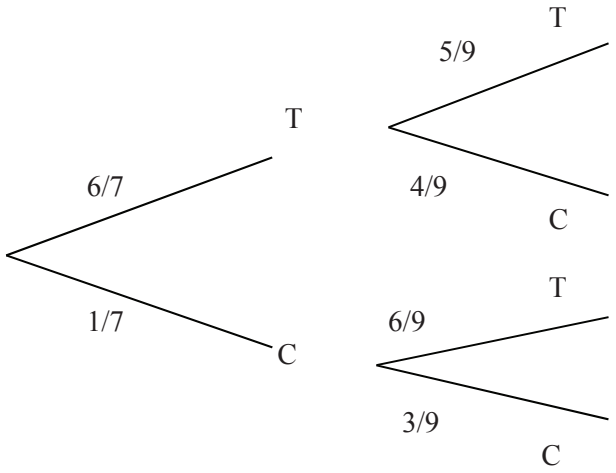
Question	Answer	Marks	Guidance
1	$P(S) = \frac{1}{2}$	**B1**	
	$P(T) = \frac{16}{36}\left(\frac{4}{9}\right)$	**B1**	
	$P(S \cap T) = \frac{10}{36}\left(\frac{5}{18}\right)$	**M1**	$P(S \cap T)$ found by multiplication scores M0 M1 awarded if *their* value is identifiable in their sample space diagram **or** Venn diagram **or** list of terms **or** probability distribution table (oe)
	$P(S)\,P(T) \neq P(S \cap T)$ so not independent	**A1**	8/36, 10/36 P(S) × P(T) and $P(S \cap T)$ seen in workings and correct conclusion stated, www
	Alternative method for question 1		
	$P(S) = \frac{1}{2}$	**B1**	
	$P(T) = \frac{16}{36}\left(\frac{4}{9}\right)$	**B1**	
	$P(S \cap T) = \frac{10}{36}\left(\frac{5}{18}\right)$	**M1**	$P(S \cap T)$ found by multiplication scores M0 M1 awarded if *their* value is identifiable in their sample space diagram **or** Venn diagram **or** list of terms **or** probability distribution table (oe)
	$P(S \mid T) = \frac{10}{16}$ or $P(T \mid S) = \frac{10}{18}$ $P(S \mid T) \neq P(S)$ or $P(T \mid S) \neq P(T)$ so not independent	**A1**	**Either** 18/36, 10/16,P(S) and $P(S \mid T)$ seen in workings and correct conclusion stated, www **Or** 16/36, 10/18, P(T) and P(T | S) seen in workings and correct conclusion stated, www
		4	

Question	Answer	Marks	Guidance
2	$P(< 28.9) = P\left(z < \frac{28.9-30}{1.5}\right)$	**B1**	Using ± standardising formula, no continuity correction, not σ^2 or $\sqrt{\sigma}$,
	$= P(z < -0.733)$ $= 1 - 0.7682$	**M1**	Appropriate area Φ from standardisation formula P(z <….) in final probability solution, Must be a probability, e.g. 1 – 0.622 is M0
	$= 0.2318$	**A1**	Correct final probability rounding to 0.232. (Only requires M1 not B1 to be awarded
	Number of cartridges is *their* 0.2318×8 $= 1.85$, so 2 (Also accept 1 but not both)	**B1**	**FT** using *their* 4 SF (or better) value, ans. rounded or truncated to integer, no approximation indicated.
		4	

