Province of the
EASTERN CAPE
EDUCATION

EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
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REPUBLIC OF SOUTH AFRICA, Website: www.ecdoe.gov.za

2018 NSC CHIEF MARKER'S REPORT

SUBJECT:	**MATHEMATICS**
PAPER:	**1**
DURATION OF PAPER:	**3 HOURS**
DATES OF MARKING:	**30/11/18 – 14/12/18**

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

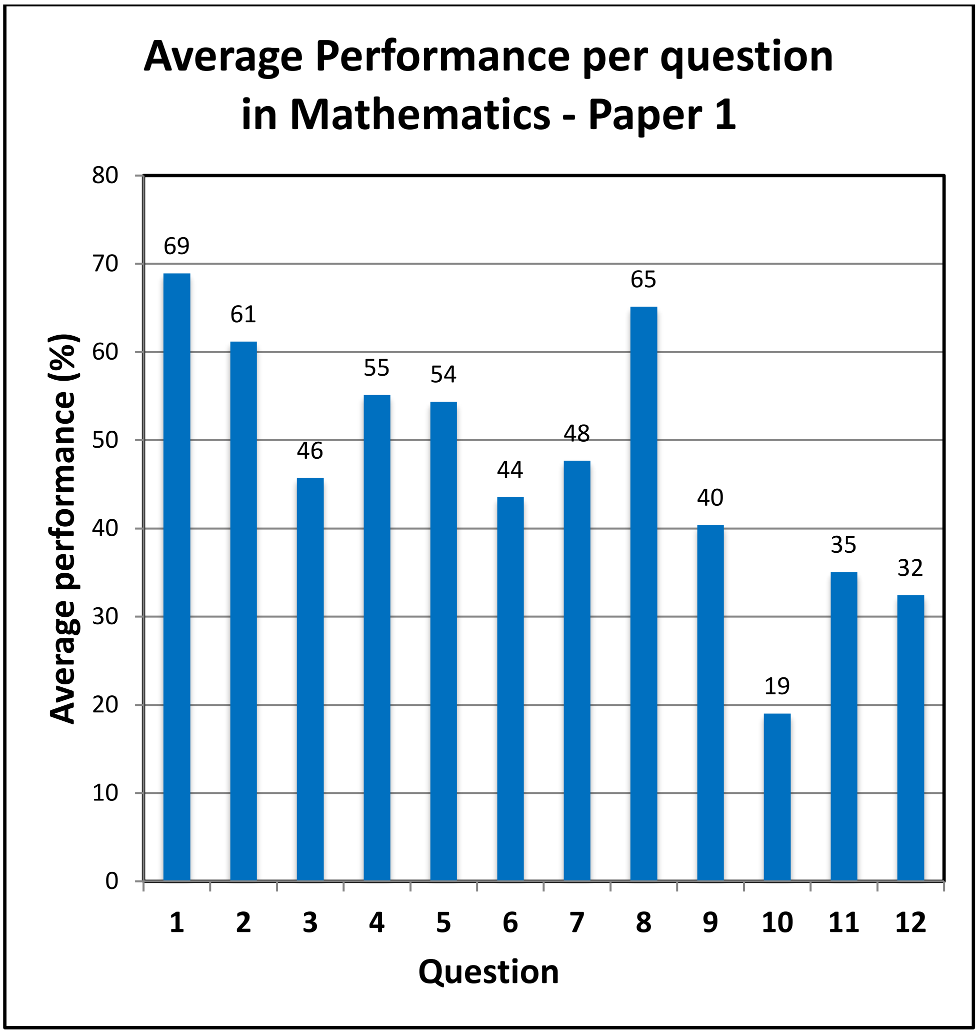
Results show an improvement in the pass rate for paper 1, which is very pleasing to see. There is, however, still a long road to be taken to reach the targeted and ideal results. All stakeholders involved in the development and teaching of Mathematics in our province must be complimented and thanked. Conditions are not always ideal but many continue to strive in making a difference.

Individual results covered the full spectrum from zero marks to almost full marks. There are centres where performance is very low but also centres of excellence where a significant number of candidates were able to achieve a level 7. Analysis of the sample of 100 scripts drawn from good, average and weak candidates indicates that candidates performed best in routine questions (1, 2 and 8) and worst in questions requiring applications and higher order thinking (10 and 12). 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.

Common mistakes were similar to those in previous papers. The report attempts to give input on how to assist educators to minimise these common errors.

Only writing the correct answer without showing any calculations does not necessarily score full marks.

BAR GRAPH FOR 100 SCRIPTS USED IN THE RASCH ANALYSIS



SECTION 2:

A bar graph is included at each question. This graph was generated from a question by question analysis of 100 scripts with total marks evenly spread from 0 to the highest mark. This will give a good indication of how the sub questions were answered and thus the report does not comment as much on the performance of the candidates.

Brief comments are made on common mistakes made and advice given to educators to implement so that candidates can achieve optimal results. Comments are also included to assist educators with internal marking as well as comments on the setting of internal papers. It is advised that educators read this report in conjunction with the official marking guideline.

Educators must remember that additional notes implemented at the marking venues only apply for the paper of 2018 and it cannot be perceived as policy.

QUESTION 1

1.1 Solve for x:

1.1.1 $x^2 - 4x + 3 = 0$ (3)

1.1.2 $5x^2 - 5x + 1 = 0$ (correct to TWO decimal places) (3)

1.1.3 $x^2 - 3x - 10 > 0$ (3)

1.1.4 $3\sqrt{x} = x - 4$ (4)

1.2 Solve simultaneously for x and y:

$3x - y = 2$ and $2y + 9x^2 = -1$ (6)

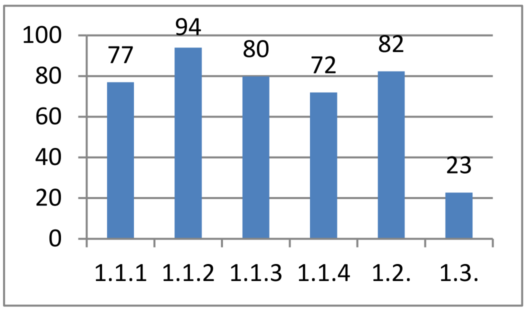
1.3 If $3^{9x} = 64$ and $5^{\sqrt{p}} = 64$, calculate, WITHOUT the use of a calculator, the value of: $\dfrac{\left[3^{x-1}\right]^3}{\sqrt{5}^{\sqrt{p}}}$

(4)

[23]

GENERAL COMMENTS

All candidates attempted Question 1. The routine start to the paper enabled candidates to make a confident start. Although the format of this question is very predictable candidates still lack the basic skills of solving quadratic equations, inequalities and simultaneous equations.

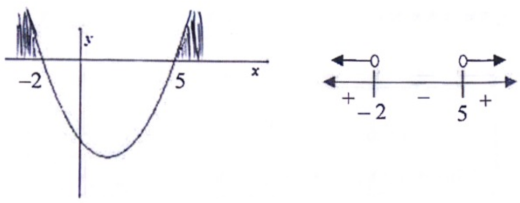


FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

1.1.1 Candidates could either have used factors or the quadratic formula to solve the equation. In the event of wrong factors or wrong substitution two marks were awarded if the roots were correct. Factorising skills play an important role in answering 1.1.1 and too many candidates lack these basic skills taught in grade 9 and 10.
Learners must be discouraged from relying on the use of calculators that have the function to solve equations.

