LUI

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Book ☐ of ☐ books used

External assessment

Biology

Paper 2

Time allowed

- Perusal time — 10 minutes
- Working time — 90 minutes

General instructions

- Answer all questions in this question and response book.
- Write using black or blue pen.
- QCAA-approved calculator permitted.
- Planning paper will not be marked.

Section 1 (45 marks)

- 11 short response questions

Queensland Government

QCAA Queensland Curriculum & Assessment Authority

Section 1

Instructions

- If you need more space for a response, use the additional pages at the back of this book.
  - On the additional pages, write the question number you are responding to.
  - Cancel any incorrect response by ruling a single diagonal line through your work.
  - Write the page number of your alternative/additional response, i.e. See page …
  - If you do not do this, your original response will be marked.
- This section has 11 questions and is worth 45 marks.

QUESTION 1 (4 marks)

a)   Explain how a species interaction may be classified as symbiotic.   *[2 marks]*

b)   Using an example, describe the symbiotic relationship of mutualism.   *[2 marks]*

QUESTION 2 (5 marks)

Two species of *Paramecium*, single-celled microorganisms, were grown for 4 days in test tubes with a fixed amount of algae added to each tube daily as their food source. The life span for each species ranges from 4–6 hours.

Test tubes 1 and 2 each contained a single species, and test tube 3 initially contained both species.

Test tube	Live *Paramecium* population after 4 days (per mL)	
	Species A	Species B
1	245	0
2	0	104
3	120	0

a)   Identify and describe the ecological principle that relates to these observations.   *[2 marks]*

b)   Explain the results of the experiment.   *[3 marks]*

QUESTION 3 (4 marks)

Explain the role of the enzymes helicase and DNA polymerase in the process of DNA replication.

QUESTION 4 (6 marks)

An ecologist investigated the species composition of mangrove trees in a natural mangrove forest and an adjacent 30-year-old planted mangrove forest.

Three 10 m-wide belt transects were sampled from inland to the sea for each of the forests, each covering 100 m on average and placed to cover various strata.

The species diversity of Forest A was determined using the Simpson's Diversity Index (SDI):

$$SDI = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

Species	Population count	
	Forest A (natural)	Forest B (planted)
Grey mangrove	91	77
Red mangrove	23	14
River mangrove	11	8
Orange mangrove	3	0
Diversity	0.46	?

a) Use the SDI formula to calculate the diversity index for Forest B. Round your answer to two decimal places. *[2 marks]*

b) Identify three reasons why the ecologist used a belt transect rather than line transects or randomly placed quadrats for collecting data to compare these two forests. *[3 marks]*

c) Identify one way in which the ecologist minimised bias in the sampling.   *[1 mark]*

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QUESTION 5 (4 marks)

Explain the process of protein synthesis in terms of transcription and translation.

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QUESTION 6 (3 marks)

The Bush Stone-curlew is a large, mainly nocturnal, ground-dwelling bird found on Hamilton Island. Bush Stone-curlews have a wide-ranging diet but prefer to feed on insects, molluscs, small lizards, seeds and, occasionally, small mammals. During the breeding season, nesting birds will search for food in the vicinity of the nest site.

a) Identify one factor that would influence carrying capacity on the island.   *[1 mark]*

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b) Discuss one way the carrying capacity of the Bush Stone-curlew on Hamilton Island could be positively or negatively affected in the future.   *[2 marks]*

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QUESTION 7 (4 marks)

Species richness (S) can be determined using the Menhinick's Index, where s is the number of different species represented in a sample and N is the total number of individual organisms in the sample.

$$\text{Species richness (S)} = \frac{s}{\sqrt{N}}$$

Sampling of two communities (Community A and Community B) were completed, with Community A having S = 0.5 for the six species identified. The results for Community B are shown in the table.

Community B	
Species	**Number of individuals**
A	12
B	15
C	19
D	22
E	25
F	7

Use S to compare Community A with Community B.

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QUESTION 8 (3 marks)

In an experiment studying the population dynamics of the house fly, two adult house flies were placed in a fly cage with a limited food supply. Population data was collected, as summarised in the table.

Generation	Number of eggs	Number of larvae	Number of pupae	Number of adults
1	0	0	0	2
2	120	110	95	88
3	250	225	213	210
4	500	475	462	12
5	20	2	0	0

Determine the population growth model exhibited by the house fly. Explain your reasoning.

QUESTION 9 (3 marks)

Fossil evidence seems to show that the morphology of the Queensland lung fish has remained relatively unchanged for the past 100 million years.

Describe the features of the theory of natural selection to explain how this may have occurred.

QUESTION 10 (3 marks)

Researchers measured the adult beak lengths of an entire population of a species of bird and plotted their results on the graph.

