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School code

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Given name/s

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Family name

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Attach your
barcode ID label here

Book

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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



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Section 1

Instructions

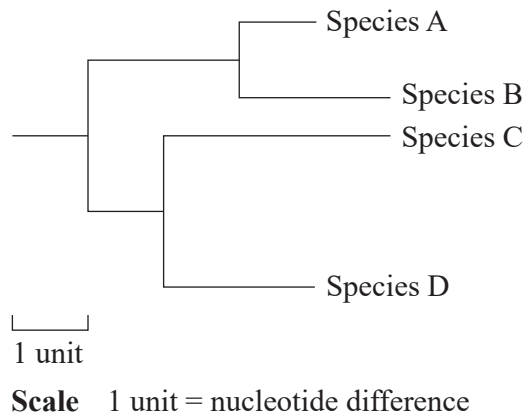
- If you need more space for a response, use the additional pages at the back of this book.
 - On the additional pages, write the question number you are responding to.
 - Cancel any incorrect response by ruling a single diagonal line through your work.
 - Write the page number of your alternative/additional 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 phylogenetic tree uses horizontal distance to represent genetic difference.



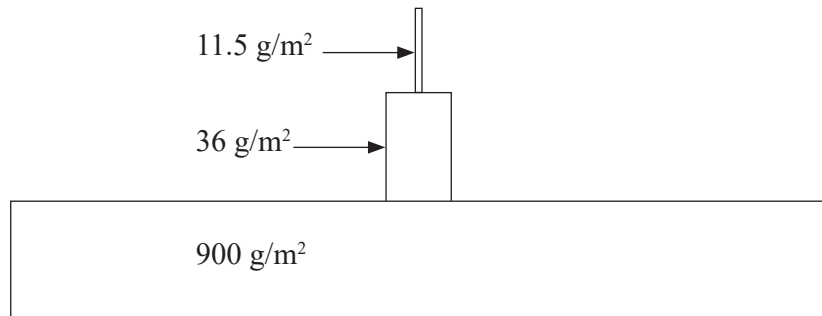
- a) Infer which species is most closely related to species B. Explain your reasoning. *[2 marks]*

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

Do not write outside this box.

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]

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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.

| Human activities | 2011 | | | | | | 2016 | | | | | |
|---------------------|------------------|-------------|------------|-----------------|------------|----------|------------------|-------------|------------|-----------------|------------|----------|
| | Assessment grade | | | | Confidence | | Assessment grade | | | | Confidence | |
| | Very high impact | High impact | Low impact | Very low impact | In grade | In trend | Very high impact | High impact | Low impact | Very low impact | In grade | In trend |
| Over-exploitation | | | | | | | | | | | | |
| Habitat destruction | | | | | | | | | | | | |
| Pollution | | | | | | | | | | | | |

| 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]*

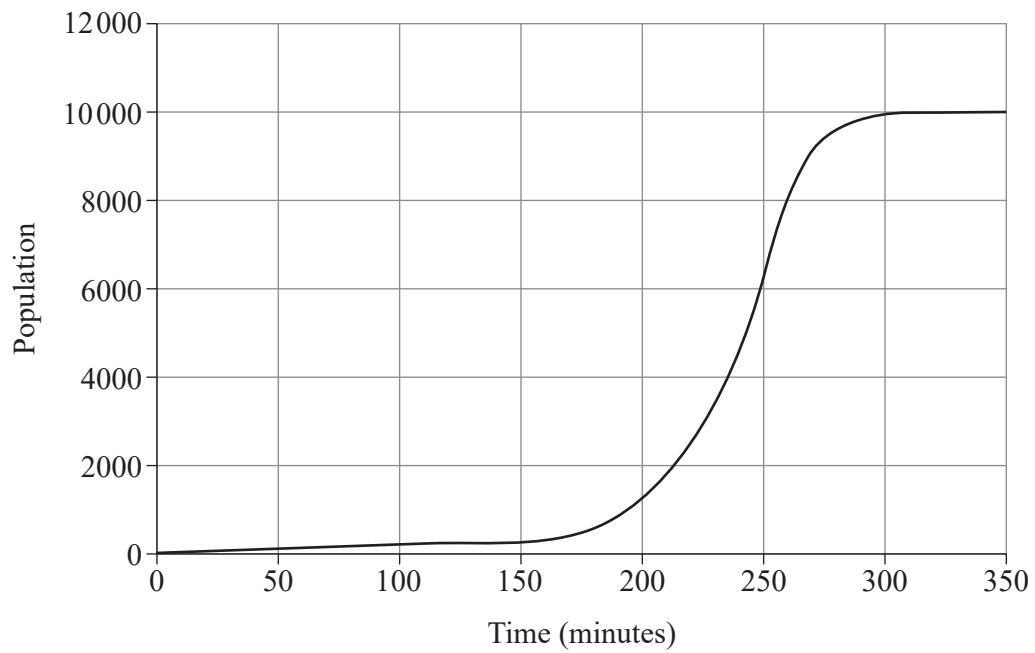
Highest impact: _____

Lowest impact: _____

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QUESTION 7 (6 marks)

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



a) Identify the mode of population growth.

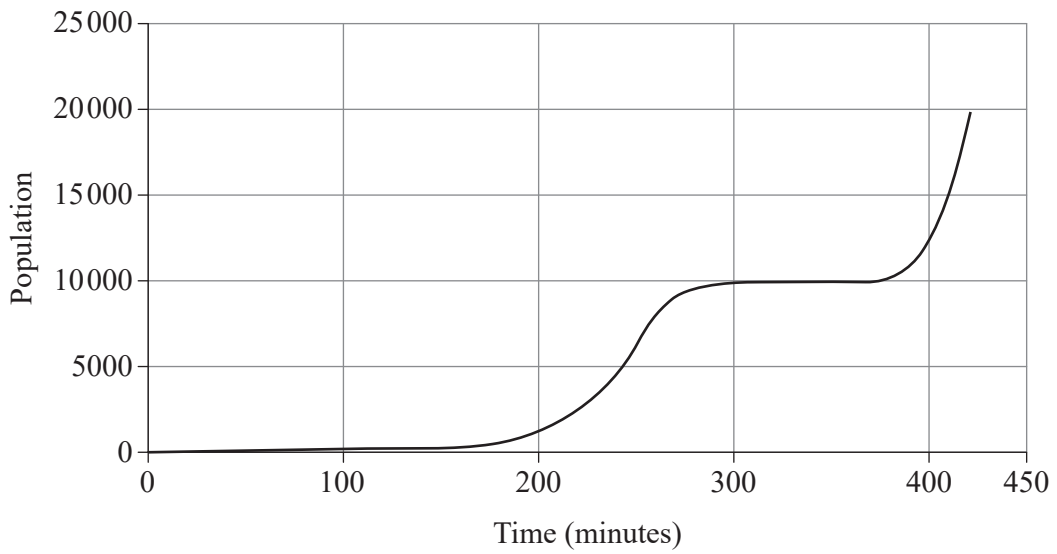
[1 mark]

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 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.

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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 |

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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).



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