

Cambridge International AS & A Level

MATHEMATICS**9709/51**

Paper 5 Probability & Statistics 1

October/November 2025**MARK SCHEME**Maximum Mark: 50

Published

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

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GENERIC MARKING PRINCIPLE 1:

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- 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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- 4 Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).
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Annotations

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	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

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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.
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	Judgment made by the PE
	Premature approximation
	Special case
	Indicates that work/page has been seen

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

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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)	$4k + k + 4k + 9k = 1, k = \frac{1}{18}$ <table><tr><td>x</td><td>-2</td><td>1</td><td>2</td><td>3</td></tr><tr><td>$P(X = x)$</td><td>$\frac{4}{18}$</td><td>$\frac{1}{18}$</td><td>$\frac{4}{18}$</td><td>$\frac{9}{18}$</td></tr></table>	x	-2	1	2	3	$P(X = x)$	$\frac{4}{18}$	$\frac{1}{18}$	$\frac{4}{18}$	$\frac{9}{18}$	B1	Using sum of probabilities =1 to form an equation in k or value of k stated.
		x	-2	1	2	3							
		$P(X = x)$	$\frac{4}{18}$	$\frac{1}{18}$	$\frac{4}{18}$	$\frac{9}{18}$							
	B1	Table with at least 2 correctly linked probabilities accurate. May be in terms of k . <table><tr><td>X</td><td>-2</td><td>1</td><td>2</td><td>3</td></tr><tr><td>$P(X = x)$</td><td>$4k$</td><td>k</td><td>$4k$</td><td>$9k$</td></tr></table> Condone extra X values if probability stated as 0.	X	-2	1	2	3	$P(X = x)$	$4k$	k	$4k$	$9k$	
X	-2	1	2	3									
$P(X = x)$	$4k$	k	$4k$	$9k$									
B1	4 correctly linked probabilities accurate. May not be in a table.												
		3											
1(b)	$[E(X) = 28k =] \frac{14}{9}, 1.56$	B1FT	FT $28 \times \text{their } k$ or correct with $0 < p < 1$.										
		1											
1(c)	$P(X \neq 2 X > 0) = \frac{10}{18} \bigg/ \frac{14}{18}$	M1	$\frac{\text{their } P(1) + P(3)}{\text{their } P(1) + P(2) + P(3)}$. May be in terms of k . With $0 < p < 1$. If table correct, accept $\frac{10}{18} \bigg/ \frac{14}{18}$ <i>or</i> $\frac{5}{9} \bigg/ \frac{7}{9}$.										
	$= \frac{5}{7}, 0.714$	A1											
		2											

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Question	Answer	Marks	Guidance
2(a)	$\left[\frac{1}{6} \left(\frac{5}{6} \right)^7 \right] = 0.0465$	B1	Accept 0.0465136... rounded to 3 or more SF. Accept $\frac{78125}{1679616}$.
		1	
2(b)	$\left(\frac{5}{6} \right)^4 \left(\frac{1}{6} \right)^3 \times {}^6C_2$	B1	$\left(\frac{5}{6} \right)^4 \left(\frac{1}{6} \right)^3 \times d, d \geq 1.$
		M1	$p^e (1-p)^{7-e} \times {}^6C_2, 0 < p < 1, \text{ accept } \frac{{}^6P_2}{2}.$
	0.0335	A1	AWRT. $\frac{3125}{93312}, \frac{9375}{279936}.$
		3	

Question	Answer	Marks	Guidance
3(a)	Median = [\$]32400	B1	Accept Q2, must be identified. <u>If thousands consistently omitted</u> SCB1 for median = [\$]324.
	[IQR = \$]33500 – [\$]31300	M1	$335[00] \leq UQ \leq 337[00] - 313[00] \leq LQ \leq 315[00].$ Implied if both quartile values are stated and an appropriate IQR calculated accurately.
	= [\$]2200	A1	CAO.
		3	

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Question	Answer	Marks	Guidance
3(b)	$[\text{Mean} =] \frac{878.3 + 896.5}{54} [= 32.867]$	B1	Accept $\frac{878300 + 896500}{54}$.
	so [\$]32900	B1	Accept [\$]32866.67 to 3 or more SF, condone [\$]32866, use of thousand dollars. Condone from $\left(\frac{878.3}{27} + \frac{896.5}{27}\right) \div 2$.
	$[\text{Variance} =] \left[\frac{28616.09 + 29815.63}{54} - \left(\frac{1774.8}{54}\right)^2 = \right]$	M1	Accept un-simplified variance formula. FT <i>their</i> mean. Ignore any square root leading to sd for this mark. Condone 1082.068... – 1080.217...
	$\frac{58431.72}{54} - \left(\frac{1774.8}{54}\right)^2$		
	= 1.8511	A1	Accept un-simplified, condone 1.85.
	$\sigma = 1.36$, so $\sigma = [\text{\$}]1360$	A1	Condone 1.36 if B1B0 scored for mean. Must be identified, e.g. sd, std d, s, σ . Condone short square root signs.
		5	

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Question	Answer	Marks	Guidance
4(a)		B1	Bag <i>B</i> branches completed correctly including Red/Blue.
		B1	2 sets of Bag <i>A</i> branches completely correctly including Red/Blue.
		B1	Final 2 sets of Bag <i>A</i> branches completely correctly including Red/Blue. Penalise omission of Red/Blue only once. If not identified, assume RB continues as for first Bag <i>A</i> .
		3	
4(b)	$[P(RRR) + P(BBB)] = \frac{8}{11} \times \frac{4}{5} \times \frac{7}{10} + \frac{3}{11} \times \frac{2}{6} \times \frac{3}{11}$	M1	Both, FT <i>their</i> tree diagram probabilities. May be seen in 4(a) .
	$\left[\frac{224}{550} + \frac{18}{726} \right] = \frac{1307}{3025}, 0.432$	A1	0.4320661... to 3 or more SF.
		2	

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Question	Answer	Marks	Guidance
5(a)	Method 1		
	$[P(5, 6, 7) =] {}^7C_5 (0.6)^5(0.4)^2 + {}^7C_6 (0.6)^6(0.4)^1 + (0.6)^7$ [= 0.261274 + 0.130637 + 0.027994]	M1	One term of the form ${}^7C_x (p)^x (1-p)^{7-x}$. $0 < p < 1, x \neq 0 \text{ or } 7$.
		A1	Correct un-simplified expression no terms omitted leading to the final answer.
	= 0.420	B1	$0.4198 < p \leq 0.42[0]$.
	Method 2		
	$[1-P(0,1,2,3,4) =] 1 - \{(0.4)^7 + {}^7C_1 (0.6) (0.4)^6 + {}^7C_2 (0.6)^2(0.4)^5 + {}^7C_3 (0.6)^3(0.4)^4 + {}^7C_4 (0.6)^4(0.4)^3\}$	M1	One term of the form ${}^7C_x (p)^x (1-p)^{7-x}$ $0 < p < 1, x \neq 0 \text{ or } 7$.
		A1	Correct un-simplified expression, no more than 2 ‘middle’ terms omitted leading to the final answer. Condone omission of final bracket ‘}’. If other brackets omitted, allow recovery if correct answer obtained.
	= 0.420	B1	$0.4198 < p \leq 0.42[0]$.
		3	

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Question	Answer	Marks	Guidance
5(b)	[Mean = $0.1 \times 150 =$]15 [Variance = $0.1 \times 150 \times 0.9 =$]13.5	B1	15 and 13.5 seen, allowed un-simplified. May be seen in the standardisation formula. $(\sigma = \sqrt{13.5}, 3.674 \leq \leq 3.6742346 \text{ implies correct variance})$. Withhold mark if variance clearly identified as standard deviation, condone $N(15, \sqrt{13.5})$ if standardisation formula correct or variance/standard deviation correctly stated as well.
	$[P(X < 22) = P(Z < \frac{21.5 - 15}{\sqrt{13.5}})]$	M1	Substituting their μ and σ into the $\pm$ standardising formula (any number for 21.5), allow σ^2 or $\sqrt{\sigma}$.
		M1	Use continuity correction 21.5 or 22.5 in standardisation formula.
	[P(Z < 1.769) = $\Phi(1.769)$] 0.962	M1	Appropriate area Φ , from final process, must be a probability Note: correct final answer implies this M1 .
		A1	AWRT 0.962.
		5	

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Question	Answer	Marks	Guidance
6(a)	$P\left(\frac{148-155}{6} < Z < \frac{160-155}{6}\right)$	M1	Substituting 155, 6 and 148 or 160 into $\pm$ standardisation formula, not σ^2 , not $\sqrt{\sigma}$, no continuity correction, Award $\frac{-7}{6}$ or $\frac{5}{6}$ M1 .
	$[= P(-1.1667 < Z < 0.8333)$ $= \Phi(1.1667) + \Phi(0.8333) - 1]$ $= 0.7975 + 0.8784 - 1$ Or $(0.7975 - 0.5) + (0.8784 - 0.5)$ Or $0.2975 + 0.3784$	M1	Calculating the appropriate probability area (leading to <i>their</i> final answer. Expect $p > 0.5$).
	$= 0.6759$	A1	AWRT 0.676 SOL. If one or both M marks not awarded, SCB1 for AWRT 0.676 SOL.
	[Expected number = $0.6759 \times 350 = 236.565$] 236	B1FT	Strict FT <i>their</i> at least 4 figure probability $\times 350$ (Check with calculator). One integer answer only, either 236 or 237. No indication of 'approximation', e.g. $\approx, \cong$, about, 3SF. Condone use of 3SF probability if more accurate probability seen in workings.
		4	

