

## 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.
- Respond in paragraphs consisting of full sentences.
- QCAA-approved calculator permitted.
- Planning paper will not be marked.

#### Section 1 (45 marks)

- 9 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 2020 QCE Biology Units 3&4 examination.

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## SECTION 1

### Instructions

- Write using black or blue pen.
  - Respond in paragraphs consisting of full sentences.
  - 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.
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### QUESTION 1 (6 marks)

The DNA molecule is too large to fit through the pores of the nuclear membrane to reach the sites of protein synthesis, so it must be copied onto a smaller molecule that can pass through the pores. The segment of DNA of a gene that is copied, however, is shorter when it reaches the ribosome than when it was copied in the nucleus.

- a) Identify and explain the process of copying the gene segment. *[2 marks]*

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- b) Explain why the segment of copied DNA reaching the ribosome is shorter than when it was copied in the nucleus. *[2 marks]*

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- c) The complete DNA molecule is not copied in the process.  
What determines which segment is copied in eukaryotic cells? *[2 marks]*

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**QUESTION 2 (6 marks)**

The Southern cassowary is an extremely important species in the tropical rainforests of Far North Queensland. Cassowaries are often called the ‘rainforest gardener’. They eat the fruit of many tropical plants, distributing the seeds of at least 45 species. After ingestion of the fruit, the seeds pass through the cassowary’s digestive system and are expelled by egestion in their faeces. The seeds are deposited unharmed in their own compost heap of dung, ready for germination, and are distributed over large areas instead of just being concentrated around the parent plant. This is beneficial for other threatened rainforest species, such as mahogany gliders and northern quolls, which eat the fruit of the plants.

- a) Cassowaries are called a keystone species in the rainforest ecosystem.

Explain the term keystone species with reference to the cassowary. *[2 marks]*

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- b) Discuss the importance of cassowaries dispersing seeds for other species and the beneficial impacts of this to the rainforest ecosystem.

*[2 marks]*

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- c) The home ranges or territories of adult cassowaries can cover up to 100 hectares, but the loss of their habitats due to farming and subdivision into small land areas for homes is resulting in decreasing population numbers and increasing concerns of the possible extinction of this endangered species.

Explain the meaning of habitat fragmentation with reference to human impact on the cassowary habitats and its impact on species survival and biodiversity. *[2 marks]*

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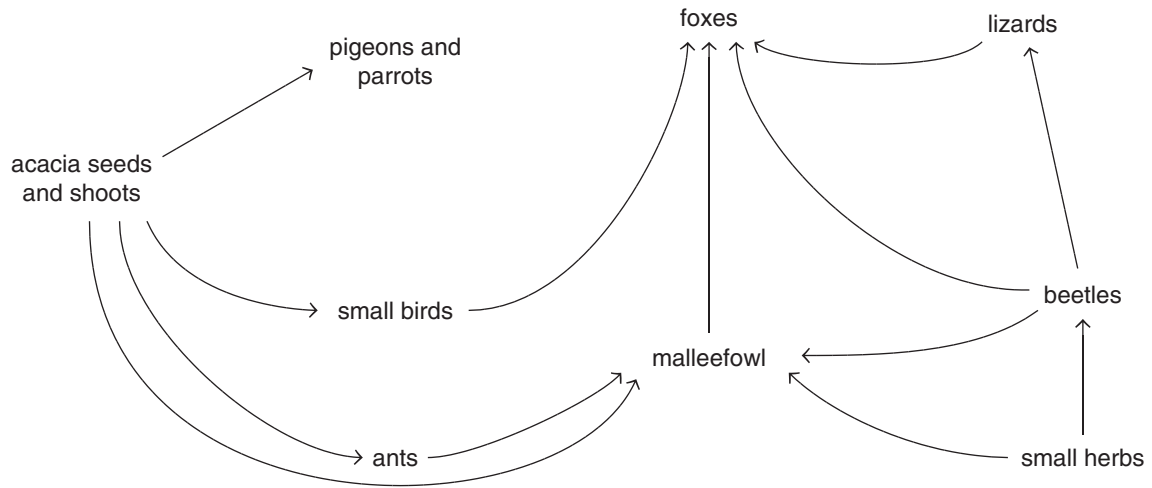
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**QUESTION 3 (3 marks)**

The figure below is a food web for a mallee scrub community in north-western Victoria.



In the spring of 2014, there was an unusually large increase in the number of parrots, as there had been high rainfall and the plants were growing rapidly with abundant flowers. It was also noticed that there was a significant decrease in the number of beetles.

From examination of the relationships of organisms within the food web, suggest why this decrease in the number of beetles may have occurred, using appropriate terms for organisms at different levels.

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**QUESTION 4 (6 marks)**

Meiosis occurs in the gonads of all sexually reproducing organisms and involves two divisions of the parent cell.

