Mark scheme

Question			Answer/Indicative content	Marks	Guidance	
1	a		2250 with correct working	5	**M3** for $(1 - (0.25 + 0.15)) \times \frac{5}{6} \times 3000$ **oe** **M1** for 0.25 × 3000 **oe** OR **B2** for rel freq of yellow disc = 0.5 or for 1200 green and red discs in bag or **M1** for 0.25+ 0.15 + P(y) + P(b) = 1 or better or for (0.25 + 0.15) × 3000 **oe** **M2dep** for (*their* 0.5 + 0.25) × 3000 **oe** or **M1dep** for (*their* 0.5 + 0.25) **oe** If **0** or **M1** only scored, instead award **SC2** for answer 2250 If **0** scored, award **SC1** for 750	"Correct working" requires evidence of **M3** Condone 2250 rounded to 2000 as answer for **5** marks For **M3** accept 1500 yellow **M1** implied by 750 For **B2** accept 750 for green and 450 for red **M1** for e.g.1 – (0.25 + 0.15) **oe** **M2dep** and **M1 dep** on at least **M1** earned **M1dep** implied by 0.75
	b		She may not have done the experiment a lot of times **oe**	1		
			Total	**6**		
2	a		Fully correct diagram	3	**B1** 0.2 and 0.9 correctly placed **B2** 0.2 and 0.8 correctly placedor **B1** for 0.2	

					correctly placed or for 0.2 and 0.8 switched	
	b		$\frac{2}{3}$ **oe**	4	**M3** for $\frac{0.8\times0.1}{0.8\times0.1+\textit{their}(0.2\times0.2)}$ **oe** or **M2** for 0.8 ×0.1+ *their* (0.2 ×0.2) or better implied by 0.12 or **M1** for 0.8 ×0.1 implied by 0.08 or for *their* (0.2 ×0.2) implied by 0.04	
			Total	**7**		
3	a		30	3	**M1** for $15=\frac{1}{5}$ or × 5 × 15 **oe** or 75 **M1** for *their*75 − 15 − 21 − 9 **oe**	Alt method **M1** for 15 × 4 **M1** for 60 − 21 − 9
	b		$\frac{15}{45}$ **oe** or $\frac{15}{15+\textit{their}\,30}$ **oe**	2FT	**B1FT** for $\frac{15}{k}$ or $\frac{k}{15+\textit{their}\,30}$ (both proper fractions)	**FT** *their* 30
			Total	**5**		
4			$\frac{61}{125}$ or 0.488	4	**B3** for 61 or **B2** for 125 or 64 or **M1** for 5 × 5 × 5 or 4 × 4 × 4	Accept any correct method e.g. **M3** for 1 × 5 × 5 + 4 × 1 × 5 + 4 × 4 × 1 or 61 or **M2** for two of these three terms correct or **M1** for one of these three terms correct
			Total	**4**		
5	a		Correct tree diagram	2	**B1** for 0.6 on missing branch in task 1 **B1** for 1 – *x* on both	If there is more than one answer on any branch, choose the one on the dotted line first

					missing branches in task 2	
	b		They are independent **oe**	1		Pick the best comment, see Appendix*. *Refer to 'Qn11b, 2024 June, Alternative J560/04, Mark Scheme Appendix' within downloadable resource materials.
	c		0.36	4	**M2** for $0.4(1 - x) + 0.6x = 0.472$ or better or **M1** for $0.4(1 - x) + 0.6x$ or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject $(0<k)$ OR **M2** for $1 - 0.4x - 0.6(1 - x) = 0.472$ or better or **M1** for $1 - 0.4x - 0.6(1 - x)$ or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject $(0< k)$ OR **FT** *their* **(a)** if not correct for up to 3 marks e.g. if in (**a**) $1 - x$ is replaced with e.g. 0.6 then **M2** for $0.4 \times 0.6 + 0.6x = 0.472$ or better or **M1** for $0.4 \times 0.6 + 0.6x$ or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject $(0< k)$ If **0** scored **SC1** for any 2 branches correctly written down and added	e.g. **M2** for $0.4 + 0.2x = 0.472$ e.g. **M1** for $0.4 + 0.2x$ e.g. $0.472 - 0.4 = 0.2x$ or better allow similar equations involving 1–0.472 e.g $0.4x + 0.6(1 - x) = 0.528$ e.g. $0.472 - 0.4 = 0.2x$ or better e.g. $0.6x = 0.472 - 0.4 \times 0.6$ or better Alternative method using trials **M1** for each correct trial up to **M3** and the correct answer from trials scores **4** marks, see appendix* *Refer to 'Qn11c, 2024 June, Alternative J560/04, Mark Scheme Appendix' within downloadable resource materials. Exactly two branches

					e.g. $0.4(1 - x) + 0.6(1 - x)$	
			Total	**7**		
6	a		$\frac{6}{13}$ **oe**	2	**B1** for answer $\frac{k}{13}$ or $\frac{6}{k}$ and must be a proper fraction	Do not accept ratio or words **isw** conversion/cancelling
	b		$\frac{8}{40} \times \frac{13}{39} + \frac{13}{40} \times \frac{8}{39}$ **oe** leading to $\frac{2}{15}$ with no errors in processing seen	3	**M2** for $[2]\left(\frac{8}{40} \times \frac{13}{39}\right)$ **oe** or **M1** for $\frac{8}{40}$ oe and $\frac{13}{39}$ oe or $\frac{13}{40}$ oe and $\frac{8}{39}$ oe seen	Award **3** marks for e.g. $\frac{8}{40} \times \frac{13}{39} = \frac{1}{15}$ and $\frac{1}{15} \times 2 = \frac{2}{15}$ 0.2 and 0.333[3..] **or** 0.325 and 0.205…
			Total	**5**		
7			$\frac{13}{31}$ **oe**	2	**M1** for $\frac{13}{k}$ with $k > 13$ or $\frac{m}{31}$ with $0 < m < 31$ or for $\frac{8+5}{12+8+6+5}$ If **0** scored, **SC1** for answer 13 : 31	Accept 0.419 to 0.42
			Total	**2**		
8	a		Fully correct diagram	3	**B1** 0.4 and 0.9 correctly placed **B2** 0.3 and 0.7 correctly placed or **B1** for 0.3 correctly placed or for 0.3 and 0.7 switched	

Examiner's Comments

Most candidates completed the tree diagram correctly.

					Misconception The few candidates who got this wrong often confused the probability tree with that of a frequency tree, thus producing probabilities on the second set of branches of the given 0.1 with 0.5, and the given 0.3 with 0.1.
	b		$\frac{1}{3}$	4	**M3** for $\frac{0.6\times0.1}{0.6\times0.1+their(0.4\times0.3)}$ oe or **M2** for 0.6 × 0.1+ their (0.4 ×0.3) or better implied by 0.18 or **M1** for 0.6 ×0.1 implied by 0.06 or for *thier* (0.4 *x* 0.3) implied by 0.12 **Examiner's Comments** Very few candidates recognised the 'given that' in the question, which should trigger thoughts of conditional probability. Over half of candidates scored 1 mark for either 0.6 × 0.1 = 0.06 or for 0.4 × 0.3 = 0.12 or 2 marks for summing these two answers to get 0.18. There was little evidence of an attempt to use this as the denominator in $\frac{0.06}{0.18}$ which leads to the answer $\frac{1}{3}$.
			Total	**7**	
9	a		1300 with correct working	5	**M3** for $(1-(0.35+0.25))\times\frac{3}{4}\times2000$ oe **M1** for 0.35 × 2000 oe OR **B2** for rel freq of yellow disc = 0.3 or for 1200 Green and red discs in bag or **M1** for 0.35+ 0.25 + P(y) + P(b) = 1 or better or for (0.35 + 0.25) × 2000 oe **M2dep** for (*their* 0.3 +

'Correct working' requires evidence of M3
Condone 1300 rounded to 1000 as answer for 5 marks
For M3 accept 600 yellow
M1 implied by 700

For B2 accept 700 for green and 500 for red

					0.35) × 2000 oe or **M1dep** for (*their* 0.3 + 0.35) oe If 0 or M1 only scored, instead award **SC2** for answer 1300 If 0 scored, award **SC1** for 700	M1 for e.g.1 – (0.35 + 0.25) oe M2dep and M1 dep on at least M1 earned M1dep implied by 0.65
					Examiner's Comments Candidates that were successful in this part, worked systematically and showed each step of their working. There were two approaches used. Some worked with the probabilities and found the probability of yellow and blue first and then added the probability of yellow and green before working out the expected number of green and yellow. Others worked out the expected number of green and red and then subtracted from 2000 and used ratio to find the numbers of blue and yellow before adding green and yellow together. Candidates need to show each step as they will not receive credit if arithmetic mistakes are made within the method, e.g. probability of yellow and blue = 0.5 with no method will not receive any credit but (1 – 0.25 – 0.35) = 0.5 will receive some credit for the method shown despite the arithmetic error.	
	b		She may not have done the experiment a lot of times oe	1	**Examiner's Comments** Candidates found this part challenging and did not focus on how the reliability of any experiment depends on the number of trials. Responses included rounding values, not recording correctly and picking the same counter more than once.	
			Total	**6**		
10	a		24	3	**M1** for $16 = \frac{1}{4}$ or 4 × 16 oe or 64 **M1** for *their* 64 – 16 – 15 – 9 oe	Alt.: **M1** for 16 × 3 and **M1** for 48 – 15 – 9

