AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.6.1.4

Catalysts

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**6**
Available paper years	**2019–2024**

Using this booklet

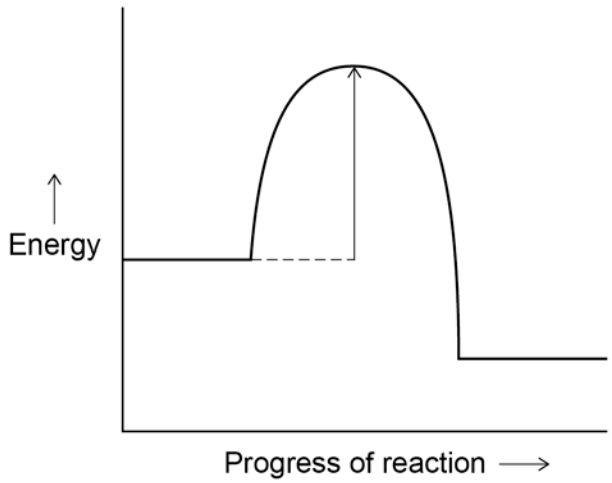
1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

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.

5.6.1.4 Catalysts

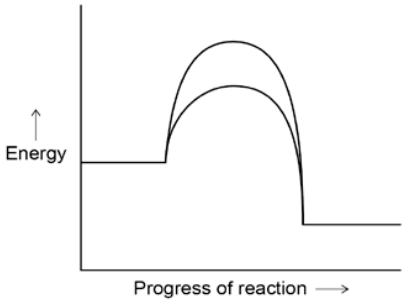
Answer 01 · Mark scheme June 2019 | 8464/C/2F | Original Q5

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

5.6.1.4 Catalysts

Answer 01 · 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**

5.6.1.4 Catalysts

Answer 01 · Mark scheme

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.6.1.4 Catalysts

Answer 02 · Mark scheme

04.1	water oxygen	ignore H_2O ignore O_2	1 1	AO1 5.1.1.1
04.2	concentration of hydrogen peroxide mass of catalyst		1 1	AO3 5.6.1.4
04.3	42 (cm^3)		1	AO2 5.6.1.4
04.4	all five points correctly plotted line of best fit drawn	allow a tolerance of ± ½ a small square allow **1** mark for 3 / 4 points correctly plotted	2 1	AO2 5.6.1.4

5.6.1.4 Catalysts

Answer 02 · Mark scheme

04.5	(for the best catalyst) curve is steepest (at the beginning) **or** highest (initial) gradient **or** greatest volume of gas in stated time		1	AO3 5.6.1.1 5.6.1.2
04.6	same volume / concentration of hydrogen peroxide (used)	ignore amount allow catalyst does not affect volume	1	AO3 5.6.1.1 5.6.1.2
04.7	the particles have more energy there are more particle collisions per second		1 1	AO1 5.6.1.2 5.6.1.3
Total			**12**	

5.6.1.4 Catalysts

Answer 02 · Mark scheme

November 2020 | 8464/C/2F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.6.1.4 Catalysts

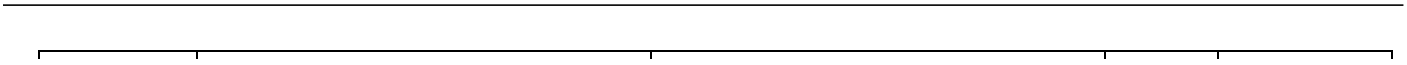
Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	bar drawn to 54 (%)	allow a tolerance of ± ½ a small square	1	AO2 5.9.3.1
02.2	city centre		1	AO3 5.3.1.4 5.9.3.1
02.3	less traffic (because) fewer people working	allow fewer lorries / cars allow (because) no school allow (because) businesses / factories closed	1 1	AO3 5.9.3.1
02.4	(mean =) $\frac{35 + 37 + 37 + 34 + 37}{5}$ = 36 (arbitrary units)		1 1	AO2 5.9.3.1
02.5	catalysts are **not** used up in a reaction catalysts lower the activation energy of a reaction		1 1	AO1 5.6.1.4
02.6	finite resource		1	AO2 5.8.1.2 5.10.1.1
02.7	limewater		1	AO1 5.8.2.3
Total			**10**	

