

Cambridge International AS & A Level

MATHEMATICS**9709/51**

Paper 5 Probability & Statistics 1

May/June 2025**MARK SCHEME**Maximum Mark: 50

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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This document consists of **19** printed pages.

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GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

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- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

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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.
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Annotations

Annotation	Meaning
	More information required
	Accuracy mark awarded zero
	Accuracy mark awarded one
	Independent accuracy mark awarded zero
	Independent accuracy mark awarded one
	Independent accuracy mark awarded two
	Benefit of the doubt
	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

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

PUBLISHED**Mark Scheme Notes**

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	$P\left(Z < \frac{1.48 - \mu}{0.14}\right) = 0.22$	B1	$0.771 < z < 0.773$ or $-0.773 < z < -0.771$ seen.
	$\frac{1.48 - \mu}{0.14} = -0.772$	M1	Use of the $\pm$ standardisation formula with μ , 1.48 and 0.14 and equating to a z-value (not 0.78, 0.22, 0.5871, 0.7823, 0.228). Condone σ^2 , $\sqrt{\sigma}$ and continuity correction ± 0.005 .
	$\mu = 1.59$	A1	$1.585 < \mu \leq 1.59$. If M0 scored SC B1 for correct answer WWW.
		3	

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Question	Answer	Marks	Guidance
2(a)	Method 1 total arrangements with As together – arrangements with As together and Os together		
	$\frac{7!}{2!} - 6!$	M1	$\frac{7!}{2} - k$, where k is an integer ≥ 1 .
	$n - 6!$	M1	$n - 6!$, where n is an integer > 720 .
	1800	A1	
		3	
	Method 2 arrangements of other 6 letters with the As together and then the Os placed		
	$5! \times \frac{6 \times 5}{2}$	M1	$5! \times p$, where p is an integer > 1 .
		M1	$q \times \frac{6 \times 5}{2}$, $q \times {}^6C_2$, $q \times {}^6P_2$, $q \times 6 \times 5$, q an integer > 1 .
	1800	A1	
		3	

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Question	Answer	Marks	Guidance
2(b)	Method 1		
	$[P(X < 6) =] 1 - \left(\frac{3}{4}\right)^5]$	M1	$1 - \left(\frac{3}{4}\right)^a \quad a = 5, 6.$
	$= 0.763, \frac{781}{1024}$	A1	$0.7626 < p \leq 0.763.$
		2	
	Method 2		
	$[P(X < 6) =] \frac{1}{4} + \left(\frac{1}{4}\right)\left(\frac{3}{4}\right) + \left(\frac{1}{4}\right)\left(\frac{3}{4}\right)^2 + \left(\frac{1}{4}\right)\left(\frac{3}{4}\right)^3 + \left(\frac{1}{4}\right)\left(\frac{3}{4}\right)^4$	M1	$\frac{1}{4} + \left(\frac{1}{4}\right)\left(\frac{3}{4}\right) + \left(\frac{1}{4}\right)\left(\frac{3}{4}\right)^2 + \left(\frac{1}{4}\right)\left(\frac{3}{4}\right)^3 + \left(\frac{1}{4}\right)\left(\frac{3}{4}\right)^4 \left[+ \left(\frac{1}{4}\right)\left(\frac{3}{4}\right)^5 \right].$
	$= 0.763, \frac{781}{1024}$	A1	$0.7626 < p \leq 0.763.$
		2	
2(c)	$\left(\frac{1}{4}\right)^2 \left(\frac{3}{4}\right)^4 \times 5 = \frac{405}{4096}$	M1	$p^2(1-p)^4 \times 5, 0 < p < 1, p \neq 1-p.$
	$= 0.0989$	A1	AWRT
		2	

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Question	Answer			Marks	Guidance																									
3(a)	<table><tr><th colspan="2">Gulls</th><th></th><th colspan="2">Herons</th></tr><tr><td colspan="2">9</td><td>7</td><td colspan="2"></td></tr><tr><td>8</td><td>6 6 3 2</td><td>8</td><td>1</td><td>3 5 7</td></tr><tr><td></td><td>8 7 2</td><td>9</td><td>2</td><td>3 5 7 9 9</td></tr><tr><td></td><td>4 0</td><td>10</td><td>8</td><td></td></tr></table>			Gulls			Herons		9		7			8	6 6 3 2	8	1	3 5 7		8 7 2	9	2	3 5 7 9 9		4 0	10	8		B1	Correct stem, ignore extra values (not in reverse, not split). If a split stem-and-leaf plot is used (i.e. stem values are repeated), the remaining B marks are available.
	Gulls			Herons																										
	9		7																											
	8	6 6 3 2	8	1	3 5 7																									
		8 7 2	9	2	3 5 7 9 9																									
	4 0	10	8																											
			B1	Correct Gulls labelled on left, leaves in order from right to left and lined up vertically (less than halfway to next column), no commas or other punctuation.																										
Key: 7 9 5 means 9.7 seconds for Gulls and 9.5 seconds for Herons			B1	Correct Herons labelled on same diagram, leaves in order and lined up vertically (less than halfway to next column), no commas or other punctuation. Penalise each error only once in question. E.g. commas in both sets of data If the correct data for Gulls & Herons is transposed, treat as a single error in Gulls and condone in Herons.																										
			B1	Correct key for their diagram, need both clubs labelled and ‘sec’ or ‘s’ stated at least once here, or in leaf headings or title. SC: If 2 separate diagrams drawn, max marks: B1 if both stems correct, B1 if Gulls is correct to the left of the stem B0 B1 if both keys correct including ‘sec’ or ‘s’																										
			4																											

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Question	Answer	Marks	Guidance
3(b)	Median = 8.8 (seconds)	B1	Clearly identified, e.g. Q2, med, m..
	[LQ 8.3, UQ 9.8] 9.8 – 8.3	M1	$9.7 \leq \text{UQ} \leq 10.0 - 8.2 \leq \text{LQ} \leq 8.6$. Implied if both quartile values are stated and the appropriate IQR is calculated accurately.
	1.5	A1	WWW If M0 scored SCB1 for 1.5 WWW.
		3	
3(c)	Mean = $\frac{175.0 + 30 \times 8.4}{50}$ or $\frac{175.0 + 252.0}{50}$	M1	
	= 8.54	A1	If M0 scored, SCB1 for 8.54 WWW.
		2	
3(d)	$1.38^2 = \frac{(1823.0 + \sum y^2)}{50} - \text{their} \left(\frac{427.0}{50} \right)^2$	M1	Substitute values into correct variance formula, any form.
	Solve to find $\sum y^2$	DM1	Rearrange equation to obtain $\sum y^2$. $\frac{\sum y^2}{50} = 1.38^2 + \text{their} \left(\frac{427.0}{50} \right)^2 - \frac{1823.0}{50}$.
	$\sum y^2 = 1918.8$	A1	Mark final answer. If one or both M marks not awarded, SCB1 for 1918.8 seen as final answer WWW mark final answer.
		3	

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Question	Answer	Marks	Guidance
4(a)	$P\left(\frac{-1.2}{2.5} < Z < \frac{1.2}{2.5}\right)$	M1	OE Using $\pm$ standardisation formula, not σ^2 , not σ , no continuity correction Use of $\pm$ standardisation formula once with 32.4, 2.5 and either 31.2 or 33.6. No continuity correction, not σ^2 , not $\sqrt{\sigma}$ Implied by either $-\frac{1.2}{2.5}$ or $\frac{1.2}{2.5}$ seen
	$[= \Phi(0.48) + \Phi(-0.48) = 2\Phi(0.48) - 1]$ $2 \times 0.6844 - 1$ or $2 \times (0.6844 - 0.5)$ or $0.6844 - 0.3156$	M1	Calculating the correct probability area (leading to their final probability). This may be implied by the correct or appropriate probability area.
	0.3688	A1	
	Expected number = $0.3688 \times 600 = 221.28$ so 221 or 222	B1 FT	FT <i>their</i> 4-figure probability to obtain a single integer answer. No approximation indicated, condone use of 3sf probability here if more accurate answer seen earlier.
		4	

