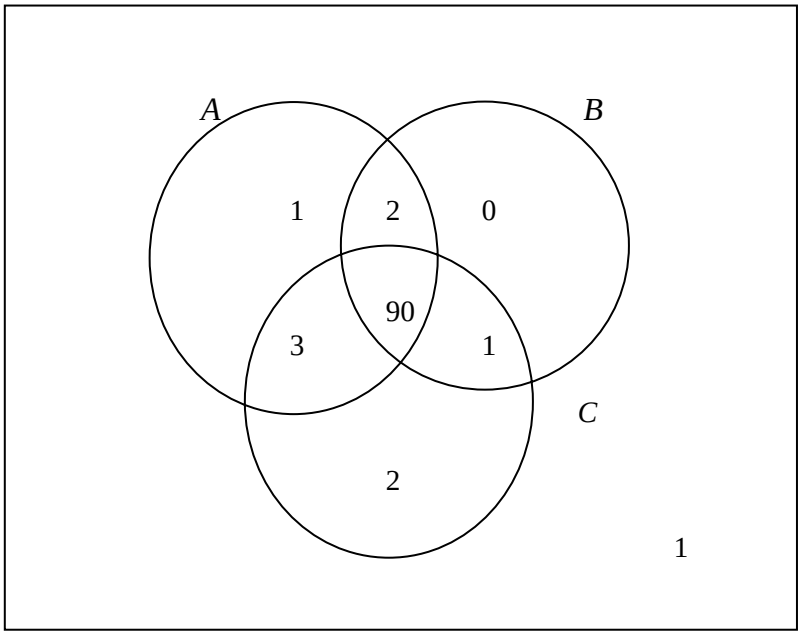
5. **Diagram may be drawn with $B \subset (A \cup C)$ or with the 0 for $B \cap (A \cup C)'$ simply left blank**

(a)



Accept decimals or probs. in Venn diagram

3cc	**M1**
90,3,2,1	**A1**
1,(0),2	**M1A1**
1 outside	**A1**
Box	**B1**

(6)

(b) P(none)=0.01 **B1ft**

(1)

(c) P(*A* but not *B*)=0.04 **M1 A1ft**

(2)

(d) P(any wine but *C*)=0.03 **M1A1ft**

(2)

(e) P(exactly two)=0.06 **M1A1ft**

(2)

(f) $P(C|A) = \frac{P(C \cap A)}{P(A)} =, \frac{93}{96}$ or $\frac{31}{32}$ or AWRT 0.969 **M1A1ft,A1**

(3)

Total 16 marks

(a) 1st M1 for 3 closed, labelled curves that overlap. A1 for the 90, 3, 2 and 1
2nd M1 for one of 1, 0 or 2 correct or a correct sum of 4 values for *A, B* or *C*
2nd A1 for all 7 values correct. Accept a blank instead of 0.

NB final mark is a B1 for the box not an A mark as on EPEN

In parts (b) to (f) full marks can be scored for correct answers or correct ft

(b) B1ft Follow through their '1'from outside divided by 100

(c) M1 for correct expression eg $P(A \cup B) - P(B)$ or calculation e.g. 3 + 1 or 4 on top
A1 for a correct probability, follow through with their '3+1' from diagram

