Cambridge Assessment International Education

Cambridge International AS & A Level

MATHEMATICS **9709/52**

Paper 5 Probability & Statistics 1 **May/June 2022**

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.

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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 descriptors 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.

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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, 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 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 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.

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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.

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Abbreviations

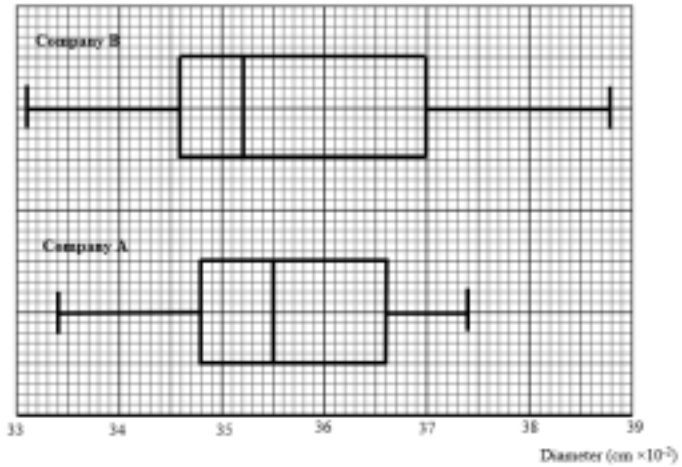
AEF/OE	Any Equivalent Form (of answer is equally acceptable) / Or Equivalent
AG	Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
CAO	Correct Answer Only (emphasising that no 'follow through' from a previous error is allowed)
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	$\Sigma x - \Sigma 200 = \Sigma(x - 200)$	**B1**	Forming a correct 3-term (linear) equation from Σx, $\Sigma 200$ and $\Sigma(x-200)$. Accept $6846 - 200n = 446$ OE. Condone 1 sign error.
	$\Sigma 200 = 200n$	**B1**	SOI
	$[200n = 6846 - 446 = 6400]$ $n = 32$	**B1**	WWW
		3	

Question	Answer	Marks	Guidance
2(a)	x: 2, 3, 4, 5, 6 p: $\frac{1}{36}$, $\frac{4}{36}$, $\frac{10}{36}$, $\frac{12}{36}$, $\frac{9}{36}$ 0.02778, 0.1111, 0.2778, 0.3333, 0.25	**B1**	Table with correct X values and at least one probability. Condone any additional X values if probability stated as 0.
		B1	3 correct probabilities linked with correct outcomes. Accept 3 sf decimals.
		B1	2 further correct probabilities linked with correct outcomes. Accept 3 sf decimals.
		3	**SC B1** for 5 probabilities ($0 < p < 1$) that sum to 1 with less than 3 correct probabilities.

Question	Answer	Marks	Guidance
2(b)	If method FT from *their* incorrect **(a)**, expressions for E(X) and Var(X) must be seen at the stage shown in **bold** (or less simplified) in the scheme with all probabilities < 1.		
	$\left[\mathrm{E}(X)=\frac{1\times2+4\times3+10\times4+12\times5+9\times6}{36}=\right]$ $\frac{\mathbf{2+12+40+60+54}}{\mathbf{36}}$	**M1**	Accept unsimplified expression. May be calculated in variance. FT *their* table with 4 or more probabilities summing to $0.999 \leqslant \text{total} \leqslant 1$ ($0 < p < 1$).
	$\left[\mathrm{Var}(X)=\frac{1\times2^2+4\times3^2+10\times4^2+12\times5^2+9\times6^2}{36}-\left(\mathit{their}\,\mathrm{E}(X)\right)^2=\right]$ $\frac{\mathbf{1\times4+4\times9+10\times16+12\times25+9\times36}}{\mathbf{36}}-\left(\mathit{their}\,\frac{\mathbf{14}}{\mathbf{3}}\right)^2$ $\left[\frac{4+36+160+300+324}{36}-\left(\mathit{their}\,\frac{14}{3}\right)^2\right]$	**M1**	Appropriate variance formula using *their* $(\mathrm{E}(X))^2$ value. FT *their* table with 3 or more probabilities ($0 < p < 1$) which need not sum to 1 and the calculation in **bold** (or less simplified) seen.
	$\mathrm{E}(X)=\frac{168}{36},\ \frac{14}{3},\ 4.67$ $\mathrm{Var}(X)=\frac{10}{9},\ 1\frac{1}{9},\ 1.11,\ \frac{1440}{1296}$	**A1**	Answers for E(X) and Var(X) must be identified. E(X) may be identified by correct use in Variance. Condone E, V, μ, σ^2 etc. If M0 earned **SC B1** for identified correct final answers.
		3	

