KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P1

COMMON TEST

JUNE 2022

MARKS: 150

TIME: 3 hours

This question paper consists of 9 pages and 1 information sheet.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of **10** questions.
2. Read the questions carefully.
3. Answer ALL the questions.
4. Number your answers exactly as the questions are numbered.
5. Clearly show ALL calculations, diagrams, graphs, etc. which you have used in determining your answers.
6. Answers only will NOT necessarily be awarded full marks.
7. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
8. If necessary, round off answers correct to TWO decimal places, unless stated otherwise.
9. Diagrams are NOT necessarily drawn to scale.
10. Write neatly and legibly.

QUESTION 1

1.1 Solve for x :

1.1.1 $5x(3x-2)=0$ (2)

1.1.2 $2x^2+5x=9$ (correct to TWO decimal places) (4)

1.1.3 $\sqrt{16a^2+x^2}-5a=0$ (5)

1.1.4 $\dfrac{-4}{(x-1)(x-5)}<0$ (4)

1.2 Solve for x and y simultaneously if:

$$x-y=3 \quad \text{and} \quad x^2-2y^2-7=xy$$ (6)

1.3 Simplify fully, without the use of a calculator:

$$\frac{\sqrt{m^{2022}-m^{2020}}}{\sqrt{25m^{2024}-25m^{2022}}}$$ (4)

[25]

QUESTION 2

Given the quadratic number pattern whose terms are : $4\ ;\ 14\ ;\ 30\ ;\ 52\ ;\ ...$ respectively.

2.1 Write down the 7^{th} and 8^{th} terms if the pattern continues. (2)

2.2 Determine the n^{th} term of the quadratic pattern. (4)

2.3 Determine the term in the sequence that has a value of 8164. (5)

[11]

QUESTION 3

3.1 In an arithmetic series, the first term is 'a' and the common difference is 'd'. Prove that the sum to n terms of the series is given by:

$$S_n = \frac{n}{2}\left[2a + (n-1)d\right]$$ (4)

3.2 Calculate the sum of the arithmetic series given: $24 + 36 + 48 + 60 + \ldots$ to 64 terms. (3)

3.3 The common difference of an arithmetic sequence is 4 and the common ratio of a geometric sequence is 4. A new sequence is formed by adding the corresponding terms of the arithmetic and the geometric sequences.

The first and second terms of the new sequence are 8 and 21 respectively.

3.3.1 Calculate the third term of the new sequence. (8)

3.3.2 Write down an expression for the n^{th} term of the new sequence. (5)

[20]

QUESTION 4

4.1 Tebego invests R120 000 for 5 years at 9,8 % p.a. compounded monthly.

Shante invests R120 000 for 5 years at 12,3 % p.a. compounded quarterly.

4.1.1 Determine the amount earned by Tebego at the end of 5 years. (2)

4.1.2 Determine the amount earned by Shante at the end of 5 years. (2)

4.1.3 Determine the difference in the interest earned by Tebego and Shante. (3)

4.2 The value of a bakkie presently is R85 000. Calculate the original value of the bakkie if it was bought 8 years ago and the bakkie had depreciated on the reducing balance method of 10,25 % p.a. (to the nearest rand). (3)

4.3 Mpume needs R10 000 at the end of 10 years to buy a new computer. She deposits Rx at the end of 2 years. She then deposits R5000 at the end of 8 years (6 years after the initial deposit).

Interest is calculated at 10 % p.a. for the first 4 years and then 12 % p.a. compounded quarterly for the next 6 years.

