



KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA



**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MATHEMATICS P1

SEPTEMBER 2021

PREPARATORY EXAMINATIONS

MARKS: 150

TIME: 3 hours

N.B. This question paper consists of 9 pages and an information sheet.

Downloaded from Stanmorephysics.com**INSTRUCTIONS AND INFORMATION**

Read the following instructions carefully before answering the questions.

1. This question paper consists of 13 questions.
2. Answer **ALL** questions.
3. Clearly show **ALL** calculations, diagrams, graphs, et cetera that you have used in determining your answers.
4. Answers only will not necessarily be awarded full marks.
5. An approved scientific calculator (non-programmable and non-graphical) may be used, unless stated otherwise.
6. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.
7. Diagrams are NOT necessarily drawn to scale.
8. Number the answers correctly according to the numbering system used in this question paper. Write neatly and legibly.

QUESTION 11.1 Solve for x :

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

1.1.2 $5x^2 - 4x = 2$ (Rounded off to 2 decimal places) (4)

1.1.3 $\sqrt{7 + 3x} + 2x = 0$ (5)

1.1.4 $3^{x+2} + 3^{2-x} = 82$ (5)

1.2 For which values of x will $\sqrt{x^2 - 5x + 4}$ be real? (4)1.3 Solve for x and y simultaneously if:

$$xy = 12 \quad \text{and} \quad x - 4 = y$$
 (5)

[25]**QUESTION 2**The p^{th} term of the first differences of a quadratic sequence is given by $T_p = 3p - 2$.

2.1 Determine between which two consecutive terms of the quadratic sequence the first difference is equal to 1450. (3)

2.2 The 40th term of the quadratic sequence is 2290 and $T_n = an^2 + bn + c$ is the n^{th} term of the quadratic sequence. Calculate the value of c . (4)**[7]**

QUESTION 3

3.1 The first four terms of an arithmetic sequence are:

65 ; 73 ; 81 ; 89 ; ...

3.1.1 Determine an expression for the n^{th} term. (2)

3.1.2 Calculate value of the term in the 1000th position. (2)

3.1.3 Calculate the sum of the first 1000 terms. (2)

3.2 An arithmetic and geometric sequence have the same first term, 5. The common difference and common ratio have the same value. The 5th term of the geometric sequence is 80. Determine the first three terms of the arithmetic sequence(s). (5)

[11]

QUESTION 4

Calculate the value of y if

$$\sum_{p=1}^5 (4y + 3p) + \sum_{k=4}^7 3 \cdot (2)^{k-1} = \sum_{j=1}^{\infty} \left(\frac{1}{3}\right)^{j-1}$$

[7]

QUESTION 5

Given $g(x) = -\frac{4}{x-1} + 2$

5.1 Write down the equations of the asymptotes of g . (2)

5.2 Determine the intercepts of the graph of g with the axes. (3)

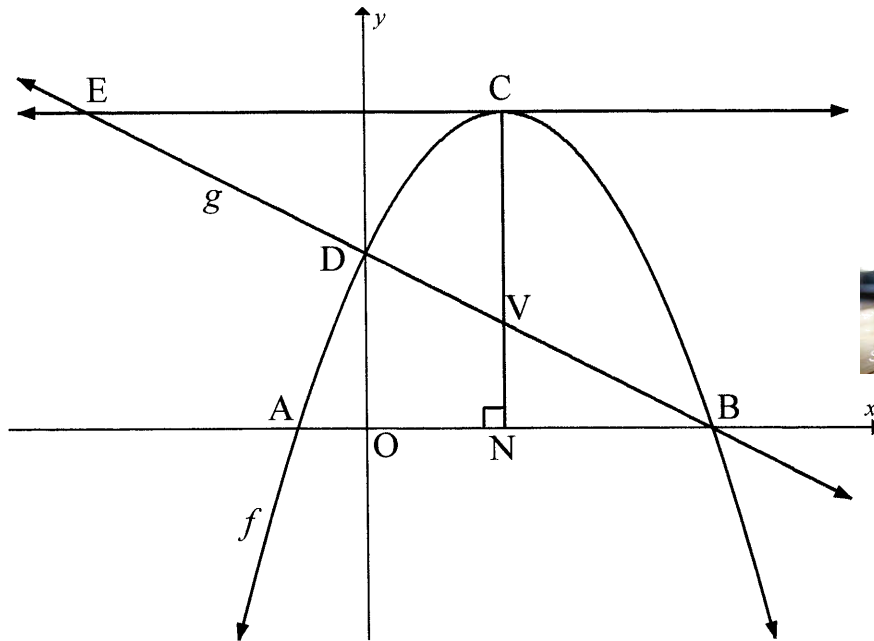
5.3 Sketch the graph of g . Show all intercepts with the axes as well as the asymptotes of the graph. (3)

