

# 17.3 Evolution

## Question Paper

Course	CIE A Level Biology
Section	17. Selection & Evolution
Topic	17.3 Evolution
Difficulty	Hard

**Time allowed:** 40  
**Score:** /29  
**Percentage:** /100

**Question 1a**

The Hawaiian archipelago is a group of volcanic islands in the Pacific ocean.

Fig. 1 shows the relative locations of five of these islands.



**Fig. 1**

Table 1 shows the size and age of these five islands and the total number of *Mecyclothorax* ground beetle species and their species density, on each island.

Data for the island of Maui is shown as two distinct regions, West and Haleakalā. This is because they formed at different times from two separate volcanoes.

**Table 1**

island	area / km <sup>2</sup>	age of island / million years	total number of <i>Mecyclothorax</i> species	species density / number of species per km <sup>2</sup>
Hawai'i	10433	0.4	30	0.003
Lāna'i	364	1.3	3	0.008
Maui (West)	443	1.3	27	0.061
Maui (Haleakalā)	1440	1.1	116	0.081
Moloka'i	673	1.9 – 1.8	43	0.064
O'ahu	1545	3.7 – 2.6	20	.....

Fig. 2 shows a ground beetle of the genus *Mecyclothorax*. All the beetle species of this genus on the Hawaiian archipelago form a monophyletic group, descended from one original colonising species that reached Maui from Australia.

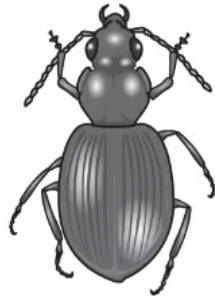


Fig. 2

(i)  
Complete Table 1 by calculating the density of *Mecyclothorax* beetle species on the island of O'ahu.

[1]

(ii)  
Use Table 1 to explain why the island of Hawai'i has the lowest density of *Mecyclothorax* beetle species.

[2]

(iii)  
Use Fig. 1 and Table 1 to suggest why O'ahu has a lower number of *Mecyclothorax* beetle species than Moloka'i.

[2]

**[5 marks]**

### Question 1b

The rate of speciation of *Mecyclothorax* beetles on the slopes of the volcano Haleakalā, on Maui, is the highest recorded for any genus or location on earth.

The volcano last erupted 400 years ago. This produced lava flows which cut through ancient forest and vegetation, dividing it into many separate microhabitats.

Explain how the large number of *Mecyclothorax* beetle species on Haleakalā developed.

[4 marks]

### Question 2a

Wisdom teeth are considered to be an example of vestigial structures in modern humans (*Homo sapiens*), since they serve very little purpose. They are third molars that human ancestors (such as *Homo habilis*) used to grind down large amounts of raw plant material. These early humans had larger jaws that could accommodate a third pair of molars but in modern humans, they may cause complications that require them to be surgically removed.

Fig. 1 below compares the lower jaw of *Homo habilis* and *Homo sapiens* according to scale.

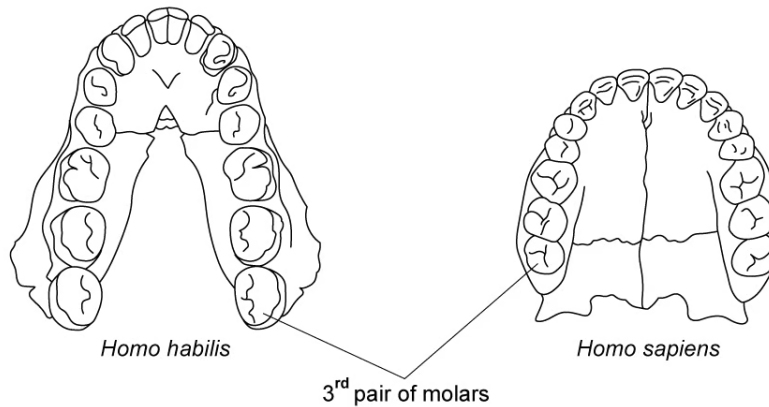


Fig. 1

Based on the information above, suggest a reason why wisdom teeth became vestigial structures in *Homo sapiens*.

[2 marks]

### Question 2b

Explain why humans still have wisdom teeth, even though it serves no purpose for them.

[1 mark]

### Question 2c

Wisdom teeth can cause a range of oral health problems in certain people, including gum infections, damage to other teeth and problems with eating due to teeth being pushed out of position by the presence of wisdom teeth. Some scientists believe that this may affect their persistence in future generations.

(i)

Predict the possible fate of wisdom teeth in future human populations, based on this information and your knowledge of natural selection.

[1]

(ii)

Explain your answer at part (i).

[1]

[2 marks]

### Question 2d

Compare and contrast allopatric and sympatric speciation.

[3 marks]

### Question 3a

There are 72 known species of the genus *Lygodactylus*, many of them found on the continent of Africa where they inhabit the same area.

One of these species is the lizard *Lygodactylus williamsi* which is more commonly known as a dwarf gecko. Scientists were investigating the number of different *Lygodactylus* species in one part of East Africa.

Describe **one** way in which scientists could distinguish if the different types of lizards belong to the same species.

[2 marks]

### Question 3b

The dwarf gecko lives in the leaf crown of screw pine trees, several metres above ground, feeding off insects and drinking water from leaves. These trees are located in forest patches in parts of Africa, especially Tanzania. Demand for timber for firewood and charcoal production in Tanzania is exceptionally high.

Suggest and explain how speciation may occur as a result of deforestation.

[4 marks]

### Question 3c

Many species of lizards are similar in size and have few differences in their appearance, apart from their colour.

Suggest how the variety of colour patterns displayed by lizards may help to maintain the lizards as separate species.

**[2 marks]****Question 3d**

*Rhagoletis pomonella* is otherwise known as the apple maggot fly. Initially, these maggots would lay their eggs on hawthorn fruit. In the 19th century a distinct group of maggots emerged that lay their eggs on apples only. Apples and hawthorn fruit are closely related.

Use this information to suggest how these two species of maggots arose by sympatric speciation.

**[4 marks]**