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**QUALITATIVE ANALYSIS OF LEARNER RESPONSES AND EVALUATION OF QUESTION PAPERS: NSC 2021**

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| **REPORT 1: EVALUATION OF THE QUESTION PAPER AND MARKING GUIDELINE** |

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| **SUBJECT** | **MATHEMATICS** |
| **PAPER** | **1** |
| **DURATION OF PAPER:** | **3 HOURS** |

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

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| The candidates have averagely performed with pass rate of 54% and standard deviation of 18.94%. This is based on the Rasch analysis from a sample of 100 randomly selected scripts. The range is 150. A full spectrum of marks is evidenced from this sample with candidates obtaining zero to full marks. Attached below is the graph of 100 randomly selected candidates across the province. These scripts drawn from a range of good, average and weak candidates with a normal distribution of marks from 0 (minimum), 75 (average) and 150 (maximum). The graph indicates that candidates performed above average in QUESTION 1 (71%), QUESTION 5 (77%) and QUESTION 9 (73%). These questions are mainly routine questions. However, most candidates performed well below average in questions that required conceptional applications, topic and concept integration skills and critical thinking. These questions include sub-questions like 1.3, 3.4, 4.4, 6.4, and 11. Generally, the paper was fair and candidates performed slightly above the average. The paper catered for and accommodated all candidates, that are weak, average and strong learners. The box and whisker diagram attached further reveal that candidate’s performance is positively skewed (skewed to the right). The average performance is 54%. This means, therefore, that more than 21% (10600 of 48959 candidates) performed above 50% (see 7-point scale). The poorest performed question is QUESTION 11 with 10% and the best performed question is QUESTION 5 with 77%.  Chart, box and whisker chart  Description automatically generated  The contents of the paper covered what is taught and what is learnt. The performance of 2021 cohort is anticipated to slightly surpass the performance of 2020 cohort. Candidates are strongly advised to practice more of complex and problem-solving questions. Furthermore, candidates should realise that mathematics topics and papers MUST NOT be practiced in isolation. Candidates must learn to integrate topics and both papers. The performance in QUESTION 1.3 (20%), 3.4 (23%) and 11 (10%) clearly indicates lack of skills by candidates to integrate topics and concepts. Therefore, candidates MUST NOT underestimate the importance of practicing past year’s examination question papers as this will improve mathematical proficiency and procedural fluency. |
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**SECTION 2: Comment on candidates’ performance in individual questions**

**Average Performance per sub-question in Mathematics Paper 1**

**Sample of 100 Scripts**

Chart, bar chart

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The bar graphs generated from the Rasch analysis are included for each question. It is imperative to note that the sample is drawn from 100 randomly selected scripts ranging from 0 mark to almost full marks. Therefore, the sample may not necessarily give a true reflection of the overall performance of all candidates. However, the sample reveals a clear indication of how the candidates have performed per question and sub-question. It is clear that the pandemic the country faced in present times negatively affected candidate performance. Candidates of 2021 went through a series of challenging years with National lockdowns and less teaching times in 2020. This is evidenced by low performance in topics such as Probability with 20% (QUESTION 12.1), Financial mathematics with 35% (QUESTION 8.3). These ‘topics’ were trimmed in year 2020 during the lockdown. Therefore, candidates may have not had enough time to revise. However, in case where the performance is very poor, it an indication that learners lack the basics and understanding of Mathematics as a whole.

This report will give the readers a wide range of comments that are meant to assist future candidates and educators teaching mathematics. Brief comments on the performance of each sub-question will be provided, misconceptions will be highlighted and areas to focus the improvement of the teaching subject will be discussed. Furthermore, the report will also assist educators with the marking of internal assessment tasks as well as setting of internal papers. It is advised that educators read this report in conjunction with the official marking guideline.