					Examiner's Comments The key in answering this problem is to link 16 with $\frac{1}{4}$ so finding the total of 64. Those who did usually found the correct answer. Some calculated $\frac{1}{4}$ × (16 + 15 + 9) and gave the answer 10.
	b		$\frac{16}{40}$ oe or $\frac{16}{16+their\ 24}$ oe	2FT	**B1FT** for $\frac{16}{k}$ or $\frac{k}{16+their\ 24}$ (both proper fractions) | **FT** *their* 24 **Examiner's Comments** Despite not getting the correct answer to part (a) many did give a fraction as an answer with 16 as the numerator thus gaining credit.
			Total	**5**	
11			$\frac{271}{1000}$ or 0.271	4	**B3** for 271 OR **B2** for 1000 or 729 OR **M1** for 10 × 10 × 10 or 9 × 9 × 9 | Accept any correct method e.g. **M3** for 1 × 10 × 10 + 9 × 1 × 10 + 9 × 9 × 1 or 271 or **M2** for two of these three terms correct or **M1** for one of these three terms correct **Examiner's Comments** Most candidates were unable to use the product rule to find the total number of different passcodes. Some thought that the number of digits from 0 to 9 was 9. The common approach was to start to write down some possibilities including 5 but these responses were generally unfinished.
			Total	**4**	
12	a		$\frac{45}{70}$ oe	2	**B1** for 34 + 11 or 45 or for $\frac{n}{34+11+6+19}$ | Accept 0.64[2…] or 64[.2…]% or 0.643 or 64.3%

					or $\frac{n}{70}$ with $n < 70$	
	b		$\frac{11}{17}$ oe	2	**B1** for $\frac{11}{n}$ with $n > 11$ or for $\frac{n}{11+6}$ or $\frac{n}{17}$ with $n < 17$	Accept 0.64[7..] to 0.65 or as %
			Total	**4**		
13	a		0.3 and 0.7 **oe** on the correct branches	3	**B1** for 0.3 or 0.7 **oe** **M1** for 0.3 and 0.7 on first branch or on all second branches in the correct places If **0** scored, award **SC1** for two probabilities consistently placed and adding to 1	Accept equivalent fractions $\frac{3}{10}$ and $\frac{7}{10}$
	b		0.91 or $\frac{91}{100}$ **oe**	3	**FT** for **M1** and **M2** and **3** from *their* 0.7 and *their* 0.3 throughout providing *their* 0.7 + *their* 0.3 = 1 **M2** for correct method e.g. 1 – *their* 0.3 × *their* 0.3 **oe** or **M1** for one correct branch e.g. *their* 0.7 × *their* 0.7 or *their* 0.3 × *their* 0.7	Accept 91% for **3** marks e.g. **M2** for *their* $\frac{7}{10}$ + *their* $\frac{7}{10}$ × *their* $\frac{3}{10}$ For one correct branch condone just P(lose) e.g. *their* $\frac{7}{10}$
	c		Any correct reason e.g. the answer will be smaller	1	**Response Mark** [The answer] It will be smaller **1** The probability of winning will increase **1 bod** The probability of losing will decrease **1 bod** They lose less games **0** The answer will change because the probabilities have changed **0**	Their answer should explain the effect on the answer to part (b), ignore calculations.

					The probability of losing will increase **0** The probability of winning will decrease **0**	
			Total	**7**		
14			Yes and $\frac{378}{720}$ **oe** or better with correct working	5	**M4** for $3\times\frac{7}{10}\times\frac{6}{9}\times\frac{3}{8}$ **oe** or **M3** for $k\times\frac{7}{10}\times\frac{6}{9}\times\frac{3}{8}$ **oe** or **M2** for $\frac{7}{10}$, $\frac{6}{9}$ and $\frac{3}{8}$ **oe** used or **M1** for $\frac{7}{10}$ **oe** seen or for three combinations **soi** YYG, YGY, GYY <u>Alternative method</u> **M4** for $3\times\frac{\frac{7}{22}\times\frac{6}{21}\times\frac{3}{20}}{\frac{10}{22}\times\frac{9}{21}\times\frac{8}{20}}$ **oe** or **M3** for $k\times\frac{\frac{7}{22}\times\frac{6}{21}\times\frac{3}{20}}{\frac{10}{22}\times\frac{9}{21}\times\frac{8}{20}}$ **oe** or **M2** for $\frac{10}{22}\times\frac{9}{21}\times\frac{8}{20}$ **oe** or $\frac{7}{22}\times\frac{6}{21}\times\frac{3}{20}$ **oe** or **M1** for $\frac{10}{22}$ **oe** seen or [$\frac{7}{22}$ **oe** seen If **0** or **M1** scored, instead award **SC2** for answer [$\frac{378}{720}$ **oe** (or better) with no or insufficient working If **0** scored, instead award **SC1** for answer $\frac{126}{720}$ or	"Correct working" requires **M4** For **5** marks **oe** or better e.g. $\frac{42}{80}$, $\frac{21}{40}$ or 0.525 Where k = 1 or 2 Where k = 1 or 2 <u>With replacement</u> (apply similar to the alternative method) **SC2** for $3\times\frac{7}{10}\times\frac{7}{10}\times\frac{3}{10}$ **oe** $\left[\frac{441}{1000}\right]$ or **SC1** for $k\times\frac{7}{10}\times\frac{7}{10}\times\frac{3}{10}$ **oe** (k = 1 or 2) <u>Circle condition missed</u> (apply similar to the alternative method) **SC2** for $3\times\frac{11}{22}\times\frac{10}{21}\times\frac{11}{20}$ **oe** $\left[\frac{11}{28}\right]$ or **SC1** for $k\times\frac{11}{22}\times\frac{10}{21}\times\frac{11}{20}$ **oe** (k = 1 or 2)

					$\frac{252}{720}$ **oe** (or better) with no or insufficient working	
			Total	**5**		
15			$\frac{10}{28}$ oe	2	**M1** for $\frac{10}{k}$ with $k > 10$ or $\frac{m}{28}$ with $0 < m < 28$ or for $\frac{4+6}{13+6+5+4}$ If **0** scored, **SC1** for answer 10 : 28 or 5 : 14	Accept 0.357 to 0.36
			Total	**2**		
16	a		$\frac{9}{16}$ oe	2		

Examiner's Comments

Frequency trees have not been assessed very often on Higher tier papers, but almost all candidates responded to this question. Many candidates unnecessarily (yet correctly) completed the missing values. Knowledge of relative frequency was however generally low and over half of candidates scored 0 marks.

For those with stronger knowledge of relative frequency, this was often a straightforward 2 marks for the correct response. A very small number of candidates scored 1 mark for a fraction with 10 as the numerator and an incorrect denominator (usually 18, from the number of journeys with seats available). Many candidates overcomplicated the question by turning it into a probability tree diagram and multiplying along the branches. Others just found the frequency of no seats being available (6 + 4 = 10).

Misconception

Candidates should be aware that relative frequency is a proportion or fraction, not just a frequency.

					B1 for answer $\frac{k}{16}$ or $\frac{9}{k}$ and must be a proper fraction	Do not accept ratio or words isw conversion/cancelling
					Examiner's Comments This part was answered quite well and many achieved at least 1 mark here (for 1 mark, candidates could give a fraction with either 9 as the numerator or 16 as the denominator). Errors included giving a fraction with a denominator of 50 or including people from sets other than athletics.	
	b		$\frac{10}{50}\times\frac{7}{49}+\frac{7}{50}\times\frac{10}{49}$ oe leading to $\frac{2}{35}$ with no errors in processing seen	3	**M2** for $[2]\left(\frac{10}{50}\times\frac{7}{49}\right)$oe or **M1** for $\frac{10}{50}$oe and $\frac{7}{49}$oe **or** $\frac{7}{50}$oe and $\frac{10}{49}$oe seen	Award 3 marks for e.g. $\frac{10}{50}\times\frac{7}{49}=\frac{1}{35}$ and $\frac{1}{35}\times 2=\frac{2}{35}$ 0.2 and 0.142 to 0.143 **or** 0.35 and 0.204…
					Examiner's Comments This part proved challenging for many. The common error was to treat the choice of the two people as independent events rather than dependent events and the calculation $\frac{10}{50}\times\frac{7}{50}$ was common. Those that recognised the probabilities as $\frac{10}{50}$ and $\frac{7}{49}$ or equivalents invariably went on to find the product and earn at least 2 marks. A number did not consider the other pair $\frac{7}{50}$ and $\frac{10}{49}$, however. More able candidates simplified the probabilities before or during multiplication and avoided a more complex calculation. A number of candidates omitted this part.	
			Total	**5**		
17	a		Correct tree diagram	2	**B1** for 0.4 on missing branch in task 1 **B1** for 1 – *x* on both missing branches in task 2	If there is more than one answer on any branch, choose the

					one on the dotted line first	
					Examiner's Comments In the first task almost everyone answered 0.4. In the second task some candidates put 1 – *x*, but others had *y* or 0.4. There were a few who initially put 1 – *x*, but then replaced it with a decimal, usually 0.4, 0.6 or their answer to part (c).	
	b		They are independent oe	1	Pick the best comment, see appendix **Mark** The pass before does not affect the results after **1** They are independent **1** The first task results do not affect the second **1** Passing first task does not affect the second task **1** Passing the second does not rely on passing the first **1** They are not linked **1** Same probability to pass second on both times **0** The probabilities of the tests do not change **0** The probability of passing will always stay the same **0** Both second tests are the same **0** **Examiner's Comments** We saw a large variety of answers. Some were correct about statistical independence. Incorrect answers included that there were only two outcomes or that the probabilit ies were the same for both tasks.	
	c		0.36	4	**M2** for 0.6(1 – *x*) + 0.4*x* = 0.528 or better or **M1** for 0.6(1 – *x*) + 0.4*x* or better **M1** for rearranging *their* linear equation, *kx* + *a* = *b*, to make *kx* the subject (0< *k*) OR **M2** for 1 – 0.6*x* – 0.4(1 – *x*) = 0.528 or better or **M1** for 1 – 0.6*x* – 0.4(1	e.g. **M2** for 0.6 – 0.2*x* = 0.528 e.g. **M1** for 0.6 – 0.2*x* e.g. 0.6 – 0.528 = 0.2*x* or better allow similar equations involving 1–0.528 e.g 0.6*x* + 0.4(1 – *x*) = 0.472 e.g. 0.6 – 0.528 = 0.2*x* or better

