HELICATE · A-LEVEL BIOLOGY · TOPIC BANK

3.7.3 Evolution may lead to speciation

Topic question bank

Version 2 · 17 October 2026

Name

Date

QUESTIONS	TOTAL MARKS	TIME	YOUR SCORE
8	57	No time limit	/ 57

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Total		**57**

Instructions

- Answer the questions in the spaces provided. Show all your working.
- The marks for each question are shown in brackets. Use them to judge how much detail to give.
- Work through a subtopic at a time, then mark your answers with the matching mark scheme.

Original questions by Helicate for AQA A-level Biology (7402), specification section 3.7.3. Not affiliated with or endorsed by AQA.

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Variation and natural selection 3.7.3

Dandelions are common flowering plants. In some dandelion populations, seeds form without meiosis or fertilisation, so every seed is genetically identical to the plant that produced it. Other dandelion populations reproduce sexually.

A scientist grew three groups of dandelions from seed and measured the length of the longest leaf on each plant after 10 weeks. Table 1 shows her results.

Table 1

Group	Origin of seeds	Where the plants were grown	Mean leaf length / mm	Range of leaf length / mm
P	One plant from an asexual population	Lowland meadow	142	118–165
Q	The same plant as group P	Mountain slope at 1800 m	86	64–104
R	40 different plants from a sexually reproducing population	Lowland meadow	139	61–228

0 1 . 1 Calculate the percentage decrease in mean leaf length of the plants in group Q compared with the plants in group P.

[1 mark]

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Answer ..... **%**

Question 1 continues on the next page

Do not write outside the box

0 1 . 2 Use the results for groups P and Q to explain what they show about the causes of variation in leaf length.

[2 marks]

0 1 . 3 The plants in group R showed a much wider range of leaf lengths than the plants in group P, although both groups grew in the same meadow.
Explain why.

[3 marks]

6

Turn over for the next question

Do not write outside the box

Tasmanian devils are carnivorous marsupials that live only on the island of Tasmania. Since the 1990s, devil facial tumour disease (DFTD) has spread across the island. DFTD is a cancer that is passed from one devil to another when they bite each other. Most infected devils die within a year. Devils first breed when they are about 2 years old.

Scientists studied a gene in devils that has two alleles, **R** and **r**. In laboratory tests, DFTD tumour cells grew more slowly in devils that had allele R.

The scientists measured the frequency of allele R in two devil populations. DFTD reached site A at the start of the study. No DFTD was recorded at site B during the study. Table 2 shows their results.

Table 2

Time since DFTD was first recorded at site A / years	Frequency of allele R	
	Site A (DFTD present)	Site B (no DFTD recorded)
0	0.12	0.13
4	0.21	0.12
8	0.34	0.14

0 2 . 1 Which of the following is evidence that the population of devils at site A evolved during the study?
Tick (✓) one box.

[1 mark]

- The number of devils at site A decreased. ☐
- The frequency of allele R at site A increased. ☐
- Devils with DFTD at site A developed larger tumours as they got older. ☐
- Devils at site A became infected with DFTD more often than devils at site B. ☐

Question 2 continues on the next page

Do not write outside the box

0 2 . 2 Use Table 2 and your knowledge of natural selection to explain the change in the frequency of allele R at site A.

[4 marks]

0 2 . 3 Calculate the mean change in the frequency of allele R per generation at site A during the 8 years of the study.
Assume that one generation of devils is 2 years.

[2 marks]

Answer _____ **per generation**

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 Allele R was already present in the population at site A before DFTD arrived, but at a low frequency.
Suggest how allele R arose, and why its frequency was low before DFTD arrived.