5.6.1.4 Catalysts

Answer 03 · Mark scheme

November 2021 | 8464/C/2F | Original Q2



5.6.1.4 Catalysts

Answer 04 · 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

5.6.1.4 Catalysts

Answer 04 · Mark scheme

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**

Answer 05 · Mark scheme

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	hydrogen peroxide → water + oxygen	allow H_2O_2 for hydrogen peroxide allow H_2O for water allow O_2 for oxygen	1	AO2 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	mass of catalyst volume of hydrogen peroxide solution		1 1	AO3 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	all points plotted correctly line of best fit	allow a tolerance of ± ½ a small square allow at least 3 points plotted correctly for **1** mark	2 1	AO2 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	manganese dioxide any **one** from: • steepest curve • reaction finishes first • greatest volume of oxygen (in given time)	allow ecf from question **04.3**	1 1	AO3 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	accurate		1	AO1 5.6.1.4

5.6.1.4 Catalysts

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	increase		1	AO1 5.6.1.2 5.6.1.3 5.6.1.4

Total Question 4	**10**

5.6.1.4 Catalysts

Answer 06 · Mark scheme

June 2024 | 8464/C/2F | Original Q7

Question 7

Question	Answers	Mark	AO / Spec. Ref.
07.1	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	AO3
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	AO2
	No relevant content	0	
	Indicative content • measure volume of (hydrochloric) acid • using a measuring cylinder • measure mass of calcium carbonate • using a balance • **add (hydrochloric) acid to calcium carbonate in conical flask** • **put stopper and delivery tube into conical flask** • **start a timer** • **record volume of gas collected at set time intervals or time how long it takes for a fixed volume of gas to be collected** • **repeat using different sized pieces of calcium carbonate** • use same mass of calcium carbonate • use same volume of (hydrochloric) acid • use same concentration of (hydrochloric) acid • use same temperature of (hydrochloric) acid • repeat each experiment		5.6.1.2

5.6.1.4 Catalysts

Answer 06 · Mark scheme

June 2024 | 8464/C/2F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(increasing the temperature) increases the rate of reaction		1	AO1 5.6.1.2 5.6.1.3
	(because) particles have more energy	allow (because) particles move faster	1	
	(so) the frequency of collisions increases	allow (so) a greater proportion of collisions have enough energy to react	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(a substance that) increases the rate of reaction	allow (a catalyst) increases / changes the rate of reaction	1	AO1 5.6.1.4
	and is not used up during the reaction	ignore does not take part in the reaction	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	enzymes		1	AO1 5.6.1.4

Total Question 7	12

5.6.1.4 Catalysts

Answer 03 · Examiner comments November 2021 | 8464/C/2F | Original Q2

Question 2 (low and standard demand)

This was a skills-based question and most students were able to draw a bar chart and calculate a mean. Only around half of the students gained full marks in the mean calculation as they determined the mean for the full week rather than Monday to Friday as required.

Many students appreciated that pollution levels were lower at the weekend but did not give a reason, or link this to reduced traffic levels for the second mark.

Answer 04 · 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.

Answer 04 · 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.

5.6.1.4 Catalysts

Answer 05 · Examiner comments

June 2023 | 8464/C/2F | Original Q4

Question 4

04.1 Around two thirds of students were able to extract the necessary information to write a word equation. Where they found difficulty was when they attempted to write a formula instead of the word.

Answer 05 · Examiner comments

June 2023 | 8464/C/2F | Original Q4

04.2 Only a quarter of students successfully identified two control variables. Over half of the students identified one of the control variables. Once again, it is worth noting that several students ticked only one box. Students must be encouraged to read the question carefully.

04.3 A quarter of students gained all three marks for plotting the graph and drawing a curve of best fit. A further two fifths plotted all the points correctly but, drew a straight line of best fit. Fewer than one in ten students gained one mark for plotting at least three points correctly. Students need to be exposed to as many examples as possible of lines of best fit that are not straight lines.

04.4 Just over a third of students either used their graphs or the lines given to choose the best catalyst and explain why for two marks. It should be noted that the mark scheme was looking for the steepest, greatest etc. A simple comparative was insufficient to get the mark as there were three lines being compared. A similar number gained one mark for identifying manganese dioxide as the best catalyst.

