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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

MAY/JUNE/MEI/JUNIE 2023

MARKS: 150

PUNTE: 150

**These marking guidelines consist of 15 pages./
*Hierdie nasienriglyne bestaan uit 15 bladsye.***

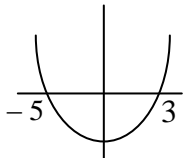
NOTE:

- 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 1/VRAAG 1

1.1.1	$x^2 - 7x + 12 = 0$ $(x - 4)(x - 3) = 0$ $x = 4$ or $x = 3$	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> Answer only: Full Marks </div>	✓ factors ✓ $x = 4$ ✓ $x = 3$ (3)
1.1.2	$3x^2 + 5x - 1 = 0$ $x = \frac{-5 \pm \sqrt{5^2 - 4(3)(-1)}}{2(3)} = \frac{-5 \pm \sqrt{37}}{6}$ $\therefore x = 0,18$ or $x = -1,85$		✓ standard form ✓ substitution into the correct formula ✓ $x = 0,18$ ✓ $x = -1,85$ (4)
1.1.3	$x^2 + 2x - 15 < 0$ $(x - 3)(x + 5) < 0$ $x = 3$ or $x = -5$ $-5 < x < 3$		✓ standard form ✓ critical values ✓ ✓ answer (4)
1.1.4	$\sqrt{2(1-x)} = x - 1$ $(\sqrt{2(1-x)})^2 = (x - 1)^2$ $2 - 2x = x^2 - 2x + 1$ $x^2 - 1 = 0$ $\therefore x = 1$ and $x \neq -1$		✓ squaring both sides ✓ simplification ✓ standard form ✓ answer with selection (4)

1.2	$3^{x+y} = 27$ $x^2 + y^2 = 17$ $3^{x+y} = 3^3$ $x + y = 3 \dots\dots(1)$ $y = 3 - x$ $x^2 + (3 - x)^2 = 17$ $2x^2 - 6x - 8 = 0$ $x^2 - 3x - 4 = 0$ $(x - 4)(x + 1) = 0$ $x = 4 \text{ or } x = -1$ $y = -1 \text{ or } y = 4$ OR/OF $3^{x+y} = 27$ $x^2 + y^2 = 17$ $3^{x+y} = 3^3$ $x + y = 3 \dots\dots(1)$ $x = 3 - y$ $(3 - y)^2 + y^2 = 17$ $9 - 6y + y^2 + y^2 - 17 = 0$ $2y^2 - 6y - 8 = 0$ $y^2 - 3y - 4 = 0$ $(y - 4)(y + 1) = 0$ $y = -1 \text{ or } y = 4$ $x = 4 \text{ or } x = -1$	$\checkmark 3^{x+y} = 3^3$ $\checkmark x + y = 3$ \checkmark substitution \checkmark standard form $\checkmark x$ -values $\checkmark y$ -values (6) OR/OF $\checkmark 3^{x+y} = 3^3$ $\checkmark x + y = 3$ \checkmark substitution \checkmark standard form $\checkmark y$ -values $\checkmark x$ -values (6)
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1.3	$\frac{1}{\sqrt{1} + \sqrt{2}} + \frac{1}{\sqrt{2} + \sqrt{3}} + \frac{1}{\sqrt{3} + \sqrt{4}} + \dots + \frac{1}{\sqrt{99} + \sqrt{100}}$ $= \frac{1}{\sqrt{1} + \sqrt{2}} \times \frac{\sqrt{1} - \sqrt{2}}{\sqrt{1} - \sqrt{2}} + \dots$ $+ \frac{1}{\sqrt{99} + \sqrt{100}} \times \frac{\sqrt{99} - \sqrt{100}}{\sqrt{99} - \sqrt{100}}$ $= -1 + \sqrt{2} - \sqrt{2} + \sqrt{3} - \sqrt{3} + 2\dots - \sqrt{99} + 10$ $= -1 + 10$ $= 9$	<p>✓ rationalisation</p> <p>✓ simplification</p> <p>✓ answer (3)</p>
		[24]

