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GRADE 12

MATHEMATICS P1

MEMORANDUM

SEPTEMBER 2018

MARKS: 150

TIME: 3 hours

This memorandum consists of 16 pages.

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 memorandum.
- Assuming values/answers in order to solve a problem is unacceptable.

QUESTION 1

1.1.1	$(x - 3)(x + 1) = 0$ $x - 3 = 0$ or $x + 1 = 0$ $x = 3$ or $x = -1$	Values/waardes of/van x $\checkmark x = 3$ $\checkmark x = -1$ (2)
1.1.2	$x^2 - x - 4 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{1 \pm \sqrt{(-1)^2 - 4(1)(-4)}}{2(1)}$ $x = \frac{1 \pm \sqrt{17}}{2}$ $x = 2,56$ or $x = -1,56$ ALTERNATIVE /ALTERNATIEF $x^2 - x - 4 = 0$ $(x - \frac{1}{2})^2 = 4\frac{1}{4}$ $x = \frac{1}{2} \pm \frac{\sqrt{17}}{2}$ $x = 2,56$ or/of $x = -1,56$	$\checkmark$ standard form <i>/standaardvorm</i> $\checkmark$ correct substitution into correct formula <i>/korrekte vervanging in</i> <i>korrekte formule</i> $\checkmark x = 2,56$ $\checkmark x = -1,56$ (5) OR $\checkmark$ standard form/std vorm $\checkmark$ completing the square <i>/voltooing van vierkant</i> $\checkmark x = 2,56$ $\checkmark x = -1,56$ (4)

1.1.3	$x + \sqrt{x-2} = 4$ $(\sqrt{x-2})^2 = (4-x)^2$ $x-2 = 16-8x+x^2$ $x^2-9x+18=0$ $(x-3)(x-6)=0$ $x=3 \text{ or/of } x=6$ $\therefore x=3$ ALTERNATIVE/ALTERNATIEF $(\sqrt{x-2})^2 = (4-x)^2$ $x-2 = 16-8x+x^2$ $x^2-9x+18=0$ $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ $= \frac{1 \pm \sqrt{(-9)^2 - 4(1)(18)}}{2(1)}$ $x = \frac{1 \pm \sqrt{9}}{2}$ $x=3 \text{ or } x=6$ $\therefore x=3$	✓ squaring both sides /kwadrering beide kante ✓ standard form/std vorm ✓ factors/faktore ✓ both values/beide waardes ✓ select/selekteer $x=3$ (5) OR ✓ squaring both sides /kwadrering beide kante ✓ standard form/std vorm ✓ formula/formule ✓ both values/beide waardes ✓ select/selekteer $x=3$ (5)
1.1.4	$x \leq 0 \text{ or } x \geq \frac{1}{2}$	✓ critical values /kritieke waardes ✓✓ both answers and inequality signs correct (3) /beide antwoorde en ongelykheids tekens moet reg wees

1.2.1	$P = \frac{4^{x+3} + 4^x}{8^{x+2} + 8^x}$ $= \frac{2^{2x+6} + 2^{2x}}{2^{3x+6} + 2^{3x}}$ $= \frac{2^{2x}(2^6 + 1)}{2^{3x}(2^6 + 1)}$ $= 2^{-x} \text{ or/of } \left(\frac{1}{2}\right)^x$ ALTERNATIVE/ALTERNATIEF $P = \frac{4^x(4^3 + 1)}{8^x(8^2 + 1)}$ $= \frac{4^x(65)}{8^x(65)}$ $= \left(\frac{1}{2}\right)^x$	✓ prime numbers with exponents/<i>priemgetalle met eksponente</i> ✓ factorisation/<i>faktorisering</i> ✓ simplification /<i>vereenvoudiging</i> ✓ answer/<i>antwoord</i> (4) OR ✓ factorisation/<i>faktorisering</i> ✓ factorisation/<i>faktorisering</i> ✓ simplification/<i>vereenvoudiging</i> ✓ answer/<i>antwoord</i> (4)
1.2.2	$P = 8$ $2^{-x} = 8$ $2^{-x} = 2^3$ $\therefore -x = 3$ $\therefore x = -3$	✓ equating/<i>stel gelyk</i> ✓ answer/<i>antwoord</i> (2)