[8]

QUESTION 6

Sketched below are the graphs of $f(x) = -x^2 + 4x + 5$ and $g(x) = mx + c$.

f and g intersect at B and D. B and D are the x - and y - intercepts of g , respectively. C is the turning point of f . V is a point on g and N is a point on the x -axis such that $CVN \perp x$ -axis. E is a point on g such that $CE \parallel x$ -axis. A and B are the x - intercepts of f .

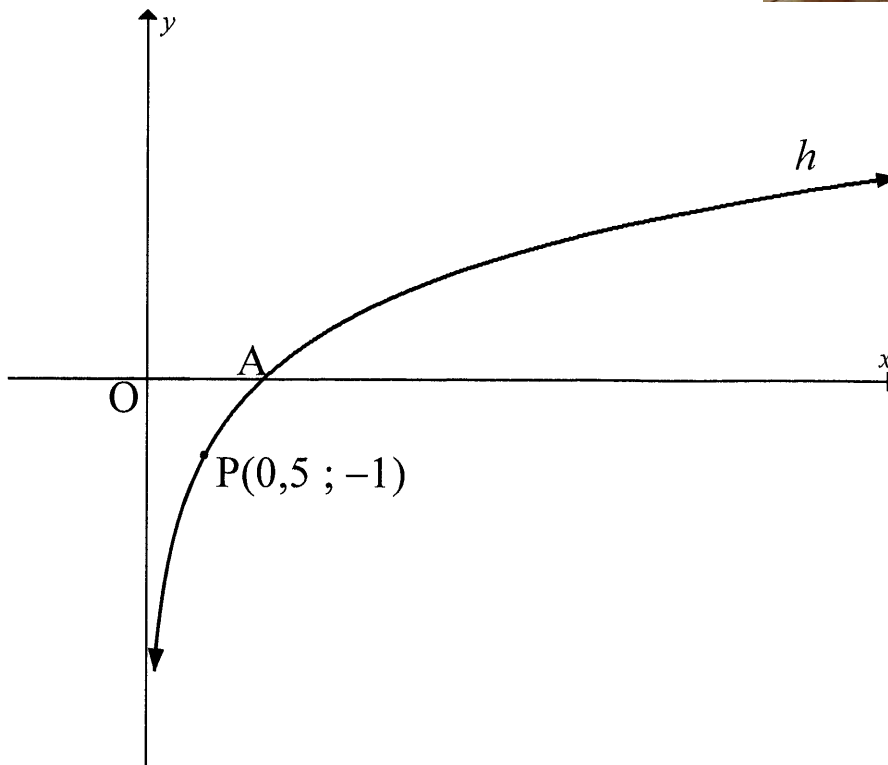


- 6.1 Determine the co-ordinates of C, the turning point of f . (3)
- 6.2 Write down the range of f . (1)
- 6.3 Calculate the length of AB. (4)
- 6.4 Determine the equation of g . (2)
- 6.5 T is a point on f such that D and T are reflections of each other over CVN. Write down the coordinates of T. (2)
- 6.6 The line EC is a tangent to f at C.
 - 6.6.1 Write down the gradient of this tangent. (1)
 - 6.6.2 Determine the coordinates of E. (2)
- 6.7 Determine the value of k for which $y = -x + k$ is a tangent to f . (5)

[20]

QUESTION 7

In the diagram, the graph $h(x) = \log_a x$ is drawn. $P(0,5 ; -1)$ lies on h .



