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JOHANNESBURG NORTH DISTRICT

2021

GRADE 12

**MATHEMATICS
PAPER 1
PRE-TRIAL EXAM**

MARKING GUIDELINES

EXAMINER: V. T. SIBANDA

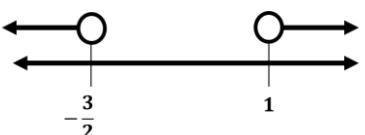
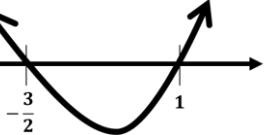
MODERATOR: T. A. SAMBO

MARKS: 150

TIME: 3 HOURS

DATE: 13 AUGUST 2021

QUESTION	CALCULATION	MARK ALLOCATION
1.1.1	$4x^2 - 25 = 0$ $(2x - 5)(2x + 5) = 0$ $x = \frac{5}{2} \text{ or } x = -\frac{5}{2}$ <p style="text-align: center;">OR</p> $4x^2 = 25$ $x^2 = \frac{25}{4}$ $\sqrt{x^2} = \pm \sqrt{\frac{25}{4}}$ $x = \frac{5}{2} \text{ or } x = -\frac{5}{2}$	✓✓ factors ✓ Answers (3) ✓ $x^2 = \frac{25}{4}$ ✓ $\pm \sqrt{\frac{25}{4}}$ ✓ Answer
1.1.2	$3x^2 + 5x - 4 = 0$ $x = \frac{-5 \pm \sqrt{5^2 - 4(3)(-4)}}{2(3)}$ $x = \frac{-5 \pm \sqrt{73}}{6}$ $x = -2,26 \text{ or } x = 0,59$ <p style="text-align: center;">OR</p> $3x^2 + 5x = 4$ $x^2 + \frac{5x}{3} + \frac{25}{36} = \frac{4}{3} + \frac{25}{36}$ $\left(x + \frac{5}{6}\right)^2 = \frac{73}{36}$ $x = -\frac{5}{6} \pm \frac{\sqrt{73}}{6}$ $x = -2,26 \text{ or } x = 0,59$	✓ standard form ✓ correct substitution ✓✓ Answers (4) ✓ for adding $\frac{25}{36}$ both sides ✓ $x = -\frac{5}{6} \pm \frac{\sqrt{73}}{6}$ ✓✓ Answers
1.1.3	$2^x - 5 \cdot 2^{x+1} = -144$ $2^x(1 - 5 \cdot 2) = -144$ $2^x(-9) = -144$ $2^x = 16$ $2^x = 2^4$ $\therefore x = 4$	✓ Factorise ✓ Simplification ✓ Answer (3)
1.1.4	$2x^2 + x - 3 > 0$ $(x - 1)(2x + 3) > 0$ $x > 1 \text{ or } x < -\frac{3}{2}$ <p style="text-align: center;">or</p> $(-\infty, -\frac{3}{2}) \cup (1; \infty)$	✓ critical values ✓✓ notation

	<p>or</p>  <p>or</p> 	(3)
1.2.1	$4^{x+2} \cdot 8^{y+1} = 2^{1-x}$ $2^{2(x+2)} \cdot 2^{3(y+1)} = 2^{1-x}$ $2x + 4 + 3y + 3 = 1 - x$ $3y = -3x - 6$ $y = -x - 2$	✓ Exponential Law ✓ Exponential Law ✓ Simplify (3)
1.2.2	$y = -x - 2 \dots\dots (1)$ $x^2 + y^2 + xy = 7 \dots\dots (2)$ <p>substitute for y in (2) using expression from (1)</p> $x^2 + (-x - 2)^2 + x(-x - 2) = 7$ $x^2 + x^2 + 4x + 4 - x^2 - 2x = 7$ $x^2 + 2x - 3 = 0$ $(x - 1)(x + 3) = 0$ $x = 1 \text{ or } x = -3$ $\therefore y = -(1) - 2 \text{ or } y = -(-3) - 2$ $y = -3 \text{ or } y = 1$	✓ Substitution ✓ Standard form ✓ Factors ✓ x -values ✓ y -values (5)
1.3	$6x^2 + 2gx - 3x - g = 0$ $6x^2 + 2x(g - 3) - g = 0$ $\Delta = b^2 - 4ac$ $\Delta = (2g - 3)^2 - 4(6)(-g)$ $\Delta = 4g^2 - 12g + 9 + 24g$ $\Delta = g^2 + 12g + 9$ $\Delta = (2g + 3)^2$ <p>$\therefore \Delta = \text{perfect square, thus rational roots.}$</p>	✓ coefficient of x ✓ correct substitution into formula ✓ factors ✓ conclusion (4)
		[25]

