Province of the
EASTERN CAPE
EDUCATION

ASSESSMENT & EXAMINATIONS
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NSC 2011 CHIEF MARKER'S REPORT

SUBJECT	**MATHEMATICS**

PAPER	**1**

DATE OF EXAMINATION:	**NOV 2011**	**DURATION:**	**3 hours**

SECTION 1:

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

Learner performance spanned the full spectrum from zero to full marks. In all districts there were some candidates who did very well. Some centres also achieved outstanding results. The vast majority of candidates, however, did poorly.

The paper contained a number of challenging questions and it was good to see that a significant number of candidates in the province were able to rise to these challenges and provide elegant solutions to the higher order questions. Unfortunately, the majority of candidates lack understanding of the subject's basic concepts and poor performances resulted. It would be good to see a serious effort made to improve advisory assistance to teachers and learners in the province.

The overall performance seems slightly better than last year in that a smaller proportion of candidates scored less than 30%. It is of concern that the vast majority of candidates still score at this level. The proportion of candidates scoring over 80% seems smaller than last year, which suggests the paper was more challenging at that level.

SECTION 2:

Comment on candidates' performance in individual questions
(It is expected that a comment will be provided for each question on a separate sheet).

QUESTION 1
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(a) Provide suggestions for improvement in relation to Teaching and Learning
(d) Describe any other specific observations relating to responses of learners

e) Any other comments useful to teachers, subject advisors, teacher development etc.
This was the question in which learners performed best. With the exception of Question 1.2.1, all parts of the question were of a routine nature and made lower level cognitive demands. The solution of quadratic equations and inequalities was tested. Question 1.1.1 required solution by factorising and was generally correctly answered. Question 1.1.2 required use of the quadratic formula. Many candidates who chose to give answers rounded off to 2 decimals, did not round off correctly. Teachers should remind learners of this technique learnt in the GET phase and not assume that it was mastered previously. Another error relating to the GET phase was incorrectly multiplying the negative integers after substitution. Basic calculator work should be practiced throughout the year. Question 1.1.3: While most candidates were able to obtain the values where the expression $3x^2 - 4x - 8$ was equal to 0, and even the graphic solution of the inequality, they were not able to write out the solution to the inequality correctly. Teachers need to emphasise the difference between the words "and" and "or" when used in mathematics. In this case the use of "or" was essential. The solution had to be written: $x \leq 0{,}25\ \boldsymbol{OR}\ x \geq 1$. Educators should teach the various options of solving quadratic inequalities to learners, including graphical solutions. Question 1.2.1 was an unfamiliar question which was poorly answered as candidates were unsure about what was required to obtain a ratio for an answer. The solution needed the expression to be factorised and the equation to be solved for *x* in terms of *y.* The ratio is then deduced. This ratio could then be used to make the simultaneous solution of equations in Question 1.2.2 easier. Most candidates, however, obtained the solution to Question 1.2.2 in the conventional way by substituting $x = 8 - y$ into the given equation. This made Question 1.2.2 routine and still earned full marks. The use of "hence" in 1.2.2 confused a significant number of candidates and they failed to recognize the basic solving of simultaneous equations in 1.2.2. In previous years, most candidates answered the question on simultaneous equations and good marks were scored. If $x = 8 - y$ was used in the substitution and the quadratic formula was used to solve the equation, candidates must take care not to use the formula as $x = \cdots$ instead of $y = \cdots$ The generally good performance in Question 1 suggests that teachers are familiar with this section of work. Grade 8 and 9 work must be revised to manage basis algebraic manipulations required to answer question 1.
QUESTION 2
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(c) Provide suggestions for improvement in relation to Teaching and Learning
(d) Describe any other specific observations relating to responses of learners