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Question	Answer	Marks	Guidance
4(b)	Method 1		
	$[P(2 \leq X < 8) = 1 - P(0, 1, 8, 9) =]$	M1	One term of the form ${}^9C_x (p)^x (1-p)^{9-x}$, $0 < p < 1, x \neq 0$ or 9
	$1 - (0.4^9 + {}^9C_1 0.4^8 0.6 + {}^9C_8 0.4^1 0.6^8 + 0.6^9) =$	A1	Correct un-simplified expression. Condone omission of last bracket only. If both brackets omitted in un-simplified expression, allow recovery for final stated calculation of $1 - 0.07434\dots$ or better.
	$[1 - 0.000262144 - 0.00353894 - 0.060466176 - 0.010077696 =]$		
	0.926	B1	$0.925 < p \leq 0.926$ from correct working.
	Method 2		
	$[P(2 \leq X < 8) = P(2, 3, 4, 5, 6, 7) =]$	M1	One term of the form ${}^9C_x (p)^x (1-p)^{9-x}$, $0 < p < 1, x \neq 0$ or 9 .
	${}^9C_2 0.4^7 0.6^2 + {}^9C_3 0.4^6 0.6^3 + {}^9C_4 0.4^5 0.6^4 + {}^9C_5 0.4^4 0.6^5 + {}^9C_6 0.4^3 0.6^6 + {}^9C_7 0.4^2 0.6^7$	A1	Correct un-simplified expression.
	0.926	B1	$0.925 < p \leq 0.926$ from correct working.
		3	

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Question	Answer	Marks	Guidance
4(c)	Mean = $80 \times 0.6 = 48$ Variance = $80 \times 0.6 \times 0.4 = 19.2$	B1	48 and 19.2 (CAO) seen, allow un-simplified. May be in standardisation formula. (4.38178... to at least 4SF identified as σ implies correct variance). Do not condone clear incorrect identification.
	$[P(X > 50) =] P(Z > \frac{50.5 - 48}{\sqrt{19.2}})$	M1	Substituting <i>their</i> 48 and <i>their</i> 19.2 into the $\pm$ standardising formula (any number for 50.5), allow σ^2 or $\sqrt{\sigma}$.
		M1	Use continuity correction 49.5 or 50.5 in <i>their</i> standardisation formula. Note: If no working $\pm \left(\frac{2.5}{\sqrt{19.2}} \right)$ or $\pm \left(\frac{2.5}{4.382} \right)$ seen gains B2 .
	$[P(Z > 0.571) = 1 - \Phi(0.571) =]$ $1 - 0.7160 =$	M1	Appropriate probability area, from final process, must be a probability. May be implied by a sketch of the required probability area. Expect final answer < 0.5 .
	0.284	A1	AWRT
		5	

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Question	Answer	Marks	Guidance
5(a)	3G 2P 1D: ${}^9C_3 \times {}^6C_2 \times {}^5C_1 = 6300$	B1	Correct outcome/value for either the 1st or 2nd scenario clearly identified, accept un-simplified, WWW.
	4G 1P 1D: ${}^9C_4 \times {}^6C_1 \times {}^5C_1 = 3780$	M1	2 correct outcomes/values obtained, accept un-simplified
	5G 0P 1D: ${}^9C_5 [\times {}^6C_0] \times {}^5C_1 = 630$	M1	Sum of 3 correct scenarios, may be identified by un-simplified expression.
	Condone ${}^5C_1 = 5$ and ${}^6C_1 = 6$		
	Total: 10710	A1	CAO If one or both M marks not awarded, SCB1 for 10710 WWW.
		4	
5(b)	Ways of selecting 1 st band: ${}^9C_3 \times {}^6C_1 \times {}^5C_1 = 2520$	M1	${}^9C_3 \times {}^6C_1 \times {}^5C_1$ or ${}^9C_3 \times 6 \times 5$ seen, condone $\times 3$ or $\times 3!$.
	Ways of selecting 2 nd band: ${}^6C_3 \times {}^5C_1 \times {}^4C_1 = 400$		
	Ways of selecting 3 rd band: $1 \times {}^4C_1 \times {}^3C_1 = 12$	M1	<i>their 2520</i> $\times$ <i>their 400</i> $\times$ <i>their 12</i> seen, accept un-simplified, condone $\times 3$ or $\times 3!$.
	[Total number of ways =] $2520 \times 400 \times 12 =$		
	12096000	A1	Condone 12100000. If one or both M marks not awarded, SCB1 for 12096000 (CAO) WWW.
		3	

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Question	Answer	Marks	Guidance
6(a)	Method 1		
	$P(X=2) = \frac{6}{10} \times \frac{5}{9} \times \frac{4}{8} \times \frac{3}{7} \times \frac{4!}{2!2!} = \frac{3}{7}$	M1	AG. $\frac{6}{10} \times \frac{5}{9} \times \frac{4}{8} \times \frac{3}{7} \times k$ or $\frac{4}{10} \times \frac{3}{9} \times \frac{6}{8} \times \frac{5}{7} \times k$ for k an integer, $k > 1$.
		A1	${}^4C_2$ may be seen for $\frac{4!}{2!2!}$.
	Method 2		
	$\frac{{}^6C_2 \times {}^4C_2}{{}^{10}C_4} = \left[\frac{15 \times 6}{210} \right] \frac{3}{7}$	M1	AG. ${}^6C_2 \times {}^4C_2$ seen as the numerator of a fraction. Condone use of permutations if used consistently.
		A1	
		2	

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Question	Answer	Marks	Guidance												
6(b)	<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>$P(X=x)$</td><td>$\frac{1}{210}$, 0.00476</td><td>$\frac{4}{35}$, 0.114</td><td>$\frac{3}{7}$</td><td>$\frac{8}{21}$, 0.381</td><td>$\frac{1}{14}$, 0.0714</td></tr></table>	x	0	1	2	3	4	$P(X=x)$	$\frac{1}{210}$, 0.00476	$\frac{4}{35}$, 0.114	$\frac{3}{7}$	$\frac{8}{21}$, 0.381	$\frac{1}{14}$, 0.0714	B1	Table with correct values of x and at least one further non-zero probability correct. Condone extra x values if probability stated as 0.
		x	0	1	2	3	4								
		$P(X=x)$	$\frac{1}{210}$, 0.00476	$\frac{4}{35}$, 0.114	$\frac{3}{7}$	$\frac{8}{21}$, 0.381	$\frac{1}{14}$, 0.0714								
		B1	Third probability correct. Accept probabilities not in table if clearly identified.												
	B1	Fourth probability correct. Accept probabilities not in table if clearly identified.													
B1	Fifth probability correct. Accept probabilities not in table if clearly identified. SCB1 for 4 further non-zero probabilities adding to $\frac{4}{7}$, 0.5712 if B2 max scored.														
	4														
6(c)	$[P(2B, 3B \mid 3B1R \text{ or } 2B2R \text{ or } 1B 3R) =] \frac{\frac{3}{7} + \frac{8}{21}}{\frac{4}{35} + \frac{3}{7} + \frac{8}{21}}$	M1	$\frac{3}{7} + \text{their } \frac{8}{21}$ seen as the numerator of a fraction.												
		B1 FT	$\text{their } \frac{4}{35} + \frac{3}{7} + \text{their } \frac{8}{21}$ seen as the denominator of a fraction.												
	$= \left[\frac{17}{21} \right]_{97}^{105} = \frac{170}{194}, \frac{85}{97}, 0.876$	A1	Accept 0.87628...to at least 3SF.												
		3													

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Highlighter	Highlight a key point in the working
	Ignore subsequent work
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	Judgement
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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.
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	Judgment made by the PE
	Premature approximation
	Special case
	Indicates that work/page has been seen

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

PUBLISHED**Mark Scheme Notes**

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	<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>$P(X = x)$</td><td>$\frac{1}{24}$</td><td>$\frac{6}{24}$</td><td>$\frac{11}{24}$</td><td>$\frac{6}{24}$</td></tr><tr><td></td><td>0.0416 7</td><td>0.25</td><td>0.458 3</td><td>0.25</td></tr></table>					x	0	1	2	3	$P(X = x)$	$\frac{1}{24}$	$\frac{6}{24}$	$\frac{11}{24}$	$\frac{6}{24}$		0.0416 7	0.25	0.458 3	0.25	B1	Table with correct values of x and at least one non-zero probability correct. Condone extra x values if probability stated as 0.
						x	0	1	2	3												
						$P(X = x)$	$\frac{1}{24}$	$\frac{6}{24}$	$\frac{11}{24}$	$\frac{6}{24}$												
		0.0416 7	0.25	0.458 3	0.25																	
B1	Two more correct non-zero probabilities linked with correct outcome (3 correct probabilities present). Accept probabilities not in table if clearly identified.																					
B1	Four correct probabilities linked with the correct outcomes. Accept probabilities not in table if clearly identified. Non-exact decimals correct to at least 3SF. SCB1 for 4 non-zero probabilities (not all $\frac{1}{4}$) in table with correct x values adding to 1 if B1 max scored.																					
						3																

