Province of the
EASTERN CAPE
EDUCATION

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

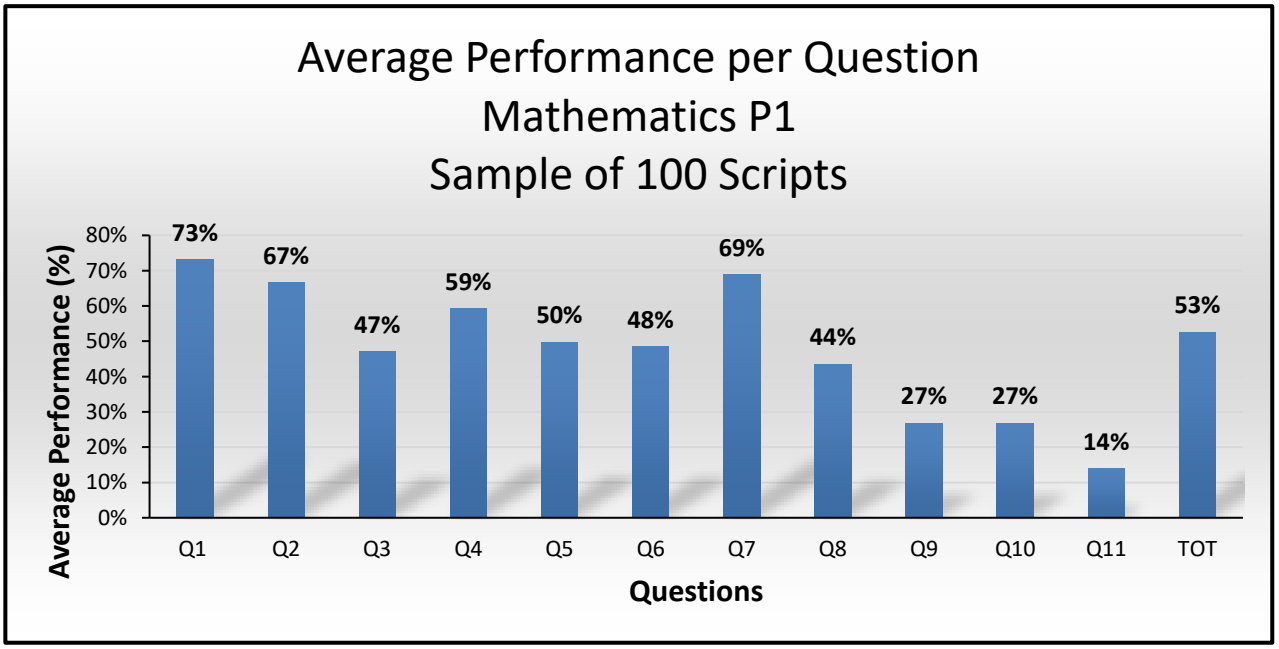
2020 NSC CHIEF MARKER'S REPORT

SUBJECT		**MATHEMATICS**
PAPER		**1**
DURATION OF PAPER		**3 hours**

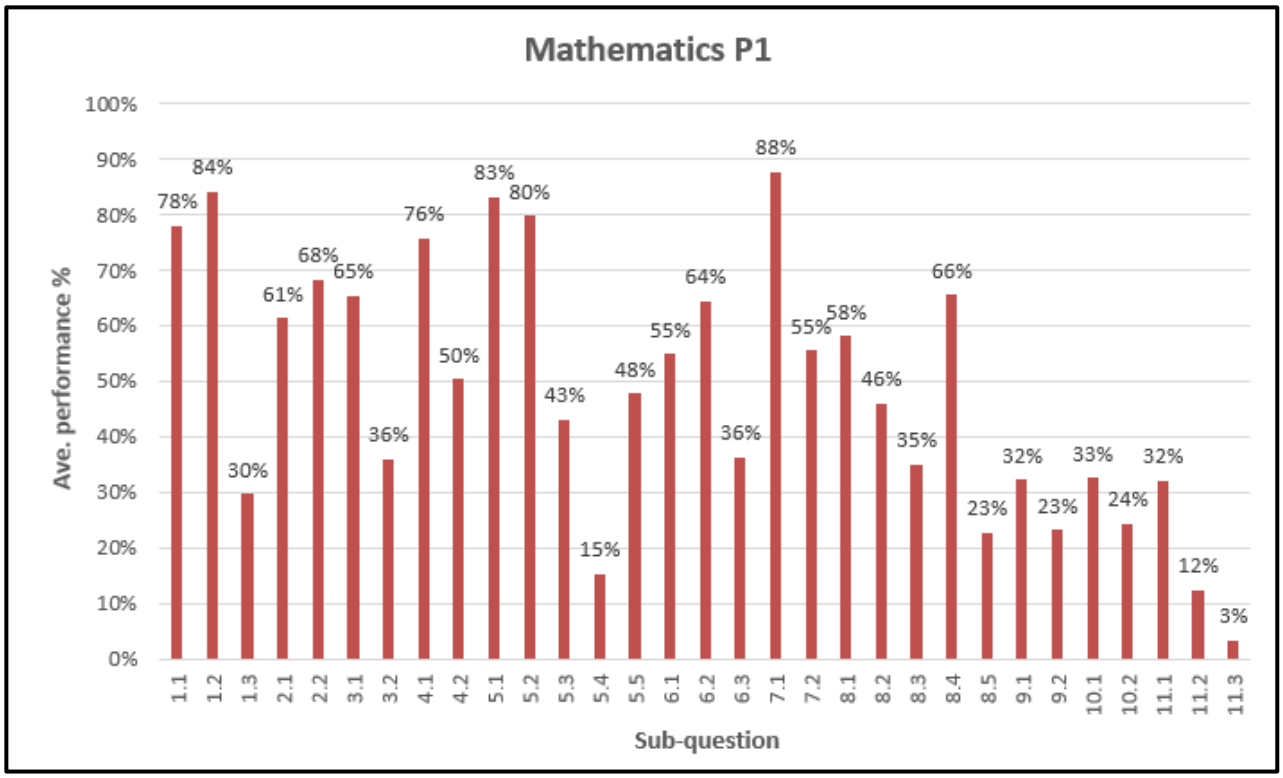
SECTION 1: (General overview of Learner Performance in the question paper as a whole)

Candidate results covered the full spectrum from zero marks to full marks. The graph below shows an analysis of the marks for 100 scripts drawn from good, average and weak candidates with an even distribution of marks from 0 to almost full marks. The graph indicates that these candidates performed best in routine questions
(1, 2 and 7) and worst in questions requiring applications and higher order thinking (9, 10 and 11).

This paper tested whether mathematical concepts is being taught in our classrooms and whether learners have the basics and conceptual understanding of certain topics. Learners should realise that it is important to understand the basic concepts in order to answer the higher cognitive level questions. It requires hard work, dedication and perseverance to achieve goals. Practising previous year's examination question papers improves mathematical proficiency and procedural fluency.



Average Performance per sub-question in Mathematics Paper 1
Sample of 100 Scripts



SECTION 2: Comment on candidates' performance in individual questions

The bar graphs generated from the Rasch analysis are included for each question. Please note that this is drawn from 100 scripts ranging from 0 to almost full marks and does not give a true reflection of the overall achievement of all candidates but gives a good indication of how the results for the subquestions vary. The challenging year definitely had an influence on the overall achievement of candidates. In many cases performance was very poor as too many learners lack the basic knowledge and understanding of Mathematics.

Brief comments are made on common mistakes made and advice is given to educators to implement so that future 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 2020 and it cannot be perceived as policy or a way of teaching maths going forward.

QUESTION 1

1.1 Solve for x:

1.1.1 $x^2 - 6x = 0$ (2)

1.1.2 $x^2 + 10x + 8 = 0$ (correct to TWO decimal places) (3)

1.1.3 $(1-x)(x+2) < 0$ (3)

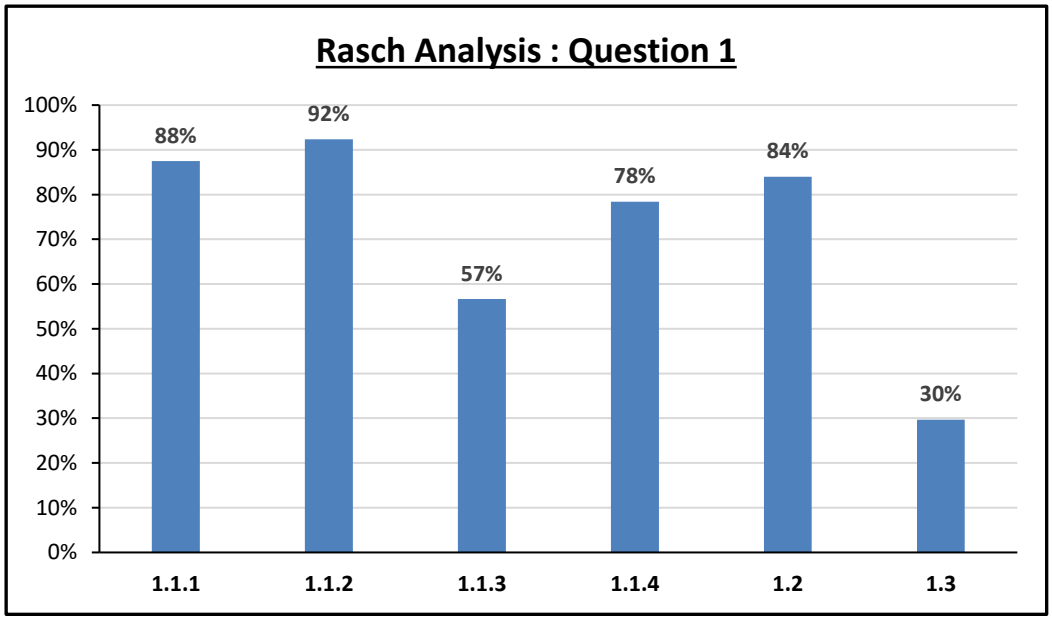
1.1.4 $\sqrt{x+18} = x - 2$ (5)

1.2 Solve simultaneously for x and y:

$x + y = 3$ and $2x^2 + 4xy - y = 15$ (6)

1.3 If n is the largest integer for which $n^{200} < 5^{300}$, determine the value of n. (3)

[22]



It is expected that question 1 should be one of the best answered questions as it once again contained very routine questions. From the subquestion graphs it is clear which were well or poorly answered.	
1.1.1	Consistent accuracy was applied for wrong factors.
1.1.2	No marks are allocated if a wrong formula was used or if candidates factorised the quadratic expression. This is the question where one mark is lost for incorrect rounding.
1.1.3	Candidates are still faced with the challenge of understanding the concept of solving inequalities. Most candidates scored 1/3 for critical values. Treating the inequality sign as an equal (=) sign is a B/D. Candidates doesn't know the difference between "or" & "and". There are various methods that can be used in the solving of inequalities, e.g. parabola, number line or tables. It would help learners to understand the solution to an inequality if the problem is unpacked and demonstrated by using various values within the intervals. Visualizing the question by means of the graph of the function can assist in the understanding of the method. Topic taught using "short-cuts" with candidates having no understanding. Educators can refer to the method illustrated in the Mind the Gap study guide compiled by the Department of Basic Education.
1.1.4	Candidates answered this question well. Many candidates who managed to complete the question neglected to discard the -2 as a solution. Testing answers to ensure full marks should be emphasized.
1.2	Routine question that was fairly well answered. There were still some candidates that made unnecessary simple mistakes resulting in standard form which cannot factorise, i.e. making x or y the subject of the linear equation, instead of $y = 3 - x$ they wrote $y = x - 3$ *or* $y = x + 3$. Although substitution is handled well by the majority, the algebraic manipulation thereafter needs attention.
1.3	Although this question required basic exponential/surd skills it was complicated by many candidates applying incorrect mathematics to solve for n. There are many different ways to solve this question. This was a challenging question for candidates and it was one of the most poorly answered questions. Many candidates also left the solution as n < 11,18 ($5\sqrt{5}$). Most candidates did not even attempt this question.

General comments

- Most of the content of question 1 is completed in grade 11. Learners must regularly revisit these sections from the start of grade 12.
- Learners who struggle to factorise solving quadratic equations can be motivated to use the formula.
- Ensure that learners know how to round off; do not assume that they know.
- Teach the use of the quadratic formula not only in terms of x but using other unknowns as well. This will prevent candidates from interchanging y and x when first solving y in simultaneous equations.
- Encourage learners to use calculator as check device.

