AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.7.1.2

Abiotic factors

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**4**
Available paper years	**2018–2023**

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.

4.7.1.2 Abiotic factors

Answer 01 · Mark scheme

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>01.1</td><td>
<table>
<tr><th>Factor</th><th>Biotic</th><th>Abiotic</th></tr>
<tr><td>Diseases</td><td>✓</td><td></td></tr>
<tr><td>Herbivores</td><td>✓</td><td></td></tr>
<tr><td>Temp</td><td></td><td>✓</td></tr>
<tr><td>Water</td><td></td><td>✓</td></tr>
</table>
</td><td>allow 1 mark for 2 or 3 correct</td><td>2</td><td>AO1
4.7.1.3
4.7.1.2</td></tr>
<tr><td>01.2</td><td>(leaves block light near tree so) more light (as you move outwards)

for photosynthesis

(which) produces (more) glucose / proteins (for growth)</td><td>allow low light intensity under tree
ignore Sun

allow less photosynthesis under the tree

ignore growth
ignore food

allow molecules, cell components or other correct substances instead of proteins

if no other mark awarded allow less water / ions / minerals / nutrients under the tree</td><td>1

1

1</td><td>AO2
4.7.2.1

AO1
4.7.2.1
4.4.1.1
4.4.1.3

AO1
4.7.2.1
4.4.1.1
4.4.1.3</td></tr>
<tr><td>01.3</td><td>
quadrat

light meter</td><td>in this order

correct spelling only

allow lux meter
allow light intensity meter
allow light data logger</td><td>
1

1</td><td>AO1
4.7.2.1</td></tr>
<tr><td>01.4</td><td>1.5(0) (m^2)</td><td>allow 15 000 cm^2</td><td>1</td><td>AO2
4.7.2.1</td></tr>
</table>

4.7.1.2 Abiotic factors

Answer 01 · Mark scheme

June 2018 | 8464/B/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	to keep light (intensity) as similar as possible	allow the light (intensity) might change ignore references to temperature ignore weather ignore Sun	1	AO3 4.7.2.1
01.6	any **one** from: • repeat (investigation) around the tree • repeat (investigation) for other trees / areas • sample every one metre • count the number of each species present (rather than percentage cover)	allow repeat in different directions ignore repeats unqualified ignore repeat at different times / days / seasons ignore different size quadrat ignore random sampling	1	AO3 4.7.2.1
01.7	daisy		1	AO3 4.7.2.1
01.8	as light (intensity) increased so did the percentage / cover of plants up to 100% / maximum at 175 (arbitrary units)	ignore directly proportional ignore positive correlation unqualified ignore distance	1 1	AO3 4.7.2.1

4.7.1.2 Abiotic factors

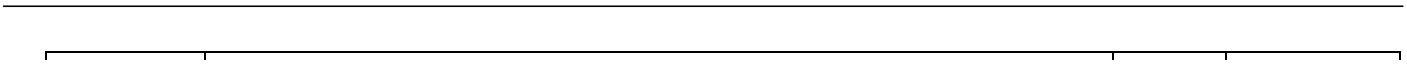
Answer 01 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.9	any pair from: • (lack of) water / rain (1) because the leaves are stopping the rain **or** because the roots of the tree are absorbing it (1) • (lack of) minerals / ions (1) because the tree (roots) have absorbed them (1) • temperature (1) because less thermal energy from the sun is reaching under the tree canopy (1)	ignore carbon dioxide do **not** accept oxygen allow soil moisture allow magnesium / nitrate / nutrients allow too cold / cooler allow 'heat' for thermal energy allow pH / acidity (1) because (some) fallen leaves are acidic (1)	2	AO2 4.7.2.1
Total			**15**	

