Agricultural Science General Senior Syllabus 2019 v1.2

Subject report 2020

February 2021

Contents

Introduction

The first summative year for the new Queensland Certificate of Education (QCE) system was unexpectedly challenging. The demands of delivering new assessment requirements and processes were amplified by disruptions to senior schooling arising from the COVID-19 pandemic. This meant the new system was forced to adapt before it had been introduced — the number of summative internal assessments was reduced from three to two in all General subjects. Schools and the QCAA worked together to implement the new assessment processes and the 2020 Year 12 cohort received accurate and reliable subject results.

Queensland's innovative new senior assessment system combines the flexibility and authenticity of school-based assessment, developed and marked by classroom teachers, with the rigour and consistency of external assessment set and marked by QCAA-trained assessment writers and markers. The system does not privilege one form of assessment over another, and both teachers and QCAA assessors share the role of making high-stakes judgments about the achievement of students. Our commitment to rigorous external quality assurance guarantees the reliability of both internal and external assessment outcomes.

Using evidence of student learning to make judgments on student achievement is just one purpose of assessment. In a sophisticated assessment system, it is also used by teachers to inform pedagogy and by students to monitor and reflect on their progress.

This post-cycle report on the summative assessment program is not simply being produced as a matter of record. It is intended that it will play an active role in future assessment cycles by providing observations and findings in a way that is meaningful and helpful to support the teaching and learning process, provide future students with guidance to support their preparations for summative assessment, and promote transparency and accountability in the broader education community. Reflection and research are necessary for the new system to achieve stability and to continue to evolve. The annual subject report is a key medium for making it accessible to schools and others.

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Background

Purpose

The annual subject report is an analysis of the previous year's full summative assessment cycle. This includes endorsement of summative internal assessment instruments, confirmation of internal assessment marks and external assessment.

The report provides an overview of the key outcomes of one full teaching, learning and assessment cycle for each subject, including:

- information about the application of the syllabus objectives through the design and marking of internal and external assessments

- information about the patterns of student achievement in each subject for the assessment cycle.

It also provides advice to schools to promote continuous improvement, including:

- identification of effective practices in the design and marking of valid, accessible and reliable assessments

- identification of areas for improvement and recommendations to enhance the design and marking of valid, accessible and reliable assessment instruments

- provision of tangible examples of best practice where relevant, possible and appropriate.

Audience and use

This report should be read by school leaders, subject leaders and teachers to inform teaching and learning and assessment preparation. The report is to be used by schools and teachers to assist in assessment design practice, in making assessment decisions and in preparing students for external assessment.

The report is publicly available to promote transparency and accountability. Students, parents, community members and other education stakeholders can learn about the assessment practices and outcomes for General subjects (including alternative sequences and Senior External Examination subjects, where relevant) and General (Extension) subjects.

Report preparation

The report includes analyses of data and other information from the processes of endorsement, confirmation and external assessment, and advice from the chief confirmer, chief endorser and chief marker, developed in consultation with and support from QCAA subject matter experts.

Subject data summary

Subject enrolments

Number of schools offering the subject: 52.

Completion of units	Unit 1	Unit 2	Units 3 and 4*
Number of students completed	455	475	479

*Units 3 and 4 figure includes students who were not rated.

Units 1 and 2 results

Number of students	Satisfactory	Unsatisfactory	Not rated
Unit 1	427	28	0
Unit 2	436	37	2

Units 3 and 4 internal assessment results

> **2020 COVID-19 adjustments**
>
> To support Queensland schools, teachers and students to manage learning and assessment during the evolving COVID-19 pandemic in 2020, the QCAA Board approved the removal of one internal assessment for students completing Units 3 and 4 in General and Applied subjects.
>
> In General subjects, students completed two internal assessments and an external assessment. Schools made decisions based on QCAA advice and their school context. Therefore, across the state some instruments were completed by most schools, some completed by fewer schools and others completed by few or no schools. In the case of the latter, the data and information for these instruments has not been included.

Total results for internal assessment
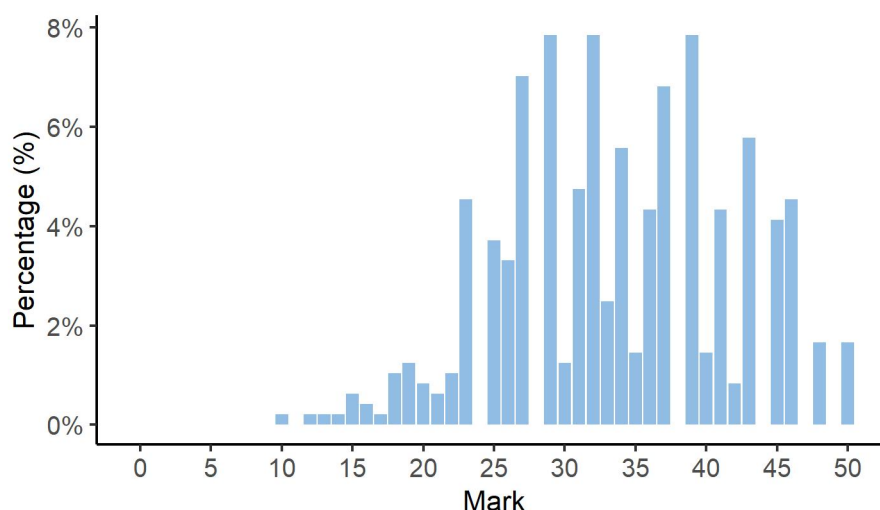
IA1 results