After many generations, the lengths of the adult beaks were again measured. By comparing this new data to the original data, the researchers concluded that the average length of beaks had increased as a result of directional selection.
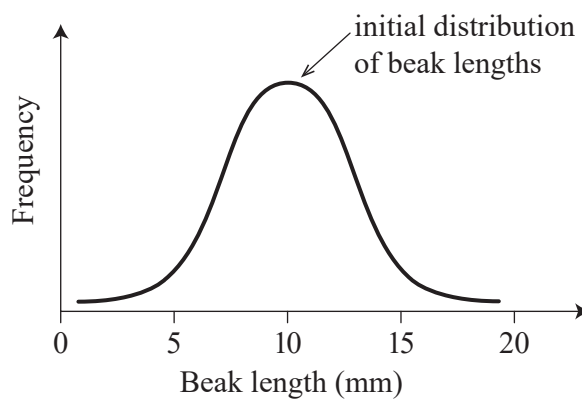
a) Describe directional selection.   *[2 marks]*

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b) On the graph provided, sketch a representation of directional selection for the beak length scenario.   *[1 mark]*
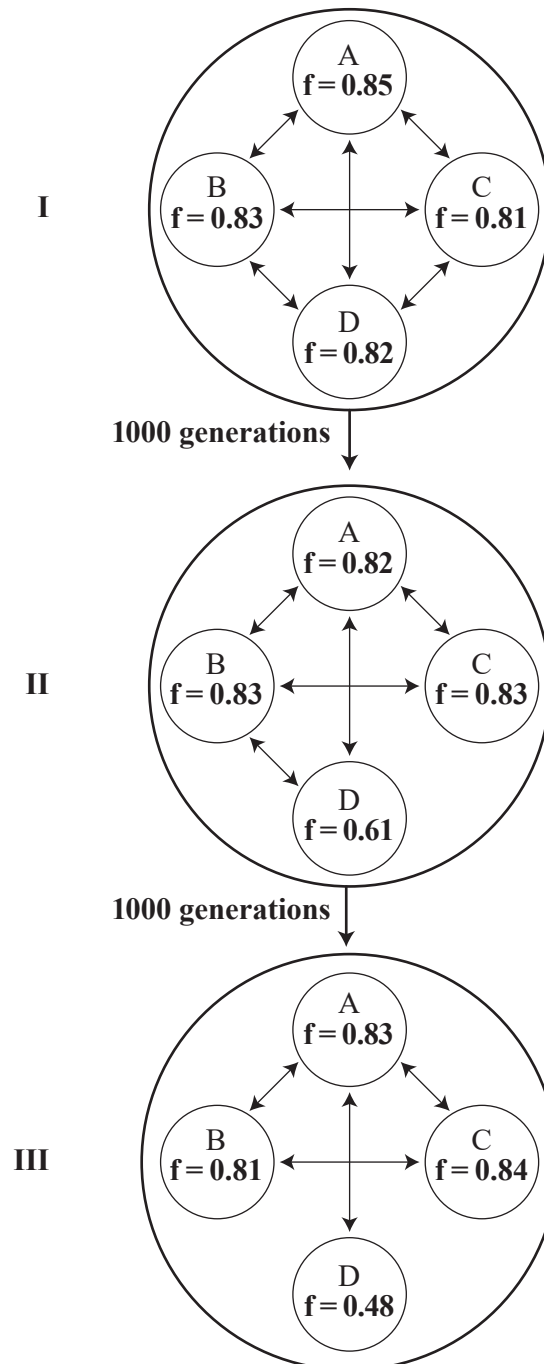
Note: If you make a mistake on the graph, cancel it by ruling a single diagonal line through your work and use the additional graph on page 17 of this question and response book.

QUESTION 11 (6 marks)

The image shows changes in the frequency of a particular gene in a single species of bird, leading to a speciation event. These changes have occurred over a period of successive time points (i.e. I, II and III) each separated by approximately 1000 generations.
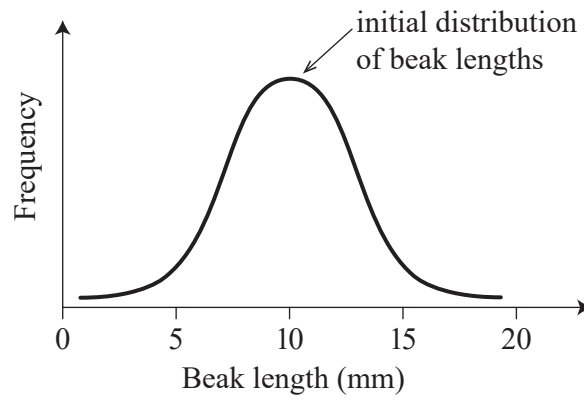
- The letters A, B, C and D represent separate niches inhabited by the birds.
- The arrows depict gene flow between the niches.
- The allelic frequency for the gene is shown as **f** in each niche.

Draw a conclusion about the type of speciation that has occurred in this population. Explain your reasoning by referring to the information provided in each of the time points.

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END OF PAPER

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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Write the question number you are responding to.

Do not write outside this box.

ADDITIONAL RESPONSE SPACE FOR QUESTION 10b)

If you want this graph to be marked, rule a diagonal line through the graph on page 9.

Do not write outside this box.