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

School name

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Family name

Attach your barcode ID label here

Book of books used

External assessment 2025

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 (52 marks)

- 11 short response questions

Clear zone — margin trimmed off after completion of assessment

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DO NOT WRITE ON THIS PAGE

THIS PAGE WILL NOT BE MARKED

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.

QUESTION 1 (3 marks)

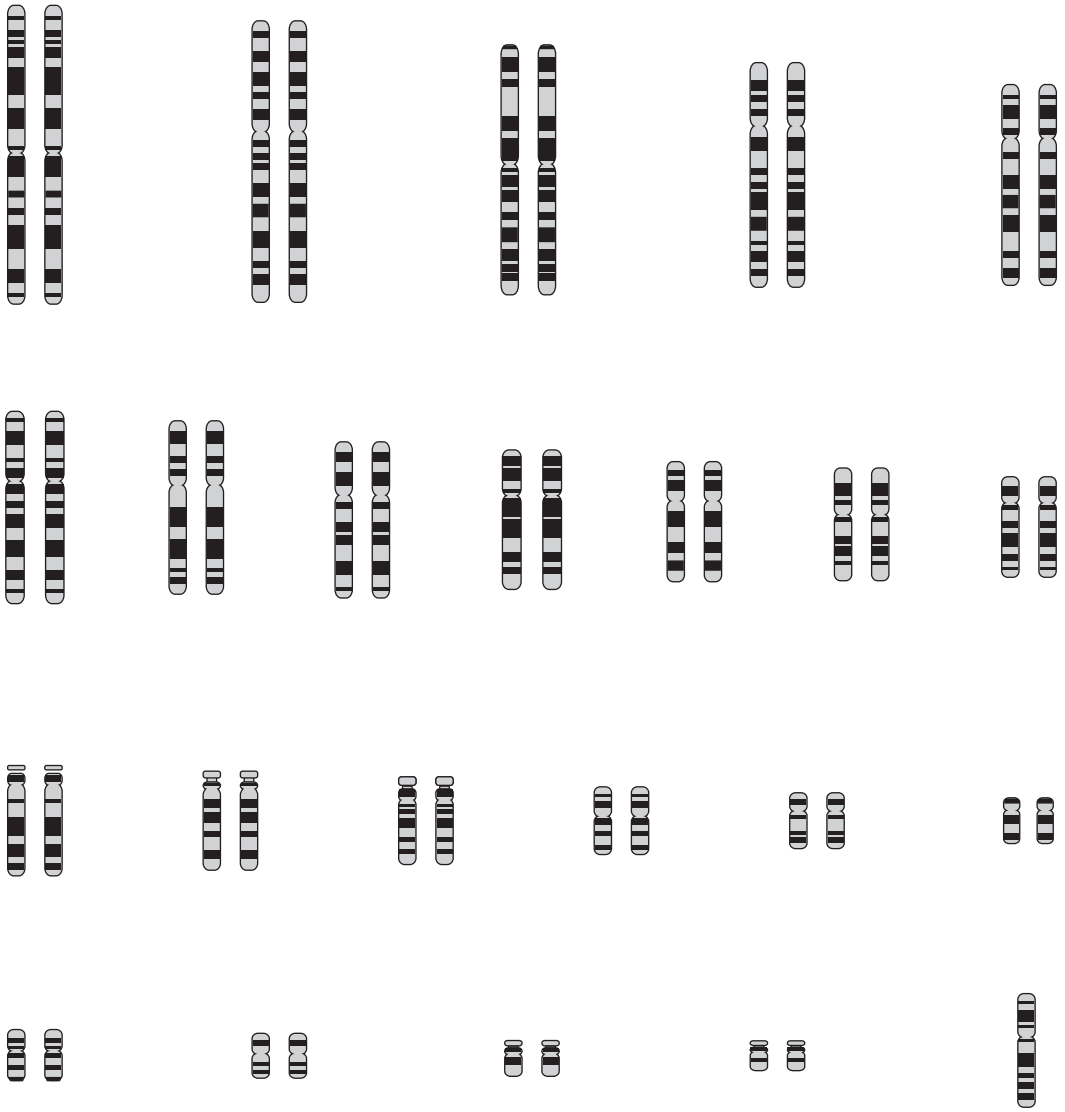
a) Define *genetic drift*. *[1 mark]*

b) Explain why genetic drift is usually high in populations affected by bottlenecks. *[2 marks]*

Do not write outside this box.

QUESTION 2 (6 marks)

A human karyotype and list of genetic conditions are shown.



