Studies Logic, Sets & Probability November 2008-20124 with MS

1a. *[4 marks]*

Complete the truth table below.

p	q	$\neg p$	$(p \wedge q)$	$(\neg p \veebar q)$	$(p \wedge q) \Rightarrow (\neg p \veebar q)$
T	T				
T	F				
F	T				
F	F				

1b. *[1 mark]*

State whether the statement $(p \wedge q) \Rightarrow (\neg p \veebar q)$ is a logical contradiction, a tautology or neither.

1c. *[1 mark]*

Give a reason for your answer to part (b)(i).

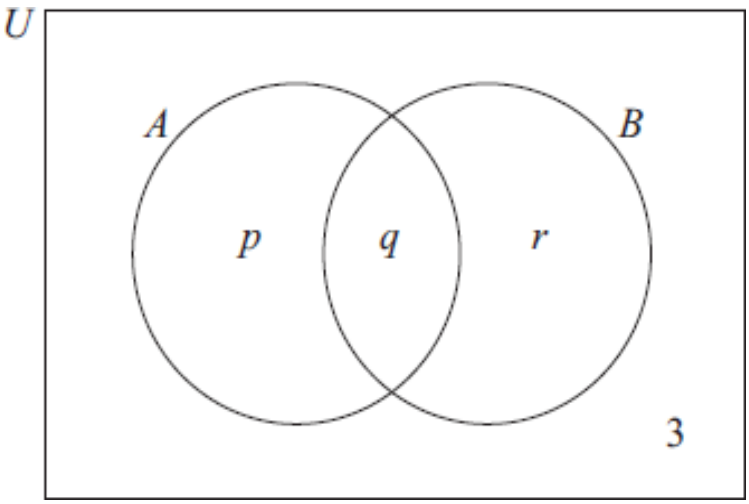
2a. *[2 marks]*

A group of 33 people was asked about the passports they have. 21 have Australian passports, 15 have British passports and 3 have neither.

Find the number that have both Australian and British passports.

2b. *[2 marks]*

In the Venn diagram below, set *A* represents the people in the group with Australian passports and set *B* those with British passports.



Write down the value of

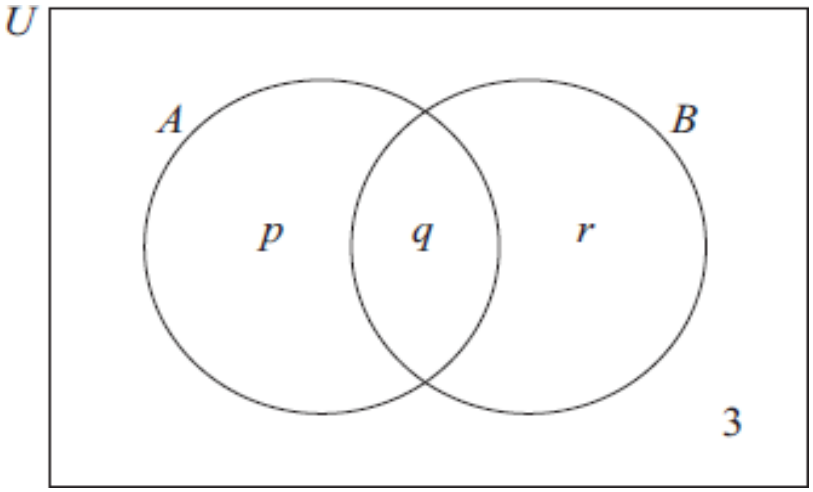
(i) q ;

(ii) p and of r .

2c. *[2 marks]*

A group of 33 people was asked about the passports they have. 21 have Australian passports, 15 have British passports and 3 have neither.

In the Venn diagram below, set A represents the people in the group with Australian passports and set B those with British passports.



Find $n(A \cup B')$.

3a. *[2 marks]*

Consider the following logic statements.

p: Carlos is playing the guitar

q: Carlos is studying for his IB exams

Write in words the compound statement $\neg p \wedge q$.

3b. *[1 mark]*

Write the following statement in symbolic form.

"Either Carlos is playing the guitar or he is studying for his IB exams but not both."

3c. *[3 marks]*

Write the **converse** of the following statement in **symbolic form**.

"If Carlos is playing the guitar then he is not studying for his IB exams."

4a. *[4 marks]*

In a college 450 students were surveyed with the following results

150 have a television

205 have a computer

220 have an iPhone

75 have an iPhone and a computer

60 have a television and a computer

70 have a television and an iPhone

40 have all three.

Draw a Venn diagram to show this information. Use T to represent the set of students who have a television, C the set of students who have a computer and I the set of students who have an iPhone.

4b. *[2 marks]*

Write down the number of students that

(i) have a computer only;

(ii) have an iPhone and a computer but no television.

4c. *[1 mark]*

Write down $n[T \cap (C \cup I)']$.

4d. *[2 marks]*

Calculate the number of students who have none of the three.

4e. *[6 marks]*

Two students are chosen at random from the 450 students. Calculate the probability that

(i) neither student has an iPhone;

(ii) only one of the students has an iPhone.

4f. *[3 marks]*

The students are asked to collect money for charity. In the first month, the students collect x dollars and the students collect y dollars in each subsequent month. In the first 6 months, they collect 7650 dollars. This can be represented by the equation $x + 5y = 7650$.

In the first 10 months they collect 13 050 dollars.

(i) Write down a second equation in x and y to represent this information.

(ii) Write down the value of x and of y .

4g. *[3 marks]*

The students are asked to collect money for charity. In the first month, the students collect x dollars and the students collect y dollars in each subsequent month. In the first 6 months, they collect 7650 dollars. This can be represented by the equation $x + 5y = 7650$.

In the first 10 months they collect 13 050 dollars.

Calculate the number of months that it will take the students to collect 49 500 dollars.

5a. *[6 marks]*

A store recorded their sales of televisions during the 2010 football World Cup. They looked at the numbers of televisions bought by gender and the size of the television screens.

This information is shown in the table below; S represents the size of the television screen in inches.

	$S \leq 22$	$22 < S \leq 32$	$32 < S \leq 46$	$S > 46$	Total
Female	65	100	40	15	220
Male	20	65	140	55	280
Total	85	165	180	70	500

The store wants to use this information to predict the probability of selling these sizes of televisions for the 2014 football World Cup.

Use the table to find the probability that

(i) a television will be bought by a female;

(ii) a television with a screen size of $32 < S \leq 46$ will be bought;

(iii) a television with a screen size of $32 < S \leq 46$ will be bought by a female;

(iv) a television with a screen size greater than 46 inches will be bought, given that it is bought by a male.

