

External assessment 2021

Multiple choice question book

Biology

Paper 1

General instruction

- Work in this book will not be marked.



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Section 1

QUESTION 1

In mammals, inherited mutations can cause variations in the genotype of offspring when they occur in

- (A) red blood cells.
- (B) somatic cells.
- (C) nerve cells.
- (D) sex cells.

QUESTION 2

The process of change in the species structure of an ecological community over time is known as

- (A) cyclic succession.
- (B) primary succession.
- (C) ecological succession.
- (D) secondary succession.

QUESTION 3

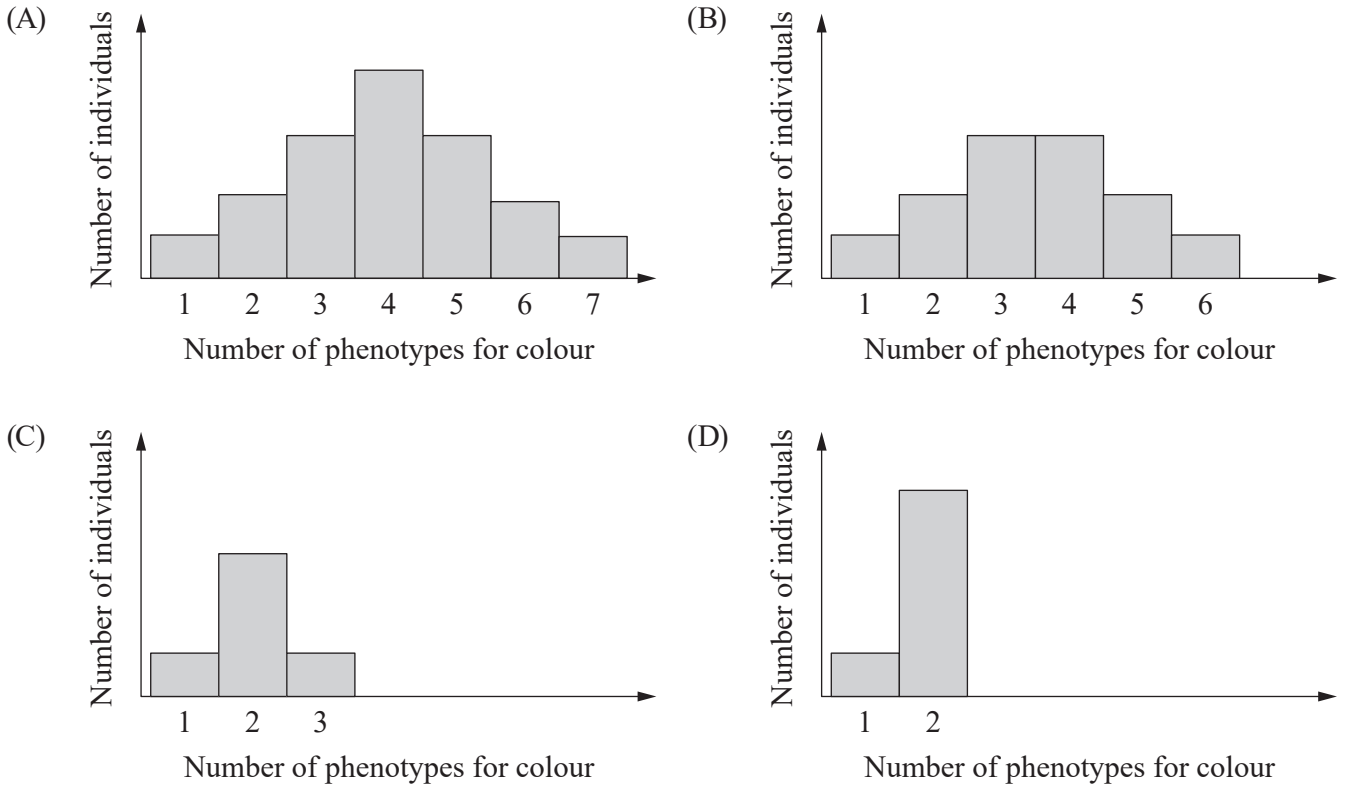
In ocean food webs, where phytoplankton is in the first trophic level, the second trophic level of zooplankton often has a higher biomass than the phytoplankton at any given time. Which explanation would account for this?

- (A) The zooplankton are also able to photosynthesize.
- (B) Different phytoplankton species are preying on each other.
- (C) Carnivores in the third trophic level have increased their consumption of zooplankton.
- (D) The phytoplankton multiply much faster than zooplankton, but their lifespan is shorter.

QUESTION 4

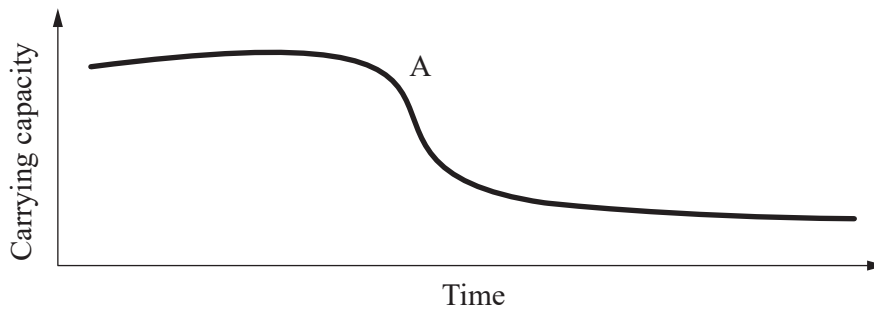
To demonstrate polygenic inheritance of colour in wheat, a cross was performed between two intermediate parents ($AaBbCc \times AaBbCc$). Each dominant allele adds a 'unit' of colour to the phenotype.