QUESTION	CALCULATION	MARK ALLOCATION
2.1	$37 - x - (x + 5) = x + 13 - (37 - x)$ $37 - x - x - 5 = x + 13 - 37 + x$ $-4x = -56$ $x = 14$	✓use of common difference for an AP ✓Simplification ✓Answer (3)
2.2	$T_1 = 19, T_2 = 23, T_3 = 27$ $d = 4$ $T_n = 19 + (n - 1)4$ $T_n = 4n + 15$	✓Correct substitution ✓✓Answer (3)
2.3	$S_3 = \frac{a(r^n - 1)}{r - 1}; r \neq 1$ $91 = \frac{a(3^3 - 1)}{3 - 1}$ $91 = \frac{a \cdot 26}{2}$ $a = 7$ <p>OR</p> $91 = a + ar + ar^2$ $91 = a + 3a + 9a$ $91 = 13a$ $a = 7$	✓Formula ✓Substitution ✓Answer ✓ $a + ar + ar^2$ ✓Simplification ✓Answer (3)
2.4	$S_\infty = \frac{a}{1 - r}; -1 < r < 1$ $\frac{375}{4} = \frac{a}{1 - r}$ $375(1 - r) = 4a$ $a = \frac{375(1 - r)}{4} \dots \dots \text{eq 1}$ $S_2 = \frac{a(r^2 - 1)}{r - 1} \dots \dots \text{eq 2}$ $90 = \frac{a(r - 1)(r + 1)}{r - 1}$ $90 = \frac{375(1 - r)(r + 1)}{4}$ $90 = \frac{-375(r - 1)(r + 1)}{4}$ $90 = \frac{375(r^2 - 1)}{4}$	✓ Equation 1 ✓ Equation 2 ✓ Substitution

	$r^2 = \frac{1}{25}$ $r = \frac{1}{5} \text{ or } r = -\frac{1}{5}$ $a = \frac{375\left(1-\frac{1}{5}\right)}{4} = 75 \text{ or } a = \frac{375\left(1-\left(-\frac{1}{5}\right)\right)}{4} = \frac{225}{2}$	✓ Simplification ✓✓ Answers (6)
2.5.1	32699 32896 33091 33284 33475 1 st difference 197 195 193 191 2 nd difference -2 -2 -2 The 2 nd difference is constant, therefore pattern is quadratic.	✓ 1 st difference and 2 nd difference ✓ conclusion (2)
2.5.2	$T_n = 197 + (n-1)(-2)$ $T_n = 199 - 2n$	✓ correct substitution ✓ $T_n = 199 - 2n$ (2)
2.5.3	$2a = -2 \quad \therefore a = -1$ $3a + b = 197$ $3(-1) + b = 197 \quad \therefore b = 200$ $a + b + c = 32699$ $-1 + 200 + c = 32699 \quad \therefore c = 32500$ $T_n = -n^2 + 200n + 32500$	✓ a ✓ b ✓ c ✓ T _n (4)
2.5.4	1 st derivative: $T'_n = -2n + 200$ $0 = -2n + 200$ $n = 100$ Maximum will be on the 100 th day. OR Complete square: $-T_n = n^2 - 200n - 32500$ $-T_n = n^2 - 200n + (-100)^2 - 32500 - (-100)^2$ $-T_n = (n - 100)^2 - 42500$ $T_n = -(n - 100)^2 + 42500$ by inspection, maximum will be on the 100 th day.	✓✓ 1 st deriveate ✓ Answer ✓✓ complete the square ✓ Answer (3)
		[26]

