CHAPTER 10

MATHEMATICS

The following report should be read in conjunction with the Mathematics question papers for the NSC November 2025 examinations.

10.1 PERFORMANCE TRENDS (2021–2025)

The number of candidates who sat for the Mathematics examinations in 2025 increased by 2 927, compared to that of 2024.

There was a decline in the pass rate this year. Candidates who passed at the 30% level and above changed from 69,1% in 2024 to 64,0% in 2025. There was a corresponding change in the pass rate at the 40% level and above over the past two years from 47,9% to 41,9%.

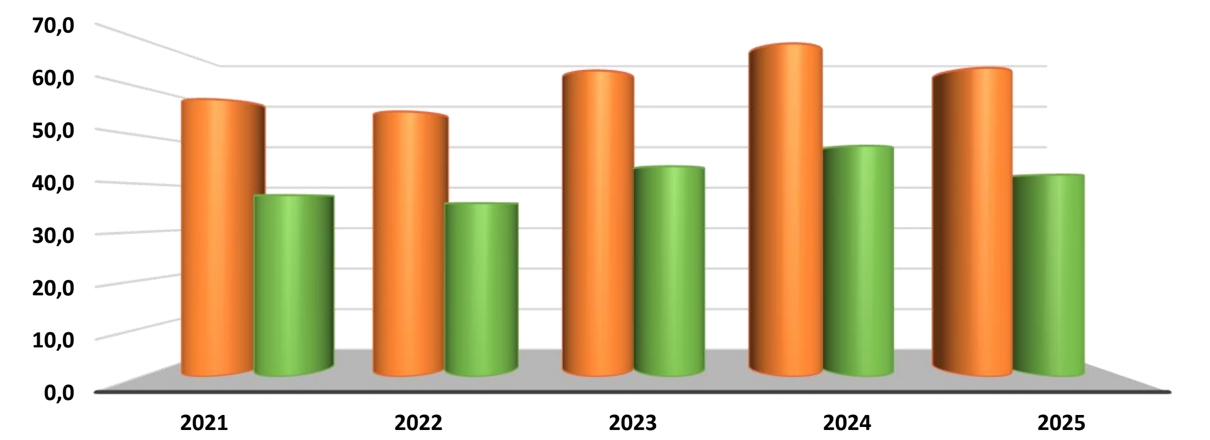
There was also a decline in the percentage over 80% from 3,9% in 2024 to 1,9% in 2025. The total number of distinctions has shown a decrease for the past two years from 9 808 in 2024 to 4 834 in 2025.

The various intervention strategies employed by teachers, subject advisors and provincial education departments were continued in 2025. The resourcefulness and diligence of the above-average candidates contributed to the overall results in the subject.

Table 10.1.1 Overall achievement rates in Mathematics

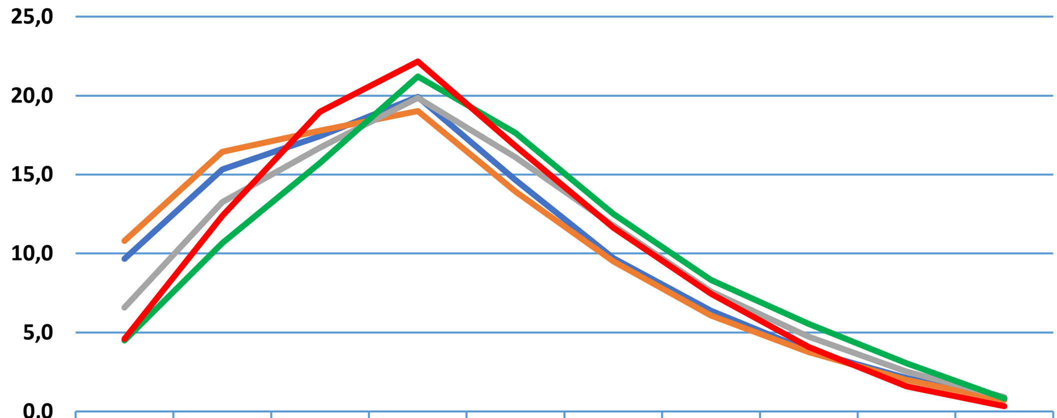
Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above	No. achieved at 40% and above	% achieved at 40% and above
2021	259 143	149 177	57,6	97 561	37,6
2022	269 734	148 346	55,0	97 041	36,0
2023	262 016	166 337	63,5	114 311	43,6
2024	251 488	173 774	69,1	120 430	47,9
2025	254 415	162 947	64,0	106 570	41,9