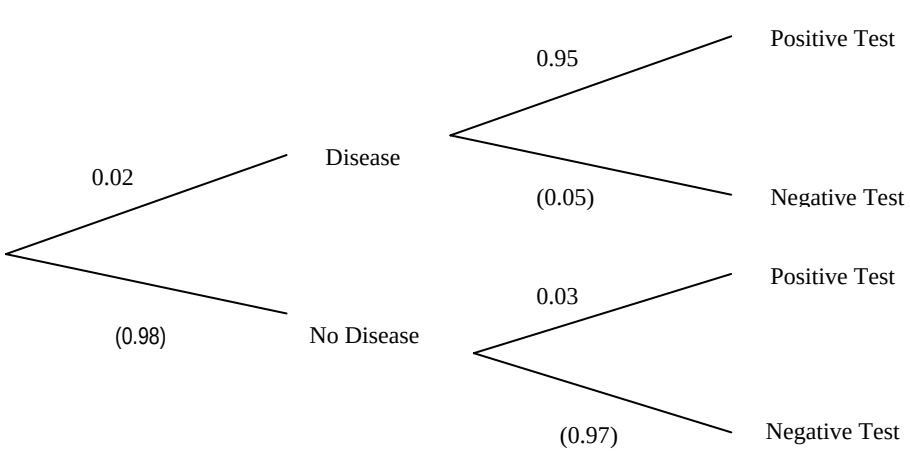
(d) M1 for correct expression or calculation e.g. 1+2+0 or 99-96 or 3 on top
A1 for a correct probability, follow through their '2+1+0' from diagram

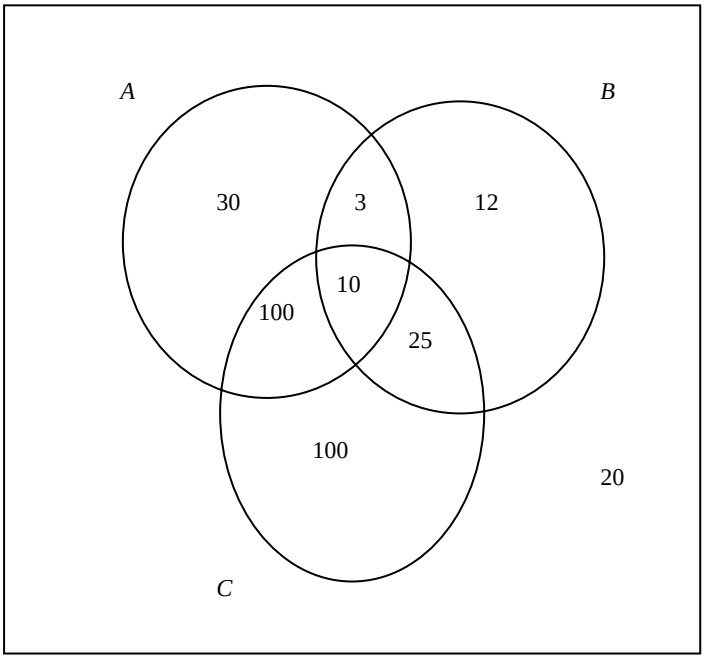
(e) M1 for a correct expression or calculation e.g. 3+2+1 or 6 on top

For M marks in (c) to (e) they must have a fraction

(f) M1 for a correct expression upto "," and some correct substitution, ft their values. One of these probabilities must be correct or correct ft. If P(*C*) on bottom M0
1st A1ft follow through their $A \cap C$ and their *A* but the ratio must be in (0, 1)
2nd A1 for correct answer only. Answer only scores 3/3, but check working P($A \cap C$)/P(*C*) is M0

June 2008
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
Q1 (a)		
	Tree without probabilities or labels	**M1**
	0.02(Disease), 0.95(Positive) on correct branches	**A1**
	0.03(Positive) on correct branch.	**A1**
		[3]
(b)	P(Positive Test) $=0.02\times0.95+0.98\times0.03$	**M1A1ft**
	$=0.0484$	**A1**
		[3]
(c)	$P(\text{Do not have disease}\mid\text{Postive test}) = \dfrac{0.98\times0.03}{0.0484}$	**M1**
	$=0.607438..$ awrt 0.607	**A1**
		[2]
(d)	Test not very useful OR High probability of not having the disease for a person with a positive test	**B1**
		[1]
		Total 9
	Notes: (a) M1:All 6 branches. Bracketed probabilities not required. (b) M1 for sum of two products, at least one correct from their diagram A1ft follows from the probabilities on their tree A1 for correct answer only or $\dfrac{121}{2500}$ (c) M1 for conditional probability with numerator following from their tree and denominator their answer to part (b). A1 also for $\dfrac{147}{242}$.	