Which graph would depict the number of individuals and number of phenotypes for the cross?



QUESTION 5

The graph shows changes for a penguin population and the theoretical carrying capacity of the environment.

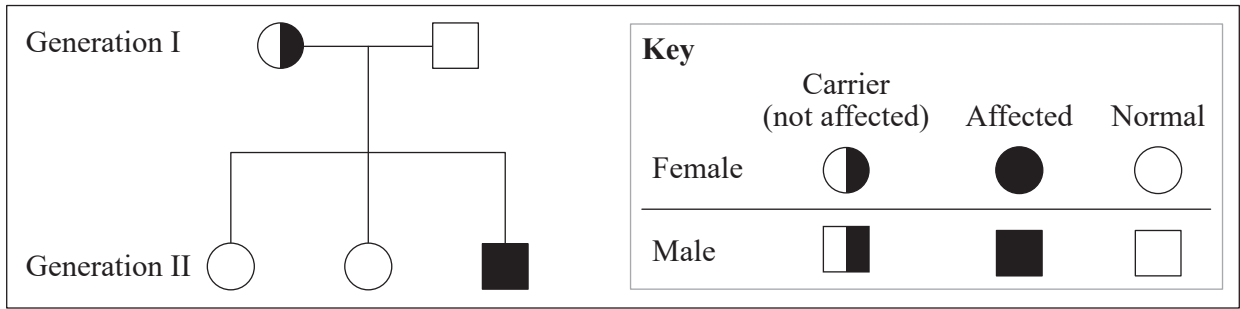


Point A on the graph indicates a change in carrying capacity triggered by

- (A) an increase in penguin pathogens.
- (B) a decrease in the number of mates available.
- (C) a reduction in space available for nesting sites.
- (D) an introduced disease affecting the penguins' survival rates.

QUESTION 6

The pedigree traces a genetic disease across two generations.

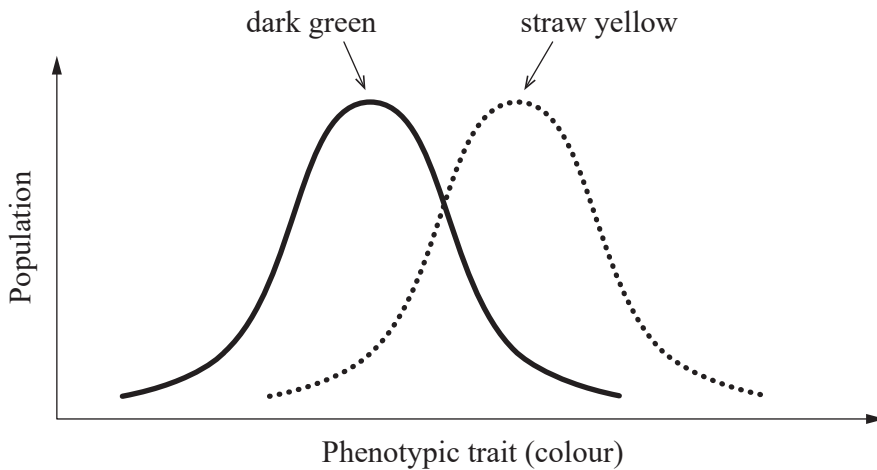


The inheritance pattern of this disease can be classified as

- (A) incomplete dominant.
- (B) autosomal dominant.
- (C) sex linked.
- (D) polygenic.

QUESTION 7

In a long-term study of grasshopper colour in a grassland ecosystem, it was found that the most abundant phenotype changed from dark green to straw yellow.



This change in the phenotype is an example of

- (A) diversifying selection.
- (B) directional selection.
- (C) stabilising selection.
- (D) disruptive selection.

