Topic 4 Part 3 *[159 marks]*

1a. *[3 marks]*

Markscheme

(i) 40

(ii) 20

(iii) 10 ***(A3)***

Notes: Award ***(A0)(A1)*****(ft)*****(A1)*****(ft)** for −40, −20, −10.

Award ***(A1)(A0)(A1)*****(ft)** for 40, 60, 70 seen.

Award ***(A0)(A0)(A1)*****(ft)** for −40, −60, −70 seen.

Examiners report

Almost all candidates were able to score on the first parts of this question; errors occurring only when insufficient care was taken in reading what the question was asking for. The graph was usually well drawn, other than for those who have no idea what centimetres are.

The majority were able to determine the simultaneous equations, if only in unsimplified form; there was less success in solving these – though this is easily done via the GDC (the preferred approach) and the equation of the asymptote proved a discriminating task. The final parts, involving correlation and regression were largely independent of the previous parts and were accessible to most. Hopefully, contrasting the large percentage error with the value of the correlation coefficient will be valuable in class discussions. Given the many scripts that gave the value of the coefficient of determination as that of r, it seems better that the former is simply not taught.

1b. *[2 marks]*

Markscheme

$24 - k = 5$ or equivalent ***(A1)(M1)***

Note: Award ***(A1)*** for 5 seen, ***(M1)*** for difference from 24 indicated.

$k = 19$ ***(AG)***

Note: If 19 is not seen award at most ***(A1)(M0)***.

Examiners report

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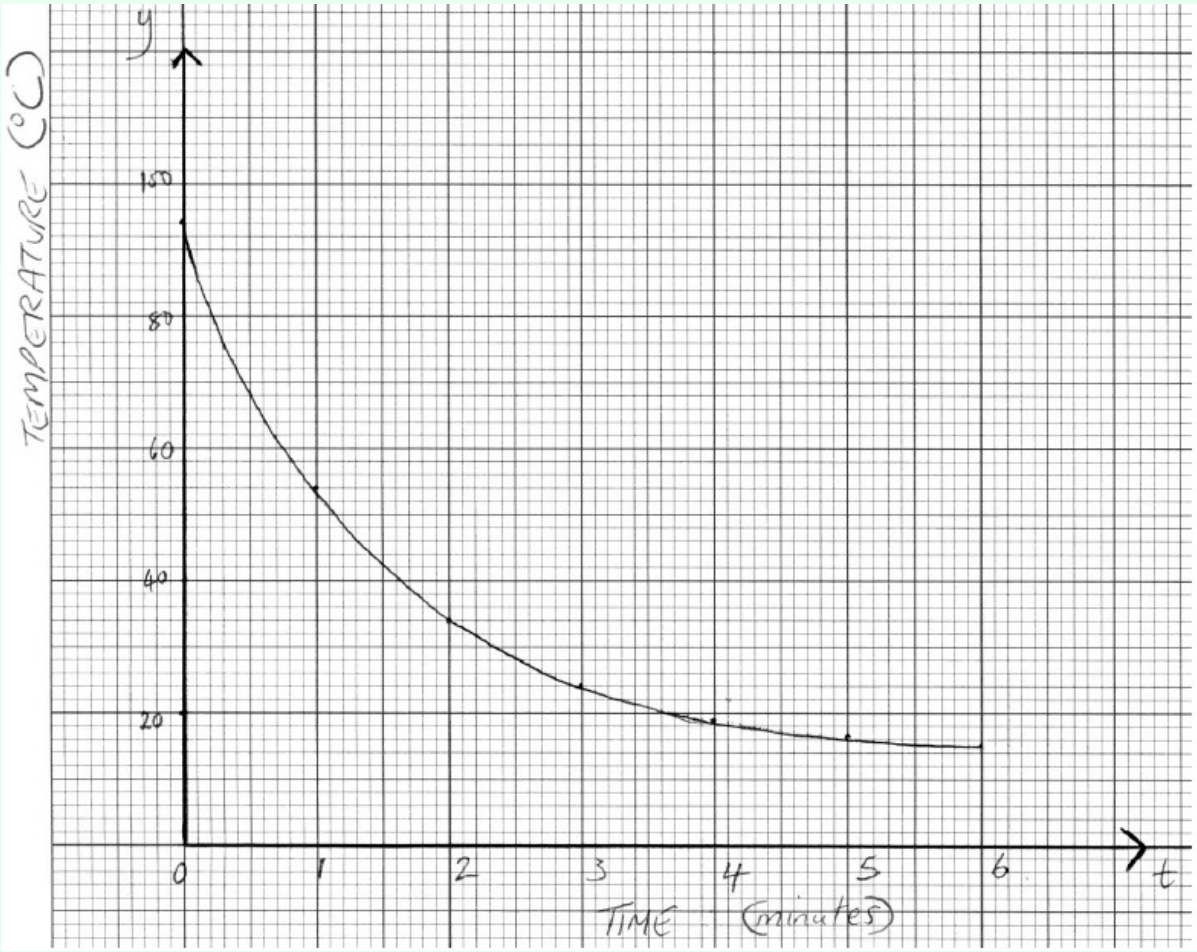
1c. *[4 marks]*

Markscheme



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

Note: Award ***(A1)*** for scales and labelled axes (t or "time" and y or "temperature").

Accept the use of x on the horizontal axis only if "time" is also seen as the label.

Award ***(A2)*** for all seven points accurately plotted, award ***(A1)*** for **5 or 6** points accurately plotted, award ***(A0)*** for 4 points or fewer accurately plotted.

Award ***(A1)*** for smooth curve that passes through all points on domain [0, 6].

If graph paper is not used or one or more scales is missing, award a maximum of ***(A0)(A0)(A0)(A1)***.

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1d. *[2 marks]*

Markscheme

(i)

$94 = p + q$ ***(A1)***

(ii)

$54 = 0.5p + q$ ***(A1)***

Note: The equations need not be simplified; accept, for example $94 = p(2^{-0}) + q$.

Examiners report

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1e. *[2 marks]*

Markscheme

$p = 80$, $q = 14$ ***(G1)(G1)*****(ft)**

Note: If the equations have been incorrectly simplified, follow through even if no working is shown.

