Province of the
EASTERN CAPE
EDUCATION

ASSESSMENT & EXAMINATIONS
Bundy Park, Schornville, KWT * Private Bag X 4571, KWT, 5600
REPUPLIC OF SOUTH AFRICA, Website: www.ecdoe.gov.za

NSC 2015 CHIEF MARKER'S REPORT

SUBJECT	MATHEMATICS

PAPER	1

DATE OF EXAMINATION:	30/10/15	DURATION:	3 hours

This report is aimed at providing valuable feedback to schools, subject advisors, teachers and learners about common errors committed by candidates in the answering of questions, to assist teachers and subject advisors to identify areas that need to be given special attention in the teaching and learning of the subject in 2015.

Your responses will be based on two parts:

Section 1: General overview of Learner performance in the question paper as a whole

Section 2: Comment on candidates' performance on individual questions (Detailed explanations must be provided **per question** as follows: (You may include sub questions where necessary)

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

(b) Why the question was poorly answered?

(c) Provide suggestion 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

SECTION 1:

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

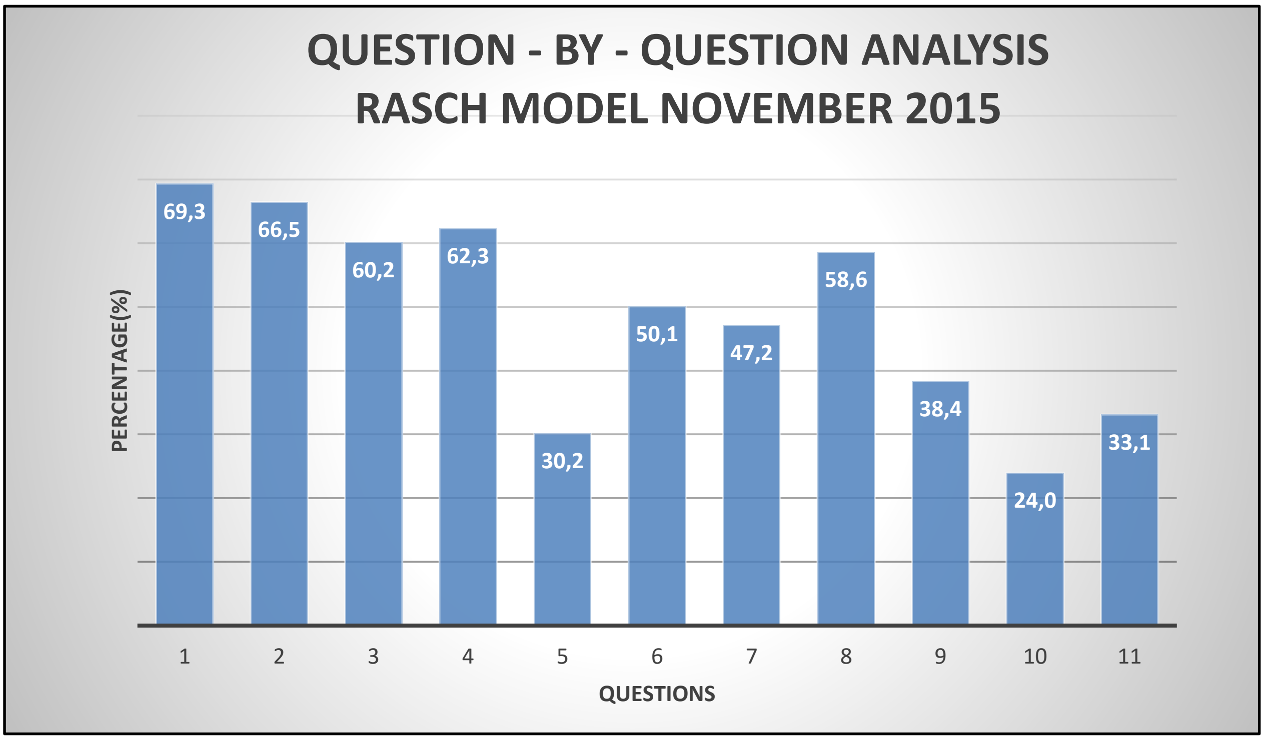
Candidate results covered the full spectrum from no marks to full marks. There are encouraging signs of improvement in most districts, with even poor performing centres having at least some candidates with decent results. There are also genuine centres of excellence where a significant number of candidates were able to achieve level 7. However there are also quite a number of underperforming centres. We are aware of the fact that there are many contributing factors. While there seems to be continued improvement in performing routine operations in a familiar context, candidates still struggle to apply knowledge in an unfamiliar context. Functions which are at the core of the curriculum also continue to be a challenge for candidates. Candidates struggled with using graphs to obtain solutions. Other areas with which candidates coped poorly were inequalities, inverse functions, calculus applications and counting principles. Many candidates fail to show working or are sloppy with mathematical notation. This causes them to lose marks. It is also important that learners be taught to use a calculator correctly.

It is important that teachers ensure that candidates are exposed to all types of questions so that learners can become used to thinking more broadly about the underlying mathematical concepts in their work and learn to apply knowledge.

RASCH ANALYSIS SAMPLE AVERAGES P1

Question	1	2	3	4	5	6	7	8	9	10	11	Total
Ave %	69.3	66.5	60.3	62.3	30.2	50.1	47.2	58.6	38.4	24.0	33.1	49.2

The overall average for Mathematics Paper 1 was **49.2%** in the sample of 100 scripts.



SECTION 2:

(a) & (b) Comment on candidates' performance in individual questions and possible reasons for performances.

QUESTION 1[26 marks]

QUESTION 1

1.1 Solve for x:

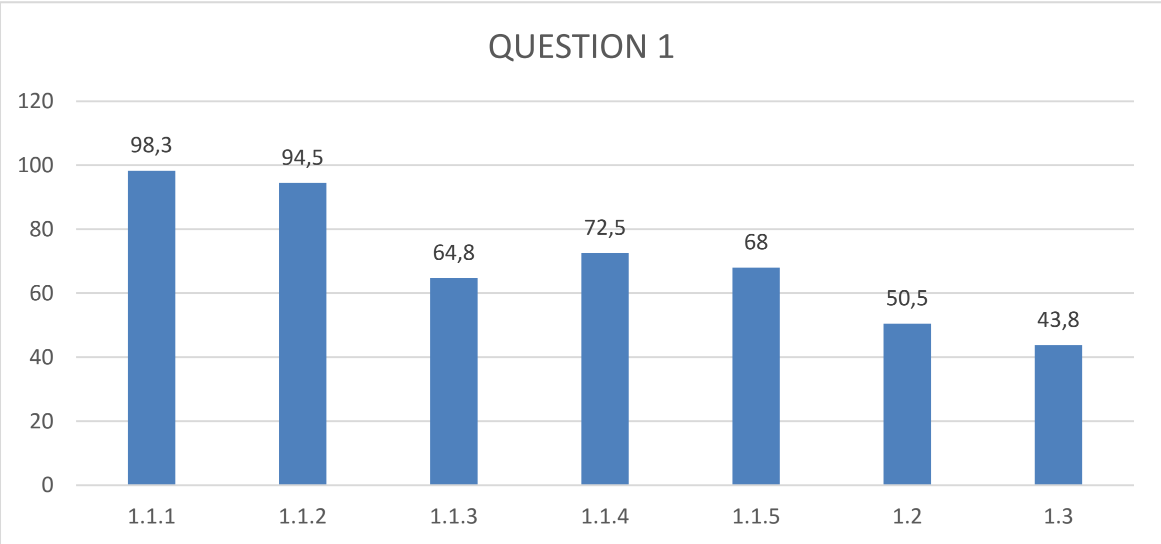
1.1.1	$x^2 - 9x + 20 = 0$	(3)
1.1.2	$3x^2 + 5x = 4$ (correct to TWO decimal places)	(4)
1.1.3	$2x^{\frac{-5}{3}} = 64$	(4)
1.1.4	$\sqrt{2-x} = x - 2$	(4)
1.1.5	$x^2 + 7x < 0$	(3)

1.2 Given: $(3x - y)^2 + (x - 5)^2 = 0$

Solve for x and y. (4)

1.3 For which value of k will the equation $x^2 + x = k$ have no real roots? (4)

[26]



General Comments:

This question was attempted by every candidate and most achieved good marks for 1.1.1 and 1.1.2. Although the format of this question is very predictable candidates still lack the basic skills of solving quadratic equations, inequalities and simultaneous equations. Factorizing skills play an important role in answering question 1 and too many candidates lack these basic skills taught in grade 9 and 10. All the sub-questions were quite routine, except for question 1.2, the simultaneous equation question that was asked a bit differently. Question 1 is the question where candidates are expected to get good marks and this is confirmed by the graph above. I would suggest continuous revision of these questions such that learners master it by the time they write the Midyear and Trial Examinations. This routine start to the paper enabled candidates to make a confident start and the performance in the sample supports this contention.