04.5 Just over a third of students knew the definition of accurate, with the most common incorrect response being approximate.

04.6 Over four in five students were able to identify that the rate increased with an increase in temperature.

5.6.1.4 Catalysts

Answer 06 · Examiner comments

June 2024 | 8464/C/2F | Original Q7

Question 7 (standard demand)

07.1 This AO2 and AO3 variation of one of the rates Required Practical Activities proved challenging to most students, with over a quarter of students not attempting it. Of the 30% of responses that did gain any marks most were limited to Level 1. To reach Level 2, three key steps, or two with control variables, were required. To achieve Level 3 marks, all key steps and control variables were needed.

The two most common steps identified were adding the hydrochloric acid to the calcium carbonate in the conical flask and then attaching the stopper and delivery tube. Many students made no further progress as they often referred to 'counting bubbles' or to 'reading the volume when the reaction had finished' with no link to timing so that calculating a rate would be impossible. Another common response was to 'repeat with a different mass of calcium carbonate' instead of using different sized pieces.

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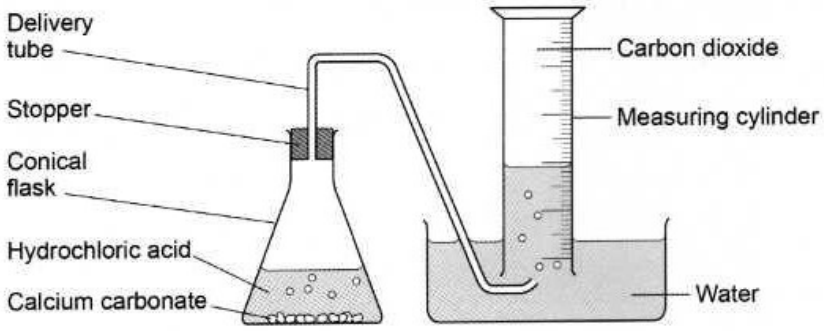
5.6.1.4 Catalysts

Answer 06 · Examiner comments June 2024 | 8464/C/2F | Original Q7

0 7 . 1 A student investigated the effect of changing the particle size of calcium carbonate on the rate of reaction with hydrochloric acid.

Figure 6 shows the apparatus.

Figure 6



Describe a method the student could use to produce valid results.

[6 marks]

Add hydrochloric acid to a conical flask and add calcium carbonate. Then add a stopper and put in a delivery tube and put that in some water. Calculate the calcium carbonate that the gas has forced to move in the measuring cylinder.

This student has described the two most common key steps but has not gone on to add anything further so has not met the Level 2 descriptor: 1 mark was awarded.

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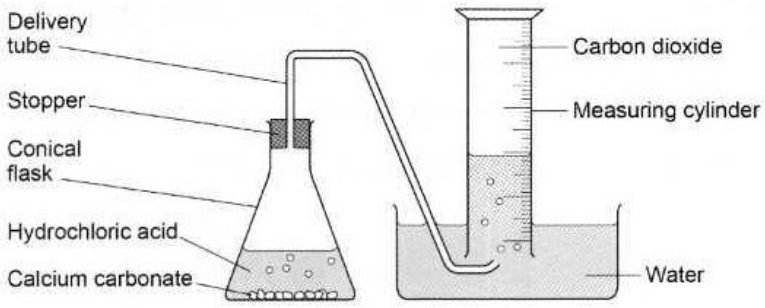
5.6.1.4 Catalysts

Answer 06 · Examiner comments June 2024 | 8464/C/2F | Original Q7

0 7 . 1 A student investigated the effect of changing the particle size of calcium carbonate on the rate of reaction with hydrochloric acid.

Figure 6 shows the apparatus.

Figure 6



Describe a method the student could use to produce valid results.

[6 marks]

1.) Measure the mass of the calcium carbonate

2.) Add 50 cm^3 of hydrochloric acid into the conical flask and put the ~~delivery~~ stopper over to trap the gasses in.

3.) connect the delivery tube to the water so that the gasses can enter it.

4.) Measure the ~~amount of~~ ~~gas produced~~ amount of carbon dioxide.

