



education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

NATIONAL SENIOR CERTIFICATE EXAMINATION

MATHEMATICS P1

SEPTEMBER 2021

GRADE 12

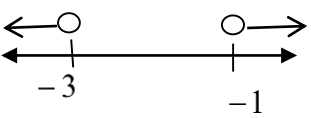
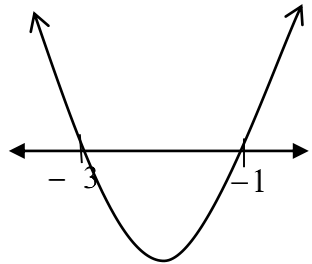
MEMORANDUM

MARKS: 150

TIME: 3 HOURS

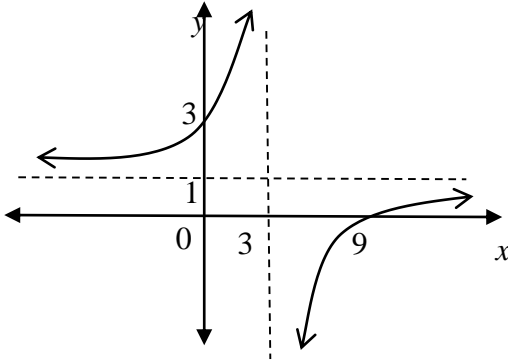
This MEMORANDUM consists of 11 pages.

QUESTION 1 [23]		
1.1.1	$x(2 - x) = 0$ $x = 0 \text{ or } x = 2$	✓ ✓ answers (2)
1.1.2	$(2x + 3)(3 - x) = 2$ $6x - 2x^2 + 9 - 3x - 2 = 0$ $2x^2 + 3x + 7 = 0$ $x = \frac{-(3) \pm \sqrt{(3)^2 - 4(-2)(-2)}}{2(-2)}$ $x = \frac{-3 \pm \sqrt{65}}{-4}$ $x = 2,77 \text{ or } x = -1,27$ <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-top: 10px;">-1 for rounding</div>	✓ standard form ✓ substitution into correct formula ✓ $\sqrt{65}$ ✓ answers (4)
1.1.3	$27^x \cdot 9^{x-2} = 1$ $(3^3)^x \cdot (3^2)^{x-2} = 1$ $3^{3x+2x-4} = 3^0$ $5x = 4$ $x = \frac{4}{5}$	✓ exponential law ✓ 3^0 ✓ answer (3)
1.1.4	$\sqrt{5-2x} = \frac{x}{2} + 4$ $(\sqrt{5-2x})^2 = \left(\frac{x}{2} + 4\right)^2$ $5-2x = \frac{x^2}{4} + 4x + 16$ $20-8x = x^2 + 16x + 64$ $x^2 + 24x + 44 = 0$ $(x+2)(x+22) = 0$ $x = -2 \text{ or } x \neq -22$	✓ squaring both sides ✓ standard form ✓ factors ✓ both x -values ✓ exclusion (5)

1.1.5	$x(x+4) \geq -3$ $x^2 + 4x + 3 \geq 0$ $(x+3)(x+1) \geq 0$  $x \leq -3 \text{ or } x \geq -1$ <p>OR</p> $x \in (-\infty; -3] \cup [-1; \infty)$ 	<p>✓ standard form</p> <p>✓ factors</p> <p>✓ method</p> <p>✓ answer</p> <p>(4)</p>
1.2	$x - y = 1$ $x = y + 1$ $(2x - y)(x + 2y - 3) = 0$ $(2(y + 1) - y)((y + 1) + 2y - 3) = 0$ $(y + 2)(3y - 2) = 0$ $y = \frac{2}{3} \quad \text{or} \quad y = -2$ $x = \frac{2}{3} + 1 = \frac{5}{3} \quad x = -2 + 1 = -1$ <p>OR</p> $y = x - 1$ $(2x - y)(x + 2y - 3) = 0$ $(2x - (x - 1))(x + 2(x - 1) - 3) = 0$ $(x + 1)(3x - 5) = 0$ $x = \frac{5}{3} \quad \text{or} \quad x = -1$ $y = \frac{5}{3} - 1 = \frac{2}{3} \quad y = -1 - 1 = -2$	<p>✓ isolation</p> <p>✓ substitution</p> <p>✓ standard form</p> <p>✓ y-values</p> <p>✓ x-values</p> <p>(5)</p> <p>✓ isolation</p> <p>✓ substitution</p> <p>✓ standard form</p> <p>✓ x-values</p> <p>✓ y - values</p> <p>(5)</p>