Question Number	Scheme	Marks
Q5 (a)	 3 closed intersecting curves with labels 100 100,30 12,10,3,25 Box	**M1** **A1** **A1** **B1** **[4]**
(b)	P(Substance C) $= \frac{100+100+10+25}{300} = \frac{235}{300} = \frac{47}{60}$ or exact equivalent	**M1A1ft** **[2]**
(c)	P(All 3 $\|A$) $= \frac{10}{30+3+10+100} = \frac{10}{143}$ or exact equivalent	**M1A1ft** **[2]**
(d)	P(Universal donor) $= \frac{20}{300} = \frac{1}{15}$ or exact equivalent	**M1A1 cao** **[2]** **Total 10**
	Notes: (a) 20 not required. Fractions and exact equivalent decimals or percentages. (b) M1 For adding their positive values in C and finding a probability A1ft for correct answer or answer from their working (c) M1 their 10 divided by their sum of values in A A1ft for correct answer or answer from their working (d) M1 for 'their 20' divided by 300 A1 correct answer only	

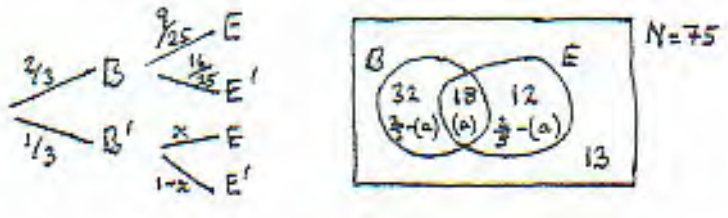
Question Number	Scheme	Marks
2 (a)	E = take regular exercise B = always eat breakfast $\mathrm{P}(E \cap B) = \mathrm{P}(E \mid B) \times \mathrm{P}(B)$ $= \frac{9}{25} \times \frac{2}{3} = 0.24$ or $\frac{6}{25}$ or $\frac{18}{75}$	M1 A1 (2)
(b)	$\mathrm{P}(E \cup B) = \frac{2}{3} + \frac{2}{5} - \frac{6}{25} = \frac{62}{75}$ | or $\mathrm{P}(E' \mid B') = \frac{13}{25}$ | or $\mathrm{P}(B' \cap E) = \frac{12}{75}$ | or $\mathrm{P}(B \cap E') = \frac{32}{75}$ $\mathrm{P}(E' \cap B') = 1 - \mathrm{P}(E \cup B) = \frac{13}{75}$ or $0.17\dot{3}$	M1 A1 M1 A1 (4)
(c)	$\mathrm{P}(E \mid B) = 0.36 \neq 0.40 = \mathrm{P}(E)$ or $\mathrm{P}(E \cap B) = \frac{6}{25} \neq \frac{2}{5} \times \frac{2}{3} = \mathrm{P}(E) \times \mathrm{P}(B)$ So E and B are not statistically independent	M1 A1 (2) **[8]**

(a) M1 for $\frac{9}{25} \times \frac{2}{3}$ or $\mathrm{P}(E|B) \times \mathrm{P}(B)$ and at least one correct value seen. A1 for 0.24 or exact equiv.
NB $\frac{2}{5} \times \frac{2}{3}$ alone or $\frac{2}{5} \times \frac{9}{25}$ alone scores M0A0. Correct answer scores full marks.

