Specialist Mathematics subject report

2025 cohort

January 2026

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

260031

Queensland Curriculum & Assessment Authority
PO Box 307 Spring Hill QLD 4004 Australia

Phone: (07) 3864 0299
Email: office@qcaa.qld.edu.au
Website: www.qcaa.qld.edu.au

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

314
schools offered Specialist Mathematics

95.68%
of students received a C or higher

16.47%
increase in enrolment since 2024

Subject data summary

Unit completion

The following data shows students who completed the General subject or alternative sequence (AS).

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 Specialist Mathematics: 314.

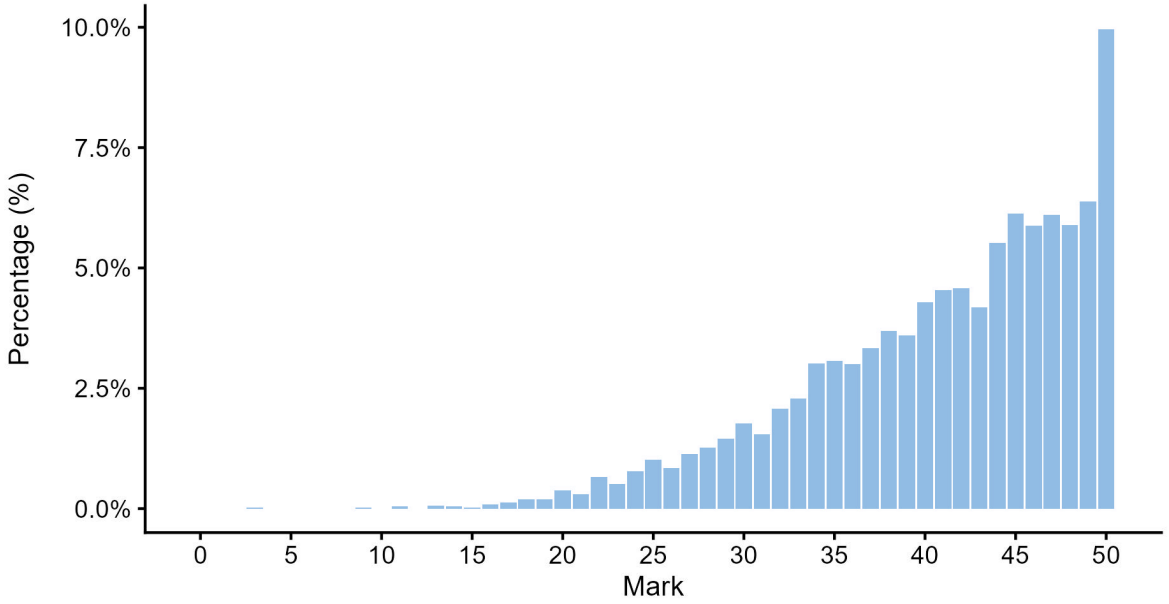
Completion of units	Unit 1	Unit 2	Units 3 and 4
Number of students completed	5,328	5,078	4,722

Units 1 and 2 results

Number of students	Unit 1	Unit 2
Satisfactory	5,108	4,703
Unsatisfactory	220	375

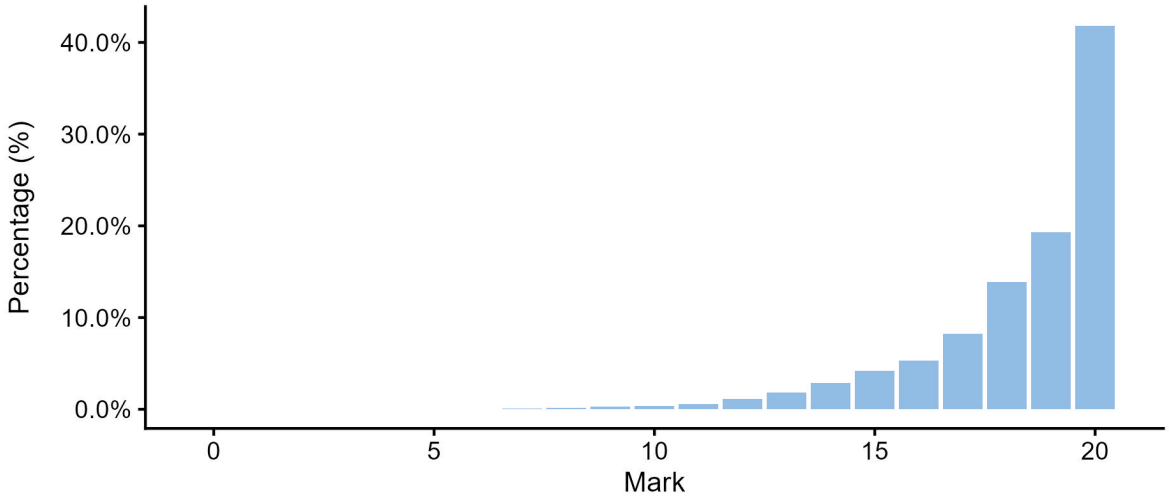
Units 3 and 4 internal assessment (IA) results

