EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
Home of Examinations and Assessment, Zone 6, Zwelitsha, 5600
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2025 NSC CHIEF MARKER'S REPORT

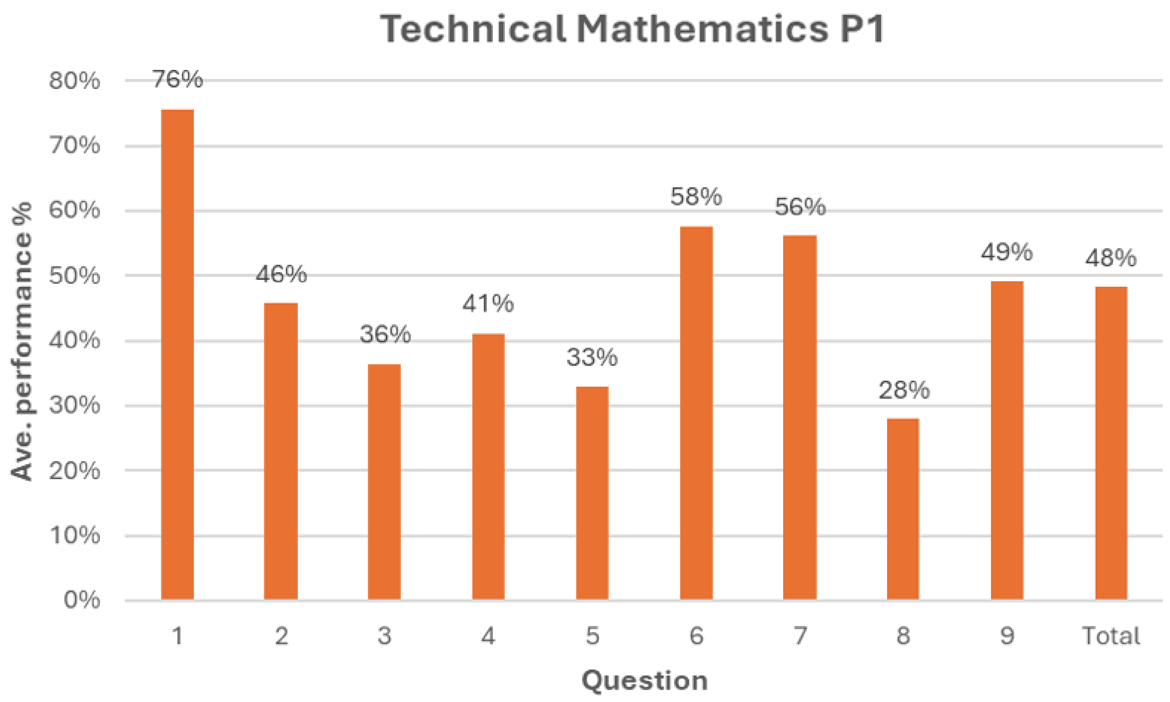
SUBJECT	Technical Mathematics		
QUESTION PAPER	1 X	2	3
DURATION OF QUESTION PAPER	3 hours		
PROVINCE	**Eastern Cape**		
NAME OF THE INTERNAL MODERATOR	**Ms N. Tom**		
NAME OF THE CHIEF MARKER	**Mrs U. Chagi-Mnyameni**		
DATES OF MARKING	**28 Nov – 12 Dec 2025**		
HEAD OF EXAMINATION:	**Mr E.M Mabona**		

SECTION 1: (General overview of Learner Performance in the question paper as a whole)

A total of 3 268 Eastern Cape NSC candidates wrote the final NSC Technical Mathematics Paper 1 in 2025.During the marking process, a sample of 100 scripts was collected. This sample consisted of scripts moderated by the Internal Moderator, Chief Marker, and/or Senior Marker.

The graphical analysis presented in this report is based on the responses of these 100 sampled candidates, selected as shown in the table that follows.

	[0; 44]	[45; 59]	[60; 74]	[75; 89]	[90; 104]	[105; 119]	[120; 150]	TOTAL
Required	15	15	20	20	20	5	5	100
Actual	23	12	20	16	16	8	5	100
Percentage	23%	12%	20%	16%	16%	8%	5%	



Question	Topic	Ave. performance %
2	Nature of roots	46%
3	Exponents, Logs and Complex numbers	36%
4	Functions and Graphs	41%
5	Finance, Growth and Decay	33%
6	Differential Calculus	58%
7	Cubic Functions	56%
8	Calculus Applications	28%
9	Integration	49%
Total		**48%**

Candidates performed fairly at an average of 48 % in this paper. In Ques.1, candidates performed very well at an average of 76%. They scored marks in questions requiring knowledge and routine procedures. Although many candidates displayed thorough understanding of the quadratic equations concept there were some who displayed limited algebraic skills required to solve involving inequalities. In 2025, performance in Ques. 2 on nature of roots, candidates performed fairly at 46% average.

Candidates in Ques. 6 and Ques. 7 performed well at an average of 58% and 56% respectively. These questions were based on content taught in grade 12, basic Calculus and cubic functions. An addition to these topics is Integration in Ques. 9 performed fairly at an average of 49%, content covered in grade 12.

Functions and graphs in Ques. 6, a topic which cuts cross all grades from garde 8-12, candidates performed fairly at an average of 41%.

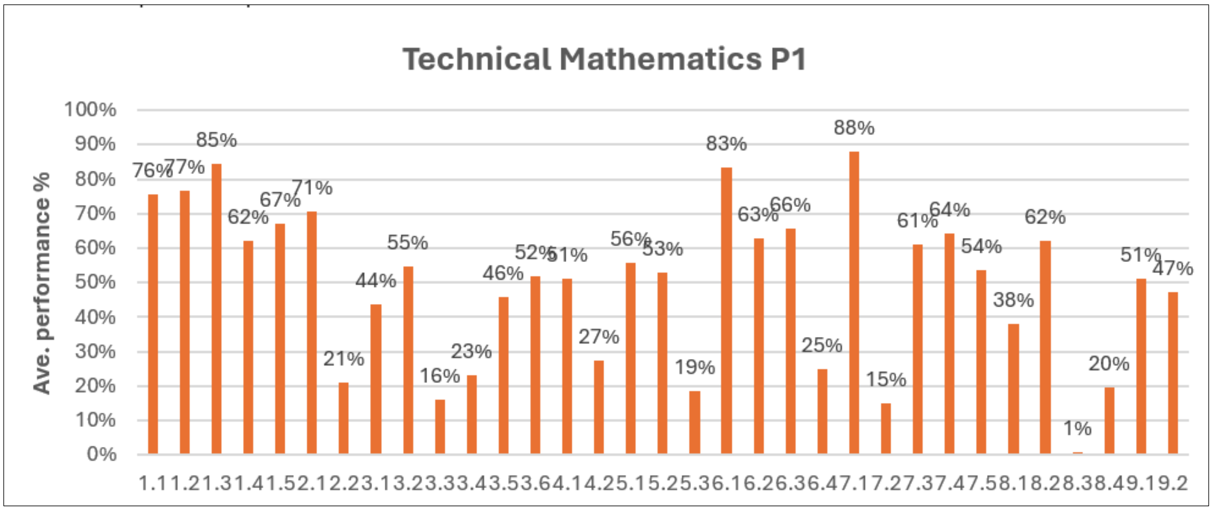
The questions in which candidates performed poorly below 40% were Ques. 3 at 36%, Ques. 5 at 33 % respectively. These questions assessed Exponents, Surds and Logs which were done in previous grade, complex numbers and Finance, growth and Decay across all three grades.

The worst performed question at an average of 28 % was Ques. 8 which assessed application of Calculus. Candidates were challenged by interpretation and formulation of correct responses.

There were instances where candidates did not adhere to the instructions as stipulated in the question paper and answer book. Few candidates even changed the order of questions, by deleing a question and write another question which does not belong in that question although an additional space has been provided.