IA1 total
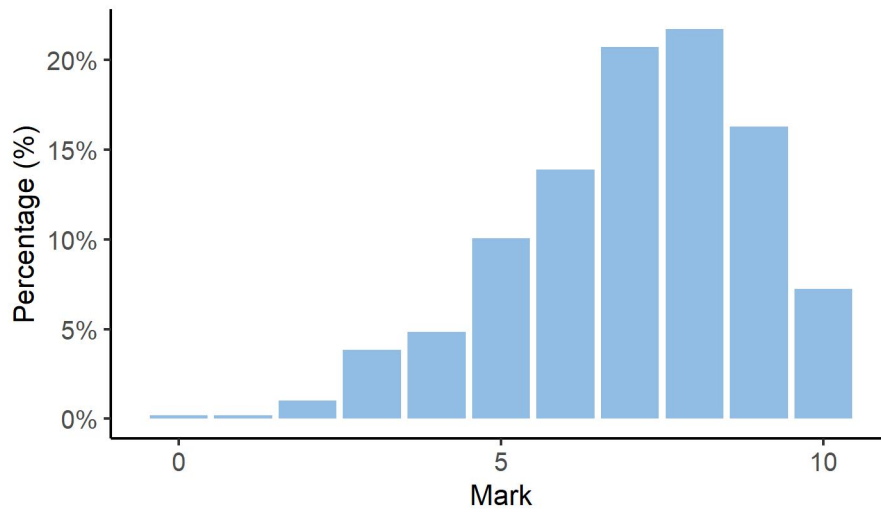
IA1 Criterion 1
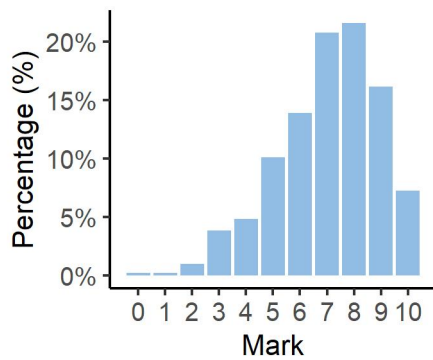
IA2 results

IA2 total
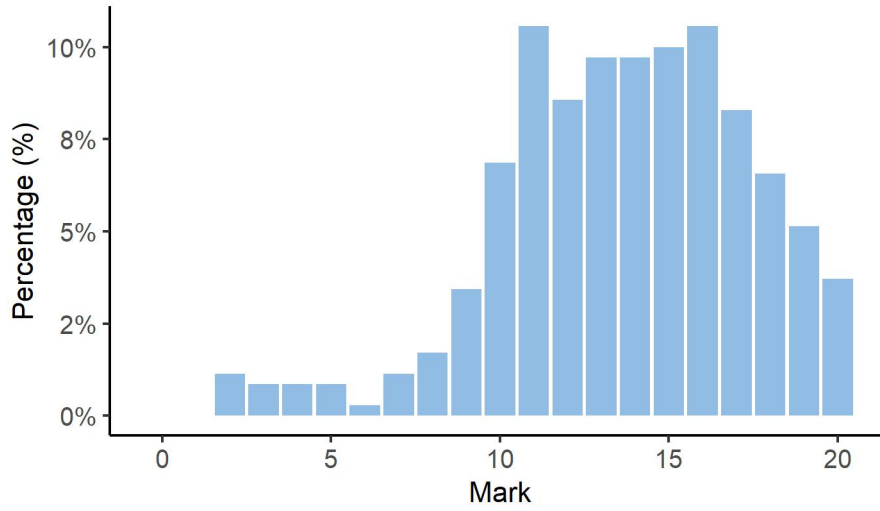
IA2 Criterion 1
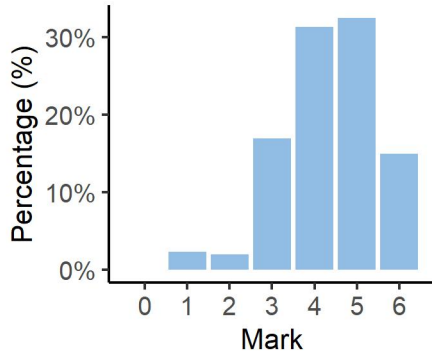
IA2 Criterion 2
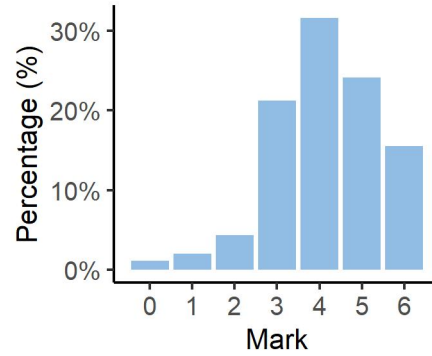
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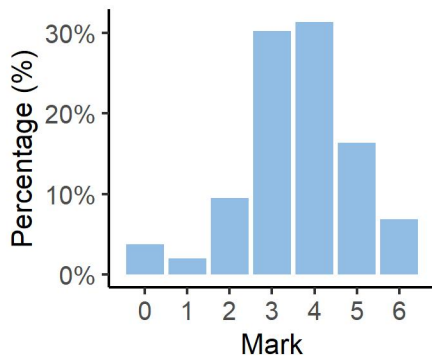
IA2 Criterion 4
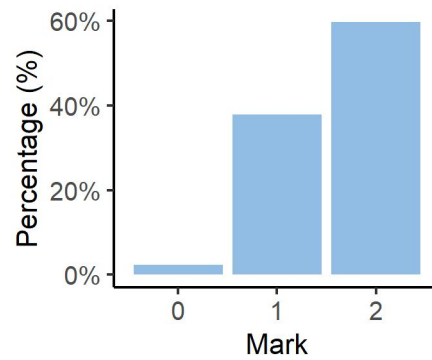
IA3 results