Total marks for IA

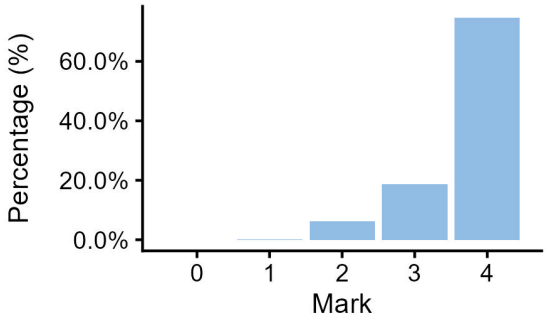


IA1 marks

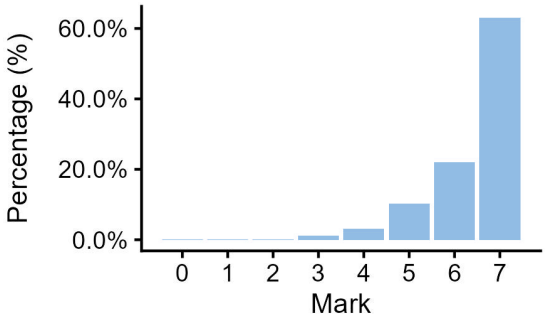
IA1 total



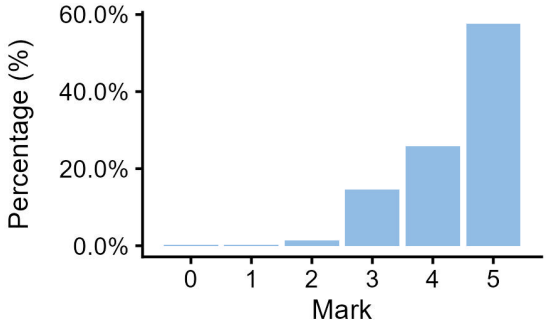
IA1 Criterion: Formulate



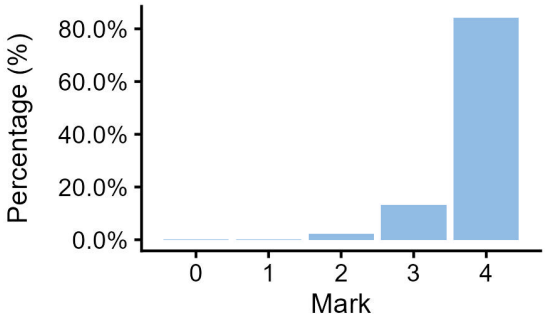
IA1 Criterion: Solve



IA1 Criterion: Evaluate and verify

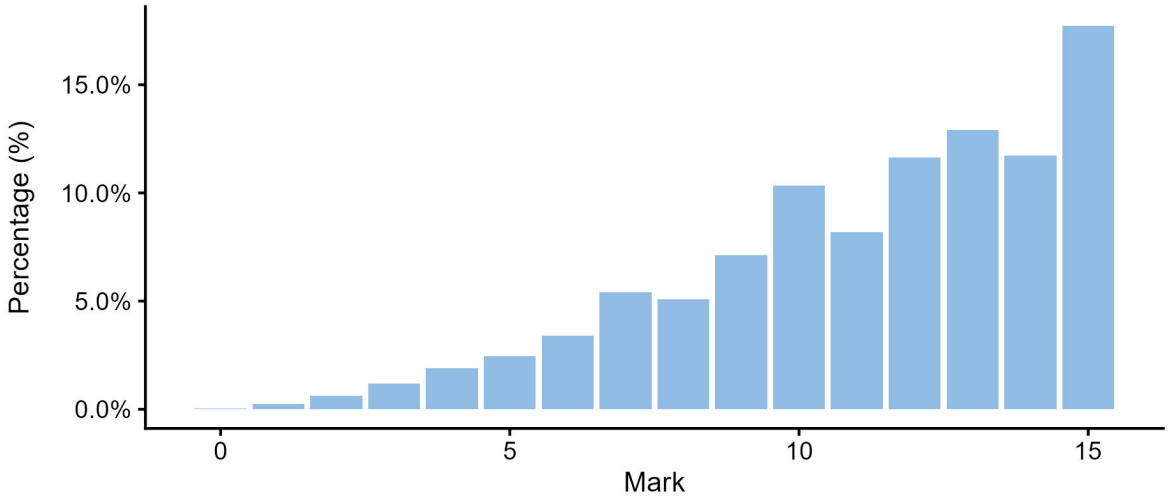


IA1 Criterion: Communicate

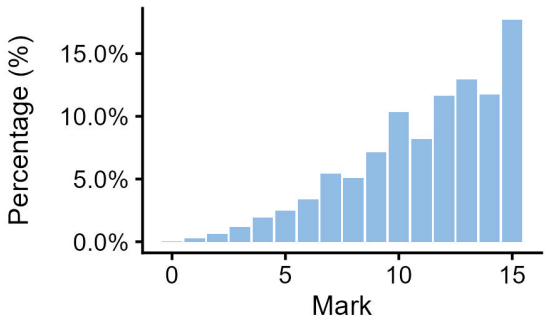


IA2 marks

IA2 total

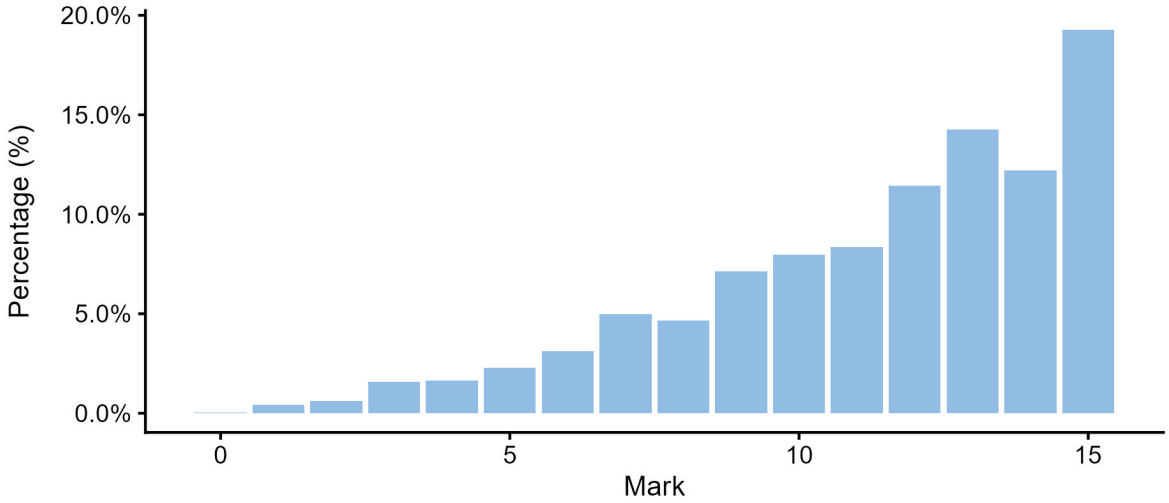


IA2 Criterion: Foundational knowledge and problem-solving

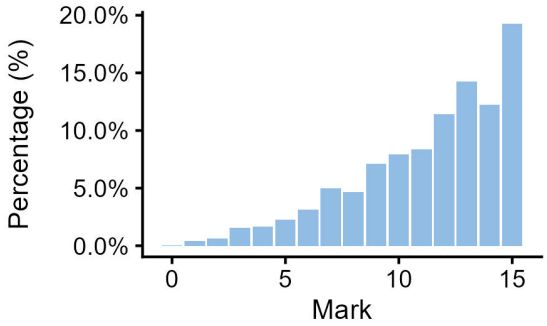


IA3 marks

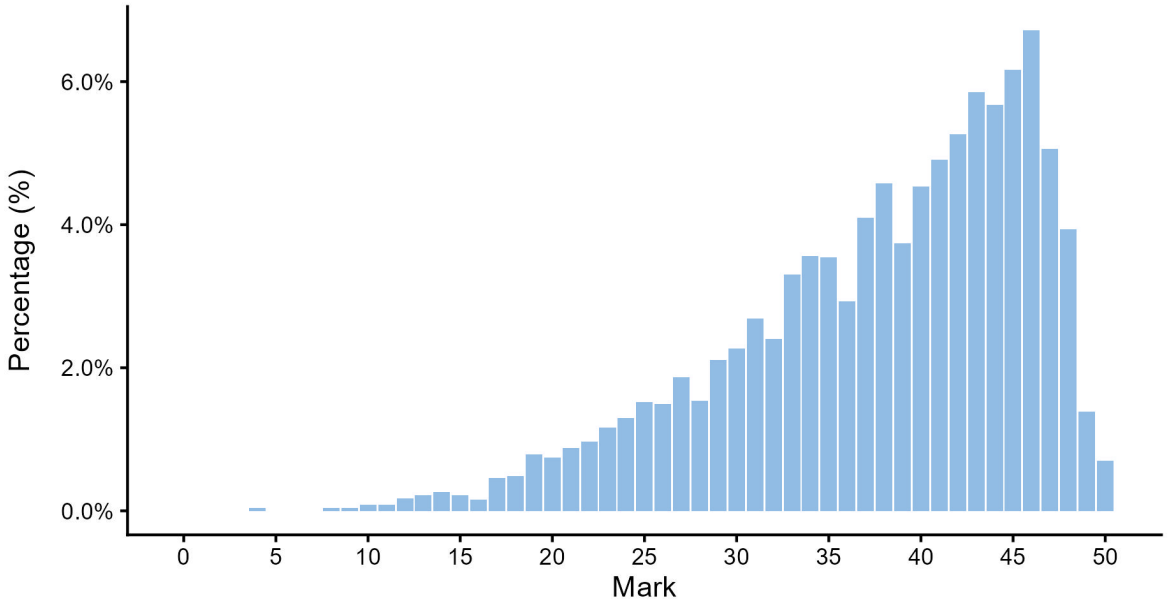
IA3 total



IA3 Criterion: Foundational knowledge and problem-solving

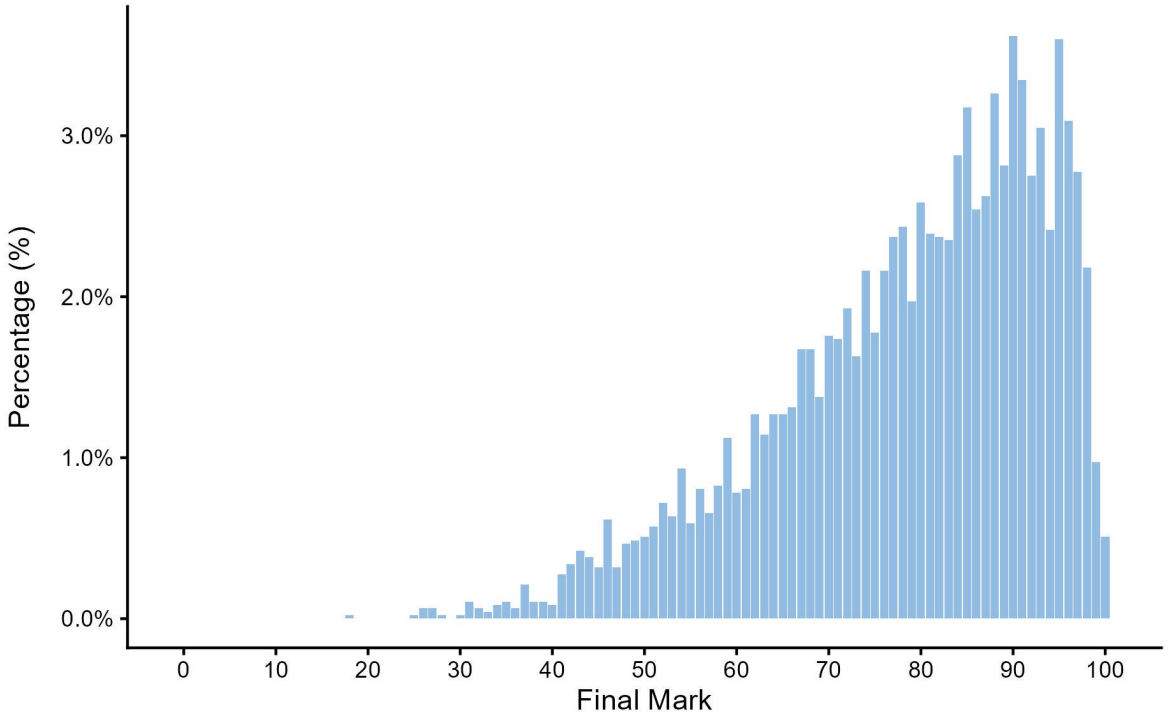


External assessment (EA) marks



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	85–70	69–49	48–23	22–0

Distribution of standards

Number of students who achieved each standard across the state.

Standard	A	B	C	D	E
Number of students	1,868	1,685	965	203	1
Percentage of students	39.56	35.68	20.44	4.30	0.02

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	313	313	311
Percentage endorsed in Application 1	80	30	61

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

IA	Number of schools	Number of samples requested	Number of additional samples requested	Percentage agreement with provisional marks
1	310	1,973	0	97.42
2	310	1,970	0	100.00
3	310	1,956	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: Vectors and matrices
- Topic 3: Complex numbers 2.

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	12
Authenticity	7
Item construction	2
Scope and scale	19

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- included tasks that allowed students to demonstrate mathematical reasoning in authentic contexts that are aligned to Unit 3 subject matter
- provided sufficient scope for students to address all four stages of the problem-solving and modelling approach
- avoided repeating QCAA sample tasks and public examples to allow students the opportunity for unique responses
- used scaffolding and stimulus that supported interpretation without reducing complexity or directing the response.

Practices to strengthen

It is recommended that assessment instruments:

- provide a context that aligns clearly with Unit 3 subject matter but avoids narrowing the scope by directing students to specific content or methods
- avoid excessive scaffolding that limits student autonomy or exploration
- allow for a variety of approaches
- allow students to develop individual, authentic responses, e.g. if dominance matrices are used, the task must allow for opportunities that go beyond simple win–loss data.

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	0
Language	8
Layout	1
Transparency	8

Effective practices

There were no significant issues identified for improvement.

Practices to strengthen

There were no significant issues identified for improvement.

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 Topic 2: Vectors and Matrices and/or Topic 3: Complex numbers 2, 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.

Schools should also:

- ensure that the context is broad enough to enable independent exploration.

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	99.68	0.32	0.00	0.00
2	Solve	99.35	0.65	0.00	0.00
3	Evaluate and verify	98.06	1.61	0.32	0.00
4	Communicate	99.68	0.00	0.32	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 Evaluate and verify criterion, the highest mark was only awarded when there was evidence of consideration of results, observations and assumptions in the evaluation of the reasonableness of solutions
- for the Communicate criterion, the highest mark was only awarded when the responses were coherent and concise with mathematical symbols, terminology and conventions were used correctly
- 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 appropriate assumptions and relevant observations. To be considered important, the assumptions and observations are required for the problem to be mathematised.
- In the Solve criterion in the 2025 syllabus, responses matched to the highest performance level must demonstrate efficient use of technology rather than accurate and appropriate use of technology. Efficient technology is evident when the technology selected allows the solution to be developed quickly, easily and effectively.
- The Evaluate and verify criterion in the 2019 syllabus is named Evaluate in the 2025 syllabus. Responses matched to the highest performance must include verification of the results of calculations through the solution development process.

- In the Communicate criterion in the 2025 syllabus, responses matched to the highest performance level must demonstrate correct use of appropriate mathematical language, including terminology, symbols, conventions and representations.