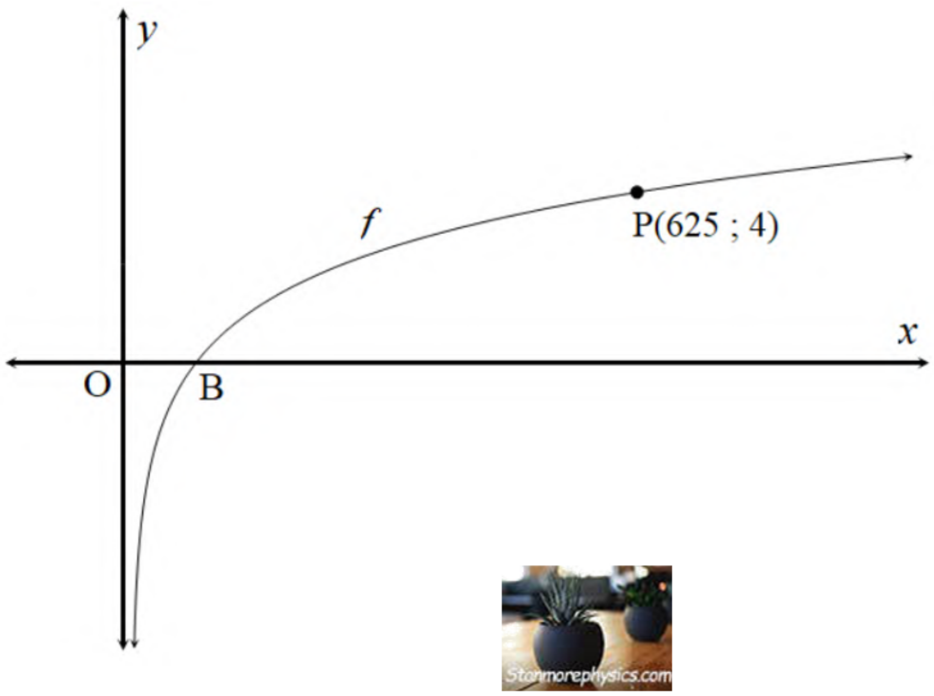
Calculate the value of x. (6)

[16]

QUESTION 5

Given: $f(x) = \log_a x$. $P(625\ ;\ 4)$ is a point on the graph of f.

The asymptote to the graph is the y – axis. The graph intersects the x – axis at B.



5.1 Calculate the value of a. (3)

5.2 Write down the coordinates of B. (2)

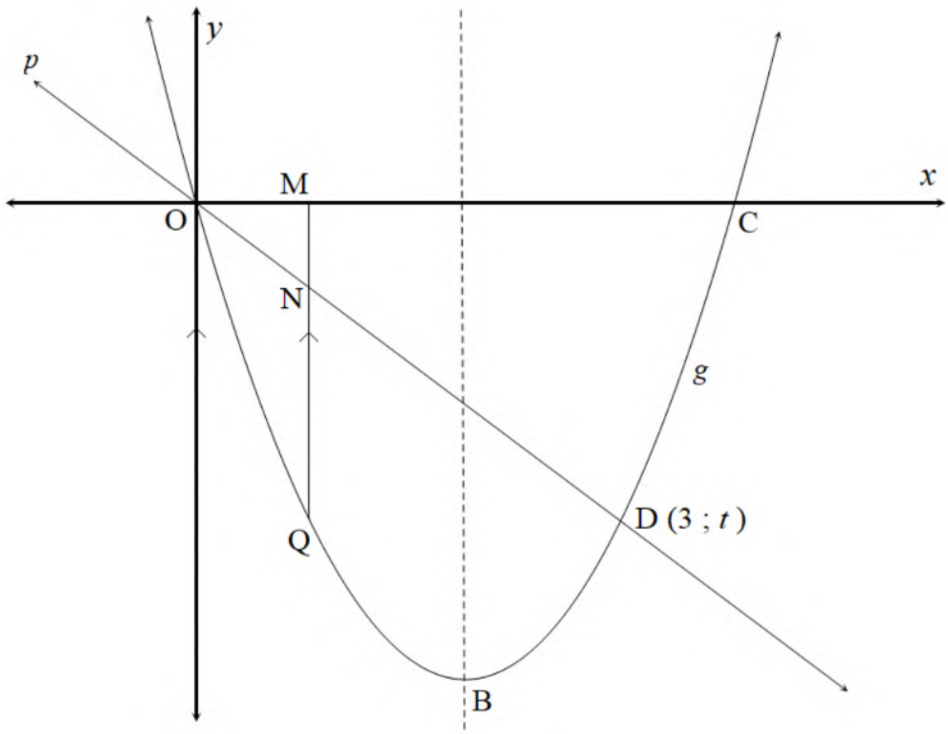
5.3 Determine the equation of f^{-1}, the inverse of f, in the form $y = \ldots$ (2)

5.4 If the point P is reflected about the line $y = x$. Write down the coordinates of the image point, P' (2)

[9]

QUESTION 6

The graph of $g(x) = 3(x-2)^2 - 12$ is sketched below. O and C are the x-intercepts of g and B is the turning point of g. $p(x) = mx + q$ passes through O and D(3 ; t).
MNQ is parallel to the y–axis with N and Q on the graphs of p and g respectively.



