Ecosystems – 2021/20 GCE Biology A Component 02

1. Nov/2021/Paper_H420/02/No.20

   Charles Darwin visited the Galapagos Islands in the 1820s. The organisms living on the Galapagos Islands provided Darwin with evidence that helped him to develop his theory of evolution by natural selection.

   (a) Finches are small birds that are common on the Galapagos Islands.

   The variation in the sizes of beak of the various Galapagos finch species provided evidence for evolution by natural selection.

   Scientists recently studied the beak sizes of two species of Galapagos finch living on the same island, *Geospiza fuliginosa* and *Geospiza fortis*.

   Beak size is an overall measurement that includes length, depth and width. The arbitrary units are relative to the average of all of the individual birds measured.

   Some of the scientists' results are shown in **Fig. 20.1**.
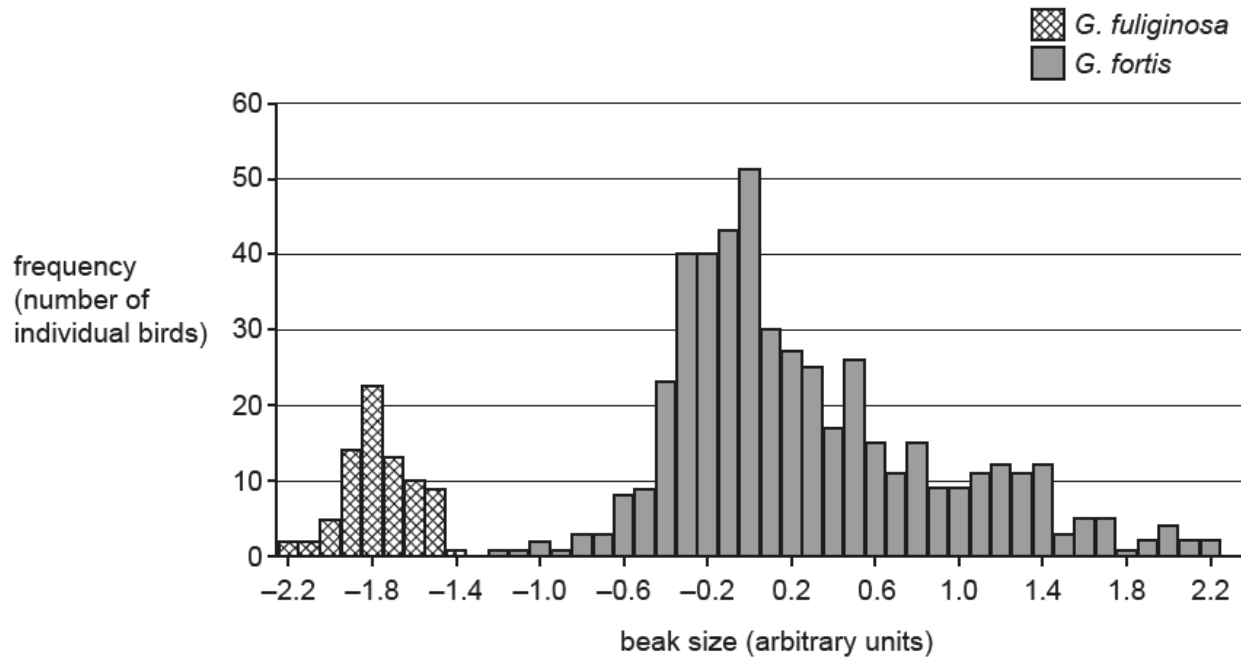
Fig. 20.1

(i) Identify the modal beak size of *G. fuliginosa*.

Size = ... arbitrary units **[1]**

(ii) Calculate the range of *G. fuliginosa* beak size as a proportion of the range of *G. fortis* beak size.

Give your answer to **2** significant figures.

Proportion = ... **[2]**

(iii) The scientists concluded that the data showed evidence of disruptive selection in the population of *G. fortis*. In disruptive selection, extreme phenotypes are selected for and average phenotypes selected against.

