CARIBBEAN EXAMINATIONS COUNCIL

ADDITIONAL MATHEMATICS

Subject Report

May–June 2025

CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

MAY–JUNE 2025

ADDITIONAL MATHEMATICS
GENERAL PROFICIENCY

Table of Contents

INTRODUCTION

This guide has been compiled using candidates’ responses to the 2025 May–June examination in CSEC Additional Mathematics.

The examination comprises the following papers.

- Paper 01 — Multiple Choice
- Paper 02 — Structured Essay
- Paper 031 — School-Based Assessment (SBA)
- Paper 032 — Alternative to School-Based Assessment

A total of 4473 candidates sat the examination in 2025 which is an increase from 4217 in 2024 and 4335 in 2023. In 2025, approximately 66 per cent of candidates achieved acceptable grades (Grades I–III).

PAPER 01 — MULTIPLE CHOICE

This paper, worth 60 marks, is made up of 45 multiple-choice items.

In 2025, the mean score (out of a possible 60 marks) was 36.88 and the standard deviation 12.61, compared with a mean score of 37.05 and a standard deviation of 13.26 in 2024, indicating a marginally stronger overall performance in 2024.

PAPER 02 — STRUCTURED ESSAY

This paper consists of four sections comprising a total of six compulsory questions. The mean score was 38.76 (out of a possible 100 marks) and the standard deviation 27.15.

Question 1

Part (a)

Candidates' ability to solve an exponential equation and to express the solution exactly was assessed. Many candidates correctly recognized that the equation was exponential and that logarithms were required to solve it. An acceptable solution is shown below.

$3^{2x+1} = 21$

$\log(3^{2x+1}) = \log 21$

$(2x + 1)\log 3 = \log 21$

$2x\log 3 + \log 3 = \log 21$

$2x\log 3 = \log 21 - \log 3$

$x = \frac{\log 21 - \log 3}{2\log 3}$ OR $x = \frac{\log 7}{\log 9}$

Part (b)

Candidates were required to determine the values of x and y by solving a pair of simultaneous equations, one linear and one non-linear. Most candidates were able to recognize the equations as simultaneous and to identify appropriate methods, ideally using a substitution method for solving them. This resulted in a quadratic equation in x, which many candidates solved, often without showing their working, which suggests that they may have used a calculator before proceeding to find the two corresponding values of y. The expected solution is shown below.

Equation (1): $y + 3x = 2$

Equation (2): $y + 4 = x(5 - 2x)$

From Equation (2): $y + 4 = 5x - 2x^2$

$$y = -2x^2 + 5x - 4$$

From Equation (3): $y = -2x^2 + 5x - 4$

Substituting Equation (3) into Equation (1): $-2x^2 + 5x - 4 = -3x + 2$

$$-2x^2 + 8x - 6 = 0$$

$$x^2 - 4x + 3 = 0$$

$$(x - 1)(x - 3) = 0$$

$$x = 1 \text{or} x = 3$$

When $x = 1$: $y = -3(1) + 2 = -1$

When $x = 3$: $y = -3(3) + 2 = -7$

Part (c)

This question required candidates to determine the solution set of a rational inequality, express the result using set-builder notation, and to explain how this solution differs from that of a related product inequality.

Most candidates were unable to accurately determine the solution set from the identified roots. Many of them did not provide a response or produced incomplete responses. Many candidates failed to recognize that, for a rational inequality, both the numerator and denominator must be considered. Common errors included multiplying or cross multiplying by an expression without accounting for its sign (leading to incorrect inequality directions) and failing to note that division by zero is undefined.

A common error was that candidates multiplied through or cross multiplied by $(x-1)$, leading to incorrect statements such as $(3x - 2) = 0$ or $(3x - 2) < 0$. Some candidatesarrived at the correct expression $(3x + 2)(x - 1) \leq 0$ without justification. Among those candidates who reached $(3x + 2)(x - 1) \leq 0$, many incorrectly included $x = 1$ in the final solution set, even though the original rational expression is undefined at this value. Consequently, fully correct responses to Part (c) (ii) were uncommon and marks were often awarded on a follow-through basis. The expected solutions are shown below.

