

Probability 2 MS

Q1.

<p>6 (i) $p = 0.2$ $\mu = 96 \times 0.2 = 19.2$ $\sigma^2 = 96 \times 0.2 \times 0.8 = 15.36$</p> $P(< 20) = P\left(z < \frac{19.5 - 19.2}{\sqrt{15.36}}\right) = P(z < 0.07654)$ $= 0.531$	<p>B1</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>A1</p>	<p>[5]</p>	<p>96×0.2 and $96 \times 0.2 \times 0.8$ seen</p> <p>standardising must have sq rt continuity correction either 19.5 or 20.5 correct area (> 0.5) correct value</p>
<p>(ii) $P(\text{OT} B) = \frac{0.2 \times 0.6}{0.05 \times 0.3 + 0.2 \times 0.6 + 0.75}$</p> $= \frac{0.12}{0.885}$ $= 0.136 \text{ (8/59)}$	<p>B1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>[4]</p>	<p>their $0.2 \times (0.6 \text{ or } 0.4)$ as numerator of a fraction attempt at $P(B)$ or $P(NB)$ anywhere involving sum of 2 or 3 products correct unsimplified num or denom of a fraction correct answer</p>

Q2.

<p>1 (i) $P(A \text{ Later}) = 0.5 \times 0.2 = 0.1$</p>	<p>B1</p>	<p>[1]</p>	
<p>(ii) $P(L \text{ given } I) = (0.2 \times 0.1) / (0.5 \times 0.8 + 0.3 \times 0.6 + 0.2 \times 0.1)$</p> $= 0.02 / 0.6$ $= 0.0333 \text{ (1/30)}$	<p>B1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>[4]</p>	<p>0.2×0.1 seen on its own as num or denom of a fraction</p> <p>Attempt at $P(I)$ summing 2 or 3 2-factor prods, seen anywhere Correct unsimplified $P(I)$ as num or denom of a fraction Correct answer accept 0.033</p>

Q3.

<p>2 either $55/90$ ($11/18$) or $95/160$ ($19/32$) seen</p> $P(M \text{ and } 18 - 60) = 0.6 \times 55/90$ $= 0.367 \text{ (11 / 30)}$ $P(18 - 60) = 0.6 \times 55/90 + 0.4 \times 95/160$ $(\text{= } 29/48 \text{ or } 0.604)$ $P(M \mid 18 - 60) = \frac{P(M \cap 18 - 60)}{P(18 - 60)}$ $= 88/145 \text{ (0.607)}$	<p>B1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>oe</p> <p>[5]</p>	<p>0.6 mult by $55/90$ seen as num / denom of a fraction</p> <p>Summing 2 two-factor products seen anywhere</p> <p>Correct unsimplified answer seen as num/denom of a fraction</p> <p>Correct answer</p>
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Q4.

3 (i) $\frac{74}{170} \left(\frac{37}{85} \right)$ (0.435)	B1 1	Correct answer
(ii) $\frac{38}{96} \left(\frac{19}{49} \right)$ (0.396)	B1 2	Correct unsimplified numerator or denominator Correct answer
(iii) P(high GDP and high birth rate) = 0 So they are exclusive	B1* B1dep* 2	Correct reason Correct answer, CWO
(iv) $\frac{42}{74} \times \frac{41}{54}$ $= \frac{1722}{3996} \left(\frac{287}{666} \right)$ (0.431)	M1 B1 A1 3	Multiplying 2 probabilities with different numerators and denominators, only One correct probability seen Correct answer

Q5.

5 (a) $P(W_2) = P(W_1W_2) + P(L_1W_2)$ $= 0.3 \times 0.6 + 0.7 \times 0.15$ $= 0.285$ $P(W_1 W_2) = \frac{P(W_1 \cap W_2)}{P(W_2)} = \frac{0.18}{0.285}$ $= 0.632, \frac{12}{19}$	B1 M1 A1 A1 [4]	0.3 × 0.6 alone as num or denom of a fraction Attempt at P(W ₂) as sum of two 2-factor options seen anywhere Correct unsimplified P(W ₂) as num or denom of a fraction Correct answer
(b) $x + 4$ oe seen $\frac{10}{15} \times \frac{7}{x+4} = \frac{7}{18}$ $x = 8$	B1 M1 A1 A1 [4]	Seen anywhere Mult two probabilities, one containing x and equating to $\frac{7}{18}$ Correct unsimplified equation Correct answer

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Q6.

