Topic 3 Part 4 *[163 marks]*

1a. *[2 marks]*

Markscheme

If a quadrilateral is not a square (then) the four sides of the quadrilateral are not equal.   *(A1)(A1)*   *(C2)*

Note: Award *(A1)* for "if…(then)", *(A1)* for the correct phrases in the correct order.

[2 marks]

Examiners report

There was confusion among some students about which was the inverse and converse of the given statement.

1b. *[2 marks]*

Markscheme

If the four sides of the quadrilateral are equal (then) the quadrilateral is a square.   *(A1)(A1)***(ft)**   *(C2)*

Note: Award *(A1)* for "if…(then)", *(A1)***(ft)** for the correct phrases in the correct order.

Note: Follow through in (b) if the inverse and converse in (a) and (b) are correct and reversed.

[2 marks]

Examiners report

There was confusion among some students about which was the inverse and converse of the given statement.

1c. *[2 marks]*

Markscheme

The converse is not always true, for example a rhombus (diamond) is a quadrilateral with four equal sides, but it is not a square. *(A1)(R1)*   *(C2)*

**Note:** Do not award *(A1)(R0)*.

[2 marks]

Examiners report

There was confusion among some students about which was the inverse and converse of the given statement. Part (c) was poorly done with very few students able to provide an example that shows that the converse is not always true.

2a.   [3 marks]

Markscheme

(A1)(A1)(A1)   (C3)
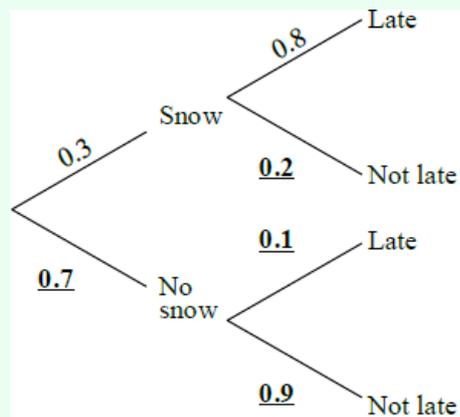
Note: Award *(A1)* for each correct pair.

[3 marks]

Examiners report

This question was answered well.

2b.   [1 mark]

Markscheme

0.7×0.1

$= 0.07(\frac{7}{100}, 7\%)$ *(A1)(ft)*   *(C1)*

[1 mark]

Examiners report

This question was answered well.

2c.   [2 marks]

Markscheme

$0.3 \times 0.8 + 0.07$ *(M1)*

$= 0.31(\frac{31}{100}, 31\%)$ *(A1)(ft)*

Note: In (b) and (c) follow through from sensible answers only i.e. not a probability greater than one.   *(C2)*

[2 marks]

Examiners report

A few students were unable to do part (c).

3a.   *[3 marks]*

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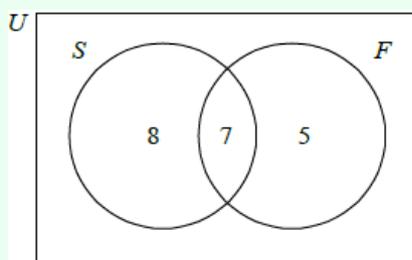
(A1)(A1)(A1)   (C3)

Note: Award *(A1)* for a labeled Venn diagram with appropriate sets.

(A1) for 7, *(A1)* for 8 and 5.

[3 marks]

Examiners report

Part (a) was done well.

3b.   *[3 marks]*

Markscheme

P (Spanish / one language only) $= \dfrac{\frac{8}{20}}{\frac{8}{20}+\frac{5}{20}}$ *(M1)(A1)(ft)*

Note: Award *(M1)* for substituted conditional probability formula, *(A1)* for correct substitution. Follow through from their Venn diagram.

$= \frac{8}{13}$(0.615, 61.5%)   *(A1)(ft)*

OR

P (Spanish / one language only) $= \frac{8}{8+5}$ *(A1)(ft)(M1)*

Note: Award *(A1)* for their correct numerator, *(M1)* for correct recognition of regions. Follow through from their Venn diagram.

$= \frac{8}{13}$(0.615, 61.5%)   *(A1)(ft)   (C3)*

[3 marks]

Examiners report

Very few were able to answer (b).

4a.

