# Topic 3 Part 5 *[102 marks]*

1a. *[2 marks]*

## Markscheme

$m \wedge (s \underline{\vee} d)$ ***(A2)***

***(A1)*** *for*
$m \wedge$

***(A1)*** *for*
$(s \underline{\vee} d)$

***(A1)(A0)*** *if brackets are missing.*

**OR**

$(m \wedge s) \underline{\vee} (m \wedge d)$ ***(A2)***

***(A1)*** *for both brackets correct,* ***(A1)*** *for disjunctive "or"* ***(A1)(A0)*** *if brackets are missing.* ***(C2)***

***[2 marks]***

## Examiners report

(a) This caused problems for many candidates. They seem to expect to include the implication symbol somewhere.

1b. *[2 marks]*

## Markscheme

If you choose a salad then you do not choose a dessert. ***(A2)***

***(A1)*** *for "if …then…"* ***(A1)*** *for salad and no dessert in the correct order.*

**OR**

If you choose a salad you do not choose a dessert. ***(A2)*** ***(C2)***

***[2 marks]***

## Examiners report

(b) Most candidates managed to write this correctly.

1c. *[2 marks]*

## Markscheme

| $s$ | $d$ | $\neg s$ | $\neg s \Rightarrow d$ |
|---|---|---|---|
| T | T | F | T |
| T | F | F | T |
| F | T | T | T |
| F | F | T | F |

***(A1)*** *for each correct column* ***(A1)(A1)(ft)*** ***(C2)***

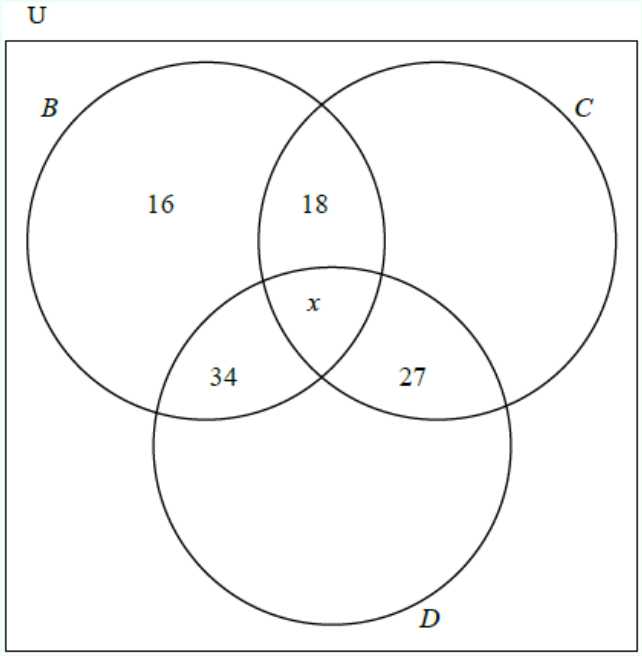
***[2 marks]***

## Examiners report

(c) Not all candidates could complete the truth table correctly. Many managed the first column but then made mistakes in the last column.

2a. *[2 marks]*

## Markscheme




*(A2)*

***(A1)*** *only if 1 error*

***(A0)*** *otherwise* ***(C2)***

***[2 marks]***

## Examiners report

Venn diagrams continue to be a problem area. Quite a good number of candidates managed to fill in the information on the Venn diagram accurately. However, finding the correct value for $x$ and calculating the number of students in the school posed a big problem for many candidates.

2b. *[1 mark]*

## Markscheme

$x + 16 + 18 + 34 = 99$

$x = 31$ ***(A1)*** ***(C1)***

***[1 mark]***

## Examiners report

Venn diagrams continue to be a problem area. Quite a good number of candidates managed to fill in the information on the Venn diagram accurately. However, finding the correct value for $x$ and calculating the number of students in the school posed a big problem for many candidates.

