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# Basic Education

KwaZulu-Natal Department of Education  
REPUBLIC OF SOUTH AFRICA

**MATHEMATICS P1**

**PREPARATORY EXAMINATION**

**SEPTEMBER 2016**

**MEMORANDUM**

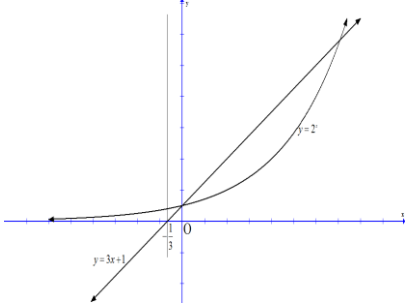
**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 12**

**MARKS: 150**

**This memorandum consists of 12 pages.**

**QUESTION 1**

1.1.1	$2x(3x-5) = 0$ $x = 0$ or $x = \frac{5}{3}$	AA✓✓ Answers	(2)
1.1.2	$x^2 - 3x = 7$ $x^2 - 3x - 7 = 0$ $x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(-7)}}{2(1)}$ $x = 4,54$ or $x = -1,54$	A✓ equation in std. form CA✓ substitution <div style="border: 1px solid black; padding: 2px; display: inline-block;">Penalise rounding off</div> CACA✓✓ answers	(4)
1.1.3	$2x - 5\sqrt{x} = 3$ $2x - 3 = 5\sqrt{x}$ $4x^2 - 12x + 9 = 25x$ $4x^2 - 37x + 9 = 0$ $(4x-1)(x-9) = 0$ $x = \frac{1}{4}$ or $x = 9$ n/a  <b>OR</b> $2x - 5x^{\frac{1}{2}} - 3 = 0$ $\left(2x^{\frac{1}{2}} + 1\right)\left(x^{\frac{1}{2}} - 3\right) = 0$ $x^{\frac{1}{2}} = \frac{-1}{2}$ or $x^{\frac{1}{2}} = 3$ No solution $x = 9$	A✓ isolating $5\sqrt{x}$ M✓ squaring both sides CA✓ standard form CA✓ factors CA✓ both answers CA✓ rejecting  A✓ standard form CA✓ factors CA✓ $x^{\frac{1}{2}} = \frac{-1}{2}$ CA✓ $x^{\frac{1}{2}} = 3$ CA✓ answer CA✓ rejecting	(6)
1.1.4	$2^x(3x+1) < 0$ $2^x > 0$ for all $x \in R$ $\therefore 3x+1 < 0$ $x < -\frac{1}{3}$ <b>OR [Graphically]</b>  $x < -\frac{1}{3}$	A✓ $2^x > 0$ for all $x \in R$ A✓ $3x+1 < 0$ A✓ $x < -\frac{1}{3}$  A✓ sketch of $y = 2^x$ A✓ sketch of $y = 3x+1$ A✓ $x < -\frac{1}{3}$	(3)

1.2	$2^{99} \cdot 2^1 - 2^{99}$ $2^{99} (2 - 1)$ $= 2^{99}$	M✓ for taking $2^{99}$ as a common factor A✓ $(2 - 1)$ A✓ answer	(3)
1.3	$2x - y = 3 \rightarrow (1)$ $x^2 + 5xy + y^2 = 15 \rightarrow (2)$ From (1) : $y = 2x - 3$ Subst. (1) into (2) $x^2 + 5x(2x - 3) + (2x - 3)^2 = 15$ $x^2 + 10x^2 - 15x + 4x^2 - 12x + 9 - 15 = 0$ $15x^2 - 27x - 6 = 0$ $(5x + 1)(3x - 6) = 0$ $x = \frac{-1}{5} \text{ or } x = 2$ $y = \frac{-17}{5} \text{ or } y = 1$ <b>OR</b> $2x - y = 3 \rightarrow (1)$ $x^2 + 5xy + y^2 = 15 \rightarrow (2)$ From (1) : $x = \frac{y + 3}{2}$ Subst. (1) into (2) $\left(\frac{y + 3}{2}\right)^2 + 5y\left(\frac{y + 3}{2}\right) + y^2 = 15$ $\left(\frac{y^2 + 6y + 9}{4}\right) + \frac{5y^2 + 15y}{2} + y^2 = 15$ $y^2 + 6y + 9 + 10y^2 + 30y + 4y^2 = 60$ $15y^2 + 36y - 51 = 0$ $5y^2 + 12y - 17 = 0$ $(5y + 17)(y - 1) = 0$ $y = \frac{-17}{5} \text{ or } y = 1$ $x = \frac{-1}{5} \text{ or } x = 2$	A✓ $y$ as subject CA✓ substitution $y = 2x - 3$  CA✓ std. form CA✓ factors CA✓ $x$ values CA✓ $y$ values  A✓ $x$ as subject  CA✓ substitution $x = \frac{y + 3}{2}$  CA✓ std. form CA✓ factors CA✓ $y$ values CA✓ $x$ values	(6)
			<b>[24]</b>