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| **QUESTION 1** |
| 1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?** |
| |  |  |  |  | | --- | --- | --- | --- | | 1.1 | Solve for *x*: | |  | |  |  |  |  | |  | 1.1.1 |  | (3) | |  |  |  |  | |  | 1.1.2 | (correct to TWO decimal places) | (3) | |  |  |  |  | |  | 1.1.3 |  | (4) | |  |  |  |  | |  | 1.1.4 |  | (4) | |  |  |  |  | | 1.2 | Solve simultaneously for *x* and *y*: | |  | |  |  |  |  | |  |  | | (6) | |  |  |  |  | | 1.3 | The roots of an equation are where are positive real numbers. The numbers in that order, form a geometric sequence. Prove that | | (4) | |  |  |  | **[24]** |   Generally, candidates are expected to score as many marks as they can in QUESTION 1. The graph above reveals that the 2021 cohort performed exceptional well in QUESTION 1 with a pass rate of 71%. However, some candidates still have challenges in factorising trinomials. They change inequality signs when transposing. Specifically, QUESTION 1.3 was poorly answered with candidates performing at an average of 20%. It is a clear indication that most candidates failed to integrate geometric patterns concepts with algebra. Further analysis of Rasch analysis, shows that most candidates still need more assistance in manipulating inequalities.  **In sum, many candidates who could not score more marks in QUESTION 1 had challenges in:**   * Factorisation * Rounding of decimals * Interpretation of inequalities * Making a variable, the subject of the formula * Failed to prove that roots are non-real |
| 1. **Why was some questions poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.** |
| **QUESTION 1.1.1**   * Consistent accuracy was applied for wrong factors. * Candidates who wrote answer only were awarded full marks. * Some candidates committed substitution error when using quadratic formula. CA applied provided solutions were correct. * For candidates who copied the question wrong, they lost factor or substitution mark. CA applied for their solution. * Incorrect solutions from correct factors was also a common error observed. In such cases candidates were awarded 1 mark for the factor.   **QUESTION 1.1.2**   * Candidates were penalised for incorrect rounding (maximum 2 out 3 marks). * Wrong substitution into the quadratic formula but correct answers (maximum of 2 out 3 marks). * Full marks were awarded for candidates who wrote answers only. This is because some candidates have advanced calculators that can solve quadratic equations. |
| **QUESTION 1.1.3**   * Many of our candidates are still faced with the challenge of understanding the concept of solving inequalities. * Most candidates make mistakes with notation and do not pay attention on which correct words to use when dealing with inequalities. They sometimes use **OR** instead of **AND** or vice versa. They sometimes use symbols like / or. * For candidates who treated the inequality sign as an equal (=) sign and have correct solution at the end got full marks. In this case, the = sign was regarded as a slip. However, for candidates who had wrong inequality CA was applied and maximum of 3 out 4 marks were awarded. * Candidates who did not pay particular attention and used the word **OR** in the solution were awarded maximum of 3 out 4 marks   **QUESTION 1.1.4**   * Most candidates answered this question well. * Many candidates who managed to complete the question did not discard the as a solution. Testing answers to ensure full marks should be emphasized. * CA marking applied for candidates who had wrong standard form and rejected both solutions (maximum 3 out 4 marks). * Candidates committed an error when squaring which led to incorrect standard form. Refer to the working below:   incorrect squaring  standard form  In such cases, CA was applied.  **QUESTION 1.2**   * Fairly answered question with candidates performing at 80%. * This question clearly shows that most of candidates are comfortable working with routine questions. However, there were candidates who made unnecessary simple mistakes resulting in the third equation being wrong, i.e. making x the subject of the linear equation, instead of they wrote . CA marking applies in such instance with candidates obtaining maximum of 5 out 6 marks if no other mistakes were committed. * Although most candidates prefer solving equations using quadratic formula, the algebraic manipulation needs attention. Simple factorizable quadratic equation can save candidates time in the examination if they can use factorisation rather than quadratic formula.   **QUESTION 1.3**   * This was a challenging question for candidates, and it was one of the most poorly answered questions. * Question 1.3 resembles a typical application of nature of roots and required candidates’ problem-solving skills. The inclusion of geometric progression concepts makes it a unique question to be expected in QUESTION 1. With candidates performing at an average of 20%, it clearly shows that below average and mediocre candidates could not attempt the question. * Candidates did not understand the question itself. Although the question required basic understanding of geometric sequences and nature of roots, it was complicated by many candidates. * Most candidates did not score marks because there was no CA applied in Question 1.3. * NO marks were awarded to candidates who used random values to prove the question. |
| **(c). Provide suggestions for improvement in relation to Teaching and Learning**   * Most of the content of question 1 is completed in grade 11. Learners must regularly revisit these sections from the start of grade 12. * Question 1.3 is an eye opener to educators as it brings the integrative aspect of topics and concepts in mathematics. * Learners who struggle to factorize solving quadratic equations can be motivated to use the formula. * Ensure that learners know how to round off; don’t assume that they know. * Teach the use of the quadratic formula not only in terms of but using other unknowns as well. This will prevent candidates from interchanging and when first solving in simultaneous equations. * Encourage learners to use calculator as checking device. * Educators must find ways to assist learners to distinguish between equations and inequalities. * Teachers can make use of GeoGebra to explain inequalities. * Educators must integrate topics when teaching. For instance, in QUESTION 1.3 where the question requires candidates’ knowledge of basic geometric sequences, equations and nature of roots. * The use of past examinations papers to prepare learners for final examinations cannot be overemphasized. This is because QUESTION 1 questions are mainly routine questions and learners are expected to score as many marks as possible. * Informal assessment tasks (topic or informal class tests) can be valuable in assisting learners to perform better in routine questions. |

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| **QUESTION 2** |
| 1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?** |
| |  |  |  |  | | --- | --- | --- | --- | | Given the geometric series: | | |  | |  |  |  |  | | 2.1 | Calculate the value of | | (2) | |  |  |  |  | | 2.2 | Show that the sum of the first | | (2) | |  |  |  |  | | 2.3 | Hence, or otherwise, calculate the sum to infinity. | | (2) | |  |  |  |  | |  |  |  | **[6]** |   Question 2 was a well answered question and the overall performance was satisfying with candidates performing at 68%. However, some candidates failed to distinguish GP from AP and they ended up treating the series as AP instead of GP. Most candidates found QUESTION 2.1 easy and was well answered with performance of 75%. However, candidates who could not get the correct value of in QUESTION 2.1, failed to score marks maximum in the whole question. Moreover, QUESTION 2.2 and QUESTION 2.3 was fairly answered by candidates performing at 65% in both questions. |

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| 1. **Why was some questions poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**   **Question 2.1**   * Few candidates used the concepts of finding differences instead of ratio. * This resulted in candidates treating the question as AP instead of GP .   **Question 2.2**   * Most candidates scored 1 out of 2 marks in this sub-question for the value of * Few had wrong instead of which lead to candidates not able to prove the question. In other words, some candidates used ratio beyond the interval * Some candidates used the given statement to solve the question. * For candidates that got 0 marks, they had wrong value and * In fewer cases candidates were found to have used Arithmetic formula which has led to 0 marks. * Some candidates who were able to use GP formula correctly failed to simplify algebraically in order prove the statement.   **Question 2.3**   * Most candidates who scored 1 mark for substitution ( used a wrong formula for instance instead of they . * Candidates NOT making use of the INFORMATION SHEET. The is provided but they still get or copy it wrong. * Lack of understanding of the concept of convergent series leads to poor answer to the question. |
| 1. **Provide suggestions for improvement in relation to Teaching and Learning**  * With regards to Number Patterns. It is strongly advised to deal with arithmetic sequences separately. After the learners have mastered that, move on to geometric sequences then provide mixed questions of arithmetic and geometric sequences so that they do not get confused between the two in tests and examinations. |