Question	Answer	Marks	Guidance
3(a)	Median = 0.355	**B1**	Identified condone Q2.
	[IQR =] 0.366 – 0.348	**M1**	$0.365 \leqslant$ UQ $\leqslant 0.369 - 0.343 \leqslant$ LQ $\leqslant 0.349$. Subtraction may be implied by answer.
	0.018	**A1**	If 0/3 scored **SC B1** for figs Median = 355 IQR = 18.
		3	
3(b)	Box-and-whisker plot on provided grid  	**B1**	All 5 key values for *B* plotted accurately in standard format using *their* scale. Labelled *B*. Check accuracy in the middle of vertical line.
		B1 FT	All 5 key values for *A*, FT from part **3(a),** plotted in standard format accurately using *their* scale. Labelled *A*. Check accuracy in the middle of vertical line.
		B1	Whiskers not through box for both, not drawn at corners of boxes, single linear scale with at least 3 values stated, covering at least 0.34 to 0.38 and labelled diameter (*d* etc) and cm. Accept as a title.
		3	If both plots attempted and plot(s) not labelled, **SC B1** for at least 1 fully correct set of values plotted.
3(c)	A comparison in context	**B1**	Single comment comparing spread or central tendency in context. Must reference either diameter or pipes. Not a simple numerical comparison of statistical values such as median, range, IQR or min/max.
		1	

Question	Answer	Marks	Guidance
4(a)	[P(1.98 < X < 2.03) =]P($\frac{1.98-2.02}{0.03} < z < \frac{2.03-2.02}{0.03}$) [= P(−1.333 < z < 0.333)]	**M1**	Use of ±standardisation formula once with 2.02, 0.03 and either 1.98 or 2.03 substituted appropriately. Condone 0.03^2 and continuity correction ±0.005, not √0.03.
	[= $\Phi(0.333)-(1-\Phi(1.333))$] = 0.6304 + 0.9087 – 1	**M1**	Calculating the appropriate probability area from *their* z-values. (or 0.6304 – 0.09121 or (0.9087 – 0.5) + (0.6304 – 0.5) etc)
	0.539	**A1**	0.539 ⩽ z < 0.5395 Only dependent upon 2nd M mark. If M0 scored **SC B1** for 0.539 ⩽ z < 0.5395.
		3	
4(b)	[P(X > 2.6) = $\frac{134}{5000} = 0.0268$] [P(X<2.6) = 1 – 0.0268 =] 0.9732	**B1**	0.9732 or $\frac{4866}{5000}$ or $\frac{2433}{2500}$ seen.
	$\frac{2.6-2.55}{\sigma} = 1.93$	**M1**	Use of ±standardisation formula with 2.6 and 2.55 substituted, no $\sigma^2, \sqrt{\sigma}$ or continuity correction.
		M1	*Their* standardisation formula with values substituted equated to z-value which rounds to ±1.93.
	$\sigma = 0.0259$	**A1**	AWRT 0.0259 or $\frac{5}{193}$. If M0 earned, **SC B1** for correct final answer.
		4	

Question	Answer	Marks	Guidance
5(a)	[P(10, 11, 12) =] $^{12}C_{10}\,0.72^{10}\,0.28^{2}\ +\ ^{12}C_{11}\,0.72^{11}\,0.28^{1}\ +\ ^{12}C_{12}\,0.72^{12}\,0.28^{0}$	**M1**	One term $^{12}C_x\,p^x\left(1-p\right)^{12-x}$, for $0<x<12$, $0<p<1$.
	= 0.193725 + 0.0905726 + 0.0194084	**A1**	Correct expression, accept unsimplified, no terms omitted, leading to final answer.
	0.304	**B1**	Final answer $0.3036 < p \leqslant 0.304$.
	Alternative method for question 5(a)		
	[1 – P(0,1,2,3,4,5,6,7,8,9) =] $1-(^{12}C_0\,0.72^{0}\,0.28^{12}\ +\ ^{12}C_1\,0.72^{1}\,0.28^{11}\ +\ ^{12}C_2\,0.72^{2}\,0.28^{10}\ +\ ^{12}C_3\,0.72^{3}\,0.28^{9}\ +\ ^{12}C_4\,0.72^{4}\,0.28^{8}\ +\ ^{12}C_5\,0.72^{5}\,0.28^{7}\ +\ ^{12}C_6\,0.72^{6}\,0.28^{6}\ +\ ^{12}C_7\,0.72^{7}\,0.28^{5}\ +\ ^{12}C_8\,0.72^{8}\,0.28^{4}\ +\ ^{12}C_9\,0.72^{9}\,0.28^{3})$	**M1**	One term $^{12}C_x\,p^x\left(1-p\right)^{12-x}$, for $0<x<12$, $0<p<1$.
		A1	Correct expression, accept unsimplified, no terms omitted, leading to final answer.
	0.304	**B1**	Final answer $0.3036 < p \leqslant 0.304$.
		3	
5(b)	Mean = $[0.52\times 90 =]46.8$, var = $[0.52\times 0.48\times 90] = 22.464$	**B1**	46.8 and 22.464 or 22.46 seen, allow unsimplified, ($4.739 < \sigma \leqslant 4.740$ imply correct variance).
	$[P(X<40) =]\ P\left(z<\dfrac{39.5-46.8}{\sqrt{22.464}}\right)$	**M1**	Substituting *their* mean and *their* variance into ±standardisation formula (any number for 39.5), not σ^2, $\sqrt{\sigma}$.
		M1	Using continuity correction 39.5 or 40.5 in *their* standardisation formula.
	$= [P(Z<-1.540)] = 1-0.9382$	**M1**	Appropriate area Φ, from final process, must be probability.
	0.0618	**A1**	$0.06175 \leqslant p \leqslant 0.0618$
		5	

