Biology marking guide and response

External assessment 2022

Combination response (87 marks)

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. describe and explain biodiversity, ecosystem dynamics, DNA, genes and the continuity of life, and the continuity of life on Earth
2. apply understanding of biodiversity, ecosystem dynamics, DNA, genes and the continuity of life, and the continuity of life on Earth
3. analyse evidence about biodiversity, ecosystem dynamics, DNA, genes and the continuity of life, and the continuity of life on Earth to identify trends, patterns, relationships, limitations or uncertainty
4. interpret evidence about biodiversity, ecosystem dynamics, DNA, genes and the continuity of life, and the continuity of life on Earth to draw conclusions based on analysis.

Note: Objectives 5, 6 and 7 are not assessed in this instrument.

Purpose

This document consists of a marking guide and a sample response.

The marking guide:

- provides a tool for calibrating external assessment markers to ensure reliability of results
- indicates the correlation, for each question, between mark allocation and qualities at each level of the mark range
- informs schools and students about how marks are matched to qualities in student responses.

The sample response:

- demonstrates the qualities of a high-level response
- has been annotated using the marking guide.

Mark allocation

Where a response does not meet any of the descriptors for a question or a criterion, a mark of '0' will be recorded.

Where no response to a question has been made, a mark of 'N' will be recorded.

Allowing for FT error — refers to 'follow through', where an error in the prior section of working is used later in the response, a mark (or marks) for the rest of the response can be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

Allow FT mark/s — refers to 'follow through', where an error in the prior section of working is used later in the response, a mark (or marks) for the rest of the response can still be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

Marking guide

Multiple choice

Question	Response
1	A
2	B
3	D
4	C
5	B
6	C
7	B
8	B
9	C
10	D
11	D
12	D
13	A
14	D
15	D
16	C
17	D
18	A
19	A
20	B

Short response

Q	Sample response	The response:
21	Strategy 1: Number of offspring — K-strategists have fewer offspring than r-strategists. Strategy 2: Age of reproduction — K-strategists reproduce at a later age than r-strategists.	• describes one reproductive strategy used to distinguish K-strategists from r-strategists **[1 mark]** • describes a second reproductive strategy used to distinguish K-strategists from r-strategists **[1 mark]**

Q	Sample response	The response:
22	Ecosystem: Rainforest Abiotic factor 1: Availability of light: In a rainforest, light becomes less available in the understorey, so only plants that are adapted to low-light conditions can survive there. Abiotic factor 2: Availability of water: Rainforest frogs need to be distributed near pools of water for their tadpoles to grow and survive.	• explains how one abiotic factor affects the distribution of species in the identified ecosystem **[1 mark]** • explains how a second abiotic factor affects the distribution of species in the identified ecosystem **[1 mark]**

Q	Sample response	The response:
23	Both involve changes in allele frequencies, but in microevolution, this change occurs within a species, whereas for macroevolution, the change is at or above the species level. This means that in microevolution, the descendant is in the same taxonomic group as the ancestor, whereas in macroevolution, the descendant is in a different taxonomic group.	• provides a similarity **[1 mark]** • provides a difference **[1 mark]** • states the significance **[1 mark]**

Q	Sample response	The response:
24	Classification allows us to document, monitor and communicate information about biodiversity, which can be used to monitor how old-growth forests recover after a disturbance, e.g. the progression from tall open woodland to tall closed forest. Classification can also be used to identify which parts of an area have similar species composition and abiotic factors. This data can be used to inform effective management, as similar management principles would apply to old growth forests with similar species composition.	• explains one way classification allows for effective management of old-growth forests **[1 mark]** • explains a second way classification allows for effective management of old-growth forests **[1 mark]**

Q	Sample response	The response:
25	Stratified sampling could be used to investigate how the percentage cover of seagrass changes along a depth gradient over a 60-month period. Quadrats could be used to estimate the percentage cover of seagrass at 250 km intervals along a 7 km belt transect north of location A, covering both shallow-water and deep-water meadows. Multiple quadrats should be placed at each interval to ensure the reliability of data, and the depth at each sampling point must be recorded. Data could be collected each month for 60 months.	• indicates the study will take place over time **[1 mark]** • indicates that sampling will occur in both deep and shallow water **[1 mark]** • identifies an appropriate surveying technique **[1 mark]** • identifies an appropriate purpose for the study **[1 mark]**