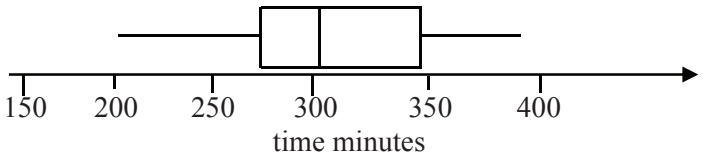
Question	Answer	Marks	Guidance
3(i)	P(at most 7) = 1 – P(8, 9, 10) $= 1 - {}^{10}C8(0.35)^8(0.65)^2 - {}^{10}C_9(0.35)^9(0.65)^1 - (0.35)^{10}$	**M1**	Use of normal approximation M0 Binomial term of form ${}^{10}C_x p^x(1-p)^{10-x}$ $0 < p < 1$ any p, $x \neq 10,0$
	[= 1 – 0.004281 – 0.0005123 – 0.00002759]	**A1**	Correct unsimplified (or individual terms evaluated) answer seen Condone 1 – A + B + C leading to correct solution
	= 0.995	**B1**	B1 **not** dependent on previous marks.
	Alternative method for question 3(i)		
	P(at most 7) = P(0,1,2,3,4,5,6,7)	**M1**	Binomial term of form ${}^{10}C_x p^x(1-p)^{10-x}$ $0 < p < 1$ any p, $x \neq 10,0$
	$= (0.65)^{10} + {}^{10}C1(0.35)^1(0.65)^9 + \ldots + {}^{10}C_7(0.35)^7(0.65)^3$	**A1**	Correct unsimplified answer or individual terms evaluated seen
	= 0.995	**B1**	
		3	
3(ii)	$1 - (0.65)^n > 0.99$ $0.01 > (0.65)^n$	**M1**	Equation or inequality with $(0.65)^n$ **and** 0.01 or $(0.35)^n$ **and** 0.99 only (Note 1 – 0.99 is equivalent to 0.01 etc.)
	$n > 10.69$	**M1**	Solving their $a^n = c$, $0 < a,c < 1$ using logs **or** Trial and Error If answer inappropriate, at least 2 trials are required for Trial and Error M mark
	smallest $n = 11$	**A1**	CAO
		3	

Question	Answer	Marks	Guidance
4	$z = 0.842 = \left(\frac{121-\mu}{\sigma}\right)$ so $0.842\sigma = 121 - \mu$	**B1**	± 0.842 seen but B0 if 1 ± 0.842 oe seen
		M1	One appropriate standardisation equation with a z-value, μ, σ and 121 **or** 102, condone continuity correction. Not 0.158, 0.42,…
	$z = -0.58 = \left(\frac{102-\mu}{\sigma}\right)$ so $-0.58\sigma = 102 - \mu$	**B1**	± 0.58(0) seen but B0 if 1 ± 0.58 oe seen
	Solving	**M1**	Correct algebraic elimination of μ or σ from *their* two simultaneous equations to form an equation in one variable, condone 1 numerical slip
	$\sigma = 13.4$ $\mu = 110$	**A1**	If M0A0 scored (i.e. no algebraic elimination seen), **SC B1** can be awarded for both answers correct Consistent use of σ^2 or $\sqrt{\sigma}$ throughout apply **MR** penalty to A mark or SC B mark.
		5	

Question	Answer	Marks	Guidance
5(i)		**B1**	First pair of branches labels and probs correct (6/7 and 1/7 or rounding to 0.857 and 0.143) (Labelling must be logically…e.g. (T and T) or (T and Not T) would be acceptable)
		B1	Either of second top pair or bottom of branches labels and probs correct
		B1	Both second pairs of branches labels and probs correct. No additional / further branches.
		3	
5(ii)	<table><tr><td>No of toffees taken (*T*)</td><td>0</td><td>1</td><td>2</td></tr><tr><td>prob</td><td>$\frac{3}{63}$, 0.0476(2)</td><td>$\frac{30}{63}$, 0.476(2)</td><td>$\frac{30}{63}$, 0.476(2)</td></tr></table>	**B1**	P(1) correct
		B1	P(0) or P(2) correct
		B1	**FT** Correct values in table, any additional values of *T* have stated probability of zero. For FT $\Sigma p = 1$,
		3	
5(iii)	$E(X) = \frac{90}{63}\ (\frac{10}{7})\ (1.43)$	**B1**	Not FT
		1	

Question	Answer	Marks	Guidance
5(iv)	$P(1^{st}\ C \mid 2^{nd}\ T) = \dfrac{P(C \cap T)}{P(T)} = \dfrac{\frac{1}{7}\times\frac{6}{9}}{\frac{1}{7}\times\frac{6}{9}+\frac{6}{7}\times\frac{5}{9}} = \dfrac{\frac{6}{63}}{\frac{36}{63}}$	**B1**	$P(C \cap T)$ attempt seen as numerator of a fraction, consistent with *their* tree diagram or correct
		M1	Summing 2 appropriate two-factor probabilities, consistent with *their* tree diagram or correct seen anywhere
		A1	$\frac{36}{63}$ oe or correct unsimplifed expression seen as numerator or denominator of a fraction
	$\frac{1}{6}$ oe	**A1**	Final answer
		4	