Question	Answer	Marks	Guidance
6(a)	$\left[\frac{9!}{2!2!}=\right]$ 90 720	**B1**	
		1	
6(b)	**Method 1** Arrangements Cs at ends – Arrangements Cs at ends and Os together		
	[Os not together =] $\frac{7!}{2!}-6!$ [= 2520 – 720]	**M1**	$\frac{w!}{2!}-y$, $w = 6, 7$ y an integer. Condone $2\times\left(\frac{w!}{2!}\right)-y$.
		M1	a – 6! or a – 720, a an integer resulting in a positive answer.
	1800	**A1**	
	Method 2 identified scenarios R ^ ^ ^ R		
	[Os not together =] $5!\times\frac{6\times5}{2!}=$	**M1**	5! × b, b integer >1.
		M1	$c\times\left(\frac{6\times5}{2!}\text{ or }{}^6\text{C}_2\text{ or }\frac{{}^6P_2}{2!}\text{ or }15\right)$, c integer > 1.
	1800	**A1**	
		3	

Question	Answer	Marks	Guidance
6(c)	CCO _ $^5C_1 = 5$ CC _ _ $^5C_2 = 10$ OOC _ $^5C_1 = 5$ OO _ _ $^5C_2 = 10$ C _ _ _ $^5C_3 = 10$ O _ _ _ $^5C_3 = 10$	**B1**	Correct outcome/value for 1 identified scenario. Accept unsimplified. WWW
		M1	Add 5 or 6 values of appropriate scenarios only, no additional incorrect scenarios, no repeated scenarios. Accept unsimplified. Condone use of permutations.
	[Total =] 50	**A1**	
		3	
6(d)	Both Os in group with a C $^5C_2 = 10$ Both Os in group without a C $^5C_2 \times {}^3C_2 = 30$ One O in a C group, one not $^5C_1 \times {}^4C_2 = 30$ One O with each C $(^5C_1 \times {}^4C_1) \div 2! = 10$	**B1**	A correct scenario calculated accurately. Accept unsimplified.
		M1	Add 3 or 4 correct scenario values, no incorrect scenarios, accept repeated scenarios. Accept unsimplified.
	[Total =] 80	**A1**	
	Alternative method for question 6(d)		
	CCO O^^ ^^^ = $^5C_2 = 10$ CC^ O^^ O^^ = $^5C_1 \times {}^4C_2 = 30$ CC^ OO^ ^^^ = $^5C_1 \times {}^4C_1 = 20$	**B1**	A correct scenario calculated accurately. Accept unsimplified.
	Total ways of making three groups $\frac{^9C_6 \times {}^6C_3}{2 \times 2 \times 3} = 140$ 140 – (*their* 10+ *their* 30+ *their* 20)	**M1**	Total subtract 2 or 3 correct scenario values, no incorrect scenarios. Accept unsimplified.
	80	**A1**	
		3	