QUESTION	CALCULATION	MARK ALLOCATION
3.1	A(0; 6)	✓ Answer (1)
3.2	$x = -\frac{b}{2a} = -\frac{5}{2(-1)} = 2,5 \quad \therefore S(5; 6)$ OR $y = x + 1$ $6 = x + 1$ $x = 5$ $S(5; 6)$ OR $y = -x^2 + 5x + 6$ $6 = -x^2 + 5x + 6$ $-x^2 + 5x = 0$ $x^2 - 5x = 0$ $x(x - 5) = 0$ $x = 0 \text{ or } x = 5$ $S(5; 6)$ OR $-x^2 + 5x + 6 = x + 1$ $x^2 - 4x - 1 = 0$ $(x - 5)(x + 1) = 0$ $x = 5 \text{ or } x = -1$ Valid x value: $x = 5 \quad \therefore S(5; 6)$	using axis of symmetry: ✓ x -value ✓ y -value ✓ Equating equation to 6 ✓ x -value ✓ Equating equation to 6 ✓ x -value ✓ Equating equations ✓ valid x -value (2)
3.3	$-x^2 + 5x + 6 = 0$ $x^2 - 5x - 6 = 0$ $(x - 6)(x + 1) = 0$ $x = 6 \text{ or } x = -1$ $B(-1; 0) \text{ and } C(6; 0)$	✓ Factors ✓ ✓ Answers (3)
3.4	$f(x) - g(x) = 5$ $-x^2 + 5x + 6 - (x + 1) = 5$ $-x^2 + 5x + 6 - x - 1 = 5$ $x^2 - 4x = 0$ $x(x - 4) = 0$ $x = 0 \text{ or } x = 4$ $OR = 4 \text{ units}$	✓ Subtract g from f ✓ Equate to 5 ✓ Solve for x ✓ State $OR = 4$ units (4)
3.5.1	$x = -\frac{b}{2a} = -\frac{5}{2(-1)} = 2,5 \quad \text{or} \quad \frac{5}{2}$	✓ Formula ✓ CA axis of symmetry ✓ CA substitution

	$f(2,5) = -(2,5)^2 + 5(2,5) + 6 = 12,25 \quad \text{or} \quad \frac{49}{4}$ $M(2,5; 12,25) \text{ or } M\left(\frac{5}{2}; \frac{49}{4}\right)$ OR $x = \frac{-1 + 6}{2} = \frac{5}{2}$ $y = -(2,5)^2 + 5(2,5) + 6 = \frac{49}{4}$ $M\left(\frac{5}{2}; \frac{49}{4}\right)$ OR $f'(x) = -2x + 5 = 0 \quad \therefore x = \frac{5}{2}$ $y = -\left(\frac{5}{2}\right)^2 + 5\left(\frac{5}{2}\right) + 6 = \frac{49}{4}$	✓CA Answer ✓Midpoint Formula ✓CA axis of symmetry ✓CA substitution ✓CA Answer ✓1 st derivative equal to 0 ✓CA axis of symmetry ✓CA substitution ✓CA Answer (4)
3.5.2	$PQ = -x^2 + 4x + 5$ $(PQ)' = -2x + 4 = 0 \quad \therefore x = 2$ $PQ \text{ max.} = -(2)^2 + 4(2) + 5 = 9 \text{ units}$ OR $x = -\frac{b}{2a} = -\frac{4}{2(-1)} = 2$ $PQ \text{ max.} = -(2)^2 + 4(2) + 5 = 9 \text{ units}$	✓PQ in terms of x ✓1 st derivative equal to 0 ✓CA x -value ✓CA Answer ✓PQ in terms of x ✓substitution ✓CA x -value ✓CA Answer (4)
		[19]
QUESTION	CALCULATION	MARK ALLOCATION
4.1	$y = 2^x$ when $x = 0$ $f(0) = 2^0 = 1$ $\text{C}(0; 1)$ thus $g(x) = -(x - 1)^2 + q$ $1 = -(0 - 1)^2 + q$ $q = 2$	✓y-intercept ✓Substitute and simplify (2)
4.2	$g(x) = -(x - 1)^2 + 2$ $\text{D}(1; 2)$	✓✓Answer (2)
4.3	$t = 2$	✓ Answer (1)
4.4	$f^{-1}: x = 2^y$ $y = \log_2 x$	✓✓Answer (2)