SECTION 2: Comment on candidates' performance in individual questions

The graph below shows a RASCH analysis of learner performance based on the 100 scripts sample moderated per sub-question



Sub-question	Topic	Ave. performance %
1.1	Quadratic Equations	76%
1.2	Simultaneous equations	77%
1.3	Literal Equation	85%
1.4	Binary numbers	62%
1.5	Binary numbers	67%
2.1	Nature of roots	71%
2.2	Nature of roots	21%
3.1	Exponents and Surds	44%
3.2	Logarithms	55%
3.3	Logarithms	16%
3.4	Log Equations	23%
3.5	Complex Numbers	46%
3.6	Complex Numbers	52%
4.1	Hyperbola and Straight-line graphs	51%
4.2	Parabola and Exponential graph	27%
5.1	Simple Interest	56%
5.2	Compound interest	53%
5.3	Rate	19%

Sub-question	Topic	Ave. performance %
6.1	First Principles	83%
6.2	Differentiation rules	63%
6.3	Differentiation rules	66%
6.4	Equation of a tangent	25%
7.1	y- intercept	88%
7.2	factor theorem	15%
7.3	x- intercepts	61%
7.4	Turning points	64%
7.5	Cubic graph	54%
8.1	Number value	38%
8.2	Function value	62%
8.3	Calculating amount	1%
8.4	Optimisation	20%
9.1	Integration rule	51%
9.2	Area under a curve	47%

QUESTION 1

1.1 Solve for x:

1.1.1 $2x\left(x-\frac{4}{9}\right)=0$ (2)

1.1.2 $6+(2x-5)(x+2)=0$ (correct to TWO decimal places) (4)

1.1.3 $(3-x)(x+2)>0$ (2)

1.2 Given: $y-x+1=0$ and $x^2+xy=3$

1.2.1 Make y the subject of the equation $y-x+1=0$ (1)

1.2.2 Solve for x and y simultaneously. (5)

1.3 The formula used to determine brake power (BP) when rotational frequency (N) and torque (T) are given is:

$$\text{BP}=2\pi\,\text{N}\,\text{T}$$

Where: BP = brake power (W)
N = rotational frequency (r/s)
T = torque (Nm)

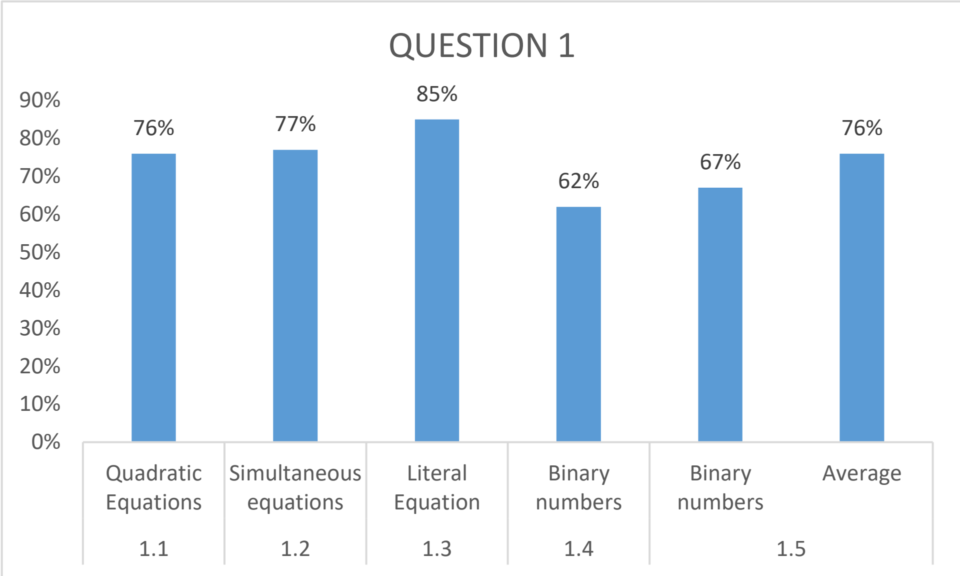
1.3.1 Make N the subject of the formula. (1)

1.3.2 Hence, calculate the numerical value of N if
BP = 117 366,54 W and T = 560,44 Nm (2)

1.4 Express 81 as a binary number. (1)

1.5 Evaluate $81 \div 11011_2$ and leave your answer as a decimal number. (2)
[20]

(a) **General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?**



The overall performance in Ques.1 was good, with an average achievement of 76%. Learners performed particularly well in Literal Equations, achieving 85%, indicating good procedural fluency in manipulating algebraic expressions. Sub-questions on Quadratic Equations and Simultaneous Equations also showed solid performance, both above 75%, suggesting that learners are generally confident with routine algebraic procedures.

However, performance within the question was noticeably low for Binary Numbers where the averages were 62% and 67% respectively. This indicates that number-system concept is not well understood, and learners may require more exposure to non-decimal representations and their conversions. The variation across sub-topics reveals that while traditional algebraic skills are well-developed, operations beyond routine procedures require strengthened instructional support.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

- The most prominent error displayed by candidates in Q1.1.1 was the misunderstanding of the factor rule in the quadratic equation. They did not simply write the solutions as the question intended, rather they incorrectly expanded the factors and ended up with incorrect values of x.
- Some of the candidates had one solution instead of two, displaying a limited understanding between a linear and a quadratic equation.
- Most candidates ignored signs when they transpose a term:

  $x=-\frac{4}{9}$, instead of $x=\frac{4}{9}$.
- In Q1.1.2 Few of the candidates substituted the value of *b* without using the brackets, thus the solutions were incorrect as shown:

  $$x=\frac{--1\pm\sqrt{-1^2-4(2)(-4)}}{2(2)}$$

  and some interchanged the variables and substituted the value of *a* in the value of *b*
- In Q1.1.3, candidates expanded incorrectly either by having incorrect signs or expanding using 6.

  Example:

  $6+(2x-5)(x+2)=12x-5x+2$ OR $6+(2x-5)(x+2)=12x-10+x+2$
- In Q1.1.3, most candidates failed to write the solution correctly. They were challenged by the interval notation, could not differentiate the meaning of square brackets [] and parentheses (), as their number lines did not align to the solution presented. To them, brackets have no meaning in terms of a value being included or excluded in the interval. some wrote $x\in[3;-2]$, yet the number line drawn indicates solutions between −2 and 3, and critical values excluded in the solution and, the critical values were also swapped around by many candidates.
- In addition, candidates misinterpreted "or" and "and" when writing the solution. Some wrote the solution as $x>-2 \text{ or } x<3$, instead of $x>-2 \text{ and } x<3$
- In Q1.2.2 Few candidates scored a maximum of 4 because they either struggled to make the variable subject of the formula or solve the values of x only.
- In Q1.3.1, candidates failed to make N the subject of the formula, they showed a misunderstanding of the concept of multiplicative and additive inverses. Some of the responses the learners wrote were: $\mathrm{N}=\frac{\mathrm{BP}}{2\pi}\times\mathrm{T}$ or $\mathrm{N}=\frac{\mathrm{BP}\text{-}2\pi}{\mathrm{T}}$ and

  $\mathrm{N}=2\pi-\mathrm{BP.T}$

- The concept of binary number is still a challenge for some of the candidates as it was also highlighted in the diagnostic report of 2024 (pg. 20). Learners failed to accurately change binary to decimal.
- Most of the misconceptions and errors displayed by 2025 candidates are as they were also identified in the 2024 cohort as per the diagnostic report (pg. 18-20), thus effective intervention strategies need to be in place to improve performance in question 1.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

i. It is highly recommended that teachers conduct thorough revision of topics covered in earlier grades, such as factors, products, solving simultaneous equations, fractions, and binary number operations.

ii. Teachers should employ a variety of methods when teaching quadratic equations and inequalities. The distinction between linear and quadratic equations should be made clear and thoroughly explained to learners.

iii. Learners should be exposed to various forms of literal equations, including changing the subject of a formula, simplifying expressions, and using calculators accurately and appropriately.

iv. Teachers should expose learners to a range of methods for solving inequalities so that they can select the most appropriate approach. Learners should also be taught to represent solutions in various forms, including verbal descriptions, graphs, interval notation, set-builder notation, and number lines.

v. Information sharing sessions should be conducted in districts prior teaching of each concept in algebra to capacitate teachers and find working strategies to present algebra in a way that will eliminate the misconceptions identified.

(d) **Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**

i. Subject teachers are strongly advised to spend enough time on the introduction of the following key principles to make question 1 more routine and manageable for learners:
   a. CFS – **Common factor, Factor form and Standard form.**
   b. BODMAS – **Bracket of Division, Multiplication, Addition and Subtraction** and
   c. ERS – **Exponential Radical and Simultaneous equations.**

CFS –will help learners to identify the stage in which the equation is at and understand that each stage has a different approach, for instance Factor form

$a\left(x+p\right)=0$ or $(x-p)(x-q)=0$

$a=0$ or $x=-p$ or $x=p$ or $x=q$

learners should be drilled to remember that when the equation is in a factor stage, the equation will have brackets and zero on the other side of the equation and thus NO need to expand they must write solutions only.

