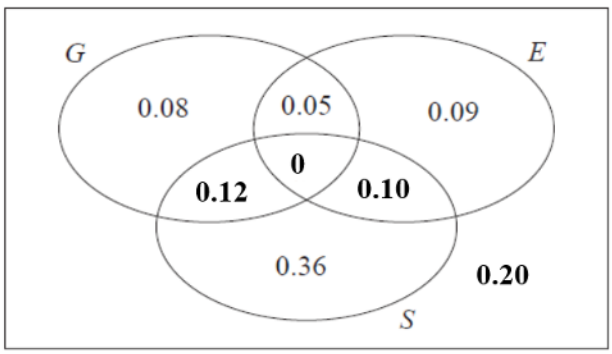
Qu 6	Scheme	Marks	AO
(a)	[Sum of probs = 1 implies] $\log_{36} a + \log_{36} b + \log_{36} c = 1$	M1	3.1a
	$\Rightarrow \log_{36}(abc) = 1$ so $abc = 36$	A1	3.4
	All probabilities greater than 0 implies each of a, b and $c > 1$	B1	2.2a
	$36 = 2^2 \times 3^2$ (or 3 numbers that multiply to give 36 e.g. 2, 2, 9 etc)	dM1	2.1
	Since a, b and c are distinct must be **2, 3, 6** **(a = 2, b = 3, c = 6)**	A1 **(5)**	3.2a
(b)	$(\log_{36} a)^2 + (\log_{36} b)^2 + (\log_{36} c)^2$	M1	3.4
	[= 0.0374137…+ 0.09398737…+0.25]		
	= 0.38140… awrt **0.381**	A1 **(2)**	1.1b
		(7 marks)	

	Notes
(a)	1st M1 for a start to the problem using sum of probabilities leading to eq'n in a, b and c
	1st A1 for reducing to the equation abc = 36 [Must follow from their equation.]
NB	Can go straight from abc = 36 to the answer for full marks for part (a).
	B1 for deducing that each value > 1 (may be implied by 3 integers all > 1 in the next line)
	2nd dM1 (dep on M1A1) for writing 36 as a product of prime factors or 3 values with product = 36 and none = 1
	2nd A1 for 2, 3 and 6 as a list or a = 2, b = 3 and c = 6
SC	**M0M0** If no method marks scored but a correct answer given score: M0A0B1M0A1 (2/5)
Ans only	This gets the SC score of 2/5 [Question says show your working clearly]
(b)	M1 for a correct expression in terms of a, b and c or values; ft their integers a, b and c Condone invisible brackets if the answer implies they are used.
	A1 for awrt 0.381

G.B. Attwood 26/10/2021

Qu 4	Scheme	Marks	AO
(a)	$0.08 + 0.09 + 0.36 = \underline{\mathbf{0.53}}$	B1	1.1b
		(1)	
(b)(i)	$\left[\mathrm{P}(G \cap E \cap S) = 0 \ \Rightarrow\right]$ $\underline{\boldsymbol{p = 0}}$	B1	1.1b
(ii)	$[\mathrm{P}(G) = 0.25 \Rightarrow]\ 0.08 + 0.05 + q + "p" = 0.25$	M1	1.1b
	$\underline{\boldsymbol{q = 0.12}}$	A1	1.1b
		(3)	
(c)(i)	$\left[\mathrm{P}(S \mid E) = \frac{5}{12} \ \Rightarrow\right] \frac{r + "p"}{r + "p" + 0.09 + 0.05} = \frac{5}{12}$	M1	3.1a
		A1ft	1.1b
	$[12r = 5r + 5 \times 0.14 \ \Rightarrow]$ $\underline{\boldsymbol{r = 0.10}}$	A1	1.1b
(ii)	$[0.08 + 0.05 + "0.12" + "0" + 0.09 + "0.10" + 0.36 + t = 1 \ \Rightarrow]$ $\underline{\boldsymbol{t = 0.20}}$	B1ft	1.1b
		(4)	
(d)	$\mathrm{P}(S \cap E') = 0.36 +$ "q" [$= 0.48$]	B1ft	1.1b
	$\mathrm{P}\left(\left[(S \cap E')\right] \cap G\right) =$ "q" [$=0.12$] **and** $\mathrm{P}(G) = 0.25$ **and**	M1	2.1
	$\mathrm{P}(S \cap E') \times \mathrm{P}(G) =$ "0.48" $\times \frac{1}{4}$ or 0.12		
	$\mathrm{P}(S \cap E') \times \mathrm{P}(G) = 0.12 = \mathrm{P}\left(\left[(S \cap E')\right] \cap G\right)$ so **are independent**	A1	2.2a
		(3)	
		(11 marks)	

	Notes
(a)	B1 for 0.53 (or exact equivalent) [Allow 53%]
(b)(i)	B1 for $p = 0$ (may be placed in Venn diagram)
(ii)	M1 for a linear equation for q (ft letter "p" or their value if $0 \leqslant p \leqslant 0.12$) $\Rightarrow$ by $p + q = 0.12$
	A1 for $q = 0.12$ (may be placed in Venn diagram)
(c)(i)	M1 for a ratio of probabilities (r on num and den) (on LHS) with num < den **and** num or den correct ft. Allow ft of letter "p" or their p where $0 \leqslant p < 0.86$ but "+ 0" is not required.
	1st A1ft for a correct ratio of probabilities (on LHS) allowing ft of their p where $0 \leqslant p < 0.86$
	2nd A1 for $r = 0.1(0)$ or exact equivalent (may be in Venn diagram) **Ans only** 3/3
(ii)	B1ft for $t = 0.2(0)$ (o.e.) or correct ft i.e. $0.42 - (p + q + r)$ where p, q, r and t are all probs
(d)	B1ft for $\mathrm{P}(S \cap E') = 0.48$ (with label) (ft letter "q" or their value if $0 \leqslant q \leqslant 0.12$)
	M1 for attempting all required probs (labelled) and using them in a correct test (allow ft of q)
	A1 for **all probs correct** and a correct deduction (no ft deduction here)
SC	**No "P"** If correct argument seen apart from P for probability for all 3 marks, award (B0M1A1)
	If unsure about an attempt using conditional probabilities, please send to review.



Section A: STATISTICS

Qu 1	Scheme	Marks	AO
(a)	c: 0 1 2 3 4 5 6 7 8 P($C = c$): $\frac{1}{9}$ $\frac{1}{9}$ $\frac{1}{9}$ $\frac{1}{9}$ $\frac{1}{9}$ $\frac{1}{9}$ $\frac{1}{9}$ $\frac{1}{9}$ $\frac{1}{9}$	B1 B1ft (2)	1.2 1.2
(b)	P($C < 4$) = $\frac{4}{9}$ (accept 0.444 or better)	B1 (1)	3.4
(c)	Probability lower than expected suggests model is <u>not</u> good	B1ft (1)	3.5a
(d)	e.g. Cloud cover will vary from month to month and place to place So e.g. use a non-uniform distribution	B1 (1)	3.5c
		(5 marks)	

Notes

(a) 1st B1 for a correct set of values for c. Allow $\left\{\frac{1}{8}, \frac{2}{8}, \ldots \frac{8}{8}\right\}$

2nd B1ft for correct probs from their values for c, consistent with discrete uniform distrib'n
Maybe as a prob. function. Allow P($X = x$) = $\frac{1}{9}$ for $0 \leqslant x \leqslant 8$ provided $x = \{0, 1, 2, \ldots, 8\}$ is clearly defined somewhere.

(b) B1 for using correct model to get $\frac{4}{9}$ (o.e.)

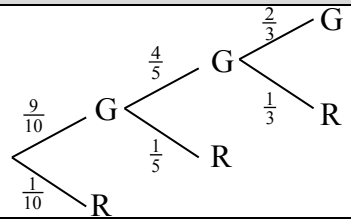
SC **Sample space {1, …, 8}** If scored B0B1 in (a) for this allow P($C < 4$) = $\frac{3}{8}$ to score B1 in (b)

(c) B1ft for comment that states that the model proposed is or is not a good one based on their model in part (a) and their probability in (b)
|(b) – 0.315| > 0.05 Allow e.g. "it is not suitable"; "it is not accurate" etc
|(b) – 0.315| ⩽ 0.05 Allow a comment that suggests it <u>is</u> suitable
No prob in (b) Allow a comparison that mentions 50% or 0.5 and rejects the model
No prob in (b) and no 50% or 0.5 or **(b) > 1** scores B0
Ignore any comments about location or weather patterns.