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Question	Answer	Marks	Guidance
6(b)	$\frac{114 - \mu}{\sigma} = 1.406$ $\frac{99.5 - \mu}{\sigma} = -0.842$	B1	$1.405 < z_1 < 1.407$, $-1.407 < z_1 < -1.405$ seen.
		B1	$0.841 < z < 0.843$, $-0.843 < z < -0.841$ seen.
		M1	Use of the $\pm$ standardisation formula once with μ , σ equating to a z -value (not 0.20, 0.80, 0.08, 0.92, 0.5793, 0.4207, 0.5319, 0.4681, 0.7881, 0.2119, 0.8212, 0.1788). Condone continuity correction ± 0.05 , not σ^2 , not $\sqrt{\sigma}$.
	Solve, obtaining values for μ and σ $\mu = 105$, $\sigma = 6.45$	M1	Solve two equations in μ and σ using the elimination method, substitution method or other appropriate approach to obtain values for both μ and σ .
		A1	$104.5 \leq \leq 105.5$. $6.44 \leq \leq 6.475$. If one or both the M marks have been withheld, SCB1 for both correct.
		5	

Question	Answer	Marks	Guidance
7(a)	$\left[\frac{10!}{2!2!3!} \right] 151200$	B1	CAO.
		1	

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Question	Answer	Marks	Guidance
7(b)	Method 1 [SC_ S _ _ _ _ _]		
	$\frac{7!}{2!3!} \times 2 \times 7$	M1	$\frac{7!}{2!3!} \times k \leq k$, a positive integer.
		M1	Integer $\times 7$.
	= 5880	A1	
		3	
	Method 2 Considering each case separately [SC-S, S-CS]		
	With Y $\frac{6!}{2!3!} \times 2 \times 7 = 840$ With H $\frac{6!}{2!3!} \times 2 \times 7 = 840$ With E $\frac{6!}{2!2!} \times 2 \times 7 = 2520$ With L $\frac{6!}{3!} \times 2 \times 7 = 1680$	M1	$\frac{6!}{2!3!} \times l$, $\frac{6!}{2!2!} \times m$ and $\frac{6!}{3!} \times n$ seen. $1 \leq l, m, n$, positive integers.
	840 + 840 + 2520 + 1680	M1	Summing 4 correct or correctly identified scenarios, oe
	= 5880	A1	

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Question	Answer	Marks	Guidance
7(b)	Method 3 Considering each case separately [SC-S, S-CS]		
	SCYS $\frac{7!}{2!3!} \times 2 = 840$ SCHS $\frac{7!}{2!3!} \times 2 = 840$ SCES $\frac{7!}{2!2!} \times 2 = 2520$ SCLS $\frac{7!}{3!} \times 2 = 1680$	M1	$\frac{7!}{2!3!} \times l$, $\frac{7!}{2!2!} \times m$ and $\frac{7!}{2!} \times n$ seen $1 \leq l, m, n$, positive integers
	$840 + 840 + 2520 + 1680$	M1	Summing 4 correct or correctly identified scenarios, OE.
	$= 5880$	A1	
		3	
7(c)	Method 1 Total arrangements with Ss at ends – arrangements with Ss at ends and Es together		
	$\frac{8!}{2!3!} - \frac{6!}{2!}$	M1	$\frac{8!}{2!3!} - q$, $1 < q < 3360$.
	$[= 3360 - 360]$	M1	$m - \frac{6!}{2!}$, $m > 360$.
	$= 3000$	A1	
		3	

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Question	Answer	Marks	Guidance
7(d)	Method 1		
	[Number of ways with 3 Es =] ${}^7C_2 (= 21)$	B1	${}^7C_2$ seen with no addition, subtraction, multiplication.
	[Total number of ways is] ${}^{10}C_5 (= 252)$	M1	Seen.
	[Probability =] $\frac{21}{252}, \frac{1}{12}$	A1	If M mark not awarded, SCB1 for $\frac{21}{252}, \frac{1}{12}$ WWW.
	Method 2		
	$\frac{3}{11} \times \frac{2}{6} \times \frac{3}{11} \times {}^5C_2$	B1	$\frac{3}{11} \times \frac{2}{6} \times \frac{3}{11}$.
		M1	${}^5C_2 \times k, 0 < k < 1$. Accept ${}^5C_3 \times k, 0 < k < 1$.
	[Probability =] $\frac{21}{252}, \frac{1}{12}$	A1	If M mark not awarded, SCB1 for $\frac{21}{252}, \frac{1}{12}$ WWW.
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- 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)	$[(0.6)^4(0.4)=] 0.05184, \frac{162}{3125}$	B1	CAO.
		1	
1(b)	$\left[1 - (1 - 0.6^6)\right] 0.6^6$ Or $1 - (0.4 + 0.4 \times 0.6 + 0.4 \times 0.6^2 + 0.4 \times 0.6^3 + 0.4 \times 0.6^4 + 0.4 \times 0.6^5)$	M1	$0.6^k, k = 5, 6, 7$. Or $1 - \left(0.4 + 0.4 \times 0.6 + 0.4 \times 0.6^2 + 0.4 \times 0.6^3 + 0.4 \times 0.6^4 + 0.4 \times 0.6^5 + 0.4 \times 0.6^6\right)$. The blue terms may be omitted or included. Condone omission of final bracket only. Condone omission of both brackets if recovered by $1 - 0.953344\dots$ or final answer 0.046656 rounded to at least 4SF.
	$= 0.0467, \frac{729}{15625}$	A1	0.046656 rounded to at least 3SF.
		2	

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Question	Answer						Marks	Guidance										
2(a)	x	1	2	3	4	5	B1	Table with correct x values and at least 1 correct probability.										
	$P(X=x)$	$\frac{5}{15}$	$\frac{4}{15}$	$\frac{3}{15}$	$\frac{2}{15}$	$\frac{1}{15}$	B1	A second correct probability correctly linked to the correct x value, need not be in table, accept un-simplified.										
		$\frac{40}{120}$	$\frac{32}{120}$	$\frac{24}{120}$	$\frac{16}{120}$	$\frac{8}{120}$	B1	Two more correct probabilities correctly linked to the correct x values, need not be in table, accept un-simplified.										
		$\frac{1}{3}$		$\frac{1}{5}$			B1	5 correct probabilities linked with correct x values. SCB1 5 non-zero probabilities (not all 1/5) summing to 1 placed in a probability distribution table with correct x values if B1B1 max scored. SCB2 for										
		0.3333	0.2667	0.2[000]	0.1333	0.06667		<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>$\frac{5}{15}$</td><td>$\frac{4}{15}$</td><td>$\frac{3}{15}$</td><td>$\frac{2}{15}$</td><td>$\frac{1}{15}$</td></tr></table>	x	0	1	2	3	4	$P(X=x)$	$\frac{5}{15}$	$\frac{4}{15}$	$\frac{3}{15}$
x	0	1	2	3	4													
$P(X=x)$	$\frac{5}{15}$	$\frac{4}{15}$	$\frac{3}{15}$	$\frac{2}{15}$	$\frac{1}{15}$													
All decimals correct to at least 3SF							OE.											
							4											

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Question	Answer	Marks	Guidance
2(b)	$[E(X) =]$ $1 \times \frac{5}{15} + 2 \times \frac{4}{15} + 3 \times \frac{3}{15} + 4 \times \frac{2}{15} + 5 \times \frac{1}{15}$ $\left[\frac{5+8+9+8+5}{15} = \frac{35}{15}, \frac{7}{3} \right]$	M1	Accept un-simplified expression. May be calculated in variance. Accept $\frac{1}{3} + \frac{8}{15} + \frac{3}{5} + \frac{8}{15} + \frac{1}{3}$ OE for the M mark. FT <i>their</i> table with 5 or 6 probabilities summing to 1 ($0 < p < 1$).
	$[\text{Var}(X) =]$ $1^2 \times \frac{5}{15} + 2^2 \times \frac{4}{15} + 3^2 \times \frac{3}{15} + 4^2 \times \frac{2}{15} + 5^2 \times \frac{1}{15}$ $-\left(\text{their} \frac{35}{15} \right)^2$ $\left[\frac{[1 \times] 5 + 4 \times 4 + 9 \times 3 + 16 \times 2 + 25 [\times 1]}{15} - \frac{49}{9} \right]$	M1	Appropriate variance formula using <i>their</i> $(E(X))^2$ value. FT <i>their</i> table with 4 or more probabilities ($0 < p < 1$) which need not sum to 1 or with an expression no more evaluated than shown in bold.
	$= \frac{14}{9}, 1.56$	A1	AWRT. WWW but allow from truncation error (e.g. 0.266 rather than 0.267). Note: $\frac{14}{9}$ also comes from SCB2 but scores M1M1A0 max.
		3	