QUESTION 2

2.1 $7\ ;\ x\ ;\ y\ ;\ -11\ ;$ ... is an arithmetic sequence. Determine the values of x and y. (4)

2.2 Given the quadratic number pattern: $-3\ ;\ 6\ ;\ 27\ ;\ 60\ ;$ ...

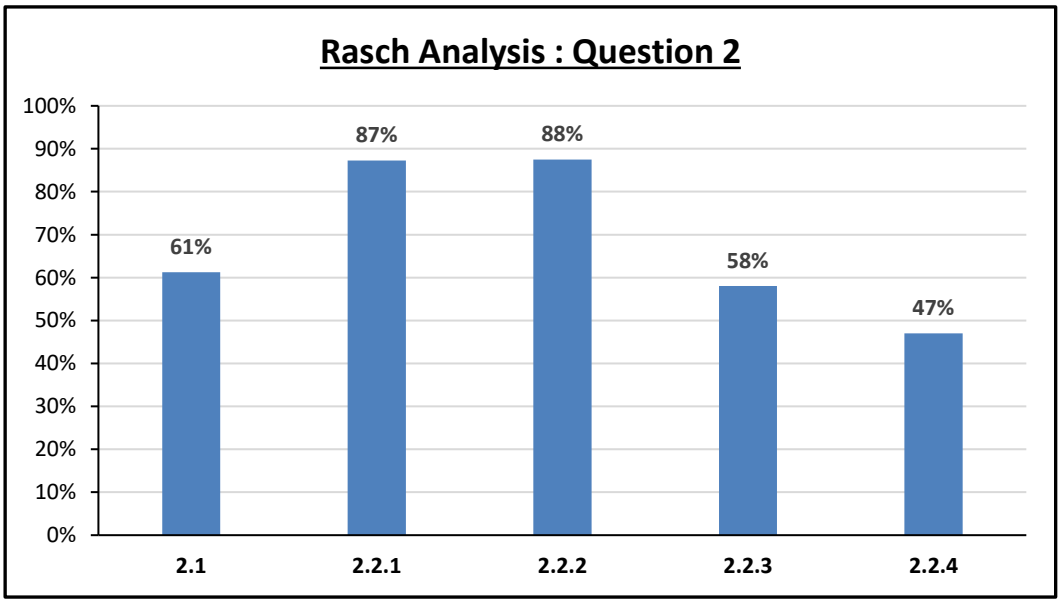
2.2.1 Determine the general term of the pattern in the form $T_n = an^2 + bn + c$ (4)

2.2.2 Calculate the value of the 50^{th} term of the pattern. (2)

2.2.3 Show that the sum of the first n first-differences of this pattern can be given by $S_n = 6n^2 + 3n$. (3)

2.2.4 How many consecutive first-differences were added to the first term of the quadratic number pattern to obtain a term in the quadratic number pattern that has a value of 21 060? (4)

[17]



The overall performance in this question was satisfying, averaging 67%. Candidates did very well in the quadratic pattern routine questions, i.e. 2.2.1 and 2.2.2

2.1	There were different ways of solving this question. Most candidates who worked out two equations struggled to solve these linear equations simultaneously. The candidates who understood that -11 was the fourth term using 7 + 3d = -11 found the question much easier to solve.
2.2.1	This is a routine question and candidates performed well in this question. Basic skills resulted in candidates losing easy marks.
2.2.2	Candidates knew what was expected of them. Even those who got 2.2.1 wrong substituted n = 50 obtaining full CA marks.
2.2.3	Many candidates did not really understand the question. They still want to get to a numerical answer for Sn or solve for n.

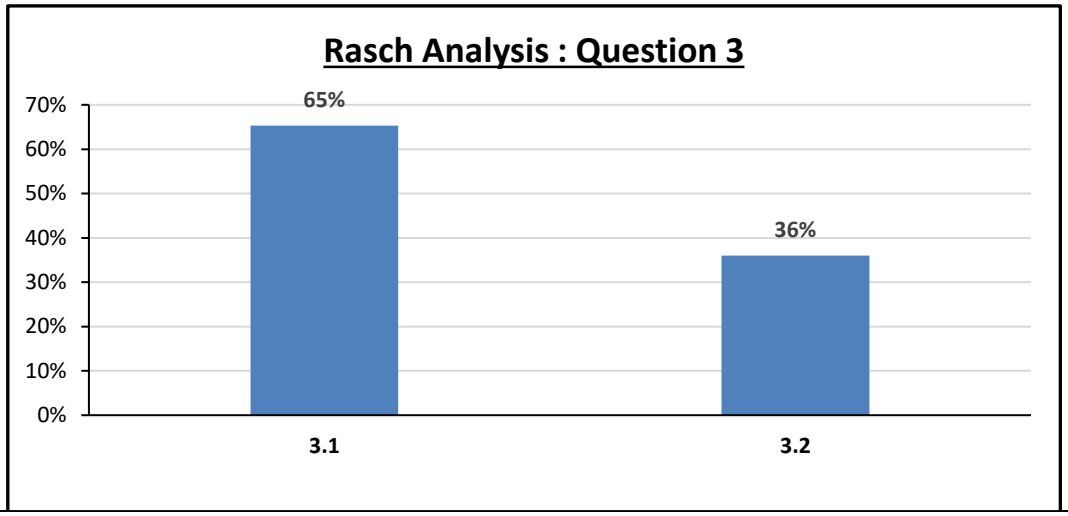
2.2.4	The most common mistake in this question was equating $6n^2 + 3n = 21060$. This is equating a Sum to a Term. Candidates must read with understanding because they missed the part of the first term of the quadratic pattern that must be added to the sum of the first differences. Some candidates equated the Tn of the quadratic pattern to 21 060, i.e. $6n^2 - 9n = 21060$ then got to n = 60 but could not conclude correctly.

QUESTION 3

3.1 Prove that $\sum_{k=1}^{\infty} 4.3^{2-k}$ is a convergent series. Show ALL your calculations. (3)

3.2 If $\sum_{k=p}^{\infty} 4.3^{2-k} = \frac{2}{9}$, determine the value of p. (5)

[8]



This question tested geometric series to infinity and sigma-notation. Overall performance in this question was below average. For many candidates 3.2 was a huge challenge. $\sum notation$ is still a challenge.

3.1	Candidates knew what was expected in this question. Some candidates got to $r = \frac{1}{3}$ but lost a mark for not writing down the conclusion. First mark was given for expansion or re-writing $T_n = 36\left(\frac{1}{3}\right)^k$.
3.2	Most candidates experienced this question as challenging and they did not know where to start or how to put the pieces together. Some candidates showed good understanding as illustrated in the following solution: $S_\infty = \frac{12}{1-\frac{1}{3}} = 18 \quad \& \quad S_4 = 12+4+\frac{4}{3}+\frac{4}{9} = 17\frac{7}{9}$ $S_\infty - S_4 = \frac{2}{9}$ $\therefore \ p = 5$ A common error was that candidates equated $T_n = \frac{2}{9}$ / $4.3^{2-k} = \frac{2}{9}$ Furthermore, 4.3^{2-k} was mistakenly seen as $(4,3)^{2-k}$ resulting in $T_1 = \frac{43}{10}$; $T_2 = 1$; $T_3 = \frac{10}{43}$ It should be clarified with candidates that 4.3^{2-k} mean $4\times 3^{2-k}$.

General comments

- Expose learners to more problem-solving type questions.

QUESTION 4

4.1 Given: $h(x)=\dfrac{-3}{x-1}+2$

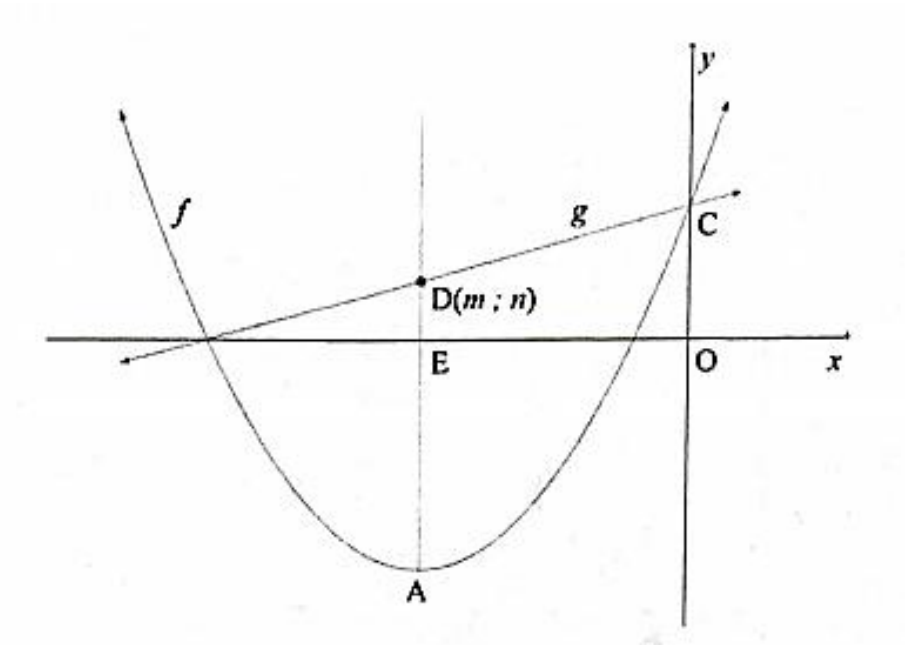
4.1.1 Write down the equations of the asymptotes of h. (2)

4.1.2 Determine the equation of the axis of symmetry of h that has a negative gradient. (2)

4.1.3 Sketch the graph of h, showing the asymptotes and the intercepts with the axes. (4)

4.2 The graphs of $f(x)=\frac{1}{2}(x+5)^2-8$ and $g(x)=\frac{1}{2}x+\frac{9}{2}$ are sketched below.

- A is the turning point of f.
- The axis of symmetry of f intersects the x-axis at E and the line g at D(m ; n).
- C is the y-intercept of f and g.



4.2.1 Write down the coordinates of A. (2)

4.2.2 Write down the range of f. (1)

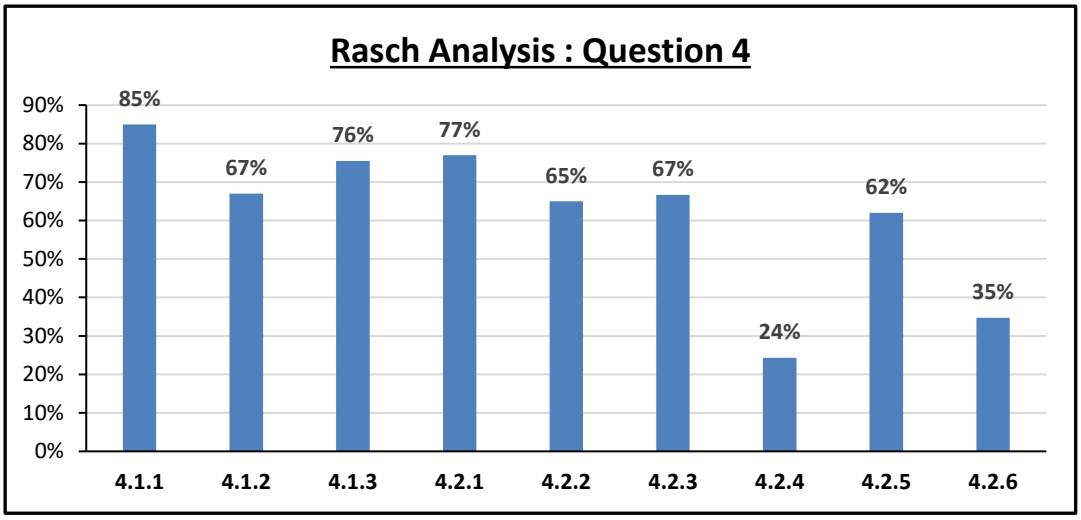
4.2.3 Calculate the values of m and n. (3)

4.2.4 Calculate the area of OCDE. (3)

4.2.5 Determine the equation of g^{-1}, the inverse of g, in the form $y = \ldots$ (2)

4.2.6 If $h(x)=g^{-1}(x)+k$ is a tangent to f, determine the coordinates of the point of contact between h and f. (4)

[23]



The overall performance for question 4 was average, with 4.2.4 and 4.2.6 found challenging by most of the candidates. Candidates did much better in 4.1 where they had to sketch the graph than in 4.2 where graph interpretation was required.
Many candidates could not answer some routine questions, i.e. domain, range, etc.

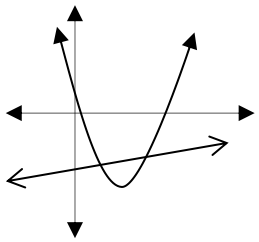
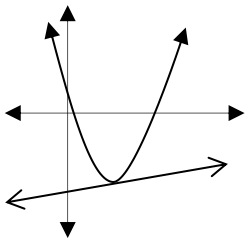
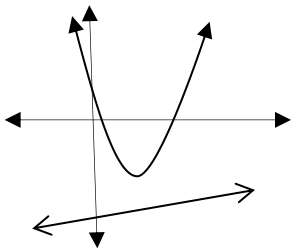
4.1.1	Most candidates did well in this question. A few still made the common error of writing p = 1 and q = 2.
4.1.2	There are different methods of answering this question. Many candidates omitted the brackets and ended up with $y=-x+1$.
4.1.3	Candidates was expected to know that they had to find the x- and y-intercepts first. An above average achievement confirms that candidates were comfortable in sketching the hyperbola. The question said sketch, therefore marks were allocated on the sketch and not at the working stage.
4.2.1	Most candidates scored full marks. Some still made the error of (5 ; -8). It is important for candidates to check if their answers corresponds with the sketch.
4.2.2	This question only counted 1 mark. Candidates lost it because they could not write down the answer correctly. Focus on brackets when interval notation is used.
4.2.3	Average performance. Candidates had a fairly good idea of what was expected. Fraction manipulation still a challenge. Calculator practice needed.
4.2.4	Poorly answered. Some candidates did not recognize the shape. Furthermore, they did not know the formula for the area of a trapezium and opted to divide it into other shapes. There were many different ways to answer this question. Learners were awarded one mark for at least showing a method of adding/subtracting areas.
4.2.5	Most learners only scored 1 mark for swopping x and y. The fractions again posed problems. $y=\frac{1}{2}x+\frac{2}{9}$ $x=\frac{1}{2}y+\frac{9}{2}$ $x-\frac{9}{2}=\frac{1}{2}y$ $y=\frac{x-\frac{9}{2}}{\frac{1}{2}}$ Candidates did not know that this is equal to $y=2x-9$ Furthermore, some introduced logs, not realising this is a straight line and not an exponential function.