QUESTION 2/VRAAG 2

2.1.1	$\frac{1}{5} + \frac{1}{15} + \frac{1}{45} + \dots$ $r = \frac{\frac{1}{15}}{\frac{1}{5}} = \frac{1}{3}$ $-1 < \frac{1}{3} < 1$ $\therefore \text{the series is convergent.}$	$\checkmark r = \frac{1}{3}$ \checkmark answer (any indicator of convergence) (2)
2.1.2	$S_{\infty} = \frac{a}{1-r}$ $= \frac{\frac{1}{5}}{1 - \frac{1}{3}}$ $= \frac{3}{10}$	\checkmark substitution \checkmark answer (2)
2.2.1	$4x ; \frac{1}{81}$	$\checkmark 4x \checkmark \frac{1}{81}$ (2)
2.2.2	$T_n = x + (n-1)x$ $= x + xn - x$ $= xn$	<div style="border: 1px solid black; padding: 5px; display: inline-block;">Answer only: Full Marks</div> \checkmark substitution \checkmark answer (2)
2.2.3	$T_n = ar^{n-1}$ $T_{13} = \frac{1}{3} \left(\frac{1}{3} \right)^{13-1}$ $T_{13} = \left(\frac{1}{3} \right)^{13} \text{ or } \frac{1}{1594323} \text{ or } 6,27 \times 10^{-7} \text{ or } 3^{-13}$	$\checkmark n = 13$ $\checkmark r = \frac{1}{3}$ \checkmark answer (3)
2.2.4	$\sum_{n=1}^{21} P_n = S_{11} + S_{10}$ $= \frac{11}{2} [2x + 10x] + \frac{\frac{1}{3} \left[1 - \left(\frac{1}{3} \right)^{10} \right]}{1 - \frac{1}{3}}$ $= 66x + 0,5$ $33,5 = 66x + 0,5$ $\therefore x = \frac{1}{2}$	$\checkmark S_{11} \checkmark + S_{10}$ \checkmark arithmetic sum \checkmark geometric sum $\checkmark 66x + 0,5 \quad (\text{A})$ \checkmark answer (6)
		[17]

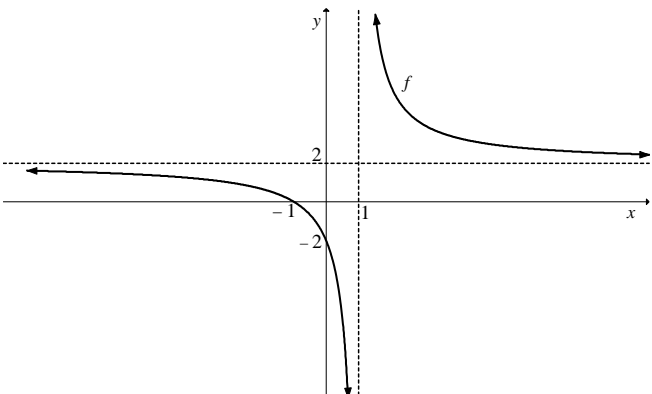
QUESTION 3/VRAAG 3

<p>3.1</p>	$ \begin{array}{c} x \quad ; \quad x \quad ; \quad T_3 \quad ; \quad \dots \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ 0 \quad \quad T_3 - x \\ \swarrow \quad \searrow \\ 10 \end{array} $ $ \begin{array}{ll} 2a = 10 & 3a + b = 0 \\ a = 5 & b = -15 \end{array} $ $ \begin{array}{l} T_3 - x - 0 = 10 \\ \therefore T_3 = x + 10 \end{array} $ $ \begin{array}{l} 2x + T_3 = 28 \\ 2x + x + 10 = 28 \\ 3x = 18 \\ x = 6 \end{array} $ $ \begin{array}{l} a + b + c = 6 \\ 5 - 15 + c = 6 \\ c = 16 \end{array} $ $\therefore T_n = 5n^2 - 15n + 16$ <p>OR/OF</p> $ \begin{array}{l} 2a = 10 \\ \therefore a = 5 \end{array} $ $ \begin{array}{lll} T_1 = a + b + c & T_2 = 4a + 2b + c & T_3 = 9a + 3b + c \\ = 5 + b + c & = 20 + 2b + c & = 45 + 3b + c \end{array} $ $ \begin{array}{l} 5 + b + c = 20 + 2b + c \\ b = -15 \end{array} $ $ \begin{array}{lll} T_1 = -10 + c & T_2 = -10 + c & T_3 = c \end{array} $ $ \begin{array}{l} T_1 + T_2 + T_3 = -10 + c - 10 + c + c \\ 28 = 3c - 20 \\ c = 16 \end{array} $	$ \begin{array}{l} \checkmark 2a = 10 \\ \checkmark 3a + b = 0 \end{array} $ $\checkmark T_3 = x + 10$ $\checkmark 2x + T_3 = 28$ $\checkmark x = 6$ $\checkmark 5 - 15 + c = 6$ <p style="text-align: right;">(6)</p> <p>OR/OF</p> $\checkmark 2a = 10$ $\checkmark 5 + b + c = 20 + 2b + c$ $ \begin{array}{l} \checkmark T_1 = -10 + c \\ \checkmark T_2 = -10 + c \end{array} $ $ \begin{array}{l} \checkmark 28 = 3c - 20 \\ \checkmark c = 16 \end{array} $ <p style="text-align: right;">(6)</p>
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3.2	$T_n = 5n^2 - 15n + 16$ $216 = 5n^2 - 15n + 16$ $5n^2 - 15n - 200 = 0$ $n^2 - 3n - 40 = 0$ $(n - 8)(n + 5) = 0$ $n = 8 \quad \text{or} \quad n = -5$ $\therefore T_8 = 216$	✓ equating ✓ standard form ✓ $n = 8$ (3)
		[9]

