

Cambridge International AS & A Level

MATHEMATICS**9709/55**

Paper 5 Probability & Statistics 1

May/June 2026**MARK SCHEME**Maximum Mark: 50

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **22** printed pages.

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: - the specific content defined in the mark scheme - the specific skills defined in the mark scheme or in the level descriptions - the standard of response required as exemplified by the standardisation scripts.
2	Examiners must award whole marks (not half marks, or other fractions).
3	Examiners must award marks positively . This means that: - marks are not deducted for errors or omissions - marks are awarded for correct/valid answers as defined in the mark scheme and also for other valid answers which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate - the quality of spelling, punctuation and grammar are judged only when the mark scheme indicates that these features are specifically assessed in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must consistently apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the full range of marks defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and must not award marks with grade thresholds or grade descriptions in mind.

Mathematics-Specific Marking Principles

- 1 Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.
- 2 Unless specified in the question, non-integer answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected.
- 3 Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points.
- 4 Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).
- 5 Where a candidate has misread a number or sign in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 A or B mark for the misread.
- 6 Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	More information required
A0	Accuracy mark awarded zero
A1	Accuracy mark awarded one
B0	Independent accuracy mark awarded zero
B1	Independent accuracy mark awarded one
B2	Independent accuracy mark awarded two
BOD	Benefit of the doubt
BP	Blank Page
	Incorrect
Dep	Used to indicate DM0 or DM1

Annotation	Meaning
DM1	Dependent on the previous M1 mark(s)
	Follow through
	Indicate working that is right or wrong
Highlighter	Highlight a key point in the working
	Ignore subsequent work
	Judgement
	Judgement
	Method mark awarded zero
	Method mark awarded one
	Method mark awarded two
	Misread
	Omission or Other solution
Off-page comment	Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to.
On-page comment	Allows comments to be entered in speech bubbles on the candidate response.
	Judgment made by the PE
	Premature approximation
	Special case
	Indicates that work/page has been seen

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Annotation	Meaning
	Error in number of significant figures
	Correct
	Transcription error
	Correct answer from incorrect working

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The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

- M** Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.
- A** Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).
- B** Mark for a correct result or statement independent of method marks.
- DM or DB** When a part of a question has two or more ‘method’ steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly, when there are several B marks allocated. The notation DM or DB is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.
- FT** Implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only.
- A or B marks are given for correct work only (not for results obtained from incorrect working) unless follow through is allowed (see abbreviation FT above).
 - For a numerical answer, allow the A or B mark if the answer is correct to 3 significant figures or would be correct to 3 significant figures if rounded (1 decimal place for angles in degrees).
 - The total number of marks available for each question is shown at the bottom of the Marks column.
 - Wrong or missing units in an answer should not result in loss of marks unless the guidance indicates otherwise.
 - Square brackets [] around text or numbers show extra information not needed for the mark to be awarded.

Abbreviations

AEF/OE	Any Equivalent Form (of answer is equally acceptable) / Or Equivalent
AG	Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
CAO	Correct Answer Only (emphasising that no ‘follow through’ from a previous error is allowed)
CWO	Correct Working Only
ISW	Ignore Subsequent Working
SOI	Seen Or Implied
SC	Special Case (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)
WWW	Without Wrong Working
AWRT	Answer Which Rounds To

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Question	Answer	Marks	Guidance
1(a)	$[Sd^2 =] \frac{32460}{60} - \left(\frac{642}{60}\right)^2$	M1	
	$[Sd = \sqrt{541 - 114.49} = \sqrt{426.51}] = 20.7$	A1	20.652...rounded to at least 3SF. SCB1 if M mark withheld WWW.
		2	
1(b)	$\sum x - 60c = 642$ Or $95.7 \times 60 = 642 + 60c$ oe Or $95.7 - c = \frac{642}{60}$ or 10.7	M1	
	$c = 85$	A1	
		2	

