Neap

Trial Examination 2023

QCE Biology Units 3&4

Paper 2

Student's Name: _____

Teacher's Name: _____

Time allowed

- Perusal time – 10 minutes
- Working time – 90 minutes

General instructions

- Answer all questions in this question and response booklet.
- Write using black or blue pen.
- QCAA-approved calculator permitted.
- Planning paper will not be marked.

Section 1 (45 marks)

- 10 short response questions

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2023 QCE Biology Units 3&4 Written Examination.

SECTION 1

Instructions

- If you need more space for a response, use the additional pages at the back of this booklet.
    - 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

THIS PAGE WILL NOT BE MARKED

QUESTION 1   (3 marks)

Identify three stages of gene regulation that can occur in a eukaryotic cell.

QUESTION 2   (4 marks)

a)   Describe how mRNA produced during transcription may be modified before being
      translated on the ribosome. *[2 marks]*

b)   Explain why the modification of mRNA during transcription enables one gene to give
      rise to more than one protein. *[2 marks]*

QUESTION 3   (5 marks)

Sickle cell anaemia is a genetic disorder that affects the protein haemoglobin, which binds to oxygen to transport it around the body. This disease is caused when the adenine nucleotide is replaced by thymine.

The DNA nucleotide sequence of a normal gene and the DNA nucleotide sequence of the mutation that results in sickle cell anaemia are shown.

Normal gene

C	T	G	A	C	T	C	C	T	G	**A**	G

Mutation

C	T	G	A	C	T	C	C	T	G	**T**	G

a)   Identify the type of mutation that has occurred.   *[1 mark]*

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b)   Explain why this mutation affects the function of the protein haemoglobin.   *[2 marks]*

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c)   Describe what would happen to the DNA nucleotide sequence and the final protein product if an additional nucleotide were inserted, rather than the adenine nucleotide being substituted.   *[2 marks]*

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QUESTION 4   (7 marks)

After the closure of a uranium mine in Queensland, an area known to contain waste material was studied over a period of 50 years. Plants that were found growing in the area were recorded as either:

•   pioneer species that grew for 1–2 years before dying

•   long-lived plants that continued to grow for several years.

The graph shows the percentage of pioneer and long-lived plants found in the area.
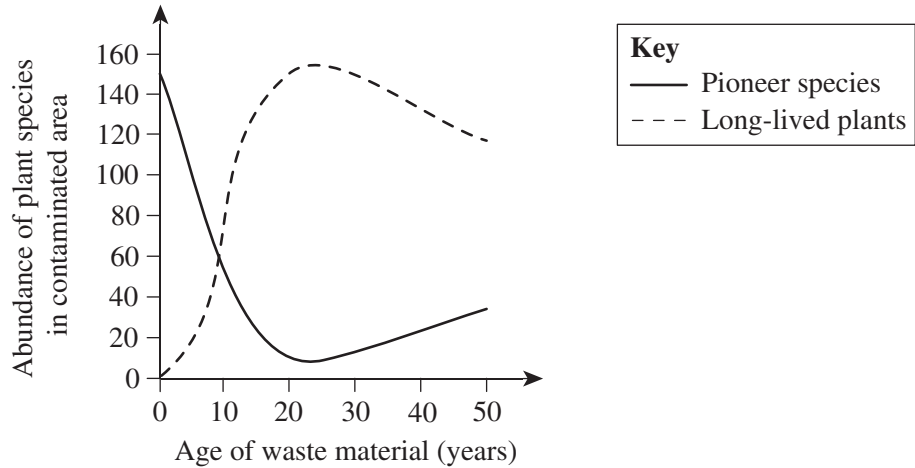
a)   Identify the type of succession that occurred.   *[1 mark]*

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b)   Explain the changes in the abundance of pioneer and long-lived plants, in terms
of the process of succession, over the first 10 years and between 20–50 years.   *[6 marks]*

Over the first 10 years: _____

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Between 20–50 years: _____

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QUESTION 5 **(4 marks)**

The tobiano pattern found in horses is an autosomal dominant trait. The gene produces white-haired patches with pink skin, with a different base coat colour. The allele for white-haired patches (H) is dominant to the allele for a lack of white-haired patches (h).

In the pedigree chart shown, horses in possession of a tobiano pattern are shaded.
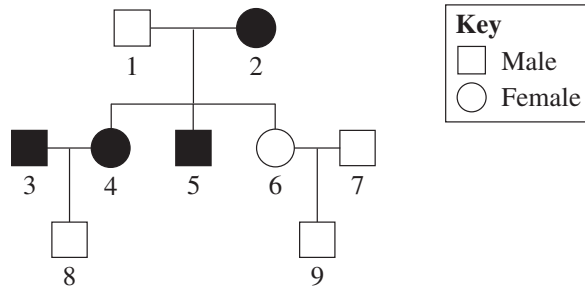
a) Identify one piece of evidence from the pedigree that shows that the allele for white-haired patches is autosomal dominant. Explain your reasoning. *[2 marks]*

