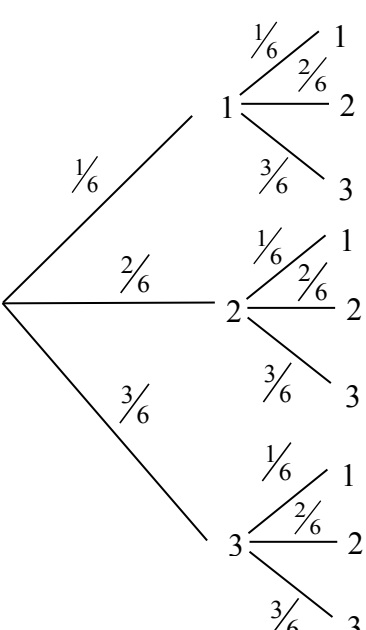


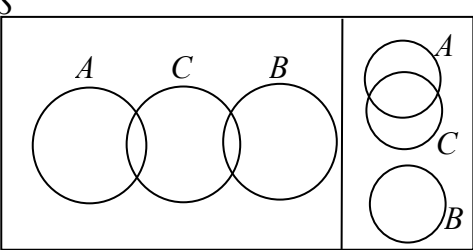
Question Number	Scheme	Marks																																																	
1.	<table style="border-collapse: collapse; margin-left: 20px;"> <tr> <td style="border-right: 1px solid black; padding-right: 5px;"></td> <td style="padding: 2px 5px;">1</td> <td style="padding: 2px 5px;">2</td> <td style="padding: 2px 5px;">2</td> <td style="padding: 2px 5px;">3</td> <td style="padding: 2px 5px;">3</td> <td style="padding: 2px 5px;">3</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;">1</td> <td style="padding: 2px 5px;">2</td> <td style="padding: 2px 5px;">3</td> <td style="padding: 2px 5px;">3</td> <td style="padding: 2px 5px;">4</td> <td style="padding: 2px 5px;">4</td> <td style="padding: 2px 5px;">4</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;">2</td> <td style="padding: 2px 5px;">3</td> <td style="padding: 2px 5px;">4</td> <td style="padding: 2px 5px;">4</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">5</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;">2</td> <td style="padding: 2px 5px;">3</td> <td style="padding: 2px 5px;">4</td> <td style="padding: 2px 5px;">4</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">5</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;">3</td> <td style="padding: 2px 5px;">4</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">6</td> <td style="padding: 2px 5px;">6</td> <td style="padding: 2px 5px;">6</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;">3</td> <td style="padding: 2px 5px;">4</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">6</td> <td style="padding: 2px 5px;">6</td> <td style="padding: 2px 5px;">6</td> </tr> <tr> <td style="border-right: 1px solid black; padding-right: 5px;">3</td> <td style="padding: 2px 5px;">4</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">6</td> <td style="padding: 2px 5px;">6</td> <td style="padding: 2px 5px;">6</td> </tr> </table> <p style="margin-left: 20px;">∴ P (sum at least 5) = $\frac{21}{36} = \frac{7}{12}$</p>		1	2	2	3	3	3	1	2	3	3	4	4	4	2	3	4	4	5	5	5	2	3	4	4	5	5	5	3	4	5	5	6	6	6	3	4	5	5	6	6	6	3	4	5	5	6	6	6	<p style="text-align: right;">$2 \times (1, 2, \dots, 3)$ M1</p> <p style="text-align: right;">Adding M1</p> <p style="text-align: right;">All ≥ 5 correctly indicated A1</p> <p style="text-align: right;">Attempt to count ≥ 5 M1</p> <p style="text-align: right;">$\frac{21}{36}; \frac{7}{12}; 0.58\dot{3}; 0.583$ A1</p> <p style="text-align: right;">(5 marks)</p>
	1	2	2	3	3	3																																													
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Alt 1	 <p style="margin-left: 20px;">Tree with relevant branches M1</p> <p style="margin-left: 20px;">All correct - $\frac{2}{6}, \frac{3}{6}$ on those branches A1</p> <p style="margin-left: 20px;"> $P(\text{sum at least } 5) = \left(\frac{2}{6} \times \frac{3}{6}\right) + \left(\frac{3}{6} \times \frac{2}{6}\right) + \left(\frac{3}{6} \times \frac{3}{6}\right)$ (At least 2 pairs & adding) M1 </p> <p style="margin-left: 20px;"> $= \frac{21}{36}; \frac{7}{12}; 0.58\dot{3}; 0.583$ A1 </p>	<p style="text-align: right;">M1</p> <p style="text-align: right;">A1</p> <p style="text-align: right;">M1</p> <p style="text-align: right;">A1</p> <p style="text-align: right;">A1 (5)</p>																																																	