1.1.2 The question was answered well. Most candidates scored marks as this is a routine question. Some candidates lost marks due to poor calculator work. Incorrect rounding was penalised only in this question and only one mark was lost.
Substituting b^2 as -5^2 instead of $(-5)^2$ resulted in a negative value for $b^2 - 4ac$. In this case candidates should conclude that there is no real solution or non-real roots and scored 2 out of the possible 3 marks. No marks are awarded if candidates conclude that the 'roots are undefined'.

1.1.3 Candidates are still faced with the challenge of understanding the method in solving inequalities and treat the inequality the same as an equation and therefore giving an incorrect solution of $x > -2 \; or \; x > 5$. This answer scores no final marks.
Educators could use various methods (number line, parabola, table function) to create an understanding of the concept of inequalities but once that has been achieved, learners should stick to one method.
Note that writing the answer as in the sketches below is not considered as a solution. It is merely considered as a method and the solution must be given as an inequality or in interval notation.



Also, note that $x\epsilon(-\infty;-2)$ can **NOT** be written as $x\epsilon(-2;-\infty)$. This is wrong notation.

1.1.4 The following common errors were made in solving $3\sqrt{x} = x - 4$.

Error 1: $9x = \boldsymbol{x^2 + 16}$ or $\boldsymbol{x^2 - 16}$

Error 2: $\boldsymbol{3x} = x^2 - 8x + 16$

These are basic skills that should be taught from grade 9. Motivate learners to write $\left(3\sqrt{x}\right)^2$ as $\left(3\sqrt{x}\right)\left(3\sqrt{x}\right)$ and $(x-4)^2$ as $(x-4)(x-4)$.

Most candidates did not check the validity of the two roots.

1.2 Solving simultaneous equations is a very predictable question and the format in which it was asked made it possible for candidates to score good marks in this question. Careless mistakes are however still being made.

1.3 This was a higher order question and the mark for raising to the power of three was in many cases the only mark scored.

Steps to follow for manipulating $\sqrt{5}^{\sqrt{p}}$:

$$\sqrt{5}^{\sqrt{p}} = \left(5^{\frac{1}{2}}\right)^{\sqrt{p}} = 5^{\left(\frac{\sqrt{p}}{2}\right)} = \sqrt{5^{\sqrt{p}}} = \sqrt{64} = 8$$

Two basic exponential laws are used: $(a^m)^n = a^{mn}$ and $a^{\frac{m}{n}} = \sqrt[n]{a^m}$

QUESTION 2

QUESTION 2

2.1 Given the quadratic sequence: 2 ; 3 ; 10 ; 23 ; …

2.1.1 Write down the next term of the sequence. (1)

2.1.2 Determine the n^{th} term of the sequence. (4)

2.1.3 Calculate the 20^{th} term of the sequence. (2)

2.2 Given the arithmetic sequence: 35 ; 28 ; 21 ; …

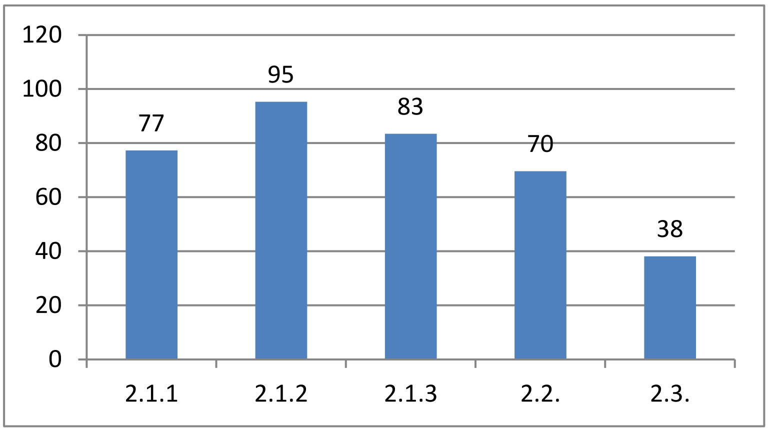
Calculate which term of the sequence will have a value of –140. (3)

2.3 For which value of n will the sum of the first n terms of the arithmetic sequence in QUESTION 2.2 be equal to the n^{th} term of the quadratic sequence in QUESTION 2.1? (6)

[16]

GENERAL COMMENTS

Question 2.1 and 2.2 were easy questions and prepared candidates were able to score high marks in these questions. The essence of question 2.3 was lost by most candidates as it required a good understanding of the language of maths.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

2.1 This question was attempted by most candidates and the most popular approach is solving the equations of $\boldsymbol{2a} = 6, \boldsymbol{3a} + \boldsymbol{b} = 1$ and $\boldsymbol{a} + \boldsymbol{b} + \boldsymbol{c} = 2$. Methods where long complicated formulae are used should be avoided as candidates use the incorrect formula and hence lose marks.
Marks were not awarded in 2.1.3 if the n-th term from 2.1.2 was not quadratic.

2.2 The most common mistake was to substitute -140 or 140 as n instead of T_n. The notation and meaning of n versus T_n should be introduced at an early level.
Emphasis must be placed on learners showing calculations. Giving only the correct answer of $n = 26$ scored only one mark.

2.3	Most candidates did not understand this question at all. The most common mistake made by candidates who did attempt the question was to equate the general term of the arithmetic sequence to the general term of the quadratic sequence. The essence of the question was to equate the sum of the arithmetic sequence to the general term of the quadratic sequence. If learners answer similar questions by means of expansion, it must be emphasized that the full expansion must be shown. In this case, $S_4 = S_7 = 98 = T_7\ (quadratic)$. Showing all calculations was again very important and only a correct answer scored only one mark.

QUESTION 3

QUESTION 3

A geometric series has a constant ratio of $\frac{1}{2}$ and a sum to infinity of 6.

3.1 Calculate the first term of the series. (2)

3.2 Calculate the 8^{th} term of the series. (2)

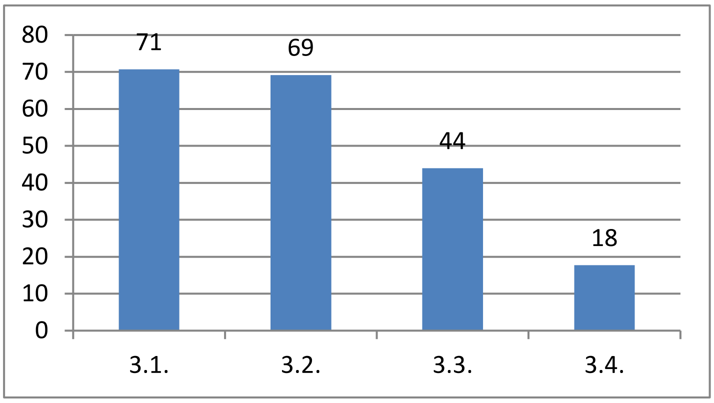
3.3 Given: $\sum_{k=1}^{n} 3(2)^{1-k} = 5{,}8125$ Calculate the value of n. (4)

3.4 If $\sum_{k=1}^{20} 3(2)^{1-k} = p$, write down $\sum_{k=1}^{20} 24(2)^{-k}$ in terms of p. (3)

[11]

GENERAL COMMENTS

Question 3.1 and 3.2 are standard questions testing geometric sequences. Question 3.3 and 3.4 proved to be more difficult and candidates performed poorly in 3.4.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

3.1 & 3.2 Although 3.1 was an easy sum to infinity question candidates still substituted $\frac{a\left(\left(\frac{1}{2}\right)^n - 1\right)}{\frac{-1}{2}} = 6$ to determine the value of a.