4.2.6	Well below average performance in this question. Most candidates did not know how to approach this question. Many of those who attempted it simply equated $\frac{1}{2}(x+5)^2-8=2x-9$ (without adding the k). Many candidates did not understand the question and tried to solve for k.

GENERAL USEFUL INFORMATION

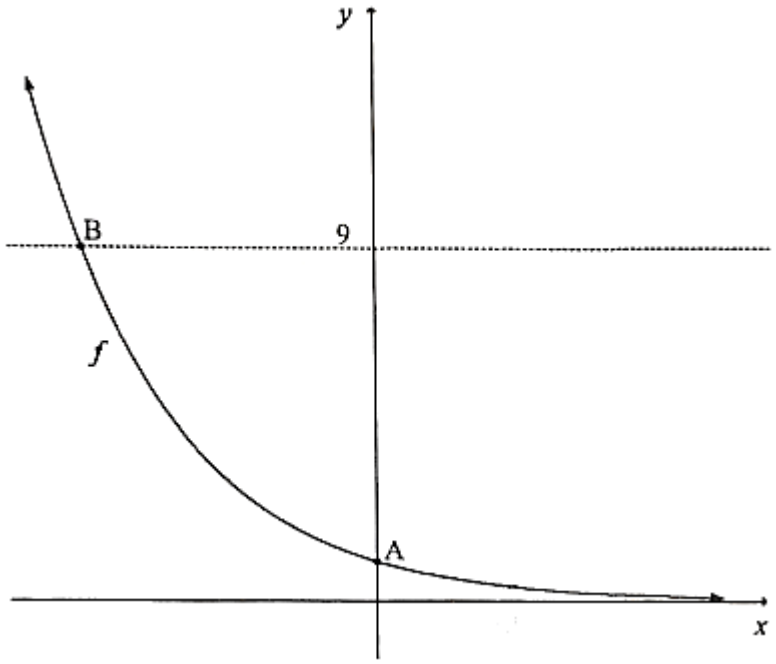
The correct use of mathematical concepts and vocabulary must be used. Learners must state that "the line intersects f at two points" rather than "the line touches f at two points". The correct concept is that if the points of intersection of a straight line (excluding a vertical line) and a quadratic function are equal, then that line is a tangent. If the gradient of the tangent is 0, then it will be a tangent at the turning point.

Although not directly connected to question 4, educators can make use of GeoGebra (free download) to illustrate the following to learners and make the connection between algebraic calculations and graphs.
Given: $f(x)=ax^2+bx+c$ and $g(x)=mx+k$
Solving for x if $f(x)=g(x)$ will yield the following possible results.
Note: The

$\Delta>0$	$\Delta=0$	$\Delta<0$
Two unequal solutions	**Two** equal solutions	No real solution
		
Secant (Line of intersection) (Cuts f twice)	Tangent (Touches f once)	Does not touch or cut f

QUESTION 5

The graph of $f(x) = 3^{-x}$ is sketched below. A is the y-intercept of f.
B is the point of intersection of f and the line $y = 9$.



5.1 Write down the coordinates of A. (1)

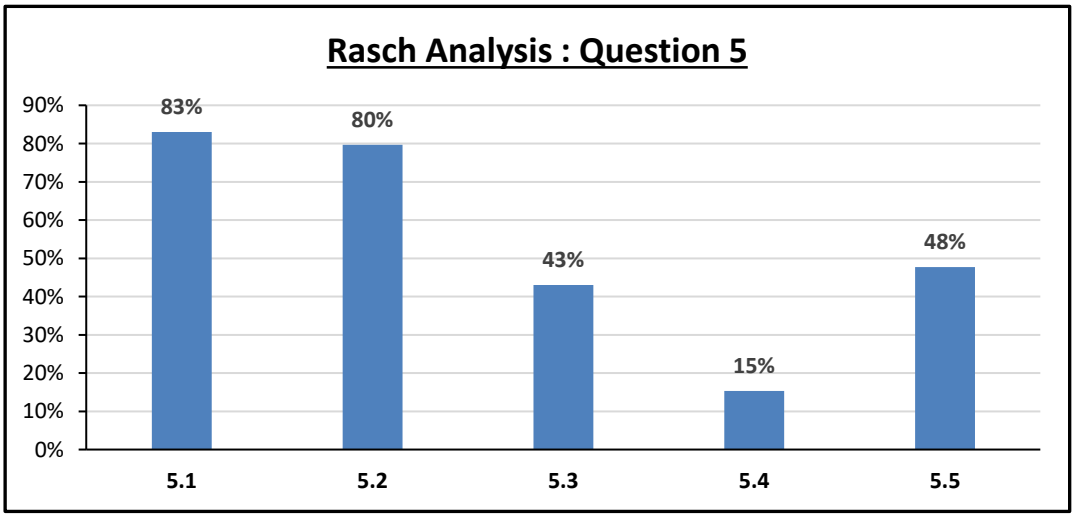
5.2 Determine the coordinates of B. (3)

5.3 Write down the domain of f^{-1} (2)

5.4 Describe the translation from f to $h(x) = \frac{27}{3^x}$. (3)

5.5 Determine the values of x for which $h(x) < 1$. (3)

[12]



In this question the overall achievement was at 50%, with 5.1 and 5.2 well answered and 5.3 to 5.5 poorly answered.	
5.1	Routine question.
5.2	Most candidates scored full marks for this question. Very few made the common error of writing $9 = 3^3$
5.3	Poorly answered. Many did not realise that it was the domain of f^{-1}. Although some knew that there is a relationship between range of f and the domain of f^{-1}, but still wrote $y \in$ for domain.
5.4	Most poorly answered sub-question. Most candidates gave the answer in terms of a vertical stretch instead of a horizontal translation. They did not realise that in order to describe the translation they first had to re-write h(x) in a different form. Some candidates got to $h(x) = 3^{-x+3}$ and from there concluded incorrectly since the correct conclusion comes from $h(x) = 3^{-(x-3)}$
5.5	Many candidates scored marks in this sub-question using the algebraic solution. In a few cases the candidates failed to change the inequality sign when needed to do so. Candidates should be familiarised with using graphs to find these solutions.
General comments • Revisit transformations from grade 8 and 9 when teaching functions. • Teach the interpretation of graphs from grade 10. • Integrate topics from grade 10.	

QUESTION 6

6.1 On 31 January 2020, Tshepo made the first of his monthly deposits of R1 000 into a savings account. He continues to make monthly deposits of R1 000 at the end of each month up until 31 January 2032. The interest rate was fixed at 7,5% p.a., compounded monthly.

6.1.1 What will the investment be worth immediately after the last deposit? (4)

6.1.2 If he makes no further payments but leaves the money in the account, how much money will be in the account on 31 January 2033? (2)

6.2 Jim bought a new car for R250 000. The value of the car depreciated at a rate of 22% p.a. annually according to the reducing-balance method. After how many years will its book value be R92 537,64? (3)

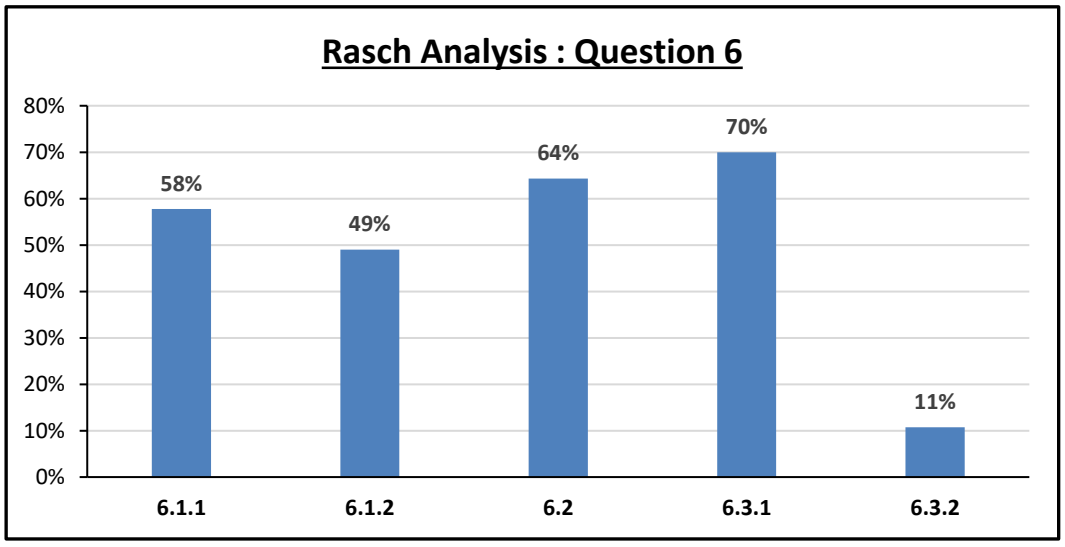
6.3 Mpho is granted a loan under the following conditions:

- The interest rate is 11,3% p.a., compounded monthly.
- The period of the loan is 6 years.
- The monthly repayment on the loan is R1 500.
- Her first repayment is made one month after the loan is granted.

6.3.1 Calculate the value of the loan. (3)

6.3.2 How much interest will Mpho pay in total over the first 5 years? (4)

[16]



The achievement in this question was average. Candidates performed better than last year. The questions were well structured and easy to understand.	
6.1.1	Many candidates attempted this question and did well. The common error was using n = 144 instead of 145. Some candidates divided the rate by 12 but left n in years. This is seen as a B/D and CA does not apply.
6.1.2	This question was not well answered because many candidates substituted n = 1 instead of n = 12.
6.2	This question was well answered with many candidates scoring marks. In some cases the use of Logs was still a problem. Common error swopping of A and P.
6.3.1	Above average performance in this sub-question. The structure of the question in bullet form contributed to the fact that candidates could easily identify the required information.
6.3.2	Poorly answered. Most candidates did not attempt this sub-question. Many candidates who did, did not know how everything fits together, i.e. Interest = Amount paid – [Loan – Balance] In Financial Mathematics there are often different methods that can be applied.
General comments • Teachers must use correct mathematical language when teaching finance. • Make sure that learners know when to use which formula when doing finance	

QUESTION 7

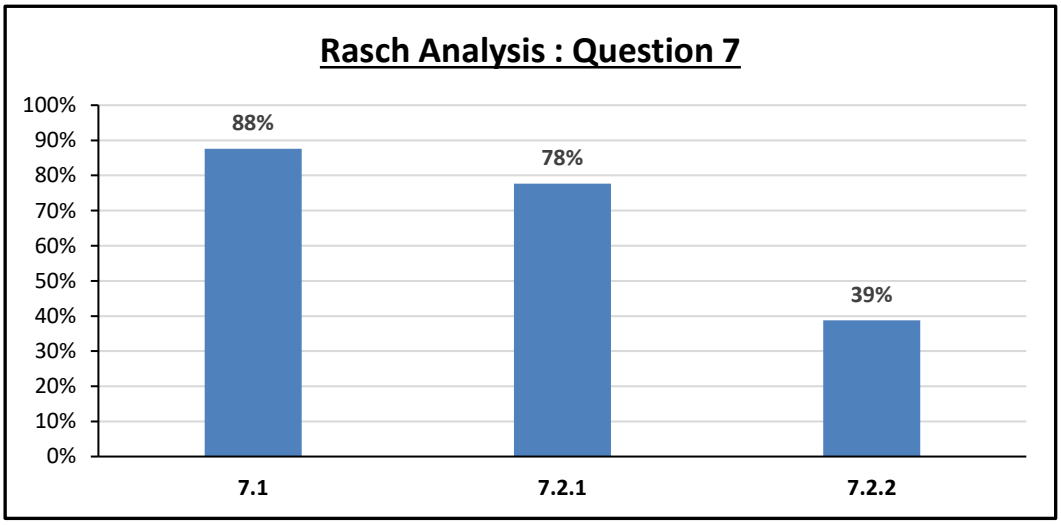
7.1 Determine $f'(x)$ from first principles if $f(x)=2x^2-1$. (5)

7.2 Determine:

7.2.1 $\dfrac{d}{dx}\left(\sqrt[5]{x^2}+x^3\right)$ (3)

7.2.2 $f'(x)$ if $f(x)=\dfrac{4x^2-9}{4x+6}$; $x\neq -\dfrac{3}{2}$ (4)

[12]

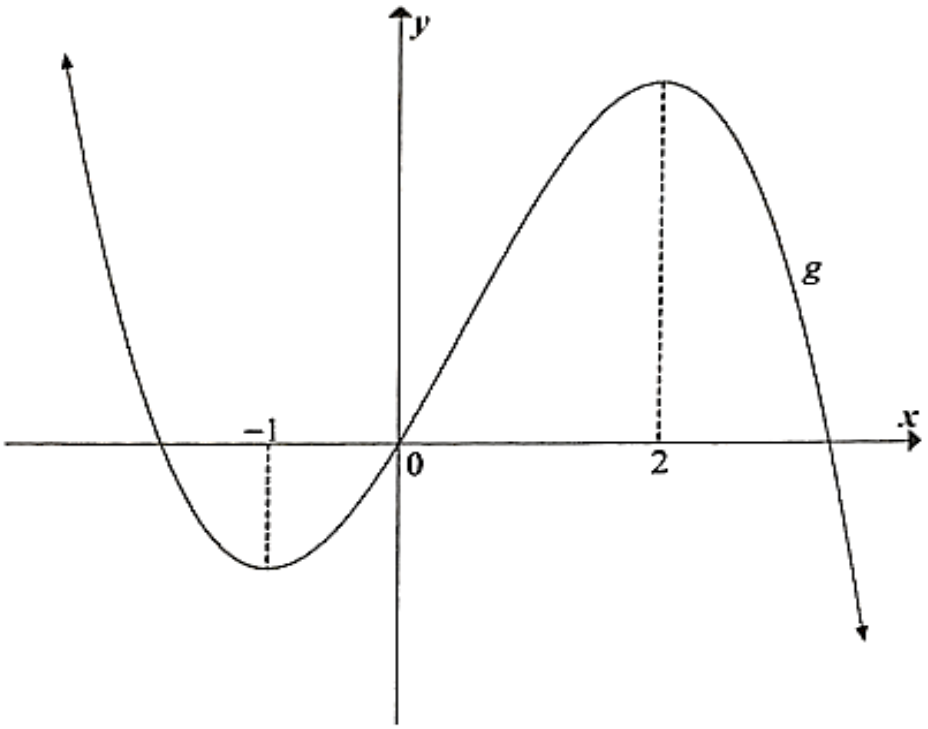


Question 7 is a very predictable question and was one of the best answered questions.