Evaluate the conclusion that disruptive selection is occurring in *G. fortis*.

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.... **[3]**

(b) The *G. fortis* all live in the same location. If disruptive selection is occurring in the *G. fortis* population, it is possible that speciation might occur.

(i) Name the type of speciation that occurs when two populations live in the same location.

.... **[1]**

(ii) Suggest how *G. fortis* with large beaks could become reproductively isolated from *G. fortis* with small beaks despite living in the same location.

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.... **[1]**

(iii) Comparing anatomy between species such as beak size in finches can be used to provide evidence to support the theory of evolution by natural selection.

Describe how DNA can be used to provide evidence to support the theory of evolution by natural selection.

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.... **[2]**

(c)* In the 1970s, another group of scientists studied beak sizes in one species of finch on Daphne Island, one of the Galapagos Islands. The study lasted three years. The results are shown in **Fig. 20.2**.

Fig. 20.2

The results suggested that stabilising selection was occurring within this population of finches.

With reference to **Fig. 20.2**, explain the effect of stabilising selection on beak size on Daphne Island. **[6]**

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(d) Alfred Russel Wallace is another important figure in the understanding of evolution.

Outline the way in which Wallace contributed to the acceptance of Darwin's theory of natural selection by the wider scientific community.
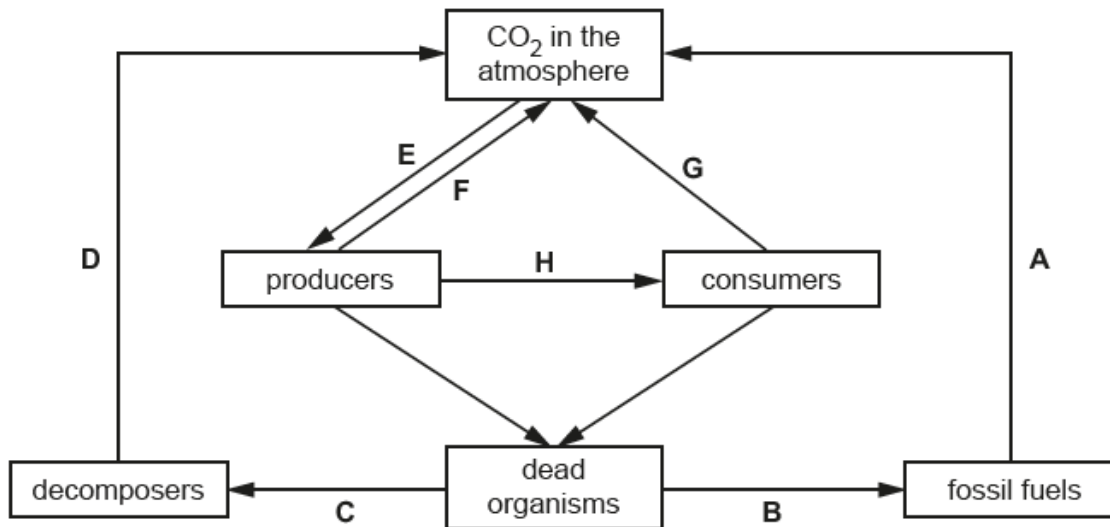
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.... **[2]**

2. Nov/2020/Paper_H420/02/No.20

Carbon and nitrogen are elements that are recycled.

The flow chart shows the carbon cycle.

(a) (i) Identify the processes occurring at **A** and **F**.

A .... **F** .... **[2]**

(ii) The concentration of carbon dioxide (CO_2) in the atmosphere varies depending on the time of year.

Suggest why the concentration of CO_2 in the atmosphere increases during the winter months and decreases during the summer months.

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.... **[1]**

(b) In plants the glucose produced by photosynthesis is changed into starch for storage. Glucose and starch are both carbohydrates.

(i) Complete the table below to show the main differences in structure between glucose and starch.

Glucose	Starch

[3]

6

(ii) Carbohydrates contain only the elements carbon, hydrogen and oxygen.

Polypeptides contain carbon, hydrogen, oxygen and nitrogen.