A common mathematical error that was seen in 3.2 was writing $3\left(\frac{1}{2}\right)^{n-1}$ as $\left(\frac{3}{2}\right)^{n-1}$. This is the same common error of $3(x-5)^2$ simplified to $(3x-15)^2$. Senior phase educators should introduce and emphasise the concept of $3(5)^2 = 3(25) = 75$. From grade eight, educators should add surds and raising to a power to the standard order of calculations learners are taught up to grade 7. They must realize that there is more to order of calculations than "BODMAS".

3.3 Although 3.3 and 3.4 are still linked to the original geometric sequence, there was no need for candidates to recognize the link and they could have treated each question individually. There is still a lack of understanding of sigma notation with the majority of learners. Educators are advised to start the discussion on sigma notation with elementary examples leading to the level of understanding required to answer 3.3 and 3.4. e.g.

$$\sum_{k=1}^{3} 2k = 2(1) + 2(2) + 2(3) = 12 \quad (sum\ of\ 3\ terms)$$

$$\sum_{k=0}^{3} 2k = 2(0) + 2(1) + 2(2) + 2(3) = 6 \quad (sum\ of\ 4\ terms)$$

$$\sum_{k=3}^{7} 2k = 2(3) + 2(4) + 2(5) + 2(6) + 2(7) = 50 \quad (sum\ of\ 5\ terms)$$

Once the basic fundamental understanding is reached, examples can progress to the next levels.

Determine:

$$\sum_{k=1}^{5} 3(2)^{1-k}$$

Calculate the value of n:

$$\sum_{k=1}^{n} 3(2)^{1-k} = 5{,}8125$$

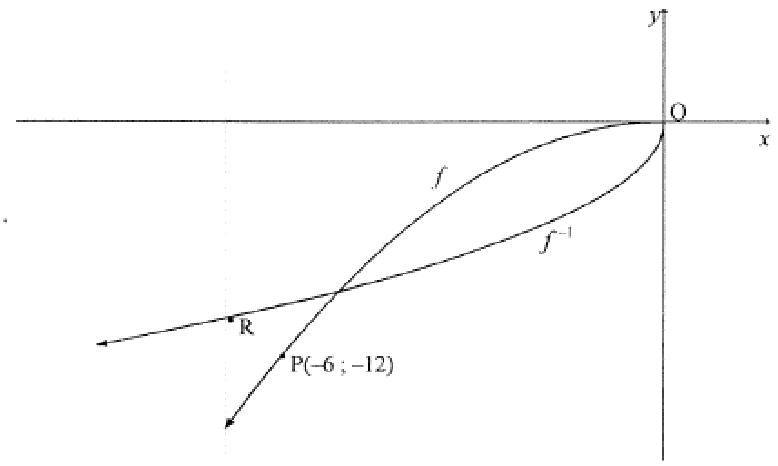
The most common error made was to use r as 2. Learners must be reminded to calculate the first three terms and use that to determine the value of r and not simply accept the base 2 as the value of r.

3.4 At first glance this question might be classified as a higher order question and was accordingly answered very poorly. However, if the S_n formula is used to calculate both sums the answers of 6 and 24 are reached. It is then not so difficult to identify the relation as either $4p$ or $p + 18$.

QUESTION 4

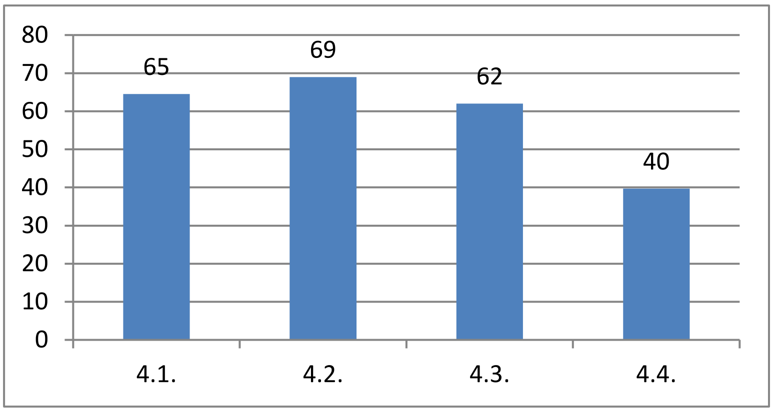
QUESTION 4

In the diagram below, the graph of $f(x) = ax^2$ is drawn in the interval $x \leq 0$.
The graph of f^{-1} is also drawn. P(–6 ; –12) is a point on f and R is a point on f^{-1}.



4.1	Is f^{-1} a function? Motivate your answer.	(2)
4.2	If R is the reflection of P in the line $y = x$, write down the coordinates of R.	(1)
4.3	Calculate the value of a.	(2)
4.4	Write down the equation of f^{-1} in the form $y = ...$	(3) **[8]**

GENERAL COMMENTS
Compared to previous papers, this was a fairly easy question testing inverse functions.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

4.1 Note that the following reasons for f^{-1} being a function was not accepted:

Wrong response	**Preferred response**
Vertical line test	Passes vertical line test
Horizontal lines cuts only once	Horizontal line cuts ***f*** only once

4.2 & 4.3	These are lower order questions testing the basic knowledge of inverse functions and the substitution of a point on a graph to determine the equation of the function. The use of brackets when substituting a negative value must be encouraged.
4.4	The majority of candidates knew the concept of swopping x and y to determine the inverse equation. Very few showed an understanding of the constraint on y to only being negative. Full marks were awarded if candidates determined the equation of the inverse in terms of $a.\left(y=-\sqrt{\frac{x}{a}}.\right)$

QUESTION 5

QUESTION 5

Given: $f(x)=\frac{-1}{x-1}$

5.1 Write down the domain of f. (1)

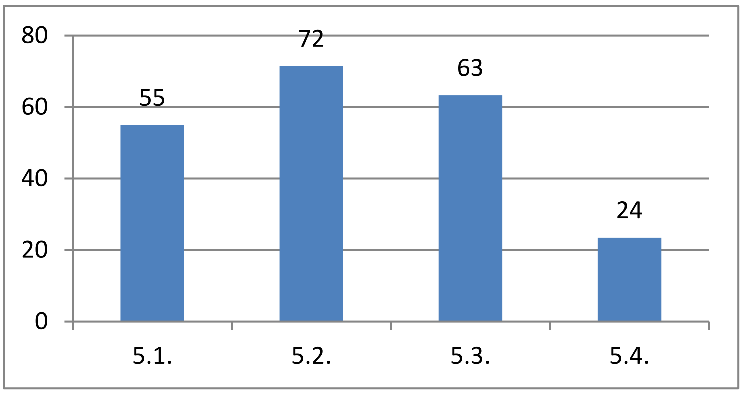
5.2 Write down the asymptotes of f. (2)

5.3 Sketch the graph of f, clearly showing all intercepts with the axes and any asymptotes. (3)

5.4 For which values of x will $x.f'(x)\geq 0$? (2)
[8]

GENERAL COMMENTS

Questions 5.1 to 5.3 were standard questions testing the hyperbola. Educators must do examples where the hyperbola is drawn first and learners asked to give the domain and equations of the asymptotes after sketching the graph and also vice versa as was the case in this question.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

5.1 Candidates were not penalised for excluding $x\epsilon R$ in the answer. Educators should, however, encourage learners to include it as part of the understanding of the number system.

