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

School name

Given name/s

Family name

Attach your barcode ID label here

Book of books used

External assessment 2024

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 (50 marks)

- 11 short response questions

Clear zone — margin trimmed off after completion of assessment

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

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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.

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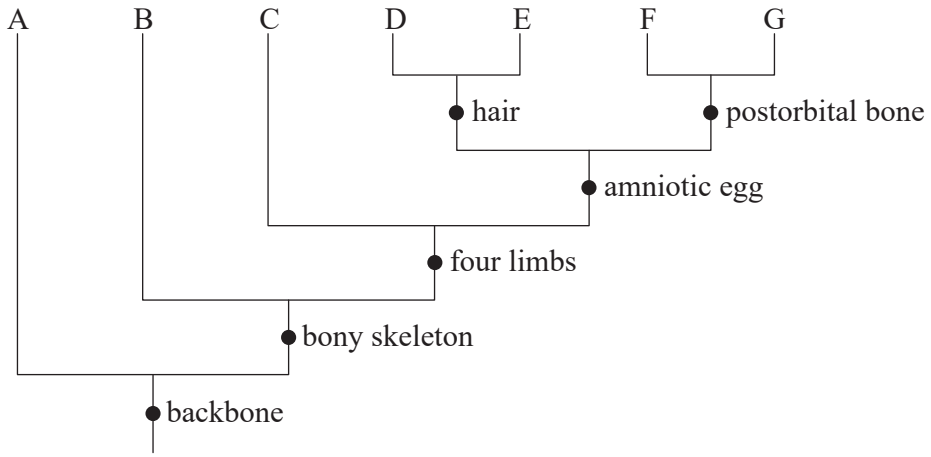
QUESTION 1 (3 marks)

This cladogram shows the development of key features in species A to G.



a) Identify the most distant relative of species C. *[1 mark]*

b) List all the features you would expect to observe in the most recent common ancestor of species C and F. *[1 mark]*

c) Identify the features that could be used to distinguish between species C and D. *[1 mark]*

Do not write outside this box.

QUESTION 2 (3 marks)

a) Define *carrying capacity*. *[1 mark]*

b) Identify two factors that affect the carrying capacity of plant species in an ecosystem. *[2 marks]*

QUESTION 3 (2 marks)

The table shows data for a population in 2023.

Starting population	Births	Deaths	Immigration	Emigration
4000	835	324	34	65

Calculate the population growth rate. Show your working.

Do not write outside this box.

QUESTION 4 (6 marks)

a) Describe the roles of helicase and DNA polymerase in DNA replication. *[2 marks]*

b) Explain two ways the structure of DNA allows helicase and DNA polymerase to carry out their roles. *[2 marks]*

c) Explain how errors during DNA replication can lead to point and frameshift mutations. *[2 marks]*

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QUESTION 5 (3 marks)

a) Describe a *population bottleneck.* *[1 mark]*

b) Explain why populations affected by bottlenecks face increased risk of extinction. *[2 marks]*

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QUESTION 6 (4 marks)

Sickle-cell anaemia is an autosomal recessive condition that reduces the ability of red blood cells to carry oxygen. This is usually considered detrimental; however, individuals who are heterozygous for the trait may be less prone to the infectious disease malaria.

These maps show the distribution of malaria and frequency of the sickle-cell anaemia allele in Africa.

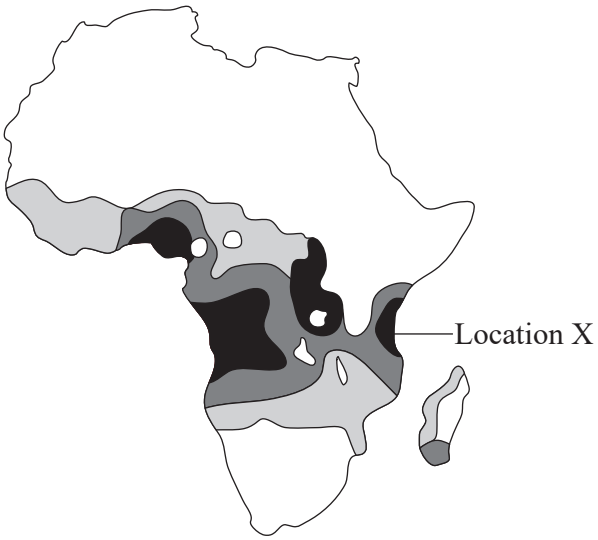
Not to scale

Malaria distribution

Key

Malaria present Malaria not present

Frequency of sickle-cell anaemia allele



Key

>20% >10–20% 1–10% <1%

This table shows the genotypes of individuals living at location X.

Genotype	Number of individuals
AA	830
Aa	540
aa	23

Do not write outside this box.

a) Calculate the frequency of the recessive allele, a, in the population at location X. Show your working. *[2 marks]*

b) Identify evidence for the sickle-cell anaemia allele being advantageous for individuals living where malaria is prevalent. Explain your reasoning. *[2 marks]*

Do not write outside this box.

