

- 1 Following the extraction of coal from the ground in the United Kingdom, the unwanted material was usually deposited in large heaps known as bings. Most of the material in a bing is shale fragments composed of minerals and clay.

There have been a number of studies of the colonisation and the development of plant communities on bings. In these studies, the approximate age of the bing can be estimated by reference to the type of plant community growing on the bing. This is shown in the table below.

Type of plant community	Approximate age of bing / years
Lichens and mosses	3 – 15
Grasses and small herbs	15 – 40
Grasses, small herbs and large herbs	40 – 70
Small trees and shrubs	60 – 80
Large trees, small trees and shrubs	80 – more than 100

- (a) Place a cross ☒ in the box next to the mineral ion that would need to be present if plants, such as grasses and herbs, are to grow successfully on a bing.

(1)

- A Copper
- B Nitrates
- C Sodium
- D Sulphites

- (b) Place a cross ☒ in the box that describes the gradual change in the type of plant community growing on a bing.

(1)

- A Endemism
- B Evolution
- C Phylogeny
- D Succession

(d) After 100 years, the community on a bing becomes stable.
State the term used to describe this type of community and explain why it is stable.

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(Total for Question 1 = 11 marks)

2 A wetland is an area where the soil is saturated with moisture either permanently or seasonally. The distribution and abundance of organisms in a wetland will be influenced by various abiotic factors including the degree of saturation of the soil by water. Within most wetlands, there will be areas which are relatively dry and other areas which are submerged under water throughout the year.

(a) (i) Explain why the degree of saturation of the soil by water is considered to be an abiotic factor.

(1)

(ii) Place a cross ☒ in the box next to the **biotic** factor that might influence the distribution and abundance of organisms in a wetland.

(1)

A Mineral availability

B pH

C Predation

D Water temperature

(b) A group of students studied an area of wetland. They placed twenty 1m² quadrats on a line from a relatively dry area to an area where there was free-standing water. Each quadrat was divided up into 25 smaller sections.

(i) Place a cross ☒ in the box next to the term that describes the technique that uses a line of quadrats to investigate the distribution of organisms.

(1)

A Transact

B Transcript

C Transect

D Transept

(ii) Suggest why the quadrats were divided up into 25 smaller sections.

(2)

Figure 1 – Percentage cover of each species at each quadrat

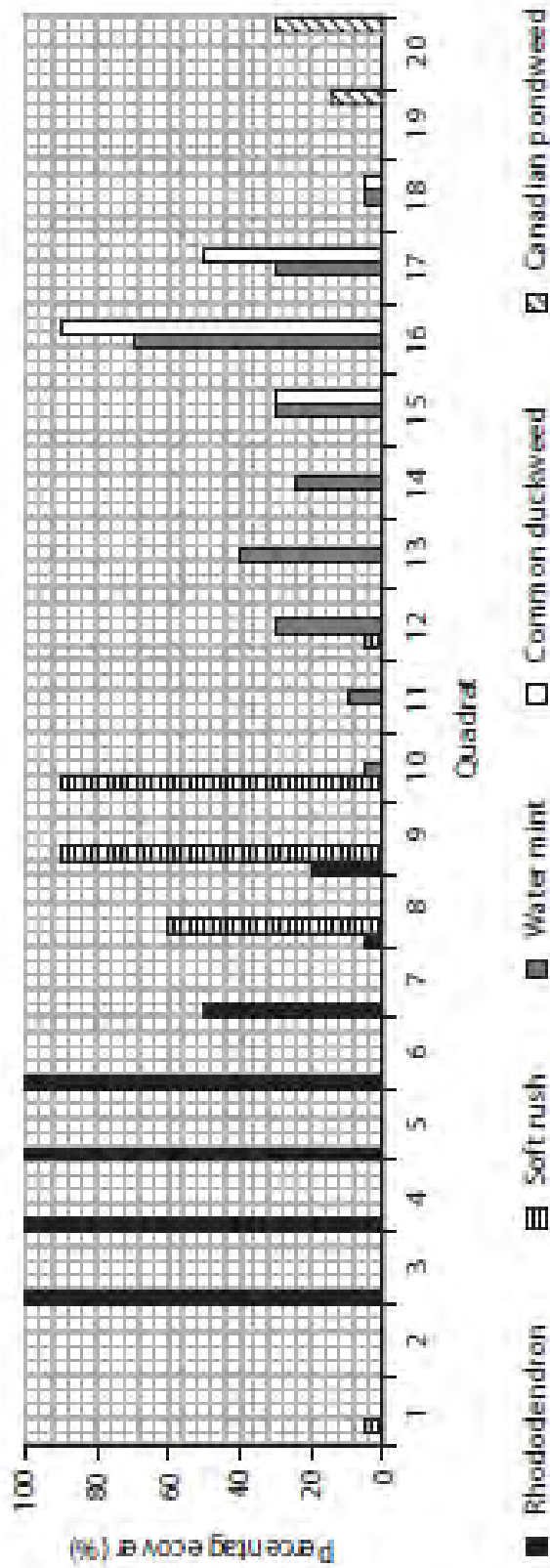


Figure 2 – Water depth at each quadrat

Quadrat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Water depth / cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	20	30	40	50	60

- (iii) The students estimated the percentage cover of each of five species of plant within each quadrat. They also measured the depth of free-standing water.