Secondly when the equation is in the standard form, they may factorise or make use of the quadratic equation **directly quoted** from the answer sheet provided in the question paper.
BODMAS- order of operation need to be revisited and not be assumed to be known and easy to learners as it impacts negatively in solving literal equations and manipulating formulae in finance and simultaneous equation.
ERS- learners need to be drilled on changing from radical form to exponential form as done as far as grade 9, the principle: $\sqrt[b]{x^a}=x^{\frac{a}{b}}$ should be part of informal assessment and learners should not be limited to exponents that are integers but also be given rational exponents to drill them in working with fractions as they seem challenged by in calculus.

ii. Calculator possession should be made compulsory to drill learners in using the calculator accurately, such as function of storing answers to avoid premature rounding especially in topics like finance.
iii. Formula sheets should not be provided only during examinations. Learners should have formula sheets pasted in their notebooks and use them regularly. This consistent practice will help learners become familiar with selecting, using, and accurately copying the correct formulas from the sheet.

iv. Educators are advised to introduce inequalities with comparing numbers as done in grade 8 and gradually move to visual number line representation taking into consideration the following:

Key ideas to reinforce visually:

- **Closed circle / solid dot** = value included → **[ ]**
- **Open circle** = value NOT included → **( )**
- Two intervals shaded together → **OR**
- One continuous interval → **AND**

Symbol	Meaning	Closed or Open Circle
<	Less Than	Open ○
>	Greater Than	Open ○
≤	Less Than or Equal to	Closed ●
≥	Greater Than or Equal to	Closed ●

QUESTION 2

2.1 Given: $x^2 - 2x + 2 = 0$

2.1.1 Write down the formula for the discriminant (Δ). (1)

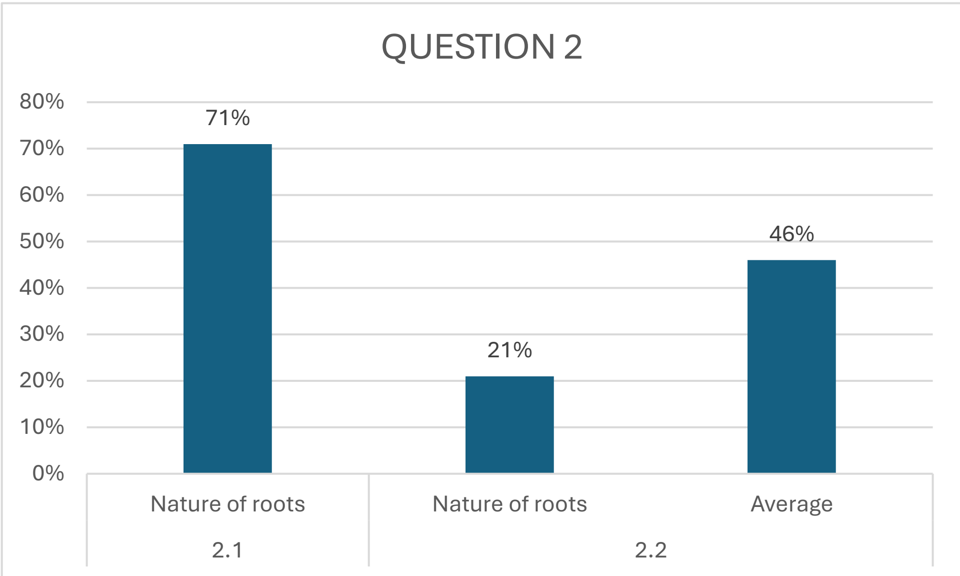
2.1.2 Determine the numerical value of the discriminant of the equation. (2)

2.1.3 Hence, or otherwise, describe the nature of the roots of the equation. (1)

2.2 Determine the numerical value of m for which the equation $x^2 + 2x - 4 = m$ will have equal roots. (4)

[8]

(a) **General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?**



The performance in Ques. 2 was fair at an average of 46%. The average reveals a significant disparity in learners' understanding of the nature of roots as question 2.1 was well performed reasonably well, with 71% of learners demonstrating correct use of the discriminant to describe the nature of roots. This suggests that when the question is straightforward and procedural, most learners can apply the concept correctly.

However, performance dropped sharply in 2.2, where only 21% of learners achieved the correct response. This indicates a serious conceptual gap, likely linked to interpreting the discriminant in a more complex or less familiar context. The overall average of 46% highlights that although the foundational idea of the discriminant is known by many learners, its deeper conceptual application is weak.

(b) **Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**

- In Q2.1.1 some candidates wrote the discriminant incorrectly though they know the quadratic formula and this stems from misunderstanding the structure of the quadratic formula versus its components. Below are different misrepresentations:

  $\Delta = -b^2 - 4ac$ or $\Delta = 4ac - b^2$ or $\Delta = -b \pm \sqrt{b^2 - 4ac}$ or $\Delta = b^2 + 4ac$

- In Q2.2 most of the candidates failed to write $x^2 + 2x - 4 = m$ in the standard form, hence they gave solutions such as: $(2)^2 - 4(1)(-4) = m \quad \therefore m = 20$, which is a misconception as m doesn't represent the discriminant.
- Few of the candidates managed to write the equation in its standard form but failed to expand and solve correctly:

  $$\begin{aligned} &x^2 + 2x - 4 - m = 0 \\ &(2)^2 - 4(-4 - m) = 0 \\ &4 - 16 + 4m = 0 \\ &m = 3 \end{aligned} \quad ;$$

  This displayed inconsistency as far understanding the multiplication of terms with different signs, which then resulted in incorrect answer.

(c) **Provide suggestions for improvement in relation to Teaching and Learning.**

i. In teaching the nature of roots, teachers should emphasise that the discriminant, $\Delta = b^2 - 4ac$, is used to determine the nature and number of roots of a quadratic equation.

ii. Teachers should explicitly demonstrate and explain to learners that the discriminant $\Delta = b^2 - 4ac$ originates from the quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

In other words, the quadratic formula can be expressed as

$$x = \frac{-b \pm \sqrt{\Delta}}{2a},$$

which highlights the discriminant as a distinct component responsible for determining the type of roots obtained.

iii. In addition, learners can clearly see that the discriminant is the component under the square root that governs whether the solutions are real, equal or non-real. This approach helps correct the common misconception where learners miswrite the discriminant because they memorise the quadratic formula procedurally without understanding the structure and purpose of its components. By making the relationship between the quadratic formula and the discriminant explicit, teachers help learners appreciate why the sign and arrangement of $b^2 - 4ac$ must be accurate and meaningful when describing the nature of roots.

(d) **Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**

i. Teachers are advised to prioritise conceptual understanding over procedural knowledge.

ii. Learners may remember the quadratic formula but do not fully grasp the specific roles of the coefficients a, b, and c, nor the mathematical significance of the discriminant. To address this, teachers should use strategies that foreground structure and meaning. For instance, colour-coding the coefficients in the quadratic expression and matching these colours within the discriminant and quadratic formula helps learners visually track where the components originate. Similarly, using graphical representations of parabolas—showing cases where $\Delta > 0$, $\Delta = 0$, and $\Delta < 0$ allows learners to connect algebraic conditions to geometric features, reinforcing conceptual understanding.

iii. Furthermore, teachers should integrate error analysis by presenting common incorrect versions of the discriminant and guiding learners to identify and explain the errors. This encourages metacognition and supports deeper reasoning about why the expression must remain $b^2 - 4ac$. When applied consistently, such teaching practices help shift learners from rote memorisation to meaningful engagement with the concept. Ultimately, by emphasising the derivation, purpose, and interpretive power of the discriminant, teachers enable learners to understand the nature of roots more accurately and confidently, strengthening both their algebraic reasoning and their ability to solve quadratic equations effectively.

QUESTION 3

3.1 Simplify the following, **showing ALL calculations**, where applicable:

3.1.1 $\sqrt[3]{27p^{12}}$ (2)

3.1.2 $\dfrac{3 \times 2^x}{2^{x+2} - 2^x}$ (3)

3.2 Given: $2 \log_a \sqrt{a}$

3.2.1 Convert $\sqrt{a}$ to exponential form. (1)

3.2.2 Hence, or otherwise, simplify the expression. (2)

3.3 Given: $\log 2 = p$ and $\log 3 = q$

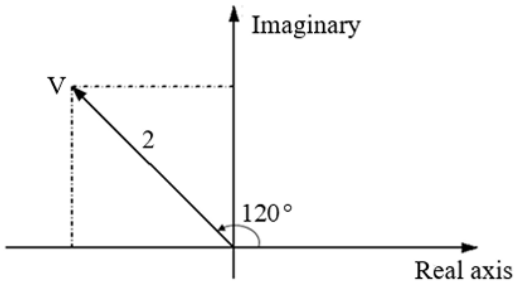
Determine the following in terms of p and q:

3.3.1 $\log 27$ (2)

3.3.2 $\log 60$ (3)

