Neap

Trial Examination 2021

Question and response booklet

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)

- 7 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 2021 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.
- This section has seven questions and is worth 45 marks.

QUESTION 1 (4 marks)

Identify four ways that an alien species can affect community structure in an ecosystem.

QUESTION 2 (4 marks)

Torre Guaceto is a marine protected area that covers over 22 km^2 of the Adriatic Sea in south-eastern Italy. A food chain within this area is shown below.

seagrass *Cymodocea nodosa* ⟶ sea urchin *Paracentrotus lividus* ⟶ sea bream *Sparus aurata*

The data in the table below refers to the numbers of these three species inside the marine protected area, where fishing is limited, and outside the marine protected area, where fishing is allowed.

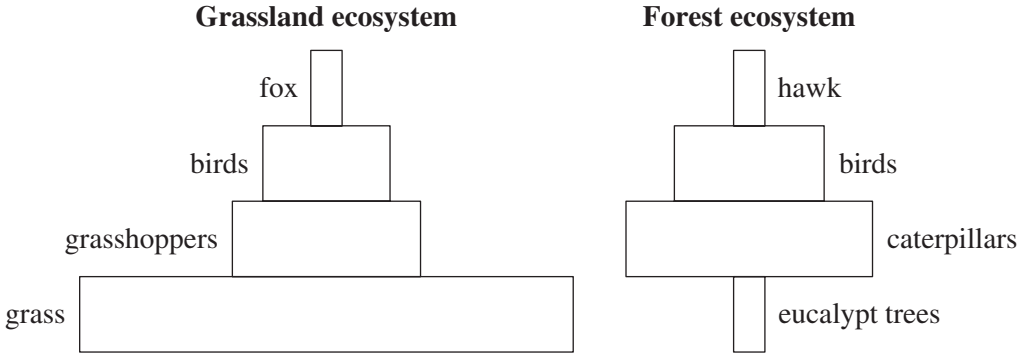
	Within the protected area	**Outside the protected area**
Sea bream individuals per 100 m^2	30	3
Sea urchin individuals per 100 m^2	70	690
Seagrass cover (%)	47	15

a) Identify the trophic feeding level of the sea urchin. *[1 mark]*

b) Use this food chain to explain what is meant by the term *keystone species*. *[3 marks]*

QUESTION 3 (3 marks)

The diagrams below are used as a practical means of analysing ecosystems. The data for these diagrams was collected by counting the number of organisms in the area during a fieldwork project examining both a grassland ecosystem and a forest ecosystem.



a) What is the name given to the type of diagram used above? *[1 mark]*

b) Explain why the two diagrams have different shapes. *[2 marks]*

QUESTION 4 (6 marks)

The common ringtail possum is found along the eastern coast of Australia. The various forms of ringtail possum were once classified as distinct species.

a) Define the term *species*. *[1 mark]*

The species concept is often explained in terms of the allele frequencies in the different populations of one species compared to the allele frequencies in the population of a different species. The terms used include 'gene pool' and 'gene flow'.

b) Draw and label a diagram that shows several different populations of one species and one population of a different species. In the diagram, show the relationship between gene pools and gene flow. *[2 marks]*

There have been recent studies of the blood proteins of ringtail possums from populations along the eastern coast. The blood proteins show similarities that support the view that the populations are not different enough to be called different species.

