AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 4.6.3.1

Evidence for evolution

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**5**
Available paper years	**2020–2025**

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.

4.6.3.1 Evidence for evolution

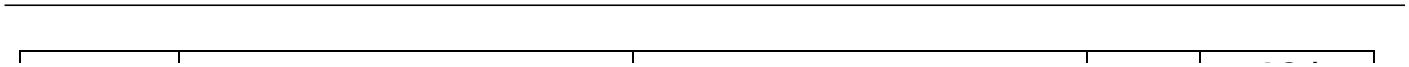
Answer 01 · Mark scheme November 2020 | 8464/B/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	archaea	allow archea or archaia as phonetic spelling	1	AO1 4.6.4
06.2	horizontal line from –415 to –65 (labelled ammonites)	allow -410 to -420 for -415 (to -65) allow oblique line	1	AO2 4.6.3.3
06.3	ammonites = 350 (million years) **and** trilobites = 266 (million years) 84 million (years) or 84 000 000	allow range 345 to 355 allow correct calculation from their answer for ammonites allow answers in standard form	1 1	AO2 4.6.3.3
06.4	68 and 96 [(96-68) ÷ 68] × 100 41.17647… **or** 41.2 **or** 41	allow +/- half a small square	1 1 1	AO2 4.6.3.3
Total			**7**	

4.6.3.1 Evidence for evolution

Answer 01 · Mark scheme

November 2020 | 8464/B/2H | Original Q6



4.6.3.1 Evidence for evolution

Answer 02 · Mark scheme

November 2021 | 8464/B/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	*Ourasphaira*	ignore italics ignore capitalisation do **not** accept *Ourasphaira giraldae*	1	AO2 4.6.4
03.2	the mud stopped oxygen reaching the fungus		1	AO2 4.6.3.2
03.3	any **one** from: • 2.1×10^8 (years) • 210 000 000 (years)		1	AO2 4.6.3.2
03.4	any **one** from: • fossil(s) of the fungus may have been destroyed (by geological activity) • fossil(s) of the fungus may not have been found (yet) • dating methods are not precise / accurate • the time at which an organism / fungus evolves from ancestors is difficult to pinpoint	ignore some destroyed ignore some not found (yet) allow point of speciation is not known	1	AO3 4.6.3.2
03.5	eukaryota	allow eukaryote(s)	1	AO1 4.6.4

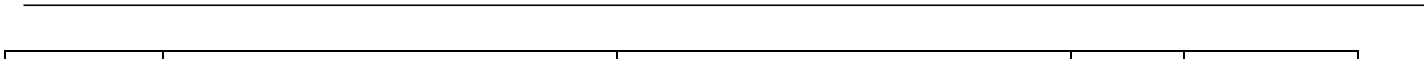
4.6.3.1 Evidence for evolution

03.6	can survive in extreme environments cytoplasm contains DNA		1 1	AO1 AO2 4.6.4 4.1.1.1 4.1.1.2 4.6.2.4
03.7	any **three** from: • studies of internal / cell structures with light microscopes • studies of internal / cell structures with electron microscopes • chemical analysis • comparison of biochemical processes • DNA / genetic analysis • studies of evolution(ary relationships)	allow organelles for internal / cell structures if neither mark awarded allow studies of internal / cell structures (with microscopes) for **1** mark	3	AO1 4.6.4
Total			**10**	

4.6.3.1 Evidence for evolution

Answer 02 · Mark scheme

November 2021 | 8464/B/2H | Original Q3



4.6.3.1 Evidence for evolution

Answer 03 · Mark scheme

June 2023 | 8464/B/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	any **one** from: • plasmid • chromosome • DNA / genes	 do **not** accept nucleus allow alleles allow genetic material	1	AO2 4.1.1.1 4.1.2.1 4.3.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	 no clear area (around C and E) (so) no bacteria killed (by antibiotic)	if no letters are given assume they are referring to antibiotics C and E allow (so) antibiotic did not work	 1 1	AO2 AO3 4.3.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	increased the concentration of antibiotic	allow increased the dose of antibiotic ignore increased the volume of antibiotic ignore left it longer ignore used a different temperature ignore used a different sized disc	1	AO3 AO2 4.3.1.8
	clear area seen (around disc) **or** bacteria (around disc) killed	mark dependent on describing a change to the method	1	