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Question	Answer	Marks	Guidance
3(a)	$P\left(\frac{182.4-187.4}{6.4} < Z < \frac{192.4-187.4}{6.4}\right)$	M1	Substituting 187.4 and 6.4 and either 182.4 or 192.4 appropriately into one $\pm$ standardising formula, allow σ^2 or $\sqrt{\sigma}$. Note $-\frac{5}{6.4}$ or $\frac{5}{6.4}$ scores M1 .
	$[= P(-0.78125 < Z < 0.78125) = 2\Phi(0.7813) - 1]$ $= 2 \times 0.7826 - 1$ Or $0.7826 - (1 - 0.7826)$ Or $0.7826 - 0.2174$ Or $(0.7826 - 0.5) + (0.7826 - 0.5)$ Or 2×0.2826	M1	Appropriate area Φ , from final process. Must be a probability. There may be small variations in the probability values used – the values here are from the tables. Expect final answer > 0.5 . Condone omission of brackets if recovered for <i>their</i> values.
	0.5652	A1	$0.565 \leq p < 0.5655$ SOI. If one or both M marks not awarded, SCB1 for $0.565 \leq p < 0.5655$ SOI.
	[Expected number = $124 \times 0.5652 = 70.08$,] 70	B1FT	Strict FT <i>their</i> at least 4 figure probability $\times 124$ (Check with calculator) One integer answer, expect 70 or 71. No indication of ‘approximation’, e.g. $\approx$, $\cong$, about, 2SF.
		4	

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Question	Answer	Marks	Guidance
3(b)	$[P(X < 170.3) = 0.23, \quad P(Z > \frac{170.3-172.7}{\sigma}) = 0.77]$	B1	$0.7385 < z < 0.7395$ or $-0.7395 < z < -0.7385$ seen.
	$\frac{170.3-172.7}{\sigma} = -0.739$ or $\frac{172.7-170.3}{\sigma} = 0.739$	M1	$\pm$standardisation formula with 170.3, 172.7, σ equated to a z-value (not 0.23, 0.77, 0.261, 0.591, 0.409, 0.7794, 0.2206, 1 – <i>their</i> z-value ...). Condone continuity correction ± 0.05. Do not allow σ^2 or $\sqrt{\sigma}$. Condone $\pm \frac{2.4}{\sigma} = 0.739$.
	$\sigma = 3.25$	A1	$3.245 \leq \sigma \leq 3.25$. Do not award for improper fractions. There must be consistency with signs in the solution, e.g. $\frac{172.7-170.3}{\sigma} = -0.739$, so $\sigma = 3.25$ is not acceptable, A0.
		3	

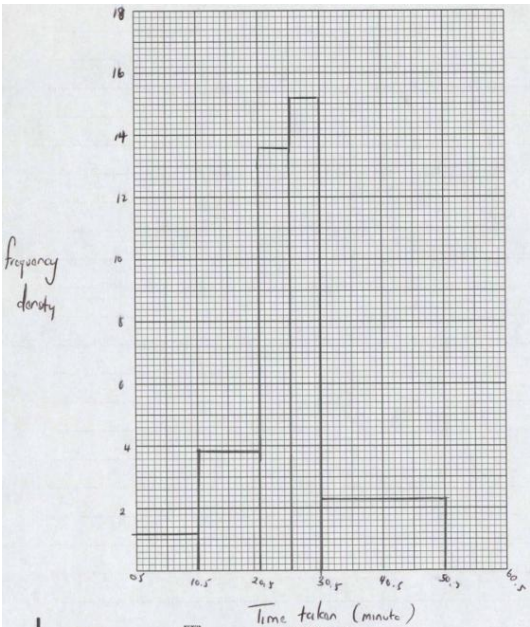
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Question	Answer	Marks	Guidance
4(a)	$[P(BB) = 2 \times P(CC)]$ $\frac{6}{18} \times \frac{x-12}{x} = 2 \times \frac{10}{18} \times \frac{9}{x}$ $\left[\frac{x-12}{3x} = \frac{10}{x} \right]$	B1	Either $\frac{6}{18} \times \frac{x-12}{x}$. Or $\frac{10}{18} \times \frac{9}{x}$ seen. OE.
		B1	Correct equation formed. Fractions may be simplified.
	$x^2 - 12x = 30x$ or $x^2 - 42x = 0$ or $x(x - 42) = 0$	M1	Rearrange probabilities to form quadratic equation and solve to find a value for x . Condone elimination of x on denominators: $\frac{6}{18} \times (x - 12) = 2 \times \frac{10}{18} \times 9$ OE. Must be an equation throughout.
	$[x =]42$	A1	If M1 not awarded, SCB1 for $[x =]42$ WWW. Note $x = 42$ must be selected if $x = 0$ is present.
		4	

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Question	Answer			Marks	Guidance
4(b)	BB	$\frac{6}{18} \times \frac{30}{42}, \frac{6}{18} \times \frac{(x-12)}{x}$	$\frac{10}{42}, 0.238$	M1	Two identified un-simplified outcomes with <i>their</i> x substituted. Correct values linked to identified outcomes acceptable (using $x = 42$).
	CC	$\frac{10}{18} \times \frac{9}{42}, \frac{10}{18} \times \frac{9}{x}$	$\frac{5}{42}, 0.119$	M1	Add probabilities, $0 < p < 1$, for 3 correct scenarios, no incorrect/repeated scenarios. Identification can be implied by un-simplified expressions.
	TT	$\frac{2}{18} \times \frac{3}{42}, \frac{2}{18} \times \frac{3}{x}$	$\frac{1}{126}, 0.00794$		
	$= 0.365, \frac{23}{63}$			A1	0.365079... rounded to at least 3SF. OE. SCB1 $\frac{10}{42} + \frac{5}{42} + \frac{1}{126} = \frac{23}{63}$ OE.
				3	

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Question	Answer	Marks	Guidance												
5(a)	<table><tr><td>CW</td><td>10</td><td>10</td><td>5</td><td>5</td><td>20</td></tr><tr><td>FD</td><td>1.2</td><td>3.8</td><td>13.6</td><td>15.2</td><td>2.3</td></tr></table>	CW	10	10	5	5	20	FD	1.2	3.8	13.6	15.2	2.3	M1	At least 4 correct frequency densities (F/CW, e.g. $\frac{12}{10}, \frac{38}{10}, \frac{68}{5}, \frac{76}{5}, \frac{46}{20}$). Accept un-simplified. May be read from graph if scale sufficiently accurate.
	CW	10	10	5	5	20									
	FD	1.2	3.8	13.6	15.2	2.3									
		A1	All heights correct on graph. Daylight rule applied full width of bar. <u>Minimum scale: FD axis uses at least ½ the grid.</u>												
B1		Bar ends at 0.5, 10.5, 20.5, 25.5, 30.5, 50.5, with a linear scale, 0.5 to 50.5, and at least 3 values indicated ‘linearly’. Daylight rule applied 0 cm ≤ FD ≤ 1 cm vertically.													
B1		Axes labelled frequency density (OE e.g. fd) and time, minutes (OE e.g. t, min). FD scale starts at 0 with a linear scale and at least 3 values indicated ‘linearly’. (condone 0.5 on time scale and no value on FD scale). <u>Minimum: time scale use at least ½ the grid.</u> Axes can be reversed.													
		4													

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Question	Answer	Marks	Guidance						
5(b)	Mean = $\frac{5.5 \times 12 + 15.5 \times 38 + 23 \times 68 + 28 \times 76 + 40.5 \times 46}{240}$	M1	At least 4 correct midpoints <table border="1"><tr><td>Midpoints</td><td>5.5</td><td>15.5</td><td>23</td><td>28</td><td>40.5</td></tr></table> May be seen by data table, accept un-simplified.	Midpoints	5.5	15.5	23	28	40.5
		Midpoints	5.5	15.5	23	28	40.5		
	M1	Correct mean formula using <i>their</i> 5 midpoints (must be within class, not upper bound, not lower bound), condone 1 error.							
	= 25.875	A1	Accept $\frac{207}{8}$ or $25\frac{7}{8}$ or 25.88 or 25.9 WWW. If 1 or more M not scored, SCB1 for $\frac{207}{8}$, $25\frac{7}{8}$ or 25.875 WWW.						
	3								

Question	Answer	Marks	Guidance
6(a)	$[\left(\frac{5}{7}\right)^{10} =] 0.0346, \frac{9765625}{282475249}$	B1	0.03457...
		1	

