

External assessment

Multiple choice question book

Biology

Paper 1

General instruction

- Work in this book will not be marked.

Section 1

QUESTION 1

In prokaryotes, deoxyribonucleic acid (DNA) is found as unbound circular DNA in the

- (A) mitochondria.
- (B) chloroplasts.
- (C) nucleus.
- (D) cytosol.

QUESTION 2

Which form of inheritance usually determines traits that display continuous phenotypic variation?

- (A) polygenic
- (B) sex-linked
- (C) multiple allele
- (D) incomplete dominance

QUESTION 3

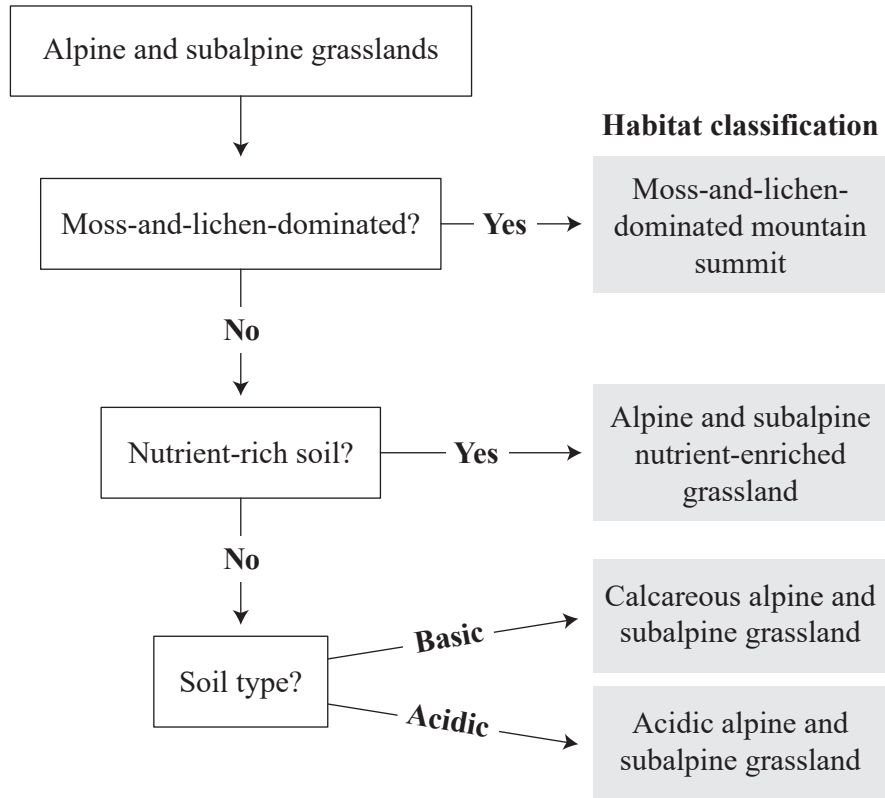
A genome is defined as

- (A) the molecular unit of heredity.
- (B) all the genetic material in the chromosomes of an organism.
- (C) the sequence of triplets of DNA nucleotides that make up a gene.
- (D) the combination of alleles for a particular trait carried by an individual.

QUESTION 4

The following information includes:

- a key that is used to classify the types of alpine and subalpine grassland habitats
- a table of abiotic and biotic data obtained from a habitat survey.



Abiotic physical parameter	Reading	Reference range for nutrient-poor soil (mg/kg)
pH	6.1	
Nitrates/nitrites (mg/kg)	4	< 5
Ammonia (mg/kg)	1	< 4
Total phosphorous	16	< 20