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| **QUESTION 3**   1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?**  |  |  |  |  | | --- | --- | --- | --- | | Consider the quadratic number pattern: | | |  | | 3.1 | Write down the value of | | (1) | |  |  | |  | | 3.2 | Show that the general term of this number pattern is | | (3) | |  |  | |  | | 3.3 | Between which TWO terms of the quadratic number pattern will there be a difference of –121? | | (4) | |  |  | |  | | 3.4 | What value must be added to each term in the number pattern so that the value of the maximum term in the new number pattern formed will be 1? | | (3) | |  |  |  | **[11]** |     Generally, candidates performed averagely in QUESTION 3 with pass rate of 51%. QUESTION 3.1 and QUESTION 3.2 were well answered with performances of 88% and 82% respectively. Most candidates understood the concept of extending the sequence and obtaining the next term in QUESTION 3.1. Moreover, most candidates found it easy to use the method to find the values of This has led to many candidates obtaining maximum mark in QUESTION 3.2. Some candidates found it difficult to understand QUESTION 3.3, therefore it was poorly answered. QUESTION 3.4 was the poorest performed question by candidates with an average performance of 23%. |

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| 1. **Why was some questions poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**   **QUESTION 3.2**   * Candidates using the given statement to show the values of without using any method or showing any calculations. * Some of the candidates did not know how and where to start when a question requires them to show a given statement.   **QUESTION 3.3**   * Few candidates knew how to use the concept of to find consecutive terms. * Candidates made error in using quadratic sequence and equate to that is instead of This has led to candidates obtaining 0 marks. * Candidates assumed that the question requires them to find number of terms in the sequence, hence equating quadratic general term to and ended up solving for * Candidates did not understand the relationship between linear and quadratic. * Most candidates who used trial and error method could not score marks.   **QUESTION 3.4**   * It’s a high order question and majority of candidates did know where to start. * Candidates failed to link the concept of getting maximum value from functions which is or calculus that is * In most cases the question was not answered. * Lack of knowledge of topic and concepts integration has led to poor performance in this question. |
| **(c) Provide suggestions for improvement in relation to Teaching and Learning**   * Expose learners to more problem-solving type questions. * Topic integration must always be emphasized. Quadratic number pattern deals with quadratic statements hence educators must integrate it with concepts of the methods of finding maximum or minimum value (point) as taught in functions and calculus. |

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| **QUESTION 4**   1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?**  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Consider the linear pattern: 5 ; 7 ; 9 ; … | | | | |  | | |  | | 4.1 | Determine . | |  | | | (3) | | | | | 4.2 | | Calculate the sum of the first 51 terms. | |  | | | (2) | | | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 4.3 | Write down the expansion of  Show only the first 3 terms and the last term of the expansion. | |  | | (1) | | 4.4 | Hence, or otherwise, calculate  ALL working details must be shown. |  | | (4) | | | |  |  |  | | **[10]** | | | |
| Candidates performed fairly well in QUESTION 4 with average performance of 61%. Most candidates scored marks in QUESTION 4.1 and 4.2 with an average performance of 82% and 77% respectively. QUESTION 4.1 and QUESTION 4.2 are routine questions. However, QUESTION 4.3 and QUESTION 4.4 poorly answered with candidates performing at 35% and 43% respectively. Weak performance of candidates in QUESTION 4.3 and QUESTION 4.4 is an indication of how candidates struggle to understand SIGMA notation or .  Few candidates got QUESTION 4.4 correct. |
| 1. **Why was some questions poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**   **QUESTION 4.1**   * Common error that candidates committed was to equate the term of the given linear sequence with instead of substituting with that is to * Candidates who used a calculator and wrote wrong answer lost CA mark.   **QUESTION 4.2**   * Incorrect copying of the formula by candidates made them to lose marks in this question, that is instead of . * Candidates who did not make use of INFORMATION SHEET and did not know the formula led to QUESTION 4.2 left unanswered. * Wrong substitution for led to candidates finding the value of instead of the sum that is instead of .   **QUESTION 4.3**   * Most candidates answered the question unfortunately they listed the terms ( instead of ADDING terms . * Some of candidates listed and added but only first three terms They did not indicate the last term.   **QUESTION 4.4**   * Most candidates left the question unanswered. * Lack of understanding of SIGMA sign (SUM) by candidates led to poor performance in this question. * Candidates did not release that QUESTION 4.4 can be calculated separately and add their sum as per second option of the marking guideline. * Candidates were able to expand and obtain and . In some cases, some candidates who presented the first   and last term could not work further. Therefore, maximum marks they got were 2 marks.   * Candidates failed to link QUESTION 4.3 with QUESTION 4.4, hence managed to get only 2 marks. * Candidates incorrectly substituted the value of in both Most candidates were unable to calculate in . * Candidates still have challenges in differentiating between and They end up swapping the formulae. |
| 1. **Provide suggestions for improvement in relation to Teaching and Learning.**  * More exposure to higher level questions relating especially to Sigma notation. * The concept of common difference and common ratio must be made clear to leaners when teaching and more informal assessment given for practice purposes. * The difference between sequences and series must also be emphasised. |

