

Answer ALL questions in the spaces provided.

1. The diagram below shows part of a label from a commercial ‘feed-and-weed’ preparation used to control weed growth and enhance the growth of the grasses on a lawn. This preparation contains selective weedkillers and fertilisers.

Active weedkillers:
2,4D and mecoprop-P 0.96%

Fertilisers:
Nitrate salts 38.0%
Phosphate salts 6.0%
Potassium salts 3.0%

- (a) (i) The weed killers 2,4D and mecoprop-P act by stimulating the growth of weeds. Suggest what type of substance is represented by 2,4D and mecoprop-P.

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(1)

- (ii) Explain the advantages of using this type of substance to control the weeds that grow on lawns.

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(b) Explain how the mineral salts in the fertiliser would enter the root hair cells from the soil.

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Q1

(Total 7 marks)



2. In maize, the seeds can be yellow or white in colour. In addition, the seeds may have a smooth surface or a wrinkled surface.

Each of these characteristics of maize seeds is an example of single-gene inheritance.

If a pure-breeding (homozygous) variety of maize with yellow, smooth seeds is crossed with a pure-breeding variety with white, wrinkled seeds, all of the F₁ generation have yellow, smooth seeds.

- (a) (i) Suggest suitable symbols that could be used in a genetic diagram for the alleles involved in these characteristics.

Allele for yellow colour

Allele for white colour

Allele for smooth seed.....

Allele for wrinkled seed.....

(1)

- (ii) Using these symbols, give the genotype of both the pure-breeding varieties.

Variety producing yellow, smooth seeds

Variety producing white, wrinkled seeds

(2)



3. For many centuries, sheep have grazed on the grasslands on many of the islands off the coast of Scotland. These grassland communities are examples of plagioclimax.

As the demand for wool from the sheep reduced, the farming of sheep stopped on many of the islands. Within a few years, the grasslands on some of these islands developed into shrub communities.

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

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(2)

(b) Explain why the grassland on the islands might develop into shrub communities after sheep farming stopped.

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(4)



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(c) On some of the islands where sheep farming stopped, the grasslands remained for a longer time before any change started to be noticed.

Suggest **two** reasons for this.

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Q3

(Total 8 marks)

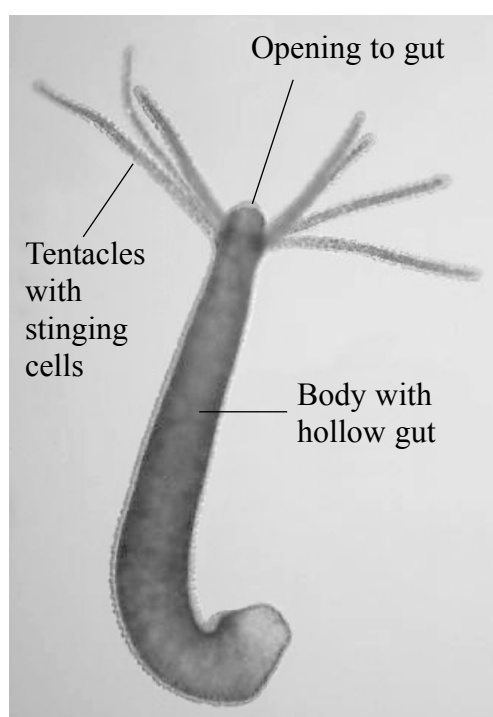


Synoptic Section

The questions in this section are designed to give you the opportunity to make connections between different areas of biology and to use skills and ideas developed throughout the course in new contexts. You should include in your answers any relevant information from the whole of your course.

4. Cnidaria is the name of a phylum that includes sea anemones, jellyfish and small simple-structured animals known as polyps. *Hydra viridis* is a polyp organism found attached to pondweed in freshwater habitats, such as ponds and streams.

Hydra viridis



Magnification $\times 10$

Hydra viridis feeds on small pond animals, such as *Daphnia* sp. (the water flea), by paralysing them with stinging cells. It then pushes the paralysed animal into its gut to be digested by enzymes.

Cells of *Hydra viridis* contain living cells of *Zoochlorella* sp., a unicellular photosynthetic alga. Both of these organisms benefit from this relationship.