Question	Answer	Marks	Guidance
2	Mean = $160 \times 0.7 = 112$ Variance = $160 \times 0.7 \times 0.3 = 33.6$	B1	112 and 33.6 (CAO) seen, allow un-simplified. May be in standardisation formula. ($\sigma = \sqrt{33.6}, 5.79655\dots$ to at least 4SF implies correct variance). Withhold mark if variance clearly identified as standard deviation. Condone $N(112, \sqrt{33.6})$ if <u>standardisation formula correct</u> or variance/standard deviation stated correctly as well.
	$P(X > 120) = P\left(Z > \frac{120.5 - 112}{\sqrt{33.6}}\right)$	M1	Substituting <i>their</i> 112 and <i>their</i> 33.6 into the $\pm$ standardising formula (any number for 120.5), allow σ^2 or $\sqrt{\sigma}$.
		M1	Use continuity correction 119.5 or 120.5 in <i>their</i> standardisation formula. Note: If no standardisation formula seen $\pm \left(\frac{8.5}{\sqrt{33.6}}\right)$ or $\pm \left(\frac{8.5}{5.797}\right)$ scores M2 BOD .
	$[P(Z > 1.466) = 1 - \Phi(1.466)]$ $= 1 - 0.9287$	M1	Appropriate area Φ , from final process, must be a probability. May be implied by a sketch of the required probability area. Note: correct final answer implies this M1 . Expect final answer < 0.5 .
	$= 0.0713$ final answer	A1	Final answer AWRT.
		5	

Question	Answer	Marks	Guidance
3(a)	$[P(\text{both same colour}) =] \frac{4}{16} \times \frac{4}{16} + \frac{12}{16} \times \frac{11}{15}$	M1	OE. $\frac{4}{16} \times \frac{4}{16}$ and either $\frac{12}{16} \times \frac{11}{15}$ or $\frac{12}{16} \times \frac{11}{16}$ seen. Decimals to 4SF but condone $\frac{11}{15} = 0.733$. No additional terms.
	$= \frac{49}{80}, 0.6125$	A1	ISW. CAO, $(0.6125, \frac{49}{80} \text{ must be seen})$. If M mark not scored, SCB1 for $\frac{49}{80}, 0.6125$ WWW.
		2	

Question	Answer	Marks	Guidance
3(b)	$\left[P(1B 2R) = \frac{P(1B \cap 2R)}{P(2R)} \right]$ $= \frac{\frac{4}{16} \times \frac{12}{16}}{\frac{4}{16} \times \frac{12}{16} + \frac{12}{16} \times \frac{11}{15}}$	M1	$\frac{4}{16} \times \frac{12}{16}$ seen as a numerator of a single fraction. If 0.1875 or $\frac{3}{16}$ is seen as the numerator, the calculation must be seen in the working for the denominator – or in 3(a) , including by the tree diagram. The question will need to be linked if the work is in 3(a) .
		M1	$\left\{ \text{their} \left(\frac{4}{16} \times \frac{12}{16} \right) \text{ or correct} \right\}$ $+ \left\{ \text{their} \left(\frac{12}{16} \times \frac{11}{15} \right) \text{ from part (a)} \right\}$ or 0.7375 or $\frac{59}{80}$ <i>or correct</i> seen as the denominator of a single fraction.
	$\frac{15}{59}, 0.254$	A1	0.254237... to at least 3 SF. If one or more M not scored SCB1 for $\frac{15}{59}, 0.254237...$ to at least 4 SF WWW.
		3	

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Question	Answer	Marks	Guidance
4(a)	$0.3 \times 0.25 \times 0.45 \times 6$	M1	OE. $0.3 \times 0.25 \times 0.45 \times k$, k an integer > 1 . E.g. $6 = 3! = {}^3P_3$ etc.
	$0.2025, \frac{81}{400}$	A1	CAO exact answer.
		2	
4(b)	Method 1		
	$1 - 0.7^8$	M1	$1 - 0.7^d$, $d = 8, 9$, 0.75, 0.3 are not misreads.
	$= 0.942$	A1	$0.942 \leq p < 0.9425$.
	Method 2		
	$0.3 + 0.3(0.7) + 0.3(0.7)^2 + 0.3(0.7)^3 + 0.3(0.7)^4 + 0.3(0.7)^5 + 0.3(0.7)^6 + 0.3(0.7)^7$	M1	$0.3 + 0.3(0.7) + 0.3(0.7)^2 + 0.3(0.7)^3 + 0.3(0.7)^4 +$ $0.3(0.7)^5 + 0.3(0.7)^6 + 0.3(0.7)^7 \left[+ 0.3(0.7)^8 \right]$
	$= 0.942$	A1	$0.942 \leq p < 0.9425$.
		2	
4(c)	$(0.3)^2 (0.7)^5 \times 6$	M1	$(p)^2 (1 - p)^5 \times k$, $0 < p < 1, k = 5 \text{ or } 6$.
	$= 0.0908$	A1	AWRT.
		2	

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Question	Answer	Marks	Guidance
5(a)	Cumulative frequency graph drawn	B1	At least 5 points plotted accurately at class upper end points: (10, 34), (20, 86), (30, 142), (40, 208), (60, 265), (90, 300). Linear cf scale $0 \leq \text{cf} \leq 300$ and linear time scale $0 \leq \text{time} \leq 90$ with at least 3 values identified on each. Bar/histograms score B0 . Required axes must be over 50% of grid size. Axes can be the other way round.
		B1	All points plotted correct, curve drawn, no line segments and joined to (0,0) passing within $\frac{1}{2}$ square of points. Axes labelled cumulative frequency (cf), time (t) and minutes (min or m) – or a suitable title. Curve must be <300 for $0 \leq t < 90$.
		2	
5(b)	Line drawn from 180 on cf axis to meet graph	M1	Use of graph must be seen. Must be an increasing graph. Annotate this mark on 5(a) grid.
	$[k =]$ 35 minutes	A1 FT	Strict FT , reading at their curve condone use of t .
		2	

Question	Answer	Marks	Guidance
5(c)	Frequencies: [34,] 52, 56, 66, 57, 35	B1	May be un-simplified and/or in variance calculation.
	Midpoints: 5, 15, 25, 35, 50, 75	B1	At least 5 correct midpoints seen, may be un-simplified, may be in calculation, may be by data table.
	$\text{Mean} = \frac{34 \times 5 + 52 \times 15 + 56 \times 25 + 66 \times 35 + 57 \times 50 + 35 \times 75}{300}$ $\left[\frac{170 + 780 + 1400 + 2310 + 2850 + 2625}{300} \right]$ $\left[= \frac{10135}{300} \right]$	M1	Correct un-simplified mean formula with <i>their</i> 6 midpoints (not upper bound, lower bound, upper limits, lower limits, class width, frequency density, frequency or cumulative frequency and must be within class) and <i>their</i> frequencies (not cw, cf, or fd), accept un-simplified. Condone 1 value error on numerator. The ‘table’ approach may be used with multiplications and additions implied by appropriate values.
	= 33.8	A1	WWW. $33.78 \leq \text{mean} \leq 33.8, \frac{2027}{60}, 33\frac{47}{60}$. If M not scored, SCB1 for $\frac{2027}{60}, 33\frac{47}{60}, 33.78$. (Note: $\frac{10135}{300}$ scores A0).