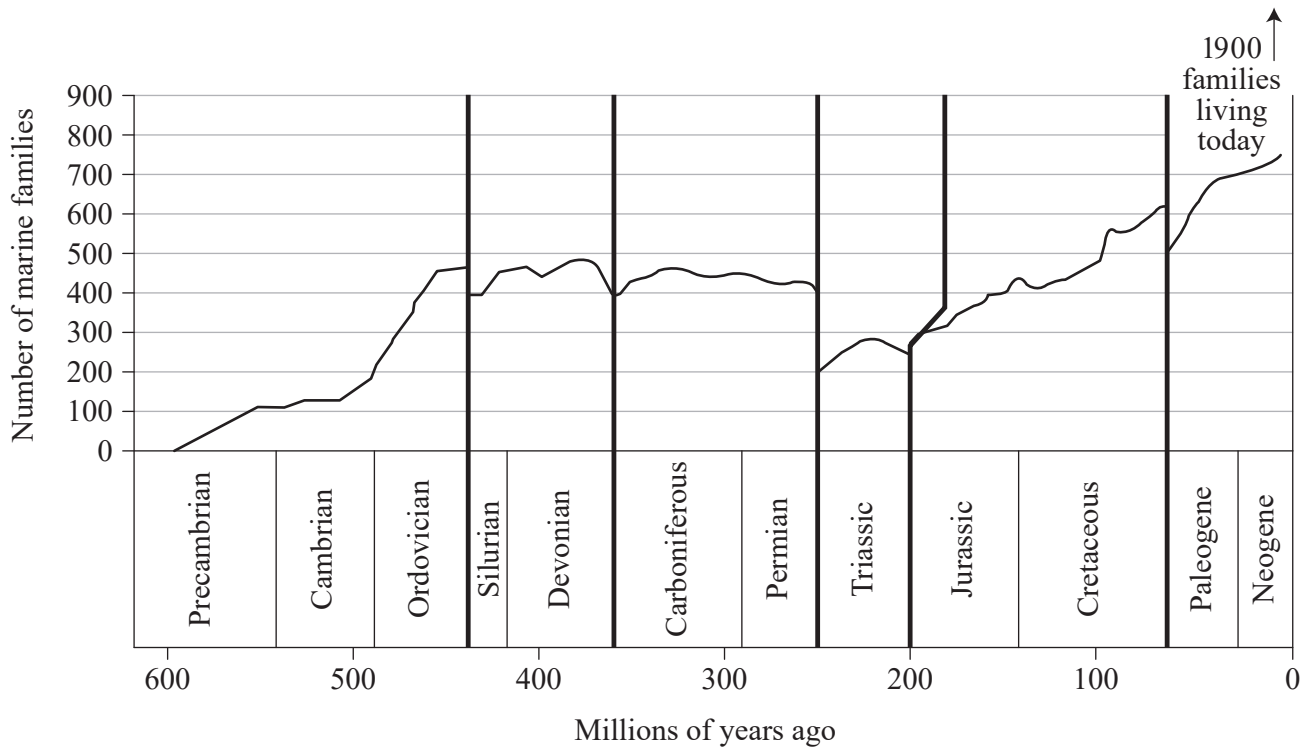
Biotic description: Small amount of low-lying moss, growing on soil substrate. Predominantly low-lying grasses.

Using the data in the table and the key, this alpine and subalpine grassland would be classified as

- (A) a moss-and-lichen-dominated mountain summit.
- (B) an alpine and subalpine nutrient-enriched grassland.
- (C) a calcareous alpine and subalpine grassland.
- (D) an acidic alpine and subalpine grassland.

QUESTION 5

The figure shows the diversity of marine animals since the late Precambrian time. The data is from marine animal families that have been reliably preserved in the fossil record.



Which of the following time periods saw the greatest evolutionary radiation of the marine families?

- (A) Ordovician
- (B) Cretaceous
- (C) Devonian
- (D) Permian

QUESTION 6

The carrying capacity of an ecosystem refers to the

- (A) total biomass of primary producers in the ecosystem at a given time that supports the higher trophic levels.
- (B) size of a population that can be supported indefinitely on the available resources and services of that ecosystem.
- (C) number of individual top predators in the ecosystem at a given time that can be supported by the lower trophic levels.
- (D) maximum population of individuals of different species that the ecosystem can support for an extended period of time.

QUESTION 7

When predicting successional change, which of the following would typically indicate that an ecosystem is progressing toward its climax community?

	Abundance of K-selected species	Biomass
(A)	Increasing	Decreasing
(B)	Decreasing	Increasing
(C)	Increasing	Increasing
(D)	Decreasing	Decreasing

QUESTION 8

The table shows the daily energy input and output for a typical leaf.

Process	Energy value (kJ)
Incident sunlight	42.3
Evaporation	31.2
Heat loss (radiation)	2.1
Reflection of sunlight	6.1
Transmission of sunlight	2.1

Calculate the daily net energy stored by the leaf.

