Mathematical Methods subject report

2025 cohort

January 2026

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

260030

For all Queensland schools

Queensland Curriculum & Assessment Authority
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Contents

Introduction

The annual subject reports seek to identify strengths and opportunities for improvement of internal and external assessment processes for all Queensland schools. The 2025 subject report is the culmination of the partnership between schools and the QCAA. It addresses school-based assessment design and judgments, and student responses to external assessment for General and General (Extension) subjects. In acknowledging effective practices and areas for refinement, it offers schools timely and evidence-based guidance to further develop student learning and assessment experiences for 2026.

The report also includes information about:

- how schools have applied syllabus objectives in the design and marking of internal assessments
- how syllabus objectives have been applied in the marking of external assessments
- patterns of student achievement
- important considerations to note related to the revised 2025 syllabus (where relevant).

The report promotes continuous improvement by:

- identifying effective practices in the design and marking of valid, accessible and reliable assessments
- recommending where and how to enhance the design and marking of valid, accessible and reliable assessment instruments
- providing examples that demonstrate best practice.

Schools are encouraged to reflect on the effective practices identified for each assessment, consider the recommendations to strengthen assessment design and explore the authentic student work samples provided.

Audience and use

This report should be read by school leaders, subject leaders, and teachers to:

- inform teaching and learning and assessment preparation
- assist in assessment design practice
- assist in making assessment decisions
- help prepare students for internal and external assessment.

The report is publicly available to promote transparency and accountability. Students, parents, community members and other education stakeholders can use it to learn about the assessment practices and outcomes for senior subjects.

Subject highlights

431
schools offered Mathematical Methods

9.45%
increase in enrolment since 2024

96.27%
of students received a C or higher

Subject data summary

Unit completion

The following data shows students who completed the General subject.

Note: All data is correct as at January 2026. Where percentages are provided, these are rounded to two decimal places and, therefore, may not add up to 100%.

Number of schools that offered Mathematical Methods: 431.

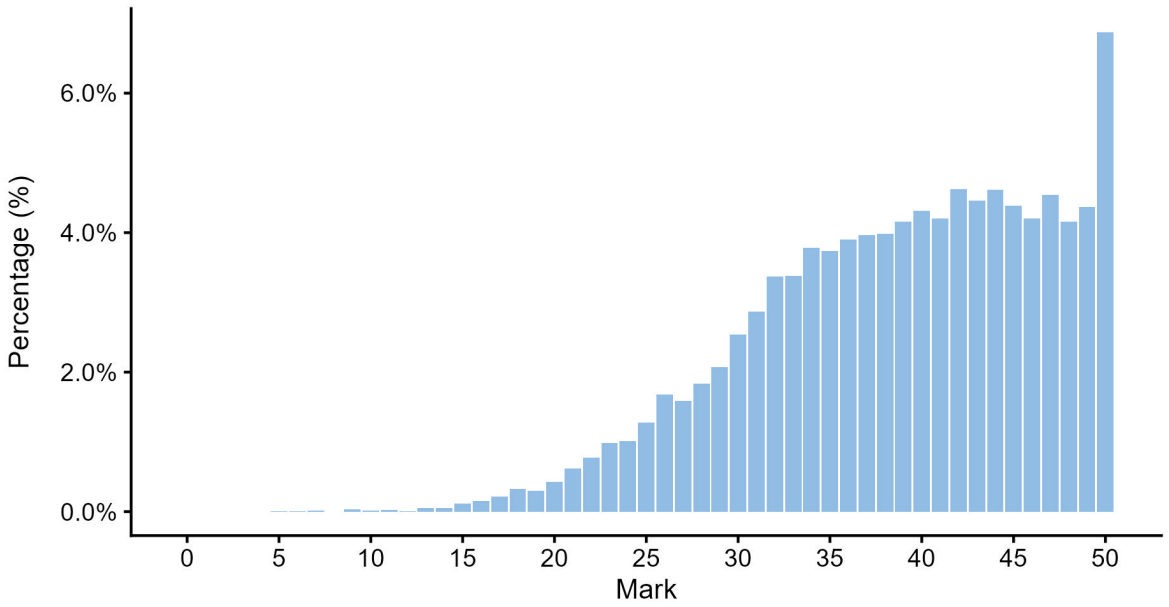
Completion of units	Unit 1	Unit 2	Units 3 and 4
Number of students completed	16,348	14,464	12,616

Units 1 and 2 results

Number of students	Unit 1	Unit 2
Satisfactory	15,254	12,614
Unsatisfactory	1,094	1,850

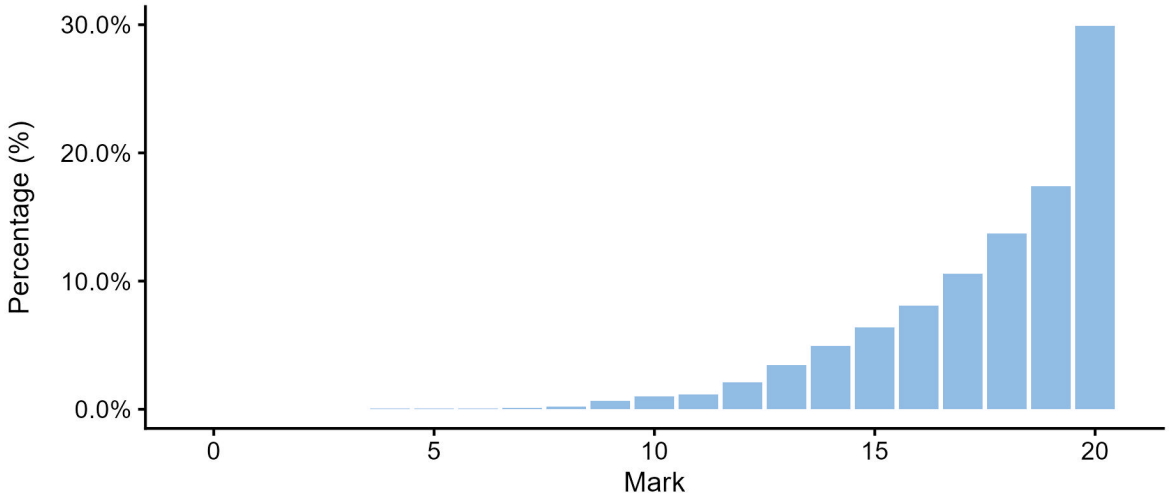
Units 3 and 4 internal assessment (IA) results