6.1 Write down the coordinates of B, the turning point of g. (2)

6.2 Calculate the value of t. (2)

6.3 Write down the equation of the graph of p. (2)

6.4 Determine the maximum length of NQ between O and D. (5)

6.5 Determine the values of k for which $g(x-1) - 15 = k$ has 2 unequal positive real roots. (2)

6.6 Determine the maximum value of $2^{-\frac{1}{2}g(x)}$ (2)

[15]

QUESTION 7

Given the graph of $h(x)=\frac{4}{x-3}-8$

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

7.2 Determine the intercepts of the graph of h with the axes. (3)

7.3 Sketch the graph of h. Clearly show ALL intercepts with the axes and the asymptotes. (3)

7.4 Write down the equation of the vertical asymptote of $q(x)=h(x-4)$. (2)

7.5 If $y=k-x$ is the equation for one of the axes of symmetry to the graph of h, determine the value of k. (2)

[12]

QUESTION 8

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

8.2 Determine:

8.2.1 $g'(x)$ if $g(x)=\left(\frac{4}{x}-\frac{x}{4}\right)^2$ (4)

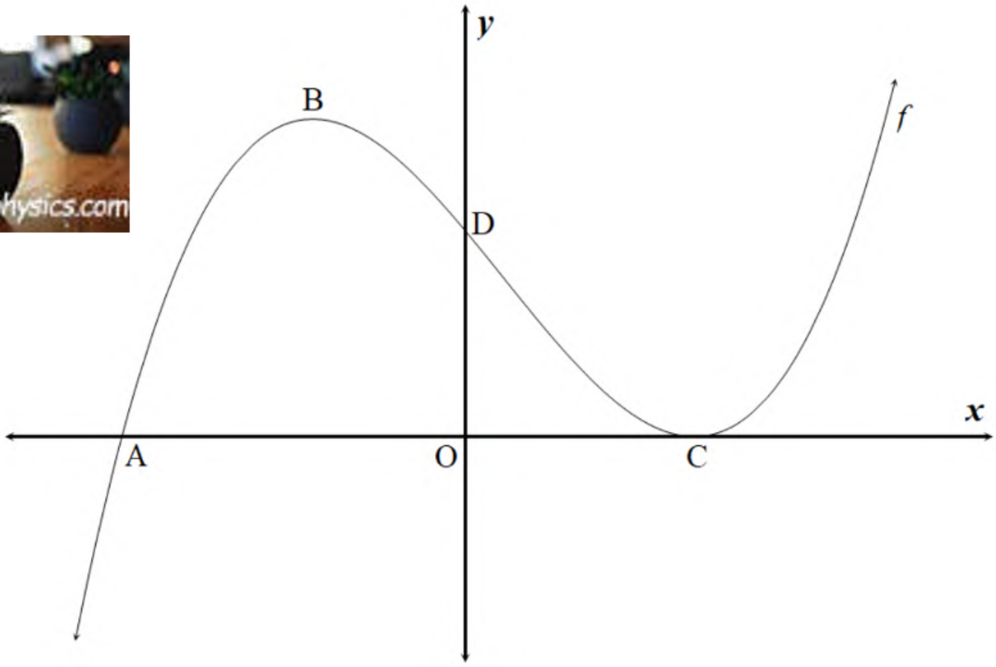
8.2.2 $D_x\left[\frac{7}{\sqrt{x}}-\frac{2}{x^3}\right]$ (4)

8.3 Determine the equation of the tangent to the curve $t(x)=\sqrt{x^3}$ at $x=4$. (4)

[17]

QUESTION 9

The graph of $f(x) = x^3 - x^2 - 8x + 12$ is sketched below. B and C are the turning points, A and C are the x-intercepts, and D is the y-intercept.



9.1 Write down the coordinates of D. (2)

9.2 Determine the coordinates of the turning points of f. (5)

9.3 Show that $f(x)$ has a point of inflection at $x = \frac{1}{3}$. (4)

9.4 If $g(x) = f(-x) + 1$, write down the coordinates of C', the image of C. (2)

9.5 Write down the value(s) of k for which $f(x) = k$ will have

9.5.1 two unequal real roots. (2)

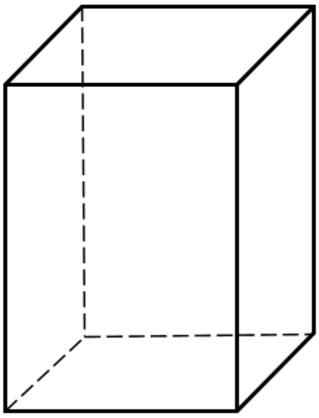
9.5.2 one of the roots equal to 0. (2)

[17]

QUESTION 10

A rectangular box of cereal has a height of $(5-x)$ units.