5b. *[1 mark]*

The manager of the store wants to determine whether the screen size is independent of gender. A Chi-squared test is performed at the 1 % significance level.

Write down the null hypothesis.

5c. *[2 marks]*

The manager of the store wants to determine whether the screen size is independent of gender. A Chi-squared test is performed at the 1 % significance level.

Show that the expected frequency for females who bought a screen size of $32 < S \leq 46$, is 79, correct to the nearest integer.

5d. *[1 mark]*

The manager of the store wants to determine whether the screen size is independent of gender. A Chi-squared test is performed at the 1 % significance level.

Write down the number of degrees of freedom.

5e. *[2 marks]*

The manager of the store wants to determine whether the screen size is independent of gender. A Chi-squared test is performed at the 1 % significance level.

Write down the χ^2 calculated value.

5f. *[1 mark]*

The manager of the store wants to determine whether the screen size is independent of gender. A Chi-squared test is performed at the 1 % significance level.

Write down the critical value for this test.

5g. *[2 marks]*

The manager of the store wants to determine whether the screen size is independent of gender. A Chi-squared test is performed at the 1 % significance level.

Determine if the null hypothesis should be accepted. Give a reason for your answer.

6a. *[1 mark]*

U is the set of **positive** integers less than or equal to 10.

A, B and C are subsets of U.

$A = \{\text{even integers}\}$

$B = \{\text{multiples of 3}\}$

$C = \{6,\ 7,\ 8,\ 9\}$

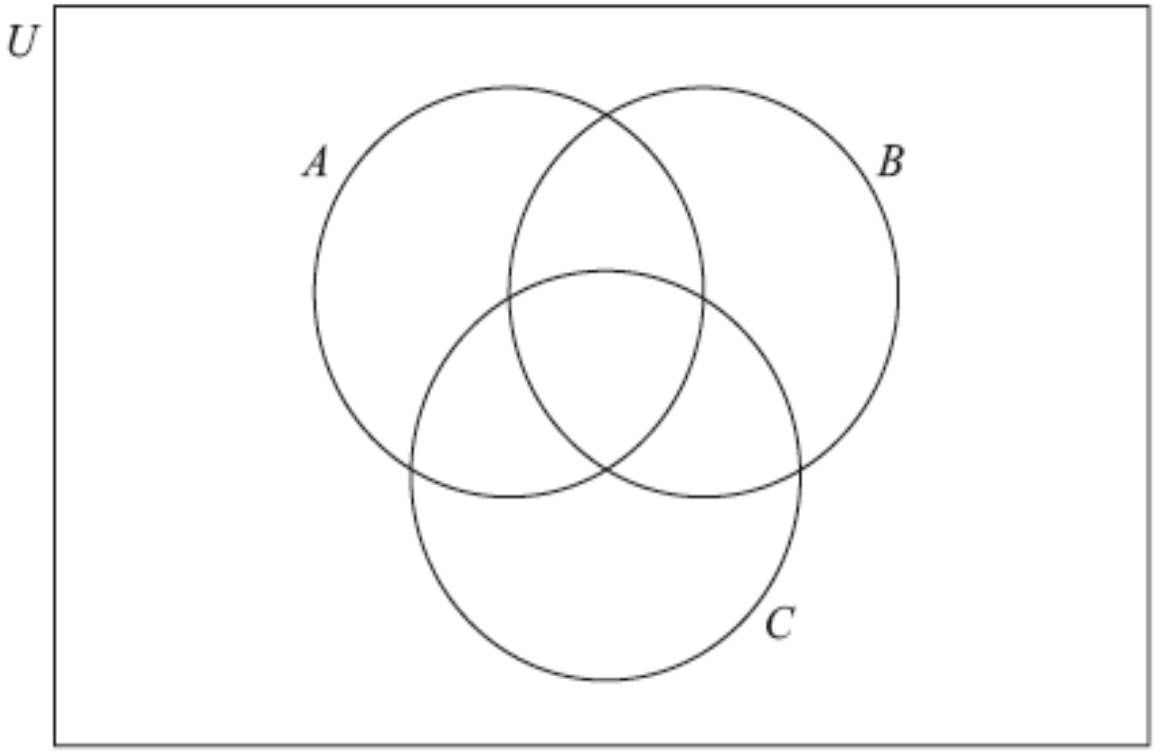
List the elements of A.

6b. *[1 mark]*

List the elements of B.

6c. *[4 marks]*

Complete the Venn diagram with **all** the elements of U.



7a. *[2 marks]*

Consider the propositions

p: *I have a bowl of soup.*

q: *I have an ice cream.*

Write down, in words, the compound proposition $\neg p \Rightarrow q$.

7b. *[2 marks]*

Complete the truth table.

p	q	$\neg p$	$\neg p \Rightarrow q$
T	T		
T	F		
F	T		
F	F		

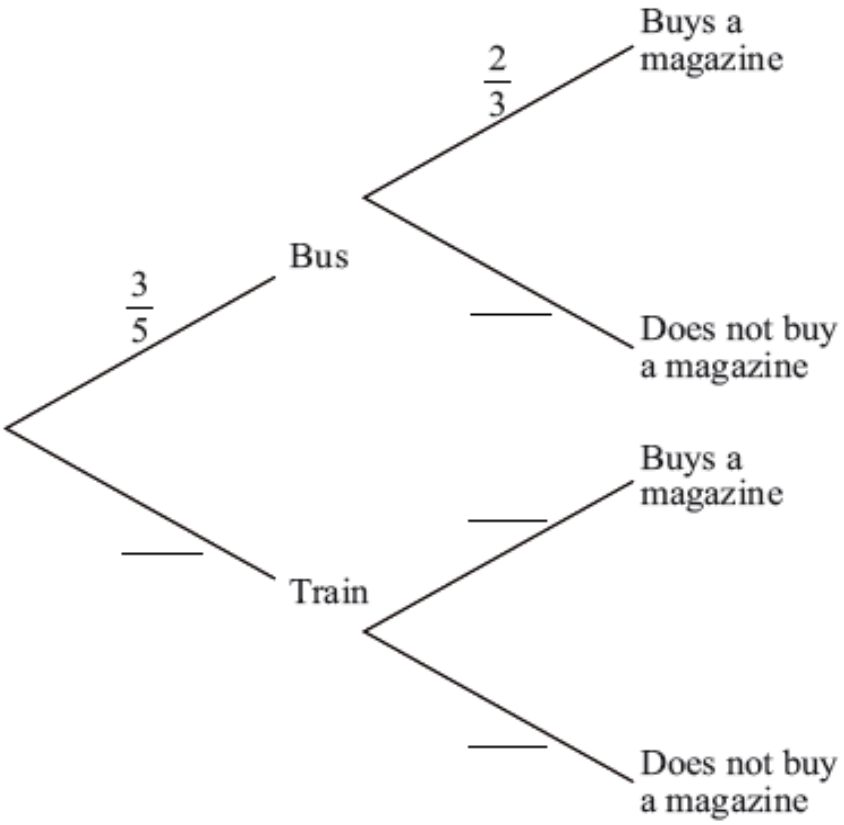
7c. *[2 marks]*

Write down, in symbolic form, the converse of $\neg p \Rightarrow q$.

