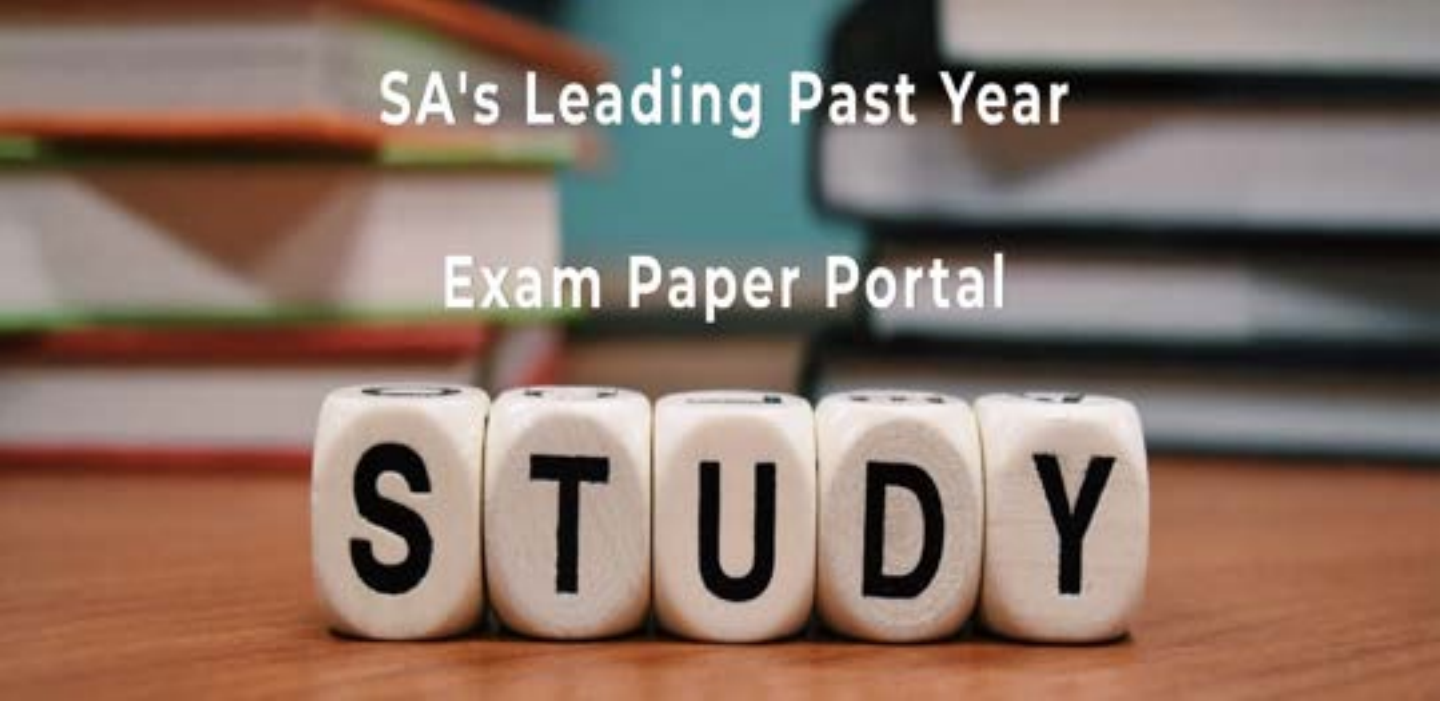

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GRADE 12

MATHEMATICS P1

PREPARATORY EXAMINATION

SEPTEMBER 2022

MARKING GUIDELINE

MARKS: **150**
TIME: **3 hours**

NOTE:

- If a candidate answered a QUESTION TWICE, mark only the FIRST attempt.
- If a candidate crossed out an answer and did not redo it, mark the crossed-out answer.
- Consistent accuracy applies to ALL aspects of the marking guidelines.
- Assuming values/answers in order to solve a problem is unacceptable.