3.4 Solve for x: $\log_3 x + \log_3 (x + 2) = 1$ (5)

3.5 The voltage (V) in an alternating current circuit is represented by the Argand diagram below.



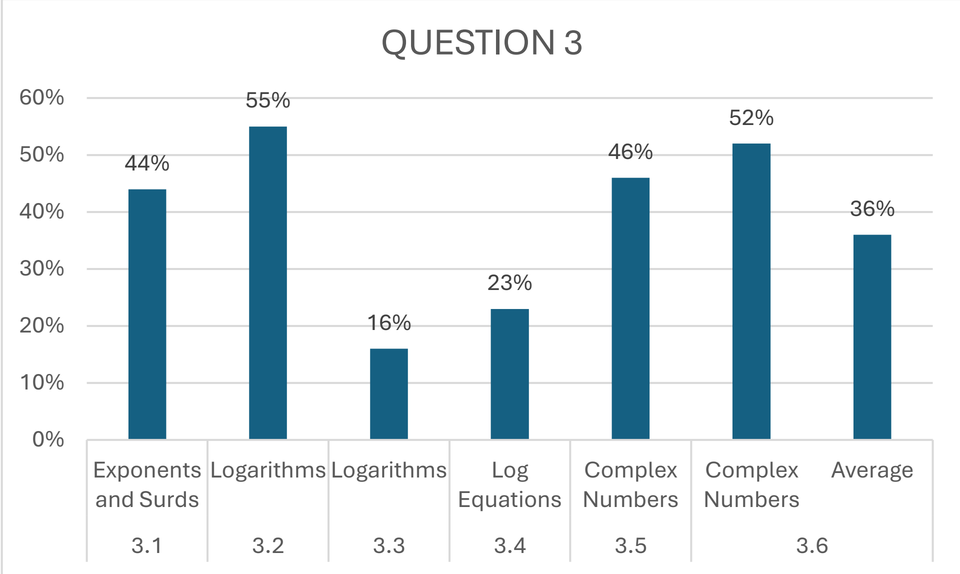
3.5.1 Use the Argand diagram above to write down the voltage in the form $V = r \text{ cis } \theta$ (1)

3.5.2 Hence, or otherwise, express V in rectangular form. Leave your answer in simplest surd form. (2)

3.6 Write down the numerical values of a and b if $a + 7bi = -21i^2 + 21i$ (3)

[24]

(a) **General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?**



Performance in Question 3 was generally weak, with an overall average of 36%, indicating widespread difficulties across the assessed algebraic and number-system concepts. Learners showed moderate strength in logarithms (3.2) and complex numbers (3.6), scoring 55% and 52% respectively, suggesting partial familiarity with routine procedures in these areas.

However, performance was notably poor in 3.3 (Logarithms) at 16% and 3.4 (Log Equations) at 23%, highlighting severe conceptual gaps in applying log laws, manipulating logarithmic expressions, and solving logarithmic equations. These low scores imply that learners may rely heavily on memorised procedures without understanding when or why specific log rules apply.

Sub-question 3.1 (Exponents and Surds), with 44%, also reveals that foundational knowledge of exponent laws and surd manipulation remains fragile for many learners.

The combined results indicate that higher-order algebraic manipulation, particularly with logarithms and exponents, is a major weakness for this group. There is a clear need for reinforced conceptual teaching, step-by-step scaffolding, and increased practice with non-routine problems to build confidence and deepen understanding.

(b) **Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**
• In Q 3.1.1 candidates did not simplify correctly or fully $\sqrt[3]{27p^{12}} = 27p^{\frac{12}{3}}$ • In Q 3.1.2 candidates made mistakes when taking out the common factor, $\frac{3.2^x}{2^x.2^2 - 2^x} = \frac{3.2^x}{2^x(4-0)} = \frac{3}{4}$ • A common error was also treating the question as division of powers with the same base such that $\frac{3.2^x}{2^{x+2} - 2^x} = 3.2^{x-x-2-x} = 3.2^{-2-x}$ • In addition, other candidates multiplied in the numerator and did not factorize in the denominator such that they had: $\frac{6^x}{2^x.2^2 - 2^x} = \frac{6^x}{4}$ • Other candidates also made an error in the denominator and wrote 2^{x+2} as $2^x + 2^2$ which then led to an incorrect simplification and a breakdown was applied. • In Q 3.2.1 and 3.2.2 few candidates did not know the approach to the problem, which gave an indication of a gap in changing the algebraic term from radical to exponential form. • In Q 3.2.2 some of the responses the candidates applied addition instead of multiplication the coefficient by the exponent: $2 + 2\log_a a = 4$ • In Q 3.3.1 most candidates did not answer the question completely and 1 mark was awarded, they left it as $\log 27 = \log 3^3 = 3\log 3$ • Q 3.3.2 was not attempted by some candidates. • In Q 3.4 candidates displayed limited understanding of the laws of logs • Majority did not apply the power rule of logs. • Majority answered as shown below and did not conclude on the solution. $\log x(x+2) = 1$ $x^2 + 2x - 1 = 0$ $x = 0,41 \text{ or } x = -2,41$ • In Q 3.5.1 candidates omitted i and ended finding the sum $v = 2(\cos 120° + i\sin 120°) = -1 + \sqrt{3} = 0,73$ • In Q 3.6 did not substitute $i = -1$

(c) Provide suggestions for improvement in relation to Teaching and Learning.
i. Educators are advised to revise laws of exponents and logs. ii. Educators are advised teach laws of exponents in conjunction with surds iii. Educators should also intensify revision of complex numbers and not assume that it is an easy section. iv. Educators should expose learners to structured exercises that move from simple to complex on basic surds, and expressions requiring simplification after conversion.
(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.
Subject advisors should capacitate educators through information sharing session on effective teaching strategies that clearly link surds and exponential forms by emphasising the meaning of fractional exponents, the relationship between numerators (powers) and denominators (roots), and the role of exponent laws. Such explicit connections will help learners move from procedural manipulation to true conceptual understanding, allowing them to rewrite expressions accurately and confidently.

QUESTION 4

4.1 Given the functions f and g defined by $f(x) = \frac{3}{x} + 3$ and $g(x) = 3x + 3$ respectively.

4.1.1 Write down the equations of the asymptotes of f. (2)

4.1.2 Write down the domain of f. (1)

4.1.3 Determine the x- and y-intercepts of g. (2)

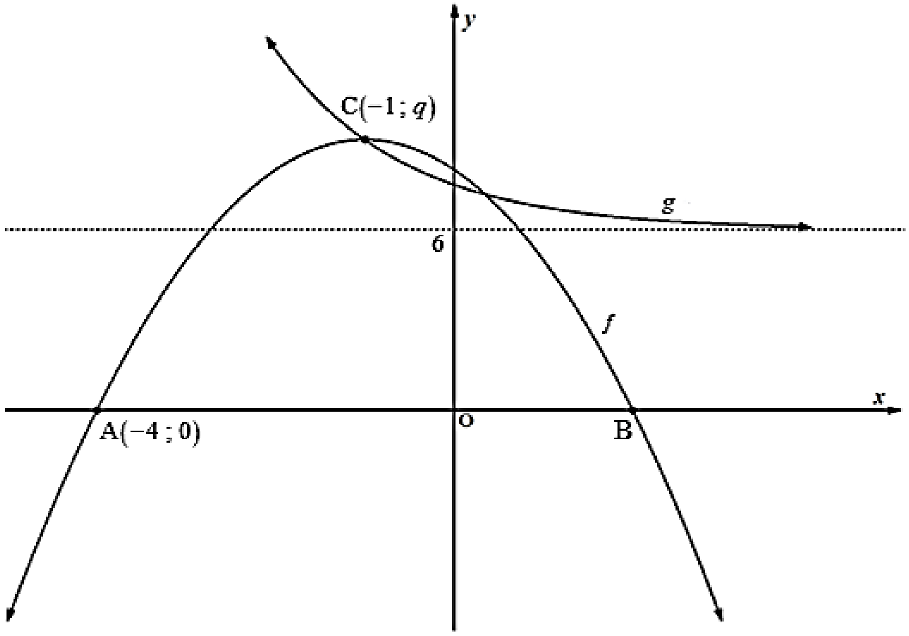
4.1.4 Determine the x-intercept of f. (2)

4.1.5 Sketch the graphs of f and g on the same set of axes provided in the SPECIAL ANSWER BOOK. Clearly show ALL the intercepts and asymptotes. (5)