4.7.1.2 Abiotic factors

Answer 01 · Mark scheme

June 2018 | 8464/B/2H | Original Q1



4.7.1.2 Abiotic factors

Answer 02 · Mark scheme

June 2019 | 8464/B/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	repeat for another ten quadrats		1	AO3 4.7.2.1
	use a random method to place the quadrats		1	
05.2		an answer of 4.8 x 10^5 scores **5** marks an answer of 481 766.4 **or** 481 766 **or** 480 000 scores **4** marks an answer of 15 744 × 4 × 7.65 scores **3** marks an answer of 15 744 (m^2) scores **2** marks		AO2 4.7.2.1
	(area of field =) 62 × 164 + 164 × 68 ÷ 2 **or** equivalent		1	
	15 744 (m^2)		1	
	15 744 × 4 × 7.65	allow use of incorrect area allow $\frac{7.65}{0.25}$ × 15744	1	
	481 766.4	allow 481 766 **or** 480 000	1	
	4.8 × 10^5	allow incorrect calculation expressed correctly	1	

4.7.1.2 Abiotic factors

Answer 02 · Mark scheme

Question	Answers	Mark	AO/ Spec. Ref
05.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3-4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content • trees over / in field • (which) reduce light for photosynthesis • (so) fewer daisies there • trees over / in field • (which) take water / nitrates / ions from the soil • (so) fewer daisies there • trampling on sports pitches • (will) kill plants • (so) fewer daisies there • competition from plants / grasses on field • (will) use up water / nitrates / ions / space • (so) fewer daisies there • gardener may water / fertilise / mow field • (which provides) more water / nitrates / ions • (so) more / fewer daises grow there • more insects / disease / animals in some areas • (may) eat / kill plants • (so) fewer daisies there • school buildings • (which) reduce light for photosynthesis • (so) fewer daisies near school • pollution / toxins from vehicles on roads • (which will) reduce growth • (so) fewer daisies near roads • wrong pH **or** lack of ions **or** poor drainage **or** poor / wet / dry soil in some areas • (which will) slow growth • (so) fewer daisies there Level 3 answers must refer to several factors in accurate detail		4.7.1.1 4.7.1.2 4.7.1.3 4.4.1.1
Total		**13**	

4.7.1.2 Abiotic factors

Answer 02 · Mark scheme

June 2019 | 8464/B/2H | Original Q5



4.7.1.2 Abiotic factors

Answer 03 · Mark scheme

June 2022 | 8464/B/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	any **one** from: • competition • herbivores • trampling / mowing • pollinators • pathogens	allow other plants / trees (growing in the field) allow named herbivore allow pests allow insects or named pollinator allow infection ignore disease unqualified	1	AO2 4.7.1.3 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	any **six** from: • mark out (grid) area in wet and in dry area • method for placing quadrat(s) • count / record number of buttercups (in the quadrat) • use at least 5 quadrats in each area • take soil moisture readings • use suitable equipment for readings, eg soil moisture meter • calculate the mean (in each area) • use the mean and area to calculate total number in wet area and total number in dry area **OR** any **six** from (6): • transect between wet area and dry area • place quadrat(s) regularly along transect • count / record number of buttercups (in the quadrat) • use at least 5 quadrats along transect • take soil moisture readings • use suitable equipment for readings, eg soil moisture meter • repeat transects • calculate the mean at each distance along the transects	allow mark out a transect in each of the two areas allow description of a method to place quadrat(s) randomly / systematically do **not** accept throwing quadrats randomly ignore percentage cover of buttercups allow (for each area) total number of buttercups divided by total area sampled, multiplied by total area for **2** marks allow description of a method to place quadrat(s) systematically	6	AO1 4.7.2.1 RPA7

Total Question 3		7

4.7.1.2 Abiotic factors

Answer 04 · Mark scheme

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	measure / string / transect / line at right angles to river (edge)	allow measure / string perpendicular to river (edge) allow shown on **Figure 1** allow measure / string / transect / line straight from the river into the field ignore measure / string / transect / line from the river into the field unqualified	1	AO1
	place quadrat at intervals (along transect)	allow place quadrat at named intervals (of between 1 m and 10 m) allow place quadrats along transect do **not** accept place quadrat at random intervals	1	AO1
	count the (different plant) species (in each quadrat) at each distance	ignore references to counting numbers of plants **or** percentage cover	1	AO1
	repeat for 2 more transects	allow 2 or more repeats (of transect) allow repeat at 2 or more locations (along the river) allow 3 or more correct transect lines shown on **Figure 1**	1	AO1 4.7.2.1 RPA7

