External assessment 2022

Multiple choice question book

Biology

Paper 1

General instruction

- Work in this book will not be marked.

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Section 1

QUESTION 1

What is the molecular unit of heredity?

(A) gene

(B) genome

(C) nucleotide

(D) chromosome

QUESTION 2

Which stage of making recombinant DNA requires DNA ligase?

(A) cutting

(B) joining

(C) isolation

(D) transformation

QUESTION 3

A survey of grasshopper species was conducted across four eucalypt communities. Counts were conducted and the average abundance per 400 m^2 recorded.

	Grasshopper species (A–F)						
Community	**A**	**B**	**C**	**D**	**E**	**F**	**Total**
I	32	18	1	3	0	46	100
II	3	2	0	1	3	12	21
III	3	2	28	3	18	51	105
IV	18	13	12	14	16	15	88

Which community has both the highest species richness and highest evenness for grasshoppers?

(A) I

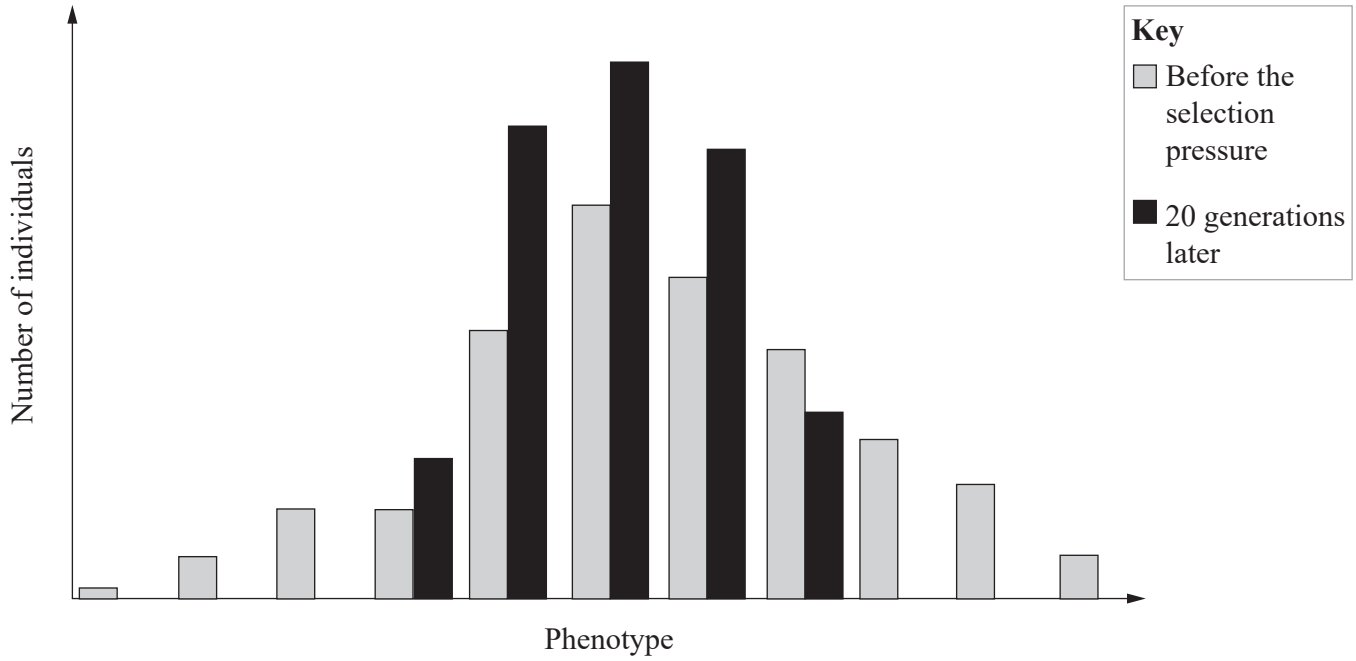
(B) II

(C) III

(D) IV

QUESTION 4

The graph shows the effect of a selection pressure on a hypothetical population.



Which mode of phenotypic selection corresponds with the data?

(A) negative

(B) disruptive

(C) stabilising

(D) directional

QUESTION 5

A researcher captured, marked and released 36 frogs. The following day they captured 24 frogs and 18 were marked.

Calculate the approximate size of the frog population using the Lincoln index: $N = \frac{M \times n}{m}$

(A) 27

(B) 48

(C) 54

(D) 60

QUESTION 6

The role of helicase in DNA replication is to

(A) initiate the process by binding to recognition sites along the template strand.

(B) add complementary bases to the template strand.

(C) unwind and separate DNA strands.

(D) join DNA strands together.

QUESTION 7

What is used directly by plants for protein synthesis?