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Question	Answer	Marks	Guidance
6(b)	Method 1		
	$[P(0, 1, 2) =] {}^{10}C_2 \left(\frac{6}{7}\right)^8 \left(\frac{1}{7}\right)^2 + {}^{10}C_1 \left(\frac{6}{7}\right)^9 \left(\frac{1}{7}\right) + \left(\frac{6}{7}\right)^{10}$ $[= 0.2675729 + 0.3567639 + 0.2140583 =]$	M1	One term ${}^{10}C_x (p)^x (1-p)^{10-x}$. With $0 < p < 1, x \neq 0$ or 10 .
		A1	Correct un-simplified expression. Allow 10 for ${}^{10}C_1$.
	0.838	B1	$0.838 \leq p \leq 0.839$.
	$[P(0,1,2) =] 1 - \left\{ \left(\frac{1}{7}\right)^{10} + {}^{10}C_9 \left(\frac{6}{7}\right) \left(\frac{1}{7}\right)^9 + {}^{10}C_1 \left(\frac{6}{7}\right)^2 \left(\frac{1}{7}\right)^8 + {}^{10}C_1 \left(\frac{6}{7}\right)^3 \left(\frac{1}{7}\right)^7 + {}^{10}C_1 \left(\frac{6}{7}\right)^4 \left(\frac{1}{7}\right)^6 + {}^{10}C_1 \left(\frac{6}{7}\right)^5 \left(\frac{1}{7}\right)^5 + {}^{10}C_1 \left(\frac{6}{7}\right)^4 \left(\frac{1}{7}\right)^6 + {}^{10}C_1 \left(\frac{6}{7}\right)^3 \left(\frac{1}{7}\right)^7 \right\}$	M1	One term ${}^{10}C_x (p)^x (1-p)^{10-x}$. With $0 < p < 1, x \neq 0$ or 10 .
		A1	Correct un-simplified expression. Allow 10 for ${}^{10}C_1$. Condone omission of up to 5 of the middle 6 terms. Condone omission of last bracket only. If both brackets omitted in un-simplified expression allow recovery for final stated calculation of $1 - 0.1616$ or final answer WRT to 0.8384.
	0.838	B1	$0.838 \leq p \leq 0.8385$.
		3	

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Question	Answer	Marks	Guidance
6(c)	$[\text{Mean} = 392 \times \frac{1}{7} =] 56$ $[\text{Variance} = 392 \times \frac{1}{7} \times \frac{6}{7} =] 48$	B1	56 and 48 seen, allow un-simplified, may be seen in the standardisation formula. $(\sigma = \sqrt{48}, 4\sqrt{3}, 6.928 \leq \leq 6.9283 \text{ implies correct variance.})$ Condone $N(30, \sqrt{48})$ if standardisation formula is correct or variance/standard deviation correctly stated as well.
	$[P(X > 65) = P(Z > \frac{65.5 - 56}{\sqrt{48}})]$	M1	Substituting <i>their</i> μ and positive σ into the $\pm$ standardising formula (any number for 65.5), allow σ^2 or $\sqrt{\sigma}$.
		M1	Use continuity correction 64.5 or 65.5 in $\pm$ standardisation formula Note: If no standardisation formula seen $\pm \left(\frac{9.5}{\sqrt{48}} \right)$ or $\pm \left(\frac{9.5}{6.928} \right)$ scores M2 .
	$[= 1 - \Phi(1.3712)]$ $= 1 - 0.9149$	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 .
	$= 0.0851$ final answer	A1	Final answer Accept $0.08505 \leq p \leq 0.0852$.
		5	

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Question	Answer	Marks	Guidance
7(a)	Method 1 Total arrangements with 3 Os together – total arrangements with 3 Os together and 2 Ls together.		
	$\frac{8!}{2!} - 7!$	B1	$\frac{8!}{2!}$ seen alone (not multiplied/divided).
		B1	$b - 7!$, $5040 < b$.
		M1	$\frac{8!}{c!} - \frac{7!}{c!d!}$, $c = 1, 2$ $d = 1, 3$.
	$= 15120$	A1	CAO.
	Method 2 $^6P_3 \times ^4P_2$, Arrangements with OOs together and no Ls, Ls inserted separately.		
	$6! \times \frac{7 \times 6}{2}$	B1	$6! \times e$, $\leq \leq 42$.
		B1	$f \times \frac{7 \times 6}{2}$, $1 < f$ accept ${}^7P_2$ or $\frac{{}^7P_2}{2}$.
		M1	$\frac{6!}{g!} \times \frac{7 \times 6}{h}$, $g = 1, 3$ $h = 1, 2, 3$.
	$= 15120$	A1	CAO.
		4	

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Question	Answer	Marks	Guidance
7(b)	Method 1 L _ _ _ _ L _ _ _		
	$\frac{8!}{3!} \times 4$	B1	$\frac{8!}{3!} \times i, i \geq 1.$
		M1	$\frac{8!}{j!} \times 4, j = 1, 2, 3.$
	26880	A1	CAO.
	Method 2		
	${}^8P_5 \times \frac{4!}{3!}$	B1	${}^8P_5 \times k, k \geq 1.$
		M1	${}^8P_m \times \frac{4!}{3!}$ or ${}^8P_m \times 4, m = 3, 4, 5.$ or ${}^8C_5 \times \frac{4!}{3!}$ or ${}^8C_5 \times 4.$
	26880	A1	CAO.
		3	

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Question	Answer	Marks	Guidance
7(c)	Method 1 1 – P(2 letters the same)		
	$1 - \left(\frac{3}{10} \times \frac{2}{9} + \frac{2}{10} \times \frac{1}{9} \right)$	M1	$\frac{3}{10} \times \frac{2}{9} + \frac{2}{10} \times \frac{1}{9}$ seen.
		M1	$1 - \left(\frac{3}{d} \times \frac{2}{d} + \frac{2}{d} \times \frac{1}{d} \right)$ $d = 9$ or 10 . Accept $1 - \left(\frac{6}{90} \text{ or } \frac{3}{45} \text{ or } \frac{2}{30} \text{ or } \frac{1}{15} + \frac{2}{90} \text{ or } \frac{1}{45} \right)$.
	$= \frac{41}{45}, 0.911$	A1	If one or more M mark not awarded, SCB1 for $\frac{41}{45}, 0.911$ WWW.
	Method 2 $P(O\bar{O}) + P(L\bar{L}) + P(\bar{O}\bar{L})$		
	$\frac{3}{10} \times \frac{7}{9} + \frac{2}{10} \times \frac{8}{9} + \frac{5}{10} \times \frac{9}{9}$		
		M1	$\frac{3}{d} \times \frac{7}{d} + \frac{2}{d} \times \frac{8}{d} + \frac{5}{d} \times \frac{9}{d}$, $d = 9$ or 10 . Accept $\left(\left(\frac{21}{90} \text{ or } \frac{7}{30} \right) + \left(\frac{16}{90} \text{ or } \frac{8}{45} \right) + \left(\frac{45}{90} \text{ or } \frac{9}{18} \text{ or } \frac{1}{2} \right) \right)$.
	$= \frac{41}{45}, 0.911$	A1	If one or more M mark not awarded, SCB1 for $\frac{41}{45}, 0.911$ WWW.

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Question	Answer	Marks	Guidance												
7(c)	Method 3 Combination approach using OO and LL														
	[Probability =] $1 - \frac{{}^3C_2 + {}^2C_2}{{}^{10}C_2}$	M1	${}^3C_2 + {}^2C_2$ seen.												
		M1	$1 - \frac{f}{{}^{10}C_2}, 1 \leq f < 45.$												
	$= \frac{41}{45}, 0.911$	A1	If one or more M mark not awarded, SCB1 for $\frac{41}{45}, 0.911$ WWW.												
	Method 4 Combinations with scenarios OL, $O\bar{L}$, $\bar{O}L$, $\bar{O}\bar{L}$														
	<table><tr><td>O and L</td><td>${}^3C_1 \times {}^2C_1$</td><td>[6]</td></tr><tr><td>O and not L</td><td>${}^3C_1 \times {}^5C_1$</td><td>[15]</td></tr><tr><td>Not O and L</td><td>${}^5C_1 \times {}^2C_1$</td><td>[10]</td></tr><tr><td>Not O and not L</td><td>${}^5C_2$</td><td>[10]</td></tr></table>	O and L	${}^3C_1 \times {}^2C_1$	[6]	O and not L	${}^3C_1 \times {}^5C_1$	[15]	Not O and L	${}^5C_1 \times {}^2C_1$	[10]	Not O and not L	${}^5C_2$	[10]	M1	${}^3C_1 \times {}^2C_1 + {}^3C_1 \times {}^5C_1 + {}^5C_1 \times {}^2C_1 + {}^5C_2$ seen
		O and L	${}^3C_1 \times {}^2C_1$	[6]											
		O and not L	${}^3C_1 \times {}^5C_1$	[15]											
		Not O and L	${}^5C_1 \times {}^2C_1$	[10]											
		Not O and not L	${}^5C_2$	[10]											
[Probability =] $\frac{6+15+10+10}{{}^{10}C_2}$	M1	$\frac{g}{{}^{10}C_2}, 1 \leq g < 45$													
$= \frac{41}{45}, 0.911$	A1	If one or more M mark not awarded, SCB1 for $\frac{41}{45}, 0.911$ WWW.													
	3														

Cambridge International AS & A Level

MATHEMATICS**9709/53**

Paper 5 Probability & Statistics 1

October/November 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 October/November 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **24** 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.

PUBLISHED**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.

