Question	Answer	Marks	Guidance
1(i)	$\frac{120}{300} = 0.4$	**B1**	OE
		1	
1(ii)	P(male) × P(not piano) = $\frac{160}{300} \times \frac{225}{300}$ $\left(\frac{8}{15} \times \frac{3}{4}\right) = \frac{2}{5}$	**M1**	P(M) × P(P') seen Can be unsimplified but the events must be named in a product
	As P(male ∩ not piano) also = $\frac{120}{300} = \frac{2}{5}$ The events are **Independent**	**A1**	Numerical comparison and correct conclusion
	Alternative method for question 1(ii)		
	P(male ∩ not piano) = $\frac{120}{300}$; P(not piano) = $\frac{225}{300}$	**M1**	P(M|P') or P(P'|M) unsimplified seen with *their* probs with correctly named events
	P(M | not piano) = $\frac{\frac{120}{300}}{\frac{225}{300}} = \frac{120}{225} = \frac{8}{15}$ = P(male) **or** P(not piano | M) = $\frac{\frac{120}{300}}{\frac{160}{300}} = \frac{120}{160} = \frac{3}{4}$ = P(not piano) Therefore the events are **Independent**	**A1**	Numerical comparison with P(M) or P(P') and correct conclusion
		2	

Question	Answer	Marks	Guidance
2(i)	$\frac{9!}{2!3!} = 30240$	**B1**	9! Divided by at least one of 2! or 3!
		B1	Exact value
		2	
2(ii)	D _ _ _ _ _ _ _ R: $\frac{7!}{2!2!} = 1260$ D _ _ _ _ _ _ _ O: $\frac{7!}{3!} = 840$	**B1**	7! Seen alone or as numerator in a term, can be multiplied not + or –
		B1	One term correct, unsimplified
	Total = 2100	**B1**	Final answer
		3	

Question	Answer	Marks	Guidance
3(i)	$3A\ 2D\ 2M$: ${}^6C_3 \times {}^5C_2 \times {}^4C_2$ (= 1200) $4A\ 2D\ 1M$: ${}^6C_4 \times {}^5C_2 \times {}^4C_1$ (= 600) $3A\ 3D\ 1M$: ${}^6C_3 \times {}^5C_3 \times {}^4C_1$ (= 800)	**M1**	${}^6C_x \times {}^5C_y \times {}^4C_z$, $x + y + z = 7$
		A1	2 correct products, allow unsimplified
		M1	Summing their totals for 3 correct scenarios only
	Total = 2600	**A1**	Correct answer **SC1** ${}^6C_3 \times {}^5C_2 \times {}^4C_1 \times {}^9C_1 = 7200$
		4	

Question	Answer	Marks	Guidance
3(ii)	${}^7C_4 \times 1$	**B1**	${}^7C_3$ or ${}^7C_4$ seen anywhere
	35	**B1**	
		2	

Question	Answer	Marks	Guidance
4(i)	$P(h < 148) = 0.67$	**B1**	$z = \pm 0.44$ seen
	$\frac{h-148}{8} = 0.44$	**M1**	z-value $= \pm \frac{(h-148)}{8}$
	$151.52 \approx 152$	**A1**	CAO
		3	
4(ii)	$P(144 < X < 152) = P\left(\frac{144-148}{8} < Z < \frac{152-148}{8}\right)$	**M1**	Using ± standardisation formula for either 144 or 152, $\mu = 148$, $\sigma = 8$ and no continuity correction, allow σ^2 or $\sqrt{\sigma}$
	$= P\left(-\frac{1}{2} < Z < \frac{1}{2}\right) = 0.6915 - (1 - 0.6915) = 2 \times 0.6915 - 1$	**M1**	Correct final area legitimately obtained from phi(*their* z_2) – phi(*their* z_1)
	$= 0.383$	**A1**	Final probability answer
	$0.383 \times 120 = 45.96$ Accept 45 or 46 only	**B1FT**	*Their* prob (to 3 or 4 sf) × 120, rounded to a whole number or truncated
		4	

Question	Answer	Marks	Guidance
5(i)	Correct labels and scales	**B1**	Axes labelled 'cumulative frequency' (or cf) and 'time (or t) [in] min(utes)', linear scales from 0 to 90 and 0 to 200 with at least 3 values marked on each axis.
	7 correctly plotted points above upper boundaries joined in a curve or line segments	**B1**	(0, 0); (10, 16); (20, 50); (30, 106); (50, 146); (70,176); (90,200)
		2	
5(ii)	29	**B1**	28 ⩽ median ⩽ 30
		1	
5(iii)	120 seen	**M1**	For seeing 120 in a calculation or marked on the graph
	37	**A1FT**	36 ⩽ Ans ⩽ 39 or FT from *their* graph **SC1** unsupported answer in range
		2	
5(iv)	Frequencies 16 34 56 40 30 24	**B1**	Seen. Allow unsimplified
	Est. Mean = $\frac{5\times16+15\times34+25\times56+40\times40+60\times30+80\times24}{200}$	**M1**	At least 4 correct midpoints (5, 15, 25, 40, 60, 80) used in a calculation
	$\frac{7310}{200}$	**M1**	Summing products of *their* 6 mid-points (not lower or upper bound or class width) × *their* frequencies / 200 (or *their* ∑f), unsimplified
	36.55	**A1**	Accept 36.6
		4	