Examiners report

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The majority were able to determine the simultaneous equations, if only in unsimplified form; there was less success in solving these – though this is easily done via the GDC (the preferred approach) and the equation of the asymptote proved a discriminating task. The final parts, involving correlation and regression were largely independent of the previous parts and were accessible to most. Hopefully, contrasting the large percentage error with the value of the correlation coefficient will be valuable in class discussions. Given the many scripts that gave the value of the coefficient of determination as that of r, it seems better that the former is simply not taught.

1f. *[2 marks]*

Markscheme

$y = 14$ ***(A1)(A1)*****(ft)**

Note: Award ***(A1)*** for y = a constant, ***(A1)*** for their 14. Follow through from part (e) only if their q lies between 0 and 15.25 inclusive.

Examiners report

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The majority were able to determine the simultaneous equations, if only in unsimplified form; there was less success in solving these – though this is easily done via the GDC (the preferred approach) and the equation of the asymptote proved a discriminating task. The final parts, involving correlation and regression were largely independent of the previous parts and were accessible to most. Hopefully, contrasting the large percentage error with the value of the correlation coefficient will be valuable in class discussions. Given the many scripts that gave the value of the coefficient of determination as that of r, it seems better that the former is simply not taught.

1g. *[4 marks]*

Markscheme

(i) –0.878 (–0.87787...) ***(G2)***

Note: Award ***(G1)*** if –0.877 seen only. If negative sign omitted award a maximum of ***(A1)(A0)***.

(ii) $y = -11.7t + 71.6$ ($y = -11.6517...t + 71.6336...$) ***(G1)(G1)***

Note: Award ***(G1)*** for $-11.7t$, ***(G1)*** for 71.6.

If $y =$ is omitted award at most ***(G0)(G1)***.

If the use of x in part (c) has **not** been penalized (the axis has been labelled "time") then award at most ***(G0)(G1)***.

Examiners report

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1h. *[2 marks]*

Markscheme

$-11.6517...(3) + 71.6339...$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in their part (g)(ii).

= 36.7 (36.6785...) ***(A1)*****(ft)*****(G2)***

Note: Follow through from part (g). Accept 36.5 for use of the 3sf answers from part (g).

Examiners report

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The majority were able to determine the simultaneous equations, if only in unsimplified form; there was less success in solving these – though this is easily done via the GDC (the preferred approach) and the equation of the asymptote proved a discriminating task. The final parts, involving correlation and regression were largely independent of the previous parts and were accessible to most. Hopefully, contrasting the large percentage error with the value of the correlation coefficient will be valuable in class discussions. Given the many scripts that gave the value of the coefficient of determination as that of r, it seems better that the former is simply not taught.

1i. *[2 marks]*

Markscheme

$\frac{36.6785...-24}{24} \times 100$ ***(M1)***

Note: Award ***(M1)*** for their correct substitution in percentage error formula.

= 52.8% (52.82738...) ***(A1)*****(ft)*****(G2)***

Note: Follow through from part (h). Accept 52.1% for use of 36.5.

Accept 52.9 % for use of 36.7. If partial working ($\times 100$ omitted) is followed by their correct answer award ***(M1)(A1)***. If partial working is followed by an incorrect answer award ***(M0)(A0)***. The percentage sign is not required.

Examiners report

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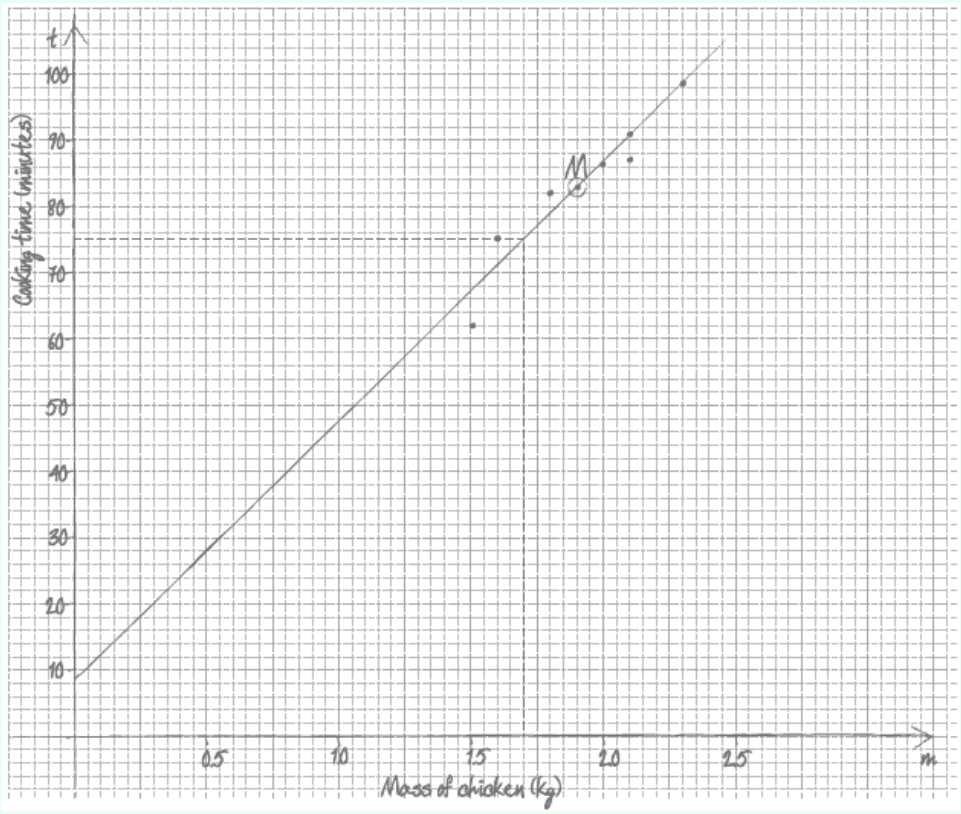
The majority were able to determine the simultaneous equations, if only in unsimplified form; there was less success in solving these – though this is easily done via the GDC (the preferred approach) and the equation of the asymptote proved a discriminating task. The final parts, involving correlation and regression were largely independent of the previous parts and were accessible to most. Hopefully, contrasting the large percentage error with the value of the correlation coefficient will be valuable in class discussions. Given the many scripts that gave the value of the coefficient of determination as that of r, it seems better that the former is simply not taught.

