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NASIONALE SENIORSERTIFIKAAT-EKSAMEN**

MATHEMATICS P1/WISKUNDE V1

MARKING GUIDELINES/NASIENRIGLYNE

2022

MARKS: 150

PUNTE: 150

**These marking guidelines consist of 16 pages.
*Hierdie nasienriglyne bestaan uit 16 bladsye.***

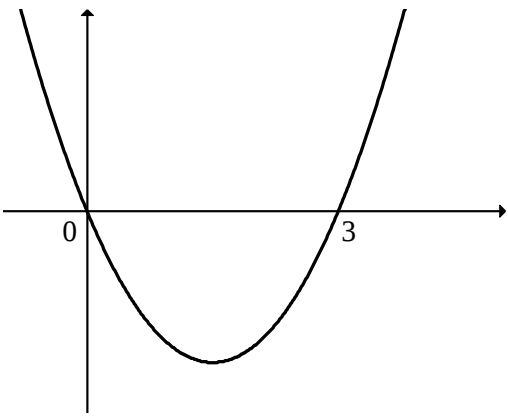
NOTE:

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

LET WEL:

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

QUESTION/VRAAG 1

1.1.1	$x^2 + 2x - 15 = 0$ $(x + 5)(x - 3) = 0$ $x = -5$ or $x = 3$	✓ factors ✓ $x = -5$ ✓ $x = 3$ (3)
1.1.2	$5x^2 - x - 9 = 0$ $x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(5)(-9)}}{2(5)}$ $x = \frac{1 \pm \sqrt{181}}{10}$ $x = 1,45$ or $x = -1,25$	✓ substitution into the correct formula ✓ $x = 1,45$ ✓ $x = -1,25$ (3)
1.1.3	$x^2 \leq 3x$ $x^2 - 3x \leq 0$ $x(x - 3) \leq 0$  $0 \leq x \leq 3$ OR $x \in [0; 3]$	✓ standard form ✓ factors ✓✓ answer (4)
1.2.1	$a + \frac{64}{a} = 16$ $a^2 - 16a + 64 = 0$ $(a - 8)^2 = 0$ $a = 8$	✓ standard form ✓ factors ✓ answer (3)

1.2.2	$2^x + 2^{6-x} = 16$ $2^x + \frac{64}{2^x} = 16$ $2^x = 8 \quad (\text{from } 1.2.1)$ $2^x = 2^3$ $x = 3$	✓ exp law ✓ $2^x = 8$ ✓ answer (3)
1.3	$\sqrt{\frac{2^{1002}(1+2^4)}{17(2)^{998}}}$ $= \sqrt{\frac{2^4(17)}{17}}$ $= \sqrt{2^4}$ $= 2^2$ $= 4$	✓ common factor ✓ second factor ✓ simplification ✓ answer (4)
1.4	$2x - y = 2 \quad \dots(1)$ $\frac{1}{x} - 3y = 1 \quad \dots(2)$ $y = 2x - 2$ $\frac{1}{x} - 3(2x - 2) = 1$ $\frac{1}{x} - 6x + 6 - 1 = 0$ $1 - 6x^2 + 6x - x = 0$ $-6x^2 + 5x + 1 = 0$ $6x^2 - 5x - 1 = 0$ $(6x + 1)(x - 1) = 0$ $x = -\frac{1}{6} \quad \text{or} \quad x = 1$ $y = 2\left(-\frac{1}{6}\right) - 2 \quad \text{or} \quad y = 2(1) - 2$ $y = -\frac{7}{3} \quad \text{or} \quad y = 0$	✓ $y = 2x - 2$ ✓ substitution ✓ simplification ✓ standard form ✓ x-values ✓ y-values (6)

OR/OF

$$x = \frac{2+y}{2} \quad \dots(1)$$

$$\frac{1}{x} - 3y = 1 \quad \dots(2)$$

$$\frac{\frac{1}{\frac{2+y}{2}} - 3y = 1$$

$$\frac{2}{2+y} - 3y = 1$$

$$\frac{2 - 6y - 3y^2}{2+y} = 1$$

$$2 - 6y - 3y^2 = 2 + y$$

$$-3y^2 - 7y = 0$$

$$-y(3y + 7) = 0$$

$$y = 0 \quad \text{or} \quad y = -\frac{7}{3}$$

$$x = 1 \quad \text{or} \quad x = -\frac{1}{6}$$

OR/OF

$$\checkmark x = \frac{2+y}{2}$$

✓ substitution

✓ simplification

✓ standard form

✓ y-values

✓ x-values

(6)
[26]