4.6.3.1 Evidence for evolution

Answer 03 · Mark scheme

June 2023 | 8464/B/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	the treatment injected around the implant		1	AO2 4.1.2.3 4.3.1.3 4.3.1.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	any **one** from: (stem cells from fat tissue) • easier to obtain • less invasive	ignore reference to cost allow quicker to obtain allow fewer side effects allow less painful ignore reference to rejection	1	AO3 4.1.2.3 4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	by diffusion concentration of antibiotic lower inside cells than in solution **or** concentration of antibiotic higher in solution than inside cells	no marks if incorrect process selected allow 'it' for antibiotic allow correct reference to concentration gradient	1 1	AO2 4.1.1.2 4.1.2.3 4.1.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	0.09 to 0.31	allow 0.31 to 0.09	1	AO2 4.1.2.3 4.3.1.1 4.3.1.3 4.3.1.8

4.6.3.1 Evidence for evolution

Answer 03 · Mark scheme

June 2023 | 8464/B/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.8	any **two** from: **Pros:** stem cells containing antibiotic had: • smallest area of infection (**:** total tissue area) • small(est) range of results • no overlap with unreactive solution (suggesting significant effect)		2	AO3
	any **two** from: **Cons:** • only tested on 5 patients • some results for antibiotic treatment similar to stem cells containing antibiotic • some results for stem cell treatment similar to stem cells containing antibiotic • age / health of patients not controlled • only tested on one type of bacterium • only tested on one type of implant • only collected results after 7 days • may lead to antibiotic resistance (in *S. aureus* bacteria) • rejection of stem cells • need donors for stem cells • allergic reaction to antibiotic	allow small sample size ignore only tested on one infection ignore cost ignore religion ignore use of embryonic stem cells ignore references to viruses ignore side effects unqualified	2	AO3 AO2 4.1.2.3 4.3.1.1 4.3.1.3 4.3.1.8

Total Question 7	14

4.6.3.1 Evidence for evolution

Answer 04 · Mark scheme

June 2023 | 8464/B/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	humans have not found evidence of every species		1	AO3 4.6.3.2 4.6.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	fossils	allow fossil record allow remains of organisms allow DNA do **not** accept fossil fuels	1	AO1 4.6.3.1 4.6.3.2 4.6.3.3

4.6.3.1 Evidence for evolution

Answer 04 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
02.3	**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	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
	Methods of reducing rate of evolution and linked explanation
	• doctors should not prescribe antibiotics inappropriately
	  ○ so fewer *C. difficile* are exposed to antibiotic(s)
	• do not use antibiotics to treat mild (bacterial) infection
	  ○ because the immune system can respond (to mild bacterial infection)
	• do not use antibiotics to treat (any) viral infections
	  ○ because antibiotics do not kill viruses
	• patients should complete their course of antibiotics
	  ○ so (more likely that) all *C. difficile* are killed
	  ○ so none survive to mutate (and form resistant strains)
	• the agricultural use of antibiotics should be restricted
	  ○ so fewer *C. difficile* are exposed to antibiotic(s)
	• hand washing after going to toilet
	  ○ will reduce spread of *C. difficile*
	• people with diarrhoea / *C. difficile* should stay away from school / work
	  ○ to reduce spread of *C. difficile*
	• develop new antibiotic against *C. difficile*
	  ○ so all *C. difficile* are killed
	  ○ so none survive to mutate and form (another) resistant strain
	• develop vaccine against *C. difficile*
	  ○ would decrease the use of antibiotics
	For **Level 3**, answers must refer to method(s) and linked explanation(s).
			4.6.3.4
			4.6.3.1
			4.6.2.2

Total Question 2	**8**

4.6.3.1 Evidence for evolution

Answer 05 · Mark scheme

June 2025 | 8464/B/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	behaviour(al)	allow functional	1	AO2 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	any **two** from: • (new) predators • (new) disease / pathogen • competition for food • lack of mates	ignore habitat ignore competition unqualified allow hunters / poachers allow named example allow lack of food allow competition for mates	2	AO1 4.6.3.3 4.7.1.3