2a. *[4 marks]*

Markscheme



(A1) *for correct scales and labels (mass or m on the horizontals axis, time or t on the vertical axis)*

(A3) *for 7 or 8 correctly placed data points*

(A2) *for 5 or 6 correctly placed data points*

(A1) *for 3 or 4 correctly placed data points,* ***(A0)*** *otherwise.* ***(A4)***

Note: If axes reversed award at most ***(A0)(A3)*****(ft)**. If graph paper not used, award at most ***(A1)(A0)***.

Examiners report

[N/A]

2b. *[2 marks]*

Markscheme

(i) 1.91 (kg) (1.9125 kg) ***(G1)***

(ii) 83 (minutes) ***(G1)***

Examiners report

[N/A]

2c. *[1 mark]*

Markscheme

Their mean point labelled. ***(A1)*****(ft)**

Note: Follow through from part (b). Accept any clear indication of the mean point. For example: circle around point, (*m*, *t*), M , etc.

Examiners report

[N/A]

2d. *[2 marks]*

Markscheme

Line of best fit drawn on scatter diagram. ***(A1)*****(ft)*****(A1)*****(ft)**

Notes:Award ***(A1)*****(ft)** for straight line through their mean point, ***(A1)*****(ft)** for line of best fit with intercept 9(±2) . The second ***(A1)*****(ft)** can be awarded even if the line does not reach the t-axis but, if extended, the t-intercept is correct.

Examiners report

[N/A]

2e. *[2 marks]*

Markscheme

75 ***(M1)(A1)*****(ft)*****(G2)***

Notes: Accept 74.77 from the regression line equation. Award ***(M1)*** for indication of the use of their graph to get an estimate **OR** for correct substitution of 1.7 in the correct regression line equation $t = 38.5m + 9.32$.

Examiners report

[N/A]

2f. *[2 marks]*

Markscheme

0.960 (0.959614...) ***(G2)***

Note: Award ***(G0)(G1)*****(ft)** for 0.95, 0.959

Examiners report

[N/A]

2g. *[2 marks]*

Markscheme

Strong and positive ***(A1)*****(ft)*****(A1)*****(ft)**

Note: Follow through from their correlation coefficient in part (f).

Examiners report

[N/A]

2h. *[2 marks]*

Markscheme

(i) Cooking time is much larger (or smaller) than the other eight ***(A1)***

(ii) The gradient of the new line of best fit will be larger (or smaller) ***(A1)***

Note: Some acceptable explanations may include but are not limited to:

The line of best fit may be further away from the plotted points
It may be steeper than the previous line (as the mean would change)
The t-intercept of the new line is smaller (larger)

Do not accept vague explanations, like:

The new line would vary
It would not go through all points
It would not fit the patterns
The line may be slightly tilted

Examiners report

[N/A]

3a. *[2 marks]*

Markscheme

The (crop) yield is independent of the (type of) fertilizer used. ***(A1)(A1)***

Note: Award ***(A1)*** for (crop) yield and (type of) fertilizer, ***(A1)*** for "independent" or "not dependent" or "not associated".

Do not accept "not correlated" or "not related" or "not connected" or "does not depend on".

Examiners report

The great majority of candidates found this question to be a good start to the paper. The common errors were (1) incorrect terminology in the null hypothesis, (2) use of the
5% level, (3) an inability to find the expected value by hand, (4) comparison of incorrect values. Note, candidates will never be asked to calculate the chi-squared statistic other than from the GDC.

3b. *[1 mark]*

Markscheme

4 ***(A1)***

Examiners report

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5% level, (3) an inability to find the expected value by hand, (4) comparison of incorrect values. Note, candidates will never be asked to calculate the chi-squared statistic other than from the GDC.

3c. *[1 mark]*

Markscheme

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

Note: Accept 13.3. Follow through from part (b).

Examiners report

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5% level, (3) an inability to find the expected value by hand, (4) comparison of incorrect values. Note, candidates will never be asked to calculate the chi-squared statistic other than from the GDC.

3d. *[2 marks]*

Markscheme

$\frac{50}{120} \times \frac{40}{120} \times 120$ **or**
$\frac{50 \times 40}{120}$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in the expected value formula.

$= 16.6666...$ ***(A1)***
= 17 ***(AG)***

Note: Both unrounded and rounded answers must be seen to award ***(A1)***.

Examiners report

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5% level, (3) an inability to find the expected value by hand, (4) comparison of incorrect values. Note, candidates will never be asked to calculate the chi-squared statistic other than from the GDC.

3e. *[3 marks]*

Markscheme

(i)
$\chi^2_{calc} = 3.86 (3.86133...)$ ***(G2)***

(ii) p-value
$= 0.425$ (
$0.425097...$) ***(G1)***

Examiners report

The great majority of candidates found this question to be a good start to the paper. The common errors were (1) incorrect terminology in the null hypothesis, (2) use of the
5% level, (3) an inability to find the expected value by hand, (4) comparison of incorrect values. Note, candidates will never be asked to calculate the chi-squared statistic other than from the GDC.

3f. *[2 marks]*

Markscheme

Since
$\chi^2_{calc} <$ Critical Value ***(R1)***

Accept (do not reject) the Null Hypothesis. ***(A1)*****(ft)**

Note: Accept decision based on p-value with comparison to 1 % ($0.425097... > 0.01$) . Do not award ***(R0)(A1)***. Follow through from parts (c) and (e). Numerical answers must be present in the question for a valid comparison to be made.

Examiners report

The great majority of candidates found this question to be a good start to the paper. The common errors were (1) incorrect terminology in the null hypothesis, (2) use of the
5% level, (3) an inability to find the expected value by hand, (4) comparison of incorrect values. Note, candidates will never be asked to calculate the chi-squared statistic other than from the GDC.

4a. *[1 mark]*

Markscheme

Holiday destination is independent of gender. ***(A1)*** ***(C1)***

Note: Accept gender is independent of holiday destination, accept *"not associated"*, do not accept *"not correlated"*.

Examiners report

[N/A]

4b. *[2 marks]*

Markscheme

$(2-1)(5-1)$ ***(M1)***

Note: Award ***(M1)*** for correct substitution in the correct formula.

