (to measure the alkali) allow use a burette (to measure the alkali) allow use a pH probe	2	AO3 5.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	7		1	AO1 5.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	neutralisation		1	AO1 5.4.2.2

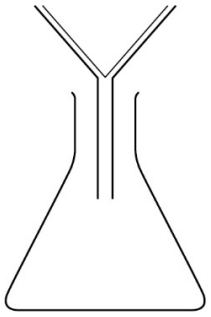
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	H^+		1	AO1 5.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	nitric (acid)	allow HNO_3	1	AO2 5.4.2.2

5.5.1.2 Reaction profiles

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(**A**) overall energy change		1	AO1 5.5.1.2
	(**B**) progress of reaction		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	filter funnel with filter paper inside		1	AO1 5.4.2.3 RPA8
	a container to collect the filtrate		1	
		an answer of  scores **2** marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.8	zinc	allow Zn	1	AO2 5.4.2.1

Total Question 5	11

5.5.1.2 Reaction profiles

Answer 01 · Examiner comments

June 2018 | 8464/C/1F | Original Q6

Question 6 (standard demand)

06.1 This question discriminated well with 27% of students achieving some degree of credit. Many students did not consider the most obvious difference and similarity in the electronic structures of sodium and chlorine. Students often used the periodic table shown in the stem of the question to answer this question, but most of these students referred to periods or rows and groups or columns and so failed to gain any marks.

06.2 This question discriminated well. 23% of students achieved all four marks, often with concise statements about the transfer of the outer electron of sodium to chlorine.

Some students contradicted their description by mentioning covalent bonding, or the sharing of electrons, which restricted the number of marks they could attain. Poor expression and the use of incorrect terms were the main problem for most students. It was common to see the term ‘atom’ used instead of ‘electron’. 19% of students did not attempt to answer this question.

06.3 This question discriminated well. 26% of students achieved both marks; whereas 185 of students achieved a single mark. It was common for students to have incomplete reaction profile diagrams, by failing to include a horizontal line for the products.

Some students confused the two types of energy changes (endothermic and exothermic), while others provided a wide range of incorrect diagrams. Labels were ignored because they were not required to answer the question. 20% of students did not attempt to answer this question.

5.5.1.2 Reaction profiles

Answer 04 · Examiner comments — November 2021 | 8464/C/1F | Original Q5

Question 5 (low and standard demand)

05.1 This question was based on the required practical activity of investigating the variables that affect temperature changes. Students had difficulty in identifying improvements from the given method or from the diagram of the apparatus; just over two fifths of students gained one or more marks.

05.2 More than four fifths of students were able to determine the volume of solution in the measuring cylinder.

05.3 Nearly three fifths of students either used the fact that the temperature increased or the reaction profile to identify this as an exothermic reaction.

05.4 This calculation was very well answered by most students; nearly four fifths of students gained all four marks. They were able to use the graph to read an increase in mass with the corresponding increase in temperature and then use these values to evaluate the gradient.

05.5 A small number of students did not follow the rubric of the question to extend the line. A few students did not use a ruler or did not extrapolate the line correctly. Approximately one third of students correctly extended the line and recognised that if 10 g of zinc was used a temperature change of 84 °C would occur or that the temperature of the solution would be approximately 100 °C.

Answer 05 · Examiner comments — June 2022 | 8464/C/2F | Original Q3

Question 3

The equilibrium identified in this question is detailed in the specification, however, many students found the questions challenging.

03.1 Around half of the students were able to identify hydrogen chloride or hydrochloric acid as the other product.

03.2 Students were told that ammonia is a gas in the stem of the question. However only half of the students gained the mark on this item.

03.3 Nearly two thirds of students were able to either draw the equilibrium symbol or describe the symbol with sufficient clarity.

03.4 Three quarters of students identified the reverse reaction as exothermic.

03.5 Approximately 60% of students were able to identify rate in this item. Nearly all the incorrect responses were concentration.

5.5.1.2 Reaction profiles

Answer 05 · Examiner comments June 2022 | 8464/C/2F | Original Q3

03.6 Less than a third of students identified C correctly. The most common incorrect responses were B and D with similar numbers identifying each.