QUESTION 2	[25]
2.1.1	$ \begin{array}{c} 1; -5; -13; -23 \\ \diagdown \quad \diagup \quad \diagdown \quad \diagup \\ -6 \quad -8 \quad -10 \\ \diagdown \quad \diagup \quad \diagdown \quad \diagup \\ -2 \quad -2 \end{array} $ $ \begin{array}{lll} 2a = -2 & 3a + b = -6 & a + b + c = 3 \\ a = -1 & 3(-1) + b = -6 & -1 - 3 + c = 1 \\ & b = -3 & c = 5 \end{array} $ $T_n = -n^2 - 3n + 5$ <div style="float: right;"> ✓ value of a ✓ value of b ✓ value of c ✓ equation (4) </div>
2.1.2	$ \begin{array}{l} T_n = -n^2 - 3n + 5 \\ -643 = -n^2 - 3n + 5 \\ n^2 + 3n - 648 = 0 \\ (n - 24)(n + 27) = 0 \\ n = 24 \text{ or } n = -27 \\ T_{24} = -648 \end{array} $ <div style="float: right;"> ✓ standard form ✓ factors ✓ answer (3) </div>
2.2	$ \begin{array}{l} S_n = \frac{n}{2}[a + l] \\ 155 = \frac{n}{2}[2 + 29] \\ 310 = 31n \\ n = 10 \\ \\ T_n = a + 9d \\ 29 = 2 + 9d \\ 9d = 27 \\ d = 3 \end{array} $ <div style="float: right;"> ✓ substitution into the correct formula ✓ value of n ✓ substitution into the correct formula ✓ answer (4) </div>
2.3	$ \begin{array}{l} \sum_{3}^{14} (15 - 4n) \\ 3 - 1 - 5 \dots \\ S_n = \frac{n}{2}[2a + (n - 1)d] \\ = \frac{12}{2}[2(3) + 11(-4)] \\ = -228 \end{array} $ <div style="float: right;"> ✓ value of a, d and n ✓ substitution into the correct formula ✓ answer (3) </div>

2.4	$S_8 : S_4 = 97 : 81$ $\frac{S_8}{S_4} = \frac{a(r^8 - 1)}{r - 1} \div \frac{a(r^4 - 1)}{r - 1} = \frac{97}{81}$ $\frac{a(r^4 - 1)(r^4 + 1)}{r - 1} \times \frac{r - 1}{a(r^4 - 1)} = \frac{97}{81}$ $1 + r^4 = \frac{97}{81}$ $r^4 = \frac{16}{81}$ $r^4 = \frac{2^4}{3^4}$ $r = \frac{2}{3}$ Sequence: 9 ; 6 ; 4	✓ substitution into the correct formula ✓ factors of $r^8 - 1$ ✓ $r^4 = \frac{16}{81}$ ✓ value of r ✓ sequence (5)
2.5	$2(p - 5) + (p - 5)^2 + \frac{1}{2}(p - 5)^3 + \dots p \neq 5$	
2.5.1	$r = \frac{1}{2}(p - 5)$ $-1 < r < 1$ $-1 < \frac{1}{2}(p - 5) < 1$ $-2 < p - 5 < 2$ $3 < p < 7$	✓ value of r ✓ $-1 < r < 1$ ✓ answer (3)
2.5.2	$2(4 - 5) + (4 - 5)^2 + \frac{1}{2}(4 - 5)^3 + \dots p \neq 5$ $-2 ; 1 ; -\frac{1}{2}$ $S_\infty = \frac{a}{1 - r}$ $S_\infty = \frac{-2}{1 - (-\frac{1}{2})}$ $= -\frac{4}{3}$	✓ value of a and r ✓ substitution into the correct formula ✓ answer (3)

QUESTION 3 [14]		
3.1	$g(x) = \frac{-6}{x-3} + 1$	
3.1.1	$x = 3$ $y = 1$	✓ $x = 3$ ✓ $y = 1$ (2)
3.1.2	$y = \frac{-6}{0-3} + 1$ $y = 3$	✓ answers (1)
3.1.3	$0 = \frac{-6}{x-3} + 1$ $-6 = -1(x-3)$ $x = 9$	✓ ✓ answers (2)
3.1.4		✓ asymptotes ✓ intercepts ✓ shape (3)
3.2	$x < 3$ or $9 < x$ OR $x \in (-\infty ; 3) \cup (9 ; \infty)$	✓ ✓ answers (2)
3.3	$h(x) = x + c$ $1 = 3 + c$ $c = -2$	✓ substitution ✓ value of c (2)
3.4	Reflection $y = 1$ Translation 6 units to the left	✓ reflection $y = 1$ ✓ 6 units to the left (2)

