GCSE
STATISTICS
8382/2H

Higher Tier Paper 2

Mark scheme

June 2023

Version: Final 1.1



Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Statistics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
oe	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leq \text{value} < b$
3.14 …	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Examiners should consistently apply the following principles.

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

Questions which ask students to show working

Instructions on marking will be given but usually marks are not awarded to students who show no working.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced

Erased or crossed out work that is still legible should be marked.

Work replaced

Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

Continental notation

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

Q	Answer	Marks	Comments
1(a)	$\frac{23}{50}$	B1	

Q	Answer	Marks	Comments
1(b)	$\frac{5}{9}$	B1	

Q	Answer	Marks	Comments
2	7	B1	

Q	Answer	Marks	Comments
3	Multivariate	B1	

Q	Answer	Mark	Comments
4(a)	$\frac{807\ 300}{62\ 260\ 000} \times 1000$	M1	
	[12.9, 13]	A1	SC1 digits 129
	Additional Guidance		
	Do not penalise further work seen after a correct answer		

Q	Answer	Mark	Comments
4(b)	Jack's conclusion may be wrong and valid reason	B1	eg we would need to know the population (to find the number of births)
	Additional Guidance		
	Accept the UK has a higher population than Iceland		
	Accept "it" to refer to Iceland		
	Accept "Jack is correct if Iceland has a larger population."		B1
	"Jack is correct" with no valid justification		B0

Q	Answer	Mark	Comments
5(a)	Student ability / previous results / target grades	B1	oe
	Additional Guidance		
	Whether students have a suitable device for the app		B1

Q	Answer	Mark	Comments
5(b)(i)	68	B1	

Q	Answer	Mark	Comments
5(b)(ii)	(LQ =) 57(%) or (UQ =) 77(%)	M1	
	77(%) – 57(%) = 20(%)	A1	
	Additional Guidance		
	Check diagram for working		

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>Comments</th></tr>
<tr><td rowspan="4">5(c)</td><td>3 added to stem
and
label ‘Book group’</td><td>B1</td><td>oe
allow unambiguous labelling for ‘Book group’</td></tr>
<tr><td>Key correct</td><td>B1</td><td>percent signs must be there but allow abbreviations for naming groups</td></tr>
<tr><td>Left-hand side correct and ordered</td><td>B2</td><td>B1
left-hand side correct but unordered
or
left-hand side ordered with up to two errors</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="3">
<table>
<tr><th colspan="6">Book group</th><th></th><th colspan="4">App group</th></tr>
<tr><td></td><td></td><td></td><td></td><td>9</td><td>7</td><td>3</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>6</td><td>4</td><td>2</td><td>0</td><td>4</td><td>5</td><td></td><td></td><td></td></tr>
<tr><td></td><td>8</td><td>7</td><td>6</td><td>5</td><td>0</td><td>5</td><td>2</td><td>3</td><td>7</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>9</td><td>6</td><td>4</td><td>5</td><td>6</td><td>8</td></tr>
<tr><td></td><td></td><td></td><td></td><td>9</td><td>1</td><td>7</td><td>0</td><td>3</td><td>5</td><td>7</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>3</td><td>8</td><td>1</td><td>9</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>9</td><td>2</td><td></td><td></td><td></td></tr>
</table>
Key 0 | 4 | 5 represents 40% for the Book group and 45% for the App group
</td></tr>
</table>

Q	Answer	Mark	Comments
5(d)	Median for book = 55 or Mean for book = [55, 56] or Mean for app = [68, 69]	B1ft	correct or ft their ordered stem-and-leaf
	(LQ for book =) 42 or (UQ for book =) 69	M1	correct or ft their ordered stem-and-leaf
	(IQR for book =) 27	A1ft	correct or ft their ordered stem-and-leaf SC1 46 (book) or 47(app) (ranges)
	The book group did worse on average or The book group did worse as the median/mean is smaller	B1ft	oe ft their medians or means
	The book group had more varied / less consistent scores (as the IQR is larger)	B1ft	oe ft their book IQR or their ranges
	Additional Guidance		
	Their comparisons must be based on figures seen and should be given in context		
	Comparison of average must mention average or mean/median and must match their figures		
	Check the full script for workings		

Q	Answer	Mark	Comments
5(e)	Small sample	B1	oe
	Additional Guidance		
	Only tested on one class / in a single test		B1
	Specific reference to unequal revision conditions outside the classroom		B1
	Reference to extraneous variables with a specific, valid example eg app not working		B1
	Reference to extraneous variables with no valid example eg people in book group use the internet or the app as well		B0
	Reference to future experiments / ways to improve		B0

Q	Answer	Marks	Comments
6(a)	Convenience or Opportunity or Judgement	B1	
	Additional Guidance		
	Accept poor spellings but not if convenient/opportunistic/judgemental seen		