Genetic condition	Common name
Monosomy 5	Cri du chat syndrome
Monosomy X	Turner syndrome
Trisomy 13	Patau syndrome
Trisomy 21	Down syndrome
Trisomy X	Triple X syndrome

Do not write outside this box.

a) Which genetic condition is indicated by the karyotype? *[1 mark]*

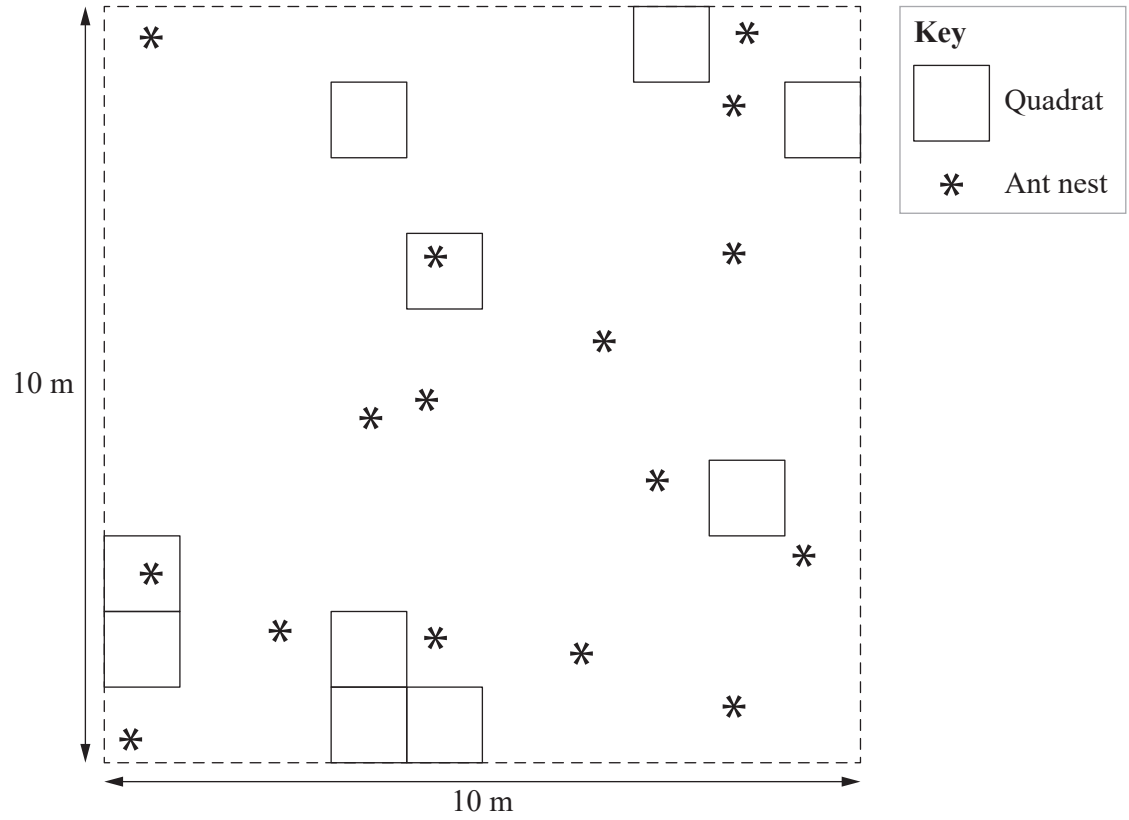
b) Explain how errors in meiosis may have led to this condition. *[3 marks]*

c) Describe how the karyotype would be different for a male with Down syndrome. *[2 marks]*

Do not write outside this box.

QUESTION 3 (6 marks)

Students used 10 quadrats, each 1 m^2 in size, to investigate the number of ant nests in a 100 m^2 section of their school oval. A random number generator was used to determine the location of each quadrat. Results are shown.



a) Use the quadrat data to predict the number of ant nests in the 100 m^2 section of the oval. Show your working. *[2 marks]*

Do not write outside this box.

b) Contrast the actual number of ant nests with that predicted by the quadrat data. *[2 marks]*

c) Explain why the students did not use stratified sampling for this investigation. *[2 marks]*

QUESTION 4 (3 marks)

Explain how transcription factors allow for cell differentiation, using an example.

Do not write outside this box.

QUESTION 5 (9 marks)

A student investigating the health of two freshwater ecosystems collected the data shown.