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b) Identify the genotype of parent 2. Show your working. *[2 marks]*

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QUESTION 6   (3 marks)

In 1999, fallow deer (*Dama dama*) became feral on Kangaroo Island in South Australia when up to 300 deer escaped from a deer farm. Most of these deer were female. The graph shows the increase in the number of fallow deer on Kangaroo Island between 1999 and 2005.
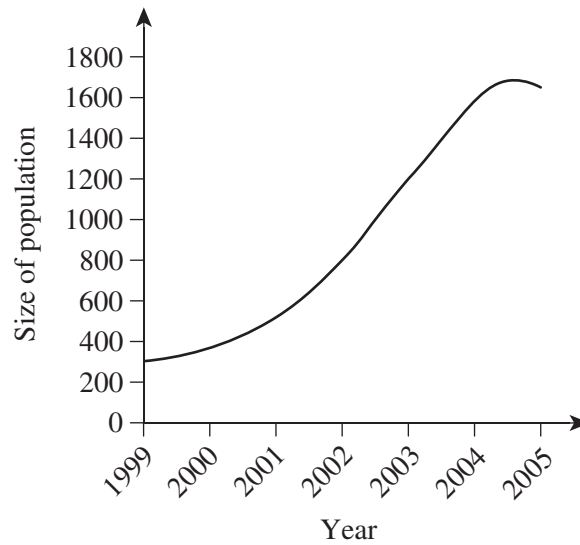
In 2005, an eradication program was implemented to remove the deer from the island, as scientists were concerned that the deer could be carrying a potentially fatal disease that could spread to cattle.

a)   State the mode of population growth shown in the graph.   *[1 mark]*

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b)   Identify two factors that could limit the size of the deer population without intervention
     by the eradication plan.   *[2 marks]*

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QUESTION 7 **(6 marks)**

In 2020, a research assistant at the University of Kansas discovered that a snake that had been on display was actually a new species. The new species of the Dwarf burrowing snake (*Levitonius mirus*), was originally thought to be a variation of the Philippine shrub snake (*Oxyrhabdium leporinum*). Both have a long and narrow skull relative to their size; however, the Dwarf burrowing snake was found to reach a maximum length of 17 cm, whereas the Philippine shrub snake can reach 60 cm.

a) Explain how DNA profiling could be used to show that these snakes are different species. *[2 marks]*

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b) Explain how these two species of snake could have emerged from a common ancestor. *[4 marks]*

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QUESTION 8 (5 marks)

Different Australian ecosystems possess different net primary productivity values, as shown in the graph.
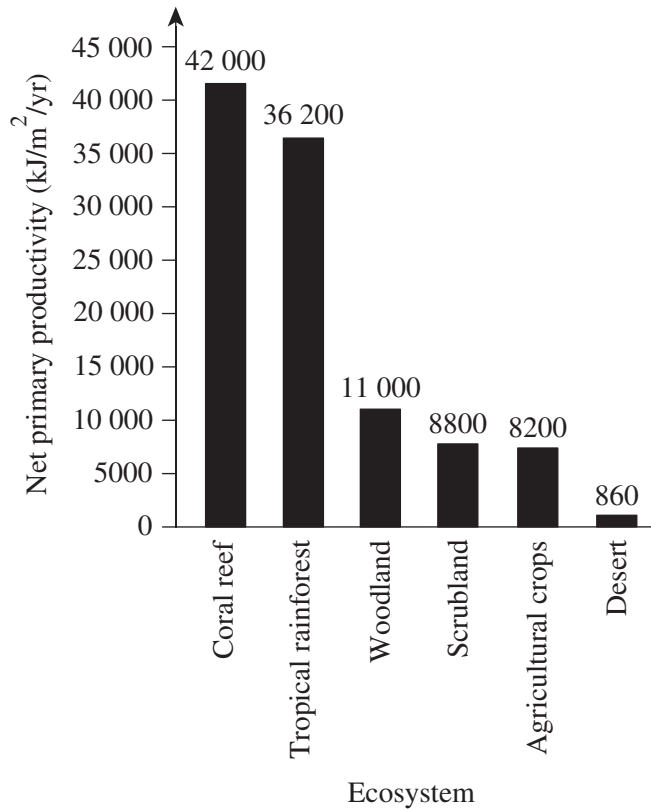
a) The ecological efficiency of a rainforest is calculated by using the following formula.

$$\frac{\text{average net primary productivity}}{\text{average amount of solar energy striking Earth's atmosphere}} \times 100$$

The average amount of solar energy striking Earth's atmosphere is estimated to be 4.4×10^7 kJ/m^2/yr.