(d) B1 for a sensible refinement considering variations in month or location
Just saying "not uniform" is B0
Context & "non-uniform" Allow mention of different locations, months <u>and</u> non-uniform <u>or</u> use more locations to form a new distribution with probabilities based on frequencies
Context & "binomial" Allow mention of different locations, months <u>and</u> binomial
Just refined model Model must be outlined and discrete and non-uniform
e.g. higher probabilities for more cloud cover <u>or</u> lower probabilities for less cloud cover
Continuous model Any model that is based on a continuous distribution. e.g. normal is B0

Qu 3	Scheme	Marks	AO
(a)	The probability of a dart hitting the target is constant (from child to child and for each throw by each child) (o.e.)	B1	1.2
	The throws of each of the darts are independent (o.e.)	B1 (2)	1.2
(b)	[P($H \geqslant 4$) = 1 – P($H \leqslant 3$) = 1 – 0.9872 = 0.012795.. =] awrt **0.0128**	B1 (1)	1.1b
(c)	P($F = 5$) = $0.9^4 \times 0.1$, = 0.06561 = awrt **0.0656**	M1, A1 (2)	3.4 1.1b
(d)	n | 1 | 2 | … | 10 P($F = n$) | 0.01 | $0.01 + \alpha$ | … | $0.01+9\alpha$	M1	3.1b
	Sum of probs = 1 $\Rightarrow \frac{10}{2}[2\times 0.01+9\alpha]=1$	M1A1	3.1a 1.1b
	[i.e. $5(0.02 + 9\alpha) = 1$ or $0.1 + 45\alpha = 1$] so α = **0.02**	A1 (4)	1.1b
(e)	P($F = 5$| Thomas' model) = **0.09**	B1ft (1)	3.4
(f)	Peta's model assumes the probability of hitting target is constant (o.e.) **and** Thomas' model assumes this probability increases with each attempt(o.e.)	B1 (1)	3.5a
		(11 marks)	

	Notes
(a)	1st B1 for stating that the probability (or possibility or chance) is constant (or fixed or same) 2nd B1 for stating that throws are independent ["trials" are independent is B0]
(b)	B1 for awrt 0.0128 (found on calculator)
(c)	M1 for a probability expression of the form $(1-p)^4 \times p$ where $0 < p < 1$ A1 for awrt 0.0656 **SC** Allow M1A0 for answer only of 0.066
(d)	1st M1 for setting up the distribution of F with at least 3 correct values of n and P($F = n$) in terms of α. (Can be implied by 2nd M1 or 1st A1) 2nd M1 for use of sum of probs = 1 **and** clear summation or use of arithmetic series formula (allow 1 error or missing term). (Can be implied by 1st A1) 1st A1 for a correct equation for α 2nd A1 for α = 0.02 (must be exact and come from correct working)
(e)	B1ft for value resulting from $0.01 + 4\times$"their α" (provided α and the answer are probs) **Beware** If their answer is the same as their (c) (or a rounded version of their (c)) score B0
(f) **ALT**	B1 for a suitable comment about the probability of hitting the target Allow idea that Peta's model suggests the dart may never hit the target but Thomas' says that it will hit at least once (in the first 10 throws).

Question	Scheme	Marks	AOs
1(a)		B1 dB1	1.1b 1.1b
		(2)	
(b)	$\frac{9}{10}\times\frac{4}{5}\times\frac{2}{3}$	M1	1.1b
	$=\frac{12}{25}(=0.48)$	A1	1.1b
		(2)	
(c)	$\frac{9}{10}\times\frac{1}{5}+\frac{9}{10}\times\frac{4}{5}\times\frac{1}{3}$ or $1-\left(\frac{1}{10}+\frac{9}{10}\times\frac{4}{5}\times\frac{2}{3}\right)$	M1	3.1b
	$=\frac{21}{50}$ $(=0.42)$	A1	1.1b
		(2)	
(d)	[P(Red from B|Red selected)] $=\frac{\frac{9}{10}\times\frac{1}{5}}{\frac{1}{10}+\frac{9}{10}\times\frac{1}{5}+\frac{9}{10}\times\frac{4}{5}\times\frac{1}{3}}\left[=\frac{\frac{9}{50}}{\frac{13}{25}}\right]$	M1	3.1b
	$=\frac{9}{26}$	A1	1.1b
		(2)	
			(8 marks)

Notes	
	Allow decimals or percentages throughout this question.
(a)	**B1:** for correct shape (3 pairs) and at least **one** label on **at least two** pairs G(reen) and R(ed) allow G and G' **or** R and R' as labels, etc. condone 'extra' pairs if they are labelled with a probability of 0 **dB1:** (dep on previous B1) all correct i.e. for all 6 correct probabilities on the correct branches with at least one label on **each** pair
(b)	**M1:** Multiplication of 3 correct probabilities (allow ft from their tree diagram) **A1:** $\frac{12}{25}$ oe
(c)	**M1:** Either addition of only two correct products (product of two probs + product of three probs) which may ft from their tree diagram or for $1-('\frac{1}{10}'+'(b)')$ **A1:** $\frac{21}{50}$ oe
(d)	**M1:** Correct ratio of probabilities **or** correct ft ratio of probabilities e.g. $\frac{'\frac{9}{10}'\times'\frac{1}{5}'}{1-'(b)'}$ or $\frac{'\frac{9}{10}'\times'\frac{1}{5}'}{'\frac{1}{10}'+'(c)'}$ with num < den **A1:** $\frac{9}{26}$ (allow awrt 0.346)

Qu 1	Scheme	Marks	AO
(a)	A, C <u>or</u> D, B <u>or</u> D,C	B1 **(1)**	1.2
(b)	[$p = 0.4 - 0.07 - 0.24 =$] **<u>0.09</u>**	B1 **(1)**	1.1b
(c)	A and B independent implies		1.1b
	$\mathrm{P}(A)\times 0.4 = 0.24$ <u>or</u> $(q + 0.16 + 0.24)\times 0.4 = 0.24$	M1	
	so P(A) = 0.6 and q = **<u>0.20</u>**	A1cso **(2)**	1.1b
(d)(i)	$\mathrm{P}(B' \mid C) = 0.64$ gives $\frac{r}{r+p} = 0.64$ <u>or</u> $\frac{r}{r+"0.09"} = 0.64$	M1	3.1a
	$r =$ 0.64r + 0.64 "p" so 0.36r = 0.0576 so r = **<u>0.16</u>**	A1	1.1b
(ii)	Using sum of probabilities = 1 e.g. "0.6" + 0.07 + "0.25" + s =1	M1	1.1b
	so s = **<u>0.08</u>**	A1 **(4)**	1.1b
		(8 marks)	

	Notes
(a)	B1 for one correct pair. If more than one pair they must all be correct. Condone in a correct probability statement such as $\mathrm{P}(A \cap C) = 0$ or correct use of set notation e.g. $A \cap C = \varnothing$ BUT e.g. "P(A) and P(C) are mutually exclusive" alone is B0
(b)	B1 for p = 0.09 (Maybe stated in Venn Diagram [VD]) [If values in VD and text conflict, take text or a value <u>used</u> in a later part]
(c)	M1 for a correct equation in one variable for P(A) or q using independence <u>or</u> for seeing **both** $\mathrm{P}(A \cap B) = \mathrm{P}(A)\times\mathrm{P}(B)$ <u>and</u> $0.24 = 0.6\times 0.4$ A1cso for q = 0.20 or exact equivalent (dep on correct use of independence)
Beware	Use of P(A) = 1 – P(B) = 0.6 leading to q = 0.2 scores M0A0
(d)(i)	1st M1 for use of $\mathrm{P}(B' \mid C) = 0.64$ leading to a correct equation in r and possibly p. Can ft their p provided $0 < p < 1$ 1st A1 for r = 0.16 or exact equivalent
(ii)	2nd M1 for use of total probability = 1 to form a linear equation in s. Allow p, q, r etc Can follow through their values provided each of p, q, r are in [0, 1) 2nd A1 for s = 0.08 or exact equivalent

