External assessment 2023

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 (43 marks)

- 9 short response questions

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.

DO NOT WRITE ON THIS PAGE

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QUESTION 1 (6 marks)

The profile diagram shows a representative section of an ecosystem.
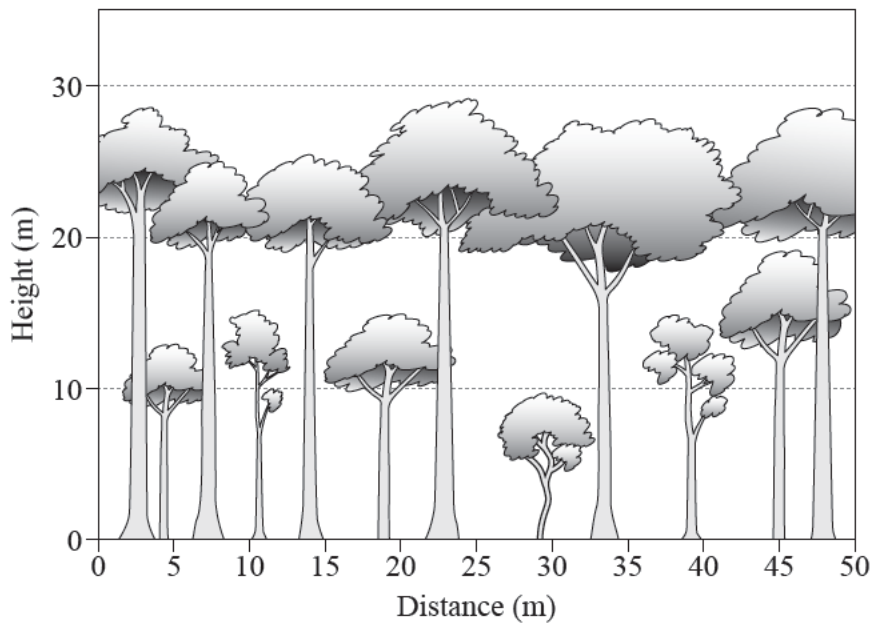
This table can be used to classify ecosystems based on Specht's classification system.

Life form and height of tallest stratum	Foliage cover of tallest plant layer		
	Dense (70–100%)	Mid-dense (30–70%)	Sparse (10–30%)
Trees >30 m	Tall closed-forest	Tall open-forest	Tall woodland
Trees 10–30 m	Closed-forest	Open-forest	Woodland
Trees 5–10 m	Low closed-forest	Low open-forest	Low woodland
Shrubs 2–8 m	Closed-scrub	Open-scrub	Tall shrubland

a) Classify this ecosystem.   *[1 mark]*

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b) Describe how field data could be collected for the purpose of classifying this ecosystem
   using Specht's classification system. Include at least one strategy to minimise bias.   *[3 marks]*

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c) Explain how Specht's classification system could be used to monitor how the ecosystem recovers after a logging event that removes 80% of trees from the tallest plant layer.

[2 marks]

QUESTION 2 (4 marks)

The diagram shows feeding relationships for an Australian ecosystem.

This content has been redacted until copyright has been assessed and cleared..

a) Use the data to explain why dingoes are a keystone species.   *[2 marks]*

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b) Predict the effect a drastic reduction in the number of dingoes would have on the termite population. Justify your response. *[2 marks]*
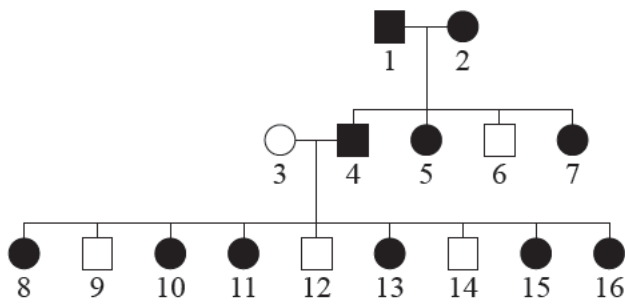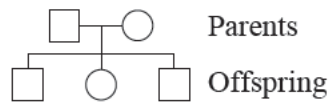
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QUESTION 3 (7 marks)

The chart shows the inheritance pattern of a trait, which is thought to be sex-linked dominant.

Key

■ Male with the trait
● Female with the trait
□ Male without the trait
○ Female without the trait

□—○ Parents

□ ○ □ Offspring

1–16 used to identify each individual

a) Identify how many offspring of individuals 1 and 2 have the trait.   *[1 mark]*

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b) Identify evidence to support the conclusion that the trait is sex-linked dominant. Justify your response using a Punnett square. *[4 marks]*

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c) Infer the genotype of individual 6. Explain your reasoning. *[2 marks]*

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QUESTION 4 (5 marks)

The hummingbird hawkmoth (phylum: *Arthropoda*) is named for its similarity to hummingbirds (phylum: *Chordata*). The two species have independently developed similar feeding structures, which they use to draw nectar from tube-shaped flowers. Both species help plants reproduce by distributing their pollen.