5.2 When setting an internal paper, it must be noted that the question must state: "Write down the equation of the asymptotes." Due to the wording in this paper "x-axes" was accepted for the horizontal asymptote.
Learners must not say "vertical asymptote is 1" or $p=1$ and $q=0$. Marks are not allocated for these responses.

5.3 The instruction in this question is to sketch the graph of f. Marks were not allocated if candidates only gave a table containing various coordinates.
The y-value of the y-intercept and the x-value or equation of the vertical asymptote must be clearly written. Many candidates simply left out these values.
Care must be taken not to touch the asymptotes or shaping the graph in such a way that it tends to become circular. Candidates were penalised if this happened.

5.4 This question was poorly answered due to a lack of understanding of what was asked.
Candidates tried to solve the question by attempting to determine the derivative of f. In most cases this resulted in a mathematical breakdown as it is not part of the syllabus. Make use of the graph in 5.3 to answer this question.

Learners need to know the following:
If the graph is increasing, then $f'(x) > 0$
If the graph is decreasing, then $f'(x) < 0$
In this case f is increasing for all real values of x except at $x = 1$ and therefore $f'(x)$ is positive for all real values of x except at $x = 1$.

Drawing a table, as below or simply indicating the same information on the sketch will assist learners in understanding the essence of the question.

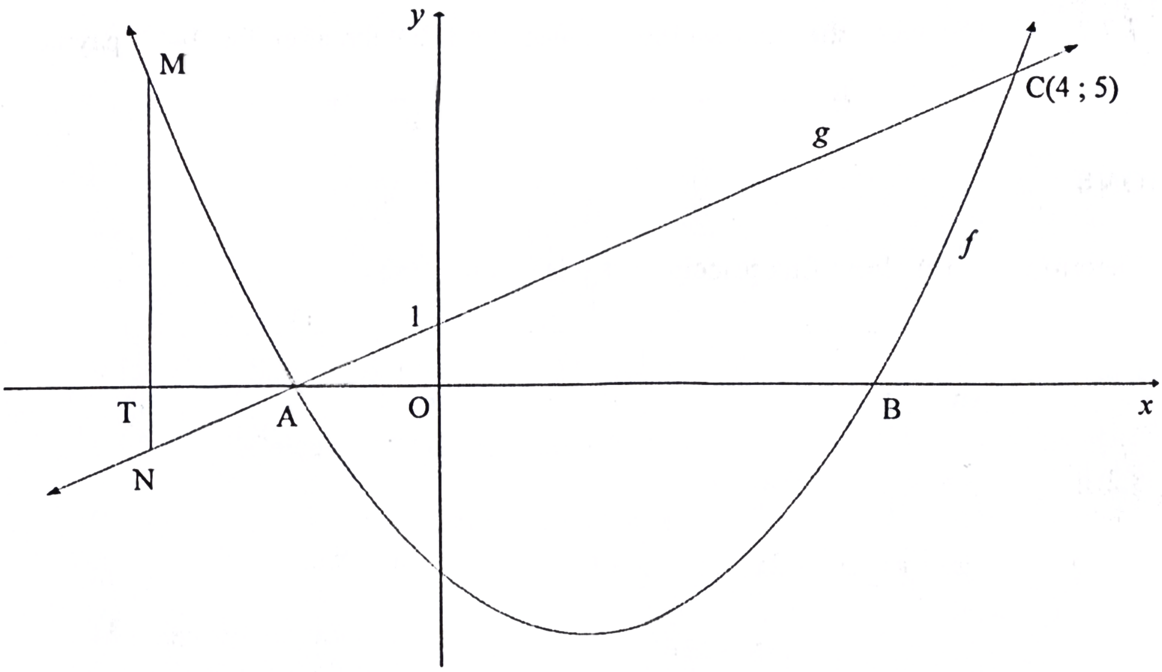
$x - values$	-5	-4	-3	-2	-1	0	1 $asymptote$	2	3	4	5	6
$x\ (+ or -)$	$-$	$-$	$-$	$-$	$-$	0	$+$	$+$	$+$	$+$	$+$	$+$
$f'(x)$	$+$	$+$	$+$	$+$	$+$	0	$excluded$	$+$	$+$	$+$	$+$	$+$
$\therefore x.f'(x)$	$-$	$-$	$-$	$-$	$-$	0	$excluded$	$+$	$+$	$+$	$+$	$+$

$\therefore x \geq 0, x \neq 1$

QUESTION 6

QUESTION 6

In the diagram below, A and B are the x-intercepts of the graph of $f(x) = x^2 - 2x - 3$.
A straight line, g, through A cuts f at C(4 ; 5) and the y-axis at (0 ; 1).
M is a point on f and N is a point on g such that MN is parallel to the y-axis.
MN cuts the x-axis at T.



6.1 Show that $g(x) = x + 1$. (2)

6.2 Calculate the coordinates of A and B. (3)

6.3 Determine the range of f. (3)

6.4 If MN = 6:

6.4.1 Determine the length of OT if T lies on the negative x-axis. Show ALL your working. (4)

6.4.2 Hence, write down the coordinates of N. (2)

6.5 Determine the equation of the tangent to f drawn parallel to g. (5)

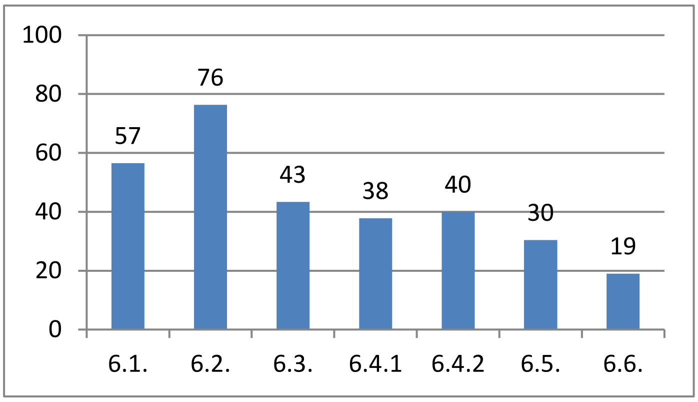
6.6 For which value(s) of k will $f(x) = x^2 - 2x - 3$ and $h(x) = x + k$ NOT intersect? (1)

[20]

GENERAL COMMENTS

It must be emphasized that if a question asks for coordinates the learners must give answers as coordinates and not only x-values. Although this is not always required it remains a good practice to encourage. If a question asks for an equation, learners must give the final step as an equation and not stop after c is calculated.

When setting internal papers, educators must refrain from giving accurate sketches as learners have the notion of measuring and estimating values. The nature of this sketch opened a door to estimations. Candidates assumed that C and M are symmetrical and that $OA = AT$. Both these assumptions were true but there was no information given that justified these assumptions. Although it is good practice to not draw sketches accurately, it must be emphasised that sketches should not be misleading. Learners should be able to check the validity of their answers according to the sketch.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

6.1 When learners answer questions of the nature "show that" as in 6.1 they will not score marks if they assume values from what needs to be shown. The focus of this question was in calculating the value of the gradient and thus assuming the gradient as $m = 1$ resulted in zero marks.
When setting similar questions for internal papers it is recommended to state the questions as follows.

a) Determine the gradient of g.
b) If it is given that $g(x) = x + 1$, calculate ……….

