AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.7.3.5

Global warming

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**5**
Available paper years	**2019–2025**

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.

4.7.3.5 Global warming

Answer 01 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	methane	allow CH_4 **or** water (vapour) **or** H_2O allow correct example such as CFCs, nitrous oxide, ozone	1	AO1 4.7.3.5
02.2	any **two** from: • ice caps melting • rise in sea levels • desertification • extreme weather • change in species distribution • change in migration patterns • loss of biodiversity • coral bleaching • crop failure **or** food insecurity • loss of habitat qualified	ignore references to increased temperature and greenhouse gas / effect allow storms **or** droughts **or** flooding allow some species become extinct / endangered allow correct examples such as polar bears losing ice ignore forest fires	2	AO1 4.7.3.5

4.7.3.5 Global warming

Answer 01 · Mark scheme

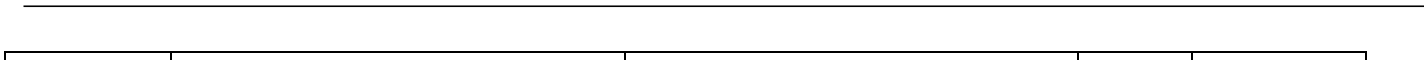
June 2019 | 8464/B/2H | Original Q2

Question	Answers	Mark	AO/ Spec. Ref
02.3	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	4–6	AO1 4.7.2.2 4.4.1.1 4.4.1.3 4.4.2.1
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1-3	
	No relevant content	0	
	Indicative content Photosynthesis • (carbon dioxide is) taken in through stomata / leaves • (carbon dioxide is) used in photosynthesis • to make glucose / carbohydrate • (glucose used) to make other carbon compounds or named example such as proteins, lipids • (glucose) stored as starch Feeding • plants are eaten / consumed by animals • which use the carbon compounds to make other carbon compounds Decay • when plants / animals die they are decomposed / decayed • by microorganisms • which use the carbon compounds to make other carbon compounds Respiration • plants / animals / microorganisms respire • (respiration) releases carbon dioxide back into the atmosphere Level 2 answers must consider photosynthesis and at least one other process in the carbon cycle. Level 2 answers must include some accurate detail.		
Total		**9**	

4.7.3.5 Global warming

Answer 01 · Mark scheme

June 2019 | 8464/B/2H | Original Q2



4.7.3.5 Global warming

Answer 02 · Mark scheme

November 2020 | 8464/B/1H | Original Q5

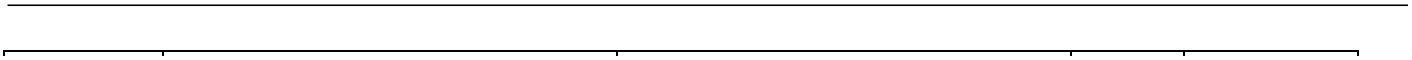
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	measure the volume of oxygen produced in a given time **or** when more oxygen is produced in a given time the rate of photosynthesis is faster	a reference to rate is needed allow gas for oxygen allow when oxygen is produced faster the rate of photosynthesis is faster ignore the faster the rate of photosynthesis, the more oxygen is produced allow the slower the oxygen is produced the slower the rate of photosynthesis **or** less oxygen being produced in a given time, the slower the rate of photosynthesis	1	AO1 4.4.1.1 4.4.1.2 RPA 5
05.2	light (intensity)	ignore temperature	1	AO2 4.4.1.2
05.3	20 000 (lux)	allow answers in range 19 500 to 20 500 (lux)	1	AO3 4.4.1.2

05.4	there is a cost for heating the greenhouse		1	AO3 4.4.1.1 4.4.1.2
	there is a cost for increasing the carbon dioxide in the atmosphere (of the greenhouse)		1	
		allow there is a cost for lighting (in winter)		
	(therefore) the additional costs might exceed the (additional) sale price / profit **or** (additional) costs could not be recovered by increasing the sale price of the tomatoes	ignore these additional costs would reduce profits unqualified	1	
05.5	when there is no light there is no photosynthesis		1	AO1
	(so) no oxygen is produced		1	AO1
	(but) respiration happens (all the time) and oxygen is used		1	AO1
	(therefore) the net / overall oxygen production is negative / - 2 (arbitrary units)	do **not** accept an answer of -2 (arbitrary units) unqualified	1	AO2 4.4.1.1 4.4.1.2 4.4.2.1
Total			**10**	