- (a) State the term used to describe the mode of heterotrophic nutrition shown by *Hydra viridis*.

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(1)



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5. In many of the hotter regions of the World, maize is grown as a crop plant. It is a good source of starch for humans and livestock such as cattle.

(a) Give **two** differences in the molecular structure of the two components of starch, **amylose** and **amylopectin**.

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(2)

(b) Explain the role of starch in the diet of humans.

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(c) Traditional varieties of maize can be severely damaged by insect pests. New varieties of maize have been developed to try to reduce the loss in yield caused by insect pests.

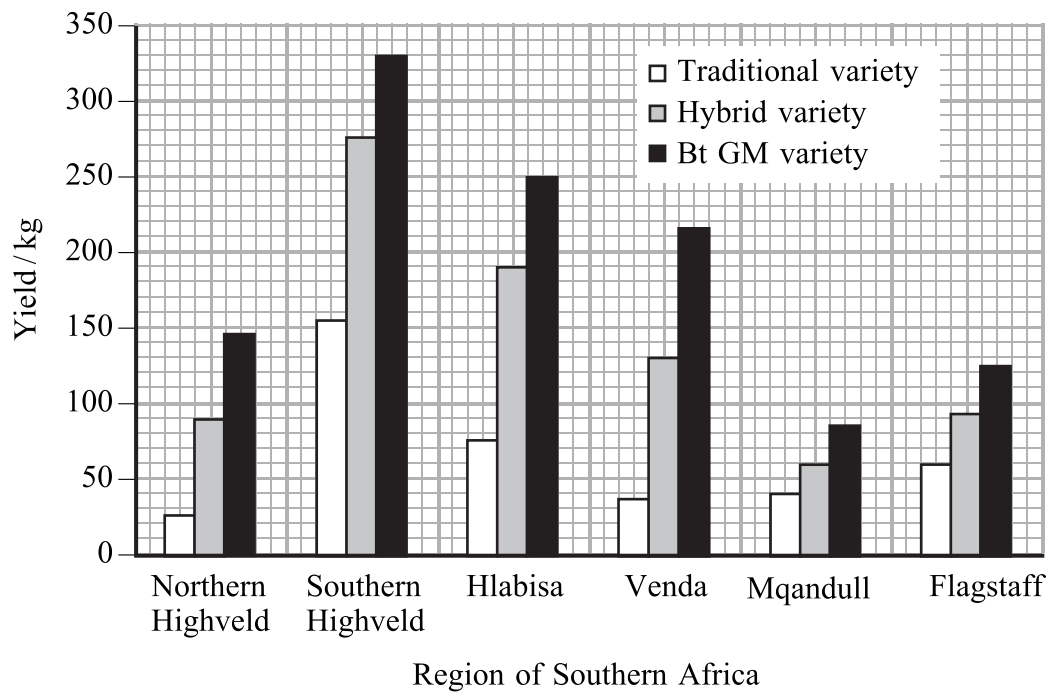
Hybrid varieties are produced by cross breeding and selective breeding of maize varieties used in different parts of the world.

Genetically-modified varieties of maize have been produced which are resistant to attack by insects. These plants (Bt GM maize) have been genetically modified by inserting a gene for the production of Bt toxin, a natural insecticide. This gene is extracted from a species of bacterium, *Bacillus thuringiensis*.

In a survey of the yield of maize crops in six regions of southern Africa, data for three varieties of maize (traditional, hybrid and Bt GM) were compared. For each variety, the yield from one kilogramme of seed sown was measured.



The results of this survey are shown in the graph below.



(i) Suggest why it might be necessary to use the polymerase chain reaction (PCR) during the development of a Bt GM variety of maize.

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(ii) Explain how the data in the graph indicate that abiotic factors may vary considerably in the different regions.

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(iii) In all of the survey regions, using Bt GM variety maize gives the highest yield. With reference to the data in the graph, suggest why some regions might still choose to use the hybrid variety to increase the yield.