7 (i)	number of balls in B is $5 + x + 1 = x + 6$ $P(Y) = x/(x + 6)$ AG	B1	[1]	Sensible reason
(ii)	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">box A</div> <div style="text-align: center;">box B</div> </div>	B1 B1 B1 B1	 [4]	both correct for box A 1 correct 1 correct 1 correct
(iii)	$P(W_B) = \frac{6}{x+6} = \frac{1}{3}$ $x = 12$ AG	M1 A1	 [2]	their $\frac{6}{x+6} = 1/3$ or $x/x+6 = 2/3$ Verification or solving legit
(iv)	$P(Y) = \frac{8}{10} \times \frac{12}{18} + \frac{2}{10} \times \frac{13}{18}$ $= \frac{61}{90}$ $P(= (AY BY) = \frac{P(AY \cap BY)}{P(Y)}$ $= \frac{2}{10} \times \frac{13}{18} / \frac{61}{90}$ $= \frac{13}{61} (0.213)$	M1 A1 B1 A1	 [4]	Attempt at $P(, Y)$ involving 2 two-factor fractions, seen anywhere. Correct $P(Y)$ seen as num or denom of a fraction $(2/10) \times (13/18)$ seen as num or denom of a fraction Correct answer

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Q7.

<p>7 (i) options (3, 4, 4) or (4, 3, 4) or (4, 4, 3) Probs $(4/10 \times 6/9 \times 5/8) \times 3C1$ $= 360/720$ $= \frac{1}{2}$ AG</p> <p style="text-align: center;">OR $\frac{{}_6C_2 \times {}_4C_1}{{}_{10}C_3} = \frac{1}{2}$ AG</p> <p>(ii)</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse; text-align: center;"> <tr> <td>sum</td> <td>9</td> <td>10</td> <td>11</td> <td>12</td> </tr> <tr> <td>Prob</td> <td>24/720</td> <td>216/720</td> <td>360/720</td> <td>120/720</td> </tr> </table> <p>$P(3, 3, 3) = 4/10 \times 3/9 \times 2/8 = 24/720$ (1/30) $P(3, 3, 4) = 4/10 \times 3/9 \times 6/8 \times 3C1$ $= 216/720$ (3/10) $P(4, 4, 4) = 6/10 \times 5/9 \times 4/8 = 120/720$ (1/6)</p> <p>(iii) $P(R) = 0.5$ $P(S) = 0.4$ $P(R \cap S) = 120/720$ $P(R \cap S) = 120/720 \neq P(R) \times P(S)$ Not indep</p> <p>(iv) $P(R \cap S) \neq 0$ or there is an overlap between R and S (34,4) Not exclusive $\Sigma xf / \Sigma f$</p>	sum	9	10	11	12	Prob	24/720	216/720	360/720	120/720	<p>M1 M1 A1 M1 M1 A1 B1 B1 B1 B1 B1 M1 A1ft B1ft</p>	<p>Summing three 3-factor options oe $10 \times 9 \times 8$ seen in denom</p> <p>[3] Correct answer</p> <p>One of $6C2$ or $4C1$ seen in num $10C3$ in denom Correct answer</p> <p>[4] 9, 10, 11, 12 only seen</p> <p>One correct prob other than P(11), with or without replacement Another correct prob</p> <p>Σ all 4 probs = 1</p> <p>[3] $P(R \cap S) = 120/720$ (1/6) Numerical attempt to compare P(R and S) with $P(R) \times P(S)$ provided $P(R \cap S) \neq 1/5$ Correct conclusion ft wrong $P(R \cap S) \neq 1/5$, P(S) correct</p> <p>[1] Correct answer following correct reasoning ft wrong non zero $P(R \cap S)$</p>
sum	9	10	11	12								
Prob	24/720	216/720	360/720	120/720								

Q8.

<p>7 (i) $P(\text{same}) = P(1, 1) + P(3, 3) + P(5, 5)$ $= \frac{2}{9} \times \frac{1}{8} + \frac{4}{9} \times \frac{3}{8} + \frac{3}{9} \times \frac{2}{8}$ $= 5/18$ (0.278)</p> <p>Alt. method: $\frac{{}_2C_2 + {}_4C_2 + {}_3C_2}{{}_9C_2}$ or $\frac{2 \times 1 + 3 \times 4 + 2 \times 3}{{}_9C_2 \times 2}$ oe</p>	<p>M1 M1 A1 3</p>	<p>Summing 3 two-factor options</p> <p>Multiplying terms by one less in the numerator or denominator</p> <p>Correct answer</p> <p>M1 for numerator, M1 for denominator, A1 correct answer</p>
<p>(ii) $P(5, \bar{5}) + P(\bar{5}, 5)$</p> <p>$= \frac{3}{9} \times \frac{6}{8} + \frac{6}{9} \times \frac{3}{8} = \frac{36}{72} = \frac{1}{2}$ or 0.5</p> <p>Alt. method: $\frac{{}_6C_1 \times {}_3C_1 (\times 2)}{{}_9C_2 (\times 2)}$ oe</p>	<p>M1 M1 A1 3</p>	<p>Mult 2 probs whose numerators sum to 9 o.e. Summing 2 options or mult by 2 (may be 4 options)</p> <p>Correct answer</p> <p>M1 for numerator, M1 for denominator, A1 correct answer</p>