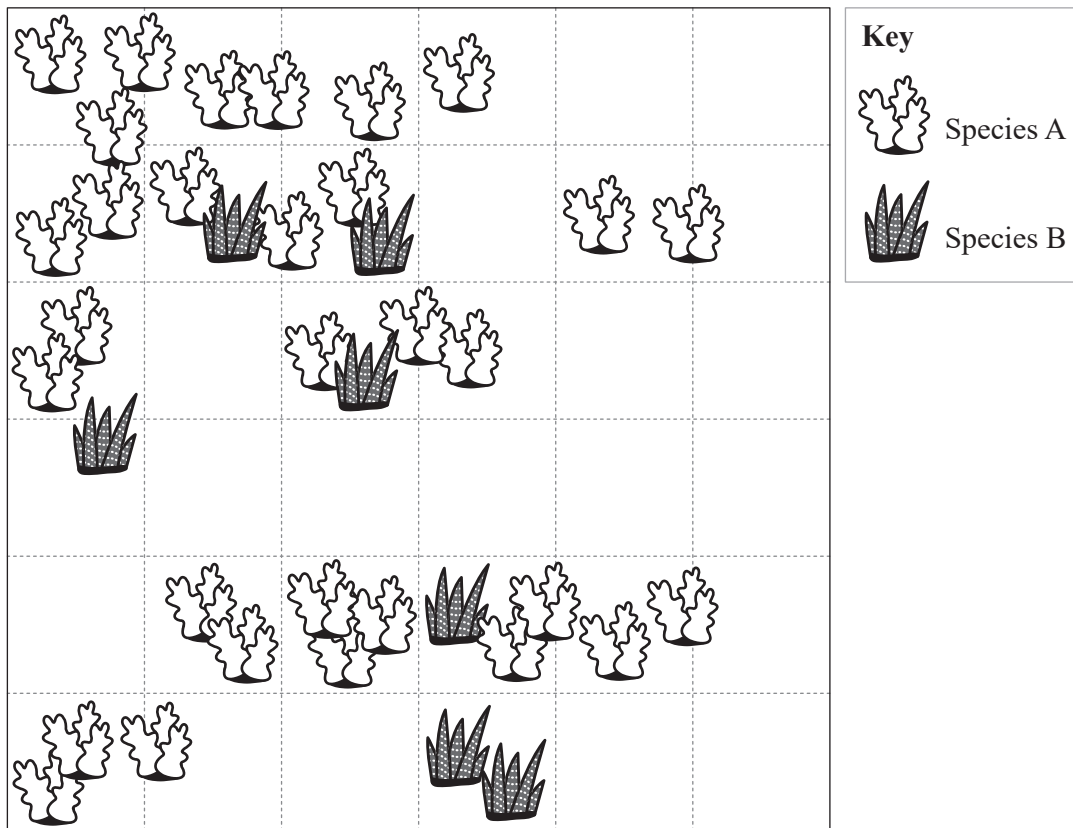
QUESTION 8

The place where an organism lives is called its

- (A) niche.
- (B) habitat.
- (C) community.
- (D) environment.

QUESTION 9

The image represents a gridded quadrat of 20 cm × 20 cm squares used in a plant survey. To calculate cover for a species, the surveyor identified each plant species and then counted the number of squares in which the species appeared.



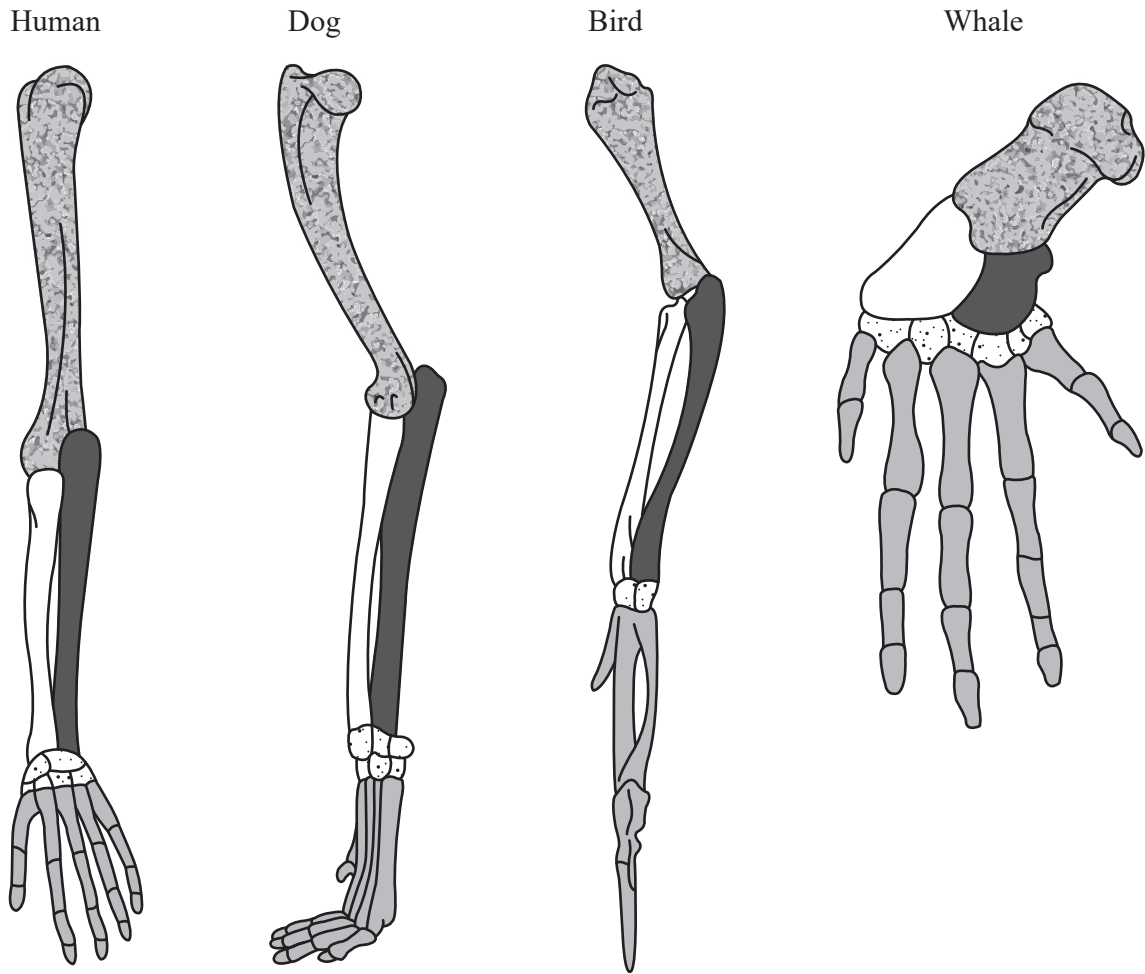
Not to scale

What is the approximate percentage cover of Species A?