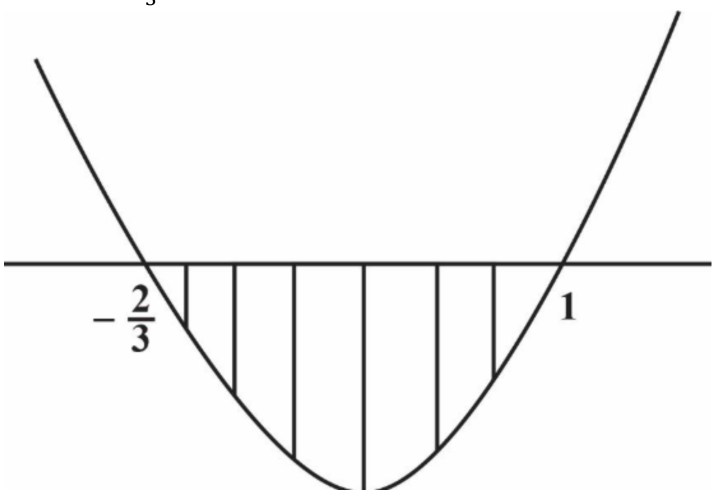
<u>Part (c) (i)</u>

$\frac{3x+2}{x-1} \leq 0$

Multiply both sides by $(x-1)^2$

(3x + 2) (x – 1) ≤ 0

Roots are $-\frac{2}{3}, 1$ (but $x \neq 1$)



Solution: $\{x: -\frac{2}{3} \leq x < 1, x € R\}$

Part (c) (ii)

Solution set to rational inequality: $\{x: -\frac{2}{3} \leq x < 1, x € R\}$ to Part (c) (ii)

Solution set to corresponding product inequality $(3x+2)(x-1) \leq 0$ is $\left\{x : -\frac{2}{3} \leq x \leq 1,\ x \in R\right\}$

This solution includes $x = 1$, highlighting the difference between the solution sets of the rational inequality and the corresponding product inequality.

Recommendations

- Teachers can engage in more solution analysis exercises (similar to the way in which chess players review grandmaster games). This will help develop students' analytical and critical thinking skills, which are necessary for responding to certain questions where the solution method is not obvious at first glance.
- When solving a quadratic equation, students should be reminded that the expression, whether factorized or not, must be set equal to zero up to the penultimate step of the solution.
- With logarithms, a common misconception was as follows: log21 divided by log3 = log7. This is incorrect. Greater emphasis should be placed on the correct application of logarithmic laws, particularly when changing the base of a logarithm.

Question 2

Part (a)

In Part (a) (i), candidates were required to use the laws of indices and logarithms to linearize an exponential relationship by expressing it in the form $y = \log\ b + ax$. Candidates were then required, in Part (a) (ii), to state the y-intercept of the resulting straight-line graph of y against x. Some candidates earned full marks by providing responses such as those shown below.

Part (a) (i)

$10^{2x} \times 10^{y} = 3$

$10^{2x+y} = 3$

Taking logarithms of both sides,

$\log\,(10^{2x+y}) = \log\ 3$

$(2x + y)\log\ 10 = \log\ 3$

$2x + y = \log\ 3$

$y = \log 3 - 2x$ (in the required form)

Part (a) (ii)

$y - \text{intersect} = \log 3$

Part (b)

This part assessed candidates' ability to examine the terms of the series and to determine whether it was arithmetic or geometric. They were also required to provide a justification. Candidates were awarded two marks for correctly identifying $2 + 6 + 18 + 54 + 162$ as a geometric series with $a = 2$, $r = 3$, and $n = 5$.

Part (c)

Candidates had to use given information about a geometric progression to determine the common ratio, given the value of the third term, the sum of the first two terms and the condition that $r > 0$. Full marks were given if the following expected response was provided by candidates.

Equation (1): $ar^2 = 25$

Equation (2): $a + ar = 500$

Dividing Equation (2) by Equation (1):

$$\frac{a(1+r)}{ar^2} = \frac{500}{25}$$

$$\frac{1+r}{r^2} = 20$$

$$20r^2 - r - 1 = 0$$

$$20r^2 - 5r + 4r - 1 = 0$$

$$5r(4r-1) + 1(4r-1) = 0$$

$$(5r+1)(4r-1) = 0$$

$r = -0.2$ OR $r = 0.25$

Since $r > 0$,

Common ratio, $r = 0.25$

Part (d)

Candidates were given expressions for the area and length of a rectangular garden and had to use them to determine the value of a parameter, by forming and simplifying an algebraic expression for the width. The expected response is shown below.