- a) Compare and contrast Metaphase I and Metaphase II of meiosis by drawing a cell of each type that would be found in a *Drosophila melanogaster* fly with diploid number  $2n = 6$ . Show the two unique processes that occur in Prophase I and are still observed in Metaphase I by clearly labelling the paternal and maternal chromosomes. Label a chromosome, a chromatid and an homologous pair where appropriate on both drawings, and any other labels that aid in comparing and contrasting the two stages. [4 marks]

- b) Explain the importance of the two processes that occur in Metaphase I to the survival of the species. [2 marks]

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**QUESTION 5 (5 marks)**

Salmon migrate from freshwater streams to the ocean but then return to these streams to spawn. When migrating from their stream of birth to an estuary and out into the sea, salmon tend to swim in large schools. In a study of salmon population size in a migrating school of salmon, 400 fish were caught and marked with a small snip out of their tail fin. When the fish arrived at the sea, a random sample of 400 were collected by net. In this sample, 50 of the fish were marked.

- a) Use the formula for the Lincoln index,  $N = \frac{M \times n}{m}$ , to determine the estimated number of salmon in the migrating population at the beginning of the migration. *[2 marks]*

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- b) During the migration, the salmon will be exposed to various biotic and abiotic limiting factors that affect survival of the fish.  
Explain the meaning of this statement, using at least two examples relevant to salmon to support your explanation. *[3 marks]*

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**QUESTION 6 (5 marks)**

In 1794 Captain Vancouver visited Glacier Bay in Alaska and made detailed notes on the glaciers. Using this information, scientists have been able to determine the time since the start of succession, when the glaciers retreated. The first species to colonise the bare rock were lichens, moss and bacteria, followed by flowering shrubs, then deciduous alder trees. A stable ecosystem was reached when spruce and hemlock trees grew as a forest.

- a) Discuss the meaning of stability in an ecosystem and the concept of succession, particularly focusing on the type of succession involved in the glacial retreat area in Glacier Bay.

[3 marks]

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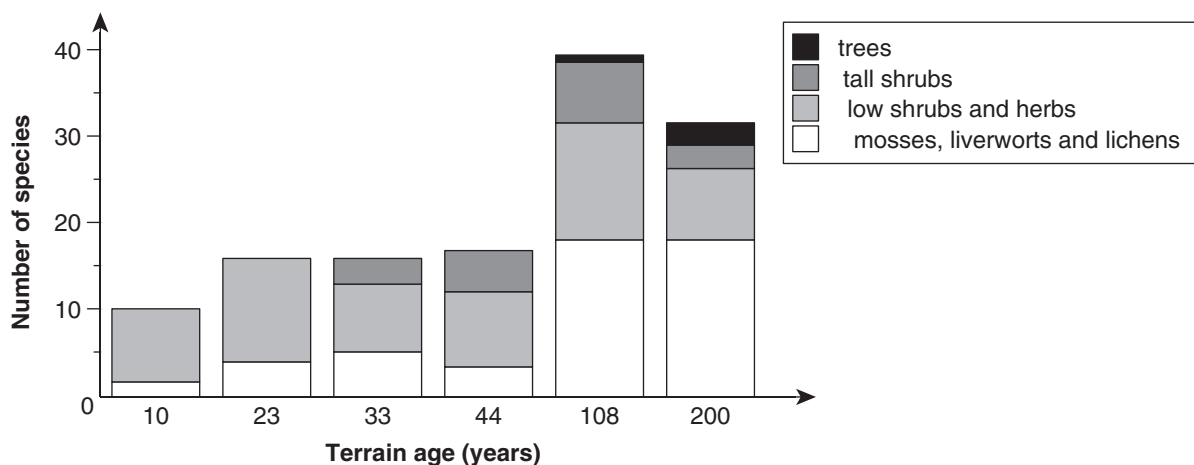


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- b) The graph below shows the number of species found in Glacier Bay since the glacier covered the terrain.



Comment on the species richness and evenness in the glacial retreat area.

[2 marks]