PUBLISHED**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
B0D	Benefit of the doubt
BP	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

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Annotation	Meaning
 SF	Error in number of significant figures
	Correct
 TE	Transcription error
 XP	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)	$[(0.6)^3 =] 0.216, \frac{27}{125}$	B1	OE.
		1	
1(b)	Method 1		
	$[P(X < 9) = 1 - P(9, 10, 11) =] 1 - \{ {}^{11}C_9(0.75)^9(0.25)^2 + {}^{11}C_{10}(0.75)^{10}(0.25) + (0.75)^{11} \}$	M1	One term of form ${}^{11}C_x (p)^x (1-p)^{11-x}$ with $0 < p < 1, x \neq 0$ or 11.
	$[= 1 - (0.258104 + 0.154862 + 0.042235)]$	A1	Correct un-simplified expression, no terms omitted leading to final answer. Condone omission of final bracket ‘}’ If other brackets omitted, allow recovery if $1 - 0.455$ (or better) seen. Accept $\sum_9 {}^{11}C_x (p)^x (1-p)^{11-x}$ with $p = 0.75$.
	$= 0.545$	B1	$0.5445 < p \leq 0.545$.
	Method 2		
	$[P(X < 9) = P(0, 1, 2, 3, 4, 5, 6, 7, 8) =] (0.25)^{11} + {}^{11}C_1(0.75)(0.25)^{10} + \dots + {}^{11}C_7(0.75)^7(0.25)^4 + {}^{11}C_8(0.75)^8(0.25)^3$	M1	One term of form ${}^{11}C_x (p)^x (1-p)^{11-x}$ with $0 < p < 1, x \neq 0$ or 11.
		A1	Correct un-simplified expression, no more than 6 ‘middle’ terms omitted leading to final answer. Accept $\sum_0^8 {}^{11}C_x (p)^x (1-p)^{11-x}$ with $p = 0.75$.
	$= 0.545$	B1	$0.5445 < p \leq 0.545$.
		3	

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Question	Answer				Marks	Guidance																
2	<table><tr><td>Scenario</td><td>S(16) D(10)</td><td></td><td></td></tr><tr><td>SSSSDD</td><td>4 2</td><td>$^{16}C_4 \times ^{10}C_2$</td><td>[81900]</td></tr><tr><td>SSSDDD</td><td>3 3</td><td>$^{16}C_3 \times ^{10}C_3$</td><td>[67200]</td></tr><tr><td>SSDDDD</td><td>2 4</td><td>$^{16}C_2 \times ^{10}C_4$</td><td>[25200]</td></tr></table>				Scenario	S(16) D(10)			SSSSDD	4 2	$^{16}C_4 \times ^{10}C_2$	[81900]	SSSDDD	3 3	$^{16}C_3 \times ^{10}C_3$	[67200]	SSDDDD	2 4	$^{16}C_2 \times ^{10}C_4$	[25200]	B1	Expression of the form $^{16}C_x \times ^{10}C_y$ with $x + y = 6$ linked to a correct identified scenario.
	Scenario	S(16) D(10)																				
	SSSSDD	4 2	$^{16}C_4 \times ^{10}C_2$	[81900]																		
	SSSDDD	3 3	$^{16}C_3 \times ^{10}C_3$	[67200]																		
	SSDDDD	2 4	$^{16}C_2 \times ^{10}C_4$	[25200]																		
				M1	Two identified outcomes evaluated accurately, accept un-simplified. Identification can be implied by un-simplified expression. Condone consistent use of permutations.																	
				M1	Sum of <i>their</i> values of 3 correct identified scenarios, no incorrect/repeated scenarios. Identification can be implied by un-simplified expression.																	
Total = 174 300				A1	If either or both Ms not awarded, SCB1 for 174 300 WWW.																	
				4																		

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Question	Answer	Marks	Guidance
3(a)	Method 1 Total arrangements with Ds at ends – arrangements with Ds at ends and Fs together		
	$\frac{7!}{2!} - 6!$ [= 2520 – 720]	M1	$\frac{7!}{2!}$ seen alone, not multiplied or divided in a calculation nor subtracted from another value.
		M1	$\frac{l!}{m!} - 6!$, $l = 7, 8 \text{ or } 9$, $m = 1 \text{ or } 2$
	= 1800	A1	
	Method 2 D ^ ^ ^ ^ ^ D, Fs inserted not next to each other		
	$5! \times \frac{6 \times 5}{2}$	M1	$5! \times a$, $\leq \leq 30$ 1 can be implied, a is an integer. No other terms added or subtracted.
		M1	$b! \times \frac{6 \times 5}{2}$ or $b! \times {}^6C_2$ or $b! \times \frac{6P2}{2!}$. Where $b = 5, 6 \text{ or } 7$.
	= 1800	A1	
		3	

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Question	Answer	Marks	Guidance
3(b)	Method 1		
	[Number of outcomes with 4 letters between Ds ($D \wedge \wedge \wedge D \wedge \wedge$)] $\frac{7!}{2!} \times 4$ [= 10080]	M1	Accept $\frac{7!}{2} \times 4$ or 10080 alone or as the numerator or denominator of a fraction.
	[Total number of arrangements =] $\frac{9!}{2!2!}$ [= 90720] seen as denominator in a fraction	M1	Accept 90720 as denominator in a fraction.
	[Probability =] $\frac{10080}{90720}, \frac{1}{9}, 0.111$	A1	WWW.
	Method 2		
	[Total number of outcomes with 4 letters between Ds ($D_1 \wedge \wedge \wedge D_2 \wedge \wedge$)] $7! \times 4 \times 2!$ [= 40320]	M1	Accept $7! \times 4 \times 2!$ or 40320 alone or as the numerator or denominator of a fraction.
	[Total number of arrangements of $D_1AF_1F_2OD_2ILS$ =] $9!$ [=362880] seen as denominator in a fraction.	M1	Accept 362880 as denominator in a fraction.
	[Probability =] $\frac{40320}{362880}, \frac{1}{9}, 0.111$	A1	WWW.

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Question	Answer	Marks	Guidance
3(b)	Method 3		
	[When 2 F's are not part of the 4 letters between the D's] $\frac{{}^5P_4 \times 4!}{2!} \text{ or } \frac{5! \times 4!}{2!} [= 1440]$ [When 1F is part of the 4 letters between the D's] ${}^5C_3 \times 4! \times 4! [= 5760]$ [When 2F's are part of the 4 letters between the D's] $\frac{{}^5C_2 \times 4!}{2!} \times 4! [= 2880]$ $[1440 + 5760 + 2880] = 10080$	M1	Accept 10080 alone or as the numerator or denominator of a fraction.
	[Total number of arrangements =] $\frac{9!}{2!2!} [= 90720]$ seen as denominator in a fraction	M1	Accept 90720 as denominator in a fraction.
	[Probability =] $\frac{10080}{90720}, \frac{1}{9}, 0.111$	A1	WWW.
		3	

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Question	Answer						Marks	Guidance
4(a)	x	0	1	2	3	4	B1	Table with correct x values and one correct probability.
	$P(X = x)$	$\frac{3}{16}$	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{5}{16}$	$\frac{4}{16}$	B1	2 more probabilities correct linked to the correct x value, need not be in table, accept un-simplified.
		0.1875	0.0625	0.1875	0.3125	0.25	B1	5 correct probabilities linked with correct outcomes.
	Accept	0.188	0.0625	0.188	0.313	0.25		SCB1 5 non-zero probabilities (not all 1/5) summing to 1 placed in a probability distribution table with correct x values if only one of the first two B marks are scored.
							3	

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Question	Answer	Marks	Guidance
4(b)	$[E(X) =] [0] + 1 \times \frac{1}{16} + 2 \times \frac{3}{16} + 3 \times \frac{5}{16} + 4 \times \frac{4}{16}$ $\left[= \frac{[0] + 1 + 6 + 15 + 16}{16} \right]$ $\left[= \frac{38}{16} = \frac{19}{8} \right]$	M1FT	Accept un-simplified or bold expression with probabilities ($0 < p < 1$) that add to 1. May be calculated in variance. FT <i>their</i> table with 4 or 5 probabilities adding to 1.
	$\text{Var}(X) = \frac{1 + 3 \times 2^2 + 5 \times 3^2 + 4 \times 4^2}{16} - \left(\frac{19}{8} \right)^2$ $\left[= \frac{1 + 3 \times 4 + 5 \times 9 + 4 \times 16}{16} - \frac{361}{64} \right]$ $\left[= \frac{122}{16} - \left(\frac{19}{8} \right)^2 \right]$	M1FT	Appropriate variance formula using <i>their</i> $(E(X))^2$ value. FT <i>their</i> table with 4 or more probabilities ($0 < p < 1$) which need not sum to 1 or with an expression no more evaluated than shown.
	$= \frac{127}{64}, 1\frac{63}{64}, 1.98$	A1	Accept 1.984375 to 3 or more SF. SCB1 for 1.98 if M0 M1 scored.
		3	

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Question	Answer	Marks	Guidance
4(c)	Method 1		
	$1 - \left(\frac{3}{4}\right)^7$	M1	$1 - \left(\frac{3}{4}\right)^n$ with n = 6, 7, 8.
	= 0.867	A1	= 0.8665 to 4SF.
	Method 2		
	$[P(X < 8) =] \frac{1}{4} + \left(\frac{3}{4}\right)\left(\frac{1}{4}\right) + \left(\frac{3}{4}\right)^2\left(\frac{1}{4}\right) + \left(\frac{3}{4}\right)^3\left(\frac{1}{4}\right) + \left(\frac{3}{4}\right)^4\left(\frac{1}{4}\right) +$ $\left(\frac{3}{4}\right)^5\left(\frac{1}{4}\right) + \left(\frac{3}{4}\right)^6\left(\frac{1}{4}\right)$	M1	Condone extra term $\left(\frac{3}{4}\right)^7\left(\frac{1}{4}\right)$ or the term $\left(\frac{3}{4}\right)^6\left(\frac{1}{4}\right)$ missing.
	= 0.867	A1	
		2	