					– x) or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject ($0< k$) OR **FT** *their* **(a)** if not correct for up to **3** marks e.g. if in **(a)** 1 - x is replaced with e.g. 0.4 then **M2** for $0.6 \times 0.4 + 0.4x = 0.528$ or better or **M1** for $0.6 \times 0.4 + 0.4x$ or better **M1** for rearranging *their* linear equation, $kx + a = b$, to make kx the subject ($0< k$) If **0** scored **SC1** for any 2 branches correctly written down and added e.g. $0.6(1 – x) + 0.4(1 – x)$	e.g. $0.4x = 0.528 – 0.6 \times 0.4$ or better alternative method using trials **M1** for each correct trial up to **M3** and the correct answer from trials scores **4** marks, see appendix exactly two branches

Value(x)	probability
0.2	0.56
0.21	0.558
0.22	0.556
0.23	0.554
0.24	0.552
0.25	0.55
0.26	0.548
0.27	0.546
0.28	0.544
0.29	0.542
0.3	0.54
0.31	0.538
0.32	0.536

0.33	0.534
0.34	0.532
0.35	0.53
0.36	0.528
0.37	0.526
0.38	0.524
0.39	0.522
0.4	0.52
0.41	0.518
0.42	0.516
0.43	0.514
0.44	0.512
0.45	0.51

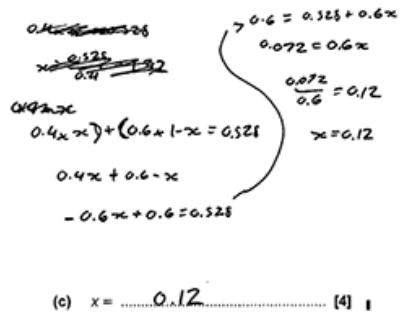
Examiner's Comments

Many answers involved the use of just one branch, so common responses were $0.4x = 0.528$ or $0.6x = 0.528$, leading to answers of 1.32 or 0.88. Others solved the equation $0.6(1 – x) = 0.528$, which led to an answer of 0.12. The most common error was not to use or expand brackets, so we often saw things such as $0.6 \times 1 – x$ 'simplified' to $0.6 – x$.

Assessment for learning

Expressions such as '0.6' multiplied by '$1 – x$' should be written $0.6(1 – x)$ using brackets to preserve the priority of operations, so that the subtraction is done before the multiplication. To write this without brackets must be $0.6 – 0.6x$.

Exemplar 1

					 (c) $x =$ 0.12 [4]	The first line should be $0.4 \times x + 0.6 \times (1 - x) = 0.528$. The second line would then become $0.4x + 0.6 - 0.6x = 0.528$, which leads to the correct answer of 0.36.
			Total	**7**		
18	a		The two events are dependent oe and $\frac{50}{70} \times \frac{49}{69}$ isw	2	**B1** for either	Accept e.g. The second probability is not $\frac{5}{7}$ oe The second probability is wrong oe The second probability is $\frac{49}{69}$ There is one less for the second pick oe It is out of 69 for the 2nd pick oe Any incorrect statement is B0
	b		$\frac{15}{38}$ oe with correct working	5	**M4** for $2\left(\frac{15}{20} \times \frac{5}{19}\right)$ oe or **M3** for $\frac{15}{20} \times \frac{5}{19}$ oe or **M2** for $\frac{15}{20}$ and $\frac{5}{19}$ **or** $\frac{15}{19}$ and $\frac{5}{20}$ oe seen or **M1** for $\frac{15}{20}$ or $\frac{5}{20}$ oe seen If **0** or **M1** scored, instead award **SC2** for $\frac{15}{n} \times \frac{5}{n-1}$ oe or for $2\left(\frac{15}{20} \times \frac{5}{20}\right)$ oe or for answer $\frac{30}{76}$ oe with no or insufficient working	'Correct working' needs evidence of M2 Must be proper fractions and $n \leq 70$ Must be proper fractions and $n \leq 70$

					If **0** scored **SC1** for $\frac{15}{n}$ and $\frac{5}{n-1}$ or $\frac{15}{n-1}$ and $\frac{5}{n}$ seen or for answers $\frac{15}{76}$ oe or $\frac{3}{8}$ oe with no or insufficient working	
			Total	**7**		
19			$\frac{18}{40}$ or $\frac{9}{20}$ or 0.45 or 45%	2	**B1** for $\frac{18}{n}$ or $\frac{n}{40}$ and it must be a proper fraction	
			Total	**2**		
20			1232	3	**M2** for 7 × 11 × 16 Or **M1** for 7 × 11 × 16 with at most one error If **0** scored award **SC2** for $\frac{1}{7}\times\frac{1}{11}\times\frac{1}{16}$ or $\frac{1}{1232}$ Or **SC1** for 1 × 1 × 2 = 2	e.g. **M1** for 7 × 11 × 18 or 1386 Condone 7 × 11 × 1 for **M1** not 7 × 11
			Total	**3**		
21	a		[0].0625 or $\frac{7}{112}$ oe or 6.25%	1	e.g. $\frac{1}{16}$ but not in words or as a ratio	
	b		827	2	**FT** for *their* (a) for **2** marks, answer must be an integer **M1** for 13231 × *their* [0].0625 or 13230 × *their* [0].0625	Condone 826 as answer. **M1** implied by 826.9[3…]…
			Total	**3**		
22			$\frac{656}{1056}$ **oe** or 0.62 or 0.621 or 0.6212 or 0.62121… or 62% or 62.1% or 62.12% or 62.121% with correct working	5	**M4** for $1 - \frac{10}{11}\times\frac{5}{8}\times\frac{8}{12}$ **oe** OR **M3** for $\frac{10}{11}\times\frac{5}{8}\times\frac{8}{12}$	"Correct working" requires evidence of at least **M3** or **M1M1M1** Equivs. Include $\frac{328}{528}, \frac{164}{264}, \frac{82}{132}, \frac{41}{66}$ Condone $\frac{1}{11}\times\frac{3}{8}\times\frac{4}{12}\left[=\frac{1}{1056}\right]$ for

					OR **M1** for $\frac{1}{11}\times\frac{3}{8}\times\frac{4}{12}$ OR **M1** for [total choices=] 11 × 8 × 12 implied by 1056 and **M3** for (1 × 8 × 12) + (10 × 3 × 12) + (10 × 5 × 4) or 96 + 360 + 200 implied by 656 or **M2** for (1 × 8 × 12) + (11 × 3 × 12) + (11 × 8 × 4) or 96 + 396 + 352 implied by 844 or **M1** for one bracketed term correct from the **M3** expression e.g. 1 × 8 × 12 OR **M1** for [total choices=] 11 × 8 × 12 implied by 1056 and **M2** for [choices no languages=] (11 – 1) × (8 – 3) × (12 – 4) implied by 400 or **M1** for this expression with one error and **M1** for *their* 1056 – *their* 400 or 656 If **0** or **M1** scored **SC2** for correct answer with no or insufficient working Note: For MR see Appendix	**M1** [total choices] <u>Alternative equivalent methods</u> **M4** for fully correct method leading to *their* 1056 and *their* 656 or **M1** for [total choices=] 11 × 8 × 12 implied by 1056 and **M3** for (1×3×4) + (10×3×4+1×5×4+1×3×8) + (1×5×8+10×3×8+10×5×4) or (12) + (120 + 20 + 24) + (40 + 240 + 200) implied by 656 or **M2** for this expression with at least two of the bracketed terms correct or **M1** for at least one of the bracketed terms correct or any three of the individual terms correct e.g. 1 × 3 × 4 <u>Use of tree diagrams</u> See Appendix
					<u>Using tree diagrams :</u> **M4** for method A: $1 - \frac{10}{11}\times\frac{5}{8}\times\frac{8}{12}$ **oe** e.g. method B : $\frac{1}{11}\cdot\frac{3}{8}\cdot\frac{4}{12}+\frac{1}{11}\cdot\frac{3}{8}\cdot\frac{8}{12}+\frac{1}{11}\cdot\frac{5}{8}\cdot\frac{4}{12}+\frac{10}{11}\cdot\frac{3}{8}\cdot\frac{4}{12}+\frac{1}{11}\cdot\frac{5}{8}\cdot\frac{8}{12}+\frac{10}{11}\cdot\frac{3}{8}\cdot\frac{8}{12}+\frac{10}{11}\cdot\frac{5}{8}\cdot\frac{4}{12}$ **M3** for $\frac{10}{11}\times\frac{5}{8}\times\frac{8}{12}$ or method B with at least five relevant branches correct or	

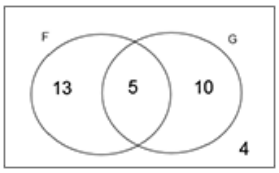
					M2 for method B with at least four relevant branches correct or **M1** for method B with at least one relevant branch correct <u>Misreads</u> Some candidates read this as 12, 11 and 16 subjects. Treat this as a misread (MR) so the mark scheme for them will be (max. of **4** marks): **M4** for $1 - \frac{11}{12} \times \frac{8}{11} \times \frac{12}{16}$ **oe** implied by answer $\frac{1056}{2112} = \frac{1}{2}$ **oe** or 0.5 OR **M3** for $\frac{11}{12} \times \frac{8}{11} \times \frac{12}{16}$ **oe** implied by $\frac{1056}{2112} = \frac{1}{2}$ **oe** or 0.5 OR **M1** for [total choices=] 12 × 11 × 16 implied by 2112 AND **M3** for 1 × 11 × 16 + 11 × 3 × 16 + 11 × 8 × 4 or 176 + 528 + 352 implied by 1056 or **M2** for 1 × 11 × 16 + 12 × 3 × 16 + 12 × 11 × 4 or 176 + 576 + 528 implied by 1280 or **M1** for this expression with one term correct or at least 5 numbers correct OR **M1** for [total choices=] 12 × 11 × 16 implied by 2112 **M2** for [choices no langs =] (12 – 1) × (11 – 3) × (16 – 4) implied by 1056 or **M1** for this expression with one error and **M1** for *their* 2112 – *their* 1056 <u>Alternative equivalent methods</u> **M4** for fully correct method leading to *their* 2112 and *their* 1056 or **M1** for [total choices=] 12 × 11 × 16 implied by 2112 and **M3** for (1 × 3 × 4) + (11 × 3 × 4 + 1 × 8 × 4 + 1 × 3 × 12) + (1 × 8 × 12 + 11 × 3 × 12 + 11 × 8 × 4) or (24) + (168 + 96 + 90) + (360 + 630 + 672) or 2040 (12) + (132 + 32 + 36) + (96 + 396 + 352) or 1056 or **M2** for two of the bracketed terms or **M1** for one of the bracketed terms or any three of the individual terms correct
			Total	**5**	
23	a		Tuesday [0].7 **oe** and [0].3 **oe** in the correct places and	2	