Question	Answer	Marks	Guidance
2(a)		B1	- At least 5 points plotted accurately at class upper endpoints (50,8), (75,30), (100,62), (150,102), (200,128), (250,143), (310,154), (400,160). - Linear cf scale $0 \leq cf \leq 160$ and linear time scale $50 \leq \text{time} \leq 400$ with at least 3 values identified on each. - Bar charts/histograms score B0. - Axes can be the other way round.
		B1	- All points plotted correctly, curve drawn (no line segments) and joined to (0,0) and curve passing within $\frac{1}{2}$ square of plotted points. - Axes labelled cumulative frequency (cf), time (t) and seconds (s, sec). - Axes must be over 50% of grid size. - Curve must not rise above 160 before the final point. If 0/2 scored, SCB1 for plotting 8 points at correct height (not (0,0)), curve drawn, no line segment and joined to (0,0) passing within $\frac{1}{2}$ square of plotted points to create an increasing curve. Axes correctly labelled.
		2	
2(b)	$180 \leq UQ \leq 190 - 80 \leq LQ \leq 85$	M1	Use of graph must be seen for either the UQ or LQ. Must be an increasing graph – indicate on 2a grid where seen. FT incorrect increasing graph.
	[IQR =] 105	A1	$95 \leq IQR \leq 110$.
		2	

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Question	Answer	Marks	Guidance
3(a)	$0.2 \times 0.25 + 0.35 \times 0.4 + 0.45 \times x = 0.505$ [$0.45x = 0.315$]	M1	Three 2-factor probability terms ($p(\text{drink}) \times p(\text{cake})$) added to form an equation in x equated to 0.505.
	[$x =$] 0.7	A1	If M1 not scored, SCB1 for [$x =$] 0.7 WWW.
		2	
3(b)	$\left[P(\text{juice} \text{not cake}) = \frac{P(\text{juice} \cap \text{not cake})}{P(\text{not cake})} \right]$ $= \frac{0.35 \times 0.6}{1 - 0.505} = \frac{0.21}{0.495}$	B1	$1 - 0.505$ or 0.495 or $\frac{99}{200}$. (or $0.2 \times 0.75 + 0.35 \times 0.6 + 0.45 \times 0.3$) seen on its own as a numerator or denominator in a fraction.
		M1	$[P(\text{juice} \cap \text{not cake}) =]$. 0.35×0.6 or $0.35 \times (1 - 0.4)$ seen as the numerator of a fraction.
	$= 0.424, \frac{14}{33}$	A1	SCB1 if M0 .
		3	

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Question	Answer	Marks	Guidance
4(a)	EITHER: Method 1		
	$[P(X < 7) = 1 - (P(7, 8, 9)) =]$ $1 - ({}^9C_7 (0.8)^7 (0.2)^2 + {}^9C_8 (0.8)^8 (0.2)^1 + (0.8)^9 (0.2)^0)$ $[= 1 - (0.3019899 + 0.3019899 + 0.1342177)]$	(M1)	${}^9C_x (p)^x (1-p)^{9-x}$ With $0 < p < 1, x \neq 0$ or 9 Note: $\sum_a^b {}^9C_x (p)^x (1-p)^{9-x}$ implies M1 With $0 < p < 1, x \neq 0$ or $9, b \leq 8, a < b$.
		A1	Correct un-simplified expression. Allow 9 for ${}^9C_8$. Condone omission of final bracket. Note: $1 - \sum_{x=7}^9 {}^9C_x (0.8)^x (0.2)^{9-x}$ implies M1A1 , condone p not substituted if clearly stated, e.g. $p = 0.8$.
	$= 0.262$	B1)	$0.2615 < p \leq 0.262$.
	OR: Method 2		
	$[P(X < 7) = P(0, 1, 2, 3, 4, 5, 6) =]$ $(0.8)^0 (0.2)^9 + {}^9C_1 (0.8)^1 (0.2)^8 + {}^9C_2 (0.8)^2 (0.2)^7 + {}^9C_3$ $(0.8)^3 (0.2)^6 + {}^9C_4 (0.8)^4 (0.2)^5 + {}^9C_5 (0.8)^5 (0.2)^4 + {}^9C_6$ $(0.8)^6 (0.2)^3$	(M1)	${}^9C_x (p)^x (1-p)^{9-x}$ with $0 < p < 1, x \neq 0$ or 9 . Note: $\sum_a^b {}^9C_x (p)^x (1-p)^{9-x}$ implies M1 With $0 < p < 1, x \neq 0$ or $9, b \leq 8, a < b$.