4.7.3.5 Global warming

Answer 02 · Mark scheme

November 2020 | 8464/B/1H | Original Q5



4.7.3.5 Global warming

Answer 03 · Mark scheme

June 2024 | 8464/B/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$		1	AO2 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(as temperature increases) the rate of photosynthesis increases **then** (the rate of photosynthesis) decreases	ignore references to volume unqualified	1	AO3 4.4.1.2
	fastest rate between 30 °C **and** 35 °C	allow a fastest rate at a temperature above 30 °C and below 35 °C allow reaches an optimum temperature between 30 °C and 35 °C	1	
	up to 30 °C the rate doubles every 5 °C increase	allow up to 30 °C the rate increases at an increasing rate allow up to 30 °C the rate increases exponentially	1	

4.7.3.5 Global warming

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	enzymes (in the plant / chloroplast) become destroyed (because) active site changes shape **OR** the active site changes shape (1) (so) the substrate no longer fits / binds (1) **OR** enzymes (in the plant / chloroplast) become destroyed (1) (so) the substrate no longer fits / binds (1)	allow enzymes become denatured do **not** accept enzymes are killed do **not** accept cells / plants are denatured allow enzymes become denatured do **not** accept enzymes are killed do **not** accept cells / plants are denatured ignore the plant is killed / dead	1 1	AO2 AO3 4.2.2.1 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	repeat the investigation, measuring the volume of gas to 0.5 cm^3		1	AO3 4.4.1.2

4.7.3.5 Global warming

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	any **two** from: • may have too many tomatoes to eat / sell • other factors could limit photosynthesis • the optimum temperature might be above / below 25 °C • greenhouses are poorly insulated • pollution from the heater • increase the rate of transpiration • increased spread of plant disease(s)	allow the idea of a glut **or** all ripen at the same time allow other named limiting factor could limit photosynthesis allow factors could limit tomato production allow increase carbon dioxide emissions allow increase global warming allow increase the water loss from the plant if no other mark awarded allow it is a fire hazard for **1** mark	2	AO3 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	meristem		1	AO1 4.1.2.3

Total Question 4	10

4.7.3.5 Global warming

Answer 04 · Mark scheme

June 2024 | 8464/B/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	domain		1	AO1 4.6.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	offspring are genetically identical		1	AO1 4.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	a gamete contains half of the number of chromosomes		1	AO1 4.6.1.1 4.6.1.2

4.7.3.5 Global warming

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **one** from: • similar / same structure / characteristics / phenotype (as potatoes)	allow named similar structure / characteristics such as same shape / leaves / flowers / taste allow studied with microscopes ignore 'look the same / similar' unqualified	1	AO1 4.6.4
	• similar DNA / genes	allow DNA analysis allow analysis of genetic material allow similar genetic material ignore genetic information do **not** accept same DNA / genes		
	• similar / same biochemistry			
	• same first part of binomial (name)	allow same first part of Latin / scientific name		

Answer 04 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
02.5	**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 allow reference to named crop throughout **effects of climate change** • climate change will change weather patterns / trends • climate change causes flooding **or** drought **or** temperature change • farming land decreased by sea level rise / flooding / desertification • current crops cannot grow / survive (in changing conditions) **benefits of GM** ○ GM may allow crops to grow in wider range of conditions ○ GM may allow crops to be resistant to wider range of pests / diseases ○ GM may allow crops to be stored for longer ○ GM may increase crop yield **or** increase growth rate ○ to feed the increasing human population ○ useful if less area available for farming ○ larger human population needs more land for housing **other relevant content** ▪ variation amongst current crops reduced by asexual reproduction **or** selective breeding ▪ rate of evolution (by natural selection) may be slower than rate of climate change For **Level 3**, answers must explain effect(s) of climate change **and** benefit(s) of GM with logical link.		4.6.2.4 4.7.3.2 4.7.3.5 4.7.3.6