5.) ~~Also measure the amount of~~ ~~Repeat the experi~~ Record the results of carbon dioxide and how much calcium carbonate was used.

6.) Repeat steps 1-5 ~~but~~ with different masses of calcium

Turn over ▶

This student has achieved the first two key steps; however, they have not described what they are going to measure or change in the repeats to achieve the other key steps.

The student has specified 50 cm^3 of hydrochloric acid and done repeats (of something) so that they have given a control variable. This would therefore just place this answer into Level 2 and 3 marks are awarded.

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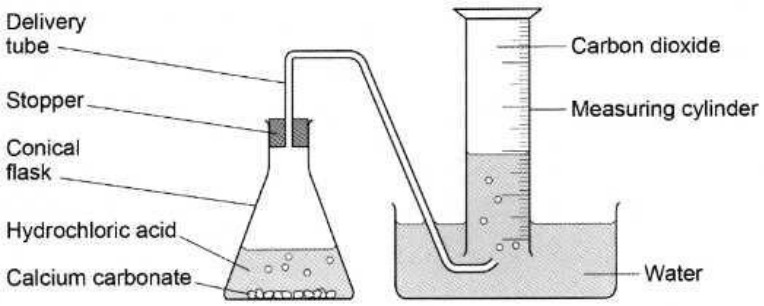
5.6.1.4 Catalysts

Answer 06 · Examiner comments June 2024 | 8464/C/2F | Original Q7

0 2 . 1 A student investigated the effect of changing the particle size of calcium carbonate on the rate of reaction with hydrochloric acid.

Figure 3 shows the apparatus.

Figure 3



Describe a method the student could use to produce valid results. **[6 marks]**

- Use a balance to ~~find out the M~~ make sure your using the correct mass of calcium carbonate
- then place the calcium carbonate into the hydrochloric acid and place the stopper with the delivery tube on very quickly.
- record the amount of carbon dioxide in the measuring cylinder every 30 seconds ~~repeat this~~ until the calcium carbonate stops bubbling.
- repeat this method but with bigger particle size of calcium carbonate but they have to be the same mass as the smaller particles.

In this response the student has suggested that the 'correct mass' of calcium carbonate should be used in the first bullet point. This is insufficient for a control variable, but in the final bullet point the 'same mass' has been identified, so there is one control variable here. The first two key steps are identified in the second bullet point. Key steps 3 and 4 are given in the third bullet point. 'Amount' would not be acceptable in a points-based mark scheme, but this response should be marked holistically as it is an extended response. There is no explicit mention of starting a stopwatch; however, it is implied in the statement 'every 30 seconds.' The final bullet point gives the repeats with a different particle size and one control variable.