Qu 4	Scheme	Marks	AO
(a)	$\frac{k}{10}+\frac{k}{20}+\frac{k}{30}+\frac{k}{40}+\frac{k}{50}=1$ or $\frac{1}{600}\left(60k+30k+20k+15k+12k\right)=1$	M1	1.1b
	So $k=\frac{600}{137}$ (*)	A1cso	1.1b
		(2)	
(b)	(Cases are:) $D_1=30, D_2=50$ and $D_1=50, D_2=30$ and $D_1=40, D_2=40$	M1	2.1
	$\mathrm{P}\left(D_1+D_2=80\right)=\frac{k}{50}\times\frac{k}{30}\times 2 + \left(\frac{k}{40}\right)^2$	M1	3.4
	= 0.0375619… awrt **0.0376**	A1	1.1b
		(3)	
(c)	Angles are: $a,\quad a+d,\quad a+2d,\quad a+3d$	M1	3.1a
	$S_4 = a + (a + d) + (a + 2d) + (a + 3d) = 360$	M1	2.1
	$2a + 3d = 180$ (o.e.)	A1	2.2a
	Smallest angle is $a > 50$ consider cases:	M1	3.1b
	$d = 10$ so $a = 75$ or $d = 20$ so $a = 60$ [$d = 30$ gives $a = 45$ no good]		
	$\mathrm{P}(D = 10 \text{ or } 20) = \frac{3k}{20} = \frac{90}{137}$	A1	1.1b
		(5)	
		(10 marks)	

Notes

(a)

M1 for clear use of sum of probabilities = 1 (all terms seen)

A1 cso (*) M1 scored and no incorrect working seen.

Verify **(Assume $k = \frac{600}{137}$)** to score the final A1 they must have a final comment "$\therefore k = \frac{600}{137}$"

(b)

1st M1 for selecting at least 2 of the relevant cases (may be implied by their correct probs)
e.g. allow 30, 50 and 50,30 i.e. D_1 and D_2 labels not required

2nd M1 for using the model to obtain a correct expression for two different probabilities.
May use letter k or their value for k.

Allow for $\frac{k}{50}\times\frac{k}{30} + \left(\frac{k}{40}\right)^2$ or $2\times\left(\frac{k}{50}\times\frac{k}{30} + \left(\frac{k}{40}\right)^2\right)$

A1 for awrt 0.0376 (exact fraction is $\frac{705}{18769}$)

(c)

1st M1 for recognising the 4 angles and finding expressions in terms of d and their a

2nd M1 for using property of quad with these 4 angles (equation can be un-simplified)
Allow these two marks for use of a (possible) value of d
e.g. $a + a + 10 + a + 20 + a + 30 = 360$ (If at least 3 cases seen allow A1 for e.g. $4a = 300$)
or allow M1M1 for a set of 4 angles with sum 360 and possible value of d (3 cases for A1)
e.g. (for $d = 20$) 60, 80, 100, 120

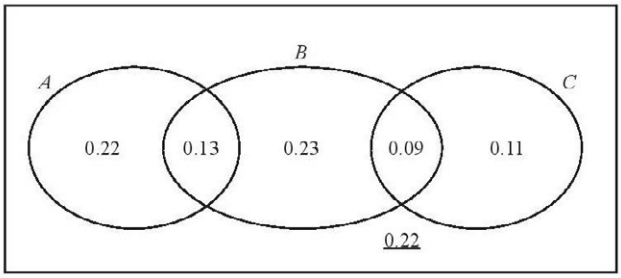
1st A1 for $2a + 3d = 180$ condition (o.e.) [Must be in the form $pa + qd = N$]

3rd M1 for examining cases and getting $d = 10$ and $d = 20$ only

2nd A1 for $\frac{90}{137}$ or exact equivalent

The correct answer and no obviously incorrect working will score 5/5

A final answer of awrt 0.657 (0.65693…) with no obviously incorrect working scores 4/5

Question	Scheme	Marks	AOs
4(a)	$\mathrm{P}(A' \mid B') = \dfrac{\mathrm{P}(A' \cap B')}{\mathrm{P}(B')}$ or $\dfrac{0.33}{0.55}$	M1	3.1a
	$= \dfrac{3}{5}$ or 0.6	A1	1.1b
		(2)	
(b)	e.g. $\mathrm{P}(A) \times \mathrm{P}(B) = \frac{7}{20} \times \frac{9}{20} = \frac{63}{400} \neq \mathrm{P}(A \cap B) = 0.13 = \frac{52}{400}$ or $\mathrm{P}(A' \mid B') = 0.6 \neq \mathrm{P}(A') = 0.65$	B1	2.4
		(1)	
(c)		B1	2.5
		M1	3.1a
		A1	1.1b
		M1	1.1b
		A1	1.1b
		(5)	
(d)	$\mathrm{P}(B \cup C)' = 0.22 + 0.22$ or $1-[0.56]$ or $1-[0.13+0.23+0.09+0.11]$ o.e.	M1	1.1b
	= 0.44	A1	1.1b
		(2)	
			(10 marks)

Notes:

(a)

M1: for a correct ratio of probabilities formula and at least one correct value.

A1: a correct answer

(b)

for a fully correct explanation: correct probabilities and correct comparisons.

(c)

B1: for box with B intersecting A and C but C not intersecting A.(Or accept three intersecting circles, but with zeros entered for $A \cap C$ and $A \cap B \cap C$)No box is B0

M1: for method for finding P($B \cap C$)

A1: for 0.09

M1: for 0.13 and their 0.09 in correct places and method for their 0.23

A1: fully correct

(d)

M1: for a correct expression – ft their probabilities from their Venn diagram.

A1: cao

Question Number	Scheme	Marks
2. (a)	B and C (only)	B1 (1)
(b)	$\mathrm{P}(A \cap C) = 0.6 \times 0.35$ so [w =] **0.21**	B1cso (1)
(c)	$x = \mathrm{P}(C) - w$ = **0.14** $y = \mathrm{P}(A) - w - \mathrm{P}(B)$,= **0.24** $z = 1 - \mathrm{P}(A \cup C)$ = **0.26**	B1 M1,A1 B1ft (4)
(d)	[$x + y$ =] **0.38**	B1ft (1)
(e)	[$\mathrm{P}(B \cup C) = 0.15 + 0.35$] = **0.5**	B1cao (1)
(f)	$\left[\mathrm{P}\left(A \mid [B \cup C]\right)\right] = \dfrac{\mathrm{P}(A \cap [B \cup C])}{\mathrm{P}(B \cup C)} = \dfrac{0.15 + 0.21}{"0.5"}$ = **0.72**	M1A1ft A1 (3)
		[Total 11]

Notes

(a) B1 for just B and C [NB Just writing $\mathrm{P}(B \cap C) = 0$ is B0]

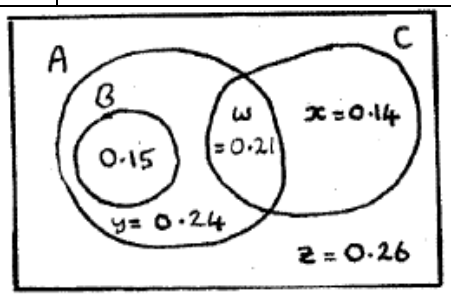
(b) B1cso for 0.21 clearly from $\mathrm{P}(A) \times \mathrm{P}(C)$ or 0.6×0.35 and no incorrect statements seen

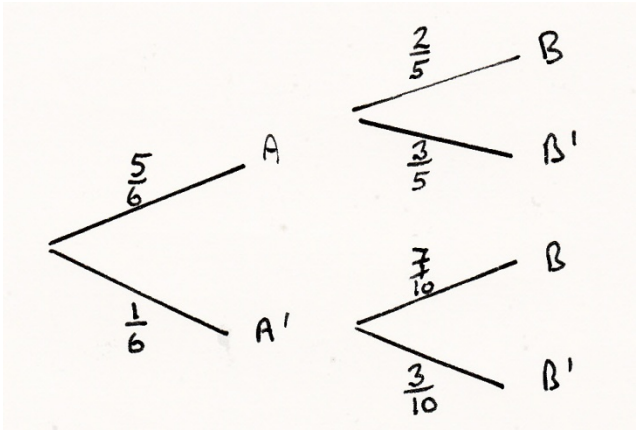
(c) 1st B1 for $x = 0.14$
M1 for a correct expression for y
A1 for $y = 0.24$
2nd B1ft for $z = 0.26$ or correct ft of their values to make sum = 1 (provided all probs)
These values may be seen in correct regions in the Venn diagram