			Wednesday [0].7 **oe** with [0].3 **oe** and [0].25 **oe** with [0].75 **oe** in the correct places		**B1** for one pair of probabilities correct in one branch e.g. Tuesday or one of the Wednesday branches	
	b		[0].565 or $\frac{113}{200}$ **oe nfww**	3	**M2** for [0].7 × [0].7 + [0].3 × [0].25 **oe** or **M1** for [0].7 × [0].7 or [0].3 × [0].25 **oe** implied by .49 or .075 or $\frac{49}{100}$ or $\frac{3}{40}$ **oe**	If **(a)** is not correct **FT** *their* tree for **3** marks, **M2** and **M1** Allow 56.5% for **3** marks
			Total	**5**		
24	a		42 23 29 6	3	**B2** for 42 or 23 or 29 correctly placed or **B1** for the total of F = 65 or for the total of S = 52 or F∩S' + (F∩ S) + F'∩S = 94	Do not accept a blank region as 0, for any marks we need to see a number in each region
	b	i	$\frac{71}{100}$ or 0.71 or 71%	2	**FT** $\frac{\textit{their}\,(42+49)}{100}$ from *their* **(a)** for **2** or **1** marks or **M1** for *their* (42 + 29) or 71	**FT** if *their* (42 + 49) < 100 and 0 < fraction < 1
		ii	$\frac{23}{65}$ or 0.353 to 0.354 or 0.35	2	**FT** $\frac{\textit{their}\,(23)}{\textit{their}\,(42+23)}$ from *their* **(a)** for **2** or **1** marks **B1** for 0.23 **oe** or $\frac{\textit{their}\,23}{k}$ or $\frac{k}{\textit{their}\,65}$ (*k* is an integer)	Accept e.g. 35% or 35.4 to 35.5% for **2** marks from *their* **(a)** and 0 < fraction < 1
			Total	**7**		
25			$\frac{3}{5}$ **oe** with correct working	5		"Correct working" requires evidence of **M1** and **M3** or convincing alternate approach

					M1 for green = 12 and red = 4 **M3** for $\frac{12}{16}\times\frac{11}{15}+\frac{4}{16}\times\frac{3}{15}$ **oe** or **M2** for $\frac{12}{16}\times\frac{11}{15}$ **oe** or $\frac{4}{16}\times\frac{3}{15}$ **oe** or **M1** for correct tree diagram or sample space or for $\frac{12}{16}$ **and** $\frac{11}{15}$ or $\frac{4}{16}$ **and** $\frac{3}{15}$ **oe seen** If **0** scored, **SC1** for correct answer with no or insufficient working or for P(G) = $\frac{3}{4}$ **oe** and P(R) = $\frac{1}{4}$ **oe**	**M1** implied from e.g. $\frac{12}{16}$ and $\frac{4}{16}$, [G : R =] 12: 4 Do not award this mark if they then go on to e.g. use 3 and 1 in working on the tree diagram in both stages for the probabilities but allow the FT method marks for the products or probabilities For **M3**, **M2** allow evaluated products e.g. for **M3** allow $\frac{132}{240}+\frac{12}{240}$ **oe** provided tree diagram given with individual probabilities shown **M2** not awarded if part of a larger product of probabilities For **M3, M2, M1 FT** *their* green and red e.g. green 3 and red 1 **M3** for $\frac{3}{4}\times\frac{2}{3}+\frac{1}{4}\times\frac{0}{3}$[answer $\frac{1}{2}$ **oe**] **M2** for $\frac{3}{4}\times\frac{2}{3}$ **or** $\frac{1}{4}\times\frac{0}{3}$ **M1** for $\frac{3}{4}$ **and** $\frac{2}{3}$ **or** $\frac{3}{4}$ **and** $\frac{0}{3}$ **or** $\frac{1}{4}$ **and** $\frac{2}{3}$ **or** $\frac{3}{4}$ **and** $\frac{0}{3}$
			Total	**5**		
26			0.36 oe nfww	4	**M3** for $0.5^2 + 0.3^2 + 0.1^2 + 0.1^2$ oe or **M2** for 0.5^2 oe and 0.3^2 oe and 0.1^2 or **M1** for 0.5^2 oe or 0.3^2 oe or 0.1^2 oe	**M2** for correct method spoilt e.g. $\frac{(0.5^2 + 0.3^2 + 0.1^2 + 0.1^2)}{4}$ Likely equivalents: 0.5^2 = 0.25 or $\frac{1}{4}$ or 25% 0.3^2 = 0.09 or $\frac{9}{100}$ or 9% 0.1^2 = 0.01 or $\frac{1}{100}$ or 1%
			Total	**4**		
27			298 598 400 with correct working	4		

					B1 for 900 or 9 × 100 or 9 × 10 × 10 AND **M2** for 24 × *their* 900 × 24 × 24 × 24 oe or **M1** for 24 [× …] × 24 or 24 × *their* 900 [× …] or for 24,9,10,10,24,24,24 in any order If 0 or 1 scored, instead award **SC2** for 298 598 400 with no working If 0 scored, instead award **SC1** for 24 × *their* 900 × 24 × 24 × 24	"correct working" requires at least **M1** Allow 9 × 100 or 9 × 10 × 10 or 899 for *their* 900 e.g. **M1** for 24 × 5 × *their* 900 or for 24 × 23 × *their* 900 × 22 × 21 × 20 Accept list, summed, or on diagram
			Total	**4**		
28	a		<table><tr><td></td><td>2</td><td>3</td><td>4</td></tr><tr><td>2</td><td>4</td><td>6</td><td>8</td></tr><tr><td>3</td><td>6</td><td>9</td><td>12</td></tr><tr><td>4</td><td>8</td><td>12</td><td></td></tr></table>	2	**B1** for at least 7 correct values in the table	
	b		$\frac{4}{16}$ oe	1FT		lsw if final answer comes from simplifying $\frac{4}{16}$ Accept decimal, percentage with % but not ratio or "in".
	c		$\frac{12}{16}$ oe	1FT		lsw if final answer comes from simplifying $\frac{12}{16}$ Do not penalise ratio or "in" if already penalised in (b)
			Total	**4**		

29	a		54	4	**B3** for $x = 15$ or **M2** for $3(x + 11) = 2(x + 24)$ oe or better or for 39 : 26 seen or **M1** $(x + 11)$ and $(x + 24)$ seen or better	For M2 accept [P =] 39 and [F =] 26 (An answer of 69 may indicate this but check working for 39 and 26) For M1, could appear as $\overset{3}{x+24}$ $\overset{2}{x+11}$ or e.g. $3y = 24 + x$ and $2y = x + 11$
	b		$\frac{8}{13}$ oe	2FT	**B2FT** for $\frac{24}{\text{their(a)} - 15}$ dep on $0 <$ answer < 1 or **B1** for numerator $8n$ or for denominator $13n$ or *their* (a) – 15	isw cancelling/conversion after correct answer seen For FT - if fraction is simplified or given as a decimal check for equivalents for B2FT or B1 **B1** must be part of a proper fraction $0 < P < 1$
			Total	**6**		
30			$\frac{108}{210}$ oe	4	**B1** for $\frac{8}{14}$ or $\frac{6}{14}$ or $\frac{9}{14}$ or $\frac{5}{14}$ **M1** for $\frac{9}{15} \times \frac{6}{14}$ or $\frac{6}{15} \times \frac{9}{14}$ or $\frac{54}{210}$ oe **M1** for $2 \times$ *their* $\frac{54}{210}$ oe (must be $2 \times$ a product) If **0** scored allow **SC2** for answer $\frac{108}{225}$ oe or **SC1** for answer $\frac{54}{225}$ oe	May be on a diagram or in a calculation Common equivalents for **4** marks include $\frac{54}{105}, \frac{36}{70}, \frac{18}{35}$ or 0.514… or 51.4…%, condone 0.51 with evidence of some correct working Alternative method **B1** as in mark scheme **M1** for $\frac{9}{15} \times \frac{8}{14} + \frac{6}{15} \times \frac{5}{14}$ or $\frac{102}{210}$ oe **M1** for $1 - \frac{102}{210}$ oe equivs. e.g. 0.48 or

						48% equivs. e.g. 0.24 or 24%
			Total	**4**		
31	a		336	2	**M1** for 6 × 7 × 8 or 6 × 56 or 42 × 8 or 48 × 7 If **0** scored **SC1** for 7 × 7 × 8	Condone for **M1** e.g. $\frac{18}{336}$
	b		$\frac{18}{336}$ oe	2	**M1** for 3 × 2 × 3 or 18 or $\frac{3}{6}\times\frac{2}{7}\times\frac{3}{8}$ **FT** 336 from *their* answer to **(a)** for **2** marks i.e. $\frac{18}{\textit{their}\ 336}$ If **0** scored **SC2** for $\frac{24}{392}$	Equivs. include $\frac{9}{168}$, $\frac{6}{112}$, $\frac{3}{56}$, 0.054, 0.0536 and 0.05357… and allow percentages with sign e.g. 5.4%, isw changing form after correct answer seen
			Total	**4**		
32	a			3	**B2** for 13, 5 or 10 correctly placed Or **B1** for the total of F = 18 or for the total of G = 15 or for all 3 regions add up to 28 or for 18 – *x*, *x*, 15 – *x*	Do not accept a blank region to represent 0
	b		$\frac{65}{248}$ **oe** or 0.262(…) with correct working	5	**B1** for $\frac{13}{32}$ **oe soi** or $\frac{10}{32}$ **soi** **M1** for P(F only, G only) [+] P(G only, F only)	'Correct working' requires evidence of at least **M1M1** e.g. correct branches identified on tree or implied by *their* subsequent calculation FT *their* **(a)**

