# Biology marking guide and response

Sample external assessment 2020

## Science (95 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 | Queensland Curriculum & Assessment Authority

*For all Queensland schools*

# Introduction

The Queensland Curriculum and Assessment Authority (QCAA) has developed mock external assessments for each General senior syllabus subject to support the introduction of external assessment in Queensland.

An external assessment marking guide (EAMG) has been created specifically for each mock external assessment.

The mock external assessments and their marking guides were:

- developed in close consultation with subject matter experts drawn from schools, subject associations and universities
- aligned to the external assessment conditions and specifications in General senior syllabuses
- developed under secure conditions.

# Purpose

This document consists of an EAMG and an annotated response.

The EAMG:

- 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.

# 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.

# External assessment marking guide

## Paper 1: Multiple choice

| Question | Response |
|---|---|
| 1 | B |
| 2 | D |
| 3 | B |
| 4 | A |
| 5 | D |
| 6 | A |
| 7 | D |
| 8 | D |
| 9 | B |
| 10 | D |
| 11 | A |
| 12 | A |
| 13 | B |
| 14 | B |
| 15 | C |
| 16 | D |
| 17 | D |
| 18 | C |
| 19 | B |
| 20 | D |
| 21 | C |
| 22 | B |
| 23 | C |
| 24 | C |
| 25 | B |

**Paper 1: Short response (25 marks)**

| Question | | Sample response | The response |
|---|---|---|---|
| 26 | | Mutations result from environmental pressures over time and result in new alleles in a population. Mutations that enhance survival will result in a selection advantage. The frequency of particular alleles may vary within a species. | • identifies that mutations<br>– result in new alleles [1 mark]<br>– result in selective advantage [1 mark]<br>– result from environmental pressures over time [1 mark]<br>– result from small scale variation of allele frequencies within species [1 mark] |
| 27 | a | Although Strain M1 and M2 appear to have achieved higher selection coefficient for competitive ability, the error bars overlap with the result for the wild type. Therefore, no difference in results can be confidently identified.<br>Growth rate and maximal growth rate for the WT strain were similar to M1 and M2 strains. | • identifies that error bars overlap and therefore there is no difference in results [1 mark]<br>• provides a conclusion from the data about competitive ability and growth rate being similar for WT and M1/M2 strains [1 mark] |
| | b | There was no significant difference in the maximal growth rate between mutant and wild type bacteria.<br>The mutations did not provide a selective advantage. | • identifies that there was no significant difference in maximal growth rate[1 mark]<br>• identifies that the mutations did not provide a selective advantage [1 mark] |
| 28 | a | Species C and D. | • provides C and D [1 mark] |
| | b | There would have been divergent diversification. | • provides divergent [1 mark] |
| | c | TT = 25%<br>Tt = 50%<br>tt = 25% | • provides TT = 25%, Tt = 50% and tt = 25% [1 mark]<br>• provides Trait 1 = 75% and Trait 2 = |

| Question | | Sample response | The response |
|---|---|---|---|
| | | Phenotype 1 = 75%<br>Phenotype 2 = 25%<br>Inheritance pattern for Phenotype 1 is autosomal dominant. | 25% [1 mark]<br>• provides autosomal dominant for inheritance pattern [1 mark] |
| 29 | a | Evidence of a biotic change is that the species diversity decreases in strata 3, 4 and 5.<br>The evidence in each stratum is different. This could indicate that abiotic changes (linked to strata types) influenced the diversity of species.<br>Another piece of evidence of a change to the ecosystem is that the species types change after stratum 6. | • identifies evidence of a biotic change [1 mark]<br>• identifies evidence of an abiotic change [1 mark]<br>• identifies evidence of another abiotic change or another biotic change [1 mark] |
| | b | $D = \frac{s}{\sqrt{N}}$<br>$D = \frac{4}{\sqrt{6}}$ | • shows substitution correctly performed [1 mark] |
| | | $D$ = 1.6 | • provides 1.6 for D [1 mark] |

| Question | | Sample response | The response |
|---|---|---|---|
| | c | Not all biota are preserved as fossils. | ● identifies a limitation [1 mark] |

| Question | Sample response | The response |
|---|---|---|
| 30 | Surveying technique: line transect, positioned in the direction of the environmental gradient.<br>Provides a good method of visualising change along a gradient.<br>Provides less data on relative density of individual species<br>Sampling method: systematic sampling.<br>Taking samples at fixed intervals allows a clear environmental gradient to be established.<br>If a minimum number of samples which should be taken to be representative isn't estimated before commencing the survey, the cost per unit effort will be disproportionately high. | • identifies a valid technique [1 mark]<br>• identifies a strength of the technique [1 mark]<br>• identifies a limitation of the technique [1 mark]<br>• identifies systematic sampling as the sampling method [1 mark]<br>• identifies a strength of systematic sampling [1 mark]<br>• identifies one limitation of systematic sampling [1 mark] |