Question	Answer	Marks	Guidance
7(a)	YYY: $\frac{5}{12}\times\frac{4}{11}\times\frac{3}{10} = \frac{60}{1320}, \frac{1}{22}$ OOO: $\frac{4}{12}\times\frac{3}{11}\times\frac{2}{10} = \frac{24}{1320}, \frac{1}{55}$ RRR: $\frac{3}{12}\times\frac{2}{11}\times\frac{1}{10} = \frac{6}{1320}, \frac{1}{220}$	**M1**	**Either** $12 \times 11 \times 10$ in denominator **or** $a \times (a-1) \times (a-2)$, $a = 5, 4, 3$ in numerator seen in at least one expression.
		A1	One expression $\frac{a}{12}\times\frac{a-1}{11}\times\frac{a-2}{10}$, $a = 5, 4, 3$ (consistent in expression). Correct order of values in the numerator is essential.
		M1	$\frac{5}{12}\times\frac{4}{d}\times\frac{3}{e}+\frac{4}{12}\times\frac{3}{d}\times\frac{2}{e}+\frac{3}{12}\times\frac{2}{d}\times\frac{1}{e}$, either $d = 11$, $e = 10$ or $d = 12$, $e = 12$. Condone $\frac{1}{22}+\frac{1}{55}+\frac{1}{220}$ OE
	[Total =] $\frac{90}{1320}, \frac{3}{44}, 0.0682$	**A1**	0.06818. Dependent only upon the second M mark.

Question	Answer	Marks	Guidance
7(a)	**Alternative method for question 7(a)**		
	YYY: $\frac{{}^{5}C_{3}}{{}^{12}C_{3}} = \frac{10}{220}, \frac{1}{22}$ OOO: $\frac{{}^{4}C_{3}}{{}^{12}C_{3}} = \frac{4}{220}, \frac{1}{55}$ RRR: $\frac{{}^{3}C_{3}}{{}^{12}C_{3}} = \frac{1}{220}$	**M1**	Either ${}^{12}C_{3}$ in denominator or ${}^{a}C_{3}$ in numerator seen in at least one expression.
		A1	One expression $\frac{{}^{a}C_{3}}{{}^{12}C_{3}}$ $a = 5, 4, 3$
		M1	$\frac{{}^{5}C_{3}}{{}^{12}C_{3}} + \frac{{}^{4}C_{3}}{{}^{12}C_{3}} + \frac{{}^{3}C_{3}}{{}^{12}C_{3}}$ Condone $\frac{1}{22} + \frac{1}{55} + \frac{1}{220}$ OE
	[Total =] $\frac{90}{1320}, \frac{3}{44}, 0.0682$	**A1**	0.06818. Dependent only upon the second M mark.
		4	
7(b)	[P(YYY | all same colour) =] $\frac{60}{1320} \div \frac{90}{1320}$	**M1**	$\frac{\textit{their}\ \mathrm{P(YYY)} \text{ or } \frac{60}{1320} \text{ or } \frac{1}{22}}{\textit{their}\ 7(\mathrm{a}) \text{ or } \frac{90}{1320} \text{ or } \frac{3}{44}}$
	$\frac{2}{3}$, 0.667	**A1**	OE
		2	

Question	Answer	Marks	Guidance
7(c)	In each method, the M mark requires the scenarios to be identifiable. This may be implied by a list of scenarios and then the calculations which will be assumed to be in the same order. A correct value/expression will be condoned as identifying the connected scenario.		
	Method 1		
	[1 – no orange =] $1-\frac{8}{12}\times\frac{7}{11}\times\frac{6}{10}$ or $1-\frac{{}^{8}C_{3}}{{}^{12}C_{3}}=1-\frac{14}{55}$	**B1**	$\frac{8}{12}\times\frac{7}{11}\times\frac{6}{10}$ or $\frac{{}^{8}C_{3}}{{}^{12}C_{3}}$ seen, condone $\frac{336}{1320}$ or $\frac{56}{220}$ only, not OE.
		M1	$1-\frac{f}{12}\times\frac{g}{d}\times\frac{h}{e}$ Either $d = 11$, $e = 10$ or $d = 12$, $e = 12$ or 1 - $\frac{{}^{8}C_{3}}{{}^{12}C_{3}}$. Condone $1-\frac{14}{55}$ OE (not $\frac{41}{55}$).
	$\frac{41}{55}$	**A1**	$0.745 \leqslant p \leqslant 0.74545$ If M0 scored **SC B1** $0.745 \leqslant p \leqslant 0.74545$.

