



Province of the
EASTERN CAPE
EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

MATHEMATICS – FIRST PAPER

NOVEMBER 2009

MEMORANDUM

MARKS: 150

TIME: 3 hours

This memorandum consists of 13 pages.

QUESTION 1			
1.1.1	$\frac{x}{2x+1} = \frac{2}{x+3}$		
	$x(x+3) = 2(2x+1)$	✓ cross multiplication	
	$x^2 + 3x = 4x + 2$	✓ simplification	
	$x^2 - x - 2 = 0$	✓ standard form	
	$(x-2)(x+1) = 0$	✓ factors	
	$x = 2$ or $x = -1$	✓ both solutions	(5)
1.1.2	$(x-3)(2x+1) = 5$		
	$2x^2 - 5x - 3 = 5$		
	$2x^2 - 5x - 8 = 0$	✓ standard form	
	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	✓ formula	
	$= \frac{-(-5) \pm \sqrt{(-5)^2 - 4(2)(-8)}}{2(2)}$	✓ substitution	
	$= \frac{5 \pm \sqrt{89}}{4}$		
	$= 3,61$ or $-1,11$	✓✓ answers	(5)
1.1.3	$2x - 2 < -3x^2 - 6x - 6$		
	$3x^2 + 8x + 4 < 0$	✓ standard form	
	$(3x+2)(x+2) < 0$	✓ factors	
	$-2 < x < -\frac{2}{3}$	✓✓ answer	(4)
1.2	$r = 2$	✓ value of r	
	$s = -7$	✓ value of s	
	$t = 3$	✓ value of t	(3)
1.3	OPTION 1:		
	$2x = y - 8 \dots\dots\dots(1)$		
	$y + 16 = 2x^2 + 10x \dots\dots\dots(2)$		
	$y = 2x + 8 \dots\dots\dots(3)$	✓ making y the subject	
	Substitute (3) into (2):		
	$2x + 8 + 16 = 2x^2 + 10x$	✓ substitution	
	$2x^2 + 8x - 24 = 0$		
	$x^2 + 4x - 12 = 0$	✓ standard form	
	$(x+6)(x-2) = 0$	✓ factors	
	$x = -6$ or $x = 2$	✓ answers	

	Substitute $x = -6$ into (3):		
	$y = 2(-6) + 8$		
	$y = -4$	✓ y-value	
	Substitute $x = 2$ into(3):		
	$y = 2(2) + 8$		
	$y = 12$	✓ y-value	
	<u>OPTION 2:</u>		
	$2x = y - 8 \dots\dots\dots(1)$		
	$y + 16 = 2x^2 + 10x \dots\dots\dots(2)$		
	$x = \frac{y}{2} - 4 \dots\dots\dots(3)$	✓ making x the subject	
	Substitute (3) into (2):		
	$y + 16 = 2\left(\frac{y}{2} - 4\right)^2 + 10\left(\frac{y}{2} - 4\right)$	✓ substitution	
	$y + 16 = 2\left(\frac{y^2}{4} - 4y + 16\right) + 5y - 40$		
	$y + 16 = \frac{y^2}{2} - 8y + 32 + 5y - 40$		
	$2y + 32 = y^2 - 16y + 64 + 10y - 80$		
	$y^2 - 8y - 48 = 0$	✓ standard form	
	$(y - 12)(y + 4) = 0$	✓ factors	
	$y = 12$ or $y = -4$	✓ answers	
	Substitute $y = 12$ into (3):		
	$x = \frac{12}{2} - 4$		
	$x = 2$	✓ x-value	
	Substitute $y = -4$ into (3):		
	$x = \frac{-4}{2} - 4$		
	$x = -6$	✓ x-value	(7)
			[24]