- (A) 22%
- (B) 44%
- (C) 53%
- (D) 58%

QUESTION 10

The forelimbs of humans, dogs, birds and whales have a very similar pattern of bones.



Not to scale

The similarity of these structures is best explained by which pattern of evolution?

- (A) convergent evolution
- (B) divergent evolution
- (C) parallel evolution
- (D) coevolution

QUESTION 11

In which environment would primary succession occur?

- (A) fresh lava field
- (B) harvested wheat crop
- (C) grassland cleared by fire
- (D) forest damaged by a cyclone

QUESTION 12

The phenotypic expression of genes is regulated by

- (A) transcription factors.
- (B) random fertilisation.
- (C) DNA polymerase.
- (D) helicase.

QUESTION 13

Which combination of processes demonstrates spermatogenesis?

	Where process occurs	Outcome of process
(A)	testes	one functional gamete with 2–3 polar bodies
(B)	ovaries	four functional haploid gametes
(C)	testes	four functional haploid gametes
(D)	ovaries	one functional gamete with 2–3 polar bodies

QUESTION 14

Which event could cause a frameshift mutation?

- (A) non-disjunction during meiosis
- (B) error during replication
- (C) base pair substitution
- (D) heat damage

QUESTION 15

The table identifies the condition associated with a variety of ploidy changes.

Chromosome number (ploidy)	Condition name
Monosomy 5	Cri du chat syndrome
Trisomy 21	Down syndrome
Trisomy 23	Klinefelter syndrome
Monosomy 23	Turner syndrome

For a person who has 45 chromosomes ($2n-1$) due to an autosomal condition, which condition do they have?

- (A) Cri du chat syndrome
- (B) Down syndrome
- (C) Klinefelter syndrome
- (D) Turner syndrome

QUESTION 16

A small group of dingoes migrated to a new area and established a population. After several generations, the new population showed a different genetic composition from the original population. This is an example of

- (A) microevolution and gene flow.
- (B) macroevolution and gene flow.
- (C) microevolution and genetic drift.
- (D) macroevolution and genetic drift.

QUESTION 19

What is the role of DNA polymerase in DNA replication?

- (A) breaking the hydrogen bonds that hold the complementary bases of DNA together
- (B) adding complementary nucleotide bases to the exposed DNA strands
- (C) sealing the sequence of DNA into two continuous double strands
- (D) joining RNA primers to the lagging strand of DNA

QUESTION 20

A keystone species is defined as a species that

- (A) is the top predator in an ecosystem.
- (B) is a major producer in an ecosystem.
- (C) has a unique and crucial role in an ecosystem.
- (D) directly influences all species in an ecosystem.

References

Question 10

Adapted from OpenStax 2018, *Figure 6* in 'OpenStax Biology 2e', *Lumencandela*, available at <https://courses.lumenlearning.com/suny-osbiology2e/chapter/understanding-evolution/>. Licensed under CC BY 4.0.



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books used

External assessment 2021

Question and response book

Biology

Paper 1

Time allowed

- Perusal time — 10 minutes
- Working time — 90 minutes

General instructions

- Answer all questions in this question and response book.
- QCAA-approved calculator permitted.
- Planning paper will not be marked.

Section 1 (20 marks)

- 20 multiple choice questions

Section 2 (30 marks)

- 8 short response questions



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Section 1

Instructions

- Choose the best answer for Questions 1–20.
- This section has 20 questions and is worth 20 marks.
- Use a 2B pencil to fill in the A, B, C or D answer bubble completely.
- If you change your mind or make a mistake, use an eraser to remove your response and fill in the new answer bubble completely.

	A	B	C	D
Example:	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	A	B	C	D
1.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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8.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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10.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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16.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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QUESTION 22 (3 marks)

Describe two ways carbon is transformed and one way it is transferred as it cycles through the biotic components of an ecosystem.