1.1.1	This question was well answered by most candidates. Some candidates used their calculators (eg. Casio 991) to determine the roots and lost one mark for just writing the answers and not showing the factorisation step. Although the use of the quadratic formula is not wrong, it is advisable that candidates factorises and write down solutions. The mark for factors is awarded for correct substitution.
1.1.2	The question was answered well. Most candidates scored marks here, as this is a routine question. Some candidates lost marks due to poor calculator work. Very few candidates lost marks for rounding off. This is a great improvement. All calculations should be shown. Full marks were not awarded for correct answers only or if the substitution step was not shown. This was a question where the candidates had to show all their calculations to be awarded full marks. Only one mark was penalized for incorrect rounding to two decimals for the whole paper. If candidates incorrectly substituted $c = 4$ the value for delta was negative. Educators should remind learners that if $\Delta < 0$, they should understand and state that there is no real solution. Replacing the formula/substitution step with $(x + 2{,}26)(x - 0{,}59) = 0$ was not awarded full marks.
1.1.3	This question was not well answered at all. Candidates lacked the basic skills of applying exponential laws. The most common error: • Candidates did not divide by 2 first. • They then $\left(2x^{-\frac{5}{3}}\right)^{-\frac{3}{5}} = 64^{-\frac{3}{5}}$ and got $2x = ????$ Many candidates made use of their calculators and scored some marks. There were many methods to solve this equation. Although the use of calculators was permitted, teachers must revise and test basic exponential laws regularly. Most options required division by 2 on both sides. In the third option where the calculator was used and division by 2 was not essential many candidates only raised $x^{\frac{-5}{3}}$ to the power $\frac{-3}{5}$ and not $\left(2x^{\frac{-5}{3}}\right)^{\frac{-3}{5}}$. This was also a question where the candidates had to show calculations to be awarded full marks. An rounded answer of 0,13 was accepted.
1.1.4	This question was fairly well-answered. Most candidates knew that they had to square both sides but then some struggled to do that correctly. Many candidates who were able to calculate the values of x, lost the mark for not testing the validity of the solutions and selecting the correct solution. Educators should emphasize the importance of testing solutions. The first mark is awarded for the method/idea of squaring both sides and not for the simplification from squaring both sides.
1.1.5	Most of the candidates scored the first mark for factorisation. Although the solving of an inequality is a very common question, it is still very clear that candidates don't have an understanding of inequalities, ie lack of understanding of the theory. Educators should explain this section to learners from first principles using the sign-table. Many learners still treat the inequality as an equality. Very few learners have a conceptual understanding of inequalities. When teaching this section, multiple representation should be used, ie sketches and table method instead of just pure algebraic manipulation. Some candidates were able to provide the correct graphical representation (on the number line), but concluded incorrectly. Drawing a parabola is considered a method of solving the inequality and should not be regarded as the solution. Candidates must be able to write down the correct solution using correct notation. They should also understand the difference between "OR" and "AND".

<table>
<tr>
<td></td>
<td>
The answer must be given as an inequality and not in graphical form.
Educators should consider teaching the option of using a table in solving the inequality so that learners might get a better understanding of the problem.

<table>
<tr><th></th><th></th><th>-7</th><th></th><th>0</th><th></th></tr>
<tr><td>x</td><td>−</td><td>−</td><td>−</td><td>0</td><td>+</td></tr>
<tr><td>x + 7</td><td>−</td><td>0</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>x(x +7)</td><td>+</td><td>0</td><td>−</td><td>0</td><td>+</td></tr>
</table>

$\therefore\ -7 < x < 0$

No mark was awarded for the critical values this year.
</td>
</tr>
<tr>
<td>1.2</td>
<td>The simultaneous equation question was posed differently from the past. This question was attempted by many candidates. Most did not really understand the crux of the question. Some got to the correct solutions purely by coincidence, sometimes even using incorrect mathematics. The lack of basic mathematical skills prevented many from achieving full marks, ie finding a solution for the first unknown and using that solution to find the second unknown.</td>
</tr>
<tr>
<td>1.3</td>
<td>Surprisingly, this question was answered very poorly and it is evident that learners do not know or understand the theory behind nature of roots. An answer only without any justification was not awarded full marks. Although the question asked for a singular value for k candidates must look at the allocation of marks and realize that an answer only is not sufficient for full marks. Educators could show higher level thinking learners the correlation between this question and the graphs of $y = k$ and $y = x^2 + x.$ (See the last option on the memo.)
This is where the use of Geogebra or other maths software comes in handy.</td>
</tr>
</table>

QUESTION 2

The following geometric sequence is given: $10 \,;\, 5 \,;\, 2{,}5 \,;\, 1{,}25 \,;\, ...$

2.1 Calculate the value of the 5^{th} term, T_5, of this sequence. (2)

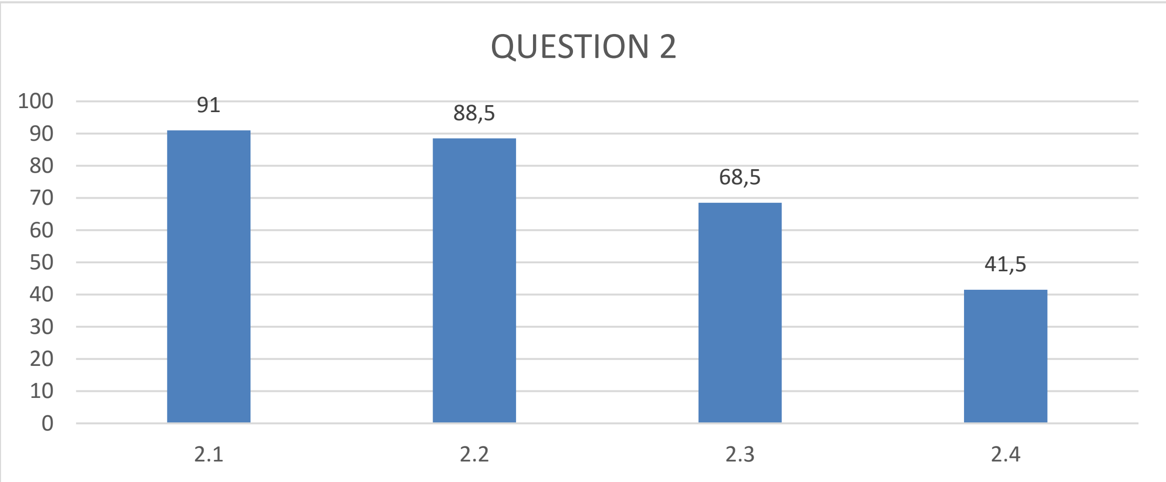
2.2 Determine the n^{th} term, T_n, in terms of n. (2)

2.3 Explain why the infinite series $10 + 5 + 2{,}5 + 1{,}25 + ...$ converges. (2)

2.4 Determine $S_\infty - S_n$ in the form ab^n, where S_n is the sum of the first n terms of the sequence. (4)

[10]

QUESTION 2 [10 marks]



GENERAL COMMENTS:

This question tested knowledge of the geometric sequences & series and was answered by most candidates. Questions 2.1, 2.2 and 2.3 were answered fairly well but many candidates found 2.4 challenging. Candidates struggled to get the last two marks for question 2.4.
No marks were awarded if candidates used the wrong formula.

