Neap

Trial Examination 2022

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)

- 8 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 2022 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.

QUESTION 1 (4 marks)

The Earth supports rich ecosystems that consist of populations of different species that live and interact with one another. The ways in which these ecosystems have developed and changed over time is known as ecological succession. The two types of ecological succession, primary and secondary, have different starting points.

a) What determines the type of ecological succession that occurs? *[1 mark]*

b) Define the term pioneer species. *[1 mark]*

c) Identify the four factors that make a pioneer species effective. *[2 marks]*

Factor 1 _____

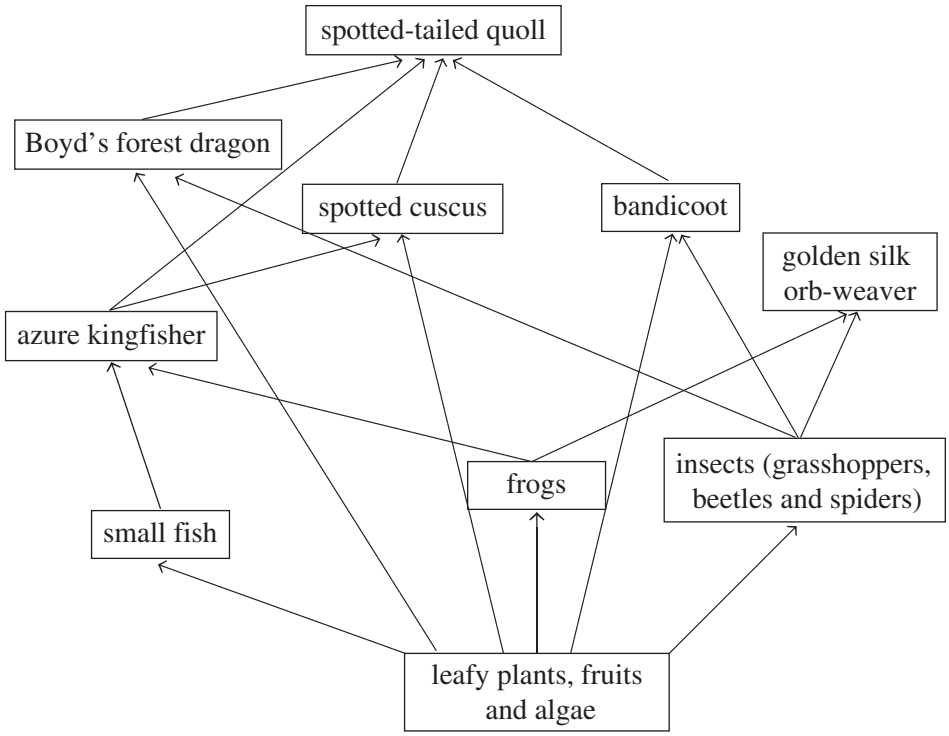
Factor 2 _____

Factor 3 _____

Factor 4 _____

QUESTION 2 (2 marks)

The diagram shown is a food web.

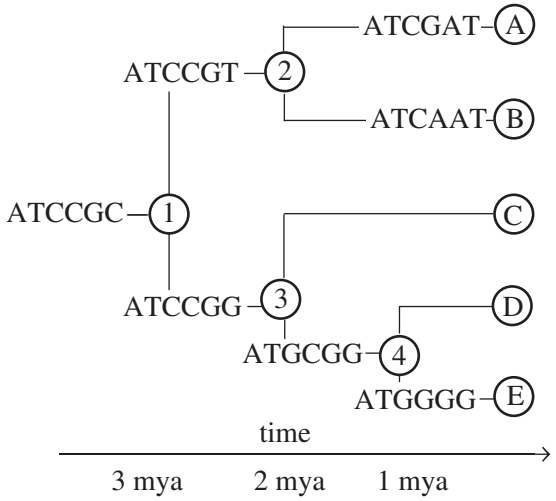


Identify the keystone species in the food web and explain your choice.

QUESTION 3 (4 marks)

A very small segment of a DNA sequence is shown in the diagram to demonstrate how the DNA may change over time.