					M1 for P(F only, G only) = $\frac{\text{their } 13}{32} \times \frac{\text{their } 10}{31 \text{ or } 32}$ or $\frac{\text{their } 10}{32} \times \frac{\text{their } 13}{31 \text{ or } 32}$ **A1** for $\frac{130}{992}$ or $\frac{65}{496}$ or 0.131(…) If **0**, **1** or **2** scored, instead award **SC3** for answer $\frac{65}{248}$ **oe** or 0.262(…) with no or insufficient working If **0** or **1** scored, instead award **SC2** for $\frac{130}{992}$ or $\frac{65}{496}$ or 0.131(…) with no or insufficient working If **0** scored **SC1** for $\frac{130}{512}$ or $\frac{65}{256}$, or 0.253[9..] to 0.254 with no working	*Their* 13 and *their* 10 are FT *their* **(a)** Likely incorrect answers with working: **B1M1M1** for answer $\frac{260}{1024}$ or $\frac{130}{512}$, $\frac{65}{256}$ or 0.253[9…] to 0.254 **B1M0M1** for answer $\frac{130}{1024}$ or $\frac{65}{512}$ or 0.127 or 0.1269[...]
			Total	**8**		
33			$\frac{6}{20}$ **oe** with correct working	5	With *x* representing the number of laptop and tablet: **B3** for [laptop and tablet =] 6 may be on a Venn diagram **oe** Or **M2** for [*x* =] 26 + 20 + 10 – 50 **oe** Or **M1** for 26 – *x* + *x* + 20 – *x* + 10 = 50 **oe** or for Venn diagram with 26 – *x*, *x* and 20 – *x* correctly placed	**isw** cancelling / conversion to other forms For full marks 'correct working' requires **B3** i.e. [laptop and tablet =] 6 with evidence of **M1** or **M2** or alternative convincing approach **M1** FT *their* 6 provided < 20 For Venn diagrams, condone omission of universal set, rectangle and 10 for **M1**, **M2**, **B3** and full marks

					AND **M1** for fraction $\frac{n}{20}$ or $\frac{6}{n}$ that leads to the answer If **0** scored **SC2** for $\frac{6}{20}$ **oe** with no working	For **M1** must be a proper fraction
			Total	**5**		
34	a		$\frac{29}{70}$ oe	2	**B1** for 11 + 18 or 29 or for $\frac{n}{25+11+18+16}$ or $\frac{n}{70}$ with n < 70 **Examiner's Comments** Most candidates gave the correct response. Common errors were to think there were only 18 customers asking for sugar rather than 11 + 18, or to not count the 16 who had neither milk nor sugar as customers.	Accept 0.41[4…] or 41[.4…]%
	b		$\frac{11}{36}$ oe	2	**B1** for $\frac{11}{n}$ with n > 11 or for $\frac{n}{25+11}$ or $\frac{n}{36}$ with n < 36 **Examiner's Comments** Most candidates gave the correct numerator of 11, but some did not appreciate the conditional nature of the demand and so had a denominator of 70 again rather than 36. **Assessment for learning** The phrase 'given that' is often used to provide information about a conditional situation.	Accept 0.30[5..] to 0.31 or as %
			Total	**4**		
35			Yes and $\frac{336}{720}$ **oe** or better with correct working	5		"Correct working" requires **M4**

						For 5 marks oe or better e.g. $\frac{7}{15}, \frac{21}{45}$ 0.467 or 0.4666..
					M4 for $3\times\frac{8}{10}\times\frac{7}{9}\times\frac{2}{8}$ **oe**	
					or **M3** for $k\times\frac{8}{10}\times\frac{7}{9}\times\frac{2}{8}$ **oe**	where k = 1 or 2
					or **M2** for $\frac{8}{10}, \frac{7}{9}$ and $\frac{2}{8}$ **oe** used	
					or **M1** for $\frac{8}{10}$ **oe** seen	
					or for three combinations **soi** BBR, BRB, RBB	
					<u>Alternative Method:</u>	
					M4 for $3\times\frac{\frac{8}{22}\times\frac{7}{21}\times\frac{2}{20}}{\frac{10}{22}\times\frac{9}{21}\times\frac{8}{20}}$ **oe**	
					or **M3** for $k\times\frac{\frac{8}{22}\times\frac{7}{21}\times\frac{2}{20}}{\frac{10}{22}\times\frac{9}{21}\times\frac{8}{20}}$ **oe**	where k = 1 or 2
					or **M2** for $\frac{10}{22}\times\frac{9}{21}\times\frac{8}{20}$ **oe** or $\frac{8}{22}\times\frac{7}{21}\times\frac{2}{20}$ **oe**	
					or **M1** for $\frac{10}{22}$ **oe** seen or $\frac{8}{22}$ **oe** seen	
					If **0** or **M1** scored, instead award	<u>With replacement</u> (apply similar to the alternative method):
					SC2 for answer $\frac{336}{720}$ **oe** (or better) with no or insufficient working	**SC2** for $3\times\frac{8}{10}\times\frac{8}{10}\times\frac{2}{10}$ **oe** $\left[\frac{48}{125}\right]$ or **SC1** for $k\times\frac{8}{10}\times\frac{8}{10}\times\frac{2}{10}$ **oe** (k = 1 or 2)
					If **0** scored, instead award	
					SC1 for answer $\frac{112}{720}$ or $\frac{224}{720}$ **oe** (or better) with no or insufficient working	<u>Circle condition missed</u> (apply similar to the alternative method):
						SC2 for $3\times\frac{11}{22}\times\frac{10}{21}\times\frac{11}{20}$ **oe** $\left[\frac{11}{28}\right]$
						or **SC1** for $k\times\frac{11}{22}\times\frac{10}{21}\times\frac{11}{20}$ **oe** (k = 1 or 2)

					Examiner's Comments There were a small number of fully correct solutions to this challenging question, although, many candidates were given a mark for writing a single relevant probability that could be used as a starting point. Most did not consider the condition that Riley's cards all have a circle and incorrect probabilities out of 11 and 22 were often seen. Very few considered a product of three probabilities within their working.
			Total	**5**	
36	a		0.4 and 0.6 oe on the correct branches	3	**B1** for 0.4 or 0.6 oe **M1** for 0.4 and 0.6 on first branch or on all second branches in the correct places If **0** scored **SC1** for two probabilities consistently placed and adding to 1 Accept equivalent fractions $\frac{1}{5}$ and $\frac{3}{5}$ **Examiner's Comments** Most candidates found $\frac{2}{5}$ and $\frac{3}{5}$ but some only put these probabilities on the first branch, with many going on to put $\frac{1}{3}$ and $\frac{2}{3}$ or $\frac{1}{4}$ and $\frac{3}{4}$ on the second branches. Despite this being a probability tree, some candidates wrote integers in the spaces.
	b		0.64 or $\frac{16}{25}$ oe	3	**FT** for **M1** and **M2** and **3** from *their* 0.6 and *their* 0.4 throughout providing *their* 0.6 + *their* 0.4 = 1 **M2** for correct method e.g. 1 – *their* 0.6 × *their* 0.6 oe or **M1** for one correct branch e.g. *their* 0.6 × *their* 0.6 or *their* 0.4 × *their* 0.6 Accept 64% for **3** marks e.g. **M2** for $\textit{their}\frac{2}{5}+\textit{their}\frac{3}{5}\times\textit{their}\frac{2}{5}$ for one correct branch condone just P(win) e.g. $\textit{their}\frac{2}{5}$ **Examiner's Comments** Most candidates did write down one correct product, but many only wrote down the two products that lead to the probability of exactly one win when they were

					asked for the probability at least one win. Most did multiply the two probabilities on successive branches and add together the alternatives, although some multiplied all the probabilities together.
	c		any correct reason e.g. the answer will be smaller	1	Their answer should explain the effect on the answer to part (b), ignore calculations, see appendix [the answer] it will be smaller **1** the probability of winning will decrease **1bod** The probability of losing will increase **1 bod** They win less games **0** the answer will change because the probabilities have changed **0** the probability of losing will decrease **0** the probability of winning will increase **0** **Examiner's Comments** The question asks for the effect on the answer to part (b), but many candidates discussed how many games they are likely to win and some started to do calculations. Some thought that there would be a greater chance of winning. Still there were many correct responses to this question.
			Total	**7**	
37	a		36 19 41 4	3	**B2** for 36 or 19 or 41 correctly placed or **B1** for the total of F = 55 or for the total of S = 60 or F∩S' + (F∩ S) + F'∩S = 96 Do not accept a blank region as 0, for any marks we need to see a number in each region **Examiner's Comments** While many candidates answered this question correctly, many lacked the concept needed to ensure that each whole circle relates to one group. The two

					most common errors demonstrated this, having either the correct totals for those who visited Spain and for those that visited France yet their overall total wasn't 100, or had the correct total of 100 yet the totals for individual countries were incorrect. The most successful method was 60 + 55 + 4 = 119, intersection = 119 − 100 = 19 then subtracting 19 from the two totals for France and Spain. A common error was to forget to include the 4 people who had visited neither country in this calculation (this gave an intersection of 15).
	b	i	$\frac{77}{100}$ or 0.77 or 77%	2	FT $\frac{their(36+41)}{100}$ from *their* **(a)** for **2** or **1** marks or **M1** for *their* (36 + 41) or 77 **FT** if *their* (36 + 41) < 100 and 0 < fraction < 1 **Examiner's Comments** This part of the question was generally answered correctly for their Venn diagram.
		ii	$\frac{19}{60}$ or 0.316 to 0.317 or 0.32	2	FT $\frac{their(19)}{their(19+41)}$ from *their* **(a)** for **2** or **1** marks **B1** for 0.19 oe or $\frac{their19}{k}$ or $\frac{k}{their60}$ (*k* is an integer) Accept e.g. 32% or 31.6 to 31.7% for **2** marks from *their* **(a)** and 0 < fraction < 1 **Examiner's Comments** Many candidates did not understand that they were finding the probability of a person being selected from the 60 who had visited Spain. From this error, a very common wrong answer was $\frac{19}{100}$ or 19% (or their equivalent of these, if their Venn diagram was not correct), instead of $\frac{19}{60}$.
			Total	**7**	