[2 marks]

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Turn over for the next question

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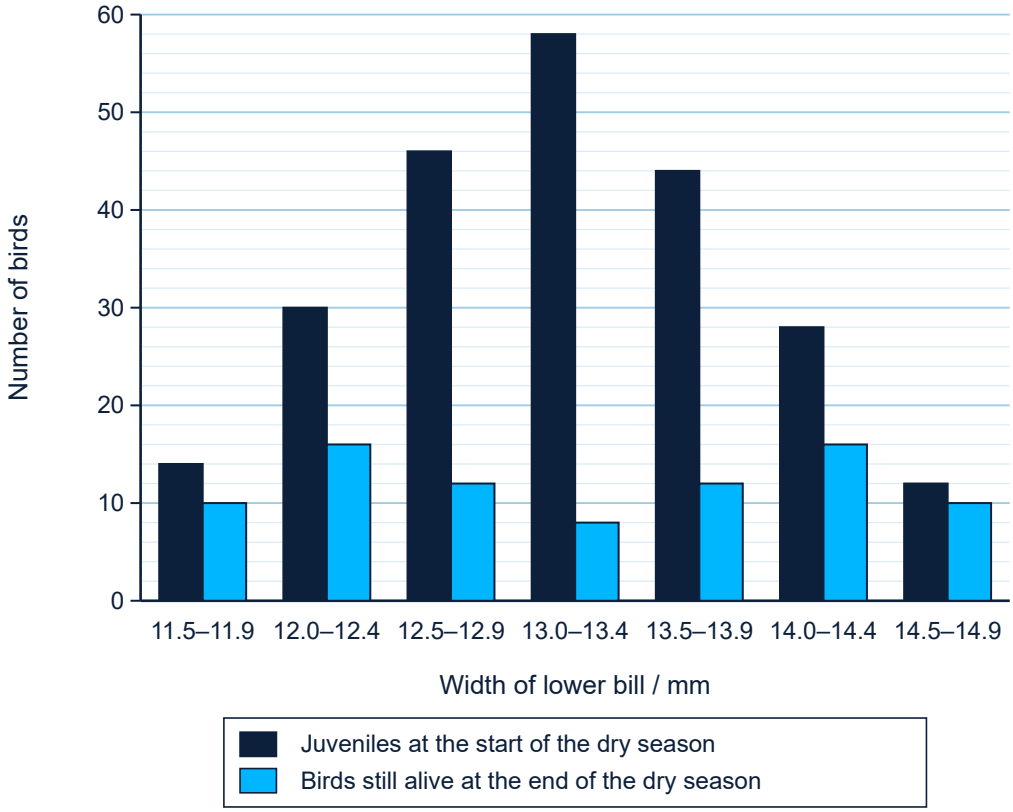
Types of selection 3.7.3

The black-bellied seedcracker is a small finch that lives in West Africa. The width of a seedcracker's bill is mainly determined by its genes.

At the start of a dry season, scientists caught and marked all the juvenile seedcrackers in one population and measured the width of each bird's lower bill. At the end of the dry season they recorded which marked birds were still alive. During the dry season, the main foods available were the seeds of two plants: one with large, very hard seeds and one with small, soft seeds.

Figure 1 shows their results.

Figure 1



Question 3 continues on the next page

Do not write outside the box

0 3 . 1 Which statement correctly describes the selection shown in Figure 1?
Tick (✓) one box.

[1 mark]

Directional selection, because birds with wider bills were more likely to survive. ☐

Disruptive selection, because birds with bills at both extremes of width were more likely to survive. ☐

Stabilising selection, because birds with bills of intermediate width were more likely to survive. ☐

Stabilising selection, because birds with bills at both extremes of width were more likely to survive. ☐

0 3 . 2 Calculate how many times greater the percentage survival of birds in the 14.5–14.9 mm class was than the percentage survival of birds in the 13.0–13.4 mm class.
Give your answer to **two** significant figures.

[2 marks]

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Answer .....

Question 3 continues on the next page

Do not write outside the box

0 3 . 3 Use the information about the seeds and Figure 1 to explain the pattern of survival in this population. Explain how this selection would affect the distribution of bill width in later generations.