Markscheme

(A1)(A1)(A1)
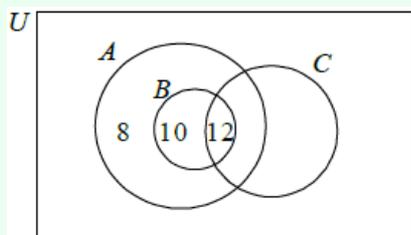
Note: Award *(A1)* for each correct number in the correct position.

[3 marks]

Examiners report

This part was successfully attempted by the great majority. The less familiar form of the Venn diagram seemed not to cause too many problems, although a common mistake was the failure to add the 20 in set A in part (b). A surprising number seemed unfamiliar with set notation in (d) and thus were not able to attempt this part.

4b.

Markscheme

28   *(A1)*(ft)

Note: 20 + their 8.

[1 mark]

Examiners report

This part was successfully attempted by the great majority. The less familiar form of the Venn diagram seemed not to cause too many problems, although a common mistake was the failure to add the 20 in set A in part (b). A surprising number seemed unfamiliar with set notation in (d) and thus were not able to attempt this part.

4c.

Markscheme

59   *(A1)*(ft)

[1 mark]

Examiners report

This part was successfully attempted by the great majority. The less familiar form of the Venn diagram seemed not to cause too many problems, although a common mistake was the failure to add the 20 in set A in part (b). A surprising number seemed unfamiliar with set notation in (d) and thus were not able to attempt this part.

4d.   *[2 marks]*

Markscheme

$10 + 12 + 20 + 6$ *(M1)*

Note: Award *(M1)* for use of the correct regions.

$= 48$ *(A1)(ft)(G2)*

OR

$59 - 8 - 3$ *(M1)*

$= 48$ *(A1)(ft)*

[2 marks]

Examiners report

This part was successfully attempted by the great majority. The less familiar form of the Venn diagram seemed not to cause too many problems, although a common mistake was the failure to add the 20 in set A in part (b). A surprising number seemed unfamiliar with set notation in (d) and thus were not able to attempt this part.

4e.   *[2 marks]*

Markscheme

$p \wedge \neg q$ *(A1)(A1)*

Note: Award *(A1)* for
$\wedge$, *(A1)* for both statements in the correct order.

[2 marks]

Examiners report

The work on logic also proved accessible to the great majority with a large number of candidates attaining full marks. The most common errors were the omission of the "If" in the conditional statement in (b) and the inability to follow the implication in the truth table in (c).

4f.   *[3 marks]*

Markscheme

If it is not snowing and the roads are open (then) we will go skiing.   *(A1)(A1)(A1)*

Note: Award *(A1)* for "if…(then)", *(A1)* for "not snowing and the roads are open", *(A1)* for "we will go skiing".

[3 marks]

Examiners report

The work on logic also proved accessible to the great majority with a large number of candidates attaining full marks. The most common errors were the omission of the "If" in the conditional statement in (b) and the inability to follow the implication in the truth table in (c).

4g.

Markscheme

p	q	r	$\neg\,p$	$\neg p \wedge q$	$(\neg p \wedge q) \Rightarrow r$
T	T	T	F	F	T
T	T	F	F	F	T
T	F	T	F	F	T
T	F	F	F	F	T
F	T	T	T	T	T
F	T	F	T	T	F
F	F	T	T	F	T
F	F	F	T	F	T

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

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

[3 marks]

Examiners report

The work on logic also proved accessible to the great majority with a large number of candidates attaining full marks. The most common errors were the omission of the "If" in the conditional statement in (b) and the inability to follow the implication in the truth table in (c).

5a.

Markscheme

If the sun is shining then I will go swimming.   *(A1)(A1)*   *(C2)*

Note: Award *(A1)* for "if…then" and *(A1)* for correct order.

[2 marks]

Examiners report

The most common error was poor use of the "If...then" connective.

5b.

Markscheme

Either the sun is not shining or I will go swimming.   *(A1)(A1)*   *(C2)*

Note: Award *(A1)* for both correct statements and *(A1)* for "either" "…or".

[2 marks]

Examiners report

Confusion between "and" and "or" was rare, however, the use of implication in this part was a little too common.

5c.

Markscheme

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

(A1) (C1)

[1 mark]

Examiners report

Precise, correct terminology was expected in this part.

5d.

Markscheme

They are (logically) equivalent.   *(A1)   (C1)*

Note: Do not accept any other answers.

[1 mark]

Examiners report

[N/A]

6a.