Hummingbird hawkmoth

Hummingbird

Proboscis

Beak
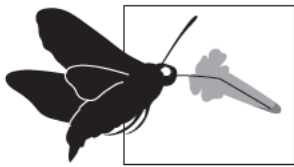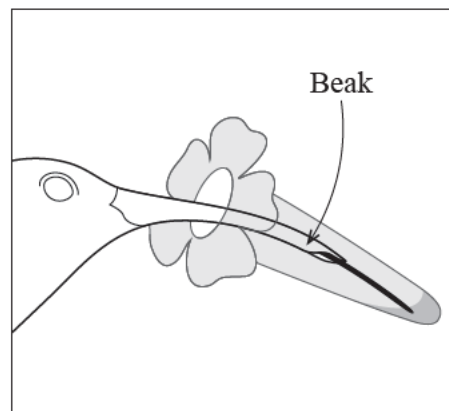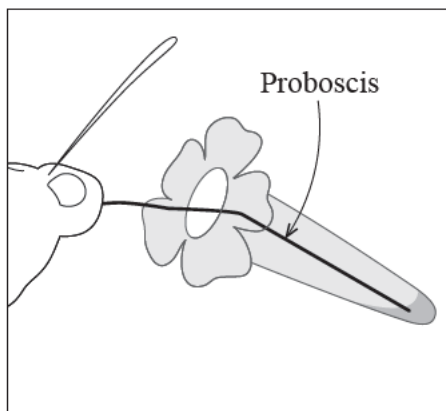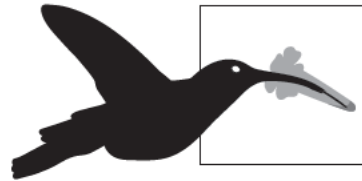
a) Identify the diversification pattern demonstrated by the hummingbird and the hummingbird hawkmoth.   *[1 mark]*

b) Use the principles of natural selection to explain the similarities between
    the two species.   *[2 marks]*

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c) Explain how coevolution of the hummingbird hawkmoth and tube-shaped flowers
    may have occurred.   *[2 marks]*

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QUESTION 5 (3 marks)

Nucleic acid sequences were used to investigate evolutionary relationships between four species.

Species	Nucleic acid sequence
B. bartonus	G A C C G C A T T T A C G T A
B. deakinii	G A C G T C A T A T C C G T A
B. reidus	G A C C G C A T T T C C G T A
B. watsonii	G A C G G C A T A T C C G T A

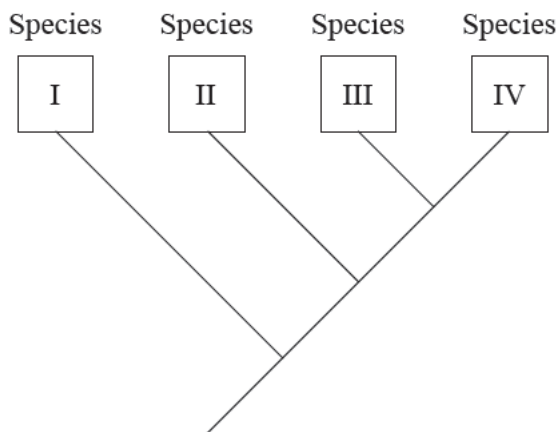a) Explain how data from conserved molecular sequences can be used to estimate time since divergence. *[2 marks]*

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b) Use the data to infer species II–IV in the cladogram. *[1 mark]*

Species I   Species II   Species III   Species IV

I: *B. bartonus*

II: _____

III: _____

IV: _____

QUESTION 6 (3 marks)

Explain how twin studies can be used to investigate the effect of the environment on gene expression.

QUESTION 7 (5 marks)

The diagram shows the stages of succession in an ecosystem.

| Stage 1
Bare rock | Stage 2
Lichen and
herbaceous plants | Stage 3
Trees and shrubs | Stage 4
Mature forest |

Time
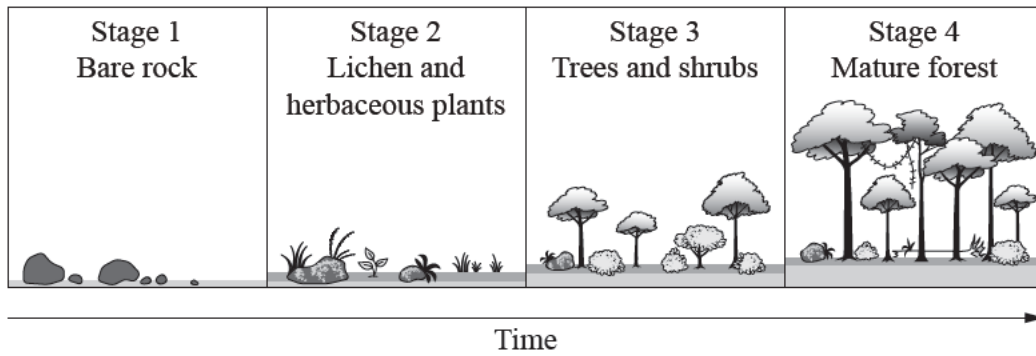
a) Identify the type of ecological succession depicted. Explain your reasoning. *[2 marks]*

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b) Infer two features of the species in stage 2 and describe the role of these species in ecological succession. *[3 marks]*

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QUESTION 8 (3 marks)

Explain how temporal isolation can lead to speciation.