Question Number	Scheme	Marks														
<p>Alt 2</p>	<p>Outcomes (2, 3), (3, 3), (3, 2)</p> <p>$(\frac{2}{6} \times \frac{3}{6}) + (\frac{3}{6} \times \frac{3}{6}) + (\frac{3}{6} \times \frac{2}{6})$</p> <p style="text-align: center;">$\frac{21}{36}$</p>	<p>Recognising 2 pairs Can be implied</p> <p>All correct</p> <p>Multiplying 2 pairs of 2 probs. & adding</p> <p>All correct</p> <p>M1 A1 M1 A1 A1 (5)</p>														
<p>Alt 3</p>	<p>$P(\text{sum} \geq 5) = 12 (\frac{1}{6} \times \frac{1}{6}) + 9 (\frac{1}{6} \times \frac{1}{6})$</p> <p style="text-align: center;">$\frac{21}{36}$</p>	<p>$a(p_1 \times p_2)$ or $b(p_1 \times p_2)$</p> <p>$p_1 = p_2 = \frac{1}{6}$</p> <p>$a() + b()$</p> <p>21 or 12 + 9</p> <p style="text-align: center;">$\frac{21}{36}$</p> <p>M1 A1 M1 A1 A1 (5)</p>														
<p>Alt 4</p>	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 5px;">x</td> <td style="padding: 5px;">2</td> <td style="padding: 5px;">3</td> <td style="padding: 5px;">4</td> <td style="padding: 5px;">5</td> <td style="padding: 5px;">6</td> <td style="padding: 5px;">2, 3, 4, 5, 6</td> </tr> <tr> <td style="padding: 5px;">$P(X=x)$</td> <td style="padding: 5px;">$\frac{1}{36}$</td> <td style="padding: 5px;">$\frac{4}{36}$</td> <td style="padding: 5px;">$\frac{10}{36}$</td> <td style="padding: 5px;">$\frac{12}{36}$</td> <td style="padding: 5px;">$\frac{9}{36}$</td> <td style="padding: 5px;">Adding probability</td> </tr> </table> <p>$P(X \geq 5) = \frac{12}{36} + \frac{9}{36}$</p> <p style="text-align: center;">$\frac{21}{36}$</p>	x	2	3	4	5	6	2, 3, 4, 5, 6	$P(X=x)$	$\frac{1}{36}$	$\frac{4}{36}$	$\frac{10}{36}$	$\frac{12}{36}$	$\frac{9}{36}$	Adding probability	<p>2, 3, 4, 5, 6</p> <p>Adding probability</p> <p>All correct</p> <p>Adding P(5) & P(6)</p> <p>M1 M1 A1 M1 A1 (5)</p>
x	2	3	4	5	6	2, 3, 4, 5, 6										
$P(X=x)$	$\frac{1}{36}$	$\frac{4}{36}$	$\frac{10}{36}$	$\frac{12}{36}$	$\frac{9}{36}$	Adding probability										

Question Number	Scheme	Marks
2. (a)	Scatter diagram Labels (not x, y) Sensible scales allow axis interchange Points (-1 ee)	B1 B1 B2 (4)
(b)	$S_{hc} = 884484 - \frac{1562 \times 5088}{9} = 1433\frac{1}{3}$ $S_{hh} = 1000\frac{2}{9}; S_{cc} = 2550$ (NB: accept :- 9; i.e.: - 159 $\frac{7}{27}$; 111 $\frac{11}{81}$; 283 $\frac{1}{3}$)	correct use of S M1 1433 $\frac{1}{3}$; 1433. $\dot{3}$ A1 1000 $\frac{2}{9}$, 1000. $\dot{2}$; 2550 A1; A1 (4)
(c)	$r = \frac{1433\frac{1}{3}}{\sqrt{1000\frac{2}{9} \times 2550}}$ = 0.897488....	substitution in correct formula M1 A1 ft AWRT 0.897(accept 0.8975) A1 (3)
(d)	Taller people tend to be more confident	context B1 (1)
(e)	$b = \frac{1433.\dot{3}}{1000.\dot{2}} = 1.433014.....$ $a = \frac{5088}{9} - \frac{1433.\dot{3}}{1000.\dot{2}} \times \frac{1562}{9} = 316.6256...$ $\therefore c = 317 + 1.43h$	M1 allow use of their b M1 3sf A1 (3)
(f)	$h = 180 \Rightarrow c = 574.4$ or 574.5683....	subt. of 180 M1 574 - 575 A1 (2)
(g)	$161 \leq h \leq 193$	B1 (1)
NB (a) No graph paper \Rightarrow 0/4		(18 marks)