4.7.1.2 Abiotic factors

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	the mean value students can be most certain about is 5 metres from the river		1	AO3 4.7.2.1 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	moisture levels in the soil		1	AO1 4.7.1.2 4.7.1.1

Question	Answers	Mark	AO / Spec. Ref.
03.4	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO2
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content.	0	
	Indicative content **consequences of increasing number of cows** • fewer plants • due to more trampling • due to more plants being eaten (by cows) • (fewer plants so) less photosynthesis • so more carbon dioxide in the atmosphere • (more) cows will release carbon dioxide • from respiration • (more) cows release methane • deforestation to provide farmland • more (cow) faeces entering river / streams / watercourses **environmental implications** ○ carbon dioxide is a greenhouse gas ○ methane is a greenhouse gas ○ global warming may be greater ○ description of consequence(s) of global warming ○ description of consequence(s) of (cow) faeces entering river / streams / watercourses ○ less land available to grow crops ○ effects of deforestation (eg reduced biodiversity) For **Level 3**, explanations include consequence(s) and linked environmental implication(s).		4.7.1.3 4.7.2.1 4.7.2.2 4.7.3.4 4.7.3.5 4.7.3.2

Total Question 3	**12**

4.7.1.2 Abiotic factors

Answer 01 · Examiner comments

June 2018 | 8464/B/2H | Original Q1

Question 1 (standard demand)

01.1 86% of students were able to identify two or three factors that were biotic or abiotic, with about 64% identifying all four correctly.

01.2 Most students noted that light increased as you moved away from the tree. However, a much lower number related light to photosynthesis and fewer still could link to glucose for growth, although some answered with 'providing food'. There were students who mixed up photosynthesis and respiration.

01.3 Many students identified a quadrat and most of these could spell it correctly. Much fewer identified the light meter, with solar panel and light dependent resistor (LDR) as the most common wrong answers. 'Lightometer' was seen but unless this was qualified as a mobile phone app it did not gain credit. Similarly a 'light sensor' was only correct if linked to a data logger.

01.4 Most students attempted a calculation, with 15% answering correctly. Some students were able to correctly calculate the area of one quadrat as 0.25 m^2 but then multiplied by either ten or five instead of the six sites sampled.

01.5 A wide variety of answers were seen suggesting that students understood that light intensity could change during the day. Provided the idea was clear credit was awarded.

01.6 The many students who just wrote 'repeat the investigation' did not gain credit. However 38% of students knew that this would only improve validity if it was in a different direction or for a different tree. Sampling every metre was also a correct common response.

01.7 74% of students identified 'daisy'. A number of students wrote more than one answer and so lost the mark under the list rule. Clover was a common incorrect answer, possibly because that was the species with the highest percentage cover at high light intensity rather than the species which **only** grew at high light intensity.

01.8 The first straightforward mark point for increasing light intensity showing an increased percentage cover of plants was stated by 62% of students although some incorrectly inferred that it was the percentage cover of plants causing the increased light intensity.

Only the most mathematically astute students were able to note that a maximum of 100% cover was seen from 175au of light for the second mark. A number of students did not read the question carefully enough and gave detailed descriptions of what was happening for each species instead.

4.7.1.2 Abiotic factors

Answer 01 · Examiner comments June 2018 | 8464/B/2H | Original Q1

01.9 While 69% of students were able to identify a factor for one mark, often seen and credited within the reason section, very few were able to explain this in terms of the tree. Instead students gave very general reasons for why the factor was needed by plants. Many students wrote about the carbon dioxide level under a tree changing which is not the case.

Answer 02 · Examiner comments June 2019 | 8464/B/2H | Original Q5

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

05.1 Most students were able to identify one way to improve the method given for the RPA of measuring a population of organisms; in this case, daisies in a school field. 57% of students gave both improvements correctly.

05.2 Most students made a good attempt at this tough multistep calculation. A third gained two marks for correctly calculating the area of the school field. A further 12% of students gained a further one mark, most usually for converting the incorrect answer they derived into standard form with two significant figures. 10% correctly calculated the result but failed to express it in the required format, while 7% calculated a totally correct answer.

