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.

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 50th 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 $\displaystyle\sum_{k=1}^{\infty} 4.3^{2-k}$ is a convergent geometric series. Show ALL your calculations.   (3)

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

[8]

QUESTION 4

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

        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.
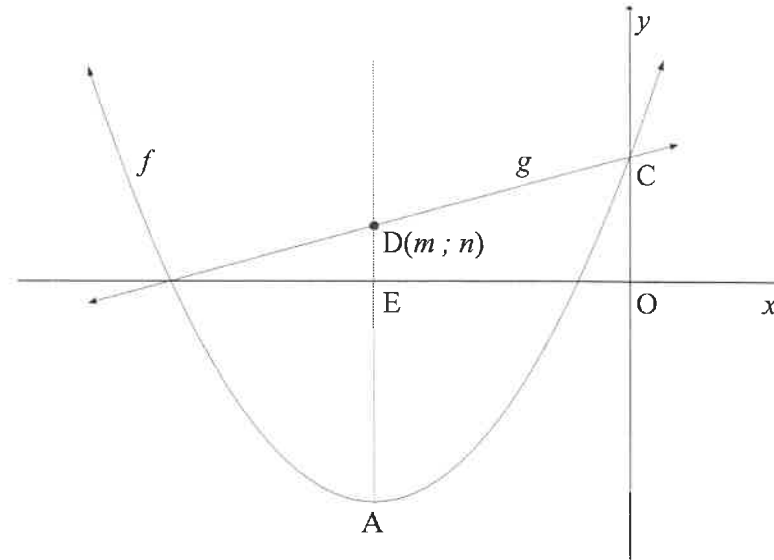
4.2.1   Write down the coordinates of A.   (2)

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]

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 $y = 9$.
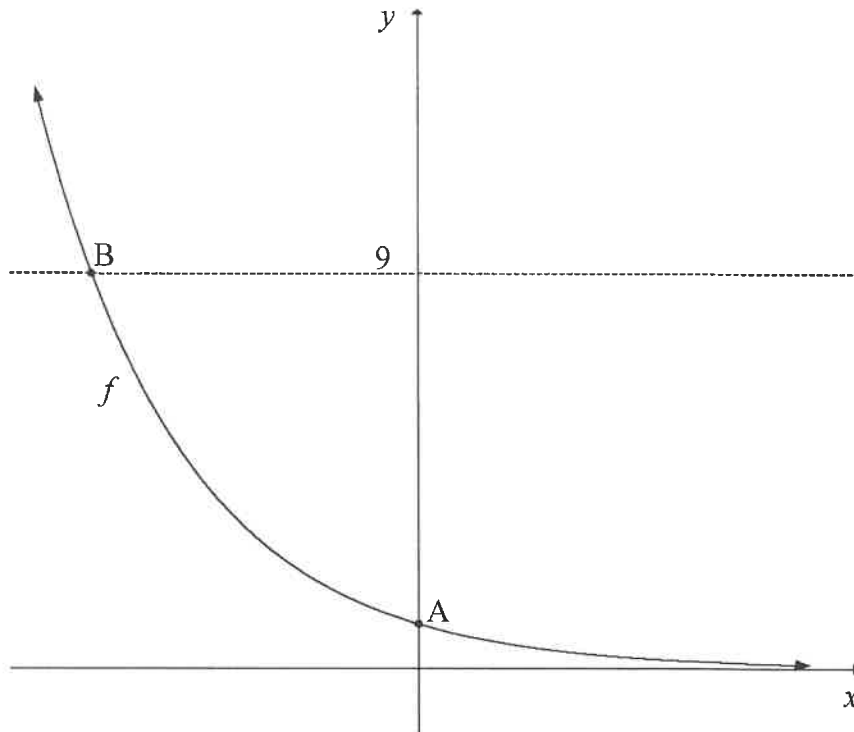
5.1   Write down the coordinates of A.   (1)