- 7.1 Calculate the value of a . (3)
- 7.2 Write down the equation of h^{-1} , the inverse of h , in the form $y = \dots$ (2)
- 7.3 Write down the domain of h^{-1} . (1)
- 7.4 Determine the values of x if $h(x) \leq -1$. (2)

[8]

QUESTION 8

- 8.1 ABC traders purchased a truck for R500 000. The truck depreciates at 8,5 % p.a. on a reducing balance. Determine the value of the truck after 12 years (to the nearest rand). (3)
- 8.2 Sipho takes a bank loan to pay for his new car. He repays the loan by means of monthly payments of R3300 for a period of 5 years. The repayments start one month after the loan is granted. The interest rate is 16 % p.a. compounded monthly.
- 8.2.1 Calculate the purchase price of the car if Sipho is granted a loan for the full purchase price of the car. (4)
- 8.2.2 If the trade in value of his old car is R10 000 and he decides to use this amount as deposit, determine the new monthly instalments that Sipho will now make. (3)
- 8.2.3 Calculate the savings he will make if he pays the deposit of R10 000. (4)

[14]**QUESTION 9**

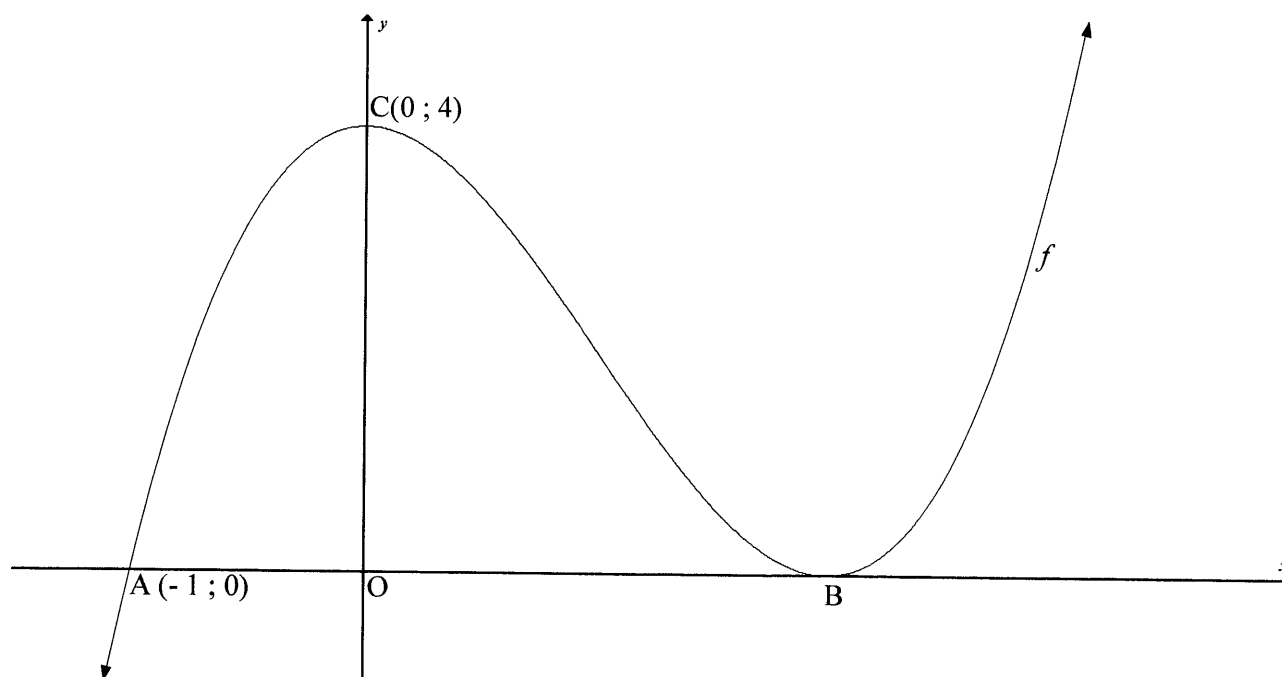
- 9.1 Determine $f'(x)$ from first principles given $f(x) = x^2 + 5x - 6$. (5)
- 9.2 Determine:
- 9.2.1 $f'(x)$ if $f(x) = 3x(\sqrt{x} - 4)$ (3)
- 9.2.2 $\frac{dy}{dx}$ if $y = \frac{x^3 - 4x}{2 - x}$ (4)

[12]

QUESTION 10

The graph of $f(x) = x^3 + bx^2 + cx + d$; $a \neq 0$ is sketched below.