(A) nitrite, NO_2^-

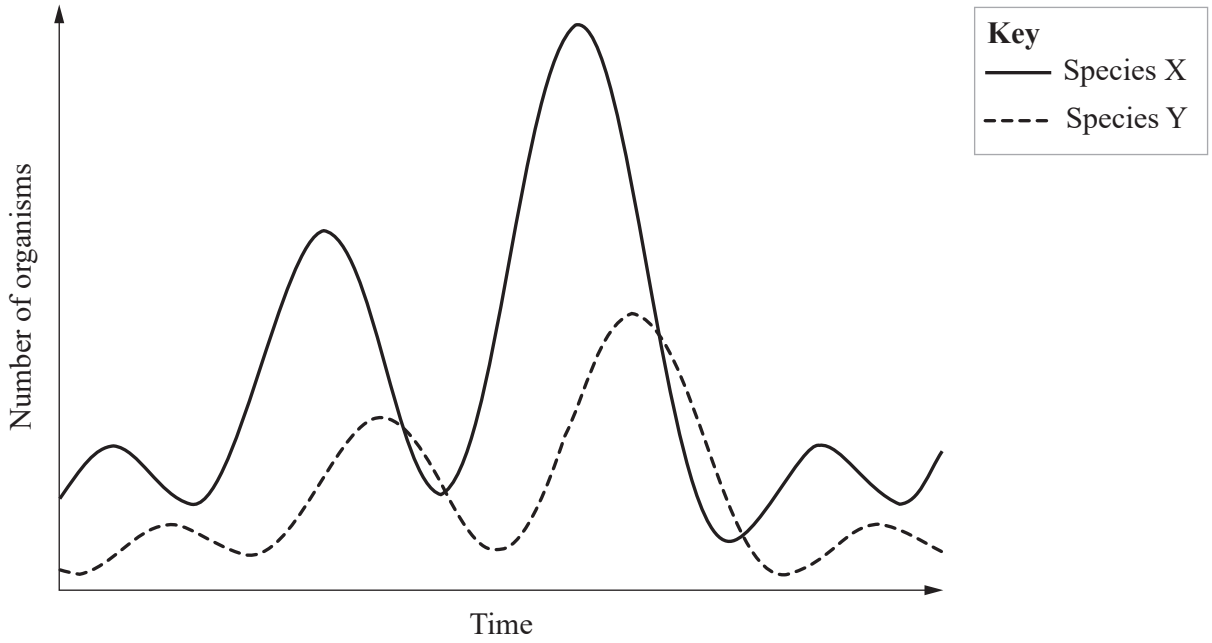
(B) nitrate, NO_3^-

(C) ammonia, NH_3

(D) atmospheric nitrogen, N_2

QUESTION 8

The graph shows how the populations of two species in an ecosystem change over time.



Which species interaction is represented?

(A) predation, where species X preys on species Y

(B) predation, where species Y preys on species X

(C) competition, where species X outcompetes species Y

(D) competition, where species Y outcompetes species X

QUESTION 9

Polygenic inheritance involves multiple

(A) alleles for a single gene.

(B) genes with the same alleles.

(C) genes coding for a single characteristic.

(D) characteristics resulting from a single gene.

QUESTION 10

Wings in birds, bats and pterosaurs are phenotypically similar, though they belong to different families and do not have a common ancestor with the trait. While the general morphology is similar, the structure and organisation of each wing is different.

This is an example of

(A) coevolution.

(B) parallel evolution.

(C) divergent evolution.

(D) convergent evolution.

QUESTION 11

Evolutionary relationships were investigated by sequencing a section of protein from five different species. Each letter represents an amino acid.

Species I	D	E	V	G	W	E	A	L	G	R	L	V	S
Species II	D	E	V	G	W	E	G	L	G	R	A	V	S
Species III	D	E	A	G	S	E	G	L	A	R	L	E	S
Species IV	D	E	V	G	S	E	G	L	G	R	L	E	S
Species V	D	E	V	G	W	E	A	L	A	R	L	V	S

It can be inferred that Species I is most closely related to

(A) Species II.

(B) Species III.

(C) Species IV.

(D) Species V.

QUESTION 12

Speciation occurs when

(A) the gene pool of an existing species becomes too small to support a viable population.

(B) selection pressures cause significant changes to the allele frequencies of a population.

(C) genetic drift is no longer occurring within populations.

(D) gene flow is no longer occurring between populations.

QUESTION 13

An error during DNA replication resulted in the following change to mRNA transcripts.

mRNA before	AUGAAGUUUGGCAUC … (continued)
mRNA after	AUGAAGUUUGCAUCG … (continued)

The DNA replication error most likely involved

(A) deletion of cytosine.

(B) insertion of guanine.

(C) substitution of uracil with guanine.

(D) substitution of guanine with cytosine.

QUESTION 14

Prior to fertilisation, a secondary oocyte will arrest at which stage of meiosis?

(A) prophase I

(B) prophase II

(C) metaphase I

(D) metaphase II

QUESTION 15

The environment's influence on gene expression can be investigated by comparing the rate of concordance in monozygotic (identical) and dizygotic (non-identical) twins. Concordance occurs when both twins express a trait.

Strong environmental influence is suspected when concordance is

(A) higher in monozygotic twins.

(B) only observed in dizygotic twins.