QUESTION 7 (4 marks)

a) Explain how habitat fragmentation can lead to speciation. *[3 marks]*

b) Identify the type of speciation that occurs due to habitat fragmentation. *[1 mark]*

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QUESTION 8 (6 marks)

The table shows data from a transect study along a sand dune.

	Zone			
	A	**B**	**C**	**D**
Distance from sea (m)	0–100	>100–150	>150–250	>250–300
Age of dune (years)	0–50	>50–100	>100–125	>125–150
pH of soil	8.4	7.4	6.9	6.0
Organic matter in soil (%)	1	2.5	5	30
Number of grass species	2	4	6	2
Number of tree species	0	1	3	8

a) Contrast species richness in zones A and D. Refer to data in your response. *[2 marks]*

b) Infer how organic matter affects the pH of soil. Justify your response. *[2 marks]*

c) Predict which zone would have the highest proportion of K-selected species. Explain your reasoning. *[2 marks]*

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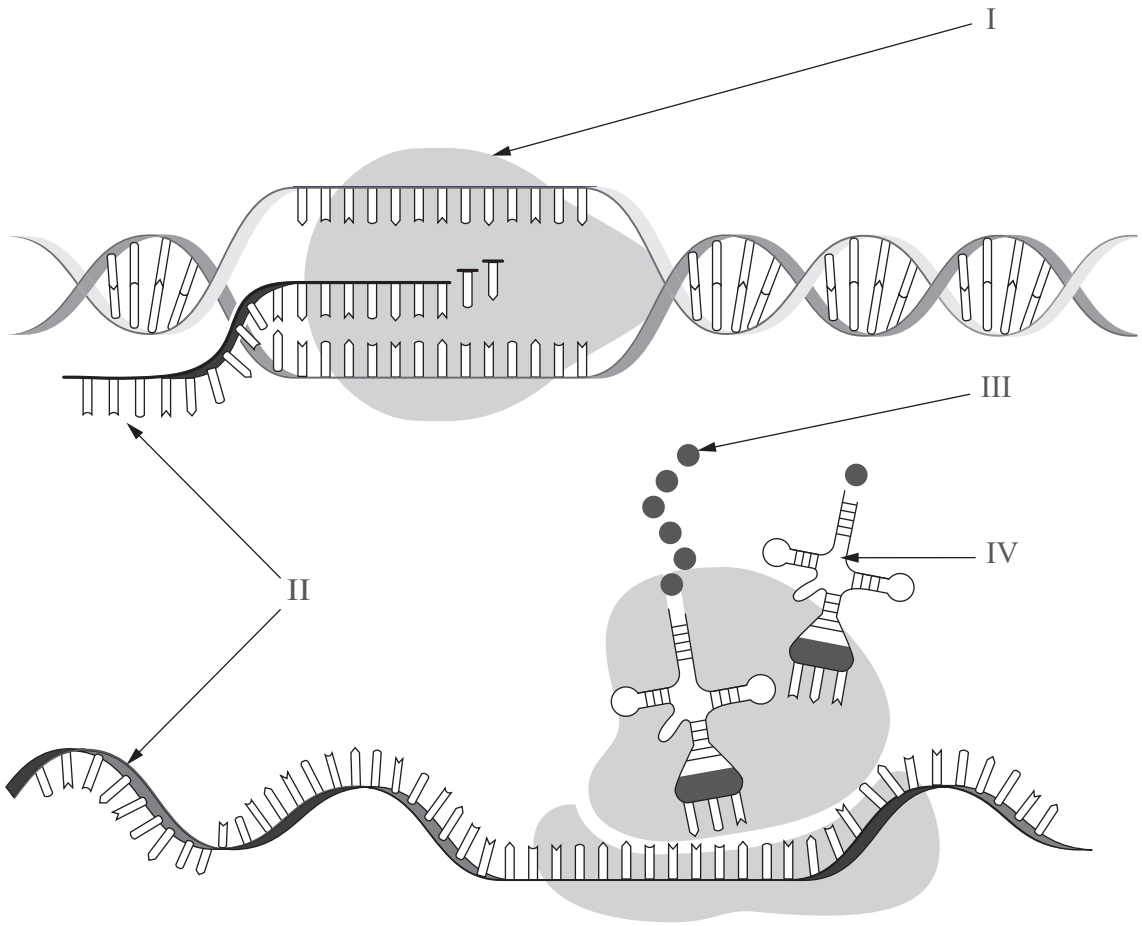
QUESTION 9 (10 marks)

The diagram shows key stages of gene expression.



a) Identify structures I, II and III. *[3 marks]*

I: _____

II: _____

III: _____

b) Describe the role of structure IV and explain how it carries out this function. *[3 marks]*