$A(-1; 0)$ is an x -intercept. $C(0; 4)$ is a turning point and B is both a local minimum and x -intercept of f .



- 10.1 Write down the value of d . (1)
- 10.2 Show that $b = -3$ and $c = 0$. (4)
- 10.3 Determine the equation of the tangent to f at $x = 5$. (4)
- 10.4 For which values of k will $f(x) = k$ have 2 unequal positive roots and 1 negative root simultaneously. (2)
- 10.5 Determine the coordinates of the local minimum of g if $g(x) = f(-x) + 3$. (4)

[15]

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QUESTION 11

11.1 Use the information below to draw a graph of the function defined by

$$f(x) = ax^3 + bx^2 + cx + d.$$

Indicate the intercepts with the axes as well as the coordinates of the turning points.

- $f(0) = 3$ and $f(-3) = 0$
 - $f'(-2) = f'(1) = 0$
 - $f(-2) = 5$ and $f(1) = 1$
- (5)

11.2 Use the graph to answer the questions below:

11.2.1 Determine the values of x for which $x \cdot f(x) < 0$. (2)

11.2.2 If $g(x) = -f(x)$, write down the coordinates of the local minimum point of g . (2)
[9]

QUESTION 12

The word **PANDEMIC** is an important word used in the COVID – 19 crises in the world today. The letters of this word are randomly arranged to form new arrangements of the letters.

12.1 How many unique arrangements of the letters can be made? (2)

12.2 Determine the number of unique arrangements of the letters that are possible if each arrangement must start with the letter P and end with the letter C. (3)

12.3 Calculate the probability that randomly chosen unique arrangements of the letters will start with the letter P and end with the letter C. (2)
[7]

QUESTION 13

Each passenger on ABC Airways flight chose exactly one beverage from tea, coffee or fruit juice. The results are shown in the table below.

	MALE	FEMALE	TOTAL
Tea	20	40	60
Coffee	b	c	80
Fruit Juice	d	e	20
TOTAL	60	100	a

13.1 Write down the value of a . (1)

13.2 Determine the probability that a randomly selected passenger is male. (2)

13.3 Given that the event of a passenger choosing coffee is independent of being a male, calculate the value of b . (4)

[7]

Total Marks: 150

**INFORMATION SHEET: MATHEMATICS**

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

$$A = P(1 + ni)$$

$$A = P(1 - ni)$$

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

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

$$T_n = a + (n - 1)d$$

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

$$T_n = ar^{n-1}$$

$$S_n = \frac{a(r^n - 1)}{r - 1}; \quad r \neq 1$$

$$S_\infty = \frac{a}{1 - r}; \quad -1 < r < 1$$

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

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

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

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$M\left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c$$

$$y - y_1 = m(x - x_1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \tan \theta$$

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

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

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A \quad \text{area } \triangle ABC = \frac{1}{2} ab \cdot \sin C$$

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

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

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

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

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

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

$$\bar{x} = \frac{\sum f \cdot x}{\sum f}$$



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

$$P(A) = \frac{n(A)}{n(S)}$$

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

$$\hat{y} = a + bx$$

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



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MARKING GUIDELINE

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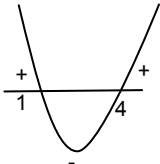
This marking guideline consists of 10 pages.

