Question	Answer	Marks	Guidance
1	${}^{38}C_r$ or ${}^{n}C_{34}$	**M1**	Either expression seen OE, no other terms, condone x1
	${}^{38}C_{34}$	**A1**	Correct unsimplified OE
	73815	**A1**	If M0, **SCB1** ${}^{38}C_{34}$ x *k, k* an integer
		3	

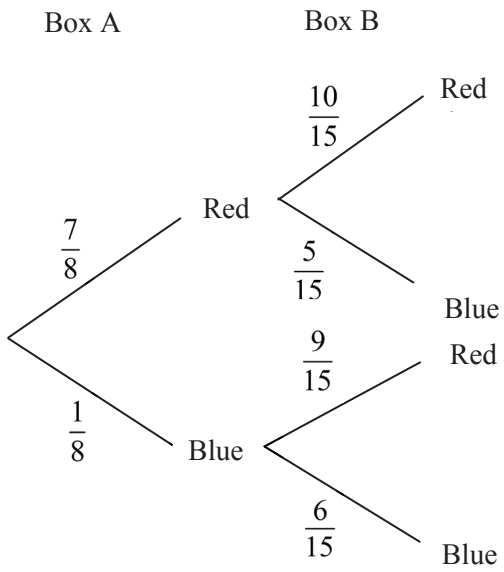
Question	Answer	Marks	Guidance
2(a)	$\left(\frac{1}{3}\right)\left(\frac{2}{3}\right)^2+\left(\frac{1}{3}\right)\left(\frac{2}{3}\right)^3+\left(\frac{1}{3}\right)\left(\frac{2}{3}\right)^4$	**M1**	One correct term with $0<p<1$
	$=\frac{4}{27}+\frac{8}{81}+\frac{16}{243}\left(=\frac{2432}{7776}\right)$	**A1**	Correct expression, accept unsimplified
	$=\frac{76}{243}$ or 0.313	**A1**	
		3	

Question	Answer	Marks	Guidance
2(b)	x: 0, 1, 2, 3 P(x): $\frac{8}{27}$, $\frac{12}{27}$, $\frac{6}{27}$, $\frac{1}{27}$	**B1**	Probability distribution table with correct values of x, no additional values unless with probability of 0 stated, at least one non-zero probability included
	$P(0) = \left(\frac{2}{3}\right)^3$ $P(1) = \left(\frac{1}{3}\right)\left(\frac{2}{3}\right)^2 \times 3$ $P(2) = \left(\frac{2}{3}\right)\left(\frac{1}{3}\right)^2 \times 3$ $P(3) = \left(\frac{1}{3}\right)^3$	**B1** **B1**	1 correct probability seen (may not be in table) **or** 3 or 4 non-zero probabilities summing to 1 All probabilities correct
		3	
2(c)	$E(X) = \left[0 \times \frac{8}{27}\right] + 1 \times \frac{12}{27} + 2 \times \frac{6}{27} + 3 \times \frac{1}{27}$ $= \left[\frac{0}{27}\right] + \frac{12}{27} + \frac{12}{27} + \frac{3}{27}$	**M1**	Correct method from *their* probability distribution table with at least 3 terms, $0 \leqslant$ *their* P(x) $\leqslant 1$, accept unsimplified
	$= 1$	**A1**	
		2	