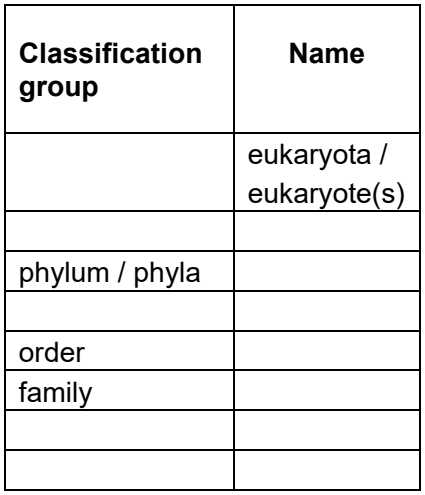
4.6.3.1 Evidence for evolution

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3		allow skeleton **or** hard parts for bones throughout ignore compression ignore reference to oxygen		
	(plesiosaur) died and sank (to bottom of ocean / sea)		1	AO2
	any **two** from: • (plesiosaur died and) is buried in sediment / sand / mud / silt • (only) soft parts decayed / eaten **or** bones were not decayed / eaten • bone(s) / remains replaced by minerals	do **not** accept plesiosaur (died and) is buried in rock(s) allow mineralisation of bones allow bone(s) left imprint in mud / sand / sediment (that then hardened to rock) ignore bones turned to stone / rock	2	AO1 4.6.3.2

4.6.3.1 Evidence for evolution

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	any **two** from: • fossil record may be incomplete • DNA will be destroyed by fossil formation • no evidence of soft tissues which are decomposed (before fossilisation) • only able to study phenotype (from fossils)	allow not all fossils have been found allow (some) fossils may have been destroyed allow there are not enough fossils (to study) allow chromosomes / genes / alleles will be destroyed by fossil formation allow fossils do not contain DNA / chromosomes / genes / alleles allow only able to study observable characteristics (of bones / skeleton)	2	AO2 4.6.2.1 4.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5		**2** marks for 4 correct **1** mark for 2 or 3 correct **No** marks for 1 correct ignore italics and upper / lower case letters	2	AO1 AO2 4.6.4

4.6.3.1 Evidence for evolution

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	Cryptoclidus eurymerus	ignore italics and upper / lower case letters do **not** accept Cryptoclididae eurymerus	1	AO2 4.6.4

Total Question 5	**11**

4.6.3.1 Evidence for evolution

Answer 02 · Examiner comments November 2021 | 8464/B/2H | Original Q3

Question 3 (standard and standard/high demand)

Overall, there was a poor understanding of classification. Many students could not give the genus name when provided with the binomial. The calculation of the range required manipulation of figures in standard form, and was generally answered clearly. The most common incorrect answer was 2.1×10^7. Students gained credit whether or not their correct answer was given in standard form.

In **03.4**, many students did not move beyond the idea that had been given in the question, that humans were not alive when the fungus was alive and therefore there are no records of the fungus; this was insufficient. Some students could give the domain eukaryota, and phonetic spelling was allowed, as explained at the beginning of the mark scheme. **03.5** asked for recall of three types of evidence that are used now to classify living things. Despite being prompted not to refer to appearance, many responses did this, such as referring to size or external features.

Answer 03 · Examiner comments June 2023 | 8464/B/1H | Original Q7

Question 7

07.1 Half of the students knew where mutations happen in a bacterial cell. In plasmids or in DNA were the most common responses. DNA was often described as a strand, loop or ball of DNA. The most common incorrect response was in the nucleus.

07.2 Almost half the students scored both marks and more than a third scored 1 mark. The first mark was for describing the evidence in the diagram that *S. aureus* oteNwas resistant to antibiotics C and E. Quite a lot of students did not give this evidence, but just said that no bacteria were killed to score the second mark.

07.3 This question was set at the highest level of demand. Only a fifth of students scored any marks and very few scored both marks. A suggestion of a change to the method had to be made in order to access any marks, although the change did not have to be creditworthy in order to access the second mark. For example, many students said leave the Petri dish for longer, or incubate it at

4.6.3.1 Evidence for evolution

Answer 03 · Examiner comments

a different temperature, which did not score marking point 1, but gave access to marking point 2. An increase in the concentration of the antibiotic was needed. The second mark was for how the change might show that *S. aureus* is not resistant to antibiotic E. A reference to a clear area then being seen, or that the bacteria would then be killed, was required. Simply saying the antibiotic would then work was insufficient.

07.4 Almost two thirds of students identified the independent variable in the investigation as the treatment injected around the implant. The most common incorrect response was the type of antibiotic used.