The results of this part of the study are shown in Figure 1 and Figure 2.

Use the data in Figure 1 and Figure 2 to complete the table below.

(2)

Species	Description
Canadian pondweed	Delicate plant that is suspended in the water
Rhododendron	Woody shrub that requires reasonably dry, firm soil
.....	Non-woody plant that requires very moist conditions
.....	Semi-submerged plant which floats in shallow water
.....	Semi-woody plant which requires fairly moist conditions

- (iv) Suggest why the students were **not** able to draw valid conclusions about the effect of saturation of the soil by water on the distribution of the five plant species.

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(Total for Question 2 = 10 marks)

3 The distribution and abundance of an organism within its habitat can be influenced by both abiotic and biotic factors.

(a) Explain the difference between **abiotic** and **biotic** factors.

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(b) Periwinkles are similar to snails and are one of the common invertebrates found on many seashores around Britain. A study of the distribution of two species of periwinkle, *Littorina littorea* and *Littorina obtusata*, was carried out.

Areas of a sloping seashore were selected at different heights above sea level. Within each of these areas, the mean density (individuals per m²) of each of the periwinkle species was recorded.

(i) Place a cross in the box next to the name of the most suitable piece of apparatus for obtaining the data for the density of the periwinkles.

(1)

- A** quadrant
- B** quadrat
- C** quadrille
- D** quartile

*(ii) Explain how this piece of apparatus would be used to obtain the mean density of the two species of periwinkle in each area.

(3)

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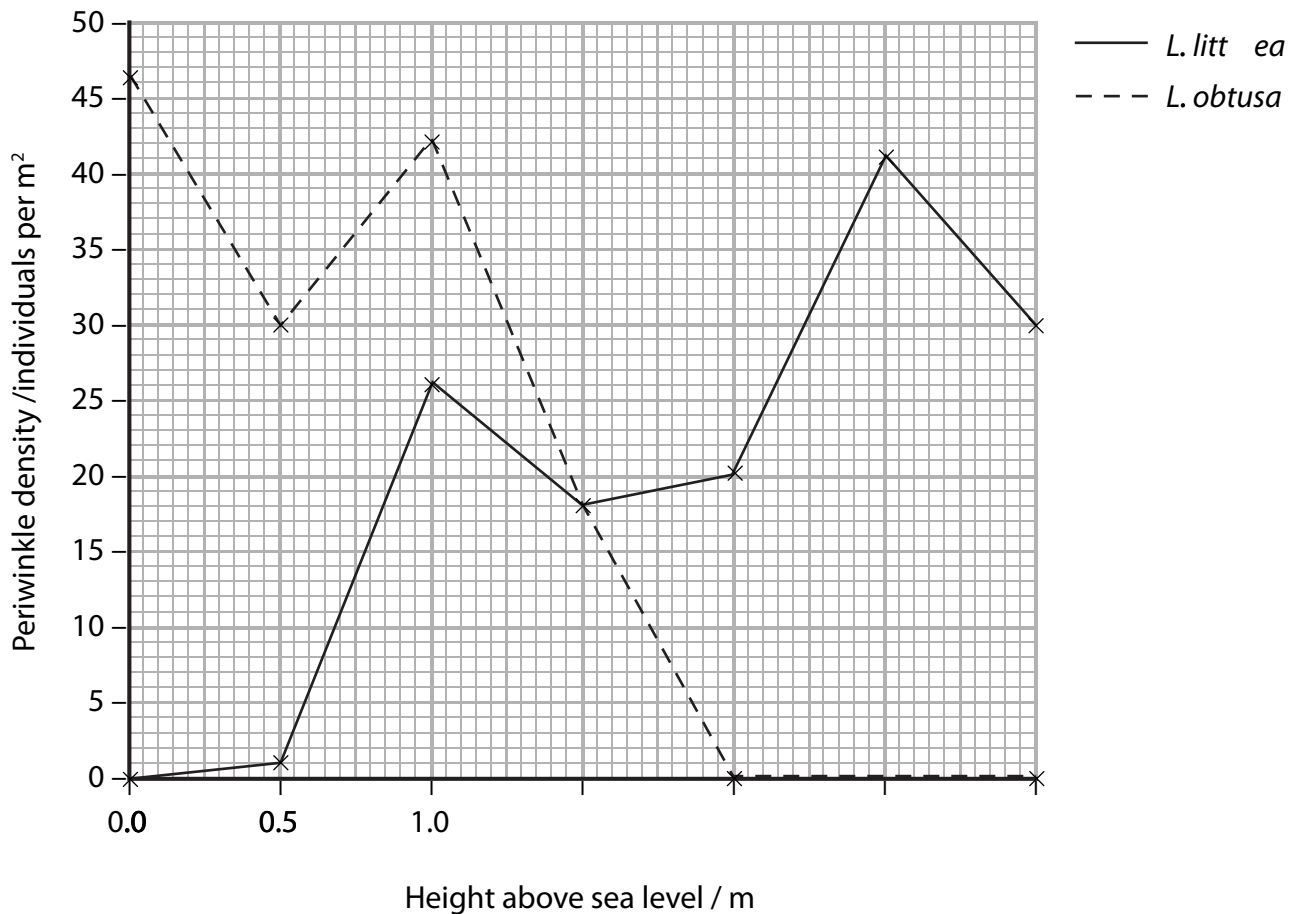
(iii) Suggest **one** abiotic factor and **one** biotic factor that may influence the distribution of the periwinkles on the seashore.