4.1.6 Hence, use your graph to determine the values of x for which $f(x) \leq g(x)$, where $x < 0$ (2)

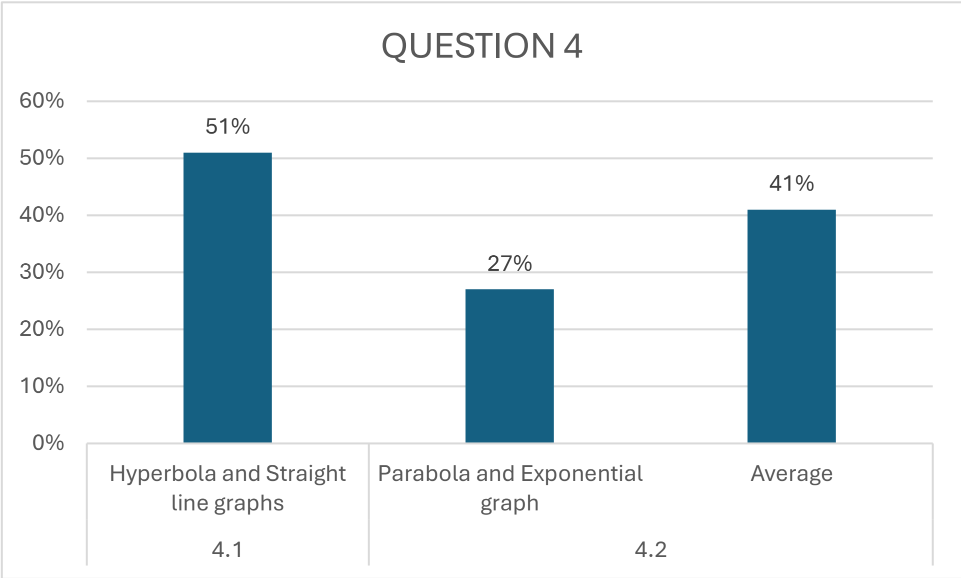
4.2 The graphs below represent functions f and g defined by $f(x) = -(x+p)^2 + q$ and $g(x) = a^x + 6$

- A $(-4\,;0)$ and B are the x-intercepts of f.
- C $(-1\,;q)$ is the turning point of f and also the point of intersection of f and g.



4.2.1	Write down the equation of the axis of symmetry of the parabola.	(1)
4.2.2	Write down the coordinates of B.	(2)
4.2.3	Hence, determine the numerical value of q.	(3)
4.2.4	Hence, write down the range of f.	(1)
4.2.5	Write down the equation of the asymptote of g.	(1)
4.2.6	Hence, determine the equation of g.	(2)
		[24]

(a) **General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?**



The performance in Question 4 was fair overall, with an average of 41%, indicating that many learners struggled with the functions and graphs assessed in this question. Learners performed better in the section on Hyperbola and Straight Line, achieving 51%, which suggests a reasonable understanding of routine procedures such as identifying asymptotes and intercepts when given familiar graph types.

However, performance dropped sharply to 27% in the Parabola and Exponential Graph sub-section. This indicates significant difficulties in interpreting and analysing these graphs, particularly in understanding key features, and the relationship between the algebraic equation and the graphical representation. Exponential graphs remain particularly challenging for many learners, contributing to the lower scores.

(b) **Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**

- In Q4.1.1 some of the candidates wrote the equations of the asymptotes as: $p = 0$ and $q = 3$ or as coordinates $(0;3)$ or asymptote = 0 and asymptote = 3 and lastly as digits 0 and 3.
- In Q4.1.2 candidates displayed a lack of understanding of the concept of the domain, such that their responses had y as part of their incorrect solutions.
- In Q 4.1.3 and 4.1.4 few candidates were challenged by manipulating the equation, they had incorrect signs.

  $0 = 3x + 3 \quad \therefore x = 1$, they struggled with the principle of additive inverses.
- In addition to errors in Ques 4.1.4 candidates misunderstood the question which also led to an exposure of the misunderstood concept of undefined solution.

$y = \frac{3}{0} + 3 \ \therefore y = 3$

The candidates failed to conclude that the solution is undefined.

- In Q4.1.5 most candidates plotted the hyperbolic function incorrectly as it intersected the vertical asymptote $(y = 0)$, which displayed lack of conceptual understanding in the concept of the asymptote.
- In Q4.1.6 most candidates did not do well in this question and those who attempted wrote incorrect notation which could be linked to misunderstanding of inequalities as explained in Q.1.
- In Q4.2.2 Candidates swapped x and y coordinates of B as $\mathrm{B}(0;2)$ and others wrote $\mathrm{B}(3;0)$.
- In Q4.2.3 candidates failed to analyze the function, they did not take note of the given x-value of the turning point. Few managed to respond accurately to this question.
- In addition, candidates incorrectly substituted in the parabola of the form, $0 = -(-1-4)^2 + q \ \therefore q = 25$
- In Q4.2.4 candidates struggled with correct notation such that they responded as $y \in [9; -\infty)$ or $y < 9$ and lastly $y \in [-\infty; 9)$, such responses indicated that candidates lack conceptual understanding of the concept of inequality notation.
- In Q4.2.5 some the candidates wrote asymptote as 6 or just the value 6, others wrote it as a function value: $g(x) = 6$
- In Q4.2.6 most candidates failed to find the correct value of *a* accurately either because of incorrect substitution or simplification.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

i. Educators are advised to put an emphasis on what asymptotes represent, how they relate to the function and how to express them algebraically gradually building this concept from equation of a vertical and horizontal line.

ii. Learners should be given thorough explanations and demonstrations of the meaning of inequalities, the correct use of inequality notation, and the distinction between the domain and range of a function.

iii. Effective teaching of interpretation skills requires a well-prepared teacher equipped with appropriate teaching and learning aids. Visual tools such as algebraic expressions, diagrams, and graphical interpretation should be supported with different coloured chalks, pens, or markers to highlight key regions and changes. In addition, regular class tests focusing on interpretation and application should be administered to help learners practise, analyse, and interpret mathematical statements with confidence.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

i. Educators are strongly advised to have glossary list for all topics that assist in correcting the misconception and clearly unpack what each term defines and relate to graphical representation and interpretation. Such as
An **equation** is a mathematical statement that shows that two expressions are equal. It uses the symbol "=" to indicate equality.

ii. Additionally, defining an equation prior asking for its algebraic representation could strengthen the understanding that an equation must always have an equal sign, and an emphasis on asymptote being associated with either x or y and nothing else should be done continuously by educators.

iii. Subject Advisors should work collaboratively with the e-Learning section to ensure that teachers are trained on the available graph applets. These digital tools can greatly support learners' understanding of interpretation questions.

iv. Subject advisors and departmental heads should conduct topic information sharing sessions to capacitate educators on the concepts, style of questioning and different easier methods to deliver the content and help improve knowledge retention of learners. Such would also eliminate content gap and misconception educators might have.

QUESTION 5

5.1 A machine, initially valued at R4 990, depreciates over a period of n years at a rate of 5,89% per annum, on a straight-line method.

5.1.1 Write down the formula to calculate simple depreciation. (1)

5.1.2 Determine the value of the machine at the end of 7 years. (2)

5.2 Determine the value of an investment at the end of 4 years, if R32 000 is invested at a rate of 7,15% per annum, compounded annually. (3)

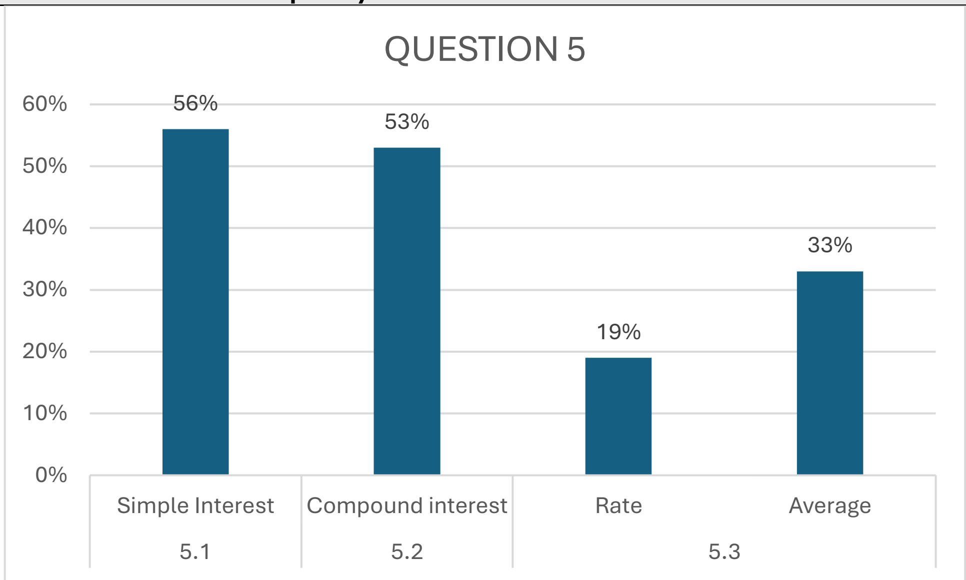
5.3 5 000 litres of water is released from a container at a rate of r% per minute, using the reducing-balance method. After 35 minutes, the water in the container is half of the original volume.