**QUESTION 2**

<p>2.1</p> <p><math>2a = 4</math> <math>a = 2</math> <math>3a + b = 0</math> <math>b = -6</math> <math>a + b + c = 4</math> <math>c = 8</math> <math>T_n = 2n^2 - 6n + 8</math></p> <p><b>OR</b></p> <p><math>2a = 4</math> <math>a = 2</math> <math>3a + b = 0</math> <math>b = -6</math> <math>T_0 = c = 8</math> <math>T_n = 2n^2 - 6n + 8</math></p> <p><b>OR</b></p> <p><math>T_n = T_1 + (n-1)d_1 + \frac{(n-1)(n-2)}{2}d_2</math> <math>= 4 + (n-1)(0) + \frac{(n-1)(n-2)}{2}(4)</math> <math>= 5 + 0 + 2n^2 - 6n + 4</math> <math>= 2n^2 - 6n + 8</math></p>	<p>A✓ <math>a</math> value CA✓ <math>b</math> value CA✓ <math>c</math> value CA✓ general term</p> <p>A✓ <math>a</math> value CA✓ <math>b</math> value CA✓ <math>c</math> value CA✓ general term</p> <p>A✓ formula A✓ substituting first and second difference values CA✓ simplifying CA✓ general term</p>	<p>(4)</p> <p>(4)</p> <p>(4)</p>
<p>2.2</p> <p><math>T_n = 4n - 4 = 28088</math> <math>4n = 28092</math> <math>n = 7023</math> Between the 7023<sup>rd</sup> and 7024<sup>th</sup> terms.</p> <p><b>OR</b></p> <p><math>T_n - T_{n-1} = 28088</math> <math>2n^2 - 6n + 8 - [2(n-1)^2 - 6(n-1) + 8] = 28088</math> <math>2n^2 - 6n + 8 - 2n^2 + 4n - 2 + 6n - 6 - 8 - 28088 = 0</math> <math>4n - 28096 = 0</math> <math>4n = 28096</math> <math>n = 7024</math> Between the 7023<sup>rd</sup> and 7024<sup>th</sup> terms.</p>	<p>A✓ <math>4n - 4</math> CA✓ <math>4n - 4 = 28088</math></p> <p>CA(<math>n \in \mathbb{N}</math>)✓ <math>n = 7023</math> CA✓ (<math>n \in \mathbb{N}</math>) conclusion</p> <p>A✓ <math>T_n - T_{n-1} = 28088</math></p> <p>CA✓ <math>4n - 28096 = 0</math></p> <p>CA✓ (<math>n \in \mathbb{N}</math>) <math>n = 7024</math> CA✓ (<math>n \in \mathbb{N}</math>) conclusion</p>	<p>(4)</p> <p>(4)</p>
		<p><b>[8]</b></p>

**QUESTION 3**

3.1.1	6 ; 2 ; 10 ; 2 ; 14 ; 2 ; ... 18 ; 2	AA✓✓ answers	(2)
3.1.2	$a = 2$ and is a constant sequence $\therefore S_{50} = 50 \times 2$ $= 100$	A✓ 100	(1)
3.1.3	$a = 6; d = 4; n = 50$ $S_{50} = \frac{50}{2}[2(6) + 4(50 - 1)]$ $= 5200$  $S_{100} = 5200 + 100$ $= 5300$	A✓ for $a, d$ and $n$ values  CA✓ for substitution into formula  CA✓ 5200  CA✓ answer	(4)
3.2	$S_n = a + ar + ar^2 + \dots + ar^{n-1} \rightarrow (1)$ $rS_n = ar + ar^2 + \dots + ar^n \rightarrow (2)$ (2) - (1): $rS_n - S_n = ar^n - a$ $S_n(r - 1) = a(r^n - 1)$ $\therefore S_n = \frac{a(r^n - 1)}{r - 1}$	A✓ for equation (1) A✓ for equation (2)  A✓ subtraction on LHS and RHS A✓ factorising  if $S_n = \frac{a(1 - r^n)}{1 - r}$ penalize 1 mark	(4)
			<b>[11]</b>