Question	Answer	Marks	Guidance
5(a)		B1	Correct tree diagram structure. (3 tiers).
		B1	Counter and first marble probabilities correct with outcomes labelled.
		B1	Second marble probabilities correct with outcomes labelled.
		3	

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Question	Answer				Marks	Guidance
5(b)	P(WRB)	$\frac{3}{5} \times \frac{4}{7} \times \frac{3}{6}$	$\left[\frac{6}{35} \right]$	0.171(4)	M1	At least 2 correct 3-term products linked to correct scenarios. May be clearly identified on tree diagram. FT from a 3-tier tree.
	P(WBR)	$\frac{3}{5} \times \frac{3}{7} \times \frac{4}{6}$	$\left[\frac{6}{35} \right]$	0.171(4)	M1	4 correct identified scenarios added. May be clearly identified on the tree diagram, condone identification by correct (or FT) un-simplified products.
	P(YRB)	$\frac{2}{5} \times \frac{5}{8} \times \frac{3}{7}$	$\left[\frac{3}{28} \right]$	0.107(1)		
	P(YBR)	$\frac{2}{5} \times \frac{3}{8} \times \frac{5}{7}$	$\left[\frac{3}{28} \right]$	0.107(1)		
		[Total	$\frac{39}{70}]$	0.557		
	$= \frac{39}{70}, 0.557$				A1	SCB1 for $\frac{39}{70}$ if one or both M marks not scored WWW.
					3	

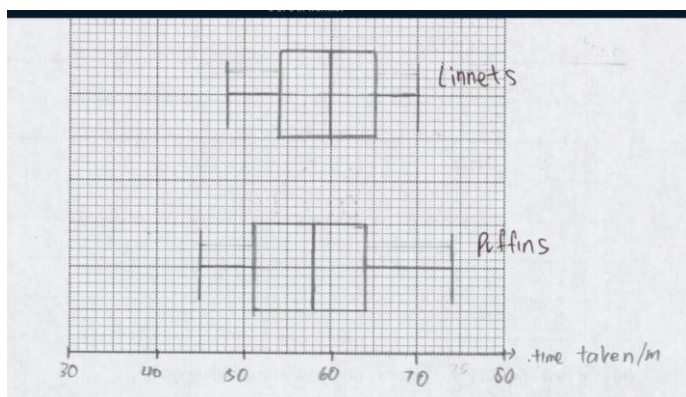
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Question	Answer	Marks	Guidance
5(c)	$P(\text{White} (b)) = \frac{\frac{3}{5} \times \frac{4}{7} \times \frac{3}{6} + \frac{3}{5} \times \frac{3}{7} \times \frac{4}{6}}{\text{their } \frac{39}{70}} \left[\frac{\frac{36}{210} + \frac{36}{210}}{\text{their } \frac{39}{70}} \right]$	M1	Correct formula for conditional probability using <i>their</i> probabilities from 3-tier tree with <i>their</i> (b) < 1 or correct in denominator. Condone $\frac{\frac{12}{35} \text{ or their } P(WRB) + P(WBR) \text{ from part b}}{\text{their } \frac{39}{70} \text{ or unsimplified expression}}$.
	$= \frac{8}{13}, 0.615$	A1	
		2	

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Question	Answer	Marks	Guidance																				
6(a)	<table><thead><tr><th>Linnets</th><th></th><th></th><th>Puffins</th></tr></thead><tbody><tr><td>8</td><td>4</td><td>5</td><td>9</td></tr><tr><td>9 7 4 1</td><td>5</td><td>1</td><td>5 5 8 9</td></tr><tr><td>8 5 4 4 0</td><td>6</td><td>2</td><td>4 4</td></tr><tr><td>0</td><td>7</td><td>4</td><td></td></tr></tbody></table> Key: 4 5 5 means 54 minutes for Linnets and 55 minutes for Puffins	Linnets			Puffins	8	4	5	9	9 7 4 1	5	1	5 5 8 9	8 5 4 4 0	6	2	4 4	0	7	4		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.
	Linnets			Puffins																			
	8	4	5	9																			
	9 7 4 1	5	1	5 5 8 9																			
	8 5 4 4 0	6	2	4 4																			
0	7	4																					
B1	Correct Linnets labelled on left, leaves in order from right to left and lined up vertically, no commas or other punctuation.																						
B1	Correct Puffins labelled on same diagram, leaves in order and lined up vertically, no commas or other punctuation. Penalise each error only once in question (apart from omission of data) e.g. commas in both sets of data.																						
B1	Correct non-symmetrical key, for their diagram, need both team names and ‘mins’ at least once here or in leaf headings (or title). If 2 separate diagrams drawn, max marks B1 if both stems correct, B1 if Linnets correct to the left of the stem, B1 if both keys correct including ‘mins’ and team name.																						
	4																						
6(b)	[IQR =] 65 – 54	M1	$64 \leq UQ \leq 68-51 \leq LQ \leq 57$ Implied if both quartile values are stated and an appropriate IQR calculated accurately. Condone 54 and 65 clearly identified in the table or their stem and leaf diagram.																				
	= 11	A1																					
		2																					

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Question	Answer	Marks	Guidance												
6(c)	 <table border="1" data-bbox="333 675 860 804"><tr><td>Linnets</td><td>48</td><td>54</td><td>60</td><td>65</td><td>70</td></tr><tr><td>Puffins</td><td>45</td><td>51</td><td>58</td><td>64</td><td>74</td></tr></table>	Linnets	48	54	60	65	70	Puffins	45	51	58	64	74	B1	Single linear scale from 45 to 75, at least 3 equally spaces values marked, using a scale of 2cm = 10 or 20 minutes only. Label to include time and minutes/min/m. SCB1 for 2 labelled box plots correct relative to each other and no scale is present. No further marks can be gained.
		Linnets	48	54	60	65	70								
		Puffins	45	51	58	64	74								
		B1FT	Correct plot labelled ‘Linnets’ with 5 key values using their linear scale. Daylight rule applied. Whiskers not at top/bottom of box or through box (penalise only once). Condone missing vertical lines on max/min values. LQ and UQ correct or FT <i>their</i> values from 6(b).												
B1	Correct plot labelled ‘Puffins’ with 5 key values using the same linear scale as Linnets. Whiskers not at top/bottom of box or through box (penalise only once). Condone missing vertical lines on max/min values. SCB1 for neither plot identified assuming Linnets at top of grid and both correct. SCB1 for only one unidentified plot – mark as Linnets.														
		3													

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Question	Answer	Marks	Guidance
6(d)	Acceptable comment about spread/central tendency e.g. the times taken by the Puffins are more spread out/less consistent than those of the Linnets, the times taken by the Linnets are less varied/more consistent than for the Puffins, Linnets are slower [on average], Linnets have slower times Puffins are faster [on average], Puffins have faster times	B1	Not just a comment comparing median or range. Ignore extra comment(s) if not contradicting a correct statement.
		1	

Question	Answer	Marks	Guidance
7(a)	$[P(X > 15.6) = P(Z > \frac{15.6 - 14.8}{1.5})]$	M1	Use of $\pm$ standardisation formula with 15.6, 14.8 and 1.5 substituted, condone σ^2 , condone $\sqrt{\sigma}$, condone continuity correction of ± 0.05 .
	$[= 1 - \Phi(0.5333)]$ $= 1 - 0.7029$	M1	Calculating the appropriate probability area (leading to their final answer, expect < 0.5).
	$= 0.297$	A1	AWRT 0.297. If one or both M marks not awarded, SCB1 for AWRT 0.297 WWW.
		3	

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Question	Answer	Marks	Guidance
7(b)	$[P(X > 15.6) = P(Z >)] [P(Z > \frac{t-14.8}{1.5}) = 0.9]$ $\frac{t-14.8}{1.5} = -1.282$	B1	–1.282 or 1.282 seen, CAO – critical value.
		M1	Using $\pm$ standardisation formula with 14.8, 1.5 and t equating to a z-value (not 0.8159, 0.1841, 0.9, 0.1, 0.5398, 0.4602 ...) not σ^2 , not $\sqrt{\sigma}$, no continuity correction.
	$t = 12.9$	A1	AWRT 12.9.
		3	

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Question	Answer	Marks	Guidance
7(c)	$[P(X > 13.8) = P(Z > \left(\frac{13.8-14.8}{1.5}\right)) \text{ and/or}$ $[P(X < 15.8) = P(Z < \left(\frac{15.8-14.8}{1.5}\right))$ Or $[P(Z > \left(\frac{-1}{1.5}\right)) \text{ and/or}$ $[P(Z < \left(\frac{1}{1.5}\right))$	M1	Substituting 14.8 and 1.5 and either 13.8 or 15.8 appropriately into one $\pm$ standardising formula, not σ^2 or $\sqrt{\sigma}$, no continuity correction. SCM1 – Condone substituting 14.8 and 1.5 and either 14.3 or 15.3 appropriately into one $\pm$ standardising formula, not σ^2 or $\sqrt{\sigma}$, no continuity correction.
	$[= 2 \Phi(0.6667) - 1]$ $= 2 \times 0.7477 - 1$ Or $2 \times (0.7477 - 0.5)$ Or $0.7477 - (1 - 0.7477)$ Or $0.7477 - 0.2523$	M1	Calculating the appropriate probability area (leading to their final answer, expect < 0.5) from their Z-values.
	$= 0.495(4)$	A1	AWRT 0.495. If one or both M marks not awarded, SCB1 for AWRT 0.495 SOI.
	[Expected number of days =] $0.4954 \times 5 \times 45 = 111.465$, so 111 days	B1FT	Strict FT <i>their</i> at least 4 figure probability $\times 225$ (Check with calculator). One integer answer, expect 111 or 112. No indication of ‘approximation’, e.g. $\approx$, $\cong$, <i>about</i> , 3SF.
		4	

Cambridge International AS & A Level

MATHEMATICS**9709/55**

Paper 5 Probability & Statistics 1

October/November 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 October/November 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **19** 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.