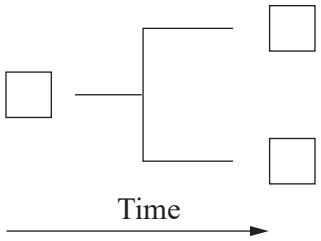
(C) only observed in monozygotic twins.

(D) similar in monozygotic and dizygotic twins.

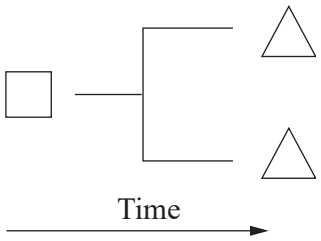
QUESTION 16

If each shape represents a different species, which diagram shows the common assumptions of cladistics?

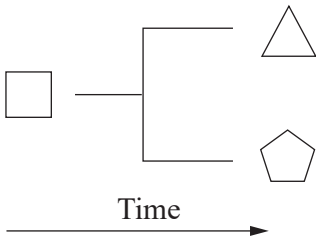
(A)



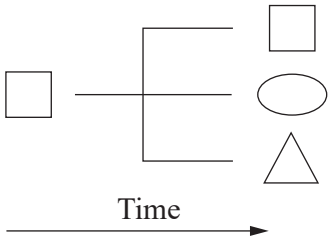
(B)



(C)



(D)



QUESTION 17

Students used quadrats to investigate biodiversity in a grassland community with scattered distribution of plant species. The students agreed on a counting criteria for each quadrat to

(A) reduce the time taken to count the different species.

(B) minimise statistical uncertainty.

(C) ensure all strata were sampled.

(D) minimise bias.

QUESTION 18

The competitive exclusion principle applies to different species occupying the same

(A) niche.

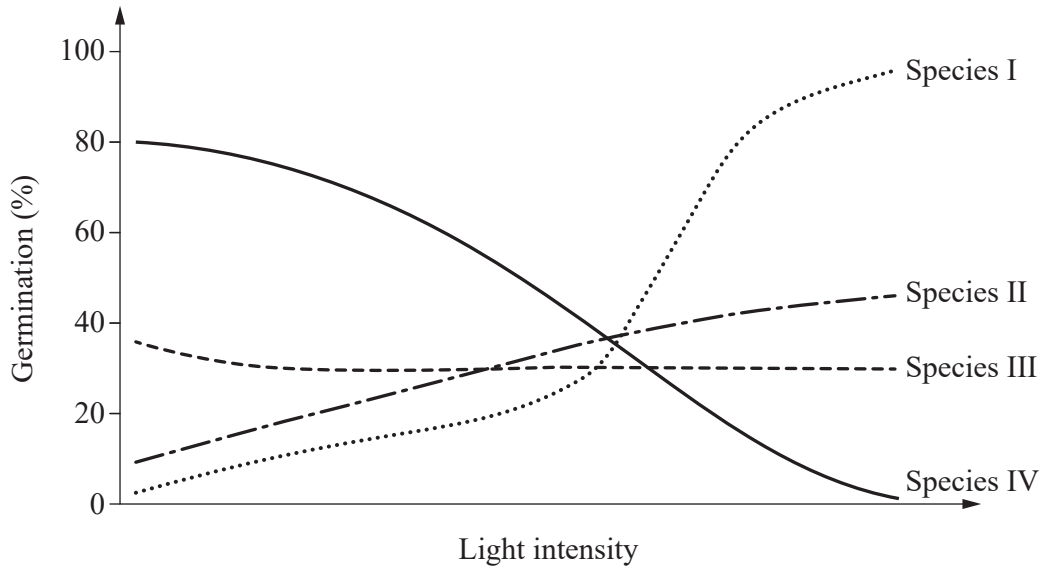
(B) habitat.

(C) environment.

(D) trophic level.

QUESTION 19

The graph shows the effect of light intensity on the germination success of seeds from four plant species.



Which is most likely to be a pioneer species?

(A) I

(B) II

(C) III

(D) IV

QUESTION 20

A section of DNA is made up of two strands, I and II.

Base	Strand I composition	Strand II composition
adenine		
cytosine		25%
guanine		14%
thymine	29%	

It can be inferred that

(A) strand I contains 25% cytosine.

(B) strand I contains 32% adenine.

(C) strand II contains 29% thymine.

(D) strand II contains 71% adenine.

References

Question 8

Modified from LotkaVolterra en.svg — Wikimedia Commons 2010, https://commons.wikimedia.org/wiki/File:LotkaVolterra_en.svg, CC BY-SA 3.0.

LUI | | | | | | | | | | | School code | | | | |

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Book of books used

External assessment 2022

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 (22 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:	●	○	○	○

	A	B	C	D
1.	○	○	○	○
2.	○	○	○	○
3.	○	○	○	○
4.	○	○	○	○
5.	○	○	○	○
6.	○	○	○	○
7.	○	○	○	○
8.	○	○	○	○
9.	○	○	○	○
10.	○	○	○	○
11.	○	○	○	○
12.	○	○	○	○
13.	○	○	○	○
14.	○	○	○	○
15.	○	○	○	○
16.	○	○	○	○
17.	○	○	○	○
18.	○	○	○	○
19.	○	○	○	○
20.	○	○	○	○

Do not write outside this box.

