Biology marking guide and response

External assessment 2025

Combination response (101 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.

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

For all Queensland schools

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.

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.

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

Paper 1: Short response

Q	Sample response	The response:
21a)	The Linnaean system is hierarchical, grouping organisms into taxa based on similarity of physical features. It assigns a two-part name to species which consists of the genus name and a species name, e.g. *Homo sapiens.*	• describes one key feature of the Linnaean system **[1 mark]** • describes a second key feature of the Linnaean system **[1 mark]**
21b)	Because the system is hierarchical, organisms in the same taxa can be assumed to have a set of common physical characteristics, for example, all organisms in the phylum Chordata have a backbone.	• explains how the Linnaean system allows researchers to infer similarities between species **[1 mark]** • provides an example **[1 mark]**

Q	Sample response	The response:
22a)	Similarity: All pioneer species play a key role in making an area habitable for other species. Difference: Because primary succession occurs in areas that lack habitable soils, primary pioneers must establish the soil, whereas secondary pioneers do not. Significance: Because of this, primary pioneer species tend to be lichens, algae and fungi, which have high tolerance to extreme conditions, whereas secondary pioneer species tend to be grasses that germinate rapidly.	• identifies a similarity **[1 mark]** • identifies a difference **[1 mark]** • identifies the significance **[1 mark]**
22b)	Climax communities contain a higher proportion of K-strategists than pioneer communities. Climax communities are also greater in biomass.	• describes one difference **[1 mark]** • describes a second difference **[1 mark]**

Q	Sample response	The response:
23a)	Enzyme 1: Helicase Function: Helicase unwinds the double helix and separates the strands. Enzyme 2: DNA polymerase Function: DNA polymerase forms new complementary strands by adding nucleotides using the base pairing rules.	• identifies an enzyme involved in DNA replication **[1 mark]** • describes the function of this enzyme **[1 mark]** • identifies a second enzyme involved in DNA replication **[1 mark]** • describes the function of the second enzyme **[1 mark]**
23b)	Synthesis of the leading strand is continuous, whereas synthesis of the lagging strand occurs in segments, creating Okazaki fragments which must later be joined.	• explains that synthesis of the leading strand is continuous **[1 mark]** • explains that synthesis of the lagging strand is non-continuous **[1 mark]**

Q	Sample response	The response:
24	Plasmids are small, circular DNA molecules found in bacteria. They are used as vectors to carry new genes into cells and allow the new gene to be replicated.	• describes the structure of plasmids **[1 mark]** • describes the role of plasmids in recombinant DNA technology **[1 mark]**

Q	Sample response	The response:
25a)	The red panda	• infers red panda **[1 mark]**
25b)	According to the table, polar bears and red pandas had 45 amino acid differences in protein 1. This suggests they diverged approximately 50 million years ago. The protein 2 line on the graph indicates that species that diverged 50 million years ago will have ~20 amino acid differences per 100 residues.	• predicts 20 amino acid differences **[1 mark]** • provides appropriate justification **[1 mark]**
25c)	Both types of evolution may result in organisms with similar structures, but in divergent evolution, structural similarity is due to the short period of time since divergence (i.e. organisms are closely related), whereas in convergent evolution, similarity is due to similar environments. This means that some organisms have similar features without being closely related, so physical features aren't always a reliable indicator.	• distinguishes between divergent and convergent evolution **[1 mark]** • explains the difference in accuracy **[1 mark]**

Q	Sample response	The response:
26a)	At the end of the Cretaceous period, the ocean temperature dropped from ~21 ºC to ~16 ºC and then rose again to ~24 ºC at the beginning of the Paleogene period.	• identifies the changes **[1 mark]** • provides appropriate data **[1 mark]**
26b)	As ocean temperature decreases, body length increases.	• identifies that as ocean temperature decreases, body length increases **[1 mark]**
26c)	Larger body size provided a selective advantage to marine organisms. Organisms with larger bodies were more likely to survive until reproductive age, when they could pass on the advantageous alleles to their offspring. This caused the allele/s for increased body size to become more common in the population over time.	• explains the observed trends, referring to – phenotypic variation **[1 mark]** – differential survival and reproduction **[1 mark]** – change over time **[1 mark]**
26d)	Directional selection	• identifies directional selection **[1 mark]**