**QUESTION 4**

4.1	$a = 1 \quad r = \frac{2}{3}$  $S_\infty = \frac{a}{1 - r}$ $= \frac{1}{1 - \frac{2}{3}}$ $= 3$	A✓ $a$ and $r$ value  CA✓ substitution of $r$ into formula  CA✓ answer	(3)
4.2	$S_n = 3n^2 - n$ $T_4 = S_4 - S_3$ $= [3(4)^2 - (4)] - [3(3)^2 - (3)]$ $= 44 - 24$ $= 20$ <b>OR</b>	M✓ $T_4 = S_4 - S_3$  AA✓✓ substitution  A✓ answer	(4)

$S_1 = T_1 = a = 2$ $S_2 = T_1 + T_2 = 3(2)^2 - 2 = 10$ $T_2 = 10 - 2 = 8$ $S_3 = T_1 + T_2 + T_3 = 3(3)^2 - 3 = 24$ $T_3 = 24 - 8 - 2 = 14$ $d = 6$ $T_4 = a + 3d = 2 + 3(6) = 20$	A✓ $a$ value  A✓ second term value  CA✓ $d$ value CA✓ answer	(4)
		[7]

**QUESTION 5**

5.1	$A = P(1 - i)^n$ $A = 255000(1 - 0,125)^7$ $= R\ 100\ 137,46$	A✓ formula A✓ correct substitution  CA✓ answer	(3)
5.2.1	$A = P(1 + i)^n$ $= 10\ 000\left(1 + \frac{0,095}{12}\right)^5$ $= R10\ 402,15$	A✓ correct substitution into correct formula CA✓ answer	(2)
5.2.2	$P = \frac{x[1 - (1 + i)^{-n}]}{i}$ $10\ 402,15 = \frac{450\left[1 - \left(1 + \frac{0,095}{12}\right)^{-n}\right]}{\frac{0,095}{12}}$ $\frac{10\ 402,15 \times \frac{0,095}{12}}{450} = 1 - \left(1 + \frac{0,095}{12}\right)^{-n}$ $\left(1 + \frac{0,095}{12}\right)^{-n} = 0,816999213$ $-n = \frac{\log 0,816999213}{\log\left(1 + \frac{0,095}{12}\right)}$ $n = 25,6315128$ $\therefore n = 26 \text{ payments}$	CA✓ correct substitution of $P$ into formula  A✓ $x = 450$  CA✓ $n$ as subject  M✓ using logs  CA( $n \in \mathbb{N}$ )✓ answer	(5)

<p>5.2.3</p>	<p>Balance on Loan after the 25<sup>th</sup> payment</p> $= 10\,402,15 \left(1 + \frac{0,095}{12}\right)^{25} - \frac{450 \left[ \left(1 + \frac{0,095}{12}\right)^{25} - 1 \right]}{\frac{0,095}{12}}$ <p>= R12668,90 – R12386,54 = R282,36</p> <p><b>OR</b></p> $P = \frac{x[1 - (1+i)^{-n}]}{i}$ $= \frac{450 \left[ 1 - \left(1 + \frac{0,095}{12}\right)^{-0,6315128} \right]}{\frac{0,095}{12}}$ <p>= R282,36</p>	<p>M✓ (A - F<sub>v</sub>) formula A✓ n = 25 CA✓ 10 402,15 <math>\left(1 + \frac{0,095}{12}\right)^{25}</math> CA✓ <math>\frac{450 \left[ \left(1 + \frac{0,095}{12}\right)^{25} - 1 \right]}{\frac{0,095}{12}}</math></p> <p>CA✓ answer</p> <p><b>OR</b></p> <p>A✓ formula A✓ subst. 450 CA✓ subst <math>\frac{0,095}{12}</math> CA✓ subst 0,6315128 CA✓ answer</p>	<p>(5)</p> <p>(5)</p> <p>[15]</p>
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**QUESTION 6 (For learners who did not receive the errata and used P(-4;4) , should be marked accordingly)**