2.1	Straight forward question. Most of the candidates got the correct answer. There are many different ways to obtain this solution. Many candidates wrote down the answer only. This is always a risk. Eg. $T_5 = (10)\left(\frac{1}{2}\right)^4 = \frac{10}{16}/\frac{5}{8}/0{,}625$ / $T_5 = T_4 \times \frac{1}{2} = 1{,}25 \times 0{,}5 = 0{,}625$
2.2	Well answered. Candidates got to: $T_n = 10 \times \left(\frac{1}{2}\right)^{n-1}$ which earned them full marks. Some tried to simplify further but made a number of errors in the process. Fortunately they were not penalised for it.
2.3	Many learners just wrote down $-1 < r < 1$, without making reference to the value of r. There is still a lack of understanding the concept of convergence. Learners must be very specific when giving responses to a question regarding converging sequences. They must state the value of r and then conclude that r is in the range of $-1 < r < 1$. If their r value used in previous questions was not within this range, no marks were awarded.
2.4	Most candidates found this question challenging. This was a higher level question that required algebraic manipulation after substitution. Some obtained the first two marks and could not simplify further, especially when the denominators of the two fractions were not the same, ie (1 – r) and (r – 1) / $\frac{1}{2}$ and $-\frac{1}{2}$. Very few candidates achieved full marks.

QUESTION 3 [12 marks]

QUESTION 3

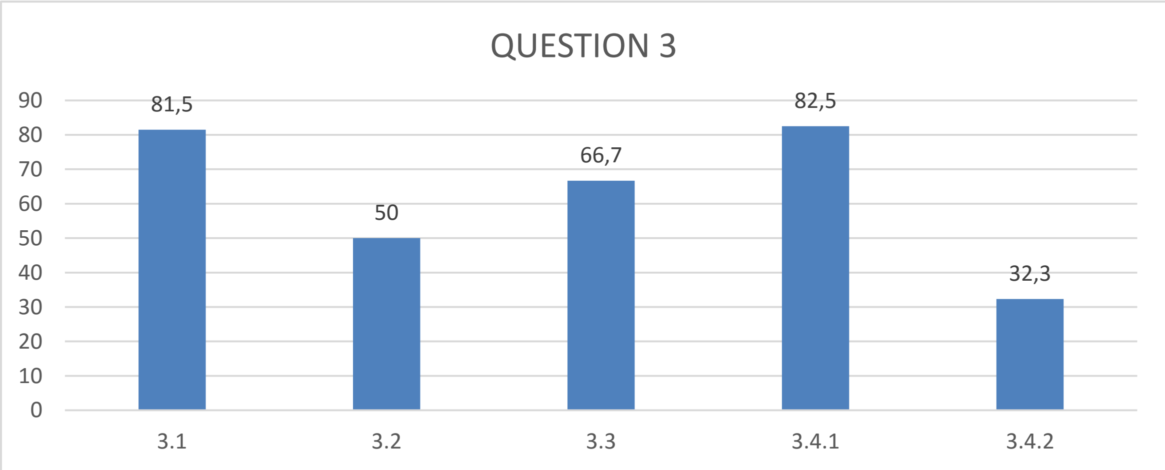
Consider the series: $S_n = -3 + 5 + 13 + 21 + \ldots$ to n terms.

3.1	Determine the general term of the series in the form $T_k = bk + c$.	(2)
3.2	Write S_n in sigma notation.	(2)
3.3	Show that $S_n = 4n^2 - 7n$.	(3)

3.4 Another sequence is defined as:

$Q_1 = -6$
$Q_2 = -6 - 3$
$Q_3 = -6 - 3 + 5$
$Q_4 = -6 - 3 + 5 + 13$
$Q_5 = -6 - 3 + 5 + 13 + 21$

3.4.1	Write down a numerical expression for Q_6.	(2)
3.4.2	Calculate the value of Q_{129}.	(3)
		[12]



GENERAL COMMENTS:
This question tested arithmetic sequences. Many learners scored some marks in this question. Questions 3.3 and 3.4 were asked differently. Very few learners obtained full marks in this question.

3.1	Well answered. This is a lower level question and many candidates gave their answer in terms of n.
3.2	This question was not answered very well. The correct application of sigma-notation needs to be practiced. Candidates should be able to expand a given sigma-notation and should also be able to write a series as sigma-notation. Although many learners were able to give the general term of the sequence they showed a clear lack of understanding of the sigma notation. Writing a series in sigma notation is not a familiar question and learners should practise this skill more often. Candidates made the following mistakes: $\sum_{n=1}^{n} T_n = 8n - 11$ **OR** $\sum_{n=1}^{k} = \cdots \ldots \ldots \ldots . OR \sum_{k=1}^{n} 8n - 11$ They used the value of the first term as n. Many also did not know what to replace T_n with. The use of brackets should also be emphasized.
3.3	Fairly well answered by many learners. Some learners tried to get to the answer by incorrect manipulation. All steps/calculations should be shown as full marks will not necessarily be awarded for correct answers only.
3.4	This was a non-routine question and was not well answered. Most candidates scored the first two marks for 3.4.1 but really struggled with 3.4.2

3.4.1	Well answered. Even a candidate that scored 2/150 got this question correct. Many candidates gave the answer as a single number and not a numerical expression.
3.4.2	This was a higher level question and was poorly answered. Most candidates had no idea of how to approach this question. More time should be spent on higher level questions in different content topics. Most candidates could not see the link in the question. There are many different ways in which this question could be solved. Although this was not an unfair question it was an unfamiliar question to many candidates. Poorly answered question. Candidates really struggled with this question. Many candidates just simply did not attempt the question, while very few candidates scored full marks. Teachers need to expose stronger candidates to more examples of higher level questions. Simply teaching the basic skills will not help learners to achieve good marks for admission to further studies for certain careers.

QUESTION 4 [6 marks]

QUESTION 4

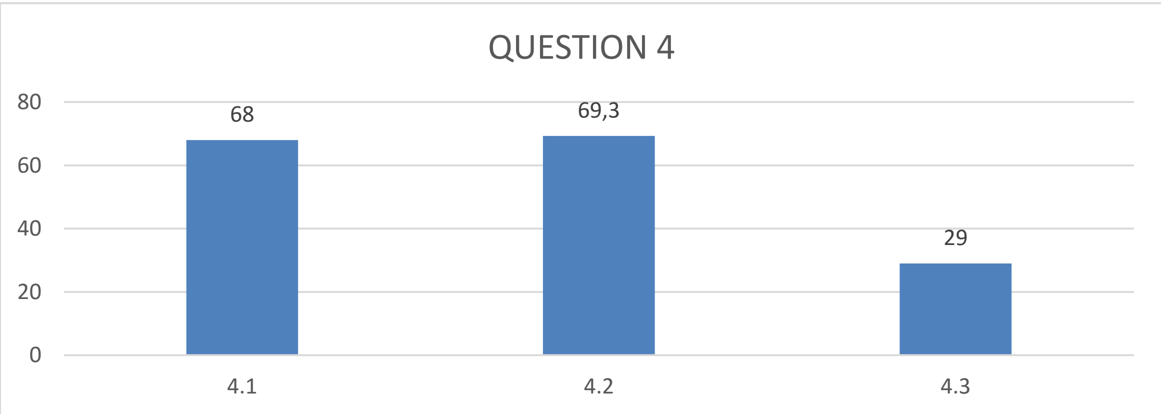
Given: $f(x) = 2^{x+1} - 8$

4.1 Write down the equation of the asymptote of f. (1)

4.2 Sketch the graph of f. Clearly indicate ALL intercepts with the axes as well as the asymptote. (4)

4.3 The graph of g is obtained by reflecting the graph of f in the y-axis. Write down the equation of g. (1)

[6]



GENERAL COMMENTS:

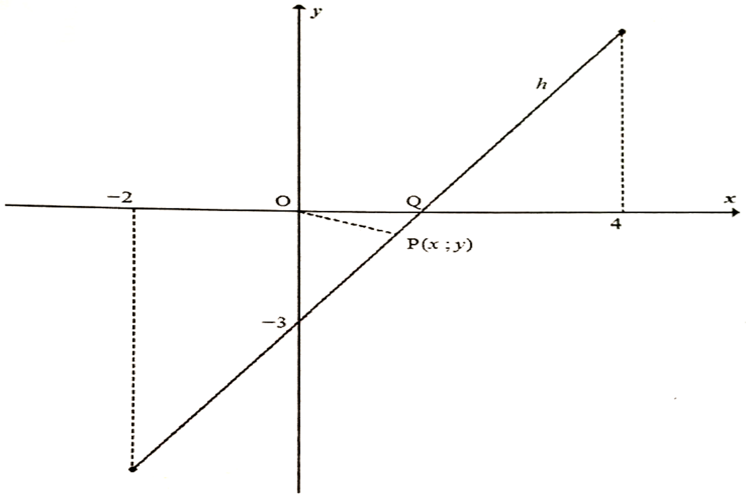
Question 4 tested knowledge of the exponential function. Candidates who lacked the basic mathematical knowledge and skills could not get the correct answers. Fairly well answered, except for 4.3.