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| **QUESTION 5**   1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?**  |  |  |  | | --- | --- | --- | | Given: |  |  |      |  |  |  |  | | --- | --- | --- | --- | | 5.1 | Write down the equations of the asymptotes of *f*. |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 5.2 | Write down the domain of *f*. |  | (1) |  |  |  |  |  | | --- | --- | --- | --- | | 5.3 | Determine the coordinates of the *x*-intercept of *f*. |  | (2) |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | 5.4 | Write down the coordinates of the *y*-intercept of *f*. | |  | | (2) | | |  |  | |  | |  | | | 5.5 | Draw the graph of *f*. Clearly show ALL the asymptotes and intercepts with the axes. |  | | (3) | | |  |  |  | | **[10]** | |   A well answered question with candidates performing at an average of 77%. This satisfactory performance clearly shows that most of candidates are comfortable with routine questions. QUESTION 5.1 with a performance of 87% required candidates’ understanding of asymptotes of which most of them obtained all marks. QUESTION 5.2 with 57% is the least performed question in QUESTION 5. It requires candidates’ knowledge of domain. This question reveals the candidates’ challenges in dealing with inequality as indicated in QUESTION 1.1.3. Therefore, it was averagely answered. QUESTION 5.3 and QUESTION 5.4 were routine questions and candidates answered well with performance pass of 79% and 87% respectively. The concept of calculating intercepts is well received by candidates. However, some candidates still struggle with manipulating algebraic fraction. Sketching of hyperbola function in QUESTION 5.5 was well done by most of the candidates hence a satisfactory performance of 70%. CA marking was applied in most of candidates whose QUESTION 5.1, 5.3 and 5.4 were incorrect. |
| 1. **Why was some questions poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**   **QUESTION 5.1**   * Though QUESTION 5.1 is routine, some candidates committed error in swopping the variable for instance instead of * Some candidates did NOT change the sign of the vertical asymptotes ( instead of * This common error made by candidates in QUESTION 5.1 affected them to represent their sketch correctly in QUESTION 5.5. However, CA was applied. * Some candidates indicated asymptotes as These candidates were awarded full marks. * In some cases, candidates represented the solutions as as well as No marks were awarded.   **QUESTION 5.2**   * The concepts of range and domain requires candidates’ understanding of inequalities. * Most candidates do not have understanding of the meaning of the term DOMAIN. * Candidates committed errors in different ways when answering QUESTION 5.2. These errors include:  1. Incorrect inequality notation such as 2. Using wrong variable 3. Writing only   **QUESTION 5.3 and QUESTION 5.4**   * Candidates failed to distinguish between For instance instead of they calculated In such cases candidates were NOT penalized. * Some candidates’ common errors solving the equation after correct substitution for instance, when calculating :   .  In this case, candidates committed error in transposing ending up with incorrect   * Most candidates DO NOT write solution in the required coordinate form instead they answer as when required to calculate :   .  In such case, candidates were NOT penalized but the required solution  should have been written as .  **QUESTION 5.5**   * Candidates represented asymptotes as in QUESTION 5.1 were, in many cases, unable to sketch the graph. They would not know whether represent asymptote. * Candidates with correct but failing to plot or indicate on the sketch graph. * CA marking applies for candidates who were consistent from QUESTION 5.3 and QUESTION 5.4 provided the drawn hyperbolic function as an increasing function. * 1 mark for asymptote was awarded in cases where candidates failed to represent intercepts and then shape becomes incorrect. * In cases where candidates DO NOT show intercepts on the sketch, maximum of 2 marks were awarded. |

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| 1. **Provide suggestions for improvement in relation to Teaching and Learning**  * Calculator practice needed. This will assist learners who are struggling to calculate intercepts. * Teach basics of functions like domain and range. More emphasis must be on inequality notations when dealing with domain and range. * Teachers must try hard to explain how to write equations of asymptotes, domain and range. * Teachers need to teach hyperbolas with more examples. There is evidence that learners know how to attempt the hyperbola but when it comes to the *x*-intercepts, they need more practice. |

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| **QUESTION 6**   1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?**  |  |  |  | | --- | --- | --- | | The graph of  is drawn below.  B(*k* ; 2) is a point on *f*. |  |  |   Diagram  Description automatically generated   |  |  |  |  | | --- | --- | --- | --- | | 6.1 | Calculate the value of *k*. |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 6.2 | Determine the values of *x* for which – |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 6.3 | Write down the equation of , the inverse of *f*, in the form *y* = … |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 6.4 | For which values of *x*  will ? |  | (2) | |  |  |  | **[8]** |   Candidates performed slightly below average in QUESTION 6 with average performance of 47%.Specifically, candidates answered QUESTION 6.1 and QUESTION 6.3 quite well. QUESTION 6.2 and QUESTION 6.4 was poorly answered. Candidates’ performance in questions that involves inequalities is a worrying factor throughout the question paper. QUESTION 6.2 and QUESTION 6.4 required candidates’ understanding of inequalities. In summary, candidates seem to be more comfortable working with exponential functions than logarithms functions. Candidates struggle to change logarithm functions to exponential or vice versa. |
| 1. **Why was some questions poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**   **QUESTION 6.1**   * Candidates substitute correctly but failed to solve logarithm equation. * Some candidates changed the logarithm function to be an exponential function In such cases candidates end up having wrong value of Refer to the working below:   **QUESTION 6.2**   * Most candidates made error in inequality notation like * In all cases above, candidates were awarded 1 mark for calculating . * In other instance, candidates interpreted inequalities wrongly and end -up representing solution as . * Candidates failing to write exponential form when solving for for instance instead of they write .   **QUESTION 6.3**   * Candidates were able to swop the variable BUT failed to solve to logarithm function. Refer to the working below:     candidates become stuck thereafter as they do not know how to make  the subject of formula. In other words, candidates DO NOT understand  the concept of logarithms.   * In some case, candidates presenting instead of   **QUESTION 6.4**   * Poorly answered question because candidates could not imagine the shape of the inverse graph. Could have been answered better if the candidates were required to sketch the graph. * Candidates incorrectly represent the inequality sign for instance   . Such candidates obtained zero marks.   * Candidates failed to interpret the graph and understand the concept of inverse graphs. |
| 1. **Provide suggestions for improvement in relation to Teaching and Learning**  * Educators must train learners on how to interpret graphs. In most cases mathematics software like graph system or GeoGebra can be used for illustration and visualization purposes. * Learners should be thoroughly trained in logarithm functions, exponential functions and inverse function. * Educators to more emphasize on the concept of solving logarithm equations and how it relates with the exponential functions. * Graph interpretation and how to interpret inequalities from graphs should form part educators’ lesson planning when teaching functions. |