[4 marks]

7

Turn over for the next question

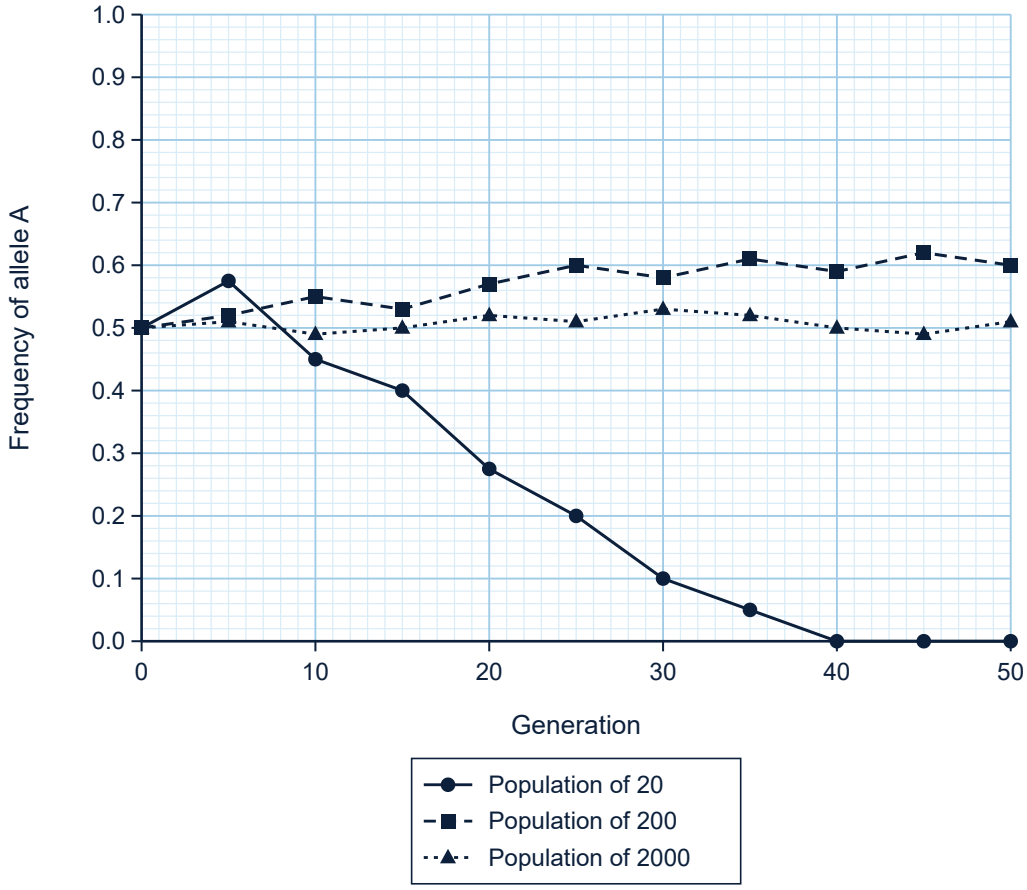
Genetic drift 3.7.3

Scientists used a computer program to model changes in the frequency of one allele, **A**, of a gene in populations of three different sizes. In the model:

- each population stayed the same size in every generation
- the parents of each generation were chosen at random
- neither allele of the gene gave a selective advantage
- there was no mutation and no movement of individuals into or out of the population.

At the start, the frequency of allele A was 0.5 in each population. Figure 2 shows the results of one run of the model for each population.

Figure 2



Question 4 continues on the next page

Do not write outside the box

0 4 . 1 Explain why the frequency of allele A changed in the model, even though neither allele gave a selective advantage.

[2 marks]

0 4 . 2 Use Figure 2 to explain why genetic drift is important only in small populations.

[3 marks]

0 4 . 3 In the population of 20, the frequency of allele A did not change after generation 40.
Explain why.

[1 mark]

Question 4 continues on the next page

Do not write outside the box

0 4 . 4 A student said that these results show that allele A will always be lost from a population of 20.
Explain why the student's conclusion is **not** valid.

[2 marks]

8

Turn over for the next question

Do not write outside the box

A student wanted to use coloured beads to model the effect of population size on genetic drift. Each bead represents one allele of a gene that has two alleles.