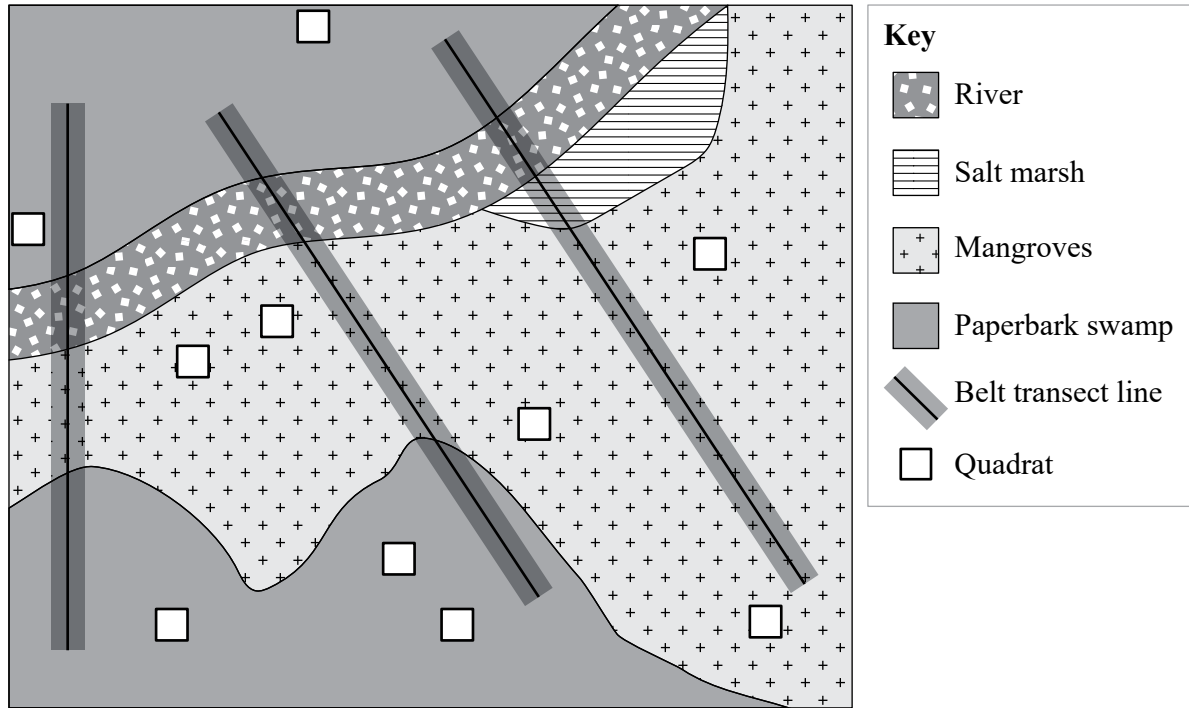
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QUESTION 23 (5 marks)

To determine the species diversity and species richness of a wetland ecosystem, ecologists surveyed communities adjacent to a river, using two methods for each community:

1. random species sampling with predetermined grid numbers, with 10 quadrats of 4 m² each used for these grids
2. three belt transect lines (50 m × 2 m) across predetermined sampling locations based on strata variation.

The map shows the locations of quadrats and transect lines. The table shows survey results.



Not to scale

	Survey method	
	Quadrat	Belt transect
Species diversity (Simpson's diversity index)	0.6	0.8
Species richness (number of species)	16	22

Do not write outside this box.

a) Identify three differences between the survey methods used to determine species diversity and species richness in the ecosystem.

[3 marks]

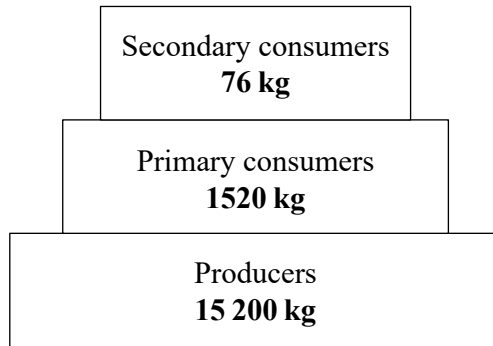
b) Draw a conclusion about the most suitable method for estimating species diversity and species richness of the communities in this wetland ecosystem. Give a reason to support your conclusion.

[2 marks]

Do not write outside this box.

QUESTION 24 (5 marks)

The diagram is a hypothetical biomass pyramid for a community.



Not to scale

- a) Contrast the efficiency of the biomass transfers between each level of the pyramid. *[3 marks]*

- b) Explain the difference in biomass transfer efficiency identified in Question 24a). *[2 marks]*

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QUESTION 26 (4 marks)

a) State the three components of a DNA nucleotide.

[1 mark]

b) Describe the steps involved in DNA profiling.

[3 marks]

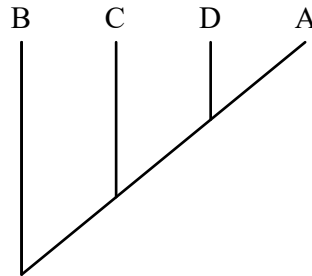
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QUESTION 27 (3 marks)

The table shows the percentage sequence similarity for three different parts of a gene found in four different eukaryotic species. The data was obtained by comparing DNA from one member of each species to Species A.

From this data, a proposed phylogenetic tree was produced.

Species	Gene region 1	Gene region 2	Gene region 3
A	100%	100%	100%
B	98%	96%	82%
C	99%	92%	96%
D	99%	99%	92%

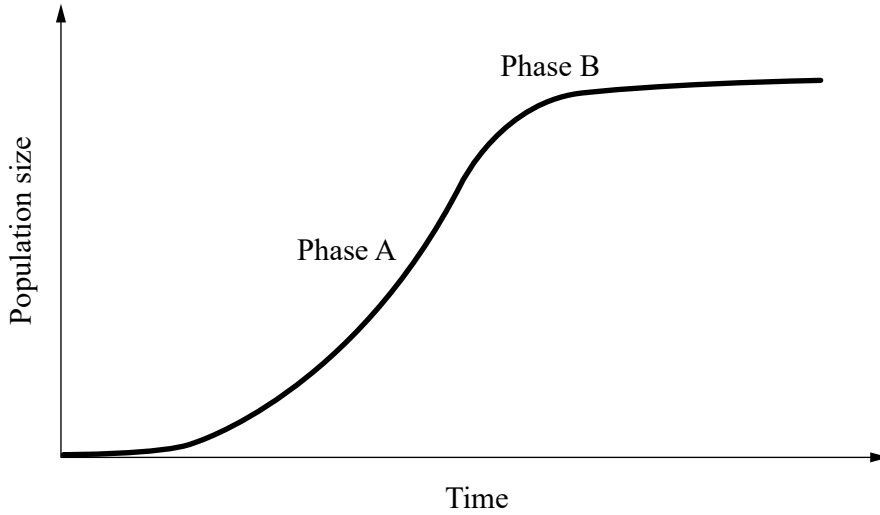


Determine whether the phylogenetic tree has been drawn correctly based on the DNA comparison. Explain your reasoning.

