Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

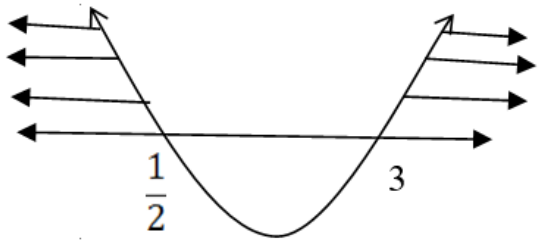
SEPTEMBER 2018

TECHNICAL MATHEMATICS P1
MARKING GUIDELINE

MARKS: 150

This marking guideline consists of 15 pages.

QUESTION 1

1.1	1.1.1	$x(x–3)$ $x = 0$ or $x = 3$	✓ $x = 0$ ✓ $x = 3$	(2)
	1.1.2	$3x^2 - 2x - 10 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(3)(-10)}}{2(3)}$ $x = \frac{2 \pm \sqrt{(-2)^2 - 4(3)(-10)}}{2(3)}$ $x = 2,2$ or $x = -1,5$ **-1 Mark for incorrect rounding**	✓Formula ✓Substitution ✓ $x = 2,2$ ✓ $x = -1,5$	(4)
	1.1.3	$2x^2 - 7x + 3 \geq 0$ $(2x–1)(x– 3) < 0$ Critical values : $x = \frac{1}{2}$ or $x = 3$  $x \leq \frac{1}{2}$ or $x \geq 3$	✓Critical values ✓$x \leq \frac{1}{2}$ ✓ $x \geq 3$	(3)
1.2		$\frac{x^2 - 4}{x + 2}$ $= \frac{(x + 2)(x - 2)}{x + 2}$ $= x - 2$ $= 2\,000\,000\,000\,002 - 2$ $= 2\,000\,000\,000\,000$ $= 2 \times 10^{12}$	✓Factors ✓Substitution ✓ 2×10^{12}	(3)

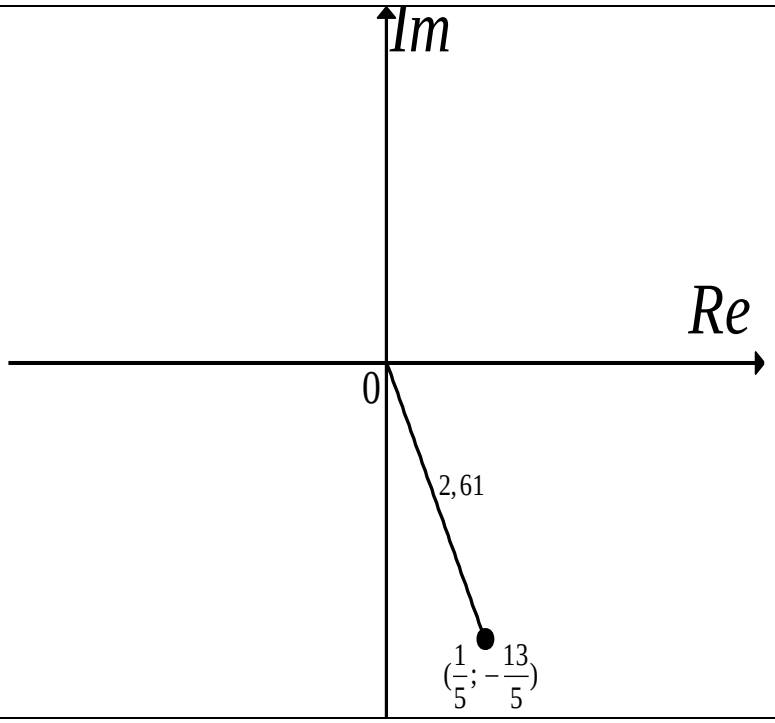
1.3	$2y + x = 3$ .....(1) $y = x^2 - x$ .....(2) Substitute (2) into (1): $2(x^2 - x) + x = 3$ $2x^2 - 2x + x - 3 = 0$ $2x^2 - x - 3 = 0$ $x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(2)(-3)}}{2(2)}$ $x = -1$ or $x = \frac{3}{2}$ $y = (1)^2 - (1)$ or $y = \left(\frac{3}{2}\right)^2 - \left(\frac{3}{2}\right)$ $y = 0$ or $y = \frac{3}{4}$	✓Substitution ✓STD form ✓Substitution ✓$x = -1$ ✓ $x = \frac{3}{2}$ ✓ $y = 0$ or $y = \frac{3}{4}$	
	OR $2y + x = 3$ .....(1) $y = x^2 - x$ .....(2) Substitute (2) into (1): $2(x^2 - x) + x = 3$ $2x^2 - 2x + x - 3 = 0$ $2x^2 - x - 3 = 0$ $(x + 1)(2x - 3) = 0$ $x = -1$ or $x = \frac{3}{2}$ $y = (1)^2 - (1)$ or $y = \left(\frac{3}{2}\right)^2 - \left(\frac{3}{2}\right)$ $y = 0$ or $y = \frac{3}{4}$	**OR** ✓Substitution ✓STD form ✓Factors ✓$x = -1$ ✓ $x = \frac{3}{2}$ ✓ $y = 0$ or $y = \frac{3}{4}$	(6)
1.4	$b^2 - 4ac < 0$ $(-3)^2 - 4(2)p < 0$ $9 - 8p < 0$ $p > \frac{9}{8}$	✓ $b^2 - 4ac < 0$ ✓Substitution ✓ $p > \frac{9}{8}$	(3)
			[21]