(d) B1ft for their $x + y$ or 0.38

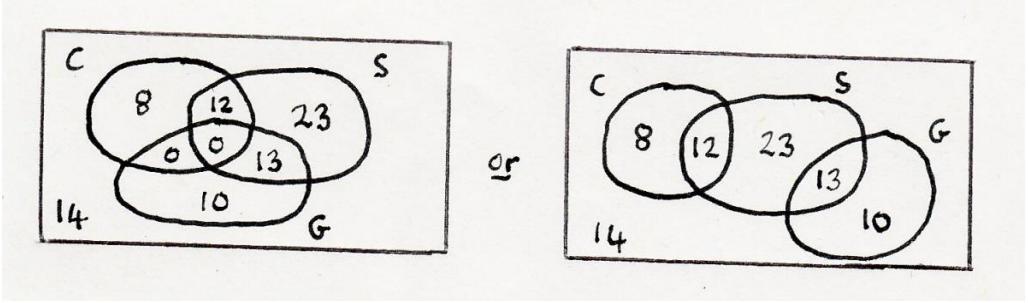
(e) B1 for 0.5 or exact equivalent

(f) M1 for a correct ratio of probabilities formula num of: $\mathrm{P}(B \cup C \cap A)$ or $\mathrm{P}(A \cap [B \cup C])$ with brackets and some correct probability, ft their (e) May be implied by correct ratio.
1st A1ft for a numerator of 0.15 + 0.21 and a denominator of their (e)
Can award M1A1ft for $\dfrac{0.15 + 0.21}{"\text{their } 0.5"}$ even if their formula is incorrect
2nd A1 for 0.72 or exact equivalent e.g. $\frac{18}{25}$



Question Number	Scheme	Marks
4. (a)	[Let P(A) = p]	
	$0.4p + 0.7(1-p) = 0.45$	M1A1
	$0.25 = 0.3p$	M1
	$\boldsymbol{p} = \frac{5}{6}$	A1
		B1ft B1
		(6)
(b)	$\left[\mathrm{P}(A' \mid B')\right] = \frac{\frac{1}{6} \times 0.3}{0.55}$	M1
	$= \frac{1}{11}$	A1
		(2)
		[Total 8]

	Notes
(a)	1st M1 for $0.4p$ or $0.7(1-p)$ seen in an equation for p 1st A1 for a fully correct equation for p
ALT	1st M1 for attempt at 2 sim' eq'ns in p and q Allow one error. $0.4p + 0.7q = \frac{9}{20}$ and $0.6p + 0.3q = \frac{11}{20}$ 1st A1 for any correct equation in p or q
	2nd M1 for simplifying their linear equation with at least 2 terms in p or q to $a = bp$ or bq 2nd A1 for P(A) = $\frac{5}{6}$ or exact equiv e.g. $0.8\dot{3}$ (may be seen on their tree diagram) 1st B1ft for 1st 2 branches i.e. $\frac{5}{6}$ and $\frac{1}{6}$ (follow through their P(A)) 2nd B1 for 2nd 4 branches i.e. $\frac{3}{5}$ and $\frac{3}{10}$
(b)	M1 for a ratio of probabilities ft their numerator from their tree diagram but denom = 0.55 A1 for $\frac{1}{11}$ or exact equivalent e.g. $0.\dot{0}\dot{9}$
SC	**[P(A) $\neq \frac{5}{6}$]** award M1A0 for $\frac{\mathrm{P}(A') \times \frac{3}{10}}{\mathrm{P}(A) \times \frac{3}{5} + \mathrm{P}(A') \times \frac{3}{10}}$ ft their P(A) and $\mathrm{P}(A') = 1 - \mathrm{P}(A)$

Question Number	Scheme	Marks
3. (a)		B1 B1 B1 B1 (4)
(b)(i)	$P(S) = \left[\frac{12+23+13}{80}\right] = \frac{48}{80}$ or $\frac{3}{5}$ or 0.6	B1ft (1)
(ii)	$P(S \mid C) = \frac{P(S \cap C)}{P(C)} = \frac{\frac{12}{80}}{\frac{20}{80}}$ $= \frac{12}{20}$ or 0.6	M1 A1cso (2)
(iii)	$P(S) = P(S\|C)$ or $P(C) = 0.25$, $P(C \cap S) = 0.15$ and $P(C) \times P(S) = 0.6 \times 0.25$ so S and C are independent	B1ft dB1ft (2)
(c)	Need $P(S \mid G) = \frac{13}{23}$ $P(S \mid C) = 0.6 > 0.565$ so assistant selling coats has the better performance	M1A1 A1 (3) **[Total 12]**

Notes

(a)
1st B1 for 3 labelled circles with 12, 13 & $n(C \cap G) = 0$ marked or implied (e.g.RH diagram)
2nd B1 for 8 and 10 correctly placed
3rd B1 for 23 correctly placed
4th B1 for box and 14

May use probabilities not integers
A blank space does not imply a zero

(b)(i) B1ft for 0.6 or any exact equivalent (single fraction) or ft their values (ft blank as 0)

(ii) M1 for a correct conditional prob. Correct expression and one correct ft prob. Num < Den
A1cso for 0.6 which must come from a denominator of 20

(iii) 1st B1ft for a full reason. If not $P(S) = P(S|C)$ then all values must be stated, labelled and correct or correct ft from diagram. Correct not'n required so $P(S \cup C) = 0.15$ is B0B0
2nd dB1ft dep. on a correct reason for correct conclusion for their values

(c) M1 for attempt at $P(S \mid G)$ correct ratio of probabilities or numbers using their figs
1st A1 for $\frac{13}{23}$ (accept awrt 0.565) [Sight of $P(S \mid G) = \frac{13}{23}$ is M1A1]
2nd A1 for a correct conclusion that chooses "coats" based on a correct comparison
Allow incorrect $P(S|C)$ provided > 0.565 to score 2nd A1 and so all 3 marks
Condone poor use of notation eg $S|G$ with no P(..). Probabilities may be described in words.
Condone comparison of $\frac{13}{23}$ with 0.6 even if $\frac{13}{23}$ is not labelled as $P(S|G)$

Question	Scheme	Marks
4. (a)	$0.4p + 0.15(1-p) = 0.26$	M1
	$0.25p = 0.11$	dM1
	$p = \underline{\mathbf{0.44}}$	A1
		(3)
(b)	$\dfrac{"0.56"q}{"0.56"q + "0.44" \times 0.6} = 0.175$	M1A1ft
	$0.462q = 0.0462$	dM1
	$q = \underline{\mathbf{0.1}}$	A1
		(4)
(c)	$P(C) = (1-p)\times(1-0.15-q) =$ "0.56" × "0.75"	M1
	$= \underline{\mathbf{0.42}}$	A1
		(2)
(d)	$[P(R \mid C') =] \quad \dfrac{P(R)}{P(C')} = \dfrac{(a)}{1-(c)} = \dfrac{"0.44"}{"0.58"}$	M1
		M1
	$= \dfrac{22}{29} = 0.75862\ldots$ or awrt $\underline{\mathbf{0.759}}$	A1
		(3)
		(12 marks)

Notes

(a)

1st M1 for attempt at correct equation for p (Must have at least 2 terms in p) **and** must be set equal to 0.26

2nd dM1 dep on 1st M1 for solving their linear equation in p by reducing to $Ap = B$ with at least 1 of A or B correct

A1 for $p = 0.44$ (or exact equivalent e.g. $\frac{11}{25}$)

(b)

1st M1 for a probability ratio of the form $\dfrac{rq}{rq + (1-r)\times 0.6}$

1st A1ft for $r = 1 -$ their p and the $= 0.175$

2nd dM1 dep on 1st M1 for rearranging their equation into the form $Aq = B$ with at least 1 of A or B correct or correct ft

2nd A1 for $q = 0.1$ or an exact equivalent

(c)

M1 for (1 – their p) × (1 – 0.15 – their q)

A1 for 0.42 or an exact equivalent

(d)

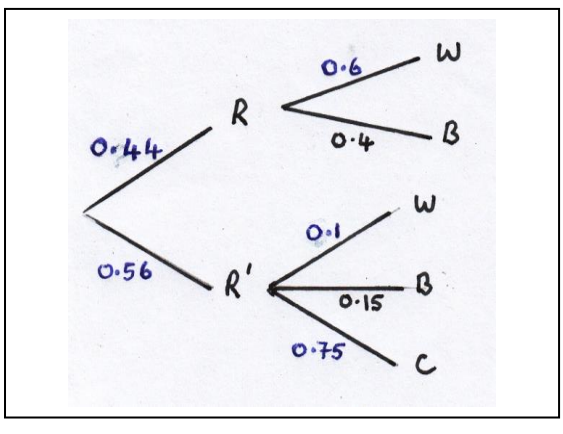
1st M1 for a ratio of **probabilities** with 0.44 or 'their (a)' on num.