Area = Length × Width

$$10 - 3\sqrt{5} = \left(5 - 2\sqrt{5}\right) \times w$$

$$w = \frac{10 - 3\sqrt{5}}{5 - 2\sqrt{5}}$$

Rationalizing denominator

$$w = \frac{10 - 3\sqrt{5}}{5 - 2\sqrt{5}} \times \frac{5 + 2\sqrt{5}}{5 + 2\sqrt{5}}$$

$$w = \frac{(10 - 3\sqrt{5})(5 + 2\sqrt{5})}{(5 - 2\sqrt{5})(5 + 2\sqrt{5})}$$

$$w = \frac{50 + 20\sqrt{5} - 15\sqrt{5} - 6(5)}{25 - 4(5)}$$

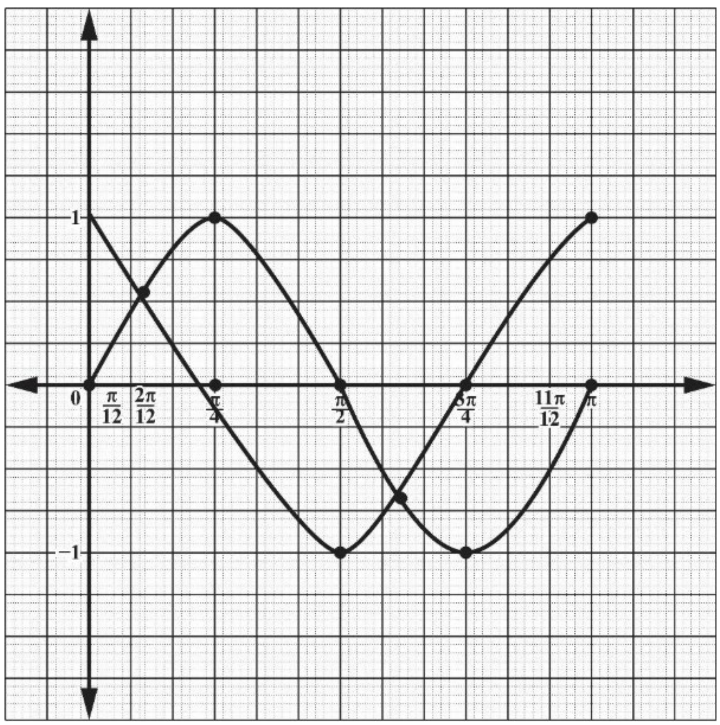
$$w = \frac{20 + 5\sqrt{5}}{5}$$

$w = 4 + \sqrt{5}$ m where a = 4

Question 3

Part (a)

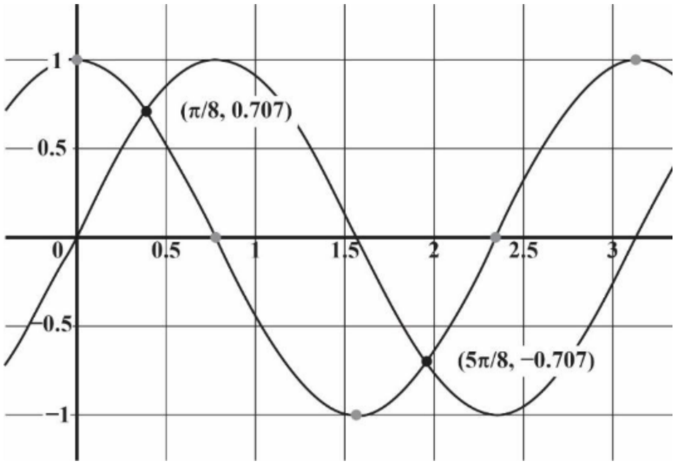
Part (a) (i) required candidates to draw accurate graphs of $\sin 2x$ and $\cos 2x$ over the interval $0 \leq x \leq \pi$. Most candidates were familiar with the general shapes of these curves. The expected graphs are shown below, together with the corresponding tabulated values.



x	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π
$y = \sin 2x$	0	1	0	-1	0
$y = \cos 2x$	1	0	-1	0	1

In Part (a) (ii), candidates were required to use the graphs or an alternative method, to determine the solutions of the equation $\sin 2x = \cos 2x$ for the specified interval. Examples of both acceptable approaches are shown below.

Graphical Method



In the first quadrant, the x-value (point of intersection) occurs approximately halfway between $\frac{\pi}{12}$ and $\frac{2\pi}{12}$, giving $x = \frac{\pi}{8}$, with a corresponding y-value of approximately 0.7.

In the fourth quadrant, the x-value (point of intersection) occurs approximately halfway between $\frac{7\pi}{12}$ and $\frac{8\pi}{12}$, giving $x = \frac{5\pi}{8}$, with a corresponding y-value of approximately -0.7. Hence, when $x = \frac{\pi}{8}, y = \frac{1}{\sqrt{2}}$, and when $x = \frac{5\pi}{8}, y = -\frac{1}{\sqrt{2}}$.