4.1	Fairly well answered. Candidates must know to give an equation when asked for it. Many candidates just wrote (– 8) and lost the mark. Concepts must not be taught in isolation. Eg. When speaking of an asymptote, teachers should make learners aware where to look algebraically and graphically.
4.2	Fairly well answered. Many candidates knew that they had to let y = 0 to find x-intercept and let x = 0 to find y-intercept. Graph sketching / shapes are still problematic.
4.3	Not well answered at all. Although this is an easy question candidates were unable to write the correct equation for g. May be this is due to the fact that transformations is no longer part of the syllabus and that it is not given enough attention when dealing with graphs. Most candidates just left out the question.

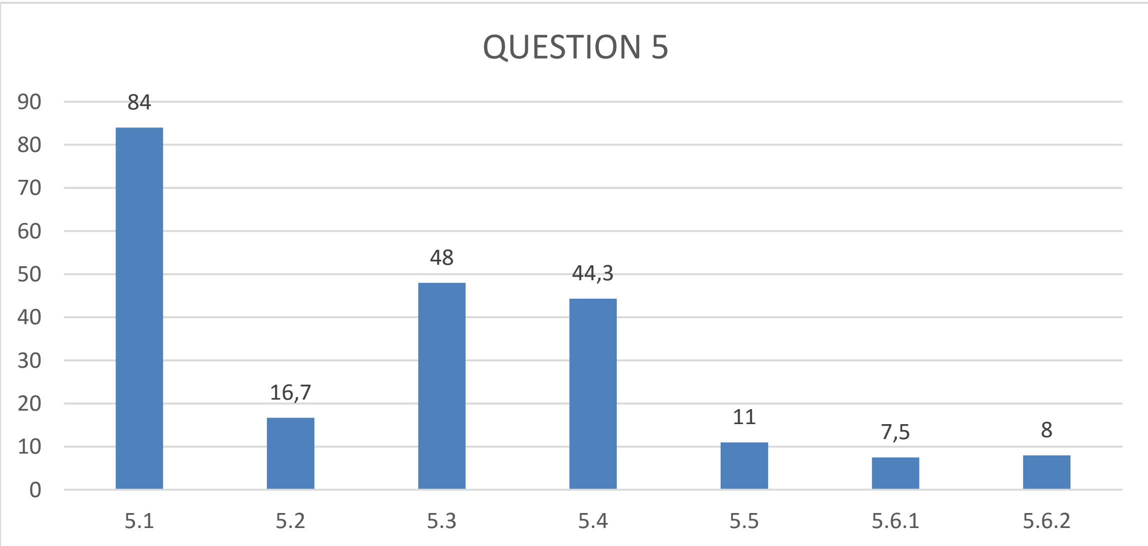
QUESTION 5 [19 marks]

QUESTION 5

Given: $h(x) = 2x - 3$ for $-2 \leq x \leq 4$. The x-intercept of h is Q.



5.1	Determine the coordinates of Q.	(2)
5.2	Write down the domain of h^{-1}.	(3)
5.3	Sketch the graph of h^{-1} in your ANSWER BOOK, clearly indicating the y-intercept and the end points.	(3)
5.4	For which value(s) of x will $h(x) = h^{-1}(x)$?	(3)
5.5	$P(x\,;\,y)$ is the point on the graph of h that is closest to the origin. Calculate the distance OP.	(5)
5.6	Given: $h(x) = f'(x)$ where f is a function defined for $-2 \leq x \leq 4$.	
5.6.1	Explain why f has a local minimum.	(2)
5.6.2	Write down the value of the maximum gradient of the tangent to the graph of f.	(1) **[19]**



GENERAL COMMENTS:

This question tested knowledge of inverse functions and the theory. It also tested the understanding of calculus in relation to functions and graphs. It was experienced as a difficult question by most candidates. The unfamiliar style of questioning as well as its complex nature contributed greatly to its challenging nature. Educators are again advised to teach the prescribed curriculum and not to rely too much on past papers. This question was well within the boundaries of the curriculum but candidates could just not bring it together.

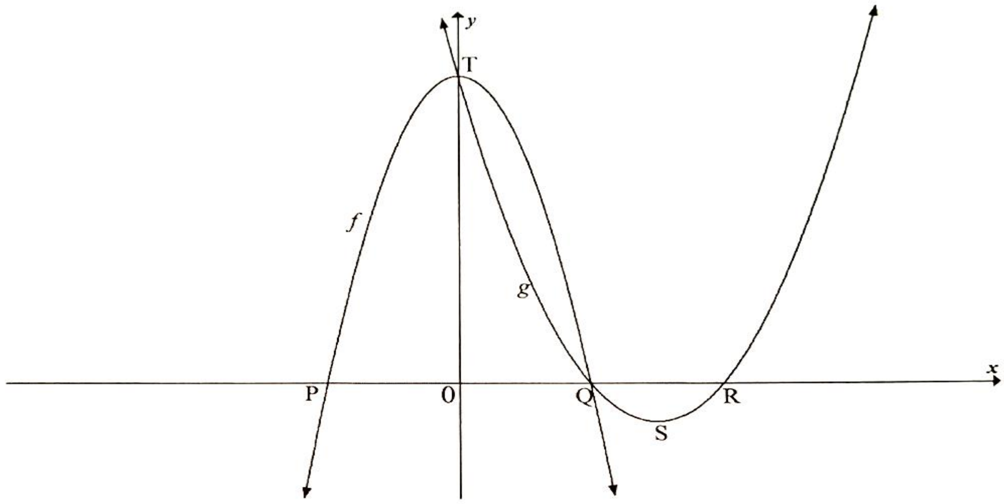
5.1	Best attempted sub-question - well answered. Many candidates got 2 marks for this sub-question even though the x-intercept was a fraction $\left(\frac{3}{2}\ ;0\right)$.
5.2	Poorly answered. The majority of candidates had no clue of what to do. Again this is evident of a lack of understanding of inverses. The basic rule of interchanging x and y to find the inverse need to be taught. The crux is that the domain of the inverse = the range of the original function, which brings us back to the basic rule of my x-values become my y-values and vice versa.
5.3	Not well answered. Candidates were awarded some marks for consistent accuracy based on their incorrect domain. The knowledge of line segment and endpoints were tested and candidates failed. Candidates should be made aware of the different methods to sketch the graphs of any inverse function.
5.4	Not well answered. Again there are different methods that can be used to find the points of intersection between a graph and its inverse. Most candidates struggled to write down the inverse function and could not continue to find the solutions. Please refer to the memorandum when it becomes available.
5.5	Poorly answered. This was a very challenging question. Only the top learners obtained marks for this question. Most candidates had no clue of how to approach this question. They tried various ways to get the coordinates of P but all incorrect. Yet there were so many ways in which to find the solution. See the memo for different alternatives. The crux of the problem was to know that the line representing the shortest distance from a point to a line is perpendicular.
5.6.1	It was very difficult for the majority of the candidates to answer this question. Really poorly answered. Candidates have no understanding of the relationship between a function and its first derivative. They also find it difficult to express their thoughts to make mathematical sense.
5.6.2	Again only the top candidates obtained marks for this question. Candidates need to understand the relationship between gradient at a point and the derivative.

QUESTION 6 [12 marks]

QUESTION 6

6.1 The graphs of $f(x) = -2x^2 + 18$ and $g(x) = ax^2 + bx + c$ are sketched below.

Points P and Q are the x-intercepts of f. Points Q and R are the x-intercepts of g. S is the turning point of g. T is the y-intercept of both f and g.