- (A) 0.8 kJ
- (B) 5.0 kJ
- (C) 36.2 kJ
- (D) 73.5 kJ

QUESTION 9

The table provides population statistics for a species of tree kangaroo in northern Queensland.

Year	Births	Deaths	Immigration	Emigration	Final population
2016	253	175	153	131	1100
2017	290	167	182	140	

Determine the population growth rate for tree kangaroos in 2017.

- (A) 14.6%
- (B) 15.0%
- (C) 26.5%
- (D) 86.9%

QUESTION 10

DNA profiling using polymerase chain reaction (PCR) and gel electrophoresis allows the comparison of

- (A) genes.
- (B) entire genomes.
- (C) DNA fragments.
- (D) specific sites of mutations.

QUESTION 11

The Linnaean system originally used which type of evidence for classifying organisms?

- (A) physical features
- (B) common ancestry
- (C) molecular phylogeny
- (D) reproduction methods

QUESTION 12

In the structure of DNA, adenine pairs with which other base?

- (A) uracil
- (B) guanine
- (C) cytosine
- (D) thymine

QUESTION 13

Which of the following molecules is involved in the transcription of DNA?

- (A) RNA polymerase
- (B) DNA helicase
- (C) transfer RNA
- (D) amino acids

QUESTION 14

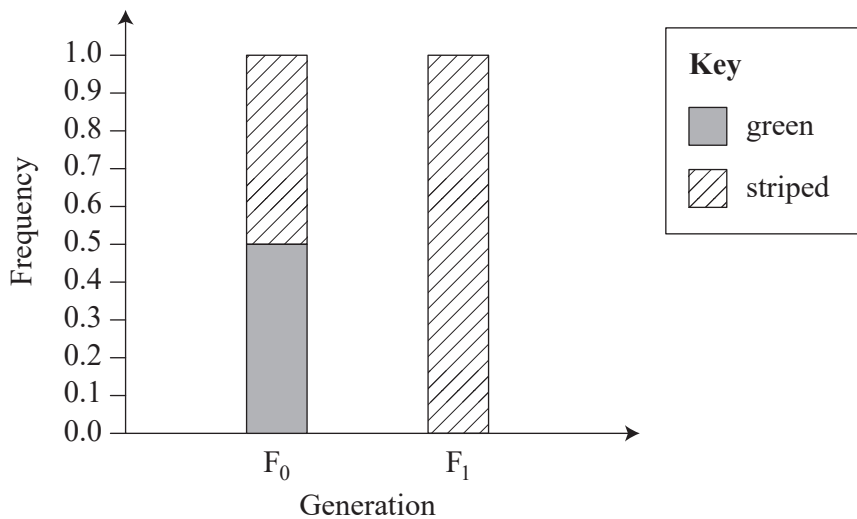
One of the common assumptions in cladistics is that

- (A) not all organisms are related by descent.
- (B) the characteristics of organisms in a population stay the same over time.
- (C) new kinds of organisms may arise when existing populations divide into two groups.
- (D) the more shared characteristics two organisms have, the more closely related they are.

QUESTION 15

In watermelon, skin colour is controlled by a single autosomal gene. The two phenotypic variants are green and striped. Two plants, one homozygous for the green alleles, and one homozygous for the striped alleles, were crossed.

The figure shows the phenotypic frequency for the initial (F_0) generation and the subsequent (F_1) generation.