Alternative Method

$\frac{\sin\ 2x}{\cos\ 2x} = \frac{\cos\ 2x}{\cos\ 2x} \Rightarrow \tan\ 2x = 1$ OR $2x = \tan^{-1}(1)$

In the first quadrant: $2x = \frac{\pi}{4} \Rightarrow x = \frac{\pi}{8}$

In the fourth quadrant: $2x = \frac{5\pi}{4} \Rightarrow x = \frac{5\pi}{8}$

When $x = \frac{\pi}{8}, y = \frac{1}{\sqrt{2}} = 0.707$

When $x = \frac{5\pi}{8}, y = -\frac{1}{\sqrt{2}} = -0.707$

Part (b)

For Part (b) (i) candidates were asked to derive the identity for $\sin 2x$, using an appropriate double-angle formula. The expected calculation is shown below.

Using the compound-angle formula: $\sin(A+B) = \sin A\cos B + \sin B\cos A$

Substituting $A = x$ and $B = x$

$$\sin(x+x) = \sin x\cos x + \sin x\cos x$$

$$\sin 2x = 2\sin x\cos x$$

In Part (b) (ii), candidates had to apply this identity to prove the given trigonometric identity. Overall, performance on this part was weak. Although some candidates correctly substituted $\sin 2x = 2\sin x\cos x$, many were unable to proceed beyond this step. A common error was the incorrect cancellation of fractions. Additionally, most candidates failed to recognize that $\sin^2 x + \cos^2 x = 1$ or that the numerator could be rewritten as a perfect square. Candidates therefore experienced difficulty completing the proof correctly. The following is an example of the expected response.

Consider the left-hand side (LHS).

$$\frac{1 + \sin 2x}{\sin x + \cos x}$$

Substituting $\sin 2x = 2\sin x\cos x$

$$\frac{1 + 2\sin x\cos x}{\sin x + \cos x}$$

Using $1 = \sin^2 x + \cos^2 x$

$$\frac{\sin^2 x + \cos^2 x + 2\sin x\cos x}{\sin x + \cos x}$$

$$\frac{(\sin x + \cos x)^2}{\sin x + \cos x}$$

$$= \sin x + \cos x$$

$= \text{RHS}$

Part (c)

Candidates were given the coordinates of two points and were required to use vector methods. Part (c) (i) required candidates to express the unit vector $\overrightarrow{AB}$ in the form $x\mathrm{i} + y\mathrm{j}$. Many candidates were unable to calculate a unit vector parallel to a given vector. The expected solution is shown below.

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$

$= (-2\text{i} - 3\text{j}) + (-3\text{i} + 2\text{j})$

$= -5\text{i} - \text{j}$

$$\widehat{AB} = \frac{xi + yj}{\sqrt{x^2 + y^2}}$$

Substituting $x = -5$ and $y = -1$

$$\widehat{AB} = \frac{-5\text{i} - \text{j}}{\sqrt{(-5)^2 + (-1)^2}}$$

$$\widehat{AB} = \frac{1}{\sqrt{26}}\,(-5\text{i} - \text{j})$$

$$\widehat{AB} = -\frac{5}{\sqrt{26}}\text{i} - \frac{1}{\sqrt{26}}\text{j}$$

In Part (c) (ii), candidates were required to find the angle $A\hat{O}B$ using vector techniques. Many candidates were able to correctly determine the vector $\overrightarrow{AB}$; however, several did not proceed to find the unit vectors AB. Full marks were awarded for responses similar to the one shown below.

$$\cos\ AOB = \frac{\text{a} \cdot \text{b}}{|\ \text{a}\ ||\ \text{b}\ |}$$

$$= \frac{(2 \times -3) + (3 \times 2)}{\sqrt{2^2 + 1^2}\,\sqrt{(-3)^2 + 2^2}}$$

$$= \frac{-6 + 6}{\sqrt{5}\sqrt{13}}$$

$= 0$

$AOB = \cos^{-1}(0)$

$AOB = 90°$

In Part (c) (iii), candidates were required to use the result from Part (c) (ii) to state the relationship between the vectors $\overrightarrow{OA}$ and $\overrightarrow{OB}$. While most candidates were able to set up the formula and calculate the angle correctly, many were unsure about which vectors should be used when determining the angle between convergent or divergent vectors. To gain full marks, candidates were expected to state that $\overrightarrow{OA}$ is perpendicular (at right angles) to $\overrightarrow{OB}$.

Performance on Part (c), which focused mainly on vectors, was stronger than on Parts (a) and (b), which tested trigonometry. Some candidates demonstrated proficiency in determining position vectors and unit vectors. Candidates were also generally familiar with the identity for $\sin\ 2x$.

However, many candidates made significant errors when attempting trigonometric proofs. While some were able to correctly substitute identities for 1 and $\sin\ 2x$, many were unable to proceed beyond this stage. In addition, many candidates were unable to solve the equation $\sin\ 2x = \cos\ 2x$, indicating weaknesses in applying trigonometric identities to equation solving.

Recommendations

Teachers are encouraged to do the following.