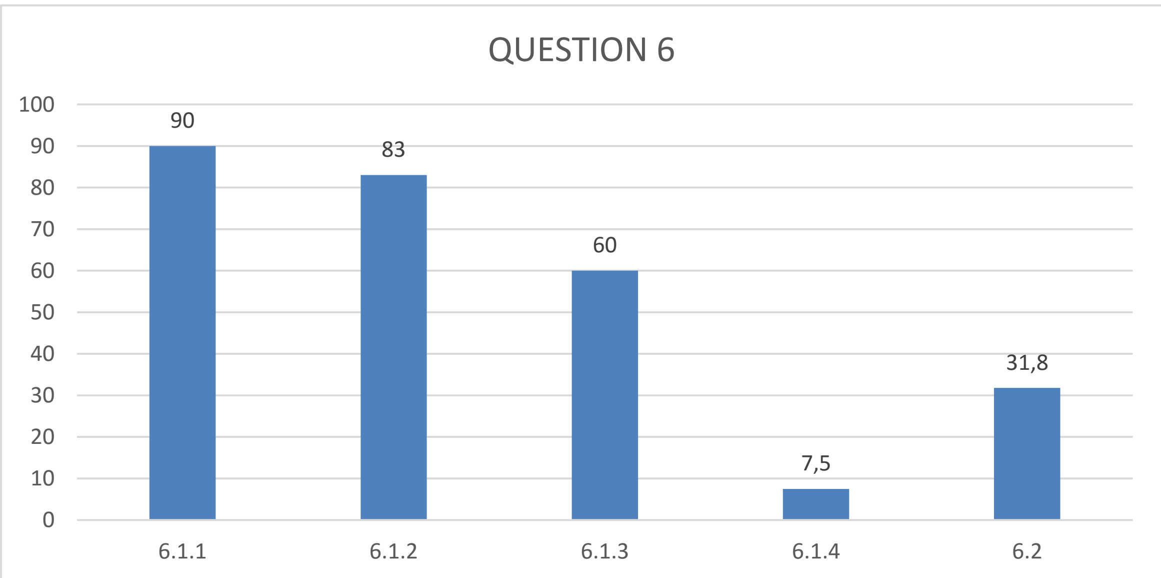
6.1.1	Write down the coordinates of T.	(1)
6.1.2	Determine the coordinates of Q.	(3)
6.1.3	Given that $x = 4{,}5$ at S, determine the coordinates of R.	(2)
6.1.4	Determine the value(s) of x for which $g''(x) > 0$.	(2)

6.2 The function defined as $y = \dfrac{a}{x+p} + q$ has the following properties:

- The domain is $x \in R,\ x \neq -2$.
- $y = x + 6$ is an axis of symmetry.
- The function is increasing for all $x \in R,\ x \neq -2$.

Draw a neat sketch graph of this function. Your sketch must include the asymptotes, if any. **(4)**

[12]



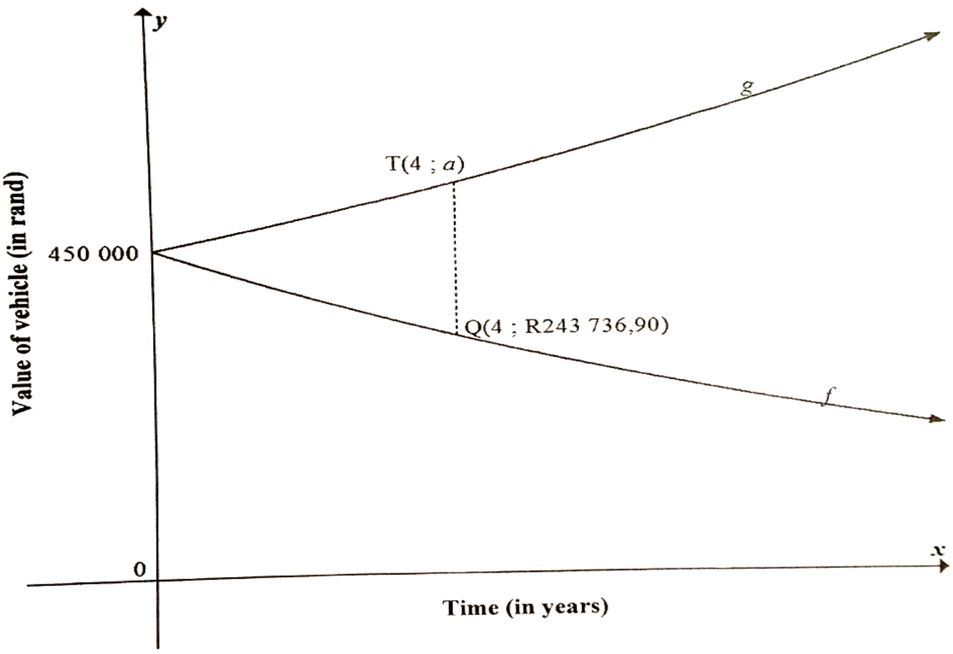
GENERAL COMMENTS:
This question tested the quadratic function/parabola and the hyperbola.
Educators should provide a variety of questions on functions so that the learners can familiarize themselves with the various ways of testing functions. Don't repeat the same type of questions when testing functions. Learners must not only practice the sketching of functions but also determining the equations in various forms, as well as interpretation and higher order questions testing understanding. Educators should revise functions more often in grade 12 as the bulk of this module is completed in grade 11.

6.1.1	Educators must emphasize the importance of writing point in coordinate form. Giving only 18 as the answer did not receive any marks. Candidates had to write $(0; 18)$.
6.1.2	When intercepts are calculated (in this case x-intercepts) the substitution of $y = 0$ must be shown. When asked for a coordinate learners must come into the habit of writing the values in coordinate form and not only $x = 3$. Full marks were not awarded in this case but only one mark.
6.1.3	The concept of the axis of symmetry was not understood by most candidates. The basic concepts and terminology of functions must be clearly illustrated or discovered through investigations. Where technology is available educators must make use of GeoGebra to lay the foundations of functions. This program is available for free on the internet and can be downloaded and installed on a computer, laptop or tablets.
6.1.4	The application of the second derivative is normally associated with cubic functions and not necessarily with quadratic functions. This was an easy question if the concept of the second derivative is understood. See question 9 for further discussion on the second derivative and its meaning.
6.2	This was a refreshing take on the hyperbola. Candidates were often asked to sketch the graph of the hyperbola, given the equation. When sketching the graph of a hyperbola, given the equation, educators should let learners write down the following each time a sketch is made: • The range and domain. • The equations of the asymptotes. • The coordinates of the point of intersection of the asymptotes. • The equations of the two axis of symmetry. • For which values of x will the function be increasing or decreasing. If learners are able to determine these aspects every time a sketch is drawn, they should be able to interpret the information when given as in this question. Learners should take care when drawing the graph not to touch or intersect the asymptotes and not to "curl" away from the asymptotes at a point. The mark for shape of the hyperbola is not awarded in these cases.

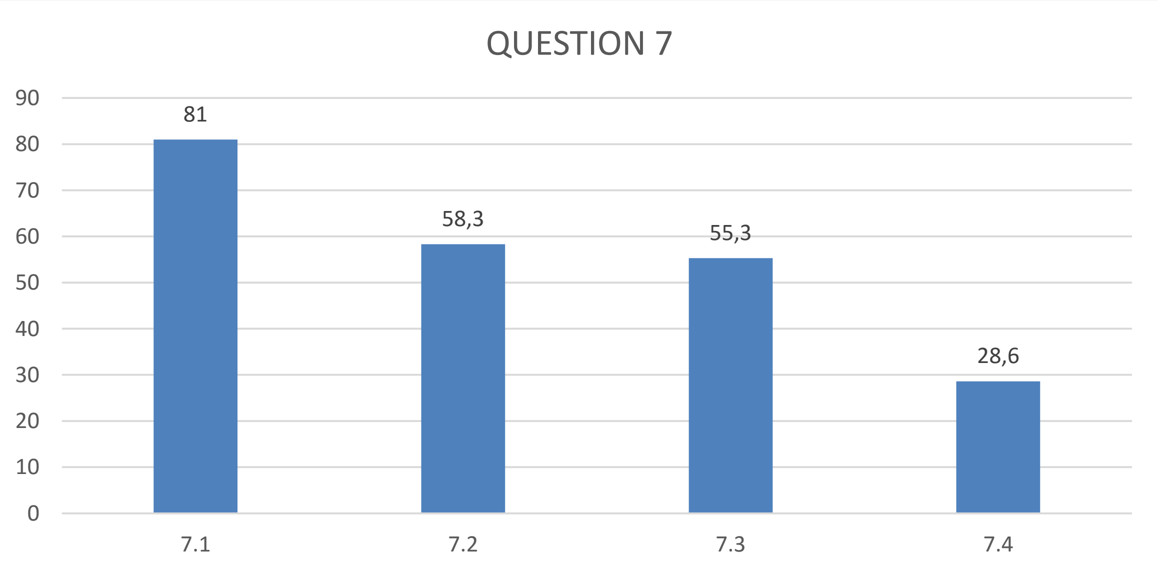
QUESTION 7 [13 marks]

QUESTION 7

The graph of f shows the book value of a vehicle x years after the time Joe bought it.
The graph of g shows the cost price of a similar new vehicle x years later.