Q	Sample response	The response:
26a)	The sperm cell is missing a sex chromosome.	• identifies the sperm cell is missing a chromosome **[1 mark]**
26b)	The abnormality may have occurred due to non-disjunction during meiosis, where the sex chromosomes failed to separate at anaphase and ended up in the same daughter cell. This results in the daughter cells (gametes) containing either two copies of the sex chromosome/s or no copies, as is the case for karyotype A.	• identifies the abnormality may be due to non-disjunction **[1 mark]** • explains that non-disjunction occurs when chromosomes fail to separate during meiosis **[1 mark]**
26c)	Turner syndrome.	• predicts Turner syndrome **[1 mark]**

Q	Sample response	The response:
27	Gel electrophoresis separates DNA segments based on size to produce characteristic banding patterns.	• identifies that gel electrophoresis is used to separate DNA fragments based on size **[1 mark]** • explains that this produces characteristic banding patterns **[1 mark]**

Q	Sample response	The response:
28	The introduction of the myxoma virus conferred a selective advantage on the myxomatosis-resistant phenotype. Myxomatosis-resistant rabbits had an increased chance of surviving to reproduce and pass on the trait. This led to an increase in the frequency of this phenotype in the population from approximately 9% in 1950 to approximately 96% in 1953. After 1953, most of the remaining rabbits possessed the myxomatosis-resistant phenotype, so the disease was no longer effective at reducing rabbit numbers.	• recognises that the myxomatosis-resistant phenotype provided a selective advantage **[1 mark]** • uses evidence from the graph to establish that this caused myxomatosis resistance to increase in the population **[1 mark]** • concludes that myxomatosis became less effective as the percentage of myxomatosis-resistant rabbits increased **[1 mark]**

Paper 2: Short response

Q	Sample response	The response:
1a)	Species A. Species A and B have the least genetic difference, suggesting there has been less time since they diverged for mutations to occur.	• infers species A is most closely related to species B **[1 mark]** • provides appropriate reasoning **[1 mark]**
1b)	6 nucleotides	• states 6 nucleotides **[1 mark]**

Q	Sample response	The response:
2a)	Energy transfer = 36/900 × 100% = 4%	• correctly calculates energy transfer **[1 mark]** • shows appropriate working **[1 mark]**
2b)	At each trophic level, some energy is lost to respiration and decomposition. In these processes, organic compounds that contribute to biomass are converted into inorganic substances, such as CO_2 and H_2O.	• identifies a process that accounts for loss of biomass **[1 mark]** • explains the process **[1 mark]**

Q	Sample response	The response:
3a)	Pioneer species, such as lichens will begin the process of soil formation by breaking down the substrate and adding organic material through their own death and decay. This will allow new species to colonise/inhabit the area, changing the community composition. The community composition will continue to change over time until a climax community is established.	• explains – pioneer species' role in establishing soil **[1 mark]** – changes in community composition **[1 mark]** – establishment of a climax community **[1 mark]**
3b)	Primary succession	• identifies primary succession **[1 mark]**

Q	Sample response	The response:
4	A plant or animal that plays a unique and crucial role in the way an ecosystem functions.	• provides an appropriate definition **[1 mark]**

Q	Sample response	The response:
5a)	Messenger RNA (or mRNA) provides copies of the gene from the DNA template strand. Transfer RNA (or tRNA) decodes mRNA sequences by matching amino acids to codons of the mRNA.	• describes the role of messenger RNA in protein synthesis **[1 mark]** • describes the role of transfer RNA in protein synthesis **[1 mark]**
5b)	Transcription factors are proteins that turn specific genes on or off by binding to nearby sections of DNA. This allows different genes to be expressed in different cell types. For example, the SRY gene on the Y chromosome promotes the development of testes by producing a protein that regulates the expression of genes (production of proteins) required by Sertoli cells.	• recognises that transcription factors regulate gene expression by binding to specific DNA sequences **[1 mark]** • explains that this allows for differential gene expression **[1 mark]** • provides an example **[1 mark]**