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 22 marks.

QUESTION 21 (2 marks)

Describe two reproductive strategies used to distinguish K-strategists from r-strategists.

Strategy 1: _____

_____

_____

Strategy 2: _____

_____

_____

Do not write outside this box.

QUESTION 22 (2 marks)

Explain how two abiotic factors affect the distribution of species in an ecosystem.

Ecosystem: _____

Abiotic factor 1: _____

Abiotic factor 2: _____

Do not write outside this box.

QUESTION 23 (3 marks)

Compare microevolution and macroevolution.

Do not write outside this box.

QUESTION 24 (2 marks)

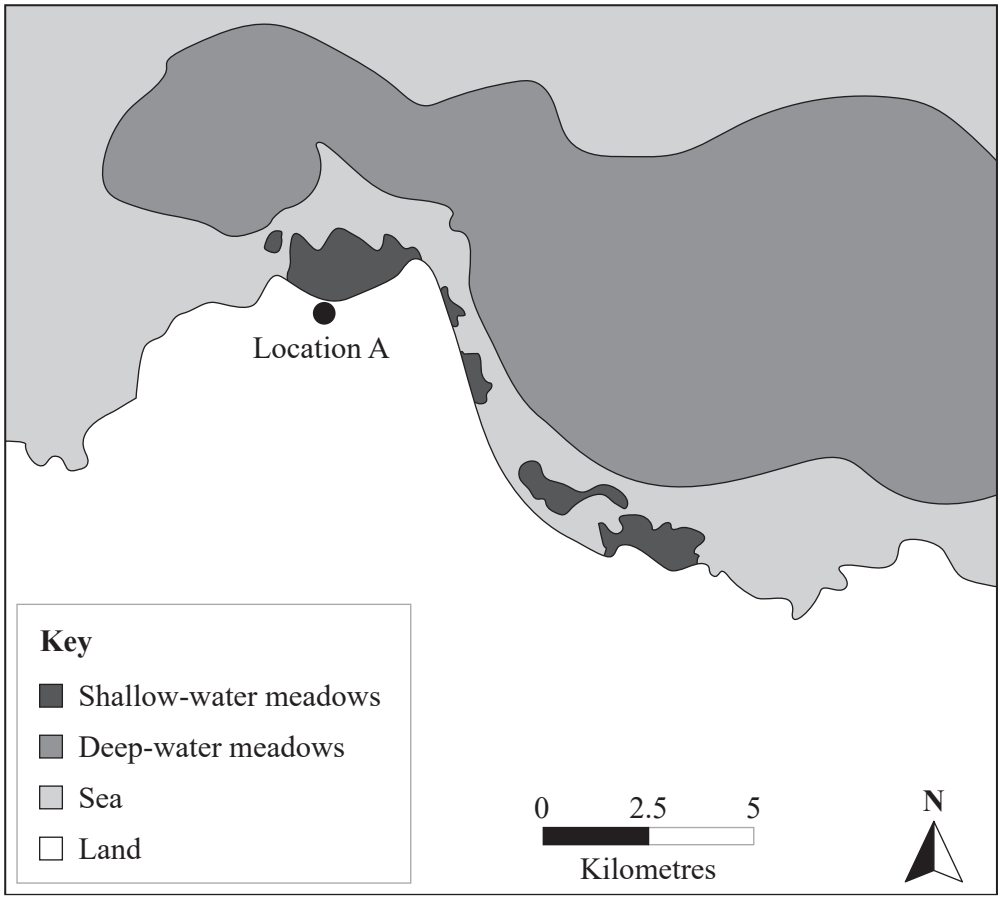
Explain two ways that classifying ecosystems allows for effective management of old-growth forests.

Do not write outside this box.

QUESTION 25 (4 marks)

Severe weather events have caused widespread loss of seagrass in meadows off Location A.

Seagrasses have the capacity to recover from weather-associated disturbances and return to pre-impact levels within 4 to 60 months. Deep-water meadows have a higher rate of recovery than shallow-water meadows.



Describe how stratified sampling could be used to study how seagrass meadows off Location A recover after a severe weather event. Identify a surveying technique and purpose for the study in your response.

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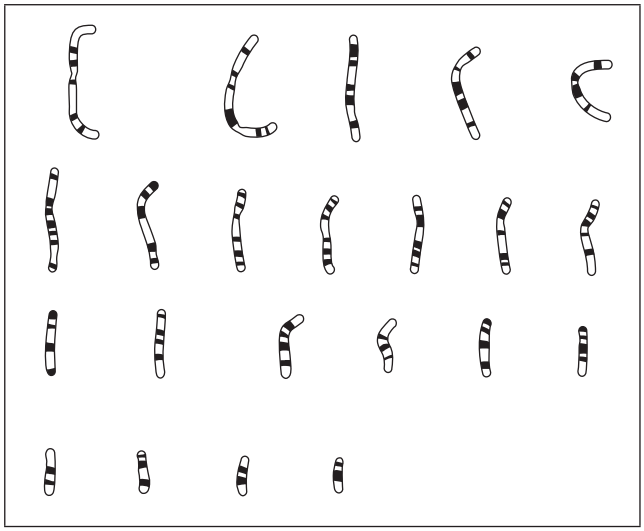
Do not write outside this box.