IA3 total
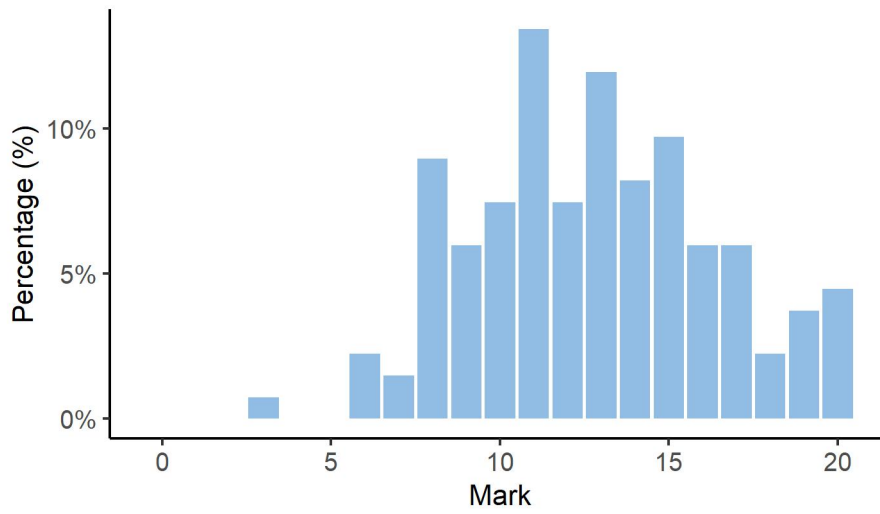
IA3 Criterion 1
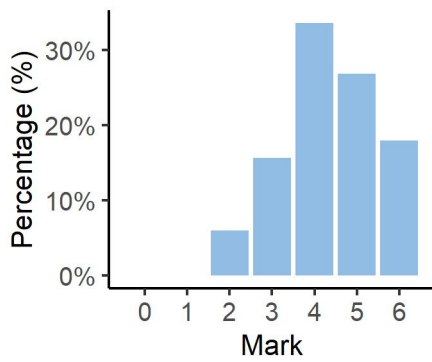
IA3 Criterion 2
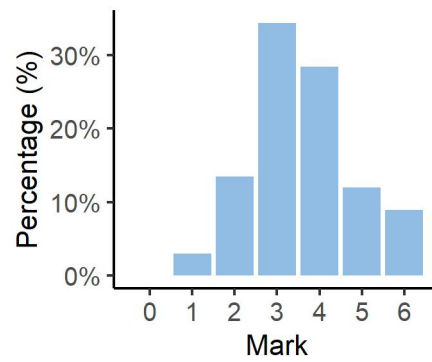
IA3 Criterion 3
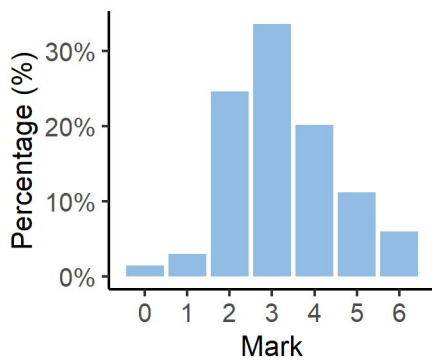
IA3 Criterion 4
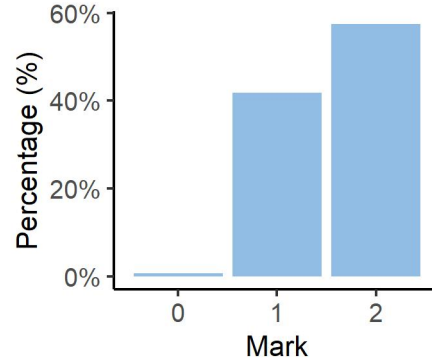
External assessment results
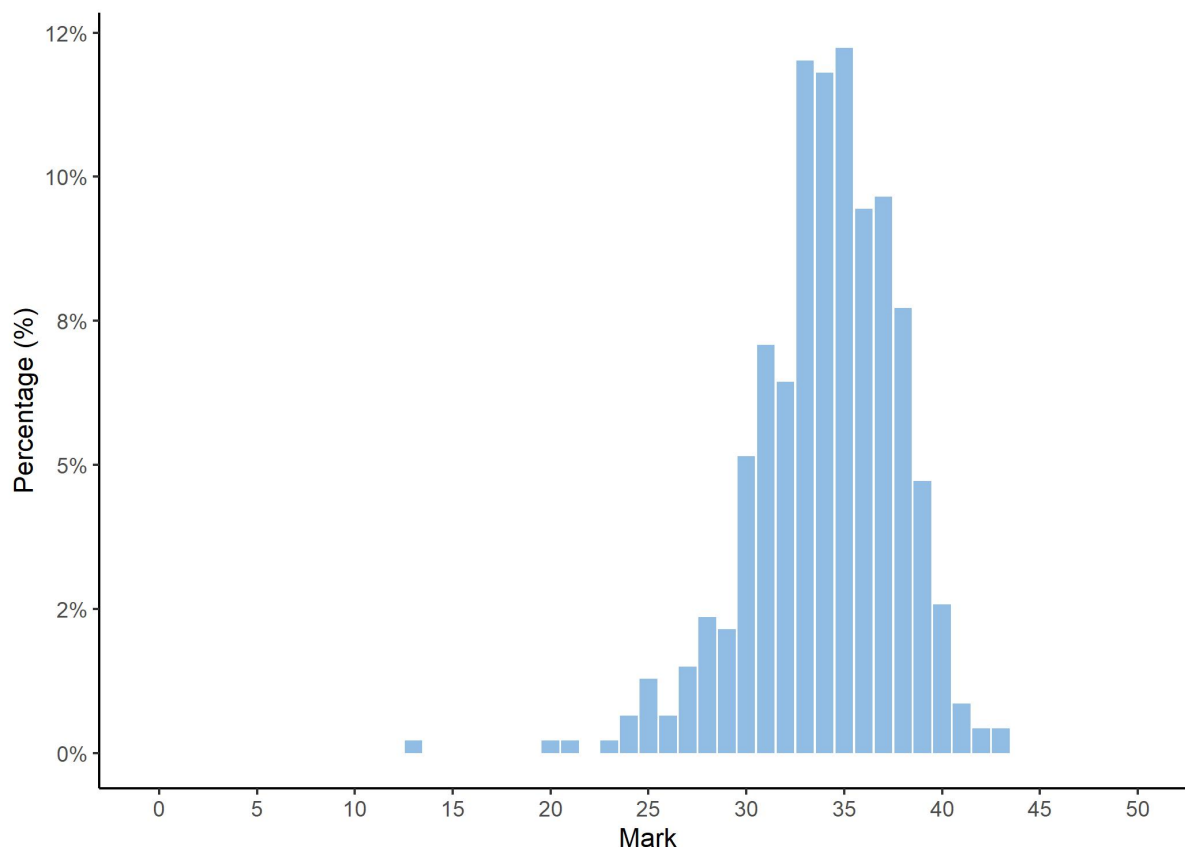
Final standards allocation

The number of students awarded each standard across the state are as follows.

Standard	A	B	C	D	E
Number of students	77	233	150	6	0

Grade boundaries

The grade boundaries are determined using a process to compare results on a numeric scale to the reporting standards.

Standard	A	B	C	D	E
Marks achieved	100–80	79–64	63–46	45–21	20–0

Internal assessment

The following information and advice pertain to the assessment design and assessment decisions for each IA in Units 3 and 4. These instruments have undergone quality assurance processes informed by the attributes of quality assessment (validity, accessibility and reliability).

Endorsement

Endorsement is the quality assurance process based on the attributes of validity and accessibility. These attributes are categorised further as priorities for assessment and each priority can be further broken down into assessment practices. Data presented in the assessment design sections identifies the reasons why IA instruments were not endorsed at Application 1, by the priority for assessments. An IA may have been identified more than once for a priority for assessment, e.g. it may have demonstrated a misalignment to both subject matter and to the assessment objective. Refer to the quality assurance tools for detailed information about the assessment practices for each assessment instrument.