2c. *[3 marks]*

## Markscheme

Choir only

$= 88 - (18 + 27 + 31) = 12$ ***(A1)*****(ft)**

Drama only

$= 110 - (27 + 34 + 31) = 18$ ***(A1)*****(ft)**

Total

$= 16 + 34 + 18 + 31 + 12 + 27 + 18 = 156$ ***(A1)*****(ft)** ***(C3)***

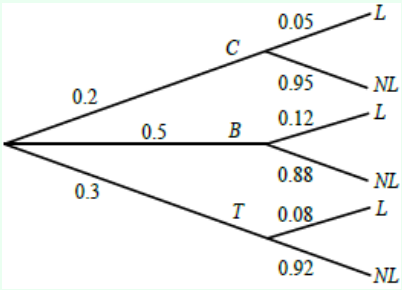
***[3 marks]***

## Examiners report

Venn diagrams continue to be a problem area. Quite a good number of candidates managed to fill in the information on the Venn diagram accurately. However, finding the correct value for $x$ and calculating the number of students in the school posed a big problem for many candidates.

3a. *[5 marks]*

## Markscheme




*Award* ***(A1)*** *for 0.5 at B,* ***(A1)*** *for 0.3 at T, then* ***(A1)*** *for each correct pair. Accept fractions or percentages.* ***(A5)***

***[5 marks]***

## Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

3b. *[1 mark]*

## Markscheme

0.06 (*accept*

$0.5 \times 0.12$ *or* 6%) ***(A1)*****(ft)**

***[1 mark]***

## Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

3c. *[3 marks]*

## Markscheme

*for a relevant two-factor product, either*
$C \times L$ *or*
$T \times L$ ***(M1)***

*for summing three two-factor products* ***(M1)***

$(0.2 \times 0.05 + 0.06 + 0.3 \times 0.08)$

$0.094$ ***(A1)*****(ft)*****(G2)***

***[3 marks]***

## Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

3d. *[3 marks]*

## Markscheme

$\frac{0.3 \times 0.08}{0.094}$ ***(M1)******(A1)*****(ft)**

*award* ***(M1)*** *for substituted conditional probability formula seen,* ***(A1)*****(ft)** *for correct substitution*

$= 0.255$ ***(A1)*****(ft)*****(G2)***

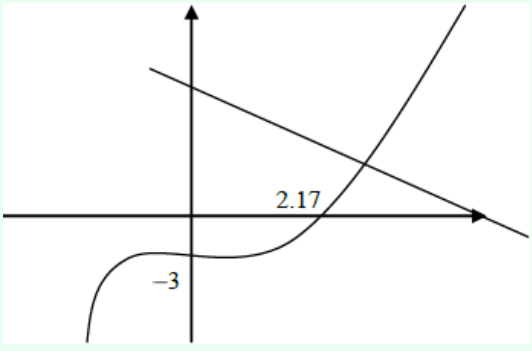
***[3 marks]***

## Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

3e. *[3 marks]*

## Markscheme




***(G3)***

***[3 marks]***

## Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

The curve sketching and straight line were well drawn but not all candidates indicated the intersection points with the axes. In finding the line / curve intersection some candidates did not use the intersection function on the GDC. Few candidates managed the last part. Many just chose two sets of coordinates and used the gradient formula.

3f. *[3 marks]*

## Markscheme

*line drawn with* ***–ve*** *gradient and* ***+ve*** *y-intercept* ***(G1)***

(2.45, 2.11) ***(G1)(G1)***

***[3 marks]***


## Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

The curve sketching and straight line were well drawn but not all candidates indicated the intersection points with the axes. In finding the line / curve intersection some candidates did not use the intersection function on the GDC. Few candidates managed the last part. Many just chose two sets of coordinates and used the gradient formula.


3g. *[2 marks]*

## Markscheme

$f'(1.7) = 3(1.7)^2 - 4(1.7) + 1$ ***(M1)***

*award* ***(M1)*** *for substituting in their* \(f' (x)\)

2.87 ***(A1)(G2)***

***[2 marks]***


## Examiners report

This should have been an easy first question but, even so, there were some candidates who were unable to fill in the tree diagram correctly let alone evaluate any probabilities. The majority of candidates were confident with answering parts (a), (b) and (c) but the conditional probability question was not well answered with few candidates managing to recognise that it was a conditional type.