Markscheme

$\frac{4}{24}$
$\left(\frac{1}{6}, 0.167, 16.7\,\%\right)$ *(A1)(A1)   (C2)*

Note: Award *(A1)* for numerator, *(A1)* for denominator.

[2 marks]

Examiners report

The diagram caused some difficulty for some candidates, however the majority of candidates were successful.

6b.

$\frac{7}{24}$
$(0.292, 29.2\,\%)$

Examiners report

The diagram caused some difficulty for some candidates, however the majority of candidates were successful in (a).

The term "difference" was well understood by the candidature.

6c. *[2 marks]*

Markscheme

$\frac{3}{7}$
$(0.429, 42.9 \%)$ *(A1)(A1)(ft)*   *(C2)*

Note: Award *(A1)* for numerator *(A1)(ft)* for denominator, **(ft)** from their numerator in (b).

[2 marks]

Examiners report

The diagram caused some difficulty for some candidates, however the majority of candidates were successful in (a).

7a. *[3 marks]*

Markscheme
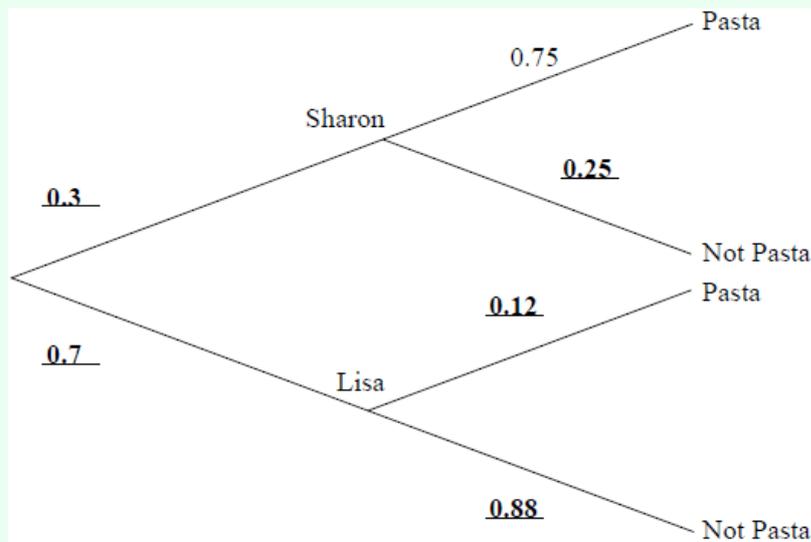
Note: Award *(A1)* for each correct pair.   *(A3)*

[3 marks]

Examiners report

The tree diagram was quite well answered by many students, but sometimes it was missing on many papers. It seemed they had it on their examination paper because the subsequent questions were answered accurately. Conditional probability was of great difficulty to many candidates.

[2 marks]

Markscheme

$0.7 \times 0.88 = 0.616 \left(\frac{77}{125}, 61.6\%\right)$ *(M1)(A1)(ft)(G2)*

Note: Award *(M1)* for multiplying the correct probabilities.

[2 marks]

Examiners report

The tree diagram was quite well answered by many students, but sometimes it was missing on many papers. It seemed they had it on their examination paper because the subsequent questions were answered accurately. Conditional probability was of great difficulty to many candidates.

[3 marks]

Markscheme

$0.3 \times 0.25 + 0.7 \times 0.88$ *(M1)(M1)*

Notes: Award *(M1)* for a relevant two-factor product, could be
$S \times NP$ **OR**
$L \times NP$.

Award *(M1)* for summing 2 two-factor products.

$P = 0.691 \left(\frac{691}{1000}, 69.1\%\right)$ *(A1)(ft)(G2)*

Notes: **(ft)** from their answer to (b).

[3 marks]

Examiners report

The tree diagram was quite well answered by many students, but sometimes it was missing on many papers. It seemed they had it on their examination paper because the subsequent questions were answered accurately. Conditional probability was of great difficulty to many candidates.

[3 marks]

Markscheme

$\frac{0.616}{0.691}$ *(M1)(A1)*

Note: Award *(M1)* for substituted conditional probability formula, *(A1)* for correct substitution.

$P = 0.891 \left(\frac{616}{691}, 89.1\%\right)$ *(A1)(ft)(G2)*

[3 marks]

Examiners report

The tree diagram was quite well answered by many students, but sometimes it was missing on many papers. It seemed they had it on their examination paper because the subsequent questions were answered accurately. Conditional probability was of great difficulty to many candidates.