Total number of items endorsed in Application 1

Number of items submitted each event	IA1	IA2	IA3
Total number of instruments	53	53	53
Percentage endorsed in Application 1	32	85	92

Confirmation

Confirmation is the quality assurance process based on the attribute of reliability. Teachers make judgments about the evidence in students' responses using the instrument-specific marking guide (ISMG) to indicate the alignment of students' work with performance-level descriptors and determine a mark for each criterion. These are provisional criterion marks. The QCAA makes the final decision about student results through the confirmation processes. Data presented in the assessment decisions section identifies the level of agreement between provisional and final results.

Number of samples reviewed at initial, supplementary and extraordinary review

IA	Number of schools	Number of samples requested	Supplementary samples requested	Extraordinary review	School review	Percentage agreement with provisional
1	52	247	0	0	0	100
2	31	152	12	0	0	97.34
3	21	96	9	0	2	87.31

Internal assessment 1 (IA1)

Data test (10%)

The IA1 data test requires students to apply a range of cognitions to multiple provided items. Students respond to items using qualitative and/or quantitative data derived from practicals, activities or case studies on topics from Unit 3. The task requires students to identify unknown scientific quantities or features; identify trends, patterns, relationships, limitations or uncertainty in datasets; and draw conclusions based on the analysis of data.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment — validity practices

Validity priority	Number of times priority was identified in decisions*
Alignment	27
Authentication	0
Authenticity	5
Item construction	3
Scope and scale	8

*Total number of submissions: 53. Each priority might contain up to four assessment practices.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that featured:

- a variety of datasets that were clearly derived from Unit 3 subject matter, e.g. mandatory or suggested practicals

- items that demonstrated clear alignment with the objectives being assessed by using the cognitive verbs listed in the mark allocation table in the syllabus, e.g. objective 2 items that used the following verbs: calculate, determine, identify, recognise and use

- authentic datasets and items that were clearly based on teaching and learning activities that students had experienced, e.g. results from a fertiliser plant production trial

- authentic datasets and items that accurately reflected industry specifications, e.g. market specifications for steers for domestic and export trade

- items that showed clear alignment between the cognition in the question, the objective being assessed and the expected student response

- items that used only one cognition

- a marking scheme that clearly matched each mark to a valued feature of the expected response, e.g. 1 mark for correctly substituting values into the formula and 1 mark for calculating the correct value

- only the relevant data that students would need to respond to the given items

- questions that were scaffolded to assess objectives independently, e.g. using separate items to a) calculate the average daily growth rate (objective 2) and b) draw a conclusion about which treatment was most effective (objective 4).

Practices to strengthen

It is recommended that assessment instruments:

- include unseen datasets that are appropriately different from QCAA sample assessments

- include a sequence of items that is appropriately different from QCAA sample assessments

- include an appropriate amount of data within each dataset to allow students to understand the dataset and respond to the items within 60 minutes

- include a balance of items across the apply, analyse and interpret objectives as per the syllabus instrument mark allocation table

- include only items that require students to use the given datasets

- avoid assessing objective 1 — describe and explain; valid data test items only assess objectives 2, 3 and 4

- avoid unnecessary repetition of cognitions, subject matter or calculations

- contain all the information required to answer the questions posed

- are designed so that each item on the data test requires a unique response that does not lead on from another item

- include only item types appropriate to a data test, i.e. avoid multiple-choice items.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment — accessibility practices

Accessibility priority	Number of times priority was identified in decisions*
Transparency	6
Language	6
Layout	14
Bias avoidance	8

*Total number of submissions: 53. Each priority might contain up to four assessment practices.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that featured:

- clear links between the items and the data required to answer the question, e.g. see figure 1 in dataset 1

- consistent layout and language with clearly legible datasets, including legends, labelled axes, correct units and figure labels

- minimal distractors, e.g. brief and succinct instructions that avoided unnecessary detail or complexity

- a response space that matched the length of the expected response, e.g. only one line if a single word response was expected.

Practices to strengthen

It is recommended that assessment instruments:

- use language consistently between datasets and items, e.g. avoid referring to the same measurement using different terms — *average* height versus *mean* height

- are written with the use of the maths editor to correctly represent formulas

- are formatted using the page break tool in the Endorsement application to ensure that datasets, figure labels and items are not separated across pages. The print preview function should be used to ensure the layout of the task is appropriate.

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and final results

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional
1	Data test	100	0	0

Effective practices

Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- marking schemes were updated to demonstrate how unexpected responses were marked

- marks allocated were an accurate reflection of the work required to respond to the question

- schools applied their marking schemes consistently across cohorts.

Samples of effective practices

There are no student response excerpts because either the student/s did not provide permission or there were third-party copyright issues in the response/s.

Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG in this IA, it is recommended that:

- schools check that mark totals and percentages have been determined correctly

- schools correctly use the percentage cut-offs from the ISMG to determine the final mark out of 10

- schools implement internal quality assurance processes (e.g. cross marking) to ensure intra-marker and inter-marker reliability

- marking schemes accurately reflect the marks allocated to each question, e.g. whether half marks are being used.

Additional advice

- Teachers should note that objective 7 — Communication is not assessed in this IA. Therefore, marks should not be awarded for units and rounding.

- Schools should seek feedback on draft assessment tasks from across their community of practice (i.e. within the school and, where possible, between schools) to ensure accuracy of subject matter content.

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Internal assessment 2 (IA2)

Student experiment (20%)

The IA2 student experiment requires students to modify (i.e. refine, extend or redirect) an experiment to address their own hypothesis or question related to topics from Unit 3. Students may use a practical performed in class as the basis for their methodology. They develop a research question, collect and process primary data, analyse and interpret evidence, and evaluate the reliability and validity of their experimental process.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment — validity practices

Validity priority	Number of times priority was identified in decisions*
Alignment	5
Authentication	1
Authenticity	0
Item construction	0
Scope and scale	0

*Total number of submissions: 53. Each priority might contain up to four assessment practices.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that featured:

- clear alignment of cognitions and language with the syllabus and the assessment objectives

- authentication strategies that included guidance for drafting, scaffolding and teacher feedback

- checkpoints to monitor student progress through the task, e.g. select modifications, complete risk assessment, collect and analyse data, submit draft, submit final response

- clear directions for the way students should respond, to effectively model scientific investigations

- clear communication of the genre to be used, e.g. scientific report or multimodal presentation

- an indication of how students can work collaboratively and how the school will manage authentication of student work in these situations, e.g. the teacher will compare the responses of students who have worked together in groups

- clear scaffolding that modelled processes and directed students to address all components of the task without leading students to a pre-determined response

- a clear statement that feedback can only be provided on one draft.