PUBLISHED**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.

PUBLISHED**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

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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

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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)	$\left[\left(\frac{5}{6} \right)^6 \left(\frac{1}{6} \right) = 0.0558, \frac{15625}{279936} \right]$	B1	
		1	
1(b)	$\left(\frac{5}{6} \right)^2 \left(\frac{1}{6} \right) + \left(\frac{5}{6} \right)^3 \left(\frac{1}{6} \right) + \left(\frac{5}{6} \right)^4 \left(\frac{1}{6} \right)$ Or $\left(\frac{5}{6} \right)^2 - \left(\frac{5}{6} \right)^5$	M1	$(1-p)^2 p + (1-p)^3 p + (1-p)^4 p$ Or $p^2 - p^5 \quad 0 < p < 1$
	$= \frac{2275}{7776}, 0.293$	A1	
		2	

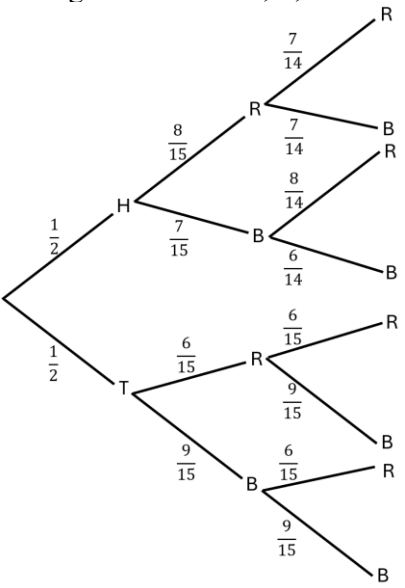
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Question	Answer	Marks	Guidance
2(a)	$[4p + 0.4 = 1,] \quad p = 0.15, \frac{3}{20}$	B1	May be seen used in formulae.
	$[E(X) =] \quad 1 \times 0.15 + 2 \times 0.4 + 3 \times 0.3 + 4 \times 0.15$ $[= \mathbf{0.15} + \mathbf{0.8} + \mathbf{0.9} + \mathbf{0.6} = 2.45, \frac{49}{20}]$	M1	Accept un-simplified numerical expression. May be calculated in variance. $1 \times p + 2 \times 0.4 + 3 \times 2p + 4 \times p, 0 < p < 1, \sum p = 1.$
	$[Var(X) =] \quad 0.15 \times 1^2 + 0.4 \times 2^2 + 0.3 \times 3^2 + 0.15 \times 4^2 - (their\ 2.45)^2$ $[0.15 \times 1 + 0.4 \times 4 + 0.3 \times 9 + 0.15 \times 16 - 6.0025]$ $[6.85 - 6.0025]$	M1	Appropriate variance formula using <i>their</i> $(E(X))^2$ value FT their p , acceptable at the bold partially evaluated stage. Must be a numerical expression, condone $\sum p \neq 1$. Accept $0.15 + 1.6 + 2.7 + 2.4 - 2.45^2$ or 6.0025 .
	$= 0.8475, \frac{339}{400}$	A1	If either or both M marks not awarded, SCB1 for correct answer WWW.
		4	

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Question	Answer	Marks	Guidance
2(b)	Method 1		
	$[P(X < 8) = 1 - (P(8, 9, 10) =]$ $1 - \{ {}^{10}C_8 (0.4)^8 (0.6)^2 + {}^{10}C_9 (0.4)^9 (0.6)^1 + {}^{10}C_{10} (0.4)^{10} \}$ $[= 1 - (0.0106168 + 0.00157286 + 0.00010486)]$	M1	One term of form ${}^{10}C_x (p)^x (1-p)^{10-x}$. With $0 < p < 1, x \neq 0$ or 10 .
		A1	Correct un-simplified expression, no terms omitted, leading to final answer. Condone omission of final bracket '}'.
	= 0.988	B1	$0.9875 < p \leq 0.988$.
	Method 2		
	$[P(X < 8) = P(0, 1, 2, 3, 4, 5, 6, 7) =]$ ${}^{10}C_0 (0.6)^{10} + {}^{10}C_1 (0.4)^1 (0.6)^9 + {}^{10}C_2 (0.4)^2 (0.6)^8 + {}^{10}C_3$ $(0.4)^3 (0.6)^7 + {}^{10}C_4 (0.4)^4 (0.6)^6 + {}^{10}C_5 (0.4)^5 (0.6)^5 + {}^{10}C_6$ $(0.4)^6 (0.6)^4 + {}^{10}C_7 (0.4)^7 (0.6)^3$	M1	One term of form ${}^{10}C_x (p)^x (1-p)^{10-x}$. With $0 < p < 1, x \neq 0$ or 10 .
		A1	Correct un-simplified expression, no more than 5 'middle' terms omitted, leading to final answer.
	= 0.988	B1	$0.9875 < p \leq 0.988$.
		3	

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Question	Answer	Marks	Guidance
3(a)	Tree diagram with all 2, 4, 8 branches 	B1	Structure, including labelling H, T, R & Bs and 4 or more correct probabilities.
	$\frac{1}{2}, \frac{1}{2}, \frac{8}{15}, \frac{7}{15}, \frac{6}{15}, \frac{9}{15}, \frac{7}{14}, \frac{7}{14}, \frac{8}{14}, \frac{6}{14}, \frac{6}{15}, \frac{9}{15}, \frac{6}{15}, \frac{9}{15}$	B1	Remaining probabilities correctly placed.
		2	
3(b)	$\frac{1}{2} \times \frac{7}{15} \times \frac{6}{14} + \frac{1}{2} \times \frac{9}{15} \times \frac{9}{15}$	M1	OE. FT P(HBB) + P(TBB) from incorrect tree diagram or $\frac{1}{2} \times \frac{a}{15} \times \frac{a-1}{14} + \frac{1}{2} \times \frac{b}{15} \times \frac{b}{15}, a=8, 7 b=6, 9$
	$= \frac{7}{25}, 0.28$	A1	
		2	

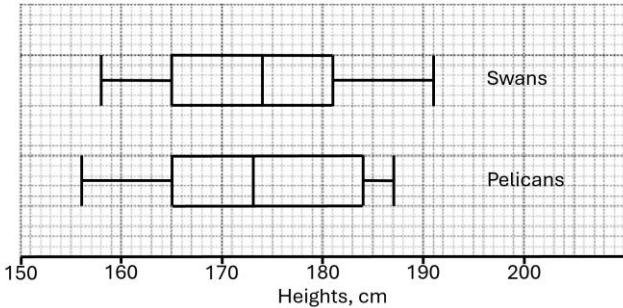
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Question	Answer	Marks	Guidance
3(c)	$[P(1R \text{ or } 2R) = 1 - P(BB) = 1 - \frac{7}{25} = \frac{18}{25}, 0.72]$	B1	FT 1 – their 3(b) or $\frac{18}{25}$ seen.
	$P(X \cap 1R \text{ or } 2R) = \frac{1}{2} \times \frac{8}{15} \times 1 + \frac{1}{2} \times \frac{7}{15} \times \frac{8}{14} \left[= \frac{6}{15} \right]$	M1	FT from incorrect tree diagram or $\frac{1}{2} \times \frac{a}{15} \times 1 + \frac{1}{2} \times \frac{15-a}{15} \times \frac{a}{14}$ or $\frac{1}{2} \times \frac{a}{15} \times \left(\frac{a-1}{14} + \frac{15-a}{14} \right) + \frac{1}{2} \times \frac{a-1}{15} \times \frac{a}{14}$ $a = 8, 7.$
	$P(X 1R \text{ or } 2R) = \left[\frac{P(X \cap 1R \text{ or } 2R)}{P(1R \text{ or } 2R)} \right] = \frac{\frac{6}{15}}{\frac{18}{25}}$	M1	Identified values substituted into $\frac{\text{their } P(X \cap 1R \text{ or } 2R)}{\text{their } P(1R \text{ or } 2R)}$ or correct.
	$= \frac{5}{9}, 0.556$	A1	
		4	