Markscheme

3   *(A1)*

[1 mark]

Examiners report

This question was well handled although part (d) proved too difficult for many candidates and demonstrated, overall, a poor level of understanding of basic set notation. Students generally had the algebraic skills required to solve for *x* in part (e)(ii).

Markscheme

For 5, 4, 7 (0) seen with no extra values   *(A1)*

16   *(A1)(G2)*

[2 marks]

Examiners report

This question was well handled although part (d) proved too difficult for many candidates and demonstrated, overall, a poor level of understanding of basic set notation. Students generally had the algebraic skills required to solve for *x* in part (e)(ii).

Markscheme

They like (both) the *Salseros (S)* **and** they like the *Bluers (B)*   *(A1)(A1)*

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

[2 marks]

Examiners report

This question was well handled although part (d) proved too difficult for many candidates and demonstrated, overall, a poor level of understanding of basic set notation. Students generally had the algebraic skills required to solve for *x* in part (e)(ii).

$R \cap B \cap S'$

$R \cap B$
$\cap S'$

Examiners report

This question was well handled although part (d) proved too difficult for many candidates and demonstrated, overall, a poor level of understanding of basic set notation. Students generally had the algebraic skills required to solve for x in part (e)(ii).

7i.   *[2 marks]*

Markscheme

$21 + 3x = 33$ *(M1)*

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

[2 marks]

Examiners report

This question was well handled although part (d) proved too difficult for many candidates and demonstrated, overall, a poor level of understanding of basic set notation. Students generally had the algebraic skills required to solve for x in part (e)(ii).

7j.   *[1 mark]*

Markscheme

17   *(A1)(ft)*

[1 mark]

Examiners report

This question was well handled although part (d) proved too difficult for many candidates and demonstrated, overall, a poor level of understanding of basic set notation. Students generally had the algebraic skills required to solve for x in part (e)(ii).

8a.   *[1 mark]*

Markscheme

$P(A \cap B) = 0$ *(A1)*   *(C1)*

[1 mark]

Examiners report

This question proved to be difficult with many candidates unaware of the significance of mutually exclusive events in probability. A significant number gave the answer to (b) as the answer to (a).

8b.   *[2 marks]*

Markscheme

$P(A \cap B) = P(A) \times P(B)$

$= \frac{4}{13} \times \frac{5}{13}$ *(M1)*

Note: Award *(M1)* for product of two fractions, decimals or percentages.

$P(A \cap B) = \frac{20}{169} (= 0.118)$ *(A1)*   *(C2)*

[2 marks]

8c. [3 marks]

Markscheme

$\frac{7}{13} = \frac{4}{13} + \frac{5}{13} - \mathrm{P}(A \cap B)$ *(M1)(M1)*

Notes: Award *(M1)* for
$\frac{4}{13} + \frac{5}{13}$ seen, *(M1)* for subtraction of
$\frac{7}{13}$ shown.

OR

Award *(M1)* for Venn diagram with 2 intersecting circles, *(A1)* for correct probabilities in diagram.

$\mathrm{P}(A \cap B) = \frac{2}{13}(= 0.154)$ *(A1)*   *(C3)*

[3 marks]

9a. [2 marks]

Markscheme

(i) $m = 1$ *(A1)*

(ii) $n = 3$ *(A1)*   *(C2)*

Note: Award *(A0)(A1)(ft)* for
$m = \frac{1}{8}, n = \frac{3}{8}$.

Award *(A0)(A1)(ft)* for $m = 3$, $n = 1$.

[2 marks]

9b.

Markscheme

$P(B/R') = \frac{\frac{3}{8}}{\frac{6}{8}} = \frac{3}{6}\left(\frac{1}{2}, 50\%, 0.5\right)$ *(M1)(A1)*(ft)   *(C2)*

Note: Award *(M1)* for correctly substituted conditional probability formula or for 6 seen as part of denominator.

[2 marks]

Examiners report

The answers 1/8 and 3/8 were provided by many rather than 1 and 3. The conditional probability question was correctly answered more often when the formula was used. A common incorrect answer to part (c) was 3/8 × 2/7.

9c.

