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basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE EXAMINATIONS/
SENIORSERTIFIKAAT-EKSAMEN
NATIONAL SENIOR CERTIFICATE EXAMINATIONS/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN**

**MATHEMATICS P1/
WISKUNDE VI**

MARKING GUIDELINES/NASIENRIGLYNE

2021

**MARKS: 150
PUNTE: 150**

**These marking guidelines consist of 13 pages.
Hierdie nasienriglyne bestaan uit 13 bladsye.**

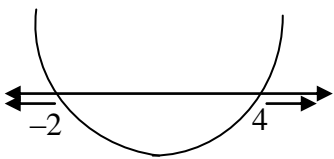
NOTE:

- If a candidate answers a question TWICE, only mark the FIRST attempt.
- Consistent Accuracy applies in all aspects of the marking memorandum.

LET WEL:

- Indien 'n kandidaat 'n vraag TWEE keer beantwoord, merk slegs die EERSTE poging.
- Volgehoue akkuraatheid is DEURGAANS op ALLE aspekte van die memorandum van toepassing.

QUESTION/VRAAG 1

1.1.1	$x^2 - x - 20 = 0$ $(x-5)(x+4) = 0$ $x = 5 \quad \text{or} \quad x = -4$	✓ factors ✓ $x = 5$ ✓ $x = -4$ (3)
1.1.2	$3x^2 - 2x - 6 = 0$ $x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(3)(-6)}}{2(3)}$ $x = \frac{1 \pm \sqrt{19}}{3}$ $x = -1,12 \quad \text{or} \quad x = 1,79$	✓ substitution ✓ simplification ✓ $x = -1,12$ ✓ $x = 1,79$ (4)
1.1.3	$(x-1)^2 > 9$ $x^2 - 2x - 8 > 0$ $(x-4)(x+2) > 0$ Critical values: $x = 4 \quad \text{or} \quad x = -2$  $x < -2 \quad \text{or} \quad x > 4$ OR/OF $(-\infty; -2) \quad \text{or} \quad (4; \infty)$ OR/OF $x - 1 > 3 \quad \text{or} \quad x - 1 < -3$ $x > 4 \quad \text{or} \quad x < -2$	✓ standard form ✓ critical values ✓✓ $x < -2 \quad \text{or} \quad x > 4$ (4) OR/OF ✓✓ $(-\infty; -2) \quad \text{or} \quad (4; \infty)$ OR/OF ✓ $x - 1 > 3$ ✓ $x - 1 < -3$ ✓✓ $x > 4 \quad \text{or} \quad x < -2$ (4)

1.1.4	$2\sqrt{x+6} + 2 = x$ $2\sqrt{x+6} = x - 2$ $4(x+6) = (x-2)^2$ $4x + 24 = x^2 - 4x + 4$ $x^2 - 8x - 20 = 0$ $(x-10)(x+2) = 0$ $x = 10 \quad \text{or} \quad x \neq -2$	✓ isolating the surd ✓ $4x + 24 = x^2 - 4x + 4$ ✓ $x = 10$ ✓ $x \neq -2$ (4)
1.2	$4x = 2 - y \quad . . . (1)$ $4x + y^2 = 8 \quad . . . (2)$ $\therefore 2 - y + y^2 = 8$ $y^2 - y - 6 = 0$ $(y-3)(y+2) = 0$ $y = 3 \quad \text{or} \quad y = -2$ $x = -\frac{1}{4} \quad \text{or} \quad x = 1$ OR/OF $y = -4x + 2 \quad . . . (1)$ $4x + y^2 = 8 \quad . . . (2)$ $4x + (-4x + 2)^2 = 8$ $4x + 16x^2 - 16x + 4 - 8 = 0$ $16x^2 - 12x - 4 = 0$ $4x^2 - 3x - 1 = 0$ $(4x+1)(x-1) = 0$ $x = -\frac{1}{4} \quad \text{or} \quad x = 1$ $y = 3 \quad \text{or} \quad y = -2$	✓ $4x = 2 - y$ ✓ substitution ✓ standard form ✓ y-values ✓ x-values (5) OR/OF ✓ $y = -4x + 2$ ✓ substitution ✓ standard form ✓ x-values ✓ y-values (5)
1.3	$2^x \times 3^y = (2^3 \times 3)^6$ $2^x \times 3^y = 2^{18} \times 3^6$ $2^x = 2^{18} \quad \text{and} \quad 3^y = 3^6$ $x = 18 \quad \text{and} \quad y = 6$ $\therefore x - y = 18 - 6$ $\therefore x - y = 12$	✓ $2^3 \times 3$ ✓ $2^{18} \text{ or } 3^6$ ✓ $x = 18 \text{ or } y = 6$ ✓ answer (A) (4)
		[24]