e) Any other comments useful to teachers, subject advisors, teacher development etc.
This question was pitched at the "routine procedures" and "knowledge" cognitive levels. Candidates' performance was, however, disappointing, particularly in the case of Question 2.3 which tested the recall of theory which simply had to be learnt. Very few candidates were able to produce the required proof. Teachers need to read the Examination Guideline carefully and note that it states on page 8 that "Proofs of the sum of arithmetic and geometric series are examinable". Candidates should then be reminded to learn these proofs. Question 2.1 was generally well answered. Some candidates swopped the AS and GS and lost the marks. The use of $T_2 - T_1 = T_3 - T_2$ and $\frac{T_2}{T_1} = \frac{T_3}{T_2}$ is an easy method to solving this question and should be practiced. In 2.1.2 $\frac{T_2}{T_1} = \frac{T_3}{T_2}$ lead to the equation $x^2 = 128$. Only a few candidates managed to solve this as $x = \pm\sqrt{128}$ and many gave the answer as $x = \sqrt{128}$. Question 2.2 tested sigma notation and the use of the formula for the sum of a geometric series. While many candidates scored marks in this routine question, those that struggled either did not interpret the sigma notation correctly or were unable to calculate values of terms with negative exponents. When teaching geometric series, a useful opportunity arises for revising exponents and pointing out the need for knowing how to work with exponents. Teachers should use this opportunity. The fact that the sigma sign requires that a sum be taken must be emphasised. Only 1 mark out of a possible 4 was awarded in 2.2 if a candidate wrote only the correct answer and showed no calculations. Teachers must emphasize the instruction that states that full marks will not necessarily be awarded for answers only.
QUESTION 3
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(c) Provide suggestions for improvement in relation to Teaching and Learning
(d) Describe any other specific observations relating to responses of learners

e) Any other comments useful to teachers, subject advisors, teacher development etc.
Most learners attempted this question and at least one of the answers for 3.1 was given correctly by most candidates. Question 3.2 and 3.3 was answered very poorly. The fact that an arithmetic and geometric sequence were combined into a single sequence made this question difficult. Candidates who were able to identify the two sequences scored marks in Question 3.1 and were generally able to determine the general terms of the split sequences in Question 3.2. Very few, however scored full marks in Question 3.2 as they were unable to correctly determine which term of the split sequences corresponded to the 52nd and 51st terms of the given sequence. The 52nd term of the given sequence is the 26th term of the geometric sequence and the 51st term of the given sequence is the 26th term of the arithmetic sequence. Question 3.3 was very poorly answered. Many candidates seemed not to understand the question and used the fact that sequence was "infinite" to try to use the formula for the infinite sum. Others tried to prove by example. The correct approach was to show that the n^{th} term of each of the split sequences is a multiple of 3. In the case of the arithmetic sequence $6n - 3 = 3(2n - 1)$ and in the geometric sequence 3.2^{n-1}. Candidates who tried to explain in words often demonstrated an inadequate mathematical vocabulary. Mentioning only that because $d = 6$ in the AS, was not enough to prove that all terms of the AS was divisible by 3. The fact that $a = 3$ is also divisible by 3 should also be mentioned. To better prepare candidates for such questions teachers should when teaching this section expose learners not just to the theory regarding the individual types of sequences, but also concentrate on the number pattern aspect in integrated questions. Question 3.3 required of the learners to generalize and candidates are unable to do this. Teachers need to refer to the previous HG question papers to find examples of questions where the generalized form was used. Learners can do investigations to enhance their understanding of number patterns, sequence and series, e.g. Pascal's Triangle.
QUESTION 4
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(c) Provide suggestions for improvement in relation to Teaching and Learning
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This question was asked in an unfamiliar manner and required a depth of understanding of quadratic sequences. It was one of the worst answered questions on the paper. Candidates and teachers have become used to questions which provide 4 successive terms of the sequence and require the general term to be found. This question was different and required candidates to understand the underlying structure of a quadratic sequence. It has now clearly become necessary for quadratic sequences to be studied in depth and not merely as a type of number pattern to be recognised and completed.

Many candidates successfully used a trial and error approach to arrive at the answer.
To be awarded full marks when using trial and error the candidates had to show their work. If an answer only was given without any working shown only 3 marks were awarded. Teachers should once again emphasize the instruction that all working should be shown and answers only avoided.

An easy option to solve this problem is to let $T_1 = x$ and $T_4 = y$.

The first differences then become $1 - x; -8; y + 6$ and $-14 - y$.

The second differences are then $-8 + x; y + 13$ and $-20 - 2y$.

$$\therefore\ y + 13 = -20 - 2y$$
$$3y = -33$$
$$y = -11$$

$\therefore$ the second difference is $y + 13 = 2$

With the second difference known, the first difference between the 2nd and 1st term can be calculated and hence the 1st term as needed in Question 4.2

Candidates got confused when using the general form, stating incorrectly that $T_1 = 1$, therefore $a + b + c = 1$, whereas actually $T_2 = 1$, and therefore $4a + 2b + c = 1$.