8a. *[3 marks]*

Ramzi travels to work each day, either by bus or by train. The probability that he travels by bus is $\frac{3}{5}$. If he travels by bus, the probability that he buys a magazine is $\frac{2}{3}$. If he travels by train, the probability that he buys a magazine is $\frac{3}{4}$.

Complete the tree diagram.



8b. *[3 marks]*

Find the probability that Ramzi buys a magazine when he travels to work.

9a. *[5 marks]*

A group of 120 women in the USA were asked whether they had visited the continents of Europe (E) or South America (S) or Asia (A).

7 had visited all three continents

28 had visited Europe only

22 had visited South America only

16 had visited Asia only

15 had visited Europe and South America but had not visited Asia

x had visited South America and Asia but had not visited Europe

$2x$ had visited Europe and Asia but had not visited South America

20 had not visited any of these continents

Draw a Venn diagram, using sets labelled E, S and A, to show this information.

9b. *[2 marks]*

Calculate the value of x.

9c. *[2 marks]*

Explain, in words, the meaning of $(E \cup S) \cap A'$.

9d. *[1 mark]*

Write down $n((E \cup S \cup A)')$.

9e. *[2 marks]*

Find the probability that a woman selected at random from the group had visited Europe.

9f. *[2 marks]*

Find the probability that a woman selected at random from the group had visited Europe, given that she had visited Asia.

9g. *[3 marks]*

Two women from the group are selected at random.

Find the probability that both women selected had visited South America.

1a. *[4 marks]*

Markscheme

p	q	$\neg p$	$(p \wedge q)$	$(\neg p \veebar q)$	$(p \wedge q) \Rightarrow (\neg p \veebar q)$
T	T	F	T	T	T
T	F	F	F	F	T
F	T	T	F	F	T
F	F	T	F	T	T

(A1)(A1)(A1)*(ft)*(A1)*(ft) *(C4)

Notes: Award ***(A1)*** for each correct column.

Award first ***(A1)*(ft)** from their third column in the table.

Award second ***(A1)*(ft)** from their fourth and fifth column in the table.

[4 marks]

Examiners report

Weaker candidates had some difficulty here with the majority scoring less than 2 marks on this question. The more confident candidates were able to score well with most marks being lost only on completing the truth table for $(\neg p \veebar q)$. As a consequence, the final column entries of the table were often incorrect but earned the (A1)(ft) mark. Many candidates went on to correctly identify the correct (ft) response to (b)(i) and were able to support their answer with a correct reason.

1b. *[1 mark]*

Markscheme

Tautology ***(A1)*(ft) *(C1)***

Note: Answer must be consistent with last column in table.

[1 mark]

Examiners report

Weaker candidates had some difficulty here with the majority scoring less than 2 marks on this question. The more confident candidates were able to score well with most marks being lost only on completing the truth table for $(\neg p \veebar q)$. As a consequence, the final column entries of the table

were often incorrect but earned the (A1)(ft) mark. Many candidates went on to correctly identify the correct (ft) response to (b)(i) and were able to support their answer with a correct reason.

1c. *[1 mark]*

Markscheme

All entries (in the final column) are true.***(R1)*****(ft)*****(C1)***

Note: Answer must be consistent with their answer to part (b)(i).

Note: Special case ***(A1)(R0)*** may be awarded.

[1 mark]

Examiners report

Weaker candidates had some difficulty here with the majority scoring less than 2 marks on this question. The more confident candidates were able to score well with most marks being lost only on completing the truth table for $(\neg p \veebar q)$. As a consequence, the final column entries of the table were often incorrect but earned the (A1)(ft) mark. Many candidates went on to correctly identify the correct (ft) response to (b)(i) and were able to support their answer with a correct reason.

2a. *[2 marks]*

Markscheme

$21 + 15 + 3 - 33$ or equivalent ***(M1)***

Note: Award ***(M1)*** for correct use of all four numbers.

$= 6$ ***(A1) (C2)***

[2 marks]

Examiners report

Much good work was seen in parts (a) and (b). However, there was much confusion in candidates' responses to part (c) as many could not determine the required answer where a union was involved with a complement. The result was that either candidates simply ignored $n[(A \cup B)']$ and evaluated $n(A) = 21$ or ignored $n[(A \cap B)]$ and evaluated $n(B') = 18$. Irrespective of ability, the modal mark for this question was four with very few candidates achieving more than this mark.

2b. *[2 marks]*

Markscheme

(i) $q = 6$ ***(A1)*****(ft)**

(ii) $p = 15$, $r = 9$ ***(A1)*****(ft)** ***(C2)***

Note: Follow through from their answer to part (a).

[2 marks]

Examiners report

Much good work was seen in parts (a) and (b). However, there was much confusion in candidates' responses to part (c) as many could not determine the required answer where a union was involved with a complement. The result was that either candidates simply ignored $n[(A \cup B)']$ and evaluated $n(A) = 21$ or ignored $n[(A \cap B)]$ and evaluated $n(B') = 18$. Irrespective of ability, the modal mark for this question was four with very few candidates achieving more than this mark.

2c. *[2 marks]*

Markscheme

15 + 6 + 3 ***(M1)***

Note: Award ***(M1)*** for their figures seen in a correct calculation:

15 + 6 + 3 or 21 + 3 or 33 – 9

= 24 ***(A1)*****(ft)** ***(C2)***

Note: Follow through from parts (a) and (b) or from values shown on Venn diagram.