Markscheme

$P(B, B) = \frac{3}{8} \times \frac{3}{8} = \frac{9}{64}(0.141)$ *(M1)(A1)*(ft)   *(C2)*

Note: Award *(M1)* for product of two correct fractions, decimals or percentages.

(ft) from their answer to part (a) (ii).

[2 marks]

Examiners report

The answers 1/8 and 3/8 were provided by many rather than 1 and 3. The conditional probability question was correctly answered more often when the formula was used. A common incorrect answer to part (c) was 3/8 × 2/7.

10a.

Markscheme

(A1)(A1)(A1)(A1)(A1)
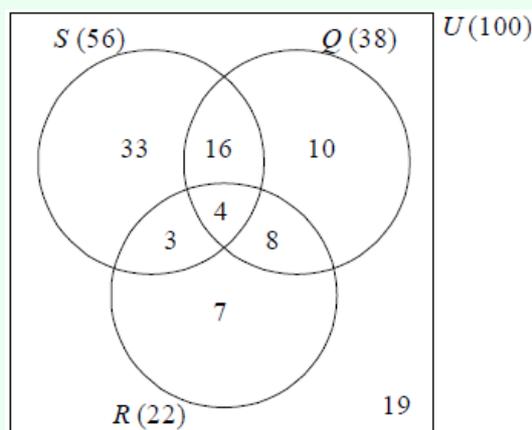
Note: Award *(A1)* for rectangle (*U not required*), *(A1)* for 3 intersecting circles, *(A1)* for 4 in central intersection, *(A1)* for 16, 3, 8 and *(A1)* for 33, 10, 7 (ft) if subtraction is carried out, or for S(56), Q(38) and R(22) seen by the circles.

[5 marks]

10b.   *[2 marks]*

Markscheme

$100 - 81$ *(M1)*

19 *(A1)(ft)(G2)*

Note: Award *(M1)* for subtracting their total from 100.

[2 marks]

10c.   *[3 marks]*

Markscheme

$33 + 10 + 7$ *(M1)*

Note: Award *(M1)* for adding their values from (a).

$\left(\frac{50}{100}\right) \times 100 \ \%$ *(A1)(ft)*

$50 \ \% \ (50)$ *(A1)(ft)(G3)*

[3 marks]

10d.   *[2 marks]*

Markscheme

P (own a cat given they own a bird)
$= \frac{12}{22} \left(0.545, \frac{6}{11}\right)$ *(A1)(ft)(A1)(ft)*

Note: Award *(A1)(ft)* for the numerator, *(A1)(ft)* for the denominator.

[2 marks]

11a. [4 marks]

Markscheme

$u_1 r^4 = 324$ *(A1)*

$u_1 r = 12$ *(A1)*

$r^3 = 27$ *(M1)*

$r = 3$ *(A1)(G3)*

Note: Award at most *(G3)* for trial and error.

[4 marks]

Examiners report

An easy ratio to find and the majority of candidates found $r = 3$, though many had trouble showing the appropriate method, thus losing marks.

11b. [3 marks]

Markscheme

$4 \times 3^9 = 78732$ **or** $12 \times 3^8 = 78732$ *(A1)(M1)(A1)(ft)(G3)*

Note: Award *(A1)* for $u_1 = 4$ if $n = 9$, **or** $u_1 = 12$ if $n = 8$, *(M1)* for correctly substituted formula.

(ft) from their (a).

[3 marks]

Examiners report

A fairly straightforward part for most candidates.

11c. [3 marks]

$k-1$

th   th

The majority found $k - 7$; many without supporting work which lost them a mark. Where candidates had difficulty in this part, it was generally a case of poor algebraic skills.

11d. [3 marks]

Markscheme

If the number is even and the number does not end in zero, (then) the number is not a multiple of five.   *(A1)(A1)(A1)*

Note: Award *(A1)* for "if…(then)", *(A1)* for "the number is even and the number does not end in zero", *(A1)* for the number is not a multiple of 5.

[3 marks]

Examiners report

This question on logic was straightforward for most candidates who scored full marks for parts (a) and (b) (i). A few omitted the brackets in part (b).

11e. [4 marks]

Markscheme

$(p \wedge \neg q) \Rightarrow \neg r$ *(A1)(A1)(A1)(A1)*

(A1) for
$\Rightarrow$, *(A1) for*
$\wedge$, *(A1) for* p and
$\neg q$, *(A1) for*
$\neg r$

Note: If parentheses not present award at most *(A1)(A1)(A1)(A0)*.