05.3 This extended response question asking about factors which would affect the distribution of daisy plants on the school field was intended to be challenging. To give answers reaching Level 2 or 3 the student needed to include a high degree of accurate detail to explain each factor. Students who identified only factors, or who discussed only one factor, would be unlikely to get a mark awarded above Level 1. To gain a mark in Level 3 quite a lot of strong linking with accurate detail was needed for several factors and a clear understanding of how each one affected the distribution. It was not required to label each factor as biotic or abiotic but if the student chose to do so it needed to be correct.

11% of students gave enough accurate detail to be awarded five or six marks (Level 3). 57% of students gained three or four marks (Level 2) and 26% achieved one or two marks (Level 1). Very few students gained no credit or did not attempt a response. This question differentiated well throughout the ability range of students.

4.7.1.2 Abiotic factors

Answer 03 · Examiner comments — June 2022 | 8464/B/2H | Original Q3

Question 3 (standard & standard/high demand)

03.1 Half the students could identify one biotic factor affecting the number of buttercups. Abiotic factors were frequently seen, such as light intensity and minerals in the soil.

03.2 The mark scheme allowed for two alternative valid methods to investigate if the amount of water in the soil affects the number of buttercups in the field. Transects were often referred to but not always correctly. Students who described a transect in the wet area and also a transect in the dry area were following the first method on the mark scheme. For the first method, references to marking a grid in each area were seen, and more frequently, for the second marking point, some reference to a method of placing quadrats such as a description of using a random number generator and coordinates. It was equally valid to describe a random method or a systematic method to place quadrats. However, throwing quadrats is not random or systematic and therefore was not accepted. Simply stating 'randomly place quadrats' was insufficient for this marking point because a method was required.

Many students gained the third marking point. Estimating percentage cover was insufficient.

Few students made an attempt to measure soil moisture readings or to describe how this could be achieved.

Clear descriptions of calculating a mean and using the total area correctly in calculations were seen.

The alternative method could also gain all six marks. Many of the marking points are the same for the two alternative methods. Care was required if students referred to calculating a mean from the results from a transect. Sometimes, students indicated they would use all the results along a transect to calculate a mean, which was incorrect for the eighth marking point.

Answer 04 · Examiner comments — June 2023 | 8464/B/2H | Original Q3

Question 3 (Standard, Standard/high and High demand)

03.1 This investigation is part of Required Practical Activity 7. This was a challenging novel context for students to apply their knowledge of practical techniques. Many students assumed this required random sampling of the plant species in the field. which was incorrect. Students were prompted to explain how to use a transect in their method. Many students used the term transect in place of quadrat. In a high proportion of answers there was confusion between a transect and quadrat, eg 'place a $1m^2$ transect on the ground' and

'count how many plant species there are in each transect'. Some students also referred to 'using a quadrat (transect)' which implies that the terms can be used interchangeably. There is clearly confusion amongst students between the words and their meanings, with a key misconception being that a transect is the same as a quadrat.

Where students knew the difference between a transect and quadrat, there were still many examples of students not knowing the name of a quadrat, with terms such as metal grid, transquare, wire panels and even Punnett square being used.

Few students correctly described how to place the transect. Some of the clearest answers drew their transect and locations for quadrats on Figure 1. Marks could be awarded in these cases.

When students understood what a transect was, it was common for them to score marking points 2 and 3. These students could refer to placing quadrats at set intervals and counting the number of species in each quadrat at these intervals. Marking points 1 and 4 were less commonly seen. For marking point 1, this was usually because students gave no indication of the direction the transect should be. Students awarded marking point 1 often added a transect line to the diagram provided or used the word perpendicular, which gained them credit. Marking point 4 was rarely seen. It seems that most students do not think about repeating transects in the same way as other sampling techniques / experiments. Students often failed to get marking point 4 because it wasn't clear if they were talking about repeating the quadrat sampling along the same transect or if they were talking about moving the transect along the river.