1.3	$3y = -3 + x + x^2$ $\sum_{k=3}^4 x(k-2)^2 = 5y$ $k = 3 : x(3-2)^2 = x$ $k = 4 : x(4-2) = 4x$ $\therefore x + 4x = 5y$ $5x = 5y$ $\therefore x = y$ $(1) \dots 3x = -3 + x + x^2$ $0 = x^2 - 2x - 3$ $0 = (x+1)(x-3)$ $\therefore x = -1 \text{ or } x = 3$ $y = -1 \text{ or } y = 3$	✓ both values in terms of x /beide waardes in terme van ✓equating/stel gelyk ✓ standard form/standaardvorm ✓ $x = -1$ or $x = 3$ ✓ $y = -1$ or $y = 3$ (5)
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[25]

QUESTION 2/VRAAG 2

2.1	$10 - 3y ; 7 ; 15 ; 8y + 1.$ $ \begin{array}{ccccccc} 10 - 3y & ; & 7 & ; & 15 & ; & 8y + 1 \\ & \swarrow & & \searrow & \swarrow & & \searrow \\ & -3 + 3y & & 8 & & 8y - 14 & \\ & & \swarrow & & \searrow & & \\ & & 11 - 3y & & 8y - 22 & & \\ & & 11 - 3y = 8y - 22 & & & & \\ & & \therefore y = 3 & & & & \end{array} $	✓ First differences /eerste verskil ✓ Second differences /tweede verskil ✓ equating /gelykstelling ✓ value of y /waarde van (4)
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2.2	$1 ; 7 ; 15; 25$ $2a = 2$ $\therefore a = 1$ $6 = 3(1) + b$ $3 = b$ $1 + 3 + c = 1$ $c = -3$ $T_n = n^2 + 3n - 3$	✓ The quadratic row /kwadratiese ry ✓ value of a /waarde van ✓ value of b /waarde van ✓ value of c /waarde van (4)
2.3	$n^2 + 3n - 3 > 2157$ $n^2 + 3n - 2160 > 0$ $(n + 48)(n - 45) > 0$ $n < -48$ or $n > 45$ $\therefore T_{46}$ ALTERNATIVE: $n^2 + 3n - 3 > 2157$ $n^2 + 3n - 2160 > 0$ $n = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $n = \frac{-3 \pm \sqrt{8649}}{2}$ $n = -48$ or/of $n = 45$ $\therefore T_{46}$	✓ inequality /ongelykheid ✓ factorization faktorisering ✓ select correct value of n /selekteer korrekte waarde (3) OR ✓ inequality /ongelykheid ✓ formula /formule ✓ select correct value of n /selekteer regte waarde (3)

[11]