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(Total 12 marks)

Q5

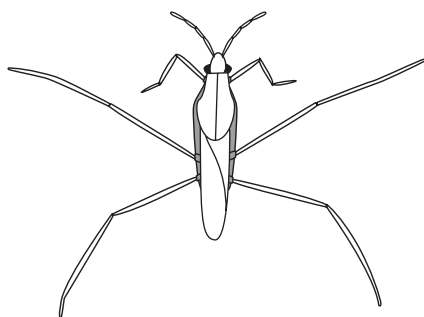
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6. The pond skater, *Gerris* sp., is an insect that forms part of the community in freshwater ponds. It uses its specially-adapted feet to skate across the surface of the pond, searching for insects that fall into the pond.

A pond skater, *Gerris* sp.



Magnification $\times 3$

Pond skaters are attracted to drowning insects by the vibrations sent out across the surface as the insect struggles. They pierce the prey with their needle-like mouthparts to inject protease enzymes which digest the tissues, producing a liquid. This liquid is then drawn up by the pond skater through its mouthparts. In their turn, pond skaters are one of the important food sources for pond-dwelling fish.

A group of students studied a population of pond skaters on a pond in farmland near their school grounds. Using the Lincoln Index, they estimated the size of the pond skater population.

- (a) Distinguish between the terms **population** and **community**.

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(1)



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(b) As part of their population study, the students marked a sample of 100 pond skaters with a small spot of paint before releasing them back into the pond. Explain how this would enable them to obtain an estimate of the size of the pond skater population.

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(c) Some of the students suggested that the pond skaters are primary consumers. State whether they are correct. Give reasons for your answer.

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(d) Suggest why acid rain might interfere with the digestion of drowning insects by the pond skaters.

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(e) Kingfishers are birds that feed on fish in the pond. Suggest how the use of non-biodegradable insecticides on the surrounding farmland might have an effect on these birds.

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(Total 12 marks)

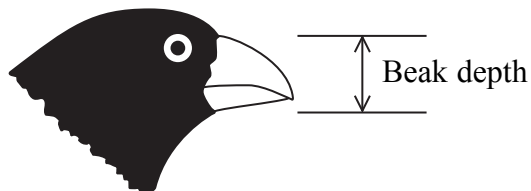
Q6

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7. The Galapagos Islands lie several hundred kilometres off the coast of South America. Populations of birds, belonging to the group known as finches, are found on most of the islands. Many of the islands have their own distinct species of finches.

One of these islands has a population of the seed-eating finch, *Geospiza fortis*. This population has been studied by a group of scientists. One of the features studied was the beak depth of the finches. Beak depth is measured as shown below.