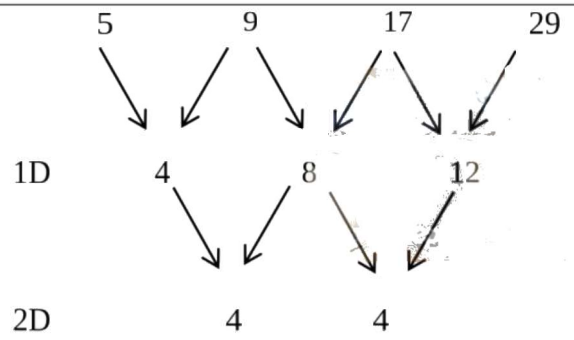
This marking guideline consists of 12 pages.

QUESTION 1

1.1.1	$x = -5 \quad or \quad x = \frac{1}{2}$	A✓ – 5 A✓ $\frac{1}{2}$	(2)
1.1.2	$-3x^2 - 7x + 8 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-(-7) \pm \sqrt{(-7)^2 - 4(-3)(8)}}{2(-3)}$ $x = -3{,}17 \quad or \quad 0{,}84$ (Penalize 1 mark if rounding off is incorrect – once here for entire paper)	A✓ standard form CA✓ correct substitution into quadratic formula CA✓CA✓answers	(4)
1.1.3	$\sqrt{x+5} + 1 = x$ $\sqrt{x+5} = x - 1$ $\left(\sqrt{x+5}\right)^2 = (x-1)^2$ $x + 5 = x^2 - 2x + 1$ $x^2 - 3x - 4 = 0$ $(x+1)(x-4) = 0$ $x = -1 \; or \; x = 4$ *n/a*	A✓ isolating surd CA✓ standard form CA✓ factors CA✓ $x \neq -1$ CA✓ $x = 4$	(5)
1.1.4	$-5 \leq x \leq \frac{3}{2}$	A✓ critical value – 5 A✓ critical value $\frac{3}{2}$ CA✓ interval notation	(3)

1.2	$x + 3y = 5 \quad \rightarrow (1)$ $xy + y^2 - 3 = 0 \quad \rightarrow (2)$ From (1): $x = 5 - 3y \quad \rightarrow (3)$ Substituting (3) into (2): $y(5 - 3y) + y^2 - 3 = 0$ $-2y^2 + 5y - 3 = 0$ $2y^2 - 5y + 3 = 0$ $(2y - 3)(y - 1) = 0$ $y = \frac{3}{2} \text{ or } y = 1$ $x = \frac{1}{2} \text{ or } x = 2$ **OR** $x + 3y = 5 \quad \rightarrow (1)$ $xy + y^2 - 3 = 0 \quad \rightarrow (2)$ From (1): $y = \frac{5-x}{3} \quad \rightarrow (3)$ Substituting (3) into (2): $x\left(\frac{5-x}{3}\right) + \left(\frac{5-x}{3}\right)^2 - 3 = 0$ $3x(5 - x) + 25 - 10x + x^2 - 27 = 0$ $-2x^2 + 5x - 2 = 0$ $2x^2 - 5x + 2 = 0$ $(2x - 1)(x - 2) = 0$ $x = \frac{1}{2} \text{ or } x = 2$ $y = \frac{3}{2} \text{ or } y = 1$	A✓ making x the subject CA✓ substitution CA✓ standard form CA✓ factors CA✓ y – values CA✓ x – values **OR** A✓ making y the subject CA✓ substitution CA✓ standard form CA✓ factors CA✓ x – values CA✓ y – values	(6) (6)
1.3	$\sqrt[n]{\frac{10^n + 2^{n+2}}{5^{2n} + 4.5^n}}$ $= \sqrt[n]{\frac{2^n.5^n + 2^n.2^2}{5^{2n} + 4.5^n}}$ $= \sqrt[n]{\frac{2^n(5^n + 4)}{5^n(5^n + 4)}}$ $= \sqrt[n]{\frac{2^n}{5^n}}$ $= \frac{2}{5}$	A✓ factorising numerator A✓ factorising denominator CA✓ simplifying CA✓ answer	(4)
			[24]

QUESTION 2

2.1	45 ; 65	AA✓✓ answers	(2)
2.2	 $2a = 4 \quad \therefore a = 2$ $3a + b = 4 \quad \therefore b = -2$ $a + b + c = 5 \quad \therefore c = 5$ $T_n = 2n^2 - 2n + 5$	A✓ $2a = 4$ A✓ $a = 2$ A✓ $3a + b = 4$ A✓ $a + b + c = 5$	(4)
2.3	$T_n = 2n^2 - 2n + 5 = 2023$ $2n^2 - 2n - 2018 = 0$ $n^2 - n - 1009 = 0$ $n = \frac{1 \pm \sqrt{1 + 4036}}{2} = 32.27 \ or \ -31.27$ Since n is not a Natural Number, 2023 is not a term of the sequence.	A✓ equating n^{th} term to 2023 CA✓ standard form CA✓ n – values CA✓ conclusion	(4)
			[10]