QUESTION/VRAAG 2

2.1.1	$a + 6d = 35$ $-1 + 6d = 35$ $6d = 36$ $d = 6$ OR/OF $\frac{35 - (-1)}{7 - 1} = 6$	ANSWER ONLY: FULL MARKS	✓ substitution ✓ answer (2) OR/OF ✓ substitution ✓ answer (2)
2.1.2	$T_n = a + (n - 1)d$ $473 = -1 + (n - 1)(6)$ $79 = n - 1$ $\therefore n = 80$	ANSWER ONLY: FULL MARKS	✓ substitution into the correct formula ✓ equating to 473 ✓ answer (3)
2.1.3	$S_n = \frac{n}{2}[2a + (n - 1)d]$ $S_{40} = \frac{40}{2}[2(-1) + (40 - 1)(6)]$ $\therefore S_{40} = 4640$ OR/OF $T_{40} = 6(40) - 7$ $= 233$ $S_n = \frac{n}{2}(a + l)$ $= \frac{40}{2}(-1 + 233)$ $= 4640$		✓ substitution ✓ answer (2) OR/OF ✓ substitution ✓ answer (2)
2.2.1	$\begin{array}{ccccccc} 75 & & 53 & & 35 & & 21 \\ & \backslash & / & \backslash & / & \backslash & / \\ & -22 & & -18 & & -14 & \\ & & \backslash & / & & \backslash & / \\ & & 4 & & 4 & & \end{array}$ $T_5 = 11$		✓ answer (A) (1)
2.2.2	$T_n = an^2 + bn + c$ $2a = 4$ $a = 2$ $3a + b = -22$ $6 + b = -22$ $b = -28$ $a + b + c = 75$ $2 - 28 + c = 75$ $c = 101$ $\therefore T_n = 2n^2 - 28n + 101$		✓ $T_n = an^2 + bn + c$ ✓ $a = 2$ ✓ $b = -28$ ✓ $c = 101$ (4)

2.2.3

Minimum value of T_n

$$n = -\frac{b}{2a} = -\frac{(-28)}{2(2)}$$

$$n = 7$$

$$\text{Minimum value of } T_n = 2(7)^2 - 28(7) + 101 = 3$$

Each term in the new pattern is $-\frac{1}{5}$ the value of the terms in the old pattern.

$$\text{Maximum value of new pattern} = -\frac{3}{5}$$

OR/OF

$$T'_n = 4n - 28$$

$$4n - 28 = 0$$

$$4n = 28$$

$$n = 7$$

$$\text{Minimum value of } T_n = 2(7)^2 - 28(7) + 101 = 3$$

Each term in the new pattern is $-\frac{1}{5}$ the value of the terms in the old pattern.

