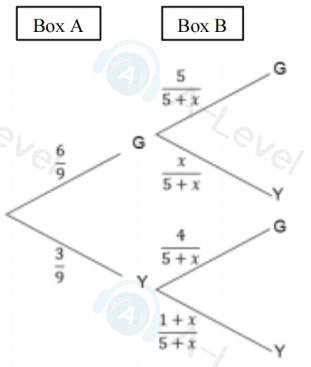
Question	Answer	Marks	Guidance
3(a)	[P(WW) = P(AWW) + P(BWW) =] $\frac{2}{6}\times\frac{8}{15}\times\frac{7}{14}+\frac{4}{6}\times\frac{6}{15}\times\frac{5}{14}$	M1	Either $\frac{2}{6}\times\frac{8}{15}\times\frac{7}{14}$ or $\frac{4}{6}\times\frac{6}{15}\times\frac{5}{14}$ seen, accept unsimplified.
		M1	$\frac{q}{6}\times\frac{r}{15}\times\frac{r-1}{14}+\frac{6-q}{6}\times\frac{s}{15}\times\frac{s-1}{14}$ seen, no additional terms, accept unsimplified. Condone $\frac{q}{6}\times\frac{r}{15}\times\frac{r}{15}+\frac{6-q}{6}\times\frac{s}{15}\times\frac{s}{15}$, $1 \leqslant q \leqslant 5$, $1 < r, s < 9$.
	$\left[=\frac{56}{630}+\frac{60}{630}=\frac{4}{45}+\frac{2}{21}\right]=\frac{58}{315}$ or 0.184	A1	**SC B1** for 58/315 if either M mark withheld.
		3	

Question	Answer	Marks	Guidance
3(b)	$\left[\text{P(B }\vert\text{WR or RW)}=\frac{\text{P(W \& R from bag B)}}{\text{P(W and R)}}=\right]$ $\frac{\frac{4}{6}\times\frac{6}{15}\times\frac{7}{14}+\frac{4}{6}\times\frac{7}{15}\times\frac{6}{14}}{\frac{2}{6}\times\frac{8}{15}\times\frac{4}{14}+\frac{2}{6}\times\frac{4}{15}\times\frac{8}{14}+\frac{4}{6}\times\frac{6}{15}\times\frac{7}{14}+\frac{4}{6}\times\frac{7}{15}\times\frac{6}{14}}$ or $\frac{2\times\frac{4}{6}\times\frac{6}{15}\times\frac{7}{14}}{2\times\frac{2}{6}\times\frac{8}{15}\times\frac{4}{14}+2\times\frac{4}{6}\times\frac{6}{15}\times\frac{7}{14}}$	B1	P(W & R from bag B) $=\frac{2}{3}\times\frac{6}{15}\times\frac{7}{14}+\frac{2}{3}\times\frac{7}{15}\times\frac{6}{14}$ or $2\times\frac{2}{3}\times\frac{6}{15}\times\frac{7}{14}$ $\left[=\frac{4}{15}\text{ or }0.267\right]$ Seen alone or as numerator/denominator of conditional probability.
		M1	P(WR or RW) = P(W & R from bag A) + P(W & R from bag B) $=a\times\frac{2}{6}\times\frac{8}{15}\times\frac{4}{14}+a\times\frac{4}{6}\times\frac{6}{15}\times\frac{7}{14}$ or $=a\times\frac{2}{6}\times\frac{8}{15}\times\frac{4}{14}+$ *their* P(W & R from bag B). $a = 1$ or 2. [expect $\frac{116}{315}$ or 0.368] Seen alone or as numerator/denominator of conditional probability.
	$\frac{\frac{168}{630}}{\frac{232}{630}}=\frac{\frac{4}{15}}{\frac{116}{315}}$	M1	$\frac{\textit{their}\text{ identified P}(W\ \&R\ \textit{from bag}\ B)}{\textit{their}\text{ identified P(WR or RW)}}$ Accept unsimplified.
	$=\frac{168}{232}, \frac{21}{29}$ or 0.724	A1	0.7241379 to at least 3SF.
		4	