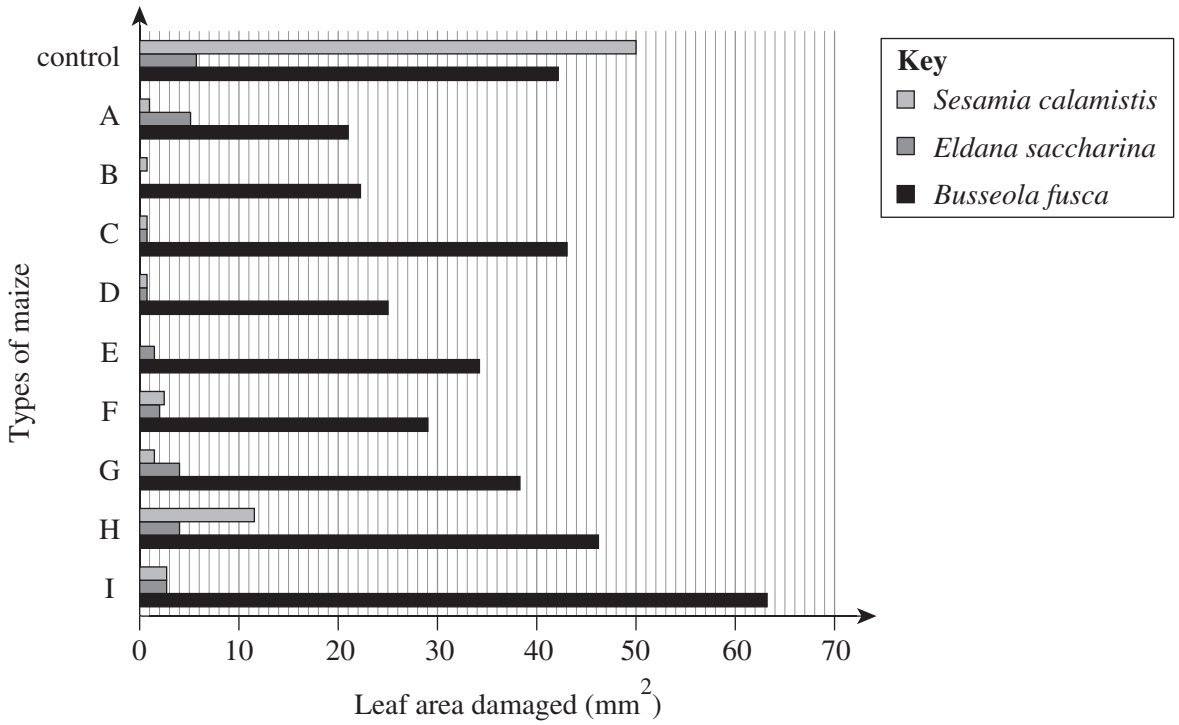
c) In these studies, what differences could be detected? *[1 mark]*

d) Identify and describe how another modern method of biochemical analysis could be used to determine if ringtail possums are one or several different species. *[2 marks]*

QUESTION 5 (14 marks)

Genetic engineering allows genes for resistance to pest organisms to be inserted into various crop plants. Bacteria such as *Bacillus thuringiensis* (Bt) produce proteins that are highly toxic to specific pests.

Stem borers are insects that cause damage to maize crops. In Kenya, a study was carried out to see which types of Bt genes and their protein products would be most efficient against three species of stem borer. The stem borers were allowed to feed on nine types of maize (A–I) modified with Bt genes. The graph below shows the area of leaves damaged by the stem borers after feeding on maize leaves for five days.



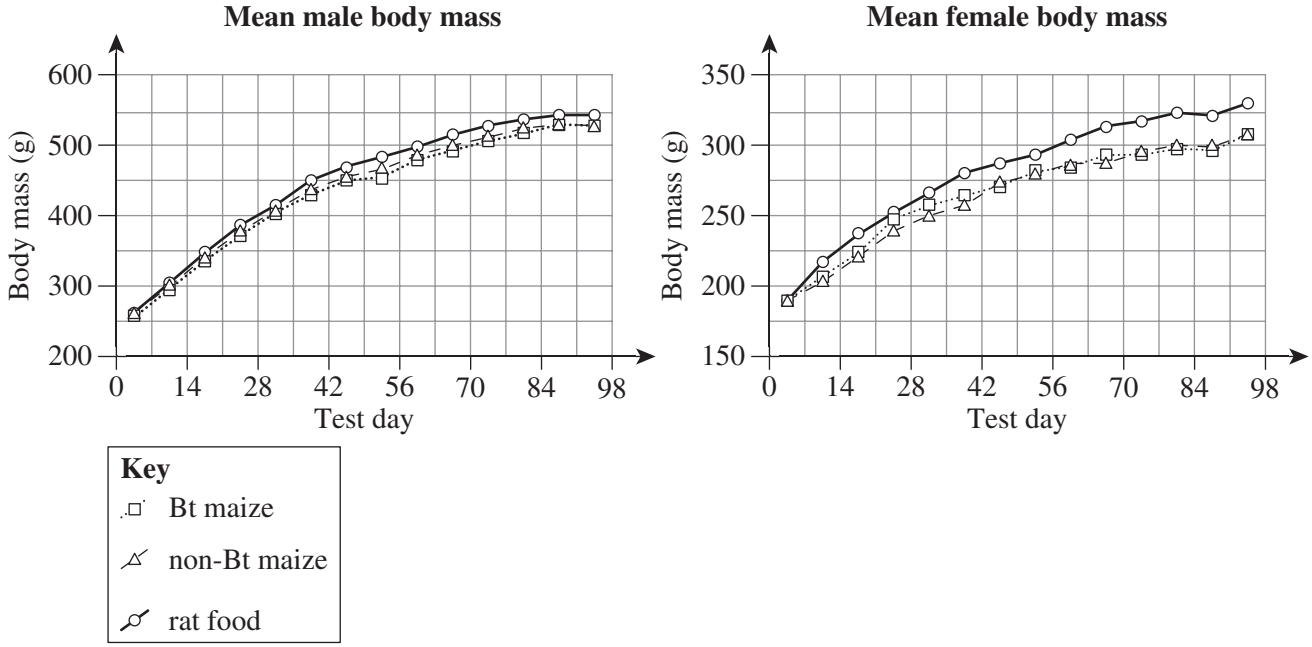
a) Calculate the percentage difference in leaf area damaged by *Sesamia calamistis* between the control and maize type H. Show your working. *[2 marks]*