[2 marks]

Examiners report

Much good work was seen in parts (a) and (b). However, there was much confusion in candidates' responses to part (c) as many could not determine the required answer where a union was involved with a complement. The result was that either candidates simply ignored $n[(A \cup B)']$ and evaluated $n(A) = 21$ or ignored $n[(A \cap B)]$ and evaluated $n(B') = 18$. Irrespective of ability, the modal mark for this question was four with very few candidates achieving more than this mark.

3a. *[2 marks]*

Markscheme

Carlos is not playing the guitar and he is studying for his IB exams. ***(A1)(A1) (C2)***

Note: Award ***(A1)*** for "and", ***(A1)*** for correct statements.

[2 marks]

Examiners report

In part (a) occasionally *'if...then...'* was not seen but generally this was well done.

3b. *[1 mark]*

Markscheme

$p \veebar q$ ***(A1) (C1)***

[1 mark]

Examiners report

Part (b) was also well done despite the dearth of previous testing of the *exclusive or* statement.

3c. *[3 marks]*

Markscheme

$\neg q \Rightarrow p$ ***(A1)(A1)(A1) (C3)***

Notes: Award ***(A1)*** for implication, ***(A1)*** for the $\neg q$, ***(A1)*** for both $\neg q$ and p in the correct order. If correct converse seen in words only award ***(A1)(A1)(A0)***. Accept $p \Leftarrow \neg q$. Accept $\neg q$ for $\neg q$.

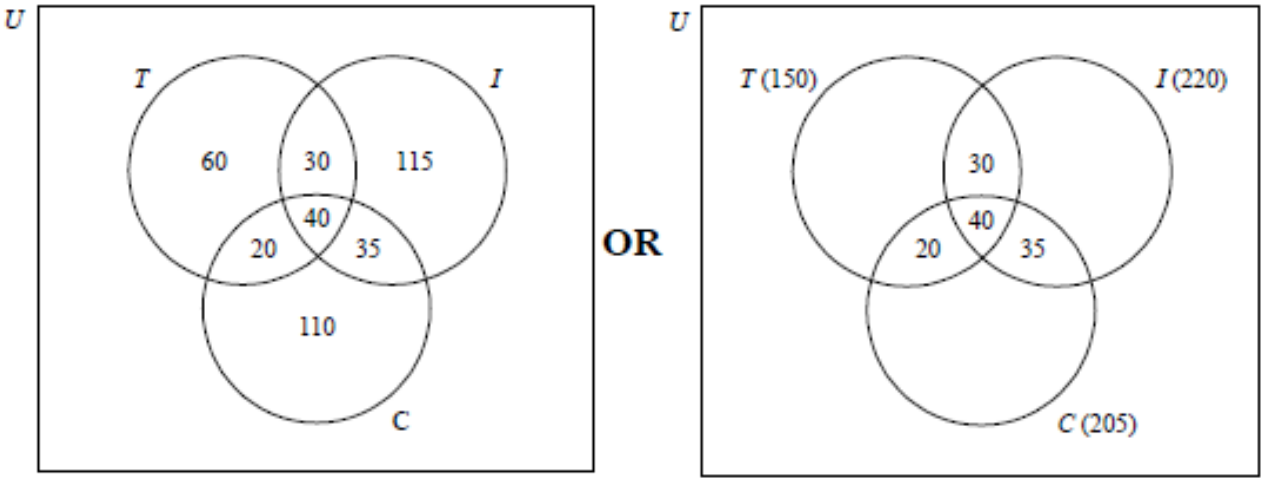
[3 marks]

Examiners report

Finding the converse of a statement in part (c) proved to be difficult for a significant number of candidates and incorrect answers of the form $q \Rightarrow \neg p$ were more frequently seen than the correct answer. Such incorrect answers lost two marks.

4a. *[4 marks]*

Markscheme



(A1)(A1)(A1)(A1)

Notes: Award ***(A1)*** for labelled sets *T*, *C*, and *I* included inside an enclosed universal set. (Label *U* is not essential.) Award ***(A1)*** for central entry 40. ***(A1)*** for 20, 30 and 35 in the other intersecting regions. ***(A1)*** for 60, 110 and 115 or *T*(150), *C*(205), *I*(220).

[4 marks]

Examiners report

The question was moderately well answered. The majority of candidates answered part (a) and at least parts of (b), and (d).

4b. *[2 marks]*

Markscheme

In parts (b), (c) and (d) follow through from their diagram.

(i) 110 ***(A1)*****(ft)**

(ii) 35 ***(A1)*****(ft)**

[2 marks]

Examiners report

The question was moderately well answered. The majority of candidates answered part (a) and at least parts of (b), and (d).

4c. *[1 mark]*

Markscheme

In parts (b), (c) and (d) follow through from their diagram.

60 ***(A1)*****(ft)**

[2 marks]

Examiners report

The question was moderately well answered. Part (c) proved to be difficult, as it required understanding and interpreting set notation.

4d. *[2 marks]*

Markscheme

In parts (b), (c) and (d) follow through from their diagram.

450 − (60 + 20 + 40 + 30 + 115 + 35 + 110) ***(M1)***

Note: Award ***(M1)*** for subtracting all their values from 450.

= 40 ***(A1)*****(ft)*****(G2)***

[2 marks]

Examiners report

The question was moderately well answered. The majority of candidates answered part (a) and at least parts of (b), and (d).

4e. *[6 marks]*

Markscheme

(i) $\frac{230}{450} \times \frac{229}{449}$ ***(A1)(M1)***

Note: Award ***(A1)*** for correct fractions, ***(M1)*** for multiplying their fractions.

$\frac{52670}{202050}\left(\frac{5267}{20205}, 0.261, 26.1\%\right)(0.26067\ldots)$ ***(A1)(G2)***

Note: Follow through from their Venn diagram in part (a).

(ii) $\frac{220}{450} \times \frac{230}{449} + \frac{230}{450} \times \frac{220}{449}$ ***(A1)(A1)***

Note: Award ***(A1)*** for addition of their products, ***(A1)*** for two correct products.

OR

$\frac{230}{450} \times \frac{220}{449} \times 2$ ***(A1)(A1)***

Notes: Award ***(A1)*** for their product of two fractions multiplied by 2, ***(A1)*** for correct product of two fractions multiplied by 2. Award ***(A0)(A0)*** if correct product is seen not multiplied by 2.

$\frac{2024}{4041}(0.501,\ 50.1\%)(0.50086\ldots)$ ***(A1)(G2)***

Note: Follow through from their Venn diagram in part (a) and/or their 230 used in part (e)(i).

Note: For consistent use of replacement in parts (i) and (ii) award at most ***(A0)(M1)(A0)*** in part (i) and ***(A1)*****(ft)*****(A1)(A1)*****(ft)*** in part (ii).