QUESTION 3

	26 ; 22 ; 18 ; ... $S_n = \frac{n}{2}[2a + (n-1)d]$ $S_{50} = \frac{50}{2}[2(26) + (50-1)(-4)]$ $S_{50} = -3600$ **OR** $S_n = \frac{n}{2}[a + T_n]$ $S_{50} = \frac{50}{2}[26 + (-170)]$ $S_{50} = -3600$	A✓ n – value A✓ a – value A✓ d – value CA✓ answer **OR** A✓ n – value A✓ a – value A✓ T_{50} – value CA✓ answer	(4) (4)
			[4]

QUESTION 4

4.1	$S_n = a + ar + ar^2 + ar^3 + \cdots + ar^{n-1} \quad \rightarrow (1)$ $rS_n = ar + ar^2 + ar^3 + \cdots + ar^{n-1} + ar^n \quad \rightarrow (2)$ $(2) - (1)$: $rS_n - S_n = ar^n - a$ $S_n(r-1) = a(r^n - 1)$ $S_n = \frac{a(r^n-1)}{r-1}\ ; r \neq 1$	A✓ equation (1) A✓ equation (2) A✓ subtracting LHS and RHS terms A✓ factorising	(4)
4.2.1	AS: $12 + d\ ; 12 + 2d\ ; \ldots.$ GS: $12r\ ; 12r^2\ ; \ldots.$	A✓ AS set up of terms A✓ GS set up of terms	(2)
4.2.2	$12 + d = 12r \quad \rightarrow (1)$ $36 + 3d + 3 = 12 + 12r + 12r^2 \quad \rightarrow (2)$ From (1): $d = 12r - 12 \quad \rightarrow (3)$ Substituting (3) into (2), we have $36 + 3(12r - 12) + 3 = 12 + 12r + 12r^2$ $12 + (12r - 12) + 1 = 4 + 4r + 4r^2$ $4r^2 - 8r + 3 = 0$ $(2r - 1)(2r - 3) = 0$ $r = \frac{1}{2} \ or \ r = \frac{3}{2}$	A✓ equation (1) and (2) A✓ making d the subject CA✓ standard quadratic form CA✓ factors CA✓ answers	(5)
			[11]

QUESTION 5

5.1	$y = 1 - \frac{1}{x-2}$ $x = 2 \ and \ y = 1$	A✓ $x = 2$ A✓ $y = 1$	(2)
5.2	$y - \text{intercept} : \left(0\ ; 1\frac{1}{2}\right)$ $x - \text{intercept}: x = 3$ $(3;\ 0)$	A✓ y-intercept A✓ $x = 3$ CA✓ coordinate form	(3)
5.3	$y = x - 1$	A✓ Gradient value A✓ y – intercept	(2)
5.4	$y \in R; y \neq 1$ **OR** $y \in (-\infty; 1) \cup (1; \infty)$	A✓ answer **OR** A✓ answer	(1) (1)
			[8]