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QUESTION 9 (7 marks)

The graphs show the findings of an experiment investigating the competitive exclusion principle. Two species of protozoa (*P. aurelia* and *P. caudatum*) were grown separately and together under identical conditions.

Grown separately

Population density (cells/mL) vs Time (days) — *P. aurelia*, *P. caudatum*

Grown together

Population density (cells/mL) vs Time (days) — *P. aurelia*, *P. caudatum*
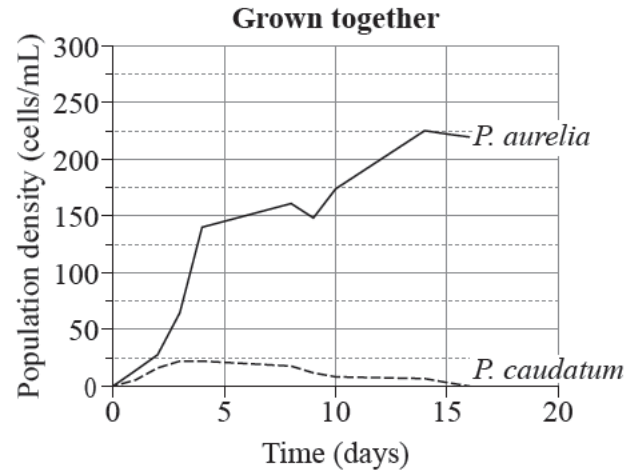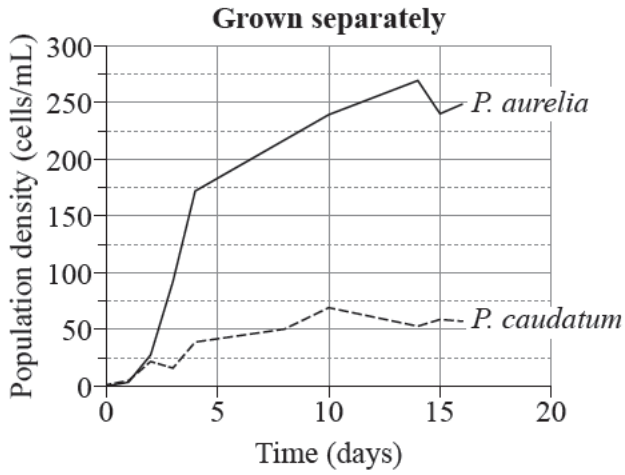
a)   Identify the population density of *P. caudatum* on day 10 when grown separately.   *[1 mark]*

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b)   Compare the growth of *P. aurelia* in the two graphs.   *[3 marks]*

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c) Use the data to explain the competitive exclusion principle. *[3 marks]*

END OF PAPER

ADDITIONAL PAGE FOR STUDENT RESPONSES

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ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

Do not write outside this box.

References

Question 1

Figure inspired by Lowman, MD 1995, 'Herbivory in Australian forest — a comparison of dry sclerophyll and rain forest canopies', *Proceedings of the Linnean Society of New South Wales*, vol. 115, pp. 77–87, https://canopymeg.com/PDFs/papers/0049.pdf.

Table of Specht's 1970 classification scheme found at Australian National Herbarium 2015, 'A simplified look at Australia's vegetation', www.anbg.gov.au/aust-veg/veg-map.html.

Question 2

Adapted from The Savage Savanna, *Food web of Australian tropical savanna*, https://visitthesavannahtoday.weebly.com/food-web.html.

Question 4

Hummingbird moth: Ahisgett, 'Hummingbird moth 3', *Openverse*, https://search-production.openverse.engineering/image/c0e5f29f-948f-4fb8-9716-c2b4f9be744f.

Hummingbird: Sharp Photography 2010, 'Purple-throated carib hummingbird feeding', *Wikimedia Commons*, https://commons.wikimedia.org/w/index.php?curid=12374160.

Question 7

Image adapted from:

Rcole17 2015, 'Primary succession diagram', *Wikimedia Commons*, https://commons.wikimedia.org/wiki/File:Primary_Succession_Diagram.svg.

LucasMartinFrey 2011, 'Forest succession depicted over time', *Wikimedia Commons*, https://commons.wikimedia.org/wiki/File:Forest_succession_depicted_over_time.png.

Question 9

Adapted from OpenStax 2016, *Biology*, Rice University Publishers. OpenStax is licensed under Creative Commons Attribution License v4.0.