At three million years ago (mya), the extinct species at node 1 has the DNA segment ATCCGC. This segment has mutated over time to produce the ancestral species at nodes 2 and 3, which have the segments ATCCGT and ATCCGG respectively. Over time, these segments have mutated further to produce another extinct species at node 4, as well as the current living species indicated by the letters A–E. The mutation rate appears to be one substitution per million years.



a) Using the diagram as a guide, give one possible DNA sequence for species C and D. *[2 marks]*

C _____

D _____

b) Explain why species A and B are considered more closely related than species A and E. *[2 marks]*

_____

_____

_____

_____

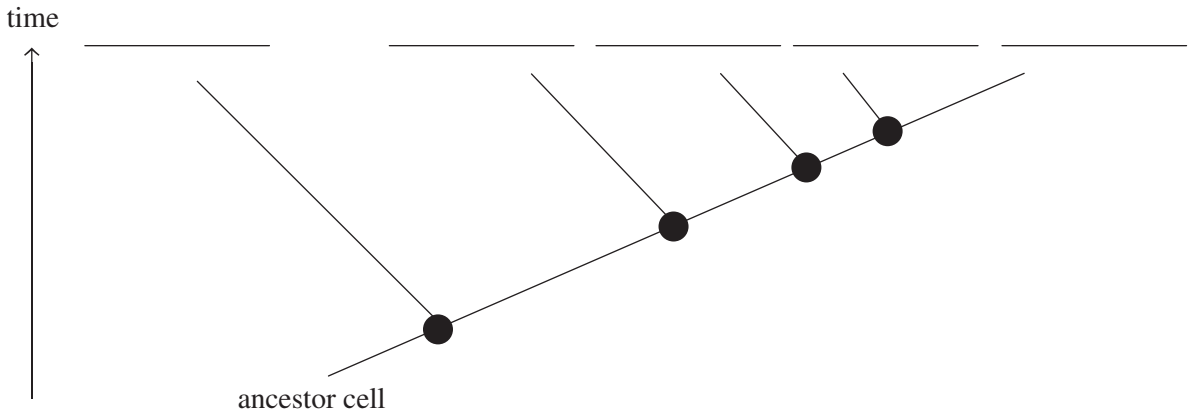
QUESTION 4 (5 marks)

Cytochrome c is a protein that is found in the electron transport chain located within the mitochondria of most animal and plant species. By studying the protein sequences from different species, conclusions can be formed as to how similar or different one species is to another.

a) The table shows the number of mutations found in each of the partial cytochrome c DNA sequences compared the ancestor cell.

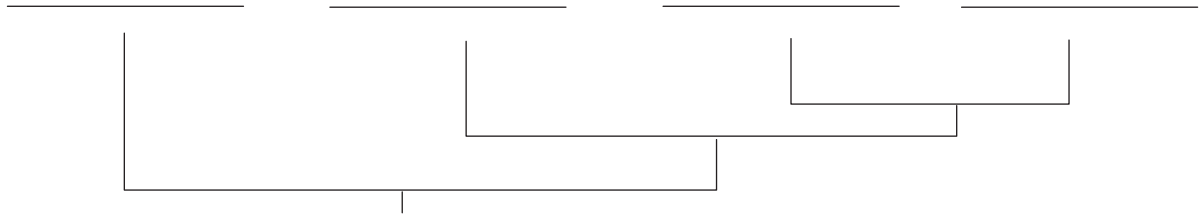
Complete the table by determining the number of mutations for the grey and red kangaroo and fill in the cladogram based on your results. *[3 marks]*

Organism	DNA sequence	Mutations
ancestor cell	ATTAGCGACCAGTATATCCTACAATCCGTCTACTTCATT	0
fruit bat	ATTAGCGACCACTATATCCTAGAATCCGTCTACTTCATT	2
wombat	ATTTGCGACCACTATATGCTAGAATCCGTCTCCTTCATT	5
wallaby	ATTTGCGACCACTATTTGCTAGAATCCGTCTCCTTCCTT	7
grey kangaroo	ATTTGCGTCCACTATTTGCTAGAATCCGTCTCCTTCCTT	
red kangaroo	ATTTGCGTCCACTATTTGCTAGAATCCGTCTCCTTCCTT	



b) Kangaroos and wallabies of the family *Macropodidae* have traditionally been divided among the genus *Macropus* with three subgenera: *Macropus* (kangaroo), *Osphranter* (wallaroo) and *Notamacropus* (wallaby); as well as the single species genus *Wallabia* (swamp wallaby). Recent molecular analysis clarifies the placement of *Wallabia* as most closely related to *Notamacropus*, with *Osphranter* and *Macropus* branching successively deeper.

Label the phylogenetic tree with the four related organisms: kangaroo, wallaroo, wallaby and swamp wallaby. *[2 marks]*



QUESTION 5 (4 marks)

Four Punnett squares (A–D) are shown.