QUESTION 2

2.1				
	2.1.1	$\frac{\sqrt{-18}.\sqrt{-12}}{\sqrt{-6}} = \frac{\sqrt{-3^2.2}.\sqrt{-2^2.3}}{\sqrt{-2.3}}$ $= \frac{3i.\sqrt{2}.2\sqrt{3i}}{\sqrt{2}.\sqrt{3i}}$ $= 6i$	✓Prime factors ✓ $i = \sqrt{-1}$ ✓ $6i$	
		OR $\frac{\sqrt{-18}.\sqrt{-12}}{\sqrt{-6}} = \frac{\sqrt{-6.3}.\sqrt{-4.3}}{\sqrt{-6}}$ $= \sqrt{3}.2i\sqrt{3}$ $= 6i$	**OR** ✓Prime factors ✓ $i = \sqrt{-1}$ ✓ $6i$	(3)
	2.1.2	$\log 6 + 2\log 20 - \log 3 - 3\log 2$ $\log 6 + \log(20)^2 - \log 3 - \log 2^2$ $= \log 6 + \log 400 - \log 3 - \log 8$ $= \log\left(\frac{6 \times 400}{3 \times 8}\right)$ $= \log 100$ $= \log 10^2$ OR $= \log(10 \times 10) = \log 10 + \log 10$ $= 2$	✓Power law ✓Addition law ✓Subtraction law ✓Same base law ✓2	(5)
2.2				
	2.2.1	$\sqrt{\frac{5^{x+1} - 5^x}{5^{x-1}}} + 5 = 5$ $L.H.S = \sqrt{\frac{5^x.5^1 - 5^x}{5^x.5^{-1}}} + 5$ $= \sqrt{\frac{5^x(5^1 - 1)}{5^x.5^{-1}}} + 5$ $= \sqrt{\frac{5 - 1}{5^{-1}}} + 5$ $= \sqrt{4.5} + 5$ $= \sqrt{25}$ $= 5$ $= R.H.S$	✓Power rule ✓Factors ✓Simplification ✓ $\sqrt{25}$	(4)