7.1	How much did Joe pay for the vehicle?	(1)
7.2	Use the reducing-balance method to calculate the percentage annual rate of depreciation of the vehicle that Joe bought.	(4)
7.3	If the average rate of the price increase of the vehicle is 8,1% p.a., calculate the value of a.	(3)
7.4	A vehicle that costs R450 000 now, is to be replaced at the end of 4 years. The old vehicle will be used as a trade-in. A sinking fund is created to cover the replacement cost of this vehicle. Payments will be made at the end of each month. The first payment will be made at the end of the 13^{th} month and the last payment will be made at the end of the 48^{th} month. The sinking fund earns interest at a rate of 6,2% p.a., compounded monthly. Calculate the monthly payment to the fund.	(5) [13]



GENERAL COMMENTS:

This question tested knowledge and interpretation of Financial Maths. Although the questions were not of a high level the question was answered poorly. Candidates simply attempted questions without really understanding what is required of them. Some learners showed a complete lack of understanding and basic skills and used incorrect formulae. The question was accompanied with a graphical representation. Educators indicated that the graphs for the increase and decrease appeared to be linear which is a very valid statement. Closer inspection would however show that they are not.

The fact that the graphs looked like straight lines caused some confusion.

No advantage was given for this possible misconception in 7.2 as the question clearly stated by using the reducing-balance method. In 7.3 advantage was given for this possible misconception by awarding marks for the use of the formula $A = P(1 + in)$ as well. Any other formula was considered as the wrong formula and no marks were awarded.

Although the questions were not of a high level the question was answered poorly. Candidates struggled because of the nature of the question. Question 7.4 was poorly answered. Teachers must emphasize that learners must take care not to round values too soon and only when giving the final answer.

7.1	This question was answered well as it required reading a value from the graph.
7.2	The most common error was the swopping of the A and P values when substituting. Learners must practise the steps of making i the subject of the equation when $n > 3$. They do not show confidence in solving i when $n > 3$.
7.3	Careless mistakes were made when writing $8{,}1\%$ as a decimal value of $0{,}081$.
7.4	Candidates did not see the relation between this question and the previous ones. The whole principle of sinking funds has not been tested in recent years and might have been neglected over the years. Too many candidates simply used $R450\ 000$ as F_v. Teachers should encourage learners to draw timelines as to illustrate and understand the question better.
	More practice and drilling in financial maths are necessary so that learners can distinguish between the different formulae. Educators should use the different terminologies in class. Financial maths requires two crucial skills which are often neglected by learners. This is reading skills and calculator skills. The learners must read the financial maths question very carefully and make sure that they understand what is asked and calculator work is essential when doing financial maths and this should be practised.

QUESTION 8 [11 marks]

QUESTION 8

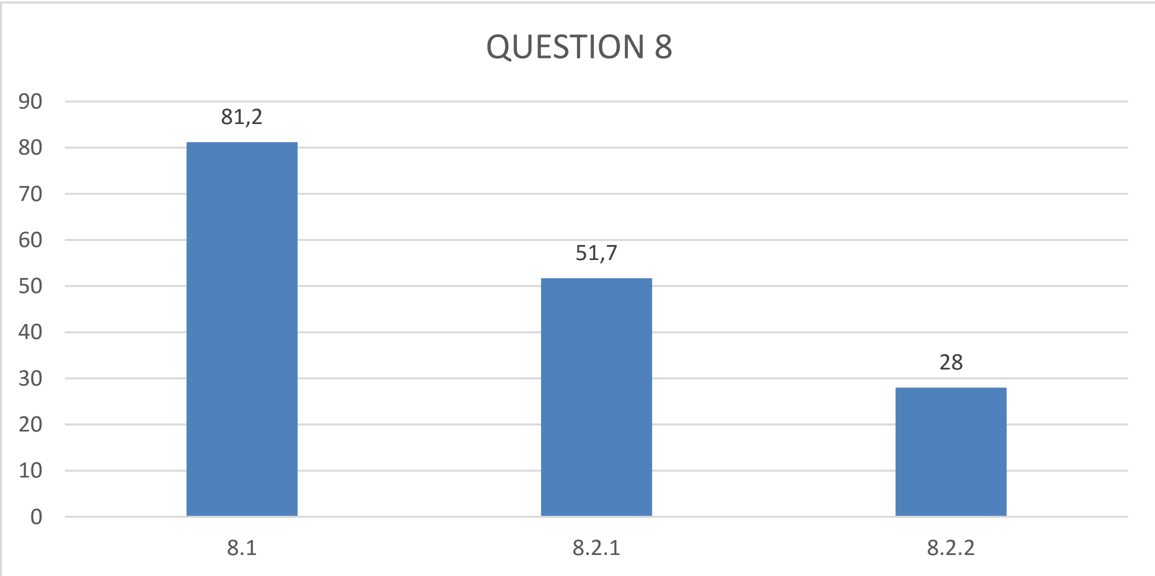
8.1 If $f(x) = x^2 - 3x$, determine $f'(x)$ from first principles. (5)

8.2 Determine:

8.2.1 $\frac{dy}{dx}$ if $y = \left(x^2 - \frac{1}{x^2}\right)^2$ (3)

8.2.2 $D_x\left(\frac{x^3 - 1}{x - 1}\right)$ (3)

[11]



GENERAL COMMENTS:

This is the question where teachers should emphasize notation. Candidates were penalized one mark for incorrect notation in Question 8. Educators must feel confident in teaching calculus. Cluster groups can be formed to support each other in understanding and sharing teaching strategies for calculus. Most learners experience calculus as an abstract section and struggle to answer any higher level questions. It is important that learners be given experiences which promote understanding rather than recipes. In teaching calculus, teachers should encourage learners to do many application problems, so that they develop an appreciation for its power and confidence in the methods.

8.1	This is a very predictable question. Most candidates used the correct formula and knew what to do but could not simplify $(x + h)^2 - 3(x + h)$. Simplification and notation errors were made which resulted in some marks being lost. One mark is penalised for notation errors in the whole of question 8. Learners expect that all terms not containing a h must cancel. If not, they tend to manipulate the expression to make it happen instead of working through their results to find the error. This approach to getting to a solution was penalized and no marks were awarded thereafter.

<table>
<tr><td></td><td>Teachers should note that omitting the brackets in the following step is not mathematically correct and could be penalised in future:
$$\lim_{h\to 0}(2x + h - 3)$$
Common notation errors are the following and these errors were penalised:
• If $f'(x)$ was not shown as part of the formula.
• If the lim was kept too long or omitted too soon.
• If an equal sign was written between the lim and the fraction part.</td></tr>
<tr><td>8.2.1</td><td rowspan="2">Removing the brackets or factorizing the difference of two cubes proved to be a problem for many candidates. These skills are taught in grade 10 and should be revised and tested more often.
Using the chain rule or the quotient rule to determine the derivative should be discouraged at school level. No marks were awarded if the derivative determined by using these rules was partially correct. Although the options of using these rules are included in the memo, not all markers are familiar with these rules as it is not part of CAPS and only taught in AP Maths.</td></tr>
<tr><td>8.2.2</td></tr>
</table>

QUESTION 9 [17 marks]

QUESTION 9

Given: $h(x) = -x^3 + ax^2 + bx$ and $g(x) = -12x$. P and Q$(2\,;\,10)$ are the turning points of h. The graph of h passes through the origin.