[6 marks]

Examiners report

The question was moderately well answered. Part (e) was rarely answered in its entirety.

4f. *[3 marks]*

Markscheme

(i) $x + 9y = 13050$ ***(A1)***

(ii) $x = 900$ ***(A1)*****(ft)**

$y = 1350$ ***(A1)*****(ft)**

Notes: Follow through from their equation in (f)(i). Do not award ***(A1)*****(ft)** if answer is negative. Award ***(M1)(A0)*** for an attempt at solving simultaneous equations algebraically but incorrect answer obtained.

[3 marks]

Examiners report

The question was moderately well answered. Part (f) was answered by many candidates, but most of them offered a partial answer to part (g); a typical response was 36 instead of 37.

4g. *[3 marks]*

Markscheme

$49500 = 900 + 1350n$ ***(A1)*****(ft)**

Notes: Award ***(A1)*****(ft)** for setting up correct equation. Follow through from candidate's part (f).

$n = 36$ ***(A1)*****(ft)**

The total number of months is 37. ***(A1)*****(ft)*****(G2)***

Note: Award ***(G1)*** for 36 seen as final answer with no working. The value of n must be a positive integer for the last two ***(A1)*****(ft)** to be awarded.

OR

$49500 = 900 + 1350(n - 1)$ ***(A2)*****(ft)**

Notes: Award ***(A2)*****(ft)** for setting up correct equation. Follow through from candidate's part (f).

$n = 37$ ***(A1)*****(ft)*****(G2)***

Note: The value of n must be a positive integer for the last ***(A1)*****(ft)** to be awarded.

[3 marks]

Examiners report

The question was moderately well answered. Part (f) was answered by many candidates, but most of them offered a partial answer to part (g); a typical response was 36 instead of 37.

5a. *[6 marks]*

Markscheme

(i) $\frac{220}{500}\ \left(\frac{11}{25}, 0.44, 44\%\right)$ ***(A1)(G1)***

(ii) $\frac{180}{500}\ \left(\frac{9}{25}, 0.36, 36\%\right)$ ***(A1)(G1)***

(iii) $\frac{40}{500}\ \left(\frac{2}{25}, 0.08, 8\%\right)$ ***(A1)(A1)(G2)***

(iv) $\frac{55}{500}\ \left(\frac{11}{56}, 0.196, 19.6\%\right)$ ***(A1)(A1)(G2)***

Note: Award ***(A1)*** for numerator, ***(A1)*** for denominator. Award ***(A0)(A0)*** if answers are given as incorrect reduced fractions without working.

[6 marks]

Examiners report

Part (a) was generally well answered by most of the students, except for part (a)(iv) which called for conditional probability.

5b. *[1 mark]*

Markscheme

"The size of the television screen is independent of gender." ***(A1)***

Note: Accept "not associated", do not accept "not correlated".

[1 mark]

Examiners report

Most students correctly stated the null hypothesis in part (b), and answered parts (d), (e), (f) and (g).

5c. *[2 marks]*

Markscheme

$\frac{180}{500} \times \frac{220}{500} \times 500$ **OR** $\frac{180 \times 220}{500}$ ***(M1)***

= 79.2 ***(A1)***

= 79 ***(AG)***

Note: Both the unrounded and the given answer must be seen for the final ***(A1)*** to be awarded.

[2 marks]

Examiners report

In some responses to part (c) it seemed that the difference between calculation of the expected value and showing that the value is 79 was not clear to the candidates. It is important that teachers explain to their students that in a ***"show that"*** *question* they are expected to demonstrate the mathematical reasoning through which the given answer is obtained.

5d. *[1 mark]*

Markscheme

3 ***(A1)***

[1 mark]

Examiners report

Most students correctly stated the null hypothesis in part (b), and answered parts (d), (e), (f) and (g).

5e. *[2 marks]*

Markscheme

χ^2_{calc} = 104(103.957...) ***(G2)***

Note: Award ***(M1)*** if an attempt at using the formula is seen but incorrect answer obtained.

[2 marks]

Examiners report

Most students correctly stated the null hypothesis in part (b), and answered parts (d), (e), (f) and (g).

5f. *[1 mark]*

Markscheme

11.345 ***(A1)*****(ft)**

Notes: Follow through from their degrees of freedom.

[1 mark]

Examiners report

Most students correctly stated the null hypothesis in part (b), and answered parts (d), (e), (f) and (g).

5g. *[2 marks]*

Markscheme

$\chi^2_{calc} > \chi^2_{crit}$ **OR** $p < 0.01$ ***(R1)***

Do not accept H. ***(A1)*****(ft)**

Note: Do not award ***(R0)(A1)*****(ft)**. Follow through from their parts (d), (e) and (f).

[2 marks]

Examiners report

Most students correctly stated the null hypothesis in part (b), and answered parts (d), (e), (f) and (g).

6a. *[1 mark]*

Markscheme

$2, 4, 6, 8, 10$ ***(A1) (C1)***

Note: Do not penalize the use of $\{\}$.

[1 mark]

Examiners report

This question was done well by most candidates. The most frequent error was to omit the placement of 1 and 5 or to include 0 in the set of even integers.

6b. *[1 mark]*

Markscheme

$3, 6, 9$ ***(A1) (C1)***

Note: Do not penalize the use of $\{\}$.

Follow through from part (a) only if their U is listed.