Question Number	Scheme	Marks
3. (a)	$0.5 + b + a = 1$ $0.3 + 2b + 3a = 1.7$ $\therefore a = 0.4$	use of $\sum P(X=x) = 1$ M1 A1 use of $E(x) = \sum xP(X=x)$ M1 A1
(b)	$b = 0.1$ $P(0 < X < 1.5) = P(X = 1) = 0.3$	$a = 0.4, b = 0.1$ B1 (5) B1 (1)
(c)	$E(2X - 3) = 2E(X) - 3$ $= 2 \times 1.7 - 3 = 0.4$	Use of $E(aX + b)$ M1 A1 (2)
(d)	$\text{Var}(X) = (1^2 \times 0.3) + (2^2 \times 0.1) + (3^2 \times 0.4) - 1.7^2$ $= 1.41 \quad (*)$	Use of $E(x^2) - \{E(x)\}^2$ M1 A1 ft (3)
(e)	$\text{Var}(2X - 3) = 2^2 \text{Var}(X)$ $= 4 \times 1.41 = 5.64$	cso A1 (3) Use of Var M1 A1 (2) (13 marks)

Question Number	Scheme	Marks
<p>5.</p> <p>(a)</p> <p>(b)</p> <p>(c)</p>	<p>Let L represent length of visit $\therefore L \sim N(90, \sigma^2)$</p> <p>$P(L < 125) = 0.80$ or $P(L > 125) = 0.20$</p> <p>$\therefore P\left(Z < \frac{125 - 90}{\sigma}\right) = 0.8$ $\therefore P\left(L > \frac{125 - 90}{\sigma}\right) = 0.20$</p> <p>$\therefore \frac{125 - 90}{\sigma} = 0.8416$</p> <p>$\therefore \sigma = \frac{35}{0.8416} = 41.587\dots$</p> <p>$P(L < 25) = P\left(Z < \frac{125 - 90}{41.587\dots}\right)$</p> <p>$= P(Z < -1.56)$</p> <p>$= 1 - P(Z < 1.56)$ For use of symmetry or $\Phi(-z) = 1 - \Phi(z)$; $p < 0.5$</p> <p>$= 0.0594$</p> <p>$90 + 3\sigma = 215 \Rightarrow 6.25$ pm for latest arrival</p> <p>$90 + 2\sigma = 173.\dot{3} \Rightarrow 7.07$ pm for latest arrival</p> <p>\therefore This normal distribution is <u>not</u> suitable.</p>	<p>Standardising, $\pm(125 - 90), \sigma/\sigma^2/\sqrt{\sigma}$</p> <p>M1</p> <p>0.8416 B1</p> <p>$\frac{\pm(125 - 90)}{\sigma} = z$ value M1</p> <p>AWRT 41.6 A1 (4)</p> <p>Standardising 25, 90, their +ve 41.587 M1</p> <p>M1</p> <p>A1 (3)</p> <p>B1</p> <p>Based on $2\sigma/3\sigma$ rule</p> <p>B1 (2)</p> <p>(9 marks)</p>

Question Number	Scheme	Marks
<p>6. (a)</p>	<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">  </div> <div> <p>A, B, C inside S A, B no overlap</p> <p>A, C overlap</p> </div> </div>	<p>B1 B1</p> <p>B1 (3)</p>
(b)	$P(A C) = \frac{P(A \cap C)}{P(C)} = \frac{P(A)P(C)}{P(C)} = P(A)$ <p style="text-align: right;">Use of independence</p>	<p>M1</p>
(c)	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$ <p style="text-align: right;">use of $P(A \cup B)$ & $P(A \cap B) = 0$ can be implied</p> $= 0.2 + 0.4 - 0$ $= 0.6$	<p>A1 (2)</p> <p>M1</p>
(d)	$P(A \cup C) = P(A) + P(C) - P(A \cap C)$ <p style="text-align: right;">Use of $P(A \cup C)$ & independence</p> $\therefore 0.7 = 0.2 + P(C) - 0.2 P(C)$ $\therefore 0.5 = P(C) \{1 - 0.2\}$ <p style="text-align: right;">Solving for $P(C)$ from an equation with $2P(C)$ terms</p> $\therefore P(C) = \frac{5}{8}$	<p>A1 (2)</p> <p>M1</p> <p>M</p> <p>A1 (4)</p>
	<p>NB $P(B \cup C) = P(B) + P(C) - P(B \cap C)$</p> $= 0.4 + 0.625 - P(B \cap C) \Rightarrow P(B \cap C) > 0$	<p>(11 marks)</p>