Total marks for IA

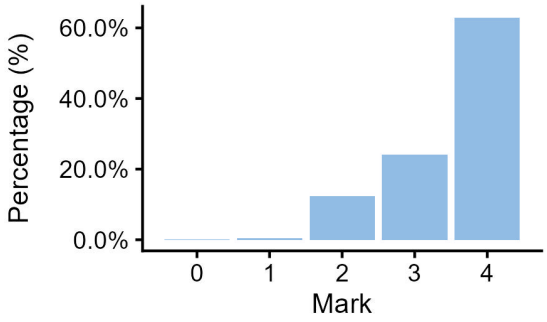


IA1 marks

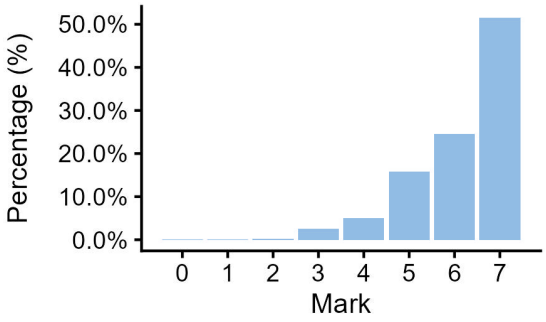
IA1 total



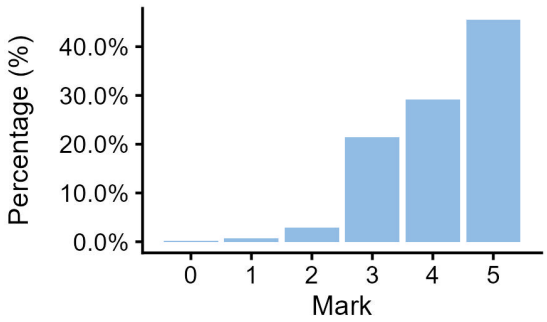
IA1 Criterion: Formulate



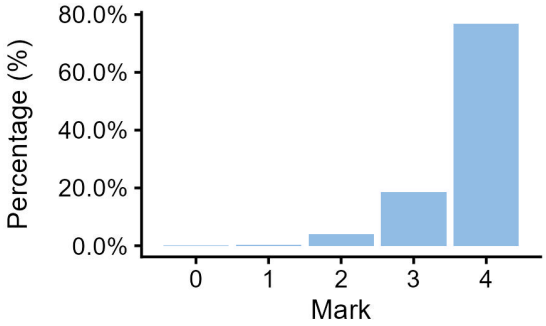
IA1 Criterion: Solve



IA1 Criterion: Evaluate and verify

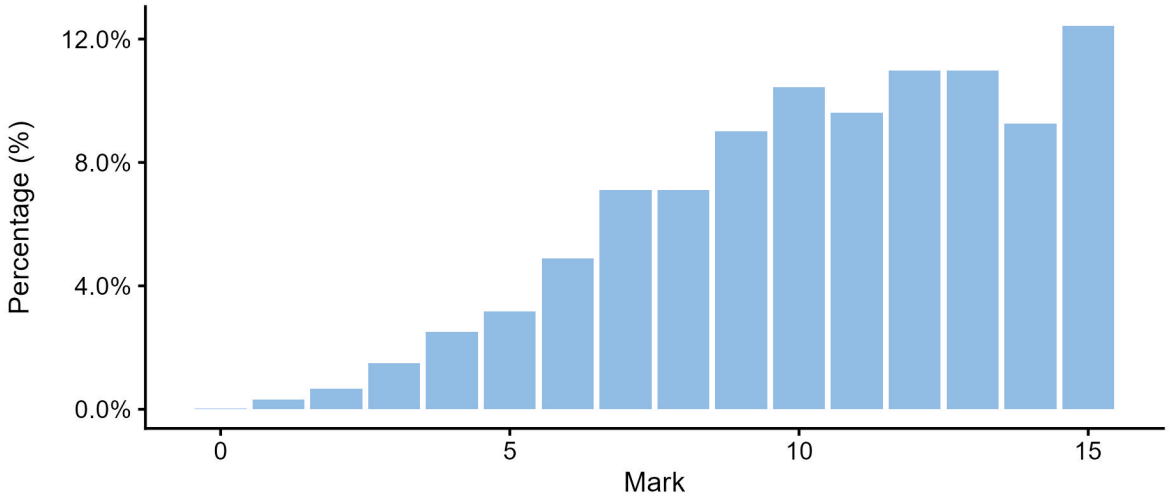


IA1 Criterion: Communicate

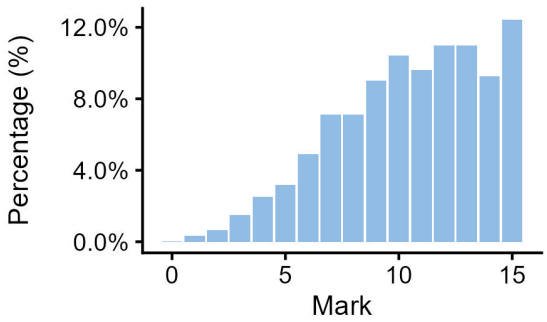


IA2 marks

IA2 total

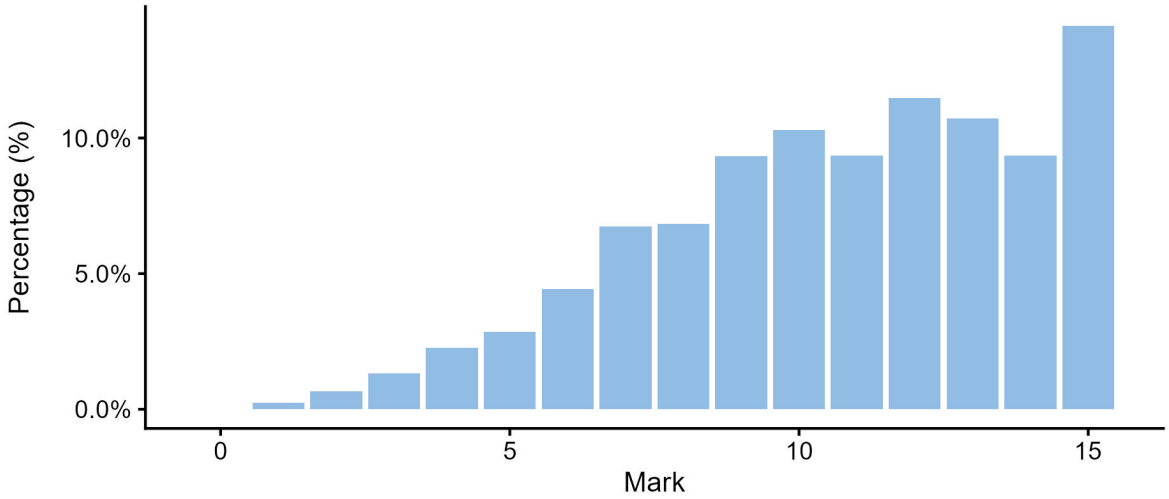


IA2 Criterion: Foundational knowledge and problem-solving

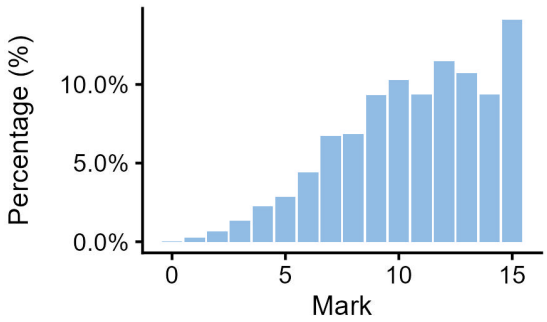


IA3 marks

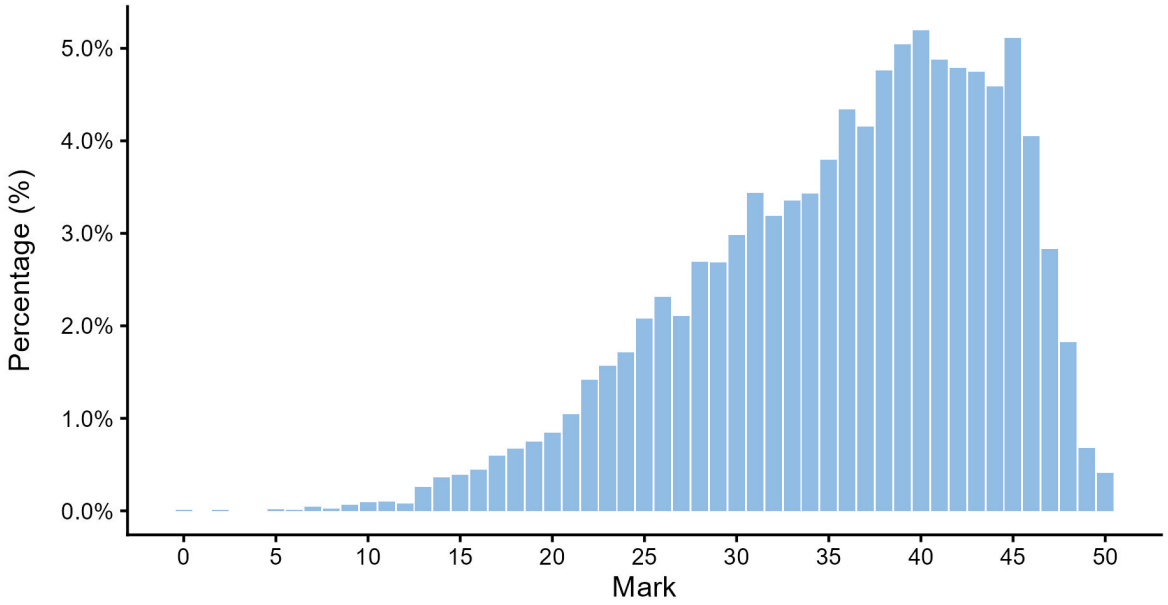
IA3 total



IA3 Criterion: Foundational knowledge and problem-solving

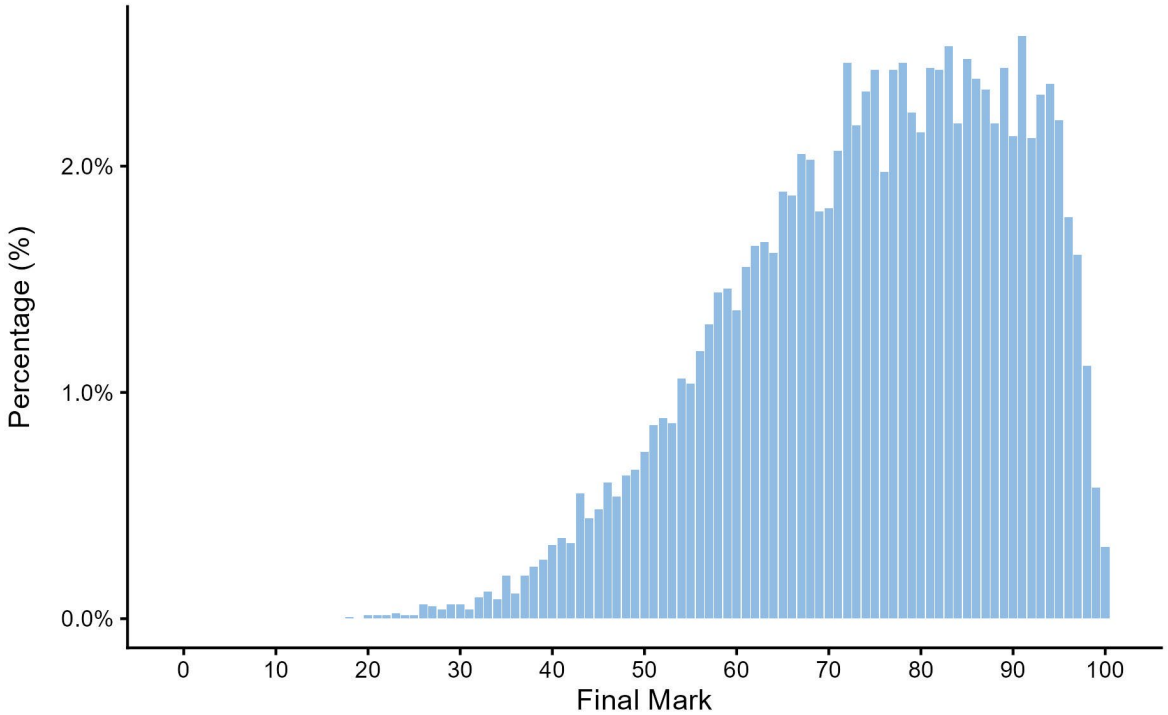


External assessment (EA) marks



Final subject results

Final marks for IA and EA



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	100–86	85–69	68–45	44–23	22–0

Distribution of standards

Number of students who achieved each standard across the state.

Standard	A	B	C	D	E
Number of students	3,590	4,842	3,713	464	7
Percentage of students	28.46	38.38	29.43	3.68	0.06

Internal assessment

This information and advice relate 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 section identifies the reasons why IA instruments were not endorsed at Application 1, by the priority for assessment. An IA may have been identified more than once for a priority for assessment, e.g. it may have demonstrated a misalignment to both the subject matter and the assessment objective/s.

Refer to *QCE and QCIA policy and procedures handbook v7.0*, Section 9.5.

Percentage of instruments endorsed in Application 1

Internal assessment	IA1	IA2	IA3
Number of instruments	430	430	429
Percentage endorsed in Application 1	83	46	57

Confirmation

Confirmation is the quality assurance process based on the attribute of reliability. The QCAA uses provisional criterion marks determined by teachers to identify the samples of student responses that schools are required to submit for confirmation.

Confirmation samples are representative of the school's decisions about the quality of student work in relation to the instrument-specific marking guide (ISMG) and are used to make decisions about the cohort's results.

Refer to *QCE and QCIA policy and procedures handbook v7.0*, Section 9.6.

The following table includes the percentage agreement between the provisional marks and confirmed marks by assessment instrument. The Assessment decisions section for each assessment instrument identifies the agreement trends between provisional and confirmed marks by criterion.

Number of samples reviewed and percentage agreement

A	Number of schools	Number of samples requested	Number of additional samples requested	Percentage agreement with provisional marks
1	426	3,238	2	95.77
2	425	3,236	0	100.00
3	425	3,224	0	100.00

Internal assessment 1 (IA1)

Problem-solving and modelling task (20%)

This assessment focuses on the interpretation, analysis and evaluation of ideas and information. It is an independent task responding to a particular situation or stimuli. While students may undertake some research in the writing of the problem-solving and modelling task, it is not the focus of this technique. This assessment occurs over an extended and defined period of time. Students will use class time and their own time to develop a response.

The problem-solving and modelling task must use subject matter from one or both of the following topics in Unit 3:

- Topic 2: Further differentiation and applications 2
- Topic 3: Integrals.

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 priority	Number of times priority was identified in decisions
Alignment	32
Authentication	27
Authenticity	2
Item construction	7
Scope and scale	7

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- used a real-world context that is relevant to students and could be understood independent of teacher explanation, e.g. designing a smooth, continuous Go Kart track, determining the area of a mini-golf course, designing a rollercoaster
- provided succinct instructions that ensured the scale of the task was appropriate, yet broad enough to allow an authentic response

  provided opportunities for students to identify observations and assumptions outside of those detailed on the task sheet.

Practices to strengthen

It is recommended that assessment instruments:

- provide a context that aligns clearly with Unit 3 (or, in the 2025 syllabus, Unit 3 or 4) subject matter but avoids narrowing the scope by directing students to specific content or methods
- avoid excessive scaffolding that limits student autonomy or exploration
- in the checkpoints, provide an opportunity for feedback on one complete or near-complete draft (*QCE and QCIA policy and procedures handbook v7.0*, Section 8.2.5).

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 priority	Number of times priority was identified in decisions
Bias avoidance	4
Language	9
Layout	0
Transparency	6

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- featured clear language, without jargon, relevant to the task
- used the **Print preview** button prior to submission to ensure that all text, stimulus and pictures were formatted correctly and fitted on the page.

Practices to strengthen

It is recommended that assessment instruments:

- are checked prior to submission for references to previous assessment instruments (where the instrument has been rolled over from a previous year in the Endorsement app), so that the instrument makes sense. For instance, if the context of an instrument has been changed from designing a golf course to designing a pool, ensure all references about a golf course have been deleted.

Additional advice

When developing an assessment instrument for this IA, it is essential to consider the following key differences between the 2019 and 2025 syllabuses:

- The duration of 4 weeks has been removed from the assessment conditions. Therefore, schools will now determine the duration of the task, ensuring the scope and scale of the task is appropriate for the selected duration.
- While the 2019 syllabus required the use of subject matter drawn from Unit 3 subject matter, the 2025 syllabus requires the use of subject matter from at least one of the topics in Unit 3 or Unit 4.

- While students are expected to follow the approach to problem-solving and mathematical modelling flowchart, it is not necessary to include or refer to this flowchart in the task.

Assessment decisions

Reliability

Reliability refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Formulate	98.12	1.88	0.00	0.00
2	Solve	99.06	0.70	0.23	0.00
3	Evaluate and verify	97.89	1.41	0.70	0.00
4	Communicate	99.77	0.00	0.23	0.00

Effective practices

Reliable judgments were made using the ISMG for this IA when:

- for all criteria, the best-fit approach was applied accurately
- for the Solve criterion, the use of complex procedures to develop a valid solution was evident through clear demonstrations of students applying subject matter in multiple, related steps drawn from Unit 3 Topic 2 and/or Topic 3. Appropriate and accurate use of technology was shown when students employed tools that actively facilitated problem-solving, extending beyond basic functions such as graphing
- for the Evaluate and verify criterion, marks were awarded where responses demonstrated clear connections between the evaluation of result reasonableness and previously documented assumptions and observations
- for the Communicate criterion, marks were awarded where responses featured precise technical and procedural vocabulary and were coherently structured with an introduction, body and conclusion that comprehensively addressed the task
- schools used the ISMG as provided in the Endorsement application (app) and did not edit, modify, or retype it.

Practices to strengthen

When making judgments for this IA for the 2025 syllabus, it is essential to consider the following key differences between the ISMGs in the 2019 and 2025 syllabuses:

- In the Formulate criterion in the 2025 syllabus, responses matched to the highest performance level must include justified statements of important assumptions and observations, rather than simply appropriate assumptions and relevant observations. To be considered important, these assumptions and observations must be essential for the problem to be mathematised and the solution to be reached.