7.1	Many candidates attempted this question and scored good marks. Educators must emphasise the importance of writing down the complete formula and taking care to use the correct notation throughout the solution. The following are regarded as notation errors and are penalised: • If $f'(x)$ was not shown as part of the formula. • If the lim is omitted too soon. • If an equal sign was written between the $\lim$ and the fraction part.
7.2.1	This sub-question was well-answered. Converting from surd form to exponential form was a slight challenge. Furthermore, it should be emphasized that the derivative of both terms must be determined in the same step and NOT **=>** $\dfrac{d}{dx}\left(\sqrt[5]{x^2}+x^3\right)$ $\dfrac{d}{dx}\left(x^{\frac{2}{5}}+3x^2\right)$
7.2.2	This question was disappointingly poorly answered. Most candidates did not spot the difference between two squares in the numerator and common factor in the denominator. Most probably the $x\neq -\dfrac{3}{2}$ distracted them. Some just divided the terms and cancelled out – all incorrect mathematics. Others over-complicated the question and ended up getting stuck.

QUESTION 8

The graph of $g(x) = ax^3 + bx^2 + cx$, a cubic function having a y-intercept of 0, is drawn below.
The x-coordinates of the turning points of g are -1 and 2.



8.1 For which values of x will g increase? (2)

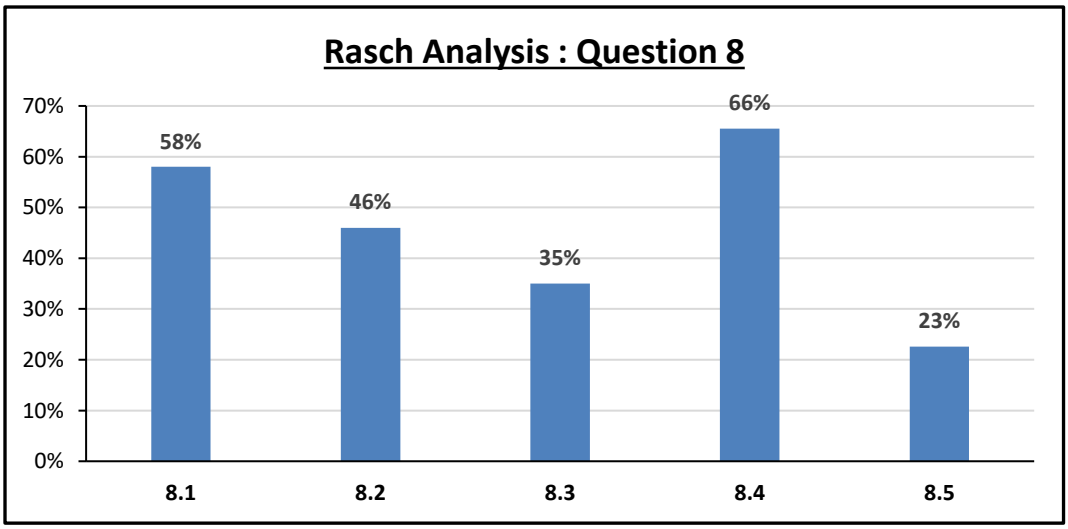
8.2 Write down the x-coordinate of the point of inflection of g. (2)

8.3 For which values of x will g be concave down? (2)

8.4 If $g'(x) = -6x^2 + 6x + 12$, determine the equation of g. (4)

8.5 Determine the equation of the tangent to g that has the maximum gradient. Write your answer in the form $y = mx + c$. (5)

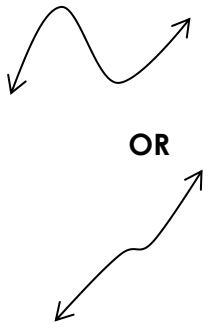
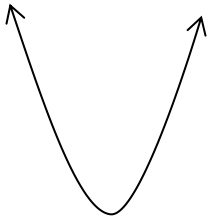
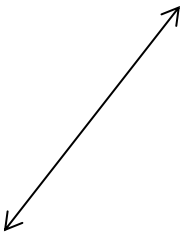
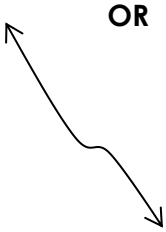
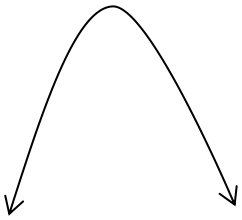
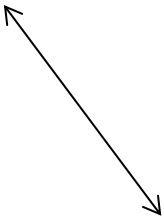
[15]



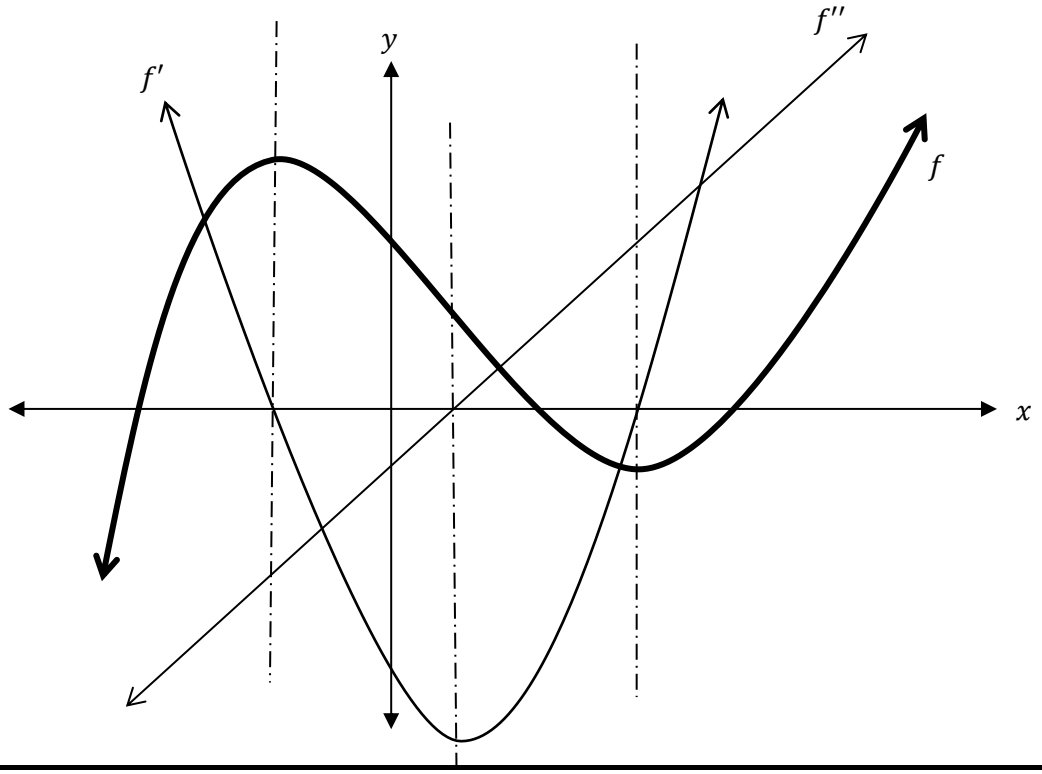
Achievement in this question was below average. Q8.1 – 8.4 were fairly accessible. Concepts of increasing, decreasing, concavity etc still need a lot of practice.	
8.1	The achievement in this sub-question was disappointing. Many candidates did not know how to represent the answer. Eg. $2 > x < -1 \quad or \quad -1 > x > 2$
8.2	Poorly answered. Candidates did not realise that the point of inflection is halfway between – 1 and 2. They used answer given in 8.4 – which is not allowed.
8.3	Poorly answered. Concavity is still "greek" to many. Since the sketch was given candidates were expected to easily identify the concavity.
8.4	This sub-question was well-answered and many candidates scored 4/4. It is clear that this was emphasized in the teaching and learning.
8.5	Most candidates had no clue of where the gradient is a maximum. Very few candidates scored full marks for this sub-question. This sub-question had independent steps to get to the final solution. i.e. • Knowing that the maximum gradient is at $x = \frac{1}{2}$ • Finding the gradient by substituting $x = \frac{1}{2}$ in $g'(x)$ • Findidng the y-value of g(x) at $x = \frac{1}{2}$ • Finding the equation of the tangent

SUMMARY OF USEFUL INFORMATION

It can be very helpful if the learner can visualise the following connection between f, f' and f''. Given $h(x) = ax^3 + bx^2 + cx + d$

Graph of h	Graph of h'	Graph of h''
Cubic	Quadratic	Linear
If $a > 0$  **OR**	Minimum turning point 	Increasing 
If $a < 0$  **OR** 	Maximum turning point 	Decreasing 

Graphs of f, f' and f'' together.



Educators can show the correlation between the following points on the combined sketch.

1. x-values of turning points of $f \leftrightarrow x$-value of x-intercepts of f'.
2. x-value of turning point of $f' \leftrightarrow x$-intercept of f''.
3. x-intercept of $f'' \leftrightarrow x$-value of point of inflection of f.

This combined sketch can also assist in interpreting the cubic function if the graph of the derivative function is given.

Stationary points are calculated by first solving f'(x)=0. The stationary points can then either be defined as turning points or inflection points. See the figures below, extracted from "Mind the Gap: Mathematics".

figure 1

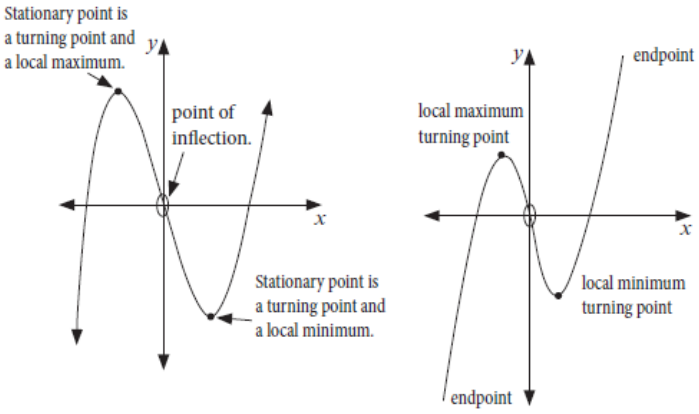
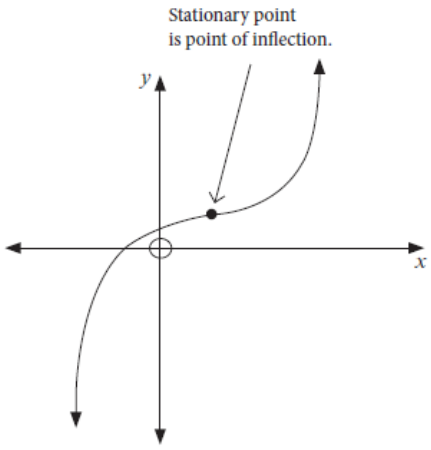


figure 2



When working with the quadratic function, the stationary point is therefore a turning point.

QUESTION 9

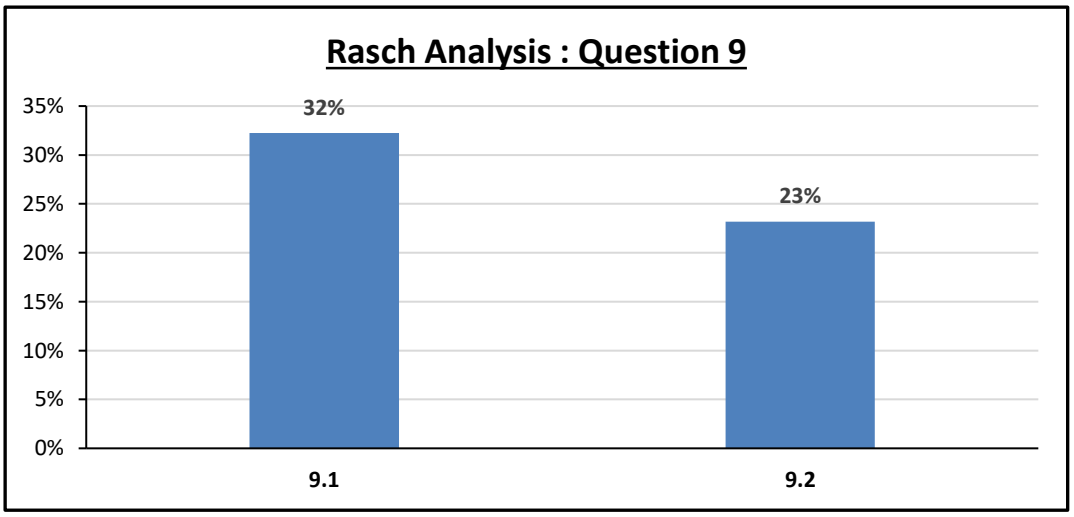
A closed rectangular box has to be constructed as follows:

- Dimensions: length (l), width (w) and height (h).
- The length (l) of the base has to be 3 times its width (w).
- The volume has to be $5m^3$.