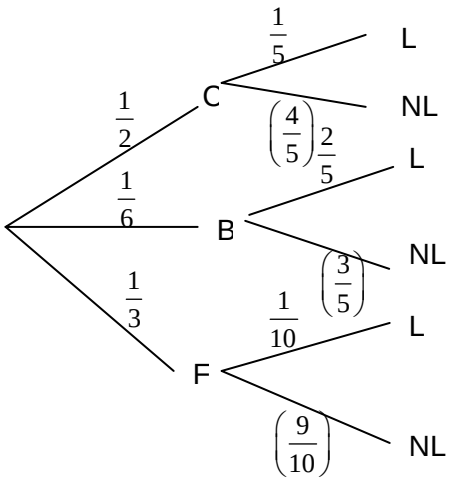
(b) 1st M1 for use of the addition rule. Must have 3 terms and some values, can ft their (a)
Or a full method for P($E'|B'$) requires 1 - P($E|B'$) and equation for P($E|B'$): (a) $+\frac{x}{3} = \frac{2}{5}$
Or a full method for $\mathrm{P}(B' \cap E)$ or $\mathrm{P}(B \cap E')$ [or other valid method]
2nd M1 for a method leading to answer e.g. $1 - \mathrm{P}(E \cup B)$
or $\mathrm{P}(B') \times \mathrm{P}(E' \mid B')$ or $\mathrm{P}(B') - \mathrm{P}(B' \cap E)$ or $\mathrm{P}(E') - \mathrm{P}(B \cap E')$
Venn Diagram 1st M1 for diagram with attempt at $\frac{2}{5} - \mathrm{P}(B \cap E)$ or $\frac{2}{3} - \mathrm{P}(B \cap E)$. Can ft their (a)
1st A1 for a correct first probability as listed or 32, 18 and 12 on Venn Diagram
2nd M1 for attempting 75 - their (18 +32 + 12)

(c) M1 for identifying suitable values to test for independence e.g. P(E) = 0.40 and P($E|B$) = 0.36
Or $\mathrm{P}(E) \times \mathrm{P}(B) = ...$ and $\mathrm{P}(E \cap B) =$ their (a) [but their (a) $\neq \frac{2}{5} \times \frac{2}{3}$]. Values seen somewhere
A1 for correct values and a correct comment

Diagrams You may see these or find these useful for identifying probabilities.

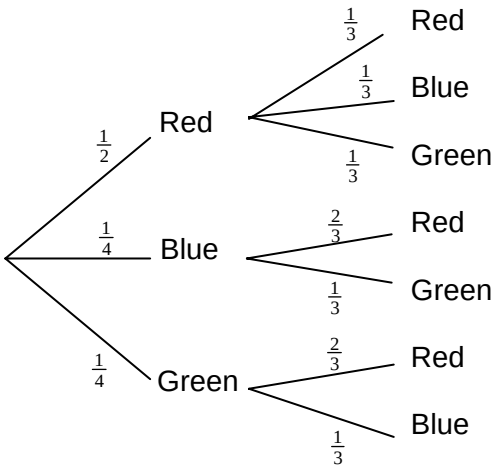


Common Errors
(a) $\frac{9}{25}$ is M0A0
(b) P(EUB)= $\frac{53}{75}$ scores M1A0
$1 - \mathrm{P}(E \cup B) = \frac{22}{75}$ scores M1A0
(b) $\mathrm{P}(B') \times \mathrm{P}(E') = \frac{1}{3} \times \frac{3}{5}$
scores 0/4

