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**NATIONAL
SENIOR CERTIFICATE/
NASIONALE SENIOR
SERTIFIKAAT**

GRADE 12/GRAAD 12

MATHEMATICS P1/WISKUNDE VI

NOVEMBER 2021

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

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

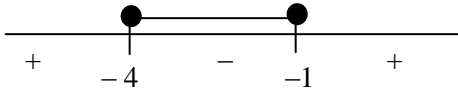
NOTE:

- 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, sien slegs die EERSTE poging na.
- Volgehoue akkuraatheid is op ALLE aspekte van die nasienriglyne van toepassing.

QUESTION/VRAAG 1

1.1.1	$x^2 - 2x - 24 = 0$ $(x-6)(x+4) = 0$ $x = 6$ or $x = -4$	✓ factors ✓ $x = 6$ ✓ $x = -4$ (3)
1.1.2	$2x^2 - 3x - 3 = 0$ $x = \frac{3 \pm \sqrt{(-3)^2 - 4(2)(-3)}}{2(2)}$ $x = \frac{3 \pm \sqrt{33}}{4}$ $x = 2,19$ or $x = -0,69$	✓ substitution into the correct formula ✓ $x = 2,19$ ✓ $x = -0,69$ (3)
1.1.3	$x^2 + 5x \leq -4$ $x^2 + 5x + 4 \leq 0$ $(x+4)(x+1) \leq 0$ Critical values: $x = -4$ or $x = -1$  $-4 \leq x \leq -1$ OR/OF $x \in [-4 ; -1]$	✓ standard form ✓ critical values ✓✓ answer (4)
1.1.4	$\sqrt{x+28} = 2-x$ $(\sqrt{x+28})^2 = (2-x)^2$ $x+28 = 4-4x+x^2$ $x^2 - 5x - 24 = 0$ $(x-8)(x+3) = 0$ $x \neq 8$ or $x = -3$	✓ squaring both sides ✓ standard form ✓ factors ✓ answers with selection (4)

1.2	$2y = 3 + x$ $x = 2y - 3 \quad \dots (1)$ $2xy + 7 = x^2 + 4y^2 \quad \dots (2)$ $2y(2y - 3) + 7 = (2y - 3)^2 + 4y^2$ $4y^2 - 6y + 7 = 4y^2 - 12y + 9 + 4y^2$ $4y^2 - 6y + 2 = 0$ $2y^2 - 3y + 1 = 0$ $(2y - 1)(y - 1) = 0$ $y = \frac{1}{2} \text{ or } y = 1$ $x = -2 \text{ or } x = -1$ OR/OF $2y = 3 + x$ $y = \frac{3}{2} + \frac{x}{2} \quad \dots (1)$ $2xy + 7 = x^2 + 4y^2 \quad \dots (2)$ $2x\left(\frac{3}{2} + \frac{x}{2}\right) + 7 = x^2 + 4\left(\frac{3}{2} + \frac{x}{2}\right)^2$ $3x + x^2 + 7 = x^2 + 9 + 6x + x^2$ $x^2 + 3x + 2 = 0$ $(x + 2)(x + 1) = 0$ $x = -2 \text{ or } x = -1$ $y = \frac{1}{2} \text{ or } y = 1$	✓equation 1 ✓substitution ✓simplification ✓standard form ✓y – values ✓x – values (6) OR/OF ✓equation 1 ✓substitution ✓simplification ✓standard form ✓x – values ✓y – values (6)
1.3	$\frac{n}{m} = \frac{p}{n}$ $n^2 = mp$ $\Delta = b^2 - 4ac$ $\Delta = n^2 - 4mp$, but $n^2 = mp$ $\Delta = n^2 - 4n^2$ OR/OF $\Delta = mp - 4mp$ $\Delta = -3n^2$ $\Delta = -3mp$ $n^2 > 0$ $mp > 0$ $\therefore -3n^2 < 0$ $\therefore -3mp < 0$ $\therefore \Delta < 0 \Rightarrow x \text{ is a non-real number}$	✓ $\frac{n}{m} = \frac{p}{n}$ ✓ $n^2 = mp$ ✓ $\Delta = -3n^2 \text{ or } -3mp$ ✓ $\Delta < 0$ (4)
		[24]