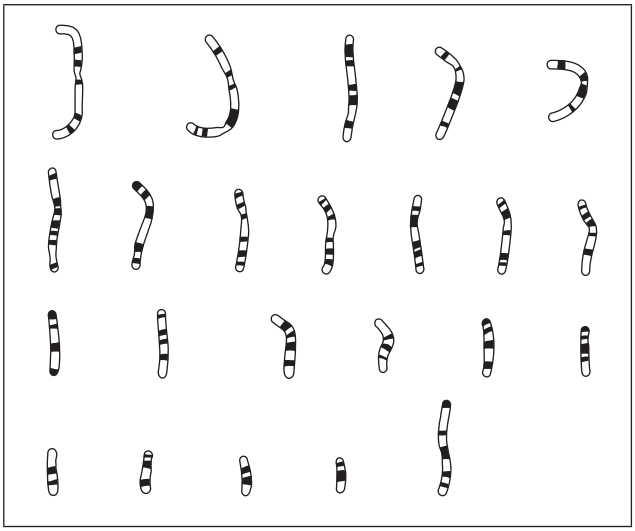
QUESTION 26 (4 marks)

Karyotypes for two human gametes are shown.

Karyotype A (sperm cell)



Karyotype B (egg cell)



a) Identify which cell exhibits aneuploidy. Refer to evidence from the karyotype. *[1 mark]*

Do not write outside this box.

b) Explain how this chromosome abnormality may have occurred. *[2 marks]*

This table lists some genetic conditions resulting from chromosomal abnormalities.

Genetic condition	Common name
Monosomy 5	Cri du chat syndrome
Monosomy X	Turner syndrome
Trisomy 13	Patau syndrome
Trisomy 18	Edwards syndrome
Trisomy X	Triple X syndrome

c) Predict which genetic condition would occur if the two gametes produced a zygote. *[1 mark]*

Do not write outside this box.

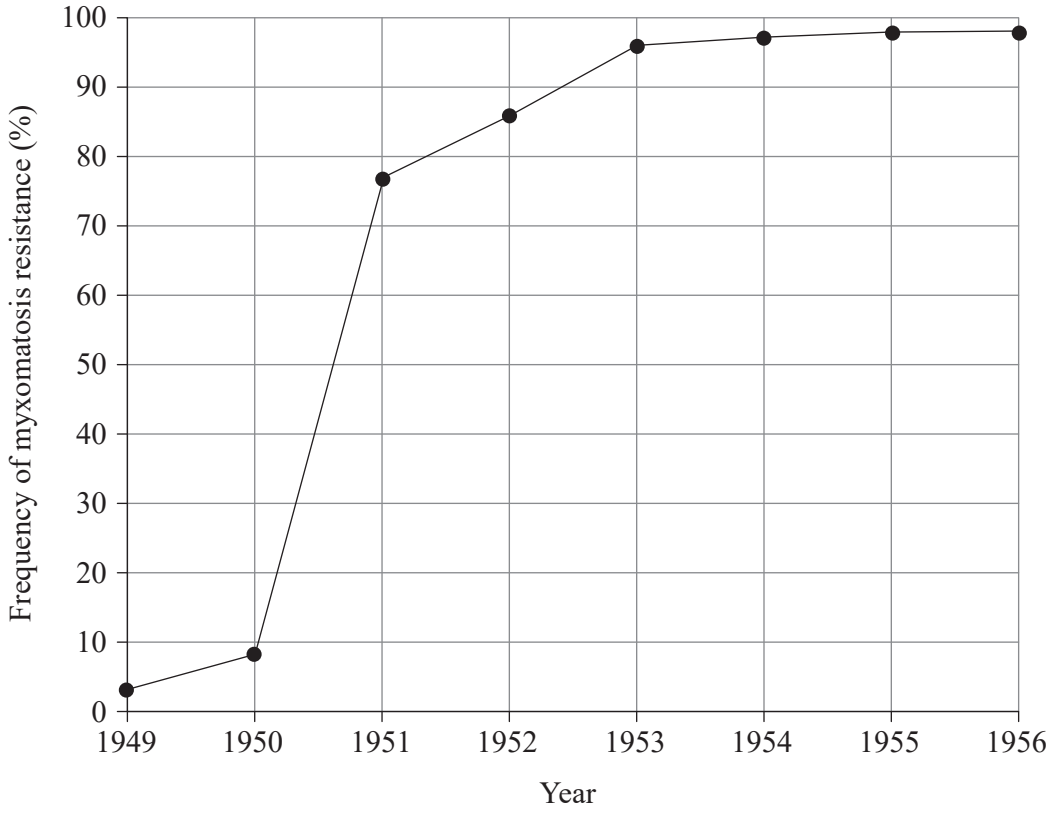
QUESTION 27 (2 marks)

Explain the purpose of gel electrophoresis in DNA profiling.