[4 marks]

Examiners report

This question on logic was straightforward for most candidates who scored full marks for parts (a) and (b) (i). A few omitted the brackets in part (b).

11f. *[2 marks]*

Markscheme

$r \Rightarrow (\neg p \lor q)$ **OR**
$r \Rightarrow \neg (p \land \neg q)$ *(A1)(ft)(A1)(ft)*

Note: Award *(A1)(ft)* for reversing the order, *(A1)* for negating the statements on both sides.

If parentheses not present award at most *(A1)(ft)(A0)*.

Do not penalise twice for missing parentheses in (i) and (ii).

[2 marks]

Examiners report

Very poorly answered with many candidates scoring just one mark. The main error was to open the bracket and not use the "or".

12a. *[2 marks]*

Markscheme

Grade	Frequency
1	1
2	4
3	(2)
4	3
5	(4)
6	5
7	(1)

(A2)   (C2)

Notes: Award *(A1)* for three correct. Award *(A0)* for two or fewer correct.

[2 marks]

Examiners report

Parts (a) and (b) were well done by the vast majority of candidates.

12b. *[1 mark]*

Markscheme

Mode $= 6$ *(A1)(ft)*   *(C1)*

[1 mark]

Examiners report

Parts (a) and (b) were well done by the vast majority of candidates.

12c. *[2 marks]*

Markscheme

Median $= 4.5$ *(M1)(A1)(ft)*   *(C2)*

Note: *(M1)* for attempt to order raw data (if frequency table not used) or *(M1)* halfway between 10th and 11th result.

[2 marks]

12d. *[1 mark]*

Markscheme

$\frac{7}{20}$ (0.35, 35%) *(A1)(ft)* *(C1)*

[1 mark]

13a. *[2 marks]*

Markscheme

p	q	$p \vee q$	$\neg(p \vee q)$
T	T	T	F
T	F	T	F
F	T	T	F
F	F	F	T

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

Note: *(A1)* for each correct column.

[2 marks]

Markscheme

It is not true that food or drinks may be taken into the cinema.

Note: *(A1)* for "it is not true". *(A1)* for "food or drinks".

OR

Neither food nor drinks may be taken into the cinema.

Note: *(A1)* for "neither". *(A1)* for "nor".

OR

No food and no drinks may be taken into the cinema.

Note: *(A1)* for "no food", "no drinks". *(A1)* for "and".

OR

No food or drink may be brought into the cinema.   *(A2)*   *(C2)*

Note: *(A1)* for "no", *(A1)* for "food or drink". Do not penalize for use of plural/singular.

Note: the following answers are incorrect:
No food and drink may be brought into the cinema. Award *(A1) (A0)*
Food and drink may not be brought into the cinema. Award *(A1) (A0)*
No food or no drink may be brought into the cinema. Award *(A1) (A0)*

[2 marks]

Examiners report

(b) lack of precision in language led to many errors.

Markscheme

$\neg p \wedge \neg q$

Note: *(A1)* for both negations, *(A1)* for conjunction.

OR

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

Note: *(A1)* for negation, *(A1)* for
$p \vee q$ in parentheses.

[2 marks]

Examiners report

(a) was generally answered well.

(b) lack of precision in language led to many errors.

Markscheme

9   *(A1)*   *(C1)*

[1 mark]

Examiners report

14b.

[1 mark]

Markscheme

12   *(A1)*   *(C1)*

[1 mark]

Examiners report

This question was well attempted by the majority. The major error was the omission of the " 6" in the candidates' calculations. Perhaps better positioning would have helped in this regard.

14c.

[2 marks]

Markscheme

$8 + 3 + 9 + 6$ *(M1)*

$= 26$ *(A1)*   *(C2)*

Note: Award *(A1)* for
20 seen if answer is incorrect.

[2 marks]

Examiners report

This question was well attempted by the majority. The major error was the omission of the " 6" in the candidates' calculations. Perhaps better positioning would have helped in this regard.

14d.

[2 marks]

Markscheme

$5 + 2 + 3$ *(M1)*

$= 10$ *(A1)*   *(C2)*

Note: Award *(A1)* for
29 or
19 seen if answer is incorrect.

[2 marks]

Examiners report

This question was well attempted by the majority. The major error was the omission of the " 6" in the candidates' calculations. Perhaps better positioning would have helped in this regard.