Practices to strengthen

It is recommended that assessment instruments:

- include only experiments clearly related to Unit 3 subject matter for students to modify, e.g. experiments on crop yield (Unit 3), not crop growth (Unit 1)

- include all the task specifications in the task description

- include appropriate information from the syllabus in the scaffolding section, e.g. timeline, checkpoints, prompts about the requirements for the response

- include appropriate drafting and authentication strategies, e.g. collecting progressive samples of student work, interviews with students.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment — accessibility practices

Accessibility priority	Number of times priority was identified in decisions*
Transparency	1
Language	2
Layout	0
Bias avoidance	0

*Total number of submissions: 53. Each priority might contain up to four assessment practices.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that featured:

- clear instructions that aligned to the specifications within the syllabus, the assessment objectives and the ISMG

- clear communication of task elements, using clear, succinct language and featuring accurate spelling, grammar and textual features

- communication that avoided jargon and colloquial language

- clear, appropriate headings

- checkpoints that provided an indication of the time available to students (e.g. Week 4) rather than specific dates.

Practices to strengthen

It is recommended that assessment instruments:

- include scaffolding that clearly directs students to address all aspects of the task, including the rationale

- avoid repetition of elements of the task in different sections.

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and final results

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional
1	Research and planning	97.41	0.57	2.01
2	Analysis of evidence	95.11	2.59	2.3
3	Interpretation and evaluation	96.84	2.87	0.29
4	Communication	100	0	0

Effective practices

Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- in the Research and planning criterion, students who developed a hypothesis for their experiments also provided a *specific and relevant* research question

- in the Analysis of evidence criterion

  - the following analysis techniques were used to demonstrate *thorough* identification of trends, patterns or relationships

    - measures of central tendency, e.g. mean

    - measures of dispersion, e.g. standard deviation

    - measures of correlation, e.g. regression analysis coefficient, R^2

  - the following analysis techniques were used to demonstrate *thorough and appropriate* identification of uncertainty and limitations of evidence

    - indicators of uncertainty, e.g. standard error, confidence intervals

    - statistical tests, e.g. Student's t-test

- in the Interpretation and evaluation criterion, discussion of the reliability and validity of the experimental process was *justified* by referring to the uncertainty and limitations identified in the analysis of the evidence.

Samples of effective practices

The following is an excerpt from a response that illustrates the characteristics for the criterion at the performance level indicated. The sample may provide evidence of more than one criterion. The characteristics highlighted may not be the only time the characteristics have occurred throughout the response.

| **Research and planning (5–6 marks)** **A considered rationale for the experiment** The rationale clearly connects the research question to Unit 3 subject matter. **Research and planning (5–6 marks)** **A specific and relevant research question** The research question is clearly connected to Unit 3 subject matter and can be answered within the required response length. | produce goods. Gibberellic acid (GAcid) is known for stimulating cell division and stem elongation. GAcid is known to manipulate flowering and fruit development in horticultural crops (Agric, 2019). GAcid is produced in young and growing plant tissues, such as shoots, young leaves and flowers (NCBI, 2013). GAcid is required throughout the plant's entire lifespan from its germinative state to the plant's reproductive state. It is one of the most important hormones in the plant, allowing for its growth and development. In agriculture, GAcid is used to increase the growth rates of plants, mainly in early development. **Research Question:** What is the optimal concentration of Gibberellic acid needed to increase the growth rate of mung bean seeds? *– clearly defined + measurable* *– clear IV + DV* |

| **Research and planning (5–6 marks)** **A methodology that enables the collection of sufficient, relevant data** The modifications to the methodology ensured that the experiment collected enough data to draw valid conclusions to the research question. | Table 2: Raw height of Mung bean seed stems (+ leaves) in cm, under different concentrations |

Days:	0ppm GAcid Conc	500ppm GAcid Conc	2000ppm GAcid Conc
Day 0	0,0,0,0,0,0	0.5,0,0.5,0,0,0.5	1,1,1,1,1,0
Day 1	0,0,0,0.2,0,0	0,0,0.1,0.7,0.8,1	1,1,0,1,1.1,1.2
Day 2	0,0,0,0,0,0.4	0,0.2,0.4,1,1.2,1.3	1,0,1,1.3,1.2,1.4
Day 3	0.6,0,0,0,0,0	1.5,1.5,1.5,0.5,0.5,0	0,1,1,1.5,1.5,1.5
Day 4	0,0,0.5,0.5,0,3.4	2.8,5.5,0,0,5.9,3.8	5,1.5,6.5,6,6.2,0
Day 5	0,0,0.5,0.5,4.5,0	6.5,3.4,4.1,6.3,7.5,4.8	7.1,8.3,8,2.4,7.5,0
Day 6	1,1.1,0,2,6,7	8,5.5,9.5,4.5,7,9.5	10,9,9.5,0,9,2
Day 7	1.8,2.3,0,2.4,6.5,7.7	8.3,5.7,9.8,5.3,7.8, 10	10.6,9.8,10.2,0.5,9.4,2.7
Day 8	2.9,3.4,0,3.2,7.8,8.6	7.2, 6.4, 9.5, 12.3, 12.7, 13.6	5,11.3,13,14.2,0,4.5
Day 9	0,6.3,7.4,15,15,15	15,14,15,10,12,9	8.5,13,16,17,16,0

Shaded areas represent outliers

Sufficient + relevant raw data

Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG in this IA, it is recommended that:

- in the Research and planning criterion
  - a *considered* rationale should clearly connect the research question to Unit 3 subject matter
  - a *specific* research question should be explicit enough to be answered within the required response length

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- *justified* modifications to the methodology should ensure that the experiment collects sufficient data to draw valid conclusions, e.g. at least five subjects in a sample population, at least five data points to establish a trend

- in the Analysis of evidence criterion, *thorough and appropriate* identification of trends/patterns/relationships and uncertainty/limitations of evidence should demonstrate a suitable match between the data analysis techniques used and the type of data collected, e.g. if testing for a difference, a Student t-test is appropriate and regression analysis is not appropriate.

Additional advice

- Schools should use the ISMG from the syllabus without making any changes to wording or formatting.

- In the best-fit process for using ISMGs, when all the descriptors in a performance level have been demonstrated, the mark should be the higher of the two possible marks for that performance level.