_____

_____

_____

_____

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c) Describe two ways gene expression is regulated. *[2 marks]*

d) Explain two reasons why genetic mutations do not always affect the phenotype of an individual. *[2 marks]*

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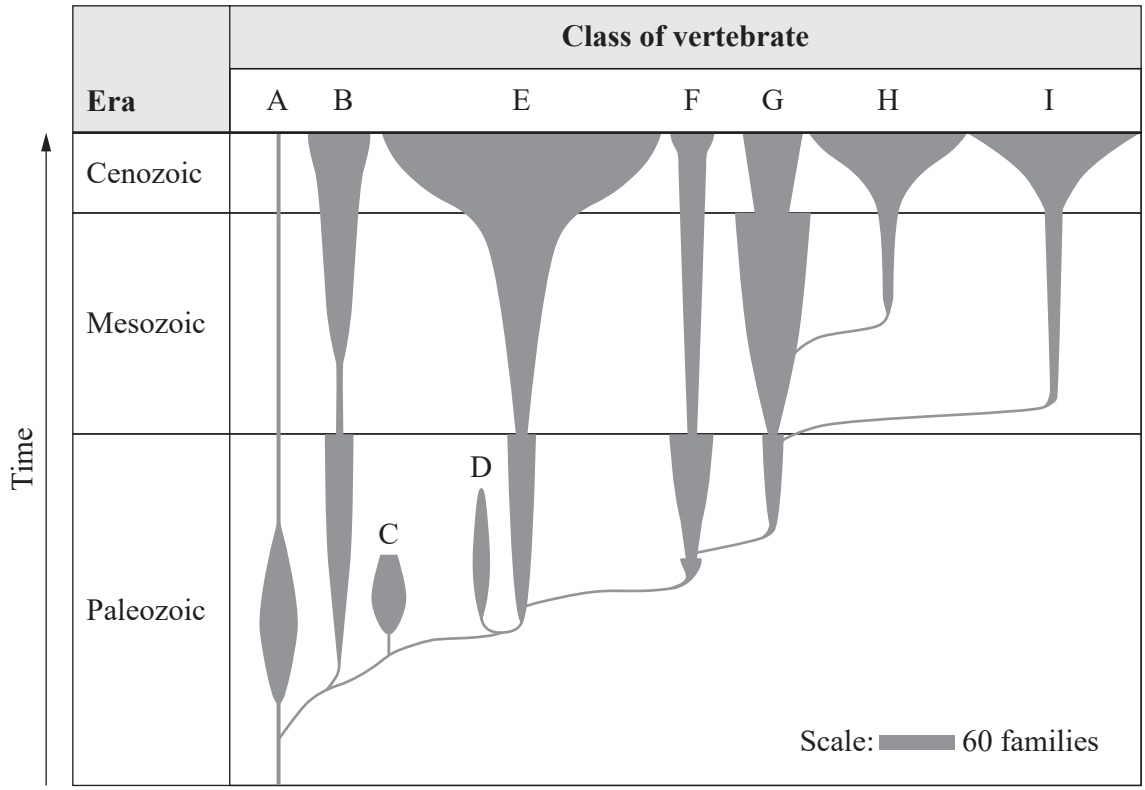
QUESTION 10 (5 marks)

The chart shows the number of families in nine classes of vertebrate (A to I) over geological time.



a) Identify a trend in vertebrate biodiversity over time. Refer to data to support your response. *[2 marks]*

Do not write outside this box.

b) Identify which classes became extinct during this time and the era/s in which the extinctions occurred. *[2 marks]*

c) Which class had family extinctions at the boundary of the Mesozoic and Cenozoic eras? *[1 mark]*

QUESTION 11 (4 marks)

a) Describe the process of ecological succession. *[3 marks]*

b) Distinguish between primary and secondary succession. *[1 mark]*

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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References

Question 1

Modified from StackExchange 2017, 'Example of impossibility in the nested heirarchy?', *Biology*, https://biology.stackexchange.com/questions/65364/example-of-impossibility-in-the-nested-hierarchy. CC BY-SA 3.0

Question 6

Adapted from Allison, A 2009, *Malaria_versus_sickle-cell_trait_distributions*, https://en.m.wikipedia.org/wiki/File:Malaria_versus_sickle-cell_trait_distributions.png. Public Domain

Question 8

Adapted from JAGS Geography South Wales 2013, *Idealised sand dune*, https://jagssouthwales2013.files.wordpress.com/2013/03/idealised-sand-dune.png

Question 9

Adapted from National Human Genome Research Institute 2022, *MRNA-interaction*, Wikimedia Commons, available at https://commons.wikimedia.org/wiki/File:MRNA-interaction.svg#globalusage. Public Domain

Question 10

Adapted from Bøckman, P 2011, *Spindle Diagram*, https://commons.wikimedia.org/wiki/File:Spindle_diagram.jpg. Public Domain