QUESTION 4		
4.1.1	$f(x) = 2^0 - 8$ $f(x) = 1 - 8$ $B(0 ; -7)$ $0 = 2^x - 8$ $2^x = 2^3$ $x = 3$ $C(3 ; 0)$	✓ value of y ✓ $y = 0$ ✓ value of x (3)
4.1.2	$y = a(x + p)^2 + q$ $4,5 = a(0 - 3)^2 + 0$ $a = \frac{1}{2}$ $y = \frac{1}{2}(x - 3)^2 + 0$ $y = \frac{1}{2}(x^2 - 6x + 9)$ $b = -3$	✓ substitution of $A(0 ; 4,5)$ ✓ substitution of $C(3 ; 0)$ ✓ value of a ✓ value of b (4)
4.1.3	$-f(x) = -2^x + 8$ $\therefore y \leq 8$ OR $y \in (-\infty ; 8]$	✓ ✓ answer (2)
4.1.4	$h(x) = f(2x) + 8$ $= 2^{2x} - 8 + 8$ $h(x) = 4^x$ $h^{-1}(x) = \log_4 x$	✓ $h(x) = 4^x$ ✓ swop x and y ✓ answer (3)
4.1.5.a	$x \leq 3$ OR $x \in (-\infty ; 3]$	✓ ✓ answers (2)
4.1.5.b	$g'(x) = x - 3$ $x > 3$ or $x < 0$ OR $x \in (3; \infty) \cup (-\infty; 0)$	✓ $x > 3$ ✓ $x < 0$ answers (2)
4.2	$y = 4x - x^2$ $y' = 4 - 2x$ $m_{OA} = 4$ $\tan \hat{XOA} = 4$ $\hat{XOA} = 75,96^\circ$ $\tan \hat{XOB} = \frac{1}{2}$	✓ y' ✓ gradient of OA ✓ $\hat{XOA} = 75,96^\circ$ ✓ $\hat{XOB} = 26,56^\circ$

	$\hat{XOB} = 26,56^\circ$ $\therefore \hat{AOB} = 75,96^\circ - 26,56^\circ = 49^\circ$	✓ 49° (rounded to nearest degree) (5)
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[21]**QUESTION 5****[15]**

5.1.1	$A = P(1+i)^n$ $150\,000 = 18\,000 \left(1 + \frac{0,12}{12}\right)^{12n}$ $\log(1,01)^{12n} = \log\left(\frac{150}{18}\right)$ $12n = \frac{\log\left(\frac{150}{18}\right)}{\log(1,01)}$ $12n = 213,084$ $n = 17,76$ $\therefore 18 \text{ years}$	✓ substitution into correct formula ✓ correct use of logs ✓ n value ✓ answer (4)
5.1.2	$F = \frac{x[(1+i)^n - 1]}{i}$ $150 \left[\left(1 + \frac{0,12}{12}\right)^{216} - 1 \right]$ $= \frac{0,12}{12}$ $F = R\,113\,679,09$	✓ i value ✓ n value ✓ substitution into correct formula ✓ answer (4)
5.2.1	$\left(1 + \frac{i}{2}\right)^2 = \left(1 + \frac{0,16}{4}\right)^4$ $= (1,04)^4$ $i = 2[(1,04)^2 - 1]$ $= 0,1632$ Rate = 16,32%	✓ $\left(1 + \frac{i}{2}\right)^2$ ✓ $\left(1 + \frac{0,16}{4}\right)^4$ ✓ simplification (3)
5.2.2	$P = \frac{x[1 - (1+i)^{-n}]}{i}$ $2500 \left[1 - \left(1 + \frac{0,1632}{2}\right)^{-15} \right]$ $P = \frac{0,1632}{2}$	✓ substitution into correct formula ✓ value of i ✓ value of n

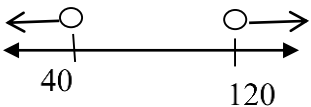
	$= R21\,191,22$	✓ answer (4)
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Penalty of -1 for notation in Question 6

QUESTION 6		[14]
6.1	$f(x) = 3x^2 - 2$ $f(x+h) = 3(x+h)^2 - 2$ $f(x+h) = 3x^2 + 6xh + 3h^2 - 2$ $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{3x^2 + 6xh + 3h^2 - 2 - (3x^2 - 2)}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{3x^2 + 6xh + 3h^2 - 2 - 3x^2 + 2}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{6xh + 3h^2}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{h(6x + 3h)}{h}$ $= 6x$	<p>✓ substitute $f(x+h)$</p> <p>✓ correct substitution into formula and notation</p> <p>✓ simplification</p> <p>✓ common factor</p> <p>✓ answer (5)</p>
6.2.1	$f(x) = 3x^2 - 5x$ $f'(x) = 6x - 5$	<p>✓ $6x$</p> <p>✓ -5 (2)</p>
6.2.2	$D_x \left[\frac{-2x + \sqrt{x}}{x^2} \right]$ $= D_x \left[-\frac{2x}{x^2} + \frac{x^{\frac{1}{2}}}{x^2} \right]$ $= D_x \left[-2x^{-1} + x^{\frac{-3}{2}} \right]$ $= 2x^{-2} - \frac{3}{2}x^{\frac{-5}{2}}$	<p>✓ $\sqrt{x} = x^{\frac{1}{2}}$</p> <p>✓ simplified expression</p> <p>✓ $2x^{-2}$</p> <p>✓ $-\frac{3}{2}x^{\frac{-5}{2}}$ (4)</p>
6.3	$y = \left(\frac{1-8x^3}{1-2x} \right)$ $y = \left(\frac{(1-2x)(1+2x+x^2)}{1-2x} \right)$ $y = 1+2x+x^2$ $\frac{dy}{dx} = 2+2x$	<p>✓ factors</p> <p>✓✓ derivative (3)</p>