QUESTION/VRAAG 2

2.1	$\frac{90}{x} = \frac{81}{90}$ $81x = 8100$ $x = 100$ <p>OR/OF</p> $x = 90 \times \frac{10}{9}$ $x = 100$	$\checkmark \frac{90}{x} = \frac{81}{90}$ $\checkmark \text{ answer} \quad (2)$ <p>OR/OF</p> $\checkmark \frac{10}{9}$ $\checkmark \text{ answer} \quad (2)$
2.2	$S_n = \frac{a(1-r^n)}{1-r}$ $S_n = \frac{100(1-(0,9)^n)}{1-0,9}$ $S_n = \frac{100(1-(0,9)^n)}{0,1}$ $\therefore S_n = 1\,000(1-(0,9)^n)$	$\checkmark r = 0,9$ $\checkmark \text{substitution into correct formula} \quad (2)$
2.3	$S_\infty = \frac{a}{1-r}$ $S_\infty = \frac{100}{1-\frac{9}{10}}$ $S_\infty = 1000$ <p>OR/OF</p> $S_\infty = \lim_{n \rightarrow \infty} [1\,000(1-(0,9)^n)]$ $S_\infty = 1000$	$\checkmark \text{ substitution}$ $\checkmark \text{ answer} \quad (2)$ <p>OR/OF</p> $\checkmark S_\infty = \lim_{n \rightarrow \infty} [1\,000(1-(0,9)^n)]$ $\checkmark \text{ answer} \quad (2)$
		[6]

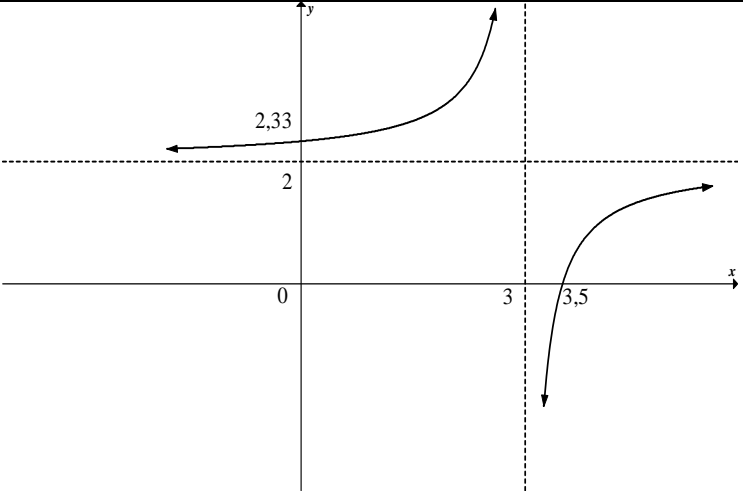
QUESTION 3

3.1	-82	✓ answer (1)
3.2	$ \begin{array}{c} -145 ; -122 ; -101 ; \dots \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ 23 \quad \quad 21 \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ -2 \quad \quad -2 \end{array} $ <p> $2a = -2 \quad \therefore a = -1$ $3a + b = 23 \quad \therefore 3(-1) + b = 23 \quad \therefore b = 26$ $a + b + c = -145 \quad \therefore -1 + 26 + c = -145 \quad \therefore c = -170$ $\therefore T_n = -n^2 + 26n - 170$ </p> <p>OR/OF</p> <p> $2a = -2 \quad \therefore a = -1$ $c = -145 + (-2) - 23 = -170$ $\therefore T_n = -n^2 + bn - 170$ $-145 = -1 + b - 170$ $b = 26$ $\therefore T_n = -n^2 + 26n - 170$ </p>	<p> $\checkmark 2a = -2$ $\checkmark 3(-1) + b = 23$ $\checkmark -1 + 26 + c = -145$ (3) </p> <p>OR/OF</p> <p> $\checkmark 2a = -2$ $\checkmark c = -145 + (-2) - 23$ $\checkmark -145 = -1 + b - 170$ (3) </p>
3.3	$ \begin{array}{l} T_n = bn + c \\ T_n = -2n + 25 \\ -2n + 25 = -121 \\ -2n = -146 \\ n = 73 \\ \text{Between } T_{73} \text{ and } T_{74} \end{array} $ <p>OR/OF</p> $ \begin{array}{l} T_{n+1} - T_n = -(n+1)^2 + 26(n+1) - 170 - (-n^2 + 26n - 170) \\ -121 = -2n + 25 \\ n = 73 \\ \text{Between } T_{73} \text{ and } T_{74} \end{array} $	$ \begin{array}{l} T_n = a + (n-1)d \\ = 23 + (n-1)(-2) \\ = 25 - 2n \end{array} $ <p> $\checkmark T_n = -2n + 25$ $\checkmark T_n = -121$ $\checkmark n = 73$ \checkmark answer (4) </p> <p>OR/OF</p> <p> $\checkmark T_n = -2n + 25$ $\checkmark T_n = -121$ $\checkmark n = 73$ \checkmark answer (4) </p>
3.4	$ \begin{array}{l} n = \frac{-b}{2a} = \frac{-26}{2(1)} = 13 \\ T_{13} = -1 \\ \therefore \text{add 2} \end{array} $ <p>OR/OF</p> $ \begin{array}{l} T'_n = -2n + 26 = 0 \\ n = 13 \\ T_{13} = -(13)^2 + 26(13) - 170 = -1 \\ \therefore \text{add 2} \end{array} $	<p> $\checkmark 13$ $\checkmark T_{13} = -1$ \checkmark add 2 (3) </p> <p>OR/OF</p> <p> $\checkmark 13$ $\checkmark T_{13} = -1$ \checkmark add 2 (3) </p>
		[11]