The material for the top and the bottom parts costs R15 per square metre and the material for the sides costs R6 per square metre.

9.1 Show that the cost to construct the box can be calculated by:
$\text{Cost} = 90w^2 + 48wh$ (4)

9.2 Determine the width of the box such that the cost to build the box is a minimum. (6)
[10]



Application of calculus has always been one of the worst answered questions. This year was no exception.	
9.1	Below average achievement. Candidates struggled to find the total surface area in terms of given dimensions. Surface area and volume formulae needs attention.
9.2	The cost function was in terms of 2 variables: $C = 90w^2 + 48wh$. This posed a challenge to candidates. They disregarded this and simply determined $C'(w)$, treating h as aconstant. $h = \frac{5}{3w^2}$ had to be substituted first before continuing. It was however good to see that a number of candidates scored full marks for Q9.
	Visualisation of simple solids is a challenge. Many candidates cannot draw 3D solids.

QUESTION 10

In a certain country, 10-digit telephone numbers with the following format were introduced:

Format	Area Code	Exchange Code	Number
Number of digits	3 digits	3 digits	4 digits
Example	901	544	1230

Digits may be repeated.

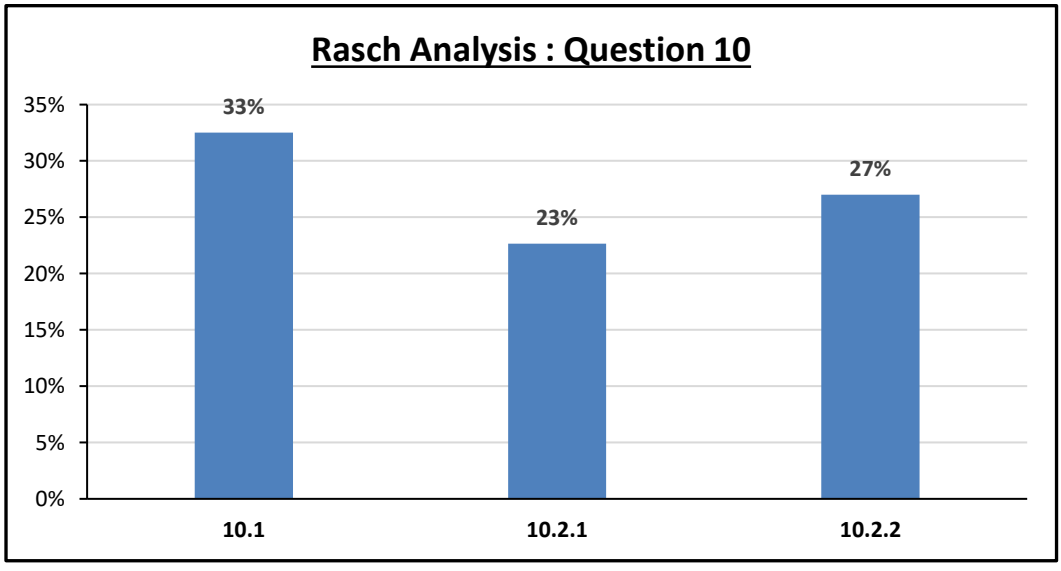
10.1 How many possible 10-digit telephone numbers could be formed? (2)

10.2 Certain restrictions were placed on the groups of digits:

- Area Code: must be 3 digits and the first digit can NOT be 0 or 1
- Exchange Code: must be 3 digits and the first and second digits can NOT be 0 or 1
- Number: must be 4 digits and the first digit MUST be a 0 or 1

10.2.1 How many valid 10-digit telephone numbers could be formed by applying the given restrictions? (3)

10.2.2 Determine the probability that any randomly chosen 10-digit telephone number would be a valid phone number. (2)
[7]



Candidates once again did not read the given information. This question was poorly answered. Continuous accuracy was applied to candidates who continued using no repetition in 10.2.

10.1	Most common error was candidates ignoring repetition and giving the answer as 10!.
10.2.1	Although the question was well structured, candidates were not able to apply the restrictions to the 3 parts of the telephone number.
10.2.2	The candidates who answered had an idea of what to do and received CA marks. Candidates should know that probability is a number between 0 & 1.

QUESTION 11

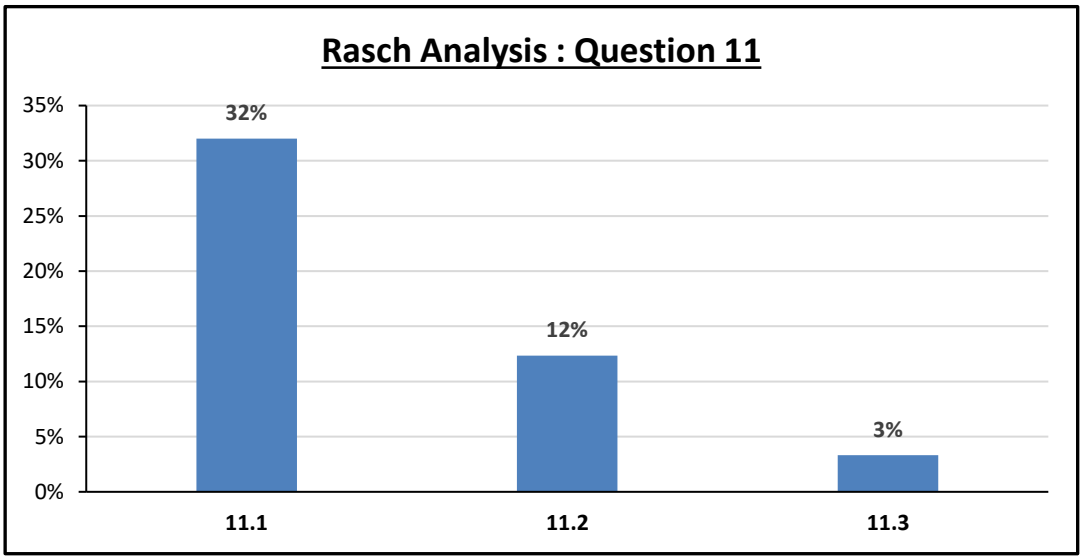
Harry shoots arrows at a target board. He has a 50% chance of hitting the bull's eye on each shot.

11.1 Calculate the probability that Harry will hit the bull's eye in his first shot and his second shot. (2)

11.2 Calculate the probability that Harry will hit the bull's eye at least twice in his first three shots. (3)

11.3 Glenda also has a 50% chance of hitting the bull's eye on each shot. Harry and Glenda will take turns to shoot an arrow and the first person to hit the bull's eye will be the winner. Calculate the probability that the person who shoots first will be the winner of the challenge. (3)

[8]



This question was answered poorly, candidates scoring marks in 11.1 and with most candidates not attempting or answering 11.3.

11.1	The most common error was that candidates did not know whether to multiply or add the probabilities.
11.2	Candidates who did not draw a tree diagram was completely lost. It should be part of teaching – how to get the answer directly from the outcomes.
11.3	Very few candidates attempted this question. It was quite difficult to make sense of how to actually get to the answer. Sum to infinity was integrated with probability. It was very difficult to spot.

The following general suggestions, observations and additional comments are given annually. A word of thanks must go out to all the dedicated educators who are really trying their best, often under difficult circumstances.

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.
All cognitive levels (1 – 4) should be done in class – categorized based on learner ability.
Motivate learners to work through previous papers as to familiarize 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 realize that they cannot expect great things to happen if they don't put in effort and some sacrifices to achieve their dreams.
Do not only focus on improving weaker learners but also focus on enriching stronger learners. Make an effort to look for higher order questions. Use the Independent Examination Board papers as reference as well.

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.
Strong candidates answered the L4 questions using different methods – this is very encouraging to see. Eg. Instead of using Calculus in 9.2 they used knowledge of turning point.
In Finance, candidates mixed up months and years when substituting i and n.
SEE ABOVE FOR QUESTION SPECIFIC OBSERVATIONS.

ADDITIONAL COMMENTS USEFUL TO TEACHERS, SUBJECT ADVISORS, TEACHER DEVELOPMENT ETC.
Educators are encouraged to make use of this report throughout the year and not only read through once.
Common errors, misconceptions by learners to be cleared in each topic.
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.
The use of technology is highly recommended to enhance conceptual understanding.
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.

ADDITIONAL NOTES

1.1.4	Many candidates wrote $\sqrt{x+8}$ instead off $\sqrt{x+18}$
1.3	Candidates tried various ways to solve this question – instead of doing basics $n^{200} < 5^{200}.5^{100}$ $\left(\frac{n}{5}\right)^{200} < 5^{100}$ $\frac{n}{5} < 5^{\frac{1}{2}}$ $n < 5^{\frac{3}{2}}$
2.1	$d = T_3 - T_2$ $= -11 - y$ $T_n = 7 + (n-1)d$ $-11 = 7 + 3(-11 - y)$ $-18 = -33 - 3y$ $15 = -3y$ $y = -5$ $\therefore\ d = -11 + 5 = -6$ $\Rightarrow\ x = 1$
7.2.2	Wrong mathematics leading to correct answer. $f(x) = \frac{4x^2 - 9^3}{4x + 6_2}$ $f(x) = x - \frac{3}{2}$ $f'(x) = 1$
7.2.2	One candidate attempted to answer this question using First Principles.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE/ NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P1

NOVEMBER 2020

MARKS: 150

TIME: 3 hours

This question paper consists of 10 pages and 1 information sheet.

* M A T H E 1 *

EASTERN CAPE

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 11 questions.
2. Answer ALL the questions.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Clearly show ALL calculations, diagrams, graphs, etc. that you have used in determining your answers.
5. Answers only will NOT necessarily be awarded full marks.
6. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
7. If necessary, round off answers to TWO decimal places, unless stated otherwise.
8. Diagrams are NOT necessarily drawn to scale.
9. An information sheet with formulae is included at the end of the question paper.
10. Write neatly and legibly.

QUESTION 1

1.1 Solve for x:

1.1.1 $x^2 - 6x = 0$ (2)

1.1.2 $x^2 + 10x + 8 = 0$ (correct to TWO decimal places) (3)

1.1.3 $(1-x)(x+2) < 0$ (3)

1.1.4 $\sqrt{x+18} = x-2$ (5)

1.2 Solve simultaneously for x and y:

$x + y = 3$ and $2x^2 + 4xy - y = 15$ (6)

1.3 If n is the largest integer for which $n^{200} < 5^{300}$, determine the value of n. (3)

[22]

QUESTION 2

2.1 $7 \; ; \; x \; ; \; y \; ; \; -11 \; ; \; \ldots$ is an arithmetic sequence. Determine the values of x and y. (4)

2.2 Given the quadratic number pattern: $-3 \; ; \; 6 \; ; \; 27 \; ; \; 60 \; ; \; \ldots$

2.2.1 Determine the general term of the pattern in the form $T_n = an^2 + bn + c$. (4)

2.2.2 Calculate the value of the 50^{th} term of the pattern. (2)

2.2.3 Show that the sum of the first n first-differences of this pattern can be given by $S_n = 6n^2 + 3n$. (3)

2.2.4 How many consecutive first-differences were added to the first term of the quadratic number pattern to obtain a term in the quadratic number pattern that has a value of 21 060? (4)

[17]

QUESTION 3

3.1 Prove that $\sum_{k=1}^{\infty} 4.3^{2-k}$ is a convergent geometric series. Show ALL your calculations. (3)

3.2 If $\sum_{k=p}^{\infty} 4.3^{2-k} = \frac{2}{9}$, determine the value of p. (5)

[8]

QUESTION 4

4.1 Given: $h(x) = \frac{-3}{x-1} + 2$

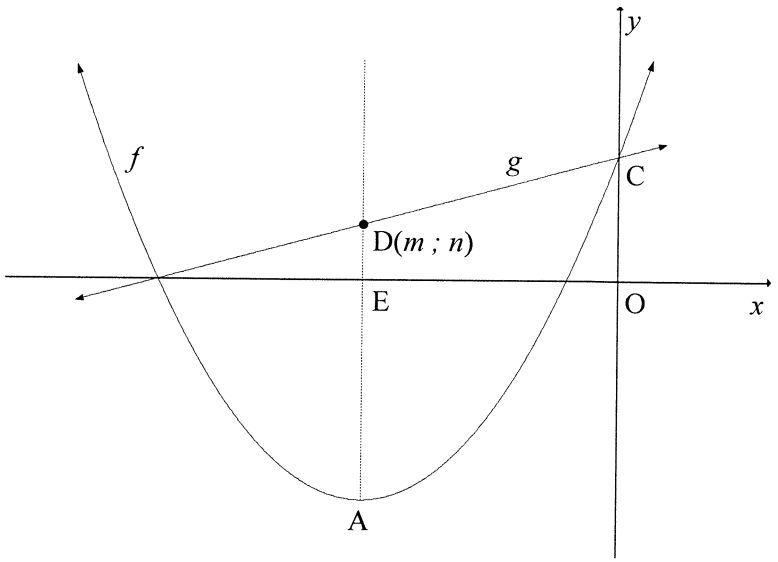
4.1.1 Write down the equations of the asymptotes of h. (2)

4.1.2 Determine the equation of the axis of symmetry of h that has a negative gradient. (2)

4.1.3 Sketch the graph of h, showing the asymptotes and the intercepts with the axes. (4)

4.2 The graphs of $f(x)=\frac{1}{2}(x+5)^2-8$ and $g(x)=\frac{1}{2}x+\frac{9}{2}$ are sketched below.

- A is the turning point of f.
- The axis of symmetry of f intersects the x-axis at E and the line g at D(m ; n).
- C is the y-intercept of f and g.