	2.2.2	$\sqrt{\frac{5^{x+1}-5^{x}}{5^{x-1}}+5}=\left(\frac{1}{5}\right)^{x-2}$ $5=\left(\frac{1}{5}\right)^{x-2}$ $5=\left(5^{-1}\right)^{x-2}$ $5=5^{-x+2}$ $1=-x+2$ $x=1$	✓Substitute 5 ✓Powers with base 5 ✓Same base rule ✓$x=1$	
		OR $\sqrt{\frac{5^{x+1}-5^{x}}{5^{x-1}}+5}=\left(\frac{1}{5}\right)^{x-2}$ $5=\left(\frac{1}{5}\right)^{x-2}$ $5=\frac{1}{5^{x-2}}$ $5^{x-2+1}=1$ $5^{x-2+1}=5^{0}$ $x-1=0$ $x=1$	**OR** ✓Substitute 5 ✓Zero exponent rule ✓$x=1$	(4)
	2.2.3	$4\log_2 x-1=\log_2 8$ $4\log_2 x=\log_2 8+\log_2 2$ $\log_2 x^4=\log_2 16$ $x^4=16$ $x^4=2^4$ $x=2$	✓$1=log_2 2$ ✓Simplification ✓Equal base *logs* ✓$x=2$	
		O R $4\log_2 x-1=\log_2 2^3$ $\log_2 x^4-1=3\log_2 2$ $\log_2 x^4=3+1=4$ $x^4=2^4$ $x=2$	**OR** ✓Power rule ✓$1=log_2 2$ ✓Exponential form ✓$x=2$	(4)
				[20]

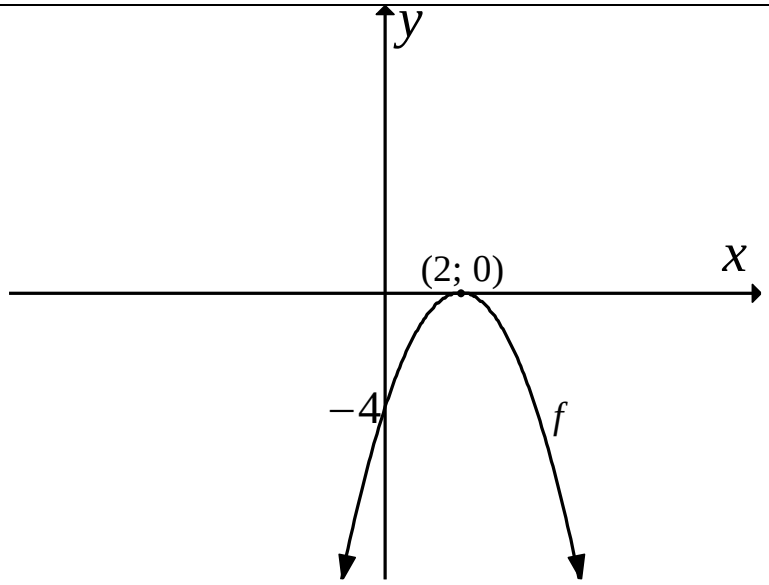
QUESTION 3				
3.1	3.1.1	$z_5 = z_1 + z_2$ $= 2+3i+(-3-2i)$ $= -1 + i$	✓-1 Real part ✓ i Imaginary part	(2)
	3.1.2	$z_6 = z_5 \times z_3$ $= (-1 + i)(-4 + i)$ $= 4 - i - 4i + i^2$ $=3 - 5i$	✓Expansion ✓$3 - 5i$	(2)
	3.1.3	$\text{Output} = \frac{z_6}{z_4} = \frac{3-5i}{2+i}$ $= \frac{3-5i}{2+i} \times \frac{2-i}{2-i}$ $= \frac{6-3i-10i+5i^2}{4-i^2}$ $= \frac{1-13i}{5}$ $= \frac{1}{5} - \frac{13i}{5}$	✓Conjugate product ✓Expansion ✓Simplification ✓$\frac{1}{5} - \frac{13i}{5}$	(4)
3.2	3.2.1	$\lvert\text{Output}\rvert = \sqrt{\left(\frac{1}{5}\right)^2 + \left(\frac{-13}{5}\right)^2}$ $= 2.61$	✓Substitution ✓|Output|	(2)

	3.2.2		✓Correct quadrant ✓Coordinates	(2)
	3.2.3	No, the learner did not manage to cut out a circular piece, because the modulus of the output is less than 5 and the quadrant of the argument of the output is in the fourth quadrant; so a square was cut.	✓Conclusion ✓Modulus and Argument	(2)
				[14]