5.3.1 How many litres of water remain in the container after 35 minutes? (1)

5.3.2 Hence, determine the rate at which the water is released from the container. (4)

5.3.3 Determine whether there will be more than 1 500 litres of water left in the container after 1 hour, if it continues to be released at the same rate calculated in QUESTION 5.3.2. (4)

[15]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
 Learners performed relatively better in Simple Interest and Compound Interest, scoring 56% and 53% respectively. These scores suggest that most candidates can apply the basic interest formulas when the questions follow routine procedures. The major area of concern is Interest Rate, where the performance dropped dramatically to 19%. This low score shows that learners struggle when required to isolate the interest rate or manipulate the formula in non-standard ways. The overall performance for Question 5 is weak, with an average of 33%, indicating that learners struggled significantly with financial mathematics. The overall performance reveals that while learners can handle straightforward interest calculations, they experience serious difficulty when deeper conceptual understanding or formula manipulation is required.
(b) **Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**
• In question 5, candidates failed to choose relevant formula per question. For instance, candidates chose a reducing balance instead of linear depreciation and linear interest instead of compound interest, thus led to a breakdown. • In Q5.1.2 most candidates rounded off the given interest rate which led to a penalty of 1 mark. • Again, in Q5.1.2 majority of candidates opted for compound interest, which might be that they are mostly exposed to compound interest calculation and limited to decay. • In Q5.2 candidates made errors when substituting the interest rate $A = 32000(1+7{,}15)^4$, the omission of % in the interest rate led to an incorrect solution.

- In addition, on Q5.2 few of the candidates used the equation $A = P\left(1 + \frac{i}{n}\right)^{n \times m}$ and ended up confusing the compounding period with the number of years during substitution.
- In Q5.3.1 few candidates failed to calculate the amount of water if it were to be half of the volume, language became the barrier, and contextual understanding was extremely limited.
- In Q5.3.2 candidates were challenged by contextual understanding of the given statement, they ended up substituting incorrectly, assuming that $A > P$,yet it is depreciation and lasty they failed make if the subject of the formula.
- In addition, candidates concluded that $i = 1,96\%$ instead of $i = 0,0196 \text{ or } r = 1,96\%$. The candidates displayed inability to differentiate that **i – refers to interest per compounding period and is in decimal** $i = \frac{r}{100} \times \frac{1}{m}$, m being the compounding period.
  r – annual interest rate in %

- In Q5.3.3 Most candidates missed that an hour is equivalent to 60 minutes as the question required amount of water per minute.
- In general, question 5 candidates had limited contextual and conceptual understanding, coupled with language as the barrier.

(c) **Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**
i. Educators should strengthen understanding of literal equations as most learners are greatly challenged to make variables subject of the formula. ii. Educators should encourage learners to read and analyse given scenarios and train them on identifying key words that hint towards the correct formula such as Compound interest – (compound growth, population growth, inflation). Simple interest – (linear growth, higher purchase). Compound decay – (reducing balance, compound depreciation). Simple decay – (straight line depreciation). iii. Educators should define the variables used in the formulars and maintain them throughout, for example, if m defines compounding period, it should be maintained even in the formula for calculating the nominal and effective rate. iv. Subject advisors should conduct content workshops to capacitate educators in this topic.

(d) **Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**
i. Educators should strengthen understanding of literal equations as most learners are greatly challenged to make variables subject of the formula. ii. Educators should encourage learners to read and analyse given scenarios and train them on identifying key words that hint towards the correct formula such as a. Compound interest – (compound growth, population growth, inflation). b. Simple interest – (linear growth, higher purchase). c. Compound decay – (reducing balance, compound depreciation). d. Simple decay – (straight line depreciation). iii. Educators should define the variables used in the formulars and maintain them throughout, for example, if m defines compounding period, it should be maintained even in the formula for calculating the nominal and effective rate. Subject advisors should conduct content workshops to capacitate educators in this topic.

QUESTION 6

6.1 Determine $f'(x)$ using FIRST PRINCIPLES if $f(x)= 4+\frac{1}{3}x$ (5)

6.2 Given: $y=\frac{-3x^6}{x^4}$

6.2.1 Simplify y. (1)

6.2.2 Hence, determine $\frac{dy}{dx}$. (1)

6.3 Determine:

6.3.1 $D_x\left(5x^8-11\right)$ (2)

6.3.2 $\frac{d}{dx}\left(-\frac{10}{x}\right)$ (2)

6.3.3 $f'(x)$ if $f(x)=-\frac{4x}{3}+\sqrt[4]{x^{-5}}$ (3)

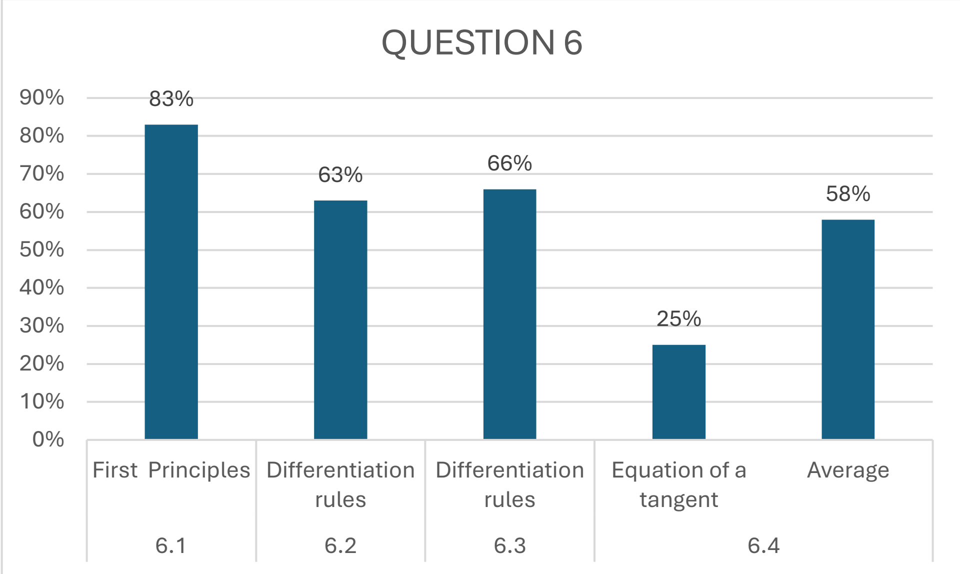
6.4 The equation of a tangent to the function $h(x)=ax^3+6x^2$ is $y=100+15x$

6.4.1 Write down the gradient of the tangent. (1)

6.4.2 Determine the value of a if the y-value at the point of contact of the tangent to the curve is 25. (5)

[20]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



Learners performed exceptionally well in 6.1 (First Principles), achieving an impressive 83%. The strong performance indicates good procedural fluency and an ability to follow the standard steps involved in substituting into the formula, simplifying, and taking the limit. The greatest difficulty is seen in 6.4 (Equation of the Tangent), where the performance drops sharply to 25%. However, the significant drop in application-based tasks, such as determining the equation of a tangent, shows that conceptual understanding and multi-step reasoning require further reinforcement.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

- In Q6.1 candidates got a penalty for notational errors such as:

  $f(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ in this case the candidate wrote the definition as function which is incorrect.

  $\lim_{h\to 0}=\frac{f(x+h)-f(x)}{h}$ in this case the candidate had an equal sign between the limit and the fraction.

- Furthermore, candidates made errors in the substitution such as

  $f(x+h)-f(x)=4+\frac{1}{3}x+h-4-\frac{1}{3}x$, brackets were omitted when substituting

- In addition to incorrect substation candidates wrote: $f(x+h)=4(x+h)+\frac{1}{3}x$, this displayed that they are used to questions where the first term in the expression has the variable x to be substituted on.
- In Q6.2.1 most candidates couldn't simplify accurately; some left the solution as $-3x^{6-4}$ or $y=-3x^{6}-x^{-4}$.
- In Q6.3.1 candidates differentiated but concluded incorrectly:
  $\frac{dy}{dx}=40x^{7}-11=29x$
- In Q6.3.2 most candidates simplified incorrectly due to misunderstood laws of exponents -10^{-x} or $\frac{dy}{dx}=-10\ln x$
- In Q6.3.3 candidates made errors when changing the term from radical form to exponential form.
  $f(x)=-\frac{4}{3}x+x^{-\frac{4}{5}}$; this clearly indicates a gap in writing in equivalence form.
- Q6.4 was poorly performed; few candidates couldn't even write the value of the gradient. In 6.4.2 candidates made an error of equating the derivative with 100 instead of zero.
- Lastly, candidates tend to integrate instead of deriving or do both methods at once.

(c) **Provide suggestions for improvement in relation to Teaching and Learning.**

I. Educators should train learners to copy first principle and rule of differentiation from the formula sheet.

II. Educators are advised to use pneumonic like **SRIFD** to help learners remember all they must do prior differentiating:

S – simplification inclusive of expanding where necessary or making sure that y is the subject of the formula if the equation is not arranged well.