- In the Solve criterion in the 2025 syllabus, responses must demonstrate efficient use of technology rather than accurate and appropriate use of technology. Efficient use of technology is evident when the technology selected allows the solution to be developed quickly, easily and effectively.
- The Evaluate and verify criterion is renamed Evaluate in the 2025 syllabus. Responses matched to the highest performance level must include verification of the results as part of the solution development process.
- In the Communicate criterion in the 2025 syllabus, responses must demonstrate correct use of appropriate mathematical language, including terminology, symbols, conventions, and representations. Furthermore, this criterion now includes justification of decisions using mathematical reasoning as a key descriptor.

To further ensure reliable judgments are made using the ISMG for this IA, it is recommended that:

- schools ensure evaluations of solution reasonableness include both strengths and limitations, with clear justification for each
- schools ensure students understand the distinction between the cognitions 'explain' and 'justify', so that students do not confuse explaining an assumption with providing a justification of an assumption
- teachers use the *Unpacking internal assessment terminology document* (available under Resources in the Syllabuses app) as a guide to interpreting the 2025 ISMG descriptors in practice when marking student work. Teachers can further enhance their judgments by using the discussion prompts in this resource during moderation sessions, planning meetings, or review conversations.

Additional advice

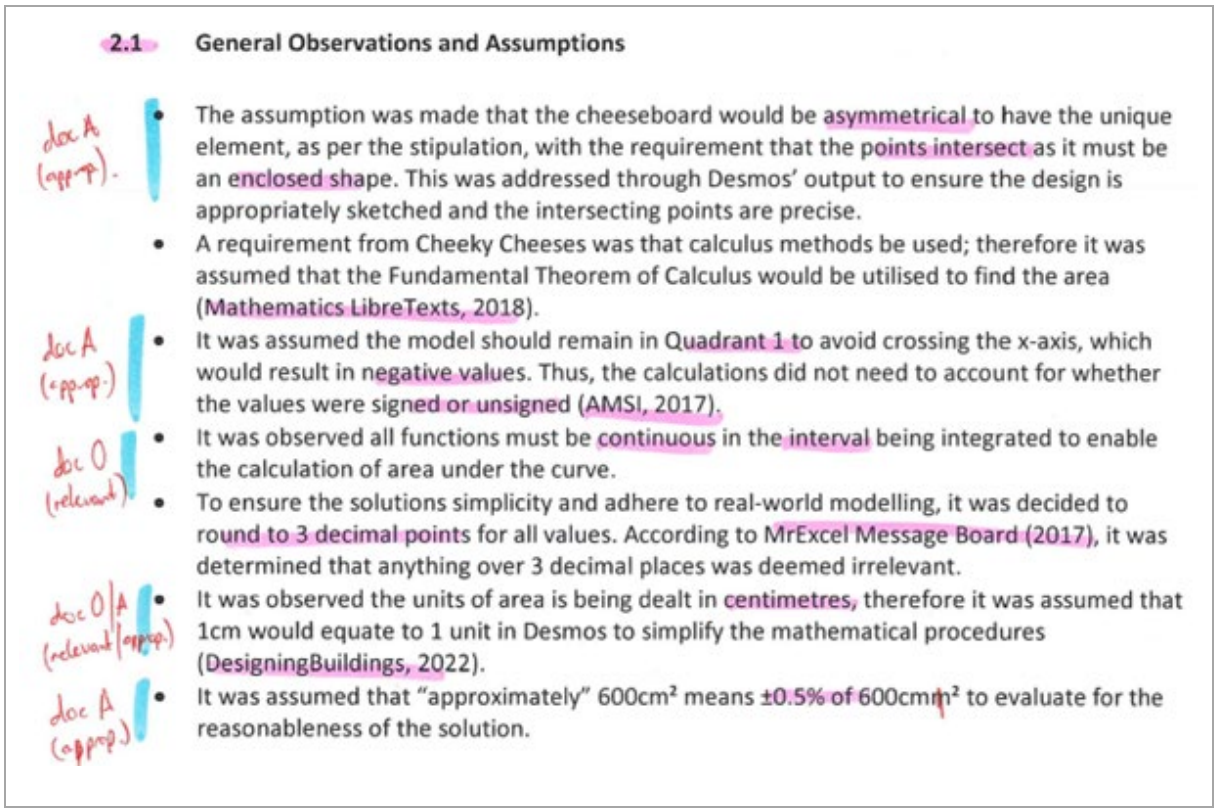
It is essential to consider the following key differences in the 2019 and 2025 syllabuses:

- For the 2025 syllabus, each descriptor describes a single characteristic that may be evidenced in a student response, while the 2019 syllabus descriptors sometimes contained several characteristics. Therefore, when the school makes a judgment on a characteristic in the revised syllabus, it must be the whole descriptor that is matched to the evidence available.
- A described characteristic may be singular or plural, e.g. the
  - Formulate criterion at the 3–4 mark range requires 'justified statements of important assumptions' (plural) and 'justified statements of important observations' (plural). This means the response must typically justify more than one assumption and more than one observation, respectively
  - Evaluate criterion requires 'a verified result' (singular) at 2–3 mark range and 'verified results' (plural) at the 4–5 mark range .
- The Evaluate and verify criterion in the 2019 syllabus is now Evaluate in the 2025 syllabus. At the top performance level, there are five descriptors. The previous descriptor regarding strengths and limitations has been split into two separate descriptors, and the descriptor on evaluation of reasonableness of solutions by considering results, assumptions, and observations has also been separated for clarity.
- The descriptors for 'justification of decisions' are now located in the Communicate criterion (rather than in Evaluate and verify). Each performance level in this criterion now includes three descriptors.

Samples

The following excerpt demonstrates the documentation of appropriate assumptions and relevant observations, as well as the use of teacher annotations to identify characteristics within the student's response.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.



2.1 General Observations and Assumptions

doc A (app-p).
- The assumption was made that the cheeseboard would be asymmetrical to have the unique element, as per the stipulation, with the requirement that the points intersect as it must be an enclosed shape. This was addressed through Desmos' output to ensure the design is appropriately sketched and the intersecting points are precise.
- A requirement from Cheeky Cheeses was that calculus methods be used; therefore it was assumed that the Fundamental Theorem of Calculus would be utilised to find the area (Mathematics LibreTexts, 2018).

doc A (app-p)
- It was assumed the model should remain in Quadrant 1 to avoid crossing the x-axis, which would result in negative values. Thus, the calculations did not need to account for whether the values were signed or unsigned (AMSI, 2017).

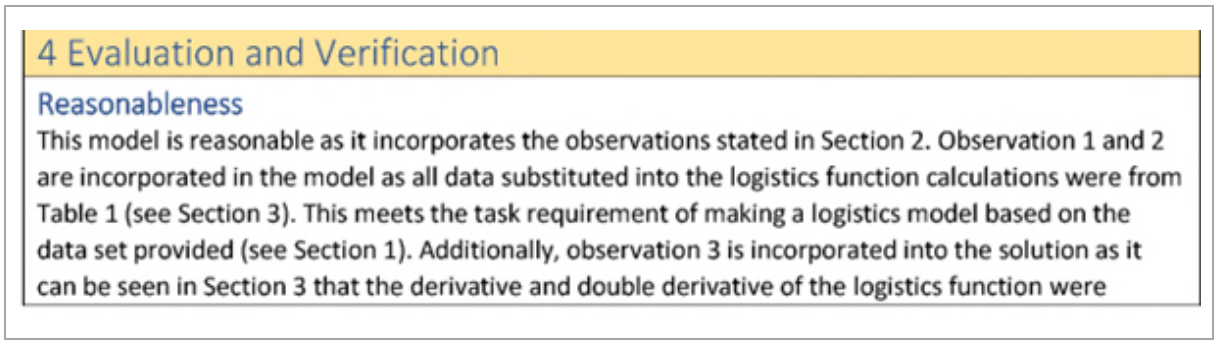
doc O (relevant)
- It was observed all functions must be continuous in the interval being integrated to enable the calculation of area under the curve.
- To ensure the solutions simplicity and adhere to real-world modelling, it was decided to round to 3 decimal points for all values. According to MrExcel Message Board (2017), it was determined that anything over 3 decimal places was deemed irrelevant.

doc O|A (relevant|app-p)
- It was observed the units of area is being dealt in centimetres, therefore it was assumed that 1cm would equate to 1 unit in Desmos to simplify the mathematical procedures (DesigningBuildings, 2022).

doc A (app-p)
- It was assumed that "approximately" 600cm² means ±0.5% of 600cm² to evaluate for the reasonableness of the solution.

The following excerpt has been included to demonstrate the evaluation of the reasonableness of a solution considering identified assumptions and observations.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.



4 Evaluation and Verification

Reasonableness

This model is reasonable as it incorporates the observations stated in Section 2. Observation 1 and 2 are incorporated in the model as all data substituted into the logistics function calculations were from Table 1 (see Section 3). This meets the task requirement of making a logistics model based on the data set provided (see Section 1). Additionally, observation 3 is incorporated into the solution as it can be seen in Section 3 that the derivative and double derivative of the logistics function were

calculated to compare/verify the GRoC of the Israel and Chad data sets. This meets the task requirement of comparing the growth rate of the virus (see Section 1). Lastly, observation 4 is incorporated in the solution as the effect of population density on the rate of infection of the two counties in 2020 was included in Section 3. This makes the model reasonable as it also meets the task requirement of comparing the growth rate of the virus in the two data sets (see Section 1). Additionally, the model is reasonable as it aligns with the assumptions stated in Section 2. The model aligns with assumption 2 as the model never has a negative rate (see Figure 2). Covid is an extremely infectious virus so it is logical that the number of cases would be increasing over time. This proves that the testing equipment is accurate as it aligns with the existing knowledge that covid spreads easily in a dense population (Boscaini, 2022). Additionally, the model aligns with assumption 3 as the APE is fairly low. This makes the model reasonable as it proves that the values provided from the task/respective technology are accurate as it is known that percentage error reflects on the accuracy

evaluation of reasonableness –observations & assumptions

The following excerpt demonstrates the effective use of technology to verify a result. The student used graphing to further prove that the function does not have stationary points, by showing that the derivative function does not have x-intercepts.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.

No solutions exist, confirming that $P(t)$ has no stationary points. $P'(t)$ was plotted graphically in Figure 4 below.

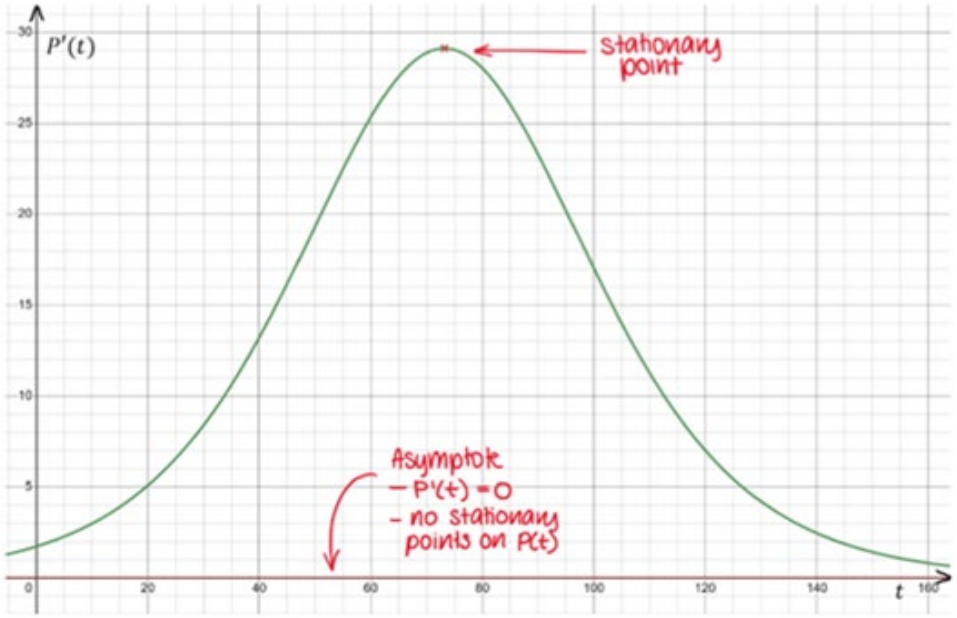


Figure 4: Graph of $P'(t)$

The curve never intercepts the x-axis, further proving that there are no stationary points on $P(t)$ where the rate of change is equal to zero. However, unlike $P(t)$, $P'(t)$ does has a stationary point as indicated by the maximum turning point.