The essence of calculating the gradient is still tested and weaker learners can continue with follow up questions.

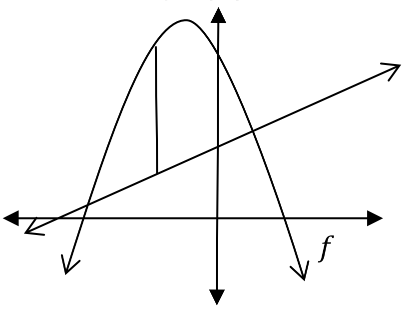
6.2 The marking guideline required learners to indicate $y = 0$ in calculating the x-intercepts.

6.3 It is encouraged that learners show all calculations as to allow consistent accuracy to apply. The order of interval notation (if used) is once again important and learners must be encouraged to write $y\epsilon[-4;\infty)$ and not only $[-4;\infty)$.

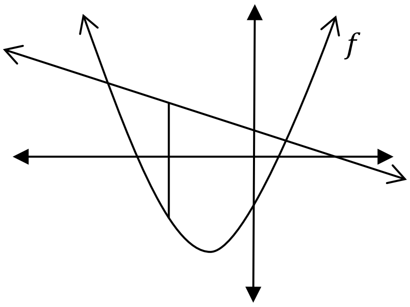
6.4.1& 6.4.2 Common mistakes in this question were the following:

- $f(x) = 6$
- $f(x) - g(x) = 0$
- $f(x) - g(x) = x^2 - 2x - 3 - x + 1 = 6$ (omitting the brackets)

The concept of the vertical distance between two functions can be introduced at an early stage so that learners have the necessary skills and knowledge that a length is always a positive value.
Learners must be able to clearly distinguish between the two cases below where the length(d) of the vertical line is involved:



$d = f(x) - g(x)$



$d = g(x) - f(x)$

Where technology is, available educators can make use of GeoGebra to lay the foundations of functions. This program is available free of charge on the internet and can be downloaded and installed on a computer, laptop or tablets.

6.5 This was a good critical thinking question where integration of the parabola, straight line and calculus was used. GeoGebra can once again effectively be used to give learners a better understanding of what is asked and also the thinking behind the calculations.

The essence of this question was to equate the derivative of f to the gradient g. Refer to notes in question 9 that could be of assistance in helping learners in answering this question.

QUESTION 7

QUESTION 7

7.1 Selby decided today that he will save R15 000 per quarter over the next four years. He will make the first deposit into a savings account in three months' time and he will make his last deposit at the end of four years from now.

7.1.1 How much will Selby have at the end of four years if interest is earned at 8,8% per annum, compounded quarterly? (3)

7.1.2 If Selby decides to withdraw R100 000 from the account at the end of three years from now, how much will he have in the account at the end of four years from now? (3)

7.2 Tshepo takes out a home loan over 20 years to buy a house that costs R1 500 000.

7.2.1 Calculate the monthly instalment if interest is charged at 10,5% p.a., compounded monthly. (4)

7.2.2 Calculate the outstanding balance immediately after the 144^{th} payment was made. (5)

[15]

GENERAL COMMENTS

The questions relating to finance were not of a very high level.

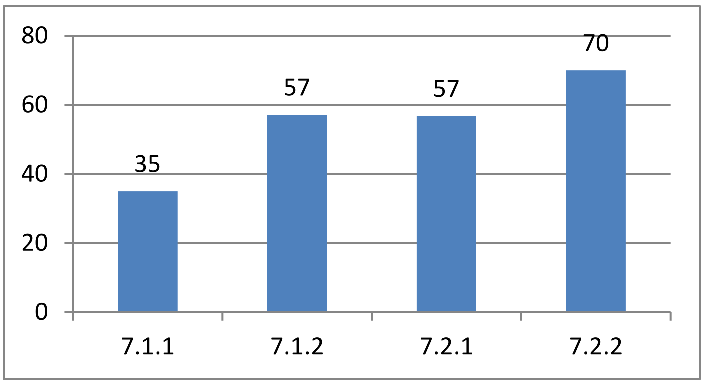
Some learners showed a complete lack of understanding and basic skills and use of formulae.

Although there are various ways of solving present and future value problems it is advised that educators do not provide too many options to the learners as this only leads to confusion.

It is reported annually that language is often a problem in the understanding of the question. Educators must use correct terminology and ensure that learners have a clear understanding of all the financial terminologies.

It is disappointing to see that candidates don't set up a timeline that will give a visual illustration of the information. The timeline sets the scene for mathematical thinking and there will be no need to repeatedly read the question.

It was acknowledged that there was a slight translation error in the Afrikaans maths paper in 7.1. The marking guideline made provision for misinterpretation of the question, if necessary. There was, however, no evidence of misconceptions and candidates were therefore not disadvantaged by the translation.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

7.1 This question was answered very poorly. The common mistakes were incorrect formula and incorrect i and n values.
It is recommended that learners practise the i and n value independently from the formulae. Once a learner understands the impact of different compounding periods they can thereafter focus on interpretation and substitution using the correct formulae.
There are two popular methods in solving 7.1.2 (Refer to marking guidelines). As said above, it is not advisable to expose especially weaker learners to all the options although it can be very enriching for brighter learners.

7.2 It appears that this question was answered better than 7.1. This could be attributed to the familiarity of the questions. Unnecessary marks were lost because of wrong i values and confusing the different methods.

It is recommended that special attention be given to this topic and that workshops be organised in various districts as to enrich the educators so that they can be empowered and hopefully give learners a better understanding of the topic.
Learners should also be exposed to the various scenarios giving guidelines as to the selection of the best formula.
Reading skills and calculator skills play a crucial role in the answering of financial maths and these skills must be practised.

QUESTION 8

QUESTION 8

8.1 Determine $f'(x)$ from first principles if it is given $f(x) = x^2 - 5$.

8.2 Determine $\frac{dy}{dx}$ if:

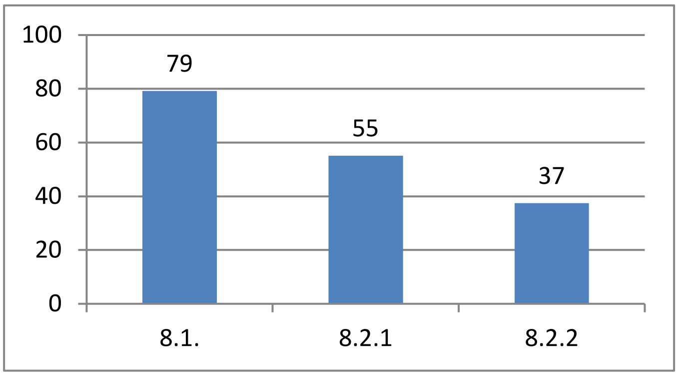
8.2.1 $y = 3x^3 + 6x^2 + x - 4$ (3)

8.2.2 $yx - y = 2x^2 - 2x \quad ; \quad x \neq 1$ (4)

[12]

GENERAL COMMENTS

Question 8.1 and 8.2.1 were very straight forward questions and the performance of the class of 2018 shows a pleasant improvement.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

8.1 This is one of the most predictable questions in paper 1 and it can be clearly seen that educators are assisting learners in coping with this question.
The following common mistakes were identified:

1) Omitting the brackets in substitution into the formula.
$x^2 + 2xh + h^2 - 5 - (x^2 - 5)$
Omitting the brackets led to $2xh + h^2 - 10$.
Learners know that all terms not containing h must cancel and should go back and look for the error. Simply omitting the -10 in the factorizing step resulted in a breakdown.
2) Notation errors were made. Notation was only penalized in 8.1 this year and nowhere else in calculus. The following two cases are considered as notation errors and learners must be informed:

$$\lim_{h \to 0} = \frac{f(x+h) - f(x)}{h}$$

If the lim section is left out too soon.
There was no penalty this year if the $'$ was left out in $f'(x)$.