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| **QUESTION 7**   1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?** |
| |  |  |  | | --- | --- | --- | | The graph of  is drawn below.  The parabola cuts the *x*-axis at B and D and the *y*-axis at G.  C is the turning point of *f*. Line AE has an angle of inclination of  and cuts the *x*-axis and *y*-axis at A and E respectively. T is a point on *f*  between B and G. |  |  |   Diagram  Description automatically generated   |  |  |  | | --- | --- | --- | | 7.1 | Write down the coordinates of B and D. | (2) |  |  |  |  | | --- | --- | --- | | 7.2 | Calculate the coordinates of C. | (2) |  |  |  |  | | --- | --- | --- | | 7.3 | Write down the range of *f*. | (1) |  |  |  |  | | --- | --- | --- | | 7.4 | Given that *θ* = 14,04° and the tangent to f at T is perpendicular to AE. |  |  |  |  |  |  | | --- | --- | --- | --- | |  | 7.4.1 | Calculate the gradient of AE, correct to TWO decimal places. | (1) |  |  |  |  |  | | --- | --- | --- | --- | |  | 7.4.2 | Calculate the coordinates of T. | (5) |  |  |  |  |  | | --- | --- | --- | --- | | 7.5 | A straight line, *g*, parallel to AE, cuts *f* at K(–3 ; –9) and R.  Calculate the *x*-coordinate of R. | | (6) | |  |  |  | **[17]** |   Candidates performed averagely at 54% in QUESTION 7. QUESTION 7.1 and QUESTION 7.2 were well answered with a performance of 87% and 78% respectively. QUESTION 7.2 was routine to candidates as the graph assisted in showing that C is the turning point. However,most candidates still have challenge in giving answers in coordinates form. The perfornamce was below average in QUESTION 7.3, 7.4 and 7.5. Therefore, these questions were not satisfactory answered. Candidates’ understanding of inequalities continues to pose a challenge hence, below average performance in QUESTION 7.3 (43%). In QUESTION 7.4 and 7.5 candidates and challenges in undestanding what the questions requires. However, QUESTION 7.4.1 was fairly well answered as most of the candidates remember the angle of inclination. Suprisingly, QUESTION 7.5 with candidates performing at 49% was answered fairly well and in many cases CA was applied. In summary, the inclusion of gradient concept needed in QUESTION 7.4 and QUESTION 7.5 confuses candidate with little understanding of parallel and perpendicular lines which has led to more marks lost. Candidates with skills of integrating topics scored more marks. Functions in paper 1 cannot be practised in isolation with Analytical geometry in paper 2 especially when dealing with concept of gradient. |

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| **(b). Why was some questions poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**  **QUESTION 7.1**   * Candidates DO NOT represent solutions in the required form instead they write In such instance, candidates were not awarded marks. * In other instance candidates presented their solutions as B instead of * Some candidates represented solutions in coordinates form BUT did not lable whether its B or D that is * Some candidates did not change the sign instead of * Candidates representing their solution as In such case, all marks were lost.   **QUESTION 7.2**   * Candidates incorrectly expanded which has led to wrong and value. For instance, when expanding the expression: which led to instead of . In such cases candidates end up obtaining . CA was applied, maximum of 1 mark provided that the was negative.   **QUESTION 7.3**   * Incorrect inequality or interval notation made candidates to obtain zero mark. These cases include:    * Candidates used variable instead of for instance * For candidates who had challenges in calculating QUESTION 7.2 could not answer QUESTION 7.3, otherwise, CA was applied in most instances.   **QUESTION 7.4**   * In QUESTION 7.4.2 some candidates treated point T as the midpoint of points B and G or C. These candidates lost all marks. Refer to working below:      * Candidates did not realise that they first have to derive the function and then equate.   **QUESTION 7.5**   * Most candidates failed to link QUESTION 7.4.1 with QUESTION 7.4.2. * Candidates used tangent gradient () instead of parallel gradient . Refer to the working below:   Equate with    In such case, candidates could not solve the equation. CA was applied in  this case and similar cases provided the value of was positive.   * Most candidates missed the fact that the product of perpenducular line is . Candidates assumed that the implies that the perpendicular gradient is . * Some candidates were NOT selecting the correct answer. For instance, a candidate would leave the solution as instaed of |
| **(c) Provide suggestions for improvement in relation to Teaching and Learning**   * Revisit transformations from grade 8 and 9 when teaching functions. * Teach the interpretation of graphs from grade 10. * Integrate topics from grade 10. * The concept of plotting points on cartesian plane must be revised. This will remind learners on how to write solutions in coordinate form. * Educators can make use of GeoGebra (free download) to illustrate the concept of parallel, perpendicular and tangents to learners and make the connection between algebraic calculations and graphs. For instance, when teaching the concept of tangents and parabola, GeoGebra can be utilised to illustrate as shown in the diagram below:   A picture containing text, antenna  Description automatically generated   * For instance, in case of 7.4 GeoGebra can be used to illustrate given: and Solving for if * Interpretation of functions and the correct notations (inequalities) should be stressed when revising. Putting more emphasis on grade 10 and 12 functions. * Revision of basics algebra when teaching functions because functions need algebraic skills like factorization, solving of equations etc. |