Internal assessment 2 (IA2)

Examination (15%)

This examination assesses the application of a range of cognitions to a number of items, drawn from all Unit 3 topics. Student responses must be completed individually, under supervised conditions, and in a set timeframe.

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 priority	Number of times priority was identified in decisions
Alignment	292
Authentication	0
Authenticity	2
Item construction	7
Scope and scale	18

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- representatively sampled all Unit 3 topics and sub-topics so students could demonstrate their understanding of the subject matter
- featured at least one question so students could cover Assessment objective 4: evaluate the reasonableness of solutions
- required students to answer a balance of technology-free and technology-active questions by either
  - specifying whether each question was technology-free or technology-active
  - using cues within each question (i.e. ‘using technology’ or ‘use algebraic techniques’) to indicate the response required
  - constructing the instrument with separate technology-free and technology-active sections.

Practices to strengthen

It is recommended that assessment instruments:

- feature complex unfamiliar questions where all the information required to solve the problem is not immediately identifiable and the procedure is not clear from the way the problem is posed
- provide complex familiar opportunities where questions have a number of elements and connections are made with subject matter within and/or across the domains of mathematics,

without being explicitly scaffolded. For instance, a question involving parts a), b), c) — each a simple familiar level of difficulty — is not equivalent to one complex familiar question

- include an appropriate number of questions, of a suitable length, so that students can respond to all items within the available time.

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 priority	Number of times priority was identified in decisions
Bias avoidance	3
Language	30
Layout	4
Transparency	12

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- featured appropriate language and avoided unnecessary jargon
- provided clear instructions using cues that aligned to the unit objectives and ISMG.

Practices to strengthen

It is recommended that assessment instruments:

- provide complex unfamiliar questions written in plain English that avoid information not relevant to solving the problem and do not require an extensive amount of reading
- are proofread and checked for spelling, grammatical and typographical errors before submission
- are quality assured by the teacher to ensure that all questions provided to students are mathematically sound and able to be solved.

Additional advice

When developing an assessment instrument for this IA, it is essential to consider the following key differences between the 2019 and 2025 syllabuses:

- Solving equations involving exponential and logarithmic functions with base e is the appropriate subject matter for Unit 3 topic 1.
- Solving cubic (and higher order polynomial) equations without a calculator now requires the equations to be in factorised form.
- The examination working time has changed from 120 minutes to 90 minutes, with perusal time remaining at 5 minutes. This requires a more concise paper design with careful item selection to ensure coverage of the assessment objectives within the reduced timeframe.
- The revised syllabus specifies that assessment items must sample subject matter from any three of the five Unit 3 topics, rather than requiring all topics. Students must be able to answer

the questions using the subject matter from the three nominated topics and assumed knowledge from previous units.

Assessment decisions

Reliability

Reliability refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Foundational knowledge and problem-solving	100	0.00	0.00	0.00

Effective practices

Reliable judgments were made using the ISMG for this IA when:

- accurate marking schemes were submitted for confirmation. All questions had a breakdown of mark allocation within a question, and this was adhered to in marking, particularly with the allocation of part marks
- teachers annotated the student responses by identifying the use of follow-through marks where student responses were partially incorrect due to an error
- the marks awarded on the student response clearly aligned with the processes or attributes identified on the marking scheme, or had annotations that clearly identified the alternate reason for awarding the mark
- the number of marks awarded for each question was clearly identified on the response
- there was evidence that students used clear mathematical reasoning to justify procedures and decisions.

Practices to strengthen

To further ensure reliable judgments are made using the ISMG for this IA, it is recommended that:

- the marking scheme be updated when common alternative correct methods are identified, clearly indicating where marks are awarded for each method
- the full calculation for determining the overall percentage is shown on the ISMG, e.g. 42.5 /56 = 75.89%
- internal quality assurance processes are implemented to ensure the
  - marking scheme does not contain mathematical errors
  - number of marks awarded matches the number of marks on the endorsed item.

Additional advice

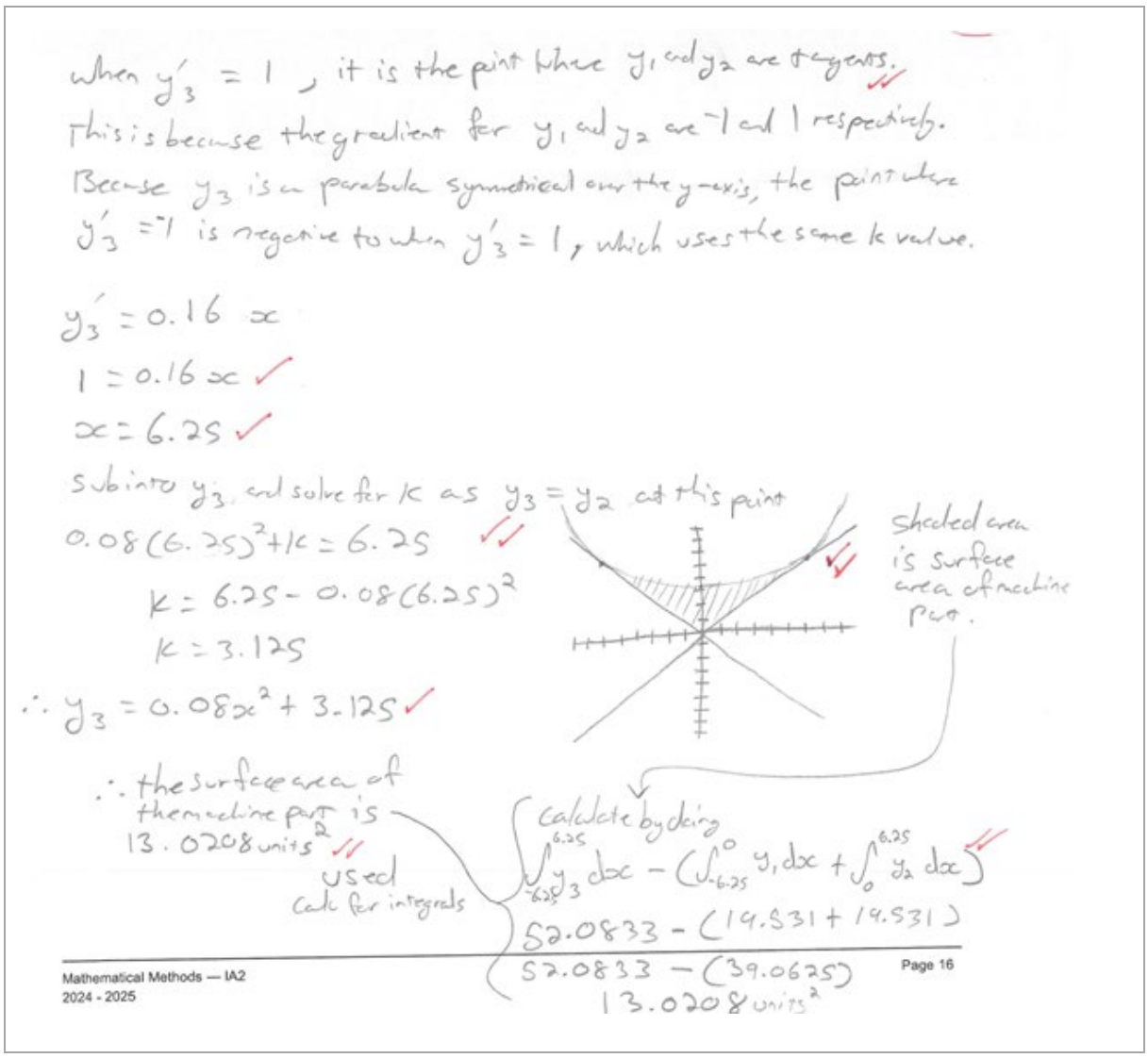
Schools should:

- administer the endorsed instrument without changes or modifications (*QCE and QCIA policy and procedures handbook v7.0*, Section 7.3.3 and Section 8.3)
- indicate in Student Management in the individual student's learning account and in the Confirmation app if a comparable assessment instrument has been administered to a sampled student. Schools must develop comparable assessments in the Endorsement app to ensure the correct examination and its matching marking scheme are available for the confirmation review (*QCE and QCIA policy and procedures handbook v7.0*, Section 7.4 and Section 9.6.3). For further information, see the *Upload samples* guide in the Help section of the Confirmation app
- ensure the required samples of student assessment responses for the confirmation review align with the *Confirmation submission information* for Mathematical Methods, which is available under Resources in the Syllabuses app (*QCE and QCIA policy and procedures handbook v7.0*, Section 9.6.3). Schools are advised to check that all scanning of student work has been completed without error, to ensure that
  - no pages are missing from the response
  - all pages are visible and legible
  - the submitted response matches the selected student.

Samples

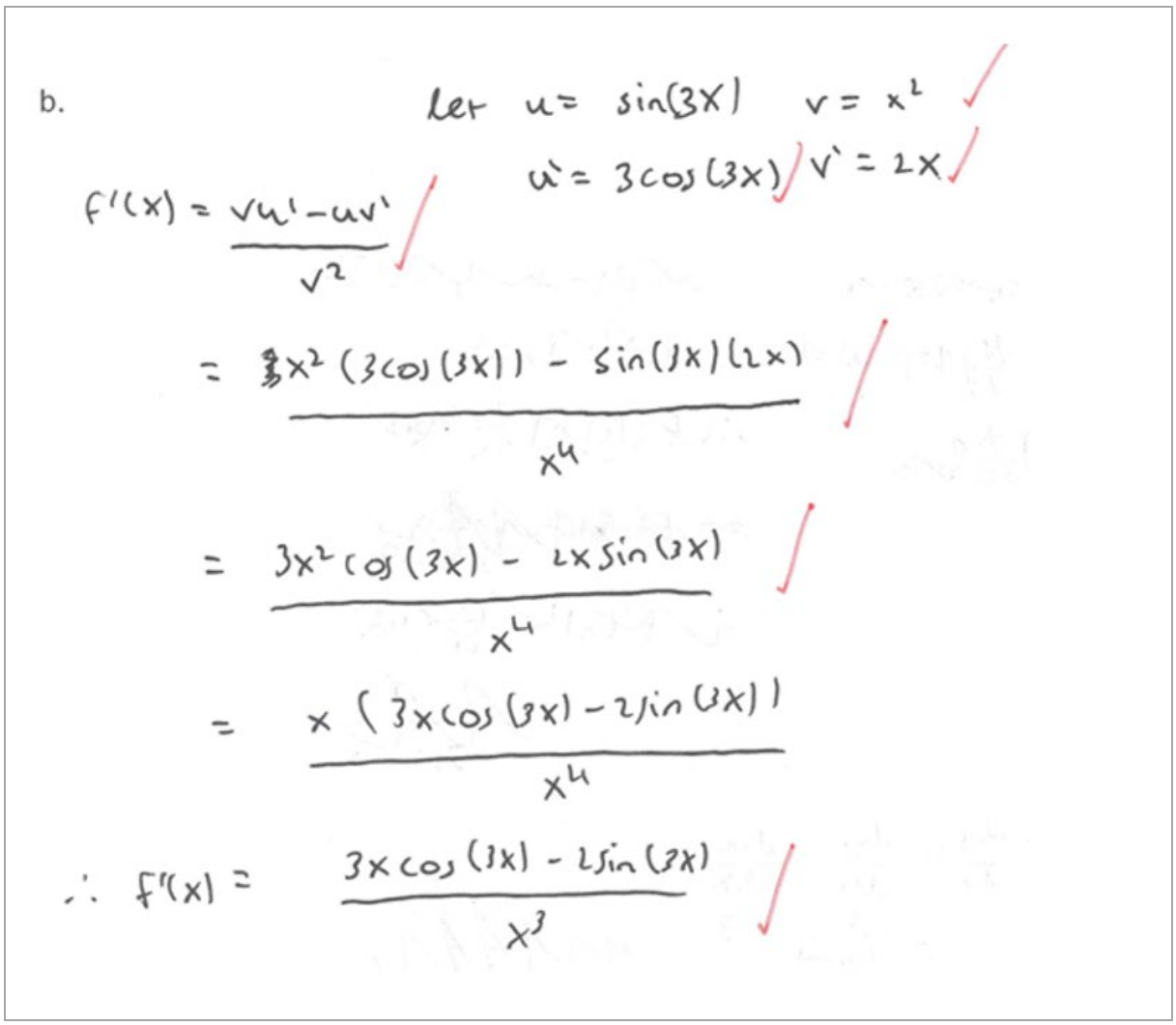
The following excerpt illustrates the use of clear mathematical reasoning to justify procedures and decisions.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.