$=4$ ***(A1)*** ***(C2)***

Examiners report

[N/A]

4c. *[1 mark]*

Markscheme

9.488 ***(A1)*****(ft)** ***(C1)***

Notes: Follow through from their answer to part (b). Accept 9.49.

Examiners report

[N/A]

4d. *[2 marks]*

Markscheme

Accept the null hypothesis **or** Accept H_0. ***(A1)*****(ft)**

Note: Accept gender is independent of holiday destination.

$\chi^2_{(\text{calc})} < \chi^2_{(\text{crit})}$ **or** $8.73 < 9.488$ ***(R1)*** ***(C2)***

Notes: Do not award ***(A1)(R0)***. Follow through from their answer in part (c).

Examiners report

[N/A]

5a. *[1 mark]*

Markscheme

The (preferred) swimming style is independent of gender ***(A1)*** ***(C1)***

Notes: Accept “not associated”. Do not accept “not related”, “not correlated” or “not influenced”.

[1 mark]

Examiners report

This question was well answered by the majority of the candidates, many scoring the mark.

5b. *[1 mark]*

Markscheme

3 ***(A1)*** ***(C1)***

[1 mark]

Examiners report

This question was well answered by the majority of the candidates, many scoring the mark.

5c. *[2 marks]*

Markscheme

$\chi^2_{calc} = 16.4\,(16.4285\ldots)$ ***(A2)*** ***(C2)***

[2 marks]

Examiners report

This question was well answered by the majority of the candidates, many scoring both marks.

5d. *[2 marks]*

Markscheme

Do not accept the Null Hypothesis (Reject the Null Hypothesis).

$\chi^2_{calc} > \chi^2_{crit}$ **OR**

$16.4 > 7.815$ ***(R1)(A1)*****(ft)**

OR

Do not accept the Null Hypothesis (Reject the Null Hypothesis).

p-value of

$9.26148\ldots \times 10^{-4} < 0.05$ ***(R1)(A1)*****(ft)** ***(C2)***

Notes: Follow through from their answer to part (c).

Accept "(preferred) swimming style is not independent (dependent) of gender" as the conclusion.

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

If using the

p-value the value must be seen.

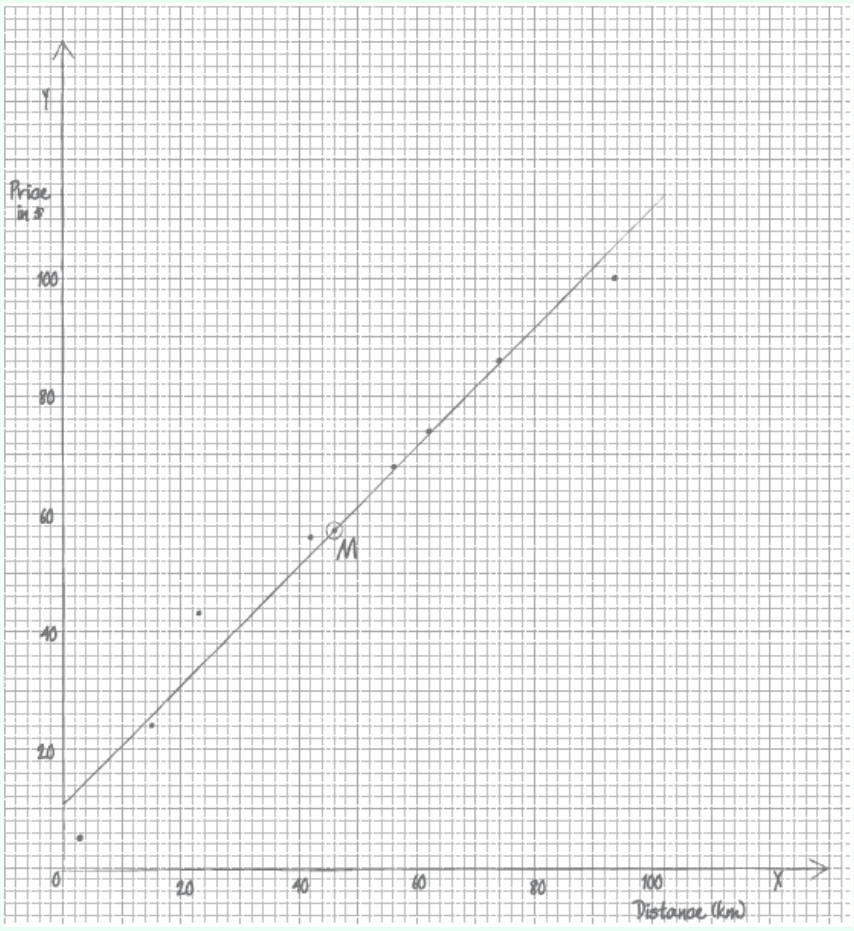
[2 marks]

Examiners report

This question was well answered by the majority of the candidates, many scoring both marks.

6a. *[4 marks]*

Markscheme



(A4)

Notes: Award ***(A1)*** for correct scale and labels (accept x and y).

Award ***(A3)*** for 7 or 8 points plotted correctly.

Award ***(A2)*** for 5 or 6 points plotted correctly.

Award ***(A1)*** for 3 or 4 points plotted correctly.

Award at most ***(A1)(A2)*** if points are joined up.

If axes are reversed, award at most ***(A0)(A3)***.

If graph paper is not used, award at most ***(A1)(A0)***.

[4 marks]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point *M*, a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

6b. *[2 marks]*

Markscheme

(i)

$(\bar{x} =) \ 46$ ***(G1)***

(ii)

$(\bar{y} =) \ 57$ ***(G1)***

[2 marks]

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6c. *[1 mark]*

Markscheme

$\mathrm{M}(46, 57)$ plotted and labelled on the scatter diagram ***(A1)*****(ft)**

Notes: Follow through from their part (b).

Accept

$(\bar{x}, \ \bar{y})$ as the label.

[1 mark]

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6d. *[3 marks]*

Markscheme

(i)

0.986

$(0.986322...)$ ***(G1)***

(ii)

$y = 1.01x + 10.3$

$(y = 1.01431...x + 10.3412...)$ ***(G1)(G1)***

Notes: Award ***(G1)*** for

$1.01x$, ***(G1)*** for

10.3.