- Teach trigonometric graphs in radians using graphical software (for example, GeoGebra, Graphmatica), to support the understanding of concepts and to help students recognize intercepts with the axes.
- Solidify quadratic factorization methods within the teaching and learning process.
- Emphasize the dot-product test. If the dot product is zero, then the angle between the vectors is 90° and the vectors are perpendicular. Students need not compute the angle once a zero numerator is obtained.
- Have students practise numerous trigonometric identity proofs; there is no single standard approach, so familiarity with the theory and the reasoning or thinking process is essential.
- Encourage students to sketch or plot the sine, cosine and tangent curves when solving trigonometric equations so they can anticipate how many solutions to expect and where those solutions lie within the stated domain.

Question 4

Part (a)

Candidates were required to differentiate and simplify a given expression. Many candidates were able to correctly differentiate polynomial and trigonometric terms. However, overall performance on this part was poor. Several candidates unnecessarily applied the product rule and other advanced techniques, failing to recognize the simplicity of the expression. An example of an expected response is shown below.

$$\frac{d}{dx}\left(\sin\ 4x + \frac{3}{x^4}\right) = \frac{d}{dx}(\sin\ 4x) + \frac{d}{dx}(3x^{-4})$$

$$= 4\cos\ 4x - 12x^{-5}$$

$$= 4\cos\ 4x - \frac{12}{x^5}$$

Part (b)

Part (b) (i) required candidates to find the coordinates of all stationary points of a given curve by differentiation. Most candidates knew that the derivative must be set equal to zero at a stationary point $\left(\frac{dy}{dx} = 0\right)$ and were able to solve the resulting quadratic equation. The expected response is shown below.

$$y = \frac{1}{3}x^3 - \frac{5}{2}x^2 + 4x - \frac{1}{2}$$

For stationary points, $\frac{\mathrm{dy}}{\mathrm{dx}} = 0$

$$\frac{dy}{dx} = x^2 - 5x + 4$$

$$\Rightarrow x^2 - 5x + 4 = 0$$

$$\Rightarrow (x-1)(x-4) = 0$$

$$\Rightarrow x = 1 \text{ and } x = 4$$

When $x = 1$, $y = \frac{1}{3}(1)^3 - \frac{5}{2}(1)^2 + 4(1) - \frac{1}{2} = \frac{4}{3}$

When $x = 4$, $y = \frac{1}{3}(4)^3 - \frac{5}{2}(4)^2 + 4(4) - \frac{1}{2} = -\frac{19}{6}$

Coordinates of the stationary points $\left(1,\ \frac{4}{3}\right)$ and $\left(4,\ -\frac{19}{6}\right)$

For Part (b), candidates were required to determine the nature of each stationary point using an appropriate method. The expected response is shown below.

From $\frac{dy}{dx} = x^2 - 5x + 4$, we obtain $\frac{d^2y}{dx^2} = 2x - 5$.

When $x = 1, \frac{d^2y}{dx^2} = 2(1) - 5 = -3$

Therefore, $\left(1,\ \frac{4}{3}\right)$ is a maximum point.

When $x = 4,\ \frac{d^2y}{dx^2} = 2(4) - 5 = 3$

Therefore, $\left(4,\ -\frac{19}{6}\right)$ is a minimum point.

Part (c)

In Part (c), candidates had to apply related rates to calculate the rate of change of the volume of a cube, given the rate at which the length of its edge was increasing at a specified instant. Overall, performance on this part was poor, as many candidates were unable to correctly apply the chain rule to related rates problems. The expected response is shown below.

Let the length of each edge of the cube be $x$cm.

$$\frac{dx}{dt} = 0.25 \text{ cm/s}$$

The volume of the cube is $V = x^3$

$$\frac{dV}{dx} = 3x^2$$

Applying the chain rule

$$\frac{dV}{dt} = \frac{dV}{dx} \times \frac{dx}{dt}$$

Substituting values

$$\frac{dV}{dt} = 3x^2 \times 0.25$$

When $x = 8$ cm, $\frac{dV}{dt} = 3 \times 8^2 \times 0.25$

$$\frac{dV}{dt} = 48\ cm^3/s$$

The rate of change of the volume of the cube is $48\ cm^3/s$.

Recommendations

Teachers are encouraged to

- emphasize that once the x-coordinates of stationary points have been found, the corresponding y-coordinates must be obtained by substituting back into the original function
- stress the conditions under which each rule of differentiation should be applied, ensuring that students know when a particular rule is required and when it is not.

Question 5

Part (a)

Part (a) (i) required candidates to evaluate an indefinite integral of an algebraic function while Part (a) (ii) required candidates to integrate a trigonometric expression. Overall, performance on this section was poor, as many candidates failed to earn full marks in both Parts (a) (i) and (ii). Expected responses for both subparts are shown below.