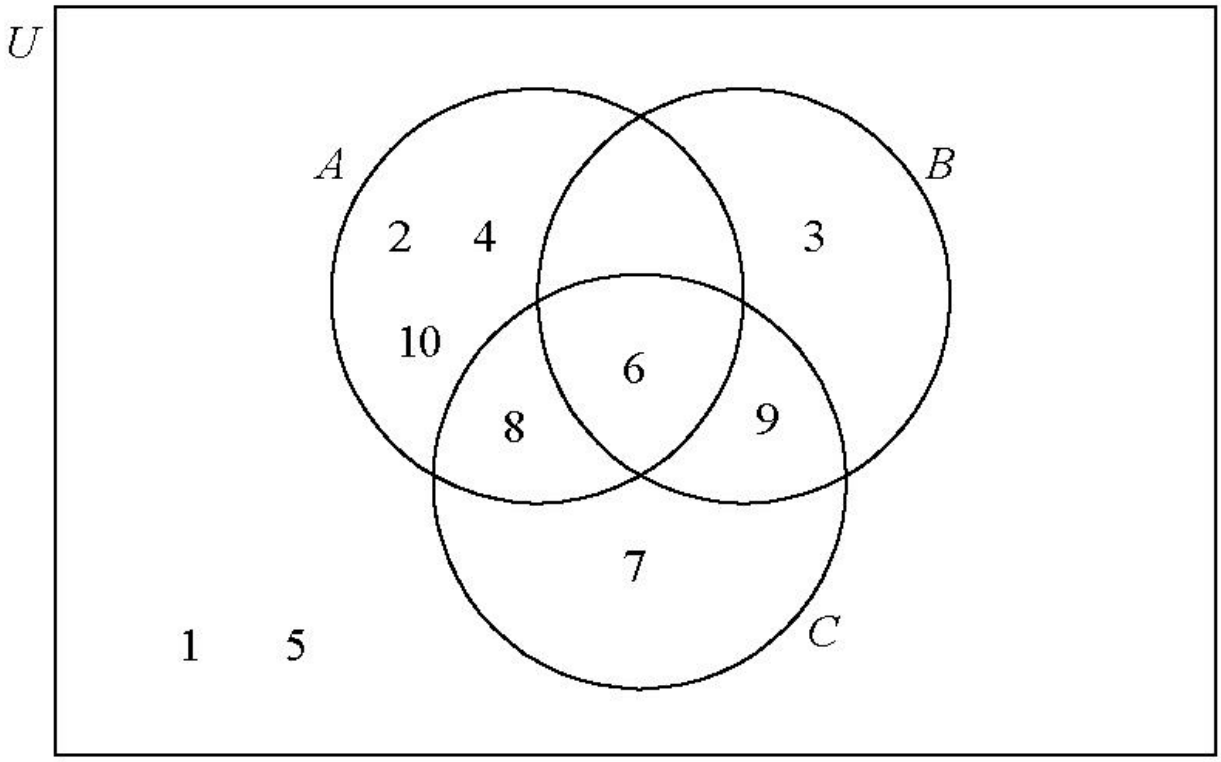
[1 mark]

Examiners report

This question was done well by most candidates. The most frequent error was to omit the placement of 1 and 5 or to include 0 in the set of even integers.

6c. *[4 marks]*

Markscheme



(A1)*(ft)*(A1)*(ft)*(A1)*(ft)*(A1)*(ft) *(C4)

Notes: Award ***(A1)*****(ft)** for the correct placement of 6.

Award ***(A1)*****(ft)** for the correct placement of 8 and 9 and the empty region.

Award ***(A1)*****(ft)** for the correct placement of 2, 4, 3, 7, and 10.

Award ***(A1)*****(ft)** for the correct placement of 1 and 5.

If an element is in more than one region, award ***(A0)*** for that element.

Follow through from their answers to parts (a) and (b).

[4 marks]

Examiners report

This question was done well by most candidates. The most frequent error was to omit the placement of 1 and 5 or to include 0 in the set of even integers.

7a. *[2 marks]*

Markscheme

If I do not have a bowl of soup then I have an ice cream. ***(A1)(A1) (C2)***

Notes: Award ***(A1)*** for If… then…

Award ***(A1)*** for correct statements in correct order.

[2 marks]

Examiners report

Most candidates were able to write the compound proposition in words, however many were not able to write the converse in symbolic form. While they were able to fill in the third column of the truth table, many were unable to complete the fourth column correctly.

7b. *[2 marks]*

Markscheme

p	q	$\neg p$	$\neg p \Rightarrow q$
T	T	**F**	**T**
T	F	**F**	**T**
F	T	**T**	**T**
F	F	**T**	**F**

(A1)(A1)*(ft) *(C2)

Note: Follow through from third column to fourth column.

[2 marks]

Examiners report

Most candidates were able to write the compound proposition in words, however many were not able to write the converse in symbolic form. While they were able to fill in the third column of the truth table, many were unable to complete the fourth column correctly.

7c. *[2 marks]*

Markscheme

$q \Rightarrow \neg p$ ***(A1)(A1) (C2)***

Notes: Award ***(A1)*** for $\Rightarrow$.

Award ***(A1)*** for q and $\neg p$ in correct order.

Accept $\neg p \Leftarrow q$.

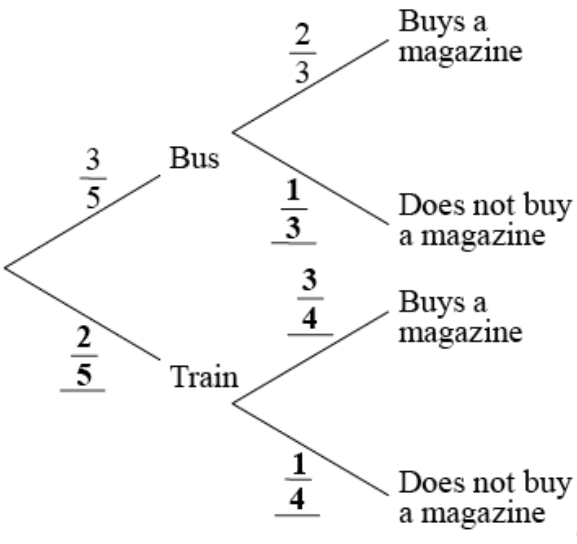
[2 marks]

Examiners report

Most candidates were able to write the compound proposition in words, however many were not able to write the converse in symbolic form. While they were able to fill in the third column of the truth table, many were unable to complete the fourth column correctly.

8a. *[3 marks]*

Markscheme



(A1)(A1)(A1) (C3)

Note: Award ***(A1)*** for each correct pair of branches.

[3 marks]

Examiners report

Candidates showed that they were able to place probabilities in the correct position on the tree diagram and many went on to find the correct probability, gaining full marks for this question. Some candidates did not recognize that addition of two products was required. A mistake that was seen too frequently on candidate scripts was giving probabilities, in part (b), that were greater than 1.

8b. *[3 marks]*

Markscheme

$\frac{3}{5} \times \frac{2}{3} + \frac{2}{5} \times \frac{3}{4}$ ***(A1)*****(ft)*****(M1)***

Notes: Award ***(A1)*****(ft)** for two consistent products from tree diagram, ***(M1)*** for addition of their products.

Follow through from their tree diagram provided all probabilities are between 0 and 1.