QUESTION 2			
2.1	$\sqrt{\frac{2^{x+2} + 2^x}{2^{x-3}} + 9}$		
	$= \sqrt{\frac{2^x(2^2 + 1)}{2^x \cdot 2^{-3}} + 9}$	✓ common factor	
	$= \sqrt{5 \cdot 2^3 + 9}$	✓ simplification	
	$= \sqrt{40 + 9}$		
	$= \sqrt{49}$	✓ simplification	
	$= 7$	✓ answer	(4)
2.2.1	$x = 0$	✓ answer	(1)
2.2.2	$2x + 4 < 0$	✓ method	
	$x < -2$	✓ answer	(2)
2.3	Hypotenuse = $\sqrt{(\sqrt{5} + 1)^2 + (\sqrt{5} - 1)^2}$	✓ method	
	$= \sqrt{5 + 2\sqrt{5} + 1 + 5 - 2\sqrt{5} + 1}$	✓ simplification	
	$= \sqrt{12}$	✓ simplification	
	$= 2\sqrt{3}$	✓ answer	(4)
			[11]

QUESTION 3			
3.1.1	-5 ; -9	✓✓ answers	(2)
3.1.2	$a + b = 7 \dots\dots\dots(1)$		
	$2a + b = 3 \dots\dots\dots(2)$		
	$-a + \quad = 4 \dots\dots\dots(1) - (2)$		
	$a = -4$	✓ value of a	
	Substitute $a = -4$ into (1)		
	$b = 7 + 4$		
	$b = 11$	✓ value of b	
	$T_n = -4n + 11$	✓ answer	(3)
3.1.3	$T_{11} = -4(11) + 11$	✓ substitution into T_n	
	$= -33$	✓ answer	(2)
3.1.4	$T_n = -4n + 11$	✓ substitution into T_n	
	$-233 = -4n + 11$		
	$-244 = -4n$		
	$61 = n$	✓ answer	
	$T_{61} = -233$		(2)
3.2.1	1 ; 2 ; 4 ; 8 ; ...	✓✓✓✓ answers	(4)
3.2.2	15	✓ answer	(1)
3.2.3	$2^{n-1} = 64$	✓ substitution	
	$2^{n-1} = 2^6$	✓ simplification	
	$n - 1 = 6$		
	$n = 7$	✓ answer	
	$T_7 = 64$		(3)
			[17]

QUESTION 4			
4.1	1 ; 3 ; 6 ; 10...		
	1 st difference : 2 ; 3 ; 4		
	2 nd difference : 1 ; 1	✓ answer	(1)
4.2	<u>OPTION 1</u> $2a = 1$		
	$\therefore a = \frac{1}{2}$	✓ value of a	
	$T_n = an^2 + bn + c$		
	Substitute $a = \frac{1}{2}$ into T_n $T_n = \frac{1}{2}n^2 + bn + c$	✓ substitution	
	$\frac{1}{2} + b + c = 1$ $b + c = \frac{1}{2} \dots\dots\dots(1)$	✓ method	
	$\frac{1}{2}(4) + 2b + c = 3$ $2b + c = 1 \dots\dots\dots(2)$		
	$(2) - (1) \quad b = \frac{1}{2}$	✓ value of b	
	Substitute $b = \frac{1}{2}$ into (2) $2(\frac{1}{2}) + c = 1$		
	$c = 0$	✓ value of c	
	$T_n = \frac{1}{2}n^2 + \frac{1}{2}n$	✓ answer	
	<u>OPTION 2</u>		
	$a + b + c = 1 \dots\dots\dots(1)$	✓ method	
	$4a + 2b + c = 3 \dots\dots\dots(2)$		
	$9a + 3b + c = 6 \dots\dots\dots(3)$		
	$(2) - (1) \quad 3a + b = 2$		
	$(3) - (2) \quad \underline{5a + b = 3}$		
	$-2a = -1$		
	$\therefore a = \frac{1}{2}$	✓ value of a	
	Substitute $\therefore a = \frac{1}{2}$ into $3a + b = 2$		
	$3(\frac{1}{2}) + b = 2$	✓ substitution	