(2)

Abiotic.....

Biotic.....

(iv) The results of this study into periwinkle density are shown in the graph below.



The three statements below show the conclusions recorded by different students following the seashore study of periwinkles.
Place a cross ☒ in the box next to one statement that could form a valid conclusion using the information shown in the graph opposite.

(1)

- A** All periwinkles are affected by the height above sea level
- B** The height above sea level influences the distribution of different species of periwinkle
- C** Neither of the species of periwinkle is affected by the height above sea level

(v) With reference to the data in the graph, discuss the validity of statements **A**, **B** and **C**.

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(Total for Question 3 = 12 marks)

- 4 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.

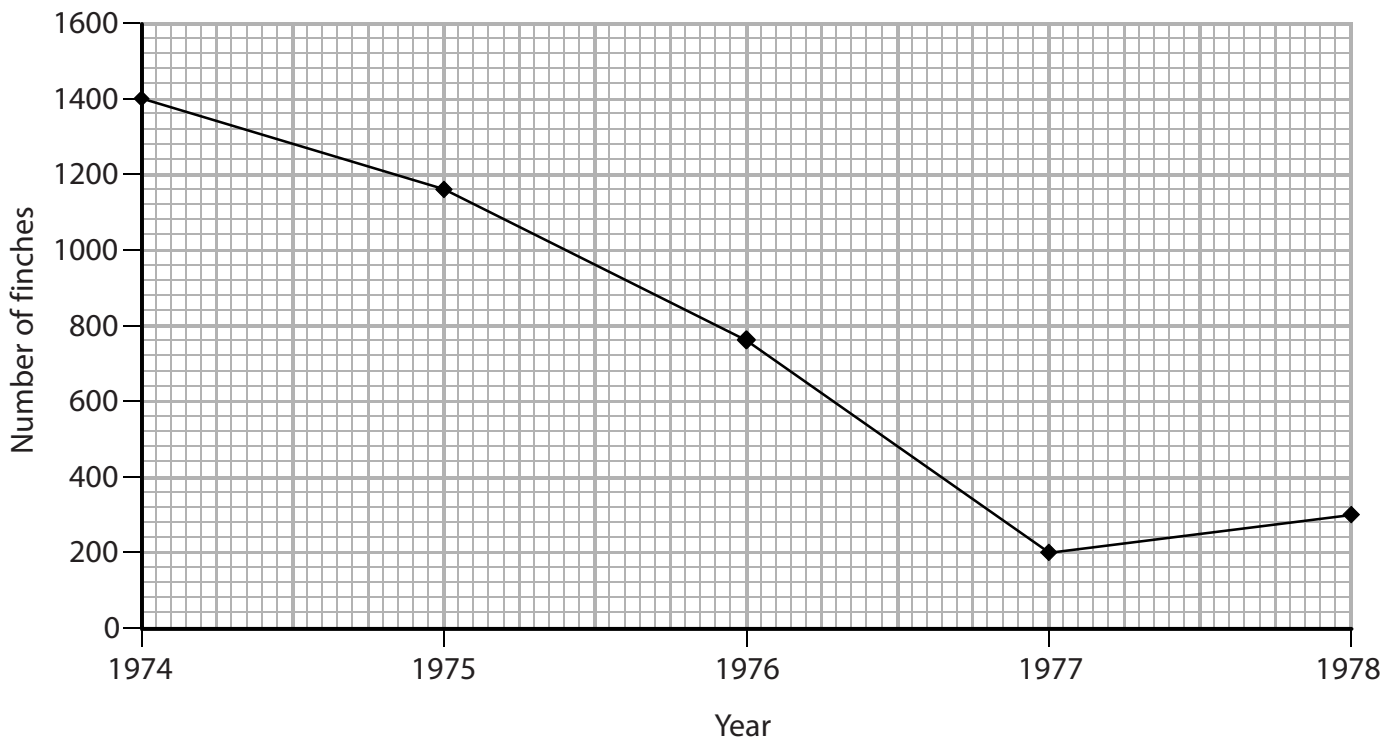


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Magnification $\times 0.5$

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)

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- (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.

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(Total for Question 4 = 8 marks)