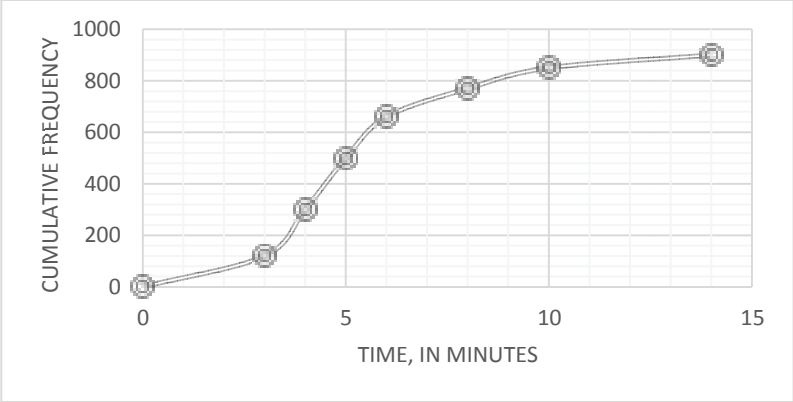
<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td rowspan="4">1</td><td rowspan="2"> 

<table>
<tr><td>t</td><td>0</td><td>3</td><td>4</td><td>5</td><td>6</td><td>8</td><td>10</td><td>14</td></tr>
<tr><td>cf</td><td>0</td><td>120</td><td>300</td><td>500</td><td>660</td><td>770</td><td>850</td><td>900</td></tr>
</table></td><td>M1 A1</td><td>Attempt to plot cumulative frequencies at ucb and all points joined between $(3,y_1)$ and $(14,y_2)$. Cf table not required.

Linear scales starting at (0,0) and axes labelled cf and time in mins, all points correct; (allow straight lines or curves)</td></tr>
<tr><td>M1</td><td>450 seen in median attempt on increasing CF graph (independent);</td></tr>
<tr><td>Median value: 4.8 (minutes)</td><td>A1 FT</td><td>Correct ($4.7 \leqslant m < 4.9$) or FT from reading their increasing graph at cf = 450</td></tr>
<tr><td></td><td>4</td><td></td></tr>
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Question	Answer	Marks	Guidance
2(i)	1 L: ${}^6C_2 = 15$	**B1**	
		1	
2(ii)	No L: ${}^6C_3 = 20$ (1 L: ${}^6C_2 = 15$)	**M1**	Either 0L or 2L correct unsimplified
	2 L: ${}^6C_1 = 6$	**M1**	Summing the 3 correct scenarios
	Total = 41	**A1**	
		3	

Question	Answer	Marks	Guidance
3(i)	(10/160 =) 1/16, 0.0625	**B1**	OE
		1	
3(ii)	(90/160) = 9/16, 0.5625	**B1**	OE
		1	
3(iii)	P(red/hatchback) = P(red hatchback) / P(hatchback) = 40/160 / 90/160	**M1**	Appropriate probabilities in a fraction
	= 4/9	**A1**	OE *Altn method: Direct from table* *M1 for 40/*a *or* b/*90,* a ≠ *160* *A1 for 40/90 oe*
		2	

Question	Answer	Marks	Guidance
3(iv)	*EITHER:* P(red) × P(hatchback) = $\frac{72}{160}\times\frac{90}{160} \neq \frac{40}{160}$	**(M1**	Use correct approach with appropriate probabilities substituted
	Not independent	**A1)**	Numerical comparison and conclusion stated
	OR: P(red/hatchback) = 40/90 and $\frac{40}{90} \neq \frac{72}{160}$	**(M1**	Use correct approach with appropriate probabilities substituted
	Not independent	**A1)**	Numerical comparison and conclusion stated
		2	

Question	Answer	Marks	Guidance
4(i)	$\Sigma p = 1$: $0.2 + 0.1 + p + 0.1 + q = 1$: $p + q = 0.6$	**M1**	Unsimplified sum of probabilities equated to 1
	$\Sigma px = 1.7$: $-0.4 + 0 + p + 0.3 + 4q = 1.7$:	**M1**	Unsimplified Sum of px equated to 1.7
	$p + 4q = 1.8$	**M1**	Solve simult. equations to find expression in p or q
	$p = 0.2$, $q = 0.4$	**A1**	
		4	
4(ii)	$\text{Var}(X) = \Sigma px^2 - 1.7^2 = 4\text{x}0.2 + 1p + 9\text{x}0.1 + 16q - 1.7^2$ $= 8.3 - 2.89$	**M1**	Use correct unsimplified expression for variance
	$= 5.41$	**A1**	
		2	