07.5 Two fifths of students gave a correct advantage of using stem cells from fat tissue, rather than from bone marrow. Saying the fat cells were easier or less painful to extract were common responses. Saying there was less risk was ignored, unless qualified. For example by saying less risk of damage to the patient. References to rejection were ignored.

07.6 The correct process for how the antibiotic entered stem cells was needed in order to score any marks. More than a third of students correctly identified diffusion as the process. A quarter of students scored 2 marks for also giving the reason, related to the concentration of antibiotic inside and outside the cells.

07.7 Three quarters of students interpreted the graph correctly and gave a range of 0.09 to 0.31. The most common error was to write 0.9 instead of 0.09.

07.8 Almost two thirds of students scored at least 1 mark. This was usually for one of the advantages of using stem cells containing antibiotic. A quarter of students scored 2 or more marks. The most common disadvantages given were that the stem cells might be rejected by the patient, or the bacterium might become resistant to the antibiotic.

4.6.3.1 Evidence for evolution

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.6.3.1 Evidence for evolution

Answer 04 · Examiner comments

June 2023 | 8464/B/2H | Original Q2

Question 2 (Standard demand)

02.1 In this question students were asked to identify why the percentage of species that are extinct is only an estimate. Over 95% of students gave the correct answer.

02.2 Most students could state that fossils or DNA are used as evidence to study species that have become extinct. References to fossil fuels were seen and did not gain credit. A few students misread the question and gave details of the reasons why species become extinct instead.

02.3 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.

In this question, students were asked to explain how the evolution of an antibiotic-resistant bacterium could be slowed down. As students were asked to explain how this could be done, it was necessary to link suggested actions with reasons in order to achieve higher level marks.

The question was not asking how antibiotic resistant bacteria evolve in the first place and neither was it about genetic engineering.

Students achieving Level 1 gave simple unconnected but appropriate suggestions such as 'isolation of infected people' or 'don't use antibiotics when not necessary'. To enter Level 2 there had to be evidence of at least an attempt at linking an idea with the underlying reason(s) behind it together with some limited but additional relevant information. To enter Level 3 students had to make several appropriate points as well as show at least one clear, logical link.

The most frequently seen suggestion was that patients should complete courses of antibiotics. This was often correctly linked with the need to kill all *C. difficile* but fewer answers then went on to say that none would therefore (survive and) mutate to form resistant strains.

Simple rewording of the question did not gain credit. Answers that simply said 'so the bacteria would not be able to evolve and become antibiotic resistant' added nothing else to be credited.

Other points that were commonly made included references to isolation of patients and to hand washing. The question context here was of infection of the digestive system by *C. difficile* and, therefore, suitable qualification of hand washing, such as 'after going to the toilet' or 'before preparing food' was required in order for a strong, reasoned link to be credited. Vague answers relating to 'good hygiene' only were insufficient. Some students thought that diet and exercise would kill the bacteria.

Several students made references to doctors not prescribing antibiotics inappropriately but few students went on to explain why. Similarly, the reason for not using antibiotics for mild infections – 'the body's own immune system can respond effectively' – was rarely seen. Students do seem to appreciate, though, that antibiotics cannot kill viruses and so a mention of this linked to no antibiotics being used in such cases often gained credit.

4.6.3.1 Evidence for evolution

Answer 04 · Examiner comments June 2023 | 8464/B/2H | Original Q2

Some answers suggested that new antibiotics might be developed but the idea that antibiotics can be made 'stronger' is incorrect. As with the point about completing courses of antibiotics, the advantage of a new antibiotic would need to be linked to 'all *C. difficile* being killed' or 'none could survive to mutate' in order to gain credit for a linked statement.

Some students commented on developing a vaccine against *C. difficile* but very few then managed to link this to an explanation.

The indicative content in the mark scheme can never cover all ideas that are worthy of credit, but are there to guide examiners. Other ideas such as 'Treatment with several antibiotics at the same time to kill all of them' was another appropriate method with linked explanation.

Many students referred to 'it' in their answer. Sometimes this meant antibiotics and other times this meant bacteria. We always read for context to make sense of the term 'it'.

'Immune bacteria' was not an acceptable alternative to resistant bacteria. It was assumed that bacteria referred to in a response meant *C. difficile*.