Question	Answer	Marks	Guidance
6(i)	$P(RR) = \frac{3}{8} \times \frac{2}{7} = \frac{3}{28}$	**B1**	OE
		1	
6(ii)	P(RW) + P(WR) $\frac{3}{8} \times \frac{5}{7} + \frac{5}{8} \times \frac{3}{7}$	**M1**	Method shown, numerical calculations identified, may include replacements
	$= \frac{15}{28}$	**A1**	AG, Fully correct calculations
	Alternative method for question 6(ii)		
	1 – (P(RR) + P(WW) $1 - \left(\frac{3}{28} + \frac{5}{8} \times \frac{4}{7}\right)$	**M1**	Method shown, numerical calculations identified, may include replacements
	$= \frac{15}{28}$	**A1**	AG, Fully correct calculations
		2	
6(iii)	$P(\text{first red}\mid\text{second red}) = \frac{\textit{their}\ \textbf{(i)}}{\textit{their}\ \textbf{(i)} + \frac{5}{8} \times \frac{3}{7}} = \frac{\frac{3}{8} \times \frac{2}{7}}{\frac{3}{8} \times \frac{2}{7} + \frac{5}{8} \times \frac{3}{7}} = \frac{\frac{3}{28}}{\frac{21}{56}}$	**M1**	Conditional probability formula used consistent with *their* probabilities or correct
	$= \frac{2}{7}$	**A1**	OE
		2	

Question	Answer	Marks	Guidance
6(iv)	$\begin{array}{\|c\|c\|c\|c\|}\hline x & 0 & 1 & 2 \\ \hline p & \frac{10}{28} & \frac{15}{28} & \frac{3}{28} \\ \hline \end{array}$	**B1**	Probability distribution table with correct values of x and at least one correct probability placed. Extra x values allowed with probability of zero stated.
		B1FT	Fully correct FT P(2) = *their* **(i)**, P(1) = *their* **(ii)**, $\Sigma(p) = 1$.
		2	
6(v)	$\mathrm{E}(X) = \frac{30}{56} + \frac{12}{56} = \frac{42}{46} \quad \left(= \frac{3}{4}\right)$	**B1**	May be implied by use in variance formula
	$\mathrm{Var}(X) = \frac{30}{56} + \frac{24}{56} - \left(\textit{their}\ \frac{3}{4}\right)^2$	**M1**	Substitute into correct variance formula, must have ' – *their* mean^2' Must be for 2 or more non-zero x-values
	$\frac{45}{112}$ or 0.402	**A1**	Correct final answer
		3	

Question	Answer	Marks	Guidance
7(i)(a)	$\mathrm{P}(0, 1, 2) = {}^6\mathrm{C}_0\ 0.3^0\ 0.7^6 + {}^6\mathrm{C}_1\ 0.3^1\ 0.7^5 + {}^6\mathrm{C}_2\ 0.3^2\ 0.7^4$	**M1**	Binomial term of form ${}^6\mathrm{C}_x p^x (1-p)^{6-x} \quad 0 < p < 1$ any p, $x \neq 6,0$
	0.1176 ... + 0.3025 ... + 0.3241 ...	**A1**	Correct unsimplified answer
	0.744	**A1**	Correct final answer
		3	

Question	Answer	Marks	Guidance
7(i)(b)	P(support neither choir) = 1 – (0.3 + 0.45) = 0.25	**M1**	0.25^n seen alone, $1 < n \leqslant 6$
	P(6 support neither choir) = 0.25^6 = 0.000244 or $\frac{1}{4096}$	**A1**	Correct final answer
		2	
7(ii)	Mean = 240 × 0.25 = 60 Variance = 240 × 0.25 × 0.75 = 45	**B1FT**	Correct unsimplified *240p* and *240pq* where p =*their* P(support neither choir) or 0.25
	$P(X < 50) = P\left(Z < \frac{49.5 - 60}{\sqrt{45}}\right) = P(Z < -1.565)$	**M1**	Substituting *their* μ and σ (condone σ^2) into the ±Standardisation Formula with a numerical value for *'49.5'*.
		M1	Using continuity correction 49.5 or 50.5 within a standardisation expression
	1 – 0.9412	**M1**	Appropriate area Φ from standardisation formula P(z< …) in final solution, (< 0.5 if *z* is –ve, > 0.5 if *z* is +ve)
	0.0588	**A1**	Correct final answer
		5	