<p>6.1</p>	<p><math>p = -3</math> <math>q = -2</math></p>	<p>A✓ p value A✓ q value</p>	<p>(2)</p>
<p>6.2</p>	<p><math>h(x) = \frac{a}{x+p} + q</math>. P(4;-4) is a point on h <math>-4 = \frac{a}{4-3} - 2</math> <math>\therefore a = -2</math></p>	<p>CA✓ subst. p, q and point P CA(negative)✓ a value</p>	<p>(2)</p>
<p>6.3</p>	<p><math>h(x) = \frac{-2}{x-3} - 2</math> <math>h(0) = \frac{-2}{0-3} - 2</math> <math>= -1\frac{1}{3}</math> <math>\left(0; -1\frac{1}{3}\right)</math></p>	<p>A✓ substituting x = 0 CA(negative)✓ answer</p>	<p>(2)</p>
<p>6.4</p>	<p><math>x = 1</math></p>	<p>CACA✓✓ answer</p>	<p>(2)</p>



<p>6.5</p> <p><math>y = -(x + p) + q</math>  <math>y = -(x - 3) - 2</math>  <math>y = -x + 1</math>  <math>\therefore c = 1</math></p> <p><b>OR</b></p> <p><math>y = -x + c</math>  <i>Point of intersection of asymptotes</i> (3 ; -2)  <math>-2 = -3 + c</math>  <math>c = 1</math></p>		<p>CA✓ substitution of <math>p</math> and <math>q</math> values into equation of line of symmetry</p> <p>CA✓ answer</p> <p>CA✓ substitution of (3 ; -2) into equation of line of symmetry</p> <p>CA✓ answer</p>	<p>(2)</p> <p>(2)</p>
			<b>[10]</b>

**QUESTION 7**

<p>7.1</p>	<p>D(0 ; -10)</p>	<p>A(must be in coordinate form)✓ answer</p>	<p>(1)</p>
<p>7.2</p>	<p><math>x^2 - 3x - 10 = 0</math>  <math>(x + 2)(x - 5) = 0</math>  <math>x = -2</math> or <math>x = 5</math>  A(-2;0)  B(5;0)</p>	<p>A✓ <math>x^2 - 3x - 10 = 0</math>  CA✓ factors  CACA(negative and positive)✓✓  each <math>x</math> - value  A(-2;0)  B(5;0)</p>	<p>(4)</p>
<p>7.3</p>	<p><math>a = 2</math> and <math>q = -10</math></p>	<p>CA(positive)✓ <math>a</math> - value  A✓ <math>q</math> - value</p>	<p>(2)</p>
<p>7.4</p>	<p><math>x = -\frac{b}{2a} = -\frac{(-3)}{2(1)} = \frac{3}{2}</math> or <math>x = \frac{-2+5}{2} = \frac{3}{2}</math>  <math>y = \left(\frac{3}{2}\right)^2 - 3\left(\frac{3}{2}\right) - 10 = -\frac{49}{4} / -12,25 / -12\frac{1}{4}</math>  C(1,5 ; -12,25)</p>	<p>A✓ <math>x = -\frac{b}{2a} = -\frac{(-3)}{2(1)} = \frac{3}{2}</math>  or  CA✓ <math>x = \frac{-2+5}{2} = \frac{3}{2}</math>  CA✓ substitution  CA✓ minimum value</p>	<p>(3)</p>
<p>7.5</p>	<p>(-1,5 ; -9,25)</p>	<p>CA✓ <math>x</math> - value CA✓ <math>y</math> - value</p>	<p>(2)</p>
<p>7.6</p>	<p><math>x \geq \frac{3}{2}</math></p> <p><b>OR</b></p> <p><math>g'(x).h'(x) \geq 0</math>  <math>(2x - 3).2 \geq 0</math>  <math>x \geq \frac{3}{2}</math></p>	<p>CACA✓✓ answer</p> <p>CA✓ product of derivatives</p> <p>CA(positive)✓ answer</p> <p>penalize 1 mark for incorrect notation</p>	<p>(2)</p> <p>(2)</p>
			<b>[14]</b>

**QUESTION 8**

8.1	$y = \log_3 x$	AA✓✓ answer	(2)
8.2		A✓ Shape of $p$ and $p^{-1}$ A✓ $y$ – intercept of $p$ A✓ $x$ – intercept of $p^{-1}$ A✓ point on each graph	(4)
8.3	$\log_3 x = 3$ $x = 27$ $0 < x \leq 27$	M✓ setting up equation CA✓ $x = 27$ CACA✓✓ for end points and inequality ANSWER ONLY full marks	(4)
			<b>[10]</b>