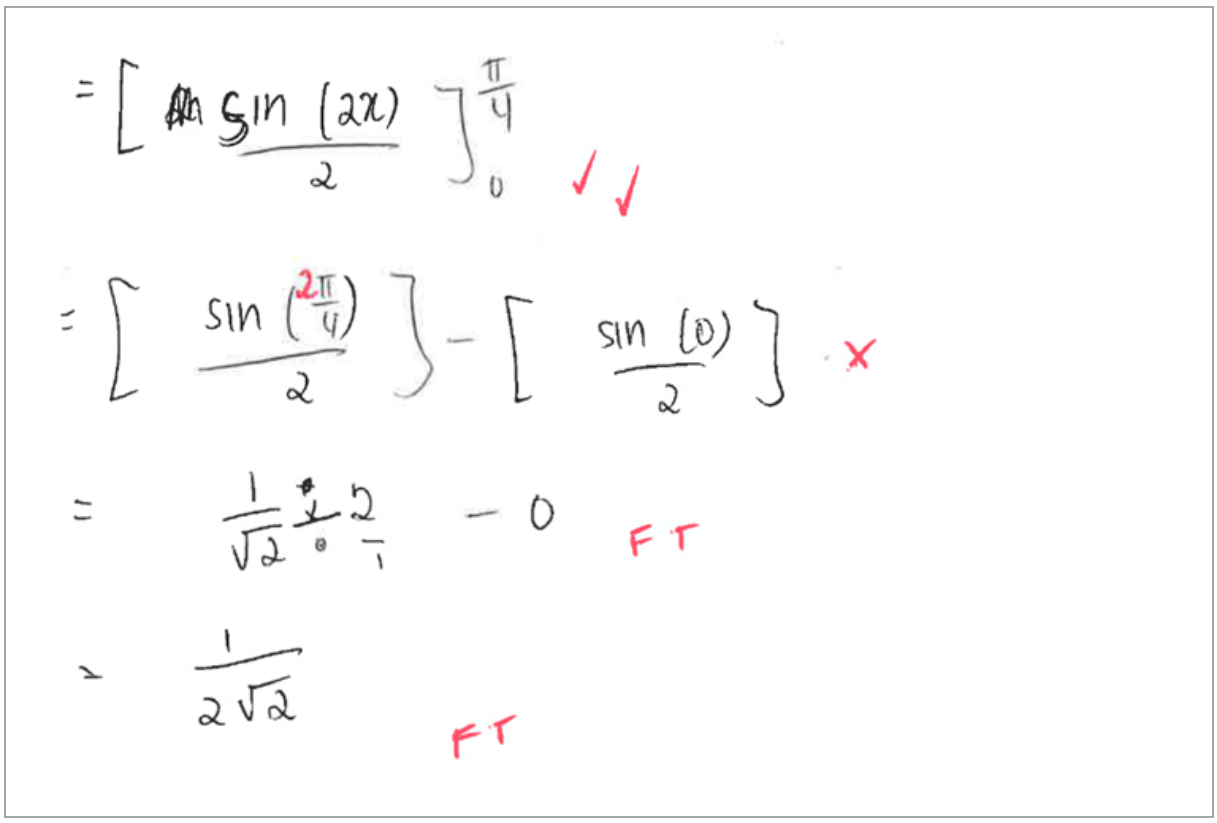
The following excerpt has been included to demonstrate the teacher annotations on student response awarding 3.5 marks, using half marks.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.



The following excerpt illustrates a clear indication of awarding follow-through marks.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.



The following excerpts have been included to demonstrate the clear summary of students marks as well as the appropriate application of the ISMG. In both cases the raw marks totals are shown and the percentage cut-off applied correctly.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.

Excerpt 1

Examinations Mark Summary

Question	Simple Familiar	Complex Familiar	Complex Unfamiliar
1	3 3	-	-
2	1 1	-	-
3	4 4.5	-	-
4	3.5 4.5	-	-
5	2.5 2.5	-	-
6	2 2.5	-	-
7	3.5 4	-	-
8	3 3		
9	3 3	-	-
10	3 4	-	-
11	3 4	-	-
12	-	4.5 5	
13	-	4.5 7	-
14	-	-	1.5 6
15	-	-	2.5 6
Total	36	12	12
Percentage	60%	20%	20%
Marks Awarded	31.5	9	4

Overall

Marks / 60	Percentage	1 - 15 Mark	Grade
44.5	74.2%	12	B

Excerpt 2

$\frac{70}{75} = 93.33\%$

Instrument-specific marking guide (IA2): Examination (15%)

Criterion: Foundational knowledge and problem-solving

Assessment objectives

1. select, recall and use facts, rules, definitions and procedures drawn from all Unit 3 topics
2. comprehend mathematical concepts and techniques drawn from all Unit 3 topics
3. communicate using mathematical, statistical and everyday language and conventions
4. evaluate the reasonableness of solutions
5. justify procedures and decisions by explaining mathematical reasoning
6. solve problems by applying mathematical concepts and techniques drawn from all Unit 3 topics.

The student work has the following characteristics:	Cut-off	Marks
• consistently correct selection, recall and use of facts, rules, definitions and procedures; authoritative and accurate command of mathematical concepts and techniques; astute evaluation of the reasonableness of solutions and use of mathematical reasoning to correctly justify procedures and decisions; and fluent application of mathematical concepts and techniques to solve problems in a comprehensive range of simple familiar, complex familiar and complex unfamiliar situations.	> 93%	15
	> 87%	14

Internal assessment 3 (IA3)

Examination (15%)

This examination assesses the application of a range of cognitions to a number of items, drawn from Unit 4 Topics 1–5. Student responses must be completed individually, under supervised conditions, and in a set timeframe.

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 priority	Number of times priority was identified in decisions
Alignment	209
Authentication	0
Authenticity	0
Item construction	14
Scope and scale	31

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- offered students authentic opportunities to respond to Assessment objective 4: evaluate the reasonableness of solutions
- representatively sampled all Unit 4 topics so students could demonstrate their understanding of the subject matter
- were of an appropriate length so students could respond to all items within the allocated time.

Practices to strengthen

It is recommended that assessment instruments:

- provide complex familiar opportunities where questions have a number of elements, and connections are made with subject matter within and/or across the domains of mathematics, without being scaffolded. For instance, asking for expected value, variance and standard deviation in one sentence is still asking the student to demonstrate three separate simple familiar skills
- provide a balance of technology-free and technology-active questions within the instrument
- requiring an algebraic response in a technology-active paper provide appropriate cues to the student to ensure the desired response, such that it matches the mark allocations in the marking scheme

- ensure that Unit 4 subject matter is being assessed, e.g.
  - normal approximation to the binomial distribution is not part of the Mathematical Methods syllabus
  - confidence intervals of sample means are part of the Specialist Mathematics syllabus, not Mathematical Methods.

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 priority	Number of times priority was identified in decisions
Bias avoidance	5
Language	20
Layout	0
Transparency	8

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- were proofread and checked for correct spelling, formatting and layout prior to submission
- featured appropriate language and avoided unnecessary jargon.

Practices to strengthen

It is recommended that assessment instruments:

- are checked for mathematical errors, particularly when providing probability density functions to students, i.e. probability density functions must meet two requirements to be classified as such
- ensure that any contextual changes in a question that was used in a prior year are made throughout the question. For instance, if changing a context from ‘pens’ to ‘staplers’, ensure that all references to pens have been replaced with ‘staplers’
- are quality assured by the teacher to ensure that all questions provided to students are mathematically sound and able to be solved under the technology conditions stipulated.

Additional advice

When developing an assessment instrument for this IA, it is essential to consider the following key differences between the 2019 and 2025 syllabuses:

- In Topic 2: Trigonometry, the first two bullet points have been removed from the 2025 syllabus.
- Calculating basic trigonometric ratios (e.g. $\sin\theta = \frac{O}{H}$) is no longer Unit 4 subject matter.
- The examination working time has changed from 120 minutes to 90 minutes, with perusal time remaining at 5 minutes. This requires a more concise paper design with careful item selection to ensure coverage of the assessment objectives within the reduced timeframe.

- The revised syllabus specifies that assessment items must sample subject matter from any three of the five Unit 4 topics, rather than requiring all topics. Students must be able to answer the questions using the subject matter from the three nominated topics and assumed knowledge from previous units.

Assessment decisions

Reliability

Reliability refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Foundational knowledge and problem-solving	100	0.00	0.00	0.00

Effective practices

Reliable judgments were made using the ISMG for this IA when:

- a detailed and updated marking scheme indicating the use of full and/or half marks for questions was submitted for confirmation
- the marking scheme had been consistently and accurately applied to all student responses
- the full calculation for determining the overall percentage was shown on the ISMG, e.g. 40.5/55 = 73.64%
- in situations where a student had responded in an alternate way to that expected in the marking scheme, the solution is annotated to show how marks had been awarded based on the merit of the response.

Practices to strengthen

To further ensure reliable judgments are made using the ISMG for this IA, it is recommended that:

- comparable tasks and the correct corresponding marking scheme are uploaded to the Endorsement app
- marking scheme and the solutions are appropriate for the questions and conditions of the examination. This is most evident in case of technology-active assessment where the marking scheme awards full set of marks based on the algebraic approach, while the use of technology simplifies the solution.

Additional advice

Schools should:

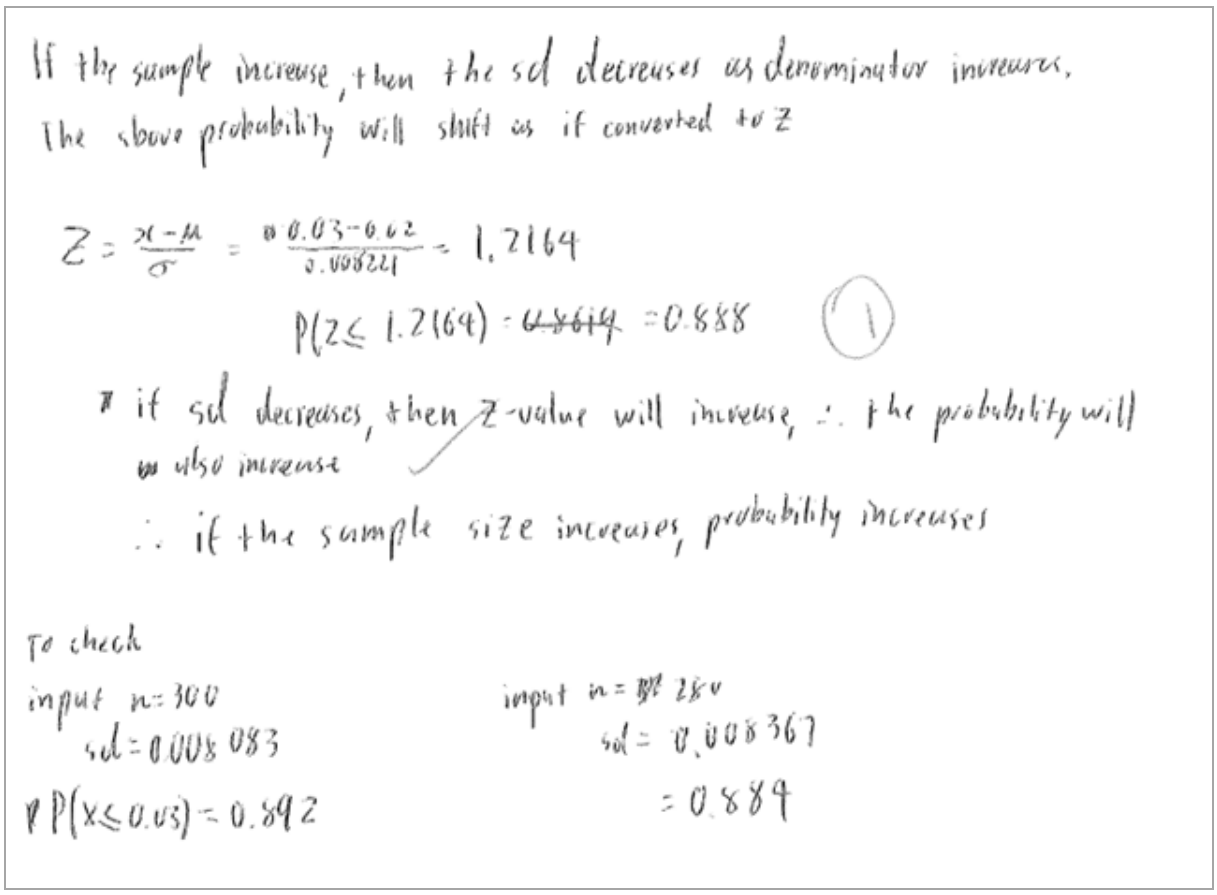
- administer the endorsed instrument without changes or modifications (*QCE and QCIA policy and procedures handbook v7.0*, Section 7.3.3 and Section 8.3)

- indicate in Student Management in the individual student's learning account and in the Confirmation app if a comparable assessment instrument has been administered to a sampled student. Schools must develop comparable assessments in the Endorsement app to ensure the correct examination and its matching marking scheme are available for the confirmation review (*QCE and QCIA policy and procedures handbook v7.0*, Section 7.4 and Section 9.6.3). For further information, see the *Upload samples* guide in the Help section of the Confirmation app
- ensure the required samples of student assessment responses for the confirmation review align with the *Confirmation submission information* for Mathematical Methods, which is available under Resources in the Syllabuses app (*QCE and QCIA policy and procedures handbook v7.0*, Section 9.6.3). Schools are advised to check that all scanning of student work has been completed without error, to ensure that
  - no pages are missing from the response
  - all pages are visible and legible
  - the submitted response matches the selected student.