Teachers are advised to vary the question types used for exercises when teaching quadratic sequences. Teachers and learners should try to devise questions which explore the structure of quadratic sequences.

QUESTION 5
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(c) Provide suggestions for improvement in relation to Teaching and Learning
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e) Any other comments useful to teachers, subject advisors, teacher development etc.

This question was amongst the better answered questions on the paper. In previous papers the calculations for x- and y-intercepts of the hyperbola were asked as a single question. This year it was separated with the y-intercept calculated in 5.1.1 and the x-intercept calculated in 5.1.2. Some candidates interchanged the intercepts and a maximum of 3 marks could then be awarded. Candidates generally knew how to find the intercepts with the axes Calculation errors were, however, common. This indicates the importance of the work on algebraic fractions taught in grades 9 and 10. In drawing the graph (Question 5.1.3), candidates need to take care that their curves tend toward the asymptotes and not away from them. Question 5.1.4 was poorly answered. This suggests that learners and teachers do not spend enough time discussing information that can be obtained from graphs. It is important when studying functions that teaching does not stop at how to sketch the curve, but that questions which require using the graph to deduce properties of the function also be considered. In this case, $f(x) > 0$ when the curve is above the x –axis, so for $-3 < x < 3$. Candidates who attempted this question failed to notice the fact that x should also be less than 3. The implication is that the concept of an asymptote is not well understood and should be explained clearly by all teachers. Question 5.1.5 required finding the average gradient between 2 points on the curve. Many candidates knew the correct formula to use. Errors were, however, often made in that arbitrary y – coordinates were used for the points where x is -2 or 0. $f(-2)$ needs to be calculated by substitution in the equation, while the y –intercept is already known. Question 5.2 was a somewhat unfamiliar question and consequently was omitted by some candidates. Candidates who attempted it generally scored at least some marks. Teachers should note that the need for learners to know the effect of the various parameters in the equation of the parabola is clearly stipulated in the SAG document. In teaching the function, learners should first know the basic curve and then be given the opportunity via worksheets to investigate the effects of changing the values of the various parameters. This could also be the topic of one of the CASS investigations in grade 11.
QUESTION 6
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(c) Provide suggestions for improvement in relation to Teaching and Learning
(d) Describe any other specific observations relating to responses of learners
e) Any other comments useful to teachers, subject advisors, teacher development etc.

Questions 6.1and 6.2 were well answered at some centres with candidates able to determine the intercepts and asymptote of the exponential function. It is good to see the improvement in the answering of basic questions on functions. Many candidates were also able to do the first step in determining the inverse required in Question 6.4 and knew the reflection rule to use in Question 6.5. A number of errors were, however, made in manipulating exponents and logs in Questions 6.3 and 6.4.

In Question 6.3 a common error was to write $f(2x)$ as $2.2^x - 8$ instead of $2^{2x} - 8$. Candidates also wrongly equated 2.2^x to 4^x..

In Question 6.4, a common error when switching the x and y is to incorrectly change $y = 2^{2x}$ to $2x = 2^y$ instead of $x = 2^{2y}$. The equation should then be written in log form as $2y = \log_2 x$ and hence $y = \frac{1}{2}\log_2 x$. A common error was to write this as $y = \log_2 2x$. Such errors indicate the need to contrast expressions such as 2.2^x and 2^{x+1} with 4^x; $(2 \times 2)^x$ and 2^{2x} and $\log_2 2x$ with $2.\log_2 x$ when studying algebraic manipulations with exponents and logs. Understanding fully what each means will eliminate many errors.

Question 6.6 was clearly a problem solving higher order question. This was a result of the sigma notation being used in an unfamiliar context. As could be expected the question was poorly answered as many candidates were unable to interpret the meaning of the notation correctly. Those that could interpret the notation often continued to determine the answer by finding the equation of the parabola, and hence the appropriate function values to determine the two sums before finding the difference between them. A more elegant solution is to use the symmetry of the parabola to notice that $g(2) = g(4)$ and $g(1) = g(5)$. Hence, the difference between the sums is $g(0) + g(3) = 4{,}5 + 0$. These functions are already known. This question illustrates the need to integrate the various topics in the syllabus. Revision exercises and investigation assignments provide opportunities for doing so.