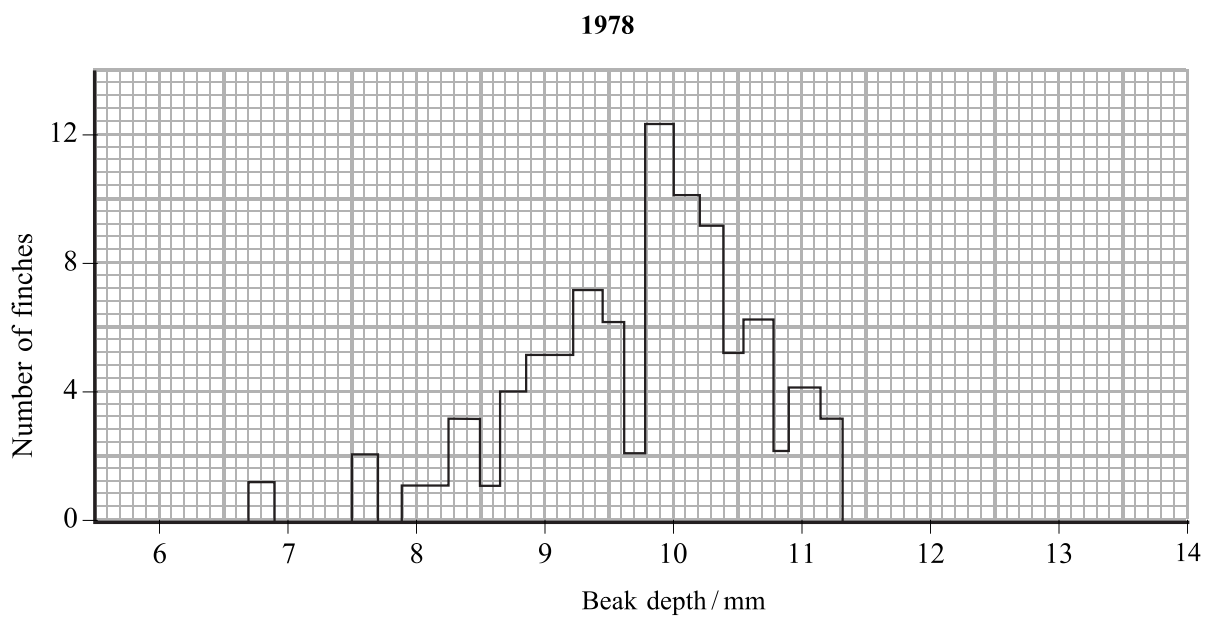
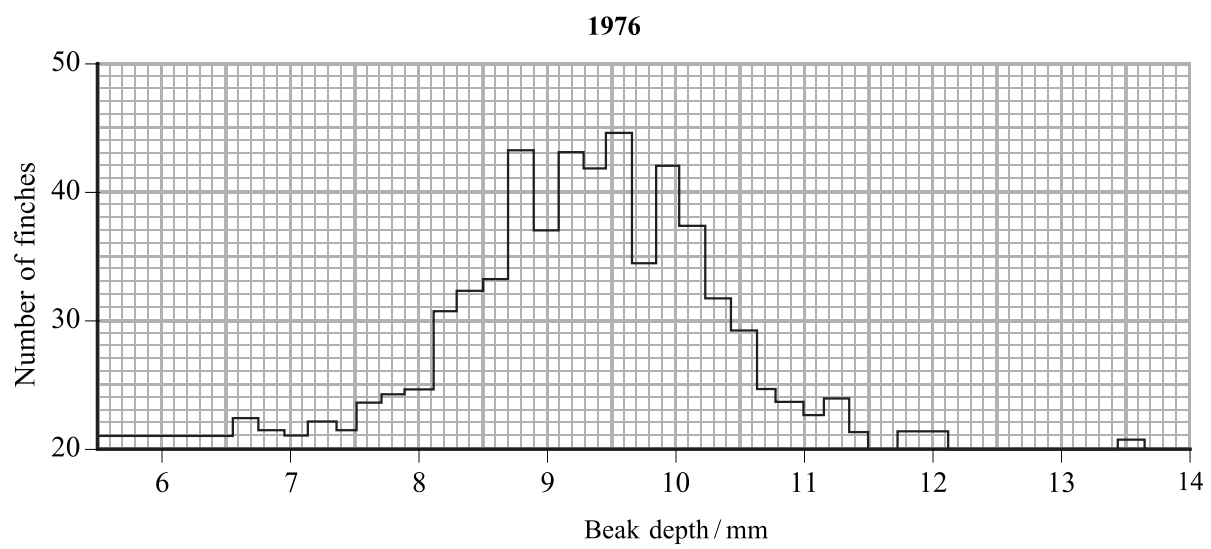
Finches with large beak depths are able to eat a wide-variety of seeds including those which are large and tough. When food is plentiful, most of the finches choose to eat the smaller, softer seeds.

In 1977, there was a severe drought on this island. This resulted in a decrease in the general availability of seeds. The smaller, softer seeds were quickly eaten, leaving only the larger, tougher ones.

The graphs on page 18 show beak depth data for the 1976 and 1978 populations of *Geospiza fortis* on this island.

QUESTION 7 CONTINUES ON THE NEXT PAGE





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(a) (i) Describe the changes, shown by the data, between 1976 and 1978.

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(ii) Suggest reasons for the changes you have described in part (i).

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QUESTION 7 CONTINUES ON THE NEXT PAGE



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(b) Beak depth in *Geospiza fortis* is an example of polygenic inheritance.

(i) Explain what is meant by **polygenic inheritance**.

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(ii) Suggest how the drought of 1977 might have affected the gene pool for beak depth.

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(c) Suggest reasons why the relative abundance of the different species in the **plant community** on this island may have changed between 1976 and 1978.

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(Total 12 marks)

Q7

TOTAL FOR PAPER: 70 MARKS

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