Abiotic indicator	Healthy range
Dissolved oxygen (% saturation)	90–110
Turbidity (NTU)	1–20
pH	6.5–8.0

		Ecosystem 1	Ecosystem 2
Abiotic data	Dissolved oxygen (% saturation)	95	105
	Turbidity (NTU)	20	5
	pH	6.2	7.5
Biotic data	Species richness	13	12
	Simpson's diversity index (SDI)	0.38	0.82

a) Infer which ecosystem has the greatest species evenness. Explain your reasoning. *[2 marks]*

Do not write outside this box.

b) Use the abiotic data to compare the health of the two ecosystems. *[3 marks]*

Similarity: _____

_____

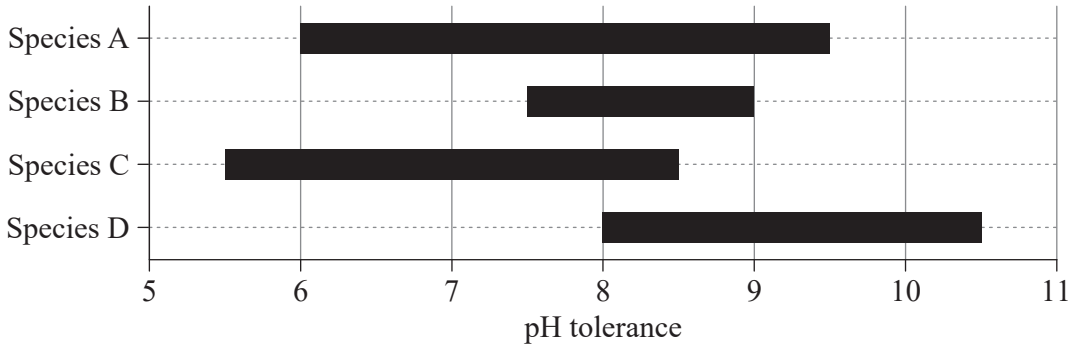
Difference: _____

_____

Significance: _____

_____

The chart shows pH tolerance ranges for phytoplankton species observed in the investigation.



c) Identify the species with the greatest pH tolerance range and state the tolerance range. *[2 marks]*

_____

d) Determine which two species were most likely observed in ecosystem 1. *[1 mark]*

_____

e) Determine the probability that two randomly caught individuals from ecosystem 2 were from the same species. *[1 mark]*

_____

_____

_____

Do not write outside this box.

QUESTION 6 (4 marks)

a) Explain how energy enters the biotic components of an ecosystem. *[2 marks]*

b) Distinguish between gross primary productivity and net primary productivity. *[2 marks]*

Do not write outside this box.

QUESTION 7 (3 marks)

The sex of chickens is determined by Z and W chromosomes. Chickens that inherit two Z chromosomes (ZZ) are male, while chickens with one Z chromosome and one W chromosome (ZW) are female. A barred feather pattern is a sex-linked dominant trait inherited on the Z chromosome.

A male chicken that was heterozygous for the barred feather pattern was bred with a female chicken that did not have the trait. They produced eight offspring.

Predict the number of offspring with the barred feather pattern. Justify your response using a Punnett square.

Do not write outside this box.

QUESTION 8 (2 marks)

Distinguish between exons and introns.

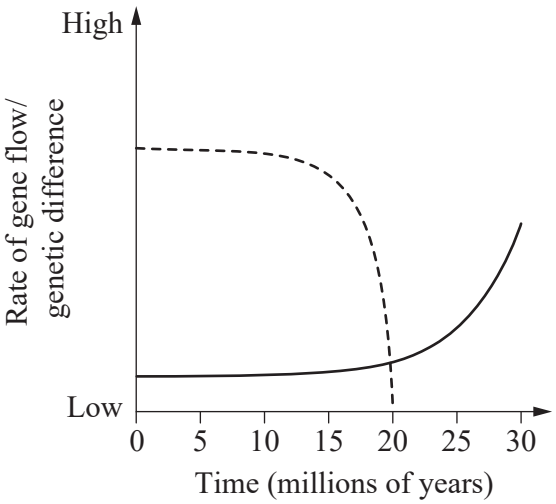
Do not write outside this box.

QUESTION 9 (2 marks)

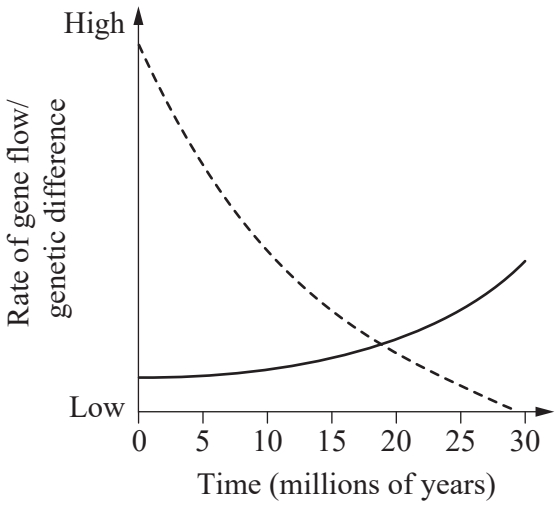
Scientists analysed data on three populations (A, B and C) in a region affected by habitat fragmentation.