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Question	Answer	Marks	Guidance
5(c)	$\text{Var} = \frac{34 \times 5^2 + 52 \times 15^2 + 56 \times 25^2 + 66 \times 35^2 + 57 \times 50^2 + 35 \times 75^2}{300} - \left(\text{their} \frac{10135}{300} \right)^2$ Or $\frac{34 \times 25 + 52 \times 225 + 56 \times 625 + 66 \times 1225 + 57 \times 2500 + 35 \times 5625}{300} - \left(\text{their} \frac{10135}{300} \right)^2$ [= 1559.25 – 1141.31 = 417.936]	M1	Correct un-simplified Variance formula with <i>their</i> midpoints and <i>their</i> frequencies – <i>their</i> mean² for variance or standard deviation. Condone one value error on numerator. Condone <i>their</i> $\sum f$ from denominator of mean calculation if not 300.
	sd = 20.4	A1	$20.4 \leq \sigma < 20.45$ WWW. At least one of the mean or the standard deviation must be linked to the value, and no incorrect identifications, for this mark to be scored.
		6	

Question	Answer	Marks	Guidance
6(a)	Method 1 M _ _ _ _ _ M (arranging the remaining letters and inserting the As)		
	$4! \times {}^5C_1$	M1	$4! \times m, m \in \mathbb{Z}, m \geq 1.$
		M1	$n \times {}^5C_1$ or $n \times {}^5C_4$ or $n \times 5$, allow $n \times {}^5P_1$ or $n \times \frac{{}^5P_4}{4!}$, $n \in \mathbb{Z}, n > 1.$ e.g. $4! \times {}^5C_1 \times k$ (oe), $k \in \mathbb{Z}, k \geq 1$ scores M1M1 .
	120	A1	
	Method 2 Total number of arrangements with Ms at end – arrangements with Ms at end and at least 2 As together		
	[Total number of arrangements: $\frac{8!}{4!} = 1680$ Arrangements with As together: (AAAA) ^ ^ ^ ^ $5!$ (AAA^)(A) ^^^ $5! \times 4$ (AA^)(AA) ^^^ $5! \times \frac{4}{2!}$ (A^)(A^)(2A) ^^ $5! \times \frac{4 \times 3}{2!}$] $\frac{8!}{4!} - 5! \times 13$	M1	$\frac{8!}{4!} \times r - 5! \times m, m \in \mathbb{Z}, m \geq 3, r = 1, 2.$
		M1	$k - 5! \times 13 \times r, k \in \mathbb{Z}, k > 1560, r = 1, 2.$
	= 120	A1	
		3	

Question	Answer	Marks	Guidance
6(b)	Method 1 M _ _ _ M _ _ _ _ _		
	$\frac{8!}{4!} \times 6$	B1	$\frac{8!}{4!} \times b, b \in \mathbb{Z}, b \geq 1.$
		M1	$\frac{c!}{d} \times 6, c = 8, 9, 10 \ d = 1, 2!, 4! \text{ or } 2! \times 4!.$
	10080	A1	
	Method 2 M ^ ^ ^ M _ _ _ _ _ letters between Ms arranged and the treated as a single item		
	$\frac{6!}{4!} \times {}^8P_3$	B1	$\frac{6!}{4!} \times b, b \in \mathbb{Z}, b \geq 1.$
		M1	$\frac{c!}{d} \times {}^8P_3, c = 6, 7, 8 \ d = 1, 2!, 4! \text{ or } 2! \times 4!.$
	10080	A1	
		3	

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Question	Answer	Marks	Guidance
6(c)	Method 1		
	MMAAA 1	B1	One identified outcome correct (excluding MMAAA or MAAAA), accept un-simplified.
	MMAA _ ${}^4C_1$ 4		
	MAA _ _ ${}^4C_2$ 6	M1	Five correct scenarios added (values do not need to be correct).
	MAAA _ ${}^4C_1$ 4		
	MAAAA 1		
	[Total] 16	A1	
	Method 2 2 Ms cannot be present in the scenarios		
	MAA ^ ^ ${}^5C_2$ 10	B1	One identified outcome correct (excluding MAAAA), accept un-simplified.
	MAAA ^ ${}^5C_1$ 5		
	MAAAA ${}^5C_0$ 1	M1	Three correct scenarios added (values do not need to be correct).
	[Total] 16		
		A1	
		3	

Question	Answer	Marks	Guidance
7(a)	$P\left(\frac{72.4 - 74.8}{3.2} < Z < \frac{76.3 - 74.8}{3.2}\right)$	M1	Use of $\pm$ standardisation formula once with 74.8, 3.2 and either 72.4 or 76.3. No continuity correction, not σ^2 , not $\sqrt{\sigma}$.
	$[\Phi(0.75) + \Phi(0.4688) - 1]$ = 0.7734 + 0.6804 – 1 or $(0.7734 - 0.5) + (0.6804 - 0.5)$ or 0.7734 – 0.3196 or 0.6804 – 0.2266 or 0.2734 + 0.1804	M1	Calculating the appropriate probability area, must be a probability (assume a 4SF value in the calculation it is a probability, assume a 3SF value in the calculation it is not a probability). (leading to their final answer, expect < 0.5). Unless there is a misread, the probability area calculation must be structured as shown.
	= 0.4538	A1	AWRT 0.454 WWW.
	Expected number = 0.4538 $\times$ 120 = 54.46 so 54 (or 55) (One integer answer stated)	B1 FT	Strict FT <i>their</i> 4-figure probability $\times$ 120 (check with calculator). One integer answer. No indication of approximation, e.g. $\approx, \cong, \text{about}, 2\text{SF}$.
		4	

Question	Answer	Marks	Guidance
7(b)	$\frac{0.202 - \mu}{\sigma} = 0.842$ $\frac{0.185 - \mu}{\sigma} = -0.583$	B1	$0.841 < z_1 < 0.843$ or $-0.843 < z_1 < -0.841$ seen.
		B1	$0.582 < z_2 < 0.584$ or $-0.584 < z_2 < -0.582$ seen.
		M1	Use of the $\pm$ standardisation formula once with μ , σ equating to a z-value (not 0.20, 0.80, 0.28, 0.72, 0.5793, 0.4207, 0.6103, 0.3897, 0.7881, 0.2119, 0.7642, 0.2358, -0.417 , 0.417 , -0.158 0.158 , etc). No continuity correction, not σ^2 , not $\sqrt{\sigma}$.
	Solve, obtaining values for μ and σ $\mu = 0.192$, $\sigma = 0.0119$	M1	Solve 2 equations in μ and σ with an attempt at the elimination method, substitution method or other appropriate approach to obtain values for both μ and σ .
		A1	AWRT $\mu = 0.192$, $\sigma = 0.0119$. There must be consistency with signs in the solution, e.g. $\sigma = \frac{0.017}{-1.425} = 0.0119$ is not acceptable, A0 . If one or both the M marks have been withheld, SCB1 for both correct WWW.
		5	

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Question	Answer	Marks	Guidance
7(c)	Method 1		
	$[P(X < 3) = P(0, 1, 2) =]$ $0.8^{10} + {}^{10}C_1 0.8^9 0.2 + {}^{10}C_2 0.8^8 0.2^2$ $[= 0.107374 + 0.268435 + 0.301989]$	M1	One term of the form ${}^{10}C_x (p)^x (1-p)^{10-x}$, $0 < p < 1, x \neq 0$ or 10.
		A1	Correct un-simplified expression.
	0.678	B1	$0.677 < p \leq 0.678$.
	Method 2		
	$[P(X < 3) = 1 - P(3, 4, 5, 6, 7, 8, 9, 10) =]$ $1 - \{ {}^{10}C_3 0.8^7 0.2^3 + {}^{10}C_4 0.8^6 0.2^4 + \dots + 0.2^{10} \}$	M1	One term of the form ${}^{10}C_x (p)^x (1-p)^{10-x}$, $0 < p < 1, x \neq 0$ or 10.
		A1	Correct un-simplified expression.
	0.678	B1	$0.677 < p \leq 0.678$
		3	

Cambridge International AS & A Level

MATHEMATICS**9709/53**

Paper 5 Probability & Statistics 1

May/June 2025**MARK SCHEME**Maximum Mark: 50

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **20** printed pages.

PUBLISHED**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors 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
	Accuracy mark awarded zero
	Accuracy mark awarded one
	Independent accuracy mark awarded zero
	Independent accuracy mark awarded one
	Independent accuracy mark awarded two
	Benefit of the doubt
	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.
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WWW	Without Wrong Working
AWRT	Answer Which Rounds To

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Question	Answer	Marks	Guidance
1(a)	$4960 - 40k = 836$ or $\frac{4960}{40} - k = \frac{836}{40}$	B1	Also accept $124 - k = 20.9$ or $40k = 4124$ OE.
	$k = 103.1$	B1	
		2	
1(b)	Method 1		
	$[\text{sd}^2 =] \frac{25410.8}{40} - \left(\frac{836}{40}\right)^2$	M1	
	$[\text{sd}^2 = 198.46,]$ $\text{sd} = 14.1$	A1	14.08758...to at least 3SF. If M not awarded SCB1 for correct answer WWW.
	Method 2		
	$[\text{sd}^2 =] \frac{622978.4}{40} - 124^2$	M1	622978.4 comes from expansion of $\sum(x - k)^2 = 25410.8$ substituting in relevant values.
	$[\text{sd}^2 = 198.46,]$ $\text{sd} = 14.1$	A1	14.08758...to at least 3SF. If M not awarded SCB1 for correct answer WWW.
		2	