QUESTION/VRAAG 2

2.1.1	$ \begin{array}{ccccccc} 72 & ; & 100 & ; & 120 & ; & 132 & ; & \dots \\ & \swarrow & & \searrow & & \swarrow & & \searrow & \\ & 28 & & 20 & & 12 & & & \\ & \swarrow & & \searrow & & \swarrow & & \searrow & \\ & & -8 & & -8 & & & & \end{array} $ $ \begin{aligned} 2a &= -8 \\ a &= -4 \\ 3a + b &= 28 \\ b &= 40 \\ a + b + c &= 72 \\ c &= 36 \\ T_n &= -4n^2 + 40n + 36 \end{aligned} $	\checkmark second differences = -8 $\checkmark a = -4$ $\checkmark b = 40$ $\checkmark c = 36$ <div style="text-align: right;">(4)</div>
2.1.2	$ \begin{aligned} T_{12} &= 36 - 8n = 36 - 8(12) = -60 \\ -4n^2 + 40n + 36 &= -60 \\ n^2 - 10n - 24 &= 0 \\ (n - 12)(n + 2) &= 0 \\ \therefore n &= 12 \end{aligned} $	$\checkmark 36 - 8n$ $\checkmark -60$ \checkmark standard form \checkmark factors $\checkmark n = 12$ <div style="text-align: right;">(5)</div>
2.1.3	$ \begin{aligned} T_n' &= -8n + 40 = 0 \\ n &= 5 \\ T_n &= -4(5)^2 + 40(5) + 36 = 136 \end{aligned} $ <p>OR/OF</p> $ \begin{aligned} \frac{-b}{2a} &= \frac{40}{8} = 5 \\ T_n &= -4(5)^2 + 40(5) + 36 \\ &= 136 \end{aligned} $	$\checkmark -8n + 40$ $\checkmark n = 5$ $\checkmark 136$ <div style="text-align: right;">(3)</div> <p>OR/OF</p> \checkmark substitution $\checkmark n = 5$ $\checkmark 136$ <div style="text-align: right;">(3)</div>
2.1.4	Maximum value = 41	\checkmark value <div style="text-align: right;">(1)</div>
2.2	$ \begin{aligned} 2\sin 3x - (-11) &= 15 - 2\sin 3x \\ 4\sin 3x &= 4 \\ \sin 3x &= 1 \\ 3x &= 90^\circ \\ \therefore x &= 30^\circ \end{aligned} $	\checkmark equating $\checkmark 4\sin 3x = 4$ $\checkmark \sin 3x = 1$ \checkmark answer <div style="text-align: right;">(4)</div>
		[17]