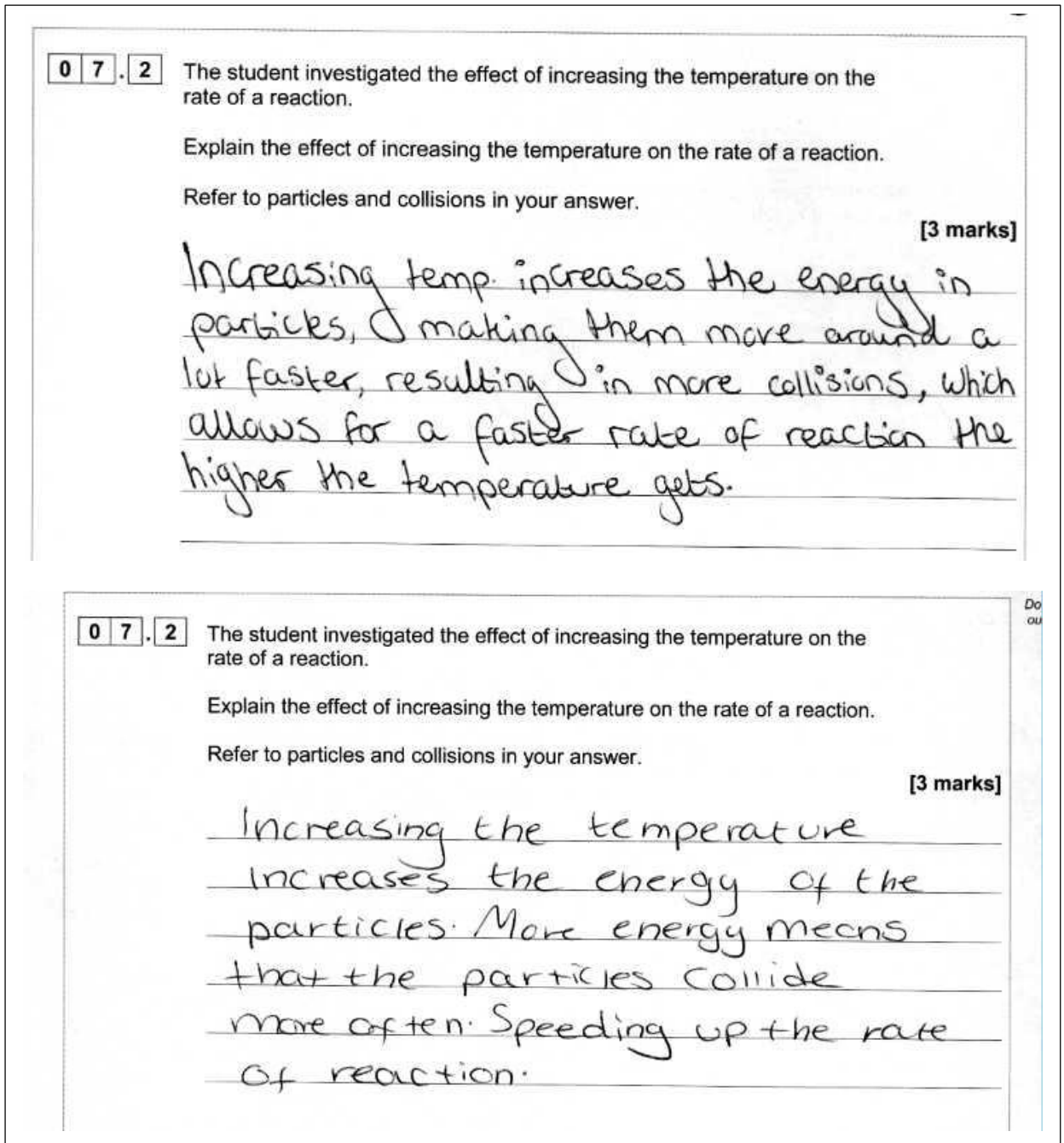
Therefore, there are all five key steps, and one control variable so this is a Level 3 response and is awarded 5 marks. An additional control variable is needed for 6 marks.

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5.6.1.4 Catalysts

Answer 06 · Examiner comments June 2024 | 8464/C/2F | Original Q7

07.2 Over half of the students gained at least 1 mark on this AO1 question, with 40% gaining 2 or more. The first two marking points were the more commonly awarded marks. Linking an increase in temperature to an increase in rate was the most common. However, very few students linked rate to the *frequency* of collisions, ie the more collisions per second, and are more likely to just talk about more collisions.



0 7 . 2 The student investigated the effect of increasing the temperature on the rate of a reaction.

Explain the effect of increasing the temperature on the rate of a reaction.

Refer to particles and collisions in your answer.

[3 marks]

Increasing temp. increases the energy in particles, making them move around a lot faster, resulting in more collisions, which allows for a faster rate of reaction the higher the temperature gets.

0 7 . 2 The student investigated the effect of increasing the temperature on the rate of a reaction.

Explain the effect of increasing the temperature on the rate of a reaction.

Refer to particles and collisions in your answer.

[3 marks]

Increasing the temperature increases the energy of the particles. More energy means that the particles collide more often. Speeding up the rate of reaction.

The first student has achieved the first two marking points, but 'more collisions' is insufficient for marking point 3.