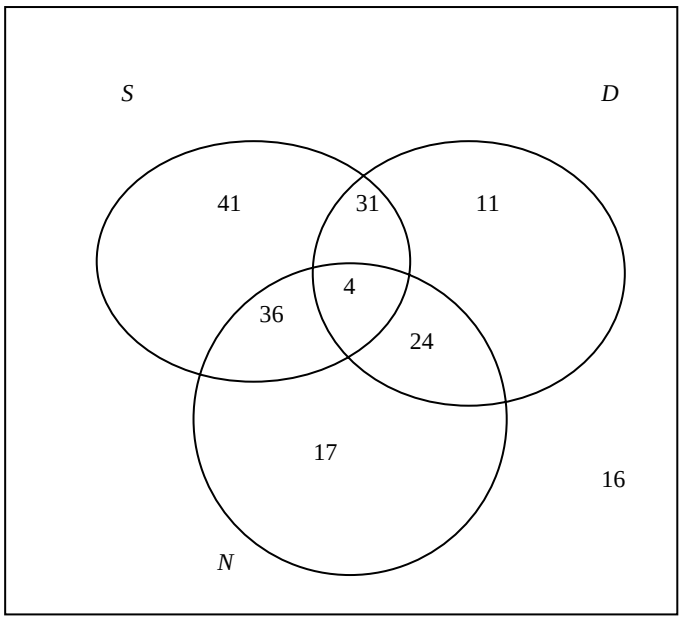
Question Number	Scheme	Marks
Q2 (a)	 Correct tree All labels Probabilities on correct branches	B1 B1 B1 (3)
(b)(i)	$\frac{1}{3}\times\frac{1}{10}=\frac{1}{30}$ or equivalent	M1 A1 (2)
(ii)	CNL + BNL + FNL $=\frac{1}{2}\times\frac{4}{5}+\frac{1}{6}\times\frac{3}{5}+\frac{1}{3}\times\frac{9}{10}$	M1
	$=\frac{4}{5}$ or equivalent	A1 (2)
(c)	$P(F'/L)=\frac{P(F'\cap L)}{P(L)}$ Attempt correct conditional probability **but see notes**	M1
	$=\frac{\frac{1}{6}\times\frac{2}{5}+\frac{1}{2}\times\frac{1}{5}}{1-(ii)}$ $\frac{\text{numerator}}{\text{denominator}}$	$\frac{\text{A1}}{\text{A1ft}}$
	$=\frac{\frac{5}{30}}{\frac{1}{5}}=\frac{5}{6}$ or equivalent cao	A1 (4) **[11]**
Notes	Exact decimal equivalents required throughout if fractions not used e.g. 2(b)(i) $0.0\dot{3}$ Correct path through their tree given in their probabilities award Ms 2(a) All branches required for first B1. Labels can be words rather than symbols for second B1. Probabilities from question enough for third B1 i.e. bracketed probabilities not required. Probabilities and labels swapped i.e. labels on branches and probabilities at end can be awarded the marks if correct. 2(b)(i) Correct answer only award both marks. 2(b)(ii) At least one correct path identified and attempt at adding all three multiplied pairs award M1 2(c) Require probability on numerator and division by probability for M1.Require numerator correct for their tree for M1. Correct formula seen and used, accept denominator as attempt and award M1 No formula, denominator must be correct for their tree or 1-(ii) for M1 1/30 on numerator only is M0, P(L/F') is M0.	

Question Number	Scheme	Marks
Q7(a) (i)	$P(A \cup B) = a + b$ cao	B1
(ii)	$P(A \cup B) = a + b - ab$ or equivalent	B1 (2)
(b)	$P(R \cup Q) = 0.15 + 0.35$ $= 0.5$ 0.5	B1 (1)
(c)	$P(R \cap Q) = P(R\|Q) \times P(Q)$ $= 0.1 \times 0.35$	M1
	$= 0.035$ **0.035**	A1 (2)
(d)	$P(R \cup Q) = P(R) + P(Q) - P(R \cap Q)$ OR $P(R) = P(R \cap Q') + P(R \cap Q)$ $= 0.15$+their (c) $0.5 = P(R) + 0.35 - 0.035$ $= 0.15 + 0.035$ $P(R) = 0.185$ $= 0.185$ 0.185	M1 A1 (2) **[7]**
Notes	7(a) (i) Accept $a + b$ - 0 for B1 **Special Case** If answers to (i) and (ii) are (i) $P(A)+P(B)$ and (ii) $P(A)+P(B)-P(A)P(B)$ award B0B1 7(a)(i) and (ii) answers must be clearly labelled or in correct order for marks to be awarded.	