Graph 10.1.1 Overall achievement rates in Mathematics (percentage)



	2021	2022	2023	2024	2025
% achieved at 30% and above	57,6	55,0	63,5	69,1	64,0
% achieved at 40% and above	37,6	36,0	43,6	47,9	41,9

Graph 10.1.2 Performance distribution curves in Mathematics (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2021	9,7	15,3	17,4	19,9	14,7	9,7	6,4	3,8	2,1	0,8
2022	10,8	16,4	17,8	19,0	13,9	9,5	6,1	3,8	2,0	0,7
2023	6,6	13,3	16,7	19,9	16,1	11,8	7,6	4,7	2,5	0,9
2024	4,5	10,7	15,7	21,2	17,6	12,5	8,3	5,6	3,1	0,8
2025	4,6	12,4	19,0	22,2	16,8	11,6	7,4	4,1	1,6	0,3

10.2 OVERVIEW OF CANDIDATES' PERFORMANCE IN PAPER 1

(a) The style of questioning was different from previous years making the paper less predictable.

(b) While calculations and performing well-known routine procedures form the basis of answering questions in a Mathematics paper, a deeper understanding of definitions and concepts cannot be overlooked. Candidates did not fare well in answering questions that assessed an understanding of concepts, even where these questions were accessible to them.

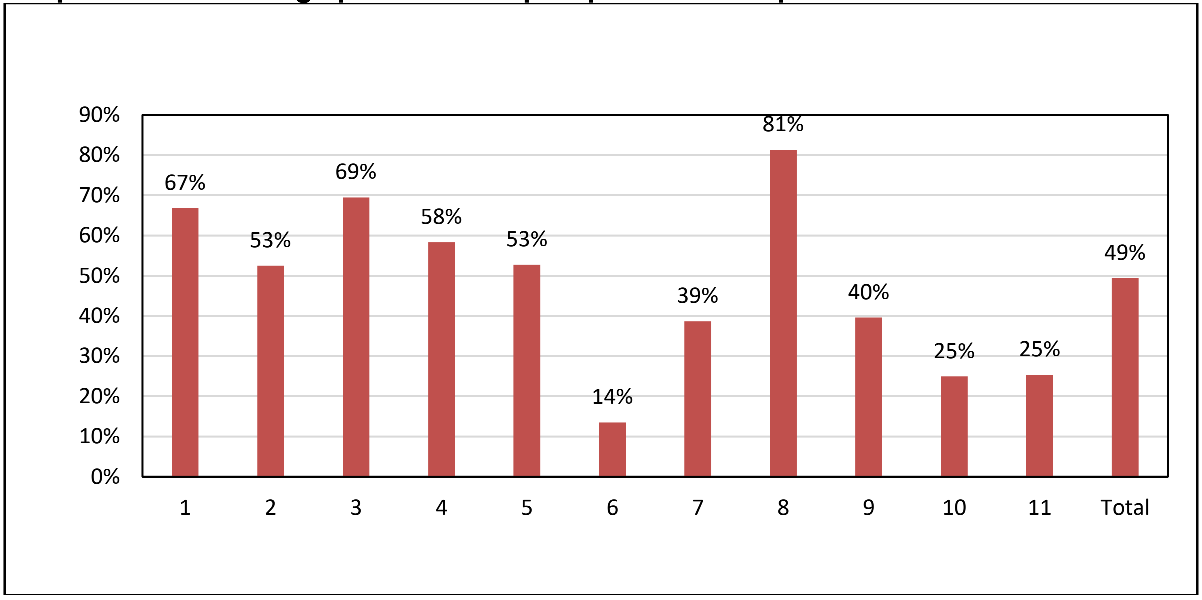
(c) Many candidates were able to answer the knowledge and routine questions correctly. This suggests that the candidates were well prepared to deal with these questions. Candidates scored some marks in most of the questions.