Do not write outside this box.

QUESTION 28 (3 marks)

The graph depicts the population change of a species after it is introduced into a previously disturbed environment.



Referring to Phase A and Phase B, determine the population growth model for the species.

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External assessment 2021

Question and response book

Biology

Paper 2

Time allowed

- Perusal time — 10 minutes
- Working time — 90 minutes

General instructions

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

Section 1 (42 marks)

- 13 short response questions



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Section 1

Instructions

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

Explain how one abiotic and one biotic factor will affect the population of mosquito larvae in a freshwater pond.

Do not write outside this box.

QUESTION 2 (3 marks)

a) Explain the difference between exons and introns.

[2 marks]

b) State a function of telomeres.

[1 mark]

Do not write outside this box.

QUESTION 3 (3 marks)

In coastal areas and deserts, bare sand dunes may be colonised by plants such as members of the *Poaceae* family (grasses). Identify three features of these plants that make them effective colonisers.

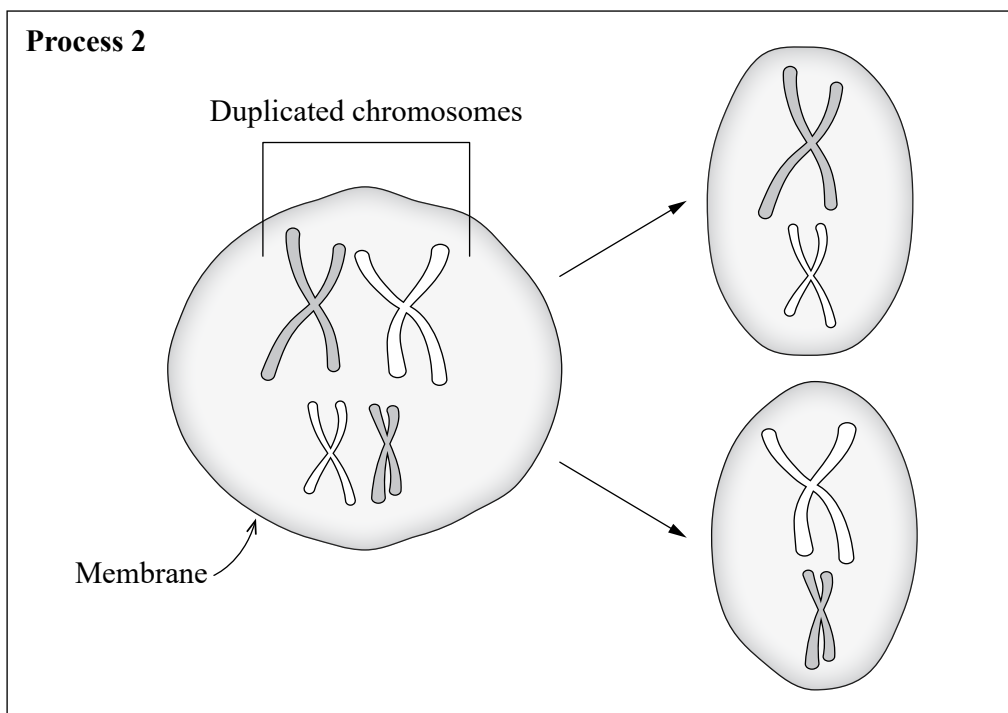
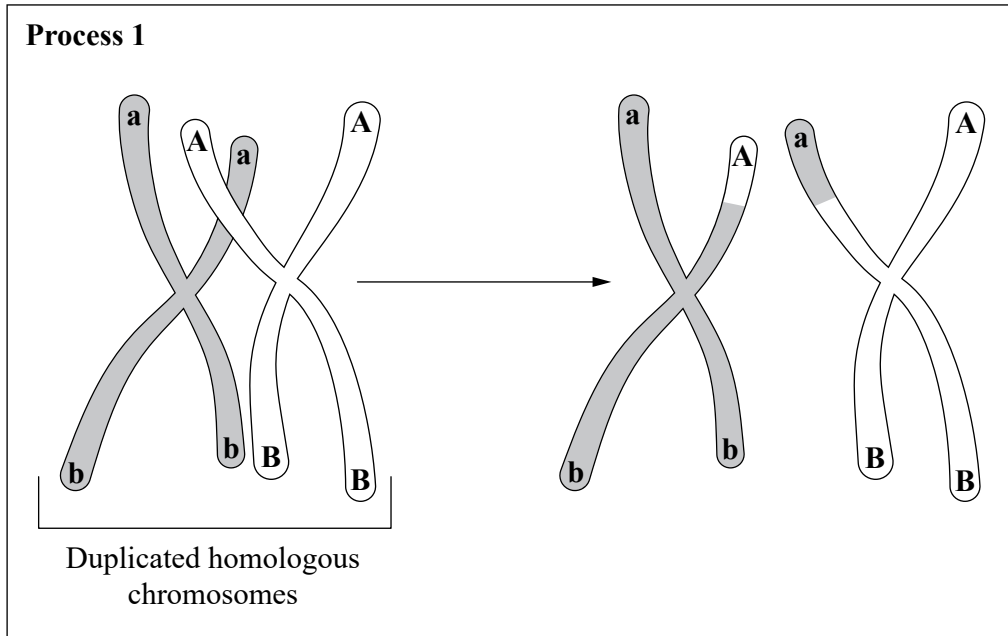
QUESTION 4 (2 marks)