R – radical form which must be written in an exponential form.

I F– inverting any fraction with the variable of interest in the denominator e.g.

$-\frac{10}{x}=-10x^{-1}$

D – Differentiating once all the 3 steps have been checked.

III. Educators should expose learners to questions with fractions.

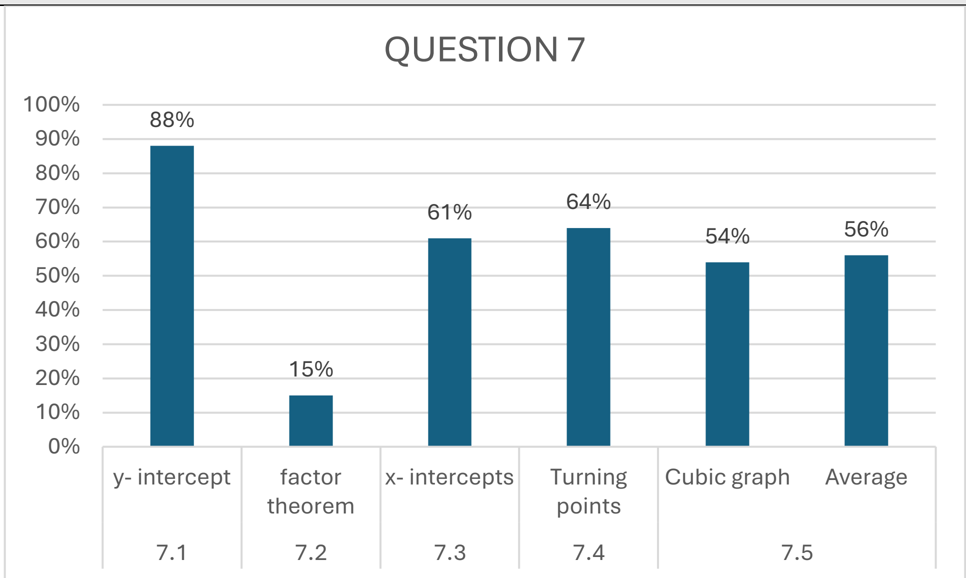
IV.	Educators should expose learners to various notations used in differentiation. The notations $f^{/}(x)$ if $f(x)=x^n$, $\frac{dy}{dx}$ if $y=x^n$, $\frac{d}{dx}\left(x^n\right)$ and $D_x\left(x^n\right)f$ all have the same meaning.
V.	The difference between the derivative and an integral of a function should be thoroughly demonstrated and explained to learners by finding the derivative and integral of the same function.
VI.	Educators should explain the meaning behind the notations such as $\frac{dy}{dx}$ which refers to deriving a function y with respect to x, therefore in the equation y must be the subject of the formula.
(d)	**Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**
i.	Educators should intensify revision of basic algebraic manipulation, including exponential laws and changing the terms from surd form to exponential form as well as working with algebraic fractions.
ii.	Activities given for revision should not be limited to those where the variable to differentiated with respect to, is already the subject, they should be given equations or expressions where they have to manipulate first and variables used should not be limited to x and y.
iii.	Subject advisors should capacitate educators with more focus on novice educators.
iv.	During information sharing meetings, the diagnostic reports should be well mediated, and a subject improvement plan be drawn based on the identified trends.
v.	Standardized revision worksheets should be provided to schools by the province or districts to ensure that the identified misconceptions and errors are eradicated by al schools.

QUESTION 7

Given: $g(x) = ax^3 - 2x^2 - 19x + 20$

7.1	Write down the y-intercept of g.	(1)
7.2	If $(x-5)$ is a factor of g, show that the numerical value of $a = 1$	(2)
7.3	Hence, determine the x-intercepts of g.	(4)
7.4	Determine the coordinates of the turning points of g.	(5)
7.5	Sketch the graph of g on the system of axes provided in the SPECIAL ANSWER BOOK. Clearly show ALL intercepts with the axes, as well as the turning points.	(4)
		[16]

(a) **General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?**



The overall performance for Question 7 was moderate at 56%, with learners showing strong mastery of routine skills but struggling with more conceptual aspects of cubic functions. They performed very well in identifying the y-intercept (88%) and showed reasonable competence in determining x-intercepts (61%) and turning points (64%), indicating familiarity with basic substitution, algebraic solving, and differentiation. However, the very low score in Factor Theorem (15%) highlights a major conceptual gap, this weakness also affected their ability to sketch the cubic graph, where performance was only moderate.

(b) **Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**

- Most candidates had a challenge with Q7,2, they used the value of a they were supposed to prove to prove that $(x-5)$ is a factor.

  $g(5)=(5)^3-2(5)^2-19(5)+20=0$.
- Candidates interchanged responses for Q 7.3 and Q 7.4 which required the x intercepts and T.P respectively.
- Candidates tend to copy the equations incorrectly either having incorrect signs or different coefficients from the given.
- In Q7.3 few candidates did not respond to the question fully, they left the solution at the factor stage and did not write the values of the intercepts as required

  $g(x)=(x-5)(x-1)(x+4)$.
- in addition, in Q 7.3 a candidate used 2 different methods, the first attempt was incorrect and the second was correct but the first was not cancelled hence the first was marked and lost marks.
- In Q 7.4 candidates derived and calculated the value axis of symmetry using the derivative and ended up plotting a parabola.

  $f^{/}(x)=3x^2-4x-19$

  $x=-\frac{-4}{2(3)}=\frac{2}{3}$

  $y=\left(\frac{2}{3}\right)^3-2\left(\frac{2}{3}\right)^2-19\left(\frac{2}{3}\right)+20=\frac{182}{27}\approx 6,7$

(c) **Provide suggestions for improvement in relation to Teaching and Learning.**

i. Educators are advised to vary sequencing of questions starting from informal tasks to avoid the confusion that occurred in 7.3 and 7.4.

ii. Educators are advised to drill learners on one method of calculating the intercepts, learners soften get confused.

iii. Subject advisors should support educators in terms of providing sufficient revised revision material and design worksheets that resemble the answer book to train learners to use the answer book as per the instruction such as writing the question in the space allocated.

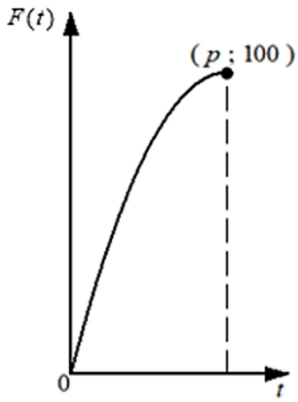
iv. Educators are advised to explain clearly to learners the difference between the cubic and quadratic functions, starting from equation, parameters and graphical representation and make it clear how the two relate.

(d) **Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**
i. Educators are advised not to ask question in a standardized manner or routine as that confuse learners when questions are structured differently. ii. Software relevant to curve sketching should be used during teaching to deepen conceptual understanding.

QUESTION 8

The number of fat cakes sold by Madlamini during break is given by the equation: $F(t) = 20t - t^2$, where $0 \leq t \leq p$

The point $(p\,;100)$ is on the graph of F, as shown below.



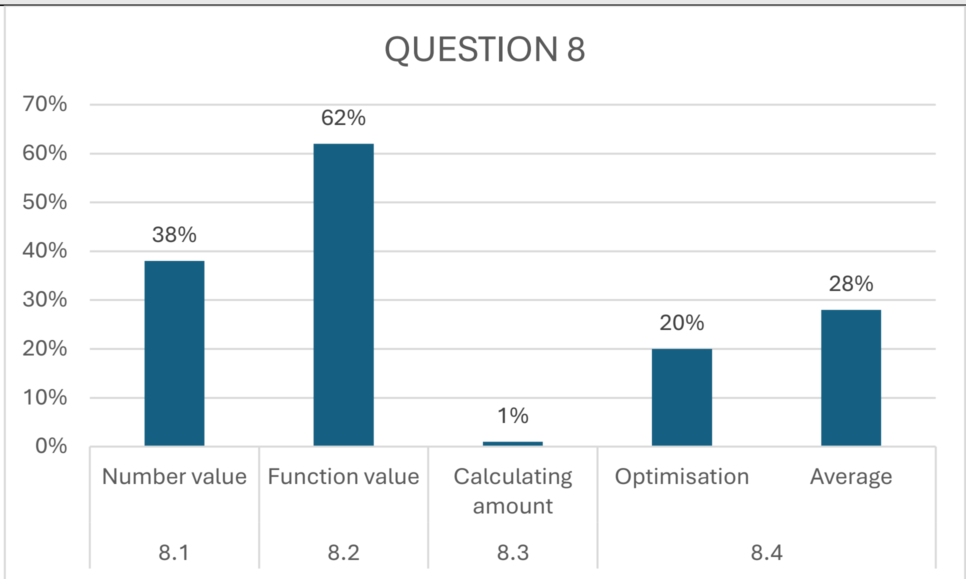
8.1 Write down the total number of fat cakes sold by Madlamini during break. (1)

8.2 Determine how many fat cakes were sold at the end of the first 5 minutes of break. (2)

8.3 Calculate the amount of money Madlamini will earn for the fat cakes sold in the interval $5 < t \leq p$ of break, if one fat cake costs R2,50. (2)

8.4 Determine the numerical value of p, the time (minutes) taken to sell ALL the fat cakes. (3)
[8]

(a) **General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?**



The overall performance for Question 8 was very poor, with an average of 20%, showing that learners struggled with most of the concepts assessed. Although function value was answered reasonably well, indicating some confidence with basic substitution, performance dropped notably in number value and even more drastically in calculating the amount, where almost no learner was able to apply the required procedures. The weak performance in optimisation further highlights learners' difficulty in applying Calculus in problem-solving contexts. Overall, the results reveal that while simple procedural tasks are manageable, learners face severe challenges with multi-step reasoning, contextual interpretation, and higher-order application.