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| **QUESTION 8**   1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?**  |  |  |  |  | | --- | --- | --- | --- | | 8.1 | A farmer bought a tractor for R980 000. The value of the tractor depreciates annually at a rate of 9,2% p.a. on the reducing-balance method. Calculate the book value of the tractor after 7 years. |  | (3) |  |  |  |  |  | | --- | --- | --- | --- | | 8.2 | How many years will it take for an amount of R75 000 to accrue to R116 253,50 in an account earning interest of 6,8% p.a., compounded quarterly? |  | (4) |  |  |  |  |  | | --- | --- | --- | --- | | 8.3 | Thabo wanted to save R450 000 as a deposit to buy a house on 30 June 2018. |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | 8.3.1 | He deposited a fixed amount of money at the end of every month into an account earning interest of 8,35% p.a., compounded monthly. His first deposit was made on 31 July 2013 and his 60th deposit on 30 June 2018. Calculate the amount he deposited monthly. |  | (3) |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | 8.3.2 | Thabo bought a house costing R1 500 000 and used his savings as the deposit. He obtained a home loan for the balance of the purchase price at an interest of 12% p.a., compounded monthly over 25 years. He made his first monthly instalment of R11 058,85 towards the loan on 31 July 2018. |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  |  | (a) | What will the balance outstanding on the loan be on 30 June 2039, 21 years after the loan was granted? |  | (3) |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  |  | (a) | Calculate the interest Thabo will have paid over the first  21 years of the loan. |  | (3)  **[16]** |   Lately and as year goes by, candidates are becoming comfortable with financial mathematics. In most cases candidates answer the questions. 2021 cohort of candidates answered QUESTION 8 averagely well (fairly done) with an average performance of 47% which is a 3% improvement comparing with the class of 2020. However, language barrier remains a candidates’ performance factor. Second language English speakers are the most affected candidates. This is evidenced with the performance of candidates in QUESTION 8.3 where the question requires candidates’ understanding of English. Hence, the average performance is 35%. Comparing Question 8.3(35%) with QUESTION 8.1(72%) and QUESTION 8.2 (57%) it clearly shows that the lesser the English words the greater the performance. Moreover, candidates are still having serious challenge in choosing correct formulae when answering financial mathematics. Candidates used future value formula in question that requires present value formula or vice versa. Use of straight-line depreciating formula instead of reducing balance formula. In all these scenarios, and until educators address them, candidates’ performance in financial mathematics remains an issue. |

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| **(b)Why was some questions poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**  **QUESTION 8.1**   * Well answered question. * For candidates who used wrong formula, zero marks were awarded. Some candidates used compound interest formula: * Other instance, candidates used straight line depreciating formula: * Candidates substitute incorrect values in the correct formula. In such case, candidates were awarded 1 mark. No CA applied because the answer mark was an accuracy mark. For instance, instead of candidates would write and/or . * Candidates swapped A and P that’s. Candidates obtained 1 mark in such instances for the correct formula.   **QUESTION 8.2**   * Candidates swopping A and P that is . In such case candidates obtained maximum of 2 marks for the interest and correct use of logarithm. * In some cases, the use of Logs was still a problem. Some candidates end up with NEGATIVE logarithms. * Candidates failing to deal with compounding period have also affected their performance in this question. Some candidates used interest rate as instead of . * Most candidates did not divide their solution by 4 quarters of which 3 marks were awarded. Refer to the working below.   **QUESTION 8.3.1**   * Candidates choose wrong formula. Instead of using future value formula, they used present value formula. In such case candidates obtained 1 mark for . * Candidates failing to deal with compounding period have also affected their performance in this question. Some candidates used interest rate as instead of . * Some candidates correctly selected the formula BUT substituted with incorrect and . CA was applied in such cases.   **QUESTION 8.3.2(a)**   * Poorly answered. In most cases, candidates left the question unanswered. * Most candidates did not know which formula to use to calculate outstanding balance.   **QUESTION 8.3.2(b)**   * Poorly answered. Most candidates did not attempt this sub-question. Many candidates who did, did not know how everything fits together, i.e. Interest = Amount paid – [ Loan – Balance]   In Financial Mathematics there are often different methods that can be  applied.   * Most candidates did not have idea of what was the requires. They get mixed up with interest paid and interest rate. |
| **(c) Provide suggestions for improvement in relation to Teaching and Learning**   * Financial terminology should be stressed to avoid misconceptions, for example interest vs interest rate etc. * More practice and informal assessment are needed when teaching financial mathematics. Learners will get used to and understand terminology and language used in financial mathematics. * Differentiate between present value and future value. * Educators must give clear explanations of all Financial Mathematics formulae, what all letters stand for and specifically practicing how to identify various values from words/sentences given. * The concepts of outstanding balance and interest paid is lacking among learners. Educators are strongly advised to revise it more with learners. |

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| **QUESTION 9**   1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?**  |  |  |  |  | | --- | --- | --- | --- | | 9.1 | Determine  from first principles if it is given that |  | (5) |  |  |  |  |  | | --- | --- | --- | --- | | 9.2 | Determine: |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | 9.2.1 | if |  | (3) |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | 9.2.2 |  |  | (4) | | |  |  | |  | | **[12]** |   Candidates QUESTION 9 answered exceptional well. QUESTION 9.1 and QUESTION 9.2 tested candidates’ knowledge in basic routine question. With the overall candidates’ performance of 73%, it clearly shows that most candidates are mastering ordinary calculus. 82% average performance in QUESTION 9.1, clearly shows that most of candidates are comfortable with FIRST PRINCIPLES. Notational error in some few cases were picked up in QUESTION 9.1 and candidates were penalized 1 mark. Candidates had challenges in manipulating QUESTION 9.2.2. Generally, candidates have problems in dealing with fractions coefficient and fraction exponents. More errors were committed in such cases which has led to an overall average performance of 66% in QUESTION 9.2. |
| **(b)Why was some questions poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**  **QUESTION 9.1**  Well answered question.  Candidates’ common error was on substitution of and sometimes simplification. They substituted only in one term (i.e leaving the other term (3). Refer to the working below:  After correct simplification candidates ends up having:  In such case, CA was applied and candidates obtained 4 marks.   * Incorrect notation was also common error committed by candidates in QUESTION 9.1 for example,  1. Candidates leaving a prime that is instead of they write 2. Candidates failing to copy the formula correctly from the INFORMATION SHEET and end up misplacing for instance, instead of   They wrote:  In such case, candidates were penalized 1 mark and obtained a maximum of 4 marks if NO other error was committed.  **QUESTION 9.2**   * QUESTION 9.2.1 was well answered, few errors we observed such as notational errors and candidates who would second differentiate the statement. In cases like that full marks were awarded provided first differentiated statement is correct. Candidates were NOT penalized for notation in QUESTION 9.2. Refer to the working below: * QUESTION 9.2.2 was poorly answered. Converting from surd form to exponential form was a slight challenge. Several errors were committed by candidates. Refer to the following errors:  1. instead of 2. instead of 3. instead of 4. Changing fractional coefficient to integers for instance: 5. Instead of they wrote as 6. instead of they wrote as or .  * CA was applied and a maximum of 2 marks were awarded such cases provided a candidate differentiated correctly. |
| **(c) Provide suggestions for improvement in relation to Teaching and Learning**   * Educators must emphasise the importance of writing down the complete formula and taking care to use the correct notation throughout the solution. * Educators MUST know that the following are regarded as notation errors and candidates are penalised once commtted:  1. If was not shown as part of the formula. 2. If the is omitted too soon. 3. If an equal sign was written between the  and the fraction part.  * Teachers must focus more on the types of questions that include root signs, brackets and denominators, when dealing with derivatives. * Assess learners on how to get expressions in a form appropriate for differentiation purposes: for instance, if the questions involve square roots and fractions. * For differentiating from first principles: Teachers need to drill learners with questions that have two or more terms with x, for example . |