b) Discuss which species of stem borer was most successfully controlled by the genetic engineering of the maize plants. *[3 marks]*

Before the use of genetically modified maize as a food source, risk assessment must be carried out. A 98-day study was carried out in which adult male and female rats were fed either:

- seeds from a Bt maize variety
- seeds from the original non-Bt maize variety
- commercially prepared rat food.

All the diets had similar nutritional qualities. The results are shown in the graphs below.



c) Calculate the change in the mean mass of male rats and of female rats fed on Bt maize from day 14 to 42. Show your working. *[2 marks]*

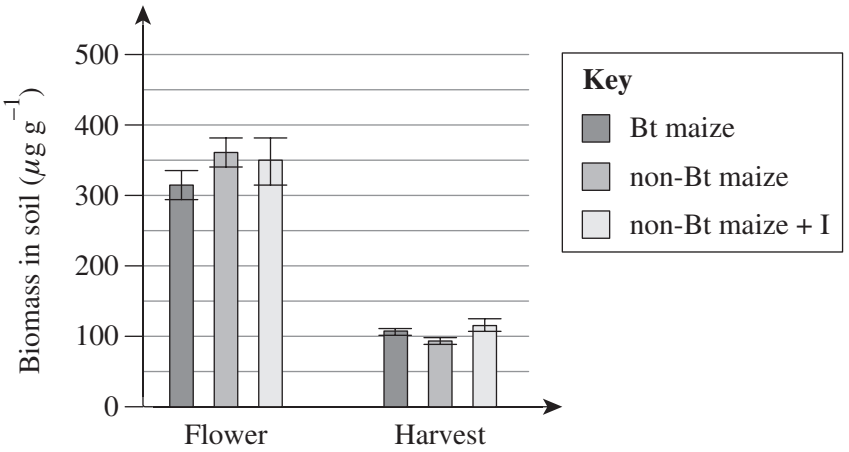
d) Evaluate the use of Bt maize as a food source on the growth of the rats, referring to two examples from the graphs in your response. *[2 marks]*

e) Comment on the use of Bt maize as a food source compared to the other diets tested. *[1 mark]*

Studies have shown that Bt proteins are released by plant roots and remain in the soil. One study looked at the biomass of microorganisms in soil surrounding the roots of:

- Bt maize
- non-Bt maize
- non-Bt maize with an insecticide (I).

The graph below shows the biomass of microorganisms at two different times in the growth cycle of the plants (during flowering and when they are ready for harvest). Error bars represent the standard error of the mean.