QUESTION/VRAAG 3

3.1.1	$T_n = ar^{n-1} = 2000\left(\frac{1}{5}\right)^{n-1}$	✓ $2000\left(\frac{1}{5}\right)^{n-1}$ (1)
3.1.2	$T_7 = 2000\left(\frac{1}{5}\right)^{7-1} = \frac{16}{125}$	✓ $\frac{16}{125}$ (1)
3.1.3	$\frac{16}{15625} = 2000\left(\frac{1}{5}\right)^{n-1}$ $\frac{1}{1953125} = \left(\frac{1}{5}\right)^{n-1}$ $\left(\frac{1}{5}\right)^9 = \left(\frac{1}{5}\right)^{n-1}$ OR $n-1 = \log_{\frac{1}{5}} \frac{1}{1953125}$ $n-1 = 9$ $n = 10$	✓ equating ✓ same base / use of log ✓ answer (3)
3.2	$S_\infty = 27 = \frac{a}{1-r}$ $S_3 = \frac{a(1-r^3)}{1-r} = 26$ $27(1-r^3) = 26$ $1-r^3 = \frac{26}{27}$ $r^3 = \frac{1}{27}$ $\therefore r = \frac{1}{3}$ OR/OF $S_\infty = 27 = \frac{a}{1-r}$ $a = 27(1-r)$ But $a + ar + ar^2 = 26$ $a(1+r+r^2) = 26$ $27(1-r)(1+r+r^2) = 26$ $(1-r)(1+r+r^2) = \frac{26}{27}$ $r^2 + r + 1 - r^3 - r^2 - r = \frac{26}{27}$ $-r^3 + 1 = \frac{26}{27}$ $r^3 = \frac{1}{27}$ $\therefore r = \frac{1}{3}$	✓ $S_\infty = 27 = \frac{a}{1-r}$ ✓ $S_3 = \frac{a(1-r^3)}{1-r} = 26$ ✓ substitution ✓ $r = \frac{1}{3}$ OR/OF ✓ $a = 27(1-r)$ ✓ $a + ar + ar^2 = 26$ ✓ substitution ✓ $r = \frac{1}{3}$ (4)
		[9]

QUESTION/VRAAG 5

5.1	$-2x^2 + 4x + 16 = 0$ $x^2 - 2x - 8 = 0$ $(x-4)(x+2) = 0$ $x = 4$ or $x = -2$ $\therefore A(-2;0)$ and $B(4;0)$	\checkmark factors $\checkmark x = -2$ $\checkmark x = 4$ (3)
5.2	$f(x) = -2x^2 + 4x + 16$ $-\frac{b}{2a} = -\frac{-4}{-2(2)} = 1$ $f(1) = -2(1)^2 + 4(1) + 16 = 18$ $\therefore C(1;18)$ OR/OF $f(x) = -2x^2 + 4x + 16$ $f'(x) = -4x + 4$ $-4x + 4 = 0$ $x = 1$ $f(1) = -2(1)^2 + 4(1) + 16 = 18$ $\therefore C(1;18)$	$\checkmark 1$ $\checkmark 18$ (2) OR/OF $\checkmark 1$ $\checkmark 18$ (2)
5.3	$y \leq 18$ OR/OF $y \in (-\infty; 18]$	$\checkmark y \leq 18$ (1) OR/OF $\checkmark y \in (-\infty; 18]$ (1)
5.4	TP (1 ; 18) for f TP (2 ; 15) for h $\therefore p = -1$ $q = -3$	\checkmark TP for h at (2 ; 15) $\checkmark p = -1$ $\checkmark q = -3$ (3)
5.5	$y = 2x + 4$ $x = 2y + 4$ $\therefore y = \frac{1}{2}x - 2$	\checkmark swop x and y $\checkmark y = \frac{1}{2}x - 2$ (2)
5.6	$g(x) = 0$ or $g^{-1}(x) = 0$ $x = 4$ or $x = -2$ (product 0 at x -intercepts)	$\checkmark x = 4$ $\checkmark x = -2$ (2)

5.7	$-2x^2 + 4x + 16 + k = 2x + 4$ $-2x^2 + 2x + 12 + k = 0$ $b^2 - 4ac < 0$ $(2)^2 - 4(-2)(12 + k) < 0$ $4 + 8(12 + k) < 0$ $100 + 8k < 0$ $k < -12,5$ OR/OF $g'(x) = 2$ $f'(x) = -4x + 4 = 2$ $x = \frac{1}{2}$ $f\left(\frac{1}{2}\right) = 17,5$ $g\left(\frac{1}{2}\right) = 5$ $\therefore k < -12,5$	✓ equating ✓ standard form ✓ $b^2 - 4ac < 0$ ✓ substitution ✓ answer (5) OR/OF ✓ $g'(x) = 2$ ✓ $f'(x) = -4x + 4$ ✓ $f\left(\frac{1}{2}\right) = 17,5$ ✓ $g\left(\frac{1}{2}\right) = 5$ ✓ answer (5)
		[18]