The expression for the volume (V) of the box is given by $V(x)=x^3-8x^2+5x+50$.



10.1 If the height of the cereal box is $(5-x)$ units, determine the area of the base of the box in terms of x. (3)

10.2 Calculate the value of x for which the volume of the box will be at a maximum. (5)

[8]

TOTAL: 150

INFORMATION SHEET: MATHEMATICS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

FINAL

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JUNE 2022

MARKING GUIDELINE

MARKS: **150**

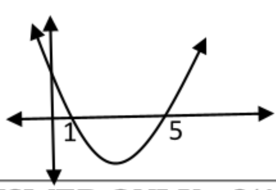
TIME: **3 hours**

NOTE:

- If a candidate answered a QUESTION TWICE, mark only the FIRST attempt.
- If a candidate crossed out an answer and did not redo it, mark the crossed-out answer.
- Consistent accuracy applies to ALL aspects of the marking guidelines.
- Assuming values/answers to solve a problem is unacceptable.

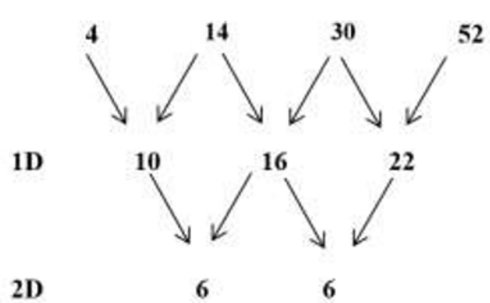
This marking guideline consists of 11 pages.

QUESTION 1

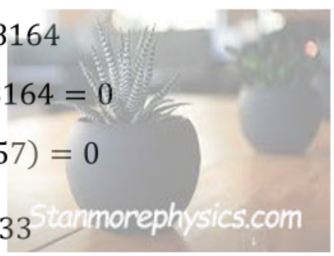
1.1.1	$x = 0 \quad or \quad x = \frac{2}{3}$	A✓ 0 A✓ $\frac{2}{3}$	(2)
1.1.2	$2x^2 + 5x - 9 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-(5) \pm \sqrt{(5)^2 - 4(2)(-9)}}{2(2)}$ $x = -3{,}71 \quad or \quad 1{,}21$ **ANSWER ONLY – MAX 1/4**	A✓standard form CA✓substitution in correct formula CACA✓✓answers **(Penalize 1 mark if rounding off is incorrect-once here for entire paper)**	(4)
1.1.3	$\sqrt{16a^2 + x^2} - 5a = 0$ $\sqrt{16a^2 + x^2} = 5a$ $16a^2 + x^2 = 25a^2$ $x^2 - 9a^2 = 0$ $(x + 3a)(x - 3a) = 0$ $x = -3a \quad or\ x = 3a$	A✓Isolating surd A✓ squaring both sides CA✓standard form CA✓factors CA✓answers	(5)
1.1.4	Since the numerator: $-4 < 0$ $\therefore (x-1)(x-5) > 0$ $x < 1 \quad or \quad x > 5$ **OR**  **ANSWER ONLY – 3/4 MARKS**	A✓condition for numerator A✓ $(x-1)(x-5) > 0$ CA✓ CA ✓ answers **OR** If graphical solution is used: AA 2 marks for graph CACA 2 marks for answer	(4) (4)
1.2	$x - y = 3 \qquad \rightarrow (1)$ $x^2 - 2y^2 - 7 = xy \qquad \rightarrow (2)$ From (1): $x = y + 3 \qquad \rightarrow (3)$ Substituting (3) into (2): $(y+3)^2 - 2y^2 - 7 = y(y+3)$ $y^2 + 6y + 9 - 2y^2 - 7 = y^2 + 3y$ $-2y^2 + 3y + 2 = 0$ $2y^2 - 3y - 2 = 0$ $(2y+1)(y-2) = 0$ $y = -\frac{1}{2} \quad or \quad y = 2$	A✓Making *x/y* the subject CA✓substitution CA✓standard form CA✓factors CA✓ *y/x* values	