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Question	Answer	Marks	Guidance
2(a)	Method 1		
	$1 - (0.55)^3$	M1	Might also be seen as $1 - {}^3C_0(0.55)^3[(0.45)^0]$.
	$= 0.834, \frac{6669}{8000}$	A1	AWRT.
	Method 2		
	${}^3C_1 (0.45)(0.55)^2 + {}^3C_2 (0.45)^2(0.55) + (0.45)^3[0.55]^0$	M1	
	$= 0.834, \frac{6669}{8000}$	A1	AWRT.
		2	

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Question	Answer	Marks	Guidance
2(b)	Method 1		
	$[P(8, 9, 10) =] {}^{10}C_8 0.55^8 0.45^2 + {}^{10}C_9 0.55^9 0.45^1 + 0.55^{10}$	M1	One term of the form ${}^{10}C_x (p)^x (1-p)^{10-x}$, $0 < p < 1, x \neq 0$ or 10.
	$[= 0.0763026 + 0.0207241 + 0.00253295]$	A1	Correct un-simplified expression.
	$= 0.0996$	B1	$0.09955 < p \leq 0.0996$.
	Method 2		
	$[1 - P(0,1,2,3,4,5,6,7)]$	M1	One term of the form ${}^{10}C_x (p)^x (1-p)^{10-x}$, $0 < p < 1, x \neq 0$ or 10.
	$1 - (0.45^{10} + {}^{10}C_1 0.55 0.45^9 + \dots + {}^{10}C_7 0.55^7 0.45^3)$	A1	Correct un-simplified expression. Condone omission of up to 5 of the 6 middle terms. Condone omission of last bracket only. If both brackets omitted in un-simplified expression, allow recovery for final stated calculation of $1 - 0.90044\dots$ or better.
	$= 0.0996$	B1	$0.09955 < p \leq 0.0996$.
		3	

Question	Answer	Marks	Guidance
3(a)	$\left[P(X=8) = \left(\frac{1}{6}\right)\left(\frac{5}{6}\right)^7 = \right] 0.0465, \frac{78125}{1679616}$	B1	
		1	

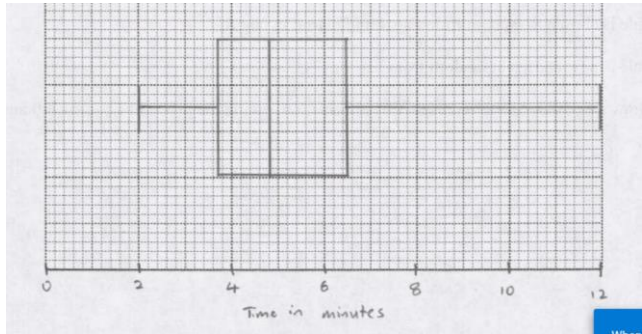
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Question	Answer	Marks	Guidance
3(b)	Method 1		
	$[P(X < 9) =] 1 - \left(\frac{5}{6}\right)^8$	M1	$1 - \left(\frac{5}{6}\right)^d, d = 8, 9.$
	$= 0.767$	A1	AWRT.
	Method 2		
	$[P(X < 9) =]$ $\frac{1}{6} + \left(\frac{5}{6}\right)\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^2\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^3\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^4\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^5\left(\frac{1}{6}\right) +$ $\left(\frac{5}{6}\right)^6\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^7\left(\frac{1}{6}\right)$	M1	$\frac{1}{6} + \left(\frac{5}{6}\right)\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^2\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^3\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^4\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^5\left(\frac{1}{6}\right) +$ $\left(\frac{5}{6}\right)^6\left(\frac{1}{6}\right) + \left(\frac{5}{6}\right)^7\left(\frac{1}{6}\right) \left[+ \left(\frac{5}{6}\right)^8\left(\frac{1}{6}\right) \right]$
	$= 0.767$	A1	AWRT.
		2	

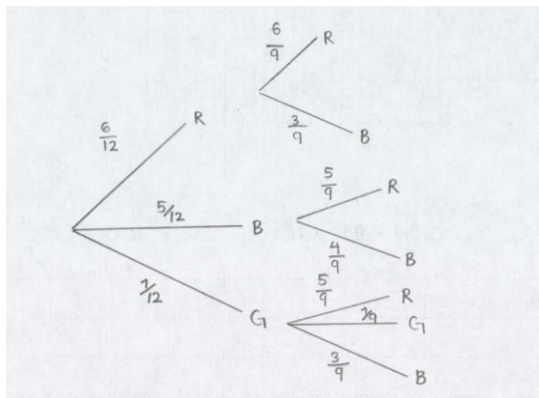
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Question	Answer	Marks	Guidance
3(c)	Method 1		
	2 throws $\left(\frac{1}{6}\right)^2$ $\frac{1}{36}$	B1	Two identified scenarios correct, accept un-simplified calculations.
	3 throws: $\left(\frac{1}{6}\right)^2 \left(\frac{5}{6}\right) \times {}^2C_1$ $\frac{10}{216}$	M1	Four correctly identified scenarios added (here they may be identified by correct un-simplified calculations). Condone ${}^2C_1 = 2$ etc.
	4 throws: $\left(\frac{1}{6}\right)^2 \left(\frac{5}{6}\right)^2 \times {}^3C_1$ $\frac{75}{1296}$		
	5 throws: $\left(\frac{1}{6}\right)^2 \left(\frac{5}{6}\right)^3 \times {}^4C_1$ $\frac{500}{7776}$		
	0.196, $\frac{763}{3888}$	A1	$0.196 \leq p < 0.1963$ SCB1 for correct answer if M mark not awarded
	Method 2		
	No threes in 5 throws $\left(\frac{5}{6}\right)^5$ $\frac{3125}{7776}$	B1	1 – 1 identified scenario correct, accept un-simplified calculations.
	One three in 5 throws $\left(\frac{1}{6}\right) \left(\frac{5}{6}\right)^4 \times {}^5C_1$ $\frac{3125}{7776}$	M1	1 – 2 correctly identified scenarios (here they may be identified by correct un-simplified calculations). Condone ${}^5C_1 = 5$.
	$1 - \left(\frac{5}{6}\right)^5 - \left\{ \left(\frac{1}{6}\right) \left(\frac{5}{6}\right)^4 \times {}^5C_1 \right\}$		
	0.196, $\frac{763}{3888}$	A1	$0.196 \leq p < 0.1963$. SCB1 for correct answer if M mark not awarded.
		3	

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Question	Answer	Marks	Guidance
4(a)	Accept 43 or 44	B1	
		1	
4(b)	 Median = 4.8	B1	Plotted on box.
	LQ = 3.7 or 3.8, UQ = 6.5 or 6.6	B1	Plotted on box.
	Correct end points for whiskers and whiskers drawn	B1	Correct end points of whiskers (2 and 12). Whiskers not through box, not drawn at corners of box. Accept end points of whiskers as dots or without vertical line.
	Linear scale and labelled Time in minutes	B1	OE. Linear scale from 2 to 12, at least 3 equally spaces values marked using at least half of the grid. Label to include time and minutes.
		4	

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Question	Answer	Marks	Guidance
5(a)	 Probabilities for Bag A selection R,B,G ($\frac{6}{12}, \frac{5}{12}, \frac{1}{12}$) Probabilities for Bag B selection: $\frac{6}{9}, \frac{3}{9}, [0]$ $\frac{5}{9}, \frac{4}{9}, [0]$ $\frac{5}{9}, \frac{3}{9}, \frac{1}{9}$	B1	Correct structure and probabilities for Bag A branches which must be the first set of branches, including labels R, B, G.
		B1	Correct structure and probabilities for one Bag B branch, including labels R, B, [G]. Condone inclusion of branches with 0 probability.
		B1	Correct structure and probabilities for remaining Bag B branches, including labels R, B, [G]. Condone inclusion of branches with 0 probability. Additional branches without a probability of zero lose this mark.
		3	
5(b)	$[P(RR) + P(BB) + P(GG) =] \frac{6}{12} \times \frac{6}{9} + \frac{5}{12} \times \frac{4}{9} + \frac{1}{12} \times \frac{1}{9}$	M1	Correct or FT tree diagram probabilities with all 3 (R, B and G) branches. Note: working may be by tree diagram.
	$= \frac{57}{108}, \frac{19}{36}$	A1	Accept 0.5278, 0.528.
		2	