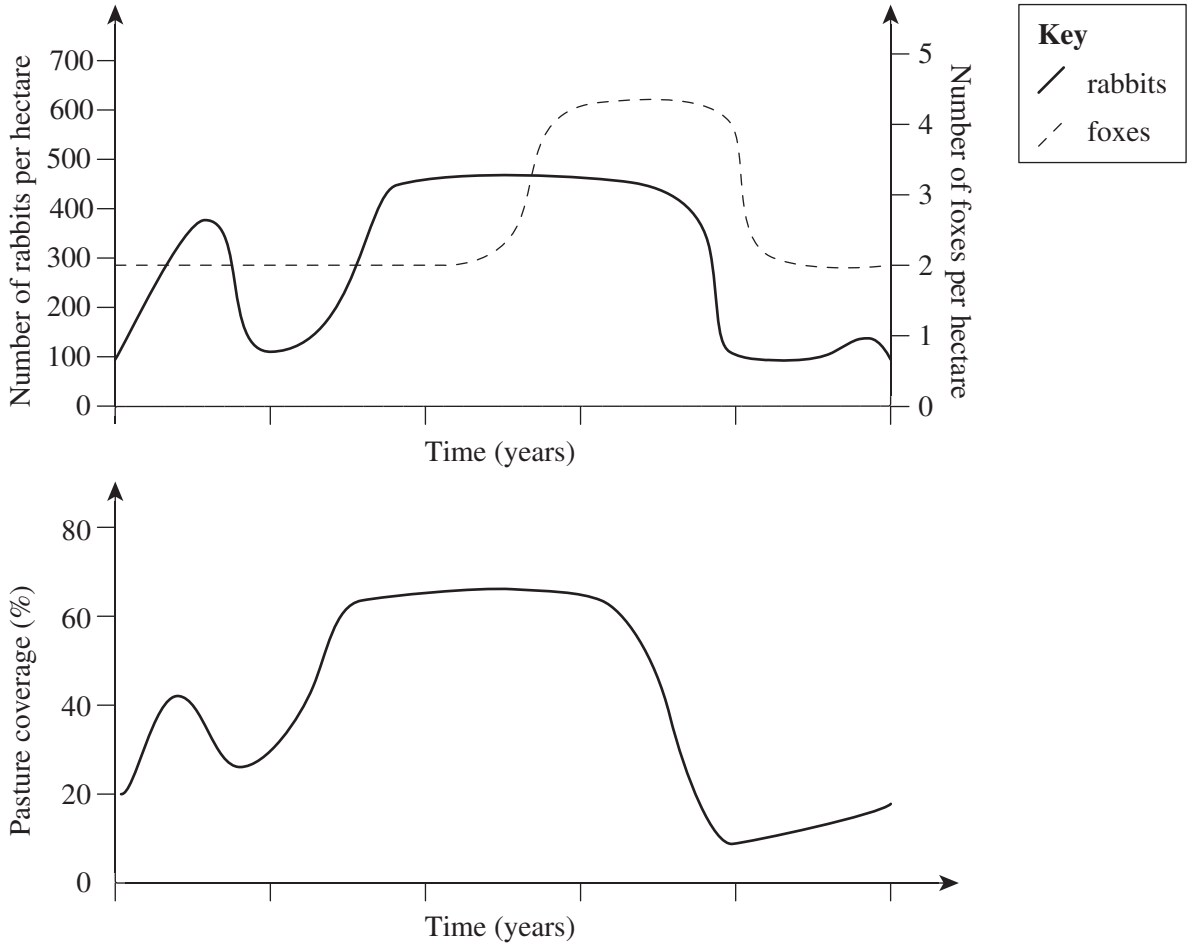
f) Compare the biomass of microorganisms in the soil surrounding the roots of Bt maize and non-Bt maize. *[2 marks]*

g) The researchers' original hypothesis stated that microorganisms would be negatively affected by the Bt protein released by the plant roots.

Discuss whether the data supports the hypothesis. *[2 marks]*

QUESTION 6 (8 marks)

The graphs below illustrate the relationships between pasture coverage and numbers of rabbits and foxes.



a) Define the term *carrying capacity* and identify the carrying capacity of the rabbit population. *[2 marks]*

b) Is the fox population entirely dependent on the rabbit population? Give a reason to support your answer. *[2 marks]*

c) Deduce the effect of an increase in pasture on the rabbit population. Give a reason to support your answer. *[2 marks]*

d) Apart from migration, identify two factors that determine changes in the size of a population. *[2 marks]*

QUESTION 7 (6 marks)

Explain how an error in meiosis can lead to Down syndrome.

END OF PAPER

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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