QUESTION 28 (3 marks)

In 1950, the myxoma virus was released into Australian pest rabbit populations to reduce their numbers. The resulting disease, myxomatosis, initially wiped out 95% of the rabbit population; however, it quickly became less effective as a population control measure.

This graph shows the frequency of myxomatosis resistance in Australia's rabbit population from 1949 to 1956.



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Use evidence from the graph and the principles of natural selection to explain how myxomatosis became ineffective as a population control measure.

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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LUI | | | | | | | | | | | School code | | | | |

School name

Given name/s

Family name

Attach your barcode ID label here

Book of books used

External assessment 2022

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

Clear zone — margin trimmed off after completion of assessment

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Section 1

Instructions

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  - 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.

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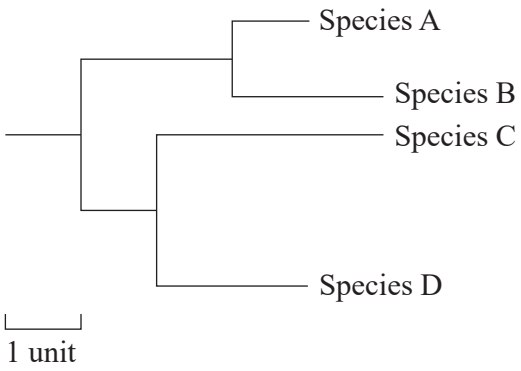
QUESTION 1 (3 marks)

This phylogenetic tree uses horizontal distance to represent genetic difference.



Scale 1 unit = nucleotide difference

a) Infer which species is most closely related to species B. Explain your reasoning. *[2 marks]*

b) Determine the genetic difference between species A and D. *[1 mark]*

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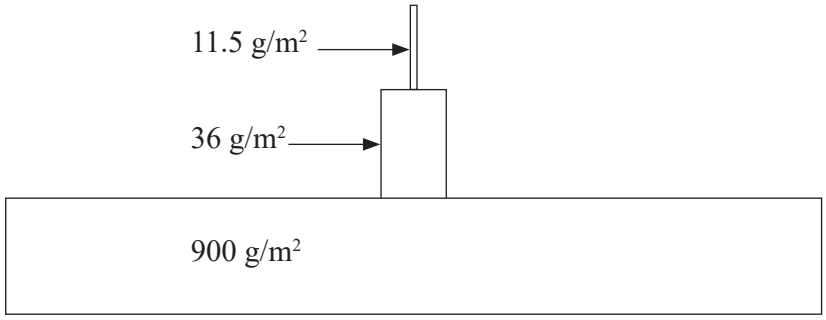
QUESTION 2 (4 marks)

This is a biomass pyramid for a grassland community.



Not to scale

a) Calculate the percentage energy transfer between the first two trophic levels. Show your working. *[2 marks]*

b) Explain the loss of biomass between trophic levels. *[2 marks]*

Do not write outside this box.

QUESTION 3 (4 marks)

A glacier has retreated, leaving a large amount of gravel, small rocks, sand and mud.

a) Explain the steps of succession that would occur if the glacier continues to retreat. *[3 marks]*

b) Identify the type of ecological succession. *[1 mark]*

QUESTION 4 (1 mark)

Define *keystone species*.

Do not write outside this box.

QUESTION 5 (5 marks)

a) Describe the roles of messenger RNA and transfer RNA in protein synthesis. *[2 marks]*

b) Explain how transcription factors control cell differentiation, using an example. *[3 marks]*