Samples

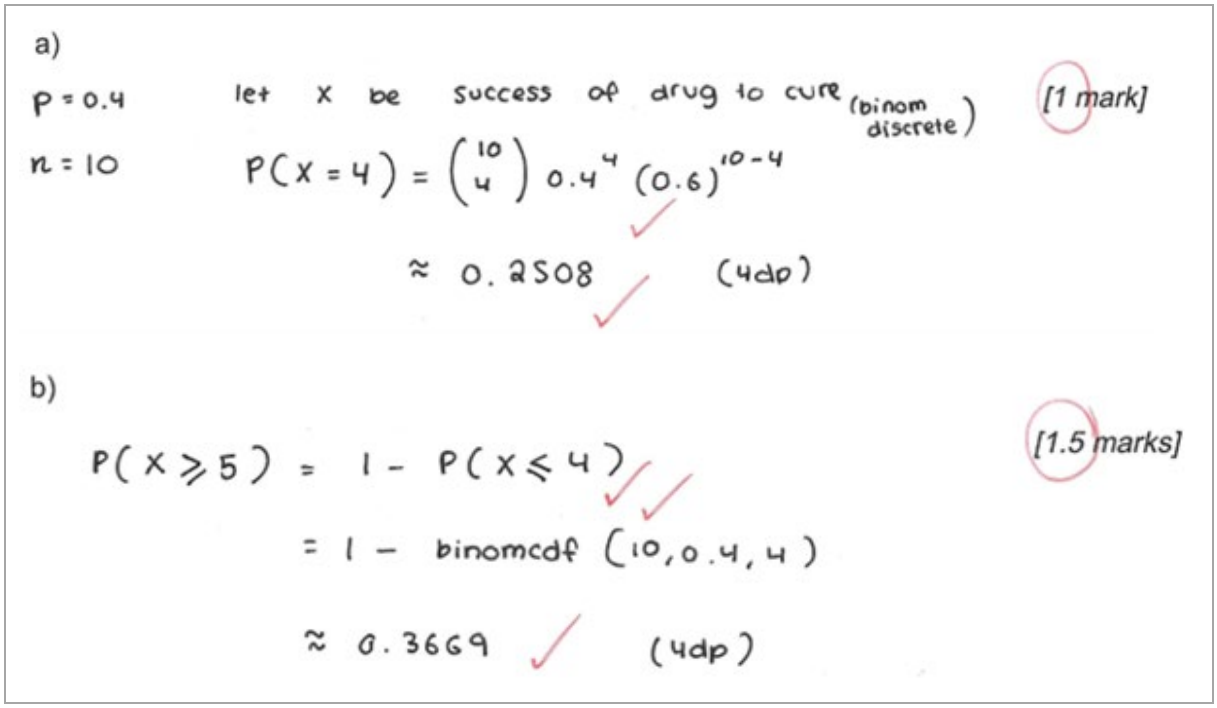
The following excerpt demonstrates the response where student correctly used mathematical reasoning to justify solution.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.



The following excerpt illustrates a teacher using clear annotations to indicate where marks (including part marks) were allocated within a response.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.



External assessment

External assessment (EA) is developed and marked by the QCAA. The external assessment for a subject is common to all schools and administered under the same conditions, at the same time, on the same day. The external assessment papers and the EAMG are published in the year after they are administered.

Examination (50%)

Assessment design

The assessment instrument was designed using the specifications, conditions and assessment objectives described in the summative external assessment section of the syllabus.
The examination consisted of two papers:

- Paper 1, Section 1 consisted of multiple choice questions (10 marks)
- Paper 1, Section 2 consisted of short response questions (45 marks)
- Paper 2, Section 1 consisted of multiple choice questions (10 marks)
- Paper 2, Section 2 consisted of short response questions (45 marks).

Assessment decisions

Assessment decisions are made by markers by matching student responses to the external assessment marking guide (EAMG).

Multiple choice question responses

There were 10 multiple choice questions in Paper 1.

Percentage of student responses to each option

Note:

- The correct answer is **bold** and in a blue shaded table cell.
- Some students may not have responded to every question.

Question	A	B	C	D
1	7.81	**84.88**	5.52	1.64
2	**65.77**	14.15	3.50	16.28
3	3.19	1.94	9.03	**85.59**
4	0.76	**88.25**	10.45	0.39
5	3.73	22.51	11.20	**62.12**
6	6.19	10.44	23.15	**59.88**
7	2.12	4.93	**89.73**	3.05
8	7.90	58.88	**28.72**	4.19
9	**67.49**	6.59	10.11	15.40
10	16.15	9.72	**71.86**	1.93

There were 10 multiple choice questions in Paper 2.

Percentage of student responses to each option

Note:

- The correct answer is **bold** and in a blue shaded table cell.
- Some students may not have responded to every question.

Question	A	B	C	D
1	**96.70**	1.07	0.75	1.30
2	1.96	6.24	**89.37**	2.09
3	**85.58**	6.77	5.63	1.77
4	**56.75**	11.97	7.53	23.27
5	24.33	3.94	27.15	**44.09**
6	10.85	7.72	9.54	**71.39**
7	6.93	18.93	**64.08**	9.38
8	6.73	14.86	**73.54**	4.49
9	17.97	**30.60**	13.56	36.98
10	9.17	**74.73**	6.54	8.78

Effective practices

Overall, students responded well to:

- the opportunities to demonstrate their knowledge and understanding of solving exponential equations and modelling using exponential functions. These skills were effectively demonstrated across both simple and complex familiar contexts
- requirements to apply differentiation and integration rules to simple logarithmic, exponential and trigonometric expressions
- problems involving discrete random variables and their probabilities in both simple and complex familiar situations
- using technology in a range of contexts, such as graphing functions to identify key features, solving equations, evaluating derivatives or rates of change, and statistical applications.

Practices to strengthen

When preparing students for external assessment, it is recommended that:

- teachers provide a range of examples of functions to illustrate changes in graph concavity and the role of second derivatives in determining inflection points. In Paper 1, Question 13, many students correctly identified that the second derivative equals zero at the given point, which is a necessary condition for an inflection point. However, a significant number of students were unable to fully justify the inflection point by demonstrating the change in concavity, which is the sufficient condition
- teachers increase opportunities for students to solve complex logarithmic equations, particularly those requiring the application of multiple logarithmic rules before demonstrating full algebraic proficiency in manipulating, recognising, and solving quadratic equations

- teachers expose students to variety of examples to deepen understanding of confidence intervals and their accurate use in a both technology-free and technology-active situations. For instance, many students struggle to determine confidence intervals in technology-free situations (Paper 1, Question 12) or fully use the confidence interval to justify a claim about a population proportion (Paper 2, Question 18)
- teachers consider providing more opportunities for students to practise complex questions across a broad range of contexts where they must develop a model to solve the problem. For instance:
  - Paper 1, Question 18 required students to use differentiation and anti-differentiation to solve problems involving the velocities of two objects
  - Paper 1, Question 19 required students to apply trigonometry to solve an optimisation problem
  - Paper 2, Questions 19 involved using an understanding of conditional probability to answer the question.

Additional advice

- Teachers should provide more opportunities for students to practise Objective 4: evaluate the reasonableness of solutions. For instance
  - in Paper 1, Question 15, students needed to evaluate the reasonableness of a solution by substituting it into a given logarithmic equation
  - in Paper 2, Question 14, the second derivative had to be used to justify the stationary point of a function
  - in Paper 2, Question 18, students were required to use a confidence interval to justify a claim.
- Ensure students understand that subject matter from Units 1 and 2 is assumed knowledge and may be drawn on when developing responses to external examination questions.
- Encourage students to read questions carefully to confirm they have answered what is being asked and to use the allocated marks as a guide for the depth of their response.
- Remind students to use designated pages at the back of the response book for additional responses. These pages are clearly labelled ‘Additional pages for student responses’. Pages assigned to a specific question should not be used for extra responses.
- Remind students that work in the multiple choice question book will not be marked. Instruct students to record their answers to the multiple choice questions in Section 1 of the question and response book by using a 2B pencil to fill in the A, B, C or D answer bubble completely. Students should ensure they have filled an answer bubble for each question.

Samples

Short response

Question 13 from Paper 1

This question required students to demonstrate that the function has an inflection point at a specified x-value, given the rule for the second derivative of the function.

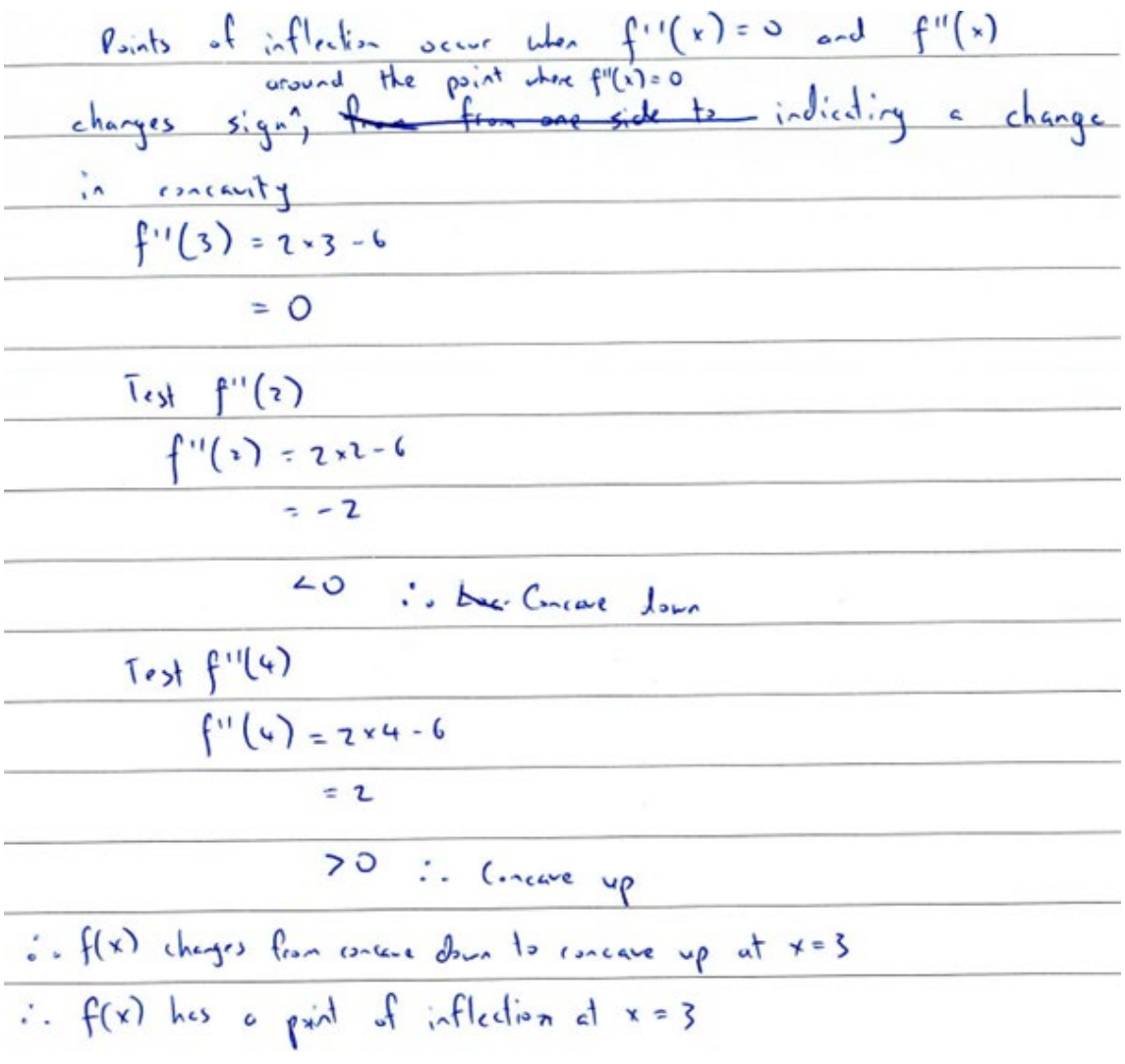
Effective student responses:

- demonstrated that the value of the second derivative is zero (necessary condition)
- investigated the sign of the second derivative around the given point
- concluded that the given point is indeed the point of inflection, based on the change in concavity (sufficient conditions).