	$x = 2\frac{1}{2}$ or $x = 5$	CA✓x/y – values	(6)
1.3	$\frac{\sqrt{m^{2022} - m^{2020}}}{\sqrt{25\, m^{2024} - 25\, m^{2022}}}$ $= \frac{\sqrt{m^{2020}(m^2 - 1)}}{\sqrt{25\, m^{2022}(m^2 - 1)}}$ $= \sqrt{\frac{1}{25m^2}}$ $= \frac{1}{5m}$ **OR** $\frac{\sqrt{m^{2022} - m^{2020}}}{\sqrt{25\, m^{2024} - 25\, m^{2022}}}$ $= \frac{\sqrt{m^{2022}\left(1 - \frac{1}{m^2}\right)}}{\sqrt{25\, m^{2024}\left(1 - \frac{1}{m^2}\right)}}$ $= \sqrt{\frac{1}{25m^2}}$ $= \frac{1}{5m}$	A✓Factorization of numerator A✓Factorization of denominator CA✓simplification CA✓answer **OR** A✓Factorization of numerator A✓Factorization of denominator CA✓simplification CA✓answer	(4) (4)
			[25]

QUESTION 2

2.1	$T_7 = 154$; $T_8 = 200$	AA✓✓ Answers	(2)
2.2	 $2a = 6 \quad \therefore a = 3$ $3a + b = 10 \quad \therefore b = 1$ $a + b + c = 4 \quad \therefore c = 0$	A✓ a – value CA✓b – value CA✓c – value CA✓answer	

	$T_n = 3n^2 + n$ **OR** $\boldsymbol{T_n = T_1 + (n-1)d_1 + \frac{(n-1)(n-2)}{2}d_2}$ **OR** $\boldsymbol{T_n = \frac{(n-1)}{2}[2a + (n-2)d] + T_1}$	**OR** **OR**	(4)
2.3	$T_n = 3n^2 + n = 8164$ $3n^2 + n - 8164 = 0$ $n = \frac{-1 \pm \sqrt{1-4(3)(-8164)}}{2(3)}$ $n = 52 \;\; or \;\; -52{,}33$ n/a **OR** $T_n = 3n^2 + n = 8164$ $3n^2 + n - 8164 = 0$ $(n-52)(3n+157) = 0$ $n = 52 \;\; or \;\; -52{,}33$ n/a **ANSWER ONLY – MAX 1/5**	A✓Equating n^{th} term to 8164 CA✓standard form CA✓substitution into formula CACA✓✓n – values and rejection **OR** A✓Equating n^{th} term to 8164 CA✓standard form CA✓factors CACA✓✓n – values and rejection	(5) (5)
			[11]



QUESTION 3

3.1	$S_n = a + (a+d) + \cdots (a+(n-2)d) + (a+(n-1)d) \quad (1)$ $S_n = (a+(n-1)d) + (a+(n-2)d) + \cdots (a+d) + a \quad (2)$ $2S_n = (2a+(n-1)d) + (2a+(n-1)d) + \cdots$ to n terms $2S_n = n(2a+(n-1)d)$ $S_n = \frac{n}{2}[2a+(n-1)d]$	A✓equation (1) A✓equation (2) A✓$2S_n$ equation A✓ $n(2a+(n-1)d)$	(4)
3.2	$S_n = \frac{n}{2}[2a+(n-1)d]$ $S_{64} = \frac{64}{2}[2(24)+(64-1)(12)]$ $= 25728$	A✓Substitution of n value A✓Substitution of a and d values CA✓Answer	(3)

3.3.1	$x+(x+4)+(x+8)+\cdots$ AS $y+4y+16y+\cdots$ GS $(x+y)+(x+4+4y)+(x+8+16y)+\cdots$ NS $x+y=8 \quad \ldots\ldots\to(1)$ $x+4+4y=21 \ldots.\to(2)$ From (1): $x=8-y \quad \ldots.\to(3)$ Subst. (3) into (2): $8-y+4+4y=21$ $3y=9$ $y=3$ $x=5$ $T_3=x+8+16y$ $T_3=5+8+16(3)$ $T_3=61$	A✓ AS terms A✓GS terms A✓NS terms A✓ $x+y=8$ A✓ $x+4+4y=21$ CA✓*y*/*x* value CA✓*x*/*y* value CA✓Answer	(8)
3.3.2	AS: 5 ; 9 ; 13 ; …... GS: 3 ; 12 ; 48 ; …… $P_n=4n+1$ …….AS $Q_n=3.4^{n-1}$ …….GS $T_n=4n+1+3.4^{n-1}$ ……. NS	CA✓ AS terms CA✓GS terms CA✓ AS – n^{th} term CA✓GS – n^{th} term CA✓NS – n^{th} term	(5)
			[20]