QUESTION/VRAAG 6

6.1.1	$y = 3^x$ $x = 3^y$ $y = \log_3 x$	✓ swop x and y ✓ equation (2)
6.1.2	$h(x) = 3^{x-4} + 2$ Transformation: 4 units left, 2 units down $P'(2;9)$	✓ $x = 2$ (A) ✓ $y = 9$ (A) (2)
6.2	$f(x) = 2^{x+p} + q$ $q = -16$ $16 = 2^{p+3} - 16$ $2^{p+3} = 32$ $2^{p+3} = 2^5$ $\therefore p + 3 = 5$ $p = 2$	✓ $q = -16$ ✓ substitute (3 ; 16) ✓ $2^{p+3} = 2^5$ or $p + 3 = \log_2 32$ ✓ $p = 2$ (4)
		[8]

QUESTION/VRAAG 7

7.1	$13\,080 = 10\,000 \left(1 + \frac{i}{4}\right)^{16}$ $\left(1 + \frac{i}{4}\right)^{16} = \frac{13080}{10000}$ $1 + \frac{i}{4} = \sqrt[16]{\frac{13080}{10000}}$ $\frac{i}{4} = 0,0169227\dots$ $i = 0,06769\dots$ $i = 6,77\%$	✓ substitution into correct formula ✓ $n = 16$ ✓ simplification ✓ answer (A)
7.2.1	$F = \frac{x[(1+i)^n - 1]}{i}$ $F = \frac{9\,000 \left[\left(1 + \frac{0,075}{12}\right)^{60} - 1 \right]}{\frac{0,075}{12}}$ $F = \text{R } 652\,743,95$	✓ $\frac{0,075}{12}$ ✓ substitution into correct Formula ✓ answer
7.2.2	$60 \times 9\,000 = \text{R } 540\,000$ $A = P(1+i)^n$ $652\,743,95 \left(1 + \frac{0,075}{12}\right)^n = 190\,214,14 + 540\,000$ $730\,214,14 = 652\,743,95 \left(1 + \frac{0,075}{12}\right)^n$ $1,1186\dots = (1,00625)^n$ $n = \log_{1,00625}(1,1186)$ $\therefore n = 18 \text{ months}$	✓ $60 \times 9\,000 = \text{R } 540\,000$ ✓ ✓ equation ✓ simplification ✓ use of logs ✓ 18 months

	<p>OR/OF</p> <p>Interest over 5 years = $652\,743,95 - 9\,000 \times 60$ $= 112\,743,95$</p> <p>\therefore interest on n years $= 190\,214,14 - 112\,743,95 = 77\,470,19$</p> <p>$652\,743,95 + 77\,470,19 = 652\,743,95 \left(1 + \frac{0,075}{12}\right)^n$</p> <p>$1,1186\dots = (1,00625)^n$ $n = \log_{1,00625}(1,1186)$ $\therefore n = 18$ months</p>	<p>OR/OF</p> <p>✓ $60 \times 9\,000$</p> <p>✓ answer</p> <p>✓ equating</p> <p>✓ simplification</p> <p>✓ use of logs</p> <p>✓ 18 months</p> <p>(6)</p>
		[13]