4.2.1 Write down the coordinates of A. (2)

4.2.2 Write down the range of f. (1)

4.2.3 Calculate the values of m and n. (3)

4.2.4 Calculate the area of OCDE. (3)

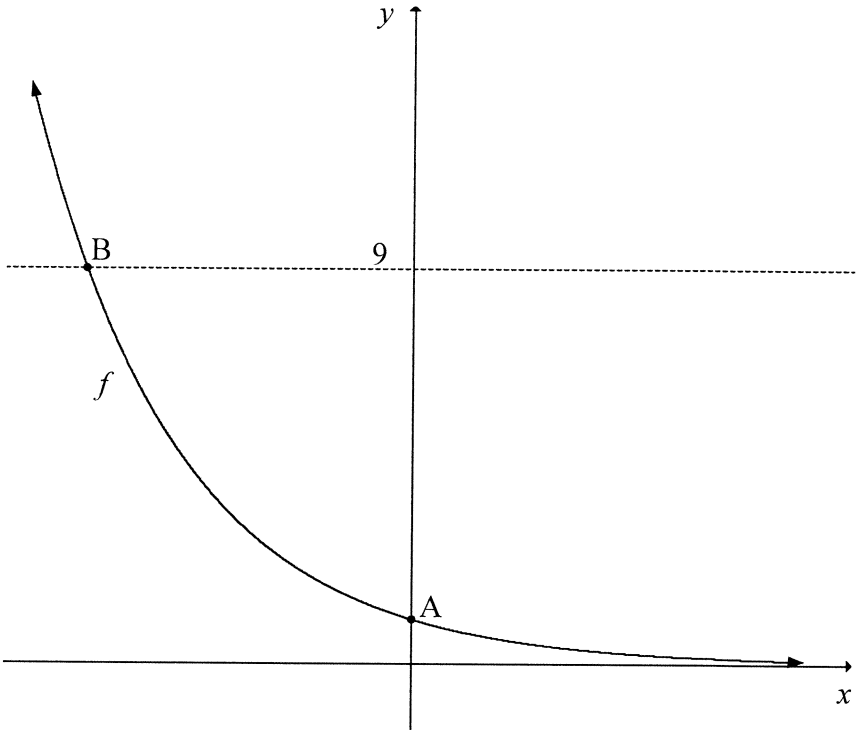
4.2.5 Determine the equation of g^{-1}, the inverse of g, in the form $y=\ldots$ (2)

4.2.6 If $h(x)=g^{-1}(x)+k$ is a tangent to f, determine the coordinates of the point of contact between h and f. (4)

[23]

QUESTION 5

The graph of $f(x)=3^{-x}$ is sketched below. A is the y-intercept of f.
B is the point of intersection of f and the line $y=9$.



5.1 Write down the coordinates of A. (1)

5.2 Determine the coordinates of B. (3)

5.3 Write down the domain of f^{-1}. (2)

5.4 Describe the translation from f to $h(x)=\frac{27}{3^x}$. (3)

5.5 Determine the values of x for which $h(x)<1$. (3)
[12]

QUESTION 6

6.1 On 31 January 2020, Tshepo made the first of his monthly deposits of R1 000 into a savings account. He continues to make monthly deposits of R1 000 at the end of each month up until 31 January 2032. The interest rate was fixed at 7,5% p.a., compounded monthly.

6.1.1 What will the investment be worth immediately after the last deposit? (4)

6.1.2 If he makes no further payments but leaves the money in the account, how much money will be in the account on 31 January 2033? (2)

6.2 Jim bought a new car for R250 000. The value of the car depreciated at a rate of 22% p.a. annually according to the reducing-balance method. After how many years will its book value be R92 537,64? (3)

6.3 Mpho is granted a loan under the following conditions:

- The interest rate is 11,3% p.a., compounded monthly.
- The period of the loan is 6 years.
- The monthly repayment on the loan is R1 500.
- Her first repayment is made one month after the loan is granted.

6.3.1 Calculate the value of the loan. (3)

6.3.2 How much interest will Mpho pay in total over the first 5 years? (4)

[16]

QUESTION 7

7.1 Determine $f'(x)$ from first principles if $f(x)=2x^2-1$. (5)

7.2 Determine:

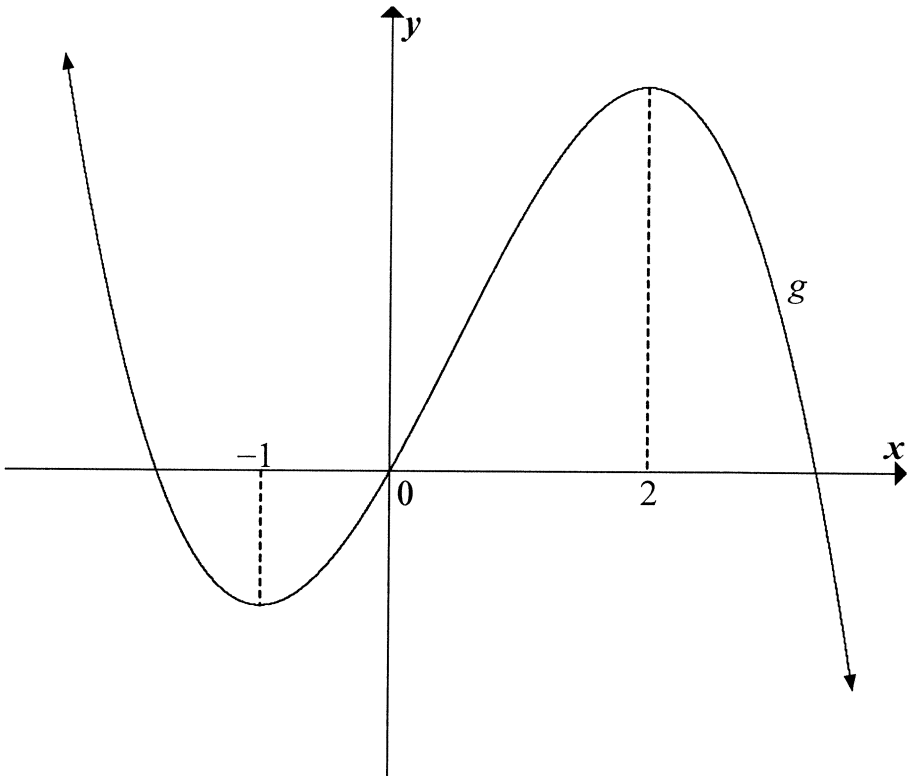
7.2.1 $\frac{d}{dx}\left(\sqrt[5]{x^2}+x^3\right)$ (3)

7.2.2 $f'(x)$ if $f(x)=\frac{4x^2-9}{4x+6}\quad ;x\neq -\frac{3}{2}$ (4)

[12]

QUESTION 8

The graph of $g(x) = ax^3 + bx^2 + cx$, a cubic function having a y-intercept of 0, is drawn below. The x-coordinates of the turning points of g are -1 and 2.



8.1 For which values of x will g increase? (2)

8.2 Write down the x-coordinate of the point of inflection of g. (2)

8.3 For which values of x will g be concave down? (2)

8.4 If $g'(x) = -6x^2 + 6x + 12$, determine the equation of g. (4)

8.5 Determine the equation of the tangent to g that has the maximum gradient. Write your answer in the form $y = mx + c$. (5)

[15]

QUESTION 9

A closed rectangular box has to be constructed as follows:

- Dimensions: length (l), width (w) and height (h).
- The length (l) of the base has to be 3 times its width (w).
- The volume has to be 5 m^3.

The material for the top and the bottom parts costs R15 per square metre and the material for the sides costs R6 per square metre.

9.1 Show that the cost to construct the box can be calculated by: Cost $= 90w^2 + 48wh$ (4)

9.2 Determine the width of the box such that the cost to build the box is a minimum. (6)
[10]

QUESTION 10

In a certain country, 10-digit telephone numbers with the following format were introduced:

Format	Area Code	Exchange Code	Number
Number of digits	3 digits	3 digits	4 digits
Example	901	544	1230

Digits may be repeated.

10.1 How many possible 10-digit telephone numbers could be formed? (2)

10.2 Certain restrictions were placed on the groups of digits:

- Area code: must be 3 digits and the first digit can NOT be 0 or 1
- Exchange code: must be 3 digits and the first and second digits can NOT be 0 or 1
- Number: must be 4 digits and the first digit MUST be a 0 or 1

10.2.1 How many valid 10-digit telephone numbers could be formed by applying the given restrictions? (3)

10.2.2 Determine the probability that any randomly chosen 10-digit telephone number would be a valid phone number. (2)
[7]

QUESTION 11

Harry shoots arrows at a target board. He has a 50% chance of hitting the bull's eye on each shot.

11.1 Calculate the probability that Harry will hit the bull's eye in his first shot and his second shot. (2)

11.2 Calculate the probability that Harry will hit the bull's eye at least twice in his first three shots. (3)

11.3 Glenda also has a 50% chance of hitting the bull's eye on each shot. Harry and Glenda will take turns to shoot an arrow and the first person to hit the bull's eye will be the winner. Calculate the probability that the person who shoots first will be the winner of the challenge. (3)
[8]

TOTAL: 150

INFORMATION SHEET

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$A = P(1+ni)$ $A = P(1-ni)$ $A = P(1-i)^n$ $A = P(1+i)^n$

$T_n = a + (n-1)d$ $S_n = \frac{n}{2}[2a + (n-1)d]$

$T_n = ar^{n-1}$ $S_n = \frac{a(r^n - 1)}{r-1}$; $r \neq 1$ $S_\infty = \frac{a}{1-r}$; $-1 < r < 1$

$F = \frac{x[(1+i)^n - 1]}{i}$ $P = \frac{x[1-(1+i)^{-n}]}{i}$

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

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $M\left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2}\right)$

$y = mx + c$ $y - y_1 = m(x - x_1)$ $m = \frac{y_2 - y_1}{x_2 - x_1}$ $m = \tan\theta$

$(x-a)^2 + (y-b)^2 = r^2$

In ΔABC: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

$a^2 = b^2 + c^2 - 2bc.\cos A$

area $\Delta ABC = \frac{1}{2}ab.\sin C$

$\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$ $\sin(\alpha - \beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$

$\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$ $\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$

$$\cos 2\alpha = \begin{cases} \cos^2\alpha - \sin^2\alpha \\ 1 - 2\sin^2\alpha \\ 2\cos^2\alpha - 1 \end{cases}$$

$\sin 2\alpha = 2\sin\alpha\cos\alpha$

$\bar{x} = \frac{\sum x}{n}$ $\sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}$

$P(A) = \frac{n(A)}{n(S)}$ $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

$\hat{y} = a + bx$ $b = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sum(x - \bar{x})^2}$

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE/*SENIOR SERTIFIKAAT*
NATIONAL SENIOR CERTIFICATE/
NASIONALE SENIOR SERTIFIKAAT

GRADE 12/*GRAAD 12*

MATHEMATICS P1/*WISKUNDE V1*

NOVEMBER 2020

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

APPROVED
23/11/2020
UMALUSI

These guidelines consist of 18 pages.
Hierdie nasienriglyne bestaan uit 18 bladsye.

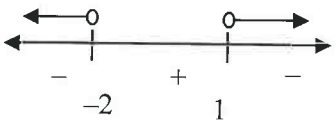
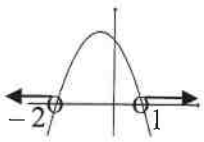
Approved
2020-11-23

APPROVED
23-11-2020
UMALUSI

NOTE:
- If a candidate answers a question TWICE, only mark the FIRST attempt.
- Consistent accuracy applies in all aspects of the marking memorandum.