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Question	Answer	Marks	Guidance
5(c)	$P(A \text{ blue} B \text{ blue}) = \frac{\frac{5}{12} \times \frac{4}{9}}{\frac{6}{12} \times \frac{3}{9} + \frac{5}{12} \times \frac{4}{9} + \frac{1}{12} \times \frac{3}{9}}$	M1	$\frac{5}{12} \times \frac{4}{9}$ or $\frac{20}{108}$ or $\frac{5}{27}$ or <i>their</i> P(BB) from Q5(b) seen as a numerator of a single fraction. FT tree diagram with values from only 2 bags.
		B1 FT	$\frac{6}{12} \times \frac{3}{9} + \frac{5}{12} \times \frac{4}{9} + \frac{1}{12} \times \frac{3}{9}$ seen as the denominator of a single fraction. $\frac{5}{27}$ or <i>their</i> P(BB) may be seen from Q5b in place of $\frac{5}{12} \times \frac{4}{9}$ FT tree diagram with values from only 2 bags.
	$= \frac{20}{41}$	A1	Accept 0.488, 0.4878. SCB1 if either M or B mark not scored $\frac{20}{41}$ or 0.4878.
		3	

Question	Answer	Marks	Guidance
6(a)	$[P(X < 2.65) =] P(Z < \frac{2.65 - 2.50}{0.12}) [= P(Z < 1.25)]$	M1	Substituting 2.65, 2.50 and 0.12 into the $\pm$ standardisation formula allow σ^2 or $\sqrt{\sigma}$. Condone continuity correction ± 0.005 .
	$= 0.894$	A1	$0.894 \leq p \leq 0.8944$.
		2	

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Question	Answer	Marks	Guidance
6(b)	$P(Z > \frac{2.50 + 1.65 \times 0.12 - 2.50}{0.12}) = P(Z > 1.65)$	M1	Seeing $2.50 + 1.65 \times 0.12$ or 2.698 and 2.50 and 0.12 substituted into the $\pm$ standardisation formula with a direct attempt to find the probability area. Accept numerator of 1.65×0.12 . Accept Z linked to 1.65 with a direct attempt to find the probability area. Do not allow σ^2 or $\sqrt{\sigma}$. No continuity correction.
	$= 1 - 0.9505 = 0.0495$	A1	AWRT.
	Expected number = $0.0495 \times 160 = 7.92$, so 7 or 8	B1 FT	Strict FT <i>their</i> at least 4-DP calculated probability, seen anywhere (not a z-value). Final answer must be a single positive integer value, no approximation or rounding stated.
		3	
6(c)	$\frac{1.26 - \mu}{\sigma} = -0.739$ $\frac{1.35 - \mu}{\sigma} = -0.151$	B1	$0.738 < z_1 < 0.740$ or $-0.740 < z_1 < -0.738$ seen.
		B1	$0.150 < z_2 < 0.152$ or $-0.152 < z_2 < -0.150$ seen.
		M1	Use of the $\pm$ standardisation formula once with μ, σ equating to a z-value (not 0.77, 0.23, 0.44, 0.56, 0.7794, 0.5910, 0.6700, 0.7123, 0.2206, 0.4090, 0.3300, 0.2877). No continuity correction, not σ^2 , not $\sqrt{\sigma}$.
	Solve, obtaining values for μ and σ $\mu = 1.37, \sigma = 0.153$	M1	Solve 2 equations in μ and σ using the elimination method, substitution method or other appropriate approach to obtain values for both μ and σ .
		A1	AWRT $\mu = 1.37, \sigma = 0.153$. If one or both the M marks have been withheld, SCB1 for both correct.
		5	

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Question	Answer	Marks	Guidance
7(a)	Method 1 Total – A and B together		
	$7! - 6! \times 2$	M1	$7! - k$, k an integer ≥ 1 .
		M1	$m - 6! \times n : n = 1, 2$ where m an integer $> 6!$ $n = 1$ can be implied.
	$= 3600$	A1	
	Method 2 Arrangements of 5 people then Ali and Ben placed		
	$5! \times 6 \times 5$	M1	$5! \times p$ where p an integer > 1 .
		M1	$q \times 6 \times 5$, $q \times {}^6C_2$, $q \times {}^6P_2$, $q \times \frac{6 \times 5}{2}$, where q an integer > 1 .
	$= 3600$	A1	
		3	
7(b)	$7! \times 4! \times 2$	M1	$7! \times r$, where r is an integer, $r > 1$ or $4! \times s$, where s is an integer, $s > 1$.
		M1	$7! \times 4! \times t$, where t is an integer, $t \geq 1$, $t = 1$ can be implied.
	241920	A1	CAO.
		3	

Question	Answer	Marks	Guidance
7(c)	${}^{11}C_6 \times {}^5C_3 \times [{}^2C_2]$	M1	${}^{11}C_v \times {}^{11-v}C_u \times [{}^{11-v-u}C_w],$ $u, v, w = 6, 3, 2 \text{ } u \neq v \neq w.$
	$= 4620$	A1	
		2	

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Question	Answer	Marks	Guidance
7(d)	Method 1 Ali, Ben and Charlie must be in the group of 6 or the group of 3.		
	group of 6: ${}^8C_3 \times {}^5C_3 \times ({}^2C_2) = 560$	B1	560 seen, accept un-simplified.
	group of 3: ${}^8C_6 (\times {}^2C_2 \times {}^3C_3) = 28$	B1	28 seen accept un-simplified.
	Probability they are in same group = $\frac{560 + 28}{4620}$	M1	$\frac{\text{their}(560 + 28)}{\text{their}(c)}$ or $\frac{\text{their}(560 + 28)}{4620}$
	$= \frac{588}{4620}, \frac{7}{55}, 0.127$	A1	
	Method 2 Ali, Ben and Charlie must be in the group of 6 or the group of 3.		
	Group of 6: $\frac{6}{11} \times \frac{5}{10} \times \frac{4}{9} \times \frac{3}{8} \times \frac{2}{7} \times \frac{1}{6} \times {}^8C_3$ $= \frac{1}{462} \times 56 = \frac{4}{33}$	B1	$\frac{4}{33}$, 0.1212... seen, accept un-simplified.
	Group of 3: $\frac{3}{11} \times \frac{2}{10} \times \frac{1}{9} = \frac{1}{165}$	B1	$\frac{1}{165}$, 0.00606(06...) seen, accept un-simplified.
	Probability they are in same group = $\frac{4}{33} + \frac{1}{165}$	M1	$\text{their } \frac{4}{33} + \text{their } \frac{1}{165}$.
	$= \frac{7}{55}, 0.127$	A1	
		4	

Cambridge International AS & A Level

MATHEMATICS**9709/55**

Paper 5 Probability & Statistics 1

May/June 2025**MARK SCHEME**Maximum Mark: 50

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **20** printed pages.

PUBLISHED**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors 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
	Accuracy mark awarded zero
	Accuracy mark awarded one
	Independent accuracy mark awarded zero
	Independent accuracy mark awarded one
	Independent accuracy mark awarded two
	Benefit of the doubt
	Blank Page
	Incorrect
Dep	Used to indicate DM0 or DM1

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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