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 $h(x) = \dfrac{27}{3^x}$.   (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 $\dfrac{d}{dx}\left(\sqrt[5]{x^2} + x^3\right)$ (3)

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

                                                                                                  [12]

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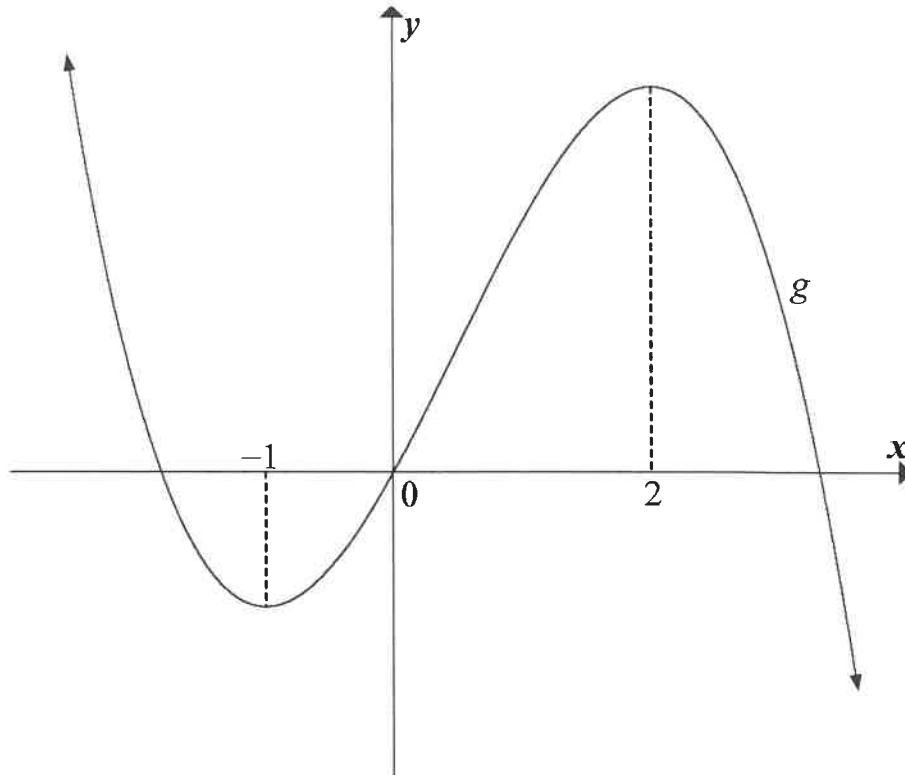
8.1   For which values of x will g increase?   (2)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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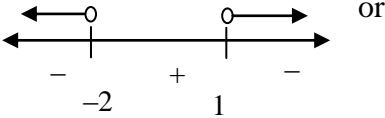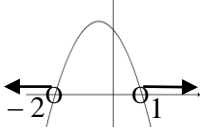- Consistent accuracy applies in all aspects of the marking memorandum.