LET WEL:
- *Indien 'n kandidaat 'n vraag TWEE keer beantwoord, sien slegs die EERSTE poging na.*
- *Volgehoue akkuraatheid is op ALLE aspekte van die nasienriglyne van toepassing.*

REMEMBER: (A) next o the description of a tick implies accuracy mark
ONTHOU: (A) langs die beskrywing van `n regmerk impliseer akkuraatheids-punt
QUESTION/*VRAAG* 1

1.1.1	$x^2 - 6x = 0$ $x(x-6) = 0$ $x = 0$ or $x = 6$	✓ common factor ✓ both answers (2)
1.1.2	$x^2 + 10x + 8 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{-10 \pm \sqrt{10^2 - 4(1)(8)}}{2(1)}$ $= \frac{-10 \pm \sqrt{68}}{2}$ $x = -0{,}88$ or $x = -9{,}12$	✓ substitution into the correct formula ✓ $-0{,}88$ ✓ $-9{,}12$ (3)
1.1.3	$(1-x)(x+2) < 0$ Critical values: $x = 1$ or $x = -2$  or  $x < -2$ or $x > 1$	✓ critical values ✓ correct method ✓ answer (3)
1.1.4	$\sqrt{x+18} = x - 2$ $x + 18 = x^2 - 4x + 4$ $0 = x^2 - 5x - 14$ $(x-7)(x+2) = 0$ $x = 7$ or $x \neq -2$	✓ squaring both sides (m) ✓ standard form ✓ factors ✓ both answers ✓ rejection of $x = -2$ (5)

1.2	$x+y=3$ $y=3-x$ ..... (1) $2x^2+4xy-y=15$ ..... (2) Substitute (1) into (2): $2x^2+4x(3-x)-(3-x)=15$ $2x^2+12x-4x^2-3+x-15=0$ $-2x^2+13x-18=0$ $2x^2-13x+18=0$ $(2x-9)(x-2)=0$ $x=\frac{9}{2}$ or $x=2$ $y=-\frac{3}{2}$ or $y=1$ **OR** $x+y=3$ $x=3-y$ ..... (1) $2x^2+4xy-y=15$ ..... (2) Substitute (1) into (2): $2(3-y)^2+4(3-y)y-y=15$ $2y^2-12y+18-4y^2+12y-y-15=0$ $-2y^2-y+3=0$ $2y^2+y-3=0$ $(2y+3)(y-1)=0$ $y=-\frac{3}{2}$ or $y=1$ $x=\frac{9}{2}$ or $x=2$	✓ y subject of the formula ✓ substitution ✓ standard form ✓ factors ✓ x-values ✓ y-values (6) **OR** ✓ x subject of the formula ✓ substitution ✓ standard form ✓ factors ✓ y-values ✓ x-values (6)
1.3	$n^{200}<5^{300}$ $(n^2)^{100}<(5^3)^{100}$ $(n^2)^{100}<(125)^{100}$ $n^2<125$ Maximum value of n is 11. **OR** $200\log n<300\log 5$ $n<10^{\frac{3}{2}\log 5}$ $n<11{,}18$ $\therefore n=11$ **OR**	✓ $(n^2)^{100}<(5^3)^{100}$ ✓ $n^2<125$ ✓ 11 (3) **OR** ✓ use of logs ✓ $n<11{,}18$ ✓ 11 (3) **OR**

	$n^{200} < 5^{300}$ $(n^2)^{100} < (5^3)^{100}$ $\sqrt{n^2} < \sqrt{5^3}$ $n < 5^{\frac{3}{2}}$ $n < 11{,}18$ $\therefore n = 11$ **OR** $n^{200} < 5^{300}$ $n < 5^{\frac{300}{200}}$ $n < 11{,}18$ $\therefore n = 11$	✓ $(n^2)^{100} < (5^3)^{100}$ ✓ $n < 11{,}18$ ✓11 (3) **OR** ✓ $n < 5^{\frac{300}{200}}$ ✓ $n < 11{,}18$ ✓ $n = 11$ (3)
		[22]

QUESTION/*VRAAG* 2

2.1

$7\ ;\ x\ ;\ y\ ;\ -11\ ;\ \ldots$

$a = 7$

$a + 3d = -11$

$7 + 3d = -11$ ✓ $7 + 3d = -11$

$d = -6$ ✓ $d = -6$

$x = a + d = 7 + (-6) = 1$ ✓ value of x

$y = a + 2d = 7 + 2(-6) = -5$ ✓ value of y

(4)

OR

$a + 3d = -11$

$3d = -11 - 7$ ✓ $3d = -11 - 7$

$3d = -18$

$d = -6$ ✓ $d = -6$

$x = 1$ ✓ $x = 1$

$y = -5$ ✓ $y = -5$

(4)

OR

$x - 7 = y - x$ and $y - x = -11 - y$ ✓ 2 equations

$2x - 7 = y$ ....(1) $2y = -11 + x$ ...(2)

(1) into (2) ✓ substitution

$2(2x - 7) = -11 + x$

$4x - 14 = -11 + x$

$3x = 3$

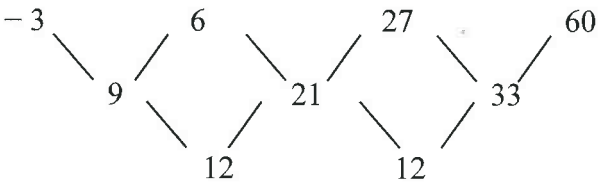
$x = 1$ ✓ value of x

$y = 2(1) - 7 = -5$ ✓ value of y

(4)

2.2.1

$-3\ ;\ 6\ ;\ 27\ ;\ 60\ ;\ \ldots$



✓ second difference

$2a = 12$

$a = 6$ ✓ $a = 6$

$3a + b = 9$

$3(6) + b = 9$

$b = -9$ ✓ $b = -9$

$a + b + c = -3$

$6 - 9 + c = -3$

$c = 0$ ✓ $c = 0$ (4)

$T_n = 6n^2 - 9n$

2.2.2

$T_{50} = 6(50)^2 - 9(50)$

$= 14\ 550$

Answer Only: Full Marks

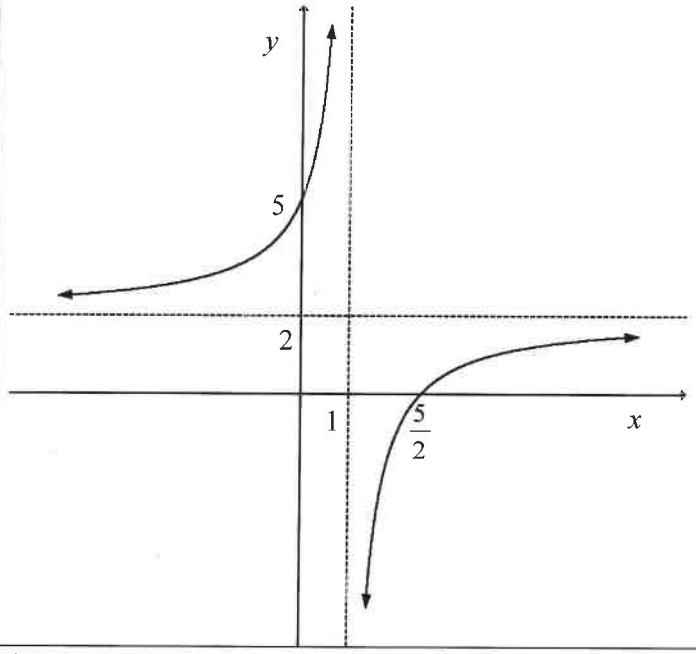
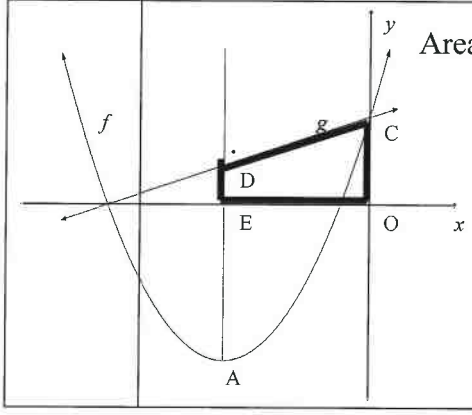
✓ substitute 50
✓ answer (2)

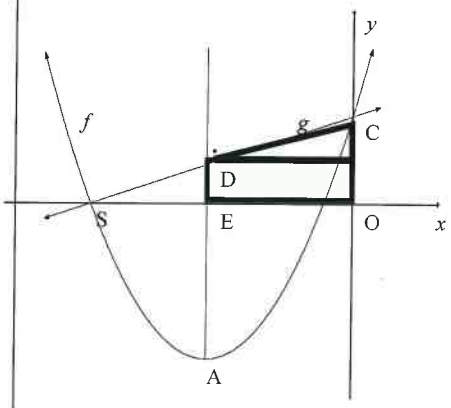
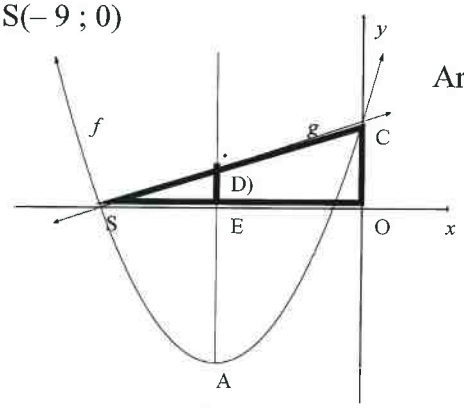
2.2.3	9 ; 21 ; 33 ; … $a = 9$ $d = 12$ $S_n = \frac{n}{2}[2a + (n-1)d]$ $S_n = \frac{n}{2}[2(9) + (n-1)(12)]$ $= \frac{n}{2}[18 + 12n - 12]$ $= \frac{n}{2}[12n + 6]$ $= 6n^2 + 3n$	✓ a and d ✓ substitution into the correct formula ✓ $\frac{n}{2}[12n + 6]$ (3)
2.2.4	$-3 + S_n = 21060$ $S_n = 21063$ $6n^2 + 3n = 21063$ $6n^2 + 3n - 21063 = 0$ $2n^2 + n - 7021 = 0$ $n = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $n = \frac{-1 \pm \sqrt{(1)^2 - 4(1)(-7021)}}{2(2)}$ $n = 59 \text{ or } n \neq \frac{-119}{2}$ $\therefore\ n = 59$ **OR** $T_n = 21060$ $6n^2 - 9n - 21060 = 0$ $2n^2 - 3n - 7020 = 0$ $n = 60$ $\therefore$ 59 first differences must be added.	✓ $-3 + S_n = 21060$ ✓ equation ✓ standard form ✓ answer (4) ✓ equation ✓ standard form ✓✓ answer (4)
		[17]

QUESTION/*VRAAG* 3

3.1	$\sum_{k=1}^{\infty} 4.3^{2-k} = 12+4+\frac{4}{3}+\ldots$ $r = \frac{4}{12} = \frac{1}{3}$ $-1 < \frac{1}{3} < 1$ $\therefore$ series is convergent $(-1 < r < 1)$	✓ $12+4+\frac{4}{3}+..$ or $36\left(\frac{1}{3}\right)^k$ ✓ value of r ✓ $-1 < r < 1$ (3)
3.2	$\sum_{k=p}^{\infty} 4.3^{2-k} = 4.3^{2-p} + 4.3^{1-p} + 4.3^{-p} + \ldots$ $a = 4.3^{2-p}$ $r = \frac{1}{3}$ $S_\infty = \frac{a}{1-r}$ $\frac{2}{9} = \frac{4.3^{2-p}}{1-\frac{1}{3}}$ $4.3^{2-p} = \frac{4}{27}$ $3^{2-p} = 3^{-3}$ $2-p = -3$ $p = 5$	✓ expression for a ✓ substitution of a, r and S_∞ ✓ simplification $\left(4.3^{2-p} = \frac{4}{27}\right)$ ✓ $3^{2-p} = 3^{-3}$ ✓ answer (5)
		[8]

QUESTION/*VRAAG* 4

4.1.1	$x = 1$ $y = 2$	✓ $x = 1$ ✓ $y = 2$ (2)
4.1.2	$y = mx + c$ $\quad y - y_1 = m(x - x_1)$ $\quad y = -(x - p) + q$ $2 = -1 + c$ **or** $y - 2 = -1(x - 1)$ **or** $= -(x - 1) + 2$ $c = 3$ $\quad y - 2 = -x + 1$ $\quad y = -x + 3$ $y = -x + 3$ $\quad y = -x + 3$	✓ substitution of $m = -1$ and $(1 ; 2)$ ✓ answer (2)
4.1.3		✓ vertical asymptote: $x = 1$ and horizontal asymptote: $y = 2$ ✓ x-intercept: $\frac{5}{2}$ ✓ y-intercept: 5 ✓ shape (A) (4)
4.2.1	$(-5 ; -8)$	✓ $x = -5$ ✓ $y = -8$ (2)
4.2.2	$y \geq -8$ **or** $[-8; \infty)$	✓ answer (1)
4.2.3	$m = -5$ $n = g(-5)$ $= \frac{1}{2}(-5) + \frac{9}{2}$ $= 2$	✓ $m = -5$ ✓ substitution ✓ $n = 2$ (3)
4.2.4		
		Area trapezium $= \frac{1}{2}(DE + OC) \times OE$ $= \frac{1}{2}(2 + 4{,}5) \times 5$ $= \frac{65}{4}$ or 16,25 ✓ method ✓ correct substitution ✓ answer (3)

	OR  Area $\Delta = \frac{1}{2}b.h$ $= \frac{1}{2}(5)\left(\frac{5}{2}\right)$ $= \frac{25}{4}$ Area rect $= b.h$ $= (5)(2)$ $= 10$ Area trapezium $= \frac{25}{4} + 10 = \frac{65}{4}$ or 16,25	**OR** ✓ method ✓correct substitution ✓answer (3)
	OR S(– 9 ; 0)  Area Δ SOC $= \frac{1}{2}b.h$ $= \frac{1}{2}(9)\left(\frac{9}{2}\right)$ $= \frac{81}{4}$ Area Δ SED $= \frac{1}{2}b.h = \frac{1}{2}(4)(2) = 4$ Area trapezium = area Δ SOC – Area Δ SED $= \frac{81}{4} - 4$ $= \frac{65}{4}$ or 16,25	**OR** ✓ method ✓correct substitution ✓answer (3)
4.2.5	g^{-1}: $x = \frac{1}{2}y + \frac{9}{2}$ g^{-1}: $y = 2x - 9$	✓ changing x and y ✓answer (2)