Paper 2: Short response

Q	Sample response	The response:
1a)	Genetic drift refers to changes in allele frequencies within a population that occur due to chance.	• provides an appropriate definition **[1 mark]**
1b)	A population bottleneck is a random event that drastically reduces the size of a population. Because the survivors of a bottleneck event usually do so by chance (as opposed to by having advantageous alleles), the allele frequencies of the surviving population are usually very different from the parent population due to sampling error.	• recognises that a bottleneck reduces the size of a population **[1 mark]** • explains why genetic drift is higher in populations affected by bottlenecks **[1 mark]**

Q	Sample response	The response:
2a)	Monosomy X	• identifies condition **[1 mark]**
2b)	The condition may have occurred due to non-disjunction, where the sex chromosomes failed to separate at anaphase. This would have resulted in some daughter cells (gametes) containing no sex chromosomes and some containing two copies. If one of the gametes containing no sex chromosomes fused with another gamete containing one X chromosome, the resulting offspring would have Turner syndrome.	• recognises the condition is due to non-disjunction **[1 mark]** • describes non-disjunction **[1 mark]** • explains how non-disjunction leads to Turner syndrome/Monosomy X **[1 mark]**
2c)	A male with Down syndrome would have an extra chromosome 21 and a Y chromosome next to the X.	• recognises there would be an extra chromosome 21 **[1 mark]** • recognises there would be a Y chromosome **[1 mark]**

Q	Sample response	The response:
3a)	$\text{Ant nest density} = \dfrac{\text{number of ant nests}}{\text{area sampled}}$ $= \dfrac{2 \text{ nests}}{(10 \times 1\ \text{m}^2)}$ $= \dfrac{0.2 \text{ nests}}{\text{m}^2}$ $\text{Predicted number of ant nests} = \dfrac{0.2\,\text{nests} \times 100\,\text{m}^2}{\text{m}^2}$	• provides appropriate working **[1 mark]**
	= 20 nests	• predicts 20 ant nests **[1 mark]**
3b)	Predicted nests: 20; actual nests: 16	• identifies actual number of nests **[1 mark]**
	$\dfrac{4}{16} \times 100\% = 25\%$ The predicted number of ant nests was 25% greater than the actual number of nests.	• contrasts predicted and actual values **[1 mark]**
3c)	Stratified sampling is used in situations where distinct strata exist that may affect the distribution of species. There is no indication that distinct strata exist in this scenario.	• recognises the purpose of stratified sampling **[1 mark]** • explains the area does not have distinct strata **[1 mark]**

Q	Sample response	The response:
4	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 bind to specific DNA sequences **[1 mark]** • explains that this allows different genes to be expressed in different cell types **[1 mark]** • provides an example **[1 mark]**

Q	Sample response	The response:
5a)	The biotic data suggests that ecosystem 2 has the greatest species evenness. Species richness is similar for both ecosystems, but SDI is much higher in ecosystem 2 (0.82 vs 0.38). Because SDI considers both richness and evenness, it can be inferred that the higher SDI is due to greater evenness.	• infers ecosystem 2 **[1 mark]** • provides appropriate reasoning **[1 mark]**
5b)	Similarity: Both ecosystems are within the healthy range for dissolved oxygen and turbidity. Difference: Only ecosystem 2 is in the healthy range for pH. Significance: This suggests that ecosystem 2 is healthier than ecosystem 1.	• identifies a similarity **[1 mark]** • identifies a difference **[1 mark]** • identifies the significance **[1 mark]**
5c)	Species A. Tolerance range: pH 6–9.5	• identifies species A **[1 mark]** • states the tolerance range **[1 mark]**
5d)	Species A and C	• determines species A and C **[1 mark]**
5e)	1 – 0.82 = 0.18 18% chance	• determines 18% **[1 mark]**