QUESTION/VRAAG 8

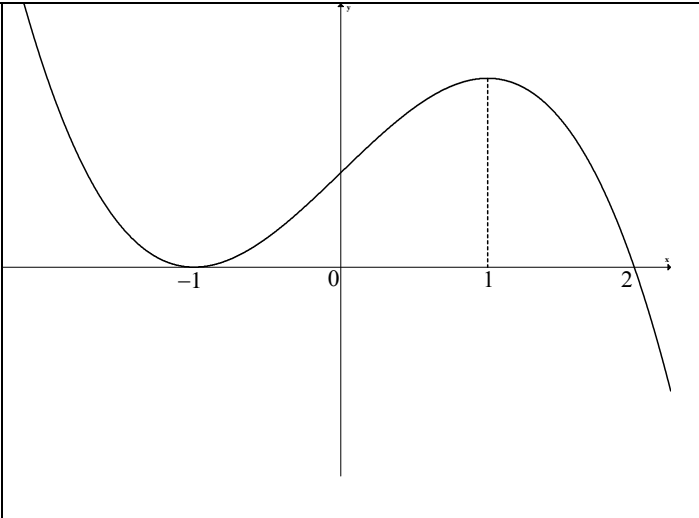
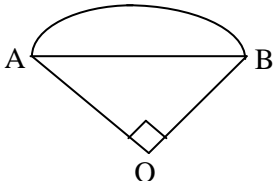
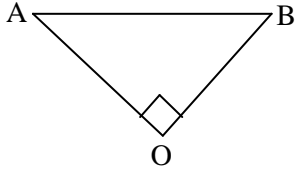
8.1	<p>$f(x) = 3x^2$</p> <p>$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$</p> <p>$f'(x) = \lim_{h \rightarrow 0} \frac{3(x+h)^2 - 3x^2}{h}$</p> <p>$f'(x) = \lim_{h \rightarrow 0} \frac{3x^2 + 6xh + 3h^2 - 3x^2}{h}$</p> <p>$= \lim_{h \rightarrow 0} \frac{6xh + 3h^2}{h}$</p> <p>$= \lim_{h \rightarrow 0} \frac{h(6x + 3h)}{h}$</p> <p>$= 6x$</p>	<p>✓ substitution</p> <p>✓ expansion</p> <p>✓ simplification</p> <p>✓ $\lim_{h \rightarrow 0} \frac{h(6x + 3h)}{h}$</p> <p>✓ $6x$</p> <p>(5)</p>
8.2.1	<p>$f(x) = x^2 - 3 + 9x^{-2}$</p> <p>$f'(x) = 2x - 18x^{-3}$</p>	<p>✓ $9x^{-2}$</p> <p>✓ $2x$</p> <p>✓ $-18x^{-3}$</p> <p>(3)</p>

8.2.2	$g(x) = (\sqrt{x} + 3)(\sqrt{x} - 1)$ $g(x) = x + 2x^{\frac{1}{2}} - 3$ $g'(x) = 1 + x^{-\frac{1}{2}}$	$\checkmark x$ $\checkmark 2x^{\frac{1}{2}}$ $\checkmark 1$ $\checkmark x^{-\frac{1}{2}}$ (4)
		[12]

QUESTION/VRAAG 9

9.1	$f'(x) = 6x^2 + 6x - 12$ $6x^2 + 6x - 12 = 0$ $x^2 + x - 2 = 0$ $(x + 2)(x - 1) = 0$ $x = -2$ or $x = 1$ $y = 20$ or $y = -7$ $\therefore A(-2 ; 20)$ and $B(1 ; -7)$	$\checkmark 6x^2 + 6x - 12$ $\checkmark = 0$ \checkmark factors $\checkmark x$ -values $\checkmark y$ -values (5)
9.2	$f''(x) = 12x + 6$ $12x + 6 > 0$ $12x > -6$ $x > -\frac{1}{2}$ OR/OF $x = \frac{-2+1}{2} = -\frac{1}{2}$ $\therefore x > -\frac{1}{2}$	$\checkmark 12x + 6$ $\checkmark f''(x) > 0$ $\checkmark x > -\frac{1}{2}$ (3) OR/OF $\checkmark x = -\frac{1}{2}$ $\checkmark \checkmark x > -\frac{1}{2}$ (3)
9.3	$f'(2) = 24$ Equation of the tangent: $y - 4 = 24(x - 2)$ $y = 24x - 44$	$\checkmark f'(2)$ $\checkmark 24$ \checkmark equation (3)
		[11]