03.7 Approximately one third of students gained a mark here. The most common correct response was for increasing the rate. Responses such as catalysts were not used up or catalysts could be reused did not answer the question.

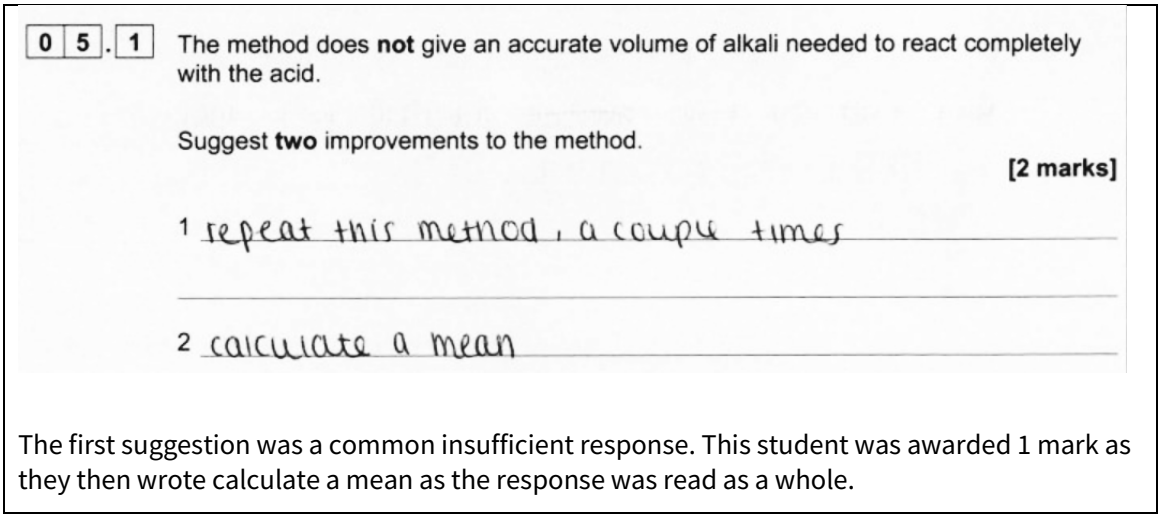
03.8 In this open question only 1 in 20 students were able to identify a formulation. Bleach was the most seen incorrect response.

Answer 06 · Examiner comments

June 2025 | 8464/C/1F | Original Q5

Question 5 (Low and Standard demand)

05.1 Improvements to methods are assessed as AO3 and are often not well attempted. Answers needed to improve the accuracy of measuring the volume of alkali, so creditworthy responses included measuring the volume of the alkali (e.g. with a measuring cylinder), ensuring that the reagents reacted by stirring the mixture or repeating and calculating a mean. This was not a high scoring question. There were many insufficient responses of 'repeat' without the necessary 'mean' included. Many responses used the inadequate terms 'amount' or 'how much' alkali, and others suggested altering the size or weight of the universal indicator paper rather than using a solution. Other uncreditworthy responses included attempting to control the 'time' or using 'more acid'. Others mentioned the need to use a measuring cylinder but referred to the acid and therefore gained no credit.



0 5 . 1 The method does **not** give an accurate volume of alkali needed to react completely with the acid.

Suggest **two** improvements to the method.

[2 marks]

1 repeat this method a couple times

2 calculate a mean

The first suggestion was a common insufficient response. This student was awarded 1 mark as they then wrote calculate a mean as the response was read as a whole.

05.2 Nearly two thirds of students knew that universal indicator paper turns green when pH = 7. The most popular incorrect distractor was pH = 5.

05.3 Nearly two thirds of students knew that neutralisation is the name of the reaction between an acid and an alkali. Combustion was the most common incorrect response.

05.4 Half of students knew that acids contain H^+ ions. The most popular incorrect distractor was Na^+ ions.

05.5 Nitric acid was the unknown acid that reacted with sodium hydroxide to produce sodium nitrate. This was not well known. Common responses that were not awarded the mark were nitrogen, nitrate (possibly because they had appeared earlier in the paper), hydrochloric acid, sulfuric acid and sodium.