QUESTION/VRAAG 4

4.1	$a = 5$ and/en $d = 2$ $T_{51} = 5 + (51 - 1)(2)$ $= 105$	✓ a and d ✓ substitution into correct formula ✓ answer (3)
4.2	$S_n = \frac{n}{2}[2a + (n - 1)d]$ $S_{51} = \frac{51}{2}[2(5) + (51 - 1)2]$ or/of $S_{51} = \frac{51}{2}[5 + 105]$ $= 2\,805$	✓ substitution into correct formula ✓ answer (2)
4.3	$\sum_{n=1}^{5\,000} (2n + 3) = 5 + 7 + 9 + \dots + 10\,003$	✓ expansion (1)
4.4	$T_1 = -3$ $T_{4\,999} = -2(4\,999) - 1 = -9\,999$ $\therefore \sum_{n=1}^{5\,000} (2n + 3) + \sum_{n=1}^{4\,999} (-2n - 1)$ $= (5 + 7 + 9 + \dots + 9\,999 + 10\,001 + 10\,003) +$ $(-3 - 5 - 7 - 9 - \dots - 9\,999)$ $= 10\,001 + 10\,003 - 3$ $= 20\,001$ OR/OF $S_{4\,999} = \frac{4\,999}{2}[2(-3) + (4\,999 - 1)(-2)] = -24\,999\,999$ $S_{5\,000} = \frac{5\,000}{2}((2)(5) + (5\,000 - 1)(2)) = 25\,020\,000$ $\sum_{n=1}^{5\,000} (2n + 3) + \sum_{n=1}^{4\,999} (-2n - 1) = 25\,020\,000 - 24\,999\,999$ $= 20\,001$	✓ $T_1 = -3$ ✓ $T_{4\,999} = -9\,999$ ✓ both expansions ✓ answer (A) (4) OR/OF ✓ $T_1 = -3$ ✓ $S_{4\,999} = -24\,999\,999$ ✓ $S_{5\,000} = 25\,020\,000$ ✓ answer (A) (4)
		[10]

QUESTION/VRAAG 5

5.1	$x = 3$ $y = 2$	✓ $x = 3$ ✓ $y = 2$ (2)
5.2	$x \in R, x \neq 3$ OR/OF $x \in (-\infty ; 3) \cup (3 ; \infty)$ OR/OF $x < 3$ or $x > 3$	✓ answer (1) OR/OF ✓ answer (1) OR/OF ✓ answer (1)
5.3	$0 = \frac{-1}{x-3} + 2$ $-2x + 6 = -1$ $x = \frac{7}{2}$ x-int: $\left(\frac{7}{2} ; 0\right)$	✓ $y = 0$ ✓ answer (2)
5.4	y-int: $\left(0 ; \frac{7}{3}\right)$	✓ $x = 0$ ✓ $\frac{7}{3}$ (2)
5.5		✓ asymptotes ✓ intercepts with the axes ✓ shape (3)
		[10]