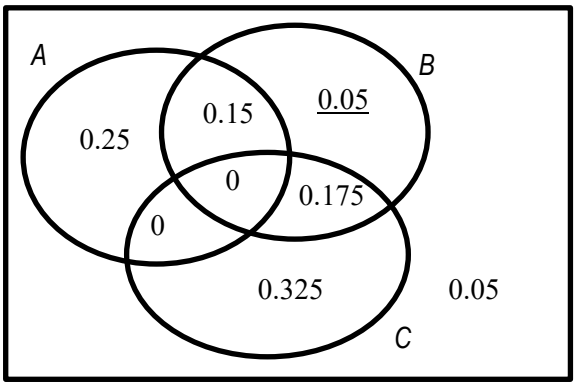
2nd M1 for a ratio of **probabilities** with 0.58 or '1 – their (c)' on denom.

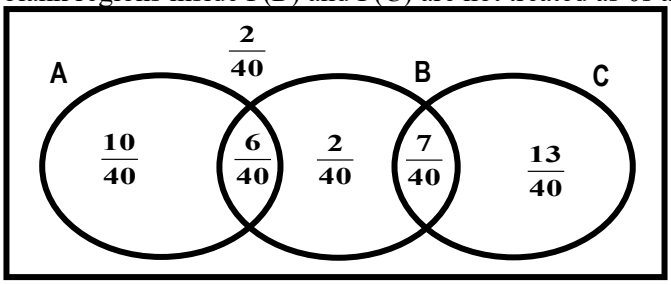
A1 for $\frac{22}{29}$ or awrt 0.759

Correct answer only scores 3 out of 3.

Note: If correct ft on num. and denom. leads to "num" > "denom" then maximum score is M0M1A0)



Question Number	Scheme	Marks
6. (a)	$[\mathrm{P}(A \cup C) =] \dfrac{9}{10}$ oe	B1 (1)
(b)	$\mathrm{P}(A \cup B) = \mathrm{P}(A) + \mathrm{P}(B) - \mathrm{P}(A) \times \mathrm{P}(B)$ $\dfrac{5}{8} = \dfrac{2}{5} + \mathrm{P}(B) - \dfrac{2}{5}\mathrm{P}(B)$ $\mathrm{P}(B) = \dfrac{3}{8}$ *	M1 M1 A1 A1cso (4)
(c)	$[\mathrm{P}(A \mid B) = \mathrm{P}(A) =] \dfrac{2}{5}$ oe	B1 (1)
(d)		Diagram B1 0.15 and 0.25 M1 0.05 and 0.05 M1 0.175 and 0.325 M1 A1 (5)
		Total 11

	Notes
(b)	1st M1 for use of $\mathrm{P}(A \cup B) = \mathrm{P}(A) + P(B) - \mathrm{P}(A \cap B)$ 2nd M1 for use of $\mathrm{P}(A \cap B) = \mathrm{P}(A) \times \mathrm{P}(B)$ (But just seeing $\frac{2}{5} \times \frac{3}{8} = \frac{3}{20}$ on its own is M0M0) 1st A1 a correct equation 2nd A1 cso (No wrong working seen dependent on all previous marks) (allow a full verification method, however, substitution of P(B)=3/8 into only one P(B) to find the other P(B) (e.g. using 3/20 to find 3/8) can score M1M0A0A0)
(d)	B1 3 circles intersecting, see diagram above, (at least 2 labelled) with the two zeros showing A does not intersect C (Do not allow blank spaces for the two zeros) **or** 3 circles, see diagram below, (at least 2 labelled) where B intersects A and C but A and C do not intersect 1st M1 0.15 placed in $(A \cap B \cap C')$ and 0.25 placed in $(A \cap B' \cap C')$ 2nd M1 0.3 – 'their 0.25' and 1 – ('their 0.15' + 'their 0.25' + 'their 0.05' + $\frac{1}{2}$) 3rd M1 $\frac{3}{8}$ – ("their 0.15" + "their 0.05"), i.e. $\mathrm{P}(B) = \frac{3}{8}$ and $\frac{1}{2}$ – "their 0.175", i.e. $\mathrm{P}(C) = \frac{1}{2}$ For the 3rd M mark, blank regions inside P(B) and P(C) are not treated as 0s and score M0 A1 fully correct with box 

Question	Scheme	Marks
3(a)	$[\text{P(Female)} =] \frac{30}{90}$ oe	B1 (1)
(b)	$[\text{P(Male} \mid < 4 \text{ years)} =] \frac{\text{P(Male} \cap < 4 \text{ years)}}{\text{P}(< 4 \text{ years})} = \frac{\frac{16}{(90)}}{\frac{16+9}{(90)}} = \frac{16}{25}$ oe	M1A1 (2)
(c)	$[\text{P(Male} \mid < 10 \text{ years)} =] \frac{\text{P(Male} \cap < 10 \text{ years)}}{\text{P}(< 10 \text{ years})} = \frac{\frac{20+16}{(90)}}{\frac{9+16+14+20}{(90)}} = \frac{36}{59}$	M1A1 (2)
(d)	$\text{P(Male} \mid < 4 \text{ years)} = '\frac{16}{25}', \ \text{P(Male)} = \frac{60}{90}$ or $\text{P}(< 4 \text{ years} \mid \text{Male}) = \frac{16}{60}, \ \text{P}(< 4 \text{ years}) = \frac{25}{90}$ or $\text{P(Male} \cap < 4 \text{ years)} = \frac{16}{90}, \ \text{P(Male)} = \frac{60}{90}, \ \text{P}(< 4 \text{ years}) = \frac{25}{90}$ $\text{P(M} \mid < 4) \neq \text{P(M)}$ or $\text{P}(< 4 \mid \text{M}) \neq \text{P}(<4)$ or $\text{P(Male} \cap < 4 \text{ years)} \neq \text{P(M)} \times \text{P}(< 4)$ so not independent.	M1 M1 A1 (3)
		Total 8

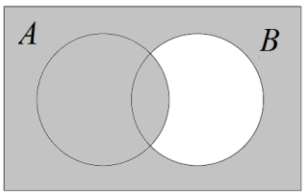
	Notes
(a)	B1 for $\frac{30}{90}$ or exact equivalent
(b)	M1 for a correct ratio expression with at least one correct probability substituted or for a correct ratio of probabilities. num>denom is M0 A1 $\frac{16}{25}$ or 0.64 (Correct answer scores 2 out of 2).
(c)	M1 for a correct ratio expression with at least one correct probability substituted or for a correct ratio of probabilities. num>denom is M0. A1 $\frac{36}{59}$ or condone awrt 0.610 (must be 3sf) (Correct answer gets 2 out of 2).
(d)	1st M1 for stating all of the required numerical probabilities for a correct test which must be labelled. The probabilities must be correct or correct ft from (b) (If attempting the first test, $\text{P(Male} \mid < 4 \text{ years)} = '\frac{16}{25}'$ was found in part(b) and need not be fully restated here). 2nd M1 for use of a correct test. Must see the product if attempting the 3rd test. A1 for correct test with all probabilities correct and a correct conclusion. NB Use of A and B throughout scores M0M0A0 unless A and B are explicitly defined.