QUESTION 4

4.1.1	Tebego: $A=P(1+i)^n$ $A=120\,000\left(1+\frac{9{,}8\%}{12}\right)^{60}$ $A=R195\,488{,}5357$	A✓Substitution CA✓Answer	(2)
4.1.2	Shante: $A=P(1+i)^n$ $A=120\,000\left(1+\frac{12{,}3\%}{4}\right)^{20}$ $A=R219\,911{,}5884$	A✓Substitution CA✓Answer	(2)
4.1.3	$\text{Interest (Tebego)}:=R75\,488{,}5357$ $\text{Interest (Shante)}:=R99\,911{,}5884$ $\text{Interest (Difference)}:=R24\,423{,}05$	CA✓Tebogo – Interest CA✓Shante – Interest CA✓Answer	(3)
4.2	$A=P(1-i)^n$ $85\,000=P(1-10{,}25\%)^8$ $\frac{85\,000}{(1-10{,}25\%)^8}=P$ Original Value of Bakkie was R 201 903	A✓Substitution *i* and *n* A✓Making P the subject CA✓Answer	(3)

4.3	$10000 = \left[x\left(1+\frac{10\ \%}{1}\right)^2\left(1+\frac{12\ \%}{4}\right)^{16}+5000\right]\left(1+\frac{12\ \%}{4}\right)^8$ $10000 = [x(1{,}1)^2(1{,}03)^{16}+5000](1{,}03)^8$ $10000 = x(1{,}1)^2(1{,}03)^{24}+5000(1{,}03)^8$ $\frac{10000-5000(1{,}03)^8}{(1{,}1)^2(1{,}03)^{24}} = x$ $x = R1490{,}50$ **OR** $x\left(1+\frac{10\ \%}{1}\right)^2\left(1+\frac{12\ \%}{4}\right)^{24}+5000\left(1+\frac{12\ \%}{4}\right)^8 = 10\ 000$ $x\left(1+\frac{10\ \%}{1}\right)^2\left(1+\frac{12\ \%}{4}\right)^{24}+6333{,}85 = 10\ 000$ $x\left(1+\frac{10\ \%}{1}\right)^2\left(1+\frac{12\ \%}{4}\right)^{24} = 3666{,}15$ $x = \frac{3666{,}15}{\left(1+\frac{10\ \%}{1}\right)^2\left(1+\frac{12\ \%}{4}\right)^{24}}$ $x = R1490{,}50$	A✓ $x\left(1+\frac{10\ \%}{1}\right)^2$ A✓$\left(1+\frac{12\ \%}{4}\right)^{16}$ A✓$\left(1+\frac{12\ \%}{4}\right)^8$ CA✓Simplifying CA✓Making *x* the subject CA✓Answer **OR** A✓ $x\left(1+\frac{10\ \%}{1}\right)^2$ A✓$\left(1+\frac{12\ \%}{4}\right)^{24}$ A✓$\left(1+\frac{12\ \%}{4}\right)^8$ CA✓6333,85 CA✓ Making *x* the subject CA✓Answer	(6) (6)
			[16]

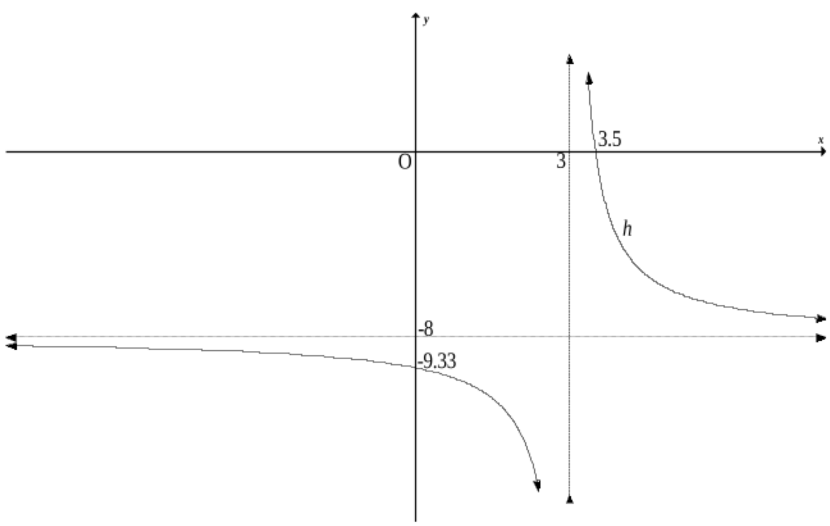
QUESTION 5

5.1	$y = \log_a x$ $4 = \log_a 625$ $a^4 = 625 = 5^4$ $a = 5$	A✓Substitution A✓Writing in exponential form CA✓Answer	(3)
5.2	B(1 ; 0)	AA✓✓answer	(2)
5.3	$y = 5^x$	CA✓ on 5 CA✓Exponential equation	(2)
5.4	$\text{P}'(4\,;625)$	A✓A✓answer	(2)
			[9]