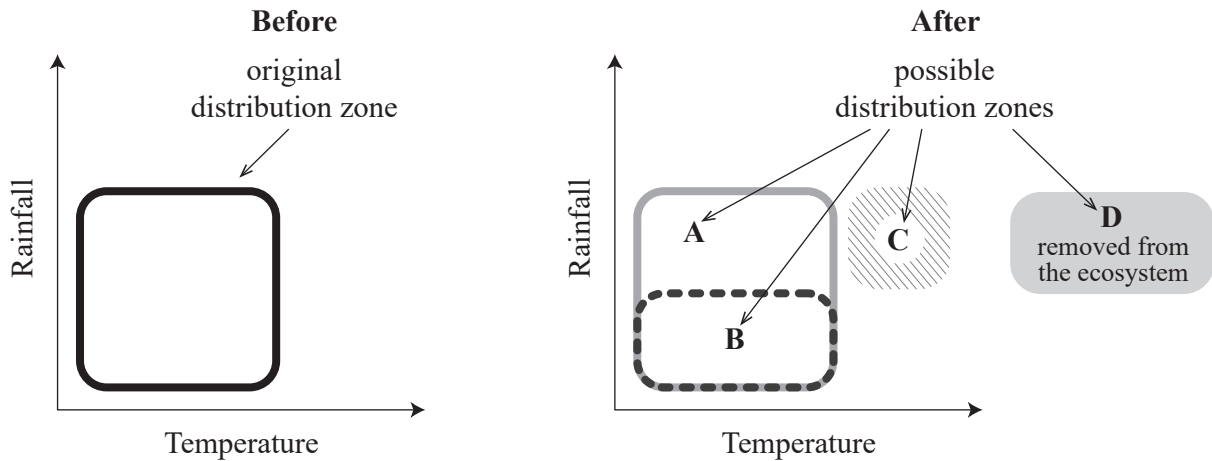
A cross was then performed between members of the F_1 generation. What would be the expected frequency of striped watermelon in the next (F_2) generation?

- (A) 1.0
- (B) 0.75
- (C) 0.50
- (D) 0.25

QUESTION 16

The figures show the original distribution zone of Species I and some possible distribution zones of Species I after the introduction of Species II.

Species II has a competitive advantage over Species I; however, it does not tolerate areas of lower rainfall.



Which of the following would be an accurate prediction of the new distribution zone for Species I?

- (A) Zone A, i.e. no change to the distribution
- (B) Zone B, i.e. reduced distribution within the original zone
- (C) Zone C, i.e. new distribution outside the original zone
- (D) Zone D, i.e. complete removal of the species from the ecosystem

QUESTION 17

The table identifies the condition associated with a variety of ploidy changes.

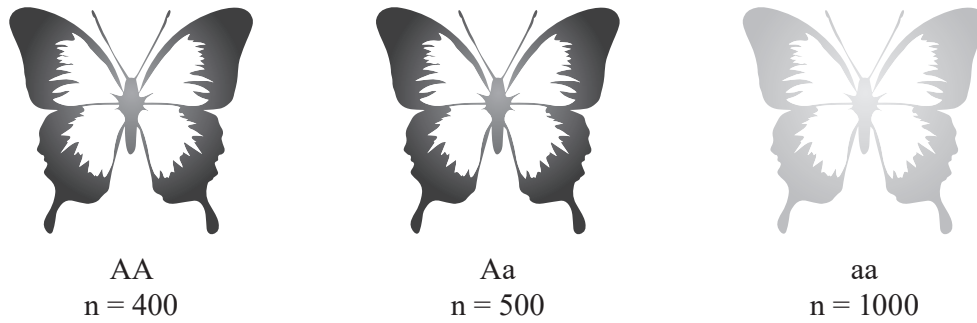
Chromosome number ploidy	Condition name
Monosomy 5	Cri du chat syndrome
Trisomy 21	Down syndrome
Trisomy 23	Klinefelter syndrome
Monosomy 23	Turner syndrome

For a person with XXY sex chromosomes, which condition would they have?

- (A) Cri du chat syndrome
- (B) Down syndrome
- (C) Klinefelter syndrome
- (D) Turner syndrome

QUESTION 18

The diagram shows the abundance (n) of phenotypic and genotypic variation for the colour trait of a species of butterfly.



If these butterflies were placed in an environment with light-coloured trees, which option from the table would be the most likely effect on the allelic frequencies?

	Frequency of allele/genotype			
	A	a	AA	aa
(A)	increase	decrease		
(B)			increase	no change
(C)	decrease	increase		
(D)			no change	increase

QUESTION 19

The table of data shows a comparison of amino acids sequences in the same section of haemoglobin molecules from a number of different species.

From the given information, which of the following species's haemoglobin protein is most similar to human haemoglobin protein?

