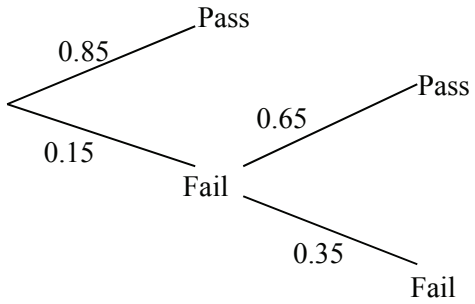
Question	Answer	Marks	Guidance
1	*EITHER:* P(at least 1 completes) = 1 – P(0 people complete) $= 1 - (0.8)^3$	**(M1**	Fully correct unsimplified expression $1 - (0.8)^3$ OE
	$= 0.488\left(\frac{61}{125}\right)$	**A1)**	
	OR1: $P(1, 2, 3) = {}^3C_1(0.2)(0.8)^2 + {}^3C_2(0.2)^2(0.8) + (0.2)^3$	**(M1**	Unsimplified correct 3 term expression
	$= 0.488\left(\frac{61}{125}\right)$	**A1)**	
	OR2: $0.2 + 0.8 \times 0.2 + 0.8 \times 0.8 \times 0.2$	**(M1**	Unsimplified sum of 3 correct terms
	$= 0.488\left(\frac{61}{125}\right)$	**A1)**	
		2	

Question	Answer	Marks	Guidance
2	$\Sigma(x - 45) = 1218 - 20 \times 45 = 318$	**B1**	
	$\frac{\Sigma(x-45)^2}{20} - \left(\frac{\Sigma(x-45)}{20}\right)^2 = 4.2^2$	**M1**	Fully correct substitution in the correct coded variance formula with their $\Sigma(x - 45)$ **OR** valid method for $\Sigma x^2 = 74\,529$ ($4.2^2 = \frac{\Sigma x^2}{20} - \left(\frac{1218}{20}\right)^2$) and expanding $\Sigma(x–45)^2$ correctly $= \Sigma x^2 - 90\Sigma x + 20 \times 45^2 = '74\,529' - 90 \times 1218 + 40\,500 = 5409$
	$\Sigma(x - 45)^2 = 5409$	**A1**	
		3	

Question	Answer	Marks	Guidance
3(i)		**M1**	Correct shape
		A1	All correct labels and probabilities
		2	

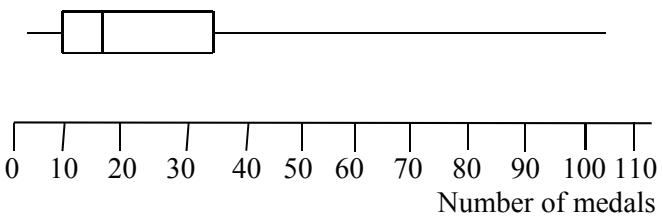
Question	Answer	Marks	Guidance
3(ii)	$\mathrm{P}(F \mid P) = \dfrac{\mathrm{P}(F \cap P)}{\mathrm{P}(P)}$	**M1**	P(P) consistent with their tree diagram seen anywhere
	$= \dfrac{0.15 \times 0.65}{0.85 + 0.15 \times 0.65}$ or $\dfrac{0.15 \times 0.65}{1 - 0.15 \times 0.35}$	**A1**	Correct unsimplified P(P) seen as num or denom of a fraction
	$= \dfrac{0.0975}{0.9475}$	**M1**	P($F \cap P$) found as correct product or consistent with their tree diagram seen as num or denom of a fraction
	$= \dfrac{39}{379} = 0.103$	**A1**	
		4	

Question	Answer	Marks	Guidance
4(i)		**B1**	At least 3 different correct values of X (can be unsimplified)
		B1	Four correct probabilities in a Probability Distribution table
		B1	Correct probs with correct values of X
		3	

x	–3	0	5	32
Prob	1/6	1/2	1/6	1/6

Question	Answer	Marks	Guidance
4(ii)	$E(X) = -3/6 + 5/6 + 32/6 = 34/6 = 17/3$ (5.67)	**M1**	Subst their attempts at scores in correct formula as long as 'probs' sum to 1
	$Var(X) = 9/6 + 25/6 + 1024/6 - (34/6)^2$	**M1**	Subst their attempts at scores in correct var formula
	$= 144\left(\frac{1298}{9}\right)$	**A1**	Both answers correct
		3	

Question	Answer	Marks	Guidance
5(i)	0 | 2 2 5 6 9 1 | 0 0 0 2 2 3 3 4 7 7 8 8 2 | 8 8 3 | 4 5 8 4 | 4 5 | 6 | 5 7 | 8 | 2 8 9 | 10 | 4 key 2 | 8 means 28 medals	**B1**	Stem, digits 5, 7, 9 can be missing here, can be upside down
		B1	All leaves in correct order increasing from stem, (5, 7 and 9 can be missing), condone commas
		B1	Reasonable shape, requires all values of the stem, only one line for each stem and leaves must be lined up. Can be upside down or sideways. No commas. Condone one 'leaf' error.
		B1	Correct key must state 'medals' or have 'medals' in leaf heading or title
		4	

Question	Answer	Marks	Guidance
5(ii)	Med = 17 LQ = 10 UQ = 35  	**B1**	Median correct
		B1	LQ and UQ correct
		B1	Uniform scale from 2 to 104 (need 3 identified points min) and label including medals (can be in title)
		B1 FT	Correct box med and quartiles on diagram, FT their values
		B1	Correct end-whiskers from ends of box but not through box
		5	