38			$\frac{1332}{2520}$ oe or 0.53 or 0.529 or 0.5286 or 0.52857… or 53% or 52.9%, 52.86% or 52.857% with correct working	5	**M4** for $1-\frac{12}{14}\times\frac{9}{12}\times\frac{11}{15}$ oe OR **M3** for $\frac{12}{14}\times\frac{9}{12}\times\frac{11}{15}$ OR **M1** for $\frac{2}{14}\times\frac{3}{12}\times\frac{4}{15}$ OR **M1** for [total choices=] 14 × 12 × 15 implied by 2520 and **M3** for (2 × 12 × 15) + (12 × 3 × 15) + (12 × 9 × 4) or 360 + 540 + 432 implied by 1332 or **M2** for (2 × 12 × 15) + (14 × 3 × 15) + (14 × 12 × 4) or 360 + 630 + 672 implied by 1662 or **M1** for one bracketed term correct from the **M3** expression e.g 2 × 12 × 15 OR	"Correct working requires evidence of at least **M3** or **M1M1M1** Equivs. Include $\frac{666}{1260}, \frac{333}{630}, \frac{111}{210}, \frac{37}{70}$ condone $\frac{1}{14}\times\frac{1}{12}\times\frac{1}{15}\left[=\frac{1}{2520}\right]$ for **M1** [total choices] <u>Alternative equivalent methods</u> **M4** for fully correct method leading to *their* 2520 and *their* 1332 or **M1** for [total choices=] 14 × 12 × 15 implied by 2520 and **M3** for (2×3×4) + (12×3×4+2×9×4+2×3×11) + (2×9×11+12×3×11+12×9×4) or (24) + (144 + 72 + 66) + (198 + 396 + 432) implied by 1332 or **M2** for this expression with at least two of the bracketed terms correct or

					M1 for [total choices=] 14 × 12 × 15 implied by 2520 and **M2** for [choices no languages=] (14 – 2) × (12 – 3) × (15 – 4) implied by 1188 or **M1** for this expression with one error and **M1** for *their* 2520– *their* 1188 or 1332 If **0** or **M1** scored **SC2** for correct answer with no or insufficient working Note : For MR see appendix	**M1** for at least one of the bracketed terms correct or any three of the individual terms correct e.g 2 × 3 × 4 <u>Use of tree diagrams</u>

<u>Using tree diagrams :</u>

M4 for method A: $1-\frac{12}{14}\times\frac{9}{12}\times\frac{11}{15}$ oe

e.g. method B : $\frac{2}{14}\times\frac{3}{12}\times\frac{4}{15}+\frac{2}{14}\times\frac{3}{12}\times\frac{11}{15}+\frac{2}{14}\times\frac{9}{12}\times\frac{4}{15}+\frac{12}{14}\times\frac{3}{12}\times\frac{4}{15}+\frac{2}{14}\times\frac{9}{12}\times\frac{11}{15}+\frac{12}{14}\times\frac{3}{12}\times\frac{11}{15}+\frac{12}{14}\times\frac{9}{12}\times\frac{4}{15}$

M3 for $\frac{12}{14}\times\frac{9}{12}\times\frac{11}{15}$ or method B with at least five relevant branches correct

or

M2 for method B with at least four relevant branches correct

or

M1 for method B with at least one relevant branch correct

<u>Misreads</u>

Some candidates read this as 16, 15 and 19 subjects. Treat this as a misread (MR) so the mark scheme for them will be (max. of **4** marks):

M4 for $1-\frac{14}{16}\times\frac{12}{15}\times\frac{15}{19}$ oe implied by answer $\frac{2040}{4560}=\frac{102}{228}=\frac{51}{114}=\frac{17}{38}$ or 0.447368…..etc rot to at least 3 s.f.

OR **M3** for $\frac{14}{16}\times\frac{12}{15}\times\frac{15}{19}$ oe implied by $\frac{2520}{4560}=\frac{126}{228}=\frac{63}{114}=\frac{21}{38}$ or 0.55263…etc rot to at least 3 s.f.

OR

					M1 for [total choices=] 16 × 15 × 19 implied by 4560 AND **M3** for 2 × 15 × 19 + 14 × 3 × 19 + 14 × 12 × 4 or 570 + 798 + 672 implied by 2040 or **M2** for 2 × 15 × 19 + 16 × 3 × 19 + 16 × 15 × 4 or 570 + 912 + 960 implied by 2442 or **M1** for this expression with one term correct or at least 5 numbers correct OR **M1** for [total choices=] 16 × 15 × 19 implied by 4560 **M2** for [choices no langs =] (16 – 2) × (15 – 3) × (19 – 4) implied by 2520 or **M1** for this expression with one error and **M1** for *their* 4560 – *their* 2520 <u>Alternative equivalent methods</u> **M4** for fully correct method leading to *their* 4560 and *their* 2040 or **M1** for [total choices=] 16 × 15 × 19 implied by 4560 and **M3** for (2×3×4) + (14×3×4 + 2×12×4 + 2×3×15) + (2×12×15 + 14×3×15 + 14×12×4) or (24) + (168 + 96 + 90) + (360 + 630 + 672) or 2040 or **M2** for two of the bracketed terms or **M1** for one of the bracketed terms or any three of the individual terms correct **<u>Examiner's Comments</u>** This question was intended to assess arrangements, particularly using the product rule for counting the numbers of outcomes. Some attempted to use probability, which made the problem even more challenging. However many candidates struggled to access the context of this question; many candidates were able to find the total number of arrangements, but nothing else. Some candidates misread the question and thus attempted the question with initially incorrect values, so a scheme for marking these was included in the mark scheme appendix.
			Total	**5**	
39	a		Tuesday [0].65 oe and [0].35 oe in the correct places and Wednesday [0].65 oe with	2	**B1** for one pair of probabilities correct in one branch e.g

			[0].35 oe and [0].3 oe with [0].7 oe in the correct places		Tuesday or one of the Wednesday branches	
					Examiner's Comments Many correct tree diagrams were seen and these were overall better than in previous years. The common errors were in Wednesday's second branch to write 0.7 for 'Rain' and 0.3 for 'No Rain', or to write 0.65 for all 'Rain's and 0.3 for all 'No Rain's.	
	b		[0].5275 or [0].528 or 0.53 or $\frac{211}{400}$ oe nfww	3	**M2** for [0].65 × [0].65 + [0].35 × [0].3 oe or **M1** for [0].65 × [0].65 or [0].35 × [0].3 oe implied by .4225 or .105 or $\frac{169}{400}$ or $\frac{21}{200}$ oe	If **(a)** is not correct **FT** *their* tree for **3** marks**,** **M2** and **M1** Allow 52.75%, 52.8% 53% for **3** marks
					Examiner's Comments There were many correct solutions, the two main errors being just considering one branch (either 0.65 × 0.65 or 0.65 × 0.3). Many candidates were awarded follow through marks for a correct answer from their incorrect tree diagram.	
			Total	**5**		
40			$\frac{1}{3}$ oe with correct working	5	**M1** for blue = 20 and yellow = 5	Correct working" requires evidence of M1 and M3 or convincing alternate approach M1 implied from e.g. $\frac{20}{25}$ and $\frac{5}{25}$, [B : Y =] 20: 5 Do not award this mark if they then go on to e.g. use 4 and 1 in

						working on the tree diagram in both stages for the probabilities but allow the FT method marks for the products or probabilities
					M3 for $\frac{5}{25}\times\frac{20}{24}+\frac{20}{25}\times\frac{5}{24}$ oe or **M2** for $\frac{5}{25}\times\frac{20}{24}$ oe	For M3, M2 allow evaluated products e.g. for M3 allow $\frac{100}{600}+\frac{100}{600}$ oe provided tree diagram given with individual probabilities shown. M2 not awarded if part of a larger product of probabilities
					or **M1** for correct tree diagram or sample space	
					or for $\frac{5}{25}$ and $\frac{20}{24}$ or $\frac{20}{25}$ and $\frac{5}{24}$ oe seen	For M3, M2, M1 FT *their* blue and yellow e.g. blue 4 and yellow 1 M3 for $\frac{4}{5}\times\frac{1}{4}+\frac{1}{5}\times\frac{4}{4}$ [answer $\frac{2}{5}$ oe] M2 for $\frac{4}{5}\times\frac{1}{4}$ or $\frac{1}{5}\times\frac{4}{4}$ M1 for $\frac{4}{5}$ and $\frac{1}{4}$
					If 0 scored, **SC1** for correct answer with no or insufficient working or for P(B) = $\frac{4}{5}$ oe and P(Y) = $\frac{1}{5}$ oe	
					Examiner's Comments Many candidates were successful with this question and the majority used a tree diagram to structure the problem. Almost all candidates were able to score at least 1 mark for finding the number of blue and yellow counters, or for working with some correct probabilities within their working. Most used fractions for the probabilities; those that used decimals such as 0.8 and 0.2 for the first disc often made errors with the probabilities for the second disc owing to the dependency of the second probability on the first. Some candidates incorrectly treated the problem as a 'with replacement' problem and gave the same	

					probabilities for the second disc as the first disc. For those showing the correct products of probabilities, many were able to multiply the fractions correctly and then add the two correct pairs. Some used unsimplified fractions for the products and made errors in multiplying the denominators (24 × 25). Other errors occurred in adding the product pairs, $\frac{1}{6}+\frac{1}{6}=\frac{2}{12}$. A common error for those using tree diagrams was to record the first stage probabilities as simplified fractions $\frac{1}{5}$ and $\frac{4}{5}$ and then to use $\frac{0}{4}, \frac{4}{4}, \frac{3}{4}$ and $\frac{1}{4}$ for the second stage probabilities, thinking there were 5 discs in the bag originally. In this case the second stage probabilities were a correct 'follow through' of the first stage without replacement and so method marks for the products were available; many scored 3 marks for a correct method shown with their probabilities (which led to an answer of $\frac{2}{5}$ in this case). There were other cases of this where the first stage probabilities were incorrect, but the second stage correctly followed through and method marks were then earned for the products. Most understood when to multiply and when to add probabilities in their method. **Assessment for learning** When recording fractional probabilities on a tree diagram, it is better to record unsimplified fractions on the branches to make sure that where the second stage probabilities are dependent on the first, the values used for the second stage are more easily recognised. Answers to probability questions do not need to be given as unsimplified fractions unless the question specifically requests that.
			Total	**5**	
41	a		The two events are dependent oe and $\frac{40}{60}\times\frac{39}{59}$ isw	2	**B1** for either Accept e.g. The second probability is not $\frac{2}{3}$ oe