Q	Sample response	The response:
6a)	Energy enters the biotic components of an ecosystem via photosynthesis, where solar energy from the sun is used to convert carbon dioxide and water into chemical energy in the form of glucose.	• recognises that energy enters the biotic components of an ecosystem via photosynthesis **[1 mark]** • explains photosynthesis **[1 mark]**
6b)	Gross primary productivity (GPP) is the total amount of solar energy converted into chemical energy by photosynthesis, whereas net primary productivity (NPP) is the total energy stored as biomass and made available to consumers.	• describes gross or net primary productivity **[1 mark]** • distinguishes between gross and net primary productivity **[1 mark]**

Q	Sample response	The response:
7	<table><tr><td></td><td>Z^B</td><td>Z^b</td></tr><tr><td>Z^b</td><td>$Z^B Z^b$</td><td>$Z^b Z^b$</td></tr><tr><td>W</td><td>Z^B W</td><td>Z^b W</td></tr></table> Barred feather pattern (Z^B Z^b, Z^B W) $= \frac{2}{4} = 50\%$ Number of offspring with barred pattern $= 0.5 \times 8$ $= 4$ offspring	• identifies parental genotypes **[1 mark]** • provides an appropriate Punnett square **[1 mark]** • predicts number of offspring with the barred feather pattern **[1 mark]**

Q	Sample response	The response:
8	Exons are sections of DNA (or mRNA) that code for proteins; whereas introns are non-coding sections that get spliced out.	• describes exons or introns **[1 mark]** • distinguishes between exons and introns **[1 mark]**

Q	Sample response	The response:
9	Populations A and B. Allopatric speciation occurs when populations become geographically isolated, preventing gene flow from occurring. The graph for populations A and B shows that gene flow stopped suddenly at ~20 million years.	• infers population A and B **[1 mark]** • provides appropriate justification **[1 mark]**

Q	Sample response	The response:
10a)	37 000	• identifies number of seal pups in 1800 **[1 mark]**
10b)	Population growth $= 15\ 000 - 2000$ $= 13\ 000$	• determines population growth **[1 mark]**
	Population growth $=$ (births $+$ immigration) $-$ (deaths $+$ emigration) $13\ 000 = (B + I) - (D + E)$ $13\ 000 = (B + 1500) - (1\ 217\ 900 + 600)$ $13\ 000 = B - 1\ 217\ 000$ $13\ 000 + 1\ 217\ 000 = 1\ 230\ 000$	• determines the number of births **[1 mark]**
10c)	The fur seal population hasn't reached carrying capacity. The number of seal pups has been increasing since ~1890 (except 1960–1970) and shows no signs of plateauing. This suggests the ecosystem has sufficient resources to support a growing population.	• infers the fur seal population has not reached carrying capacity **[1 mark]** • justifies response using appropriate evidence from the graph **[1 mark]**
10d)	As krill are a main food source for fur seals, a 40% decrease in the krill population would mean insufficient food to support the current population, reducing carrying capacity.	• predicts the carrying capacity of fur seals would decrease **[1 mark]** • explains reasoning **[1 mark]**
10e)	Number of seal pups in 2025 $= \frac{(230 \times 250)}{2}$ $= 28\ 750$	• calculates number of seal pups in 2025 **[1 mark]**
	Growth rate $= \frac{(28\ 750 - 15\ 000)}{15\ 000}$ $= 92\%$	• determines growth rate **[1 mark]**
	Average annual population growth rate $= \frac{92\%}{25 \text{ years}}$ $= 3.7\% / \text{year}$	• determines average annual population growth rate **[1 mark]**

Q	Sample response	The response:
11a)	The background extinction rate has decreased over time.	• identifies that the background extinction rate has decreased **[1 mark]**
11b)	3 mass extinctions	• determines 3 mass extinctions **[1 mark]**
11c)	The competitive exclusion principle states that two species with identical niches cannot coexist indefinitely. Mass extinctions create new niches for different species to exploit.	• describes the competitive exclusion principle **[1 mark]** • explains that mass extinctions create new niches **[1 mark]**