Name one **other** element present in polypeptides.

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(c)* The nitrogen cycle shares many similarities with the carbon cycle.

Describe the similarities between the nitrogen cycle and the carbon cycle.

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.... [6]

3. Nov/2020/Paper_H420/02/No.21

Algae are photosynthetic organisms that live in water.

(a) A rapid increase in the population of algae is known as an algal bloom.

Scientists studied the population of algae in a river in the UK at different times of year. Their results are shown in Fig. 21.1.
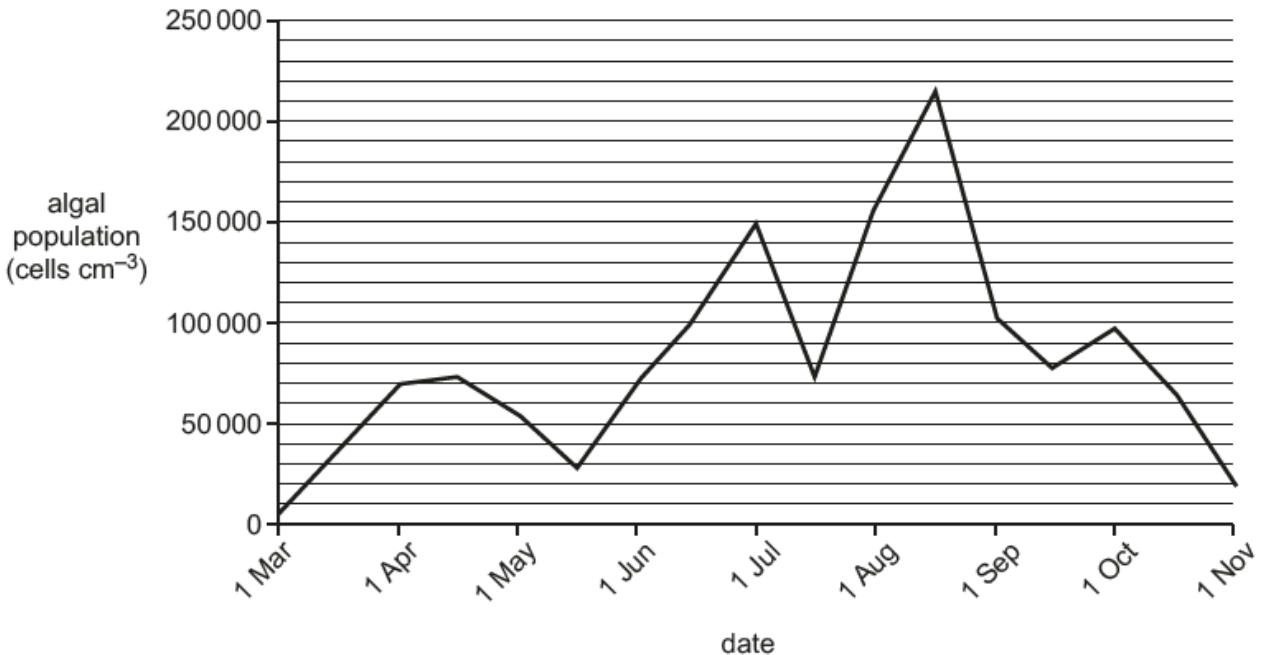

Fig. 21.1

(i) Calculate the percentage decrease in the population of algae between the peak population and 1 November.

percentage decrease = ... **[2]**

(ii) The river in which the study was conducted is described as a dynamic ecosystem.

Use Fig. 21.1 to explain why this ecosystem could be described as dynamic.

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.... **[2]**

(iii) A student concluded that the increase in population of algae was due to higher temperatures and higher light intensity in the summer months.

Considering Fig. 21.1 as the student's data source, discuss the weaknesses in this conclusion.

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.... **[3]**

(b) Many algal species are unicellular organisms. Some occur in colonies of more than one cell.

Fig. 21.2 shows a typical algal cell.

Fig. 21.2

(i) At various times, algae have been classified in different kingdoms.