QUESTION/VRAAG 10

10.1		<ul style="list-style-type: none"> ✓ $x = -1$ and $x = 2$ ✓ TP at $x = -1$ ✓ TP at $x = 1$ ✓ shape <p style="text-align: right;">(4)</p>
10.2.1	 <p>Area of segment = $\frac{1}{4}$ Area of big circle</p> $= \frac{1}{4} \pi (x - x^2)^2$  <p>Area triangle ABO counted</p> $= \text{Area } \Delta = \frac{1}{2} (x - x^2)^2$ <p>Area of shaded region</p> $= \frac{1}{4} \pi (x - x^2)^2 - \frac{1}{2} (x - x^2)^2$ $= \frac{\pi - 2}{4} (x - x^2)^2$ $= \left(\frac{\pi - 2}{4} \right) (x^2 - 2x^3 + x^4)$	<ul style="list-style-type: none"> ✓✓ $\frac{1}{4} \pi (x - x^2)^2$ ✓ Area $\Delta = \frac{1}{2} (x - x^2)^2$ ✓ subtract areas ✓ common factor <p style="text-align: right;">(5)</p>

10.2.2	<p>Area of shaded region</p> $= \frac{(\pi - 2)}{4}(x^4 - 2x^3 + x^2)$ $\frac{dA}{dx} = \left(\frac{\pi - 2}{4}\right)(4x^3 - 6x^2 + 2x)$ $4x^3 - 6x^2 + 2x = 0$ $x(2x^2 - 3x + 1) = 0$ $x(2x - 1)(x - 1) = 0$ $x \neq 0 \quad \text{or} \quad x = \frac{1}{2} \quad \text{or} \quad x \neq 1$	$\checkmark \left(\frac{\pi - 2}{4}\right)(4x^3 - 6x^2 + 2x)$ $\checkmark \text{ factors}$ $\checkmark x = 0; x = 1; x = \frac{1}{2}$ $\checkmark x = \frac{1}{2} \quad (4)$
		[13]

QUESTION/VRAAG 11

11.1	<p>$P(A) = 1 - P(\text{not } A) = 0,6$</p> <p>$P(A \text{ and } B) = P(A) \times P(B)$ $= 0,6 \times 0,3$ $= \frac{9}{50}$ $= 0,18$</p>	$\checkmark 0,6$ $\checkmark P(A \text{ and } B) = P(A) \times P(B)$ $\checkmark \text{ answer (A)}$ <p>(3)</p>
11.2.1	$a = \frac{15}{150} = 0,1$	$\checkmark \frac{15}{150} \text{ (A)}$ <p>(1)</p>
11.2.2	$m = 1 - 0,7 = 0,3$	$\checkmark 0,3 \text{ (A)}$ <p>(1)</p>
11.2.3	<p>$0,24 + 0,14 + 0,02 + 0,12 + 0,1 + 2b = 0,7$</p> <p>$2b = 0,08$</p> <p>$b = 0,04$</p> <p>$0,04 \times 150 = 6$</p>	$\checkmark \text{ addition}$ $\checkmark \text{ simplification}$ $\checkmark b = 0,04$ $\checkmark 6$ <p>(4)</p>
11.3.1	$9 \times 9 \times 8 = 648$	$\checkmark 9 \quad \checkmark 9 \times 8$ <p>(2)</p>
11.3.2	<p>$2 \times 8 \times 4 = 64$</p> <p>$2 \times 8 \times 5 = 80$</p> <p>Total number = $64 + 80 = 144$</p>	$\checkmark \checkmark 2 \times 8 \times 4$ $\checkmark 2 \times 8 \times 5$ $\checkmark 144 \text{ (A)}$ <p>(4)</p>
		[15]

TOTAL/TOTAAL: 150