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	$x^2 + 10x + 8 = 0$ $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \dfrac{-10 \pm \sqrt{10^2 - 4(1)(8)}}{2(1)}$ $= \dfrac{-10 \pm \sqrt{68}}{2}$ $x = -0{,}88$ 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 subject of the formula
	$\quad\quad y = 3 - x$ .... (1)	
	$2x^2 + 4xy - y = 15$ .... (2)	
	Substitute (1) into (2):	✓ substitution
	$\quad 2x^2 + 4x(3-x) - (3-x) = 15$	
	$\quad 2x^2 + 12x - 4x^2 - 3 + x - 15 = 0$	
	$\quad\quad\quad -2x^2 + 13x - 18 = 0$	✓ standard form
	$\quad\quad\quad 2x^2 - 13x + 18 = 0$	✓ factors
	$\quad\quad\quad (2x - 9)(x - 2) = 0$	
	$\quad\quad\quad x = \dfrac{9}{2} \quad \text{or} \quad x = 2$	✓ x-values
	$\quad\quad\quad y = -\dfrac{3}{2} \quad \text{or} \quad y = 1$	✓ y-values
		(6)
	OR	**OR**
	$\quad\quad x + y = 3$	✓ x subject of the formula
	$\quad\quad\quad x = 3 - y$ .... (1)	
	$2x^2 + 4xy - y = 15$ .... (2)	
	Substitute (1) into (2):	✓ substitution
	$\quad 2(3-y)^2 + 4(3-y)y - y = 15$	
	$2y^2 - 12y + 18 - 4y^2 + 12y - y - 15 = 0$	
	$\quad\quad\quad -2y^2 - y + 3 = 0$	✓ standard form
	$\quad\quad\quad 2y^2 + y - 3 = 0$	✓ factors
	$\quad\quad\quad (2y + 3)(y - 1) = 0$	
	$\quad\quad y = -\dfrac{3}{2} \quad \text{or} \quad y = 1$	✓ y-values
	$\quad\quad x = \dfrac{9}{2} \quad \text{or} \quad x = 2$	✓ x-values
		(6)
1.3	$n^{200} < 5^{300}$	
	$\left(n^2\right)^{100} < \left(5^3\right)^{100}$	✓ $\left(n^2\right)^{100} < \left(5^3\right)^{100}$
	$\left(n^2\right)^{100} < (125)^{100}$	
	$n^2 < 125$	✓ $n^2 < 125$
	Maximum value of n is 11.	✓ 11
		(3)
	OR	**OR**
	$200 \log n < 300 \log 5$	✓ use of logs
	$n < 10^{\frac{3}{2}\log 5}$	
	$n < 11{,}18$	✓ $n < 11{,}18$
	$\therefore n = 11$	✓ 11
		(3)
	OR	**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** $n^{200} < 5^{300}$ $n < 5^{\frac{300}{200}}$ $n < 11,18$ $\therefore n = 11$	$\checkmark (n^2)^{100} < (5^3)^{100}$ $\checkmark n < 11,18$ $\checkmark 11$ (3) **OR** $\checkmark n < 5^{\frac{300}{200}}$ $\checkmark n < 11,18$ $\checkmark n = 11$ (3)
		[22]