Question	Answer	Marks	Guidance
7(c)	**Method 2**		
	$P(1\ O)=\left(\frac{4}{12}\times\frac{3}{11}\times\frac{2}{10}+\frac{4}{12}\times\frac{5}{11}\times\frac{4}{10}+2\times\frac{4}{12}\times\frac{5}{11}\times\frac{3}{10}\right)\times 3=\frac{672}{1320}$ $P(2O)=\frac{4}{12}\times\frac{3}{11}\times\frac{8}{10}\times 3=\frac{288}{1320}$ $P(3O)=\frac{24}{1320}$	**B1** **M1**	P(1 O)or P(2 O) correct, accept unsimplified. 3 correct scenarios added, with at least one 3-term product of form $\frac{f}{12}\times\frac{g}{d}\times\frac{h}{e}$ seen, either $d = 11$, $e = 10$ or $d = 12$, $e = 12$.
	[Total =] $\frac{984}{1320}=\frac{41}{55}$, 0.745	**A1**	$0.745 \leqslant p \leqslant 0.74545$ If M0 scored **SC B1** $0.745 \leqslant p \leqslant 0.74545$.
	Method 3		
	O Y R = ${}^4C_1 \times {}^5C_1 \times {}^3C_1$ = 60 O R R = ${}^4C_1 \times {}^3C_2$ = 12 O Y Y = ${}^4C_1 \times {}^5C_2$ = 40 O O Y = ${}^4C_2 \times {}^5C_1$ = 30 O O R = ${}^4C_2 \times {}^3C_1$ = 18 O O O = ${}^4C_3$ = 4 Total = 164 Prob = $\frac{164}{{}^{12}C_3}$	**B1** **M1**	Number of ways either 1 or 2 orange sweets obtained correctly (112 or 48). Accept unsimplified Note ${}^4C_1 \times {}^8C_2 = 112$ or ${}^4C_2 \times {}^8C_1 = 48$ are correct alternatives. 3 correct scenarios (1, 2 or 3 orange sweets) added on numerator, denominator ${}^{12}C_3$
	$\frac{984}{1320}=\frac{41}{55}$, 0.745	**A1**	$0.745 \leqslant p \leqslant 0.74545$ If M0 scored **SC B1** $0.745 \leqslant p \leqslant 0.74545$.

Question	Answer	Marks	Guidance
7(c)	**Method 4**		
	$P(R\ R\ O) = \frac{3}{12}\times\frac{2}{11}\times\frac{4}{10} = \frac{1}{55}$ $P(R\ O\ \ ) = \frac{3}{12}\times\frac{4}{11} = \frac{1}{11}$ $P(R\ Y\ O) = \frac{3}{12}\times\frac{5}{11}\times\frac{4}{10} = \frac{1}{22}$ $P(O\ \ \ \ ) = \frac{4}{12} = \frac{1}{3}$ $P(Y\ R\ O) = \frac{5}{12}\times\frac{3}{11}\times\frac{4}{10} = \frac{1}{22}$ $P(Y\ O\ \ ) = \frac{5}{12}\times\frac{4}{11} = \frac{5}{33}$ $P(Y\ Y\ O) = \frac{5}{12}\times\frac{4}{11}\times\frac{4}{10} = \frac{2}{33}$	**B1**	$P(R\ ^\ ^) = \frac{17}{110}$ or $P(Y\ ^\ ^) = \frac{17}{66}$. Accept unsimplified.
		M1	3 correct scenarios added, with at least one 3-term product of form $\frac{f}{12}\times\frac{g}{d}\times\frac{h}{e}$ seen, either $d = 11$, $e = 10$ or $d = 12$, $e = 12$.
	$\frac{984}{1320} = \frac{41}{55}$, 0.745	**A1**	$0.745 \leqslant p \leqslant 0.74545$ If M0 scored **SC B1** $0.745 \leqslant p \leqslant 0.74545$.

Question	Answer	Marks	Guidance
7(c)	**Method 5**		
	P(O) $= \frac{4}{12} = \frac{1}{3}$ P(^ O) $= \frac{8}{12} \times \frac{4}{11} = \frac{8}{33}$ P(^ ^ O) $= \frac{8}{12} \times \frac{7}{11} \times \frac{4}{10} = \frac{28}{165}$	**B1**	P(^ O) $= \frac{8}{33}$ or P(^ ^ O) $= \frac{28}{165}$. Accept unsimplified.
		M1	3 correct scenarios added, with at least one 3-term product of form $\frac{f}{12} \times \frac{g}{d} \times \frac{h}{e}$ seen, either $d = 11$, $e = 10$ or $d = 12$, $e = 12$ with correct numerator.
	$\frac{984}{1320} = \frac{41}{55}$, 0.745	**A1**	$0.745 \leqslant p \leqslant 0.74545$ If M0 scored **SC B1** $0.745 \leqslant p \leqslant 0.74545$.
		3	