$\frac{7}{10}$ $\left(0.7, 70\%, \frac{42}{60}\right)$ ***(A1)*****(ft)** ***(C3)***

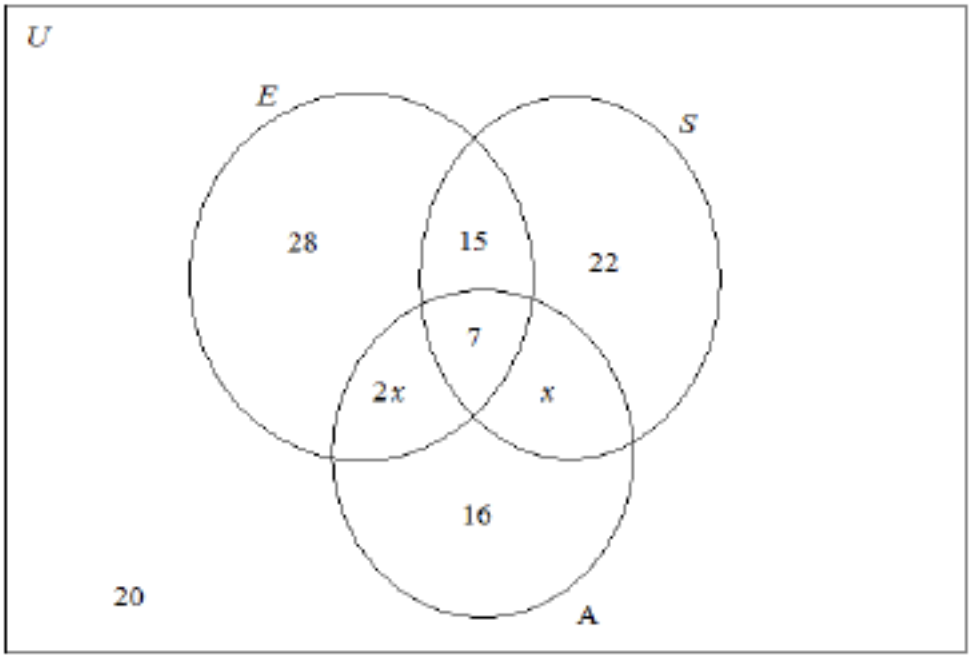
[3 marks]

Examiners report

Candidates showed that they were able to place probabilities in the correct position on the tree diagram and many went on to find the correct probability, gaining full marks for this question. Some candidates did not recognize that addition of two products was required. A mistake that was seen too frequently on candidate scripts was giving probabilities, in part (b), that were greater than 1.

9a. *[5 marks]*

Markscheme



(A1)(A1)(A1)(A1)(A1)

Notes: Award ***(A1)*** for rectangle and three labelled intersecting circles.

Award ***(A1)*** for 7 in correct place.

Award ***(A1)*** for 28, 22 and 16 in the correct places.

Award ***(A1)*** for 15, x and $2x$ in the correct places.

Award ***(A1)*** for 20 in the correct place.

Accept 4 and 8 instead of x and $2x$.

Do not penalize if U is omitted from the diagram.

[5 marks]

Examiners report

Candidates seemed to be well-drilled in the technique of creating Venn diagrams and using the data from their diagrams to solve problems in probability and this question was well answered. Except for the odd mistake in determining the value of *x* in part (b), many candidates scored full marks on the first two parts of the question. Indeed, those who calculated an incorrect value of *x* were able to recover many of the marks in the remainder of the question with the use of follow through marks. 'Explain in words…' required candidates to answer part (c) in the context of the question so '*E* union *S* intersection not *A*' earned no marks. Of those candidates who did answer in context, many scored 1 mark for 'had not visited Asia' but a significant number used 'and' rather than 'or' and consequently were not awarded the other mark for expressing $E \cup S$ in words. Whilst many correct answers of 20 were seen for part (d), a significant number of candidates wrote down the incorrect value of 113 which presumably was arrived at by evaluating $n((E \cap S \cap A)')$ rather than the actual demand of the question. Having a Venn diagram seemed to be a good aid for parts (e) and (f) and much good work was seen in these two parts. However, in part (g), a significant

number of candidates either chose a “with replacement” method or simply did not know what to do with the probabilities once they were found. As a consequence, this part of the question proved to be quite a discriminator.

9b. *[2 marks]*

Markscheme

$3x = 120 - (20 + 28 + 15 + 22 + 7 + 16)$ ***(M1)***

Note: Award ***(M1)*** for setting up a correct equation involving x, the 120 and values from their diagram.

$x = 4$ ***(A1)*****(ft)*****(G2)***

Note: Follow through from part (a). For the follow through to be awarded x must be a positive integer.

[2 marks]

Examiners report

Candidates seemed to be well-drilled in the technique of creating Venn diagrams and using the data from their diagrams to solve problems in probability and this question was well answered. Except for the odd mistake in determining the value of *x* in part (b), many candidates scored full marks on the first two parts of the question. Indeed, those who calculated an incorrect value of *x* were able to recover many of the marks in the remainder of the question with the use of follow through marks. ‘Explain in words…’ required candidates to answer part (c) in the context of the question so ‘*E* union *S* intersection not *A*’ earned no marks. Of those candidates who did answer in context, many scored 1 mark for ‘had not visited Asia’ but a significant number used ‘and’ rather than ‘or’ and consequently were not awarded the other mark for expressing $E \cup S$ in words. Whilst many correct answers of 20 were seen for part (d), a significant number of candidates wrote down the incorrect value of 113 which presumably was arrived at by evaluating $n((E \cap S \cap A)')$ rather than the actual demand of the question. Having a Venn diagram seemed to be a good aid for parts (e) and (f) and much good work was seen in these two parts. However, in part (g), a significant number of candidates either chose a “with replacement” method or simply did not know what to do with the probabilities once they were found. As a consequence, this part of the question proved to be quite a discriminator.

9c. *[2 marks]*

Markscheme

(Women who had visited) Europe **or** South America and (but had) **not** (visited) Asia ***(A1)(A1)***

Notes: Award ***(A1)*** for “(visited) Europe **or** South America” (or both).

Award ***(A1)*** for “and (but) had **not** visited Asia”.

E(urope) union S(outh America) intersected with not A(sia) earns no marks, ***(A0)***.