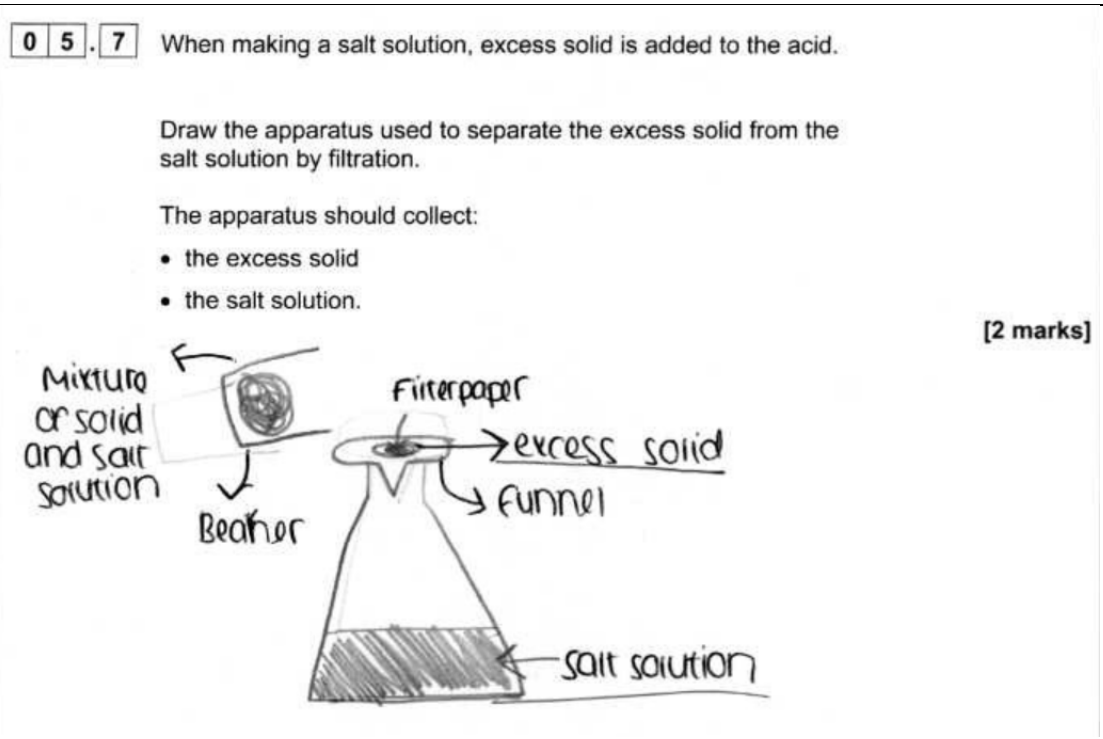
05.6 A third of students were able to select the labels from the box to complete the reaction profile. Reactants and products were common incorrect distractors. Credit was awarded if the student identified the correct answer in the box.

© 2024 AQA and its licensors. All rights reserved.

5.5.1.2 Reaction profiles

Answer 06 · Examiner comments June 2025 | 8464/C/1F | Original Q5

05.7 Students had to draw apparatus used to separate excess solid from salt solution by filtration. Filter paper inside a filter funnel gained the first mark. Many diagrams had either the funnel or paper missing but those students who clarified their diagrammatic response with labels (for the paper and funnel) were awarded credit even if it was not clear that both pieces of equipment were drawn. The second mark was for any container to collect the filtrate although this could only be accessed if there was some evidence of filtration apparatus even if incorrect. Those students who included additional equipment which would affect the filtrate, for example, a Bunsen burner to heat the collection vessel with were not awarded the second mark. More than a quarter of students did not attempt this question.



Both marking points were awarded. It is not clear that there is filter paper inside a filter funnel but this student has clarified their diagram with two labels. A conical flask after filtration is creditworthy.

05.8 Half the students knew that the zinc reacts with hydrochloric acid to produce zinc chloride and hydrogen gas. Phonetic spellings were credited. Chlorine was the main incorrect response, zinc oxide/hydroxide often appeared, and there were a few other metals e.g. iron, infrequently.

© 2024 AQA and its licensors. All rights reserved.