QUESTION 4/VRAAG 4

4.1.1	decreasing	✓ decreasing (1)
4.1.2	$y = \left(\frac{1}{3}\right)^x$ $x = \left(\frac{1}{3}\right)^y$ $\therefore y = \log_{\frac{1}{3}} x$ OR/OF $y = 3^{-x}$ $x = 3^{-y}$ $\therefore y = -\log_3 x$	✓ swop x and y ✓ answer (2) OR/OF ✓ swop x and y ✓ answer (2)
4.1.3	$x > 0; x \in R$	✓ answer (1)
4.1.4	$y = -5$	✓ answer (1)
4.2.1	$x = 1$ $y = 2$	✓ $x = 1$ ✓ $y = 2$ (2)
4.2.2	$\frac{4}{x-1} + 2 = 0$ $4 = -2x + 2$ $2x = -2$ $x = -1$	✓ let $y = 0$ ✓ $x = -1$ (2)

4.2.3		<ul style="list-style-type: none"> ✓ asymptotes ✓ x-intercept ✓ y-intercept ✓ shape <p style="text-align: right;">(4)</p>
4.2.4	$\frac{4}{x-1} \geq -2$ $\frac{4}{x-1} + 2 \geq 0$ $x \leq -1 \quad \text{or} \quad x > 1$	<ul style="list-style-type: none"> ✓ $x \leq -1$ ✓ $x > 1$ <p style="text-align: right;">(2)</p>
4.2.5	$y = -x + c$ $2 = -3 + c$ $c = 5$ $y = -x + 5$ <p>OR/OF</p> $y = -x + c$ $2 = -1 + c$ $c = 3$ $y = -x + 3$ $y = -(x-2) + 3$ $y = -x + 5$ <p>OR/OF</p> $y = -(x+p) + q$ $y = -((x-2) + (-1)) + 2$ $y = -x + 5$	<ul style="list-style-type: none"> ✓ intersection of axes at (3 ; 2) ✓ subst (3 ; 2) and $m = -1$ ✓ $y = -x + 5$ <p style="text-align: right;">(3)</p> <p>OR/OF</p> <ul style="list-style-type: none"> ✓✓ $-(x-2) + 3$ ✓ $y = -x + 5$ <p style="text-align: right;">(3)</p> <p>OR/OF</p> <ul style="list-style-type: none"> ✓✓ $y = -((x-2) + (-1)) + 2$ ✓ $y = -x + 5$ <p style="text-align: right;">(3)</p>
		[18]

QUESTION 5/VRAAG 5

5.1	T.P($-3;4$)	✓ -3 ✓ 4 (2)
5.2	$y \leq 4$ or $y \in (-\infty;4]$	✓ answer (1)
5.3	$f(x) = g(x)$ $-(x+3)^2 + 4 = x + 5$ $-x^2 - 6x - 9 + 4 = x + 5$ $-x^2 - 7x - 10 = 0$ $x^2 + 7x + 10 = 0$ $(x+5)(x+2) = 0$ $x = -5$ or $x = -2$	✓ equating ✓ $-x^2 - 6x - 9$ ✓ standard form ✓ factors (4)
5.4	The graph must shift more than 2 and less than 5 units to the right $\therefore -5 < c < -2$	✓✓ answer (2)
5.5	$D(x) = f(x) - g(x) = -x^2 - 7x - 10$ Max: $-2x - 7 = 0$ OR/OF $x = \frac{-(-7)}{2(-1)}$ $x = -\frac{7}{2}$ $D\left(-\frac{7}{2}\right) = -\left(-\frac{7}{2}\right)^2 - 7\left(-\frac{7}{2}\right) - 10 = 2,25$ $\therefore k = 2,25$ $\therefore h(x) = x + 7,25$	✓ distance ✓ $-2x - 7 = 0$ ✓ $x = -\frac{7}{2}$ ✓ $k = 2,25$ ✓ $h(x) = x + 7,25$ (5)
		[14]

