Captivate
EDUCATION

SAMPLE QUESTIONS
One question from each section of this exam, with its marking scheme, so teachers can see what the full paper is like. Full exam and solutions: captivateeducation.com.au/trial-exams

Environmental Science

Question and Answer Book

Practice examination 1 – 2027

- Reading time is 15 minutes
- Writing time is 2 hours

Approved materials

- One scientific calculator

Materials supplied

- Question and Answer Book
- Multiple-Choice Answer Sheet

Instructions

- Follow the instructions on your Multiple-Choice Answer Sheet.
- At the end of the examination, place your Multiple-Choice Answer Sheet inside the front cover of this book.

Students are not permitted to bring mobile phones and/or any unauthorised electronic devices into the examination room.

Contents

Section A (30 questions, 30 marks)

Section B (8 questions, 90 marks)

Practice material in the layout of the 2025 VCAA paper – generated 2027. Not a VCAA examination.

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Section A – Multiple-choice questions

Instructions

- Answer **all** questions in pencil on your Multiple-Choice Answer Sheet.
- Choose the response that is correct or that best answers the question.
- A correct answer scores 1; an incorrect answer scores 0.
- Marks will not be deducted for incorrect answers.
- No marks will be given if more than one answer is completed for any question.
- Unless otherwise indicated, the diagrams in this book are not drawn to scale.

Sample – Question 1 of the 30 questions in this section.

Question 1

A small, isolated population of a native shrub has very low genetic diversity. Compared with a large population of the same species with high genetic diversity, the small population is

A. more likely to adapt quickly to a warming climate because fewer alleles are present.

B. less likely to contain individuals with alleles that allow them to survive a newly arrived disease.

C. likely to have a higher species richness.

D. likely to have a higher Simpson's Index of Diversity.

End of Section A

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Section B

Instructions

- Answer **all** questions in the spaces provided.
- Write your responses in English.

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- Unless otherwise indicated, the diagrams in this book are not drawn to scale.

Sample – Question 1 of the 8 questions in this section; Question 1 is shown to part c of its 6 parts.

Question 1 (6 marks)

Western Port, south-east of Melbourne, contains large seagrass meadows that provide food and shelter for fish, crabs and shorebirds. A class sampled the invertebrates living among the seagrass at low tide, using 0.5 m × 0.5 m square quadrats placed at random within a grid marked out on the intertidal flat. Their results for one quadrat are shown in the table in part a.

a. Calculate Simpson's Index of Diversity (SID) for this quadrat by completing the table. Give your answer to two decimal places. 2 marks

Species	**n_i**	**$n_i - 1$**	**$n_i(n_i - 1)$**
grass shrimp	14	14 − 1 = 13	14(13) = 182
mud snail	9	9 − 1 = 8	9(8) = 72
shore crab	6	6 − 1 = 5	6(5) = 30
bristle worm	5	5 − 1 = 4	5(4) = 20
sea slug	2	2 − 1 = 1	2(1) = 2
N =			
$\Sigma[n_i(n_i - 1)]$ =			
$N(N - 1)$ =			

$$SID = 1 - \Sigma[n_i(n_i - 1)] / [N(N - 1)]$$

SID for the quadrat is

b. A second quadrat, placed on bare sand 50 m from the seagrass meadow, contained three species and had an SID of 0.31.
Compare the species diversity of the two quadrats and suggest **one** reason for the difference. 2 marks

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c. Explain what is meant by edge effects in quadrat sampling, and why a circular quadrat of the same area would reduce them. 2 marks

End of sample questions

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Marking scheme for the sample questions

Section A

Question	Key	Question	Why
1	**B**	A small, isolated population of a native shrub has very low genetic diversity. Compared with a large population of the same species with high genetic diversity, the small population is	Genetic diversity is the variety of alleles within a population; with fewer alleles there is less chance that some individuals can survive a new disease or other environmental change. Option A is incorrect as fewer alleles reduces, not increases, the capacity to adapt. Options C and D are incorrect as species richness and SID measure species diversity, not genetic diversity within one species.

Section B

Question 1a. (2 marks)

Calculate Simpson's Index of Diversity (SID) for this quadrat by completing the table. Give your answer to two decimal places.

To be awarded full marks, students were required to:

Complete the SID table and calculate SID, including the final 1 − D step.

> $N = 14 + 9 + 6 + 5 + 2 = 36$
> $\Sigma[n_i(n_i - 1)] = 182 + 72 + 30 + 20 + 2 = 306$
> $N(N - 1) = 36 \times 35 = 1260$
> $SID = 1 - 306/1260 = 1 - 0.243 = 0.76$

Not awarded: using the number of species (5) as N; stopping at 306/1260 = 0.24 without subtracting from 1.

Mark allocation: 1 mark for correct working (N, the sum and N(N − 1)); 1 mark for 0.76 (0.757 accepted).

Question 1b. (2 marks)

A second quadrat, placed on bare sand 50 m from the seagrass meadow, contained three species and had an SID of 0.31.

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*Compare the species diversity of the two quadrats and suggest **one** reason for the difference.*

To be awarded full marks, students were required to:

Make an explicit comparison using both values and give a habitat-based reason.

Not awarded: 'the seagrass quadrat has more animals' without reference to diversity; a reason not linked to habitat.

Mark allocation: 1 mark for the comparison using both SID values; 1 mark for a plausible reason linked to the seagrass habitat.

Responses could have included:

- the seagrass quadrat has much higher species diversity (0.76) than the bare sand quadrat (0.31)
- the seagrass quadrat has more species (five versus three) and its individuals are spread more evenly among species
- seagrass provides shelter from predators and waves, and food (detritus, algae growing on leaves), so more species can live there
- bare sand is more exposed and offers fewer niches, so one or two tolerant species dominate

Sample full-mark response

> The seagrass quadrat is far more diverse (SID 0.76) than the bare sand quadrat (0.31), as it has more species and a more even spread of individuals. The seagrass leaves provide shelter and food, creating more niches than open sand.

Question 1c. (2 marks)

Explain what is meant by edge effects in quadrat sampling, and why a circular quadrat of the same area would reduce them.

To be awarded full marks, students were required to:

Define edge effects and link quadrat shape to the length of edge.

Not awarded: answers about the edge of the seagrass meadow (habitat edge) rather than the edge of the quadrat.

Mark allocation: 1 mark for the meaning of edge effects; 1 mark for linking a circle's smaller perimeter for the same area to fewer edge decisions.

Responses could have included:

- edge effects are errors that arise when deciding whether organisms lying across the edge of the quadrat should be counted
- different observers make different decisions, so counts become inconsistent
- a circle has the smallest perimeter for a given area, so fewer organisms lie on the edge

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- fewer edge decisions reduce the error in the counts

Sample full-mark response

> Edge effects occur when organisms straddle the quadrat boundary and observers must decide whether to count them, which introduces error. A circle has less perimeter than a square of the same area, so fewer animals lie on the boundary and fewer such decisions are needed.

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