Award ***(G1)(G0)*** if not written in the form of an equation.

OR

$(y - 57) = 1.01(x - 46)$

$(y - 57 = 1.01431...(x - 46))$ ***(G1)(G1)*****(ft)**

Note: Award ***(G1)*** for

1.01, ***(G1)*** for their

57 and

46.

[3 marks]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point *M*, a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

6e. *[2 marks]*

Markscheme

straight line drawn on the scatter diagram ***(A1)*****(ft)*****(A1)*****(ft)**

Notes: The line must be straight for either of the two marks to be awarded.

Award ***(A1)*****(ft)** passing through their M plotted in (c).

Award ***(A1)*****(ft)** for correct y-intercept (between 9 and 12).

Follow through from their y-intercept found in part (d).

If part (d) is used, award ***(A1)*****(ft)** for their intercept (± 1).

[2 marks]

Examiners report

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6f. *[3 marks]*

Markscheme

$y = 1.01431... \times 76 + 10.3412...$ ***(M1)***

Note: Award ***(M1)*** for substitution of
76 into their regression line.

$= 87.4295...$ ***(A1)*****(ft)**

Note: Follow through from part (d). If 3 sf values are used the value is
87.06.

\$87 ***(A1)*****(ft)*****(G2)***

Notes: The final ***(A1)*** is awarded for their answer given correct to the nearest dollar.
Method, followed by the answer of
87 earns ***(M1)(G2)***. It is not necessary to see the interim step.
Where the candidate uses their graph instead of the equation, and arrives at an answer other than
87, award, at most, ***(G1)*****(ft)**.
If the candidate uses their graph and arrives at the required answer of
87, award ***(G2)*****(ft)**.

[3 marks]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point *M*, a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

6g. *[1 mark]*

Markscheme

76 is within the range of distances given in the data **OR** the correlation coefficient is close to
1. ***(R1)***

Notes: Award ***(R1)*** if **either** condition is given.
Sufficient to indicate that
76 is 'within the data range' and the correlation is 'strong'.
Allow
r^2 close to
1.
Do **not** accept "within the range of prices".

[1 mark]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point *M*, a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

6h. *[2 marks]*

Markscheme

$\text{Percentage error} = \frac{87-80}{80} \times 100$ ***(M1)***

Note: Award ***(M1)*** for correct substitution into formula.

8.75% ***(A1)*****(ft)*****(G2)***

Notes: Follow through from their answer to part (f).
Accept either the rounded or unrounded answer to part (f).
If no integer value seen in part (f), follow through from their unrounded answer to part (f).
Answer must be positive.

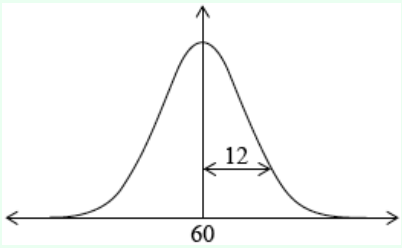
[2 marks]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point *M*, a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

7a. *[2 marks]*

Markscheme



(A1)(A1)

Notes: Award *(A1)* for rough sketch of normal curve centred at
60, *(A1)* for some indication of
12 as the standard deviation *eg*, as diagram, or with
72 and
48 shown on the horizontal axis in appropriate places, or for
96 and
24 shown on the horizontal axis in appropriate places.

[2 marks]

Examiners report

[N/A]

7b. *[1 mark]*

Markscheme

$0.5\left(\frac{1}{2}, 50\%\right)$ *(A1)*

Note: Accept only the exact answer.

[1 mark]

Examiners report

[N/A]

7c. *[2 marks]*

Markscheme

0.0478 (0.0477903...) *(G2)*

Note: Award *(G1)* for
0.952209..., award *(M1)(G0)* for diagram with correct area shown but incorrect answer.

[2 marks]

Examiners report

[N/A]

7d. *[2 marks]*

Markscheme

0.955 (0.955434...) ***(G2)***

Note: Award ***(G1)*** for
0.044565 . . ., award ***(M1)(G0)*** for diagram with correct area shown but incorrect answer.

[2 marks]

Examiners report

[N/A]

7e. *[2 marks]*

Markscheme

$0.0446 < 0.0478$ ***(R1)***

Notes: Award ***(R1)*** for correct comparison seen. Accept alternative methods, for example,
1– (their answer to part (c)) used in comparison or a comparison based on
z scores.

the Physics result is better ***(A1)*****(ft)**

Notes: Do not award ***(R0)(A1)***. Follow through from their answers to part (c) and part (d).

[2 marks]

Examiners report

[N/A]

7f. *[3 marks]*

Markscheme

76 ***(G3)***

Notes: Award ***(G1)*** for
75.8155 . . ., award ***(G2)*** for
75.
Award ***(M1)(G0)*** for diagram with correct area shown but incorrect answer.

[3 marks]

Examiners report

[N/A]

8a. *[2 marks]*

Markscheme

$r = 0.814$
$(0.813745...)$ ***(A2)*** ***(C2)***

[2 marks]

Examiners report

Able candidates scored very well on this question showing good use of their GDC and marks in excess of 4 were achieved by a large majority of these candidates. It was clear however, from some responses, that either the topic had not been taught or had been poorly understood by candidates and few, if any, marks were achieved by such candidates.

8b. *[2 marks]*

Markscheme

$y = 0.888x + 13.5$
$(y = 0.887686\ldots x + 13.4895\ldots)$ ***(A1)(A1)***

Note: Award ***(A1)*** for
$0.888x$, ***(A1)*** for
13.5. If the answer is not in the form of an equation award ***(A1)(A0)***.

OR

$y - 63.2 = 0.888(x - 56)$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A1)*** for
0.888, ***(A1)*** for the correct means,
$\bar{x}$ and
$\bar{y}$ used.

[2 marks]

Examiners report

Able candidates scored very well on this question showing good use of their GDC and marks in excess of 4 were achieved by a large majority of these candidates. It was clear however, from some responses, that either the topic had not been taught or had been poorly understood by candidates and few, if any, marks were achieved by such candidates. In part (b), many candidates quoted a correct regression line equation using
$\bar{x}, \bar{y}, s_{xy}$ and
s_{x^2} but then seemed to be at a loss as to what to do with it.

