Question	Answer	Marks	Guidance
1(i)	38	**B1**	
		1	
1(ii)	Median = 38.5	**B1**	CAO
	IQR = 40 – 38	**M1**	$39 < UQ < 45 - 36 < LQ \leqslant 38$
	= 2	**A1**	If M0 awarded **SCB1** for **both** UQ = 40 or 40.5 **and** LQ = 38 or 37.75 seen
		3	

Question	Answer	Marks	Guidance
2(i)	**Method 1** $$P(M \cap H) = \frac{3}{4} \times \frac{3}{5} = \frac{9}{20} \ (0.45)$$	B1	Seen, accept unsimplified
	$$P(F \text{ or } M \cap H) = \frac{1}{4} + \frac{9}{20} = \frac{14}{20}$$	M1	Numerical attempt at $P(F) + P(M \cap H)$
		A1	Correct unsimplified expression
	$$= \frac{7}{10} \ (0.7) \text{ OE}$$	A1	Correct final answer
	Method 2 $$P(M \cap H') = \frac{3}{4} \times \frac{2}{5} = \frac{6}{20} \ (0.3)$$	B1	Seen, accept unsimplified
	$$P(F \text{ or } M \cap H) = 1 - P(M \cap H')$$	M1	Numerical attempt at $1 - P(M \cap H')$
	$$= 1 - \frac{3}{4} \times \frac{2}{5}$$	A1	Correct unsimplified expression
	$$= \frac{7}{10} \ (0.7) \text{ OE}$$	A1	Correct final answer

Question	Answer	Marks	Guidance
2(i)	**Method 3** $P(F \cap H' \text{ or } H) = \dfrac{1}{4} \times \dfrac{1}{5} + \dfrac{1}{4} \times \dfrac{4}{5} + \dfrac{3}{4} \times \dfrac{3}{5}$	B1	$\dfrac{3}{4} \times \dfrac{3}{5}$ $\left(\dfrac{9}{20}\right)$ **or** $\dfrac{1}{4} \times \dfrac{4}{5}$ $\left(\dfrac{4}{20}\right)$ **or** $\dfrac{3}{4} \times \dfrac{3}{5} + \dfrac{1}{4} \times \dfrac{4}{5}$ $\left(\dfrac{13}{20}\right)$ seen
	$= \dfrac{1}{20} + \dfrac{4}{20} + \dfrac{9}{20}$	M1	Numerical attempt at $P(F \cap H') + P(F \cap H) + P(M \cap H)$
		A1	Correct unsimplified expression
	$= \dfrac{7}{10}$ (0.7) oe	A1	Correct final answer
	Method 4 – Venn diagram style approach $P(F \cup H) = P(F) + P(H) - P(F \cap H)$	B1	$\dfrac{3}{4} \times \dfrac{3}{5}$ $\left(\dfrac{9}{20}\right)$ **or** $\dfrac{1}{4} \times \dfrac{4}{5}$ $\left(\dfrac{4}{20}\right)$ **or** $\dfrac{3}{4} \times \dfrac{3}{5} + \dfrac{1}{4} \times \dfrac{4}{5}$ $\left(\dfrac{13}{20}\right)$ seen
	$= \dfrac{1}{4} + \dfrac{1}{4} \times \dfrac{4}{5} + \dfrac{3}{4} \times \dfrac{3}{5} - \dfrac{1}{4} \times \dfrac{4}{5}$	M1	Numerical attempt at $P(F) + P(H) - P(F \cap H)$
	$= \dfrac{1}{4} + \dfrac{4}{20} + \dfrac{9}{20} - \dfrac{4}{20}$	A1	Correct unsimplified expression
	$= \dfrac{7}{10}$ (0.7) oe	A1	Correct final answer
		4	

Question	Answer	Marks	Guidance
2(ii)	**Method 1** $$(P(M) \times P(H) =) \frac{3}{4} \times their \frac{13}{20} = \frac{39}{80}$$ $$(P(M \cap H) =) \frac{3}{4} \times \frac{3}{5} = 0.45$$	M1	Unsimplified, or better, legitimate numerical attempt at $P(M) \times P(H)$ **and** $P(M \cap H)$ Descriptors $P(M \cap H)$ **and** $P(M) \times P(H)$ seen, correct numerical evaluation and comparison, conclusion stated
	$\frac{39}{80}$ (0.4875) $\neq$ 0.45, not independent	A1	
	Method 2 $$P(M \mid H) = \frac{P(M \cap H)}{P(H)} = \frac{\frac{9}{20}}{their \frac{13}{20}} = \frac{9}{13}$$ $$P(M) = \frac{3}{4}$$	M1	Unsimplified, or better, numerical attempt at $P(H)$ and $P(M \cap H)$, $P(M)$
	$\frac{9}{13} \neq \frac{3}{4}$, not independent	A1	Descriptors $P(M \cap H)$, $P(H)$ **and** $P(M)$ **OR** $P(M\mid H)$ **and** $P(M)$ seen, numerical evaluation **and** comparison, conclusion stated Any appropriate relationship can be used, the M is awarded for an unsimplified, or better, numerical attempt at the terms required, the A mark requires the correct descriptors, numerical evaluation and comparison and the conclusion
		2	