QUESTION/VRAAG 6

6.1	$f(x) = \log_4 x$ $2 = \log_4 k$ $4^2 = k$ $\therefore k = 16$	✓ substitution of $(k ; 2)$ ✓ answer (2)
6.2	$-1 = \log_4 x \quad \therefore x = \frac{1}{4}$ $\frac{1}{4} \leq x \leq 16 \quad \text{or/of} \quad x \in \left[\frac{1}{4} ; 16 \right]$	✓ $x = \frac{1}{4}$ ✓ answer (2)
6.3	$f(x) = \log_4 x$ $y = \log_4 x$ $x = \log_4 y$ $y = 4^x$	✓ swopping x and y ✓ answer (2)
6.4	$x < 0$ OR/OF $x \in (-\infty ; 0)$	✓✓ answer (2) OR/OF ✓✓ answer (2)
		[8]

QUESTION 7

7.1	B(-4 ; 0) D(6 ; 0)	✓ B(-4 ; 0) ✓ D(6 ; 0) (2)
7.2	$f(x) = x^2 - 2x - 24$ $x_{tp} = \frac{-b}{2a}$ OR/OF $2x - 2 = 0$ OR/OF $x = \frac{-4 + 6}{2}$ $x = \frac{-(-2)}{2(1)}$ $\therefore x_{tp} = 1$ $y_{tp} = f(1)$ $= 1^2 - 2(1) - 24$ $= -25$ C(1 ; -25)	✓ $x_{tp} = 1$ ✓ $y_{tp} = -25$ (2)
7.3	$y \geq -25$ OR/OF $y \in [-25 ; \infty)$	✓ answer (1) OR/OF ✓ answer (1)
7.4.1	$m_{AE} = \tan 14,04^\circ = 0,25 = \frac{1}{4}$	✓ answer (1)
7.4.2	$m_{\text{tang}} = -4$ $f'(x) = 2x - 2$ $2x - 2 = -4$ $x_T = -1$ $y_T = -21$	✓ $m_{\text{tang}} = -4$ ✓ $f'(x) = 2x - 2$ ✓ equating ✓ $x_T = -1$ ✓ $y_T = -21$ (5)
7.5	$m_{\text{line}} = \frac{1}{4}$ $y + 9 = \frac{1}{4}(x + 3)$ OR/OF $-9 = \frac{1}{4}(-3) + c$ $y + 9 = \frac{1}{4}x + \frac{3}{4}$ $c = -\frac{33}{4} = -8,25$ $y = \frac{1}{4}x - \frac{33}{4}$ OR/OF $y = 0,25x - 8,25$ $x^2 - 2x - 24 = \frac{1}{4}x - \frac{33}{4}$ $4x^2 - 8x - 96 = x - 33$ $4x^2 - 9x - 63 = 0$ $(4x - 21)(x + 3) = 0$ $\therefore x = \frac{21}{4} = 5,25$ or $x \neq -3$	✓ $m_{\text{line}} = \frac{1}{4}$ ✓ substitution m and $K(-3 ; -9)$ ✓ $y = \frac{1}{4}x - \frac{33}{4}$ ✓ equating ✓ standard form ✓ answer with selection (6)
		[17]

QUESTION/VRAAG 8

8.1	$A = P(1-i)^n$ $A = 980\,000(1-0,092)^7$ $A = R498\,685,82$	✓ correct formula ✓ substitution ✓ answer (A) (3)
8.2	$A = P(1+i)^n$ $116\,253,50 = 75\,000\left(1 + \frac{0,068}{4}\right)^{4n}$ $1,550\,046\,667 = (1,017)^{4n}$ $\log(1,550\,046\,667) = 4n\log(1,017)$ $4n = \frac{\log(1,550\,046\,667)}{\log(1,017)}$ or $4n = \log_{1,017}(1,550\,046\,667)$ $4n = 25,99 \dots$ $n = 6,50$ years	✓ $\frac{0,068}{4}$ ✓ substitution in correct formula ✓ correct use of logs ✓ answer (4)
8.3.1	$F = \frac{x[(1+i)^n - 1]}{i}$ $450\,000 = \frac{x\left[\left(1 + \frac{0,0835}{12}\right)^{60} - 1\right]}{\frac{0,0835}{12}}$ $x = R6\,068,69$	✓ $i = \frac{0,0835}{12}$ ✓ substitution into correct formula ✓ answer (3)
8.3.2(a)	$P = \frac{x[1 - (1+i)^{-n}]}{i}$ $11\,058,85 = \frac{x\left[1 - \left(1 + \frac{0,12}{12}\right)^{-4 \times 12}\right]}{\frac{0,12}{12}}$ $P = R419\,948,32$ OR/OF Balance = A – F $= P(1+i)^n - \frac{x[(1+i)^n - 1]}{i}$ $= 1\,050\,000\left(1 + \frac{0,12}{12}\right)^{12 \times 21} - \frac{11\,058,85\left[\left(1 + \frac{0,12}{12}\right)^{12 \times 21} - 1\right]}{\frac{0,12}{12}}$ $= R12\,887\,702,20 - R12\,467\,749,81$ $= R419\,952,39$	✓ $n = 48$ in P-formula ✓ substitution into correct formula ✓ answer (A) (3) OR/OF ✓ $n = 252$ in both formulae ✓ subst into correct formulae ✓ answer (A) (3)