The curve sketching and straight line were well drawn but not all candidates indicated the intersection points with the axes. In finding the line / curve intersection some candidates did not use the intersection function on the GDC. Few candidates managed the last part. Many just chose two sets of coordinates and used the gradient formula.


4a. *[1 mark]*

## Markscheme

Both are 'p or q', the first is 'but not both' ***(A1)***

*Note: Award mark for clear understanding if wording is poor.* ***(C1)***

***[1 mark]***

## Examiners report

a) The majority of candidates were able to explain the difference between inclusive and exclusive correctly but many used “and” and “or” to distinguish between the two.

4b. *[4 marks]*

## Markscheme

| $\neg q$ | $p \veebar q$ | $\neg p \veebar \neg q$ | $p \veebar q \Rightarrow \neg p \veebar \neg q$ |
|---|---|---|---|
| | F | | T |
| T | | | |
| | | | |
| | | F | |

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

*Note: Follow through is for final column.* ***(C4)***

***[4 marks]***

## Examiners report

b) Less than half were able to find the truth value of the two disjunctions in the table correctly. Most candidates did gain some marks but a number of them left at least one cell blank even though it was a 50% chance of getting the correct value.

4c. *[1 mark]*

## Markscheme

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

***[1 mark]***

## Examiners report

c) Most candidates answered this part correctly with many receiving follow through for “neither” from an incorrect table.

5a. *[1 mark]*

## Markscheme

$A = 8, 10, 12, 14, 16$ ***(A1)*** ***(C1)***

***[1 mark]***

## Examiners report

Parts (a) and (b) were well done although some candidates added 1 as a multiple of 3.

5b. *[1 mark]*

## Markscheme

$B = 3, 6, 9, 12, 15, 18$ ***(A1)*** ***(C1)***

***[1 mark]***

## Examiners report

Parts (a) and (b) were well done although some candidates added 1 as a multiple of 3.

5c. *[2 marks]*

## Markscheme

$A \cup B = 3, 6, 8, 9,10,12,14,15,16,18$ ***(A2)*****(ft)**

*Award* ***(A1)*** *only if a single element is missing or a single extra element is present,* ***(A0)*** *otherwise.* ***(C2)***

***[2 marks]***

## Examiners report

Part (c) was reasonably well attempted although some candidates found the intersection instead of the union.

5d. *[2 marks]*

## Markscheme

$B' = 1, 2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 17, 19, 20$ ***(A1)*****(ft)**

$A \cap B' = 8, 10, 14, 16$ ***(A1)*****(ft)** ***(C2)***

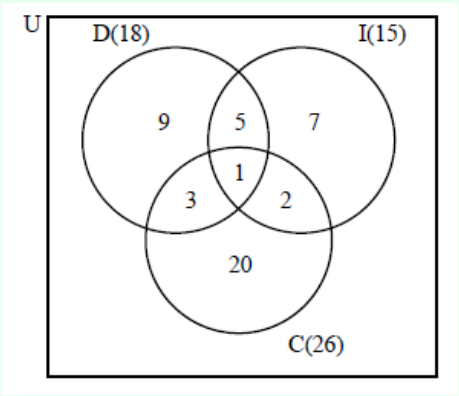
***[2 marks]***

## Examiners report

Part (d) was successfully completed by those candidates who managed to find the complement of B correctly. If they had not shown the set containing the complement of B in the working they could not be awarded the method mark.

6a. *[4 marks]*

## Markscheme




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

**Note:** ***(A1)*** for rectangle with 3 intersecting circles, ***(A1)*** for
1, ***(A1)*** for
5,
3,
2, ***(A1)*(ft)** for
9,
7,
20 if subtraction is carried out, or
18,
15,
26 seen by the letters D, I and C.

***[4 marks]***

## Examiners report

The Venn diagram was well drawn on the whole although some of the candidates missed out the Universal box and others filled in the intersections wrongly but still gained ft marks for the remaining parts of the question.