	$\therefore b = \frac{1}{2}$	✓ value of b	
	Substitute $a = \frac{1}{2}$ and $b = \frac{1}{2}$ into (1)		
	$\frac{1}{2} + \frac{1}{2} + c = 1$		
	$c = 0$	✓ value of c	
	$T_n = \frac{1}{2}n^2 + \frac{1}{2}n$	✓ answer	
	OPTION 3		
	Let T_n be the nth terms of the sequence.		
	$T_2 - T_1 = 2$	✓ method	
	$T_3 - T_2 = 3$		
	$T_4 - T_3 = 4$		
	$T_n - T_{n-1} = \dots\dots\dots$		
	Add both sides		
	$T_n - T_1 = 2 + 3 + 4 + \dots\dots(n-1)$ terms	✓ method	
	$T_n - 1 = \frac{(n-1)}{2} [2(2) + (n-2)1]$	✓ substitution	
	$T_n - 1 = 2(n-1) + \frac{(n-1)(n-2)}{2}$	✓ simplification	
	$T_n = 2(n-1) + \frac{n^2 - 3n + 2}{2} + 1$	✓ simplification	
	$T_n = 2n - 2 + \frac{n^2}{2} - \frac{3n}{2} + 1 + 1$		
	$T_n = \frac{n^2}{2} + \frac{n}{2}$	✓ answer	(6)
4.3	$T_n = \frac{1}{2}n^2 + \frac{1}{2}n$		
	$231 = \frac{1}{2}n^2 + \frac{1}{2}n$	✓ substitution	
	$0 = n^2 + n - 462$	✓ standard form	
	$0 = (n - 21)(n + 22)$	✓ factors	
	$n = 21$ or $n = -22$		
	21 cans in the bottom layer.	✓ answer	(4)
			[11]

QUESTION 5			
5.1	Loan Account = R160 000 – R50 000 = R110 000	✓ answer	
	$A = P(1 + i)^n$	✓ formula	
	$= 110\,000\left(1 + \frac{0,1}{12}\right)^{36}$	✓ i ✓ n	
	= R148 300	✓ answer	
	Monthly instalment = $\frac{148\,300}{36}$		
	= R4 119,44	✓ answer	(6)
5.2	$A = P(1 - i)^n$	✓ formula	
	$1000 = 4800(1 - i)^5$	✓ substitution	
	$\sqrt[5]{\frac{1000}{4800}} - 1 = -i$	✓ simplification	
	-0,269278.... = -i		
	i = 0,269278.....	✓ simplification	
	r = 26,93%	✓ answer	(5)
5.3.1	$A = P(1 + i)^n$	✓ formula	
	Last 2 years: $P = \frac{45\,000}{\left(1 + \frac{0,11}{12}\right)^{24}}$	✓ substitution	
	P = R36 149,56	✓ answer	
	1 st year: $P = \frac{36\,149,56}{\left(1 + \frac{0,095}{4}\right)^4}$	✓ substitution	
	P = R32 909,96	✓ answer	
	Vuyo invested R32 909,96	Answer only – full marks	(5)
5.3.2	$i = \left(1 + \frac{i}{m}\right)^m - 1$	✓ formula	
	$= (1 + 0,02375)^4 - 1$	✓ substitution	
	= 0,098438279		
	r = 9,84 %	✓ answer	(3)
			[19]