$\int \sqrt{2x+1}\, dx$

$= \int (2x+1)^{1/2}\, dx$

$= \frac{1}{2} \times \frac{2}{3}(2x+1)^{3/2} + C$

$= \frac{1}{3}(2x+1)^{3/2} + C$

Many candidates appeared to forget that integrals can be split over addition. The coefficient $\frac{1}{2}$ proved confusing for some of them, particularly those who were not secure in the chain rule from differentiation. Candidates who were more comfortable with polynomial integrals often struggled with trigonometric identities and their integrals. Additionally, for questions involving area or volume, several candidates continued to write the integration symbol even after the integration had already been completed.

$\int (\sin\, 2x + 5\cos\, x)\, dx$

$= -\frac{1}{2}\cos\, 2x + 5\sin\, x + C$

Part (b)

In Part (b), candidates were required to calculate the area of a region bounded by a curve, a straight line and the coordinate axes, using integration. This part was generally well done by most candidates. However, a common error involved the use of incorrect limits of integration when evaluating the definite integral. Overall, candidates demonstrated understood that the shaded area under a curve is represented by a definite integral. The expected response is provided below.

Area $= \int_0^3 (x^2 + 2)\, dx$

Area $= \left[\frac{1}{3}x^3 + 2x\right]_0^3$

Area $= (9 + 6) - (0 + 0)$

Area $= 15$ sq units

Part (c)

In Part (c), candidates were required to use integration to determine the volume of a solid of revolution formed when a region bounded by a curve and the coordinate axes was rotated about the *x*-axis. Most candidates were able to correctly expand the expression $(4-x^2)^2$. They were also generally able to integrate the resulting expression and to substitute the limits they selected. However, many candidates failed to earn the mark for the correct integral formula for volume. Common errors included omitting the π factor or using incorrect limits of integration. In several cases, both the π and the squared term were missing from the initial formula. Additionally, when the square was included, $(4-x^2)^2$ was sometimes expanded incorrectly. The expected response is provided below.

Volume $= \pi \int_0^2 (4 - x^2)^2 \, dx$

Volume $= \pi \int_0^2 (16 - 8x^2 + x^4) \, dx$

Volume $= \pi \left[16x - \frac{8x^3}{3} + \frac{x^5}{5}\right]_0^2$

Volume $= \pi \left[(32 - \frac{64}{3} + \frac{32}{5}) - (0 - 0 + 0)\right]$

Volume $= \frac{256\pi}{15}$ units^3

Recommendations

- Greater emphasis should be placed on demonstrating to students how to solve integration problems involving square-root expressions, as performance on this aspect of the question was generally weak. In addition, the integration of sine and cosine functions, along with their corresponding derivatives, requires further reinforcement.
- Teachers are encouraged to make use of online learning platforms, such as Khan Academy, to supplement classroom instruction and to provide students with additional practice and guided examples in integration techniques.

Question 6

Part (a)

This question assessed candidates' understanding of conditional probability and their ability to apply probability formulas involving unions and conditional events. For Part (a), most candidates correctly recalled the expressions for the probability of $A \cup B$ and for $P(B \mid A)$. The expected responses include the following.

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$0.9 = 0.8 + 0.5 - P(A \cap B)$$

$$P(A \cap B) = 0.4$$

$$P(B|A) = \frac{P(B \cap A)}{P(A)}$$

$$P(B|A) = \frac{0.4}{0.8} = 0.5$$

Part (b)

In Part (b) (i), candidates had to use the information given about two fair dice to complete a possibility space table, showing the sum of the numbers on the faces for each possible outcome. Most candidates were able to correctly complete the table and to identify outcomes based on the sums obtained. The completed possibility space is shown below.

	Red Dice						
Blue Dice	**+**	**2**	**4**	**6**	**8**	**10**	**12**
	1	**3**	**5**	**7**	**9**	**11**	**13**
	3	**5**	**7**	**9**	**11**	**13**	**15**
	5	**7**	**9**	**11**	**13**	**15**	**17**
	7	**9**	**11**	**13**	**15**	**17**	**19**
	9	**11**	**13**	**15**	**17**	**19**	**21**
	11	**13**	**15**	**17**	**19**	**21**	**23**

For Part (b) (ii), candidates were required to use the completed possibility space to determine the probability that the sum obtained was prime and the probability that the sum obtained was even. The correct responses are as follows.

- P (sum of scores is prime) = $\frac{25}{36}$
- P (sum of the scores is even) = 0

Part (c)

In Part (c), candidates were required to use a stem-and-leaf diagram to determine the interquartile range (IQR) of a given data set. The expected response is shown below.