Total Question 2	10

4.7.3.5 Global warming

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	herbicide is added / sprayed (on soil / land / field / crop / maize)		1	AO1
	(so) weeds killed **and** (GM) maize / crop not killed	allow (so) unwanted plants killed **and** (GM) maize / crop not killed allow **only** the weeds are killed	1	AO2
	(so) (GM) maize / crop has less competition for light / water / minerals / ions / space	allow (so) (GM) maize / crop has more light / water / minerals / ions / space ignore reference to nutrients ignore (GM) maize / crop has less competition unqualified	1	AO2
	(so more) photosynthesis to produce glucose which produces protein / cellulose / starch / fat (for growth)	allow (so more) photosynthesis to produce glucose which produces amino acids (for growth)	1	AO2 4.4.1.1 4.6.2.4 4.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	use of herbicide kills weeds / wildflowers / plants (that are not the crop)	allow increased use of herbicide / weedkiller ignore (more) use of pesticides ignore herbicide kills animals / insects	1	AO3 4.6.2.4 4.7.3.1
	(causes) fewer weeds **or** fewer other plants therefore less food for animals / insects	allow fewer wildflowers therefore less food for animals / insects allow less variety of food therefore lower number of species of animals / insects allow fewer weeds / wildflowers **or** fewer other plants therefore more competition for food	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	crops / plants may be insect / bee pollinated insects may be predators of (crop) pests	allow for pollination allow a description eg insects eat crop pests allow bees may be predators of (crop) pests	1 1	AO2 4.7.1.1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	provides source of food / shelter (for insects / bees / pollinators)	allow protection / hiding from predators	1	AO2 4.7.3.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(as oxygen level increases decay increases due to aerobic) respiration of microorganisms (which) releases carbon dioxide causing global warming	allow (aerobic) respiration of bacteria / fungi / decomposers allow (which) releases carbon dioxide which is a greenhouse gas allow (which) releases carbon dioxide causing the greenhouse effect ignore (which) releases carbon dioxide causing climate change	1 1	AO2 AO1 4.7.3.3 4.7.3.5 4.7.2.2 4.4.2.1

Total Question 4	11

4.7.3.5 Global warming

Answer 01 · Examiner comments

June 2019 | 8464/B/2H | Original Q2

Question 2 (standard demand)

02.1 Approximately three quarters of students were able to name another greenhouse gas. Methane was the most common correct answer, but water vapour was also seen. The most common incorrect answers were carbon monoxide and nitrogen.

02.2 Two effects of climate change were required, and many students gained both marks for stating 'polar ice caps melt and sea levels rise.' Ice caps melting was often described in vague ways that did not gain credit including 'ice melting' and 'icebergs melting.' The most common insufficient responses were 'hotter summers' or 'changes in weather.' As global warming was given in the stem of the question rising temperatures did not gain a mark.

Loss of habitat was insufficient without qualification as much habitat loss is due to human activity. Many students referred to 'animals/plants' becoming extinct which gained credit although 'species becoming extinct' was preferable. Misconceptions included that acid rain, earthquakes and volcanoes were effects of climate change.

Answer 01 · Examiner comments

June 2019 | 8464/B/2H | Original Q2

40% of students gave two effects and a further half of students gave one effect.

02.3 This question differentiated well between students. Almost all students answered this extended response question with 43% giving answers matching the Level 2 descriptor. The students scoring in Level 1 were able to name processes but did not give details or they did not mention photosynthesis. Confusion between photosynthesis and respiration also limited some students to Level 1.

Those students who recognised and named the processes of respiration and decay often gave better linked detail. Many referred to the decay process releasing carbon dioxide rather than the respiration of the microorganisms releasing the carbon dioxide. The passing on of carbon between levels of consumers was often overlooked.

Common inaccuracies which prevented the award of a full six marks included the passing on of carbon dioxide rather than carbon and the idea that carbon is stored in the soil when organisms decay.

4.7.3.5 Global warming

Answer 03 · Examiner comments — June 2024 | 8464/B/1H | Original Q4

Question 4 (standard, standard/high & high demand)

04.1 Most students correctly selected the equation for photosynthesis.

04.2 This question proved very demanding, with 45% gaining 1 or more marks and 8% 2 or more. Students mostly commented on the volume of gas produced and not the rate of photosynthesis, which limited their ability to gain credit resulting in a maximum award of 1 mark. The most frequently awarded mark was for the optimum temperature between 30 °C and 35 °C. Many students only gave individual temperatures, eg 'the optimum temperature was at 30 °C', and therefore did not recognise that the fastest rate or optimum must have fallen between the two values given in the table. Comments about the rate doubling every 5 °C increase were rarely seen, so it was rare to see a 3-mark answer.

Many students attempted to explain why the rate changed due to enzymes, which did not answer the question and so did not gain any marks.

04.3 This question also proved challenging, with 38% gaining 1 or more marks. Responses that gained credit were usually for stating the enzyme was denatured and missing that the active site changed shape.

04.4 40% of students could select the correct way to improve the accuracy of the experiment.