QUESTION 6

6.1	$(2\,;\,-12)$	A✓A✓Answer	(2)
6.2	$g(3) = 3(3-2)^2 - 12$ $t = -9$ **ANSWER ONLY – FULL MARKS**	A✓ CA✓Answer	(2)
6.3	$p(x) = -3x$	CA✓ CA✓Answer	(2)
6.4	$\text{NQ} = -3x - [3(x-2)^2 - 12]$ $\text{NQ} = -3x - [3(x^2 - 4x + 4) - 12]$ $\text{NQ} = -3x^2 + 9x$ $\text{NQ}' = -6x + 9 = 0$ or $x = -\frac{b}{2a} = -\frac{9}{2(-6)}$ $x = \frac{3}{2}$ The maximum length of NQ: $= -3\left(\frac{3}{2}\right)^2 + 9\left(\frac{3}{2}\right)$ $= -\frac{27}{4} + \frac{27}{2}$ $= \frac{27}{4}$ units	A✓Subtraction A✓$-3x^2 + 9x$ CA✓Derivative and equal to 0 CA✓x – value CA✓Answer	(5)
6.5	$-27 < k < 0$	A✓end points CA✓interval	(2)
6.6	Maximum value of $2^{-\frac{1}{2}g(x)}$ $= 2^{-\frac{1}{2}(-12)} = 2^6$ $= 64$	A✓maximum value = – 12 CA✓Answer	(2)
			[15]

QUESTION 7

7.1	$x = 3$ $y = -8$	A✓Vertical asymptote A✓Horizontal asymptote	(2)
7.2	y – intercept : $\left(0\,;-9\tfrac{1}{3}\right)$ x – intercept: $\dfrac{4}{x-3} = 8$ $8x - 24 = 4$ $8x = 28$ $x = \dfrac{28}{8} = \dfrac{7}{2}$  	A✓ y – intercept A✓$\dfrac{4}{x-3} = 8$ CA✓ x - intercept	(3)
7.3	 	CA✓both asymptotes CA✓both x and y intercepts A✓shape	(3)
7.4	$x = 7$	CA✓CA✓Answer	(2)
7.5	$y = k - x$ $-8 = k - 3$ $k = -5$ **OR** $y = -(x-3) - 8$ $y = -x - 5$ $k = -5$	A✓subst. of (3 ; – 8) CA✓answer **OR** A✓$y = -(x-3) - 8$ CA✓answer	(2) (2)
			[12]

QUESTION 8 (penalize 1 mark once for incorrect notation in this question only)

8.1	$f'(x) = \lim\limits_{n \to 0} \dfrac{f(x+h) - f(x)}{h}$ $f'(x) = \lim\limits_{h \to 0} \dfrac{(x+h)^2 - 5(x+h) - (x^2 - 5x)}{h}$ $f'(x) = \lim\limits_{h \to 0} \dfrac{x^2 + 2xh + h^2 - 5x - 5h - x^2 + 5x}{h}$ $f'(x) = \lim\limits_{h \to 0} \dfrac{2xh + h^2 - 5h}{h}$ $f'(x) = \lim\limits_{h \to 0} \dfrac{h(2x + h - 5)}{h}$ $f'(x) = 2x - 5$ **OR** $f(x+h) = (x+h)^2 - 5(x+h)$ $= x^2 + 2xh + h^2 - 5x - 5h$ $f(x+h) - f(x) = 2xh + h^2 - 5h$ $\dfrac{f(x+h) - f(x)}{h} = \dfrac{h(2x+h-5)}{h} = (2x + h - 5)$ $f'(x) = \lim\limits_{h \to 0}(2x + h - 5)$ $f'(x) = 2x - 5$	A✓formula A✓substitution CA✓ simplification of numerator CA✓factorization CA✓answer **OR** A✓ $f(x+h)$ value CA✓ $f(x+h) - f(x)$ value CA✓ $\frac{f(x+h)}{h}$ value A✓formula CA✓answer	(5) (5)
8.2.1	$g(x) = \left(\dfrac{4}{x} - \dfrac{x}{4}\right)^2$ $g(x) = 16x^{-2} - 2 + \dfrac{1}{16}x^2$ $g'(x) = -32x^{-3} + \dfrac{1}{8}x$	A✓1st and 3rd terms A✓2nd term CACA✓✓ derivatives	(4)
8.2.2	$D_x\left[\dfrac{7}{\sqrt{x}} - \dfrac{2}{x^3}\right]$ $= D_x\left[7x^{-\frac{1}{2}} - 2x^{-3}\right]$ $= -\dfrac{7}{2}x^{-\frac{3}{2}} + 6x^{-4}$	A✓A✓writing in exponential form – each term CACA✓✓answers	(4)