(d) The algebraic skills of the candidates were poor. Most candidates lacked fundamental and basic mathematical competencies which should have been acquired in the lower grades. This made manipulation of expressions and complex calculations challenging for many candidates.

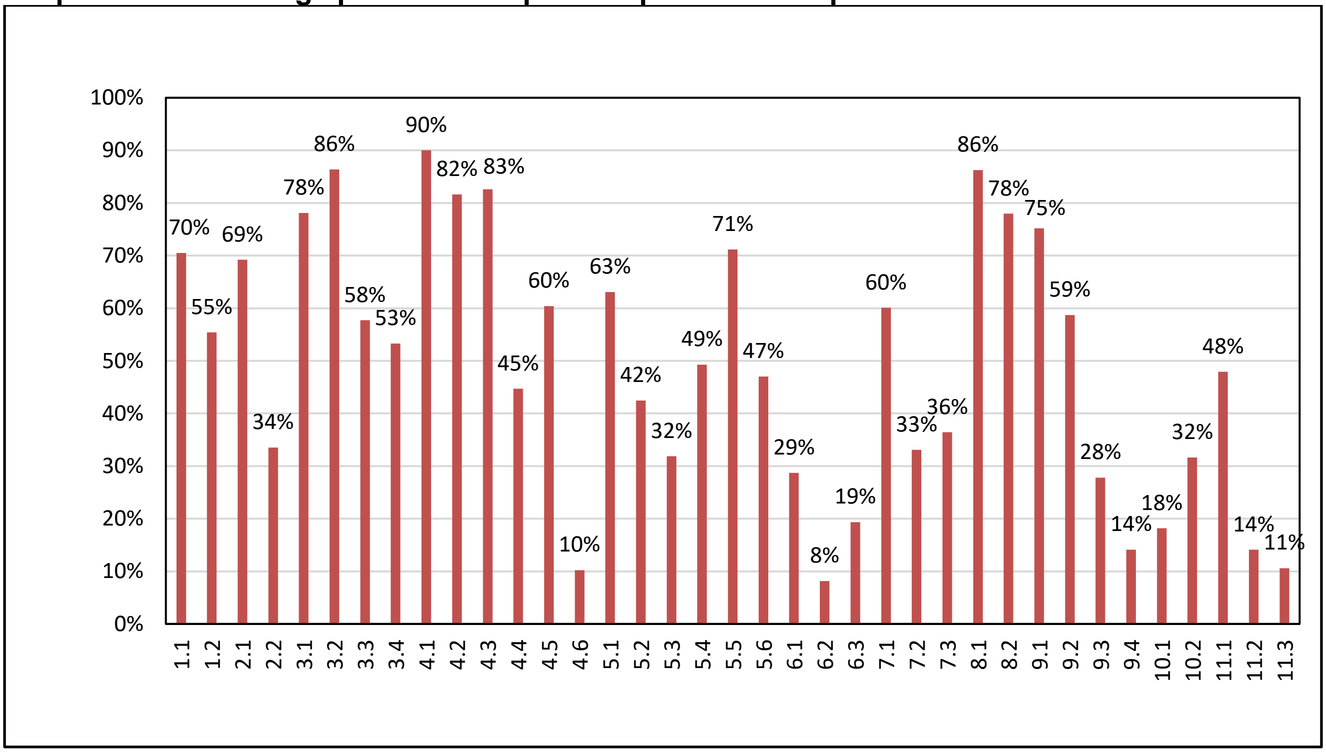
10.3 DIAGNOSTIC QUESTION ANALYSIS OF PAPER 1

The following graph is based on data from a random sample of candidates' scripts. While this graph might not accurately reflect national averages, it is useful in assessing the relative degrees of challenge of each question as experienced by candidates.

Graph 10.3.1 Average performance per question in Paper 1



Graph 10.3.2 Average performance per subquestion in Paper 1



Q	Topics
1	Equations, Inequalities and Algebraic Manipulations
2	Number Patterns and Sequences
3	Number Patterns and Sequences
4	Functions, Graphs and Inverse Functions
5	Functions and Graphs
6	Functions and Graphs

7	Finance
8	Calculus
9	Calculus
10	Calculus
11	Probability and Counting Principles

10.4 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN PAPER 1

QUESTION 1: ALGEBRA

Common errors and misconceptions

(a) In Q1.1.2 some candidates substituted incorrect values of *b* and *c* into the quadratic formula because they had not written the equation correctly in standard form. Candidates were still unable to round off their answers correct to two decimal places. Some candidates rejected the answer of $x = -1{,}54$, perhaps because the answer was a negative value.