NSC Marking Guideline


QUESTION 1

1.1.1	$x = 0$ or $x = 3$	A✓ $x = 0$ A✓ $x = 3$	(2)
1.1.2	$5x^2 - 4x - 2 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(5)(-2)}}{2(5)}$ $x = -0,35$ or $1,15$	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	$\sqrt{7 + 3x} + 2x = 0$ $\sqrt{7 + 3x} = -2x$ $(\sqrt{7 + 3x})^2 = (-2x)^2$ $7 + 3x = 4x^2$ $4x^2 - 3x - 7 = 0$ $(x + 1)(4x - 7) = 0$ $x = -1$ or $x = \frac{7}{4}$ n/a	A✓ Isolating surd A✓ squaring both sides CA✓ standard form CA✓ factors CA✓ answers and rejecting	(5)
1.1.4	$3^{x+2} + 3^{2-x} = 82$ $9 \cdot 3^x + \frac{9}{3^x} = 82$ $9 \cdot 3^{2x} - 82 \cdot 3^x + 9 = 0$ $(9 \cdot 3^x - 1)(3^x - 9) = 0$ $3^x = \frac{1}{9}$ or $3^x = 9$ $3^x = 3^{-2}$ or $3^x = 3^2$ $x = -2$ or $x = 2$	A✓ Writing as a positive index CA✓ Standard form of equation CA✓ factors CA✓ exponential forms CA✓ answers	(5)

3
orephysics.com

1.2	$x^2 - 5x + 4 \geq 0$ $(x - 1)(x - 4) \geq 0$ $x \leq 1$ or $x \geq 4$ OR 	$A\checkmark x^2 - 5x + 4 \geq 0$ $A\checkmark$ factors $CA\checkmark$ end points $A\checkmark$ interval OR If graphical solution is used: AA 2 marks for graph A /CA 2 marks for answer	(4) (4)
1.3	$xy = 12 \rightarrow (1)$ $x - 4 = y \rightarrow (2)$ Substituting (2) into (1): $x(x - 4) = 12$ $x^2 - 4x - 12 = 0$ $(x + 2)(x - 6) = 0$ $x = -2$ or $x = 6$ $y = -6$ or $y = 2$	 $A\checkmark$ correct substitution $CA\checkmark$ standard form $CA\checkmark$ factors $CA\checkmark$ x/y – values $CA\checkmark$ y/x values	 (5)
			[25]

QUESTION 2

2.1	$T_p = 3p - 2 = 1450$ $p = 484$ Between the 484 th and 485 th terms	A✓ equating p^{th} term to 1450 CA✓ p value CA✓ answer	(3)
2.2	<p>1D</p> <p>1 4 7</p> <p>↘ ↙ ↘ ↙</p> <p>2D 3 3</p> $2a = 3 \quad \therefore a = \frac{3}{2}$ $3a + b = 1 \quad \therefore b = -\frac{7}{2}$ $T_n = an^2 + bn + c$ $T_{40} = \frac{3}{2}(40)^2 - \frac{7}{2}(40) + c = 2290$ $2400 - 140 + c = 2290$ $c = 30$	 A✓ a – value CA✓ b – value CA✓ Substitution CA✓ answer	(4)
			[7]