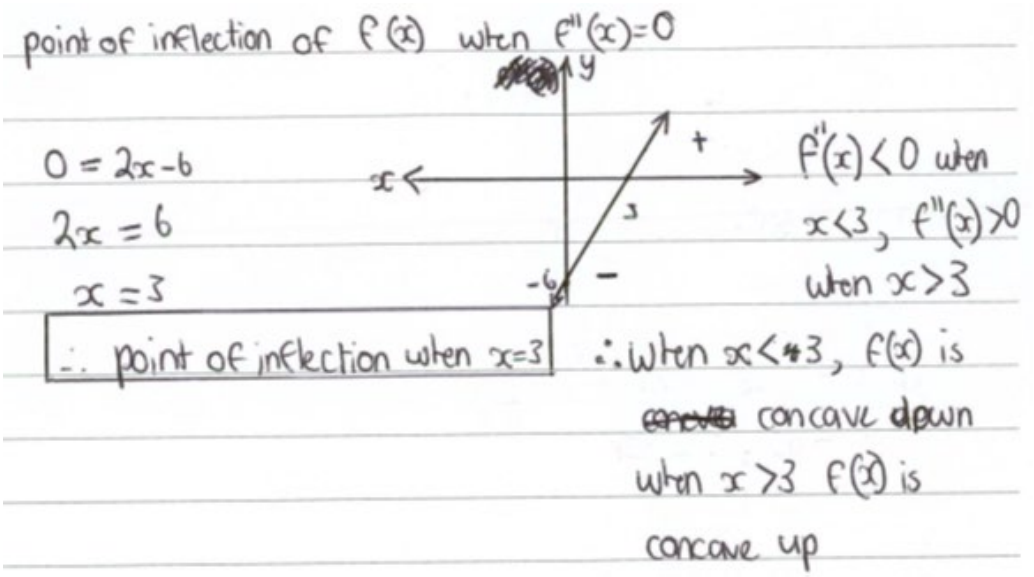
These excerpts have been included to:

- demonstrate the complete response required for this four-mark item
- demonstrate different approaches to verifying that the function changes concavity at the specified point.

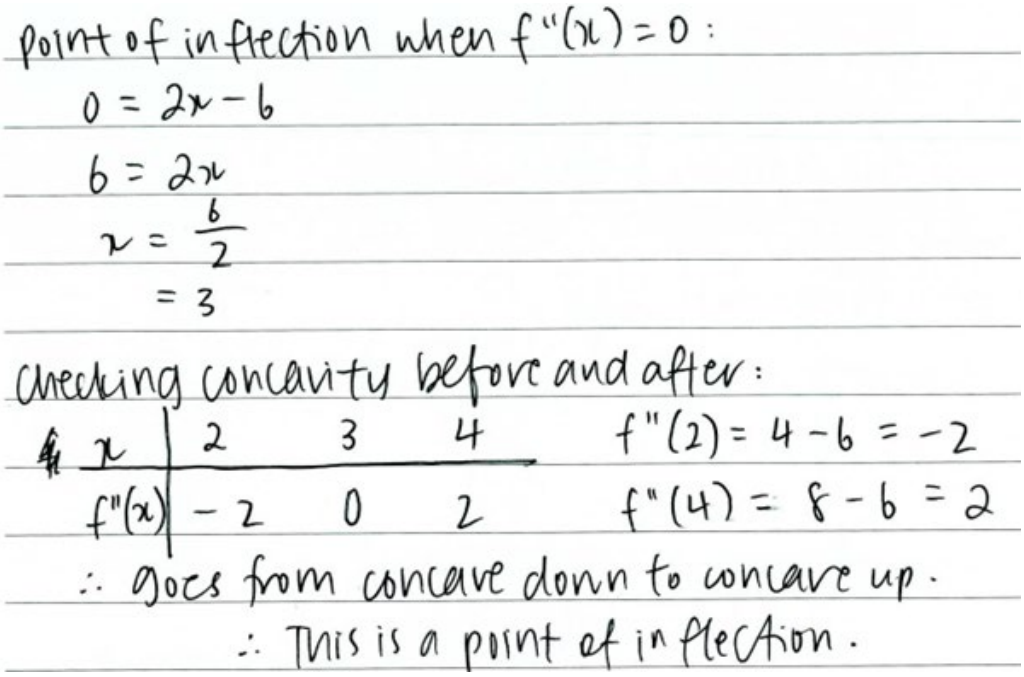
Excerpt 1



Excerpt 2



Excerpt 3



Question 15 from Paper 1

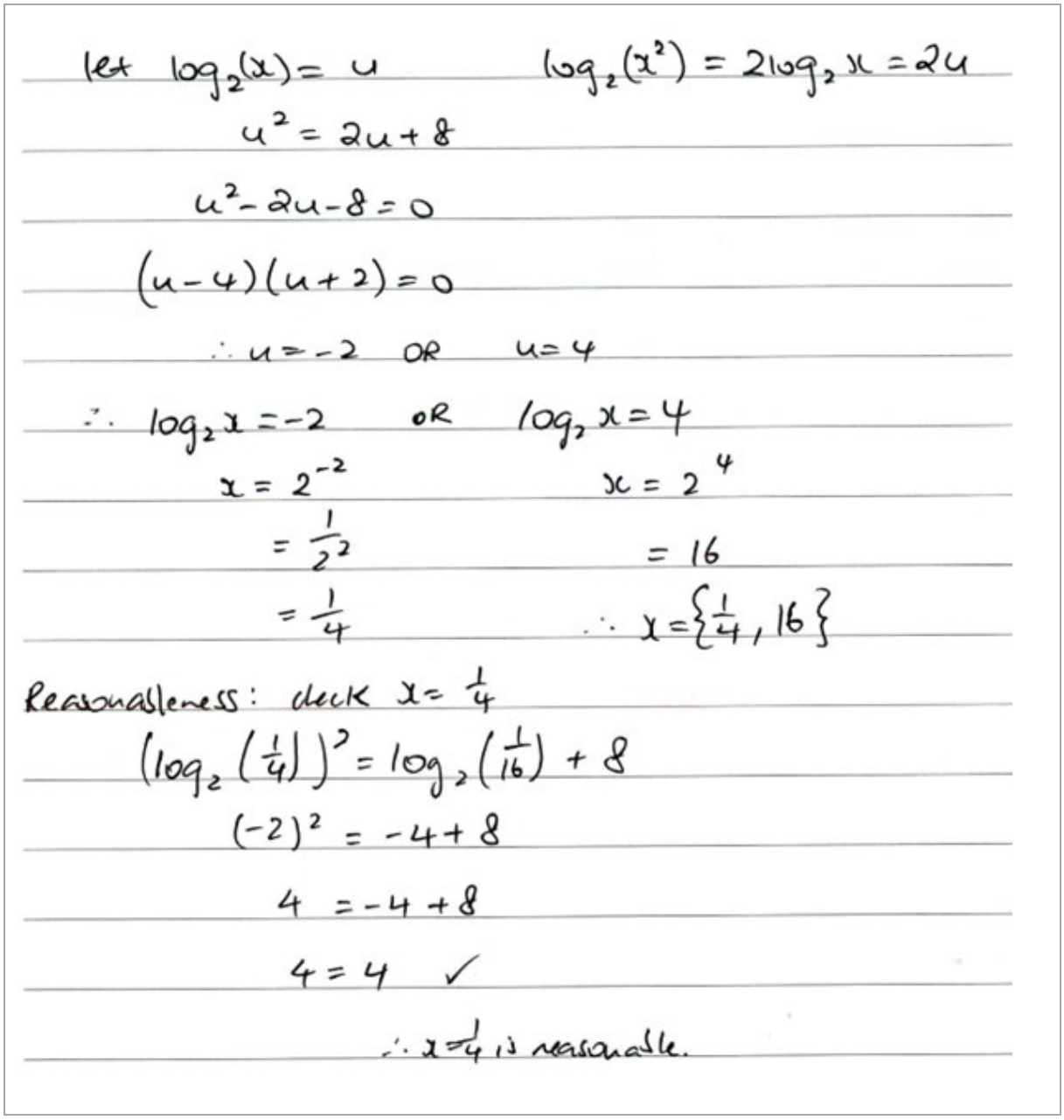
This question required students to solve a logarithmic equation.

Effective student responses:

- applied a logarithmic law of powers: $\log_b(a^n) = n\log_b(a)$
- recognised the resulting quadratic equation, e.g. $a^2 = 2a + 8$, where $a = \log_2(x)$
- solved the equation finding both solutions
- checked the reasonableness of one solution.

This excerpt has been included to demonstrate:

- the correct solution
- clear communication and justification throughout the solution.



Question 18 from Paper 1

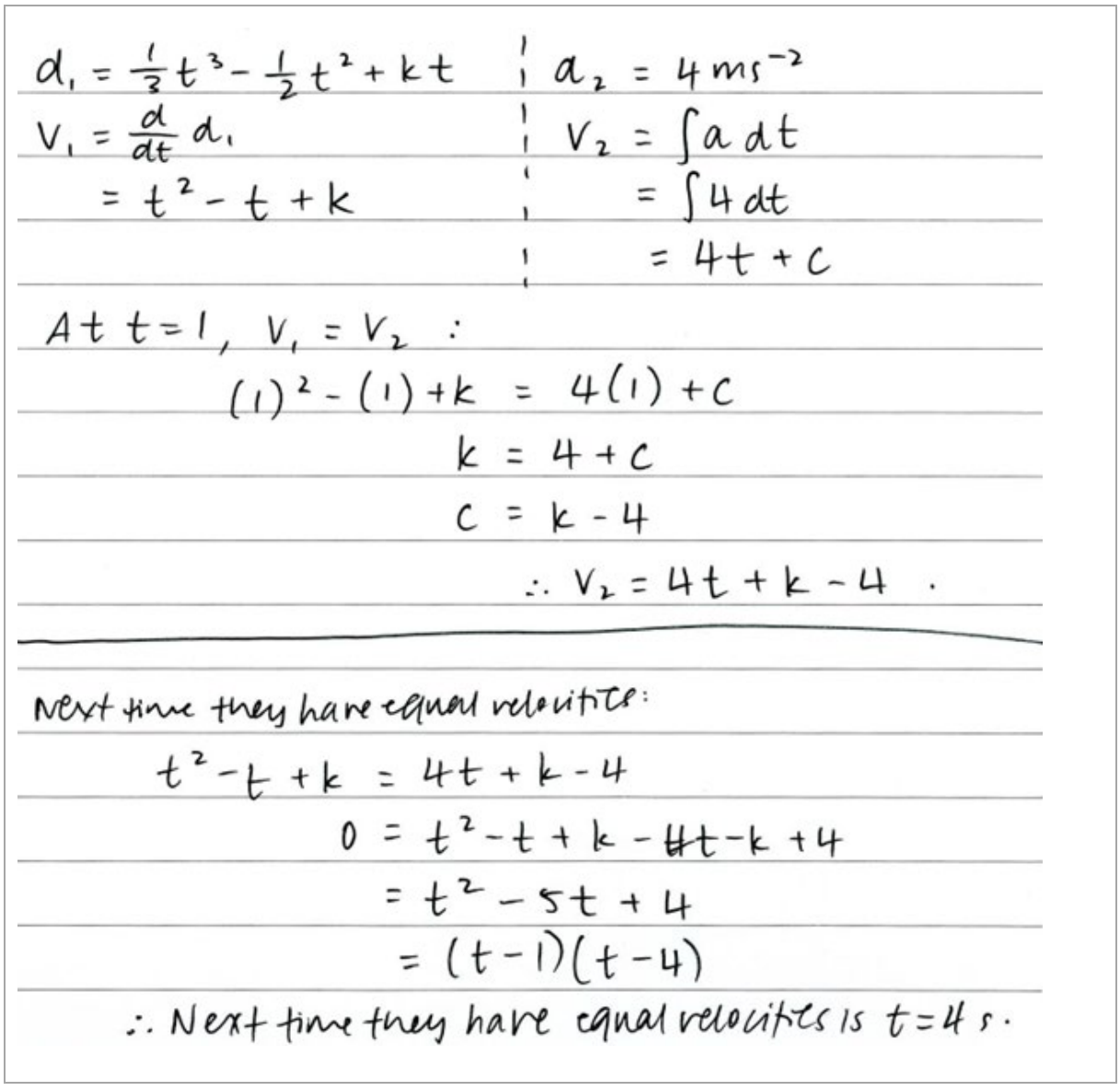
This question required students to analyse the motion of two objects and determine the difference in their displacements during a particular timeframe.