4.2.6	$f(x)=\frac{1}{2}(x+5)^2-8$ $f(x)=\frac{1}{2}(x^2+10x+25)-8$ $f(x)=\frac{1}{2}x^2+5x+4,5$ $f'(x)=x+5$ $h(x)=2x-9+k$ $x+5=2$ $x=-3 \quad y=-6$ $(-3;-6)$ **OR** $f(x)=h(x)$ $\frac{1}{2}(x+5)^2-8=2x-9+k$ $\frac{1}{2}x^2+3x+\frac{27}{2}-k=0$ $x=\frac{-3}{2\left(\frac{1}{2}\right)}=-3 \qquad b^2-4ac=0$ $y=-6$ $(-3;-6)$	✓ $f'(x)$ ✓ $x+5=2$ ✓ $x=-3$ ✓ $y=-6$ (4) **OR** ✓ equating ✓ turning point / $\triangle=0$ ✓ $x=-3$ ✓ $y=-6$ (4)
		[23]

QUESTION/*VRAAG* 5

5.1	A(0 ; 1)	✓ answer (1)
5.2	$9 = 3^{-x}$ $3^2 = 3^{-x}$ $x = -2$ B(–2 ; 9)	✓ equating ✓ $3^2 = 3^{-x}$ ✓ $x = -2$ (3)
5.3	$x \in (0;\infty)$ or $x > 0$	✓✓answer (2)
5.4	$h(x) = 27.3^{-x}$ $h(x) = 3^{-(x-3)}$ f shifted 3 units to the right	✓ $h(x) = 3^{-(x-3)}$ ✓3 units ✓ right (3)
5.5	$\frac{27}{3^x} < 1$ $\quad 3^{-x+3} < 1$ $3^x > 27$ **or** $3^{-x+3} < 3^0$ $3^x > 3^3$ $\quad -x+3 < 0$ $x > 3$ $\quad x > 3$ **OR** The graph shifts 3 units to the right Thus the y-intercept shift 3 units to the right (3 ; 1) $\therefore x > 3$	✓ $3^x > 27$ **or** $3^{-x+3} < 3^0$ ✓ $3^x > 3^3$ **or** $-x+3 < 0$ ✓ $x > 3$ (3) **OR** ✓ translation ✓ y-intercept ✓answer (3)
		[12]

QUESTION/*VRAAG* 6

6.1.1	$F = \frac{x\left[(1+i)^n - 1\right]}{i}$ $= \frac{1\,000\left[\left(1+\frac{0,075}{12}\right)^{145} - 1\right]}{\frac{0,075}{12}}$ $=$ R234 888,53	✓ $n = 145$ ✓ $i = \frac{0,075}{12}$ ✓ substitution into the correct formula ✓ answer (4)
6.1.2	$A = P(1+i)^n$ $= 234\,888,53\left(1+\frac{0,075}{12}\right)^{12}$ $=$ R253 123,54	✓ substitution into the correct formula ✓ answer (2)
6.2	$A = P(1-i)^n$ $92\,537,64 = 250\,000(1-0,22)^n$ $0,37015056 = (0,78)^n$ $n = \frac{\log 0,37015056}{\log 0,78}$ $n = 4$ years	✓ substitution into the correct formula ✓ correct use of logs ✓ answer (3)
6.3.1	Loan amount: $= \frac{x[1-(1+i)^{-n}]}{i}$ $= \frac{1500\left[1-\left(1+\frac{0,113}{12}\right)^{-72}\right]}{\frac{0,113}{12}}$ $=$ R78 173,49323	✓ 72 ✓ substitution into the correct formula ✓ answer (3)
6.3.2	Balance after 5 years: $P = \frac{x\left[1-(1+i)^{-n}\right]}{i}$ $= \frac{1\,500\left[1-\left(1+\frac{0,113}{12}\right)^{-12}\right]}{\frac{0,113}{12}}$ $=$ R16 945,00629 Amount paid: R1 500 × 60 = R90 000 Interest = Amount paid – [Loan – Balance] = R90 000 – [R78 173,49323 – R16 945,00629] = R28 771,51	✓ substitution (A) ✓ R16 945,00629 (A) ✓ R90 000 – [Loan – Balance] ✓ answer (4)

	OR Balance $= 78\,173{,}49\left(1+\frac{0{,}133}{12}\right)^{60} - \frac{1\,500\left(\left(1+\frac{0{,}113}{12}\right)^{60}-1\right)}{\frac{0{,}113}{12}}$ Balance = R16 945.00 Amount paid: R1 500×60 = R90 000 Interest = Amount paid – [Loan – Balance] = R90 000 – [R78 173,49323 – R16 945,00629] = R28 771,51	**OR** ✓ substitution ✓ R16 945,00629 ✓ R90 000 – [Loan – Balance] ✓ answer (4)
		[16]

QUESTION/*VRAAG* 7
Penalty of – 1 for notation only in 7.1

7.1	$f(x)=2x^2-1$ $f(x+h)=2(x+h)^2-1$ $=2(x^2+2xh+h^2)^2-1$ $=2x^2+4xh+2h^2-1$ $f(x+h)-f(x)=2x^2+4xh+2h^2-1-(2x^2-1)$ $=2x^2+4xh+2h^2-1-2x^2+1$ $=4xh+2h^2$ $f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $=\lim_{h\to 0}\frac{4xh+2h^2}{h}$ $=\lim_{h\to 0}\frac{h(4x+2h)}{h}$ $=\lim_{h\to 0}(4x+2h)$ $=4x$	✓ $2x^2+4xh+2h^2-1$ ✓ $4xh+2h^2$ ✓ substitution ✓ simplification ✓ answer (5)
7.2.1	$\frac{d}{dx}\left(\sqrt[5]{x^2}+x^3\right)$ $=\frac{d}{dx}\left(x^{\frac{2}{5}}+x^3\right)$ $\frac{dy}{dx}=\frac{2}{5}x^{-\frac{3}{5}}+3x^2$	✓ $x^{\frac{2}{5}}$ ✓ $\frac{2}{5}x^{-\frac{3}{5}}$ ✓ $3x^2$ (3)
7.2.2	$f(x)=\frac{4x^2-9}{4x+6}$ $=\frac{(2x-3)(2x+3)}{2(2x+3)}$ $=\frac{2x-3}{2}$ $=x-\frac{3}{2}$ $f'(x)=1$	✓ $(2x-3)(2x+3)$ ✓ $2(2x+3)$ ✓ simplification to two separate terms ✓ answer (4)
		[12]

QUESTION/*VRAAG* 8

8.1	$-1 < x < 2$	✓✓ answer (2)
8.2	$x = \frac{-1+2}{2}$ $x = \frac{1}{2}$ **Answer Only: Full Marks**	✓ method ✓ answer (2)
8.3	From the graph $x > \frac{1}{2}$ **Answer Only: Full Marks**	✓✓ answer (2)
8.4	$g(x) = ax^3 + bx^2 + cx$ $g'(x) = 3ax^2 + 2bx + c = -6x^2 + 6x + 12$ $3a = -6.$ $2b = 6$ $c = 12$ $a = -2$ $b = 3$ $g(x) = -2x^3 + 3x^2 + 12x$	✓ $g'(x) = 3ax^2 + 2bx + c$ ✓ $a = -2$ ✓ $b = 3$ ✓ $g(x) = -2x^3 + 3x^2 + 12x$ (4)
8.5	$g'\left(\frac{1}{2}\right) = -6\left(\frac{1}{2}\right)^2 + 6\left(\frac{1}{2}\right) + 12$ $m = \frac{27}{2}$ or 13,5 $y = -2\left(\frac{1}{2}\right)^3 + 3\left(\frac{1}{2}\right)^2 + 12\left(\frac{1}{2}\right)$ $y = \frac{13}{2}$ or 6,5 $y - y_1 = m(x - x_1)$ $y - 6{,}5 = 13{,}5(x - 0{,}5)$ $y = 13{,}5x - 0{,}25$	✓max gradient at $x = \frac{1}{2}$ ✓answer ✓ y value ✓substitution ✓answer (5)
		[15]

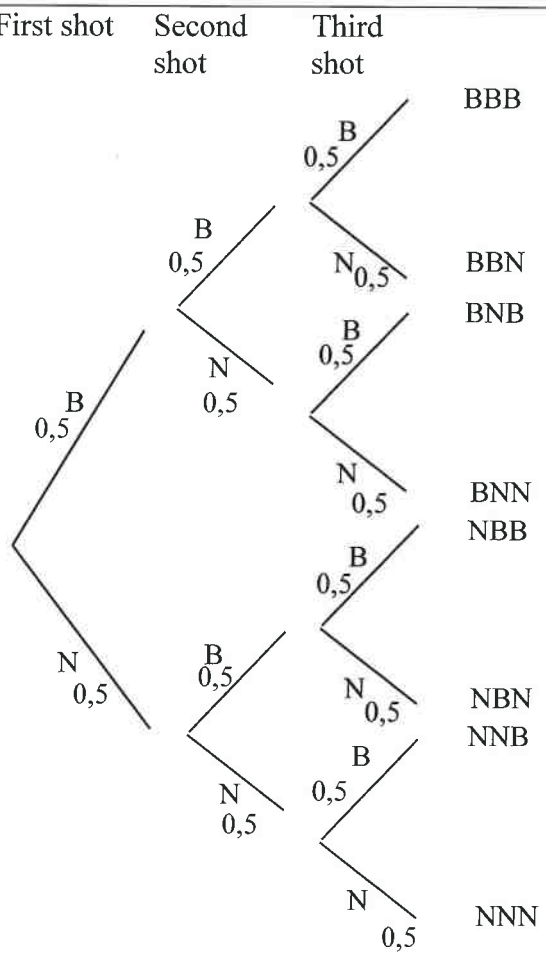
QUESTION/*VRAAG* 9

9.1	Total surface area $= 2\ell w + 2wh + 2\ell h$ but: $\ell = 3w$ Total surface area $= 6w^2 + 2wh + 6wh$ $C = 15(6w^2) + 6(2wh + 6wh)$ $= 15(6w^2) + 6(8wh)$ $= 90w^2 + 48wh$	✓ $2\ell w + 2wh + 2\ell h$ ✓ $\ell = 3w$ ✓ $15(6w^2)$ ✓ $6(2wh + 6wh)$ (4)
9.2	$5 = 3w^2h$ $h = \frac{5}{3w^2}$ $C = 90w^2 + 48wh$ $C(w) = 90w^2 + 48w\left(\frac{5}{3w^2}\right)$ $= 90w^2 + 80w^{-1}$ $C'(w) = 180w - 80w^{-2}$ $180w - 80w^{-2} = 0$ $180w^3 - 80 = 0$ $w^3 = \frac{80}{180}$ $w = \sqrt[3]{\frac{80}{180}}$ $w = 0,76$	✓ $h = \frac{5}{3w^2}$ ✓ substitution ✓ $C(w) = 90w^2 + 80w^{-1}$ ✓ derivative ✓ equating derivative to zero ✓ value of w (6)
		[10]

QUESTION/*VRAAG* 10

10.1	10^{10} or 10 000 000 000	✓✓ answer (2)
10.2.1	$\underline{8} \times \underline{10} \times \underline{10}$ × $\underline{8} \times \underline{8} \times \underline{10}$ × $\underline{2} \times \underline{10} \times \underline{10} \times \underline{10}$ Area exchange number No. of valid 10-digit numbers $= (8 \times 10 \times 10) \times (8 \times 8 \times 10) \times (2 \times 10 \times 10 \times 10)$ $= 1{,}024 \times 10^9$	✓ $\underline{8} \times \underline{10} \times \underline{10}$ or $\underline{8} \times \underline{8} \times \underline{10}$ ✓ $\underline{2} \times \underline{10} \times \underline{10} \times \underline{10}$ ✓ $1{,}024 \times 10^9$ (A) (3)
10.2.2	Probability $= \dfrac{1{,}024 \times 10^9}{10^{10}}$ $= \dfrac{64}{625} = 0{,}1024 = 10{,}24\%$	✓ $\dfrac{1{,}024 \times 10^9}{10^{10}}$ ✓ answer (2)
		[7]

QUESTION/*VRAAG* 11

11		
11.1	P (Bull's eye first shot and second shot) $= 0{,}5 \times 0{,}5$ $= 0{,}25$ or $\dfrac{1}{4}$	✓two 0,5's ✓ $0{,}5 \times 0{,}5$ (2)

11.2	P (Bull's eye at least twice in 3 shots) $= (0,5 \times 0,5 \times 0,5) + (0,5 \times 0,5 \times 0,5) + (0,5 \times 0,5 \times 0,5) + (0,5 \times 0,5 \times 0,5)$ $= 0,125 + 0,125 + 0,125 + 0,125$ $= 0,5 \quad \text{or} \quad \frac{1}{2}$	✓ $0,5 \times 0,5 \times 0,5$ ✓ four events ✓ answer (A) (3)
11.3	Person shoots first: $(0,5) + (0,5)^3 + (0,5)^5 + \ldots$ $P = \frac{a}{1-r}$ $P = \frac{0,5}{1-0,25}$ $P = \frac{2}{3} = 0,67$	✓ $(0,5) + (0,5)^3$ ✓ $\ldots + (0,5)^5 + \ldots$ ✓ $P = \frac{0,5}{1-0,25}$ (3)
		[8]

TOTAL/*TOTAAL*: 150