NSC Marking Guideline

QUESTION 3

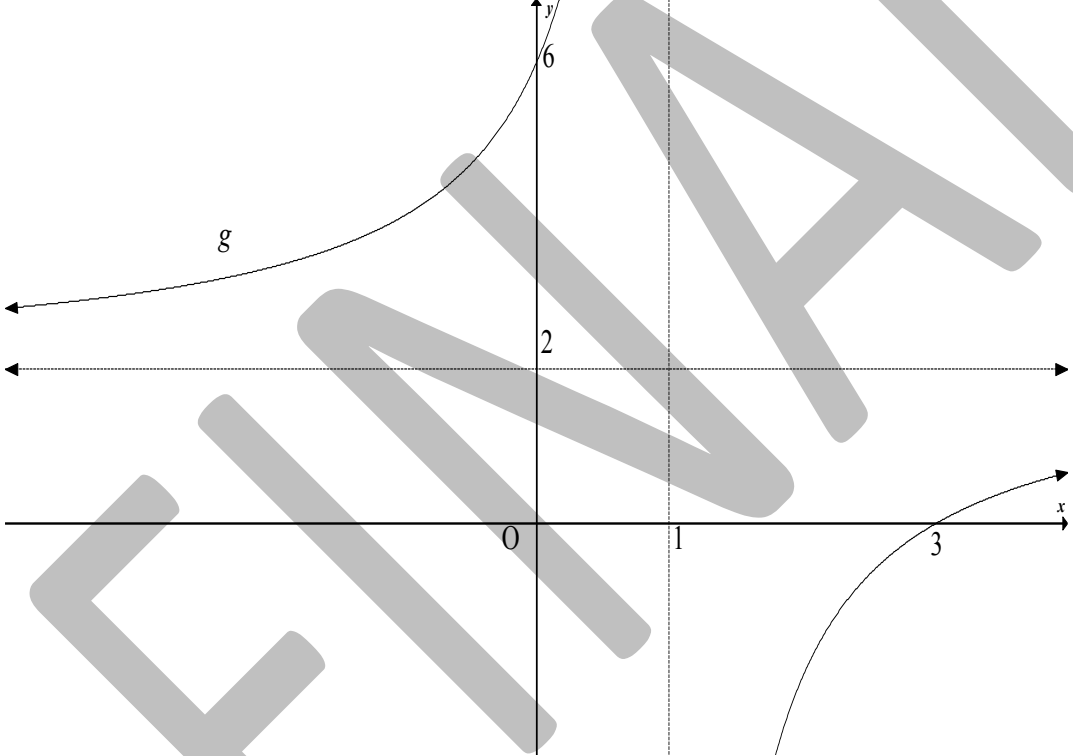
3.1.1	$T_n = 8n + 57$	A ✓ common difference CA ✓ answer	(2)
3.1.2	$T_n = 8n + 57$ $T_{1000} = 8(1000) + 57$ $T_{1000} = 8057$	CA ✓ substitution into formula CA ✓ answer	(2)
3.1.3	$S_n = \frac{n}{2}[a + T_n]$ $S_{1000} = \frac{1000}{2}[65 + 8057]$ $S_{1000} = 4061000$	CA ✓ correct substitution into sum formula CA ✓ answer	(2)
3.2	Arithmetic: $5; 5 + x; 5 + 2x; \dots$ Geometric: $5; 5x; 5x^2; 5x^3; \dots$ Now: $5x^4 = 80$ $x^4 = 16$ $x = -2 \text{ or } 2$ Sequences are: $5; 7; 9 \text{ or}$ $5; 3; 1$	A ✓ Setting up equation A ✓ dividing by 5 CA ✓ x – values CA ✓ sequence CA ✓ sequence	(5)
			[11]

QUESTION 4

4	$\sum_{p=1}^5 (4y + 3p) + \sum_{k=4}^7 3 \cdot (2)^{k-1} = \sum_{j=1}^{\infty} \left(\frac{1}{3}\right)^{j-1}$ $4y + 3 + 4y + 6 + 4y + 9 + 4y + 12 + 4y + 15$ $= 20y + 45$ $3 \cdot 2^3 + 3 \cdot 2^4 + 3 \cdot 2^5 + 3 \cdot 2^6 = 360$ $S_{\infty} = \frac{a}{1 - r}$ $= \frac{1}{1 - \frac{1}{3}}$ $= \frac{3}{2}$ $20y + 45 + 360 = \frac{3}{2}$ $20y = -403,5$ $y = -20,175$	A ✓ $20y + 45$ A ✓ 360 A ✓ correct substitution into sum to infinity formula CA ✓ $\frac{3}{2}$ CA ✓ equation CA ✓ simplifying CA ✓ answer	[7]
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NSC Marking Guideline

QUESTION 5

5.1	$x = 1$ and $y = 2$	A✓ $x = 1$ A✓ $y = 2$	(2)
5.2	y – intercept : (0 ; 6) x – intercept: $\frac{4}{x-1} = 2$ $x - 1 = 2$ $x = 3$ (3; 0)	A✓ y – intercept A✓ $x - 1 = 2$ CA✓ x – intercept (co-ordinate form not needed)	(3)
5.3		CA✓ x, y - intercepts CA✓ both asymptotes A✓ shape	(3)
			[8]