**QUESTION 9 [Penalise once for notational error in questions 9, 10 and 11]**

9.1	$f(x) = x^3$ $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \rightarrow 0} \frac{(x+h)^3 - x^3}{h}$ $= \lim_{h \rightarrow 0} \frac{x^3 + 3x^2h + 3xh^2 + h^3 - x^3}{h}$ $= \lim_{h \rightarrow 0} \frac{h(3x^2 + 3xh + h^2)}{h}$ $= \lim_{h \rightarrow 0} (3x^2 + 3xh + h^2)$ $= 3x^2$	A✓ formula A✓ substitution into correct formula CA✓ simplifying CA✓ factors CA✓ answer	(5)
9.2.1	$f(x) = x^{\frac{1}{2}} - 4x^{-2}$ $f'(x) = \frac{1}{2}x^{-\frac{1}{2}} + 8x^{-3}$	AA✓✓ exponential form CACA✓✓ answer	(4)

<p>9.2.2</p>	$\left(\frac{1}{2}x^2 - 3\right)^2 = y$ $y = \frac{1}{4}x^4 - 3x^2 + 9$ $\frac{dy}{dx} = x^3 - 6x$ <p><b>OR</b></p> $\frac{dy}{dx} = 2\left(\frac{1}{2}x^2 - 3\right) \cdot x$ $= x^3 - 6x$	<p>A✓squaring both sides</p> <p>A✓simplifying</p> <p>CACA✓✓answers</p> <p><b>OR</b></p> <p>AA✓✓derivative using chain rule</p> <p>CACA✓✓answers</p>	<p>(4)</p> <p>(4)</p>
			<p><b>[13]</b></p>

**QUESTION 10**

<p>10.1.1</p>	$f(-3) = (-3)^2 - 8 = 1$	<p>A✓ <math>y = 1</math> ( <math>y</math> - value)</p>	<p>(1)</p>
<p>10.1.2</p>	$f'(x) = 2x$ $m = f'(-3) = 2(-3) = -6$	<p>A✓ value of gradient of tangent</p>	<p>(1)</p>
<p>10.1.3</p>	<p>Equation of tangent : -</p> $y = mx + c$ $1 = -6(-3) + c$ $c = -17$ $y = -6x - 17$ <p><b>OR</b></p> $y - 1 = -6(x + 3)$ $y = -6x - 18 + 1$ $y = -6x - 17$	<p>CA✓ substitution</p> <p>CA✓ answer</p> <p>CA✓ substitution</p> <p>CA✓ answer</p>	<p>(2)</p> <p>(2)</p>
<p>10.2.1</p>	$f(x) = x^3 - 3x - 2$ $f'(x) = 3x^2 - 3 = 0$ $3(x + 1)(x - 1) = 0$ $x = -1 \quad \text{or} \quad x = 1$ $y = 0 \quad \text{or} \quad y = -4$ $A(-1 ; 0) \quad B(1 ; -4)$	<p>A✓ derivative <u>and</u> equating to 0</p> <p>CA✓ factors</p> <p>CA✓ <math>x</math> - values</p> <p>CA✓ <math>y</math> - values</p>	<p>(4)</p>



**QUESTION 12**

12.1.1	150	A✓answer	(1)
12.1.2(a)	$P(\text{Male}) = \frac{70}{150} = \frac{7}{15}$	A✓answer	(1)
12.1.2(b)	$P(\text{Eating Chocolate}) = \frac{80}{150} = \frac{8}{15}$	A✓answer	(1)
12.1.3	$P(\text{Male eating chocolate}) = \frac{45}{150} = 0,3$ $P(\text{Male}) \times P(\text{Eating chocolate})$ $= \frac{70}{150} \times \frac{80}{150} = \frac{56}{225} = 0,249$  $P(\text{Male and Eating chocolate}) \neq$ $P(\text{Male}) \times P(\text{Eating chocolate})$ Events are not independent	A✓P(male eating chocolate )  CA✓ P(Male) x P(eating chocolate) value  CA✓conclusion	(3)
12.2.1	$6 \times 7 \times 7 \times 7 = 2058$	A✓ $6 \times 7 \times 7 \times 7$ A✓2058	(2)
12.2.2	$6 \times 6 \times 5 \times 4 = 720$	A✓ $6 \times 6 \times 5 \times 4$ A✓720	(2)
12.2.3	Four digit codes divisible by 5:- $6 \times 7 \times 7 \times 1 = 252$ Probability of a four digit code divisible by 5 $= \frac{252}{2058} = \frac{7}{49} = 0,1428 = 14,28 \%$	A✓ $6 \times 7 \times 7 \times 1$ A✓252  CA✓answer	(3)
			<b>[13]</b>

**TOTAL MARKS: 150**