Question	Answer	Marks	Guidance
3(i)	$z = -1.282$	**B1**	± 1.282 seen
	$-1.282 = \dfrac{440 - \mu}{9}$	**M1**	$\pm$Standardisation equation with 440, 9 and μ, equated to a z-value, (not $1 - z$-value or probability e.g. 0.1841, 0.5398, 0.6202, 0.8159)
	$\mu = 452$	**A1**	Correct answer rounding to 452, not dependent on B1
		3	
3(ii)	$P(z > 1.8) = 1 - 0.9641 = 0.0359$	**B1**	
	Number $= 0.0359 \times 150$ $= 5.385$	**M1**	$p \times 150, \, 0 < p < 1$
	(Number of cartons =) 5	**A1FT**	Accept either 5 or 6, not indicated as an approximation, e.g. ~, about **FT** *their* $p \times 150$, answer as an integer
		3	

Question	Answer	Marks	Guidance
4(i)	<table><tr><td>X</td><td>0</td><td>1</td><td>2</td></tr><tr><td>Prob</td><td>$\frac{2}{7}$</td><td>$\frac{4}{7}$</td><td>$\frac{1}{7}$</td></tr></table>	**B1**	Prob distribution table drawn, top row correct with at least one probability $0 < p < 1$ entered, condone additional values with $p = 0$ stated
	$P(0) = \frac{5}{7} \times \frac{4}{6} \times \frac{3}{5} = \frac{2}{7}$ (0.2857)	**B1**	One probability correct (need not be in table)
	$P(1) = \frac{2}{7} \times \frac{5}{6} \times \frac{4}{5} \times {}^3C_1 = \frac{4}{7}$ (0.5713)	**B1**	Another probability correct (need not be in table).
	$P(2) = \frac{2}{7} \times \frac{1}{6} \times \frac{5}{5} \times {}^3C_2 = \frac{1}{7}$ (0.1429)	**B1**	Values in table, all probs correct (to 3SF) or 3 probabilities summing to 1
		4	
4(ii)	$\text{Var}(X) = 1 \times \frac{4}{7} + 4 \times \frac{1}{7} - (\frac{6}{7})^2$ $= \frac{8}{7} - (\frac{6}{7})^2$	**M1**	Unsimplified correct numerical expression for variance **or** *their* probabilities from **(i)** $0 < p < 1$ in **unsimplified** variance expression
	$= \frac{20}{49}$ or 0.408	**A1**	Correct answer (0.40816…) nfww Final answer does **not** imply the method mark
		2	

Question	Answer	Marks	Guidance
5(i)	$a = 40$	**B1**	
		1	
5(ii)	Mean $= \dfrac{0.5 \times 14 + 1.5 \times 46 + 3.5 \times 102 + 7.5 \times \textit{their } 40 + 20 \times 40}{242}$ $= \dfrac{1533}{242}$	**M1**	Numerator: 5 products with at least 3 acceptable mid-points × appropriate frequency FT **(i).** Denominator: 242 CAO $\dfrac{1533}{242}$ implies M1, but if **FT** an unsimplified expression required
	$= 6\dfrac{81}{242}$ or 6.33	**A1**	CAO (6.3347… rounded to 3 or more SF)
		2	
5(iii)	fd $= 14, 46, 34, (\dfrac{\textit{their } (i)}{5} =) \, 8, 2$	**M1**	Attempt at fd [f/(attempt at cw)] or scaled freq
		A1FT	Correct heights seen on diagram with linear vertical scale from $(x, 0)$ **FT** their $\dfrac{a}{5}$ only
		B1	Correct bar widths (1:1:3:5:20) at axis, visually no gaps, with linear horizontal scale from $(0, y)$, first bar starting at (0,0)
		B1	Labels (time, mins, and fd(OE) seen, some may be as a title) and a linear scale with at least 3 values marked on each axis. (Interval notation not acceptable)
		4	