Question	Scheme	Marks
4.(a)	[P(both blue) $= \frac{1}{20} \times \frac{1}{20} =] \frac{1}{400}$ oe	B1
		(1)
(b)	P(exactly 1 red) $= 2 \times \frac{1}{20} \times \frac{19}{20}, = \frac{19}{200}$ oe	M1, A1
		(2)
(c)	P(2 yellow and 1 green)$=3 \times \frac{4}{9} \times \frac{5}{8} \times \frac{4}{7} = \frac{10}{21}$ oe	B1 M1 A1
		(3)
(d)	P(All beads are yellow) $= \frac{5}{9} \times \frac{4}{8} \times \frac{3}{7} \times \frac{2}{6}$	M1
	P(At least 1 bead is green) = 1 – P(All beads are yellow)	
	$1 - \frac{5}{9} \times \frac{4}{8} \times \frac{3}{7} \times \frac{2}{6} = \frac{121}{126}$	M1A1
		(3)
		Total 9

	Notes
(a)	B1 $\frac{1}{400}$ or 0.0025
(b)	M1 for a correct equivalent expression $\frac{1}{20} \times \frac{19}{20} + \frac{19}{20} \times \frac{1}{20}$
	A1 $\frac{19}{200}$ or 0.095
(c)	B1 for 3 × … or for the sum of exactly 3 identical products attempted M1 for any one product correct
	A1 $\frac{10}{21}$ (allow awrt 0.476 from correct working)
(d)	1st M1 $\frac{5}{9} \times \frac{4}{8} \times \frac{3}{7} \times \frac{2}{6}$
	2nd M1 Use of $1 - p$ (where p is a product of 4 probabilities)
	A1 $\frac{121}{126}$ (condone awrt 0.960 must be at least 3sf from correct working)
	OR
	1st M1 List **all** 15 favourable outcomes and at least one correct product (YYYG)×4 [(YYGY), (YGYY), (GYYY)] (YYGG)×6 [(YGYG), (YGGY), (GYYG), (GYGY), (GGYY)] (GGYG)×4 [(GGGY), (YGGG), (GYGG)] (GGGG)
	2nd M1 Sum all 15 correct probabilities
	A1 $\frac{121}{126}$ (condone awrt 0.960 must be at least 3sf from correct working)

Question	Scheme	Marks
6. (a)	$P(S) = 0.31 + p$, $P(D) = 0.35$, $P(S \cap D) = 0.14$	M1
	$(0.31 + p)(0.35) = 0.14$ oe	M1
	$P(S) = 0.4$ <u>or</u> $0.31 + p = 0.4$ <u>or</u> $0.35p = 0.0315$	A1
	p = **<u>0.09</u>**	A1
		(4)
(b)	$P(S \cup M \cup D) = 1$ so $q = 1 - (0.17+0.10+0.15+0.06+0.04) - p$ <u>or</u> $0.48 - p$	M1
	q = **<u>0.39</u>**	A1ft
		(2)
(c)(i)	$[P(D \mid S \cap M =] \frac{P(D \cap S \cap M)}{P(S \cap M)} = \frac{0.10}{0.27}$	M1
	$= \underline{\frac{10}{27}}$ or awrt **<u>0.370</u>**	A1
(ii)	$[P(D \mid S' \cap M =] \frac{P(D \cap S' \cap M)}{P(S' \cap M)} = \frac{0.15}{0.54}$	M1
	$= \underline{\frac{5}{18}}$ or awrt **<u>0.278</u>**	A1
		(4)
(d)	27 order $S \cap M$ so expect $27 \times \frac{10}{27} D$ <u>or</u> 36 order $S' \cap M$ so expect $36 \times \frac{5}{18} D$	M1
	So expect **<u>20 (desserts)</u>**	A1cao
		(2)
		[12]

	Notes
(a)	1st M1 for attempting P(S), P(D) and $P(S \cap D)$ with at least 2 correct. These may be seen in a conditional probability. NB $P(S \mid D) = \frac{0.14}{0.35}$ and $P(D \mid S) = \frac{0.14}{0.31 + p}$
	2nd M1 using the independence condit' and their values to form a suitable equation for p or P(S)
	1st A1 for $P(S) = 0.4$ <u>or</u> $0.31 + p = 0.4$ <u>or</u> $0.35p = 0.0315$ (i.e. one move from p = …)
(b)	M1 for using sum of probabilities = 1 and ft their p
	A1ft for 0.48 – "their p" (provided 0 < their p < 0.48)
(c)	1st M1 for a correct ratio of probabilities <u>or</u> a correct ratio expression with at least one correct probability substituted. (M0 if numerator is P(D)×P($S \cap M$) or numerator>denominator)
	1st A1 for $\frac{10}{27}$ or awrt 0.370
	2nd M1 for a correct ratio of probabilities <u>or</u> a correct ratio expression with at least one correct probability substituted. (M0 if numerator is P(D)×P($S' \cap M$) or numerator>denominator)
	2nd A1 for $\frac{5}{18}$ or awrt 0.278
(d)	M1 for at least one correct calculation ft their probabilities from (c). i.e. either 27×their (c)(i) or 36×their (c)(ii)

Question Number	Scheme	Marks
2. (a)		**B1** **(1)**
(b)	$[\,P(C \cap D) = 0\,]$	**B1**
(i)	$P(C \cup D) = P(C) + P(D) = \frac{1}{2}$	**B1**
(ii)	$P(C \mid D)[= \frac{P(C \cap D)}{P(D)}] = 0$	**B1** **(3)**
(c)(i)	$P(F \cup G) = P(F) + P(G) - P(F \cap G)$	
	$\frac{3}{8} = \frac{1}{6} + P(G) - \frac{1}{6} \times P(G)$	**M1 M1**
	$P(G) = \frac{1}{4}$	**A1**
(ii)	$P(F \mid G')[= P(F)] = \frac{1}{6}$	**B1** **(4)** **[8 marks]**

	Notes
(a)	If a 2nd diagram is drawn then award B0 unless the incorrect diagram is crossed out
(b)	1st B1 for writing or using $P(C \cap D) = 0$ anywhere in (b)(may be implied by correct $P(C \mid D)$) $P(C \cup D) = P(C) + P(D) - P(C \cap D) = \left[\frac{1}{5} + \frac{3}{10}\right] = \frac{1}{2}$ does imply 1st B1 2nd B1 for $P(C \cup D) = 0.5$ (o.e.) (may just be labelled (b)(i) $\frac{1}{2}$) This does <u>not</u> imply 1st B1 3rd B1 for $P(C \mid D) = 0$…this <u>will</u> imply 1st B1 too
(c)(i)	1st M1 for use of addition formula (3 terms) with correct substitution of at least one term Assuming or stating $P(F \cap G) = 0$ scores M0 2nd M1 for <u>use</u> of independence $P(F \cap G) = P(F) \times P(G) = \frac{1}{6} \times P(G)$ (i.e. must be used) Use of e.g. x for $P(G)$ is fine. NB $\frac{3}{8} = \frac{1}{6} \times P(G)$ is M0M0
ALT	Let $y =$ $P(F \cap G)$ then $P(G) =$ $y + \frac{3}{8} - \frac{1}{6}$ scores 1st M1 and $y = \frac{1}{6}(y + \frac{3}{8} - \frac{1}{6})$ o.e. gets 2nd M1 A1 for $\frac{1}{4}$ o.e.
(ii)	B1 for $P(F \mid G') = \frac{1}{6}$ (may be labelled (c)(ii) $\frac{1}{6}$) Accept exact equivalents.

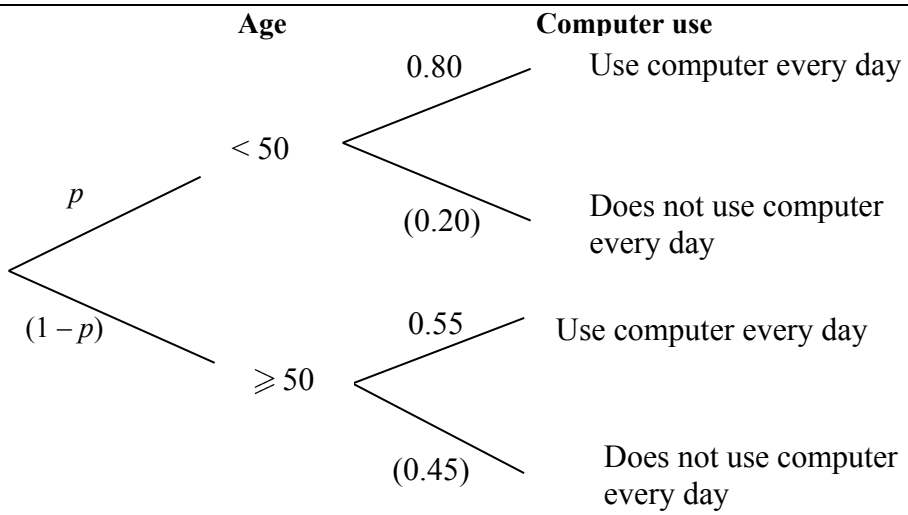
Question Number	Scheme	Marks
2. (a)	(The event that) the integer selected is prime **and** ends in a 3 (and is between 1 and 50 inclusive)	**B1** **(1)**
(b)	$\frac{15}{50}$ (or equivalent e.g. 0.30) [condone 30%]	**B1** **(1)**
(c)	$\frac{12}{50}$ (or equivalent e.g. 0.24) [condone 24%]	**B1** **(1)**
(d)	$\left[\mathrm{P}(A\mid C)=\right]\frac{\mathrm{P}(A\cap C)}{\mathrm{P}(C)}=\frac{\frac{7}{50}}{\frac{30}{50}}=,\ \frac{7}{30}$	**M1, A1** **(2)**
(e)	$\frac{15}{50}\neq\frac{7}{30}$, so not independent.	**M1, A1** **(2)**
(f)	$\left[\mathrm{P}(B\mid(A\cap C))=\right]\frac{\mathrm{P}(B\cap A\cap C)}{\mathrm{P}(A\cap C)}=\frac{\frac{2}{50}}{\frac{7}{50}}=,\ \frac{2}{7}$	**M1, A1** **(2)** **[9 marks]**