The graphs show how the rate of gene flow and genetic differences between the populations changed over time.

Populations A and B



Populations A and C



Key

---- rate of gene flow

—— genetic difference

Infer which populations underwent allopatric speciation. Justify your response.

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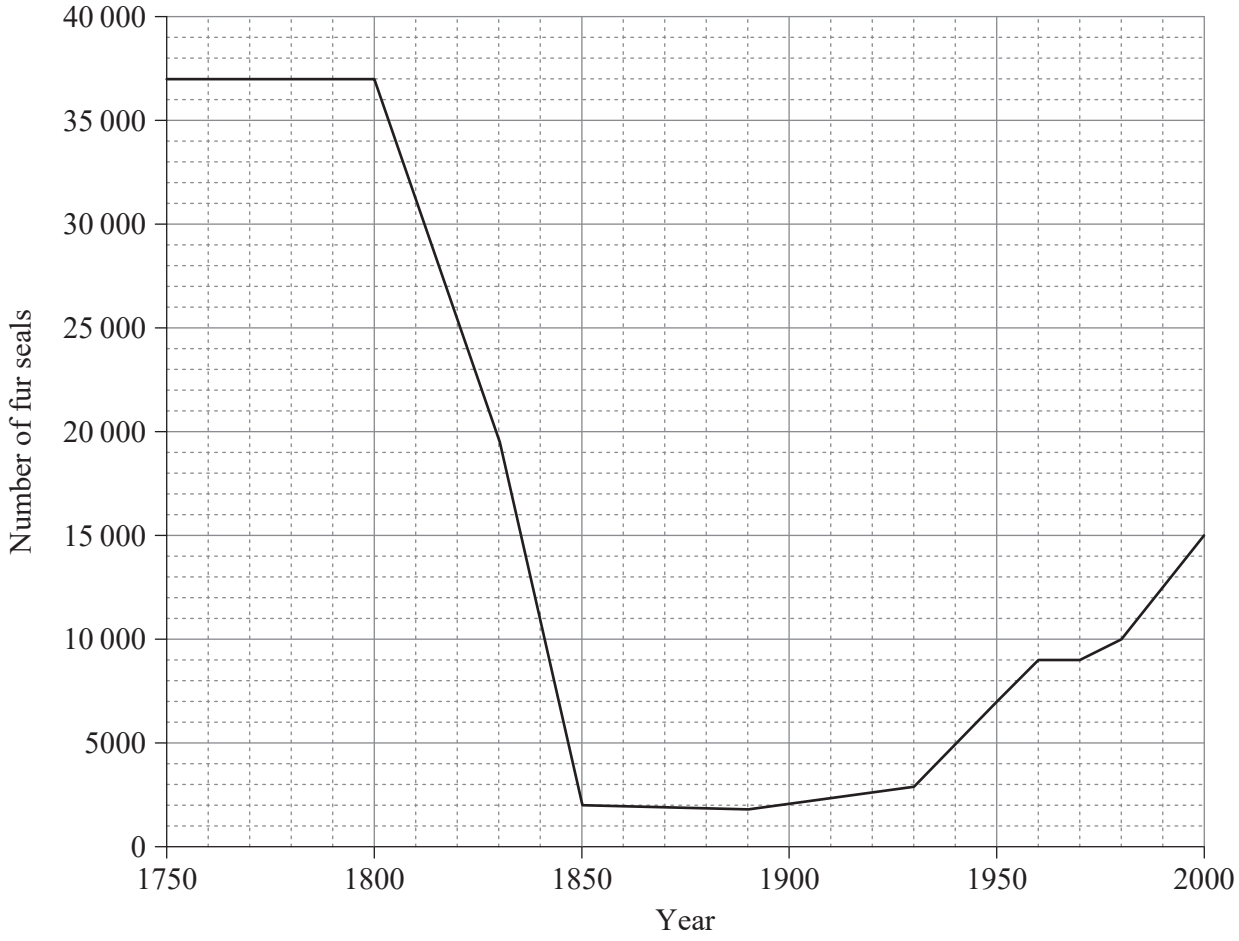
QUESTION 10 (10 marks)

Australian fur seals live in the Southern Ocean and feed on krill. In the 1800s, their population experienced a significant decline due to overharvesting. To monitor their recovery, scientists collected the data shown.