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

- schools ensure that both strengths and limitations are justified when evaluating the reasonableness of solutions
- schools ensure that students understand the difference between the cognitions of explain and justify, so that students don't confuse explaining an assumption with a justification of an assumption
- teachers use information in the *Unpacking internal assessment terminology* document (available under Resources in the Syllabuses app) as a guide to what the 2025 ISMG descriptors look like in practice when they are used to mark student work. Teachers can continue to 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 between 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 can 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), so the response must typically justify more than one assumption and more than one observation, respectively
  - Evaluate criterion requires 'a verified result' (singular) at the 2–3 mark range and 'verified results' (plural) at the 4–5 mark range.
- The Evaluate and verify criterion in the 2019 syllabus is named Evaluate in the 2025 syllabus. In the 2025 ISMG, there are now five descriptors at the top performance level for Evaluate. The 2019 descriptor regarding 'strengths and limitations' has been split into two descriptors and the descriptor 'evaluation of the reasonableness of solutions by considering the results, assumptions and observations' has also been separated for clarity.
- The descriptors for 'justification of decisions' are now in the Communicate criterion (as opposed to the Evaluate and verify criterion), so each performance level in this criterion now has three descriptors.

Samples

The following excerpts illustrate:

- documentation of both observations and assumptions (Excerpts 1 and 2)
- documentation of relevant strengths and limitations (Excerpts 3 and 4).

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

Excerpt 1

2.1 Observations.

Observation 1: It was observed that teenagers and parents have differing likelihoods of solving the problems in the escape rooms and therefore escape. This is because age can impact important puzzle solving skills, such as intelligence and attention spans (Deccan Chronicle, 2016). Therefore, the maze design will vary between parents and teenagers to accommodate for their differing probabilities of success.

Observation 2: It was observed that players may improve during the escape room, however, this cannot be considered in the mathematical model. This is because as players spend more time within the escape room their problem-solving skills improve, and therefore they increase their chance of escaping (Stottler, 2022). However, this is too complex to be considered within the mathematical model but can be considered when evaluating the proposed solution.

Observation 3: It was observed that the optimal escape room design gives customers multiple pathways or doors to exit each room. This is because it allows customers to not get stuck in one area, have choices on which path to take and increase the challenge and experience (Quill, 2023). Therefore, it is sensible to have more than one door leading out of each room, however, not too many to make it too difficult to escape.

2.2 Assumptions

Assumption 1: It was assumed that an "adjustable" design for the different groups meant adjustments were feasible and sensible, and not structural. This could include locking of doors and adjusting two-way or one-way doors, but not affecting the layout of the rooms or adjusting the number of two-way/one-way doors. This is to keep adjustments quick, easy and simple to maximise business and minimise hassle, and keep the unique number of rooms and doors that was commissioned.

Assumption 2: It was assumed that the data given for the likelihoods of success for teenagers and parents is an accurate and reasonable representation of the average success rate. This means that the data given can be assumed to apply and be accurate for a model for most groups of parents or teenagers doing the escape room. This is because a model needs to be devised of the average group moving through the escape room, representing how the wider population would succeed in the devised maze.

Assumption 3: It was assumed that participants do not know which rooms they came from, have no preference when choosing doors, and that retrying puzzles take an extra full 5 minutes. This means that the probabilities work for representing how likely the group is to escape or enter a certain room, and therefore escape outside. This is because the probabilities and model would not work if participants mapped their way out.

