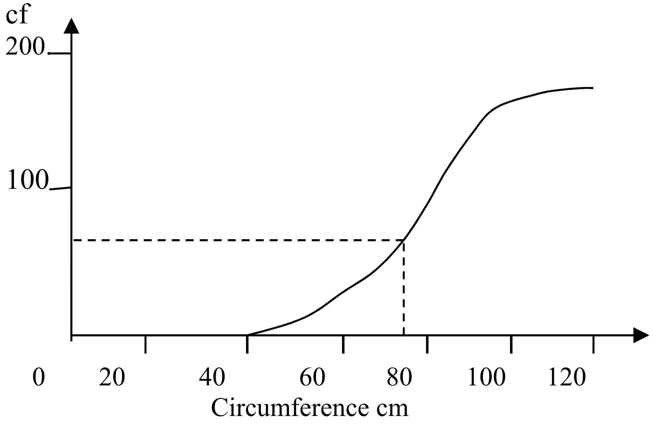
Question	Answer	Marks	Guidance
1	*EITHER:* $(\Sigma x =)\ 11.5n = 27 + 10n$	**(M1**	Expanding brackets and forming a three term equation involving 27 and at least one term in n, without x
		M1	$10n$ or $11.5n$ seen in expression without x ($1.5n = 27$ implies **M2**)
	$n = 18$	**A1)**	
	OR: $11.5 = \frac{27}{n} + 10$	**(M1**	Dividing coded sum by n and forming a three term equation involving 11.5 and at least one term in n, without x
		M1	$27/n$ seen in expression without x ($1.5 = \frac{27}{n}$ implies **M2**)
	$n = 18$	**A1)**	
		3	

Question	Answer	Marks	Guidance
2(i)	points (50, 14), (80, 62), (100, 132), (120, 140)	**B1**	Correct cfs values seen listed, in or by table or on graph, 0 not required
		**B1**	Axes labelled 'cumulative frequency' (or cf) and 'circumference [or cir or c etc.] (in) cm'. Linear scales – c.f. 0–140 circumference 40–120 (ignore <40 on circ.) At least 3 values stated on each axis, but (0,0) can be implied without stating.
		B1	All points plotted accurately
		3	
2(ii)	140 – 54 = 86	**M1**	Finding correct value from graph (checked ±1 mm) or linear interpolation. Subtraction from 140 can be implied
	Percentage = 61.4%	**A1**	60.5% ⩽ Ans ⩽ 64.5%
		2	

Question	Answer	Marks	Guidance
3(i)	*EITHER:* $P(X=3) = P(RRB) = \frac{2}{6} \times \frac{1}{5} \times \frac{4}{4}$	**(M1**	probabilities in order $\frac{2}{p} \times \frac{1}{q} \times \frac{4}{r}$, $p, q, r \leqslant 6$ and $p \geqslant q \geqslant r$, $r \geqslant 4$, accept $\times 1$ as $\frac{4}{r}$.
	$= \frac{1}{15}$ AG	**A1)**	Needs either P(RRB) OE stated or identified on tree diagram.
	OR1: $P(X=3) = P(RRB) = \frac{{}^2C_2}{{}^6C_2} \times \frac{{}^4C_1}{{}^4C_1}$	**(M1**	probabilities stated clearly, $\times \frac{{}^4C_1}{{}^4C_1}$ or $\times 1$ or $\times \frac{4}{4}$ included
	$= \frac{1}{15}$ AG	**A1)**	Needs either P(RRB) OE stated or identified on tree diagram.
	OR2: $P(X=3) = P(RRB) = \frac{{}^2C_1}{{}^6C_1} \times \frac{{}^1C_1}{{}^5C_1} \times \frac{{}^4C_1}{{}^4C_1}$	**(M1**	probabilities in order $\frac{{}^2C_1}{{}^pC_1} \times \frac{{}^1C_1}{{}^qC_1} \times \frac{{}^4C_1}{{}^rC_1}$ $p, q, r \leqslant 6$ and $p \geqslant q \geqslant r$, $r \geqslant 4$ ($\times \frac{{}^4C_1}{{}^4C_1}$ or $\times 1$ or $\times \frac{4}{4}$ acceptable)
	= 1/15 AG	**A1)**	Needs either P(RRB) OE stated or identified on tree diagram.
		2	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td rowspan="4">3(ii)</td><td rowspan="3">$P(1) = P(B) = \frac{4}{6}$ ($\frac{2}{3}$ = 0.667)
$P(2) = P(RB) = \frac{2}{6} \times \frac{4}{5} = \frac{4}{15}$ (= 0.267)
$P(3) = P(RRB) = \frac{2}{6} \times \frac{1}{5} \times \frac{4}{4} = \frac{1}{15}$ (= 0.0667)