8.3.2(b)	<p>Total paid = $11\,058,85 \times 21 \times 12 = 2\,786\,830,20$ Loan Paid = $1\,050\,000 - 419\,948,32 = 630\,051,68$ Interest paid = $2\,786\,830,20 - 630\,051,68$ = R2 156 778,52</p> <p>OR/OF</p> <p>Total paid = $11\,058,85 \times 21 \times 12 = 2\,786\,830,20$ Loan Paid = $1\,050\,000 - 419\,952,39 = 630\,047,61$ Interest paid = $2\,786\,830,20 - 630\,047,61$ = R2 156 782,59</p> <p>OR/OF</p> <p>Interest paid = $11\,058,85 \times 21 \times 12 - (1\,050\,000 - 419\,948,32)$ = $2\,786\,830,20 - 630\,051,68$ = R2 156 778,52</p>	<p>✓ $11\,058,85 \times 21 \times 12$ ✓ $1\,050\,000 - \text{Balance Outstanding}$ ✓ answer (3)</p> <p>OR/OF</p> <p>✓ $11\,058,85 \times 21 \times 12$ ✓ $1\,050\,000 - \text{Balance Outstanding}$ ✓ answer (3)</p> <p>OR/OF</p> <p>✓ $11\,058,85 \times 21 \times 12$ ✓ $1\,050\,000 - \text{Balance Outstanding}$ ✓ answer (3)</p>
		[16]

QUESTION/VRAAG 9

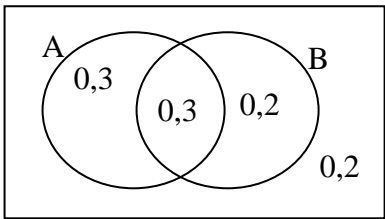
9.1	$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{2(x+h)^2 - 3(x+h) - (2x^2 - 3x)}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{2x^2 + 4xh + 2h^2 - 3x - 3h - 2x^2 + 3x}{h}$ $= \lim_{h \rightarrow 0} \frac{4xh + 2h^2 - 3h}{h}$ $= \lim_{h \rightarrow 0} \frac{h(4x + 2h - 3)}{h}$ $= \lim_{h \rightarrow 0} (4x + 2h - 3)$ $\therefore f'(x) = 4x - 3$ <p>OR/OF</p> $f(x) = 2x^2 - 3x$ $f(x+h) = 2(x+h)^2 - 3(x+h)$ $f(x+h) = 2x^2 + 4xh + 2h^2 - 3x - 3h$ $f(x+h) - f(x) = 4xh + 2h^2 - 3h$ $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \rightarrow 0} \frac{4xh + 2h^2 - 3h}{h}$ $= \lim_{h \rightarrow 0} \frac{h(4x + 2h - 3)}{h}$ $= \lim_{h \rightarrow 0} (4x + 2h - 3)$ $\therefore f'(x) = 4x - 3$	<p>✓substitution</p> <p>✓ $2x^2 + 4xh + 2h^2 - 3x - 3h$</p> <p>✓ $4xh + 2h^2 - 3h$</p> <p>✓factorisation</p> <p>✓answer (5)</p> <p>OR/OF</p> <p>✓substitution</p> <p>✓ $2x^2 + 4xh + 2h^2 - 3x - 3h$</p> <p>✓ $4xh + 2h^2 - 3h$</p> <p>✓factorisation</p> <p>✓answer (5)</p>
9.2.1	$y = 4x^5 - 6x^4 + 3x$ $\frac{dy}{dx} = 20x^4 - 24x^3 + 3$	<p>✓ $20x^4$</p> <p>✓ $-24x^3$</p> <p>✓ 3 (3)</p>