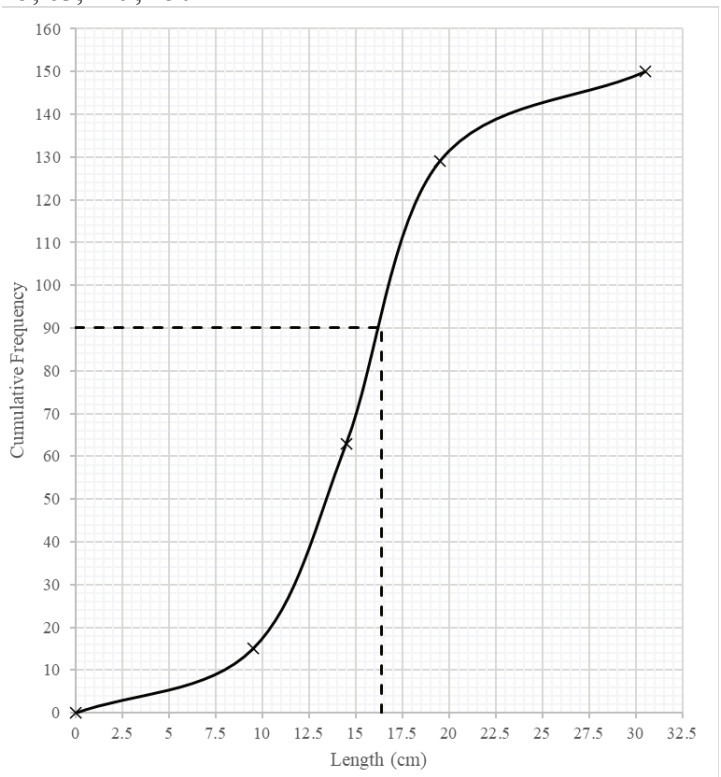
Question	Answer	Marks	Guidance
3(a)	$\mathrm{P}(X > 87) = \mathrm{P}\left(Z > \frac{87-82}{\sigma}\right) = 0.22$	**M1**	Using ± standardisation formula, not σ^2, not $\sqrt{\sigma}$, no continuity correction
	$\mathrm{P}\left(Z < \frac{5}{\sigma}\right) = 0.78$ $\left(\frac{5}{\sigma} = \right) 0.772$	**B1**	AWRT ±0.772 seen B0 for ±0.228
	$\sigma = 6.48$	**A1**	
		3	
3(b)	$\mathrm{P}\left(-\frac{4}{\sigma} < Z < \frac{4}{\sigma}\right) = \mathrm{P}(-0.6176 < Z < 0.6176)$	**M1**	Using ±4 used within a standardisation formula (SOI), allow σ^2, $\sqrt{\sigma}$ and continuity correction
		M1	Standardisation formula applied to **both** *their* ±4
	$\Phi = 0.7317$ Prob = $2\Phi - 1 = 2(0.7317) - 1$	**M1**	Correct area $2\Phi - 1$ oe linked to final solution
	= 0.463	**A1**	
		4	

Question	Answer	Marks	Guidance
4(a)	R ^ ^ ^ ^ ^ ^ ^ ^ ^ R $\frac{9!}{3!6!}$	**M1**	9! Alone on numerator, 3! × *k* or 6! × *k* on denominator
	= 84	**A1**	
		2	
4(b)	^ (B B B) ^ ^ ^ ^ ^	**M1**	$\frac{7!}{6!}\times k$ or $7k$ seen, *k* an integer > 0
	$\frac{7!}{6!}\times\frac{8\times7}{2}$	**M1**	$m\times n(n-1)$ *or* $m\times {}^nC_2$ *or* $m\times {}^nP_2$, *n*=7, 8 or 9, *m* an integer > 0
		M1	*n* = 8 used in above expression
	= 196	**A1**	
	Alternative for question 4(b)		
	[Arrangements, blues together – Arrangements with blues together and reds together =] $\frac{9!}{2!6!}-\frac{8!}{6!}$	**M1**	9! Seen alone or as numerator with subtraction
	= [252 – 56]	**M1**	8! Seen alone or as numerator in a second term and no other terms
		M1	All terms divided by 6! x *k*, *k* an integer
	= 196	**A1**	
		4	