QUESTION 6

6.1	$0 = -2(6) + d$ $d = 12$	A ✓ substitution of point T(6 ; 0) A✓ answer **Answer only full marks**	(2)
6.2	$c = 12$ $y = a(x+2)(x-6)$ $12 = a(0+2)(0-6)$ $12 = -12a$ $a = -1$ $y = -1(x+2)(x-6)$ $f(x) = -x^2 + 4x + 12$ **OR** $x = 2$ …Axis of symmetry $y = a(x-2)^2 + q$ …..(A) Substituting (0;12) into (A) $12 = a(0-2)^2 + q \quad \rightarrow 12 = 4a + q$ ….(1) Substituting (6;0) into (A) $0 = a(6-2)^2 + q \quad \rightarrow 0 = 16a + q$ …..(2) (1) – (2) : $12 = -12a$ $-1 = a$ $16 = q$ $y = -1(x-2)^2 + 16$ $f(x) = -x^2 + 4x + 12$	A✓ subst. x – intercepts A✓ substitution R(0 ; 12) A✓ a – value A✓ a – value and factors **OR** A✓ axis of symmetry value A✓ substitution R(0 ; 12) A✓ a – value A✓ a – value and TP	(4) (4)
6.3	$-2x + 4 = 0$ **or** $x = -\frac{4}{2(-1)}$ **or** $x = \frac{-2+6}{2}$ $x = 2$ $y = -(2)^2 + 4(2) + 12 = 16$ $(2\,;16)$	A✓ Using calculus/formula/midpoint CA✓ $x = 2$ (provided it is +ve) CA✓ y – value	(3)
6.4.1	$0 \leq x \leq 6$	AA✓✓answer (penalty 1 mark for incorrect notation)	(2)
6.4.2	$-2 < x < 0 \quad or \quad x > 6$	AA✓✓$-2 < x < 0$ A✓ $x > 6$	(3)
6.5	$R'(2\,;-12\,)$	A✓x – value A✓ y – value	(2)
			[17]

QUESTION 7

7.1	$A(0\,;1)$	AA✓✓answer	(2)
7.2	$y = a^x$ $32 = a^5$ $a = 2$	A✓ substitution of point T(5;32) A✓ answer	(2)
7.3	$x \in R$ **OR** $x \in (-\infty;\infty)$	A✓ answer **OR** A✓ answer	(1) (1)
7.4	$y = \log_2 x$	CACA✓✓answer	(2)
7.5	$\log_2 x = 5$ $x = 2^5 = 32$ $0 < x \leq 32$	CA✓ end points A✓ interval **Can be solved by log inequalities.** **Answer Only – Full marks**	(2)
			[9]

QUESTION 8

8.1

1 Jun 2021	31 Jul 2021	31Aug 2021	…….	30 Apr 2023
5000				
600	600	600	……..	600

Dipinda's final amount in the account:

$$= \mathrm{P}(1+i)^n + \frac{x[(1+i)^n - 1]}{i}$$

$$= 5000\left(1 + \frac{14.25\%}{12}\right)^{23} + \frac{600\left[\left(1 + \frac{14.25\%}{12}\right)^{23} - 1\right]}{\frac{14.25\%}{12}}$$

$$= \mathrm{R}22\,321{,}54$$

A – formula
A✓ value of n
A✓ value of i

FV – formula
A✓ value of n

CA✓correct substitution into A
CA✓ correct substitution into Fv
CA✓ answer (6)

8.2.1

$$\mathrm{P} = \frac{x[1-(1+i)^{-n}]}{i}$$

$$800\,000 = \frac{10000\left[1 - \left(1 + \frac{13.35\,\%}{12}\right)^{-n}\right]}{\frac{13.35\%}{12}}$$

$$\left(1 + \frac{13.35\,\%}{12}\right)^{-n} = \frac{11}{100} = 0{,}11$$

$$-n = \log_{\left(1+\frac{13.35\,\%}{12}\right)} 0.11$$

$$n = 199{,}5083362$$

Therefore the loan will be paid off in 200 months.

N.B. Candidates can also substitute the value of 200 into the Pv formula to show that the loan will be paid in 200 months.

A✓ value of P, x and value of i
A✓ substitution into formula

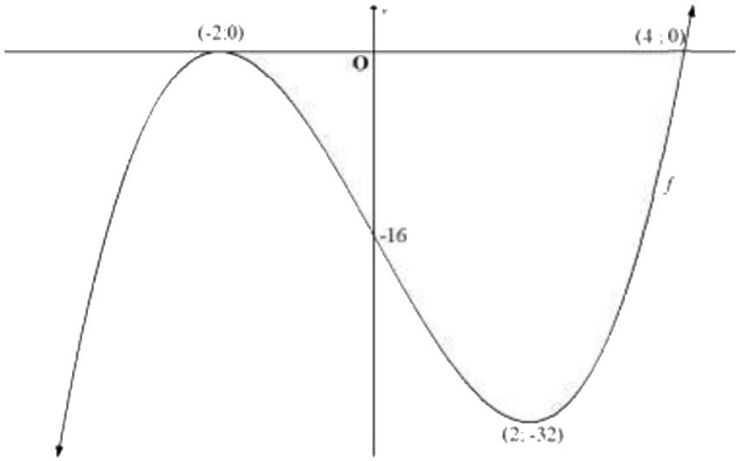
A✓ use of logs
A✓ decimal value (4)