Many students attempted to sample randomly, or to throw quadrats from different distances from the river. Throwing quadrats is never an appropriate method.

References to calculating a mean were frequent, but usually in the incorrect context of calculating the mean of the results from all distances along one transect.

Some students did not have a concept of size. This could be seen with wording such as:

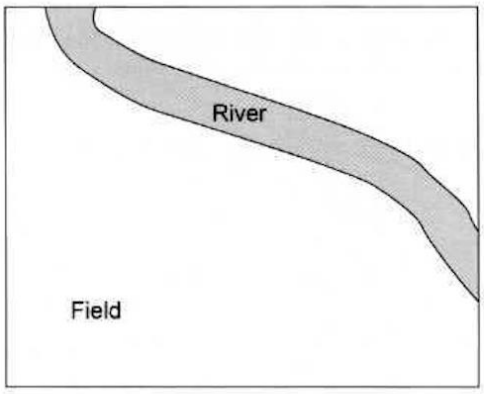
- lay down a transect of 1 m and then place 100 cm quadrats along it
- use a quadrat 10 m × 10 m
- use a 1 cm by 1 cm quadrat
- use a quadrat every 5 cm
- use a 100 m ruler.

4.7.1.2 Abiotic factors

Answer 04 · Examiner comments June 2023 | 8464/B/2H | Original Q3

0 3 **Figure 1** shows a river next to a field.

Figure 1



0 3 . 1 Describe a method to investigate how the distance from the river affects the number of different plant species in the field.

You should explain how to use a transect in your method.

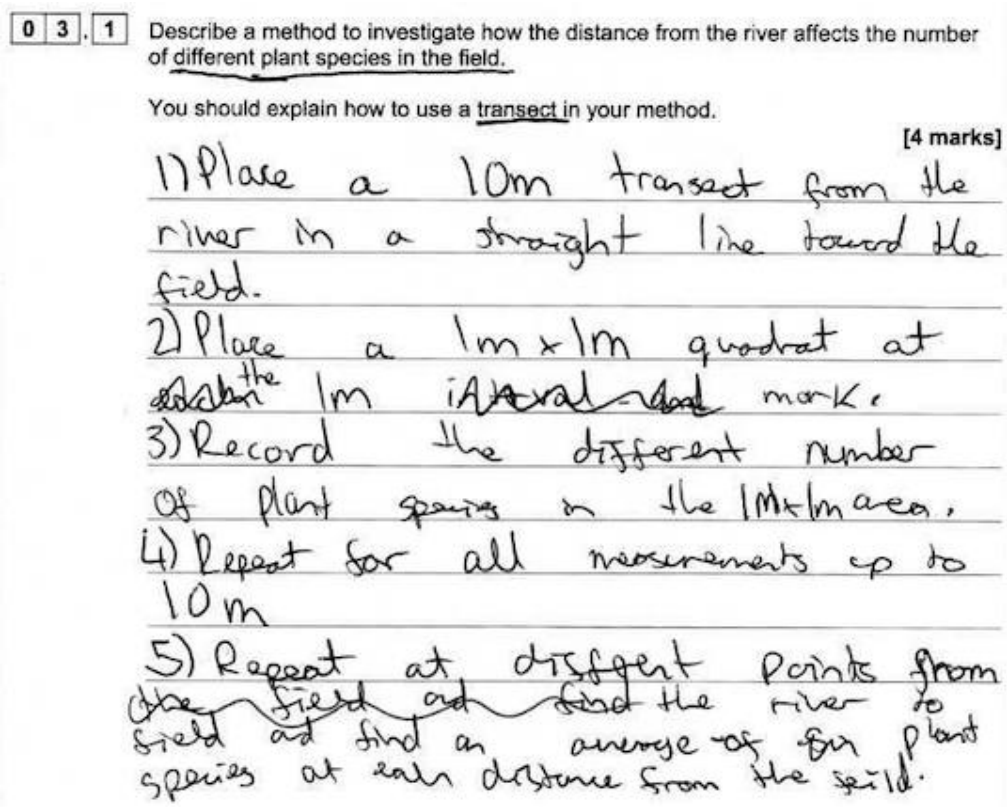
[4 marks]

You should have big net & filled with species with any measurements (like 5cm by 5cm). Then You can count the different plant species within the area. Also you do need to be a certain distance from the river everytime such 1m, 2m 3m, 4m & 5m

The response above does not describe where to place the transect, therefore no marking point 1. They have not used the term quadrat, therefore cannot access marking point 2 (notice the underlined part of marking point 2 in the mark scheme). They do collect appropriate data at each distance therefore marking point 3 was awarded. There is no appropriate reference to repeating the transect, therefore no marking point 4.