Q	Answer	Marks	Comments
6(b)(i)	Ensures each student is equally likely to be chosen.	B1	oe
	Additional Guidance		
	More likely to be representative		B1
	It's representative		B1
	Removes bias		B1
	It's random		B0
	It's quick		B0
	It's cheap		B0
	It's easy		B0

Q	Answer	Marks	Comments
6(b)(ii)	Sample could still be unrepresentative or It takes a long time	B1	oe eg if the list was done alphabetically then two siblings would not be both chosen.
	Additional Guidance		
	An advantage in b(i) cannot be used as a disadvantage in b(ii)		
	Condone irrelevant/incorrect responses with correct response(s) as long as not contradictory		
	Any pupil before the starting number will never be chosen		B1
	Not representative		B0

	There are patterns	B0

Q	Answer	Marks	Comments
6(c)(i)	Random	B1	
	Additional Guidance		
	Stratified (random)		B1

Q	Answer	Marks	Comments
6(c)(ii)	0.05 × 260	M1	oe
	13	A1	
	Additional Guidance		
	Answer line takes precedence over working space and anything written in table		
	13 on answer line with no workings		M1A1

Q	Answer	Marks	Comments
6(d)	Any two correct comparisons eg A greater proportion of people aged 65+ prefer Magnums compared to other age groups or Orange ice cream was 65+ third favourite whereas it was a Fab for 25–49	B2	oe both responses may be seen in one comparison B1 for any correct comparison
	Additional Guidance		
	Condone irrelevant/incorrect responses with correct response(s) as long as not contradictory		
	Answers should have a comparison of different age categories (not the same one)		
	65+ like orange the most (compared to all other age groups)		B1
	50-64 like magnums the most (compared to all other items)		B0
	Do not accept references to trends		
	As the age category increases so does the popularity of magnums		B0
	References to older or younger needs to be age specific		

	Reference to 'more' or 'less' implies number so does not score	
	Do not allow comparisons where it is not necessarily true	
	More 65+ liked Magnums than people aged 18–24	B0

Q	Answer	Marks	Comments
7(a)	For every month, the price of the ticket increases by £32.	B1	oe
	Additional Guidance		
	The rate of change of price must also state 'increase per month'		
	Increase in price (ticket) per month		B1

Q	Answer	Marks	Comments
7(b)	$100 = 32t - 16$ or $116 = 32t$	M1	
	3 or 3.6 or 3.63 or 3.625	A1	
	Additional Guidance		
	Trial and improvement can be used but the final answer must be correct for any marks		

Q	Answer	Marks	Comments
7(c)	(According to the model) the price would be negative (which is not possible).	B1	oe
	Additional Guidance		
	Because there won't be £0		B0
	Answer must be in words so $P = -16$ on its own		B0

Q	Answer	Marks	Comments
7(d)	No **and** the points are not on or close to the straight line	B1	oe
	Additional Guidance		
	Any reason referencing outliers does not score		

	No **and** the points appear to follow a curve	B1
	No **and** it looks like a quadratic	B1
	No **and** the points appear to be non-linear	B1
	No **and** there is not a linear relationship	B0
	No **and** there is a strong correlation but it isn't linear	B0

Q	Answer	Marks	Comments
8(a)	It has come from a (reputable) website which is more likely to be accurate or It is secondary data so we do not know how accurately it has been collected.	B1	
	Additional Guidance		
	It has come from a website which may be unreliable		B1
	It has come from a website which may be inaccurate		B1
	It has not been collected by you		B0

Q	Answer	Marks	Comments
8(b)	$\frac{280}{283} \times 100$	B1	oe

Q	Answer	Marks	Comments
8(c)(i)	$\frac{107}{100} \times 430\,000$	M1	oe
	460 100	A1	

Q	Answer	Marks	Comments
	Alternative method 1		
8(c)(ii)	$\frac{233}{215}$ (=1.0837…)	M1	oe
	1.08(37….) or 108(.37…) or 8.(37…)(%) and Yes	A1	Condone 1.084 or 108.4% or 8.4%
	Alternative method 2		
	$\frac{233000-215000}{215000}$ (× 100) (= 0.0837…)	M1	oe
	0.08(37…) or 8(.37…)(%) and Yes	A1	Condone 0.084 or 8.4%
	Alternative method 3		
	$215\,000 \times \frac{107}{100}$	M1	oe
	(£)230 050 and Yes	A1	