QUESTION 7			[13]
7.1	$f(x) = (x+2)(x-1)(x-3)$ $= (x+2)(x^2 - 4x + 3)$ $= x^3 - 4x^2 + 3x + 2x^2 - 8x + 6$ $= x^3 - 2x^2 - 5x + 6$ $b = -2 \quad c = -5 \quad d = 6$	✓ substitution into correct formula ✓ simplification	(2)
7.2	$3x^2 - 4x - 5 = 0$ $x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(3)(-5)}}{2(3)}$ $x = \frac{4 \pm \sqrt{76}}{6}$ $x = 2,12 \quad \text{or} \quad x = -0,79$	✓ derivative = 0 ✓ formula ✓ x – values	(3)
7.3	f is decreasing	✓ answers	(1)
7.4	$6x - 4 > 0$ $x > \frac{2}{3}$	✓ inequality ✓ answer	(2)
7.5	$PQ = x^3 - 2x^2 - 5x + 6 - 2x$ $= x^3 - 2x^2 - 7x + 6$ Max/Min: $3x^2 - 4x - 7 = 0$ $(3x - 7)(x + 1) = 0$ $x = \frac{7}{3} \quad \text{or} \quad x = -1$ $PQ = (-1)^3 - 2(-1)^2 - 7(-1) + 6$ $= 10$	✓ length of PQ in terms of x ✓ derivative ✓ x – values ✓ substitution ✓ value of PQ	(5)

QUESTION 8			[10]
8.1	$-\frac{3}{80}x^2 + 6x - 180 = 0$ $x^2 - 160x + 4800 = 0$ $(x - 120)(x - 40) = 0$ $x = 120 \quad \text{or} \quad x = 20$ $\therefore \text{No profit at 120km/h or 40km/h}$	✓ $P = 0$ ✓ factors ✓ answer	(3)
8.2	$-\frac{6}{80}x + 6 = 0$ $x = 80$ $P = -\frac{3}{80}(80)^2 + 6(80) - 180$ $P = 60$ $\therefore \text{Most economical speed is 80km/h}$ $\text{And a Profit of R60/h}$	✓ derivative ✓ value of x ✓ substitution into correct formula ✓ value of P	(4)

8.3	$-\frac{3}{80}x^2 + 6x - 180 < 0$ $x^2 - 160x + 4800 > 0$ $(x - 120)(x - 40) > 0$  $30 \leq x < 40 \text{ or } x > 120$	✓ inequality ✓ method ✓ answer (3)
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QUESTION 9		[15]
9.1.1	Not Mutually exclusive because $P(A \text{ and } B) \neq 0$	✓ No ✓ $P(A \text{ and } B) \neq 0$ (2)
9.1.2	$P(\text{Male and Vodacom}) = \frac{48}{236} = \frac{12}{59} = 0,203$	✓ answer (1)
9.1.3	$P(\text{Male}) = \frac{120}{236} = 0,508$ $P(\text{Vodacom}) = \frac{100}{236} = 0,424$ $P(\text{Male}) \times P(\text{Vodacom}) = 0,508 \times 0,424 = 0,215$ $P(\text{Male}) \times P(\text{Vodacom}) \neq P(\text{Male and Vodacom})$ \therefore not independent	✓ 0,508 ✓ 0,424 ✓ $P(\text{Male}) \times P(\text{Vodacom}) \neq P(\text{Male and Vodacom})$ (3)
9.2	$\frac{2! \times 5!}{7!} = \frac{1}{21}$	✓ $2! \cdot 5!$ ✓ $7!$ ✓ answer (3)
9.3.1	$7^3 = 343$	✓ 7^3 ✓ answer (2)
9.3.2	$\frac{7!}{4!} = 210$ OR $7 \times 6 \times 5 = 210$	✓ $\frac{7!}{4!}$ ✓ answer (2)
9.3.3	$4 \times 7 \times 2 - 1 = 55$ OR $14 \times 4 - 1 = 55$	✓ $4 \times 7 \times 2$ ✓ answer (2)

TOTAL: 150