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

PUBLISHED**Mark Scheme Notes**

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)	<table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>$P(X=x)$</td><td>$\frac{6}{36}$</td><td>$\frac{10}{36}$</td><td>$\frac{8}{36}$</td><td>$\frac{6}{36}$</td><td>$\frac{4}{36}$</td><td>$\frac{2}{36}$</td></tr><tr><td></td><td>$\frac{1}{6}$</td><td>$\frac{5}{18}$</td><td>$\frac{2}{9}$</td><td>$\frac{1}{6}$</td><td>$\frac{1}{9}$</td><td>$\frac{1}{18}$</td></tr><tr><td></td><td>0.167</td><td>0.278</td><td>0.222</td><td>0.167</td><td>0.111</td><td>0.056</td></tr></table>							X	0	1	2	3	4	5	$P(X=x)$	$\frac{6}{36}$	$\frac{10}{36}$	$\frac{8}{36}$	$\frac{6}{36}$	$\frac{4}{36}$	$\frac{2}{36}$		$\frac{1}{6}$	$\frac{5}{18}$	$\frac{2}{9}$	$\frac{1}{6}$	$\frac{1}{9}$	$\frac{1}{18}$		0.167	0.278	0.222	0.167	0.111	0.056	B1	Table with correct X values and at least one probability correct. Values need not be in order, lines may not be drawn, may be vertical, X and $P(X=x)$ may be omitted. Condone any additional X values if probability stated as 0.
	X	0	1	2	3	4	5																														
	$P(X=x)$	$\frac{6}{36}$	$\frac{10}{36}$	$\frac{8}{36}$	$\frac{6}{36}$	$\frac{4}{36}$	$\frac{2}{36}$																														
		$\frac{1}{6}$	$\frac{5}{18}$	$\frac{2}{9}$	$\frac{1}{6}$	$\frac{1}{9}$	$\frac{1}{18}$																														
		0.167	0.278	0.222	0.167	0.111	0.056																														
							B1	Total of four correct probabilities linked with correct outcomes, may not be in table.																													
							B1	All six probabilities are correct and linked with correct outcomes, may not be in table. If decimals are used, condone correct rounding (which will not sum to 1) or one value rounded inaccurately to sum to 1.																													
							3	SCB1 for six probs linked to X -values 0 – 5 summing to 1 with no more than 3 correct.																													
1(b)	$\left[E(X) = \frac{[0 \times 6] + 10 \times 1 + 8 \times 2 + 6 \times 3 + 4 \times 4 + 2 \times 5}{36} = \frac{10 + 16 + 18 + 16 + 10}{36} \right]$							M1	May be implied by use in Variance, accept un-simplified expression. FT <i>their</i> table if <i>their</i> 4 or more non-zero probabilities sum to 1 or 0.999.																												
	$[\text{Var} =] \frac{10 \times 1 + 8 \times 2^2 + 6 \times 3^2 + 4 \times 4^2 + 2 \times 5^2}{36} - \left(\frac{\text{their} 35}{18} \right)^2$ $\left[= \frac{210}{36} - \frac{1225}{324} = \frac{665}{324} = 2.05 \right]$							M1	Appropriate variance formula using <i>their</i> $(E(X))^2$ value. FT <i>their</i> table even if <i>their</i> 4 or more non-zero probabilities not summing to 1 Note: If table is correct, $\frac{210}{36} - (\text{their } E(X))^2$ is M1.																												
	$E(X) = \frac{35}{18}, 1.94, \text{Var}(X) = \frac{665}{324}, 2\frac{17}{324}, 2.05$							A1	OE. Answers for $E(X)$ and $\text{Var}(X)$ must be identified. Accept $\text{Var} = 2.052469\dots$ to 3sf or better.																												
								3																													

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Question	Answer	Marks	Guidance
2(a)	$[P(X < 14) =] P(Z < \frac{14 - 20}{5})$ $[= P(Z < -1.2)]$	M1	14, 20 and 5 substituted into $\pm$ Standardisation formula, no continuity correction, condone σ^2 or $\sqrt{\sigma}$.
	$= 1 - 0.8849$	M1	Appropriate area Φ , from final process, must be probability. (Expect final ans < 0.5). Note: the correct final answer may imply M1 from use of calculator.
	$= 0.115$	A1	$0.1150 \leq z \leq 0.1151$.
	[Number =] $150 \times 0.1151 = 17.265$ so 17 or 18	B1FT	FT <i>their</i> probability - final answer must be positive integer.
		4	
2(b)	$[P(X > h) = 0.25, \text{ so } P(Z < \frac{h - 20}{5}) = 0.75]$	B1	± 0.674 seen CAO – critical value.
	$\frac{h - 20}{5} = 0.674$	M1	20 and 5 substituted in $\pm$ standardisation formula, no continuity correction, not σ^2 , $\sqrt{\sigma}$, equated to a z-value. Note: 0.75; 0.25; 0.5987; 0.7734, 0.326 are NOT z-values.
	$h = 23.4$	A1	AWRT. Only dependent on M mark.
		3	

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Question	Answer	Marks	Guidance
3(a)	Mean = $80 \times 0.4 = 32$ Var = $80 \times 0.4 \times 0.6 = 19.2$	B1	Correct mean and variance, allow un-simplified. ($4.381 < \sigma \leq 4.382$ or $\frac{4\sqrt{30}}{5}$ imply correct variance).
	$P(X < 27) = P(Z < \frac{26.5 - 32}{\sqrt{19.2}}) = P(Z < -1.255)$	M1	Substituting <i>their</i> mean and variance into $\pm$ standardisation formula (any number for 26.5), not σ^2 , $\sqrt{\sigma}$.
		M1	Using continuity correction 26.5 or 27.5 in <i>their</i> standardisation formula.
	$= 1 - 0.8953$	M1	Appropriate area Φ , from final process, must be probability. (Expect final ans < 0.5). Note: the correct final answer may imply M1 from use of calculator.
	0.105	A1	$0.1045 < p \leq 0.105$.
		5	

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Question	Answer	Marks	Guidance
3(b)	Method 1		
	$[P(0, 1, 2) =] {}^{10}C_0 0.4^0 0.6^{10} + {}^{10}C_1 0.4^1 0.6^9 + {}^{10}C_2 0.4^2 0.6^8$	M1	One term ${}^{10}C_x p^x (1-p)^{10-x}$, $0 < p < 1, x \neq 0$.
	$= 0.0060466 + 0.0403107 + 0.120932$	A1	Correct expression, accept un-simplified.
	$= 0.167 [2\dots]$	B1	
	Method 2		
	$[1 - P(3, 4, 5, 6, 7, 8, 9, 10) =] 1 - ({}^{10}C_3 0.4^7 0.6^3 + {}^{10}C_4 0.4^6 0.6^4 + {}^{10}C_5 0.4^5 0.6^5 + {}^{10}C_6 0.4^4 0.6^6 + {}^{10}C_7 0.4^3 0.6^7 + {}^{10}C_8 0.4^2 0.6^8 + {}^{10}C_9 0.4^1 0.6^9 + {}^{10}C_{10} 0.4^0 0.6^{10})$	M1	One term ${}^{10}C_x p^x (1-p)^{10-x}$, $0 < p < 1, x \neq 0$.
		A1	Correct expression, accept un-simplified.
	$= 0.167 [2893\dots]$	B1	
		3	

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Question	Answer	Marks	Guidance
4(a)		B1	Fully correct labelled tree diagram for each trio of branches clearly labelled 'accepted', 'rejected' and 'test again' for each intersection (no additional branches).
		B1	All correct probabilities on 8 required branches in correct positions. Ignore additional branches.
		2	
4(b)	$[P(A) + P(T A) + P(T T A) =] 0.3 + 0.5 \times 0.3 + 0.5 \times 0.5 \times 0.25$ $[= 0.3 + 0.15 + 0.0625]$	M1	$0.3 + k + j$, where either $k = 0.5 \times 0.3$ and $0 \leq j < 1$ or $0 \leq k < 1$ and $j = 0.5 \times 0.5 \times 0.25$.
	$0.5125, \frac{41}{80}$	A1	CAO.
		2	

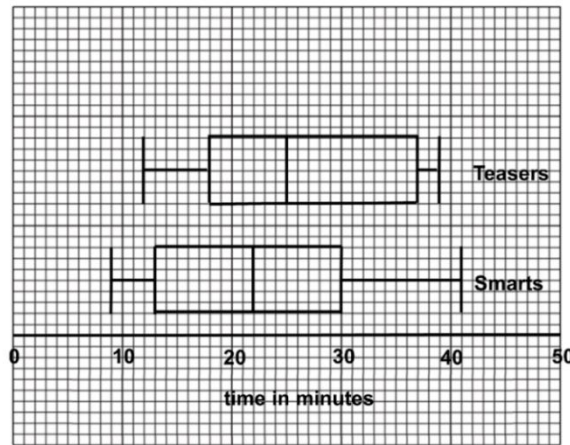
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Question	Answer	Marks	Guidance
4(c)	$\left[P(2nd\ test\ taken A) = \frac{P(TA) + P(TTA)}{P(accepted)} = \right] =$	B1	$0.5 \times 0.3 + 0.5 \times 0.5 \times 0.25$ or <i>their (b)</i> – 0.3 seen as a numerator of a fraction (accept evaluated 0.2125).
	$\frac{0.5 \times 0.5 \times 0.25 + 0.5 \times 0.3}{0.5125 \text{ or } (0.3 + 0.5 \times 0.3 + 0.5 \times 0.5 \times 0.25)}$	M1	Conditional probability formula used with <i>their (b)</i> or correct in denominator.
	$\left[= \frac{0.2125}{0.5125} = \frac{\frac{17}{80}}{\frac{41}{80}} \right] 0.415, \frac{17}{41}$	A1	0.41463... to 3SF or better.
		3	
4(d)	$(1 - 0.5125)^3 \text{ or } (0.2 + 0.5 \times 0.2 + 0.5^2 \times 0.75)^3 \text{ or } 0.4875^3 \text{ or } \left(\frac{39}{80}\right)^3$	M1	$(1 - m)^3$, $m = \text{their (b)}$ or correct.
	0.116	A1	
		2	