[2 marks]

Examiners report

Candidates seemed to be well-drilled in the technique of creating Venn diagrams and using the data from their diagrams to solve problems in probability and this question was well answered. Except for the odd mistake in determining the value of *x* in part (b), many candidates scored full marks on the first two parts of the question. Indeed, those who calculated an incorrect value of *x* were able to recover many of the marks in the remainder of the question with the use of follow through marks. 'Explain in words…' required candidates to answer part (c) in the context of the question so '*E* union *S* intersection not *A*' earned no marks. Of those candidates who did answer in context, many scored 1 mark for 'had not visited Asia' but a significant number used 'and' rather than 'or' and consequently were not awarded the other mark for expressing $E \cup S$ in words. Whilst many correct answers of 20 were seen for part (d), a significant number of candidates wrote down the incorrect value of 113 which presumably was arrived at by evaluating $n((E \cap S \cap A)')$ rather than the actual demand of the question. Having a Venn diagram seemed to be a good aid for parts (e) and (f) and much good work was seen in these two parts. However, in part (g), a significant number of candidates either chose a "with replacement" method or simply did not know what to do with the probabilities once they were found. As a consequence, this part of the question proved to be quite a discriminator.

9d. *[1 mark]*

Markscheme

20 ***(A1)***

Note: Award ***(A0)*** for the embedded answer of $n(20)$.

[1 mark]

Examiners report

Candidates seemed to be well-drilled in the technique of creating Venn diagrams and using the data from their diagrams to solve problems in probability and this question was well answered. Except for the odd mistake in determining the value of *x* in part (b), many candidates scored full marks on the first two parts of the question. Indeed, those who calculated an incorrect value of *x* were able to recover many of the marks in the remainder of the question with the use of follow through marks. 'Explain in words…' required candidates to answer part (c) in the context of the question so '*E* union *S* intersection not *A*' earned no marks. Of those candidates who did answer in context, many scored 1 mark for 'had not visited Asia' but a significant number used 'and' rather than 'or' and consequently were not awarded the other mark for expressing $E \cup S$ in words. Whilst many correct answers of 20 were seen for part (d), a significant number of candidates wrote down the incorrect value of 113 which presumably was arrived at by evaluating $n((E \cap S \cap A)')$ rather

than the actual demand of the question. Having a Venn diagram seemed to be a good aid for parts (e) and (f) and much good work was seen in these two parts. However, in part (g), a significant number of candidates either chose a "with replacement" method or simply did not know what to do with the probabilities once they were found. As a consequence, this part of the question proved to be quite a discriminator.

9e. *[2 marks]*

Markscheme

$\frac{58}{120}$ $\left(\frac{29}{60}, 0.483, 48.3\%\right)$ $(0.48333\ldots)$ ***(A1)*****(ft)*****(A1)(G2)***

Note: Award ***(A1)*****(ft)** for numerator, follow through from their value of x, or their diagram, ***(A1)*** for denominator.

[2 marks]

Examiners report

Candidates seemed to be well-drilled in the technique of creating Venn diagrams and using the data from their diagrams to solve problems in probability and this question was well answered. Except for the odd mistake in determining the value of *x* in part (b), many candidates scored full marks on the first two parts of the question. Indeed, those who calculated an incorrect value of *x* were able to recover many of the marks in the remainder of the question with the use of follow through marks. 'Explain in words…' required candidates to answer part (c) in the context of the question so '*E* union *S* intersection not *A*' earned no marks. Of those candidates who did answer in context, many scored 1 mark for 'had not visited Asia' but a significant number used 'and' rather than 'or' and consequently were not awarded the other mark for expressing $E \cup S$ in words. Whilst many correct answers of 20 were seen for part (d), a significant number of candidates wrote down the incorrect value of 113 which presumably was arrived at by evaluating $n((E \cap S \cap A)')$ rather than the actual demand of the question. Having a Venn diagram seemed to be a good aid for parts (e) and (f) and much good work was seen in these two parts. However, in part (g), a significant number of candidates either chose a "with replacement" method or simply did not know what to do with the probabilities once they were found. As a consequence, this part of the question proved to be quite a discriminator.

9f. *[2 marks]*

Markscheme

$\frac{15}{35}$ $\left(\frac{3}{7}, 0.429, 42.9\%\right)$ $(0.428571\ldots)$ ***(A1)*****(ft)*****(A1)*****(ft)*****(G2)***

Note: Award ***(A1)*****(ft)** for numerator, ***(A1)*****(ft)** for denominator, follow through from their value of x or their diagram.

[2 marks]

Examiners report

Candidates seemed to be well-drilled in the technique of creating Venn diagrams and using the data from their diagrams to solve problems in probability and this question was well answered. Except for the odd mistake in determining the value of *x* in part (b), many candidates scored full marks on the first two parts of the question. Indeed, those who calculated an incorrect value of *x* were able to recover many of the marks in the remainder of the question with the use of follow through marks. 'Explain in words…' required candidates to answer part (c) in the context of the question so '*E* union *S* intersection not *A*' earned no marks. Of those candidates who did answer in context, many scored 1 mark for 'had not visited Asia' but a significant number used 'and' rather than 'or' and consequently were not awarded the other mark for expressing $E \cup S$ in words. Whilst many correct answers of 20 were seen for part (d), a significant number of candidates wrote down the incorrect value of 113 which presumably was arrived at by evaluating $n((E \cap S \cap A)')$ rather than the actual demand of the question. Having a Venn diagram seemed to be a good aid for parts (e) and (f) and much good work was seen in these two parts. However, in part (g), a significant number of candidates either chose a "with replacement" method or simply did not know what to do with the probabilities once they were found. As a consequence, this part of the question proved to be quite a discriminator.

9g. *[3 marks]*

Markscheme

$\frac{48}{120} \times \frac{47}{119}$ ***(A1)*****(ft)*****(M1)***

Notes: Award ***(A1)*****(ft)** for two correct fractions, follow through from their denominator in part (e), follow through the numerator from their answer to part (b) or from their diagram, ***(M1)*** for multiplication of their two fractions.

$= \frac{2256}{14\,280}$ $\left(\frac{94}{595}, 0.158, 15{,}8\%\right)$ $(0.157983\ldots)$ ***(A1)*****(ft)*****(G2)***

Notes: Award ***(A1)(M1)(A1)*** for correct fractions, correctly multiplied together with an answer of 0.16.

Award ***(A0)(M1)(A0)*** for $\frac{48}{120} \times \frac{48}{120} = 0.16$.

Award ***(G1)*** for an answer of 0.16 with no working seen.

[3 marks]

Examiners report

Candidates seemed to be well-drilled in the technique of creating Venn diagrams and using the data from their diagrams to solve problems in probability and this question was well answered. Except for the odd mistake in determining the value of *x* in part (b), many candidates scored full marks on the first two parts of the question. Indeed, those who calculated an incorrect value of *x* were able to

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