8c. *[2 marks]*

Markscheme

$y = 0.887686\ldots(72) + 13.4895\ldots$ ***(M1)***

Note: Award ***(M1)*** for 72 substituted into their equation of the regression line.

$= 77$
$(77.4028\ldots)$ ***(A1)*****(ft)** ***(C2)***

Note: Accept a correct **(ft)** integer value or a decimal value which would round to the required 3 sf answer **(ft)**. Follow through from their equation in part (b).

[2 marks]

Examiners report

Able candidates scored very well on this question showing good use of their GDC and marks in excess of 4 were achieved by a large majority of these candidates. It was clear however, from some responses, that either the topic had not been taught or had been poorly understood by candidates and few, if any, marks were achieved by such candidates. In part (b), many candidates quoted a correct regression line equation using
$\bar{x}, \bar{y}, s_{xy}$ and
s_{x^2} but then seemed to be at a loss as to what to do with it.

9a. *[5 marks]*

Markscheme

(i)
$\frac{71+79+\ldots}{12}$ ***(M1)***

$72.4\left(72.4166\ldots, \frac{869}{12}\right)$ ***(A1)(G2)***

Note: Award ***(M1)*** for correct substitution into the mean formula.

(ii) 4.77 (4.76896…) ***(G1)***

(iii) 72.4 + 4.77 = 77.17 ***(M1)***

Note: Award ***(M1)*** for adding their mean to their standard deviation.

Two golfers ***(A1)*****(ft)*****(G2)***

Note: Follow through from their answers to parts (i) and (ii).

[5 marks]

Examiners report

The question was for the most part approached by almost all candidates and answered relatively well. The question in part (e) related to the use of the equation of the regression line for predicting, although regularly asked on exams, was still found to be a difficult one by some candidates. Some answers still suggested mathematical thinking and language unaccustomed to drawing conclusions and providing justifications.

9b. *[2 marks]*

Markscheme

0.990 (0.99014…) ***(G2)***

[2 marks]

Examiners report

The question was for the most part approached by almost all candidates and answered relatively well. The question in part (e) related to the use of the equation of the regression line for predicting, although regularly asked on exams, was still found to be a difficult one by some candidates. Some answers still suggested mathematical thinking and language unaccustomed to drawing conclusions and providing justifications.

9c. *[2 marks]*

Markscheme

$y = 1.01x + 0.816$ ($y = 1.01404...x + 0.81618...$) ***(G1)(G1)***

Notes: Award ***(G1)*** for $1.01x$ and ***(G1)*** for 0.816. If the answer is not an equation award a maximum of ***(G1)(G0)***.

OR

$y - 74.25 = 1.01(x - 72.4)$($y - 74.25 = 1.01404...(x - 72.4166...)$) ***(A1)(A1)***

Notes: Award ***(A1)*** for 1.01 correctly substituted in the equation, and ***(A1)*(ft)** for correct substitution of (72.4, 74.25) in the equation. Follow through from their part (a)(i). If the final answer is not an equation award a maximum of ***(A1)(A0)***.

[2 marks]

Examiners report

The question was for the most part approached by almost all candidates and answered relatively well. The question in part (e) related to the use of the equation of the regression line for predicting, although regularly asked on exams, was still found to be a difficult one by some candidates. Some answers still suggested mathematical thinking and language unaccustomed to drawing conclusions and providing justifications.

9d. *[2 marks]*

Markscheme

$y = 1.01404... \times 70 + 0.81618...$ ***(M1)***

Note: Award ***(M1)*** for substitution of 70 into their regression line equation from part (c).

$y = 72$ (71.7989...) ***(A1)*(ft)*(G2)***

Note: Follow through from their part (c).

[2 marks]

Examiners report

The question was for the most part approached by almost all candidates and answered relatively well. The question in part (e) related to the use of the equation of the regression line for predicting, although regularly asked on exams, was still found to be a difficult one by some candidates. Some answers still suggested mathematical thinking and language unaccustomed to drawing conclusions and providing justifications.

9e. *[2 marks]*

Markscheme

No, equation cannot be (reliably) used as 89 is outside the data range. ***(A1)(R1)***

OR

Yes, but the result is not valid/not reliable as 89 is outside the data range/as we extrapolate ***(A1)(R1)***

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

[2 marks]

Examiners report

The question was for the most part approached by almost all candidates and answered relatively well. The question in part (e) related to the use of the equation of the regression line for predicting, although regularly asked on exams, was still found to be a difficult one by some candidates. Some answers still suggested mathematical thinking and language unaccustomed to drawing conclusions and providing justifications.

10a. *[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.

10b. *[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).

10c. *[2 marks]*

$\frac{180}{500} \times \frac{220}{500} \times 500$

$\frac{180 \times 220}{500}$

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.

10d. *[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).

10e. *[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).

10f. *[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).

10g. *[2 marks]*

Markscheme

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

Do not accept H_0. ***(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).

11a. *[2 marks]*

Markscheme

$y = 14.9x - 80$ ***(A1)(A1)*** ***(C2)***

Notes: Award ***(A1)*** for $14.9x$ and ***(A1)*** for -80. Award at most ***(A0)(A1)*** if not given in the form of an equation.

[2 marks]

Examiners report

This question was an opportunity for candidates to show effective use of the GDC and many correct answers were seen in parts (a) and (b).

11b. *[2 marks]*

Markscheme

$14.9 \times 17 - 80$ ***(M1)***

Note: Award ***(M1)*** for substitution in their equation from part (a).

173.3 calories ***(A1)*****(ft)** ***(C2)***

Note: Accept 173 and 170 even if no working is seen.

[2 marks]

Examiners report

This question was an opportunity for candidates to show effective use of the GDC and many correct answers were seen in parts (a) and (b).

11c. *[2 marks]*

Markscheme

Reliable. 17 min is in the range of given values for x **or** correlation coefficient (r) is 0.989… ***(A1)(R1)*** ***(C2)***

Notes: Do not award ***(A1)(R0)***. Alternative acceptable reasons using correlation:

Correlation coefficient close to 1

Strong positive correlation

Strong linear correlation

Strong positive association between the variables

Strong relationship between the variables.

