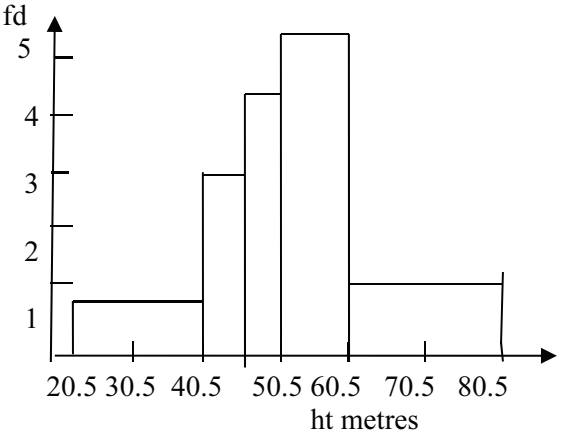
1	coded mean = 0.3 oe	**B1**		$\Sigma(t - 2.5) = 75$ B0 until ÷ 250
	sd $= \sqrt{\frac{96.1}{250} - (0.3)^2}$	**M1**		Subst in variance formula both terms coded
	$= 0.543$	**A1**	3	Correct answer
	Alt: $\Sigma(t–2.5)^2$ expanded	**Or**		
	$\Sigma t^2 = 2033.6$	**B1**		
	sd $= \sqrt{\frac{2033.6}{250} - 2.8^2}$	**M1**		Substituting their Σt^2 from expanded 3-term expression, 250 and 2.8 in variance formula
	$= 0.543$	**A1**	3	
2 **(i)**	$P(X) = \frac{20}{28}\left(\frac{5}{7}\right)(0.714), 71.4\%$	**B1**	1	oe
(ii)	$P(F) = \frac{20}{28} \times \frac{1}{4} \times \frac{8}{28} \times \frac{6}{10} = \frac{7}{20}$	**M1**		Summing two 2-factor probs created by One of ¼ or ¾ multiplied by 20/28 or 8/28 Added to 4/10 or 6/10 × altn population prob
		A1	2	Correct answer
(iii)	$P(X \mid F) = \frac{5/28}{7/20} = \frac{25}{49}(0.510)$	**M1**		Their unsimplified country X probability (5/28) as num or denom of a fraction Or (their fair hair population) ÷ (total fair hair pop)
		A1	2	Correct answer
3 **(i)**	$P(S) = \frac{3}{16}$	**M1**		Sensible attempt at P(S)
	$P(T) = \frac{4}{16}$	**M1**		Sensible attempt at P(T)
	$P(S \cap T) = \frac{2}{16}$	**B1**		Correct P($S \cap T$)
	$P(S) \times P(T) = \frac{3}{64} \neq \frac{2}{16}$	**M1**		comp P(S) × P(T) with P($S \cap T$) (their values), evaluated
	Not independent	**A1**	5	Correct conclusion following all correct working
(ii)	not exclusive since $P(S \cap T) \neq 0$ Or counter example e.g. 1 and 3 Or $P(S \cup T) \neq P(S)+P(T)$ with values	**B1**√	1	FT their P($S \cap T$), not obtained from P(S) × P(T), with value and statement.