6b. *[2 marks]*

## Markscheme

$50 - 47$ ***(M1)***

**Note:** ***(M1)*** for subtracting their value from
50.

$= 3$ ***(A1)*(ft)*(G2)***

***[2 marks]***

## Examiners report

Well answered.

6c. *[1 mark]*

## Markscheme

$\frac{9}{50}$ ***(A1)*(ft)**

***[1 mark]***

## Examiners report

Well answered.

6d. *[3 marks]*

## Markscheme

$\frac{20}{50} \times \frac{19}{49}$ ***(A1)*****(ft)*****(M1)***

$= \frac{38}{245}$ $\left(\frac{380}{2450}, 0.155, 15.5\%\right)$ ***(A1)*****(ft)*****(G2)***

**Notes:** ***(A1)*****(ft)** for correct fractions from their Venn diagram
***(M1)*** for multiplying their fractions
***(A1)*****(ft)** for correct answer.

***[3 marks]***

## Examiners report

Few correct answers. Either candidates added instead of multiplying or they used replacement and so the fractions given were the same.

6e. *[2 marks]*

## Markscheme

$\frac{6}{15}$ $\left(\frac{2}{5}, 0.4, 40\%\right)$ ***(A1)*****(ft)*****(A1)*****(ft)**

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

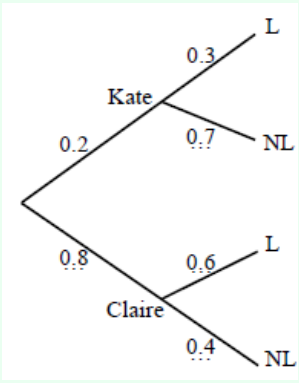
***[2 marks]***

## Examiners report

Again few correct answers. Candidates wrote the answer out of 50 instead of 15.

6f. *[3 marks]*

## Markscheme




*(A1)(A1)(A1)*

**Note:** *(A1)* for 0.8, *(A1)* for 0.7, *(A1)* for 0.6 and 0.4.

***[3 marks]***

## Examiners report

The tree diagram was well done on the whole. It appears as if some candidates may have completed this on the exam paper and this was not included with their papers. However, the question did state clearly "Copy and complete …"

6g. *[5 marks]*

## Markscheme

(i)

$0.2 \times 0.7 = 0.14$ ***(M1)(A1)*(ft)*(G2)***

**Note:** *(M1)* for multiplying correct numbers.

***[2 marks]***

(ii)

$0.2 \times 0.3 + 0.8 \times 0.6$ ***(M1)(M1)***

$= 0.54$ ***(A1)*(ft)*(G3)***

**Note:** *(M1)* for each correct product (use candidate's tree), *(A1)*(ft) for answer.

***[3 marks]***

## Examiners report

(i) This part was well done by those candidates who remembered to multiply instead of add.

(ii) Many candidates just wrote down "Claire" for this answer. Others wrongly multiplied or added 0.3 with 0.6.

7a. *[1 mark]*

## Markscheme

96 ***(A1)*** ***(C1)***

***[1 mark]***

## Examiners report

Very few candidates could draw a frequency polygon correctly. The word ‘Draw’ means that a ruler should be used. Many managed to draw from the mid-point of the bar but did not extend it to
0.5 or
5.5. Most could answer the probability part of the question.

7b. *[1 mark]*

## Markscheme

$3 \leqslant \text{weight} < 4\text{ kg}$. *Accept*
$3 - 4\text{ kg}$ ***(A1)*** ***(C1)***

***[1 mark]***


## Examiners report

Very few candidates could draw a frequency polygon correctly. The word ‘Draw’ means that a ruler should be used. Many managed to draw from the mid-point of the bar but did not extend it to
0.5 or
5.5. Most could answer the probability part of the question.


