

# 5.1 Evolution & Natural Selection

## Question Paper

Course	DP IB Biology
Section	5. Evolution & Biodiversity
Topic	5.1 Evolution & Natural Selection
Difficulty	Hard

**Time allowed:** 50  
**Score:** /40  
**Percentage:** /100

### Question 1a

a)

The apple maggot fly (*Rhagoletis pomonella*) is a species of fruit fly that lay their eggs on apples. As a result of this, they are often found in apple orchards where they can cause much damage to apple yields. Scientists studied two populations of apple maggot flies from orchards that were separated by a busy highway. They found that flies from the two populations had difficulty breeding successfully when kept in close confinement.

Suggest a reason for this observation.

[3 marks]

[3 marks]

### Question 1b

b)

The size of one of the orchards that were studied by the scientists had systematically been reduced by the farmer to make way for grazing cattle. The table below shows the size of the apple orchard and the estimated population of apple maggot flies over time.

Year	Orchard size / m <sup>2</sup>	Estimated number of apple maggot flies
1995	424	45 000
2000	316	36 000
2005	157	18 000
2010	132	12 000
2015	78	7 000

Calculate the percentage change in the population of apple maggot flies from 1995 to 2015. Show your working.

[2 marks]

[2 marks]

**Question 1c**

c)

The scientists estimated the apple maggot fly population size recorded in the previous table by sampling four trees from five randomly selected areas of the orchard between May and July. They concluded that the reduction in orchard size caused a significant decrease in apple maggot flies between 1995 and 2015.

Using the data from part b) and your own knowledge, evaluate the scientist's conclusion.

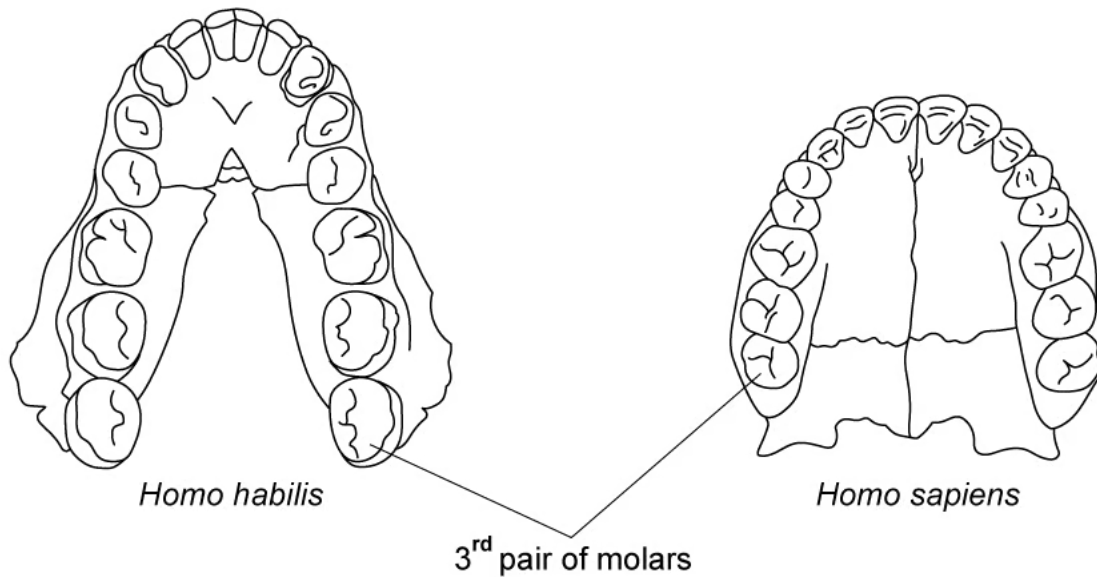
**[3 marks]****[3 marks]**

**Question 2a**

a)

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.

The diagram below compares the lower jaw of *Homo habilis* and *Homo sapiens* according to scale.



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

[2 marks]

[2 marks]

**Question 2b**

b)

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

[1 mark]

[1 mark]

## Question 2c

c)

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 mark]

ii)

Explain your answer at part i).

[1 mark]

[2 marks]

## Question 2d

d)

Compare and contrast vestigial structures with homologous structures.