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Question	Answer	Marks	Guidance																																																														
5(a)	<table><tr><th colspan="5">Smarts</th><th colspan="5">Teasers</th></tr><tr><td></td><td></td><td></td><td>9</td><td>0</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>8</td><td>8</td><td>3</td><td>1</td><td>1</td><td>2</td><td>5</td><td>8</td><td></td><td></td></tr><tr><td></td><td></td><td>9</td><td>8</td><td>2</td><td>1</td><td>5</td><td>5</td><td></td><td></td></tr><tr><td></td><td></td><td></td><td>8</td><td>0</td><td>3</td><td>2</td><td>6</td><td>7</td><td>9</td><td>9</td></tr><tr><td></td><td></td><td></td><td></td><td>1</td><td>4</td><td></td><td></td><td></td><td></td><td></td></tr></table>	Smarts					Teasers								9	0						8	8	3	1	1	2	5	8					9	8	2	1	5	5						8	0	3	2	6	7	9	9					1	4						B1	Correct stem cannot be upside down, ignore extra values.
	Smarts					Teasers																																																											
				9	0																																																												
	8	8	3	1	1	2	5	8																																																									
		9	8	2	1	5	5																																																										
			8	0	3	2	6	7	9	9																																																							
				1	4																																																												
		B1	Correct Smarts labelled on left, leaves in order from right to left and lined up vertically (less than halfway to next column), no commas or other punctuation.																																																														
		B1	Correct Teasers labelled on same diagram, leaves in order and lined up vertically (less than halfway to next column), no commas or other punctuation. Condone misalignment, commas, reverse order or omission of label if error penalised already in Smarts. If the correct data for Smarts & Teasers is transposed, treat as a single error in Smarts and condone in Teasers. If 2 errors on Teasers and 1 error is repeated in Smarts, B0B0 .																																																														
	Key 8 2 5 means 28 minutes for Smarts and 25 minutes for Teasers	B1	Correct single key for their diagram, need both teams identified and ‘minutes’ stated at least once here or in leaf headings or title. SC If 2 separate diagrams drawn, SCB1 if both keys meet these criteria (Max B1 , B0 , B0 , B1)																																																														
		4																																																															

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Question	Answer	Marks	Guidance																		
5(b)	Smarts: LQ 13 M 22 UQ 30	B1	All correct seen or plotted, even if Smarts Box Plot is not labelled.																		
	Box-and-whisker diagram	B1	All five key values for Teasers plotted accurately using <i>their</i> linear scale and labelled.																		
		B1	All five key values for Smarts, FT <i>their</i> values, plotted accurately using <i>their</i> linear scale and labelled																		
	<table border="1"><thead><tr><th></th><th>lowest</th><th>Q1</th><th>Q2</th><th>Q3</th><th>highest</th></tr></thead><tbody><tr><td>Smarts</td><td>9</td><td>13</td><td>22</td><td>30</td><td>41</td></tr><tr><td>Teaser</td><td>12</td><td>18</td><td>25</td><td>37</td><td>39</td></tr></tbody></table>		lowest	Q1	Q2	Q3	highest	Smarts	9	13	22	30	41	Teaser	12	18	25	37	39	B1	There must be two Box Plots. Whiskers not through either box or drawn at corners of boxes; single linear scale with at least three values stated and labelled time and minutes. SCB1 if there is no scaled and correctly labelled line but the two Box Plots are correct relative to each other, may or may not be labelled.
		lowest	Q1	Q2	Q3	highest															
Smarts	9	13	22	30	41																
Teaser	12	18	25	37	39																
		4																			
5(c)	Smarts are quicker	B1	Comment in context about central tendency.																		
	Smarts' times are more consistent	B1	Comment in context about spread.																		
		2																			

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Question	Answer	Marks	Guidance
6(a)	Method 1		
	$\frac{7}{12} \times \frac{5}{11} \times \frac{4}{10} \times \frac{3}{9} \times 4$	M1	$\frac{7}{12} \times \frac{5}{11} \times \frac{4}{10} \times \frac{3}{9} \times n$, n a positive integer.
		M1	$\frac{a}{b} \times \frac{c}{d} \times \frac{e}{f} \times \frac{g}{h} \times 4$, a, b, c, d, e, f, g, h positive integers.
	$\frac{14}{99}, 0.141 [4\dots]$	A1	
	Method 2		
	$\frac{{}^7C_1 \times {}^5C_3}{{}^{12}C_4}$	M1	${}^7C_1 \times {}^5C_3$ given as the numerator of a fraction.
		M1	${}^{12}C_4$ given as the denominator of a fraction.
	$\frac{14}{99}, 0.141[4\dots]$	A1	
6(b)		3	
	${}^{12}C_4 \times {}^8C_4 [\times {}^4C_4]$	M1	${}^jC_k \times k$, $j = 12, 8$ k a positive integer > 1 .
	34650	A1	SCM1 for ${}^{12}C_4 \times {}^8C_4 [\times {}^4C_4] \div 3!$ SCA1 for 5775.
		2	

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Question	Answer	Marks	Guidance
6(c)	Method 1 – summing no of ways with at least one man and one woman in each team		
	3M 1W + 3M 1W + 1M 3W 3M 1W + 2M 2W + 2M 2W	M1	$({}^7C_m \times {}^5C_{4-m})$ $1 \leq m \leq 3$ seen multiplied by at least one other Combination in form ${}^nC_r$.
	$({}^7C_3 \times {}^5C_1) \times ({}^4C_3 \times {}^4C_1) [\times ({}^1C_1 \times {}^3C_3)] \times \frac{3!}{2!}$ $= 175 \times 16 \times 3 = 8400$ $({}^7C_3 \times {}^5C_1) \times ({}^4C_2 \times {}^4C_2) [\times ({}^2C_2 \times {}^2C_2)] \times \frac{3!}{2!}$ $= 175 \times 36 \times 3 = 18900$	M1	No of ways for two correctly identified scenarios, or correct, added, no incorrect.
	27300	A1	SC A1 for 4550. SC B1 for 9100 if only one M1 has been awarded.
	Method 2 – subtracting ways with only men/women in a team from total		
	4M 0W + 3M 1W + 0M 4W 4M 0W + 2M 2W + 1M 3W	M1	${}^pC_4$ where $p = 7, 6, 5$ or 4 seen multiplied by at least 1 other Combinations in form ${}^nC_r, r \neq 0, n \neq r$.
	${}^7C_4 [\times {}^5C_0] \times {}^3C_3 \times {}^5C_1 \times 3!$ $= 175 \times 6 = 1050$ ${}^7C_4 [\times {}^5C_0] \times {}^3C_2 \times {}^5C_2 \times 3!$ $= 1050 \times 6 = 6300$ $34650 - (1050 + 6300)$	M1	No of ways for two correctly identified scenarios added (or correct) and subtracted from 34650 or <i>their (b)</i> .
	27300	A1	SC A1 for 4550.

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Question	Answer	Marks	Guidance
6(c)	Method 3 – subtracting ways with only men/women in a team from total		
	all male team ${}^7C_4 \times {}^8C_4 \times \frac{3!}{2!} = 7350$ all female team ${}^5C_4 \times {}^8C_4 \times \frac{3!}{2!} = 1050$ all male AND all female = ${}^7C_4 \times {}^5C_4 \times \frac{3!}{1!} = 1050$ $34650 - (7350 + 1050 - 1050)$	M1	$({}^7C_4 \times {}^8C_4)$ or $({}^5C_4 \times {}^8C_4)$ seen.
		M1	Subtracting (all male + all female – overlap) correctly identified or correct from 34650 or <i>their (b)</i> .
	27300	A1	SCA1 for 4550.
	Method 4 – subtracting ways with only men in a team as this includes the way with only women		
	all male team ${}^7C_4 \times {}^8C_4 \times \frac{3!}{2!} = 7350$ $34650 - 7350$	M1	$({}^7C_4 \times {}^8C_4)$ seen.
		M1	Subtracting from 34650 or <i>their (b)</i> .
	27300	A1	SCA1 for 4550.
		3	

Question	Answer	Marks	Guidance
6(d)	Method 1		
	G _ _ H _ _ _ $5! \times 2 \times 4$	M1	$5! \times n, n = 2, 4, 8.$
	960	A1	
	Method 2		
	${}^5P_2 \times 2! \times 4!$ or ${}^5C_2 \times 2 \times 2! \times 4!$	M1	${}^5P_2 \times n$ or ${}^5C_2 \times 2 \times n$ where $n = 2!, 4!$ or $2! \times 4!$
	960	A1	
		2	