Using the information given above, draw a conclusion about which kingdom is the most appropriate in which to classify algae.

In your answer explain why other kingdoms are not appropriate choices.

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.... **[4]**

(ii) Suggest one piece of evidence **not** given above that could be used to provide strong support for the classification of algae in a particular kingdom.

.... **[1]**

4. Nov/2020/Paper_H420/03/No.5

Ecologists were studying an area that contained three different habitats. The area is shown in the diagram below.
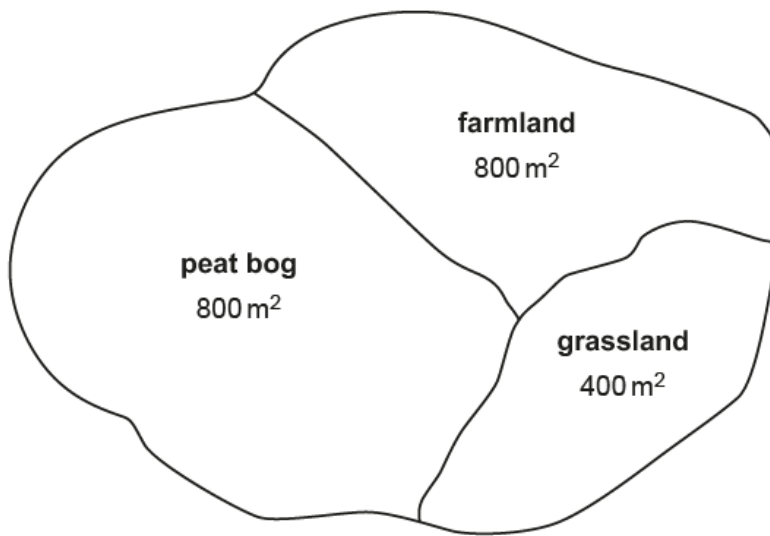
(a) The ecologists sampled the area to estimate insect biodiversity.

Describe how the ecologists should choose the number and locations of their samples to ensure that the sampling is representative.

Use a calculation to support your answer.

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.... **[3]**

(b) Two of the insect species that were sampled were the large heath butterfly and the bog hoverfly.

The ecologists used the capture-mark-recapture technique and estimated population sizes using two different calculations: the Lincoln estimate and the Chapman estimate.

(i) Calculate the population sizes of the two insect species using each of the formulae below.

Write your answers in the table.

Lincoln estimate formula: population size $= \dfrac{n1 \times n2}{m}$

Chapman estimate formula: population size $= \left(\dfrac{(n1 + 1) \times (n2 + 1)}{(m + 1)} \right) - 1$

n = number of individuals in a particular sample

m = number of marked individuals in the second sample

Species	Number captured and marked in sample 1	Total number in sample 2	Number of marked individuals in sample 2	Population estimate (number of individuals)	
				Lincoln estimate	Chapman estimate
large heath butterfly	77	73	4		
bog hoverfly	5	6	1		

[2]

(ii) The Lincoln and Chapman formulae give different estimates for population size.

Give **two** further conclusions about the difference in population estimates given by the Lincoln and Chapman formulae.

1 ....

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2 ....

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[2]

(c) The peat bog habitat had been damaged by peat extraction and by management of the neighbouring farmland. Ecologists decided to treat the peat bog in the following way:

- A buffer region was created between the peat bog and the neighbouring farmland.
- No visitors were allowed on the land.
- Ditches were blocked to raise water levels.
- Peat extraction, tree planting and the use of fertilisers were banned.

A student suggested that this was an example of preservation.

Evaluate the student's conclusion.

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.... [2]

(d) Conservation agreements can be national (within a particular country) or international.

Three conservation agreements are listed in the table below.

Place ticks (✓) in the correct boxes to indicate which features are true for each of the three conservation agreements.

Name of agreement	International agreement	Farmers are offered payments for conservation
Environmental (Countryside) Stewardship Scheme		
Convention on International Trade in Endangered Species		
Rio Convention on Biological Diversity		

[2]