4 **(i)**	$z = 1.127$	**B1**		± 1.127 seen accept rounding to ±1.13
	$1.127 = \frac{136 - 125}{\sigma}$	**M1**		Standardising no cc no sq rt, with attempt at z
	$\sigma = 9.76$	**A1**	3	(not ±0.8078, ±0.5517, ±0.13, ±0.87) Correct ans

	(ii)	$P(131<x<141)= P\left(\frac{131-125}{9.76}<z<\frac{141-125}{9.76}\right)$ $= \Phi(1.639) - \Phi(0.6147)$ $= 0.9493 - 0.7307$ $= 0.2186$ Number = $0.2186 \times 170 = 37$ or 38 or awrt 37.2	**M1** **M1** **M1** **A1** 4	Standardising once with their sd, no $\sqrt{}$,^{2}, allow cc Correct area $\Phi 2 - \Phi 1$ Mult by 170, P<1 Correct answer, nfww
5	**(a)**	e.g. **(AAOOOI)***** $\frac{8!}{2!2!}\times\frac{6!}{2!3!}=604800$	**B1** **M1** **A1** 3	8! (8 × 7!) or 6! seen anywhere, either alone or in numerator) Dividing by at least 3 of 2!2!2!3! (may be fractions added) Correct answer
	(b)	C(7) E(6) A(4) 1 1 2 $= 7 \times 6 \times {}^4C_2 = 252$ 1 2 1 $= 7 \times {}^6C_2 \times 4 = 420$ 1 3 0 $= 7 \times {}^6C_3 \times 1 = 140$ 2 1 1 $= {}^7C_2 \times 6 \times 4 = 504$ 2 2 0 $= {}^7C_2 \times {}^6C_2 \times 1 = 315$ 3 1 0 $= {}^7C_3 \times 6 \times 1 = 210$ Total = 1841	**M1** **A1** **M1*** **DM1** **A1** 5	Mult 3 appropriate combinations together assume $6={}^6C_1$, $1={}^4C_0$ etc., $\sum r=4$, C&E both present At least 3 correct unsimplified products Listing at least 4 different correct options Summing at least 4 outcomes, involving 3 combs or perms, $\sum r=4$ Correct answer SC if CE removed, M1 available for listing at least 4 different correct options for remaining 2. DM1 for ${}^7C_1\times{}^6C_1\times$(sum of at least 4 outcomes)
6	**(i)**	fd 0.9, 3, 4.2, 5.2, 1.4  	**M1** **A1** **B1** **B1** 4	Attempt at scaled freq [f/(attempt at cw)] Correct heights seen on diagram Scale no less than 1cm to 1 unit Correct bar widths visually no gaps Labels (ht/metres and fd or freq per 20 m etc.) and end points at 20.5 etc. condone 2 end point errors, scale no less than 1cm to 5m for 20,30… unless clearly accurate, linear scale between 20.5 and 80

(ii)	$(30.5 \times 18 + 43 \times 15 + 48 \times 21 + 55.5 \times 52 + 70.5 \times 28)/134$	**M1**		Attempt at unsimplified, mid points (at least 4 within 0.5)
	$= \frac{7062}{134} = 52.701$	**M1** **A1**		Attempt at Σfx their mid points ÷ 134 Correct mean rounding to 53
	$\text{Var} = (30.5^2 \times 18 + 43^2 \times 15 + 48^2 \times 21 + 55.5^2 \times 52 + 70.5^2 \times 28)/134 - 52.701^2$ $= 392203.5/134 - 52.701^2 = 149.496$ sd = 12.2	**M1** **A1**	5	Attempts at Σfx^2 their mid points ÷ their Σf – mean^2 Correct answer, nfww
7 (i)	$P(0, 1, 2) = (0.92)^{19} + {}^{19}C_1(0.08)(0.92)^{18} + {}^{19}C_2(0.08)^2(0.92)^{17}$	**M1** **M1**		Binomial term ${}^{19}C_x p^x(1-p)^{19-x}$ seen $0<p<1$ Correct unsimplified expression
	= 0.809	**A1**	3	Correct answer (no working SC B2)
(ii)	P(at least 1) = 1 – P(0) $= 1 - P(0.92)^n > 0.90$ $0.1 > (0.92)^n$ $n > 27.6$	**M1** **M1**		Eqn with their 0.92^n, 0.9 or 0.1, 1 not nec Solving attempt by logs or trial and error, power eqn with one unknown power
	Ans 28	**A1**	3	Correct answer, not approx., ≈, ⩾, >, ⩽, <
(iii)	$np = 1800 \times 0.08 = 144$ $npq = 132.48$	**B1**		correct unsimplified np and npq seen accept 132.5, 132, 11.5, awrt 11.51
	$P(\text{at least } 152) = P\left(z > \left(\frac{151.5-144}{\sqrt{132.48}}\right)\right)$	**M1** **M1**		standardising, with √ cont correction 151.5 or 152.5 seen
	$= P(z > 0.6516)$ $= 1 - 0.7429$ $= 0.257$	**M1** **A1**	5	correct area 1 – Φ (probability) correct answer
(iv)	Use because 1800×0.08 (and 1800×0.92 are both) > 5	**B1**	1	$1800 \times 0.08 > 5$ is sufficient $np > 5$ is sufficient if clearly evaluated in (iii) If $npq > 5$ stated then award B0