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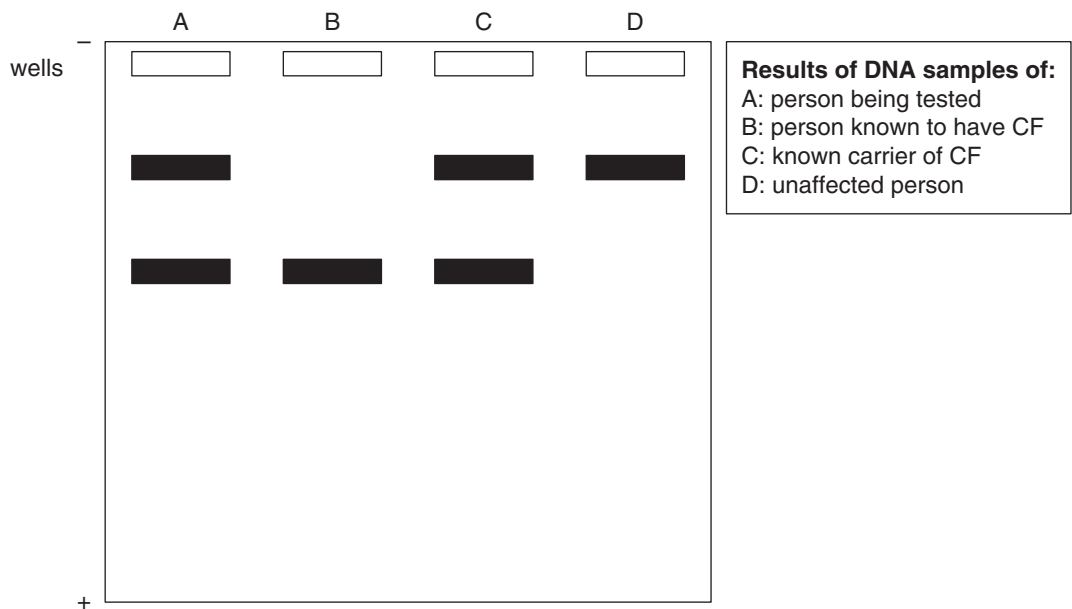
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**QUESTION 7 (5 marks)**

The figure below shows a DNA profile obtained on a gel, after a sample of DNA from an individual's cheek cells had been put through PCR and then undergone gel electrophoresis. This was to determine if the individual was a carrier for the gene for cystic fibrosis (CF), which is inherited as an autosomal recessive disorder. The affected allele of the CF gene has a 3-base deletion compared to the normal allele.



a) Outline the purpose of putting the sample through PCR. [1 mark]

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b) Discuss the properties of DNA that allowed the separation of the DNA bands on the gel. [2 marks]

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c) Interpret the DNA profile shown in the figure and determine whether the person being tested has CF, does not have CF or is a carrier for CF. [2 marks]

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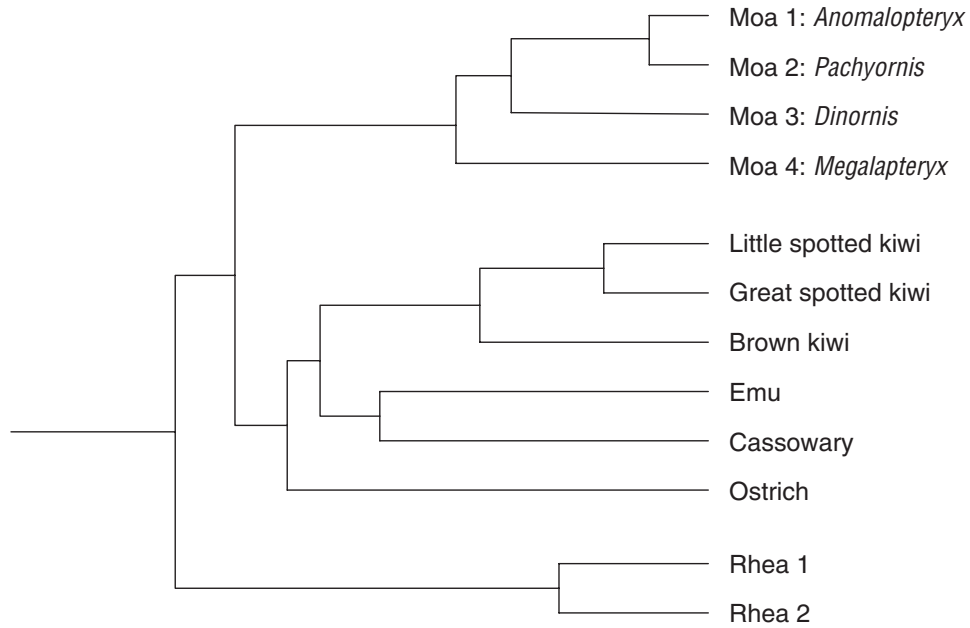


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**QUESTION 8 (6 marks)**

Ratites are flightless birds that evolved from a common ancestor over 60 million years ago. The ancestral ratite population was present on the large southern landmass called Gondwana before the continents separated by plate tectonics into the continents and islands that exist today. The figure below shows a possible phylogenetic tree for ratites, based upon comparisons of mitochondrial DNA sequences.



- a) Explain why a phylogenetic tree is useful, using one example from the ratite phylogenetic tree, and outline why mitochondrial DNA is often chosen instead of nuclear DNA or other molecules to draw such trees.

[3 marks]

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- b) Identify the process of evolution that resulted in the variety of species found on different continents and islands today and summarise the key points involved in that process. *[3 marks]*

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**QUESTION 9 (3 marks)**

Apply your knowledge to explain microevolutionary change through the processes of mutations, gene flow and genetic drift in a population of Crimson rosellas located in the Springbrook Mountain rainforest in south-east Queensland.

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**END OF PAPER**



**ADDITIONAL PAGE FOR STUDENT RESPONSES**

Write the question number you are responding to.

Lined area for student responses, consisting of 25 horizontal lines.