QUESTION 3/VRAAG 3

3.1.1	The first term $a = p$ and the constant difference $d = q - p$ $T_{10} = p + 9(q - p) = 9q - 8p$	✓ p and $(q - p)$ ✓ $9q - 8p$ (2)
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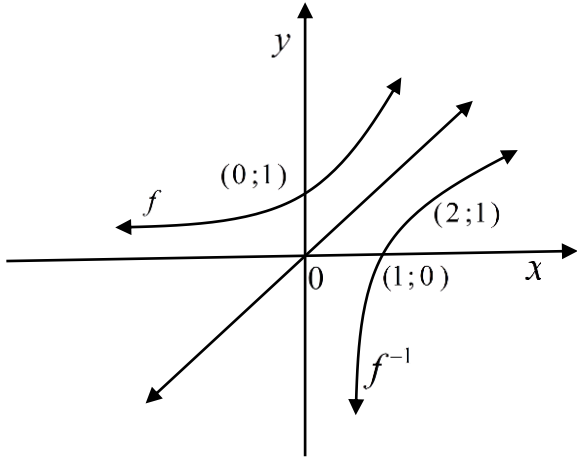
3.1.2	$S_n = \frac{n}{2} [2a + (n-1)d]$ $\therefore S_{20} = 10(2a - 19d)$ $S_{20} = 20p + 190(q - p)$ $= 190q - 170p$	✓ correct substitution into correct formula ✓ /korrekte vervanging in korrekte waarde ✓ answer /antwoord (2)
3.2.1	$T_3 + T_4 = 167$ $a + 2d + a + 3d = 167$ $2a + 5d = 167 \dots\dots\dots(1)$ $T_{21} = -4$ $a + 20d = -4$ $a = -20d - 4 \dots\dots\dots(2)$ Substitute (1) into (2): $2(-20d - 4) + 5d = 167$ $-40d - 8 + 5d = 167$ $-35d = 175$ $d = -5$	✓ equation/vergeliking 1 ✓ equation/vergeliking 2 ✓ equating : Equation 1 = equation 2 ✓ value of d (4) /waarde van
3.2.2	$a + 20d = -4$ $a = -20(-5) - 4 = 96$ $S_{21} = \frac{21}{2} [2a + 20d]$ $= \frac{21}{2} [2(96) + 20(-5)]$ $= 966$ OR $a + 20d = -4$ $a = -20(-5) - 4 = 96$ $S_{21} = \frac{21}{2} (a + l)$ $= \frac{21}{2} (96 - 4)$ $= 966$	✓ value of a /waarde van ✓ correct substitution in correct formula ✓ /korrekte vervanging in korrekte waarde ✓ answer/antwoord OR ✓ value of a /waarde van ✓ correct substitution in correct formula ✓ /korrekte vervanging in korrekte waarde ✓ answer/antwoord (3)

3.3	$a = -3; r = -\frac{1}{3}$ Sequence is: $-3; 1; -\frac{1}{3}; \frac{1}{9}; -\frac{1}{27}$ Sequence of negative numbers: $-3; -\frac{1}{3}; -\frac{1}{27}; \dots$ $a = -3; r = \frac{1}{9}$ $S_{\infty} = \frac{a}{1-r}$ $= \frac{-3}{1-\frac{1}{9}}$ $= \frac{-3}{\frac{8}{9}}$ $= -3 \frac{9}{8}$	✓ geometric sequence /meetekundige ry ✓ sequence of negative numbers /ry met negatiewe getalle ✓ value of r and a /waarde van ✓ correct substitution in correct formula /korrekte vervanging in korrekte formule ✓ correct answer /korrekte antwoord (5)
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[16]

QUESTION 4/VRAAG4

4.1	$y = 2^x$ $x = 0$ $\therefore f(0) = 2^0 = 1$ $\therefore C(0;1)$ y - intercept: $g(x) = -(x-1)^2 + q$ $C(0;1)$ $1 = -(0-1)^2 + q$ $1 = -1 + q$ $\therefore q = 2$	✓ substitute $C(0;1)$ /vervang ✓ $q = 2$ (2)
4.2	$g(x) = -(x-1)^2 + 2$ $D(1; 2)$	✓✓ answer /antwoord (2)
4.3	$t = 2$	✓ answer/antwoord (1)

4.4	$f^{-1} : x = 2^y$ $\therefore y = \log_2 x$	✓✓ answer/antwoord (2)
4.5		✓ form of the graph /vorm van die grafiek ✓ x – intercept/afsnit ✓ any other coordinate on the graph /enige ander koördinaat op die grafiek (3)
4.6	$g(x) = -(x-1)^2 + 2$ $g(x+1) - 2 = -(x-1+1)^2 + 2 - 2$ $\therefore h(x) = -x^2$	✓ +1 and – 2 ✓ answer/antwoord (2)
4.7	Domain: $x \geq 0$ or $x \leq 0$	✓ answer /antwoord (1)

[13]

QUESTION 5/VRAAG 5

5.1	$x = -2$ $y = 1$	✓ answer/antwoord ✓ answer/antwoord (2)
5.2 .1	A : $x = 0$ $y = \frac{4}{0+2} + 1$ $y = 2 + 1$ $y = 3$ A(0 ; 3)	✓ answer /antwoord (1)