15a.

Markscheme

(i)

H_0 = wearing of a seat belt and the time a driver has held a licence are independent.   *(A1)*

Note: For independent accept 'not associated' but do not accept 'not related' or 'not correlated'

(ii)

2   *(A1)*

(iii)

$\frac{98 \times 45}{200} = 22.05 = 22$ (*correct to the nearest whole number*)   *(M1)(A1)(AG)*

Note: *(M1)* for correct formula and *(A1)* for correct substitution. Unrounded answer must be seen for the *(A1)* to be awarded.

(iv)

$\chi^2 = 8.12$ *(G2)*

Note: For unrounded answer award *(G1)(G0)(AP)*. If formula used award *(M1)* for correct substituted formula with correct substitution (6 terms) *(A1)* for correct answer.

(v) "Does not accept
H_0"   *(A1)(ft)*

p-value < 0.05 *(R1)(ft)*

Note: Allow "Reject
H_0" or equivalent. Follow through from their
χ^2 statistic. Award *(R1)(ft)* for comparing the appropriate values. The *(A1)(ft)* can be awarded only if the conclusion is valid according to the comparison given. If no reason given or if reason is wrong the two marks are lost.

[8 marks]

Examiners report

The first part of the question was relatively well done. The null hypothesis and the degrees of freedom were well answered by the majority of the students. In the show that question some students used the GDC to find the expected values table and highlighted the correct value
22.05. This procedure gained no mark; the expected value formula was expected to be used here. Also those who did use the formula were expected to show the unrounded value
22.05 to gain full marks in this part question. Many lost the answer mark for not doing so. GDC was used by most of the students to find the chi-squared test though some students attempted to find this value by hand which made them waste time. Correct values were compared when deciding whether to accept or not the null hypothesis and follow through marks were awarded from their degrees of freedom and chi-squared test when incorrect.

The second part was not as successful as the first one. Simple probability was well answered. Not all the students changed the denominator to
45 for the second probability showing their weaknesses in conditional probability. It would have been useful for the students to use a tree diagram to help them solve the last part of this question but very few did so. Some of those students that reached the last part of the question forgot to add one of the three terms. Very few used the probability of the complement.

15b. [4 marks]

Markscheme

(i)

$\frac{98}{200}(= 0.49, 49\%)$ *(A1)(A1)(G2)*

Note: *(A1)* for numerator, *(A1)* for denominator.

(ii)

$\frac{15}{45}(= 0.333, 33.3\%)$ *(A1)(A1)(G2)*

Note: *(A1)* for numerator, *(A1)* for denominator.

[4 marks]

Examiners report

The first part of the question was relatively well done. The null hypothesis and the degrees of freedom were well answered by the majority of the students. In the show that question some students used the GDC to find the expected values table and highlighted the correct value
22.05. This procedure gained no mark; the expected value formula was expected to be used here. Also those who did use the formula were expected to show the unrounded value
22.05 to gain full marks in this part question. Many lost the answer mark for not doing so. GDC was used by most of the students to find the chi-squared test though some students attempted to find this value by hand which made them waste time. Correct values were compared when deciding whether to accept or not the null hypothesis and follow through marks were awarded from their degrees of freedom and chi-squared test when incorrect.

The second part was not as successful as the first one. Simple probability was well answered. Not all the students changed the denominator to
45 for the second probability showing their weaknesses in conditional probability. It would have been useful for the students to use a tree diagram to help them solve the last part of this question but very few did so. Some of those students that reached the last part of the question forgot to add one of the three terms. Very few used the probability of the complement.

15c. [6 marks]

Markscheme

(i)

$\frac{98}{200} \times \frac{97}{199} = 0.239\ (23.9\%)$ *(A1)(M1)(A1)(G3)*

Note: *(A1)* for correct probabilities seen, *(M1)* for multiplying two probabilities, *(A1)* for correct answer.

(ii)

$1 - \frac{102}{200} \times \frac{101}{199} = 0.741\ (74.1\%)$ *(M1)(M1)(A1)***(ft)***(G2)*

Note: *(M1)* for showing the product, *(M1)* for using the probability of the complement, *(A1)* for correct answer. Follow through for consistent use of with replacement.