QUESTION 4				
4.1	4.1.1	$A = P(1-i)^n$ $4\,000 = 12\,000(1-i)^{30}$ $i = 1 - \sqrt[30]{\frac{4000}{12000}}$ $= 1 - \left(\frac{1}{3}\right)^{\frac{1}{30}}$ $Rate = 3,6\%$	✓Formula ✓Substitution ✓$1 - \left(\frac{1}{3}\right)^{\frac{1}{30}}$ ✓$r = 3,6\%$	(4)
	4.1.2	$A = P(1-i)^n$ $A = 12\,000(1-0,036)^{60}$ $A = 1329.85$ Bacteria	✓Substitute A and i ✓Substitute n ✓$A = 1329.85$	(3)
4.2				
	4.2.1	18% of R600 000 = R108 000 Loan amount = R600 000 – R108 000 Loan amount = R492 000 **OR** Percentage loaned = 100% - 18% Percentage loaned = 82% Loan amount = 82% of R600 000 Loan amount = R492 600	✓11,9% of R600 000 ✓Loan amount **OR** ✓Percentage loaned ✓Loan amount	(2)
	4.2.2	$A = P(1+i)^n$ $1\,204\,860,32 = 492\,000\left(1 + \frac{0,15}{12}\right)^{12\times n}$ $12n = \log_{1,0125}\left(\frac{1\,204\,860,32}{492\,000}\right)$ $n = 6$ years	✓Formula ✓Substitution ✓Logarithm ✓$n = 6$ years	(4)
				[13]

QUESTION 5			
5.1	$q = 2$	✓Accurate answer	(1)
5.2	$0 = \frac{a}{-2} + 2$ $a = 4$	✓Substitution ✓$a = 4$	(2)
5.3	$x = 0$ and $y = 2$	✓Horizontal asymptote ✓Vertical asymptote	(2)
5.4	$x \in R$, but $x \neq 0$ or $x \in (-\infty; 0) \cup (0; \infty)$	✓Excluding $x = 0$ ✓x values	(2)
			[7]
QUESTION 6			
6.1	A (–2; 0) and B(2; 0)	✓ A (–2; 0) ✓ B (2; 0)	(2)
6.2	$2 = 2^0 + q$ $q = 1$	✓$q = 1$	(1)
6.3	$m = \frac{0-2}{2-0} = -1$ $c = 2$ $y = -x + 2$	✓$m = -x$ ✓$c = 2$	(2)
6.4	$-\frac{73}{50} < x < 0$ **OR** $x \in \left(-\frac{73}{50}; 0\right)$	✓Notation ✓Values	(2)
			[7]

QUESTION 7

7.1	$f(x) = -(x-2)^2 + 4$ $0 = -(x-2)^2 + 4$ $0 = [-(x-2)+2][(x-2)+2]$ $-(x-2)+2 = 0$ or $(x-2)+2 = 0$ $x = 4$ or $x = 0$ **OR** $0 = -(x-2)^2 + 4$ $(x-2)^2 = 4$ $x - 2 = \pm 2$ $x = 4$ or $x = 0$ **OR** $0 = -(x-2)^2 + 4$ $0 = -(x^2 - 4x + 4) + 4$ $0 = -x^2 + 4x$ $0 = -x(x-4)$ $x = 4$ or $x = 0$	✓ $f(x) = 0$ ✓Factors ✓ $x = 4$ or $x = 0$ **OR** ✓ $f(x) = 0$ ✓Square root both sides ✓ $x = 4$ or $x = 0$ **OR** ✓ $f(x) = 0$ ✓STD form ✓ $x = 4$ or $x = 0$	(3)
7.2	$f(x) = -(x-2)^2 + 4$ $y = -(0-2)^2 + 4$ $y = 0$	✓ $y = 0$	(1)
7.3	(2;4)	✓Each coordinate	(2)
7.4		✓Shape ✓*x*-intercepts ✓*y*-intercept ✓Turning point	(4)

7.5	$y < 4$ or $y \in (-\infty; 4)$	✓Accurate answer	(1)
7.6	(3;3)	✓x-coordinate ✓ y-coordinate	(2)
			[13]