Punnett square A

	R	**W**
R	RR (red flower)	RW (pink flower)
W	RW (pink flower)	WW (white flower)

Punnett square B

	T	**t**
T	TT (tall plant)	Tt (tall plant)
t	Tt (tall plant)	tt (short plant)

Punnett square C

	A	**o**
B	AB (type AB)	Bo (type B)
o	AO (type A)	oo (type O)

Punnett square D

	X^H	**X^h**
X^H	X^HY (normal female)	X^HX^h (carrier female)
Y	X^HY (normal male)	X^hY (type male)

Explain the phenotypic results shown in Punnett squares A–D by referring to a probable pattern of inheritance in each.

QUESTION 6 (3 marks)

Wheat grains can vary in colour from white to dark red, depending on the amount of red pigment they contain. Three genes control the colour of wheat grains, and each gene has two alleles (dominant for red pigment and recessive for no pigment).

The tables shown can be used to explain the continuous variation pattern of inheritance.

AaBbCc × AaBbCc

	ABC	**ABc**	**AbC**	**Abc**	**aBC**	**abC**	**aBc**	**abc**
ABC	AABBCC	AABBCc	AABbCC	AABbCc	AaBBCC	AaBbCC	AaBBCc	AaBbCc
ABc	AABBCc	AABBcc	AABbCc	AaBbcc	AaBBCc	AaBbCc	AaBBcc	AaBbcc
AbC	AABbCC	AABbCc	AAbbCC	AAbbCc	AaBbCC	AabbCC	AaBbCc	AabbCc
Abc	AABbCc	AABbcc	AAbbCc	AAbbcc	AaBbCc	AabbCc	AaBbcc	Aabbcc
aBC	AaBBCC	AaBBCc	AaBbCC	AaBbCc	aaBBCC	aaBbCC	aaBBCc	aaBbCc
abC	AaBbCC	AaBbCc	AabbCC	AabbCc	aaBbCC	aabbCC	aaBbCc	aabbCc
aBc	AaBBCc	AaBBcc	AaBbCc	AaBbcc	aaBBCc	aaBbCc	aaBBcc	aaBbcc
abc	AaBbCc	AaBbcc	AabbCc	Aabbcc	aaBbCc	aabbCc	aaBbcc	aabbcc

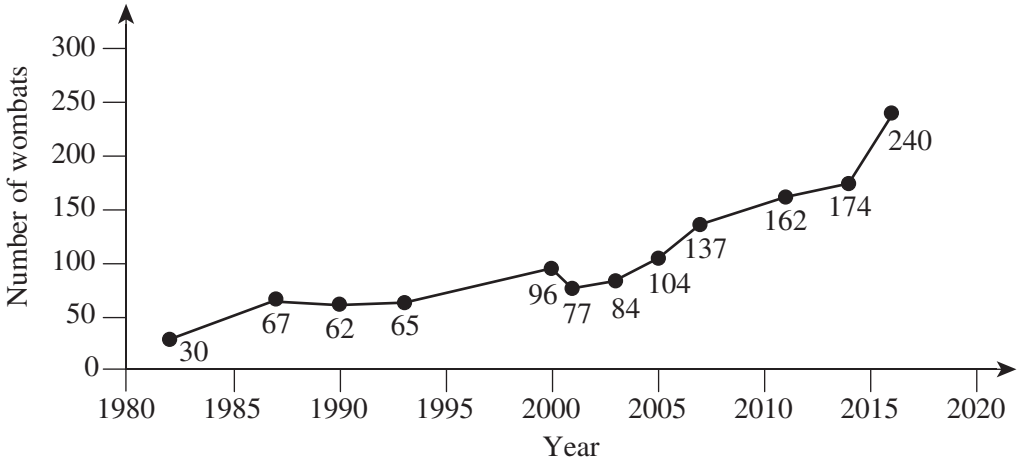
0	**aabbcc**						
1	Aabbcc	aaBbcc	aabbCc				
2	AaBbcc	AAbbcc	aaBbCc	aaBBcc	AabbCc	aabbCC	
3	AaBbCc	AABbcc	AAbbCc	AaBBcc	aaBBCc	aaBbCC	AabbCC
4	AABbCc	AABBcc	AAbbCC	AaBBCc	AaBbCC	aaBBCC	
5	aABBCC	AABcCC	AABBCc				
6	**AABBCC**						

If **AABBCC** gives the reddest colouring and **aabbcc** gives the palest colouring, explain why five other variations of colouring are also possible. Use examples to justify your response.