4.5		✓ form of the graph ✓ x-intercept ✓ any other coordinate on the graph (3)
4.6	$g(x) = -(x - 1)^2 + 2$ $g(x + 1) - 2 = -(x + 1 - 1)^2 + 2 - 2$ $h(x) = -x^2$	✓ correct substitution into g ✓ Answer
4.7	Domain: $x \geq 0$ or $x \leq 0$	✓ Answer
		[13]
QUESTION	CALCULATION	MARK ALLOCATION
5.1.1	$A = P(1 - i)^n$ $79\ 866,96 = 180\ 000(1 - 0,15)^n$ $79\ 866,96 = 180\ 000(0,85)^n$ $(0,85)^n = \frac{79\ 866,96}{180\ 000}$ $n = \frac{\log\left(\frac{79\ 866,96}{180\ 000}\right)}{\log(0,85)}$ $n = 4,999 \dots \text{years}$ $n = 5 \text{ years}$	✓ Substitution ✓ use of logs. ✓ Answer (3)
5.1.2	$A = P \left(1 + \frac{i}{4}\right)^{n \times 4}$ $A = 49\ 000 \left(1 + \frac{0,1}{4}\right)^{5 \times 4}$ $A = R80\ 292,21$ <p>Yes, the money will be enough to buy the car.</p>	✓ values of i and n . ✓ substitution ✓ conclusion (consistent with answer) (3)
5.2.1	$P = \frac{x[1 - (1 + i)^{-n}]}{i}$ $P = \frac{7853,15 \left[1 - \left(1 + \frac{0,1025}{12}\right)^{-234}\right]}{0,1025}$ $= R793\ 749,25$	✓ $n = 234$ ✓ $i = \frac{0,1025}{12}$ ✓ substitution into present value formula ✓ Answer

	<p>OR</p> <p>Balance outstanding =</p> $= 800\ 000 \left(1 + \frac{0,1025}{12}\right)^6 - \frac{7853,15 \left[\left(1 + \frac{0,1025}{12}\right)^6 - 1 \right]}{\frac{0,1025}{12}}$ $= 841\ 885,56 - 48\ 136,62$ $= R793\ 748,94$	<ul style="list-style-type: none"> ✓ n = 6 in both ✓ i = $\frac{0,1025}{12}$ ✓ A – F ✓ Answer (4)
5.2.2	$A = P(1 + i)^n$ $A = 793\ 749,25 \left(1 + \frac{0,1025}{12}\right)^3$ $= R814\ 263,3052$ <p>New instalment:</p> $P = \frac{x[1 - (1 + i)^{-n}]}{i}$ $814\ 263,3052 = \frac{x[1 - \left(1 + \frac{0,1025}{12}\right)^{-231}]}{\frac{0,1025}{12}}$ $= R8\ 089,20$	<ul style="list-style-type: none"> ✓ $793\ 749,25 \left(1 + \frac{0,1025}{12}\right)^3$ <ul style="list-style-type: none"> ✓ n = 231 ✓ substitution for new P ✓ substitution for n and i ✓ Answer (5)
		[15]
QUESTION	CALCULATION	MARK ALLOCATION
6.1	$f(x) = -3x^2$ $f'(x) = \lim_{h \rightarrow 0} \frac{f(x + h) - f(x)}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{-3(x + h)^2 - 3x^2}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{-3x^2 - 6xh - 3h^2 + 3x^2}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{-6xh - 3h^2}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{h(-6x - 3h)}{h}$ $f'(x) = -6x$	<ul style="list-style-type: none"> ✓ 1st principles formula <ul style="list-style-type: none"> ✓ $-6xh - 3h^2$ ✓ $\frac{h(-6x - 3h)}{h}$ ✓ Answer (4)
6.2	$y = 7x^4 - 5\sqrt{x} - \frac{3}{x}$ $y = 7x^4 - 5x^{\frac{1}{2}} - 3x^{-1}$ $\frac{dy}{dx} = 28x^3 - \frac{5}{2}x^{-\frac{1}{2}} + 3x^{-2}$	<ul style="list-style-type: none"> ✓ $7x^4 - 5x^{\frac{1}{2}} - 3x^{-1}$ ✓ $28x^3$ ✓ $-\frac{5}{2}x^{-\frac{1}{2}}$ ✓ $+3x^{-2}$ (4)
6.3	$g(x) = ax^3 - 24x + b$ $g'(x) = 3ax^2 - 24$ $0 = 3ax^2 - 24$	<ul style="list-style-type: none"> ✓ 1st derivative of g