QUESTION 8			
8.1	$f(1) = 2(1)^2 + (1) - 1 = 2$ $f(3) = 2(3)^2 + (3) - 1 = 20$ $\text{Average gradient} = \frac{f(3) - f(1)}{3 - 1}$ $\text{Average gradient} = \frac{20 - 2}{2}$ $= 9$	✓$f(1)$ ✓$f(3)$ ✓Average gradient formula ✓Substitution ✓Average gradient = 9	(5)
8.2	$f(x) = 3x$ $f'(x) = \lim_{x \to 0} \frac{f(x+h) - f(x)}{h}$ $f'(x) = \lim_{x \to 0} \frac{3(x+h) - 3x}{h}$ $f'(x) = \lim_{x \to 0} \frac{3h}{h}$ $f'(x) = 3$	✓Formula ✓Substitution ✓Simplification ✓ $f'(x) = 3$	(4)
	-1 Mark for incorrect notation in 8.2 or 8.3		
8.3			
8.3.1	$3x - 2y = \sqrt{x}$ $y = \frac{3x - \sqrt{x}}{2}$ $y = \frac{3x}{2} - \frac{x^{\frac{1}{2}}}{2}$ $\frac{dy}{dx} = \frac{3}{2} - \frac{x^{-\frac{1}{2}}}{4}$	✓$y = \frac{3x - \sqrt{x}}{2}$ ✓Exponential form ✓$\frac{3}{2}$ ✓$\frac{x^{-\frac{1}{2}}}{4}$	(4)

	8.3.2	$y = 6 - \frac{4}{\sqrt[3]{x}} + \frac{1}{x^4}$ $y = 6 - \frac{4}{x^{\frac{1}{3}}} + \frac{1}{x^4}$ $y = 6 - 4x^{-\frac{1}{3}} + x^{-4}$ $\frac{dy}{dx} = \frac{4}{3}x^{-\frac{4}{3}} - 4x^{-5}$ $\frac{dy}{dx} = \frac{4}{3x^{\frac{4}{3}}} - \frac{4}{x^5} = \frac{4}{3\sqrt[3]{x^4}} - \frac{4}{x^5}$	✓Exponential form ✓$\frac{4}{3}x^{-\frac{4}{3}}$ ✓$-4x^{-5}$ ✓$\frac{4}{3x^{\frac{4}{3}}} - \frac{4}{x^5}$ (positive exponents)	(4)
8.4	$g'(x) = 2x + 2 = -2$ $x = -4$ $g(-4) = (-4)^2 + 2(-4) - 3$ $g(-4) = 5$ $(-4;5)$	✓$g'(x)$ ✓$g'(x) = -2$ ✓$g(-4)$ ✓$(-4;5)$	(4)	
				[21]

QUESTION 9

Given $f(x) = (x-5)(x+1)^2$

9.1

$f(0) = (0-5)((0)+1)^2 = -5$

$(0; -5)$

✓$(0; -5)$ (1)

9.2

$f(5) = (5-5)(5+1)^2 = 0$

Then, (5; 0) is the x-intercept of f.

$(-1; 0)$ is the other x-intercept of f.

✓ $f(5) = 0$

✓ $(-1; 0)$

OR

$0 = (x-5)(x+1)^2$

$(x-5) = 0$ or $(x+1)^2 = 0$

$x = 5$ is the intercept of f

$(-1;0)$ is the other x-intercept of f.

OR

✓ $f(x) = 0$

✓ $(-1; 0)$ (2)

9.3

$f(x) = x^3 - 3x^2 - 9x - 5$

$f'(x) = 3x^2 - 6x - 9$

$0 = 3x^2 - 6x - 9$

$0 = x^2 - 2x - 3$

$0 = (x-3)(x+1)$

$x = 3$ or $x = -1$

$x = -1$;

$y = -1 - 3 + 9 - 5 = 0$

Turning point: $(-1; 0)$

$x = 3$;