QUESTION 7 (14 marks)

A population of northern hairy-nosed wombats can be found in the Epping Forest National Park, which is located on 3160 hectares of open eucalypt woodland in inland central Queensland.

The graph shows the population number estimates from the national park since 1982. Between 2000 and 2003, a predator fence was built to protect the wombat population. Fifteen wombats were removed to start a new colony elsewhere in Queensland between 2009 and 2011.



a) Identify and explain the mode of population growth seen in the graph. *[2 marks]*

b) Define the term carrying capacity and discuss whether this value can be determined from the graph. *[2 marks]*

c) There are many threats to the wombat population numbers.

Suggest one biotic and one abiotic limiting factor that could affect the abundance and explain how these factors help determine carrying capacity. *[3 marks]*

d) Six dead wombats were found between 2007 and 2011.

How many births must have occurred in the same period, assuming there was no immigration into the Epping Forest National Park population? *[2 marks]*

e) In 2016, the wombat population (N) was estimated using the Lincoln Index formula:

$$N = \frac{M \times n}{m}.$$

Forty-eight individuals (M) were originally captured and marked. When a second sample was taken, only 10 individuals (n) were caught.

Using the Lincoln Index formula, calculate how many individual wombats in the second sample must have already been marked (m). *[2 marks]*

f) The population of wombats that lives in the Epping Forest National Park is critical to the survival of the species.

Give three management actions that could be undertaken to conserve the wombats and their habitat. *[3 marks]*

QUESTION 8 (9 marks)

Random samples of the genotypes for a given genetic trait of 12 individuals from a population over a long period of time are shown.

Sample 1			
AA	AA	AA	AA
AA	AA	AA	AA
AA	Aa	Aa	Aa

generations ⟶

Sample 2			
AA	AA	AA	AA
AA	Aa	Aa	Aa
Aa	Aa	aa	aa

a) Calculate the allele frequency for the alleles A and a in samples 1 and 2 using the following formula.

$$\text{allele frequency} = \frac{\text{number of the allele in the population}}{\text{total number of all alleles in the population}}$$

Provide your answers as decimals in the table below. Show your working. *[3 marks]*

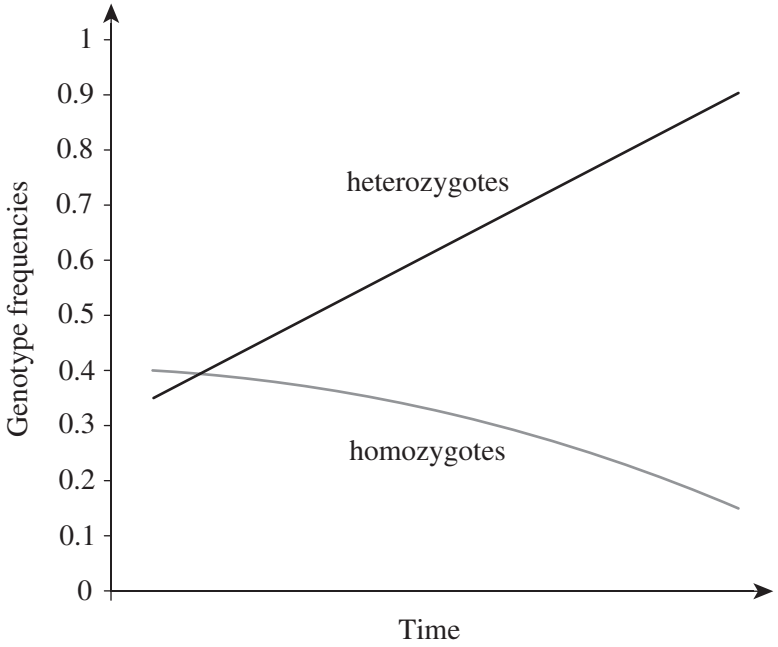
Allele	Allele frequencies	
	Sample 1	Sample 2
A		
a		

b) Explain the difference between positive and negative allele frequency selection. Use the two samples above to assist your response. *[2 marks]*

c) Allele A is dominant to allele a in terms of plant height (A being tall and a being short).

Are the two samples given on the previous page an example of stabilising, directional or disruptive phenotypic selection? Explain your answer. *[2 marks]*

d) Consider the genotype frequency data in the graph.



Explain what type of phenotypic selection is occurring in the population over time. *[2 marks]*

END OF PAPER

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

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