OR

$\frac{98}{200} \times \frac{97}{199} + \frac{98}{200} \times \frac{102}{199} + \frac{102}{200} \times \frac{98}{199} = 0.741\ (74.1\%)$ *(M1)(M1)(A1)***(ft)***(G2)*

Note: *(M1)* for adding three products of fractions (or equivalent), *(M1)* for using the correct fractions, *(A1)* for correct answer. Follow through for consistent use of with replacement.

[6 marks]

16a.   *[2 marks]*

Markscheme

Either Sean is at school or Sean is playing a game on his computer but not both.   *(A1)(A1)   (C2)*

Note: *(A1)* for 'either ... or but not both' *(A1)* for correct statements. 'Either' can be omitted.

[2 marks]

Examiners report

The common error in part (a) was not to include "but not both" and for (b), to give the inverse rather than the converse. The first column in the table (not
q) was well done but a number of candidates answered the implication incorrectly.

16b.   *[2 marks]*

Markscheme

If Sean is not playing a game on his computer then Sean is at school.   *(A1)(A1)   (C2)*

Note: *(A1)* for 'If ... then' *(A1)* for correct propositions in the correct order.

[2 marks]

Examiners report

The common error in part (a) was not to include "but not both" and for (b), to give the inverse rather than the converse. The first column in the table (not
q) was well done but a number of candidates answered the implication incorrectly.

16c.   *[2 marks]*

Markscheme

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

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

Note: *(A1)* for each correct column.

[2 marks]

17a.   *[3 marks]*

Markscheme
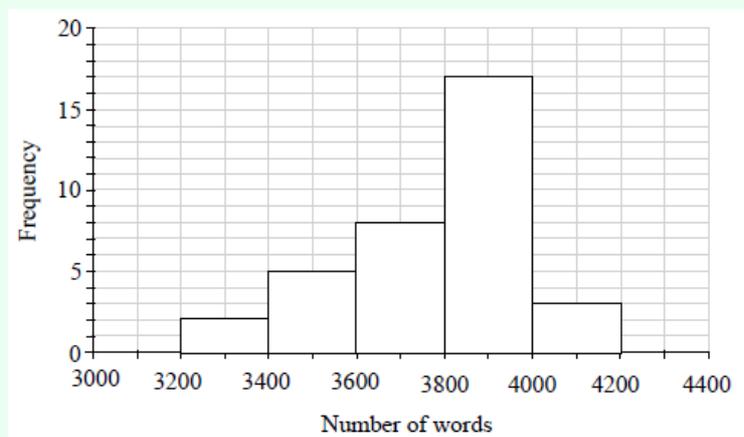
(A3)   *(C3)*

Notes: *(A3)* for correct histogram, *(A2)* for one error, *(A1)* for two errors, *(A0)* for more than two errors.
Award maximum *(A2)* if lines do not appear to be drawn with a ruler.
Award maximum *(A2)* if a frequency polygon is drawn.

[3 marks]

17b.   *[1 mark]*

Markscheme

Modal group $= 3800 \leqslant w < 4000$ *(A1)*   *(C1)*

[1 mark]

17c.   *[2 marks]*

Markscheme

Probability $= \frac{3}{35}$ $(0.0857, 8.57\%)$ *(A1)(A1)*   *(C2)*

Note: *(A1)* for correct numerator *(A1)* for correct denominator.

[2 marks]

18a.   *[4 marks]*
Markscheme

(i)

p	q	$p \wedge q$	$\neg(p \wedge q)$	$\neg p$	$\neg q$	$\neg p \vee \neg q$
T	T	**T**	**F**	F	F	**F**
T	F	**F**	**T**	F	T	**T**
F	T	**F**	**T**	T	F	**T**
F	F	**F**	**T**	T	T	**T**

(A3)

Note: Award *(A1)* for
$p \wedge q$ column correct, *(A1)(ft)* for
$\neg(p \wedge q)$ column correct, *(A1)* for last column correct.

(ii)   Yes.   *(R1)(ft)*   *(C4)*

Note: (ft) from their second and the last columns. Must be correct from their table.

[4 marks]

18b.   *[2 marks]*
Markscheme

$p \underline{\vee} q$.   *(A1)(A1)*   *(C2)*

Note: Award *(A1)* for
$p \ldots q$, *(A1)* for
$\underline{\vee}$. Accept
$(p \vee q) \wedge \neg(p \wedge q)$ or
$(p \vee q) \wedge (\neg p \vee \neg q)$.

[2 marks]