(b) In Q1.1.3 many candidates were able to calculate the *critical values* but were unable to identify the correct intervals for the solution to the inequality. They provided the following incorrect answers: $0 < x < \frac{1}{4}$ or $x > 0$ or $x > \frac{1}{4}$. Other candidates used the word 'and' in the solution, which was incorrect. Notation still seemed to be problematic as some candidates left their answer as $0 > x > \frac{1}{4}$.

(c) Factorising the exponential equation in Q1.1.4 proved to be a challenge for many candidates. Common factorisation errors were that the given equation was factorised to $2^x(2-9) = -4$ or $2.2^x - 9.2^x + 4 = 0$ was factorised to $2(2x - 9 + 2) = 0$. Some candidates used the *k*-substitution method to answer this question. They correctly arrived at $k = 4$ or $k = \frac{1}{2}$ but then failed to solve for *x*.

(d) In Q1.1.5 many candidates found it challenging to work with two *surds* that had fractions in them. Some were able to square both sides of the equation correctly and arrived at $\sqrt{\frac{1}{x}} + 2 = \frac{1}{x}$. Thereafter, they incorrectly squared the terms in this equation: $\left(\frac{1}{\sqrt{x}}\right)^2 + (2)^2 = \left(\frac{1}{x}\right)^2$. Some candidates converted the *surds* to *exponents*. However, they applied the exponential laws incorrectly. Despite being mentioned in previous reports, candidates still did not check their answers and reject the extraneous solution.

(e) Most candidates were unable to establish the correct equations from the statements given in Q1.2. The following incorrect equations were established for the second statement: $5(x+y) = 6x^2$ or $5(x+y) = 6\sqrt{x}$ or $5xy = 6x^2$ instead of $5xy = 6 + x^2$.

Suggestions for improvement

(a) Learners must ensure that they are able to correctly identify the values of *a, b* and c in any *quadratic* equation.

(b) It must be emphasised that the balance of an equation is maintained by performing the same operation on both sides of the equation. Squaring the individual terms on one side is not the same as squaring an individual term on the other side.

(c) Learners must be taught to check their solutions when using the squaring technique to solve an equation that is not originally quadratic, as well as to check the validity of solutions generated in *exponential* equations. Teachers must emphasise that implicit restrictions are placed on *surd* equations.

(d) *Quadratic inequalities* should be taught in relation to the *quadratic function*. Notation in *quadratic inequalities* should be emphasised. Graphical tools should be shown to the learners to ensure they understand what the mathematical notation means on a graph.

(e) Exponential rules, manipulation and equations should be practised. Learners should understand when to use the technique of equating *exponents* because the *bases* are the same, and when to factorise. Simplification of *exponential expressions* and solving *exponential equations* are equally important.

(f) Teachers must make time to revise work involving algebraic manipulations and exponential laws.

(g) Word problems in earlier grades should not be ignored. Translating words to mathematical statements is an important skill in understanding mathematical language.

(h) As suggested in previous reports:
- Teachers should not take for granted that learners know how to round off a number to the required number of places. Where necessary, this skill should be retaught in Grades 11 and 12. Teachers should penalise learners in class work and SBA tasks when they do not round off to the correct number of places.
- Teachers should take some time, preferably in Grade 10, to focus on teaching learners how to represent inequalities (e.g. $0 < x < \frac{1}{4}$) on a number line and how to also write an inequality from the illustration on a number line. This will benefit learners as they are required to write inequality solutions for a number of questions in both examination papers. Emphasis on the correct notation is essential when writing down the solutions to inequalities.
- Linked to this, teachers should explain the difference between 'and' and 'or' in the context of inequalities. Learners cannot use these words interchangeably as they have different meanings.

QUESTION 2: PATTERNS

Common errors and misconceptions

(a) Candidates failed to cross multiply and expand the resulting brackets correctly when answering Q2.1.1. Some candidates substituted $t = -2$ into the given expression instead of proving that $t = -2$. These candidates did not understand the question.