Explain the purpose of the polymerase chain reaction (PCR) process and provide an example of its application.

Do not write outside this box.

QUESTION 5 (6 marks)

Meiosis ensures that a wide range of genetic combinations occurs during the formation of gametes. The diagrams show two processes that occur during meiosis.



Do not write outside this box.

Describe the two processes shown in the diagrams and how they contribute to genetic variation in gametes.

Name and description of process 1: _____

Name and description of process 2: _____

Do not write outside this box.

QUESTION 6 (2 marks)

The term *species* could be defined as ‘one group of individuals that actually or potentially interbreed in nature’.

Identify two limitations of this definition.

QUESTION 7 (3 marks)

Koalas were once widespread in Australia. Due to a variety of factors, their population decreased and fragmented into small pockets, forcing them to inbreed. They have recently been hit by devastating epidemic diseases.

Explain why koalas face an increased extinction risk from disease.

Do not write outside this box.

QUESTION 8 (3 marks)

Australia has many bird species that have evolved to be largely dependent on mangroves.

These species are patchy in their distribution because of:

- the island-like distribution of their habitat
- exclusion by possible competitors
- geographical barriers.

Identify and describe the mode of speciation that may have caused diversity in mangrove bird species.

Do not write outside this box.

QUESTION 9 (3 marks)

A computer simulation was used to observe genotypic changes in the gene pool of 20 randomly selected rabbits. The simulation was set with these parameters:

- each rabbit's coat colour was either black or white
- black alleles were dominant; white alleles were recessive
- the number of rabbits was constant in each generation and breeding was random throughout the population
- an environmental factor was chosen in the simulation to provide selection pressure.

The table shows the results of the simulation at the start and after 20 generations.

Initial population genotypes	Population genotypes after 20 generations
BB BB BB BB BB BB	BB BB
Bb Bb Bb Bb Bb Bb Bb Bb Bb	Bb Bb Bb Bb Bb Bb Bb Bb
bb bb bb bb	bb bb bb bb bb bb bb bb bb

Contrast the initial allele frequency with the allele frequency after 20 generations to draw a conclusion about the effect of the selection pressure on the rabbit population.

Do not write outside this box.

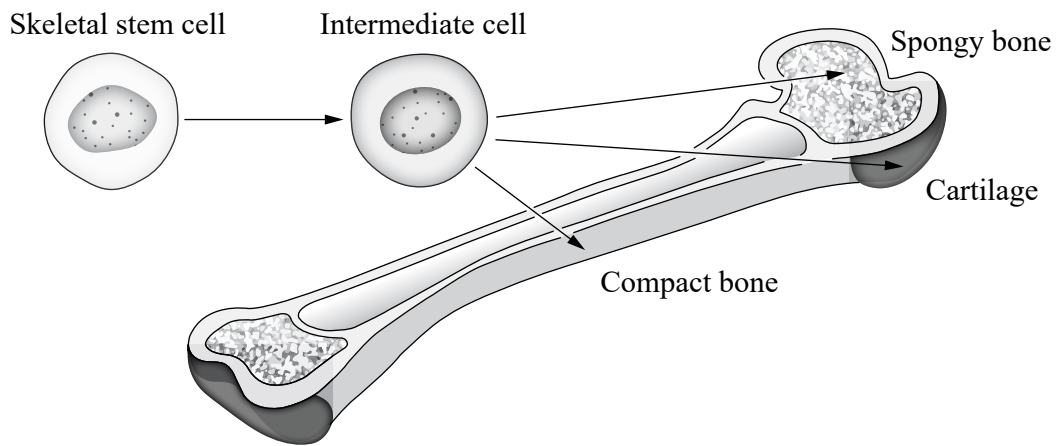
QUESTION 10 (3 marks)

Describe three ways DNA occurs in cells.

Do not write outside this box.

QUESTION 11 (2 marks)

Adult skeletal stem cells differentiate into intermediate cells and later into specialised bone tissue types.



The table shows how three transcription factors (A, B and C) affect bone tissue formation.

Transcription factor role	Intermediate cell	Cartilage	Compact bone
Activators	A	B, A	B
Repressors	—	C	A

Explain the effect of transcription factors on gene expression and tissue formation. Use an example from the table to support your answer.

Do not write outside this box.

QUESTION 12 (5 marks)

An investigation compared mangrove species diversity for two areas of different size in the same catchment. The table shows species population counts for each area.

		Area 1	Area 2
Total species count	Grey mangrove	37	7
	Red mangrove	32	3
	Yellow mangrove	25	88
SDI		0.67	?

a) Calculate Simpson’s diversity index for Area 2. Show your working.