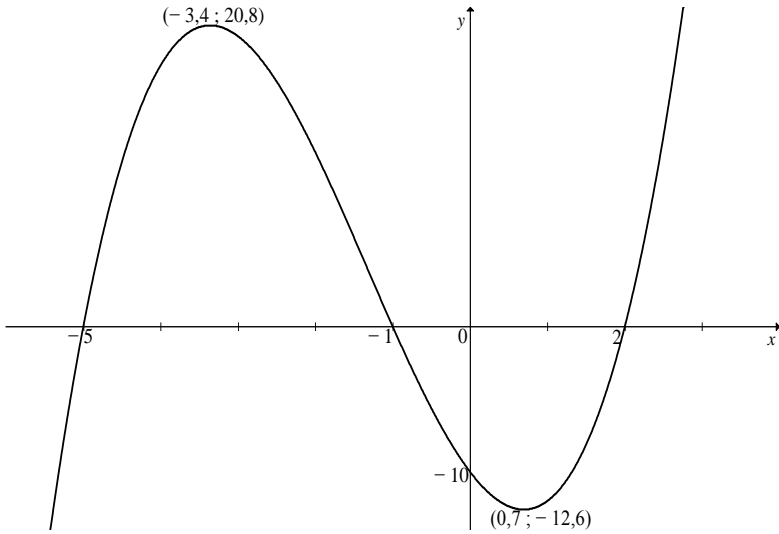
QUESTION 6/VRAAG 6

6.1.1	$A = P(1+i)^n$ $A = 150\,000(1+0,065)^5$ $A = R205\,513$	✓ substitution into the correct formula ✓ answer (2)
6.1.2	$A = P(1-in)$ $A = 150\,000(1-0,09 \times 5)$ $A = 150\,000 - 67\,000$ $A = R82\,500$	✓ substitution into the correct formula ✓ answer (2)
6.1.3	$SF = A - T = 205\,513 - 82\,500$ $= R123\,013$ $F = \frac{x[(1+i)^n - 1]}{i}$ $x = \frac{F \times i}{(1+i)^n - 1}$ $x = \frac{123\,013 \times \frac{0,0785}{12}}{\left[\left(1 + \frac{0,0785}{12}\right)^{59} - 1\right] \left(1 + \frac{0,0785}{12}\right)}$ $= R1\,704,01$	✓ answer ✓ $i = \frac{0,0785}{12}$ ✓ 59 and $\left(1 + \frac{0,0785}{12}\right)$ (A) ✓ answer (A) (4)
6.2	$P = \frac{x[1 - (1+i)^{-n}]}{i}$ $200\,000 = \frac{6\,000 \left[1 - \left(1 + \frac{0,0525}{4}\right)^{-4n}\right]}{\frac{0,0525}{4}}$ $\frac{7}{16} = 1 - \left(1 + \frac{0,0525}{4}\right)^{-4n}$ $\frac{9}{16} = \left(\frac{1621}{1600}\right)^{-4n}$ $-4n = \frac{\log \frac{9}{16}}{\log \left(\frac{1621}{1600}\right)}$ $-4n = -44,1243\dots$ $n = 11,03 \text{ years}$	✓ substitution into correct formula ✓ simplification ✓ use of logs ✓ $-4n = -44,1243\dots$ ✓ $n = 11,03 \text{ years}$ (5)
		[13]