Q	Sample response	The response:
6a)	Habitat destruction: organisms that previously inhabited the site are displaced or killed, which could disrupt food chains	• explains how a human activity reduces biodiversity **[1 mark]**
6b)	Highest impact: Habitat destruction In 2016, there was high-quality evidence and a high level of consensus that habitat destruction was causing a large proportion of species and/or ecosystems to suffer substantial adverse effects, and that the impact was deteriorating. This is in contrast to 2011, when the effects of the impact were improving. Lowest impact: Overexploitation In 2016, there was adequate high-quality evidence to suggest that overexploitation was affecting only a small proportion of species and/or ecosystems. This was an improvement from 2011 where there was high-quality evidence (and consensus) that a large proportion of species were affected. This implies that measures to improve overexploitation have been implemented since 2011.	• predicts the highest impact will be from habitat destruction **[1 mark]** • explains the prediction using evidence **[1 mark]** • predicts the lowest impact will be from overexploitation **[1 mark]** • explains the prediction using evidence **[1 mark]**

Q	Sample response	The response:
7a)	Logistic growth.	• identifies logistic growth **[1 mark]**
7b)	10 000.	• determines the carrying capacity is 10 000 **[1 mark]**
7c)	More nutrients added to the Petri dish: an increase in food availability would allow a larger population to obtain vital nutrients, therefore increasing the carrying capacity. Increasing the size of the Petri dish: This would increase the available space, so more organisms can survive and be in contact with the nutrient agar.	• identifies one modification that could cause the change **[1 mark]** • explains how the first modification increases carrying capacity **[1 mark]** • identifies a second modification that could cause the change **[1 mark]** • explains how the second modification increases carrying capacity **[1 mark]**

Q	Sample response	The response:
8	The cheetah population has suffered a severe bottleneck. This means that (by chance) certain alleles may be over- or under-represented in the surviving population, and some (potentially 'fitter') alleles may have been lost altogether. This reduces genetic variability and means that the small surviving population's gene pool is not representative of the original population. If the environment suddenly changes, the selection pressures on the cheetahs will also change. Having a limited gene pool may mean the population cannot adapt to the changing conditions and are therefore at increased risk of extinction.	• explains that – the reduction in population has reduced genetic variability **[1 mark]** – some alleles may have been eliminated from the gene pool **[1 mark]** – a population with limited genetic variability may not be able to evolve in response to changing conditions **[1 mark]**

Q	Sample response	The response:
9a)	Phylogenetic species concept	• identifies another method for defining a species **[1 mark]**
9b)	A limitation of the biological species concept is that it only applies to sexually reproducing organisms. A limitation of the phylogenetic species concept is that it requires significant morphological differences to allow for appropriate evaluation.	• identifies a limitation of the biological species concept **[1 mark]** • identifies a limitation of the method identified in Question 9a) **[1 mark]**

Q	Sample response	The response:
10	<table><tr><td></td><td>X^R</td><td>Y</td></tr><tr><td>X^r</td><td>$X^R X^r$</td><td>$X^r Y$</td></tr><tr><td>X^r</td><td>$X^R X^r$</td><td>$X^r Y$</td></tr></table> Approximately 25 red-eyed females and 25 white-eyed males.	• provides working using a Punnett square **[1 mark]** • predicts 25 females with red eyes **[1 mark]** • predicts 25 males with white eyes **[1 mark]**

Q	Sample response	The response:
11a)	Frequency (a) = [(2 x 226) + 60] / 600 = 0.85 Frequency (A) = [(2 x 14) + 60] / 600 = 0.15	• provides appropriate working **[1 mark]** • calculates the frequencies of both alleles **[1 mark]**
11b)	Allele frequencies remained relatively constant in forest X over the 10-year period, with a slight increase in allele A over time. This suggests genetic drift is occurring and the changes are likely due to chance rather than the environment favouring a particular phenotype. This contrasts with forest Y, where the frequency of allele A increases significantly over time after it first appears in 2016. The allele may have been introduced to forest Y due to migration (mice moving in from a neighbouring forest) or mutation. Either way, it is evident that the allele A provided a selective advantage to mice in forest Y, resulting in its frequency increasing over time.	• identifies allele frequencies remain relatively constant in forest X over time **[1 mark]** • infers a reason for the temporal change in forest X **[1 mark]** • identifies allele A first appeared in forest Y in 2016 **[1 mark]** • infers this is due to migration (gene flow) or mutation **[1 mark]** • identifies the frequency of allele A increases over time in forest Y **[1 mark]** • infers allele A provides a selective advantage to mice in forest Y **[1 mark]**