$$\text{Maximum value of new pattern} = -\frac{3}{5}$$

OR/OF

$$T_n = -\frac{2}{5}n^2 + \frac{28}{5}n - \frac{101}{5}$$

$$n = -\frac{b}{2a} = \frac{-\frac{28}{5}}{2\left(\frac{-2}{5}\right)}$$

$$= 7$$

$$T_7 = -\frac{3}{5}$$

OR/OF

$$\checkmark n = 7$$

$$\checkmark \text{ min value} = 3$$

$$\checkmark -\frac{1}{5} \text{ value of term of old pattern}$$

$$\checkmark \text{ max value} = -\frac{3}{5} \quad (4)$$

OR/OF

$$\checkmark n = 7$$

$$\checkmark \text{ min value} = 3$$

$$\checkmark -\frac{1}{5} \text{ value of term of old pattern}$$

$$\checkmark \text{ max value} = -\frac{3}{5} \quad (4)$$

OR/OF

$$\checkmark \checkmark T_n \div (-5)$$

$$\checkmark n = 7$$

$$\checkmark \text{ max value} = -\frac{3}{5} \quad (4)$$

OR/OF

$$T_n = -\frac{2}{5}n^2 + \frac{28}{5}n - \frac{101}{5}$$

$$T'_n = -\frac{4}{5}n + \frac{28}{5}$$

$$\checkmark\checkmark T_n \div (-5)$$

$$-\frac{4}{5}n + \frac{28}{5} = 0$$

$$-4n = -28$$

$$n = 7$$

$$\text{Minimum value of } T_n = 2(7)^2 - 28(7) + 101 = 3$$

Each term in the new pattern is $-\frac{1}{5}$ the value of the terms in the old pattern.

$$\checkmark n = 7$$

$$\text{Maximum value of new pattern} = -\frac{3}{5}$$

$$\checkmark \text{ max value} = -\frac{3}{5}$$

(4)

[16]

QUESTION/VRAAG 3

3.1.1	$T_n = ar^{n-1}$ $T_{10} = 1\,024 \left(\frac{1}{4}\right)^{10-1}$ $\therefore T_{10} = \frac{1}{256}$ ANSWER ONLY: FULL MARKS	✓ substitution into the correct formula ✓ answer (2)
3.1.2	$\sum_{p=0}^8 256(4^{1-p}) = 1\,024 + 256 + 64 + \dots$ $S_n = \frac{a[1-r^n]}{1-r}$ $S_9 = \frac{1\,024 \left[1 - \left(\frac{1}{4}\right)^9\right]}{1 - \frac{1}{4}}$ $S_9 = \frac{87\,381}{64}$ $= 1\,365,33$ OR/OF $\sum_{p=0}^8 256(4^{1-p})$ $= 1\,024 + 256 + 64 + 16 + 4 + 1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64}$ $S_9 = \frac{87\,381}{64}$ $= 1\,365,33$	✓ 1024 ✓ $n = 9$ ✓ substitution into the correct formula ✓ answer (4) OR/OF ✓ 1024 ✓ rest of expansion ✓ $n = 9$ terms ✓ answer (4)
3.2	$-t^2 - 6t - 9; \frac{t^3 + 9t^2 + 27t + 27}{2}$ $-(t^2 + 6t + 9); \frac{1}{2}(t+3)(t^2 + 6t + 9)$ $-(t+3)^2; \frac{1}{2}(t+3)^3$ $r = \frac{-(t+3)}{2}$ $-1 < \frac{-t-3}{2} < 1$ $-2 < -t-3 < 2$ $1 < -t < 5$ $-5 < t < -1$	$\frac{t^3 + 9t^2 + 27t + 27}{-t^2 - 6t - 9}$ ✓ $r = \frac{2}{-t^2 - 6t - 9}$ ✓ $-(t^2 + 6t + 9)$ ✓ $\frac{1}{2}(t+3)(t^2 + 6t + 9)$ ✓ $-1 < \frac{-t-3}{2} < 1$ ✓ answer (5)
		[11]

QUESTION 4

4.1	$10 = a\left(\frac{1}{3}\right)^{-2} + 7$ $3 = 9a$ $\therefore a = \frac{1}{3}$	✓ subs (–2 ; 10) ✓ simplification ✓ answer (3)
4.2	$y = g(0)$ $y = \frac{1}{3} \times \left(\frac{1}{3}\right)^0 + 7$ $y = \frac{22}{3} = 7,33$ $\therefore \left(0 ; \frac{22}{3}\right)$ ANSWER ONLY: FULL MARKS	✓ substitution of $x = 0$ ✓ answer (2)
4.3.1	Translation by 1 unit to the right and 7 units downwards	✓ 1 unit right ✓ 7 units downwards (2)
4.3.2	$h(x) = \left(\frac{1}{3}\right)^x$ $h^{-1}: x = \left(\frac{1}{3}\right)^y$ $y = \log_{\frac{1}{3}}(x) \quad \text{OR/OF} \quad y = -\log_3(x)$ ANSWER ONLY: FULL MARKS	✓ swap x and y ✓ answer (2)
		[9]