	$0 = 3a(-2)^2 - 24$ $12a = 24$ $a = 2$ $17 = 2(-2)^3 - 24(-2) + b$ $17 = -16 + 48 + b$ $b = -15$	✓ equating 1 st derivative to 0 and substituting $x = -2$ ✓ Answer for a ✓ substituting $x = -2$ and $y=17$ into g ✓ Answer for b (5)
		[13]
QUESTION	CALCULATION	MARK ALLOCATION
7.1.1	$f(x) = -2x^3 + 5x^2 + 4x - 3$ $0 = (x - 3)(-2x^2 - x + 1)$ $x - 3 = 0 \text{ or } -2x^2 - x + 1 = 0$ $x = 3 \text{ or } 2x^2 + x - 1 = 0$ $(3; 0) \quad (2x - 1)(x + 1) = 0$ $2x - 1 = 0 \text{ or } x + 1 = 0$ $x = \frac{1}{2} \text{ or } x = -1$ $\left(\frac{1}{2}; 0\right) \quad (-1; 0)$	✓ $-2x^2 - x + 1$ ✓ (3; 0) ✓ factors or formula ✓ both coordinates $\left(\frac{1}{2}; 0\right) \quad (-1; 0)$ (4)
7.1.2	$f(x) = -2x^3 + 5x^2 + 4x - 3$ $f'(x) = -6x^2 + 10x + 4$ $3x^2 - 5x - 2 = 0$ $(3x + 1)(x - 2) = 0$ $x = -\frac{1}{3} \text{ or } x = 2$	✓ $-6x^2 + 10x + 4$ ✓ equating 1 st derivative to 0 ✓ factors or formula ✓ Answers (4)
7.1.3	$f'(x) = -6x^2 + 10x + 4$ $f''(x) = -12x + 10$ $0 = -12x + 10$ $12x = 10$ $x = \frac{5}{6}$ $\therefore x < \frac{5}{6}$	✓ 2 nd derivative ✓ Answer (2)

7.2.1		✓ form ✓ both x -intercepts ✓ x -value of both turning points ✓ x -value of point of inflection (4)
7.2.2	$x < -2 \text{ or } x > 2; \quad x \neq 4$	✓ $x < -2$ ✓ $x > 2$ ✓ $x \neq 4$ (3)
		[17]
QUESTION	CALCULATION	MARK ALLOCATION
8.1	$s(t) = t^2 + 15t$ $v = s'(t) = (2t + 15)m/s$	✓✓ Answer (2)
8.2	$v = s'(t) = (2t + 15)m/s$ $v = s'(25) = 2(25) + 15 = 65m/s$	✓✓CA Answer (2)
8.3	$v = s'(t) = (2t + 15)m/s$ $a = s''(t) = 2m/s^2$	✓ Answer (1)
8.4	$a = s''(t) = 2m/s^2$	✓ Answer (1)
8.5	$s(t) = t^2 + 15t = 250$ $t^2 + 15t - 250 = 0$ $(t + 25)(t - 10) = 0$ $t = -25 \text{ or } t = 10$ $\therefore t = 10s$ $v = s'(t) = 2(10) + 15 = 35m/s$	✓ Equating $s(t) = 250$ ✓ Factors ✓ $t = 10s$ ✓ Answer (4)
		[10]
QUESTION	CALCULATION	MARK ALLOCATION

9.1	<p style="text-align: right;">$S = 135$</p>	✓12 ✓5; 12; 24 ✓ $2y+3$; y ; y ✓ x (4)
9.2	$2y + 3 + 5 + x + 12 = 5 + x + 24 + y$ $y = 16$ $x + y + 5 + 24 = 60$ $x + 16 + 5 + 24 = 60$ $x = 15$	✓✓Equate expressions for Maths and Accounting ✓Answer for y ✓Answer for x (4)
9.3	$P(M \text{ or } P \text{ and } A) = \frac{2y + 3 + 5 + 12 + x + 24}{135}$ $= \frac{32 + 3 + 5 + 12 + 12 + 24}{135}$ $= \frac{91}{135} \quad \text{or} \quad 0,67$	✓ $2y + 3 + 5 + 12$ ✓ $x+24$ ✓Answer (3)
		[12]

TOTAL: 150