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Question	Answer	Marks	Guidance																																																																									
4(a)	<table><tr><th colspan="6">Pelicans</th><th></th><th colspan="6">Swans</th></tr><tr><td></td><td></td><td></td><td></td><td>6</td><td>15</td><td>8</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td>7</td><td>5</td><td>4</td><td>0</td><td>16</td><td>2</td><td>3</td><td>5</td><td></td><td></td></tr><tr><td></td><td></td><td>8</td><td>3</td><td>1</td><td>0</td><td>17</td><td>0</td><td>0</td><td>4</td><td>4</td><td>4</td></tr><tr><td>7</td><td>6</td><td>5</td><td>4</td><td>2</td><td>2</td><td>18</td><td>0</td><td>1</td><td>2</td><td>3</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>19</td><td>1</td><td></td><td></td><td></td><td></td></tr></table> Key: 1 17 8 represents 171 cm for Pelicans and 178 cm for Swans	Pelicans							Swans										6	15	8								7	5	4	0	16	2	3	5					8	3	1	0	17	0	0	4	4	4	7	6	5	4	2	2	18	0	1	2	3								19	1					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.
	Pelicans							Swans																																																																				
					6	15	8																																																																					
			7	5	4	0	16	2	3	5																																																																		
			8	3	1	0	17	0	0	4	4	4																																																																
7	6	5	4	2	2	18	0	1	2	3																																																																		
						19	1																																																																					
B1	Correct Pelicans labelled on left, leaves in order from right to left and lined up vertically no commas or other punctuation.																																																																											
B1	Correct Swans labelled on same diagram, leaves in order from right to left and lined up vertically, no commas or other punctuation. Penalise each error only once in question. E.g. commas in both sets of data. Missing or incorrect leaves can be penalised in both cases.																																																																											
B1	Correct key, for their diagram, need both team names and ‘cm’ at least once here, or in leaf headings or a suitable title. <u>If 2 separate diagram drawn</u> max marks: B1 if both stems correct, B1 if Pelicans correct to the left of the stem, B1 if both keys correct including ‘cm’ and team name.																																																																											
		4																																																																										
4(b)	Median = 173 (cm)	B1	Accept Q2, must be identified.																																																																									
	[IQR =] 184 – 165	M1	$182 \leq UQ \leq 185$ – $164 \leq LQ \leq 167$ Implied if both quartile values are stated and appropriate IQR calculated accurately.																																																																									
	= 19 [cm]	A1	WWW. If M0 scored, SC1 for 19 WWW.																																																																									
		3																																																																										

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Question	Answer	Marks	Guidance												
4(c)	Box-and-whisker plot on provided grid <table><tr><td>Swans</td><td>158</td><td>165</td><td>174</td><td>181</td><td>191</td></tr><tr><td>Pelican</td><td>156</td><td>165</td><td>173</td><td>184</td><td>187</td></tr></table> Condone freehand lines Check accuracy in the middle of the vertical line using daylight rule 	Swans	158	165	174	181	191	Pelican	156	165	173	184	187	B1	All 5 key values for Swans plotted accurately in standard format using a linear scale with 3 identified values. Labelled Swans. Vertical lines may be omitted at both limits.
	Swans	158	165	174	181	191									
	Pelican	156	165	173	184	187									
	B1FT	All 5 key values for Pelicans, FT from 4b or correct , plotted accurately in standard format using a linear scale with 3 identified values. Labelled Pelicans. Vertical lines may be omitted at both limits													
B1	Whiskers not through box for both , not drawn at corners of boxes, single linear scale for the diagram and labelled “heights” (OE) and ‘cm’ .														
			- If only one plot is labelled, assume other plot is as anticipated and mark as in scheme. - If neither of 2 plots is labelled, SCB1 for 1 fully ‘correct’ set of values plotted. - If no scale or incorrect linear scale stated, SCB1 if both correct relative to each other.												
		3													
4(d)	Swans are taller or Swans’ heights more consistent. If they say Pelicans’ heights are more consistent, they need to refer to the Range	B1	Appropriate comment about heights.												
		1													

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Question	Answer	Marks	Guidance
5(a)	6S ${}^8C_6$ (= 28)	M1	One product using 2 or 3 combinations ${}^8C_x \times {}^5C_y \times {}^{12}C_z$ with $x + y + z = 6$ (one of y or z may be 0) and linked to a correct identified scenario.
	5S 1H ${}^8C_5 \times {}^5C_1$ (= 280)		
	5S 1T ${}^8C_5 \times {}^{12}C_1$ (= 672)	B1	2 correct identified outcomes, accept un-simplified. Identification can be implied by un-simplified expressions.
	4S 2H ${}^8C_4 \times {}^5C_2$ (= 700)		
	4S 1H 1T ${}^8C_4 \times {}^5C_1 \times {}^{12}C_1$ (= 4200)	M1	Add values of 6 correct scenarios, no incorrect/repeated scenarios, no extra scenarios. Identification can be implied by un-simplified expressions.
	3S 2H 1T ${}^8C_3 \times {}^5C_2 \times {}^{12}C_1$ (= 6720)		
	2 nd and 3 rd can be combined as ${}^8C_5 \times {}^{17}C_1$ and this counts as 2 scenarios for the second M1		
	Total = 12600	A1	If either or both M s not awarded, SCB1 for 12600 WWW.
		4	
5(b)	Method 1 Total arrangements – arrangements with 3 hurdlers together		
	[With 3 hurdlers not together] $8! - (6! \times 3!)$	B1	$6! \times 3!$ seen as a term added or subtracted.
		M1	$8! - (6! \times k)$, $k \geq 1$, k is an integer.
	= 36000	A1	
	Method 2 Summing no of ways with 2 hurdlers together or all separate		
	$6C3 \times 3! \times 5! + 6C2 \times 2 \times 3! \times 5!$ [= 14400 + 21600]	B1	$6C_x \times 5!$ or $6P_x \times 5!$ seen, $x = 2$ or 3 seen.
		M1	$(6C3 \times 5! + 6C2 \times 2 \times 5!) \times k$, or $6P3 \times 5! + 6P2 \times 5! \times k$ $k \geq 1$, k is an integer.
	= 36000	A1	
		3	

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Question	Answer	Marks	Guidance
5(c)	Method 1		
	$5! \times 3! \times 4$	B1	5! seen in a single term method or as a common factor in a multi term method, no dividing.
		M1	3! seen in a single term method or as a common factor in a multi term method, no dividing.
	2880	A1	
		3	

Question	Answer	Marks	Guidance
6(a)	$[P(X > 55.1)] = P\left(Z > \frac{55.1 - 46.3}{6.4}\right) [= P(Z > 1.375)]$	M1	Use of $\pm$ standardisation formula with 55.1, 46.3 and 6.4 substituted appropriately, no continuity correction, allow $\sigma^2(6.4^2)$ or $\sqrt{\sigma}(\sqrt{6.4})$.
	$[= 1 - \Phi(1.375)]$ $= 1 - 0.9155$	M1	Calculating the appropriate probability area (leading to the final answer, expect <0.5).
	$= 0.0845$	A1	$0.0845 \leq z \leq 0.0846$ If one or both M marks not awarded, SCB1 for $0.0845 \leq z \leq 0.0846$.
		3	

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Question	Answer	Marks	Guidance
6(b)	$[P(X > 4.86) = P\left(Z > \frac{48.6 - 39.8}{\sigma}\right) = 0.10,$ $P\left(Z < \frac{48.6 - 39.8}{\sigma}\right) = 0.90]$	B1	± 1.282 seen, CAO, critical value.
	$\frac{48.6 - 39.8}{\sigma} = 1.282$	M1	$\pm$ standardisation formula with 48.6, 39.8 and σ equating to a z-value (not 0.10, 0.90, 0.5398, 0.4602, 0.8159, 0.1841, 1 – <i>their</i> z-value), not σ^2 , condone continuity correction of ± 0.05 .
	$\left[\sigma = \frac{8.8}{1.282}\right] 6.86$	A1	AWRT. Not dependent on B mark being awarded. Condone 6.87.
		3	

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Question	Answer	Marks	Guidance
6(c)	$[\text{Mean} = 0.1 \times 150 =]15$ $[\text{Variance} = 150 \times 0.1 \times 0.9 =]13.5$	B1	15 and 13.5 seen, allow un-simplified. May be seen in standardisation formula. $(\sigma = \sqrt{13.5}, \frac{3\sqrt{6}}{2} \quad 3.674 \leq \sigma < 3.675 \text{ implies correct variance.}$ Withhold mark if variance clearly identified as standard deviation, condone $N(15, \sqrt{13.5})$ if standardisation formula correct or variance/standard deviation correctly stated as well.
	$[P(X < 20) =] P\left(Z < \frac{19.5 - 15}{\sqrt{13.5}}\right) [= P(Z < 1.2247)]$	M1	Using 20 (with or without a cc) and their mean and sd found using 150 in $\pm$ standardisation formula, not σ^2 .
		M1	Using continuity correction 19.5 or 20.5 in a standardisation formula. Note: $\frac{\pm 4.5}{\sqrt{13.5}}$ or $\frac{\pm 4.5}{3.674}$ gains M2 .
	$[\Phi(1.2247)] = 0.8897$	M1	Appropriate area Φ , from final process. Must be a probability. Note: correct final answer implies this M1 .
	$= 0.890$	A1	AWRT.
		5	