Effective student responses:

- determined the derivative of the displacement of the first object to find its velocity
- used integration and the initial condition to determine the velocity of the second object
- applied the given condition about objects' velocities to determine the times when their velocities were equal
- used appropriate methods to calculate the difference in displacements of both objects during the specified timeframe.

This excerpt has been included to:

- demonstrate an effective approach in determining the times, considering two unknown constants
- show the full and correct solution presented in a methodical and clear way.



For object 1:

change in distance between $t = 1$ and $t = 4$:

$$d_1(4) - d_1(1) = \left(\frac{1}{3}(4)^3 - \frac{1}{2}(4)^2 + k(4)\right) - \left(\frac{1}{3}(1)^3 - \frac{1}{2}(1)^2 + k\right)$$

$$= \left(\frac{64}{3} - \frac{16}{2} + 4k\right) - \frac{1}{3} + \frac{1}{2} - k$$

$$= \frac{63}{3} - 8 + 3k + \frac{1}{2}$$

$$= 21 - 8 + \frac{1}{2} + 3k$$

$$= 13\frac{1}{2} + 3k$$

For object 2, change in distance

$$= \int_1^4 4t + k - 4\,dt = \left[2t^2 + kt - 4t\right]_1^4$$

$$= (2(4)^2 + k(4) - 4(4)) - (2 + k - 4)$$

$$= 32 + 4k - 16 - 2 - k + 4$$

$$= 18 + 3k$$

$$d_2 - d_1 = (18 + 3k) - \left(13\frac{1}{2} + 3k\right)$$

$$= 4.5$$

$\therefore$ object 2 travels 4.5 m more.

Question 18 from Paper 2

This question required students to evaluate a claim using an incomplete confidence interval.

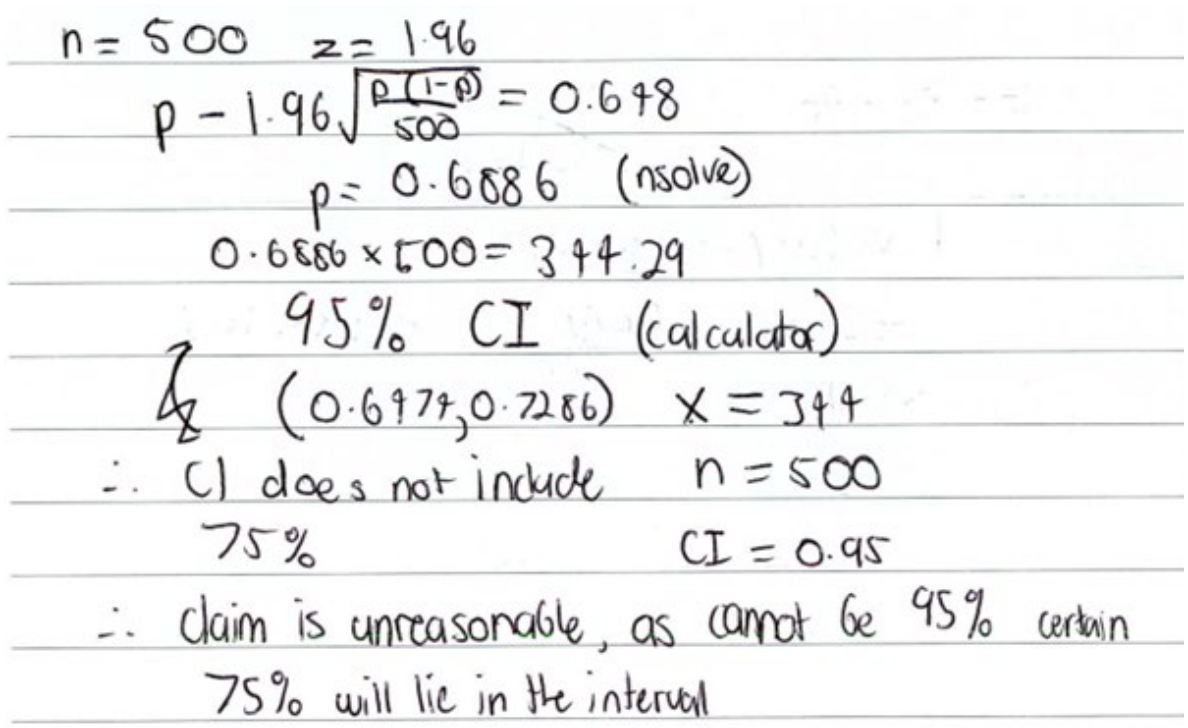
Effective student responses:

- demonstrated clear understanding of the subject matter by applying the correct rules
- used the lower end of the confidence interval to determine the sample proportion, and hence calculated the upper end of the interval
- referred to the confidence interval and justified that the claim was unsupported.

These excerpts have been included to:

- demonstrate the correct and complete solution
- show a clear evaluation of reasonableness based on mathematical findings.

Excerpt 1



Excerpt 2

$E = z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$

$= 1.96\sqrt{\frac{\hat{p}(1-\hat{p})}{500}}$

$\hat{p} - E = 0.648$

$\therefore \hat{p} - 1.96\sqrt{\frac{\hat{p}(1-\hat{p})}{500}} = 0.648$ GDC → OPTN → CALC → SOLVEN

$\hat{p} = 0.6886$

$\hat{p} - E = 0.648$

$0.6886 - E = 0.648$

$E = 0.0406$

$\therefore \hat{p} + E = 0.7292$

$\therefore$ 95% CI = (0.6480, 0.7292)

As the claim of 75% is well outside of the 95% confidence interval, the board member can only be 95% confident that the proportion of satisfied employees is between 68.86% and 72.92%. Therefore the claim is unreasonable. It is unlikely that the claim proportion of 0.75 is the true population proportion.

Question 19 from Paper 2

This question required students to develop a statistical model for the horn lengths of two beetle species in order to determine the required probability, recognising the need to apply the conditional probability rule.

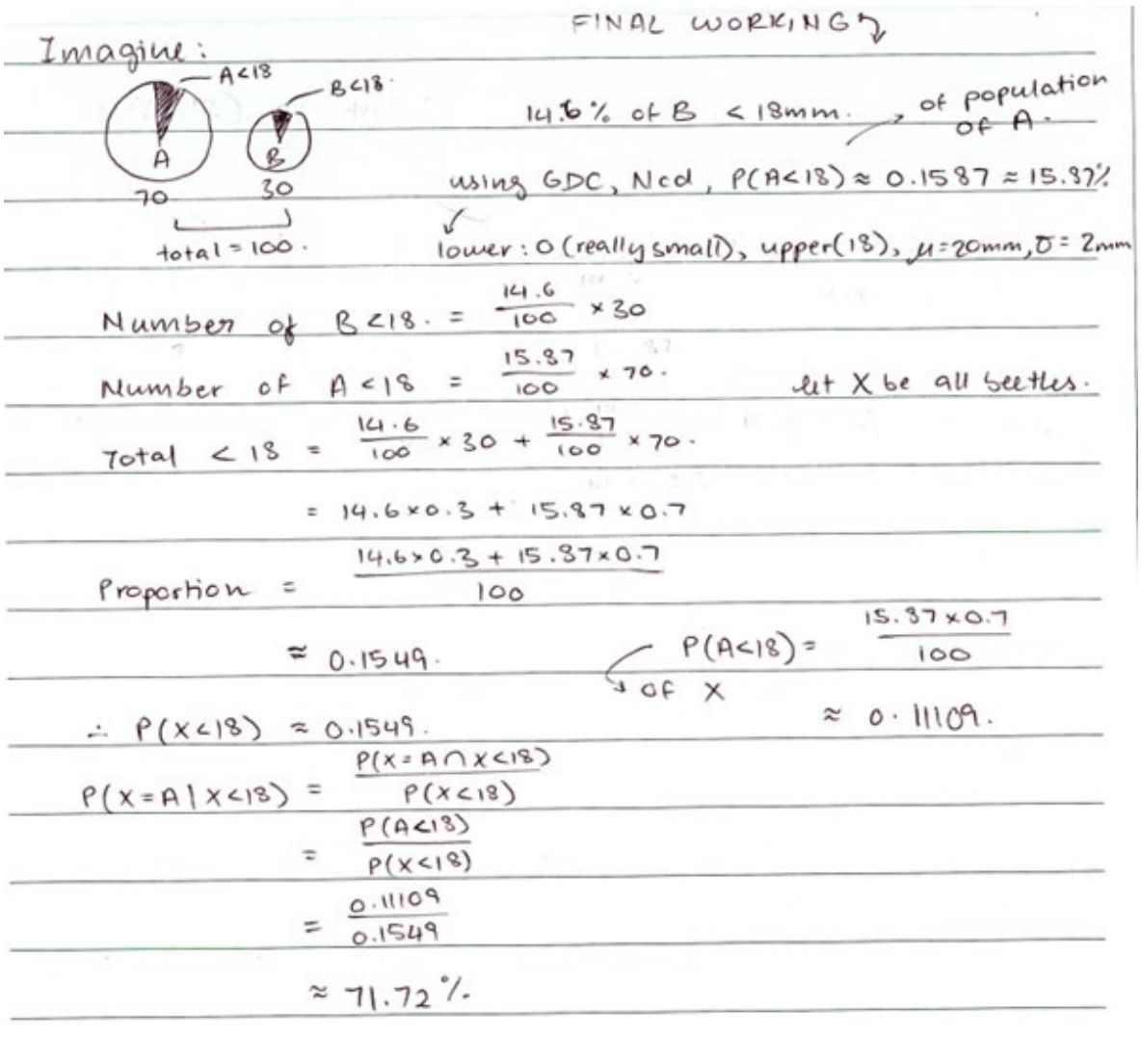
Effective student responses:

- used the provided information to determine the proportion of species A beetle with horn lengths less than 18 mm
- calculated the proportion of all beetles with horn lengths less than 18 mm, regardless of species
- applied the conditional probability rule to determine the required probability
- clearly communicated findings throughout the solution using appropriate mathematical language and logical organisation.

These excerpts have been included to:

- demonstrate a well-developed solution, using precise mathematical language and annotations to show clear and logical organisation of the response.

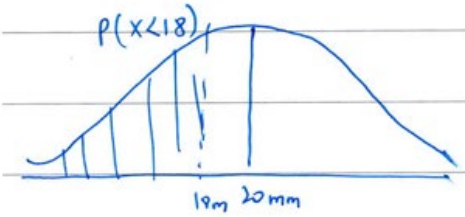
Excerpt 1



∴ Probability that beetle of horn length less than 18mm being from A is 71.72%. or 0.7172.

Excerpt 2

Species A $\mu = 20$ and $\sigma = 2$



$\therefore P(X < 18) = 0.1587$

∴ 15.87% of species A has a horn length less than 18mm.

For species B $P(X < 18) = 0.146$

$P(A) = 0.7$ and $P(B) = 0.3$

$$P(\text{species A} \mid \text{length is less than 18m}) = \frac{P(\text{species A} \cap \text{less than 18mm})}{P(\text{less than 18mm})}$$

P less than 18 mm $= (0.7 \times 0.1587) + (0.3 \times 0.146)$

$= 0.11109 + 0.0438$

$= 0.15489$

$$P(A \mid < 18) = \frac{0.7 \times 0.1587}{0.15489}$$

$= 0.7172$

therfore there is o 0.7172 chance or 71.72% chance that it is a species A.