5.2.2	$y = 0$ $0 = \frac{4}{x+2} + 1$ $-1(x+2) = 4$ $-x-2 = 4$ $x = -6$ $D(-6; 0)$	✓ equating to 0 / gelykstel aan ✓ simplification / vereenvoudiging ✓ answer/antwoord (3)
5.2.3	$\frac{4}{x+2} + 1 = 2x + 3$ $4 + 1(x+2) = (2x+3)(x+2)$ $4 = 2x^2 + 6x + 4$ B: $0 = 2x^2 + 6x$ $0 = 2x(x+3)$ $\therefore x = 0 \text{ or } x = -3$ $g(-3) = 2(-3) + 3 = -3$ $\therefore B(-3; -3)$	✓ equating / gelykstelling ✓ standard form / std vorm ✓ value of x / waarde van ✓ value of y / waarde van (4)
5.3	 Average gradient: $m = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{0 - 3}{-6 - 0} = \frac{1}{2}$	✓ applying $\frac{y_2 - y_1}{x_2 - x_1}$ / toepassing ✓ answer / antwoord (2)
5.4	$g(x) = 2x + 3$ $g'(x) = 2$ $\therefore f(x) \cdot g'(x) \leq 0$ $g'(x) > 0, \forall x \in R$ $f(x) \leq 0 \text{ for}$ $-6 \leq x < -2$	✓ $g'(x)$ ✓ explaining $g'(x) \leq 0$ / verduidelik ✓ answer of $f(x) \leq 0$ / antwoord (3)

[15]

QUESTION 6/VRAAG 6

6.1	$12\,500(1-i)^5 = 5\,546,32$ $(1-i)^5 = 0,4437056$ $\sqrt[5]{(1-i)^5} = \sqrt[5]{0,4437056}$ $1-i = 0,8500001102$ $i = 0,1499998898$ $i \approx 15\%$	✓ correct substitution in correct formula /korrekte vervanging in korrekte formule ✓ applying $\sqrt[5]{}$ /toepassing ✓ value of i (3) /waarde van
6.2.1	$i_{eff} = \left(1 + \frac{i_m}{m}\right)^m$ $1 + i_{eff} = \left(1 + \frac{0,08}{12}\right)^{12}$ $i_{eff} = 0,082999 \times 100$ $i_{eff} = 8,299 \approx 8,3$	✓ $m = 12$ ✓ correct substitution in correct formula /korrekte vervanging in korrekte formule ✓ simplification/vereenvoudig ✓ answer/antwoord (4)
6.2.2	Deposit paid = $1\,800\,000 \times \frac{60}{100} = R1\,080\,000$ <i>Deposito betaal</i> Balance owed = $OR\,180\,000 \times \frac{40}{100} = R720\,000$ Therefore/dus : R720 000 was financed by the bank was paid by the bank. <i>Was gefinansier deur die bank /betaal deur die bank.</i> $720\,000 \left(1 + \frac{0,08}{12}\right) = x \left[\frac{1 - \left(1 + \frac{8}{1\,200}\right)^{(-119)}}{\frac{8}{1\,200}} \right]$ $4832 = (0,5464730496)x$ $8842,16 = x$	✓ deposit paid/deposito betaal ✓ balance owed /balans verskuldig ✓ correct substitution in correct formula /korrekte vervanging in korrekte formule ✓ $n = -119$ ✓ answer of R8 842,16 (5) /antwoord