9.1 Show that $a = \frac{3}{2}$ and $b = 6$. (5)

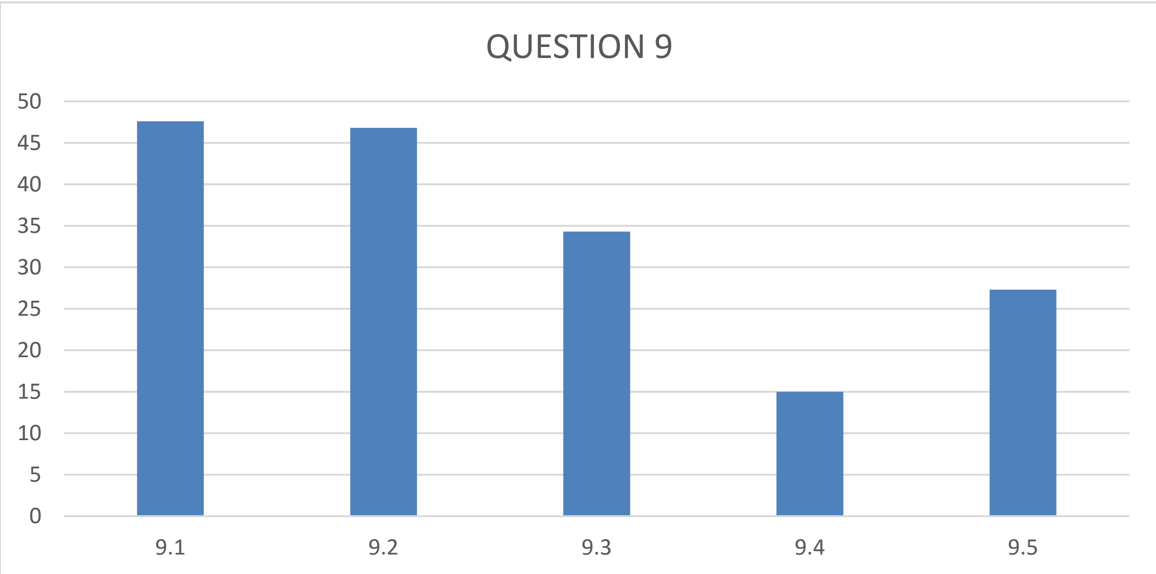
9.2 Calculate the average gradient of h between P and Q, if it is given that $x = -1$ at P. (4)

9.3 Show that the concavity of h changes at $x = \frac{1}{2}$. (3)

9.4 Explain the significance of the change in QUESTION 9.3 with respect to h. (1)

9.5 Determine the value of x, given $x < 0$, at which the tangent to h is parallel to g. (4)

[17]

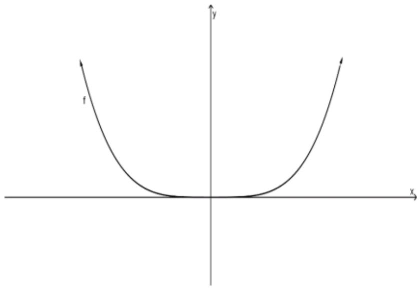


GENERAL COMMENTS

This question was challenging and thus poorly answered. The question tested knowledge on cubic functions.

When teaching this section learners should understand the following independent results for a function f.

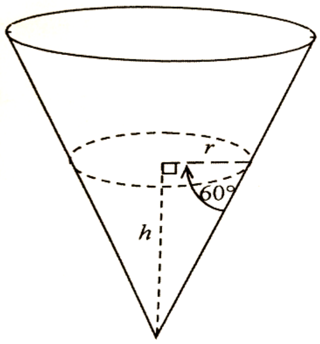
If $f(2) = 3$ then $(2\,;3)$ is a point on the graph.
If $f'(2) = 3$ then the graph has a gradient of 3 at the point where $x = 2$.
If $f''(2) = 3$ then the graph is concave up at the point where $x = 2$.
If $f(2) = 0$ then $(2;0)$ is an x-intercept.
If $f(0) = 2$ then $(0;2)$ is a y-intercept.
If $f'(2) = 0$ then the graph has a stationery point at $x = 2$.

9.1	When determining a and b, learners must understand the implications as mentioned above of $Q(2; 10)$ firstly being a point on the graph and secondly being a turning point and the subsequent application thereof. No marks were awarded if candidates used the given values of a and b to answer the question. Teachers must emphasize to the learners that these values are only given so that the remaining questions can be answered even if a candidate could not do 9.1.
9.2	Although this is a basic calculation dealt with from grade 10 most learners only scored a mark for the formula of the gradient. Marks are not awarded if candidates use random coordinates for P to determine the average gradient.
9.3	**PLEASE TAKE NOTE OF THE FOLLOWING DISCUSSION REGARDING THE CHANGE OF CONCAVITY. THIS CONCEPT MIGHT BE NEW TO MANY EDUCATORS.** Candidates were asked to show that the concavity changes at $x = \frac{1}{2}$. Calculating the x where $f''(x) = 0$ is NOT sufficient. To prove a change in concavity learners must show by substitution that $f''(x) > 0$ for values of $x < \frac{1}{2}$ and $f''(x) < 0$ for values of $x > \frac{1}{2}$. There must therefore be a change in the sign of $f''(x)$ at the point where $f''(x) = 0$. Although concavity will always change at $f''(x) = 0$ for a cubic function, this is not the general rule for change in concavity. $f''(x) = 0$ gives possible inflection points but must be tested for a change in sign to confirm or reject change in concavity. If $f''(x) > 0$ then graph is concave up at that point and if $f''(x) < 0$ then the graph is concave down at that point. Eg. $g(x) = x^4$ $g'(x) = 4x^3$ $g''(x) = 12x^2$ $12x^2 = 0$ $\therefore x = 0$ $\therefore y = 0$  Test for the point $(0; 0)$ as an inflection point. Substitute a value less than 0 and a value greater than 0. $g''(-1) = (-1)^4 = 1$ / $g''(2) = 4(2)^3 = 32$ The sign of $g''(x)$ does not change. Therefore $(0; 0)$ is not an inflection point and concavity does not change. $g''(x) > 0$ for all real values of x and therefore g is concave up for all real values of x. The graph of g confirms this.
9.4	A change in concavity implies that there is an inflection point at that point.
9.5	This was a higher level thinking question and candidates had to know their calculus theory very well to get good marks. Most candidates could only do the derivative of h.
	Educators must feel confident in teaching calculus. Cluster groups can be formed to support each other in understanding and sharing teaching strategies for calculus. Most learners experience calculus as an abstract section and struggle to answer any higher level questions. Teachers should try and keep calculus simple and structured and teach the basic principles as not to confuse learners.

QUESTION 10 [7 marks]

QUESTION 10

A rain gauge is in the shape of a cone. Water flows into the gauge. The height of the water is h cm when the radius is r cm. The angle between the cone edge and the radius is $60°$, as shown in the diagram below.