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| **QUESTION 10**   1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?**  |  |  |  | | --- | --- | --- | | The graph of  is drawn. The graph has turning points at the origin, O(0 ; 0) and B(4 ; 32). A is an *x*-intercept of *h*. |  |  |   Diagram  Description automatically generated   |  |  |  | | --- | --- | --- | | 10.1 | Show that *a* = –1 and *b* = 6. | (5) |  |  |  |  | | --- | --- | --- | | 10.2 | Calculate the coordinates of A. | (3) |  |  |  |  | | --- | --- | --- | | 10.3 | Write down the values of *x* for which *h* is: |  |  |  |  |  |  | | --- | --- | --- | --- | |  | 10.3.1 | Increasing | (2) |  |  |  |  |  | | --- | --- | --- | --- | |  | 10.3.2 | Concave down | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 10.4 | | For which values of k will  have one negative and two distinct positive roots? | (3) | |  |  | | **[15]** |   QUESTION 10 was averagely answered with candidates performing at 58% in QUESTION 10.2, 47% in QUESTION 10.3 and 46% in QUESTION 10.1. The most poorly answered question was QUESTION 10.4 with candidates performing at 11%. Generally, curve sketching is still a challenge with most of candidates. In most cases, it is as a results of candidates’ limited knowledge in integrating topics. For instance, QUESTION 10 (Calculus) links well with Algebra and Functions. Most common errors committed by candidates range from incorrect substitution to NOT understanding what the questions require of them. Notational errors are among the errors committed in QUESTION 10. Nevertheless, candidates were NOT penalized for notation errors in in QUESTION 10. In summary, candidates lack skills of interpreting graphs. |
| **(b)Why was some questions poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.**  **QUESTION 10.1**   * Candidates substituting in instead of substituting * Incorrect derivative function of of instance instead of candidates wrote * Some candidates differentiated only the first term leaving the second term. Like, instead of they had then substituted.   **QUESTION 10.2**   * Some candidates differentiated and equate to zero instead of factorising. Refer to the working below:   In such cases candidates obtained zero mark.   * Some candidates substituted and showed that then concluded that . In such cases candidates were awarded only 1 mark for the answer.   **QUESTION 10.3**   * Some candidates did not know what the question requires with the inclusion of terms like the word increasing or concave down. This has led to some candidates leaving the question unanswered. * In most case, candidates tried to work out the questions. They could NOT use the graph to answer the question. * In QUESTION 10.3.1 some candidates had challenges with representing their solutions (notational error), for instance, instead of they wrote:   In such cases, candidates obtained 1 mark for critical values.   * In QUESTION 10.3.2 common error committed were also notational. For instance, instead of candidates wrote:  1. (In some case with a negative sign) 2. (In some case with a negative sign) 3. (In some case with a negative sign)   In such cases, candidates obtained 1 mark for the value of 2.  **QUESTION 10.4**   * Poorly answered, only few candidates attempted the question. * Candidates did not understand the concept of transformation. * Some candidates simplified the brackets and solved for * Few candidates managed to find the new intercept and they were stuck. |
| **(c) Provide suggestions for improvement in relation to Teaching and Learning**   * Concepts of increasing, decreasing, concavity etc still need a lot of practice. * The concept of plotting points on cartesian plane must be revised. This will remind learners on how to write solutions in coordinate form. * Interpretation of functions and the correct notations should be stressed when revising. Putting more emphasis on grade 10 and 12 functions and also basics of algebra because functions need algebraic skills like factorisation and solving of equations. |

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| **QUESTION 11**   1. **General comment on the performance of learners in the specific questions.**   **Was the questions well answered or poorly answered?**   |  |  | | --- | --- | | After travelling a distance of 20 km from home, a person suddenly remembers that he did not close a tap in his garden. He decides to turn around immediately and return home to close the tap.  The cost of the water, at the rate at which water is flowing out of the tap, is R1,60 per hour.  The cost of petrol is  rands per km, where x is the average speed in km/h. |  | | Calculate the average speed at which the person must travel home to keep his cost as low as possible. | **[7]** |   Poorly answered question with an average performance of 10%. Most of candidates left the question unanswered. The few that attempted the question, they performed poorly with marks ranging from zero to 1. CAPS aligned though BUT it would have been better answered if the question was break into sub-questions. Probably the question could have been worded differently because it was too long and confusing. The first impression that one gets was that of evaluating the costs for the trip in both directions yet on the return trip was relevant to the question. So, the fact the person used some fuel up to that point did not matter. Secondly, asking the average that keep the cost low, in candidates’ mind implies the person should drive rather faster, but getting an answer of 80km/hr was not so convincing, this could have made some learners feel that 80km/hr was not correct. Language and inclusion of physics terminology become barrier to most of the candidates. In sum, QUESTION 11 was a higher order question and probably unfair question in the eyes of the candidates. An eye opener question to Educators to prepare learners well when revising the concept of RATE OF CHANGE. |
| **(c)** Provide suggestions for improvement in relation to Teaching and Learning   * Teacher must realised that applied calculus (including rate of change concept) is part of CAPS syllabus. It is not only physical sciences concept and all learners regardless of their streams must be taught and revision done. This will ensure better performance in questions of this nature (QUESTION 11). * Educators must teach learners to link ordinary differential calculus with applied differential calculus. Refer to examples below:   **RATE OF CHANGE**  The derivative is the (instantaneous)**rate of a function.**  Rate of change distance = speed= velocity = 1st derivative = max & min = stationary point.  Rate of change of speed = acceleration = deacceleration = 2nd derivative = inflection point.  **EXAMPLE**   1. The rate of change of 2. The rate of change of is   This means that the rate of change is a variable depending upon the value of |