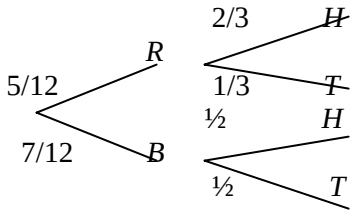
January 2010
6683 Statistics S1
Mark Scheme

Question Number	Scheme	Marks
Q1 (a)		M1 A1 A1 (3)
(b)	P(Blue bead and a green bead) $=\left(\frac{1}{4}\times\frac{1}{3}\right)+\left(\frac{1}{4}\times\frac{1}{3}\right)=\frac{1}{6}$ (or any exact equivalent)	M1 A1 (2) **Total [5]**

Q1 (a)	M1 for shape and labels: 3 branches followed by 3,2,2 with some *R*, *B* and *G* seen Allow 3 branches followed by 3, 3, 3 if 0 probabilities are seen implying that 3, 2, 2 intended Allow blank branches if the other probabilities imply probability on blanks is zero Ignore further sets of branches 1st A1 for correct probabilities and correct labels on 1st set of branches. 2nd A1 for correct probabilities and correct labels on 2nd set of branches. (accept 0.33, 0.67 etc or better here)
(b)	M1 for identifying the 2 cases *BG* and *GB* and adding 2 products of probabilities. These cases may be identified by their probabilities e.g. $\left(\frac{1}{4}\times\frac{1}{3}\right)+\left(\frac{1}{4}\times\frac{1}{3}\right)$ NB $\frac{1}{6}$ (or exact equivalent) with no working scores 2/2
Special Case	<u>With Replacement</u> (This oversimplifies so do not apply Mis-Read: max mark 2/5) (a) B1 for 3 branches followed by 3, 3, 3 with correct labels and probabilities of $\frac{1}{2},\frac{1}{4},\frac{1}{4}$ on each. (b) M1 for identifying 2, possibly correct cases and adding 2 products of probabilities but A0 for wrong answer $\left[\left(\frac{1}{4}\times\frac{1}{4}\right)+\left(\frac{1}{4}\times\frac{1}{4}\right)\right]$ will be sufficient for M1A0 here but $\frac{1}{4}\times\frac{1}{2}+\ldots$ would score M0

Question Number	Scheme	Marks
4 (a)		
	3 closed curves and 4 in centre	M1
	Evidence of subtraction	M1
	31,36,24	A1
	41,17,11	A1
	Labels on loops, 16 and box	B1
		(5)
(b)	P(None of the 3 options)= $\frac{16}{180}=\frac{4}{45}$	B1ft
		(1)
(c)	P(Networking only)= $\frac{17}{180}$	B1ft
		(1)
(d)	P(All 3 options/technician)= $\frac{4}{40}=\frac{1}{10}$	M1 A1
		(2)
		Total [9]

4 (a)	2nd M1 There may be evidence of subtraction in "outer" portions, so with 4 in the centre then 35, 40 28 (instead of 31,36,24) along with 33, 9, 3 can score this mark but A0A0 N.B. This is a common error and their "16" becomes 28 but still scores B0 in part (a)
(b)	B1ft for $\frac{16}{180}$ or any exact equivalent. Can ft their "16" from their box. If there is no value for their "16" in the box only allow this mark if they have <u>shown</u> some working.
(c)	B1ft ft their "17". Accept any exact equivalent
(d)	If a probability greater than 1 is found in part (d) score M0A0 M1 for clear sight of $\frac{\mathrm{P}(S\cap D\cap N)}{\mathrm{P}(S\cap N)}$ and an attempt at one of the probabilities, ft their values. Allow P(all 3 | $S\cap N$) = $\frac{4}{36}$ or $\frac{1}{9}$ to score M1 A0. Allow a correct ft from their diagram to score M1A0 e.g. in 33,3,9 case in (a): $\frac{4}{44}$ or $\frac{1}{11}$ is M1A0 A ratio of probabilities with a <u>product</u> of probabilities on top is M0, even with a correct formula. A1 for $\frac{4}{40}$ or $\frac{1}{10}$ or an exact equivalent Allow $\frac{4}{40}$ or $\frac{1}{10}$ to score both marks if this follows from their diagram, otherwise some explanation (method) is required.