(b) **Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**

- Many candidates left Question 8 blank or misapplied concepts, indicating that they had memorised procedures without understanding the meaning behind them.
- Candidates did not understand what the question required in 8.3
- In Q8.4 candidates understood the concept of minima associated with the derivative but used the maximum value of the turning point instead of zero

  $F^{/}(x) = 20 - 2t$

  $100 = 20 - 2t$

  $t = -40$

  The response also indicated that the candidate did not understand the meaning behind the calculations.

(c) **Provide suggestions for improvement in relation to Teaching and Learning.**
i. Strengthen conceptual understanding before procedures. Teachers should prioritise conceptual explanations such as what a "minimum value "represents, why derivatives are used, and how functions model real situations before teaching formulas or steps. i. Since learners struggled especially with Q8.3 (calculating an amount) and Q8.4 (optimisation), more contextual practice is needed. Teachers should incorporate real-world problems involving cost, profit, distance, area, and volume to help learners see the relevance and build intuition for application questions. ii. Teaching should emphasise: • $f'(x) = 0$ gives the x-*value* of a turning point • the sign of the derivative determines increasing/decreasing behaviour • the *minimum value* is $f(x)$at that x-value Use sign charts, gradient tables, and graphical illustrations to solidify this understanding.
(d) **Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**
i. Guide teachers to shift from purely procedural teaching to concept-focused explanations, especially in calculus and functions. ii. Provide teachers with strategies to teach learners how to identify what the question is *really asking*, especially multi-step questions like 8.3 and 8.4. iii. Run workshops focusing on common calculus misconceptions, such as: • The difference between the x-*value where the derivative is zero* and the *y-value at the turning point*. • Interpreting question wording (e.g., what "determine", "hence", "show that" requires).

QUESTION 9

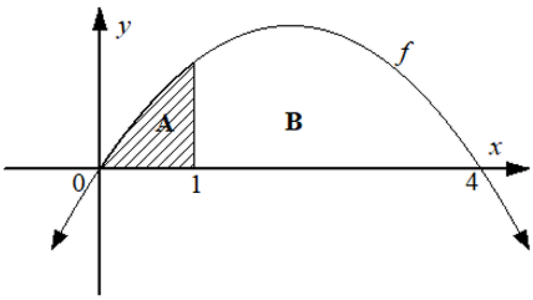
9.1 Determine:

9.1.1 $\int x^3 \; dx$ (2)

9.1.2 $\int \left[2^{3x} + \frac{1}{x^2}(x-2) \right] dx$ (5)

9.2 The sketch below shows a curve f defined by $f(x) = -2x^2 + 8x$

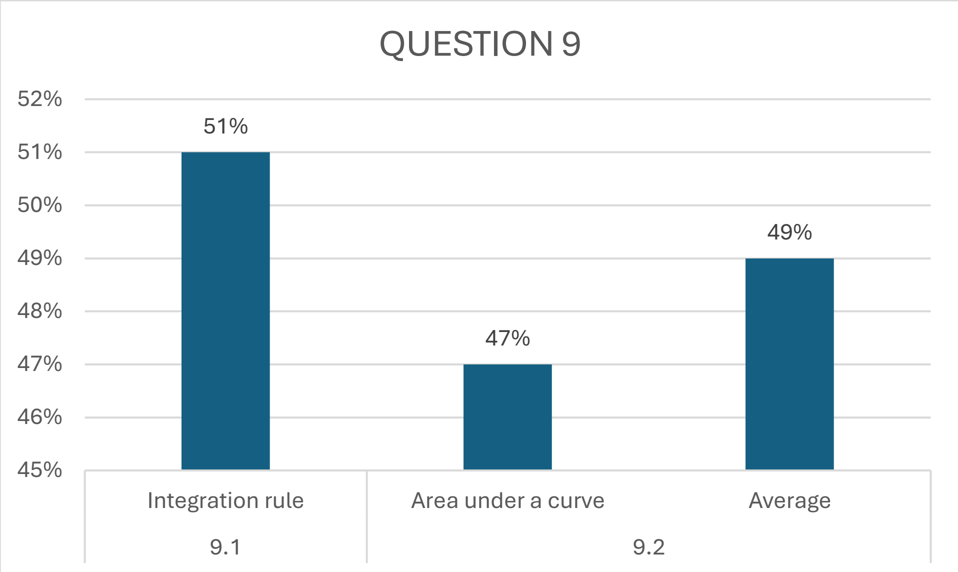
- The shaded area A is bounded by the curve f and the x-axis between $x = 0$ and $x = 1$
- The unshaded area B is bounded by the curve f and the x-axis between $x = 1$ and $x = 4$



Determine whether $\frac{\text{A}}{\text{B}} \leq 0{,}2$ (clearly show ALL working). (8)

[15]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



The overall performance for Question 9 was moderate at 49%, showing that learners have a developing but still incomplete understanding of integration. They performed slightly better on basic integration rules, indicating some competence with routine anti-differentiation, though errors with the power rule and constants were common. Performance in area under the curve slightly weaker, suggesting difficulties in applying integration in contextual settings, particularly with interpreting limits and calculating meaningful areas. Overall, the results show that while foundational skills are in place, learners require stronger conceptual grounding and more practice with application-based integration problems.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

- In Q 9.1.1 candidates omitted $+c$ and lost 1 mark.
- Few of the candidates mixed integration and differentiation.

  $$\int x^3 dx = \frac{3x^{3+1}}{3+1} + c = \frac{3x^4}{4} + c$$

- In Q 9.1.2 simplification proved to be a challenge for most candidates and they did not remember the different rules of integration.

  Incorrect simplification: $\frac{1}{x}(x-2) = \frac{1}{x^3} - \frac{1}{2x^2}$

  Incorrect integration: $\int 2^{3x} = \frac{2^{3x+1}}{3x \ln 2}$

- Candidates displayed misunderstanding of the concept of undefined solution as the integration was incorrectly done as: $\int \frac{1}{x} dx = \int x^{-1} dx = \frac{x^{-1+1}}{-1+1} = 1$
- Some candidates did not simplify but differentiated each term in the binomial without expanding first as shown: $\int \frac{1}{x^2}(x-1) = \ln 2x + \frac{x^2}{2} - x$
- In Q 9.2 some of the candidates did not integrate and substituted the limits directly to the given function.
- In addition, candidates swapped the limits when substituting and ended with a negative area.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

i. Educators should teach and encourage learners to use the integration rules given in the formula sheet.
ii. Educators should expose learners to various integration questions including those that require manipulation of fractions first.
iii. The term "substitution" needs to be clearly explained and demonstrated with an emphasis on the use of brackets when substituting.
iv. Educators should not continue to emphasize that area can never be negative.
v. Educators are advised to revise simplification of algebraic expressions prior integration.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

i. Subject advisors and teacher-development teams should prioritise strengthening teachers' conceptual understanding and instructional strategies in calculus. This includes providing targeted training on commonly misunderstood concepts such as the distinction between differentiation and integration, the correct application of integration rules, and the interpretation of limits in definite integrals.

ii. Advisors should facilitate workshops that focus on error analysis, using real learner scripts to highlight misconceptions such as incorrect simplification, mixing calculus processes, and substituting limits into the original function. By modelling effective explanations, step-by-step methodologies, and the use of visual tools, advisors can help teachers move beyond procedural teaching towards deeper conceptual clarity.

iii. In addition, advisors should support teachers by reinforcing foundational algebra skills essential for successful integration, offering high-quality teaching materials, and encouraging consistent use of diagnostic assessments to identify learner gaps early.