7c. *[2 marks]*

## Markscheme

For adding three heights or subtracting
14 from
96 ***(M1)***

$\frac{82}{96}$ $(0.854$ or $\frac{41}{48}$, $85.4\%)$ **(ft)** *from (b).* ***(A1)*****(ft)** ***(C2)***

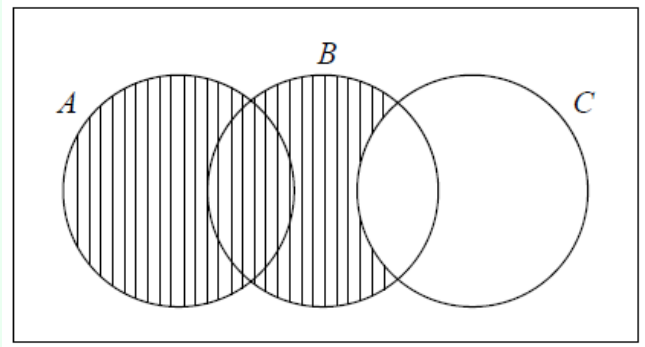
***[2 marks]***


## Examiners report

Very few candidates could draw a frequency polygon correctly. The word ‘Draw’ means that a ruler should be used. Many managed to draw from the mid-point of the bar but did not extend it to
0.5 or
5.5. Most could answer the probability part of the question.

8a. *[2 marks]*

## Markscheme




not shading
$C$ or shading
$A \cup B$ ***(A1)***

correct shading ***(A1)*** ***(C2)***

***[2 marks]***

## Examiners report

This question proved to be one of the easier questions with a number of candidates able to shade in the required region and finding values in a set. They still had problems with part (b).

8b. *[2 marks]*

## Markscheme

Identifying the correct 5 numbers
3,
4,
5,
6,
9 ***(A1)***

27 ***(A1)*** ***(C2)***

***[2 marks]***

## Examiners report

This question proved to be one of the easier questions with a number of candidates able to shade in the required region and finding values in a set. They still had problems with part (b).

8c. *[2 marks]*

## Markscheme

(i)
$M = \{3, 6, 9, 12, 15, 18\}$ *brackets not required.* ***(A1)***

(ii)
$E' \cap M = \{3, 9, 15, 21, 27, 33\}$ **(ft)** *from (i).* ***(A1)*****(ft)** ***(C2)***

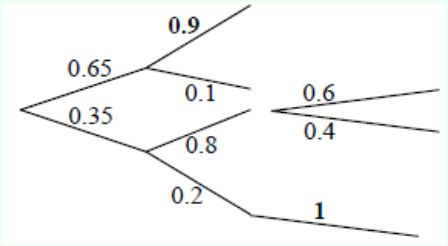
***[2 marks]***

## Examiners report

This question proved to be one of the easier questions with a number of candidates able to shade in the required region and finding values in a set. They still had problems with part (b).

9a. *[2 marks]*

## Markscheme




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

*[2 marks]*

## Examiners report

This question proved to be the easiest question (along with question 1) with many candidates gaining full marks. The probability tree diagram was completed correctly and then most could go on to find the required probability. Very few added the probabilities instead of multiplying them.

9b. *[4 marks]*

## Markscheme

$0.65 \times 0.1$ (
$= 0.065$) *(A1)*

$0.35 \times 0.8 \times 0.4$ (
$= 0.112$) *(A1)*

$0.35 \times 0.2 \times 1$ *the 1 can be implied* (
$= 0.07$) *(A1)***(ft)**

$0.247$ *(A1)***(ft)** *(C4)*

**Note:** No **(ft)** for any probabilities greater than 1.

*[4 marks]*

## Examiners report

This question proved to be the easiest question (along with question 1) with many candidates gaining full marks. The probability tree diagram was completed correctly and then most could go on to find the required probability. Very few added the probabilities instead of multiplying them.

10a. *[4 marks]*

$\frac{280}{400}$ $(0.7, 70\%$ or equivalent$)$

$\frac{57}{210}$ $\left(\frac{19}{70}, 0.271, 27.1\%\right)$

## Examiners report

Candidates answered part (a) correctly. Some lost one out of the 4 marks for making an error in the denominator of the conditional probability. In (b) many students failed to see that (b) was 'without replacement'. Parts (c), (d) and (e) seemed to be very well done by some centres and uniformly badly by others. In (e) many gave the table from the GDC and highlighted the value 63 for which no mark was gained. Expected value formula should have been used instead.