6.2.3	$A = 724800 \left(1 + \frac{8}{1\,200} \right)^{(3 \times 12)}$ $A = R920\,667,815$ $F = 8\,842,16 \left[\frac{\left(1 + \frac{8}{1\,200} \right)^{36} - 1}{\frac{8}{1\,200}} \right]$ $F = R358\,421,8873$ Balance of the loan = $R\,920\,667,815 - R35\,8421,88734\,119$ $= R\,562\,246$ ALTERNATIVE/ALTERNATIEF $P = \frac{x[1 - (1+i)^{-n}]}{i}$ $P = 8\,842,16 \left[\frac{1 - \left(1 + \frac{8}{1\,200} \right)^{(-83)}}{\frac{8}{1\,200}} \right]$ Balance of the loan: P = R562 246	✓ correct substitution in correct formula /korrekte vervanging in korrekte formule ✓ A = R920 667,815 ✓ correct substitution in correct formula /korrekte vervanging in korrekte formule ✓ difference/verskil ✓ balance/balans (5) OR ✓ correct formula /korrekte formule ✓ $n = -83$ ✓ 8 842,16 ✓ correct substitution ✓ balance/balans (5)
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[17]

QUESTION 7/VRAAG7**Penalty for notation in 7.1 or 7.2- only once.**

7.1	$\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \rightarrow 0} \frac{3(x+h)^2 + 2 - 3x^2 - 2}{h}$ $= \lim_{h \rightarrow 0} \frac{3(x^2 + 2hx + h^2) + 2 - 3x^2 - 2}{h}$ $= \lim_{h \rightarrow 0} \frac{3x^2 + 6hx + 3h^2 - 3x^2 - 2}{h}$ $= \lim_{h \rightarrow 0} \frac{6hx + 3h^2}{h}$ $= \lim_{h \rightarrow 0} \frac{h(6x + 3h)}{h}$ $= \lim_{h \rightarrow 0} (6x + 3h)$ $= 6x$	✓ correct formula ✓ subst. in formula ✓ simplifying ✓ factorising ✓ 6x (5)
7.2	$y = -(4x^2 - 12x + 9)$ $y = -4x^2 + 12x - 9$ $\frac{dy}{dx} = -8x + 12$	✓ simplifying ✓ -8x ✓ 12 (3)
7.3	$f(x) = \sqrt{x}(x+2)$ $f(x) = x\sqrt{x} + 2\sqrt{x}$ $= x^{\frac{3}{2}} + 2x^{\frac{1}{2}}$ $f'(x) = \frac{3}{2}x^{\frac{1}{2}} + x^{\frac{-1}{2}}$ $f'(4) = \frac{3}{2}(4)^{\frac{1}{2}} + (4)^{\frac{-1}{2}}$ $= 3 + 2^{-1}$ $= 3\frac{1}{2}$	✓ simplifying ✓ determining derivative of each fraction /bepaal eerste afgeleide van elke term ✓ substitution of 4 ✓ answer (4)

[12]

QUESTION 8/VRAAG 8

8.1	$g(x) = (x+1)(x+1)(x-5) = 0$ $\therefore x = -1$ or $x = 5$ $A(-1; 0)$ and $D(5; 0)$	✓ $A(-1; 0)$ ✓ $D(5; 0)$ (2)
8.2	$g'(x) = 3x^2 - 6x - 9 = 0$ $\div 3: x^2 - 2x - 3 = 0$ $(x-3)(x+1) = 0$ $x = 3$ or $x = -1$ $g(3) = -32$ $\therefore C(3; -32)$ and $A(-1; 0)$	✓ first derivative = 0 <i>/eerste afgeleide</i> ✓ $C(3; -32)$ ✓ $A(-1; 0)$ (3)
8.3	EC: $y = -32$ $\therefore -32 = x^3 - 3x^2 - 9x - 5$ $0 = x^3 - 3x^2 - 9x - 5 + 32$ $0 = x^3 - 3x^2 - 9x + 27$ $0 = (x-3)(x-3)(x+3)$ $\therefore x = 3$ or $x = -3$ $\therefore x$ - coordinate at E : $x = -3$	✓ equation of tangent <i>/vergelyking van raaklyn</i> ✓ equating /gelykstelling ✓ value of x <i>/waarde van</i> (3)
8.4.1	$g'(x) = 3x^2 - 6x - 9$ $g''(x) = 6x - 6 = 0$ $x = 1$ $g(1) = (1)^3 - 3(1)^2 - 9(1) - 5 = -16$ $\therefore$ point of inflection: $(1; -16)$ OR $x = \frac{x_A + x_C}{2}$ and $y = \frac{y_A + y_C}{2}$ $x = \frac{-1+3}{2} = 1$ and $y = \frac{0-32}{2} = -16$ $\therefore$ point of inflection: $(1; -16)$	✓ second derivative=0 <i>/tweede afgeleide</i> ✓ value of x <i>/waarde van</i> ✓ value of y <i>/waarde van</i> OR ✓ average ✓ value of x ✓ value of y (3)
8.4.2	Gradient of tangent: $g'(1) = 3(1)^2 - 6(1) - 9 = -12$ Point of inflection $(1; -16)$ $y = -12x + c$ $-16 = -12(1) + c$ Equation of tangent: $-4 = c$ $\therefore y = -12x - 4$	✓ first derivative <i>/eerste afgeleide</i> ✓ value of gradient <i>/waarde van gradient</i> ✓ substitution of coordinates of the point of inflection ✓ equation of tangent (4)