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Answer 03 · Examiner comments — June 2024 | 8464/B/1H | Original Q4

04.5 This question was not answered well: 70% of students gained no credit, and students appear to have struggled to grasp the context. Many responses talked about enzymes being denatured, despite the temperature given as 25 °C. Students who gained 1 mark usually did so for stating the optimum temperature may be higher or lower, or that there may be another limiting factor.

Many students made generic comments about use of a heater being 'bad for the environment' or 'uses lots of energy'. These comments did not go far enough with a link to global warming or climate change and so did not gain credit.

04.6 Three-quarters of students picked meristem as cells that can differentiate in plant cells.

Answer 04 · Examiner comments

June 2024 | 8464/B/2H | Original Q2

Question 2 (standard demand)

02.1 More than 50% of students could select that the classification group 'Eukaryota' is a domain.

02.2 Almost all students knew that asexual reproduction produces genetically identical offspring.

02.3 More than 80% of students knew that a gamete contains half the number of chromosomes compared to the other cells in a potato plant.

02.4 Most students could describe how a new plant species could be identified as being in the same genus as potatoes. DNA analysis or similar characteristics were the most common correct answers.

Misconceptions were seen, such as the idea that the species would have identical DNA.

02.5 Most students followed the direction of the question, stating that GM crops can be made to grow even if the climate changes.

Some students were aware of food insecurity as a result of climate change, and this could be given credit for the idea that current crops will not be able to grow/survive.

Lists of possible benefits of GM were limited to Level 1 if there was no link to climate change. Most students made very good attempts at this question and many recognised some of the effects of climate change and were able to link these to the idea that current crops would struggle to grow in these conditions. This was an attempt at a logical link and achieved a Level 2 mark.

Some students further developed this idea, and clearly had a grasp of the question being asked, as they then went on to describe how GM would enable crops (or potatoes) to survive the conditions that climate change brings. They could further strengthen their account with suggestions that more crops could be grown or crops could be grown faster. These responses were detailed and logically linked accounts and were therefore Level 3 responses.

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4.7.3.5 Global warming

Answer 04 · Examiner comments June 2024 | 8464/B/2H | Original Q2

Some students gave explanations of causes of climate change, but this did not answer the question.

Some students responded in terms of 'how' GM crops can be produced, mentioning enzymes and vectors. This was not answering the question and therefore could not be given credit. These responses often gained marks from the rest of their explanation.

0 2 . 5 Scientists have collected and stored seeds from species in the same genus as potatoes.

In the future, these seeds may be used for genetic modification of potato plants.

Genetically modified potato plants could help supply food to the human population as the climate changes.

Explain why genetic modification of crop plants may be important for the human population to survive climate change.

[6 marks]

As climate changes occurs the global temperature could get warmer. This means that agriculture will become harder and it will become harder for crops to be grown under hot conditions. This means that genetically modified crops could be modified to withstand greater heat and be produced in bigger yields. These crops could be produced with more nutrients and be bigger so that humans could get more energy in the future where there will be limited resources.

The student has described two effects of climate change (global temperature getting warmer and that it will be harder for crops to be grown). They then give two relevant benefits of GM linked to these ideas. This meets and exceeds the description for entry into Level 3, for both logical linking and detail, therefore 6 marks were awarded.

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Answer 05 · Examiner comments

June 2025 | 8464/B/2H | Original Q4

Question 4 (Standard/high and High demand)

04.1 Many students understood the term 'resistant'. However, it was clear that some students did not understand the term 'herbicide'. Some students confused herbicides with herbivores. Misconceptions surrounding herbicides were evident in statements such as 'herbicides can no longer eat the crops' and 'GM crops that are herbicide resistant cannot be eaten by herbivores' and some students confused herbicides with pesticides. Very few students were awarded marking point 1 as they often overlooked the idea that herbicide would be applied (to the crops).

For marking point 2, many students were seen to write that 'GM crops are less likely to be killed by herbicides' but did not then go on to state that the other plants / weeds would be killed. Many students incorrectly believed that maize and GM maize are grown simultaneously in the same field by the same farmer. This demonstrates a fundamental misunderstanding of how GM crops are used. Students need to be careful in their use of the word 'affected' as this was too vague for this marking point. For example, 'weeds are affected'.

Where students described the idea of competition in marking point 3, most were able to name a factor that would be competed for. However, it was very rare to see marking point 4.

Accounts of the steps involved in the process of producing GM plants were not relevant in this question but were seen in answers. In these instances, the students filled the answer space with their description before concluding with a short statement such as GM crops won't be killed. A small number of students went down the route of describing selective breeding instead of answering the question.