QUESTION 5

5.1	$g(x) = \frac{a}{x+2} + q$ Subs (1 ; 0): $0 = \frac{a}{1+2} + q$ $0 = a + 3q$ Subs $\left(0 ; -\frac{1}{2}\right)$ $-\frac{1}{2} = \frac{a}{0+2} + q$ $-1 = a + 2q$ Solving simultaneously: $q = 1$ $a = -3$ $\therefore g(x) = \frac{-3}{x+2} + 1$	$\checkmark g(x) = \frac{a}{x+2} + q$ $\checkmark 0 = a + 3q$ $\checkmark -1 = a + 2q$ $\checkmark$ solving simultaneously $\checkmark q = 1$ $\checkmark a = -3$ (6)
5.2	$y \in \mathbb{R}; y \neq 1$ OR/OF $(-\infty; 1)$ or $(1; \infty)$ OR/OF $y < 1$ or $y > 1$	$\checkmark$ answer (1)
5.3	$y - 1 = 1(x + 2)$ OR/OF $1 = 1(-2) + c$ $y = x + 3$ ANSWER ONLY: FULL MARKS $c = 3$ $y = x + 3$	$\checkmark m = 1$ $\checkmark$ subs point $(-2; 1)$ $\checkmark$ answer (3)
5.4	$K'(-3; 4)$	$\checkmark$ x-value $\checkmark$ y-value (2)
		[12]

QUESTION 6

6.1	$f(x) = -x^2 - 6x + 7$ $f'(x) = -2x - 6$ $-2x - 6 = 0$ OR/OF $x = -\frac{(-6)}{2(-1)}$ $x = -3$ E(-3 ; 16) ANSWER ONLY: FULL MARKS	✓ method ✓ x-value ✓ y-value	(3)
6.2	$k = f(-5)$ $k = -(-5)^2 - 6(-5) + 7$ $\therefore k = 12$	✓ answer (A)	(1)
6.3	C(0 ; 7) D(-5 ; 12) $m_{CD} = \frac{12 - 7}{-5 - 0}$ $m_{CD} = -1$ Equation of CD: $y = -x + 7$	✓ coordinates of C ✓ substitution ✓ m ✓ answer	(4)
6.4	$-2x - 6 = -1$ $-2x = 5$ $x = -\frac{5}{2}$ $y = f\left(-\frac{5}{2}\right) = -\left(-\frac{5}{2}\right)^2 - 6\left(-\frac{5}{2}\right) + 7 = \frac{63}{4} = 15,75$ $\therefore P\left(-\frac{5}{2}; \frac{63}{4}\right)$	✓ $f'(x) = -2x - 6$ ✓ equating to -1 ✓ x-value ✓ y-value (A)	(4)
6.5	Point by symmetry: (-1 ; 12) $-5 < x < -1$ OR/OF $-x^2 - 6x + 7 > 12$ $-x^2 - 6x - 5 > 0$ $x^2 + 6x + 5 < 0$ $(x+1)(x+5) < 0$ $-5 < x < -1$ ANSWER ONLY: FULL MARKS	✓ -1 ✓ answer ✓ -1 ✓ answer	(2)
			[14]

QUESTION 7

7.1	$A = P(1+i)^n$ $2 = 1\left(1 + \frac{0,085}{4}\right)^{4n}$ $4n = \log_{\left(1 + \frac{0,085}{4}\right)} 2$ $n = 8,24 \text{ years}$	$\checkmark 2$ $\checkmark \frac{0,085}{4}$ } In correct formula $\checkmark$ use of logs $\checkmark$ answer in years (4)
7.2.1	$A = P(1-i)^n$ $180\,000 = 500\,000(1-i)^5$ $\frac{9}{25} = (1-i)^5$ $\sqrt[5]{\frac{9}{25}} = 1-i$ $i = 0,1848068\dots$ $r = 18,48\%$	$\checkmark$ subs into correct formula $\checkmark$ simplification $\checkmark i = 0,1848\dots$ $\checkmark$ answer (4)
7.2.2	$A = P(1+i)^n$ $A = 500\,000(1+0,063)^5$ $A = R678\,635,11$	$\checkmark$ subs into correct formula $\checkmark$ answer (2)
7.2.3	Sinking Fund = $678\,635,11 - 180\,000$ = R 498 635,11 $498\,635,11 = \frac{x \left[\left(1 + \frac{0,1025}{12}\right)^{58} - 1 \right] \left(1 + \frac{0,1025}{12}\right)^3}{\frac{0,1025}{12}}$ $x = R6\,510,36$	$\checkmark$ value of sinking fund $\checkmark \frac{0,1025}{12}$ $\checkmark n = 58 \text{ (A)}$ $\checkmark \left(1 + \frac{0,1025}{12}\right)^3$ $\checkmark$ answer (A) (5)
		[15]