Some candidates incorrectly assumed this to be an *arithmetic sequence* and generated an equation of differences between the terms. They were not awarded any marks.

(b) Many candidates were able to determine the terms in the sequence and calculate the value of r correctly. However, they did not simplify their answer to b^x as required and instead gave their answer in the form $a.b^x$. Most learners who relied on their calculators to simplify expressions and equations could not reach the required answer in the simplest form. They were not awarded a mark for this.

(c) When answering Q2.1.3 some candidates were oblivious to the fact that $-1 < r < 1$ for a *converging geometric sequence*. Instead, they incorrectly used a value of r that was outside this interval. Other candidates incorrectly used the finite sum formula, $S_n = \dfrac{a\left(r^n - 1\right)}{r - 1}$, when answering this question.

(d) In Q2.2.1 some candidates incorrectly calculated the *common difference* instead of calculating the difference between T_6 and T_{14}.

(e) The errors made when answering Q2.2.2 showed that candidates had poor understanding of the concept of *sigma notation*. They were unable to calculate the number of terms in the series correctly. Many of them incorrectly indicated that there were $117 - k$ terms in the series. The first term of the series was incorrectly calculated as $4(1) - 1$ instead of $4(k) - 1$. Some of them did not know that the sum of this series of terms was 26 675.

Suggestions for improvement

(a) Teachers should emphasise the difference between *arithmetic* and *geometric sequences*.

(b) Learners need to be made aware that when a question requires them to 'show that …', they may not use this information as given. Instead, they must perform some calculations and arrive at the answer given in the statement. Learners should master the simplification of expressions and equations to the simplest form.

(c) Teachers should explain the concept of a *converging geometric series* by generating two *geometric series*, one with the value of r between -1 and 1 and the other having the value of $r > 1$. Learners should observe the value of the sum of the first n terms as more terms are added to the series.

(d) The concepts of S_n and S_∞ should be explained and the difference between them should be demonstrated as a series of terms.

(e) A solid foundation of *sigma notation* should be emphasised in the classroom. Learners should be exposed to both calculating from given *sigma notation*, and writing information from a given pattern into *sigma notation*. This should give them a better understanding of the concept.

(f) Exercises in number patterns should include variables so that learners will be able to attempt higher order questions on this topic.

QUESTION 3: PATTERNS

Common errors and misconceptions

(a) Many candidates used the *general term* given in Q3.2 to answer Q3.1. This was not acceptable and they were not awarded any marks in this instance. Some candidates incorrectly calculated the *first differences* as being: –35 ; –33 ; … This resulted in an incorrect value of the fifth term.

(b) In Q3.2 some candidates incorrectly used $2a + b = 35$ instead of $3a + b = 35$.

(c) In Q3.3 many candidates could not link maximum depth with a positive value. Some candidates were able to calculate that the maximum depth occurs at $n = 19$ but then did not proceed to calculate the maximum depth as required in the question.

(d) Many candidates did not realise that they could use the axis of symmetry to answer Q3.4. Those who did use the axis of symmetry gave the answer as 32 seconds instead of the correct answer of 35 seconds. Many candidates opted to solve the equation $T_n = 104$. However, they gave both answers instead of the time at which the submarine will be at 104 metres for the second time, namely at 35 seconds.

Suggestions for improvement

(a) Teachers should expose learners to questions on number patterns that are based on real-life contexts.

(b) Teachers must show the link between the *quadratic number pattern* and the *quadratic function* as many concepts of the *quadratic function* are tested in *quadratic number patterns*.

(c) Teachers should ask learners to interpret context-based questions and explain which mathematical concept is required to respond to it. In addition, teachers should encourage learners to ensure that their response is relevant to the context.

QUESTION 4: FUNCTIONS (EXPONENTIAL FUNCTION AND ITS INVERSE)

Common errors and misconceptions

(a) Candidates were able to swop x and y when determining the *inverse* in Q4.3. However, some of them were unable to write the equation of the *inverse* correctly. Many wrote the answer as $f^{-1}(x) = x^{\frac{1}{3}}$; they incorrectly switched the *base* and *exponent* in the answer.

(b) In Q4.4 a fair number of candidates incorrectly wrote the equation of the *asymptote* as $q = 0$ or $x = 0$ instead of $y = 0$.