					The second probability is wrong oe The second probability is $\frac{39}{59}$ There is one less for the second pick oe It is out of 59 for the 2nd pick oe Any incorrect statement is B0	
					Examiner's Comments This question was omitted by a significant number of candidates. A few referred to the second probability being incorrect which was the minimal answer to the first part. Some gave the second probability correctly as $\frac{39}{59}$. Many went to the values in the table and gave answers such as $\frac{30}{60}\times\frac{10}{60}$ or similar.	
	b		$\frac{48}{95}$ oe with correct working	5	**M4** for $2\left(\frac{8}{20}\times\frac{12}{19}\right)$ oe or **M3** for $\frac{8}{20}\times\frac{12}{19}$ oe or **M2** for $\frac{8}{20}$ and $\frac{12}{19}$ or $\frac{8}{19}$ and $\frac{12}{20}$ oe seen or **M1** for $\frac{8}{20}$ or $\frac{12}{20}$ oe seen If **0** or **M1** scored, instead award **SC2** for $\frac{8}{n}\times\frac{12}{n-1}$ oe or for $2\left(\frac{8}{20}\times\frac{12}{20}\right)$ oe or for answer $\frac{48}{95}$ oe with no or insufficient working	'Correct working' needs evidence of M2 Must be proper fractions and $n \leq 60$

					If **0** scored **SC1** for $\frac{8}{n}$ and $\frac{12}{n-1}$ or $\frac{8}{n-1}$ and $\frac{12}{n}$ seen or for answers $\frac{24}{95}$ oe or $\frac{12}{25}$ oe with no or insufficient working	Must be proper fractions and $n \leq 60$
					Examiner's Comments This part proved very challenging for all candidates. The few that attempted to multiply probabilities did not regard the two events as dependent and missed the fact that the choice was from those who took 50 seconds or less, not all 60 students. Calculations typically had only the numerators correct, such as $\frac{12}{60} \times \frac{8}{60}$. The majority did not attempt a product of probabilities, but partial credit was earned by some for stating $\frac{12}{20}$ or $\frac{8}{20}$.	
			Total	**7**		
42			1080	3	**M2** for 8 × 9 × 15 or **M1** for 8 × 9 × 15 with at most one error If **0** scored award **SC2** for $\frac{1}{8} \times \frac{1}{9} \times \frac{1}{15}$ or $\frac{1}{1080}$ or **SC1** for 1 × 1 × 2 = 2	e.g. **M1** for 8 × 9 × 17 or 1224 condone 8 × 9 × 1 for **M1** not 8 × 9
					Examiner's Comments Many different methods were seen and few candidates answered this correctly. A few treated all the milk chocolates as the same and all the plain chocolates as the same, giving the answer 2 from 1 × 1 × 2. A common error was to calculate 8 × 9 × 17.	
			Total	**3**		
43	a		[0].0625 or $\frac{6}{96}$ oe or 6.25%	1		

					e.g. $\frac{1}{16}$ but not in words or as a ratio	
					Examiner's Comments Some candidates did not know what the relative frequency was and omitted this question. Others incorrectly wrote an answer of 96 – 6 as 90 or as a ratio 16 : 1. The correct response was seen in all of its equivalent forms. Answers in percentages had to have the percentage symbol.	
	b		770	2	**FT** *their* (a) for **2** marks, answer must be an integer **M1** for 12 321 × *their* [0].0625 or 12 320 × *their* [0].0625	condone 771 as answer. **M1** implied by 770.06… or 770.1
					Examiner's Comments There were several blank responses, though many did do the correct working. A few did not round the answer to an integer so were credited with 1 mark. The most common error was to divide 12 321 by 96.	
			Total	**3**		
44			$\frac{17}{25}$ or 0.68 or 68%	2	**B1** for $\frac{17}{n}$ or $\frac{n}{25}$ and it must be a proper fraction **Examiner's Comments** Candidates usually gave the correct numerator, but the denominator was often 49 or 60 so typical incorrect answers were $\frac{17}{49}$ or $\frac{17}{60}$. The other common incorrect answer was the probability of getting an electric car, $\frac{41}{60}$.	
			Total	**2**		
45	a		280	2		

					M1 for 5 × 8 × 7 or 5 × 56 or 40 × 7 or 35 × 8 If **0** scored **SC1** for 6 × 8 × 7	Condone for **M1** e.g. $\frac{12}{280}$
					Examiner's Comments Those candidates who used the product rule gave the correct answer. Some attempted to work out the number from first principles and make a list and this was usually unsuccessful. There were some who included the '(V) denotes vegetarian' as one choice and the mark scheme did award some credit in both parts for this misunderstanding.	
	b		$\frac{12}{280}$oe	2	**M1** for 2 × 3 × 2 or 12 or $\frac{2}{5}\times\frac{3}{8}\times\frac{2}{7}$ **FT** 280 from *their* answer to **(a)** for **2** marks i.e $\frac{12}{their\ 280}$ If **0** scored **SC2** for $\frac{18}{336}$	Equivs. include $\frac{6}{140}$, $\frac{3}{70}$, 0.043, 0.0429, 0.04286 and 0.04285… and allow percentages with sign e.g 4.3%, isw changing form after correct answer seen
					Examiner's Comments Those candidates who answered part (a) correctly usually answered this part correctly. Some added the possibilities, there are 7 vegetarian courses and 20 choices altogether, so they gave $\frac{7}{20}$as their answer.	
			Total	**4**		
46			$\frac{100}{210}$oe	4	**B1** for $\frac{9}{14}$ or $\frac{5}{14}$ or $\frac{10}{14}$ or $\frac{4}{14}$ **M1** for $\frac{10}{15}\times\frac{5}{14}$ or $\frac{5}{15}\times\frac{10}{14}$ or $\frac{50}{210}$oe **M1** for 2 × *their* $\frac{50}{210}$oe (must be 2 × a product) If **0** scored allow **SC2** for answer $\frac{100}{225}$oe or **SC1** for answer $\frac{50}{225}$oe	May be on a diagram or in a calculation Common equivalents for **4** marks include $\frac{10}{21}$or 0.476… or 47.6…%, condone 0.48 with evidence of some correct working Alt. method **B1** as in mark scheme **M1** for $\frac{10}{15}\times\frac{9}{14}+\frac{5}{15}\times\frac{4}{14}$ or $\frac{110}{210}$oe **M1** for $1\ ^{1-}\frac{110}{210}$oe equivs. e.g. $\frac{20}{45}$, $\frac{4}{9}$0.444.., 44.4..%

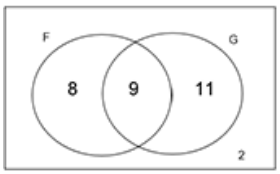
					equivs. e.g. $\frac{10}{45}$, $\frac{2}{9}$, 0.222.., 22.2..% **Examiner's Comments** The most successful candidates usually drew a tree diagram and realised that in the second draw there were just 14 sweets available. Candidates need to read the question carefully because some candidates calculated the probability of taking two of the same type of sweets. Most candidates usually multiplied two probabilities on two branches and then they added their two results together. However, many of these had 13 as a denominator, on the basis that two sweets were taken simultaneously and then another was taken. Candidates cannot always assume a tree diagram will be provided so they need to be able to work out the possibilities on the branches themselves.
			Total	**4**	
47	a		<table><tr><td></td><td>3</td><td>4</td><td>5</td></tr><tr><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>5</td><td>6</td><td>7</td><td></td></tr></table>	2	**B1** for at least 7 correct values in the table **Examiner's Comments** The whole of the first question provided a very positive experience for candidates and it was rare for full marks not to be given. The only error seen in completing the table was an occasional arithmetic slip.
	b		$\frac{8}{16}$oe	1FT	Isw if final answer comes from simplifying $\frac{8}{16}$ Accept decimal, percentage with % but not ratio or "in". **Examiner's Comments** Almost all candidates gave the correct answer of $\frac{8}{16}$or its simplified fraction, decimal or percentage equivalent.
	c		$\frac{4}{16}$oe	1FT	

						lsw if final answer comes from simplifying $\frac{4}{16}$ Do not penalise ratio or "in" if already penalised in (b)
					Examiner's Comments This part of the question was slightly less successfully answered than part (b). $\frac{14}{16}$ was the most common incorrect answer.	
			Total	**4**		
48			0.3 oe nfww	4	**M3** for $0.4^2 + 0.3^2 + 0.2^2 + 0.1^2$ oe or **M2** for 0.4^2 oe and 0.3^2 oe and 0.2^2 oe and 0.1^2 oe or **M1** for 0.4^2 oe or 0.3^2 oe or 0.2^2 oe or 0.1^2 oe	**M2** for correct method spoilt e.g. $\frac{(0.4^2 + 0.3^2 + 0.2^2 + 0.1^2)}{4}$ Likely equivalents: $0.4^2 = 0.16$ or $\frac{4}{25}$ or 16% $0.3^2 = 0.09$ or $\frac{9}{100}$ or 9% $0.2^2 = 0.04$ or $\frac{1}{25}$ or 4% $0.1^2 = 0.01$ or $\frac{1}{100}$ or 1%
					Examiner's Comments Just over half of candidates scored full marks. There was an equal divide between those that drew a tree diagram before answering and those that did not. The most common error was to double each probability and often then find the product of those values. A few candidates gave answers greater than 1 showing a lack of understanding of probability. Some candidates, having reached the correct answer of 0.3, thought they needed to divide by 4, and so spoiled their method and answer.	