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<p>(iii) $P(5 \cap \bar{5}) = \frac{3}{9} \times \frac{6}{8} = \frac{1}{4}$</p> <p>$P(\bar{5}) = \frac{1}{4} + \frac{6}{9} \times \frac{5}{8} = 48/72 = 0.6666$</p> <p>$P(5_1 \bar{5}_2) = \frac{1/4}{48/72} = 3/8$ = 0.375</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>Attempt at P(5 and not 5) seen as numerator or denominator of a fraction</p> <p>Attempt at P(not 5) sum of 2 two-factor terms seen anywhere</p> <p>Correct P($\bar{5}$) as numerator or denominator in fraction</p> <p>Correct answer</p>								
<p>(iv)</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 2px 5px;">x</td> <td style="padding: 2px 5px;">0</td> <td style="padding: 2px 5px;">1</td> <td style="padding: 2px 5px;">2</td> </tr> <tr> <td style="padding: 2px 5px;">$P(X=x)$</td> <td style="padding: 2px 5px;">5/12</td> <td style="padding: 2px 5px;">1/2</td> <td style="padding: 2px 5px;">1/12</td> </tr> </table> <p>$P(0) = P(\bar{5}, \bar{5}) = \frac{6}{9} \times \frac{5}{8} = 30/72$ (5/12) (0.4166)</p> <p>$P(1) = 0.5$ from part (ii)</p> <p>$P(2) = 6/72$ (1/12) (0.0833) from part (i)</p>	x	0	1	2	$P(X=x)$	5/12	1/2	1/12	<p>B1</p> <p>B1</p> <p>B1ft</p>	<p>Values 0, 1, 2 seen in table with at least 1 prob</p> <p>Correct P(0) unsimplified</p> <p>If $x=0,1,2,(3)$ ft $\Sigma p = 1$, no -ve values, all probabilities <1</p>
x	0	1	2							
$P(X=x)$	5/12	1/2	1/12							

Q9.

<p>5 (i) $P(X \text{ and } P) = \frac{1}{4} \times \frac{4}{9} = \frac{1}{9}$</p> <p>$P(Y \text{ and } P) = \frac{1}{4} \times \frac{2}{12} = \frac{1}{24}$</p> <p>$P(Z \text{ and } P) = \frac{1}{2} \times \frac{1}{16} = \frac{1}{32}$</p> <p>$P(P) = \frac{53}{288} = 0.184$</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p>	<p>Mult a playground prob with a P prob</p> <p>One correct prob</p> <p>Summing at least two 2-factor probs</p> <p>Correct answer</p>
<p>(ii) $P(Y C) = \frac{P(Y \cap C)}{P(C)}$</p> <p style="text-align: center;">$\frac{\frac{1}{4} \times \frac{1}{12}}{\frac{1}{4} \times \frac{1}{12} + \frac{1}{2} \times \frac{4}{16}}$</p> <p style="text-align: center;">$= \frac{1}{\frac{48}{7}} = \frac{1}{7}$</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>Attempt at $P(Y \cap C)$ as numerator of a fraction</p> <p>Attempt at $P(C)$ in form of summing two 2-factor products, seen anywhere</p> <p>Correct unsimplified $P(C)$ seen anywhere</p> <p>Correct answer</p>

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Q10.

<p>3 (i) $P(RR) = 0.6 \times 0.7 = 0.42$ $P(AA) = 0.4 \times 0.75 = 0.3$ $P(2 \text{ sets in match}) = 0.72$</p>	<p>B1 B1 B1✓</p>	<p>3 Only 2 factors Only 2 factors ft previous answers</p>
<p>(ii) $\frac{P(A \text{ wins and 2 sets})}{P(2 \text{ sets})} = \frac{P(AA)}{P(2 \text{ sets})}$ $= \frac{0.3}{0.72} = \frac{5}{12} (0.417)$</p>	<p>B1✓ B1✓</p>	<p>2 Correct num or correct denom of a fraction ft their (i) Correct answer ft their or recovered AA/their or recovered (i)</p>