8.3	$t(x) = \sqrt{x^3}$ $t(x) = x^{\frac{3}{2}}$ $t'(x) = \frac{3}{2}x^{\frac{1}{2}}$ $m = t'(4) = \frac{3}{2}(4)^{\frac{1}{2}} = 3$ $y = \sqrt{4^3} = \sqrt{64} = 8$ $y = mx + c$ $8 = 3(4) + c \qquad \therefore c = -4$ $y = 3x - 4$	A✓derivative A✓m of tangent CA✓c – value CA✓answer	(4)
			[17]

QUESTION 9

9.1	D (0 ; 12)	AA✓✓Answer	(2)
9.2	$f(x) = x^3 - x^2 - 8x + 12$ $f'(x) = 3x^2 - 2x - 8 = 0$ $(3x + 4)(x - 2) = 0$ $x = -\frac{4}{3} \quad or \quad 2$ $y = \frac{500}{27} \quad or \quad 0$ Max: $\left(-\frac{4}{3}; 18.52\right)$ Min: $(2; 0)$	A✓derivative A✓derivative equal to 0 CA✓factors CA✓ x – values CA✓ y - values	(5)
9.3	$f''(x) = 6x - 2 = 0$ $x = \frac{1}{3}$ Choose values of x on either side of $x = \frac{1}{3}$ $f''(-2) = 6(-2) - 2 = -14$ Since $f''(x) < 0 \therefore f$ is concave down for $x < \frac{1}{3}$ $f''(2) = 6(2) - 2 = 10$ Since $f''(x) > 0 \therefore f$ is concave up for $x > \frac{1}{3}$ $\therefore f$ has a point of inflection at $x = \frac{1}{3}$, since there is a change in concavity.	A✓2nd derivative = 0 A✓$x = \frac{1}{3}$ A✓2nd derivative value and conclusion A✓2nd derivative value and conclusion	(4)
9.4	$(-2\,;\ 1)$	CACA✓✓answer	(2)
9.5.1	$k = 0$ or $k = 18.52$	A✓ $k = 0$ CA✓ $k = 18.52$	(2)
9.5.2	$k = 12$	A✓ A✓Answer	(2)
			[17]

QUESTION 10

10.1	Volume(V) = Area of Base x Height $V(x) = x^3 - 8x^2 + 5x + 50 = l \times b \times h$ $V(x) = (5 - x)(10 + 3x - x^2) = l \times b \times h$ $l \times b = 10 + 3x - x^2$…. Area of base of the box.	A✓Formula A✓Product A✓Answer	(3)
10.2	$V(x) = x^3 - 8x^2 + 5x + 50$ $V'(x) = 3x^2 - 16x + 5 = 0$ $(3x - 1)(x - 5) = 0$ $x = \frac{1}{3} \quad or \quad 5$ Since the coefficient of x^3 = 1, the shape of the cubic function is  $x = \frac{1}{3}$ The volume will be at a maximum. **OR** <u>For the last mark:</u> $x = \frac{1}{3}$ The volume will be at a maximum. **OR** <u>For the last mark:</u> $V''(x) = 6x - 16$ $V''\left(\frac{1}{3}\right) = 6\left(\frac{1}{3}\right) - 16 = -14 < 0$ $V''(5) = 6(5) - 16 = 14 > 0$ $x = \frac{1}{3}$ The volume will be at a maximum.	A✓derivative A✓derivative equal to 0 CA✓factors CA✓ x – values CA✓ Conclusion	(5)
			[8]
		TOTAL	**150**