Educators must take note that the constant cannot be left out in determining the derivative from first principles and only work with $f(x) = x^2$ and not $f(x) = x^2 - 5$. Candidates were penalized when doing this.

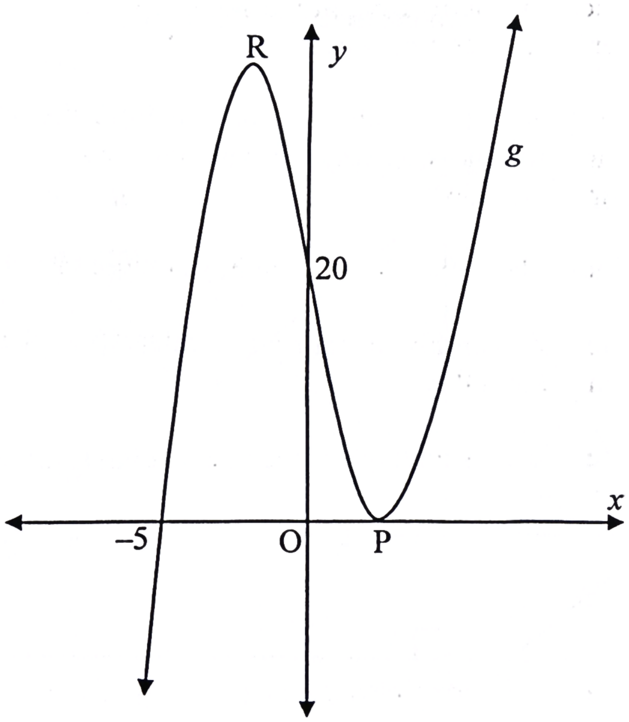
8.2 Question 8.2.1 was answered fairly well and tested very basic derivative skills.

Most candidates had no understanding of the principle of making y the subject of the expression (8.2.2) before determining the derivative. The skill of solving equations with literal coefficients is taught in grade 10 and is linked to derivatives. Remind learners that within the grade 12 syllabus the derivative can be determined once there are no surds, brackets or fractions with the deriving variable in the denominator. With the more difficult derivatives of for example $\frac{dy}{dx}$, learners must remember to make y the subject of the expression and not still have y-terms on the right. Knowledge of simplifying algebraic expressions and exponents and surds is therefore required.
Candidates who are familiar with alternative methods, i.e. chain and product rule, will not be disadvantaged if applied correctly.

QUESTION 9

QUESTION 9

9.1 The graph of $g(x) = x^3 + bx^2 + cx + d$ is sketched below.
The graph of g intersects the x-axis at $(-5 ; 0)$ and at P, and the y-axis at $(0 ; 20)$.
P and R are turning points of g.



9.1.1	Show that $b = 1$, $c = -16$ and $d = 20$.	(4)
9.1.2	Calculate the coordinates of P and R.	(5)
9.1.3	Is the graph concave up or concave down at $(0 ; 20)$? Show ALL your calculations.	(3)

9.2 If g is a cubic function with:

- $g(3) = g'(3) = 0$
- $g(0) = 27$
- $g''(x) > 0$ when $x < 3$ and $g''(x) < 0$ when $x > 3$,

draw a sketch graph of g indicating ALL relevant points. (3)

[15]

GENERAL COMMENTS
This question was poorly answered. Many learners still experience calculus as a very abstract module. Educators should keep on enriching their knowledge of calculus as to bring the content into perspective for learners. The use of GeoGebra is once again advised. Educators should try and keep calculus simple and structured and teach the basic principles as not to confuse learners. Higher level questions can thereafter be introduced to brighter learners.

The concepts below were mentioned in previous reports and need to be emphasized.
These fundamental principles were required in answering 9.1 and 9.2.
When teaching calculus, educators should ensure that learners understand the following independent results for a cubic 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 $f(2) = 0$ then $(2;0)$ is an x-intercept.

If $f(0) = 2$ then $(0;2)$ is a y-intercept.

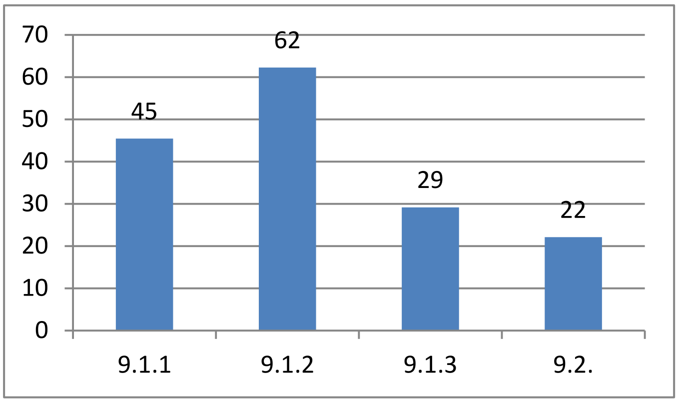
If $f'(2) = 0$ then the graph has a stationary point at $x = 2$.

If $f''(2) = 0$ then the graph has an inflection point at $x = 2$.

If $f''(2) = 3$ then the graph is concave up at the point where $x = 2$.

If $f''(2) = -3$ then the graph is concave down at the point where $x = 2$.

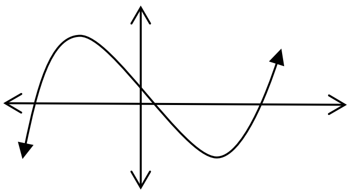
If $f''(x) > 0$ when $x < 2$ and $f''(x) < 0$ when $x > 2$ then the graph has an inflection point at $x = 2$ and the graph is concave up where $x < 2$ and concave down where $x > 2$.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

9.1.1 The essence of this question was for candidates to acknowledge the repeated root at point P. Learners must be familiar with the following principle of the cubic function and the x-intercepts.
(For simplicity, the coefficient of x^3 is used as 1.)