$y = 27 - 27 - 27 - 5 = -32$

Turning point : $(3; -32)$

✓$3x^2 - 6x - 9$

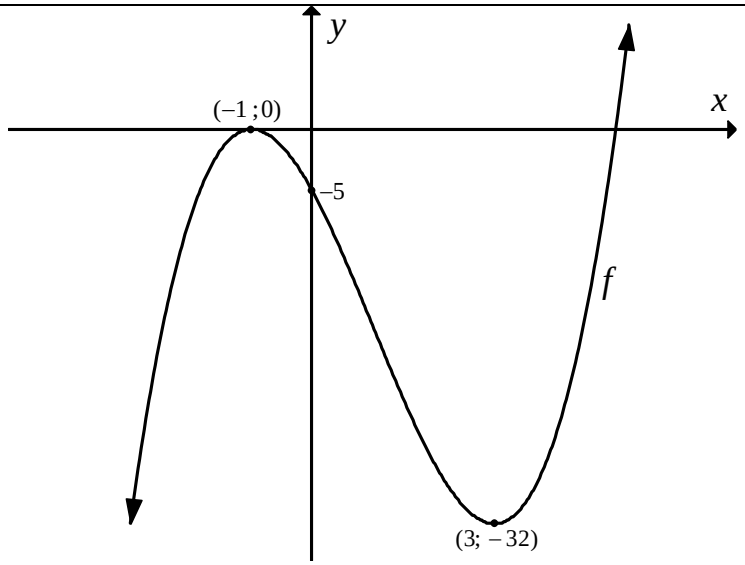
✓Factors

✓Both x values

✓$(-1; 0)$

✓ $(3; -32)$ (5)

9.4



✓Shape

✓x-intercepts

✓y-intercept = –5

✓Turning Point (–1; 0)

✓Turning Point (3; –32) (5)

			[13]

QUESTION 10

10.1	$A = 6 + 4t - t^2$ $A = 6 + 4(0) - (0)^2$ $A = 6\ \text{cm}^2$	✓Substitute 0 ✓ $A = 6\ \text{cm}^2$	(2)
10.2	$\frac{dA}{dt} = 4 - 2t$ Rate of increase in A at t =1: $= 4 - 2(1)$ $= 2\ \text{cm}^2$	✓$4 - 2t$ ✓Substitution by 1 ✓$2\ \text{cm}^2$	(3)
10.3	$\frac{dA}{dt} = 4 - 2t$ $\frac{dA}{dt} = 4 - 2t = 0$ $2t = 4$ $t = 2\ \text{seconds}$	✓$\frac{dA}{dt} = 0$ ✓t =2 seconds	(2)
10.4	$A = 6 + 4(2) - 2^2$ $= 10\ \text{cm}^2$	✓Substitution ✓ $A = 10\ \text{cm}^2$	(2)
			[9]

QUESTION 11			
11.1	$\int (2x - 4)\,dx$ $= x^2 - 4x + C$	✓ x^2 ✓ $-4x$ ✓ C	(3)
11.2	$A_1 = \int_1^3 (x^3 - 3x^2 - x + 3)\,dx$ $= \left[\frac{x^4}{4} - x^3 - \frac{x^2}{2} + 3x\right]_1^3$ $= \left[\frac{3^4}{4} - 3^3 - \frac{3^2}{2} + 3(3)\right] - \left[\frac{1^4}{4} - 1^3 - \frac{1^2}{2} + 3(1)\right]$ $= 4$ $A_2 = \int_{-1}^1 (x^3 - 3x^2 - x + 3)\,dx$ $= \left[\frac{x^4}{4} - x^3 - \frac{x^2}{2} + 3x\right]_{-1}^1$ $= \left[\frac{1^4}{4} - 1^3 - \frac{1^2}{2} + 3(1)\right] - \left[\frac{(-1)^4}{4} - (-1)^3 - \frac{(-1)^2}{2} + 3(-1)\right]$ $= 3,75$ $\therefore A_1 + A_2 = 4 + 3,75$ $= 7,75$ square units	✓A_1 definite integral formula ✓Simplify A_1 integral ✓Substitution in A_1 ✓A_1 value ✓A_2 definite integral formula ✓Substitution in A_2 ✓A_2 value ✓ $A_1 + A_2$ ✓7,75 square units	(9)
			[12]
		TOTAL:	**150**