4.7.1.2 Abiotic factors

Answer 04 · Examiner comments June 2023 | 8464/B/2H | Original Q3



0 3 . 1 Describe a method to investigate how the distance from the river affects the number of different plant species in the field.

You should explain how to use a transect in your method.

[4 marks]

1) Place a 10m transect from the river in a straight line toward the field.
2) Place a 1m x 1m quadrat at the 1m mark.
3) Record the different number of plant species in the 1M x 1m area.
4) Repeat for all measurements up to 10m
5) Repeat at different points from the field and find the river to field and find an average of the plant species at each distance from the field.

This response was awarded all 4 marks.

03.2 Approximately one-third of students could identify that the mean value the students can be most certain about is 5 metres from the river. This suggests a lack of understanding of range bars on graphs.

03.3 Approximately-two thirds of students could identify an abiotic factor that could affect the number of different plant species found near the river.

03.4 This was an 'extended response' style of question. Such questions are marked holistically. There are overall generic descriptions for the three levels of response at the top of the scheme, giving a hierarchy of response. Within each level there are 2 marks.

Students were asked to explain the environmental implications of an increasing number of cows being farmed. A mark scheme relating to a question this broad cannot cover all possible valid responses. Examiners used professional judgement with other content. For example, some students discussed rivers becoming polluted with antibiotics used when farming cows, described environmental implications of increased fertiliser use due to growing more crops to feed the higher cow numbers, or described environmental implications of increased machinery or transport use associated with increasing cow numbers. All of these were valid points.

Many students could give one or several aspects of environmental implications of farming more cows. Some students thought this would mean fewer cows and answered accordingly. Some marks could still be awarded in some such instances.

4.7.1.2 Abiotic factors

At Level 1, students needed to give some indicative content that might be a consequence or an environmental implication. This could be very simply stated such as ‘cows will release more greenhouse gases’. Crucially, if two or more ideas were given but not a linked consequence and environmental implication, the answer did not meet the criteria for Level 2.

To enter Level 2 the generic descriptor shows that there must be attempts at logical linking. To enter Level 2, therefore, students must link a consequence with an environmental implication and give another piece of indicative content. An example that gained 3 marks would be ‘More cows produce more methane and methane is a greenhouse gas, so global warming will get worse’. To decide if the response is worth 4 marks, the criteria for 3 marks plus some other indicative content must be seen.

For a Level 3 mark, students must strongly link consequence(s) with environmental implication(s), for example by linking one consequence with two associated implications or by linking two associated consequences with their implication as well as giving further indicative content points. An example that meets the Level 3 criteria and gains 5 marks would be ‘There are fewer plants growing as more plants get eaten by cows. Therefore, there are fewer plants photosynthesising and absorbing carbon dioxide from the atmosphere. Carbon dioxide is a greenhouse gas’.

We always look to positively mark, so where errors were seen, such as that cows release methane only when they die or that farming an increasing number of cows will decrease the cow population, a student could still gain credit if indicative content is also seen in the response. Such errors were helpful when deciding where within a level a response sits.

Common misconceptions included:

- confusion between the ozone layer and the greenhouse effect
- cows release methane or carbon dioxide only when they die
- trees release carbon dioxide when they are cut down
- that cows die and form fossil fuels.

4.7.1.2 Abiotic factors

Answer 04 · Examiner comments June 2023 | 8464/B/2H | Original Q3

0 3 . 4 Increasing numbers of cows are being farmed across the world.

Explain the environmental implications of increasing numbers of cows being farmed.