Examiners report

Part (c) was unusual in that questions of this nature, in the past, have focused on values outside of the range of given values of x. For correct reasoning, candidates were required to identify that 17 was in the range of values given for x in the table. Identifying that 17 was between 15 and 20 minutes was sufficient whereas identifying that 173 was between 125 and 200 was clearly not sufficient. Alternative reasons which focused on the correlation coefficient being either strong positive or close to one were seen and were accepted.

12a. *[1 mark]*

Markscheme

H_0 : Gender and choice of afterschool sport are independent. ***(A1)***

Note: Accept "not associated", do not accept "not related", "not correlated", or "not linked". Accept "the relation between gender and sport is independent".

[1 mark]

Examiners report

This question was successfully attempted by the great majority. However, the test is for the mathematical independence of the two variables; it does not address "correlation" or whether there is "no relation" between them. Further, the result of the test should be determined by the comparison of the **numerical values** of either the chi-squared calculated and critical values or the associated *p*-value and the significance level of the test. The creeping use of *k* as the critical value is the notation used in one text book; it is **not** standard notation and its use is not accepted. Comments were made on the G2 forms as to whether the the null hypothesis should be "accepted" or not rejected; both forms are acceptable.

In the compound probability questions, the lack of an explicit tree diagram determined that many candidates were not able to proceed. Determining an appropriate technique is a skill that should be taught.

12b. *[2 marks]*

Markscheme

$\frac{85}{120} \times \frac{48}{120} \times 120 \left(\frac{85 \times 48}{120}\right)$ ***(M1)***

Note: Award ***(M1)*** for correct expression.

$= 34$ ***(A1)(G2)***

[2 marks]

Examiners report

This question was successfully attempted by the great majority. However, the test is for the mathematical independence of the two variables; it does not address "correlation" or whether there is "no relation" between them. Further, the result of the test should be determined by the comparison of the **numerical values** of either the chi-squared calculated and critical values or the associated *p*-value and the significance level of the test. The creeping use of *k* as the critical value is the notation used in one text book; it is **not** standard notation and its use is not accepted. Comments were made on the G2 forms as to whether the the null hypothesis should be "accepted" or not rejected; both forms are acceptable.

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12c. *[1 mark]*

Examiners report

This question was successfully attempted by the great majority. However, the test is for the mathematical independence of the two variables; it does not address “correlation” or whether there is “no relation” between them. Further, the result of the test should be determined by the comparison of the **numerical values** of either the chi-squared calculated and critical values or the associated *p*-value and the significance level of the test. The creeping use of *k* as the critical value is the notation used in one text book; it is **not** standard notation and its use is not accepted. Comments were made on the G2 forms as to whether the the null hypothesis should be “accepted” or not rejected; both forms are acceptable.

In the compound probability questions, the lack of an explicit tree diagram determined that many candidates were not able to proceed. Determining an appropriate technique is a skill that should be taught.

12d. *[1 mark]*

Markscheme

5.99 (5.991) ***(A1)*****(ft)**

Note: Follow through from part (c).

[1 mark]

Examiners report

This question was successfully attempted by the great majority. However, the test is for the mathematical independence of the two variables; it does not address “correlation” or whether there is “no relation” between them. Further, the result of the test should be determined by the comparison of the **numerical values** of either the chi-squared calculated and critical values or the associated *p*-value and the significance level of the test. The creeping use of *k* as the critical value is the notation used in one text book; it is **not** standard notation and its use is not accepted. Comments were made on the G2 forms as to whether the the null hypothesis should be “accepted” or not rejected; both forms are acceptable.

In the compound probability questions, the lack of an explicit tree diagram determined that many candidates were not able to proceed. Determining an appropriate technique is a skill that should be taught.

12e. *[2 marks]*

Markscheme

2.42 (2.42094…) ***(G2)***

[2 marks]

Examiners report

This question was successfully attempted by the great majority. However, the test is for the mathematical independence of the two variables; it does not address “correlation” or whether there is “no relation” between them. Further, the result of the test should be determined by the comparison of the **numerical values** of either the chi-squared calculated and critical values or the associated *p*-value and the significance level of the test. The creeping use of *k* as the critical value is the notation used in one text book; it is **not** standard notation and its use is not accepted. Comments were made on the G2 forms as to whether the the null hypothesis should be “accepted” or not rejected; both forms are acceptable.

In the compound probability questions, the lack of an explicit tree diagram determined that many candidates were not able to proceed. Determining an appropriate technique is a skill that should be taught.

12f. *[2 marks]*

Markscheme

Since 2.42 < 5.99 therefore accept (do not reject) H_0 ***(R1)(A1)*****(ft)**

Note: The numerical values need not be seen, but must be consistent with their parts (d) and (e).

OR

p-value 0.298 > 0.05 therefore accept (do not reject) H_0 ***(R1)(A1)***

Note: *p-value* comparison may **not** be used as part of a follow through solution. Do not award ***(A1)(R0)***. Follow through from parts (c), (d) and (e).

[2 marks]

Examiners report

This question was successfully attempted by the great majority. However, the test is for the mathematical independence of the two variables; it does not address "correlation" or whether there is "no relation" between them. Further, the result of the test should be determined by the comparison of the **numerical values** of either the chi-squared calculated and critical values or the associated *p*-value and the significance level of the test. The creeping use of *k* as the critical value is the notation used in one text book; it is **not** standard notation and its use is not accepted. Comments were made on the G2 forms as to whether the the null hypothesis should be "accepted" or not rejected; both forms are acceptable.

In the compound probability questions, the lack of an explicit tree diagram determined that many candidates were not able to proceed. Determining an appropriate technique is a skill that should be taught.

12g. *[2 marks]*

Markscheme

(i)

$\frac{35}{120}\left(\frac{7}{24}, 0.292, 29.2\%\right)$ (0.291666...) ***(A1)***

(ii)

$\frac{25}{120}\left(\frac{5}{24}, 0.208, 20.8\%\right)$ (0.208333...) ***(A1)***

[2 marks]

Examiners report

This question was successfully attempted by the great majority. However, the test is for the mathematical independence of the two variables; it does not address "correlation" or whether there is "no relation" between them. Further, the result of the test should be determined by the comparison of the **numerical values** of either the chi-squared calculated and critical values or the associated *p*-value and the significance level of the test. The creeping use of *k* as the critical value is the notation used in one text book; it is **not** standard notation and its use is not accepted. Comments were made on the G2 forms as to whether the the null hypothesis should be "accepted" or not rejected; both forms are acceptable.