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Question	Answer	Marks	Guidance
4(a)		A1	Correct un-simplified expression. Allow 9 for ${}^9C_8$ Condone omission of up to 4 of the 5 middle terms. Note: $\sum_{x=0}^6 {}^9C_x (0.8)^x (0.2)^{9-x}$ implies M1A1 , condone p not substituted if clearly stated, e.g. $p = 0.8$.
	= 0.262	B1)	$0.2615 < p \leq 0.262$.
	Available marks	3	

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Question	Answer	Marks	Guidance
4(b)	[Mean = $0.8 \times 120 =$] 96, [variance = $0.2 \times 96 =$] 19.2	B1	96 and 19.2 seen, allow un-simplified, may be seen in the standardisation formula- $\sigma = \sqrt{19.2}$ or $\frac{4\sqrt{30}}{5}$, $4.3817 \leq \sigma \leq 4.382$ implies correct variance. Withhold mark if variance is clearly identified as standard deviation. Condone $N(96, \sqrt{19.2})$ if value substituted appropriately into standardisation formula <i>or</i> the variance/standard deviation correctly identified as well.
	$P(X > 90) = P\left(Z > \frac{90.5 - 96}{\sqrt{19.2}}\right)$	M1	Substituting <i>their</i> μ and positive σ into the $\pm$ standardisation formula (any number for 90.5), allow σ^2 or $\sqrt{\sigma}$.
		M1	Use continuity correction 89.5 or 90.5 in <i>their</i> $\pm$ standardisation formula. Note: If no standardisation formula seen $\pm\left(\frac{5.5}{\sqrt{19.2}}\right)$ or $\pm\left(\frac{5.5}{4.382}\right)$ scores M2 BOD.
	$[= P(Z > -1.255) = P(Z < 1.255) = \Phi(1.255)]$ 0.8953	M1	Appropriate area Φ , from final process, must be a probability. Note: correct final answer implies this M1 . Expect final answer > 0.5 .
	$= 0.895(3)$	A1	Final answer Accept $0.895 \leq p < 0.8955$. If they multiply this correct probability by 120, they get M1A0 .
		5	

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Question	Answer					Marks	Guidance
5(a)	x	0	1	2	3	B1	Table with correct x values and at least 1 correct probability associated with correct x -value. Values need not be in order, lines may not be drawn, may be vertical. x and $P(x)$ may be omitted. Condone any additional x values if probability stated as 0.
	$P(X=x)$	$\frac{4}{16}$	$\frac{6}{16}$	$\frac{4}{16}$	$\frac{2}{16}$		
		$\frac{2}{8}$	$\frac{3}{8}$	$\frac{2}{8}$	$\frac{1}{8}$	B1	Two more correct probabilities correctly linked to the correct x values, need not be in table, accept un-simplified. (3 correct probabilities now present).
		$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{8}$		
		0.25	0.375	0.25	0.125		
						B1	4 correct probabilities linked with correct x values, SCB1 4 non-zero probabilities (not all $1/4$) summing to 1 placed in a probability distribution table with correct x values if they have only scored 0 or 1 mark(s).
						3	

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Question	Answer	Marks	Guidance
5(b)	$[E(X) =] \left[0 \times \frac{4}{16} + \right] 1 \times \frac{6}{16} + 2 \times \frac{4}{16} + 3 \times \frac{2}{16}$ $\left[\frac{6+8+6}{16} = \frac{5}{4} \right]$	M1	Accept un-simplified expression. May be calculated in variance. Accept $\frac{3}{8} + \frac{1}{2} + \frac{3}{8}$ oe for the M mark. FT <i>their</i> table with 4 non - zero probabilities summing to 1 ($0 < p < 1$) as long as working is clear.
	$\text{Var}(X) = \frac{6 \times 1^2 + 4 \times 2^2 + 2 \times 3^2}{16} - \text{their} \left(\frac{5}{4} \right)^2$ $\left[\frac{[0+] [1 \times] 6 + 4 \times 4 + 9 \times 2}{16} - \frac{25}{16} \right]$	M1	Appropriate variance formula using <i>their</i> $(E(X))^2$ value FT <i>their</i> table with 3 or more non-zero probabilities ($0 < p < 1$) which need not sum to 1 correct.
	$= \frac{15}{16}, 0.9375$	A1	CAO. SCB1 if first M mark is withheld.
		3	
5(c)	$\left(\frac{14}{16} \right)^6 \times \frac{2}{16} \text{ or } \left(\frac{14}{16} \right)^6 - \left(\frac{14}{16} \right)^7$	B1FT	$(1-p)^6 p$ with $p = \text{their } \frac{2}{16}$ or $(1-p)^6 - (1-p)^7$.
		1	