QUESTION 7/VRAAG 7

7.1	$f(x) = -2x^2 - 1$ $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{-2(x+h)^2 - 1 - (-2x^2 - 1)}{h}$ $f'(x) = \lim_{h \rightarrow 0} \frac{-2x^2 - 4xh - 2h^2 - 1 + 2x^2 + 1}{h}$ $= \lim_{h \rightarrow 0} \frac{-4xh - 2h^2}{h}$ $= \lim_{h \rightarrow 0} \frac{h(-4x - 2h)}{h}$ $= -4x$ <p>OR/OF</p> $f(x+h) = -2(x+h)^2 - 1$ $f(x+h) = -2x^2 - 4xh - 2h^2 - 1$ $f(x+h) - f(x) = -2x^2 - 4xh - 2h^2 - 1 + 2x^2 + 1$ $f(x+h) - f(x) = -4xh - 2h^2$ $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$ $= \lim_{h \rightarrow 0} \frac{-4xh - 2h^2}{h}$ $= \lim_{h \rightarrow 0} \frac{h(-4x - 2h)}{h}$ $= -4x$	<p>✓ substitution into the correct formula</p> <p>✓ $-2x^2 - 4xh - 2h^2 - 1$</p> <p>✓ $-4xh - 2h^2$</p> <p>✓ common factor</p> <p>✓ answer (5)</p> <p>OR/OF</p> <p>✓ $-2x^2 - 4xh - 2h^2 - 1$</p> <p>✓ $-4xh - 2h^2$</p> <p>✓ substitution into the correct formula</p> <p>✓ common factor</p> <p>✓ answer (5)</p>
7.2.1	$f(x) = -2x^3 + 3x^2$ $f'(x) = -6x^2 + 6x$	<p>✓ $-6x^2$</p> <p>✓ $+6x$ (2)</p>
7.2.2	$y = 2x + \frac{1}{\sqrt{4x}}$ $y = 2x + \frac{1}{2} x^{-\frac{1}{2}}$ $\frac{dy}{dx} = 2 - \frac{1}{4} x^{-\frac{3}{2}}$	<p>✓ $\frac{1}{2}$ ✓ $x^{-\frac{1}{2}}$</p> <p>✓ 2 ✓ $-\frac{1}{4} x^{-\frac{3}{2}}$ (4)</p>
7.3	$x < 1$	<p>✓✓ answer (2)</p>
[13]		

QUESTION 8/VRAAG 8

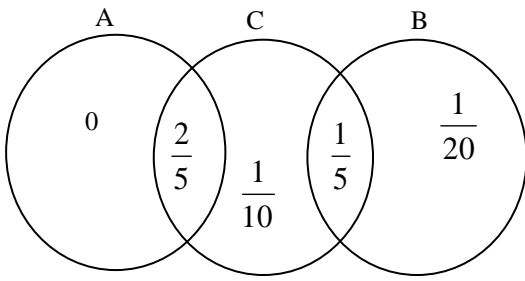
8.1	$y = -10$	✓ answer (1)
8.2	$f(x) = x^3 + 4x^2 - 7x - 10$ $f(2) = 2^3 + 4(2)^2 - 7(2) - 10 = 0$	✓ substitution of $x = 2$ ✓ $f(2) = 0$ (2)
8.3	$f(x) = (x-2)(x^2 + 6x + 5)$ $f(x) = (x-2)(x+5)(x+1)$	✓ $(x-2)$ ✓ $(x+5)$ ✓ $(x+1)$ (3)
8.4		✓ x- intercepts ✓ y-intercept ✓ sketching the graph with turning points in 2 nd and 4 th quadrant (3)
8.5.1	$x \in (-3,4 ; 0,7)$ OR/OF $-3,4 < x < 0,7$	✓✓ $x \in (-3,4 ; 0,7)$ (2)
8.5.2	$f(x) = x^3 + 4x^2 - 7x - 10$ $f'(x) = 3x^2 + 8x - 7$ $f''(x) = 6x + 8 = 0$ $\therefore x = -\frac{8}{6} = -\frac{4}{3} = -1,33$ OR/OF $\frac{-3,4 + 0,7}{2} = -1,35 = -1,35$	✓ $f''(x) = 6x + 8$ ✓ answer (2) OR/OF ✓ substitution ✓ answer (2)
8.5.3	$x \leq -3,4$ or $-1,33 \leq x \leq 0,7$ OR/OF $x \in (-\infty ; -3,4] \cup [-1,33 ; 0,7]$	✓ $x \leq -3,4$ (A) ✓✓ $-1,33 \leq x \leq 0,7$ (A 0,7) (3)
		[16]