Question	Answer	Marks	Guidance
5(a)	$1 - P(6, 7, 8)$ $= 1 - ({}^8C_6\ 0.7^6 0.3^2 + {}^8C_7\ 0.7^7 0.3^1 + 0.7^8)$	**M1**	One term ${}^8C_x\ p^x (1-p)^{8-x}$, $0 < p < 1,\ x \neq 0$
	$= 1 - 0.55177$	**A1**	Correct unsimplified expression, or better
	$= 0.448$	**A1**	
	Alternative method for question 5(a)		
	$P(0, 1, 2, 3, 4, 5)$ $= 0.3^8 + {}^8C_1\ 0.7^1 0.3^7 + {}^8C_2\ 0.7^2 0.3^6 + {}^8C_3\ 0.7^3 0.3^5 +$ ${}^8C_4 0.7^4 0.3^4 + {}^8C_5\ 0.7^5 0.3^3$	**M1**	One term ${}^8C_x\ p^x (1-p)^{8-x}$, $0 < p < 1,\ x \neq 0$
		A1	Correct unsimplified expression, or better
	$= 0.448$	**A1**	
		3	
5(b)	Mean $= 120 \times 0.7 = 84$ Var $= 120 \times 0.7 \times 0.3 = 25.2$	**B1**	Correct mean and variance, allow unsimplified
	$P(\text{ more than } 75) = P\left(z > \dfrac{75.5 - 84}{\sqrt{25.2}}\right)$	**M1**	Substituting *their* μ and σ into the ±standardising formula (any number), not σ^2, not $\sqrt{\sigma}$
		M1	Using continuity correction 75.5 or 74.5
	$P(z > -1.693)$	**M1**	Appropriate area Φ, from final process, must be a probability
	$= 0.955$	**A1**	Allow $0.9545 < p \leqslant 0.955$
		5	

Question	Answer	Marks	Guidance
6(a)		**B1**	Both correct probs, box A
		B1	2 probs correct for box B
		B1	All correct probs for box B
		3	
6(b)	$\frac{7}{8}\times\frac{5}{15}+\frac{1}{8}\times\frac{9}{15}$	**M1**	Two 2 factor terms added, correct or FT *their* **6(a)**.
	$=\frac{44}{120}\left[\frac{11}{30}\text{ or }0.367\right]$	**A1**	OE
		2	

Question	Answer	Marks	Guidance
6(c)	$\text{P(A blue } \mid \text{B blue)} = \frac{\text{P(A blue} \cap \text{ B blue)}}{\text{P(B blue)}}$ $= \frac{\frac{1}{8}\times\frac{6}{15}}{\frac{7}{8}\times\frac{5}{15}+\frac{1}{8}\times\frac{6}{15}} = \frac{\frac{1}{20}}{\frac{41}{120}}$	**M1**	*their* $\frac{1}{8}\times\frac{6}{15}$ seen as numerator or denom of fraction
		M1	*their* $\frac{7}{8}\times\frac{5}{15}+\frac{1}{8}\times\frac{6}{15}$ seen
		M1	*their* $\frac{7}{8}\times\frac{5}{15}+\frac{1}{8}\times\frac{6}{15}$ seen as denominator
	$= \frac{6}{41}$ or 0.146	**A1**	
		4	

Question	Answer	Marks	Guidance
7(a)	15, 63, 129, 150  	**B1**	Correct cumulative frequencies seen (may be on graph)
		B1	0 ⩽ Horizontal axis ⩽ 30, 0 ⩽ vertical axis ⩽ 150 Labels correct: length cm, cf
		M1	At least 3 points plotted at upper end points (e.g. allow 9, 9.5, 10) with a linear horizontal scale.
		A1	Linear vertical scale, all points at correct upper end points (9.5 etc.), curve drawn accurately, joined to (0,0) (condone (–0.5, 0))
		4	
7(b)	60% of 150 = 90	**M1**	90 seen or implied by use on graph
	Approx. 16.5 [cm]	**A1FT**	FT *their* increasing cumulative frequency graph, Use of graph must be seen. If no clear evidence of use of graph **SCB1FT** correct value from *their* graph
		2	

Question	Answer	Marks	Guidance
7(c)	Midpoints: 4.75, 12, 17, 25	**M1**	At least 3 correct midpoints used (39449.4375 implies M1)
	Var = $\dfrac{4.75^2 \times 15 + 12^2 \times 48 + 17^2 \times 66 + 25^2 \times 21}{150} - 15.295^2$	**M1**	Using midpoints ±0.5 in correct var formula, including subtraction of *their* μ^2.
	= 29.1	**A1**	
		3	