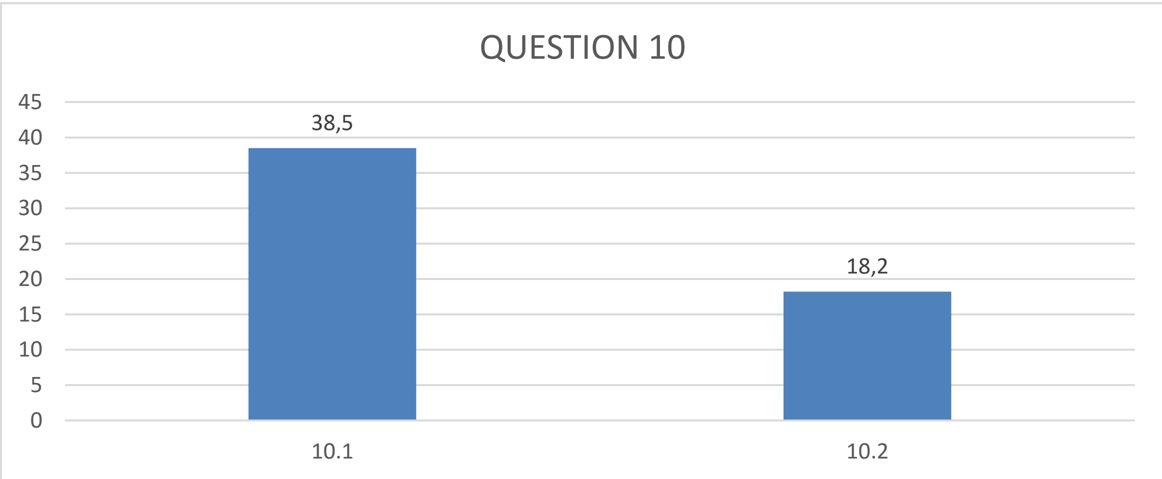
Formulae for volume:

$V = \pi r^2 h$	$V = \frac{1}{3}\pi r^2 h$
$V = lbh$	$V = \frac{4}{3}\pi r^3$

10.1 Determine r in terms of h. Leave your answer in surd form. (2)

10.2 Determine the derivative of the volume of water with respect to h when h is equal to 9 cm. (5)

[7]



GENERAL COMMENTS:

This question is still a great challenge to learners. This application of calculus was received by most candidates as a difficult question. According to the Rasch model, this was the worst answered question in the paper again. Application of calculus remains a challenge to most learners.

10.1	Very few candidates scored marks in this question.
10.2	Question 10.2 asked candidates to determine the derivative of the volume with respect to h if $h = 9$. Two common errors must be highlighted: 1. The derivative was calculated before r was substituted by $\frac{h}{\sqrt{3}}$. This implies that r was treated as a constant. 2. The value of $h = 9$ was substituted before the derivative was calculated. This lead to an expression with no h as variable to derive. Both these errors lead to a breakdown in marking.

QUESTION 11 [17 marks]

QUESTION 11

11.1 For two events, A and B, it is given that:

$P(A) = 0{,}2$
$P(B) = 0{,}63$
$P(A \text{ and } B) = 0{,}126$

Are the events, A and B, independent? Justify your answer with appropriate calculations. (3)

11.2 The letters of the word DECIMAL are randomly arranged into a new 'word', also consisting of seven letters. How many different arrangements are possible if:

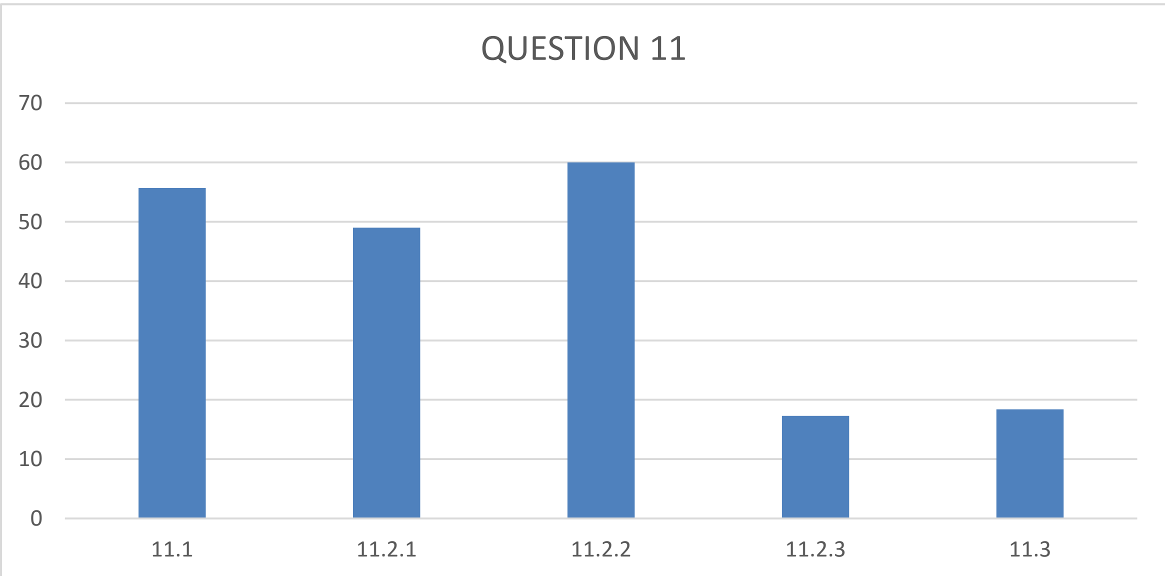
11.2.1 Letters may be repeated (2)

11.2.2 Letters may not be repeated (2)

11.2.3 The arrangements must start with a vowel and end in a consonant and no repetition of letters is allowed (4)

11.3 There are t orange balls and 2 yellow balls in a bag. Craig randomly selects one ball from the bag, records his choice and returns the ball to the bag. He then randomly selects a second ball from the bag, records his choice and returns it to bag. It is known that the probability that Craig will select two balls of the same colour from the bag is 52%.

Calculate how many orange balls are in the bag. (6)
[17]



GENERAL COMMENTS:

This was the second year that probability was tested as part of the core syllabus. It is evident that many candidates and possibly also teachers still lack confidence in this topic.Teachers can note that it is not necessary to simplify fractions when answering probability questions and that answers can be given as proper and improper fractions, decimal fractions and percentages.

11.1	Well answered by candidates who were taught. Some candidates scored one mark for $P(A) \times P(B)$. The rule for independent events was not recalled by most learners. The probability rules should be learnt by learners along with a practical understanding of the rules. Venn diagrams can be incorporated to understand the different probability rules. Teachers should note that if two events are not independent that it does not then imply that they are therefore dependent. Other variables could influence the dependency of two events and not necessarily the ones under discussion.
11.2.1 **11.2.2**	Although it was not required to determine 7^7 and $7!$ this year, learner should come into the habit to do the calculation as well. In 2014 these calculations were required. The question asked for "new word". The mathematically correct answer is: 11.2.1 $(7^7 - 1)$ and 11.2.2 $(7! - 1)$. However both answers were accepted in these questions.
11.3	This was a higher level thinking question and was answered very poorly. It was possible to determine the answer to this question through trial and error. If candidates only gave the correct answer, only one point was awarded. Learners must show that their solution worked if the determine the answer by trial and error. Eg. $t = 3$ because $\left(\frac{3}{5}\right)\left(\frac{3}{5}\right) + \left(\frac{2}{5}\right)\left(\frac{2}{5}\right) = \frac{52}{100}$

(c) Provide suggestions for improvement in relation to Teaching and Learning
Educators should drill basic mathematical skills in grade 8 and 9.
Topics covered and completed in grade 10 and 11 should be revise during grade 12 by making use of worksheets.
Educators should not assume that learners know how to use their calculators. They should be taught.
Don't coach learners for exams; teach the syllabus.
Work out as many previous papers as possible to familiarize learners with the various ways to ask the same question.
Encourage learners to work independently.
Educators should try to introduce more unseen questions to brighter learners.
Teachers as well as learners must be committed in teaching and studying the subject.
Test learners on the selection of the correct formula.
Integrate topics for higher level questions.
Candidates copy formulae incorrectly from the formula sheet.

(d) Describe any other specific observations relating to responses of learners
There are too many learners taking mathematics who lack very basic skills.
Candidates do not read the instructions/questions and do not motivate/explain an answer if asked for a motivation or explanation.
The language barrier remains a problem for many candidates.
Motivate learners to write neatly and answer the questions in numerical order.
Point out the instruction that states that an answer only will not necessarily be awarded full marks.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
Educators must regard grade 10, 11 and 12 as one unit and not only focus on grade 12.
Focus should be placed on the training and development of grade 8 and 9 educators. The understanding of basic skills are promoted in these grades.
Educators need to constantly upgrade their own mathematical knowledge and skills. Communicate with educators from surrounding schools and contact subject specialists.
If available, make use of technology in teaching certain topics. GeoGebra can be used to illustrate and teach various topics.
Be an enthusiastic maths teacher; you are involved in teaching a great subject.
Teachers should teach understanding and not only knowledge.
Subject advisors to visit schools frequently.
Subject advisors could use a memo discussion session for non-markers to enrich them.
When setting tests teachers should also include unseen higher order questions.

SIGNATURE OF CHIEF MARKER: ______________________________