QUESTION/*VRAAG* 2
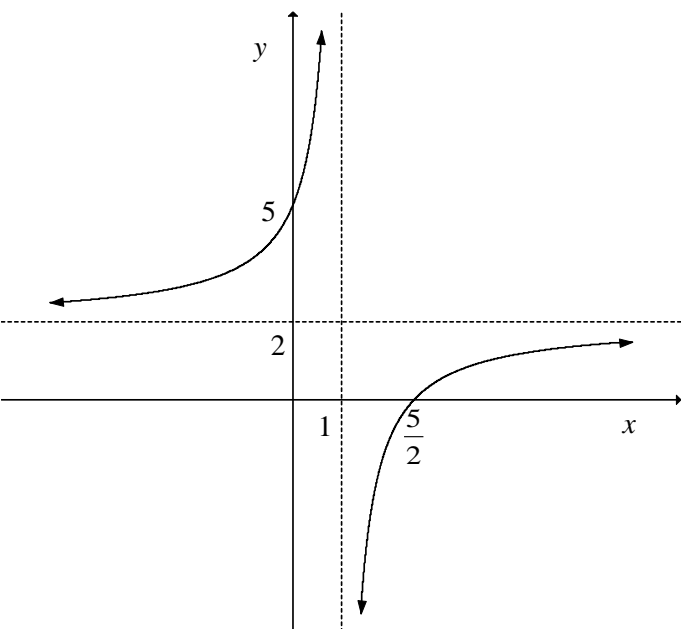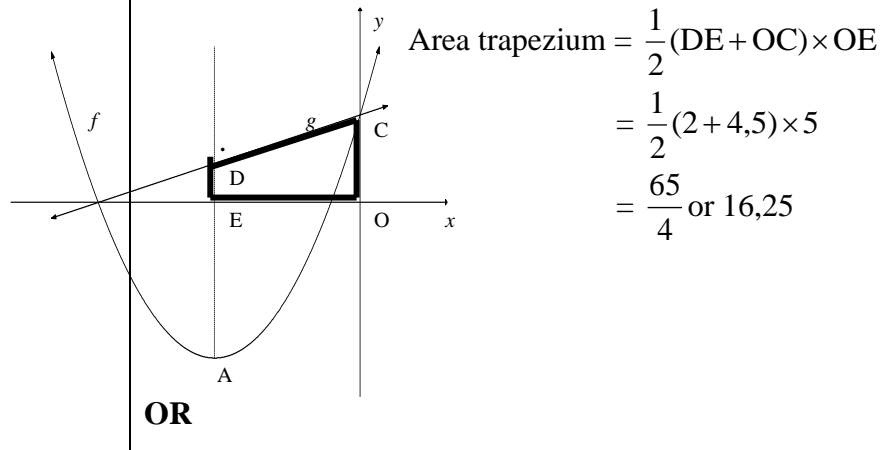
2.1	$7 \; ; \; x \; ; \; y \; ; \; -11 \; ; \; \dots$	
	$a = 7$	
	$a + 3d = -11$	
	$7 + 3d = -11$	✓ $7 + 3d = -11$
	$d = -6$	✓ $d = -6$
	$x = a + d = 7 + (-6) = 1$	✓ value of x
	$y = a + 2d = 7 + 2(-6) = -5$	✓ value of y
		(4)
	OR	**OR**
	$a + 3d = -11$	
	$3d = -11 - 7$	✓ $3d = -11 - 7$
	$3d = -18$	
	$d = -6$	✓ $d = -6$
	$x = 1$	✓ $x = 1$
	$y = -5$	✓ $y = -5$
		(4)
	OR	**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	$-3 \; ; \; 6 \; ; \; 27 \; ; \; 60 \; ; \; \dots$	
	$2a = 12$	✓ second difference
	$a = 6$	✓ $a = 6$
	$3a + b = 9$	
	$3(6) + b = 9$	
	$b = -9$	✓ $b = -9$
	$a + b + c = -3$	
	$6 - 9 + c = -3$	
	$c = 0$	✓ $c = 0$ **(4)**
	$T_n = 6n^2 - 9n$	