(d) M1 for a correct ratio expression (may be in words) with at least one correct probability substituted or correct ratio expression and $\frac{7}{n}$ or $\frac{m}{30}$ where $7 < n$ or $m < 30$
or fully correct ratio of probabilities.
A1 for $\frac{7}{30}$ or any exact equivalent e.g. $0.2\dot{3}$ but 0.233 is M1A0 (Correct ans only = M1A1)

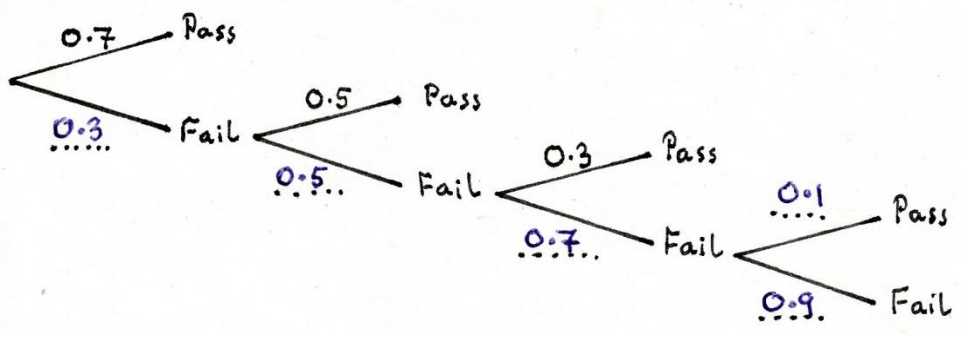
(e) M1 for correctly comparing 'their (b)' with 'their (d)', can be in words or symbols e.g. $\mathrm{P}(A)\neq\mathrm{P}(A\mid C)$ in symbols.
A1 dependent on a correct (b) and (d) (or awrt 0.233 in (d)) and for concluding not independent

SC For a correct test using correctly labelled $\mathrm{P}(A)=\frac{15}{50}$, $\mathrm{P}(C)=\frac{30}{50}$ and $\mathrm{P}(A\cap C)=\frac{7}{50}$ with all correct probabilities and $\frac{15}{50}\times\frac{30}{50}=\frac{9}{50}\neq\frac{7}{50}$ (o.e.) seen leading to "not independent" score M0A1

(f) M1 for a correct ratio expression (may be in words) with at least one correct probability substituted or correct ratio expression and $\frac{r}{7}$ or $\frac{2}{t}$ where $r < 7$ or $2 < t$
or fully correct ratio of probabilities
A1 for $\frac{2}{7}$ or an exact equivalent. **Allow** awrt 0.286 here as well.(Correct ans. only = M1A1)

Question Number	Scheme	Marks
5. (a)		**B1** **B1** **(2)**
(b)	$p \times 0.80 + (1-p) \times 0.55 = 0.70$ $p = 0.6$	**M1** **A1** **(2)**
(c)	$\left[\text{P}(< 50 \mid \text{use computer daily})\right] = \dfrac{\text{P}(< 50 \cap \text{use computer daily})}{\text{P(use computer daily)}} = \dfrac{'0.6' \times 0.80}{0.70}$ $= \dfrac{48}{70}$	**M1** **A1oe** **(2)** **[6 marks]**

	Notes
(a)	**Allow undefined letters for labels e.g. *U*(use) and *U′* or *N* and *NE*** **Allow labels on branches and probabilities at the ends** **Condone 80% and 55% etc on tree diagram and in (b)** 1st B1 for correct shape (2 branches then 4 branches) and correct labels on first set of branches (p , < 50 and $\geqslant 50$ but condone > 50) 2nd B1 for correct labels on second set of branches (0.80, 0.55, daily and not daily) Allow $0.8p$ and $0.55(1-p)$ on or at the end of the appropriate branches. NB they do not require the probabilities in brackets for either of these two marks.
(b)	M1 for a correct equation to find p using their tree diagram. A1 for 0.6 [condone 60%] (Correct answer only will score M1A1)
(c)	M1 for a correct expression with 0.70 substituted correctly and numerator < denominator or correct ratio of probabilities f.t. their p provided $0 < p < \frac{7}{8}$ A1 for $\dfrac{48}{70}$ or an exact equivalent e.g. $\dfrac{24}{35}$ (Correct answer only is M1A1) Allow awrt 0.686 following a correct expression. [68.6% is A0]

Question Number	Scheme	Marks
4.(a)		B1 B1 (2)
(b)	$1-0.3\times0.5\times0.7\times0.9$ or $0.7+(0.3\times0.5)+(0.3\times0.5\times0.3)+(0.3\times0.5\times0.7\times0.1)$ $=$ **0.9055**	M1 A1 (2)
(c)	$[\mathrm{P}(P_1\cup P_2 \mid \text{Pass})=]\ \dfrac{0.7+"0.3"\times0.5}{(b)},\ =\dfrac{0.85}{"0.9055"}$ $=0.938707\ldots=$ awrt **0.939**	M1, A1ft A1 (3)
(d)	$p+(1-p)(p-0.2)$ or $1-(1-p)(1.2-p)$ (o.e.) e.g. $p+p-p^2+0.2p-0.2=0.95\ \rightarrow p^2-2.2p+1.15=0$ (*)	M1 dM1A1cso (3)
(e)	$p=\dfrac{2.2\pm\sqrt{2.2^2-4\times1.15}}{2}$ or Complete the sq: $(p-1.1)^2-1.1^2+1.15=0$ $=\dfrac{2.2\pm0.4898...}{2}$ or $\dfrac{2.2\pm\sqrt{0.24}}{2}$ or $1.1\pm\sqrt{0.06}$ or (1.34…), 0.855… $p=0.85505102\ldots$ $p=$ **0.855**	M1 A1 A1 (3)

	Notes
(a)	1st B1 for correctly placing 0.3 and 0.5 2nd B1 for correctly placing 0.7, 0.1 and 0.9
	Apart from (d), a correct answer with no incorrect working scores full marks.
(b)	M1 for a correct expression (ft from their tree diagram) A1 for 0.9055 or exact equivalent e.g. $\frac{1811}{2000}$ Accept 0.906 only if correct expr' seen
(c)	M1 for a correct ratio of probs ft their 0.3 and their answer to (b)[if < 1]. Num > Den M0 A1ft for correct numerator and their part (b) on denominator A1 for awrt 0.939 or accept exact fraction eg $\frac{1700}{1811}$
(d)	1st M1 for a correct expression for P(pass) in terms of p[condone $p-(p-1)(p-0.2)$ etc] 2nd dM1 dep. on 1st M1 for expanding brackets and forming an equation in p Allow one slip A1cso correct processing leading to printed answer. No incorrect working seen.
(e)	M1 for attempt to solve **given** equation, correct expression. Condone just + not ± 1st A1 for correct expression and simplified square root or 1.34… and 0.855… 2nd A1 for $p = 0.855$ only (penalise any extra value > 1) Correct ans only scores 3/3
Ans. only	For $\frac{1}{10}\left(11-\sqrt{6}\right)$ or 0.855... score M1A1A0 (not to 3dp) but for 0.855 can score M1A1A1