**Paper 2: Short response (45 marks)**

| Question | Sample response | The response |
|---|---|---|
| 1 | Region/s of DNA that are made up of nucleotides. | • defines gene [1 mark] |
| 2 | The process of classifying an old growth forest (based on its dominant tree species and specific old-growth characteristics) enables managers/decision makers to make decisions about its management.<br>Agreement about the classification allows stakeholders to make decisions to serve a wide range of values.<br>Classification helps to support effective management of activities such as prescribed burning.<br>Classification of ecosystems helps to support understanding of their unique interactions and therefore the effect of specific human impacts. This can lead to longer term resilience. | • identifies that classification enables decision making [1 mark]<br>• identifies that decisions serve a range of values [1 mark]<br>• identifies an effective management technique [1 mark]<br>• identifies that classification supports long-term ecosystem resilience [1 mark] |

| Question | Sample response | The response |
|---|---|---|
| 3 | DNA is usually circular in prokaryotes and linear in eukaryotes. This is because prokaryotes evolved first. The genome of prokaryotes is significantly smaller than eukaryotes, i.e. the prokaryotes genome only contains a single copy of each gene. This results in fewer noncoding sequences for prokaryotes. | • identifies two differences [2 marks]<br>OR<br>• identifies one difference [1 mark]<br><br>• explains two of the identified differences [2 marks]<br>OR<br>• explains one of the identified differences [1 mark] |
| 4 | A restriction enzyme (endonuclease) is chosen to digest (cut) the selected plasmid at, or near, the recognition site.<br>The same restriction enzyme (endonuclease) is used to digest (cut) the target gene fragment.<br>This usually produces complementary 'sticky ends' that join by base pairing after target gene is inserted.<br>DNA ligase is then used to catalyse a reaction which links the phosphate group of one DNA strand to the hydroxyl group of the other DNA strand to form a single sugar-phosphate backbone/combined piece of DNA. | • describes the role of the restriction enzyme and the<br>– plasmid [1 mark]<br>– target gene [1 mark]<br>• describes the insertion of the target gene [1 mark]<br>• describes the joining of the DNA fragment [1 mark] |

| Question | | Sample response | The response |
|---|---|---|---|
| 5 | | Homologous chromosomes are chromosome pairs inherited from each parent. They are similar in gene position but may contain different alleles.<br>Homologous chromosomes line up with the orientation of each homologous pair being random - not affected by the orientation of any other homologous pair.<br>One of each homologous chromosome moves to a different pole of the cell, independent of each other, eventually into separate gametes.<br>The gametes produced at the end of meiosis contain a mixture of maternal and paternal genes and leads to variation in the offspring produced. | • identifies relevant features of homologous chromosomes [1 mark]<br>• identifies that pairs of homologous chromosomes randomly orient [1 mark]<br>• identifies that assortment of chromosomes into the gametes occur independently of each other [1 mark]<br>• identifies cells produced at end of meiosis contain a mixture of maternal and paternal genes and provides the variation [1 mark] |
| 6 | a | Changes to the sex chromosomes | • identifies the change [1 mark] |
| | b | Turner syndrome | • provides Turner syndrome [1 mark] |
| 7 | a | There is a common ancestor. | • identifies a correct assumption [1 mark] |
| | b | *C. psittacula*<br>It has the shortest genetic distance from the common ancestor. | • identifies *C. psittacula* [1 mark]<br>• provides a valid reason [1 mark] |

| Question | | Sample response | The response |
|---|---|---|---|
| | c | Genetic distance is less than 0.02, indicating a high level of DNA similarity. | • identifies degree of similarity [1 mark] |
| | d | Two other types of evidence are comparative genomic data and comparative anatomy. | • identifies comparative genomic data [1 mark]<br>• identifies comparative anatomy [1 mark] |
| 8 | a | A: assimilation of food by the organisms at the trophic level.<br>F: energy lost in the form of faeces and other excretory products | • identifies the transfer at A [1 mark]<br>• identifies the transfer at F [1 mark] |
| | b | Autotrophs convert solar radiation to chemical energy via photosynthesis.<br>Chemical energy transferred from autotroph to herbivore via assimilation or consumption. | • correctly explains the transformation [1 mark]<br>• correctly explains the transfer [1 mark] |
| | c | The processes are more efficient than subsequent transfer processes. | • explains that later trophic energy transfers are less efficient [1 mark] |
| 9 | | Pioneer species such as grasses grow back first.<br>Fast growing trees develop while shade-tolerant species develop in the understory.<br>The sere is overtaken by a dominant climax species. | • correctly explains the first stage of succession [1 mark]<br>• correctly explains the second stage of succession [1 mark]<br>• correctly explains the third stage of succession [1 mark] |
| 10 | a | Cassowary | • identifies cassowary as keystone species [1 mark] |

| Question | | Sample response | The response |
|---|---|---|---|
| | b | The ecosystem will collapse.<br>Seeds of fruit trees are not dispersed and all other organisms in the ecosystem rely on fruit trees. | • identifies that ecosystem will collapse [1 mark]<br>• provides a valid reason [1 mark] |
| | c | The mechanism that would most likely influence gene flow would be geographical isolation.<br>Species which are separated geographically may find it difficult to breed, thus reducing gene flow. Also, species which are separated geographically may have reduced fitness and fecundity. | • correctly identifies mechanism [1 mark]<br>• provides reduced gene flow as a reason [1 mark]<br>• provides reduced fitness as a reason [1 mark] |
| 11 | a | In both forests, soil respiration is lowest in January and highest in July. Also, in both forests, litterfall is lowest in December and highest in October.<br>However, the range of soil respiration in the secondary forest (SF) is lower compared to the primary forest (PF). This is because there is less biomass in the soil of the secondary forest (SF). | • identifies a valid similarity of soil temperature data [1 mark]<br>• identifies a valid similarity of litterfall data [1 mark]<br>• identifies a valid difference in trends [1 mark]<br>• identifies a valid significance of the trends [1 mark] |
| | b | Carrying capacity would increase leading to increased levels of litterfall.<br>This is because nutrients for primary producers are a density-independent factor. | • identifies a valid effect [1 mark]<br>• provides a valid reason [1 mark] |