0 7 . 3 A bacterium called *Clostridioides difficile* (*C. difficile*) can infect the human digestive system.

C. difficile can multiply and produce toxins. The toxins cause diarrhoea.

Doctors are concerned that new strains of *C. difficile* may evolve.
Antibiotics may **not** be able to kill these new strains.

Explain how the evolution of antibiotic resistant *C. difficile* can be slowed down.

[6 marks]

the evolution of the antibiotic resistant C. difficile can be slowed down by getting people who have it on the antibiotics instantly and make sure they take the full course correctly. Another way to stop the evolution from happening so quick is by quarantining people who have it or have been near someone who had it to stop it spreading and developing fast. also staying out/away from lots of heat as that lets bacteria multiply faster.

The student (from a Foundation tier paper) has given bullet point 7 and then linked bullet points 14 and 15 from the indicative content. This exceeds the minimum requirement to meet the Level 2 descriptor, but does not meet the Level 3 descriptor, therefore 4 marks were awarded.

4.6.3.1 Evidence for evolution

Answer 04 · Examiner comments June 2023 | 8464/B/2H | Original Q2

0 2 . 3 A bacterium called *Clostridioides difficile* (*C. difficile*) can infect the human digestive system.

C. difficile can multiply and produce toxins. The toxins cause diarrhoea.

Doctors are concerned that new strains of *C. difficile* may evolve.
Antibiotics may **not** be able to kill these new strains.

Explain how the evolution of antibiotic resistant *C. difficile* can be slowed down.

[6 marks]

Evolution of antibiotic resistant C. difficile can be slowed down if the overuse of the antibiotics used to treat this bacterial disease, is reduced by taking precautions. These might be ~~that's~~ making ~~the~~ the rules for its prescription more strict and actually having the regulations properly in place.
Another way is to encourage people to use full course of their antibiotic treatment even if the symptoms are relieved, because ~~they~~ when it is not used fully, ~~antibiotics~~ bacteria that's left alive can reproduce and develop resistance to the drug which is what ~~it~~ might cause it to evolve.
Also for lighter symptoms, if it is not serious, it might be better for the body to overcome the bacteria by itself to not introduce ~~enter~~ the drug to the bacteria.

The student (from a higher paper) has given bullet point 1 from the indicative content. They link bullet points 7 and 8. In the final paragraph they link bullet points 3 and 4. This exceeds the minimum required for the Level 3 descriptor, therefore 6 marks were awarded.

Answer 05 · Examiner comments

June 2025 | 8464/B/2H | Original Q5

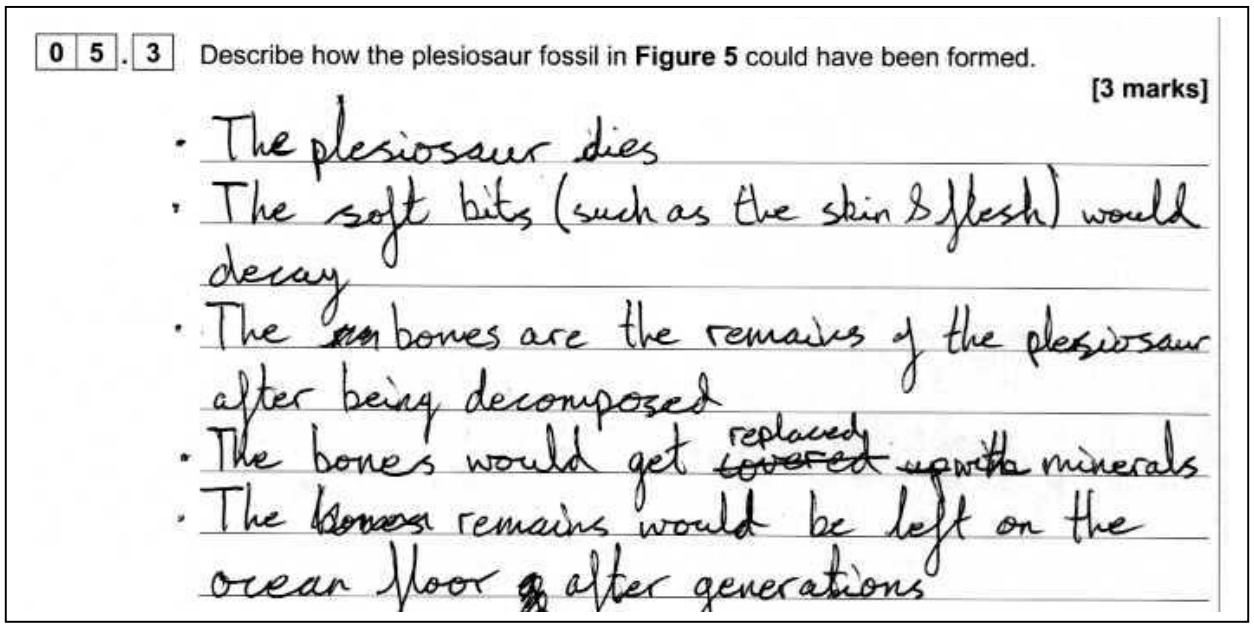
Question 5 (Standard and Standard/High demand)