- Experimental methodologies should consider only one dependent variable (e.g. mandatory or suggested practicals from the syllabus) rather than complicated experiments that considered more than one dependent variable or involved complex systems in which external variables are difficult to control.

- As part of the teaching and learning process, teachers should demonstrate the relevant data processing techniques that can be used to identify trends/patterns/relationships and uncertainty/limitations of data in practicals before students use these practicals as a basis their experiments.

- Teachers should use the strategies identified in the *QCE and QCIA policy and procedures handbook* to

  - manage response length to ensure that student responses meet the conditions of the syllabus

  - promote academic integrity to ensure that student responses clearly demonstrate their students' own achievement.

- Experiments involving animals must follow accepted ethical guidelines.

Internal assessment 3 (IA3)

Research investigation (20%)

The IA3 research investigation requires students to gather secondary evidence related to a research question in order to evaluate a claim about topics from Unit 4. Students develop a research question, collect and analyse secondary data, interpret evidence to form a justified conclusion, discuss the quality of the evidence and extrapolate the findings of the research to the claim.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment — validity practices

Validity priority	Number of times priority was identified in decisions*
Alignment	1
Authentication	0
Authenticity	0
Item construction	1
Scope and scale	0

*Total number of submissions: 53. Each priority might contain up to four assessment practices.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that featured:

- simple and direct claims that were clearly aligned to Unit 4 subject matter, e.g. continued reliance on backpackers as seasonal workers has resulted in a shortage of skilled labour

- claims that could generate multiple research questions, e.g. dryland salinity is one of the greatest environmental threats to Australian agriculture

- claims that could be narrowed down into specific and relevant research questions, e.g. management of physical or biological resources available to agricultural enterprises can be improved through the adoption of agri-technology

- claims that have sufficient data available for students to research, e.g. estimated breeding values are the best way of determining genetic potential for traits that impact profitability

- sufficient claims for the size of the cohort, allowing students to develop unique responses to the task

- authentication strategies that included guidance for drafting, scaffolding and teacher feedback

- checkpoints to monitor student progress through the task

- scaffolding that directed students to address all components of the task

- tasks that can be completed within the conditions of the syllabus, i.e. 1500–2000 words or 9–11 minutes.

Practices to strengthen

It is recommended that assessment instruments:

- include all the task specifications in the task description

- contain claims that are clearly derived from Unit 4 subject matter, i.e. enterprise management or evaluation of an agricultural enterprise

- use claims that are assertions without evidence. Science as a Human Endeavour (SHE) statements from the syllabus can be used as a starting place to develop claims; however, these statements are not necessarily suitable to be directly used as claims

- include appropriate information in the scaffolding section, e.g. it does not lead students towards a predetermined response by specifying the scientific concepts students are to investigate.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment — accessibility practices

Accessibility priority	Number of times priority was identified in decisions*
Transparency	1
Language	0
Layout	0
Bias avoidance	0

*Total number of submissions: 53. Each priority might contain up to four assessment practices.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that featured:

- claims written using clear, succinct language and featuring accurate spelling, grammar and textual features

- clear instructions that aligned to the specifications within the syllabus, the assessment objectives and the ISMG

- clear, appropriate headings

- checkpoints that provided an indication of the time available to students (e.g. Week 4) rather than specific dates.

Practices to strengthen

It is recommended that assessment instruments:

- have claims written using clear, succinct language

- identify checkpoints as a list.

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and final results

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional
1	Research and planning	86.57	5.97	7.46
2	Analysis and interpretation	84.33	14.93	0.75
3	Conclusion and evaluation	82.09	17.91	0
4	Communication	96.27	2.24	1.49

Effective practices

Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- in the Analysis and interpretation criterion, identification of *sufficient and relevant* evidence drew on qualitative and quantitative data from scientifically credible sources, e.g. peer-reviewed research papers

- in the Communication criterion, *fluent and concise* use of scientific language and representations ensured that student responses met syllabus requirements for response length.

Samples of effective practices

The following is an excerpt from a response that illustrates the characteristics for the criterion at the performance level indicated. The sample may provide evidence of more than one criterion. The characteristics highlighted may not be the only time the characteristics have occurred throughout the response.

Research and planning (5–6 marks) **A specific and relevant research question** The research question is clearly connected to Unit 4 subject matter and can be answered within the required response length.	Research Question: Can genetically modified AquAdvantage Salmon increase commercial salmon production by reducing the time required to reach a marketable weight?

| **Research and planning (5–6 marks)** **Development of the research question from the claim** The sequence of ideas linking the research question to the claim is easily seen. **Research and planning (5–6 marks)** **Selection of sufficient and relevant sources** This response uses enough sources to answer the research question. | **Claim:** 'The effect of technological advances has positively impacted upon agricultural production.' **Rationale:** Improvements in science and technology has allowed modern farms to become more productive and sustainable, which is necessary to sustain the worlds rapidly growing population (PrecisionAg, 2019). One area which has seen dramatic changes in recent years is livestock breeding and genetics. The practice of selective breeding has been around for a considerable length of time; however, technological developments have allowed significant improvements to occur, including artificial insemination, embryo transfer and identifying genes which increase production (Iowa Agriculture Literacy Foundation, 2018). Genetic modification is the changing of a gene/s in the genome of an organism (Australian Academy of Science, 2019). This can be done by selectively breeding animals or plants to develop desired traits as well as using technology to identify, isolate and transfer a gene from one organism to another (Australian Academy of Science, 2019). Genetically modified organisms (GMO) are organisms whose DNA has been modified to produce a desired effect or product (Britannica, n.d.) (e.g. herbicide resistance), while transgenic organisms are a type of GMO which has had external genes inserted into its genome (Quizlet, n.d.). An example of this is AquaBounty Technologies' transgenic AquAdvantage Salmon (AAS). |

	Number of Fish	Mean Weight (g)	Standard Error of Weight	Number of Fish Weighing > 100 g	Percent of Fish Weighing > 100 g
Control Diploids	306	72.6	1.02	15	4.9
AquAdvantage Triploids	369	261.0	3.29	364	98.6