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| **QUESTION 12**   1. **General comment on the performance of learners in the specific questions. Was the questions well answered or poorly answered?**  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | 12.1 | A and B are independent events. It is further given that:  P(A and B) = 0,3 and P(only B) = 0,2 | | |  | |  | | |  | 12.1.1 | Are A and B mutually exclusive? Motivate your answer. |  | | (1) | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | 12.1.2 | Determine: |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  | 1. P(only A) |  | (4) |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  | 1. P(not A or not B) |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 12.2 | A teacher has 5 different poetry books, 4 different dramas and 3 different novels. She must arrange these 12 books from left to right on a shelf. |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | 12.2.1 | Write down the probability that a novel will be the first book placed on the shelf. |  | (1) | | |  | 12.2.2 | Calculate the number of different ways these 12 books can be placed on the shelf if any book can be placed in any position. |  | (2) | | |  |  |  |  |  | | |  | 12.2.3 | Calculate the probability that a poetry book is placed in the first position, the three novels are placed next to each other, and a drama is placed in the last position. |  | (4) | | | |  |  | |  | | **[14]** | |   Poorly answered question with and average candidates’ performance of 27%. Surprisingly, comparing candidates’ performance in QUESTION 12.1 (20%) and QUESTION 12.2 (33%) it clearly indicates that Grade 11 probability was NOT done or well revised in most cases. In 2020 probability was one of the trimmed topics and according to the revised ATP candidates were taught in 2021. Most candidates answered counting principle much better than grade 11 probability. Generally, candidates lack an understanding of terminology used in probability. This terminology includes words like **PROBABILITY, INDEPENDENT EVENTS, MUTUALLY EXCLUSIVE EVENTS, ONLY, AND, OR, P (NOT A)** etc. |
| **QUESTION 12.1**  **QUESTION 12.1.1**   * Candidates only wrote NO without reason. No mark was awarded if a candidate did not write the reason. * Most did not know the meaning of MUTUALLY EXCLUSIVE EVENTS.   **QUESTION 12.1.2(a)**   * The most common error was that candidates did not know whether to multiply or add the probabilities. For instance, candidates would write:   instead of   * Candidates did not know basic principles of probability such as the condition that . Some of the solutions were, for instance, or * Candidates did not know the meaning of words like ONLY * Candidates used wrong formula (addition rule of probability) which led to incorrect substitution. Refer to the working below:       **QUESTION 12.1.2(b)**   * Poorly answered. Most candidates did not know method or formula to apply for . * Venn diagram could have assisted BUT most candidates did not think about it.   **QUESTION 12.2**   * Answered better than QUESTION 12.1 * Language barrier could have affected some of candidates though, the writer of the report, cannot be able to justify it. * Common errors were observed in QUESTION 12.2.3, candidates did not know where to use factorial or , for instance:  1. Instead of they wrote 2. Instead of they wrote  * In such cases, marks were awarded as prescribed by marking guideline. * NO CA was applied in QUESTION 12.2.3. |
| 1. **Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**  * Generally, there must be a system in place to ensure that basic mathematics is well covered and standard examinations (test) are given to learners before they take mathematics in Grade 10. * Don’t drill learners too much on past papers. That should be done at the end of the year. Learners should be focused on understanding key concepts first. * Learners do not read instructions given when answering questions. For instance, they must give an equation if an equation is asked and give coordinates if coordinates are asked. * Teachers need to be encouraged to attend developmental workshops. * Teachers need workshop training for Probability and Financial Mathematics. * The syllabus is too broad. Teachers should rather focus on less and do more problem-solving than to just do the basics and expect learners to do higher order questions. Focus more on core principles of Mathematics and make more time for consolidation. * Grade 11 concepts that are tested directly in Grade 12 examinations should probably form part of a controlled test in term 1 and 2 to help the learners revise. * When teaching calculus, we should also teach integration together with differentiation. There is too little done for a learner to grasp calculus and its application fully. * Syllabus must be finished before June so that there is enough time for revision. * Teachers must explain why certain formulae have to be selected for a specific question. * Teachers should teach and assess so that any misconceptions or confusion is rectified while time is available. * Intervention programs are needed to improve the learner’s performance in general. * Introduce the formula sheet at the beginning of the year and ensure that learners use them in every informal and formal test they write. * Educators should not assume that learners know how to use their calculators. * Homework should not only be levels 1-3. Include level 4 questions. * Motivate learners more. * Educators should try and introduce more unseen questions to brighter learners. * Integrate topics for higher level questions. * Language barrier remains a problem for many candidates * For learners who have a negative attitude towards mathematics, different stakeholders must be involved for instance SMT, social workers, parents and formal students. They play a fundamental role in nurturing positive attitude to learners. * Teacher development and subject advisor must train or workshop teachers to embrace and use technology in their teaching of mathematics. * Effective teaching and learning cannot be overemphasized. Educators must have strategy in place to maximise teaching and learning regardless of the pandemic. Remote teaching is one method that can be implemented in times of pandemic lockdowns and during school holidays. |