3

Excerpt 2

3.2. Assumptions

The following was assumed considering Table 1:

- **Natural immunity cannot be built up against the disease.**
  - The Leslie model has no provision for preventing repeat infection. Natural immunity often drastically reduces fatality and spread after reinfection, so was excluded in this investigation (Natural Immunity, 2024).
- **The characteristics of the disease are constant between men and women.**
  - Some infectious diseases disproportionately affect one gender (Bender, 2017). It was assumed that the infection equally effects men and women because no other data was given.
- **The disease affects all ages equally.**
  - Infections and mortalities are more prevalent in the young and elderly (Brodkey, n.d.). The Leslie model cannot accommodate the age of patients, so this factor was excluded.
- **The disease does not mutate or evolve over time**
  - Most diseases mutate, usually rendering it more contagious or fatal (Tulane University, 2023). The model does not provide adequate capacity to account for this and was ignored in this investigation.
- **Vaccines are 100% effective**
  - Even though breakthrough infections happen, this must be assumed because the Leslie matrix cannot model the effect of different vaccine efficacy rates (World Health Organisation, 2021).
- **The population is stable at 4.0×10^7, with 100 infected individuals initially.**
  - This is close to the average population of a country, 40.69 million, but rounded down for simplicity (The Global Economy, 2024). Starting with 100 is realistic of an infected plane landing in the country.
- **Immigration matches emigration**
  - Migration would have significantly skewed results considering disease spread and fatality. Ensuring incoming and outgoing numbers matched meant the investigation adhered to nature of the problem while maintaining result validity.

Excerpt 3

4.2 Strengths and limitations

4.2.1 Strengths

A strength of the model is the ease of adjusting the escape room between the teenagers' and parents' design. This is because only two doors need to be changed, both in room 2 (Assumption 1). Consequently, staff can quickly enter the maze, adjust the two doors, and then have a functional escape room for the different party, maximising time and business.

A strength of the model is the accuracy and effectiveness of Markov chains to calculate the probabilities of a group moving through the maze after set times. This means they can be a general indicator of the scenario, and problems with the solution is more likely to be encountered with real-life issues than the calculations.

A strength of the model is the simple layout featuring equally sized and shaped rooms, which will allow it to be easily constructed. Furthermore, the design is a square, which will fit most buildings, or can be easily adjusted into a rectangle with other dimensions.

4.2.2 Limitations

A limitation of the model is that Room 2 is not fully and effectively used. This is because it only has one door of entry in both designs meaning participants will not spend much time there (Observation 3). To make use of this, the company could use the room for their worst puzzle.

Good

A limitation of the model is that parents take 365 minutes to reach a state of 100% exit, which is longer than recommended (Erdei, 2023) and causes their teenagers to wait. However, the real time may be shorter as the model does not consider improvement in the maze (Observation 3). Also, this scenario will be rare, as 98% of people escape after 265 minutes. Finally, as escape rooms run off a time-based profit this will not be a major disadvantage.

Well explained

A limitation of the model is that the success rate for parents is quite low, especially after 30 minutes, where only 10% escape. With further investigation, a better model could be found.

Excerpt 4

Strengths and Limitations of Solution Considering Mathematical Model Used

Strengths:

- Logistic growth is a more realistic method of population estimation than the Leslie matrix, as the growth rate decreases as the population reaches its carrying capacity.
- Based on the accuracy of the 2100 prediction, the carrying capacity of Australia as estimated by the 1996 Rockefeller University report (Marchetti, Meyer, & Ausubel, 1996) is proven to be an accurate number of 50 million.
- Unlike the Leslie matrix model, the logistic growth model predicts population without using birth and survival rates, which is an advantage as the effects of migration are incorporated within the logistic growth.

Limitations:

- The logistic growth model did not factor in the potential change in migration rates over time which may have decreased accuracy, as this is simply something that cannot be predicted and included in the logistic growth formula.
- Calculating Australia's 2100 population based on the predicted Victoria female population has limited accuracy as sex rate (98.4:100) and Victoria's share of Australian female population (25%) are numbers used from 2008 which would have changed.

Commented [YL18]: Documented strengths and limitations of the solution/model

Internal assessment 2 (IA2)

Examination (15%)

The 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	231
Authentication	0
Authenticity	1
Item construction	16
Scope and scale	22

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- include an accurate marking scheme
- intentionally assessed all objectives, including Assessment objective 4: evaluate the reasonableness of solutions and Assessment objective 5: justify procedures and decisions, supported by appropriate mark allocation.

Practices to strengthen

It is recommended that assessment instruments:

- provide questions of appropriate complexity that match their classification. Many items mis identified as complex unfamiliar lacked multiple interacting elements or novel contexts
- are aligned with Unit 3 (AS Unit 1) subject matter, and particularly avoid reliance on Physics contexts or Mathematical Methods subject matter
- provide a marking scheme that aligns with the expected solution approach (e.g. vector calculus) where prompted.

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	0
Language	40
Layout	6
Transparency	54

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- used clear mathematical language and symbols, enhancing student access to all items
- included questions that prompted mathematical processes appropriate to Unit 3
- provided cues to students to identify if an analytical procedure was required or if technology use was appropriate.

Practices to strengthen

There were no significant issues identified for improvement.

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 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 and Mathematical Methods.

Schools should also:

- include complex unfamiliar items, with clearly defined characteristics such as non-routine context, limited scaffolding, and multi-step reasoning.

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	100.00	0.00	0.00	0.00

Effective practices

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

- the marking scheme explicitly identified the exact process or attribute to award each mark
- 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
- on the response, the number of marks awarded for each question was clearly identifiable.

Practices to strengthen

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

- the full calculation for determining the overall percentage is shown on the ISMG, e.g. 40.5/48 = 84.375%
- internal quality assurance processes are used to ensure the marking scheme does not contain mathematical errors and that the 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 7.0*, 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 Specialist Mathematics, which is available under Resources in the Syllabuses app (*QCE and QCIA policy and procedures*

handbook 7.0, 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.

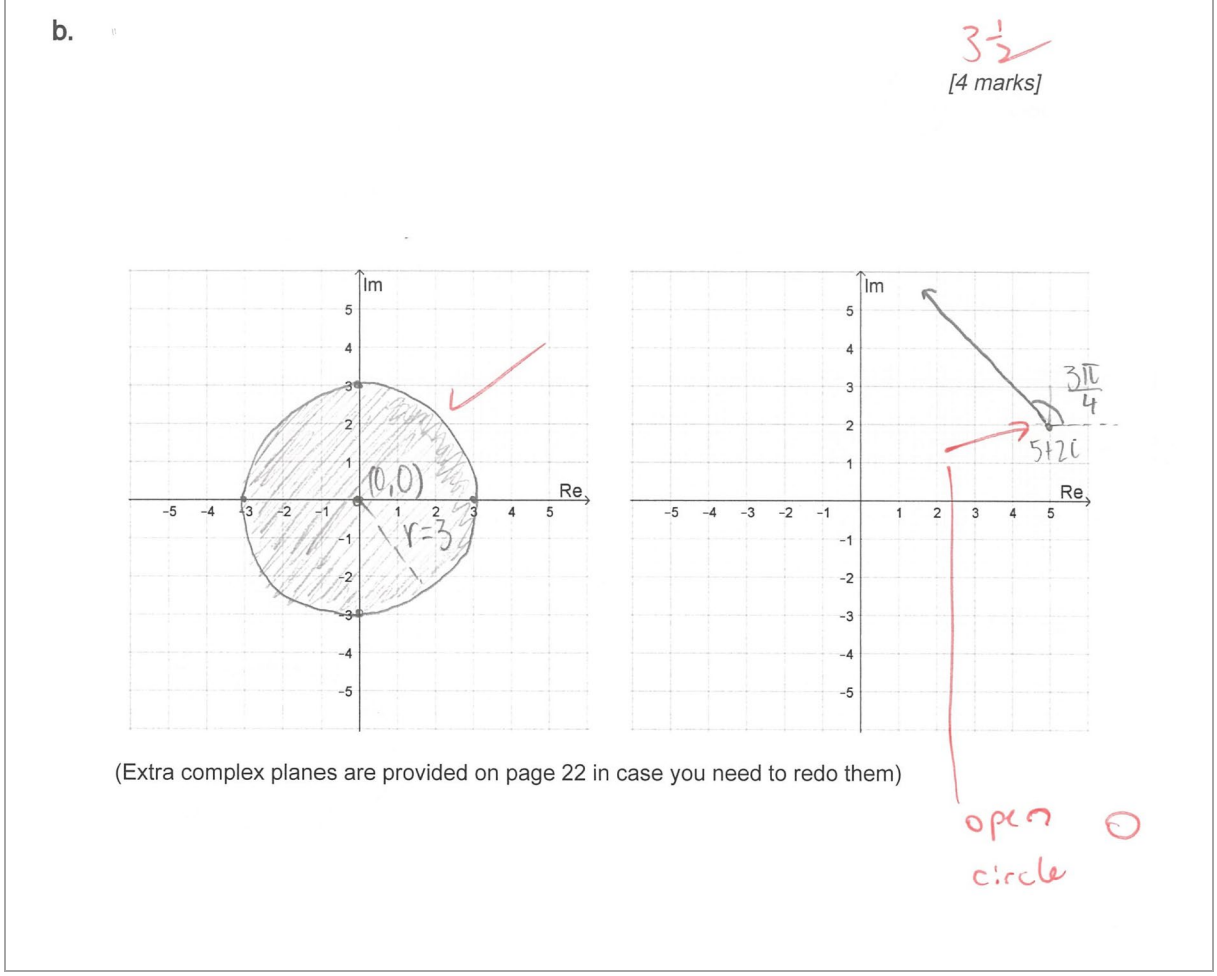
Samples

The following excerpts demonstrate:

- clear indication on the student response to show both the marks awarded for the question and the alignment to the marking scheme (Excerpt 1)
- clear annotation of the ISMG to include the total number of marks awarded, percentage calculation and ISMG mark (Excerpt 2).

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

Excerpt 1



Excerpt 2

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

Criterion: Foundational knowledge and problem-solving

$\frac{53}{55} \approx 96.36\%$

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 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 all Unit 4 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	122
Authentication	0
Authenticity	0
Item construction	7
Scope and scale	11

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- included an accurate marking scheme
- intentionally assessed all objectives, including Assessment objective 4: evaluate the reasonableness of solutions and Assessment objective 5: justify procedures and decisions, supported by appropriate mark allocation.

Practices to strengthen

It is recommended that assessment instruments:

- provide questions of appropriate complexity that match their classification. Many items mis-identified as complex unfamiliar lacked multiple interacting elements or novel contexts
- are aligned with Unit 4 (AS Unit 2) subject matter, and particularly avoid reliance on Physics contexts or Mathematical Methods subject matter
- provide a marking scheme that aligns with the expected solution approach, e.g. definite integration using technology.

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	0
Language	20
Layout	0
Transparency	16

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- used clear mathematical language and symbols, enhancing student access to all items
- included questions that prompted mathematical processes appropriate to Unit 4
- provided cues to students to identify if an analytical procedure was required or if technology use was appropriate.

Practices to strengthen

There were no significant issues identified for improvement.

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 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 and Mathematical Methods.

Schools should also:

- include complex unfamiliar items with clearly defined characteristics such as non-routine context, limited scaffolding, and multi-step reasoning.

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	100.00	0.00	0.00	0.00

Effective practices

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

- the marking scheme explicitly identified the exact process or attribute to award each mark
- 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
- on the response, the number of marks awarded for each question was clearly identifiable.

Practices to strengthen

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

- the full calculation for determining the overall percentage is shown on the ISMG, e.g. 48.5/60 = 80.833%
- internal quality assurance processes are used to ensure the marking scheme does not contain mathematical errors and that the 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 7.0*, 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 7.0*, 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 Specialist Mathematics, which is available under Resources in the Syllabuses app (*QCE and QCIA policy and procedures*

handbook 7.0, Section 9.6.3). Schools are advised to check that all scanning of student work has been completed without error to ensure that:

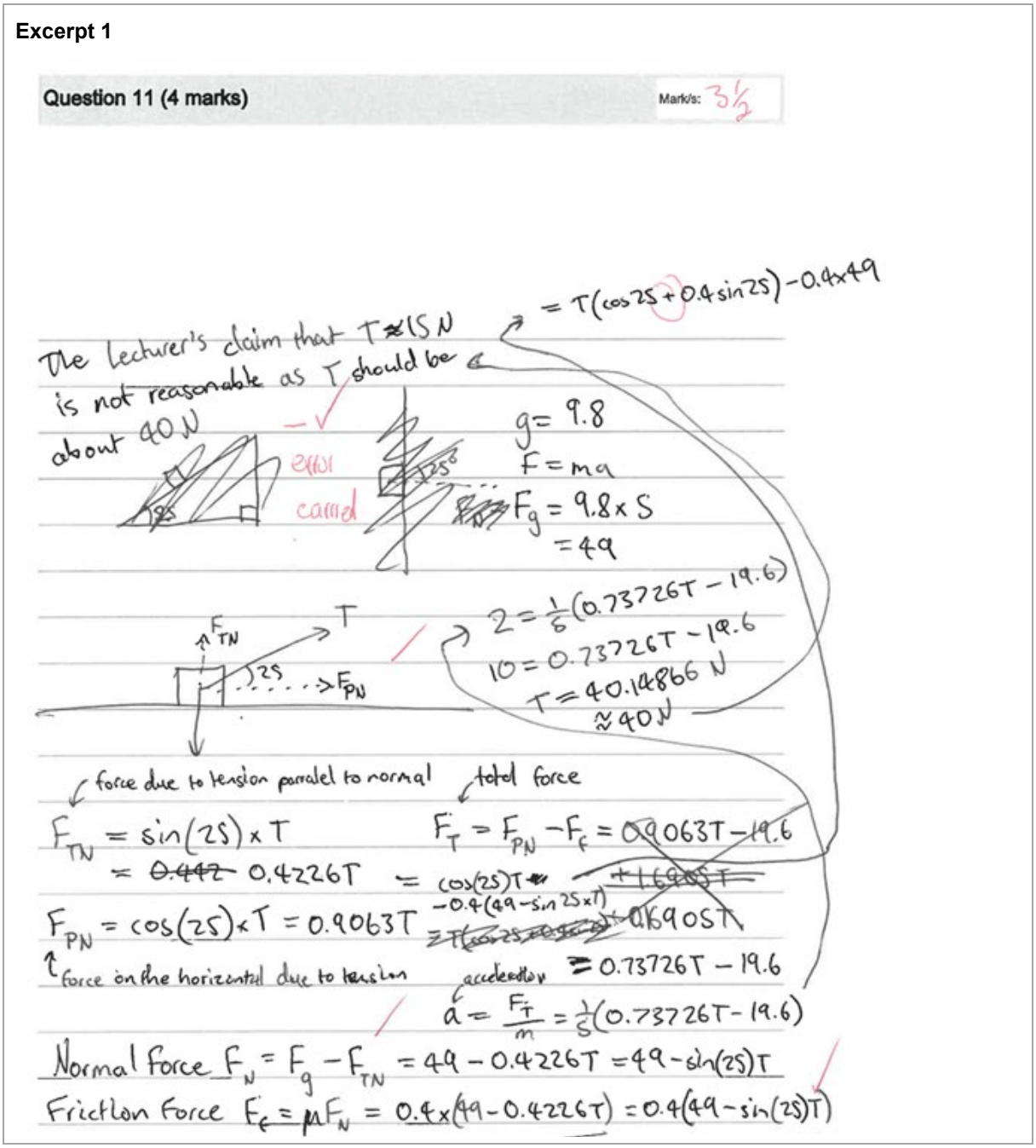
- no pages are missing from the response
- all pages are visible and legible
- the submitted response matches the selected student.

Samples

The following excerpts demonstrate clear indication on the student response where follow-through marks were awarded.

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

Excerpt 1



Excerpt 2

$T_S = 4°C$

$\frac{dT}{dt} = k(T - T_S) = k(T-4)$ ✓

$\frac{dt}{dT} = \frac{1}{k(T-4)}$

$t = \int \frac{1}{k(T-4)}\, dT$

$t = \frac{1}{k}\int \frac{1}{T-4}\, dT$

$t = \frac{1}{k}\ln|T-4| + C$ ✓

Let $t = 0$, $T = 20$ ✓

$0 = \frac{1}{k}\ln|20-4| + C$

$c = -\frac{1}{k}\ln 16$ ✓

Let $t = 30$, $T = 8$ ✓

$30 = \frac{1}{k}\ln|8-4| + C$

$c = 30 - \frac{1}{k}\ln 4$ ✓

$-\frac{1}{k}\ln 16 = 30 - \frac{1}{k}\ln 4$

TE? ✗

$-\frac{1}{k}\ln 16 + \frac{1}{k}\ln 4 = 30$

$\frac{1}{k}(\ln 4 - \ln 16) = 30$

(next page)

$\frac{1}{k}\ln\frac{4}{16} = 30$

$\frac{1}{k} = \frac{30}{\ln\frac{4}{16}}$

$k = \frac{\ln\frac{4}{16}}{30}$

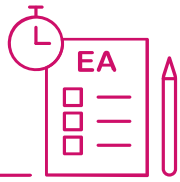
CFPA ✓

$c = -\frac{1}{k}\ln 16$

$= \frac{-30}{\ln\frac{4}{16}}\ln 16$

CFPA ✓

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 (50 marks)
- Paper 2, Section 1 consisted of multiple choice questions (10 marks)
- Paper 2, Section 2 consisted of short response questions (50 marks).