Species	Sequence of amino acids							
Human	Lys	Glu	His	Ile	Val	Glu	Phe	Lys
(A)	Lys	Glu	His	Lys	Val	Met	Phe	Lys
(B)	Lys	Glu	Lys	Ile	Val	Glu	Phe	Lys
(C)	Lys	Asp	His	Leu	Val	Met	Phe	Lys
(D)	Lys	Val	His	Asn	Val	Glu	Phe	Lys

QUESTION 20

Which of the following are features of both microevolution and macroevolution?

- (A) mutations only
- (B) mutations and gene flow only
- (C) gene flow and genetic drift only
- (D) mutations, gene flow and genetic drift

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References

Question 18

Image adapted from 'Butterfly insect wings' by Clker-Free-Vector-Images on Pixabay

Reference 'Parental generation', Cyberbridge, http://cyberbridge.mcb.harvard.edu/evolution_4.html



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books used

External assessment

Question and response book

Biology

Paper 1

Time allowed

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

General instructions

- Answer all questions in this question and response book.
- QCAA-approved calculator permitted.
- Planning paper will not be marked.

Section 1 (20 marks)

- 20 multiple choice questions

Section 2 (25 marks)

- 8 short response questions



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Section 1

Instructions

- Choose the best answer for Questions 1–20.
- This section has 20 questions and is worth 20 marks.
- Use a 2B pencil to fill in the A, B, C or D answer bubble completely.
- If you change your mind or make a mistake, use an eraser to remove your response and fill in the new answer bubble completely.

	A	B	C	D
Example:	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	A	B	C	D
1.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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6.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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8.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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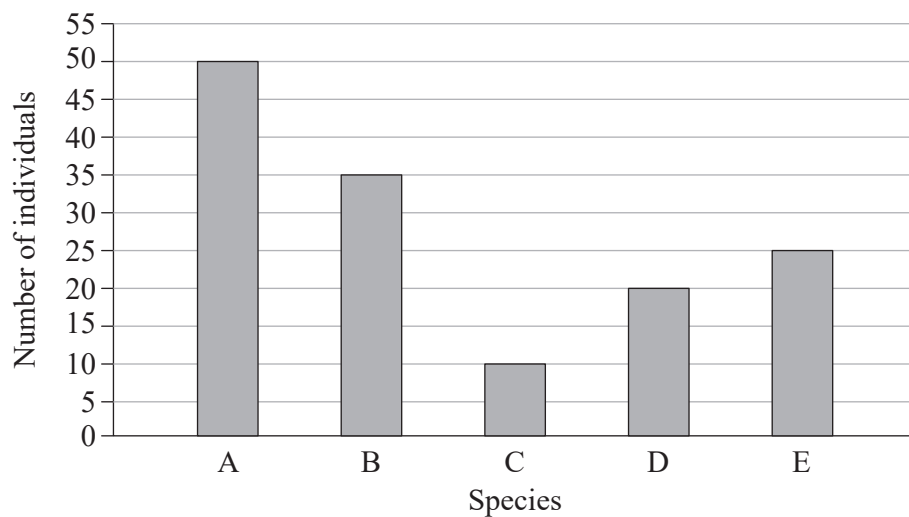
Section 2

Instructions

- Write using black or blue pen.
- 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 eight questions and is worth 25 marks.

QUESTION 21 (2 marks)

A count was conducted to determine the number of individuals for five different bird species in a woodland.

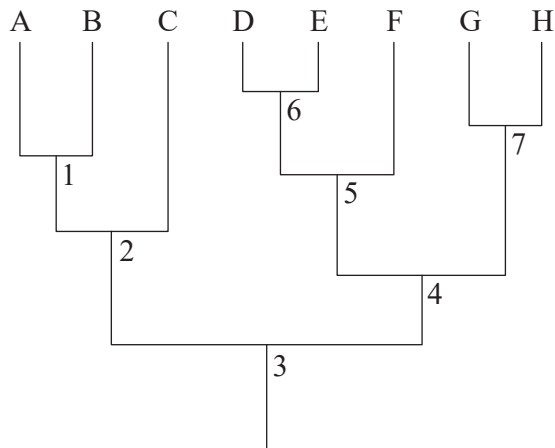


Calculate the relative percentage abundance of species B. Show your working.

Do not write outside this box.

QUESTION 22 (4 marks)

The following cladogram proposes the evolutionary history of several fish phyla (A–H).