Question	Answer	Marks	Guidance
3(a)		B1	Correct structure and probabilities for Box A branches.
		B1	Completely correct structure and one correct probability for a Box B branch including label for G or Y.
		B1	Completely correct structure and second correct probability on a Box B branch including label G or Y.
		B1	Completely correct structure and remaining two probabilities correct on Box B branches, including labels for G or Y. **SC B1** if correct shape diagram but only four correct algebraic probs for GG, GY, YG and YY.
		4	
3(b)	P(same colour) = $\frac{6}{9}\times\frac{5}{5+x}+\frac{3}{9}\times\frac{1+x}{5+x}$	M1	P(GG) + P(YY) = $\left(\frac{6}{9}\text{ or }\frac{3}{9}\right)\times\textit{their}\left(\frac{5}{5+x}\right)+\left(\frac{3}{9}\text{ or }\frac{6}{9}\right)\times\textit{their}\left(\frac{1+x}{5+x}\right)$
	$\frac{6}{9}\times\frac{5}{5+x}+\frac{3}{9}\times\frac{1+x}{5+x}=\frac{8}{15}$ and arrange as a linear equation	M1	$15(x+11)=24(x+5)$ OE Accept sum of their products equated to $\frac{8}{15}$ and rearranged to form a linear equation.
	Solve: $x = 5$	A1	
		3	

Question	Answer	Marks	Guidance
7(a)	Probabilities: $\frac{x+1}{x+10}, \frac{9}{x+10}, \frac{x}{x+10}, \frac{10}{x+10}$	B1	One probability correct in correct position.
		B1	Another probability correct in correct position.
		B1	Other two probabilities correct in correct positions.
		3	
7(b)	$\frac{4}{10} \times \textit{their} \frac{10}{x+10}$	M1	Method consistent with *their* tree diagram.
	$\frac{4}{x+10}$	A1	AG
		2	

Question	Answer	Marks	Guidance
7(c)	$\frac{4}{x+10} = \frac{1}{6}$ $x+10 = 24, \quad x = 14$	B1	Find value of x. Can be implied by correct probabilities in calculation.
	P(ARed|BRed) = P(ARed ∩ BRed) ÷ P(BRed) $\frac{\frac{6}{10} \times \textit{their} \frac{x+1}{x+10}}{\frac{6}{10} \times \textit{their} \frac{x+1}{x+10} + \frac{4}{10} \times \textit{their} \frac{x}{x+10}} = \frac{\frac{6}{10} \times \frac{15}{24}}{\frac{6}{10} \times \frac{15}{24} + \frac{4}{10} \times \frac{14}{24}} = \frac{\frac{3}{8}}{\frac{73}{120}}$	B1 FT	$\frac{6}{10} \times \textit{their} \frac{x+1}{x+10}$ as numerator or denominator of fraction.
		M1	$\frac{6}{10} \times \textit{their} \frac{x+1}{x+10} + \frac{4}{10} \times \textit{their} \frac{x}{x+10}$ seen anywhere.
		A1 FT	Seen as denominator of fraction.
	$\frac{45}{73}$, 0.616[4…]	A1	If B0 M0: **SC B1** for $\frac{\frac{3}{8}}{\frac{73}{120}}$ or $\frac{0.375}{0.6083}$ **SC B1** $\frac{45}{73}$ or 0.616.
		5	

Question	Answer	Marks	Guidance
4(a)	[Possible cases: 1 1 2, 1 2 1, 2 1 1] Probability = $\left(\frac{1}{6}\right)^3 \times 3$	M1	$\left(\frac{1}{6}\right)^3 \times k$, where k is an integer.
		M1	Multiply a probability by 3, not +, – or ÷
	$\frac{1}{72}$	A1	Accept $\frac{3}{216}$ or $0.013\dot{8}$ or 0.0139
		3	
4(b)	$P(18) = \left(\frac{1}{6}\right)^3 \left[= \frac{1}{216}\right]$	B1	
	P(18 on 5th throw) $= \left(\frac{215}{216}\right)^4 \times \frac{1}{216}$	M1	$(1-p)^4 p$, $0 < \textit{their}\ p < 1$
	0.00454	A1	
		3	

Question	Answer	Marks	Guidance
7(a)	[P(SR TR) + P(SW TR) =] $\frac{3}{8}\times\frac{2}{7}+\frac{5}{8}\times\frac{3}{7}$	M1	$\frac{3}{8}\times\frac{2}{7}+k$ or $l+\frac{5}{8}\times\frac{3}{7}$ $0<k,l<1$
	$=\frac{21}{56}, \frac{3}{8}, 0.375$	A1	**SC B1** for $\frac{3}{8}$ with no explanation.
		2	
7(b)	[RRWR, WRRR, WRWR] $\frac{3}{8}\times\frac{2}{7}\times\frac{5}{6}\times\frac{1}{5}+\frac{5}{8}\times\frac{3}{7}\times\frac{2}{6}\times\frac{1}{5}+\frac{5}{8}\times\frac{3}{7}\times\frac{4}{6}\times\frac{2}{5}$ $[=\frac{1}{56}+\frac{1}{56}+\frac{1}{14}]$	M1	$\frac{m}{8}\times\frac{n}{7}\times\frac{o}{6}\times\frac{q}{5}$ $1\leqslant m,n,o,q\leqslant 5, m\neq n\neq o\neq q$
		A1	Probability for one scenario correct, accept unsimplified.
		M1	Adding probabilities for 3 correct scenarios and no incorrect.
	$=\frac{180}{1680}, \frac{3}{28}, 0.107$	A1	Or 0.1071428… to 4SF or better. **SC B1** for 3/28 with inadequate explanation.
		4	