NSC Marking Guideline

QUESTION 6

6.1	$f'(x) = -2x + 4 = 0$ or $x = -\frac{4}{2(-1)}$ $x = 2$ $y = f(2) = -4 + 8 + 5 = 9$ $C(2; 9)$	A✓ derivative and equal to 0/ Substitution into formula CA✓ Axis of symmetry value CA✓ Maximum value	(3)
6.2	$y \leq 9$	CA✓ answer	(1)
6.3	$-x^2 + 4x + 5 = 0$ $x^2 - 4x - 5 = 0$ $(x + 1)(x - 5) = 0$ $x = -1$ or $x = 5$ AB = 6 units	A✓ standard form CA✓ factors CA✓ x - values CA✓ answer	(4)
6.4	$m = -1$ and $c = 5$ $y = -x + 5$	CACA✓✓ answer	(2)
6.5	$T(4; 5)$	CACA✓✓ answer	(2)
6.6.1	$m = 0$	A✓ answer	(1)
6.6.2	$9 = -x + 5$ $x = -4$ $E(-4; 9)$	CA✓ Equating equation to 9 CA✓ x - value	(2)
6.7	$f'(x) = -2x + 4 = -1$ $x = \frac{5}{2}$ $y = -\left(\frac{5}{2}\right)^2 + 4\left(\frac{5}{2}\right) + 5 = \frac{35}{4}$ $\frac{35}{4} = -\frac{5}{2} + k$ $k = \frac{45}{4}$	A✓ Derivative equal to -1 CA✓ x - value CA✓ y - value CA✓ substitution into equation of line CA✓ answer	(5)
			[20]

NSC Marking Guideline

QUESTION 7

7.1	$y = \log_a x$ $-1 = \log_a 0,5$ $a^{-1} = 0,5 = 2^{-1}$ $a = 2$	A✓ substitution of point P CA✓ Writing in exponential form CA✓ answer	(3)
7.2	$y = 2^x$	CACA✓✓	(2)
7.3	$x \in R \text{ or } x \in (-\infty; \infty)$	A✓ answer	(1)
7.4	$\log_2 x = -1$ $x = 2^{-1} = \frac{1}{2}$ $0 < x \leq \frac{1}{2}$	CA✓ end points A✓ interval Can be solved by log inequalities. Answer Only – Full marks	(2)
			[8]

QUESTION 8

8.1	$A = P(1 + i)^n$ $= 500\,000(1 + 8,5\%)^{12}$ $= R172\,196$	A✓ value of n A✓ value of i CA✓ answer	(3)
8.2.1	$P = \frac{x[1 - (1 + i)^{-n}]}{i}$ $= \frac{3300 \left[1 - \left(1 + \frac{16\%}{12} \right)^{-60} \right]}{\frac{16\%}{12}}$ $= R135\,701,63$	A✓ value of n A✓ value of i CA✓ Substitution into formula CA✓ answer	(4)
8.2.2	$P = \frac{x[1 - (1 + i)^{-n}]}{i}$ $125\,701,6304 = \frac{x \left[1 - \left(1 + \frac{16\%}{12} \right)^{-60} \right]}{\frac{16\%}{12}}$ $x = R3056,82$	A✓ P value CA✓ substitution into formula CA✓ answer	(3)
8.2.3	No. Deposit: $60 \times R3300 = R198\,000,00$ With Deposit: $R10\,000 + 60 \times R3056,82$ $= R\,193\,409,20$ Savings: $R4590,80$	A✓ R198 000 A✓✓ 193 409,20 CA✓ answer	(4)
			[14]