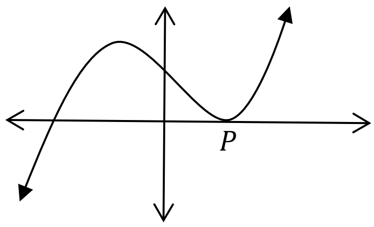
1)



$f(x) = (x - x_1)(x - x_2)(x - x_3)$

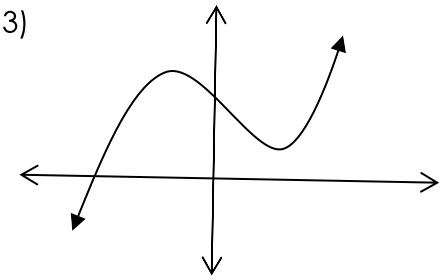
(3 unequal roots)

2)



Repeated root at P ($x = x_2$); therefore
$f(x) = (x - x_1)(x - x_2)^2$

3)



Only 1 real root.
$f(x) = (x - x_1)(ax^2 + bx + c)$

$b^2 - 4ac < 0$

The above principles can also be adapted when working with the quadratic function.

Candidates did not score any marks if the values of $b = 1$ and $c = -16$ were assumed/used in answering the question. When questions require candidates to "show" certain conditions it is essential that candidates need to convince the assessor that the given values were not used. Acknowledging and specifically referring to the repeated root was crucial in scoring full marks for this question.

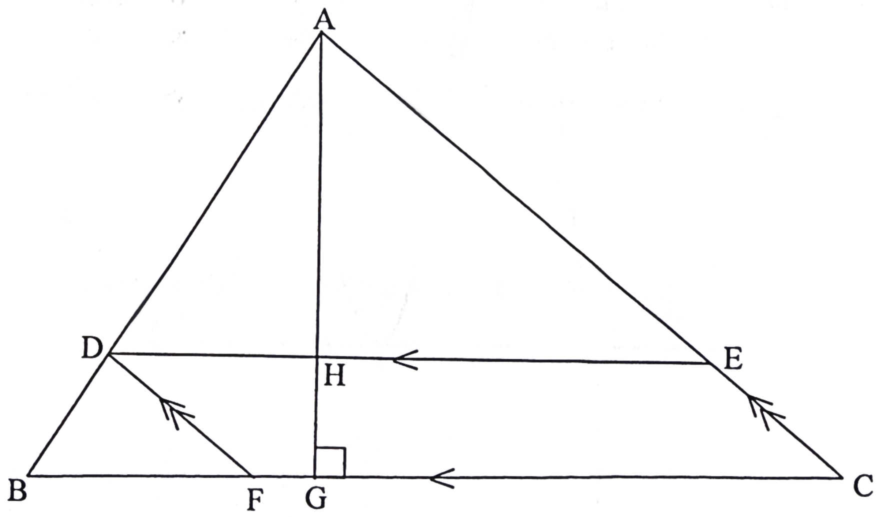
9.1.2 Emphasise the importance of showing that $f'(x) = 0$. Equating the derivative to zero can not be implied and candidates lost a mark if it was not shown.

QUESTION 10

QUESTION 10

In ΔABC:

- D is a point on AB, E is a point on AC and F is a point on BC such that DECF is a parallelogram.
- $BF : FC = 2 : 3$.
- The perpendicular height AG is drawn intersecting DE at H.
- $AG = t$ units.
- $BC = (5 - t)$ units.



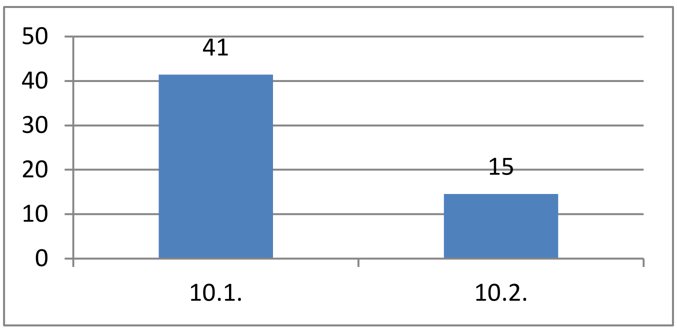
10.1 Write down AH : HG. (1)

10.2 Calculate t if the area of the parallelogram is a maximum.
(NOTE: Area of a parallelogram = base × ⊥height) (5)

[6]

GENERAL COMMENTS

The testing of application of calculus was once again the worst answered question in the paper. It was a completely new take on the testing of application as it was integrated with paper 2 theory of proportionality. The essence of the question was however still relevant to paper 1 and it was merely the theory of proportionality that was integrated and not a complex application thereof.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

10.1 The question did not clearly state that candidates need to write down the 'value' of $AH:HG$. Candidates were not penalised if they gave the answer as $AE:EC$ or $AD:DB$.

In the setting of internal papers at school, educators should be vigilant of similar ambiguous questions.

10.2 The theorem of proportionality was required to set up the expressions for the base (FC) and height (HG) of parallelogram $DFCE$.

The area of the parallelogram is proportional to the area of triangle ABC. The maximum area of the triangle will maximize the area of the parallelogram. This argument carried two marks.
The above argument followed by the calculations below is also correct.

$(Area\ of\ triangle)\ A = \frac{1}{2} \times b \times h = \frac{1}{2} \times (5-t) \times t$ ✓

$= \frac{5}{2}t - \frac{1}{2}t^2$

$\therefore \frac{dA}{dt} = \frac{5}{2} - t = 0$ ✓

$\therefore t = \frac{5}{2}$ ✓

Maximizing only $t(5-t)$ scored a maximum of 2 marks if no accompanying argument was given.

QUESTION 11

QUESTION 11

Given the digits: 3 ; 4 ; 5 ; 6 ; 7 ; 8 and 9

11.1 Calculate how many unique 5-digit codes can be formed using the digits above, if:

11.1.1 The digits may be repeated (2)

11.1.2 The digits may not be repeated (2)

11.2 How many unique 3-digit codes can be formed using the above digits, if:

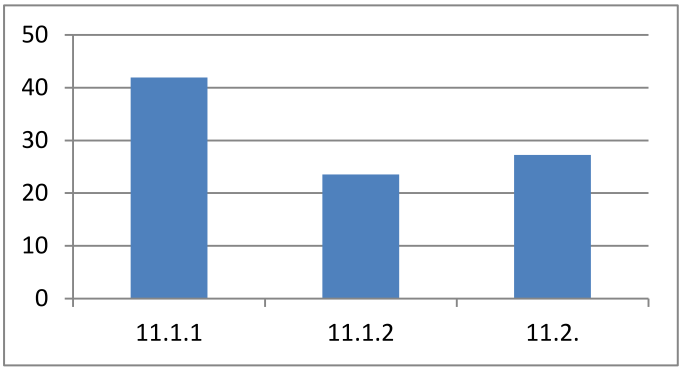
- Digits may be repeated
- The code is greater than 400 but less than 600
- The code is divisible by 5

(3)

[7]

GENERAL COMMENTS

Fundamental counting principles still prove to be a challenge to many candidates and possibly educators as well. Focus once again on the basics of counting principles and work forward by challenging brighter learners with more difficult questions.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

11.1 One method of answering questions similar to 11.1 is to set up blocks/lines where the number of possibilities can be indicated. The total number of combinations will then result in the product of these blocks/lines.

11.1.1 7 digits may be repeated.

7 possibilities	7 possibilities	7 possibilities	7 possibilities	7 possibilities
Position 1	Position 2	Position 3	Position 4	Position 5

$\therefore 7 \times 7 \times 7 \times 7 \times 7 = 7^5 = 16\ 807$

This year it was not required from candidates to give the answer as 16 807. It is recommended that learners be advised to continue to do the calculator work.

11.1.2 7 digits but may not be repeated.