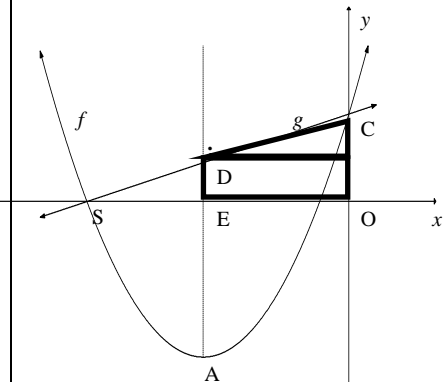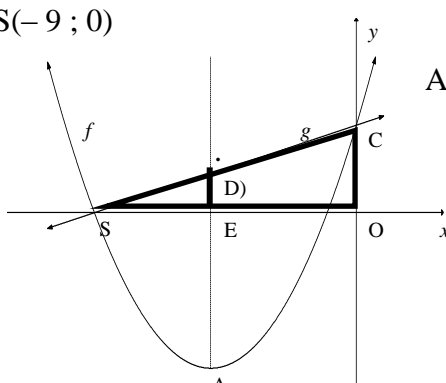|			
2.2.2	$T_{50} = 6(50)^2 - 9(50)$ $= 14\,550$	**Answer Only: Full Marks**	✓ substitute 50 ✓ answer (2)
2.2.3	$9 ; 21 ; 33 ; \ldots$ $a = 9$ $d = 12$ $S_n = \dfrac{n}{2}[2a + (n-1)d]$ $S_n = \dfrac{n}{2}[2(9) + (n-1)(12)]$ $\quad = \dfrac{n}{2}[18 + 12n - 12]$ $\quad = \dfrac{n}{2}[12n + 6]$ $\quad = 6n^2 + 3n$		✓ a and d ✓ substitution into the correct formula ✓ $\dfrac{n}{2}[12n + 6]$ (3)
2.2.4	$-3 + S_n = 21060$ $\qquad S_n = 21063$ $6n^2 + 3n = 21063$ $6n^2 + 3n - 21063 = 0$ $2n^2 + n - 7021 = 0$ $n = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $n = \dfrac{-1 \pm \sqrt{(1)^2 - 4(1)(-7021)}}{2(2)}$ $n = 59 \ or \ n \neq \dfrac{-119}{2}$ $\therefore \ n = 59$ **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	$\displaystyle\sum_{k=1}^{\infty} 4.3^{2-k} = 12 + 4 + \frac{4}{3} + ...$ $r = \dfrac{4}{12} = \dfrac{1}{3}$ $-1 < \dfrac{1}{3} < 1$ $\therefore$ series is convergent $(-1 < r < 1)$	✓ $12 + 4 + \dfrac{4}{3} + ..$ or $36\left(\dfrac{1}{3}\right)^{k}$ ✓ value of r ✓ $-1 < r < 1$ (3)
3.2	$\displaystyle\sum_{k=p}^{\infty} 4.3^{2-k} = 4.3^{2-p} + 4.3^{1-p} + 4.3^{-p} + ...$ $a = 4.3^{2-p}$ $r = \dfrac{1}{3}$ $S_{\infty} = \dfrac{a}{1-r}$ $\dfrac{2}{9} = \dfrac{4.3^{2-p}}{1 - \dfrac{1}{3}}$ $4.3^{2-p} = \dfrac{4}{27}$ $3^{2-p} = 3^{-3}$ $2 - p = -3$ $p = 5$	✓ expression for a ✓ substitution of a, r and S_{∞} ✓ simplification $\left(4.3^{2-p} = \dfrac{4}{27}\right)$ ✓ $3^{2-p} = 3^{-3}$ ✓ answer (5)
		[8]

QUESTION/*VRAAG* 4

4.1.1	$x = 1$ $y = 2$	✓ $x = 1$ ✓ $y = 2$ (2)
4.1.2	$y = mx + c$ $y - y_1 = m(x - x_1)$ $y = -(x - p) + q$ $2 = -1 + c$ **or** $y - 2 = -1(x - 1)$ **or** $= -(x - 1) + 2$ $c = 3$ $y - 2 = -x + 1$ $y = -x + 3$ $y = -x + 3$ $y = -x + 3$	✓ 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
	 OR
		✓ method
		 ✓ correct substitution
		 ✓ answer (3)
		
		 OR

Area $\Delta = \dfrac{1}{2}b.h$

$= \dfrac{1}{2}(5)\left(\dfrac{5}{2}\right)$

$= \dfrac{25}{4}$

✓ method

Area rect $= b.h$

$= (5)(2)$

$= 10$

✓ correct substitution
✓ answer   (3)

Area trapezium $= \dfrac{25}{4} + 10 = \dfrac{65}{4}$ or 16,25

OR

OR
$S(-9 ; 0)$

Area Δ SOC $= \dfrac{1}{2}b.h$

$= \dfrac{1}{2}(9)\left(\dfrac{9}{2}\right)$

$= \dfrac{81}{4}$

Area Δ SED $= \dfrac{1}{2}b.h = \dfrac{1}{2}(4)(2) = 4$

Area trapezium = area Δ SOC – Area Δ SED

$= \dfrac{81}{4} - 4$

$= \dfrac{65}{4}$ or 16,25

✓ method

✓ correct substitution

✓ answer   (3)