Question	Answer	Marks	Guidance
7(c)	[P(S first disc R |T2) =] $\frac{\frac{30}{1680}}{\frac{3}{28}}=\frac{\frac{1}{56}}{\frac{3}{28}}$	M1	$\frac{\text{their } P(RRWR) \text{ or } \frac{3}{8}\times\frac{2}{7}\times\frac{5}{6}\times\frac{1}{5}}{\text{their } 7(\mathbf{b}) - \text{must be a prob or } \frac{3}{28}}$
	$\frac{1}{6}, 0.167$	A1	
		2	

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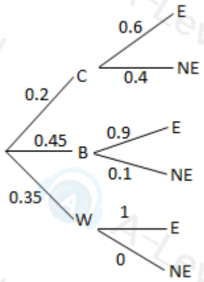
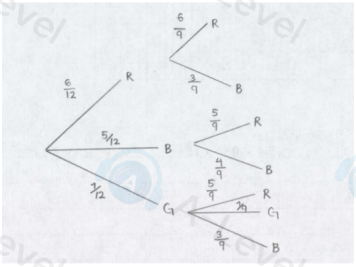
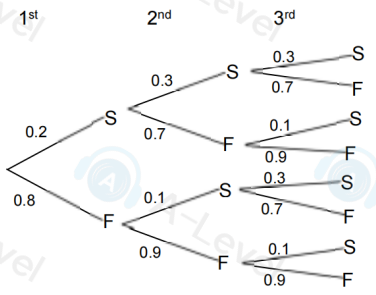
Question	Answer	Marks
1(a)		
	Fully correct labelled tree for method of transport with correct probabilities.	B1
	Fully correct labelled branches with correct probabilities for lateness with either 1 branch after W or 2 branches with the probability 0.	B1
		2
1(b)	$P(C\|E)=\frac{P(C\cap E)}{P(E)}=\frac{0.2\times0.6}{0.2\times0.6+0.45\times0.1+0.35\times1}$	M1
	Summing three appropriate 2-factor probabilities	M1
	$\frac{0.12}{0.515}$	A1
	0.233 or $\frac{12}{515}$	A1
		4

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

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

Question	Answer	Marks	Guidance
6(a)		**B1**	First and second jumps correct with probabilities and outcomes identified.
		B1	Third jump correct with probabilities and outcomes identified.
		2	
6(b)	SFF $0.2\times0.7\times0.9 = 0.126$ FSF $0.8\times0.1\times0.7 = 0.056$ FFS $0.8\times0.9\times0.1 = 0.072$	**M1**	Two or three correct 3 factor probabilities added, correct or FT from part **6(a)**. Accept unsimplified.
	[Total = probability of 1 success =] $0.254\left(\frac{127}{500}\right)$	**A1**	Accept unsimplified.
	[Probability of at least 1 success = $1-0.8\times0.9\times0.9=$]$0.352\left(\frac{44}{125}\right)$	**B1 FT**	Accept unsimplified.
	P(exactly 1 success | at least 1 success)= $\frac{\textit{their}\,0.254}{\textit{their}\,0.352}$	**M1**	Accept unsimplified.
	$0.722, \frac{127}{176}$	**A1**	$0.7215 < p \leqslant 0.722$
		5	

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Question	Answer	Marks	Guidance
6(c)	$0.8\times0.9\times0.9\times0.1\times0.3\times0.3=0.005832$ [FFFSSS] $0.2\times0.3\times0.3\times0.7\times0.9\times0.9=0.010206$ [SSSFFF]	**M1**	$a\times b\times c\times d\times e\times f$ FT from *their* tree diagram. Either a, b and c all = 0.8 or 0.9 (at least one of each) and d, e and f all = 0.1 or 0.3 (at least one of each). Or a, b, c = 0.2 or 0.3 (at least one of each) and d, e, f = 0.7 or 0.9 (at least one of each).
		A1	Either correct. Accept unsimplified.
	[Total =] 0.0160[38]	**A1**	
		3	