Stem	Leaf					
3	0	1	3	3		
4	**2**	**4**	5			
5	1	6	**6**	**8**	9	9
6	4	**7**	**7**			
7	3	6				
8	5					
9	2					

Lower quartile = $\frac{42+44}{2} = 43$

Upper quartile = 67

Interquartile range = 67 – 43 = 2 4

Part (d)

Part (d) (i) required candidates to read the median directly from the box-and-whisker plot. Most candidates did so correctly, identifying the median as *28*. In Part (d) (ii), candidates were required to determine the range of the data set. Those who stated $Range = 74 - 10 = 64$ earned the available marks.

In Part (d) (iii), candidates were required to describe the shape of the distribution. Responses that stated the following were awarded marks: *the data are positively (right) skewed about the median*.

Part (e)

Candidates were required to use the given height measurements to calculate the sample variance of the data set, expressing the result in square centimetres. This part proved challenging for many. Even candidates who understood the variance procedure often used n instead of $n-1$ in the denominator. Many candidates also attempted to use $(715-143)^2$as a sum of squares rather than summing the squared deviations from the mean. The expected response is provided below.

Given heights (cm): $135,\ 144,\ 137,\ 146,\ 153$

Mean $(\bar{x}) = \frac{135+144+137+146+153}{5} = \frac{715}{5} = 143$ cm

Sample variance formula $(S^2) = \frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n-1}$

$$= \frac{(135-143)^2 + (144-143)^2 + (137-143)^2 + (146-143)^2 + (153-143)^2}{4}$$

$$= \frac{(8)^2 + (1)^2 + (6)^2 + (3)^2 + (10)^2}{4}$$

$$= \frac{(64) + (1) + (36) + (9) + (100)}{4}$$

$= \frac{210}{4} = 52.5$ cm^2

PAPER 031 — SCHOOL-BASED ASSESSMENT (SBA)

The marking team moderated approximately 900 projects during the assessment period. The SBA carries a total of 30 marks and many projects scored within the 26–30 range. The number of submissions for Project A and Project B was relatively even. Notably, there was an increase in attempts at Project A, as well as broader engagement with a wider range of topics. Overall, the quality of projects submitted in 2025 for both Project A and Project B was generally good, with only a few instances of incomplete submissions.

This marks the fifth year in which an Additional Mathematics project could also be used to satisfy the Mathematics SBA requirement. Despite ongoing improvement, some submitted projects still reflected the level of difficulty expected for Mathematics rather than Additional Mathematics.

Students were assessed against the following criteria, with deductions applied where standards were not met.

- Level of difficulty appropriate to Additional Mathematics
- Sufficient explanations provided
- Relevant theorems and formulae used
- Accuracy and precision of calculations
- Application of solutions or proof
- Coherent discussion

Project A

Projects of this nature generally explored topics such as Differentiation and Integration (including maxima and minima), Series and Sequences, Arithmetic and Geometric Progressions, Quadratic Functions, and Kinematics. In 2025, the majority of projects focused on maximizing space, although some submissions demonstrated notable creativity in both approach and application.

Project Title

For most projects, titles were clear and concise, enabling the reader to understand what to expect from the project. However, some students chose titles that were names rather than descriptive statements, which did not clearly convey the focus or objective of the project.

Mathematical Formulation

In general, most projects successfully identified the relevant mathematical concepts and formulae required. There were very few projects in which the level of difficulty was too advanced and beyond the level of CSEC Additional Mathematics.

Purpose

Most projects had a substantial and necessary purpose, explaining why the project was being done. However, there were some cases where the problem statement was not present.

Problem and Solution

Most students presented projects that offered appropriate solutions that aligned with the stated purpose. Overall, students demonstrated a good understanding of their chosen topics by logically developing ideas and correctly applying relevant formulae and mathematical procedures to arrive at valid solutions.

Application of Solution

This part continues to present challenges for students. Many of them provided projects that did not adequately demonstrate how the solution could be applied or validated in a practical or real-world context.

Discussion of Findings/Conclusion

Most projects included a clear discussion of findings that was easy to follow. Several students also provided suggestions for future use, extending their projects to other contexts or applications. However, many projects did not include suggestions for future use. Students are reminded that this section should address how the project could be improved or applied to other real-life situations.

Overall Presentation

Overall, the presentation of projects was generally of a good standard, with most demonstrating appropriate use of mathematical symbols, satisfactory grammar and correct spelling.

Overall, students handled the project title and purpose well. However, in some cases, students included literature review-style sections, which are not required for the SBA and which added little value to the project. The mathematical formulation was generally strong, with appropriate terminology and notation. By contrast, the problem-solution section sometimes omitted key assumptions and several students did not include the necessary explanatory notes at each major step of their calculations. In addition, the discussion/conclusion sections were often weak, offering limited interpretation of results and no suggestions for future use or improvement.