QUESTION 9/VRAAG 9

9.1	<p>Perimeter of the square = $12 - 6x$</p> <p>Side length of square = $\frac{12 - 6x}{4} = \frac{6 - 3x}{2} = 3 - \frac{3}{2}x$</p>	<p>✓ $12 - 6x$</p> <p>✓ answer (2)</p>
9.2	<p>$V = \left(\frac{6-3x}{2}\right)^2 (4x)$</p> <p>$= \left(\frac{36 - 36x + 9x^2}{4}\right)(4x)$</p> <p>$= 36x - 36x^2 + 9x^3$</p> <p>$V(x) = 36x - 36x^2 + 9x^3$</p> <p>$V'(x) = 36 - 72x + 27x^2$</p> <p>$36 - 72x + 27x^2 = 0$</p> <p>$9x^2 - 24x + 12 = 0$</p> <p>$3x^2 - 8x + 4 = 0$</p> <p>$(3x - 2)(x - 2) = 0$</p> <p>$x = \frac{2}{3} \quad \text{or} \quad x = 2$</p> <p>$V\left(\frac{2}{3}\right) = 36\left(\frac{2}{3}\right) - 36\left(\frac{2}{3}\right)^2 + 9\left(\frac{2}{3}\right)^3$</p> <p>$= \frac{32}{3} \text{ m}^3 = 10,67 \text{ m}^3$</p>	<p>✓ $\left(\frac{6-3x}{2}\right)^2 (4x)$</p> <p>✓ $\left(\frac{36 - 36x + 9x^2}{4}\right)$</p> <p>✓ $36x - 36x^2 + 9x^3$</p> <p>✓ V'</p> <p>✓ $V' = 0$</p> <p>✓ values</p> <p>✓ answer (7)</p>
		[9]

QUESTION 10/VRAAG 10

10.1.1	<p>Event A</p> <p>Event B</p> <p>HC HN SC SN</p>	<p>✓ Event A</p> <p>✓ Event B Medication: for $P(C) = \frac{3}{5}$</p> <p>✓ Event B sugar pill: for $P(NC) = \frac{7}{10}$</p> <p>(3)</p>
10.1.2	<p>$P(\text{Not Cured}) = P(H) \times P(NC) + P(S) \times P(NC)$</p> <p>$= \left(\frac{1}{2}\right)\left(\frac{2}{5}\right) + \left(\frac{1}{2}\right)\left(\frac{7}{10}\right)$</p> <p>$= \frac{11}{20} = 0,55$</p>	<p>✓ substitution</p> <p>✓ answer (2)</p>
10.2.1	<p>$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$</p> <p>$P(A \text{ and } B) = \frac{13}{20} - \frac{2}{5} - \frac{1}{4} = 0$</p> <p>Events are mutually exclusive</p> <p>OR/OF</p> <p>$P(A) + P(B) = \frac{2}{5} + \frac{1}{4}$</p> <p>$= \frac{13}{20}$</p> <p>$P(A \text{ or } B) = P(A) + P(B)$</p> <p>$P(A \text{ and } B) = 0$</p> <p>Events are mutually exclusive</p>	<p>✓ substitution</p> <p>✓ answer ($P(A \text{ and } B) = 0$) (2)</p> <p>OR/OF</p> <p>✓ substitution</p> <p>✓ answer ($P(A \text{ and } B) = 0$) (2)</p>

10.2.2	$P(B \text{ and } C) = \frac{1}{5} = 0,2$ $P(\text{only } C) = \frac{7}{10} - \frac{2}{5} - \frac{1}{5} = \frac{1}{10} = 0,1$ 	$\checkmark P(B \text{ and } C) = \frac{1}{5} \text{ (A)}$ $\checkmark \frac{7}{10} - \frac{2}{5} - \frac{1}{5}$ $\checkmark \frac{1}{10} \quad (3)$
10.2.3	$P(\text{no event}) = 1 - \left(\frac{2}{5} + \frac{1}{10} + \frac{1}{5} + \frac{1}{20} \right) = \frac{1}{4} = 0,25$	$\checkmark 1 - (P(A) \text{ or } P(B) \text{ or } P(C))$ $\checkmark \text{answer} \quad (2)$
10.3.1	$3! \times 5!$ $= 720$	<p>Answer only: Full Marks</p> $\checkmark 3!$ $\checkmark 3! \times 5! \text{ (A)} \quad (2)$
10.3.2	$\frac{7! - 6! \times 2}{7!} = \frac{5}{7} = 0,71$ <p>OR/OF</p> $1 - \frac{6! \times 2}{7!}$ $= 1 - \frac{2}{7}$ $= \frac{5}{7} = 0,71$	$\checkmark 7! - 6! \times 2$ $\checkmark \text{denominator (7!)}$ $\checkmark \text{answer} \quad (3)$ <p>OR/OF</p> $\checkmark 6! \times 2$ $\checkmark \text{denominator (7!)}$ $\checkmark \text{answer} \quad (3)$
		[17]

TOTAL/TOTAAL: 150