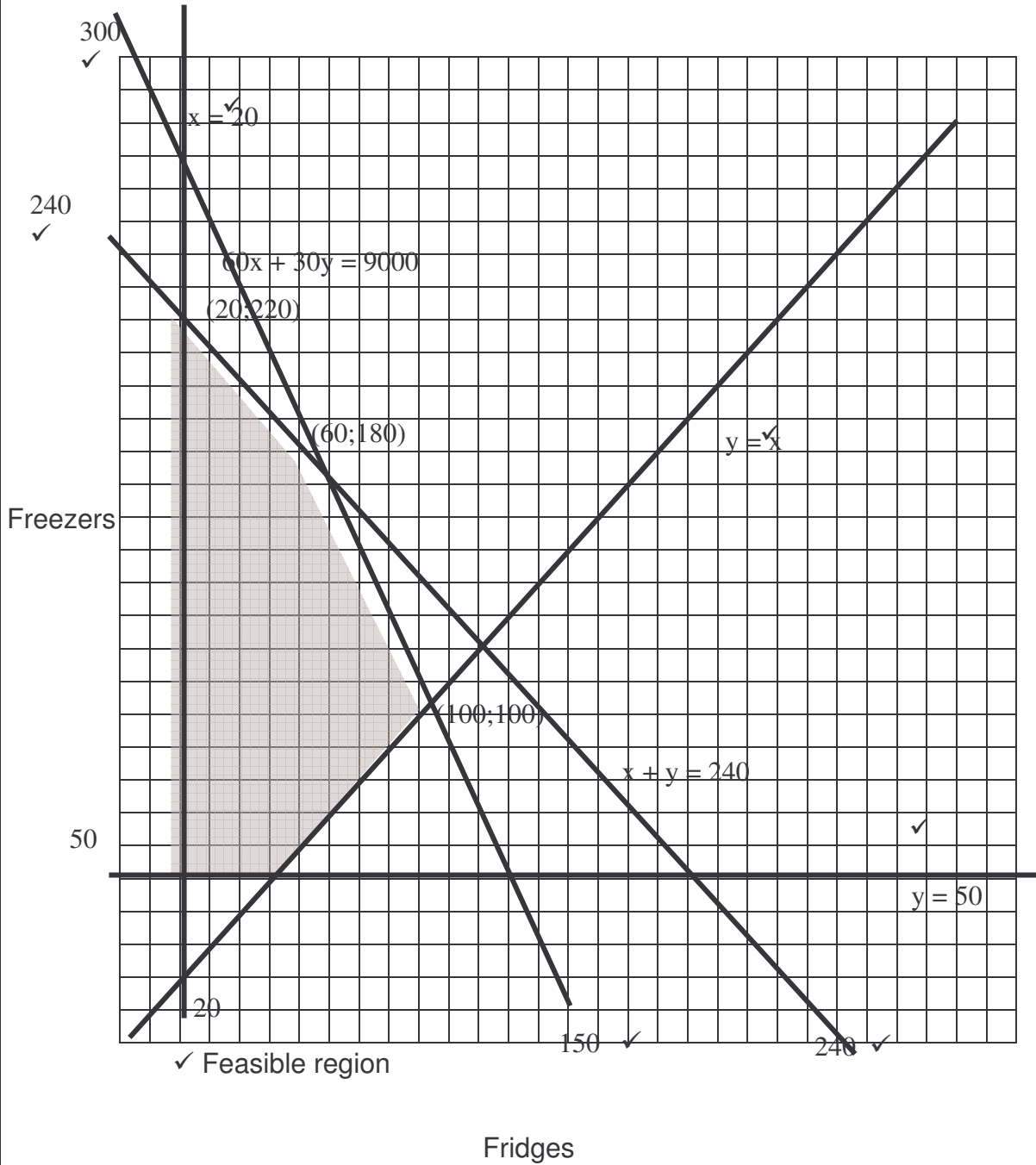
QUESTION 6			
6.1.1	$f(x) = b^x + c$ (0 ; -3)		
	$-3 = b^0 + c$	✓ substitution	
	$-3 = 1 + c$		
	$c = -4$		
	Equation of asymptote: $y = -4$	✓ answer	(2)
6.1.2	$f(x) = b^x + c$ (2 ; 5)	✓ substitution of (2 ; 5)	
	$5 = b^2 - 4$		
	$b^2 = 9$	✓ simplification	
	$b = 3$		
	$f(x) = 3^x - 4$	✓ answer	(3)
6.2	$f(-5) = 3^{-5} - 4$	✓ substitution	
	$= -3,996$	✓ answer	(2)
6.3	Shift f 4 units vertically upwards	✓ answer	(1)
6.4	$k(x) = 3^{-x}$ or $k(x) = b^{-x}$	✓ answer	(1)
6.5	$x = -2$	✓ answer	
	$y = -1$	✓ answer	(2)
6.6	$g(x) = \frac{a}{x+2} - 1$		
	$-3 = \frac{a}{2} - 1$ A(0 ; -3)	✓ substitution	
	$-6 = a - 2$		
	$a = -4$	✓ value of a	
	$g(x) = \frac{-4}{x+2} - 1$	✓ answer	(3)
6.7	$g(x) = \frac{-4}{x+2} - 1$ C(x ; -2)		
	$-2 = \frac{-4}{x+2} - 1$	✓ substitution	
	$-1 = \frac{-4}{x+2}$		
	$-x - 2 = -4$	✓ simplification	
	$-x = -2$		
	$x = 2$	✓ answer	(3)
			[17]