0 4 . 1 Maize is a crop plant.

A variety of maize has been genetically modified (GM) to be resistant to a herbicide.

Explain how growing GM herbicide-resistant maize can produce a larger yield than growing non-GM maize.

[4 marks]

as the genetically modified (GM) maize is resistant to a herbicide, it means that the maize can be sprayed by the herbicide, causing no damage to the plant but making it so no insects or bugs that will damage the maize, so more maize survives and will continue to produce a larger yei yield than growing non-GM maize.

This student gains marking point 1 but then continues to incorrectly describe function of the herbicide with a common misconception, so only marking point 1 was awarded.

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4.7.3.5 Global warming

Answer 05 · Examiner comments June 2025 | 8464/B/2H | Original Q4

04.2 This question asked students how growing GM crops decreases the biodiversity of animals. Some students made no reference to animals in their answers at all. Either they did not read the question properly or did not understand what they were being asked. A commonly seen insufficient response was 'the GM crops are genetically identical' and some students wrote about monoculture.

Many students failed to use the word herbicide correctly in this answer and as in question **04.1**, a lack of understanding of the word herbicide proved problematic. It was common for students to state that animals would not be able to eat the GM herbicide resistant crop after herbicide had been applied or that if animals ate the crop they would die. A frequently seen insufficient idea was that growing GM crops would take up more land leaving less habitat space for animals. The most frequent marking point here was marking point 2 with the idea of fewer other plants meaning less food for animals.

04.3 Very few students were awarded 2 marks for this question. Some students did not understand the term yield in the question. The most commonly awarded mark was for marking point 1, for the idea of insects as pollinators. However, there were a lot of misconceptions surrounding pollen and pollination. Commonly seen misconceptions regarding pollination included:

- bees making pollen or being a source of pollen
- bees collecting pollen for nectar
- pollination being where seeds get stuck to a bee's body
- pollen being needed by crops for photosynthesis / respiration
- the idea that bees themselves fertilise the plants, rather than facilitating pollination as a step leading to fertilisation.

Where insufficient attempts at marking point 2 was seen, some students were not clear about insects eating or destroying pests, instead suggesting insects simply deter or scare crop pests.

The idea of insects dying and decomposing and therefore providing minerals for the crops was insufficient. Some students repeated information from the question, giving answers such as 'insects increase crop yields'.

04.4 The most common correct answer for this question was 'hedgerows provide places for insects to reproduce / breed'. 'Hedgerows provide a source of food' or 'hedgerows provide a source of shelter' were also commonly seen correct answers.

The most common insufficient response was 'more hedgerows provide more habitats / places to live' as this was repeating the information given. Students must take care not to simply repeat information given to them in the question stem. Many students made vague references to increased biodiversity without linking this to the context of the question or wrote about the hedgerow providing 'ideal living conditions' for the insects without specifying what those conditions are.

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4.7.3.5 Global warming

Answer 05 · Examiner comments June 2025 | 8464/B/2H | Original Q4

04.5 This was a challenging question for many students as they failed to link microorganisms with respiration, instead writing answers implying the peat itself respired. It also appeared to be quite challenging to keep to the topic of the question, instead students frequently mentioned combustion rather than decay. There was a lot of repetition from the wording of the question, which didn't gain any marks. Very few students attained both marks available on this question, with marking point 1 rarely seen. Students who gained 1 mark, commonly gained the mark for stating that the released carbon dioxide is a greenhouse gas or that the release of carbon dioxide leads to global warming. Some students had the correct idea for marking point 2 but wrote the symbol for carbon dioxide incorrectly (e.g. 'CO2' or 'Co2', or with the 2 written superscript to the letters) and so were not awarded the mark. Refer to page 4 of the mark scheme for guidance on the use of formulae.

Most of the students achieving marking point 2 had not made the link to the source of the carbon dioxide being decomposers or respiration, with many stating that oxygen reacted with the peat to form carbon dioxide. There were not many students who could link the idea to increase oxygen enabling the microbes to respire, which produces carbon dioxide. Of the students who were not awarded marking point 2 it was frequently because the students identified that carbon dioxide would be released but did not go on to state the effect of this or simply reiterated the phrasing from the question stem (i.e. that carbon dioxide causes climate change). Several students made irrelevant references to methane or the ozone layer or stated that the process of cutting the peat released stored carbon dioxide. Another common error was stating that carbon is released into the atmosphere as opposed to carbon dioxide.

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