(c) Many candidates were able to plot the points correctly when answering Q4.5 but they were unable to draw the correct shape.

(d) Many candidates were unable to interpret Q4.6 correctly. A significant number of candidates who attempted this question, incorrectly wrote the interval in terms of x instead of y.

Suggestions for improvement

(a) Point-by-point plotting of graphs is important for learners to understand the shape of graphs. However, teachers must teach with conceptual understanding. Emphasis should be placed on the understanding of the *asymptote* of a function.

(b) The general form of functions and their shapes should be emphasised from Grade 10 and revised every time a functions question is worked through in class. In addition, the effects of the parameters a, b, p and q should be thoroughly taught, revised and practised by learners from the introduction of functions in Grade 10 through to the end of the Grade 12 academic year.

(c) Teachers should ensure that learners work with *transformations* in functions from Grade 10. This should include *point transformation*, recognition of the *transformation* applied to one function's equation to result in another and the rules of *reflection*, *horizontal* and *vertical shifts* on the equation of a function.

(d) Learners should be allowed to investigate the *inverse* of a function. They should explore the idea of swapping the x- and y-coordinates and observing how the *inverse* is different from the original function.

QUESTION 5: FUNCTIONS (HYPERBOLA AND PARABOLA)

Common errors and misconceptions

(a) In Q5.1 some candidates wrote the answer as $x \in R, x = 3$ instead of $x \in R, x \neq 3$. They did not exclude the *asymptote* from the *domain*. This confirms that some candidates did not understand the concept of *asymptote*.

(b) Q5.2 required candidates to write down the *range* of the parabola. Many candidates excluded the *turning point* in their answer and wrote the answer as $y < 8$ or $(-\infty;8)$. This was incorrect.

(c) Many candidates were able to establish the correct *critical values* when answering Q5.3. However, they were unable to identify the correct regions from the graphs and state the intervals correctly. In Q5.3.1 many candidates incorrectly wrote the answer as $3 < x < 5$ or $3 \leq x \leq 5$. In Q5.3.2 many candidates were confused about using 'and' and 'or' when stating intervals and wrote $x < 1$ *and* $x > 5$. This answer was incorrect. Some candidates used the equation of function f given in Q5.4 to answer Q5.3.1 and Q5.3.2. They tried to solve the following inequalities algebraically: $\frac{-4}{x-3} \leq -\frac{1}{2}x^2 + 3x + \frac{7}{2}$ and $-\frac{1}{2}x^2 + 3x + \frac{7}{2} < 6$. They were not awarded any marks for their efforts as they did not determine the equation of f before using it.

(d) In Q5.4 many candidates incorrectly took the value of p to be 3 instead of –3.

(e) When answering Q5.5 some candidates stated that the coordinates of M were (–1 ; 0) without showing any working. They were not awarded full marks for omitting the necessary working.

(f) Many candidates had difficulty in calculating the *gradient* of the *tangent* in Q5.6. A large number of candidates incorrectly calculated the *average gradient* between points D and P. Other candidates incorrectly took the *gradient* of the *tangent* as –1.

Suggestions for improvement

(a) Learners must be made aware that assuming facts without first proving it is not acceptable when answering questions. In this regard, learners must show all working steps and may not use the result given in a latter question to answer a question that that precedes it.

(b) Teachers should pay more attention to establishing the *domain* and *range* from the graph of a given function.

(c) Teachers should demonstrate how to read off answers from a single graph to the following statements: $f(x)=0$, $f(x)=k$, $f(x)<0$, $f(x)>0$, $f(x)\leq 0$, $f(x)\geq 0$, $f(x)<k$, etc. They should start with the *straight-line* graph and then progress to the other graphs in Grade 10. This should help learners understand how to read off answers when a question has a combination of graphs.

(d) Many learners can calculate the *derivative* of a function but they cannot interpret the answer. The concept of *derivative* must be stressed as being the *gradient of a tangent to a curve*. Learners must be exposed to determining the *gradient* of a *tangent* to any curve and not just the *cubic* curve.

QUESTION 6: FUNCTIONS (HYPERBOLA and STRAIGHT LINE)

Common errors and misconceptions

(a) In Q6.1 some candidates incorrectly wrote the coordinates of the x-intercept as $(p\ ;\ 0)$ instead of $(-p\ ;\ 0)$.