05.1 This was a poorly answered question with only one third of students giving the correct answer. Environmental, structural and physical were commonly seen wrong answers. Many students didn't give a type of adaptation as the question had asked but instead described the adaptations of the Plesiosaur.

05.2 The majority of students scored 2 marks with marking points 1 and 3 most commonly seen. Many students referred to lack of food or lack of prey as alternatives to competition for food.

A commonly seen error was just stating 'food availability' without linking it to a shortage. Competition unqualified was also another regularly seen answer but did not receive credit as students needed to describe what the competition was for. There was some confusion with abiotic factors such as temperature, oxygen, climate change or space being given by some students.

05.3 Two thirds of students gained one or more mark. Only 8% of students gained three marks. The marking point that the plesiosaur 'died and sank' was rarely seen and this was usually the reason 2-mark answers didn't pick up the 3rd mark as in the example below which scored 2 marks as there was no reference to sinking after dying.



0 5 . 3 Describe how the plesiosaur fossil in **Figure 5** could have been formed.

[3 marks]

- The plesiosaur dies
- The soft bits (such as the skin & flesh) would decay
- The bones are the remains of the plesiosaur after being decomposed
- The bones would get ~~covered~~ replaced with minerals
- The bones remains would be left on the ocean floor after generations

Many students were awarded bullet point 1, for the idea of being buried / covered in sediment (or similar) but some responses incorrectly referred to being buried in rocks which did not allow the mark to be awarded.

Bullet point 2 was often misunderstood as there were lots of references to the body or plesiosaur or bones decaying as students failed to appreciate that only the soft parts decay when fossils form, despite the photograph.

Bullet point 3 was awarded infrequently. Sometimes students had the idea of imprints forming in the 'rock' rather than in mud / sand / sediment. The most commonly seen approach which scored the mark was the idea that minerals replace the bones.

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4.6.3.1 Evidence for evolution

Answer 05 · Examiner comments June 2025 | 8464/B/2H | Original Q5

References to compression or pressure, a lack of decay due to a lack of oxygen and references to other factors needed for decay (such as microbes or higher temperature) were often seen but these were insufficient in the context of this question.

Some students referred to how the fossil could be found and assembled by scientists rather than how the fossil formed, indicating that some students misunderstood the question. Incorrect references to natural selection and evolution were also seen.

05.4 Students found this question challenging. Insufficient responses included 'there not being any plesiosaurs alive' or 'none still living to study', that 'no-one saw them' or 'you couldn't tell how old the fossils were'. There were some vague statements given such as 'lack of evidence'.

Many students referred to DNA not being present but failed to link this idea to DNA being destroyed during the formation of fossils.

05.5 Fewer than 25% of students could complete all four spaces in the classification of the plesiosaur, but a further 30% gained one mark for two or three correct words in the correct spaces. There was frequent evidence of students knowing the first letter of the group, but they got no further, or created words based on this known first letter. Mnemonics were regularly seen, but often without fully correct corresponding responses.

0 5 . 5 **Table 1** shows part of the classification of a plesiosaur.

Complete **Table 1**.

[2 marks]

Table 1

Classification group	Name
Domain	Predator
Kingdom	Animalia
Phylum	Chordata
Class	Reptilia
	Plesiosaur
	Cryptoclididae
Genus	Cryptoclidus
Species	eurymerus

King Phillip Came over for Good Soup

The student has learnt a mnemonic, but cannot put this to good use. A response of one word correct out of four did not gain a mark due to the level of demand of this question.

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