1 The finches of the Galapagos Islands have different shaped beaks to feed on different food sources.

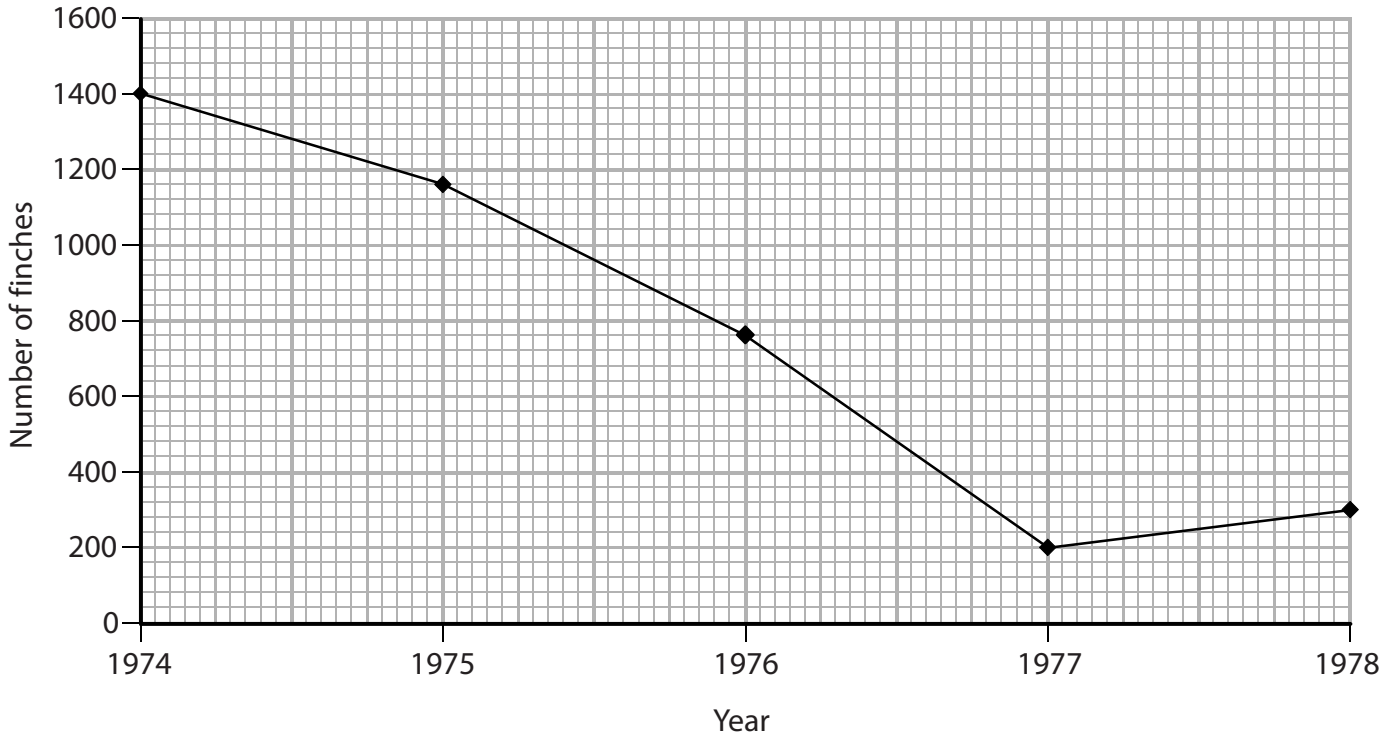
The photograph below shows one of these finches, the medium ground finch, *Geospiza fortis*. The medium ground finch has a deep beak that enables it to crush seeds.

© Greg Lasley

Magnification ×0.5

In the 1970s, there was a severe drought on the Galapagos Islands. This caused a decrease in the production of the seeds eaten by this finch.

The graph below shows the number of medium ground finches, on one of the Galapagos islands, from 1974 to 1978.



(a) Place a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(i) The deep beak of the medium ground finch is an example of

(1)

☒ **A** anatomical adaptation

☒ **B** behavioural adaptation

☒ **C** physiological adaptation

☒ **D** selective adaptation

(ii) The number of medium ground finches fell most rapidly from

(1)

☒ **A** 1974 o 197

☒ **B** 1975 o 197

☒ **C** 1976 o 197

☒ **D** 1977 o 1978

(b) Medium ground finches have a range of beak sizes.

Suggest an explanation for the variation in beak sizes in medium ground finches.

(2)

(c) One of the few plants that survived during the drought produces seeds in large, tough fruits. These are very difficult to eat for birds with small beaks.

Sampling the birds that survived and those that died provided the data shown in the table below.

Mean beak size / mm	Dead birds	Survivors
length	10.69	11.07
depth	9.42	9.96

As the population of the medium ground finches recovered, the mean beak size of the offspring increased.

Using the information in the table, suggest how this increase in mean beak size was brought about by natural selection.

(4)

(Total for Question 1 = 8 marks)

2 The photograph below shows Ethiopian wolves (*Canis simensis*). They live on isolated mountains at altitudes above 3000 metres. They are one of 19 endemic animal species living in the mountains of Ethiopia.