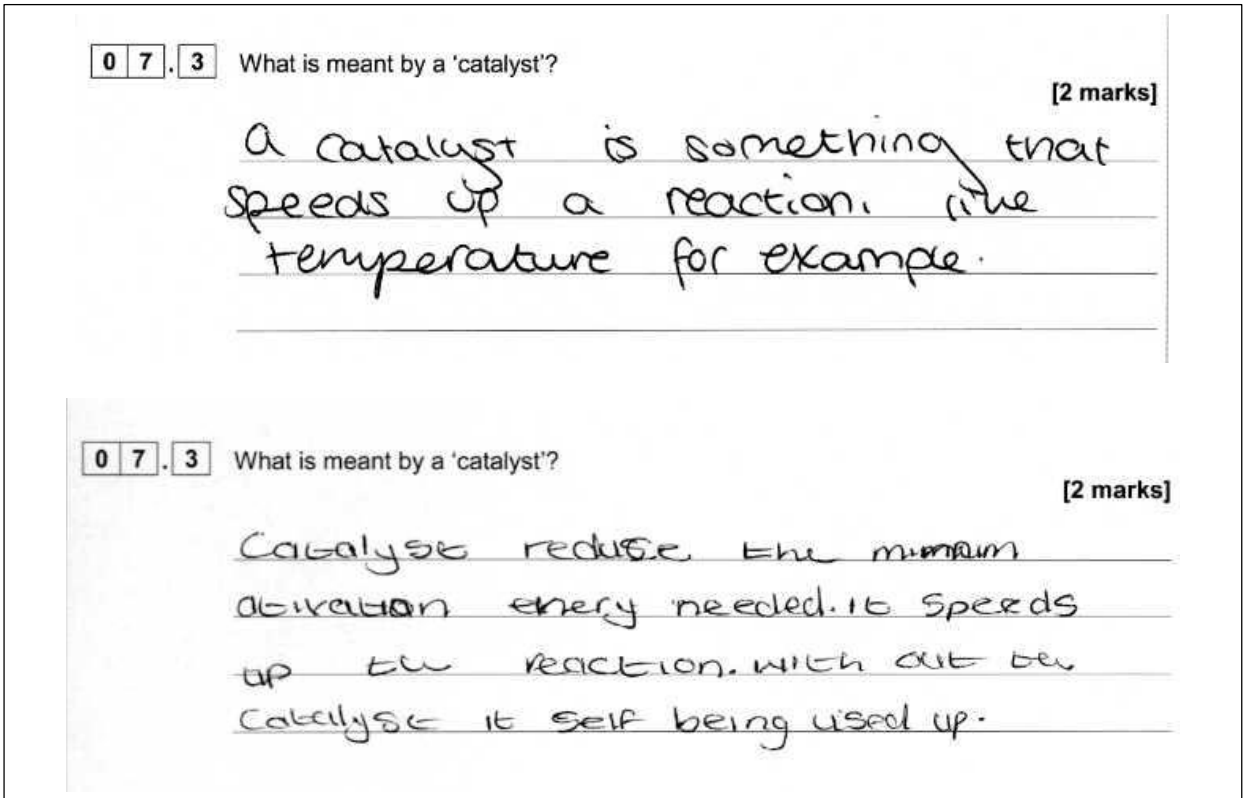
The second student has achieved all 3 marks. In addition to identifying that the energy of the particles increases, speeding up the reaction, 'particles collide more often' is equivalent to' more frequent collisions' as the collisions are linked to time.

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5.6.1.4 Catalysts

Answer 06 · Examiner comments June 2024 | 8464/C/2F | Original Q7

07.3 Over 40% of students were able to gain at least 1 mark for the AO1 definition of a catalyst. The first marking point was most seen; however, many misconceptions were also seen. One common misconception is that a catalyst is *any* change that speeds up the reaction. This contradicts what a catalyst is, so the first mark cannot be awarded.



0 7 . 3 What is meant by a 'catalyst'?

[2 marks]

A catalyst is something that speeds up a reaction. like temperature for example.

0 7 . 3 What is meant by a 'catalyst'?

[2 marks]

Catalyst reduce the minimum activation energy needed. It speeds up the reaction. without the catalyst it self being used up.

The first student starts off well; however, they suggest that temperature is a catalyst, so the mark is not awarded.

The second student clearly defines a catalyst for 2 marks, but includes information which is unnecessary, the idea that a catalyst reduces the activation energy. This would be required in an 'Explain' question, rather than the much simpler 'What is?', but does not affect the marks awarded.

07.4 Enzymes are in both the Chemistry and Biology sections of the specification; however, very few students were able to recall that biological catalysts are called enzymes.

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5.6.1.4 Catalysts

Contact us

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

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