The student had a large supply of red beads and white beads, all of the same size and mass, and several opaque bags.

0 5 Describe how the student could use these materials to investigate the effect of population size on genetic drift. Include how the student should analyse the results.

[6 marks]

6

Turn over for the next question

Do not write outside the box

Allopatric and sympatric speciation 3.7.3

About 3 million years ago, a narrow strip of land, the Isthmus of Panama, formed between North America and South America. It separated the Caribbean Sea from the Pacific Ocean. Before this, snapping shrimp on both sides were part of one population that could interbreed.

Today, the water on the Pacific coast of Panama is colder and contains more food, and its tides are larger. The water on the Caribbean coast is warmer and clearer and contains less food.

Scientists collected male and female snapping shrimp from both coasts. They placed one male and one female together in each tank of sea water. All the tanks were kept at the same temperature. The scientists recorded whether each pair produced eggs and whether the eggs hatched. Table 3 shows their results.

Table 3

Shrimp placed together	Number of pairs tested	Number of pairs that produced eggs	Number of pairs whose eggs hatched
Male and female both from the Pacific coast	40	31	27
Male and female both from the Caribbean coast	40	29	26
One shrimp from each coast	80	6	1

0 6 . 1 Calculate how many times greater the percentage of pairs that produced eggs was for pairs from the Pacific coast than for pairs with one shrimp from each coast.

[2 marks]

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Answer .....

Question 6 continues on the next page

Do not write outside the box

0 6 . 2 Suggest why the scientists kept all the tanks at the same temperature.

[2 marks]

0 6 . 3 The scientists concluded that the Pacific and Caribbean shrimp are now separate species.
Explain how the formation of the isthmus and natural selection could have led to this.

[5 marks]

9

Turn over for the next question

Do not write outside the box

Apple maggot flies lay their eggs in fruit, and the larvae develop inside the fruit. Adult flies find their mates on the fruit of the type of plant they developed in.

In North America, these flies originally laid eggs only in the fruit of hawthorn trees. About 200 years ago, apple trees were planted in the same areas, and some flies began to lay their eggs in apples. Apples ripen about three weeks earlier than hawthorn fruit.

Scientists studied flies from apple trees and from hawthorn trees growing less than 1 km apart. Table 4 shows some of their results. Allele **E** is an allele of a gene that affects how quickly the flies develop.

Table 4

Feature	Flies from apple trees	Flies from hawthorn trees
Mean date on which adult flies emerged	16 July	7 August
Percentage of flies that chose fruit of their own host plant in a choice test	86	81
Frequency of allele E	0.62	0.35

0 7 . 1 Scientists think these two groups of flies may be undergoing sympatric speciation.
Which statement describes sympatric speciation?
Tick (✓) one box.

[1 mark]

A new species arises from a population that is not geographically isolated from the rest of its species. ☐

A new species arises only after a physical barrier divides a population into two. ☐

A new species arises when one population moves to a distant habitat. ☐

A new species arises only when a population becomes very small. ☐

Question 7 continues on the next page

Do not write outside the box

0 7 . 2 Use Table 4 to explain how the flies from apple trees and the flies from hawthorn trees have become reproductively isolated, even though they live in the same area.

[3 marks]

0 7 . 3 Explain how the data for allele E support the idea that the gene pools of the two groups of flies are separating.

[2 marks]

6

Turn over for the next question

Do not write outside the box

Extended response: the diversity of species 3.7.3

The Hawaiian Islands are a chain of volcanic islands in the Pacific Ocean. The islands formed one after another over about 5 million years.

More than 50 species of honeycreeper, a group of small birds, have been found on the islands. Scientists think they all evolved from one species of finch that reached the islands from elsewhere. Honeycreeper species now have very different beaks, for example:

- thick, strong beaks that crush hard seeds
- long, curved beaks that reach nectar inside tube-shaped flowers
- short, thin beaks that pick insects from leaves.

0 8 Explain how one ancestral species could have given rise to this great diversity of honeycreeper species over a long period of time.

[6 marks]

6

END OF QUESTIONS

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