The AS assessment instrument was designed using the specifications, conditions and assessment objectives described in the summative external assessment section of the AS.
The AS 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 (50 marks)
- Paper 2, Section 1 consisted of multiple choice questions (10 marks)
- Paper 2, Section 2 consisted of short response questions (50 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	**81.78**	3.87	3.72	10.46
2	6.85	11.55	13.82	**67.40**
3	**43.15**	26.84	20.20	8.74
4	7.77	10.06	24.77	**57.21**
5	6.76	3.96	15.24	**73.43**
6	4.81	**80.97**	2.40	11.64
7	24.41	5.21	**65.18**	4.87
8	3.85	5.92	**83.27**	6.68
9	4.41	**51.47**	27.13	16.42
10	42.06	22.01	**21.05**	14.44

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	12.56	2.05	**80.92**	3.82
2	22.85	12.54	16.92	**46.91**
3	4.91	**75.50**	16.94	2.25
4	7.39	1.25	6.72	**84.18**
5	1.85	**94.44**	2.03	1.21
6	6.72	**66.82**	14.51	11.27
7	**29.73**	8.77	23.68	37.13
8	18.41	15.04	25.75	**39.68**
9	5.71	**79.11**	10.40	4.08
10	12.81	6.76	**74.74**	4.82

There were 10 multiple choice questions in Paper 1 (AS).

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	**55.17**	8.05	8.62	28.16
2	5.75	15.52	24.71	**53.45**
3	**55.17**	22.99	6.32	14.94
4	41.95	**43.10**	4.02	10.92
5	10.34	4.02	16.67	**68.39**
6	8.62	**72.41**	4.60	14.37
7	17.82	6.90	**60.34**	14.37
8	0.57	12.64	**77.01**	9.20
9	23.56	4.02	7.47	**64.94**
10	28.74	**45.98**	14.37	10.92

There were 10 multiple choice questions in Paper 2 (AS).

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	18.39	3.45	**70.69**	6.32
2	21.84	18.97	21.84	**34.48**
3	0.00	1.15	**95.40**	2.87
4	12.64	0.57	5.17	**81.03**
5	**56.90**	21.84	2.30	18.97
6	**45.40**	9.20	41.38	4.02
7	**39.08**	20.11	34.48	5.75
8	11.49	**63.22**	18.39	6.32
9	18.39	**56.32**	13.22	11.49
10	17.24	10.34	**62.64**	9.77

Effective practices

Overall, students responded well to:

- the opportunity to solve a system of equations using Gaussian elimination
- the opportunity to demonstrate knowledge and understanding of using integration by parts
- simple familiar questions on both papers where students could demonstrate their understanding of practised procedures
- multiple choice questions on both papers.

Practices to strengthen

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

- providing opportunities for students to compare the distributions of X and $\overline{X}$, including calculations and notations related to their respective means and standard deviations
- encouraging students to use correct notation, including brackets, integral notation with dx
- providing opportunities for students to practise the algebraic manipulation of complex numbers in both forms
- providing opportunities for students to practise the use of trigonometric substitutions.

Additional advice

- 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.
- Teachers should encourage students to become more familiar with the full capabilities of graphics calculator functionality.
- Teachers should ensure students understand the difference between inverse trigonometric functions and reciprocal trigonometric functions, e.g. $\cos^{-1}(\theta)$ and $\frac{1}{\cos(\theta)}$.
- Teachers should encourage students to follow the instructions in the question and response book, e.g. Questions worth more than one mark require mathematical reasoning and/or working to be shown to support answers.
- 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 simple familiar question required students to use the given a velocity function defined in terms of x. In Part a) they were required to use the function to determine the momentum of the object at the origin. In Part b) they were required to use the function to determine the acceleration of the object at the origin.

Effective student responses:

- Used $\cos^{-1}(0)=\frac{\pi}{2}$ to determine the velocity at the origin
- recalled that momentum is equal to the product of mass and velocity
- determined $\frac{d}{dx}\cos\left(\frac{x}{3}\right)$

- used either $a = v\frac{dv}{dx}$ or $a = \frac{d}{dx}\left(\frac{1}{2}v^2\right)$ to determine the acceleration at the origin.

These excerpts have been included:

- to demonstrate the clear communication of the values for both position and momentum (Excerpt 1)
- to demonstrate the clear communication of the method used to calculate acceleration when velocity is a function of position (Excerpts 2 and 3)
- to demonstrate the use of alternative notation e.g. $\arccos(x)$ (Excerpt 3).

Excerpt 1

$x = 0, \quad v = 2\cos^{-1}\left(\frac{0}{3}\right) = 2 \times \frac{\pi}{2} = \pi \text{ m/s}$

$p = mv = 3 \times \pi = 3\pi \text{ kgms}^{-1}$

Excerpt 2

$\frac{dv}{dx} = 2 \times \frac{-1}{\sqrt{9 - x^2}} = \frac{-2}{\sqrt{9 - x^2}}$

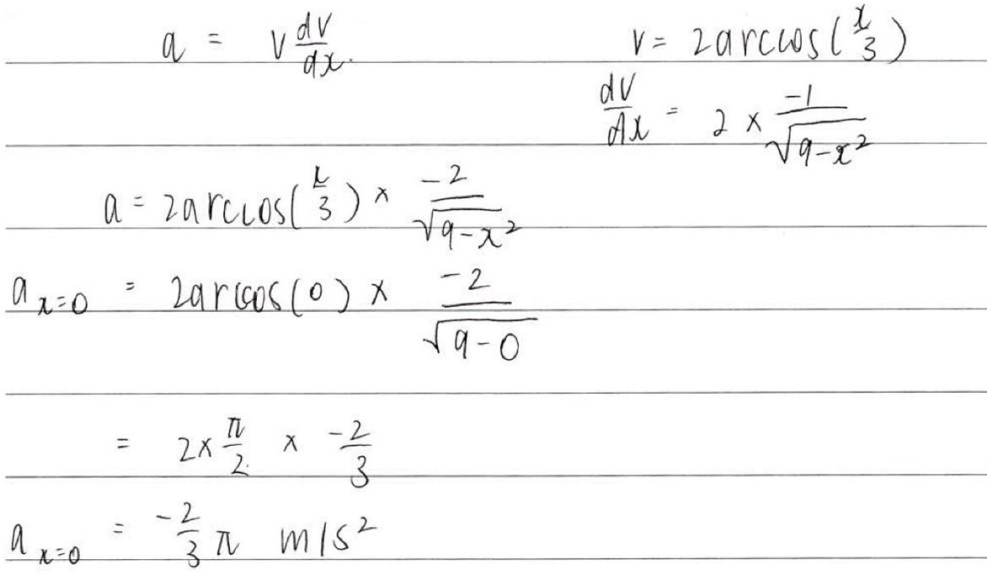
$a = v\frac{dv}{dx} = 2\cos^{-1}\left(\frac{x}{3}\right) \times \frac{-2}{\sqrt{9 - x^2}}$

when $x = 0$, $a = 2\cos^{-1}(0) \times \frac{-2}{\sqrt{9 - 0^2}}$

$= 2 \times \frac{\pi}{2} \times \frac{-2}{3}$

$= -\frac{2\pi}{3} \text{ m/s}^2$

Excerpt 3



Question 16 from Paper 1

This complex familiar question required students to prove that two diagonals of a parallelepiped bisect each other.

