

10.3 Gene Pools & Speciation

Question Paper

Course	DP IB Biology
Section	10. Genetics & Evolution (HL Only)
Topic	10.3 Gene Pools & Speciation
Difficulty	Medium

Time allowed: 60
Score: /47
Percentage: /100

Question 1a

a)

Fur colour in rabbits (*Oryctolagus cuniculus*) is determined by four alleles, each with a varying degree of dominance. Allele **C** is responsible for a brown coat colour, allele **c^{ch}** is responsible for a chinchilla coat colour, allele **c^h** will produce a himalayan coat colour, while allele **c** will produce rabbits with a white coat colour.

Scientists investigated the frequency of the different alleles within a population of rabbits. Allele **C** had a frequency of 0.65, while allele **c^{ch}** had a frequency of 0.25. Allele **c^h** had a frequency that was twice that of allele **c**.

Calculate the frequency of allele **c^h**.

[2 marks]

Question 1b

b)

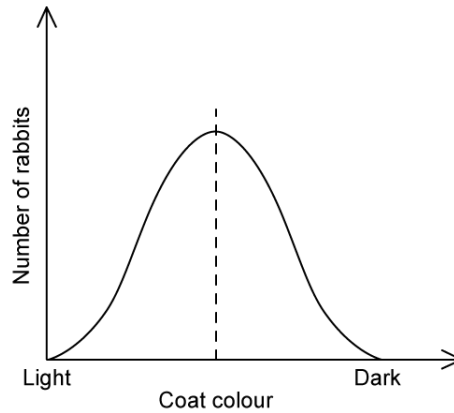
The habitat of this rabbit population changed and provided the rabbits with a white coat colour better camouflage from predators. Explain the effect this would have on the allele frequency of the population over time.

[2 marks]

Question 1c

c)

The following graph shows the distribution of coat colour within the rabbit population before the environment changed.



State, with a reason, the type of selection that would be observed **after** the environment changed.

[2 marks]

Question 1d

d)

After several generations, the rabbit population showed many phenotypic changes from other rabbit populations in nearby habitats.

Explain how scientists could determine whether rabbits from these populations still belong to the same species.

[2 marks]

Question 2a

a)

Renosterveld is a type of vegetation that is part of South Africa's Fynbos Biome found within the Cape Floristic Region. Renosterveld is characterised by a variety of species of shrubs and grasses that grow in relatively fertile soil, which make the areas where they grow popular for cultivating crops, such as wheat. Renosterveld is home to the endangered geometric tortoise (*Psammobates geometricus*), which survives in the remaining pockets of natural vegetation.

Explain how the cultivation of crops could result in speciation within a population of geometric tortoises over time.

[4 marks]

Question 2b

b)

Scientists investigated one of these tortoise populations and discovered that most individuals were either very large or very small. Very small individuals have the advantage of being able to hide away under shrubs from aerial predators, such as peregrine falcons (*Falco peregrinus*), while large individuals have the advantage of having shells that make it difficult for aerial predators to get a secure grip on them.

State, with a reason, the type of selection that is at work in this population.

[2 marks]

Question 2c

c)

A very large fire swept through the habitat of the tortoise population, destroying all the vegetation. Only ten tortoises (all with the small phenotype) near the edge of the vegetation managed to escape the blaze. They were rescued by volunteers at a reptile sanctuary and released into a small nature reserve where no other geometric tortoises occurred.

Explain the effect that this event would have on the new tortoise population that would result from these individuals.

[2 marks]

Question 3a

a)

Mining for gold produces waste rocks and mine tailings, which contain sulphur bearing minerals. When surface water and shallow groundwater come into contact with these minerals, a chemical reaction occurs which produces sulfuric acid. This process is known as acid mine drainage and it can lower the soil pH to a level where very few plants can survive.

Environmentalists studied the area around an abandoned gold mine and discovered a few specimens of earleaf acacias (*Acacia auriculiformis*) surviving in the acidic soil. They typically occur in more neutral or alkaline soils.

Explain how natural selection could produce a population of *Acacia auriculiformis* that would be tolerant to the acidic soil found around the mine shaft.

[4 marks]

Question 3b

b)

The scientists found that individuals from the population of *Acacia auriculiformis* that are tolerant to low soil pH flowered at a different time to individuals from the population of *Acacia auriculiformis* growing in the surrounding habitat, which were not tolerant to low soil pH.

Identify, with a reason, the type of speciation that could occur between the two populations of *Acacia auriculiformis*.

[2 marks]**Question 3c**

c)

State, with a reason, whether the population of *Acacia auriculiformis* that are tolerant to low soil pH could be considered a stable gene pool.

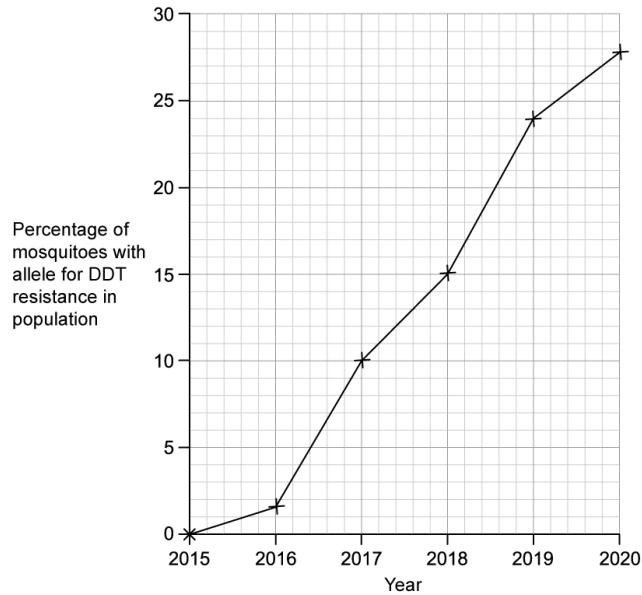
[2 marks]

Question 4a

a)

Mosquitoes spread a disease called malaria. DDT is a pesticide used to kill mosquitoes. DDT is used in many countries in Africa to try to control the spread of malaria. Some mosquitoes have an allele that gives them resistance to DDT. A group of biologists studied how frequently this allele occurred in a population of mosquitoes in Uganda (in Africa) over 5 years.

The graph below shows the biologists' results.



Explain the results shown by the graph.

[3 marks]

Question 4b

b)

Calculate the percentage increase in the allele for DDT resistance from 2017 to 2020.

[2 marks]

Question 4c

c)
Due to the increase in DDT resistance in mosquitoes, many African countries now use alternative pesticides, such as pyrethroids, instead of DDT to control the spread of malaria.

Explain the effect this may have on the allele frequency for DDT resistance over time.

[2 marks]

Question 4d

d)
Describe **one** effect of stabilising selection on a population.

[1 mark]

Question 5a

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

a)
Outline the theory of gradualism to explain the emergence of new species and include in your answer how the fossil record can support this theory.

[4 marks]

Question 5b

b)

Explain how polyploidy can lead to the formation of new species.

[4 marks]**Question 5c**

c)

Describe the process of evolution by natural selection.

[7 marks]



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