- a) Define the term *clade*. Circle an example of a clade on the cladogram. [2 marks]

Note: If you make a mistake on the cladogram, cancel it by ruling a single diagonal line through your work and use the additional cladogram on page 13 of this question and response book.

- b) Which node (1–7) represents the most recent common ancestor for species E and G? [1 mark]

- c) Which two species shared the most recent common ancestor? [1 mark]

Do not write outside this box.

QUESTION 23 (3 marks)

Describe differences between r-selected and K-selected species in terms of:

- number of offspring
- parental care and involvement
- lifespan.

	r-selected	K-selected
Number of offspring		
Parental care and involvement		
Lifespan		

QUESTION 24 (3 marks)

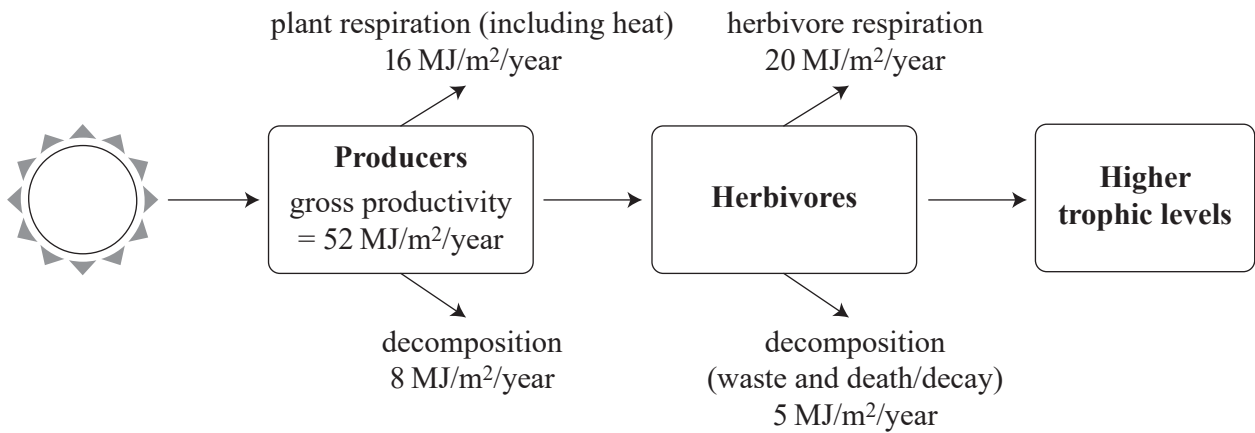
- a) Describe what is meant by the genotype of an organism. *[1 mark]*

- b) Inherited mutations can affect the genotype of offspring. Describe how this occurs. *[2 marks]*

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QUESTION 25 (4 marks)

The following simplified energy-flow diagram provides the gross productivity figures for producers and herbivores in an ecosystem.



- a) Determine the net productivity for the producers and herbivores in this ecosystem. [2 marks]

Producers: _____

Net productivity = _____ MJ/m²/year

Herbivores: _____

Net productivity = _____ MJ/m²/year

- b) Contrast the outputs of energy for the two trophic levels in the diagram. [2 marks]

Do not write outside this box.

QUESTION 26 (1 mark)

Define microevolution.

QUESTION 27 (4 marks)

In a freshwater lake in Africa, a species of crab and its snail prey species both exhibit specialisations that are unusual for freshwater species. The crabs possess strong claws with characteristics of marine crabs that crush and peel shells, and the snail prey have thick, strong shells that resist crushing.

- a) Identify which pattern of evolution this example represents. *[1 mark]*

- b) Describe how the two species may have evolved these characteristics. *[3 marks]*

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books used

External assessment

Question and response book

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



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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]

Do not write outside this box.

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.

Live <i>Paramecium</i> population after 4 days (per mL)		
Test tube	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]

Do not write outside this box.

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]

Do not write outside this box.

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]*

- 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.

Do not write outside this box.

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.