10b. *[3 marks]*

## Markscheme

$\frac{180}{400} \times \frac{179}{399}$ ***(A1)(M1)***

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

$= \frac{537}{2660}\ (= 0.202)$ ***(A1)(G3)***

***[3 marks]***


## Examiners report

Candidates answered part (a) correctly. Some lost one out of the 4 marks for making an error in the denominator of the conditional probability. In (b) many students failed to see that (b) was 'without replacement'. Parts (c), (d) and (e) seemed to be very well done by some centres and uniformly badly by others. In (e) many gave the table from the GDC and highlighted the value 63 for which no mark was gained. Expected value formula should have been used instead.


10c. *[1 mark]*

## Markscheme

$H_0$ : 'the preference of brand of cereal is independent of the city'. ***(A1)***

**OR**

$H_0$ : 'there is no association between the brand of cereal and city'.

***[1 mark]***


## Examiners report

Candidates answered part (a) correctly. Some lost one out of the 4 marks for making an error in the denominator of the conditional probability. In (b) many students failed to see that (b) was 'without replacement'. Parts (c), (d) and (e) seemed to be very well done by some centres and uniformly badly by others. In (e) many gave the table from the GDC and highlighted the value 63 for which no mark was gained. Expected value formula should have been used instead.


10d. *[1 mark]*

## Markscheme

$df = 2$ ***(A1)***

***[1 mark]***


## Examiners report

Candidates answered part (a) correctly. Some lost one out of the 4 marks for making an error in the denominator of the conditional probability. In (b) many students failed to see that (b) was 'without replacement'. Parts (c), (d) and (e) seemed to be very well done by some centres and uniformly badly by others. In (e) many gave the table from the GDC and highlighted the value 63 for which no mark was gained. Expected value formula should have been used instead.

10e. *[2 marks]*

## Markscheme

$\frac{210\times120}{400}$ ***(M1)(A1)***

**Note:** ***(M1)*** for substituting in correct formula, ***(A1)*** for correct values.

$= 63$ ***(AG)***

**Note:** Final line must be seen or previous ***(A1)*** mark is lost.

***[2 marks]***

## Examiners report

Candidates answered part (a) correctly. Some lost one out of the 4 marks for making an error in the denominator of the conditional probability. In (b) many students failed to see that (b) was 'without replacement'. Parts (c), (d) and (e) seemed to be very well done by some centres and uniformly badly by others. In (e) many gave the table from the GDC and highlighted the value 63 for which no mark was gained. Expected value formula should have been used instead.

10f. *[2 marks]*

## Markscheme

39.3 ***(G2)***

**Note:** Award ***(G1)(A0)(AP)*** if answers not to 3 significant figures.

***[2 marks]***

## Examiners report

Candidates answered part (a) correctly. Some lost one out of the 4 marks for making an error in the denominator of the conditional probability. In (b) many students failed to see that (b) was 'without replacement'. Parts (c), (d) and (e) seemed to be very well done by some centres and uniformly badly by others. In (e) many gave the table from the GDC and highlighted the value 63 for which no mark was gained. Expected value formula should have been used instead.

10g. *[2 marks]*

## Markscheme

$p-\text{value} < 0.05$ ***(R1)*****(ft)**

Do not accept
$\text{H}_0$ . ***(A1)*****(ft)**

**Notes:** Allow 'Reject
$\text{H}_0$ or equivalent'. **(ft)** from their
$\chi^2$ statistic.
Award ***(R1)*****(ft)** for comparing the appropriate values. ***(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 both marks are lost. Note that ***(R1)(A0)*****(ft)** can be awarded but ***(R0)(A1)*****(ft)** cannot.