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Question	Answer	Marks	Guidance
5(d)	${}^6C_2 \left(\frac{2}{16}\right)^3 \left(\frac{14}{16}\right)^4$	M1	$k \times (q)^3 (1-q)^4$, k integer ≥ 1 in a single term.
		M1	${}^6C_2 (q)^a (1-q)^b$, $a + b = 6, 7, 8$ in a single term. Accept ${}^6C_2, \frac{{}^6P_2}{2!}, 15$.
	= 0.0172	A1	AWRT, $\frac{288120}{2097152}$ OE.
		3	

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Question	Answer	Marks	Guidance
6(a)	$P(412 < X < 424) = P\left(\frac{412 - 420}{6.4} < Z < \frac{424 - 420}{6.4}\right)$	M1	Substituting 420 and 6.4 and either 412 or 424 appropriately into one $\pm$ standardising formula, allow σ^2 or $\sqrt{\sigma}$ no continuity correction. Note: $-\frac{8}{6.4}$ <i>or</i> $\frac{4}{6.4}$ scores M1 BOD.
	$[= \Phi(1.25) + \Phi(0.625) - 1]$ $= 0.8944 + 0.7340 - 1$ $= (0.8944 - 0.5) + (0.7340 - 0.5)$ $= 0.8944 - (1 - 0.7340)$ $= 0.7340 - (1 - 0.8944)$	M1	Appropriate area Φ , from final process. Must be a probability. Expect final answer > 0.5 . Condone omission of brackets if recovered for <i>their</i> values.
	$= 0.628, \frac{1571}{2500}$	A1	$0.628 \leq p \leq 0.6285$.
		3	
6(b)	$P(X > 245) = \frac{42}{500} = 0.0840$ $P\left(Z < \frac{245 - 240}{\sigma}\right) = 1 - 0.0840 = 0.916$	B1	0.084[0] or 0.916 seen.
	$\frac{245 - 240}{\sigma} = 1.378$	M1	Equating $\pm$ standardisation formula with 245, 240 and σ , condone continuity correction, to a z-value. Note: these are NOT z-values: 0.8201; 0.1799; 0.5335; 0.4665; 0.7995; 0.6628; 0.084; 0.916.
	$\left[\sigma = \frac{5}{1.378}\right] 3.63$	A1	AWRT.
		3	

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Question	Answer	Marks	Guidance
6(c)	$[P(X > 1.2\mu) =] P\left(Z > \frac{1.2\mu - \mu}{0.25\mu}\right)$	B1	Substituting μ , 1.2μ and 0.25μ appropriately into $\pm$ standardising formula, no continuity correction, σ^2 or $\sqrt{\sigma}$.
	$[= P(Z > 0.8) =] 1 - 0.7881,$	M1	Appropriate area Φ , from final process. Must be a probability. Expect final answer < 0.5 .
	0.212	A1	AWRT.
		3	

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Question	Answer	Marks	Guidance
7(a)	EITHER: Method 1 total arrangements with 3 As together – total arrangements with 3 As together and 2 Ns together		
	$\frac{7!}{2!} - 6!$	(B1)	$\frac{7!}{2!} - m$, where $m \geq 0$.
		M1	$b - k!$, $k = 5$ or 6 , $b > 720$. You may see this as $b - 30 \times 4!$.
	$[= 2520 - 720 =] 1800$	A1)	CAO.
	OR: Method 2 ${}^6P_3$ AAA ${}^2P_2$, arrangements with AAAs together and no Ns, Ns inserted separately		
	$5! \times \frac{6 \times 5}{2}$	(B1)	$5! \times d$, d integer ≥ 1 .
		M1	$f \times \frac{6 \times 5}{2}$, $f > 1$ accept ${}^6C_2$ or $\frac{{}^6P_2}{2}$.
	1800	A1)	CAO.
	Available marks	3	