Question	Answer	Marks	Guidance
6(i)	${}^{18}P_5$	**M1**	${}^{18}P_x$ or ${}^{y}P_5$ OE seen, $0 < x < 18$ and $5 < y < 18$, can be mult by $k \geqslant 1$
	= 1 028 160	**A1**	
		2	

Question	Answer	Marks	Guidance
6(ii)	*EITHER:* e.g. ***(CCCCC)********** in 5!×14 ways	**(B1**	5! OE mult by k ⩾ 1, considering the arrangements of cars next to each other
	= 1680	**B1**	Mult by 14 OE, (or 14 on its own) considering positions within the line
	P (next to each other) = 1680/1 028 160	**M1**	Dividing by **(i)** for probability
	P(not next to each other) = 1 – 1680/1 028 160	**M1**	Subtracting prob from 1 (or their ' 5! × 14 ' from **(i)**)
	$= 0.998\left(\frac{611}{612}\right)$ OE	**A1)**	
	OR1: $\frac{5! \times 14!}{18!} = 0.001634$	**(B1**	5! OE mult by k ⩾ 1 (on its own or in numerator of fraction) considering the arrangements of cars next to each other
		B1	Multiply by 14!, (or 14! on its own) considering all ways of arranging spaces with 5 cars together
		M1	Dividing by 18!, total number of ways of arranging spaces
	1 – 0.001634	**M1**	Subtracting prob from 1 (or '5! × 14!' from 18!)
	= 0.998(366)	**A1)**	
	OR2: 4 together – $2\times5!\times14C12 = 21\,840$ 3, 1, 1 – $3\times5!\times14C11 = 131\,040$ 3, 2 – $2\times5!\times14C12 = 21\,840$ 2,2,1 – $3\times5!\times14C11 = 131\,040$ 2,1,1,1 – $4\times5!\times14C10 = 480\,480$ 1,1,1,1,1 – $5!\times14C9 \, or \, 14P5 = 240\,240$	**(M1**	Listing the six correct scenarios (only): 4 together; 3 together and 2 separate; 3 together and 2 together; two sets of 2 together and 1 separate; 2 together and 3 separate; 5 separate.
		M1	Summing total of the six scenarios, at least 2 correct unsimplified

Question	Answer	Marks	Guidance
	Total = 1 026 480	**A1**	Total of 1 026 480
		M1	Dividing their 1 026 480 by their **6(i)**
	$1\,026\,480 \div 1\,028\,160 = 0.998(366)$	**A1)**	
		5	

Question	Answer	Marks	Guidance
6(iii)	R(5) W(4) B(3) Scenarios No. of ways 1 1 1 $= 5 \times 4 \times 3 = 60$ 0 1 2 $= 4 \times {}^3C_2 = 12$ 0 2 1 $= {}^4C_2 \times 3 = 18$ 1 0 2 $= 5 \times {}^3C_2 = 15$ 2 0 1 $= {}^5C_2 \times 3 = 30$ 1 2 0 $= 5 \times {}^4C_2 = 30$ 2 1 0 $= {}^5C_2 \times 4 = 40$	**B1** **M1** **A1** **M1**	$5C1 \times 4C1 \times 3C1$ or better seen i.e. no. of ways with 3 different colours Any of ${}^5C_2$ or ${}^4C_2$ or ${}^3C_2$ seen multiplied by $k > 1$ (can be implied) 2 correct unsimplified 'no. of ways' other than 5C1 × 4C1 × 3C1 Summing no more than 7 scenario totals containing at least 6 correct scenarios
	Total = 205	**A1**	
	OR		
	${}^{12}C_3 -$	**M1**	Seeing '${}^{12}C_3 -$', considering all selections of 3 cars
	$- {}^5C_3$	**M1**	Subt ${}^5C_3$ OE, removing only red selections
	$- {}^4C_3$	**M1**	Subt ${}^4C_3$ OE, removing only white selections
	$- {}^3C_3$	**M1**	Subt ${}^3C_3$ OE, removing only black selections
	$= 205$	**A1**	Correct answer
		5	

Question	Answer	Marks	Guidance
7(i)	$P(t > 6) = P\left(z > \frac{6-5.3}{2.1}\right) = P(z > 0.333)$	**M1**	Standardising, no continuity correction, no sq, no sq rt
	$= 1 - 0.6304$	**M1**	Correct area $1 - \Phi$ (< 0.5), final solution
	$= 0.370$ or 0.369	**A1**	
		3	
7(ii)	$z = 1.645$	**B1**	± 1.645
	$1.645 = \frac{x-5.3}{2.1}$	**M1**	Standardising, no continuity correction, allow sq, sq rt. Must be equated to a z-value
	$x = 8.75$ or 8.755 or 8.7545	**A1**	
		3	
7(iii)	$n = 10$, $p = 0.05$	**M1**	Bin term ${}^{10}C_x\, p^x(1-p)^{10-x}$
	$P(0, 1, 2) = (0.95)^{10} + {}^{10}C_1(0.05)(0.95)^9 + {}^{10}C_2(0.05)^2(0.95)^8$	**M1**	Correct unsimplified answer
	$= 0.988$ (0.9885 to 4 sf)	**A1**	
		3	
7(iv)	P(misses bus) = $P(t < 0)$	***M1**	Seeing t linked to zero
	$= P\left(z < \frac{0-5.3}{2.1}\right) = P(z < -2.524) = 1 - \Phi(2.524)$ $= 1 - 0.9942$	**DM1**	Standardising with $t = 0$, no continuity correction, no sq, no sq rt
	$= 0.0058$	**A1**	
		3	