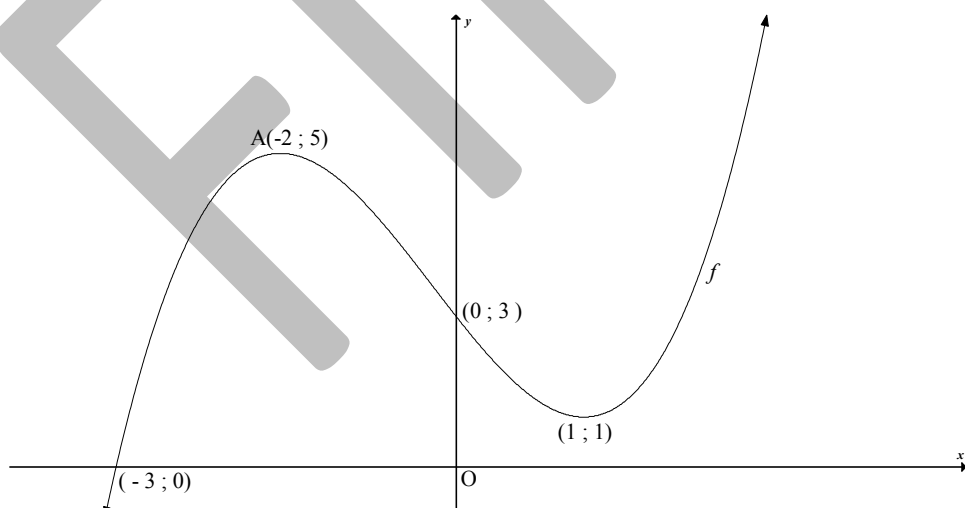
[12]

NSC Marking Guideline

QUESTION 10

10.1	$d = 4$	A✓ Answer	(1)
10.2	$0 = -1 + b - c + 4$ $b - c = -3$ $f'(x) = 3x^2 + 2bx + c$ $0 = 3(0)^2 + 2b(0) + c$ $c = 0$ $b = -3$	A✓ substitution of point $(-1 ; 0)$ A✓ equation A✓ derivative A✓ substitution of point $(-1 ; 0)$ into derivative	(4)
10.3	$f(x) = x^3 - 3x^2 + 4$ $f'(x) = 3x^2 - 6x$ $f'(5) = 3(5)^2 - 6(5) = 45$ $f(5) = (5)^3 - 3(5)^2 + 4 = 54$ $54 = 45(5) + c$ $c = -171$ $y = 45x - 171$	A✓ gradient value of tangent A✓ y - value of tangent CA✓ c - value CA✓ answer	(4)
10.4	$0 < k < 4$	AA✓ answer	(2)
10.5	$f'(x) = 3x^2 - 6x = 0$ $3x(x - 2) = 0$ $x = 0$ or $x = 2$ $y = 4$ or $y = 0$ B(2 ; 0) B'(-2 ; 3)	CA✓ x - values CA✓ y - values CA✓ x - value CA✓ y - value	(4)
			[15]

QUESTION 11

11.1		A✓ Local Maximum point A✓ Local Minimum point A✓ x - intercept A✓ y - intercept A✓ shape	(5)
11.2.1	$-3 < x < 0$	CACA✓✓	(2)
11.2.2	$(-2 ; -5)$	CACA✓✓	(2)
			[9]

NSC Marking Guideline



QUESTION 12

12.1	8! = 40 320	A✓8! A✓40 320	(2)
12.2	$1 \times 6! \times 1$ = 720	A✓✓ $1 \times 6! \times 1$ A✓720	(3)
12.3	Probability of a word starting with P and ending with C $\frac{720}{40\,320} = \frac{1}{56} = 1,79\% = 0,0179$	CA✓Numerator CA✓denominator $\frac{720}{40\,320}$ or $\frac{1}{56}$ or 0,0179 or 1,79%	(2)
			[7]

QUESTION 13

13.1	160	A✓answer	(1)
13.2	$P(\text{Male}) = \frac{60}{160} = \frac{3}{8} = 0,375 = 37,5\%$	AA ✓✓ $\frac{60}{160}$ or $\frac{3}{8}$ or 0,375 or 37,5 %	(2)
13.3	$P(\text{Male choosing coffee}) = P(\text{Male}) \times P(\text{coffee})$ $\frac{b}{160} = \frac{60}{160} \times \frac{80}{160}$ $\frac{b}{160} = \frac{3}{16}$ $b = 30$	A✓Condition for independent events AA✓✓Substitution into equation A✓Answer	(4)
			[7]

Total: 150