Question	Answer	Marks	Guidance
6(i)	Advantage: comment referring to spread or range or shape	**B1**	Comments referring to quartiles, IQR, Range, median, shape, skewness, data distribution, spread score B1 Any comments with reference to mean or standard deviation or any other 'disadvantage' will score B0 Comments referring to '5-value plot', comparison with another data set, overview or ease of drawing/plotting/reading require an appropriate advantage statement.
	Disadvantage: comment referring to limited data information provided	**B1**	Comments referring to no individual data, no information about the number of values, unable to calculate mean, standard deviation, variance and mode score B1 Any comments with reference to median, shape or any other 'advantage' will score B0 Comments referring to 'size of data set' or 'average' require an appropriate disadvantage statement. Comments referring to outliers are ignored in all cases (as outliers are not in the syllabus content) unless supported by an appropriate advantage / disadvantage statement. If comments not clearly identified, assume first comment is the advantage.
		2	

Question	Answer	Marks	Guidance
6(ii)	Not mean as data skewed by one large value	**B1**	Comment which identifies 768 (or 'a very large number') as the problem. Condone the use of 'outlier'
	Not mode as frequencies all the same	**B1**	Comment which indicates that no mode exists (e.g. all the data is different, there is no repeated number, all the values are different)
	Median	**B1**	Median identified as choice, dependent upon statements for mean and mode being given, even if incorrect or very general.
	SC: Mean is identified as most suitable		
	Not mode as frequencies all the same	**SCB1**	Comment which indicates that no mode exists
	Not median as not all values used	**SCB1**	Comment which indicates limitation of median e.g. median is not in middle of range.
		3	
6(iii)(a)	LQ = 256 or 256.5 Med = 280 UQ = 329 Min 190 max 375  	**B1**	Median, UQ and LQ values seen, may not be identified or identified correctly. (Not read from box plot unless value stated)
		B1	**FT** Median and quartiles plotted in box on graph, linear scale
		B1	Correct end points, whiskers from ends of box but not through box, not at top or bottom of box
		B1	Uniform scale from 190 to 375 (need at least 3 linear identified points min) and labelled 'time' and 'minutes' (can be in title) **No time axis or time axis with no scale attempt,** Max B1B0B0B0
		4	

Question	Answer	Marks	Guidance
6(iii)(b)	IQR = *their* 329 – *their* 256 = 73 or 72.5	**B1**	**FT Must** follow through only from ***their*** stated values (condone if correct quartiles stated here), not reading from graph.
		1	

Question	Answer	Marks	Guidance
7(a)	${}^6C_3 \times {}^3C_2 \times {}^1C_1$	**M1**	${}^6C_a \times {}^{6-a}C_b \times {}^{6-a-b}C_{6-a-b}$ seen oe ${}^{6-a-b}C_{6-a-b}$ can be implied by 1 or omission, condone use of permutations,
	$= 20 \times 3$	**A1**	Any correct method seen no addition/additional scenarios
	$= 60$	**A1**	Correct answer
	Alternative method for question 7(a)		
	$\frac{{}^6P_6}{{}^3P_3 \times {}^2P_2 \times {}^1P_1} = \frac{6!}{3! \times 2!}$	**M1**	${}^6P_6$ / (${}^nP_n$ x k) with $3 \geqslant n > 1$and $6 \geqslant$ k an integer $\geqslant 1$, not 6!/1
		A1	Correct method with no additional terms
	$= 60$	**A1**	Correct answer
		3	
7(b)(i)	$\frac{4!}{3!} \times \frac{3!}{2!} \times 2$	**M1**	A single expression with either 4!/3! × k or 3!/2! × k, k a positive integer seen oe (condone 2 identical expressions being added)
		M1	Correctly multiplying *their* single expression by 2 or 2 identical expressions being added.
	$= 24$	**A1**	Correct answer
		3	

Question	Answer	Marks	Guidance
7(b)(ii)	Total no of arrangements = $\frac{7!}{2!3!}$ = 420 (A)	**B1**	Accept unsimplified
	No with 2s together = $\frac{6!}{3!}$ = 120 (B)	**B1**	Accept unsimplified
	With 2s not together: *their* (A) – *their* (B)	**M1**	Subtraction indicated, possibly by *their* answer, no additional terms present
	= 300 ways	**A1**	Exact value www
	Alternative method for question 7(b)(ii)		
	3 _ 7 _ 7 _ 7 _ 8 _		
	$\frac{5!}{3!}\times\frac{6\times5}{2}$	**B1**	k x 5! in numerator, k a positive integer
		B1	m x $3!$ In denominator, m a positive integer
		M1	*Their* 5!/3! multiplied by ${}^6C_2$ only (no additional terms)
	= 300 ways	**A1**	Exact value www
		4	