| 4.2.5 | $g^{-1}:\ x = \dfrac{1}{2}y + \dfrac{9}{2}$

 $g^{-1}:\ y = 2x - 9$ | ✓ changing x and y

 ✓ answer
 (2) |

4.2.6	$f(x) = \dfrac{1}{2}(x+5)^2 - 8$	
	$f(x) = \dfrac{1}{2}(x^2 + 10x + 25) - 8$	
	$f(x) = \dfrac{1}{2}x^2 + 5x + 4{,}5$	
	$f'(x) = x + 5$	✓ $f'(x)$
	$h(x) = 2x - 9 + k$	
	$x + 5 = 2$	✓ $x + 5 = 2$
	$x = -3 \quad y = -6$	
	$(-3 \,; -6)$	✓ $x = -3$ ✓ $y = -6$
		(4)
	OR	**OR**
	$f(x) = h(x)$	
	$\dfrac{1}{2}(x+5)^2 - 8 = 2x - 9 + k$	✓ equating
	$\dfrac{1}{2}x^2 + 3x + \dfrac{27}{2} - k = 0$	
	$x = \dfrac{-3}{2\left(\dfrac{1}{2}\right)} = -3 \qquad b^2 - 4ac = 0$	✓ turning point / $\triangle = 0$
	$y = -6$	
	$(-3 \,; -6)$	✓ $x = -3$ ✓ $y = -6$ (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	$\dfrac{27}{3^x} < 1 \qquad\qquad 3^{-x+3} < 1$ $3^x > 27$ **or** $\quad 3^{-x+3} < 3^0$ $3^x > 3^3 \qquad\quad -x+3 < 0$ $x > 3 \qquad\qquad\quad x > 3$ **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	$F = \dfrac{x\left[(1+i)^n - 1\right]}{i}$ $= \dfrac{1\,000\left[\left(1+\dfrac{0,075}{12}\right)^{145} - 1\right]}{\dfrac{0,075}{12}}$ $= \text{R}234\,888,53$	✓ $n = 145$ ✓ $i = \dfrac{0,075}{12}$ ✓ substitution into the correct formula ✓ answer (4)
6.1.2	$A = P(1+i)^n$ $= 234\,888,53\left(1+\dfrac{0,075}{12}\right)^{12}$ $= \text{R}253\,123,54$	✓ substitution into the correct formula ✓ answer (2)
6.2	$A = P(1-i)^n$ $92\,537,64 = 250\,000(1 - 0,22)^n$ $0,37015056 = (0,78)^n$ $n = \dfrac{\log 0,37015056}{\log 0,78}$ $n = 4 \ \text{years}$	✓ substitution into the correct formula ✓ correct use of logs ✓ answer (3)
6.3.1	Loan amount: $= \dfrac{x[1 - (1+i)^{-n}]}{i}$ $= \dfrac{1500\left[1 - \left(1+\dfrac{0,113}{12}\right)^{-72}\right]}{\dfrac{0,113}{12}}$ $= \text{R}78\,173,49323$	✓ 72 ✓ substitution into the correct formula ✓ answer (3)
6.3.2	Balance after 5 years: $P = \dfrac{x\left[1 - (1+i)^{-n}\right]}{i}$ $= \dfrac{1\,500\left[1 - \left(1+\dfrac{0,113}{12}\right)^{-12}\right]}{\dfrac{0,113}{12}}$ $= \text{R}16\,945,00629$ Amount paid: $\text{R}1\,500 \times 60 = \text{R}90\,000$ Interest $= \text{Amount paid} - [\text{Loan} - \text{Balance}]$ $= \text{R}90\,000 - [\,\text{R}78\,173,49323 - \text{R}16\,945,00629]$ $= \text{R}28\,771,51$	✓ substitution (A) ✓ R16 945,00629 (A) ✓ R90 000 − [Loan − Balance] ✓ answer (4)