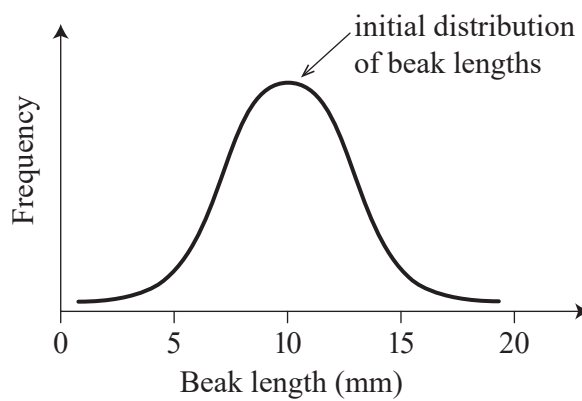
Describe the features of the theory of natural selection to explain how this may have occurred.

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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]

b) On the graph provided, sketch a representation of directional selection for the beak length scenario.

[1 mark]

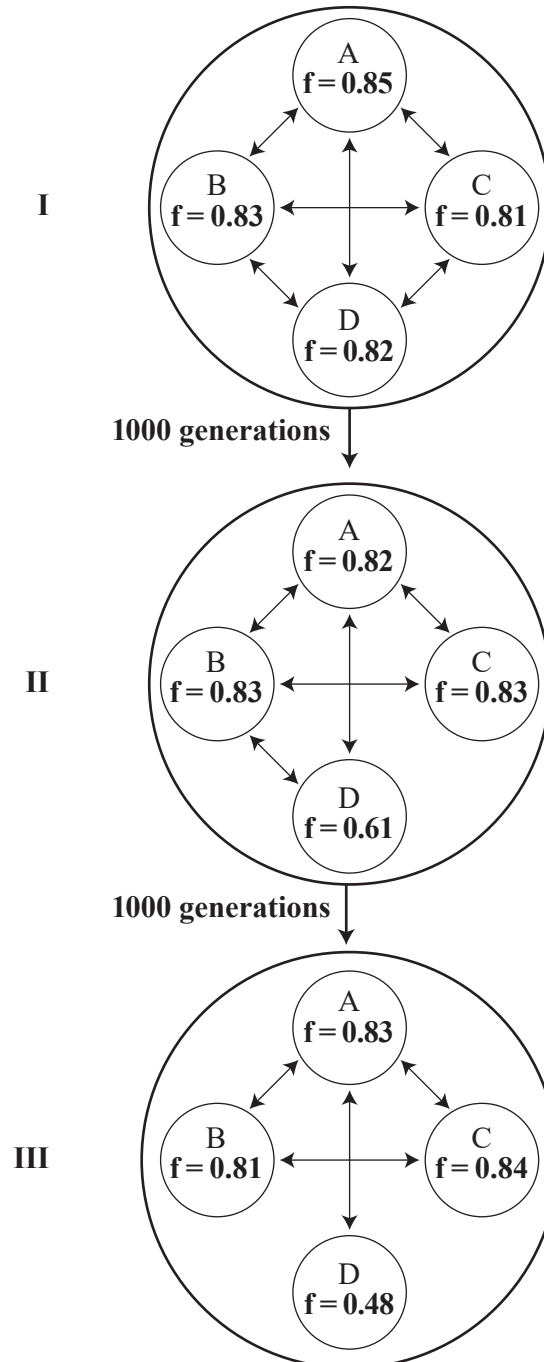
Note: If you make a mistake on the graph, cancel it by ruling a single diagonal line through your work and use the additional graph on page 17 of this question and response book.

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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.

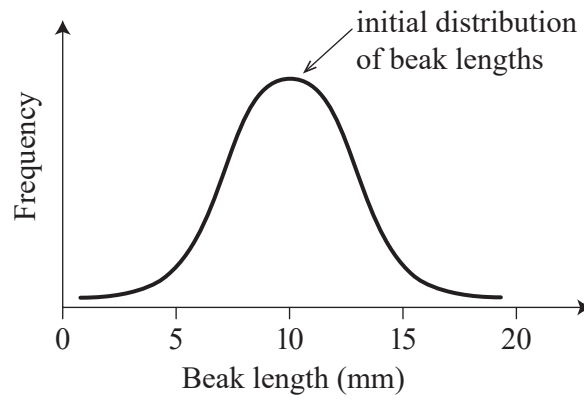
- The letters A, B, C and D represent separate niches inhabited by the birds.
- The arrows depict gene flow between the niches.
- The allelic frequency for the gene is shown as **f** in each niche.



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ADDITIONAL RESPONSE SPACE FOR QUESTION 10b)

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



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