GROWTH PERFORMANCE (MARKET SIZE)
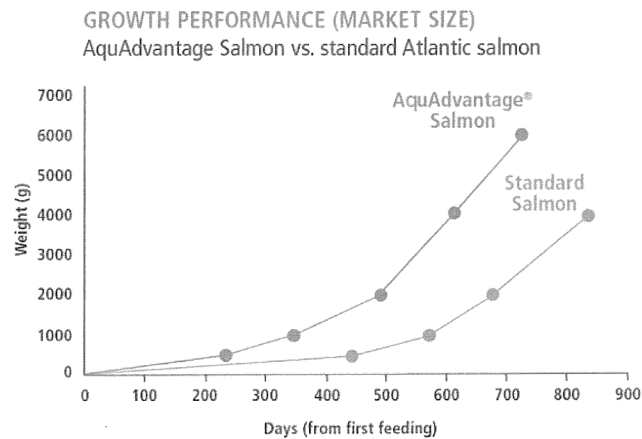AquAdvantage Salmon vs. standard Atlantic salmon

Figure 3: Growth Performance (*Source: AquaBounty Technologies, n.d.*)

| **Analysis and interpretation (5–6 marks)** **Thorough identification of relevant trends patterns or relationships** The response identifies patterns and relationships that address the research question. | Figure 3 shows similar data to figure 2, with days from first feeding displayed on the x-axis rather than days. This data on this graph follows the same general trend as the data on figure 2. The earlier increase in weight is likely explained due to the days not included prior to feeding, which could also explain the earlier increased growth rates. The data on this graph shows the growth of AAS up to 6000g and salmon to 4000g. The average growth rate of AAS was 8.45g/day, which is 3.65g/day more than standard salmon (4.8g/day). Both follow an almost exponential growth pattern, however, AAS's curve increases much more steeply than standard salmon. Extrapolation suggests that standard salmon would reach a weight of 6000g at approximately 990 days, which is nearly 280 days after AAS. |

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Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG in this IA, it is recommended that:

- in the Research and planning criterion

    – a *considered* rationale should clearly connect the research question to Unit 4 subject matter

    – a *specific* research question should be explicit enough to be answered within the required response length

    – a *relevant* research question should be clearly developed from the claim

- in the Conclusion and evaluation criterion, *insightful* discussion of the quality of the evidence should refer to the limitations already identified in the analysis.

Additional advice

- Schools should use the ISMG from the syllabus without making any changes to wording or formatting.

- Teachers should develop resources and teaching/learning strategies that reflect the specific requirements of a research investigation (e.g. a rationale that develops the research question from a claim, extrapolation of findings of the research to the claim) rather than using approaches from previous syllabuses (e.g. extended response task) or other contexts (e.g. literature review).

- Teachers should develop ways to demonstrate to their students how to access scientifically credible sources, e.g. peer-reviewed articles. Simple Google searches and internet news articles are not sufficient for this type of assessment.

- Teachers should use the strategies identified in the *QCE and QCIA policy and procedures handbook* to

    – manage response length to ensure that student responses meet the conditions of the syllabus

    – promote academic integrity to ensure that student responses clearly demonstrate their students' own achievement.

External assessment

Summative external assessment (EA) — Examination (50%)

Assessment design

Assessment specifications and conditions

Description

This examination included two papers. Each paper consisted of different types of possible items:

- multiple choice

- short response items requiring single-word, sentence or paragraph responses

- calculating using algorithms

- interpreting graphs, tables or diagrams

- responding to unseen data and/or stimulus

- extended response (300–350 words or equivalent).

Conditions

Paper 1

- Time: 90 minutes plus 10 minutes perusal.

- Other: QCAA-approved graphics calculator permitted.

Paper 2

- Time: 90 minutes plus 10 minutes perusal.

- Other: QCAA-approved graphics calculator permitted.

The assessment instrument consisted of two papers. Questions were derived from the context of Unit 3 and 4. This assessment was used to determine student achievement in the following assessment objectives:

1. describe and explain animal and plant production, agricultural enterprises, enterprise management, and evaluation of an agricultural enterprise

2. apply understanding of animal and plant production, agricultural enterprises, enterprise management, and evaluation of an agricultural enterprise

3. analyse evidence about animal and plant production, agricultural enterprises, enterprise management, and evaluation of an agricultural enterprise to identify trends, patterns, relationships, limitations or uncertainty

4. interpret evidence about animal and plant production, agricultural enterprises, enterprise management, and evaluation of an agricultural enterprise to draw conclusions based on analysis.

Paper 1 Section 1 was 20 multiple choice questions (20 marks).

Paper 1 Section 1 was 10 short response questions (44 marks).

Paper 2 Section 2 was 9 short response questions (36 marks).

Paper 2 Section 2 was 1 extended response question (15 marks).

Assessment decisions

Overall, students responded well to the following assessment aspects:

- describing and explaining concepts relevant to Unit 3 Topic 1 (animal health) and Unit 4 Topic 2 (environmental factors) subject matter.

- application of knowledge relevant to data from Unit 4 Topic 2 for environmental factors.

Effective practices

The following samples were selected to illustrate highly effective student responses in some of the assessment objectives of the syllabus.

Multiple choice item response

Assessment objective: Objective 1 — Describe and explain

Item: Paper 1, Question 9

QUESTION 9

Which part of the PPRR model of risk management best demonstrates a producer's decision to sell non-breeders during a drought?

(A) prevention

(B) preparedness

(C) response

(D) recovery

Option	Validity statements
A	This option is another part of the PPRR model that is not appropriate for this strategy.
B	This option is another part of the PPRR model that is not appropriate for this strategy.
C	This option is the key because it is the correct part of the PPRR model which would see that risk avoidance strategy occurring.
D	This option is another part of the PPRR model that is not appropriate for this strategy.

Assessment objective: Objective 1 — Describe and explain

Item: Paper 1, Question 13

QUESTION 13

The table identifies the minimum requirements for different lamb export markets.

Market segment	Liveweight range (kg)	Carcass weight range (kg)	Preferred fat score
Heavy export	38–64	20–30	2 to 4
Light export	25–35	10–16	2
'Hajj' market	35–41	18–22	No preference

Identify the lamb that is best suited to the heavy export market.

Lamb	Liveweight (kg)	Carcass weight (kg)	Fat score
(A)	50	27	1
(B)	40	23	5
(C)	40	22	3
(D)	35	19	2

'Module 3: Market focused lamb and sheepmeat production', Making More From Sheep, www.makingmorefromsheep.com.au/market-focussed-lamb-and-sheepmeat-production/tool_3.2.html (c) Australian Wool Innovation and Meat and Livestock Australia 2008. Used with permission.

Option	Validity statements
A	This option is not suitable due to the fat score not meeting market requirements.
B	This option is not suitable due to the fat score not meeting market requirements.
C	This option is the key because it correctly identifies the lamb that is best suited to the heavy export market.
D	This option is not suitable due to the liveweight not meeting market requirements.