(b) When answering Q6.2 most candidates were unable to determine the coordinates of the points along the *straight-line* in terms of *variables*. Consequently, they were unable to derive equations that were required to answer the question. A few candidates were able to derive the correct equations, but had difficulty in solving them simultaneously. Some candidates used the fact that the x-coordinate of one point on the straight line was 1 and assumed the x-coordinates of other points on the straight line. This was treated as a breakdown.

Suggestions for improvement

(a) Teachers need to emphasise that learners cannot assume information in a given scenario.

(b) Learners should be exposed to higher-order questions in earlier grades and not only in Grade 12.

QUESTION 7: FINANCE

Common errors and misconceptions

(a) In Q7.1 some candidates incorrectly used the *simple interest* formula instead of the *compound interest* formula. Other candidates swapped the values of A and P in the formula. This was considered a breakdown.

(b) In Q7.2 many candidates were unable to calculate the correct period of the investment and consequently were unable to calculate the correct number of deposits made. In addition, many candidates did not realise that the last deposit was made one quarter before the investment was withdrawn and therefore the *annuity* earned additional interest for this quarter. Some candidates incorrectly used the *present-value* formula instead of the *future-value* formula.

(c) Q7.3.1 was poorly answered by the majority of the candidates. Some candidates overlooked the fact that the loan would have accrued interest on account of three missed payments. Other candidates incorrectly used the *future-value* formula instead of the *present-value* formula. Some candidates calculated the number of payments required to settle the loan but did not add the three months for which payments were missed when calculating the total time needed to settle the loan.

(d) The common errors in Q7.3.2 were that candidates used the incorrect value of n in the formula selected to calculate the outstanding balance and they failed to add one month's interest to the outstanding balance when calculating the final payment.

Suggestions for improvement

(a) Learners should be taught to read for understanding in all problems, especially in Financial Mathematics problems. Teachers need to emphasise the importance of this skill.

(b) It may help to have learners draw timelines and identify what happens at different stages of an *annuity* (either present or future valued). Visual representation helps to break up a problem that requires reading for understanding. This also helps with determining the time-period when dates are given in the question.

(c) Drills and practice should be undertaken on different *compounding periods* and the *compound interest* formulae so that learners can familiarise themselves with the number of times that interest is compounded in a specified time frame.

(d) Teachers should teach Financial Mathematics with conceptual understanding and real-life problems.

QUESTION 8: CALCULUS

Common errors and misconceptions

(a) As mentioned in previous reports, the most common errors in Q8.1 (the *first principles* question) were incorrect notations. A few candidates left out h in the denominator. Some candidates changed the question from a linear ($f(x) = -2x + 3$) to a quadratic ($f(x) = -2x^2 + 3$), possibly because they were only exposed to questions that contained quadratic expressions and not linear expressions. They were not awarded marks for their responses.

(b) Many candidates were unable to write the expression given in Q8.2.2 in differentiable form.

Suggestions for improvement

(a) As mentioned in previous reports:
- Emphasis should be placed on the use of the correct notation when determining the derivative, either when using *first principles* or the rules.

- Teachers should revise the rules of *exponents* and *surds* when changing an expression into differentiable format.
- Integration and re-emphasis of algebraic concepts, viz. fractions, factorising, inequalities and exponential rules, should be undertaken when working with Calculus.

(b) Teachers need to cover the *derivative* using *first principles* of all the functions prescribed in CAPS and not only focus on the quadratic function.

QUESTION 9: CALCULUS

Common errors and misconception

(a) Many candidates did not explicitly state that $f'(x)=0$ when calculating the x-coordinates of the turning points. A mark was deducted for this omission.

(b) In Q9.2 some candidates were able to calculate the x-coordinate of the *point of inflection* correctly but were unable to state the interval for which the graph was *concave down* correctly. They wrote $x > \frac{8}{3}$ instead of $x < \frac{8}{3}$.

(c) Many candidates attempted to solve Q9.3 by using algebraic methods despite the question advising candidates to use the graph. However, the resulting inequality became too complex for them to solve. As was stated elsewhere in the report, some candidates failed to write down the interval correctly. They included the endpoints of the interval instead of excluding them.