QUESTION 7
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
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The financial questions were somewhat easier than in 2010 and candidates' performance in the section is also somewhat improved. Most candidates attempted this question. In Question 7.1, the key was to realize that A must be half of P in the formula for depreciation. It was pleasing to note that many candidates were able to use logs correctly in calculating the answer. Question 7.2 was one of the better answered questions on the paper. A common error was made in the calculation of the bonus of Radesh. It appears that many candidates did not know that "principal amount" referred to the original amount invested and Radesh's bonus was wrongly calculated. Some candidates wrongly tried to use the grade 12 annuity formula in this question. It is important to remember that the exam tests work from the entire three year course course. Question 7.3 was less well answered. Candidates typically did not consider that the initial deposit had to earn compound interest for 18 months. The future value formula is used to calculate the value of the annuity into which R700 is paid each month. In this case $n = 18$ as well. It is clear that candidates need practice at interpreting the terminology of financial mathematics. Performance could be improved if learners were provided with a glossary of terms to learn. The correct use of calculators is an important skill for financial maths and teachers should regularly test the calculator skills of their learners from an early stage.
QUESTION 8
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(c) Provide suggestions for improvement in relation to Teaching and Learning
(d) Describe any other specific observations relating to responses of learners
e) Any other comments useful to teachers, subject advisors, teacher development etc.

This was the second best answered question on the paper.

Candidates were generally able to carry out the routine differentiation from first principles in Question 8.1 and this is where most marks were scored. Care, however, needs to be taken with notation.
The fact that many included a line of working in which 0 was substituted for h raises some doubt as to whether the concept of a limit is properly understood. It is important to realise that $h \to 0$ (tends to 0) and is not ever equal to 0.

The use of a table as illustrated below can be useful in teaching the concept. From the table, the derivative at $x = 1$ can be determined by looking at what happens to the value of $\frac{f(1+h)-f(1)}{h}$ as the value of h gets closer to 0. In the example, let $(x) = -4x^2$. So $\frac{f(1+h)-f(1)}{h} = \frac{-4(1+h)^2+4}{h}$

h	0,5	0,1	0,01	0,001	0,0001	0,00001
$\frac{f(1+h)-f(1)}{h}$	-10	$-8{,}4$	$-8{,}04$	$-8{,}004$		

Learner's can be asked to complete the table and so observe that as the value of *h* gets closer to zero, so the value of $\frac{f(1+h)-f(1)}{h}$ gets closer to -8 which is its limit as $h \to 0$.

In Question 8.2.1, many candidates struggled to correctly write y as $\frac{3}{2}x^{-1} - \frac{1}{2}x^2$ before differentiating.

A general error was to write $\frac{3}{2x}$ as $-6x^{-1}$ This indicates how a lack of mastery of the work on exponents learnt in grades 9 and 10 prevents accurate answers despite grade 12 differentiation methods being understood. Candidates also need to take care with notation. While $y = \frac{3}{2}x^{-1} - \frac{1}{2}x^2$, $\frac{dy}{dx} = -\frac{3}{2}x^{-2} - x$.

Question 8.2.2 was generally well done. Notation again must be emphasised.
$f(x) = 49x^2 + 14x + 1$, but $f'(x) = 98x = 14$. Many candidates calculated $f(1)$ instead of $f'(1)$.

QUESTION 9

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

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

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

(d) Describe any other specific observations relating to responses of learners

e) Any other comments useful to teachers, subject advisors, teacher development etc.

Question 9.1 was poorly answered by many candidates. It tested understanding. It is possible that candidates poor performance is due to only learning how to draw cubic graphs and not how to derive the equation from given graphs. Teachers should note that the need to be able to derive the equations of cubic graphs is clearly indicated on page 13 of the Examination Guideline document. In the question (5 ; 18) and (2 ; −9) were given as turning points. Five pieces of information could be deduced from this. $f(5) = 18$, $f'(5) = 0$, $f(2) = -9$, $f'(2) = 0$ and $f''(3,5) = 0$. Any three of these deductions could be used to formulate equations to solve simultaneously to determine the values of *a*, *b* and *c*. It is important that learners understand the significance of a point being a turning point or inflection point. Candidates did not know how to set up the equations when using $f'(2)$ and $f'(5)$. It is important to note that at the stationary points $f'(2) = 0$ and $f'(5) = 0$. Equating to 0 was either omitted or $f'(2)$ and $f'(5)$ were equated to -9 and 18. If candidates substituted the values of a, b and c into the function and then showed that $f(2) = -9$, $f(5) = 18$, $f'(2) = 0$ and $f'(5) = 0$ a maximum of 4 marks was awarded as this did not constitute a proof. This approach should be discouraged. Question 9.2 tested a routine prescribed procedure. Note that the gradient is found by calculating $f'(1)$, while the *y*-coordinate is found by calculating $f(1)$. Some candidates confused this. Question 9.3 was well answered by many candidates who correctly put the second derivative equal to zero. Many teachers and learners do not fully understand the concepts underlying calculus. Subject advisors should arrange workshops for teachers to empower themselves in understanding calculus.