QUESTION 9 /VRAAG9

9.1	$\text{Area shaded} = 8x - (2x)^2 - \pi \left(\frac{2}{3} \times 2x \right)^2$ $= 8x - \pi \left(4 + \frac{16}{9} \right) x^2$ $= 8x - \frac{52}{9} \pi x^2$	✓✓ ✓ formula /formule ✓ factorization /faktorisering (4)
9.2	$A = 8x - \frac{52}{9} \pi x^2$ Maximum area: $D_x(A) = 8 - \frac{104}{9} \pi x = 0$ $\therefore 104 \pi x = 72$ $x = \frac{72}{104 \pi} = 0,22 \text{ m}$	✓ first derivative = 0 /eerste afgeleide ✓ simplifying /vereenvoudiging ✓ x value /waarde (4)
9.3	maximum area = $8(0,22) - \frac{52}{9} \pi (0,22)^2 = 0,88 \text{ m}^2$	✓ answer /antwoord (1)

[9]**QUESTION 10/VRAAG 10**

10.1	For an odd product, the two numbers must be odd. <i>Vir 'n onewe produk moet albei getalle onewe wees</i> First draw: 4 odd out of 7 cards <i>Eerste trekking: 4 onewe van 7 kaarte</i> Second draw: 3 odd out of 6 <i>Tweede trekking: 3 onewe van 6</i> $P(\text{odd product}) = \frac{4}{7} \times \frac{3}{6} = \frac{2}{7} \approx 0,3$ $P(\text{onewe produk}) = \frac{4}{7} \times \frac{3}{6} = \frac{2}{7} \approx 0,3$	✓ $\frac{4}{7}$ ✓ $\frac{3}{6}$ ✓ $\frac{2}{7}$ Or 0,3 (3)
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10.3		✓ 0,3 and 0,35 ✓ 0,25 ✓ 0,1 (3)
10.4.1	$P(A \text{ and } B^c) = 0,55 - 0,25 = 0,3$	✓ $0,55 - 0,25$ ✓ 0,3 (2)
10.4.2	$P(A \text{ or } B^c) = 1 - 0,35 = 0,65$	✓ answer /antwoord (1)

[9]

QUESTION 11/VRAAG 11

11.1	$6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$	✓✓ answer /antwoord (2)
11.2	$2! \times 5! = 2 \times 120 = 240$	✓ $2! \times 5!$ ✓ 240 (2)
11.3	Left/links : $1 \times 5!$ Right /regs: $5! \times 1$ $\frac{1 \times 5! + 5! \times 1}{6!}$ $\frac{120 + 120}{720}$ $= \frac{240}{720}$ $= \frac{1}{3}$ OR Left/links : $\frac{1}{6}$ Right /regs: $\frac{1}{6}$ $\frac{1}{6} + \frac{1}{6}$ $= \frac{2}{6} = \frac{1}{3}$	✓ $1 \times 5!$ ✓ $1 \times 5!$ ✓ $6!$ ✓ answer /answer OR (4)

[8]

TOTAL 150