8.2.2a	$\text{P} = \frac{x[1-(1+i)^{-n}]}{i}$ $= \frac{10\,000\left[1-\left(1+\frac{13.35\,\%}{12}\right)^{-80,5083362}\right]}{\frac{13.35\,\%}{12}}$ $= R530\,009,55$ **If n = 81 is used and P = $R532\,010,58$** **Give a maximum of 2/3 marks** **N.B. Candidates can also use the method of A – Fv**	A✓ value of n A✓ value of i CA✓ answer	(3)
8.2.2b	$\text{A} = P(1+i)^n$ $\text{A} = R530\,009,55\left(1+\frac{13.35\,\%}{12}\right)^4$ $\text{A} = R\,553\,991,4839$ $\text{P} = \frac{x[1-(1+i)^{-n}]}{i}$ $553\,991,4839 = \frac{x\left[1-\left(1+\frac{13.35\,\%}{12}\right)^{-77}\right]}{\frac{13.35\,\%}{12}}$ $x = R10\,748,55$	A✓ value of n CA✓ answer A✓ value of n CA✓ answer	(4)
			[17]

QUESTION 9 (penalize 1 mark once for incorrect notation in this question)

9.1	$f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ $f'(x) = \lim_{h\to 0}\frac{\frac{2}{3(x+h)}-\frac{2}{3x}}{h}$ $f'(x) = \lim_{h\to 0}\frac{2x-2(x+h)}{3x(x+h)}\times\frac{1}{h}$ $f'(x) = \lim_{h\to 0}\frac{2x-2x-2h}{3x(x+h)}\times\frac{1}{h}$ $f'(x) = \frac{-2}{3x^2}$ **OR** $f(x+h) = \frac{2}{3(x+h)}$ $f(x+h)-f(x) = \frac{2}{3(x+h)}-\frac{2}{3x}$ $\frac{f(x+h)-f(x)}{h} = \frac{-2}{3x(x+h)}$ $f'(x) = \lim_{h\to 0}\frac{-2}{3x(x+h)}$ $f'(x) = \frac{-2}{3x^2}$	A✓ formula A✓ substitution CA✓ LCD CA✓ simplification of numerator CA✓ answer **OR** A✓ value of $f(x+h)$ CA✓ value of $f(x+h)-f(x)$ CA✓ value of $\frac{f(x+h)-f(x)}{h}$ A✓ formula CA✓ answer	(5) (5)
9.2.1	$g(x) = (x+7)^3$ $g(x) = x^3+21x^2+147x+343$ $g'(x) = 3x^2+42x+147$	AA✓✓ (two terms correct 1 mark, all terms correct 2 marks) CACACA✓✓✓each term	(5)
9.2.2	$y = \sqrt{x^5}-\frac{4}{9x^2}$ $y = x^{\frac{5}{2}}-\frac{4}{9}x^{-2}$ $\frac{dy}{dx} = \frac{5}{2}x^{\frac{3}{2}}+\frac{8}{9}x^{-3}$	AA✓✓ writing in exponential form CACA✓✓ each term	(4)
			[14]

QUESTION 10

10.1.1	$x^3 - 12x - 16 = 0$ $(x+2)(x^2 - 2x - 8) = 0$ $(x+2)(x+2)(x-4) = 0$ $x = -2 \ or \ x = 4$	A✓ binomial factor AA✓✓factors CA CA ✓✓ answers	(5)
10.1.2	$f(x) = x^3 - 12x - 16$ $f'(x) = 3x^2 - 12 = 0$ $x^2 - 4 = 0$ $(x+2)(x-2) = 0$ $x = -2 \ or \ x = 2$ $y = 0 \quad or \quad y = -32$	A✓ derivative and equating to 0 CA✓ factors CA✓ x – values CA✓ y – values	(4)
10.1.3		CA✓ Maximum and Minimum points CA✓ x – intercepts A✓ y – intercept A✓ shape	(4)
10.1.4	$f''(x) = 6x > 0$ $x > 0$ Answer only: full marks	A✓ 2nd derivative A✓ answer	(2)
10.2	$p'(x) = -3x^2 - 8$ $-3x^2 \leq 0$ for all $x \epsilon R$ $-3x^2 - 8 \leq 0$ The gradient of all tangents to the graph of p is always negative.	A✓ derivative A✓ reasoning A✓ reasoning	(3)
			[18]