QUESTION 7			
7.1	$f(x) = x^2 - 4x - 5$		
	$= x^2 - 4x + 4 - 4 - 5$	✓ add / subtract 4	
	$= (x - 2)^2 - 9$	✓✓ factorise / simplify	(3)
	∴ TP (2 ; -9)		
7.2	$x = 2$	✓ answer	(1)
7.3	(4 ; -9)	✓✓ coordinates	(2)
7.4	C(0 ; -5)	✓ answer	(1)
7.5	Ave grad = $\frac{f(x_2) - f(x_1)}{x_2 - x_1}$	✓ formula	
	$= \frac{-5 + 8}{0 - 1}$	✓✓ $f(1) = 8$ and substitution	
	$= -3$	✓ answer	(4)
7.6	$f(x) = x^2 - 4x - 5$		
	$0 = x^2 - 4x - 5$	✓ $f(x) = 0$	
	$0 = (x - 5)(x + 1)$	✓ factors	
	$x = 5$ or $x = -1$	✓ both x values	
	B(5 ; 0)	✓ coordinates of B	(4)
7.7	B(5 ; 0) and C(0 ; -5)		
	$m = 1$	✓ value of m	
	$k = -5$	✓ value of k	(2)
7.8	$f(x) = x^2 - 4x - 5$ and $g(x) = x - 5$		
	FD = $x - 5 - x^2 + 4x + 5$	✓ method	
	$= -x^2 + 5x$	✓ simplification	
	Substitute $x = 2$ into FD		
	FD = $-(2)^2 + 5x$	✓ substitution	
	$= -4 + 10$		
	$= 6$	✓ answer	(4)
7.9	$k > 9$	✓✓ answer	(2)
			[23]

QUESTION 8			
8.1	a = 3	✓ answer	
	b = 2	✓ answer	
	c = 2	✓ answer	
	d = 3	✓ answer	(4)
8.2	$-4 \leq y \leq 2$	✓✓ answer	(2)
8.3	120°	✓ answer	(1)
8.4	$x \in (-45^\circ ; 45^\circ)$	✓✓ answer	(2)
			[9]

QUESTION 9		
9.1	$x + y \leq 240$	✓ inequality
	$x \geq 20$	✓ inequality
	$y \geq 50$	✓ inequality
	$60x + 30y \leq 9000$	✓ inequality
	$y \geq x$	✓ inequality
		(5)

9.2



(8)

<u>OPTION 1:</u>			
9.3	$P = 120x + 90y$	✓ profit	
	Points	Profit	
	(20 ; 220)	R22 200	✓ substitution
	(60 ; 180)	R23 400	✓ substitution
	(100 ; 100)	R21 000	✓ substitution
	For maximum profit:		
	60 fridges and 180 freezers	✓✓ answers	
<u>OPTION 2:</u>			
	$P = 120x + 90y$	✓ profit	
	$m = -\frac{4}{3}$	✓ gradient	
	Search line in optimum position	✓✓	
	For maximum profit		
	60 fridges and 180 freezers	✓✓ answers	
<u>OPTION 3:</u>			
	$P = 120x + 90y$ plus answer only	Full marks	(6)
			[19]
		TOTAL:	150