Question Number	Scheme	Marks
Q2 (a)	 P(R) and P(B) 2nd set of probabilities	B1 B1 (2)
(b)	P(H) = $\frac{5}{12}\times\frac{2}{3}+\frac{7}{12}\times\frac{1}{2},=\frac{41}{72}$ or awrt 0.569	M1 A1 (2)
(c)	P(R|H) = $\frac{\frac{5}{12}\times\frac{2}{3}}{"\frac{41}{72}"},=\frac{20}{41}$ or awrt 0.488	M1 A1ft A1 (3)
(d)	$\left(\frac{5}{12}\right)^2+\left(\frac{7}{12}\right)^2$ $=\frac{25}{144}+\frac{49}{144}=\frac{74}{144}$ or $\frac{37}{72}$ or awrt 0.514	M1 A1ft A1 (3) **Total 10**

(a) 1st B1 for the probabilities on the first 2 branches. Accept $0.41\dot{6}$ and $0.58\dot{3}$

2nd B1 for probabilities on the second set of branches. Accept $0.\dot{6}$, $0.\dot{3}$, 0.5 and $\frac{1.5}{3}$

Allow exact decimal equivalents using clear recurring notation if required.

(b) M1 for an expression for P(H) that follows through their sum of two products of **probabilities** from their tree diagram

(c)

Formula seen: M1 for $\frac{\text{P}(R\cap H)}{\text{P}(H)}$ with denominator their (b) substituted e.g. $\frac{\text{P}(R\cap H)}{\text{P}(H)}=\frac{\frac{5}{12}}{(\text{their (b)})}$ award M1.

Formula not seen: M1 for $\frac{\text{probability}\times\text{probability}}{\text{their } b}$ but M0 if fraction repeated e.g. $\frac{\frac{5}{12}\times\frac{2}{3}}{\frac{2}{3}}$.

1st A1ft for a fully correct expression or correct follow through

2nd A1 for $\frac{20}{41}$ o.e.

(d) M1 for $\left(\frac{5}{12}\right)^2$ or $\left(\frac{7}{12}\right)^2$ can follow through their equivalent values from tree diagram

1st A1 for both values correct or follow through from their original tree and +

2nd A1 for a correct answer

Special Case $\frac{5}{12}\times\frac{4}{11}$ or $\frac{7}{12}\times\frac{6}{11}$ seen award M1A0A0

Question Number	Scheme	Marks
Q4 (a)	$\frac{2+3}{\text{their total}} = \frac{5}{\text{their total}} = \frac{1}{6}$ (**** given answer****)	M1 A1cso (2)
(b)	$\frac{4+2+5+3}{\text{total}}, \quad = \frac{14}{30}$ or $\frac{7}{15}$ or $0.4\dot{6}$	M1 A1 (2)
(c)	$P(A \cap C) = 0$	B1 (1)
(d)	$P(C \mid \text{reads at least one magazine}) = \frac{6+3}{20} = \frac{9}{20}$	M1 A1 (2)
(e)	$P(B) = \frac{10}{30} = \frac{1}{3}$, $P(C) = \frac{9}{30} = \frac{3}{10}$, $P(B \cap C) = \frac{3}{30} = \frac{1}{10}$ or $P(B\|C) = \frac{3}{9}$	M1
	$P(B) \times P(C) = \frac{1}{3} \times \frac{3}{10} = \frac{1}{10} = P(B \cap C)$ or $P(B\|C) = \frac{3}{9} = \frac{1}{3} = P(B)$	M1
	So yes they are statistically independent	A1cso (3)
		Total 10

(a)	M1 for $\frac{2+3}{\text{their total}}$ or $\frac{5}{30}$
(b)	M1 for adding at least 3 of "4, 2, 5, 3" and dividing by their total to give a probability Can be written as separate fractions substituted into the completely correct Addition Rule
(c)	B1 for 0 or 0/30
(d)	M1 for a **denominator of 20** or $\frac{20}{30}$ leading to an answer with denominator of 20 $\frac{9}{20}$ only, 2/2
(e)	1st M1 for attempting all the required probabilities for a suitable test 2nd M1 for use of a correct test - must have attempted all the correct probabilities. Equality can be implied in line 2. A1 for fully correct test carried out with a comment