	OR Balance $= 78\,173,49\left(1+\dfrac{0,133}{12}\right)^{60} - \dfrac{1\,500\left(\left(1+\dfrac{0,113}{12}\right)^{60}-1\right)}{\dfrac{0,113}{12}}$ 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	$x = \dfrac{-1 + 2}{2}$ $x = \dfrac{1}{2}$	**Answer Only: Full Marks**	✓ method ✓ answer (2)
8.3	From the graph $x > \dfrac{1}{2}$	**Answer Only: Full Marks**	✓✓ answer (2)
8.4	$g(x) = ax^3 + bx^2 + cx$ $g'(x) = 3ax^2 + 2bx + c = -6x^2 + 6x + 12$ $3a = -6. \qquad 2b = 6 \qquad c = 12$ $\;a = -2 \qquad\; b = 3$ $g(x) = -2x^3 + 3x^2 + 12x$		✓ $g'(x) = 3ax^2 + 2bx + c$ ✓ $a = -2$ ✓ $b = 3$ ✓ $g(x) = -2x^3 + 3x^2 + 12x$ (4)
8.5	$g'\left(\dfrac{1}{2}\right) = -6\left(\dfrac{1}{2}\right)^2 + 6\left(\dfrac{1}{2}\right) + 12$ $\qquad m = \dfrac{27}{2} \quad$ or $\;13,5$ $y = -2\left(\dfrac{1}{2}\right)^3 + 3\left(\dfrac{1}{2}\right)^2 + 12\left(\dfrac{1}{2}\right)$ $\;y = \dfrac{13}{2} \quad$ or $\quad 6,5$ $y - y_1 = m(x - x_1)$ $y - 6,5 = 13,5(x - 0,5)$ $y = 13,5x - 0,25$		✓ max gradient at $x = \dfrac{1}{2}$ ✓ 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 $= 6w^2 + 2wh + 6wh$ $\begin{aligned}C &= 15\left(6w^2\right) + 6(2wh + 6wh)\\ &= 15\left(6w^2\right) + 6(8wh)\\ &= 90w^2 + 48wh\end{aligned}$	✓ $2\ell w + 2wh + 2\ell h$ ✓ $\ell = 3w$ ✓ $15\left(6w^2\right)$ ✓ $6(2wh + 6wh)$ (4)
9.2	$\begin{aligned}5 &= 3w^2 h\\ h &= \dfrac{5}{3w^2}\\ C &= 90w^2 + 48wh\\ C(w) &= 90w^2 + 48w\left(\dfrac{5}{3w^2}\right)\\ &= 90w^2 + 80w^{-1}\\ C'(w) &= 180w - 80w^{-2}\end{aligned}$ $180w - 80w^{-2} = 0$ $180w^3 - 80 = 0$ $w^3 = \dfrac{80}{180}$ $w = \sqrt[3]{\dfrac{80}{180}}$ $w = 0{,}76$	✓ $h = \dfrac{5}{3w^2}$ ✓ 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
	$=(8\times10\times10)\times(8\times8\times10)\times(2\times10\times10\times10)$
	$=1{,}024 \times 10^{9}$
		✓ $\underline{8} \times \underline{10} \times \underline{10}$
		    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	First shot Second shot Third shot	
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) $= (0,5 \times 0,5 \times 0,5) + (0,5 \times 0,5 \times 0,5) + (0,5 \times 0,5 \times 0,5) +$ $(0,5 \times 0,5 \times 0,5)$ $= 0,125 + 0,125 + 0,125 + 0,125$ $= 0,5 \quad$ or $\quad \dfrac{1}{2}$	✓ $0,5 \times 0,5 \times 0,5$ ✓four events ✓ answer (A) (3)
11.3	Person shoots first: $(0,5) + (0,5)^3 + (0,5)^5 + ...$ $P = \dfrac{a}{1-r}$ $P = \dfrac{0,5}{1-0,25}$ $P = \dfrac{2}{3} = 0,67$	✓ $(0,5) + (0,5)^3$ ✓ $..._{...} + (0,5)^5 + ...$ ✓ $P = \dfrac{0,5}{1-0,25}$ (3)
		[8]

TOTAL/*TOTAAL*: 150