QUESTION/VRAAG 8

8.1	$f(x) = -x^2$ $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{-(x+h)^2 + x^2}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{-x^2 - 2xh - h^2 + x^2}{h}$ $= \lim_{h \rightarrow 0} \frac{-2xh - h^2}{h}$ $= \lim_{h \rightarrow 0} \frac{h(-2x - h)}{h}$ $= \lim_{h \rightarrow 0} (-2x - h)$ $\therefore f'(x) = -2x$ OR/OF $f(x) = -x^2$ $f(x+h) = -(x+h)^2 = -x^2 - 2xh - h^2$ $f(x+h) - f(x) = -x^2 - 2xh - h^2 - (-x^2) = -2xh - h^2$ $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \rightarrow 0} \frac{-2xh - h^2}{h}$ $= \lim_{h \rightarrow 0} \frac{h(-2x - h)}{h}$ $= \lim_{h \rightarrow 0} (-2x - h)$ $\therefore f'(x) = -2x$	✓ substitution into formula ✓ $-(x^2 + 2xh + h^2)$ ✓ $-2xh - h^2$ ✓ $-2x - h$ ✓ answer (5) OR/OF ✓ $-x^2 - 2xh - h^2$ ✓ $-2xh - h^2$ ✓ substitution into the formula ✓ $-2x - h$ ✓ answer (5)
8.2.1	$f(x) = 4x^3 - 5x^2$ $f'(x) = 12x^2 - 10x$	✓ $12x^2$ (A) ✓ $-10x$ (A) (2)
8.2.2	$D_x \left[\frac{-6\sqrt[3]{x} + 2}{x^4} \right]$ $= D_x \left[\frac{-6(x)^{\frac{1}{3}}}{x^4} + \frac{2}{x^4} \right]$ $= D_x \left[-6x^{-\frac{11}{3}} + 2x^{-4} \right]$ $= 22x^{-\frac{14}{3}} - 8x^{-5}$	✓ $x^{\frac{1}{3}}$ ✓ $-6x^{-\frac{11}{3}} + 2x^{-4}$ ✓ $22x^{-\frac{14}{3}}$ ✓ $-8x^{-5}$ (4)
		[11]