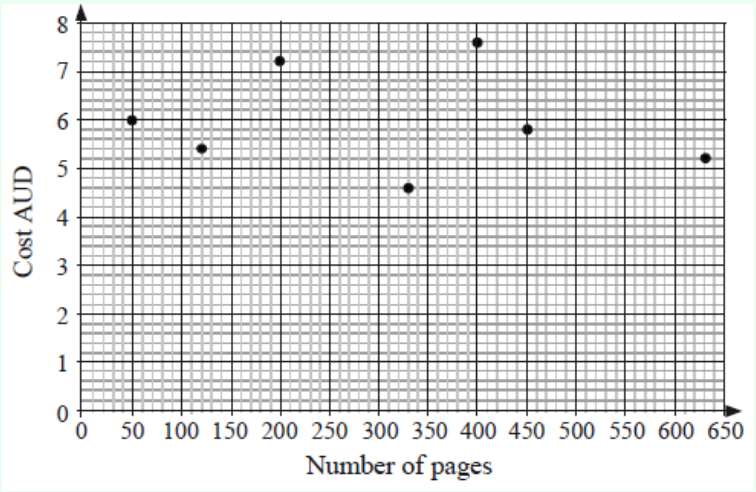
***[2 marks]***

## Examiners report

Candidates answered part (a) correctly. Some lost one out of the 4 marks for making an error in the denominator of the conditional probability. In (b) many students failed to see that (b) was 'without replacement'. Parts (c), (d) and (e) seemed to be very well done by some centres and uniformly badly by others. In (e) many gave the table from the GDC and highlighted the value 63 for which no mark was gained. Expected value formula should have been used instead.

10h. *[3 marks]*

## Markscheme




*(A1)(A1)(A1)*

**Notes:** ***(A1)*** for label and scales, ***(A2)*** for all points correct, ***(A1)*** for 5 or 6 correct. Award a maximum of ***(A2)*** if points are joined.

***[3 marks]***

## Examiners report

The graph was well done with almost all candidates labelling and scaling the axes correctly. A minority of students joined the points or drew the graph on lined paper which prevented them from gaining full marks in this part of the question.

In (b) some candidates were not able to calculate the linear correlation coefficient. A few G2 comments pointed out that the command term used may have been ambiguous to some candidates and they did not think that they could use their GDC to find *r*. Some attempted to use the formula even though the value of
$S_{xy}$ was not given. The guide says that 'A GDC can be used to calculate *r* when raw data is given'. This potential unfairness was taken into consideration during the setting of boundaries so that no candidate was disadvantaged by the possible ambiguous wording of the question. In future the command term 'Using your GDC' or 'Write down' will be used in similar questions.

Some students who did use the GDC gave
$r^2$ instead of
*r*. This really caught the attention of many examiners as
$r^2$ is not in the syllabus.

10i. *[2 marks]*

## Markscheme

$r = -0.141$ ***(G2)***

**Note:** If negative sign is missing award ***(G1)(G0)***.

***[2 marks]***

## Examiners report

The graph was well done with almost all candidates labelling and scaling the axes correctly. A minority of students joined the points or drew the graph on lined paper which prevented them from gaining full marks in this part of the question.

In (b) some candidates were not able to calculate the linear correlation coefficient. A few G2 comments pointed out that the command term used may have been ambiguous to some candidates and they did not think that they could use their GDC to find *r*. Some attempted to use the formula even though the value of
$S_{xy}$ was not given. The guide says that 'A GDC can be used to calculate *r* when raw data is given'. This potential unfairness was taken into consideration during the setting of boundaries so that no candidate was disadvantaged by the possible ambiguous wording of the question. In future the command term 'Using your GDC' or 'Write down' will be used in similar questions.

Some students who did use the GDC gave
$r^2$ instead of
*r*. This really caught the attention of many examiners as
$r^2$ is not in the syllabus.

10j. *[2 marks]*

## Markscheme

'The coefficient of correlation is too low, (very) weak (linear) relationship'. ***(R1)***

Not a sensible thing to do, *accept 'no'*. ***(A1)***

**Note:** Do not award ***(R0)(A1)***. The correlation coefficient has to be mentioned in their reasoning.

***[2 marks]***

## Examiners report

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