Question	Answer	Marks	Guidance
6(a)(i)	(AAAIU) * * * * Arrangements of vowels/repeats × arrangements of (consonants & vowel group) =	M1	$k \times 5!$ (k is an integer, $k \geqslant 1$)
	$\dfrac{5! \times 5!}{3!}$	M1	$\dfrac{m}{3}!$ (m is an integer, $m \geqslant 1$) **Both** Ms can **only** be awarded if expression is **fully correct**
	$= 2400$	A1	Correct answer
		3	
6(a)(ii)	E.g. R * * * T * * * L . Arrangements of consonants RL, RS, SL $= {}^3P_2 = 6$ Arrangements of remaining letters $= \dfrac{6!}{3!} = 120$	M1	$k \times \dfrac{6!}{3!}$ **or** $k \times {}^3P_2$ **or** $k \times {}^3C_2$ **or** $k \times 3!$ **or** $k \times 3 \times 2$ (k is an integer, $k \geqslant 1$), no irrelevant addition
	Total 120×6	M1	Correct unsimplified expression or $\dfrac{6!}{3!} \times {}^3C_2$
	$= 720$ ways	A1	Correct answer
		3	

Question	Answer	Marks	Guidance
6(b)	**Method 1** N(2) R(8) Br(4) 1 2 1 $= 2 \times {}^8C_2 \times 4 = 224$	M1	Multiply 3 combinations, ${}^2C_x \times {}^8C_y \times {}^4C_z$. Accept ${}^2C_1 = 2$ etc.
	2 1 1 $= 1 \times {}^8C_1 \times 4 = 32$ 1 1 2 $= 2 \times 8 \times {}^4C_2 = 96$	A1	3 or more options correct unsimplified
	2 0 2 $= 1 \times 1 \times {}^4C_2 = 6$ 1 0 3 $= 2 \times 1 \times 4 = 8$	M1	Summing *their* values of 4 or 5 legitimate scenarios (no extra scenarios)
	Total = 366 ways	A1	Correct answer
	Method 2 ${}^{14}C_4 - $ (2N2R or 1N3R or 4R or 3R1B or 2R2B or 1R3B or 4B)	M1	'${}^{14}C_4 - k$' seen, k an integer from an expression containing ${}^8C_x$
	$1001 - (1 \times {}^8C_2 + 2 \times {}^8C_3 + {}^8C_4 + {}^8C_3 \times 4 + {}^8C_2 \times {}^4C_2 + 8 \times 4 + 1)$	A1	4 or more 'subtraction' options correct unsimplified, may be in a list
	$1001 - (28 + 112 + 70 + 224 + 168 + 32 + 1)$	M1	*Their* ${}^{14}C_4 - $ [*their* values of 6 or more legitimate scenarios] (no extra scenarios, condone omission of final bracket)
	$= 366$	A1	Correct answer
		4	

Question	Answer	Marks	Guidance
7(i)	**Method 1** P(< 11) = 1 – P(11, 12, 13)	M1	Binomial expression of form $^{13}C_x\ (p)^x(1-p)^{13-x}$, $0 < x < 13$, $0 < p < 1$
	$= 1 - {}^{13}C_{11}(0.6)^{11}(0.4)^2 - {}^{13}C_{12}(0.6)^{12}(0.4) - (0.6)^{13}$	M1	Correct unsimplified answer
	$= 0.942$	A1	CAO
	Method 2 P(< 11) = P(0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10)	M1	Binomial expression of form $^{13}C_x\ (p)^x(1-p)^{13-x}$ $0 < x < 13$, $0 < p < 1$
	$= (0.4)^{13} + {}^{13}C_1(0.4)^{12}(0.6) + \ldots + {}^{13}C_{10}(0.4)^3(0.6)^{10}$	M1	Correct unsimplified answer
	$= 0.942$	A1	CAO
		3	
7(ii)	$\mu = 130 \times 0.35 = 45.5$ var $= 130 \times 0.35 \times 0.65 = 29.575$	B1	Correct unsimplified mean and var (condone $\sigma^2 = 29.6$, $\sigma = 5.438$)
	$P(\geqslant 50) = P\left(z > \dfrac{49.5 - 45.5}{\sqrt{29.575}}\right) = P\ (z > 0.7355)$	M1	Standardising, using $\pm\left(\dfrac{x - their\ \text{mean}}{their\ \sigma}\right)$, $x =$ value to standardise 49.5 or 50.5 seen in ± standardisation equation
	$= 1 - \Phi(0.7355)$	M1	Correct final area
	$= 1 - 0.7691$	M1	
	$= 0.231$	A1	Correct final answer
		5	

Question	Answer	Marks	Guidance
7(iii)	$1 - (0.65)^n > 0.98$ or $0.02 > (0.65)^n$	**M1**	Eqn or inequality involving, 0.65^n and 0.02 **or** 0.35^n and 0.98
	$n > 9.08$	**M1**	Attempt to solve their eqn or inequality by logs **or** trial and error
	$n = 10$	**A1**	CAO
		3	