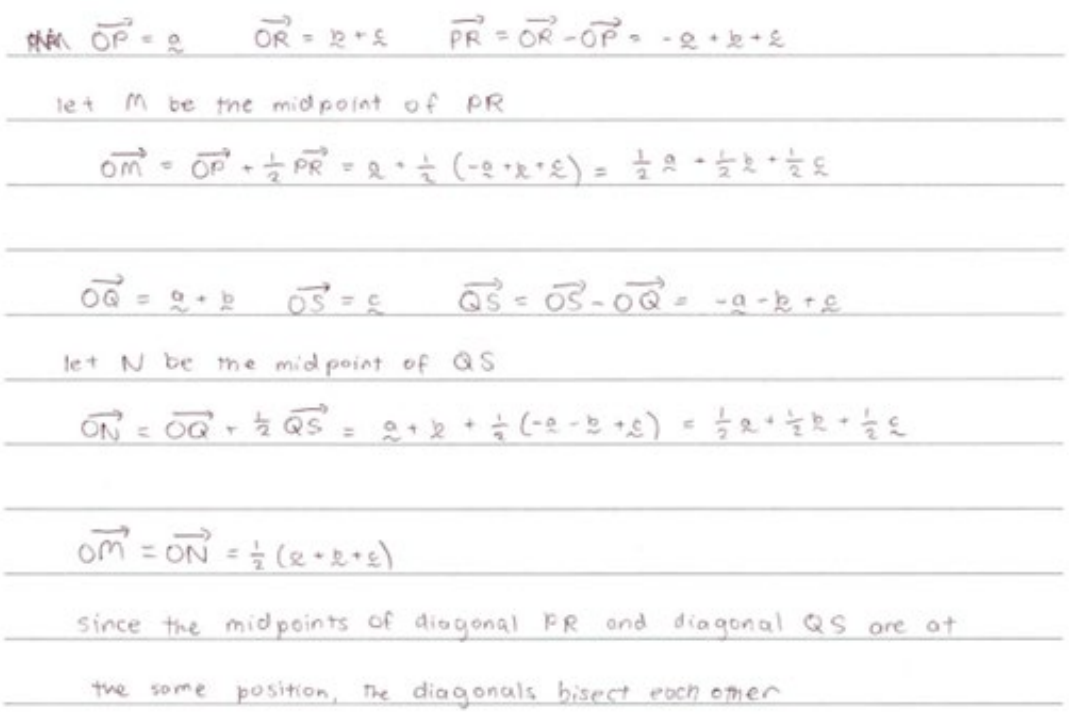
Effective student responses:

- defined the diagonals in terms of the given vectors $\boldsymbol{a}$, $\boldsymbol{b}$ and $\boldsymbol{c}$.
- determined the midpoint of each diagonal
- recognised that the midpoints were the same for both diagonals.

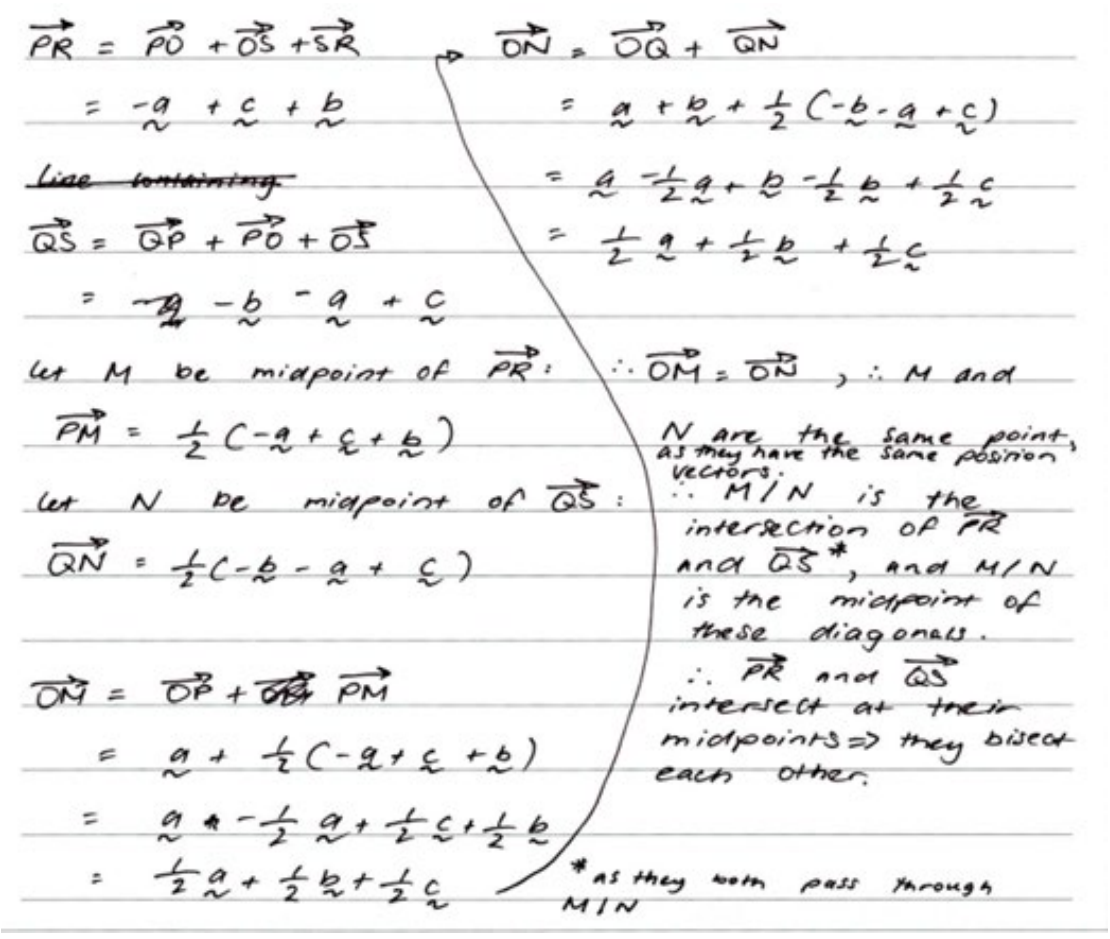
These excerpts have been included:

- to model well-constructed reasoning to develop a geometric proof using vectors
- to demonstrate the use of short statements to communicate key steps.