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Question	Answer	Marks	Guidance
7(b)	EITHER: Method 1		
	[Numerator =] $\frac{7!}{3!} \times 4$	(B1)	$\frac{7!}{3!} \times d, d \geq 1$ in a single term.
		M1	$\frac{7!}{e} \times 4, e \geq 1$ in a single term.
	[Total number of ways =] $\frac{9!}{2!3!}$ (= 30240)	B1	Seen as denominator of a fraction.
	$\frac{3360}{30240} = \frac{1}{9}$	A1)	
	OR: Method 2		
	${}^7P_4 \times \frac{4!}{3!}$	(B1)	${}^7P_4 \times k, k \geq 1$ in a single term.
		M1	${}^7P_m \times \frac{4!}{3!}$ or ${}^7P_m \times 4, m = 3, 4, 5$, in a single term.
	[Total number of ways =] $\frac{9!}{2!3!}$ (= 30240)	B1	Seen as denominator of a fraction.
	$\frac{3360}{30240} = \frac{1}{9}$	A1)	

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Question	Answer	Marks	Guidance																									
7(b)	OR: Method 3																											
	$\frac{4 \times 7! \times 2!}{9!}$	(B1)	$\frac{4 \times 7! \times g}{f!}$, (g, f) ≥ 1 in a single term.																									
		M1	$\frac{h \times 7! \times 2!}{f!}$, (h, f) ≥ 1 in a single term.																									
		B1	$\frac{h \times 7! \times g}{9!}$, (h, g) ≥ 1 in a single term.																									
	$= \frac{1}{9}$	A1)																										
	Available marks	4																										
7(c)	Method 1																											
	<table><tr><td>4 letters</td><td>3 letters</td><td>2 letters</td><td></td><td></td></tr><tr><td>A A A ^</td><td>N N ^</td><td>^ ^</td><td>${}^4C_1 \times {}^3C_1 [{}^{\times 2}C_2]$</td><td>12</td></tr><tr><td>A A A ^</td><td>^ ^ ^</td><td>N N</td><td>${}^4C_1 [{}^{\times 3}C_3]$</td><td>4</td></tr><tr><td>N N ^ ^</td><td>A A A</td><td>^ ^</td><td>${}^4C_2 [{}^{\times 2}C_2]$</td><td>6</td></tr><tr><td>^ ^ ^ ^</td><td>A A A</td><td>N N</td><td>${}^4C_4$</td><td>1</td></tr></table>	4 letters	3 letters	2 letters			A A A ^	N N ^	^ ^	${}^4C_1 \times {}^3C_1 [{}^{\times 2}C_2]$	12	A A A ^	^ ^ ^	N N	${}^4C_1 [{}^{\times 3}C_3]$	4	N N ^ ^	A A A	^ ^	${}^4C_2 [{}^{\times 2}C_2]$	6	^ ^ ^ ^	A A A	N N	${}^4C_4$	1	B1	Correct no of ways for 2 identified scenarios, accept un-simplified.
		4 letters	3 letters	2 letters																								
		A A A ^	N N ^	^ ^	${}^4C_1 \times {}^3C_1 [{}^{\times 2}C_2]$	12																						
		A A A ^	^ ^ ^	N N	${}^4C_1 [{}^{\times 3}C_3]$	4																						
		N N ^ ^	A A A	^ ^	${}^4C_2 [{}^{\times 2}C_2]$	6																						
	^ ^ ^ ^	A A A	N N	${}^4C_4$	1																							
	M1	No of ways for 4 correct scenarios added, may be identified by correct un-simplified expressions. Accept 12 + 4 + 6 + 1 OE.																										
[Total number of ways =] 23	A1																											
	3																											