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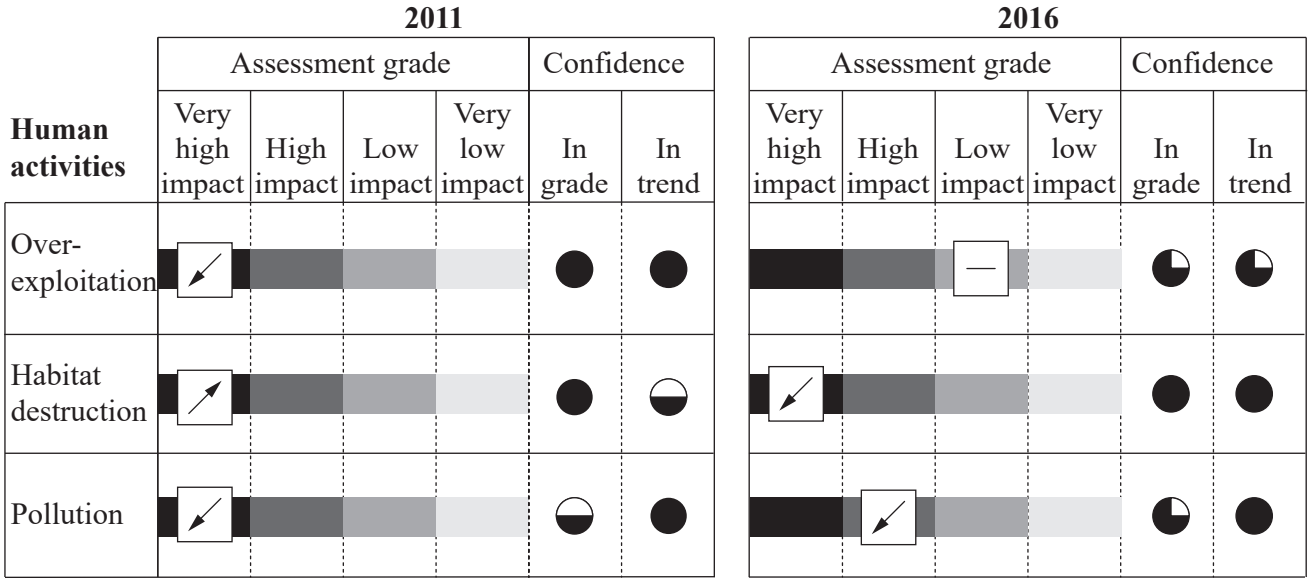
QUESTION 6 (5 marks)

An environmental report identified overexploitation, habitat destruction and pollution as human activities affecting biodiversity in Australia. The tables show the estimated impact of each activity in 2011 and 2016.



Recent trends	Grade	Confidence
Improving Getting worse Stable	**Very low impact:** Few, if any, species and/or ecosystems are suffering substantial adverse effects from this pressure	**Adequate:** Adequate high-quality evidence **and** high level of consensus
	Low impact: A small proportion of species and/or ecosystems are suffering substantial adverse effects from this pressure	**Somewhat adequate:** Adequate high-quality evidence **or** high level of consensus
	High impact: A significant proportion of species and/or ecosystems are suffering substantial adverse effects from this pressure	**Limited:** Limited evidence **or** limited consensus
	Very high impact: A large proportion of species and/or ecosystems are suffering substantial adverse effects from this pressure	**Very limited:** Limited evidence **and** limited consensus

Do not write outside this box.

a) Explain how one human activity identified in the tables could reduce biodiversity. *[1 mark]*

b) Predict which human activities will have the highest and lowest impact on biodiversity in 2023. Explain your reasoning using evidence from the tables. *[4 marks]*

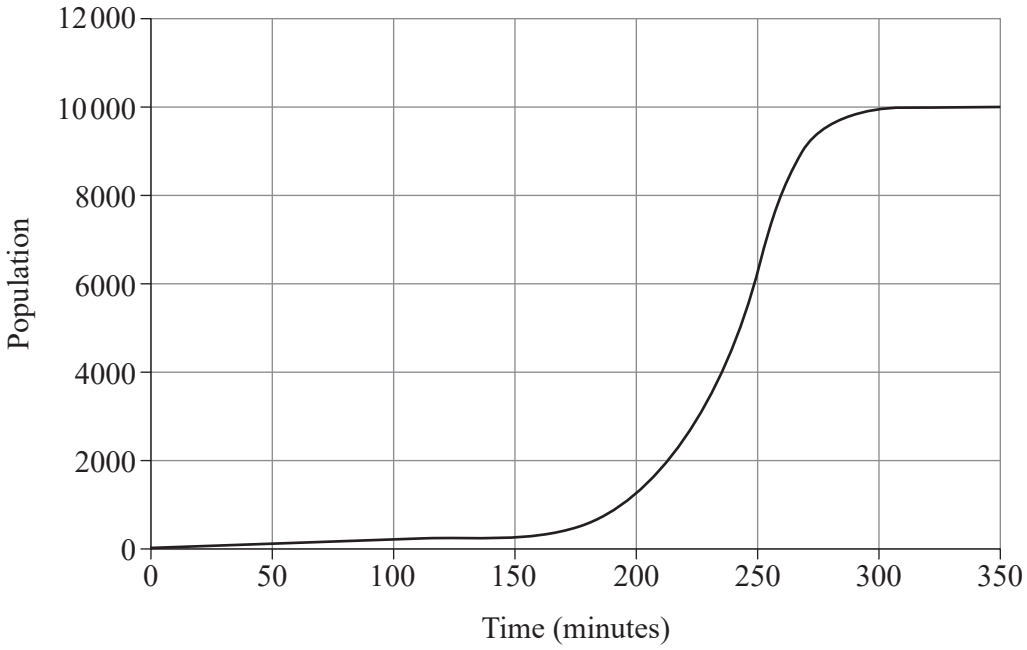
Highest impact:

Lowest impact:

Do not write outside this box.