Fur seal population data (1850–2000)	
Deaths	1 217 900
Immigration	1500
Emigration	600

a) Identify the number of fur seals in 1800. *[1 mark]*

Do not write outside this box.

b) Determine the number of fur seal births between 1850 and 2000. Show your working. *[2 marks]*

c) Infer whether the fur seal population had reached carrying capacity in 2000.
Justify your response using evidence from the graph. *[2 marks]*

Some researchers believe that the Southern Ocean krill population will decrease by 40% by 2050.

d) Predict how this would affect the carrying capacity of fur seals in the ecosystem.
Explain your reasoning. *[2 marks]*

Do not write outside this box.

In 2025, a follow-up study used the capture–recapture technique and the Lincoln index $N = \frac{M \times n}{m}$ to estimate the number of fur seals. Results are shown.

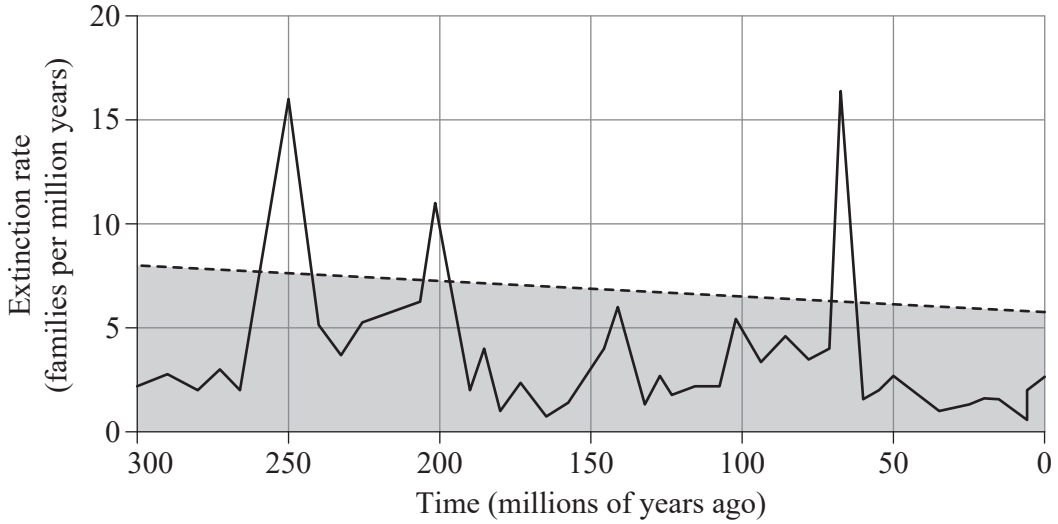
Number of fur seals in first capture	230
Number of fur seals in second capture	250
Number of marked fur seals in second capture	2

e) Use the data in the table and the graph on page 12 to determine the average annual population growth rate (%) between 2000 and 2025. *[3 marks]*

Do not write outside this box.

QUESTION 11 (4 marks)

Mass extinctions occur when the extinction rate of a taxonomic group exceeds the background extinction rate. Mass extinctions are an important part of macroevolution and are often followed by episodes of evolutionary radiation. The graph shows the extinction rate for marine animals alongside the background extinction rate.



a) Identify a trend in the background extinction rate. *[1 mark]*

b) Determine how many mass extinctions occurred in the period shown on the graph. *[1 mark]*

c) Use the competitive exclusion principle to explain why mass extinctions are often followed by episodes of evolutionary radiation. *[2 marks]*

END OF PAPER

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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References

Question 10

Graph modified from McIntosh RR, Sorrell KJ, Thalmann S, Mitchell A, Gray R, Schinagl H, et al. (2022) Sustained reduction in numbers of Australian fur seal pups: Implications for future population monitoring. PLoS ONE 17(3): e0265610. https:// doi.org/10.1371/journal.pone.0265610 Licensed CC BY.

Question 11

Graph adapted from Ritchie H, 2022, 'There have been five mass extinctions in Earth's history', Our World in Data, https://ourworldindata.org/mass-extinctions. Licensed CC BY.

Graph data from:

Barnosky, AD et al. 2011, 'Has the Earth's sixth mass extinction already arrived?', Nature, vol. 471, https://doi.org/10.1038/nature09678.

McCallum, ML 2015, 'Vertebrate biodiversity losses point to a sixth mass extinction', Biodiversity and Conservation, vol. 24, no. 10, https://doi.org/10.1007/s10531-015-0940-6 Howard Hughes Medical Institute.

Data and information provided in this paper may have been developed or adjusted for exam purposes and should not be taken as factual.