Calculate the ecological efficiency of the rainforest. Show your working.   *[2 marks]*

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The transfer of energy in a rainforest is shown in the diagram. The energy values are in kJ/m^2/yr.
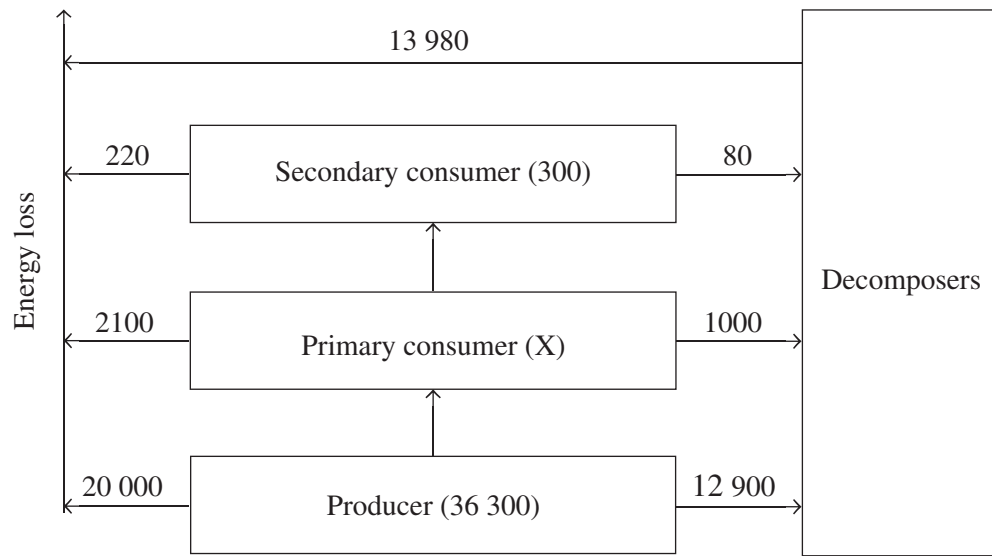
b)   Explain why the energy value at each trophic level is different.   *[2 marks]*

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c)   Using the diagram, calculate the energy, X, that is transferred to the primary consumer.   *[1 mark]*

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QUESTION 9 (3 marks)

An ear of corn is the spiked part of the plant that contains kernels. The graph shows the lengths of 46 ears of corn.
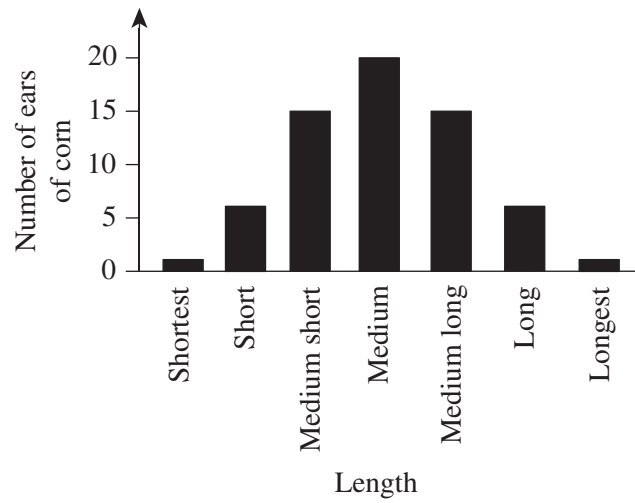
Explain how the graph provides evidence that the length of an ear of corn is due to polygenic inheritance.

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QUESTION 10   (5 marks)

A group of ecologists conducted a field investigation on a forest site populated with four different plant species (A, B, C and D). The site was measured as 1000 m × 500 m, as shown in the diagram. The ecologists wanted to determine the density of each plant species on the site.
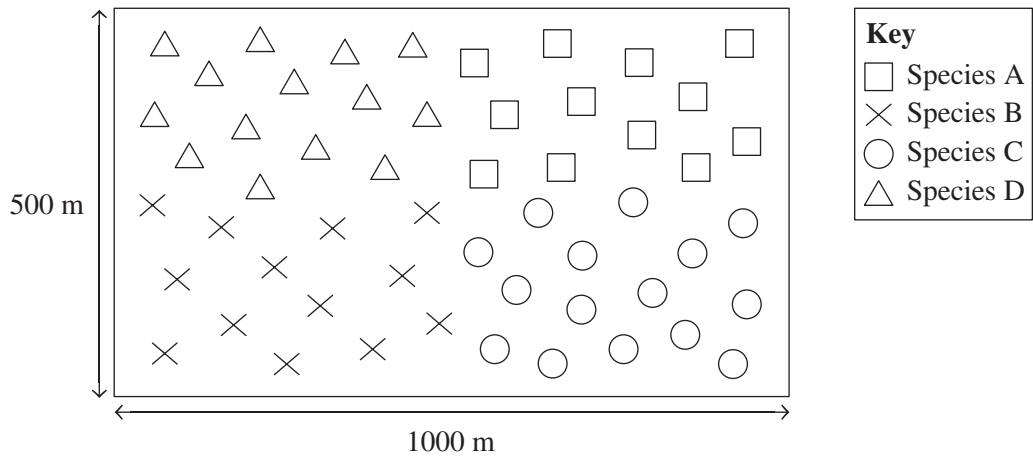
Identify and describe an ecological surveying process that could be used to effectively analyse the primary biotic and abiotic data in this ecosystem.

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END OF PAPER

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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