Recommendations

Teachers are encouraged to undertake the following.

- Guide students in selecting feasible, real-world topics.
- Provide and discuss the official rubric at the outset, clearly outlining the purpose, expected deliverables and marking criteria of the SBA.
- Set clear timelines for each section of the SBA and monitor progress at each stage of completion.
- Provide timely, constructive feedback for each section and allow students to revise their work before final submission.
- Strengthen the application of solution section by requiring students to verify their results using alternative methods, such as graphs or equivalent analytical approaches, and to clearly show how the solution applies to the real-world problem.
- Ensure that project topics are concise and set at the appropriate level of difficulty; some projects were either too advanced or more suitable for CSEC Mathematics rather than Additional Mathematics.

Project B

Projects of this nature generally explored topics in Statistics and Probability. In 2025, projects within this category covered a variety of topics, reflecting a range of student interests and approaches.

Project Title

For the majority of projects, titles were clear and concise, allowing the reader to understand what was to be expected from the project. However, in some cases, students gave projects generic names rather than descriptive titles, which did not adequately convey the focus of the study.

Methods of Data Collection

Most students provided projects that clearly identified the sample details used in the project. Several projects also included the questionnaire used to collect the data. There was noticeable improvement in how students approached the collection of raw data. However, only a few students clearly stated the type of sampling method employed and correctly identified the variables involved in the study.

Presentation of Data

In most cases, students presented a clear and purposeful rationale for collecting the data. Data presentations were generally appropriate for the stated purpose of the project.

Mathematical Knowledge/ Analysis

Overall, students submitted the correct analysis based on their findings. In a few cases, the level of difficulty was more in line with CSEC Mathematics than Additional Mathematics.

Discussion of Findings/ Conclusion

Most students attempted to include a discussion of findings in their SBAs. However, in the Statements and Findings section some students misinterpreted the results or made statements that were not fully supported by the data. There was overall improvement in the quality of discussions, particularly in projects involving ungrouped data, where students more effectively applied statistical measures and explained their findings.

Despite this improvement, many students did not address limitations of the statistical investigation in their projects. Students are reminded that all statistical studies should acknowledge limitations and that sample size alone is not considered a valid limitation. In addition, many projects lacked suggestions for future analysis. Increasing the sample size, by itself, is not an acceptable suggestion; instead, students should propose ways in which the project could be extended, refined, or applied to related real-world contexts.

Overall Presentation

Overall, the presentation of projects was generally of a good standard, with most demonstrating accurate use of mathematical notation, as well as satisfactory grammar and spelling.

In Project B SBAs, the project title, purpose and method of data collection were generally well presented. However, in some cases, key elements such as the definition of variables and the sampling technique were omitted. Students experienced the greatest difficulty with mathematical knowledge and analysis, as well as with the discussion of findings and conclusions. In several instances, the analysis lacked sufficient depth and clear links between the different statistical measures were not established.

Recommendations

Teachers are encouraged to undertake the following.

- Guide students in selecting feasible, real-world topics that are simple, meaningful and capable of generating quantitative data involving at least two variables for comparison. Topics such as “Analysing the Weight of Students in a Class”, which lack real-world relevance, should be avoided.
- Provide students with the SBA rubric at the outset and clearly explain the assessment criteria and overall objectives of the SBA.
- Provide guidance and support regarding data collection and organization, including the effective use of appropriate software tools such as Desmos and GeoGebra.
- Establish clear timelines for the completion of each section of the SBA and monitor students’ progress throughout the process.
- Provide timely, constructive feedback on each section of the SBA and allow students opportunities to revise their work prior to final submission.
- Encourage students to strengthen the analysis component of the SBA by making clear links between the different statistical measures and datasets, and by interpreting trends and relationships between variables logically.
- Continue to encourage students to clearly explain and interpret their results, with particular emphasis on analysing measures of central tendency and spread, and relating these findings to the real-world context of the problem.

FURTHER COMMENTS

Overall, there was improvement in the quality of both projects when compared with previous years. However, while there is some overlap between the Mathematics and Additional Mathematics syllabi, teachers are reminded to be more stringent in applying the requirements specific to the Additional Mathematics SBA and to advise students accordingly.

It was also observed that, in some instances, entire centres submitted identical projects, with only minor variations in the discussion or conclusion sections and differences in cover pages. Teachers should be more vigilant in such cases and should ensure that meaningful variations are introduced between SBAs. While projects may share the same topic or title, the parameters should be adjusted to allow for different diagrams, data sets and solutions.