					A few candidates ignored the context and given probabilities, and merely repeated their solution to Question 1 parts (a) and (c)
			Total	**4**	
49			716 636 160 with correct working	4	**B1** for 90 or 9 × 10 AND **M2** for 24 × 24 × *their* 90 × 24 × 24 × 24 oe or **M1** for 24 × 24 [×….] or 24 × *their* 90 [×….] or for 24,24,9, 10,24,24,24 in any order If 0 or 1 scored, instead award **SC2** for 716 636 160 with no working If 0 scored, instead award **SC1** for 26 × 26 × *their* 90 × 26 × 26 × 26 "correct working" requires at least **M1** Allow 9 × 10 or 89 for *their* 90 eg **M1** for 24 × 5 × *their* 90 or for 24 × 23 × *their* 90 × 22 × 21 × 20 Accept list, summed, or on diagram **Examiner's Comments** Many candidates were able to make a reasonable attempt and some did achieve the correct answer of 716 636 160. By far the most common error was thinking that there were 89 possible numbers (from 99 − 10), not realising that this effectively counted the numbers from 11 to 90. Some did use 90, with very few showing the calculation of 9 × 10. Having reached 89 or 90 possible numbers, several used 89 × 89 or 90 × 90 in their calculations. Another common error occurred when finding the number of letters at the beginning and the end. It was common to see calculations such as 2 × 24 and 3 × 24 or 5 × 24. Only a small number made the error of using all 26 letters in their calculations but a few did treat the choice of letters as being without replacement and calculations such as 24 × 23 × 90 × 22 etc. were seen.

					A small number of candidates attempted to work backwards, not realising that using the approximate value was never going to lead to a successful conclusion. There were a few occasions of finding probabilities, with varying degrees of success. Those that realised the denominator gave an indication of the number of combinations were able to gain marks. This was another question where a choice of answers was common, with many instances of multiple attempts at a calculation in an attempt to get a value of 720 million. All too often there was no indication of which combination of numbers to mark, and therefore marks were lost.
			Total	**4**	
50	a		59	4	**B3** for $x = 17$ or **M2** for $2(x + 28) = 5(x + 1)$ oe or better or for 45 : 18 seen For M2 accept [P =] 45 and [R =] 18 (An answer of 76 may indicate this but check working for 45 and 18) or **M1** $(x + 28)$ **and** $(x + 1)$ seen or better For M1, could appear as $\frac{5}{x+28}$ $\frac{2}{x+1}$ or e.g. $5y = 28 + x$ and $2y = x + 1$ **Examiner's Comments** Candidates found this question challenging and very few were able to combine ratio 5 : 2 to form a correct equation using the information given in the Venn diagram. The most successful responses included an equation equivalent to $2(x + 28) = 5(x + 1)$ and continued to find the value of x. A few other candidates were successful in using trial and improvement with values in the ratio 5 : 2 and finding 45 : 18 gave the correct values for set P and set R. Many candidates appeared to be randomly trying values for x, with little success.
	b		$\frac{28}{45}$ oe	2FT	**B2FT** for $\frac{28}{their(a)-14}$ isw cancelling/conversion

					dep on 0 < answer < 1 or **B1** for numerator 28 or for denominator 45 or *their* (a) – 14	For FT - if fraction is simplified or given as a decimal check for equivalents for B2FT or B1 **B1** must be part of a proper fraction 0 < *P* < 1
					Examiner's Comments Those who answered part (a) correctly invariably gave the correct probability in this part. Many other candidates were able to score 1 mark for giving a proper fraction with the numerator 28. A follow through was available for 2 marks from an incorrect answer in part (a) but this was rarely awarded.	
			Total	**6**		
51	a		0.14, 0.09, (0.19), 0.2[0], 0.13, 0.25	2	**B1** for three or four correct relative frequencies in the correct place	Accept fractions
					Examiner's Comments **Misconception** More than half of the candidates were unable to calculate relative frequencies correctly. Some responses included values greater than 1. A common wrong method was to divide the frequency by the dice score and then by 100 (i.e. ÷ 100, ÷ 200, ÷ 300 etc).	
	b	i	[Unbiased dice] would have each [rf=] 0.16 − 0.17 or [Unbiased dice] would have each [f=] 50 or comment about very unequal [relative] frequencies	1		Accept "about 0.16" Accept "about 50" Not enough to say one number was rolled the most. Must say 6 [and 4] or some numbers are much higher or 2 or 5 or some numbers are much lower

			and implied comparison		**Examiner's Comments** In part (i), few candidates were able to use evidence from the table correctly in support of an explanation that the dice might be biased. Most acceptable responses referenced the very large difference between the number of sixes and the number of twos being rolled, or similar. Even fewer candidates recognised the importance of sample size in part (ii). Some candidates used the same evidence and argument for the dice being biased in part (ii).
		ii	need larger sample oe	1	
			Total	**4**	
52	a			3	**B2** for 8, 9 or 11 correctly placed or **B1** for the total of F = 17 or for the total of G = 20 or for all 3 regions add up to 28 or for 17 – *x* , *x*, 20 – *x* Do not accept a blank region to represent 0
	b		88/435 oe or 0.202(…) with correct working	5	**B1** for $\frac{8}{30}$ oe soi or $\frac{11}{30}$ soi **M1** for P(F only, G only) [+] P(G only, F only) **M1** for P(F only, G only) = $\frac{their\ 8}{30} \times \frac{their\ 11}{29\ or\ 30}$ or $\frac{their\ 11}{30} \times \frac{their\ 8}{29\ or\ 30}$ **A1** for 88/870 or 44/435 or 0.101(…) If **0**, **1** or **2** scored, instead award **SC3** for answer 88/435 oe or 0.202(…) with no or insufficient working If **0** or **1** scored, instead award **SC2** for 88/870 or 44/435 or 0.101(…) with no or insufficient working If **0** scored **SC1** for 88/450, 44/225 or 0.195[5..] to 0.196 with no working "Correct working" requires evidence of at least **M1M1** eg correct branches identified on tree or implied by *their* subsequent calculation FT *their* **(a)** *their* 8 and *their* 11 are FT *their* **(a)** Likely incorrect answers with working: **B1M1M1** for answer 88/450, 44/225 or 0.195[5..] to 0.196 **B1M0M1** for answer 88/900, 44/450, 22/225 or 0.097[7..] to 0.098

			Total	**8**		
53			$\frac{15}{27}$ **oe** with correct working	5	With x representing the number of smartphone and tablet: **B3** for [smartphone and tablet =] 15 may be on a Venn diagram **oe** or **M2** for [x =] 40 + 27 + 8 – 60 **oe** or **M1** for 40 – x + x + 27 – x + 8 = 60 **oe** or for Venn diagram with 40 – x, x and 27 – x correctly placed and **M1** for fraction $\frac{n}{27}$ or $\frac{15}{n}$ that leads to the answer If 0 scored **SC2** for $\frac{15}{27}$ **oe** with no working	isw cancelling/conversion to other forms For full marks "correct working" requires B3 ie [smartphone and tablet =] 15 with evidence of M1 or M2 or alternate convincing approach M1 FT *their* 15 provided < 27 For Venn diagrams, condone omission of universal set rectangle and 8 for M1, M2, B3 and full marks For M1 must be a proper fraction
			Total	**5**		
54	a	i	0.2 and 0.8 in all the correct places	2	**B1** for first branch correct or second branches correct	Accept equivalent fractions and percentages (need % sign)
		ii	0.64 or $\frac{16}{25}$oe or 64%	2	**FT** *their* tree for **1** or **2** marks (*their* values < 1) **M1** for 0.8 × 0.8 oe	Allow long method : e.g. 1 – (0.04 + 0.16 + 0.16)
		iii	Suggestion of dependence between the trains or unexpected events or data may not be applicable	1		Accept any correct reason, e.g. if first train is late second train may be held up e.g. unexpected delays can occur e.g. changed schedule that day (implies data not applicable)
	b		0.73[4] or $\frac{734}{1000}$oe or 73.4%	3		

					M2 for 1 – 0.35 × 0.76 or 0.35 × 0.24 + 0.65 × 0.24 + 0.65 × 0.76 oe or **M1** for two correct products or 0.35 × 0.76	e.g. common equivalent $\frac{367}{500}$ products implied by 0.266, 0.084, 0.156, 0.494
			Total	**8**		
55			$\frac{4}{16}$ oe nfww	4	**M2** for 16 correct outcomes shown or for [4 × 4 =] 16 [outcomes] or **M1** for table, list etc, with at least 10 correct outcomes to a maximum of 16 (ignoring repeats) AND **M2FT** for correctly indicating all the primes in *their* outcomes (at least 6) and gives the correct response for *their* outcomes or **M1FT** for writing *their* correct response from *their* outcomes **or** for indicating all the primes in *their* outcomes with maximum one error to a maximum of **3** marks if **0** scored then **SC3** for a correct response from adding 16 outcomes i.e. $\frac{9}{16}$ or **SC2** for a correct response from adding (at least 6 outcomes), primes must be indicated or **SC1** for correct response from adding (at least 6 outcomes), primes are not indicated Note : an alternative method is **M3** for [P(1 with 2,3 OR 2,3 with 1)=] $\frac{1}{4} \times \frac{2}{4} + \frac{2}{4} \times \frac{1}{4}$ or **M2** for the above method with one error or **M1** for a correct tree diagram drawn	<u>M marks are for products</u> The outcomes may be a list or table showing 16 outcomes which may have numbers or ticks and crosses to show primes etc, if just numbers with nothing above 8 assume addition By e.g. shading, underlining or ringing **M1** implied by a correct numerator and a correct denominator for *their* list Note that $\frac{2}{4} \times \frac{2}{4}$ is an incorrect method

			Total	**4**	