[2 marks]

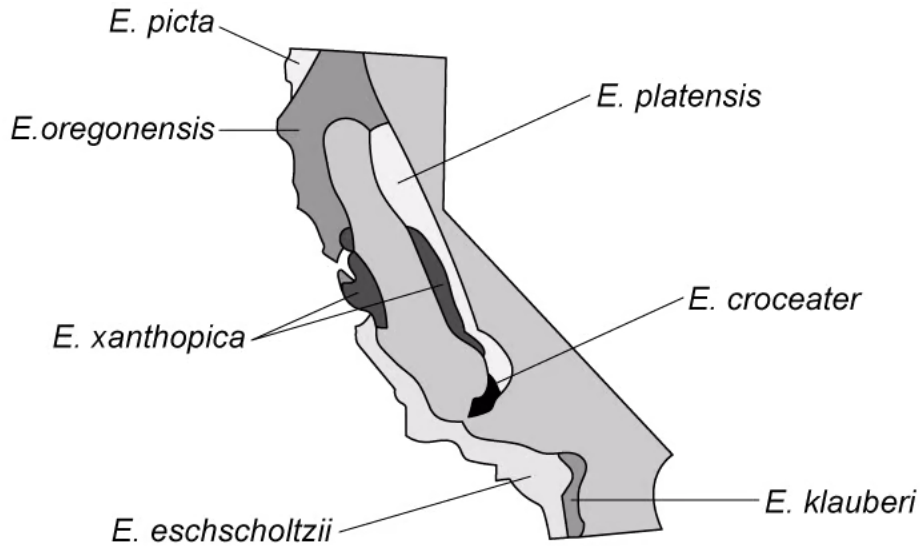
[2 marks]

**Question 3a**

a)

*Ensatina* is the genus name for a group of lungless salamanders (a type of amphibian) that occur in certain regions of the USA. Seven subspecies have been identified that are spread across California, each of which shows slight differences in colouration. Some scientists argue that the *Ensatina* populations represents different species and that they are not simply a continuum of a single species. This is due to the fact that some of the populations are not able to successfully breed with one another anymore.

The map below shows the distribution of the subspecies of *Ensatina* salamanders across California.



Explain the process that could have resulted in the slight variations in colouration between different *Ensatina* subspecies.

[3 marks]

[3 marks]

### Question 3b

b)  
Some of the more closely located populations of *Ensatina* can successfully breed with one another but the western population of *E. eschscholtzii* cannot interbreed with the eastern population of *E. klauberi*.

Based on the information provided, evaluate the claim made by some scientists that the different subspecies of *Ensatina* should be classified as separate species.

[2 marks]

[2 marks]

### Question 3c

c)  
Fossils of *Ensatina* salamanders have been found at several sites across the USA and indicates that they have been around for millions of years. The fossilised vertebrae showed great similarities in structure to modern-day *Ensatina* species, except they were slightly smaller.

Based on the information provided, explain the importance of these fossils as evidence for evolution.

[2 marks]

[2 marks]

### Question 4a

a)

The turtle-headed sea snake (*Emydocephalus annulatus*) can be found in waters off the coast of Australia, New Zealand and New Caledonia. These snakes usually display a colouration of banded patterns of white with dark rings, although some individuals exhibit a single dark colour with no banded patterns. The dark parts of the skin contains a high concentration of the pigment melanin, which binds to certain trace elements present in the water. These trace elements are removed from the body when the snake sloughs off the skin. It was found that melanic sea snakes will slough off the skin more frequently than those with banded colouration.

Scientists studied the frequency of melanic sea snakes from several sites in waters surrounding urban-industrial areas and waters from non urban-industrial areas. The results are shown in the table below.

Site	Melanic sea snakes in urban-industrial waters / %	Melanic sea snakes in non urban-industrial waters / %
A	78	23
B	95	0
C	64	14
D	92	2
E	98	7

Calculate the percentage difference in the mean frequency of melanic snakes found in urban-industrial waters and those that were present in non urban-industrial waters. Show your working.

[3 marks]

[3 marks]

### Question 4b

b)

Suggest a possible explanation for the data provided in part a).

[2 marks]

[2 marks]



### Question 4c

c)

Based on the information provided in part a), deduce the adaptive advantage of melanism to turtle-headed sea snakes.

[3 marks]

[3 marks]

### Question 5a

*One mark is available for clarity of communication throughout this question.*

a)

Natural selection would not be possible without the presence of variation within a species.

Explain how variation provides a way for natural selection to occur.

[3 marks]

[3 marks]

### Question 5b

b)

Mutation, meiosis and sexual reproduction are all considered to be sources of variation.

Outline the way in which each of these factors contributes to variation within a species.

[7 marks]

[7 marks]



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