Short response

Assessment objective: Objective 1 — Describe and explain

Item: Paper 1, Question 30

Student sample of an effective response

Effective student responses:

- identified a genetically engineered crop

- described two benefits of the identified crop.

Describe and explain (3 marks)	**QUESTION 30 (3 marks)** Use an example to explain two benefits for farmers who use genetically engineered crops. Farmers can benifet greatly from ~~GMO~~ genetically engineered clops. For example BT cotton allows farmers to reduce ~~pesticide~~ chemical use by natturaly killing the organism. Resulting in lower costs and less chemical use. ~~Further~~ Secondly BT cotton results in higher yeilds by removing the organism from affecting plants. **END OF PAPER**

This sample has been included to demonstrate a response that clearly and correctly responds to the item within the response space.

Assessment objective: Objective 2 — Apply understanding

Item: Paper 1, Question 22

Student samples of effective responses

Effective student responses:

- identified key data and relationships for calculating stocking rate

- showed appropriate working for calculating the stocking rate for 1 day

- correctly determined the stocking rate for a 25-day period

- determined the number of steers that can be run on 10 hectares for 25 days.

Apply understanding (4 marks)	**Excerpt 1** **QUESTION 22 (4 marks)** A producer has a 10-ha paddock with 2000 kg DM/ha of feed available. Calculate the number of 300-kg steers the producer could run in the paddock for 25 days. Assume these steers have a pasture intake of 10 kg DM/head/day and that pastures should be destocked to prevent over-grazing when they are at a mass of 1000 kg green DM/ha. Show your working. Feed avaible Feed consumed per head Ha feed/Ha 10 × 2000 kg 25 × 10 = 20,000 kg/DM/Ha - destocking = 250 kg/Ha - total = 20,000 - (10 × 1000) = 10,000 ÷ 250 = 20,000 - 10,000 = 40 = 10000 kg DM/Ha The producer could run 40 300 kg steers.

This sample has been included to demonstrate a response that clearly matches the features of the expected response.

Apply understanding (4 marks)	**Excerpt 2**

QUESTION 22 (4 marks)

A producer has a 10-ha paddock with 2000 kg DM/ha of feed available.

Calculate the number of 300-kg steers the producer could run in the paddock for 25 days. Assume these steers have a pasture intake of 10 kg DM/head/day and that pastures should be destocked to prevent over-grazing when they are at a mass of 1000 kg green DM/ha. Show your working.

amount each steer will eat in 25 days:

= 10 × 25

= 250 kg DM over 25 days

10ha paddock contains = 2000 × 10

= 20 000 kg DM = $\frac{20000}{2}$ to prevent overgraze

Therefore total cattle = $\frac{20000}{250}$ / $\frac{10000}{250}$

= 40 cattle

therefore a producer can run a total of 40 cattle

This sample has been included to demonstrate a response that used an alternative mathematical process to correctly respond to the item.

Assessment objective: Objective 4 — Interpret evidence

Item: Paper 1, Question 27

Student sample of an effective response

Effective student responses:

- identified an appropriate conclusion

- provided three pieces of evidence from the data to support the conclusion.

Interpret evidence (4 marks)	**QUESTION 27 (4 marks)** A trial was conducted to determine the efficacy of treatments for the Varroa mite in honey bees. Four treatments were used: the control, fungus *Metarhizium anisopliae* and pesticides (Product A and Product B). The table shows the mean values for each treatment.

Treatment	Mean values for mite infestation of adult bees (%)		Mean values for mites remaining in the hive after treatment	Honey extracted (kg)
	Before treatment	**After treatment**		
Control	1.55 ± 0.68	1.93 ± 0.38	56.79 ± 8.59	6
Metarhizium	1.28 ± 0.45	0.32 ± 0.03	21.14 ± 4.79	9
Product A	0.87 ± 0.01	0.02 ± 0.01	0.71 ± 0.10	12
Product B	0.92 ± 0.05	0.03 ± 0.01	0.81 ± 0.15	14

Use the table to draw a conclusion about the most effective treatment for the control of the Varroa mite in honey bees. Provide three pieces of evidence from the data to support your conclusion.

→ the most effective treatment would be product A. As it shows the least mites remaining in the hive after treatment (0.71), has the lowest adult bees mite infestation after treatment (0.02) and had the best reliability of results as it recorded the lowest error. However As the error bars over lap for product A and B, this indicates that there isn't a significant difference between using either of these treatments. Therefore product A would be the most effective choice but product B could also be used as there is no significant difference.

This sample has been included to demonstrate a response that clearly and correctly responds to the item within the response space.

Extended response

Assessment objectives: Objectives 1–4

Item: Paper 2 Question 10

Student sample of an effective response

Effective student responses:

- described and explained concepts relevant to social sustainability

- used graphical representations of data to determine unknown quantities

- explained regional phenomena, behaviours and implications associated with social sustainability of the identified agricultural enterprise

- identified trends in data associated with social sustainability of the identified agricultural enterprise

- drew conclusions about the social sustainability of the identified agricultural enterprise.

Interpret evidence [4 marks]	The beef cattle industry has the highest percentage of contributing family workers. This ~~teen~~ significant family involvement is ~~strength~~ advantageous for beef production as it promotes the implementation of succession planning. The emphasis on succession planning in this family context is a strength as it allows farmers to ensure that their farm is properly managed when they retire. Family involvement also provides a strong support network ~~and~~ and can help alleviate stress ~~and~~ and promote good mental health practices. Family involvement is also likely to improve the longevity of a production system as new members of families are incorporated into the farm prolonging its operational lifetime.

This sample has been included to demonstrate a section of the response that identifies student understanding of two of the three social sustainability criteria.

Practices to strengthen

It is recommended that when preparing students for external assessment, teachers consider:

- showing students how to identify the key features of items, e.g. cognitive verbs, data, cues. Examples of this include:

  – Paper 1 Question 21: Students need to respond to key features/cues of the item. A significant number of students did not identify a specific example.

  – Paper 1 Question 28: Although the item contained the cue: 'Use the table to identify the alternative method to mulesing', many students only referred to the graph.

- practise analysing primary data from mandatory practicals for students to understand the accuracy of the primary data that has been collected, for example

  – Paper 1 Item 27: Many students did not demonstrate a sufficient understanding of measures of uncertainty such as standard error and confidence intervals (e.g. 1.7 ± 0.3) to fully respond to the question.