QUESTION/VRAAG 9

9.1	$f(x) = (x+t)^2(x-3)$ $-3 = (0+t)^2(0-3)$ $1 = t^2$ $t = \pm 1$ $\therefore t = 1$ $f(x) = (x+1)^2(x-3)$ $f(x) = (x^2 + 2x + 1)(x-3)$ $f(x) = x^3 - x^2 - 5x - 3$	$\checkmark f(x) = (x+t)^2(x-3)$ $\checkmark$ subs (0 ; -3) $\checkmark t$ $\checkmark f(x) = (x+1)^2(x-3)$ $\checkmark$ expansion (5)
9.2	$f'(x) = 3x^2 - 2x - 5$ $0 = 3x^2 - 2x - 5$ $0 = (x+1)(3x-5)$ $x = -1$ or $x = \frac{5}{3}$ $N\left(\frac{5}{3}; -\frac{256}{27}\right) = (1,67; -9,48)$	$\checkmark f'(x) = 3x^2 - 2x - 5$ $\checkmark = 0$ $\checkmark$ factors $\checkmark$ x-value ($x > 0$) $\checkmark$ y-value (A) (5)
9.3.1	$x < 3$; $x \neq -1$ OR/OF $x < -1$ or $-1 < x < 3$ OR/OF $(-\infty; -1)$ or $(-1; 3)$	$\checkmark x < 3$ $\checkmark x \neq -1$ (2) OR/OF $\checkmark x < -1$ $\checkmark -1 < x < 3$ (2) OR/OF $\checkmark (-\infty; -1)$ $\checkmark (-1; 3)$ (2)
9.3.2	$x < -1$ or $x > \frac{5}{3}$ OR/OF $x \leq -1$ or $x \geq \frac{5}{3}$ OR/OF $(-\infty; -1)$ or $\left(\frac{5}{3}; \infty\right)$ OR/OF $(-\infty; -1]$ or $\left[\frac{5}{3}; \infty\right)$	$\checkmark x < -1$ $\checkmark x > \frac{5}{3}$ (2) OR/OF $\checkmark (-\infty; -1)$ $\checkmark \left(\frac{5}{3}; \infty\right)$ (2)
9.3.3	$f''(x) > 0$ $6x - 2 > 0$ $x > \frac{1}{3}$ or $\left(\frac{1}{3}; \infty\right)$ OR/OF $\frac{\frac{5}{3} + (-1)}{2} = \frac{1}{3}$ $x > \frac{1}{3}$ or $\left(\frac{1}{3}; \infty\right)$	$\checkmark 6x - 2$ $\checkmark \frac{1}{3}$ $\checkmark x > \frac{1}{3}$ (3) OR/OF $\checkmark$ substitution $\checkmark \frac{1}{3}$ $\checkmark x > \frac{1}{3}$ (3)

9.4	$\text{Distance} = x^3 - x^2 - 5x - 3 - (3x^2 - 2x - 5)$ $= x^3 - 4x^2 - 3x + 2$ $\frac{d\text{Distance}}{dx} = 3x^2 - 8x - 3$ $0 = 3x^2 - 8x - 3$ $0 = (3x + 1)(x - 3)$ $x = 3 \text{ or } x = -\frac{1}{3}$ Max distance $= \left(-\frac{1}{3}\right)^3 - 4\left(-\frac{1}{3}\right)^2 - 3\left(-\frac{1}{3}\right) + 2$ $= \frac{68}{27} = 2,52$	$\checkmark x^3 - 4x^2 - 3x + 2$ $\checkmark \frac{d\text{Distance}}{dx} = 3x^2 - 8x - 3$ $\checkmark$ factors $\checkmark$ x-values $\checkmark x = -\frac{1}{3}$ $\checkmark$ answer
		(6)
		[23]

QUESTION/VRAAG 10

10.1.1	$7! = 5\,040$	✓✓ answer (2)
10.1.2	$4! \times 4!$ $= 576$ $P(\text{African flags together}) = \frac{576}{5040} \left(= \frac{4}{35} = 0,11 \right)$	✓ $4!$ ✓ $4! \times 4!$ ✓ answer (A) (3)
10.2	$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ $0,88 = 0,4 + P(B) - P(A \text{ and } B)$ $0,88 = 0,4 + P(B) - 0,4P(B)$ $0,48 = 0,6P(B)$ $P(B) = 0,8$	✓ subs into rule ✓ $P(A \text{ and } B) = 0,4P(B)$ ✓ answer (3)
10.3	First Passenger Second Passenger Probability of first passenger choosing meat $= \frac{x}{120}$ Probability of second passenger choosing cheese $= \frac{120-x}{119}$ $\frac{x}{120} \times \frac{120-x}{119} = \frac{18}{85}$ $120x - x^2 = 3\,024$ $x^2 - 120x + 3\,024 = 0$ $(x - 84)(x - 36) = 0$ $x = 84 \text{ or } x = 36$ $\therefore P(1^{\text{st}} \text{ cheese}) = \frac{36}{120} = \frac{3}{10}$	 ✓ $\frac{x}{120}$ ✓ $\frac{120-x}{119}$ ✓ $\frac{x}{120} \times \frac{120-x}{119} = \frac{18}{85}$ ✓ $x = 84 \text{ or } x = 36$ ✓ $\frac{3}{10}$ (5)
		[13]

TOTAL/TOTAAL: 150