Magnification ×0.01

(a) Explain what is meant by the term **endemic species**.

(1)

(b) There are estimated to be only 500 Ethiopian wolves left in the wild, living in six separate populations. There are high levels of genetic diversity between these six populations.

The separate populations are geographically isolated. This prevents interbreeding between populations.

Suggest how this may affect the genetic diversity of each individual population.

(2)

(c) Ethiopian wolves are endangered in the wild.

Some scientists have suggested that moving male wolves from one population to another may help the species survive.

Suggest how this strategy of transferring individuals from one population to another could help the species survive.

(2)

(d) (i) The table below shows adaptations of the Ethiopian wolf that enable it to survive in its mountain habitat. Place a cross (✗) in the table that correctly describes whether the adaptation is behavioural, anatomical or physiological.

(3)

Adaptation	Behavioural	Anatomical	Physiological
Small sharp teeth widely-spaced to cope with small prey			
Narrow snout to fit into small gaps when hunting small prey			
Hunting alone, as prey are too small to share with other wolves			

*(ii) Suggest how natural selection has led to the evolution of this species of wolf, adapted for life in the mountains of Ethiopia.

(4)

(Total for Question 2 = 12 marks)

3 The photograph below shows a waxy leaf frog (*Phyllomedusa sauvagii*). This species of frog is found in hot, dry areas of South America.

It has glands that produce waxy lipids to spread over its skin. This reduces water loss. The waxy leaf frog is active only at night, when it hunts for insects in the trees.

Magnification ×0.5

(a) (i) Describe how the waxy leaf frog is physiologically adapted to its environment.

(1)

.....

.....

(ii) Describe a behavioural adaptation of the waxy leaf frog to its environment.

(1)

.....

.....

(iii) Suggest how the behavioural adaptation described enables the waxy leaf frog to survive in this habitat.

(1)

.....

.....

.....

(b) With reference to the waxy leaf frog, explain what is meant by the term **niche**.

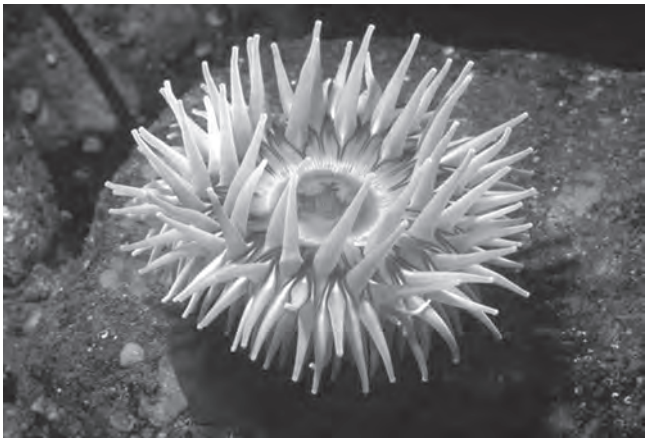
(2)

*(c) Suggest how natural selection could have given rise to the adaptations shown by the waxy leaf frog.

(5)

(Total for Question 3 = 10 marks)

4 The sea anemone, *Anthopleura elegantissima*, occupies a niche at the secondary and tertiary consumer levels in a food web on the shores of North America.



Neil G. Mcdaniel / Science Photo Library

Sea anemone Magnification ×1

At high tide, the sea anemone is active and feeds on a variety of small invertebrate animals and fish. It paralyses its prey using stinging cells on tentacles. The food is then passed into the gut of the sea anemone for digestion by enzymes. The anemones also form the food of various carnivores.

At low tide, the anemones are exposed on the rocks of the shore where they remain stationary until the water returns at high tide.
During this exposure, the tentacles and body of each anemone are contracted into a rounded mass.

(a) Explain what is meant by the term **niche**, using the sea anemone *Anthopleura elegantissima* as an example.

(3)

(b) Suggest and explain why the anemones contract when exposed at low tide.

(3)

(c) Line transects were used to study the effects of abiotic factors on the distribution of *A. elegantissima* on a rocky shore. In this study, line transects were taken from the upper shore to the low water mark.

The mean results from these line transects are shown in the table below.

Quadrat	Mean height above low water mark / m	Mean rock temperature / °C	Mean number of *A. elegantissima*
1	3.9	12	0
2	3.6	12	0
3	3.7	12	0
4	3.4	13	5
5	3.2	12	10
6	3.0	12	21
7	2.9	11	32
8	2.5	12	56
9	2.4	12	68
10	2.1	13	55
11	1.7	13	76
12	1.2	12	45
13	0.9	12	25
14	0.6	12	18
15	0.0	12	21

(i) Place a cross ☒ in the box next to the term that describes the type of sampling that uses line transects to study the distribution of *A. elegantissima*.

(1)

☒ **A** controlled

☒ **B** random

☒ **C** systematic

☒ **D** trial and error

(ii) Describe and suggest explanations for the effects of these two abiotic factors on the distribution of *A. elegantissima* on this shore.

(3)

(iii) Suggest how these data could be analysed to assess the relationship between the two abiotic factors, shown in the table, and the distribution of *A. elegantissima* on this shore.

(2)

(Total for Question 4 = 12 marks)