QUESTION 7 (6 marks)

The graph shows the population of bacteria in a Petri dish over time.



a) Identify the mode of population growth. *[1 mark]*

b) Determine the carrying capacity under these conditions. *[1 mark]*

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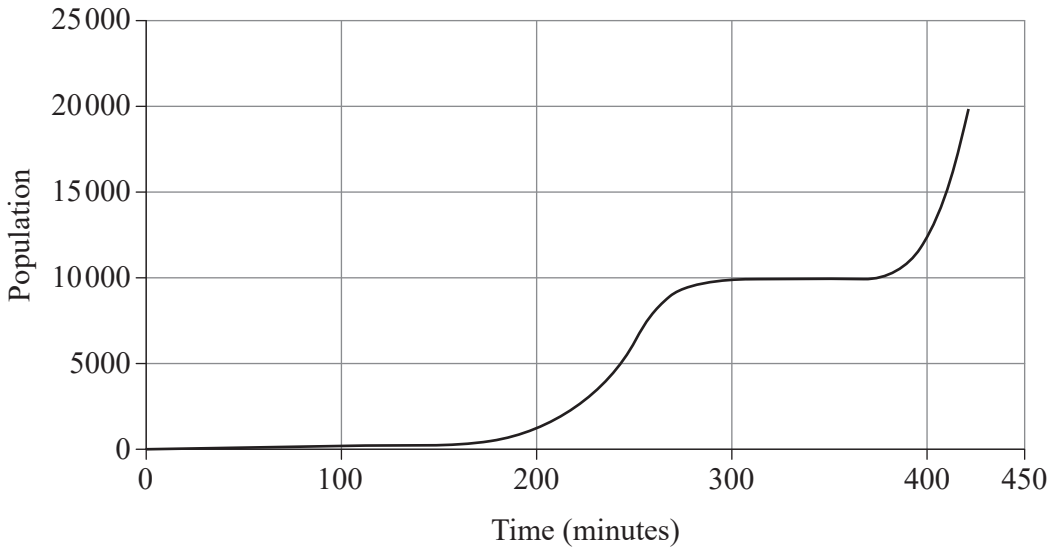
Conditions were modified at 380 minutes and the population continued to be monitored. Results are shown.



c) Identify two modifications that could cause this change. Explain your reasoning. *[4 marks]*

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QUESTION 8 (3 marks)

Over time, the South African cheetah population has suffered drastic reduction due to periodic droughts, disease and hunting. Currently, only small, isolated populations of cheetahs exist in the wild. Explain, in terms of genetic diversity, why cheetah populations are now on the verge of extinction.

Do not write outside this box.

QUESTION 9 (3 marks)

The biological species concept defines *species* as a group of organisms that can interbreed to produce fertile offspring.

a) Identify another method for defining a *species*. *[1 mark]*

b) Describe one limitation of the biological species concept and one limitation of the method identified in Question 9a). *[2 marks]*

QUESTION 10 (3 marks)

In fruit flies, eye colour is a sex-linked trait inherited on the X chromosome. The red-eye allele (R) is dominant over the white-eye allele (r). A red-eyed male and white-eyed female have 50 offspring.

Use a Punnett square to predict the number of male and female offspring and their eye colour.

Do not write outside this box.

QUESTION 11 (8 marks)

Allele frequencies were monitored in two large populations of field mice from neighbouring forests over a 10-year period. Results are shown.

Forest X

Year	Genotype			Allele frequency	
	AA	Aa	aa	A	a
2013	52	146	102	0.42	0.58
2014	48	144	108	0.40	0.60
2015	55	147	98	0.43	0.57
2016	60	150	90	0.45	0.55
2017	58	142	100	0.43	0.57
2018	58	148	94	0.44	0.56
2019	59	152	89	0.45	0.55
2020	60	148	92	0.45	0.55
2021	65	149	86	0.46	0.54
2022	66	149	85	0.47	0.53

Forest Y

Year	Genotype			Allele frequency	
	AA	Aa	aa	A	a
2013	0	0	300	0.00	1.00
2014	0	0	300	0.00	1.00
2015	0	0	300	0.00	1.00
2016	0	15	285	0.03	0.98
2017	3	46	251	0.09	0.91
2018	14	60	226		
2019	31	91	178	0.26	0.75
2020	48	104	148	0.33	0.67
2021	60	122	118	0.40	0.60
2022	66	137	97	0.45	0.55

Do not write outside this box.

a) Calculate the allele frequencies for forest Y in 2018. Show your working. *[2 marks]*

b) Identify temporal trends in allele frequency for forests X and Y and infer reasons for the observed differences. *[6 marks]*

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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References

Question 6

Adapted from

Australian Government Department of Sustainability, Environment, Water, Population and Communities, 2011, *Australia: State of the environment 2011*, p. 640, Canberra, https://soe.dcceew.gov.au/sites/default/files/2022-05/soe2011-report-biodiversity.pdf. Used under Creative Commons Attribution 4.0 licence (CC BY 4.0).

Australian Government Department of the Environment and Energy 2017, *Australia: State of the environment 2016*, pp. 39–41, Canberra, https://soe.dcceew.gov.au/sites/default/files/2022-05/soe2016-biodiversity-launch-version2-24feb17.pdf. Used under Creative Commons Attribution 4.0 licence (CC BY 4.0).