[6 marks]

Due to the increase of cows being farmed, is causing environmental problems. Cows are heavy and walk around. They are farmed in areas where crops and plants are growing, they are then trampeling over these plants causing them to die and stop progressing. More methane is also being produced and going into the atmosphere.

The response gives bullet points 1, 2 and 8, which are consequences of increasing numbers of cows being farmed. There are no links to environmental implications, therefore the response is in Level 1 and was awarded 2 marks.

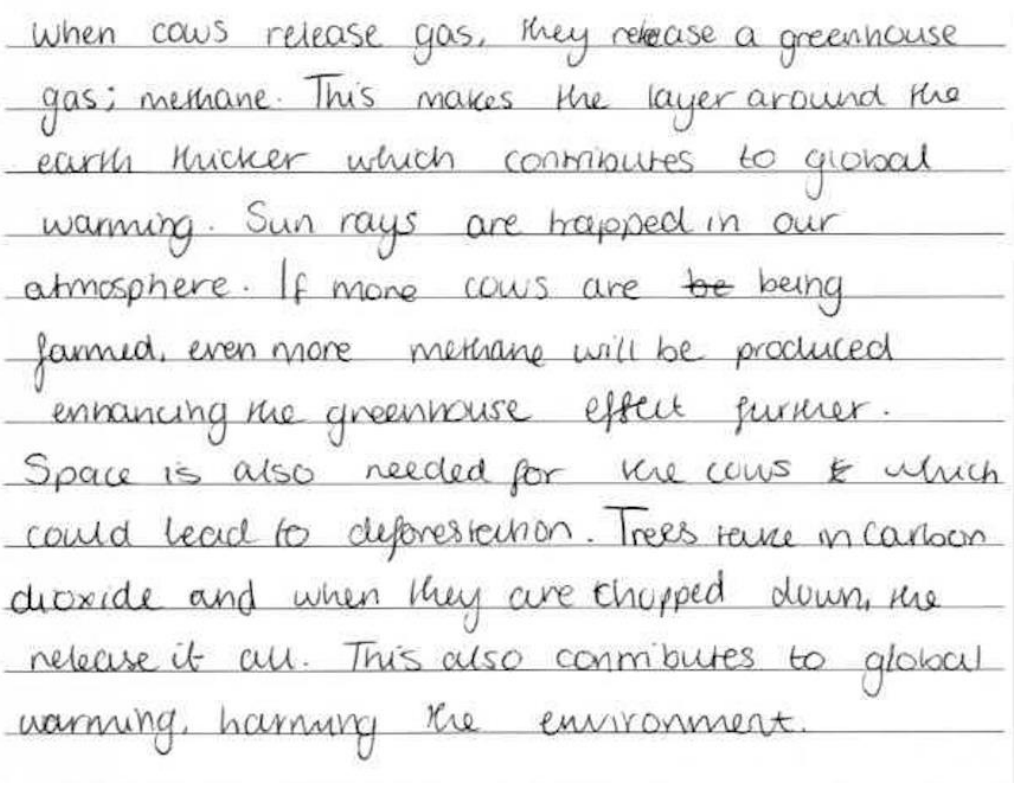
4.7.1.2 Abiotic factors

Answer 04 · Examiner comments June 2023 | 8464/B/2H | Original Q3

0 3 . 4 Increasing numbers of cows are being farmed across the world.

Explain the environmental implications of increasing numbers of cows being farmed.

[6 marks]



When cows release gas, they release a greenhouse gas; methane. This makes the layer around the earth thicker which contributes to global warming. Sun rays are trapped in our atmosphere. If more cows are ~~be~~ being farmed, even more methane will be produced enhancing the greenhouse effect further. Space is also needed for the cows & which could lead to deforestation. Trees take in carbon dioxide and when they are chopped down, the release it all. This also contributes to global warming, harming the environment.

The student links bullet points 8, 12 and 13, then bullet point 9. There is also a correct reference to carbon dioxide contributing to global warming. The statement about carbon dioxide being released when trees are chopped down was a common error. This response is in Level 3 and was awarded 5 marks.