7 possibilities	6 possibilities	5 possibilities	4 possibilities	3 possibilities
Position 1	Position 2	Position 3	Position 4	Position 5

$\therefore 7 \times 6 \times 5 \times 4 \times 3 = 2520$

11.2 Candidates who attempted this question did not always realise that all three conditions must be implemented simultaneously.
Learners need to stick to the basics of the topic and simply analyse the conditions and apply them to the block/line method.

Learners need to know that they must read all the conditions as a unit and not necessarily apply them from the first to the last.

2	7	1
The code is greater than 400 but less than 600. The first digit has only 2 possibilities, i.e. 4 or 5.	Digits may be repeated. The middle position has 7 possibilities.	The code must be divisible by 5. The last digit has one possibility, i.e. 5.

$$\therefore 2 \times 7 \times 1 = 14$$

QUESTION 12

QUESTION 12

12.1 Given: P(A) = 0,45; P(B) = y and P(A or B) = 0,74

Determine the value(s) of y if A and B are mutually exclusive. (3)

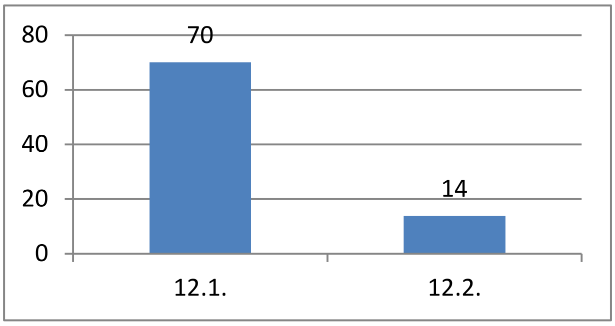
12.2 An organisation decided to distribute gift bags of sweets to a Grade R class at a certain school. There is a mystery gift in exactly $\frac{1}{4}$ of the total number of bags.

Each learner in the class may randomly select two gift bags of sweets, one after the other. The probability that a learner selects two bags of sweets with a mystery gift is $\frac{7}{118}$. Calculate the number of gift bags of sweets with a mystery gift inside. (6)

[9]

GENERAL COMMENTS

There is still a vast majority of candidates that do not attempt the questions on probability or give completely irrelevant answers. Question 12.1 was answered fairly well but 12.2 was probably the worst answered question.



FEEDBACK ON RESPONSES OF CANDIDATES, COMMON ERRORS AND COMMENTS TO IMPROVE LEARNER PERFORMANCE

12.1 The essence of this question was the understanding that if two events $(A, B)$are mutually exclusive, $P(A\ and\ B) = 0$. Candidates that applied this rule to the general probability formula mostly scored full marks.

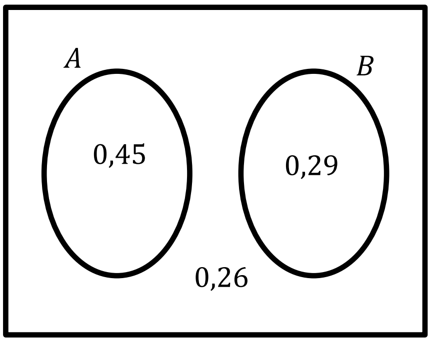
Educators must give a one page summary of all the possible events and indicate the effect it has on the general rule as well as an illustration of the Venn diagram.

For example:

General rule: $P(A\ or\ B) = P(A) + P(B) - P(A\ and\ B)$

Mutually exclusive events: $P(A\ and\ B) = 0$

$\therefore\ P(A\ or\ B) = P(A) + P(B)$



The same can be done for mutually exclusive events and complementary events. In addition to these events and their Venn diagram illustrations the rule for independent events can also be included.

12.2 This was an extremely challenging question and many candidates simply left it out. It is possible that language was a barrier in the understanding of the information given.

There were various approaches to answering this question. The most important factor in all cases was that if the first draw contained a mystery gift both the numerator and denominator must decrease by one for the probability of the second draw to also contain a mystery gift.

The approach of assuming that the probability that the second draw contains a mystery gift as x, setting up the equation $\frac{1}{4} \times x = \frac{7}{118}$ and solving for $x = \frac{14}{59}$ is not always so simple to conclude that there are 60 bags in total and 15 containing mystery gifts.

The following example illustrates the problem:

If all the information stays the same but the probability of selecting two bags with a mystery gift changes to $\frac{2}{33}$, the following will happen.

$\frac{1}{4} \times x = \frac{2}{33}$

$\therefore x = \frac{8}{33}$

Increasing the numerator and the denominator to $\frac{2}{33}$ does not give a probability of $\frac{1}{4}$.

The solution should then conclude by adding one to the multiples of both the numerator and denominator and confirming that it gives a probability of $\frac{1}{4}$.

$\therefore \frac{8n+1}{33n+1} = \frac{1}{4}$

$\therefore 32n + 4 = 33n + 1$

$\therefore n = 3$

$\frac{8n+1}{33n+1} = \frac{25}{100}$

$\therefore$ total of 100 bags of which 25 contain a mystery gift.

GENERAL SUGGESTIONS FOR IMPROVEMENT IN RELATION TO TEACHING AND LEARNING
The foundation for basic mathematical skills must be laid in grade 8 and 9.
Educators should not assume that learners know how to use their calculators.
Don't simply coach learners for exams. Teach the syllabus. This approach applies even more for learners who intend to study further in Mathematics. We need to ensure the integrity of assessments.
Motivate learners to work through previous papers as to familiarise themselves with the various ways of asking the same topic.
Encourage learners to work independently during the year. Learners can benefit from study groups as well but the final 'test' depends on the individual's ability to think.
Educators should try to introduce more unseen questions to brighter learners. Integrate topics for higher level questions.
Teachers as well as learners must be committed in teaching and studying the subject.
Test learners on the selection of the correct formula from the information sheet. Make the information sheet available during all tests (formal and informal) and examinations in grade 12.
Learners must realise that they cannot expect great things to happen if they don't put in effort and sometimes sacrifice to achieve their dreams.

OBSERVATIONS RELATING TO RESPONSES OF LEARNERS
There are too many learners taking Mathematics who lack the basic skills.
Candidates do not read the instructions/questions and do not motivate/explain an answer if asked for a motivation or explanation. They must give an equation if an equation is asked and not stop too soon. Give coordinates if coordinates are asked for.
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.
When x-intercepts, stationary points or inflection points are calculated, equating to 0 is important and carries a mark.
If a sub-question is answered out of place from the rest of the question it is always good to write a note regarding the page on which it is redone.

ADDITIONAL COMMENTS USEFUL TO TEACHERS, SUBJECT ADVISORS, TEACHER DEVELOPMENT ETC.
Educators are encouraged to make use of this report throughout the year as topics are discussed and not read through once.
Educators must regard grades 10, 11 and 12 as one unit and not only focus on grade 12.
Focus should be placed on the training and development of grades 8 and 9 educators. The understanding of basic skills is 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.
When setting tests, teachers should also include unseen higher order questions.
If available, make use of technology in teaching certain topics. As mentioned

several times in the report, 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 continue visiting schools and assist educators in various ways.
Subject advisors could use a memo discussion session for non-markers to enrich them.
ECDOE must ensure that there is a Mathematics subject advisor appointed in each district.
All stakeholders must be congratulated for the various programs that have been implemented in our province to improve Mathematics.