In the compound probability questions, the lack of an explicit tree diagram determined that many candidates were not able to proceed. Determining an appropriate technique is a skill that should be taught.

12h. *[5 marks]*

Markscheme

(i)

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

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

$= \frac{94}{595} (0.158,\ 15.8\%)\ (0.157983...)$ ***(A1)(G2)***

(ii)

$\frac{73}{120} \times \frac{72}{119}$ ***(M1)***

Note: Award ***(M1)*** for multiplying correct fractions. If sampling with replacement has been used in both parts (h)(i) and (h)(ii) do not penalise in part (h)(ii). Award a maximum of ***(M1)(A1)*****(ft)**.

$= \frac{219}{595} (0.368,\ 36.8\%)\ (0.368067...)$ ***(A1)(G2)***

[5 marks]

Examiners report

This question was successfully attempted by the great majority. However, the test is for the mathematical independence of the two variables; it does not address "correlation" or whether there is "no relation" between them. Further, the result of the test should be determined by the comparison of the **numerical values** of either the chi-squared calculated and critical values or the associated *p*-value and the significance level of the test. The creeping use of *k* as the critical value is the notation used in one text book; it is **not** standard notation and its use is not accepted. Comments were made on the G2 forms as to whether the the null hypothesis should be "accepted" or not rejected; both forms are acceptable.

In the compound probability questions, the lack of an explicit tree diagram determined that many candidates were not able to proceed. Determining an appropriate technique is a skill that should be taught.

13a. *[2 marks]*

Markscheme

$a = 8, b = 5$ ***(A1)(A1)*** ***(C2)***

Note: Award ***(A0)(A1)*****(ft)** if $a = 5, b = 8$.

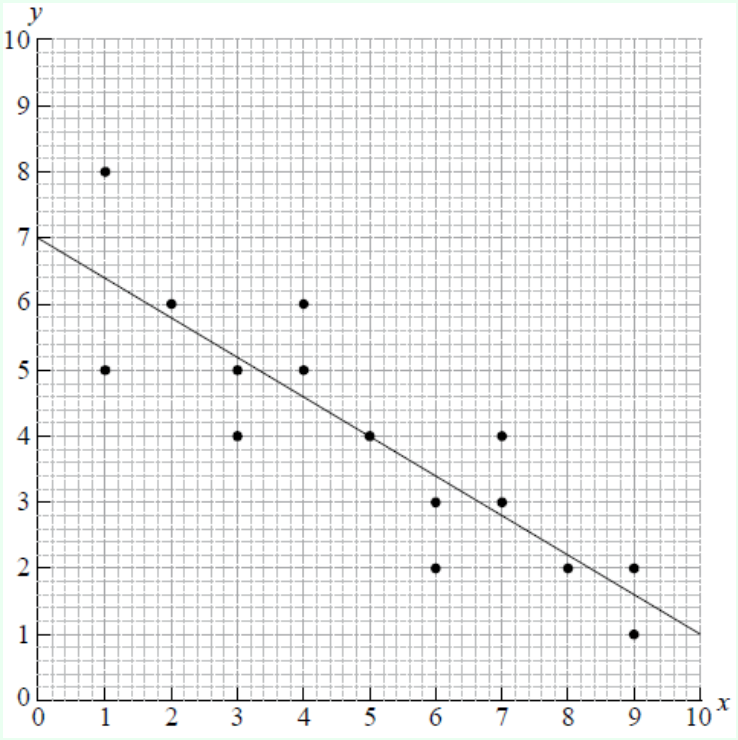
[2 marks]

Examiners report

Most candidates could find the values of *a* and *b*, draw the line of best fit and find an estimate of the value of *y*. Follow through marks could be awarded in part (c) with an incorrect line of best fit, if dotted lines were shown on their graphs, indicating their method.

13b. *[2 marks]*

Markscheme



(A1)(A1) *(C2)*

Note: Award *(A1)* for straight line passing through (5, 4), *(A1)* for y-intercept between 6.8 and 8, if necessary with the line extended.

[2 marks]

Examiners report

Most candidates could find the values of a and b, draw the line of best fit and find an estimate of the value of y. Follow through marks could be awarded in part (c) with an incorrect line of best fit, if dotted lines were shown on their graphs, indicating their method.

13c. *[2 marks]*

Markscheme

3.1 (±0.3) *(M1)(A1)*(ft) *(C2)*

Note: Award *(M1)* for an indication of use of <u>their</u> line of best fit (dotted lines or some indication of mark in the correct place on graph). Accept $y = 3.1 \pm 0.3$.

[2 marks]

Examiners report

Most candidates could find the values of a and b, draw the line of best fit and find an estimate of the value of y. Follow through marks could be awarded in part (c) with an incorrect line of best fit, if dotted lines were shown on their graphs, indicating their method.

14a. *[1 mark]*

Markscheme

Colour of car is independent of gender. (Colour of car and gender are independent) *(A1)* *(C1)*

Note: Accept "not associated". Do not accept "not related", "not correlated" or "not linked".

[1 mark]

Examiners report

This question was well answered by the majority of the candidates, many scoring the maximum number of marks. It was disappointing to see the number of candidates who left this question blank.

14b. *[2 marks]*

Markscheme

$(2-1)(5-1)=4$ ***(M1)(A1)*** ***(C2)***

[2 marks]

Examiners report

This question was well answered by the majority of the candidates, many scoring the maximum number of marks. It was disappointing to see the number of candidates who left this question blank.

14c. *[1 mark]*

Markscheme

$\chi^2_{crit}=9.488$ ***(A1)*****(ft)** ***(C1)***

Notes: Accept 9.49. Follow through from part (b).

[1 mark]

Examiners report

This question was well answered by the majority of the candidates, many scoring the maximum number of marks. It was disappointing to see the number of candidates who left this question blank.