| x | 1 | 2 | 3 |
| P | $\frac{10}{15}$ | $\frac{4}{15}$ | $\frac{1}{15}$ |</td><td>B1</td><td>Probability distribution table drawn with at least 2 correct x values and at least 1 probability. All probabilities $0 \leqslant p < 1$.</td></tr>
<tr><td>B1</td><td>P(1) or P(2) correct unsimplified, or better, and identified.</td></tr>
<tr><td>B1</td><td>All probabilities in table, evaluated correctly OE. Additional x values must have a stated probability of 0</td></tr>
<tr><td></td><td>3</td><td></td></tr>
</table>

Question	Answer	Marks	Guidance
4(i)	P(4, 2H) = $\frac{1}{4} \times {}^4C_2 \times (\frac{1}{3})^2(\frac{2}{3})^2$	**M1**	Multiplying their 2H expression by ¼ [P(4)]
		M1	Remaining factor is $(\frac{1}{3})^2(\frac{2}{3})^2$ [or $\frac{4}{81}$] multiplied by integer value $k \geqslant 1$ OE
	$= \frac{2}{27}$ (0.0741)	**A1**	
		3	
4(ii)	P(3, 3H) = $\frac{1}{4} \times (\frac{1}{3})^3 = \frac{1}{108}$ (0.00926)	**B1**	
		1	
4(iii)	P(1, 1H) = $\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$ (0.08333)	**M1**	Correct expression for 1 of P(1, 1H), P(2, 2H), P(4, 4H) Unsimplified (or better)
	P(2, 2H) = $\frac{1}{4} \times (\frac{1}{3})^2 = \frac{1}{36}$ (0.02778) P(3, 3H) = $\frac{1}{4} \times (\frac{1}{3})^3 = \frac{1}{108}$ (0.009259) P(4, 4H) = $\frac{1}{4} \times (\frac{1}{3})^4 = \frac{1}{324}$ (0.003086)	**M1**	Summing their values for 3 or 4 appropriate outcomes for the 'game' with no additional outcomes.
	Prob = $\frac{10}{81}$ (0.123)	**A1**	
		3	

Question	Answer	Marks	Guidance
5(i)	*EITHER:* P(> 2) = 1 – P(0, 1, 2)	**(M1**	Binomial term of form ${}^{30}C_x p^x(1-p)^{30-x}$, $0 < p < 1$ any p
	$= 1 - (0.96)^{30} - {}^{30}C_1(0.04)(0.96)^{29} - {}^{30}C_2(0.04)^2(0.96)^{28}$ (= 1 – 0.2938… – 0.3673… – 0.2219…)	**A1**	Correct unsimplified answer
	= 1-0.883103 = 0.117 (0.116896)	**A1)**	
	OR: P(> 2) = P(3,4,5,6,….30)	**(M1**	Binomial term of form ${}^{30}C_x p^x(1-p)^{30-x}$, $0 < p < 1$ any p
	$= {}^{30}C_3(0.04)^3(0.96)^{27} + {}^{30}C_4(0.04)^4(0.96)^{26} + \ldots + (0.04)^{30}$	**A1**	Correct unsimplified answer
	= 0.117	**A1)**	
		3	