9.2.2	$D_x \left[\frac{-\sqrt[3]{x}}{2} + \left(\frac{1}{3x} \right)^2 \right]$ $D_x \left[\frac{-x^{\frac{1}{3}}}{2} + x^{-2} \right]$ $D_x \left[-\frac{1}{2} x^{\frac{1}{3}} + \frac{1}{9} x^{-2} \right]$ $= -\frac{1}{6} x^{-\frac{2}{3}} - \frac{2x^{-3}}{9}$ $= -\frac{1}{6x^{\frac{2}{3}}} - \frac{2}{9x^3}$	$\checkmark \frac{-x^{\frac{1}{3}}}{2} \quad \checkmark \frac{x^{-2}}{9}$ $\checkmark -\frac{1}{6} x^{-\frac{2}{3}} \quad \checkmark -\frac{2x^{-3}}{9}$ <p style="text-align: right;">(4)</p>
		[12]

QUESTION/VRAAG 11

11	$\text{Time} = \frac{20}{x}$ $\text{Cost} = (\text{water cost per hour} \times \text{time}) + (\text{kms} \times \text{R/km})$ $C(x) = 1,6 \times \left(\frac{20}{x} \right) + 20 \left(1,2 + \frac{x}{4000} \right)$ $C(x) = \frac{32}{x} + 24 + \frac{x}{200}$ $C'(x) = -\frac{32}{x^2} + \frac{1}{200} = 0$ $x^2 = 6400$ $x = 80 \text{ km/h}$	$\checkmark \frac{20}{x}$ $\checkmark 1,6 \times \left(\frac{20}{x} \right)$ $\checkmark 20 \left(1,2 + \frac{x}{4000} \right)$ $\checkmark C(x) = \frac{32}{x} + 24 + \frac{x}{200}$ $\checkmark C'(x) = -\frac{32}{x^2} + \frac{1}{200}$ $\checkmark C'(x) = 0$ $\checkmark \text{answer (A)}$
		(7)
		[7]

QUESTION/VRAAG 12

12.1.1	No, because $P(A \text{ and } B) \neq 0$	\checkmark answer and reason (1)
12.1.2(a)	$P(A \text{ and } B) = 0,3$ $P(\text{only } B) = 0,2$ $P(A \text{ and } B) = P(A) \times P(B)$ $0,3 = P(A) \times 0,5$ $P(A) = 0,6$ $P(\text{only } A) = 0,3$	$\checkmark P(A \text{ and } B) = P(A) \times P(B)$ $\checkmark 0,5$ $\checkmark P(A) = 0,6$ \checkmark answer (4)
12.1.2(b)	 <p>$P(\text{not } A \text{ or not } B) = 0,2 + 0,2 + 0,3 = 0,7$</p> <p>OR/OF</p> <p>$P(\text{not } A \text{ or not } B) = 1 - P(A \text{ and } B) = 1 - 0,3 = 0,7$</p> <p>OR/OF</p> <p>$P(A' \text{ or } B') = P(A') + P(B') - P(A' \text{ and } B')$ $= 0,4 + 0,5 - 0,2 = 0,7$</p>	\checkmark method \checkmark answer (2) <p>OR/OF</p> \checkmark method \checkmark answer (2) <p>OR/OF</p> \checkmark method \checkmark answer (2)

12.2.1	$P(\text{novel}) = \frac{3}{12} = \frac{1}{4}$				✓ answer (1)
12.2.2	$12! = 479\,001\,600$				✓✓ answer (2)
12.2.3	5 (Poetry)	3! (Novels all together)	8! (Arrangements of rest of the books including the novels)	4 (Drama)	✓ 5×4 ✓ $3! = 6$ ✓ $8!$ ✓ $\frac{5 \times 3! \times 8! \times 4}{12!} = \frac{1}{99}$ (A) (4)
	P(start with poetry, end with drama AND all novels together) $= \frac{5 \times 3! \times 8! \times 4}{12!}$ $= \frac{1}{99}$				[14]

TOTAL/TOTAAL: 150