QUESTION 10
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(c) Provide suggestions for improvement in relation to Teaching and Learning
(d) Describe any other specific observations relating to responses of learners
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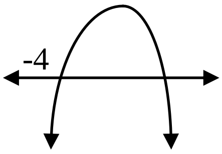
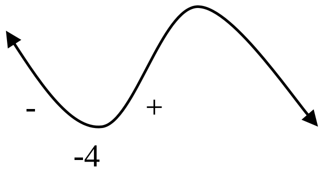
This was a higher order question which was very poorly answered, despite a similar question being asked last year. It is again emphasised that candidates need to be able to interpret the graph of the derivative.

There was much to do to earn the single mark for Question 10.1. Candidates had to realise that the turning point of the parabola was halfway between the two given *x*-intercepts. The graph of $y = f'(x)$ is decreasing to the right of this turning point. The study of decreasing and increasing functions is clearly stated in the Guideline documents. Most candidates showed no understanding of the concepts and were unable to give the answer.

In Question 10.2, candidates had to realise that the cubic function has turning points where its derivative is zero. This occurs at the *x*-intercepts of the graph of $y = f'(x)$. The function value of $y = f'(x)$ changes from negative to positive at $x = -4$, so the gradient of the graph of $y = f(x)$ does likewise. Hence, there is a local minimum at $x = -4$. This explanation could either be expressed in words, graphically or mathematical notation.

* Gradient of *f* changes from negative to positive at $x = -4$.





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* $f'(x) < 0$ for $x < -4$, so f is decreasing for $x < -4$.
  $f'(x) > 0$ for $-4 < x < 1$, so f is increasing for $-4 < x < 1$.

Learners need to spend more time practicing this demanding type of exercise.

QUESTION 11
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(c) Provide suggestions for improvement in relation to Teaching and Learning
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This was the worst answered question on the paper. Candidates possibly had not had enough practice at doing rate of change problems. Candidates also possibly struggled to interpret the rate of change terminology. Units are important in rate of change problems in this case “litres per minute”. It is important that learners do sufficient rate of change problems to become familiar with a range of contexts.

In Question 11.1 the initial volume is determined by calculating $V(0)$.

In Question 11.2, one expression for the rate of change is found by finding $V'(x) = -4$ l/min.
The other is found by noting that the rate of change equals the rate of inflow minus the rate of outflow. This gives $(5 - k)$ l/min. Teachers should note that a mark was given for the correct units in 11.2. Teachers need to emphasize the importance of giving units.

The answer to Question 11.3 is found by equating the expression found in Question 11.2.

QUESTION 12
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(c) Provide suggestions for improvement in relation to Teaching and Learning
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e) Any other comments useful to teachers, subject advisors, teacher development etc.
It is good to note that many more candidates appeared to attempt this question and managed to score some marks. The vast majority, however, wrongly deduced one of the constraint inequalities and scored at most 10 out of 17 marks. It is clear that language played a role. Candidates wrongly interpreted the sentence: “a school is planning a trip for 500 learners” as implying that at most 500 seats were required, while in fact at least 500 were required. While formulating the other constraints and graphing them was often well handled, candidates were not able to use the search line to find the solutions which minimised cost. Many reverted to testing the vertices of the feasible region as taught in grade 11. This method did not produce all the answers here as the gradient of the search line coincided with that of the constraint line forming the border of the feasible region. The points (6 ; 8), (7 ; 6), (8 ; 4), (9 ; 2) and (10 ; 0) were all solutions, In Question 12.5 a constraint was changed, making (8 ; 4) the only solution. In studying this section, learners need to continually relate mathematical solutions back to the context of the problem to see if they make sense. If the error mentioned in the first paragraph was for example made, the feasible region would include (0 ; 0) and the trivial solution of using no busses and taking no learners on the trip would result.

SIGNATURE OF CHIEF MARKER: ______________________________