[2 marks]

$$SDI = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

SDI = _____ (correct to two decimal places)

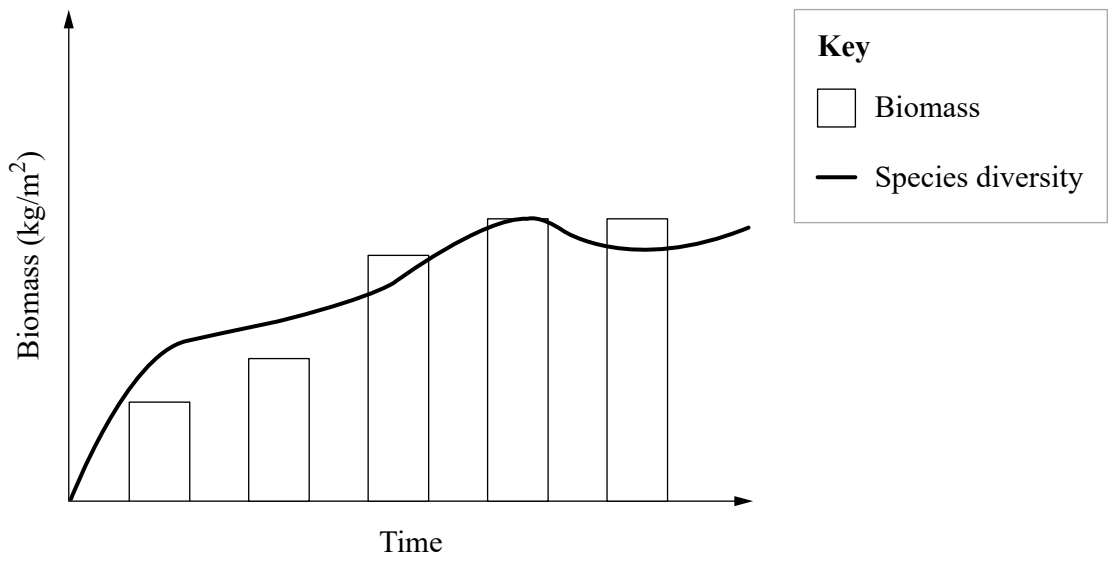
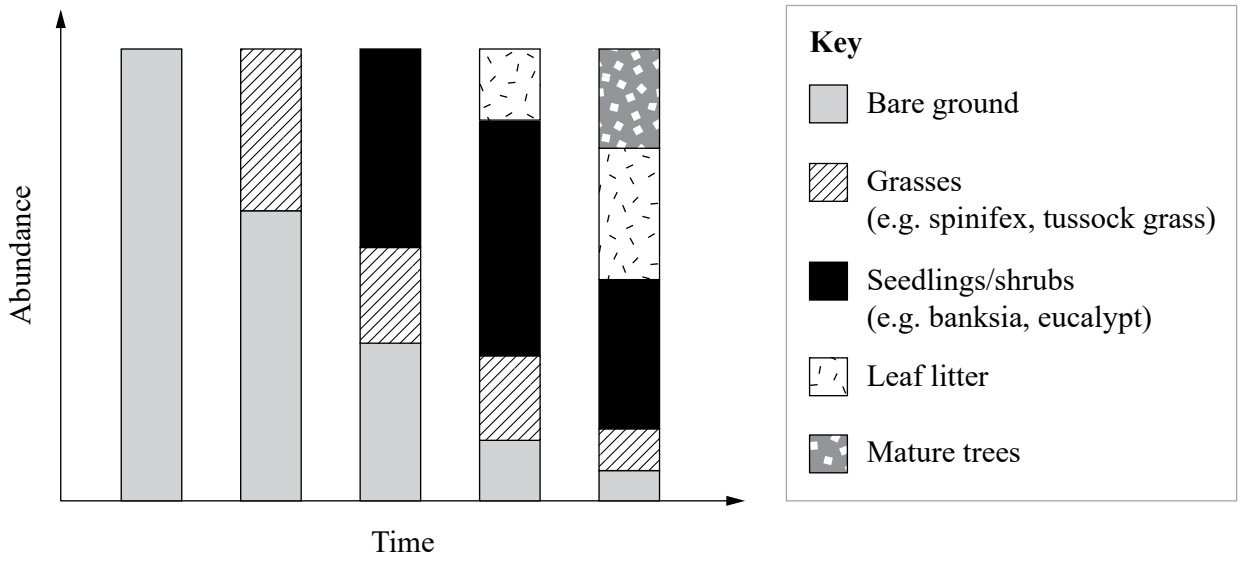
b) Using your answer for Question 12a), compare the diversity of the two areas.

[3 marks]

Do not write outside this box.

QUESTION 13 (3 marks)

The data shows changes in relative abundance of ground cover, biomass and species diversity for an abandoned sand mine site over time.



Do not write outside this box.

Based on the information provided, predict whether further ecological succession would occur in this community. Justify your answer with two relevant reasons.

END OF PAPER

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References

Question 11

Adapted from Clark, M, Choi, J & Douglas, M 2018, *Figure 38.17* in '38.2: Bone', *Biology 2e*, OpenStax, Rice University, p. 1094. Access for free at <https://openstax.org/books/biology-2e/pages/1-introduction>
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