Question	Answer	Marks	Guidance
5(i)	$24.25n - 20n = 136$ **Or** $\frac{136}{n} + 20 = 24.25$	**M1**	Unsimplified correct equation
	$n = 32$	**A1**	
		2	
5(ii)	Using coded information: Variance = $\frac{2888}{32} - \left(\frac{136}{32}\right)^2$	**M1**	unsimplified expression for variance
	$= 72.1875 = 72.19$	**A1**	accept answers 72.2 SOI
	Using uncoded information: Variance = $\frac{\sum x^2}{32} - 24.25^2$ Equate with 72.1875 to give	**M1**	Equate two expressions for variance and solve
	$\sum x^2 = 21128$	**A1**	
		4	

Question	Answer	Marks	Guidance
6(i)	$3! \times \frac{4!}{3!} \times 2$	**M1**	3! oe seen multiplied by integer ⩾ 1, no addition
		M1	4!/3! oe seen multiplied by integer > 1, no addition
	= 48	**A1**	
		3	
6(ii)	*EITHER:* Even = Total number of arrangements – Odd numbers $= 7!/3! - 3\times\frac{6\times5\times4\times3\times2\times1}{3!} = (7!/3! - 6!/2!)$ $= 840 - 360$	**B1**	7!/3! –
		B1	6!/2! OE
	$= 480$	**B1**	
	OR: No of arrangements ending in 8: $\frac{6!}{3!}$	**B1**	No. ending in 8 or no. ending in 6 correct unsimplified
	No ending in 6: 6!/2!	**B1**	Both correct and added unsimplified
	Total: $\frac{6!}{3!} + 6!/2 = 120 + 360 = 480$	**B1**	
		3	

Question	Answer	Marks	Guidance
7(i)	P($X > 410$) = 225/6000 = 0.0375 $P\left(Z > \frac{410-400}{\sigma}\right)$ = 0.0375: 0.9625	**M1**	Use 1 −225/6000 = 0.9625 to find z value
	z value = ±1.78	**A1**	z value: ± 1.78
	$\frac{10}{\sigma} = 1.78$	**M1**	(410-400)/σ = *their* z (must be a z value)
	$\sigma = 5.62$	**A1**	
		4	
7(ii)	We need P($Z < -1.5$) and P($Z > 1.5$)	**M1**	Attempt at P($Z < -1.5$) or P($Z > 1.5$) $1 - \Phi(1.5)$ seen
	$\Phi(-1.5) + 1 - \Phi(1.5)$ $= 2 - 2\Phi(1.5)$	**M1**	Or equivalent expression with values
	=2 – 2 × 0.9332 = 0.1336 (0.134)	**A1**	Correct to 3sf
	Number expected = 500 × 0.1336 = 66.8: 66 or 67 packets	**B1ft**	0.1336 used or FT their 4sf probability times 500, (not 0.9625 or 0.0375) rounded or truncated
		4	

Question	Answer	Marks	Guidance
8(i)	$P(4) + P(5) = {}^5C_4\left(\frac{1}{4}\right)^4\left(\frac{3}{4}\right)^1 + {}^5C_5\left(\frac{1}{4}\right)^5\left(\frac{3}{4}\right)^0$	**M1**	One binomial term, with $p < 1$, $n=5$, $p + q=1$
	$= 0.014648.. + 0.00097656..$	**M1**	Add 2 correct unsimplified binomial terms
	$= 0.0156$ or $\frac{1}{64}$	**A1**	
		3	
8(ii)	$1 - P(0) > 0.995$: $0.75^n < 0.005$	**M1**	Equation or inequality involving 0.75^n and 0.005 or 0.25^n and 0.995
	$n\log 0.75 < \log 0.005$ $n > 18.4$:	**M1**	Attempt to solve *their* exponential equation using logs, or trial and error May be implied by their answer
	$n = 19$	**A1**	
		3	
8(iii)	$p = 0.25$, $n = 160$: mean = 160 x 0.25 (= 40) variance = 160 x 0.25 x 0.75 (=30)	**B1**	Correct unsimplified mean and variance
	$P(X < 50) = P\left(Z < \frac{49.5 - 40}{\sqrt{30}}\right)$	**M1**	Use standardisation formulae must include square root.
		M1	Use continuity correction ±0.5 (49.5 or 50.5)
	$= P(Z < 1.734) = 0.959$	**A1**	Correct final answer
		4	