Excerpt 1



Excerpt 2



Question 17 from Paper 2

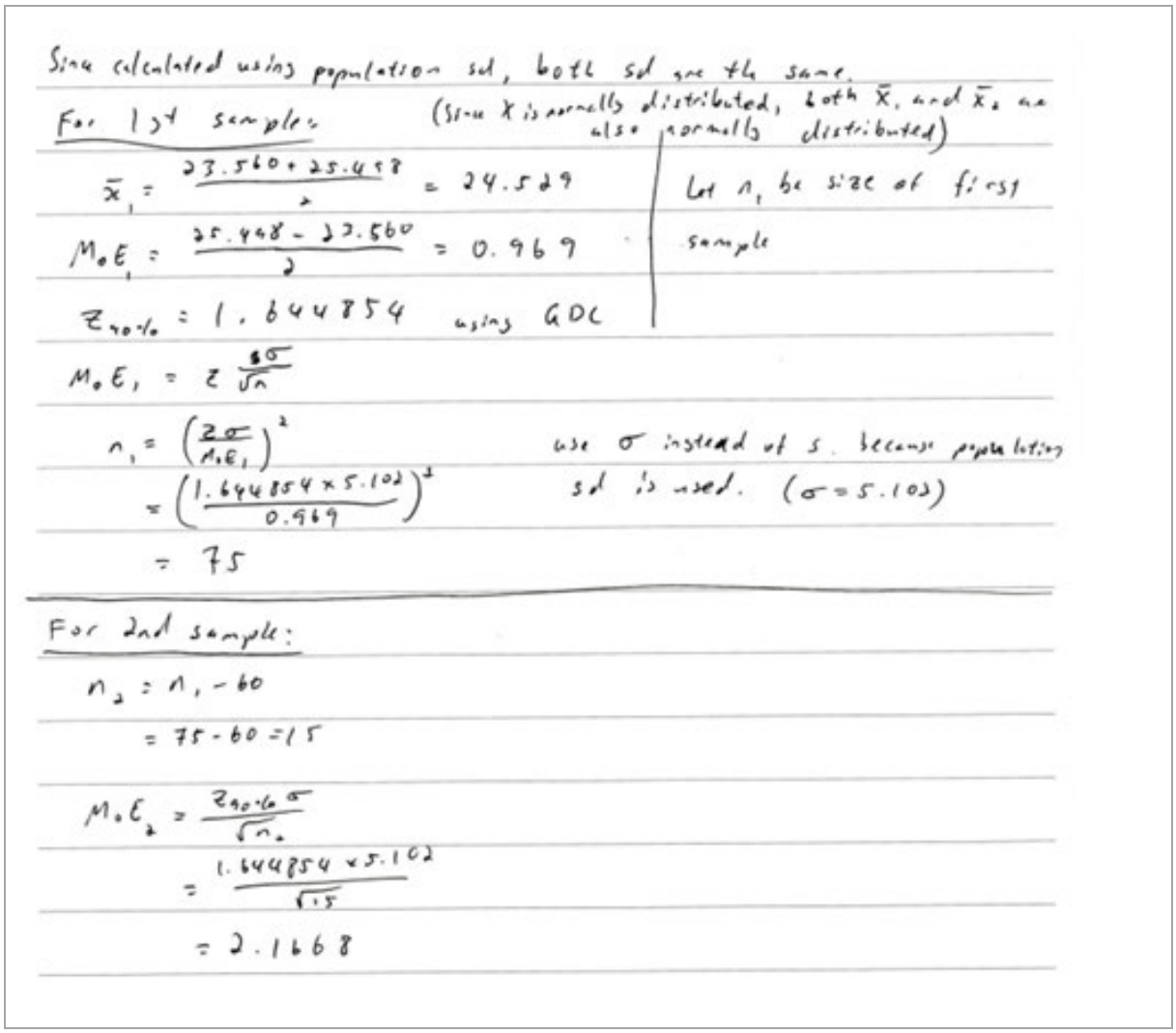
This complex unfamiliar question required students to use a confidence interval calculated from a sample to determine the probability that a confidence interval calculated from a second smaller sample overlaps the confidence interval from the first sample.

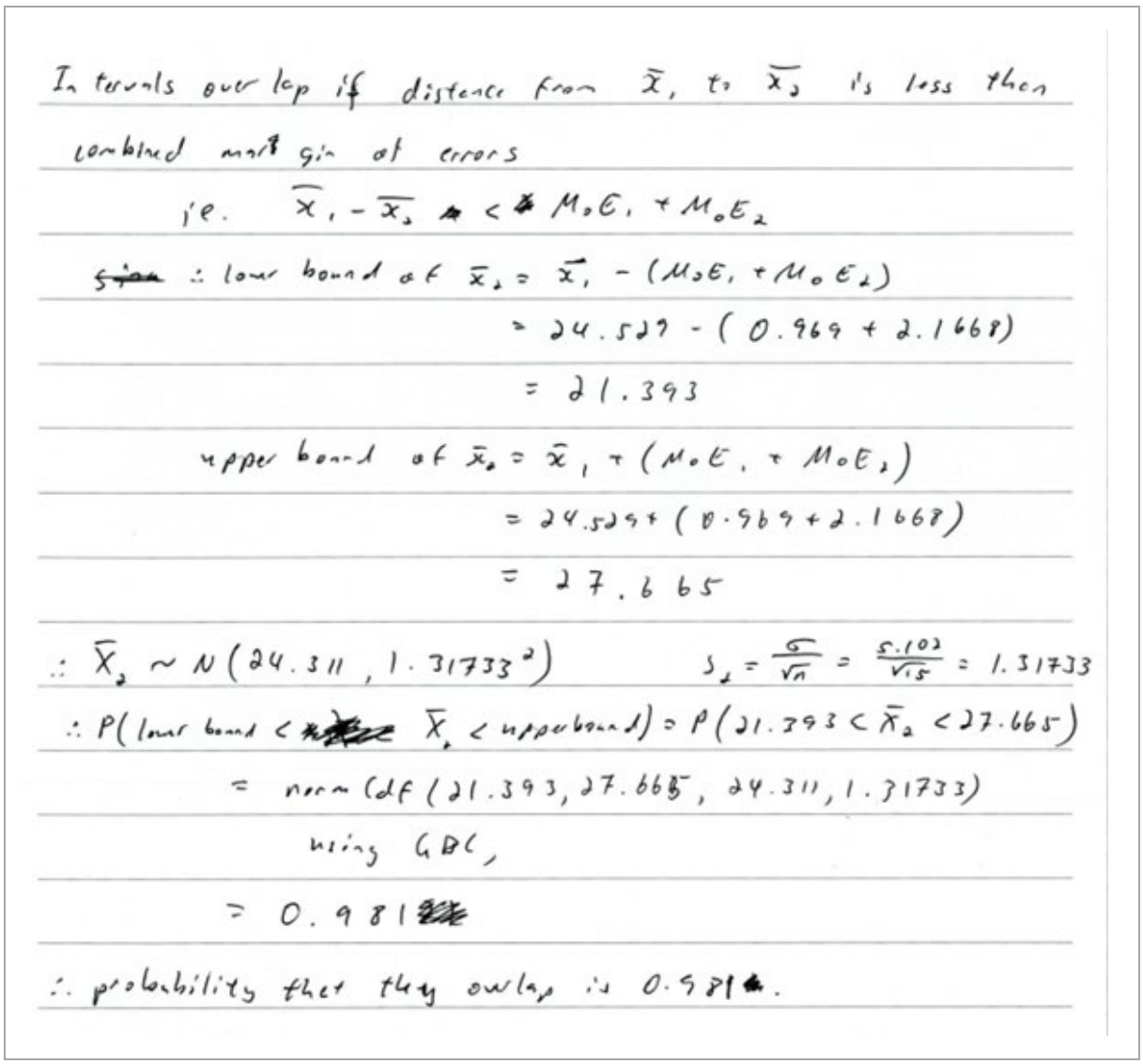
Effective student responses:

- used the given confidence interval to determine the size of the first sample
- determined the size of the second sample
- determined the confidence interval for the second sample
- used the parameters for the distribution of sample means to determine the required probability.

This excerpt has been included:

- to demonstrate accurate use and communication of statistical concepts, including recognition that the sample size must be an integer
- to demonstrate appropriate use of mathematical reasoning to solve the problem.





Question 18 from Paper 2

This complex unfamiliar question required students to use the length of a polar curve formula to determine the length of part of a polar curve.

Effective student responses:

- identified the bounds of the curve
- determined $\frac{dr}{d\theta}$
- made appropriate substitutions into the formula for the length of a polar curve
- used an appropriate trigonometric substitution
- determined the length of the curve.

This excerpt has been included:

- as an example of a complete algebraic method
- to demonstrate the use of appropriate trigonometric substitutions.

Above x-axis: $0 \leq \theta \leq \pi$.

$r = 1 + \cos(\theta)$.

$$L = \int_0^{\pi} \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2}\, d\theta.$$

$\frac{dr}{d\theta} = -\sin(\theta)$

$$= \int_0^{\pi} \sqrt{(1+\cos(\theta))^2 + (-\sin(\theta))^2}\, d\theta$$

$$= \int_0^{\pi} \sqrt{1 + 2\cos\theta + \cos^2\theta + \sin^2\theta}\, d\theta$$

using $\cos^2\theta + \sin^2\theta = 1$

$$= \int_0^{\pi} \sqrt{2 + 2\cos\theta}\, d\theta$$

using $\cos(2A) = 2\cos^2(A) - 1$

$\cos(2A) + 1 = 2\cos^2(A)$

$2[\cos(2A) + 1] = 4\cos^2(A)$

$$= \int_0^{\pi} \sqrt{4\cos^2\left(\frac{\theta}{2}\right)}\, d\theta$$

$$= \int_0^{\pi} 2\cdot\cos\left(\frac{\theta}{2}\right) d\theta$$

$$= \left[2\sin\left(\frac{\theta}{2}\right) \times \frac{1}{\frac{1}{2}}\right]_0^{\pi}$$

$$= \left[4\sin\left(\frac{\theta}{2}\right)\right]_0^{\pi}$$

$$= 4\sin\left(\frac{\pi}{2}\right) - 4\sin(0)$$

$L = 4$ units.