(d) When answering Q9.4 many candidates did not see the link between the *gradient* of the *tangent* and the *derivative* of the function. Instead, they equated the *gradient* of the *tangent* to the given function. This constituted a breakdown and they were not awarded any marks.

Suggestions for improvement

(a) Teachers must not accept sloppy notation in school-based assessment tasks. This will force learners to pay attention to the details of their answers.

(b) Teachers need to reinforce the concepts of *concave up* and *concave down*, both from the perspective of the graph and from calculations.

(c) Learners need to be exposed to graphical interpretation questions where they apply their understanding of *gradient*, *concavity*, *positive* and *negative* values of a function as examples.

(d) Teachers should continue to teach graphical interpretation in *cubic* graphs as a follow-on from the interpretation taught in Grade 10 and 11. Both notations should be used from Grade 10 so that learners can translate from one notation to the other with ease.

QUESTION 10: CALCULUS (OPTIMISATION)

Common errors and misconceptions

(a) Many candidates did not attempt Q10.1 despite it being a familiar problem. Some of those who did attempt this question used the incorrect formula for the perimeter. They used $P = x + h$ instead of $P = 2x + 2h$. Other candidates incorrectly used x as the diameter of the cylinder. These candidates did not realise that x was the circumference of the cylinder.

(b) In Q10.2 some candidates equated the volume to zero instead of the *derivative* of the volume to zero, i.e. they solved for x in the equation $V(x) = 0$ instead of $V'(x) = 0$. Many candidates struggled to determine the *derivative* of the volume because the expression contained π. They did not realise that π is a *constant* and instead treated it as a *variable*. Some candidates arrived at two answers for x but did not discard $x = 0$, the extraneous answer.

Suggestions for improvement

(a) The topic of optimisation cannot be ignored in the teaching plan. As was seen in this examination, learners lose out on obtaining accessible marks if the topic is not covered adequately.

(b) Using physical resources as a teaching tool will improve the conceptual understanding of measurement.

(c) A ready reference chart/worksheet on the formulae for measurement of various shapes should be developed for learners.

QUESTION 11: PROBABILITY

Common errors and misconceptions

(a) In Q11.1.1 many candidates failed to correctly apply the *independent* rule: $P(M \text{ and } J) = P(M) \times P(J)$ to calculate that the value of e was 84 as given in the question. A number of candidates used $e = 84$ and then proved that the events male and choosing juice were *independent*. They were not awarded marks for this response.

(b) Many candidates were able to correctly calculate the values in the table when answering Q11.1.2. However, they were unable to determine the probability correctly. They read off the incorrect values in the table.

(c) Many candidates did not realise that they could have answered Q11.2 by making use of a *tree-diagram* and therefore they did not answer the question.

(d) Q11.3.2 required candidates to establish different counting options to solve the problem. This proved to be difficult for many candidates.

Suggestions for improvement

(a) Learners need to be taught the difference between *mutually exclusive* and *independent* events and the rules that pertain to each of these concepts. This should be thoroughly drilled in Grades 10 and 11.

(b) Teachers need to expose learners to different contexts, diagrams and problems in which *independent* events can be tested.

(c) As mentioned in previous reports:
- Teaching basic concepts cannot be overlooked. When learners understand the basic concepts well enough, then the more complex concepts are easier to grasp.

- Reading for understanding must be a regular practice in the classroom. This should equip learners with the skills to deal with word problems in assessment tasks.

(d) Teachers need to teach both *tree diagrams* and *Venn diagrams* thoroughly. These concepts should be examined in school-based assessment tasks throughout the FET phase.

(e) Teach learners the *Fundamental Counting Principle* in such a way that they will be able to base their answers on their reasoning, rather than on any rule. The concept of the *factorial* needs to be explained thoroughly.

(f) When teaching learners about the number of options available for a code or set of items, it is a good idea for learners to draw lines or boxes to represent each space that is available. Thereafter, learners need to be taught to recognise how many options are available for each position in the code or list of items. It is important to stress to learners that they should put an 'x' between these numbers so that they can arrive at the correct solution using the *Fundamental Counting Principle.*

10.6 DIAGNOSTIC QUESTION ANALYSIS FOR PAPER 2