4. (a)(i)	$x + 0.1$ [P($x + 0.1$) is B0]	B1
(ii)	$P(B \mid A) = \frac{P(B \cap A)}{P(A)} = \frac{0.1}{x + 0.1}$	M1 A1 (3)
(b)	$x+y+0.1$ (o.e.) [P($x+y+0.1$) is B0]	B1 (1)
(c)	$x+y+0.1+0.32=1$ <u>or</u> $x+y+0.1=0.68$ <u>or</u> "(b)" + 0.32 = 1 o.e. $x+0.1=2(y+0.1)$ Eliminating x gives $3y = 0.48$ $x =$ **<u>0.42</u>** $y =$ **<u>0.16</u>**	M1 M1 M1 A1 A1 (5)
		(9 marks)

Notes

(a)(ii)

M1 for a correct ratio of probabilities formula with at least one correct probability value (may ft their (a)(i) in the denominator) <u>or</u> a prob ratio of the form $\frac{0.1}{\text{(a)(i)}}$

If num' > denom' score M0. NB P(A) = $0.68 - y$ and P($B|A$) = $\frac{0.1}{0.68 - y}$ is B0M1A0

A1 for $\frac{0.1}{x + 0.1}$ as their final answer

(b)

B1 for any correct expression in x and y e.g. $0.1 + x + 0.1 + y - 0.1$
Condone $x + y + 0.1 = 1 - 0.32$ or 0.68 since LHS is a correct expression

(c)

1st M1 for using sum of probs. = 1 to form a "correct" linear equ'n in x and y [$x + y = 0.58$]
Ft their (b) and or their (a)(i) e.g. "(a)(i)" +0.32 + y = 1
2nd M1 for using P(A) = 2P(B) to form a "correct" linear equ'n in x and y[$x - 2y = 0.1$]
Ft their P(A) from part (a)
If they use 2P(A) = P(B) or swap x and y score 2nd M0 but allow access to 3rd M
3rd M1 for an attempt to solve their 2 linear equations. Implied by 1st 2 Ms and correct ans.
Requires correct algebraic steps leading to an equation in one variable.
If there are not 2 equations this cannot be scored (but see **SC**)
1st A1 for $x = 0.42$ (following correct working and dep. on 1st 2 Ms)
2nd A1 for $y = 0.16$ (following correct working and dep. on 1st 2 Ms)

Beware

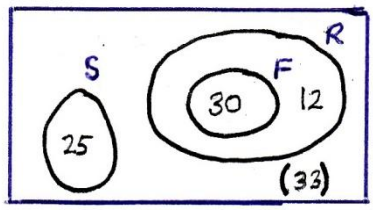
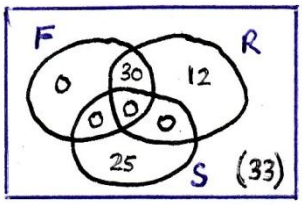
0.42 = 0.32 + 0.1 so answer only does <u>not</u> score full marks

SC

P(A) = $0.68 - y = 2(y + 0.1)$ score M2 (2nd and 3rd Ms) and 2nd A1 when $y = 0.16$ seen
Sight of $x + y + 0.1 = 0.68$ (o.e.)(scores 1st M1) and then 1st A1 if $x = 0.42$ follows.

or

P(A) = $x + 0.1 = 2(0.68 - x)$ score M2 (2nd and 3rd Ms) and 1st A1 when $x = 0.42$ seen
Sight of $x + y + 0.1 = 0.68$ (o.e.)(scores 1st M1) and then 2nd A1 if $y = 0.16$ follows.

Question Number	Scheme	Marks
5. (a)	 or 	B1 B1 B1 B1 (4)
(b)	F and S or R and S	B1 (1)
(c)	$\mathrm{P}\left(\left[F \cup R \cup S\right]'\right) = \frac{33}{100}$ or **0.33**	B1 (1)
(d)	$\mathrm{P}(R) = \frac{30+12}{100} = \frac{21}{50}$ or **0.42**	B1 (1)
(e)	$\mathrm{P}\left(F \cup S\right) = \frac{30+25}{100} = \frac{11}{20}$ or **0.55**	B1 (1)
(f)	$\left[\mathrm{P}\left(F \mid R\right)\right] = \frac{\mathrm{P}\left(F \cap R\right)}{\mathrm{P}(R)} = \frac{"0.30"}{"0.42"}$ $= \frac{30}{42}$ or $\frac{5}{7}$ (o.e.)	M1 A1 (2) **Total 10**

	Notes
(a)	**In the diagram do not treat a blank space as zero. Allow probabilities or integers** 1st B1 for 3 labelled loops and a box. The 33 is not required for any marks in (a) 2nd B1 for $F \subset R$ or indicated by zeros 3rd B1 for 30 and 12 correctly placed and n(F) = 30 and $\mathrm{n}\left(F' \cap R\right) = 12$ 4th B1 for S a separate loop, or indicated by zeros, and the 25
(b)	B1 for a correct pair. If there is more than one pair then each pair must be correct. Do not allow P(F) etc or e.g. P($R \cap S$) = 0
(c),(d),(e)	B1 cao for each answer. Accept any exact equivalent (fractions or decimals) for the probabilities
(f)	M1 ft their "30" and their answer to (d). For a correct ratio of their probabilities or a correct ratio expression and at least one correct probability. If num > den score M0 A1 for $\frac{5}{7}$ or any exact equivalent. Must be proper fraction not $\frac{0.3}{0.42}$ NB $\frac{0.3}{0.42} = 0.714$ is A0 since it is not a proper fraction and the answer is not exact Condone P(R|F) = $\frac{30}{42}$ and allow M1A1 for the correct answer but $\mathrm{P}(R \mid F) = \frac{\mathrm{P}(R \cap F)}{P(F)} = \frac{0.30}{0.42} = \frac{30}{42}$ is M0A0

Question Number	Scheme	Marks
7. (a)	$[\mathrm{P}(M \mid L) =] \ \dfrac{\mathrm{P}(M \cap L)}{\mathrm{P}(L)} = \dfrac{\frac{3}{5}\times\frac{1}{5}}{\frac{3}{10}}$	M1
	$= \underline{\mathbf{0.40}}$ (o.e)	A1
		(2)
(b)	$x = [\mathrm{P}(L \mid F)] = \dfrac{\mathrm{P}(L \cap F)}{\mathrm{P}(F)} = \dfrac{\frac{3}{10} - \frac{3}{5}\times\frac{1}{5}}{1-\frac{3}{5}}$ or $\dfrac{3}{5}\times\dfrac{1}{5} + \left(1-\dfrac{3}{5}\right)\times x = \dfrac{3}{10}$	M1
	$x = \dfrac{0.3-0.12}{0.40}$ or $0.4x = 0.3-0.12$	M1
	$x = \underline{\mathbf{0.45}}$ (o.e.)	A1
		(3)
(c)	$[\mathrm{P}(M \cap R)] = 0.6 - \mathrm{P}(M \cap L)$ or $0.6\times(1-0.2)$	M1
	$= \underline{\mathbf{0.48}}$ (o.e.)	A1
		(2)
(d)	P(one is left handed and the other right handed) = $2\times\dfrac{3}{10}\times\dfrac{7}{10}, = \dfrac{21}{50}$ or $\underline{\mathbf{0.42}}$	M1, A1
		(2)
		Total 9

Notes

(a)
M1 for a fully correct ratio e.g. $\frac{0.12}{0.30}$ or a correct ratio expression and one correct prob.
If numerator > denominator then M0
A1 for 0.40 or any exact equivalent

(b)
1st M1 for an equation for x with at least 2 of : $\left(\frac{3}{5}\times\frac{1}{5}\right)$ or $\frac{3}{10}$ or $(1-\frac{3}{5})$ correct
BUT $\dfrac{\frac{2}{5}\times\frac{3}{10}}{\frac{2}{5}}$ is M0 or allow M1 for $\mathrm{P}(L\cap F) = 0.18$
2nd M1 for a fully correct expression for x = … or $0.4x$ = ...
A1 for 0.45 or any exact equivalent

(c)
M1 for a correct expression with 0.6 follow through their $\mathrm{P}(M \cap L) = 0.12$
A1 for 0.48 or any exact equivalent

(d)
M1 for a fully correct expression including the 2. Allow 1 – 0.3 instead of 0.7
A1 for 0.42 or any exact equivalent

NB You may see Venn or tree diagram drawn but marks are given when values are used in correct expressions as above