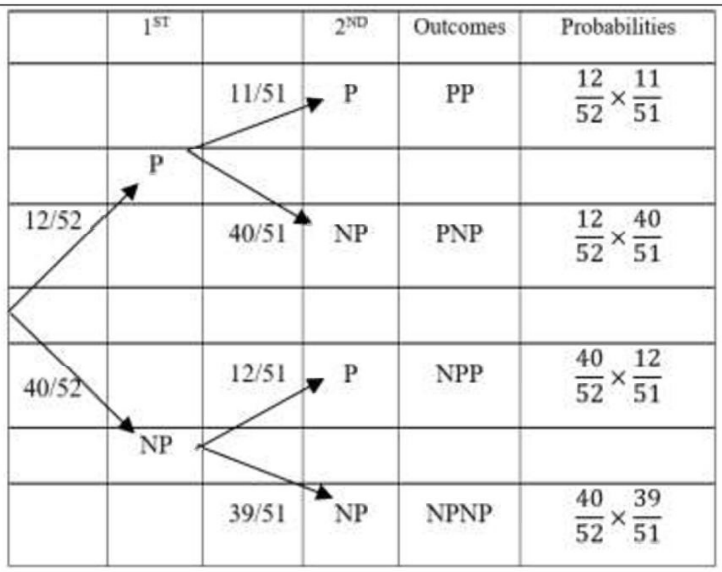
QUESTION 11

11.1	$L = 1000 + 6t - \frac{t^2}{4}$ $\frac{dL}{dt} = 6 - \frac{1}{2}t$	AA✓✓ for each term	(2)
11.2	For greatest lead: $\frac{dL}{dt} = 0$ $6 - \frac{1}{2}t = 0$ $t = 12$ minutes	CA✓ $\frac{dL}{dt} = 0$ or equating derivative to 0 CA✓ answer	(2)
11.3	$\frac{dL}{dt}_{t=60} = 6 - \frac{1}{2}(60)$ $\frac{dL}{dt}_{t=60} = -24$ The runner's lead is decreasing at 24 metres per minute	CA✓ substitution of $t = 60$ into derivative **and** value of -24 CA✓ conclusion (provided the derivative is – ve)	(2)
			[6]

QUESTION 12

12.1	7! or 5 040	A✓ A✓ 7! or 5040	(2)
12.2	$6! \times 2!$ = 1440	AA✓✓ $6! \times 2!$ A✓ 1440	(3)
			[5]

QUESTION 13

13.1	P (A or B) = P(A) + P(B) 0,63 = 3P(B)+P(B) 4P(B) = 0,63 P(B) = 0,16	A✓ condition for mutually exclusive events A✓ correct substitution A✓ P(B) value	(3)
13.2.1	$P(\text{Both Picture cards}) = \frac{12}{52} \times \frac{11}{51}$ $= \frac{11}{221} = 0{,}0498 = 4{,}98\,\%$	A✓ $\frac{12}{52} \times \frac{11}{51}$ A ✓ $\frac{11}{221} = 0{,}0498 =$ 4,98 %	(2)
13.2.2	 P (at least 1 picture card) = 1 – P (no picture card) $= 1 - \left(\frac{40}{52} \times \frac{39}{51}\right)$ $= \frac{7}{17} = 0{,}4118 = 41{,}18\,\%$ **OR** P (at least 1 picture) $= \left(\frac{12}{52} \times \frac{11}{51}\right) + \left(\frac{12}{52} \times \frac{40}{51}\right) + \left(\frac{40}{52} \times \frac{12}{51}\right)$ $= \frac{7}{17} = 0{,}4118 = 41{,}18\,\%$	A✓ Method A✓ Correct Substitution A✓ $\frac{7}{17} = 0{,}4118 =$ 41,18 % **OR** AA✓✓probabilities A✓ $\frac{7}{17} = 0{,}4118 =$ 41,18 %	(3) (3)
			[8]

TOTAL: 150