Question	Answer	Marks	Guidance
5(ii)	$np = 280 \times 0.1169 = 32.73$, $npq = 280 \times 0.1169 \times 0.8831 = 28.9$	**M1 FT**	Correct unsimplified *np* and *npq*, FT their *p from* **(i)**,
	$\mathrm{P}(\geqslant 30) = \mathrm{P}\left(z > \frac{29.5 - 32.73}{\sqrt{28.9}}\right) = \mathrm{P}(z > -0.6008)$	**M1**	Substituting *their* μ and σ ($\sqrt{npq}$ only) into the Standardisation Formula
		M1	Using continuity correction of 29.5 or 30.5
		M1	Appropriate area Φ from standardisation formula P(z >….) in final solution
	= 0.726	**A1**	
		5	

Question	Answer	Marks	Guidance
6(a)(i)	*EITHER:* 3**, 4**, 6**, 8**	(M1	${}^5P_2$ or ${}^5C_2 \times 2!$ or 5×4 OE (considering final 2 digits)
	options $4 \times 5 \times 4 = 80$	M1	Mult by 4 or summing 4 options (considering first digit)
		A1)	Correct final answer
	OR: Total number of values: $6 \times 5 \times 4 = 120$	(M1	Calculating total number of values (with subtraction seen)
	Number of values less than 300: $2 \times 5 \times 4 = 40$	M1	Calculating number of unwanted values
	Number of evens = 120 – 40 = 80	A1)	Correct final answer
		3	

Question	Answer	Marks	Guidance
6(a)(ii)	3**, 4**, 6**, 8** *EITHER:* options 4 × 6 × 4 (last)	**(M1**	6 linked to considering middle digit e.g. multiplied or in list
		M1	Multiply an integer by 4 × 4 (condone × 16) (No additional figures present for both M's to be awarded)
	= 96	**A1)**	
	OR: Total number of values 4 × 6 × 6 = 144	**(M1**	Calculating total number of values (with subtraction seen)
	Number of odd values 4 × 6 × 2 = 48	**M1**	Calculating number of unwanted values
	Number of evens = 144 – 48 = 96	**A1)**	
		3	
6(b)(i)	252	**B1**	
		1	

Question	Answer	Marks	Guidance
6(b)(ii)	B (6)G(4)		
	5 0 in ${}^6C_5$ ($\times{}^4C_0$) $= 6 \times 1 = 6$ 4 1 in ${}^6C_4 \times {}^4C_1 = 15 \times 4 = 60$ 3 2 in ${}^6C_3 \times {}^4C_2 = 20 \times 6 = 120$	M1	Multiplying 2 combinations ${}^6C_q \times {}^4C_r$, $q + r = 5$, or ${}^6C_5$ seen alone
		M1	Summing 2 or 3 appropriate outcomes, involving perm/comb, no extra outcomes.
	Total = 186 ways	A1	
		3	

Question	Answer	Marks	Guidance
7(i)	$P(> 65) = P\left(z > \dfrac{65 - 61.4}{12.3}\right) = P\ (z > 0.2927)$	M1	Standardising no continuity correction, no square or square root, condone ± standardisation formula
		M1	Correct area (< 0.5)
	$= 1 - 0.6153 = 0.385$	A1	
		3	

Question	Answer	Marks	Guidance
7(ii)	P (< 65) = 0.6153 so P(< k) = 0.25 + 0.6153 = 0.8653	**B1**	
	$z = 1.105$	**B1**	$z = \pm$ 1.105 seen or rounding to 1.1
	$1.105 = \frac{k - 61.4}{12.3}$	**M1**	standardising allow ±, cc, sq rt, sq. Need to see use of tables backwards so must be a z-value, not $1 - z$ value.
	$k = 75.0$	**A1**	Answers which round to 75.0. Condone 75 if supported.
		4	
7(iii)	$2.326 = \frac{97.2 - \mu}{\sigma}$	**B1**	± 2.326 seen (Use of critical value)
	$-0.44 = \frac{55.2 - \mu}{\sigma}$	**B1**	± 0.44 seen
		M1	An equation with a z-value, μ, σ and 97.2 or 55.2, allow $\sqrt{\sigma}$ or σ^2
		M1	Algebraic elimination μ or σ from *their* two simultaneous equations
	$\mu = 61.9$ $\sigma = 15.2$	**A1**	both correct answers
		5	