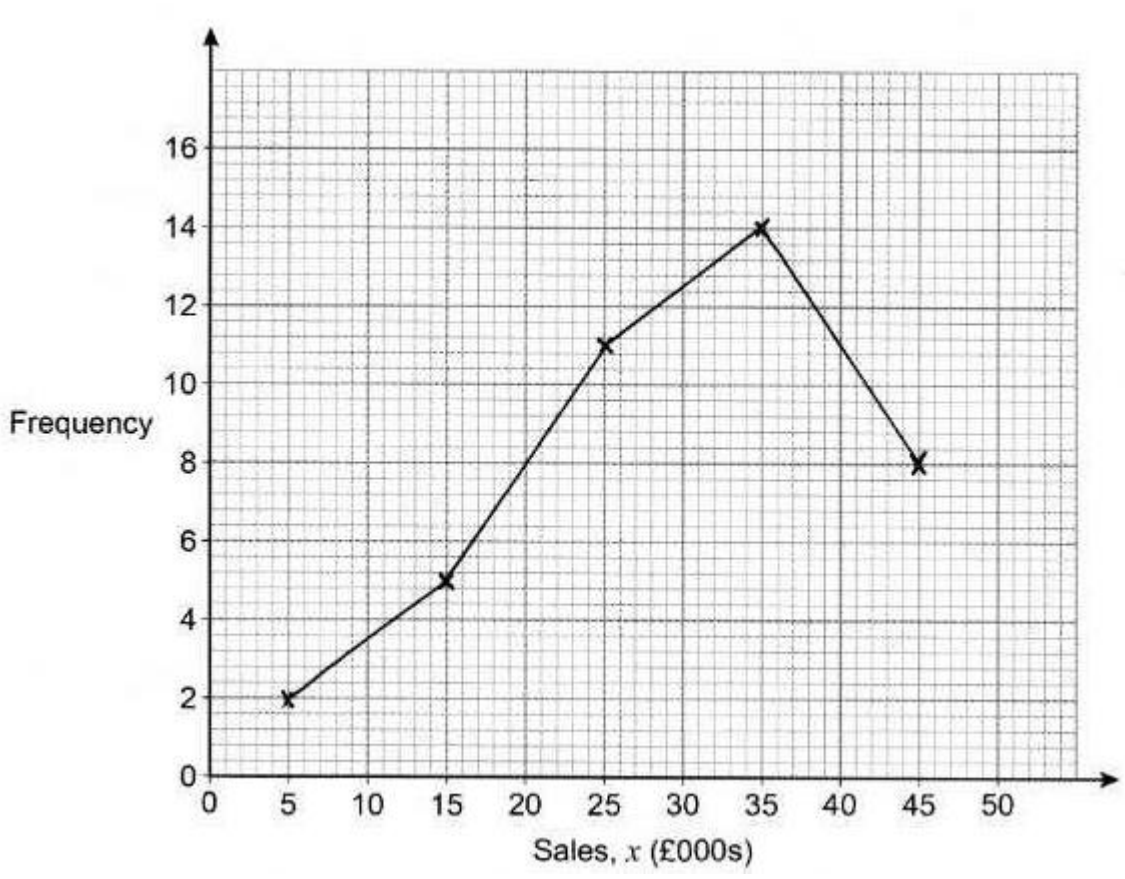
Q	Answer	Marks	Comments
8(d)	Ticks no and gives a suitable reason eg From 2017 to 2019 the house prices fell by 3.8% so 8% of a lower price is different to 8% of the original 2017 value or The house prices increased by 8.3(16…)%	B1	oe
	Additional Guidance		
	Ticks No and 96.2 x 1.08 = 103.896		B1

Q	Answer	Marks	Comments
	Alternative Method 1		
9(a)	Any one of $(25-20)\times 90$ or $(15\div 3)\times 90 (= 450)$ or $(45-25)\times 60$ (=1200) or $(60-45)\times 80$ (=1200)	M1	oe
	$(25-20)\times 90+(45-25)\times 60+(60-45)\times 80$ or their 450 + their 1200 + their 1200	M1dep	oe
	2850	A1	SC1 3300 with no working
	Alternative Method 2		
	$(10-0)\times 180$ (=1800) or $(25-10)\times 90$ (=1350) or $(45-25)\times 60$ (=1200) or $(65-45)\times 80$ (=1200) or 5550	M1	oe
	(their 1800 + their 1350 + their 1200 + their 1200) – (their 1800 + $\frac{2}{3}\times$ their 1350) or 5550 – (their 1800 + $\frac{2}{3}\times$ their 1350) or 5550 - 2700	M1dep	oe
	2850	A1	SC1 3300 with no working
	Additional Guidance		
	For the 2nd M1, 'their' values to be added must come from a correct method		

Q	Answer	Marks	Comments
9(b)(i)	(An exact average cannot be found) as the data has been grouped/we do not know the exact values.	B1	oe
	Additional Guidance		
	We are using the mid-points		B1
	We do not know the distribution of times within the interval		B1
	The time values are in a range/group		B1
	Because it's an estimate		B0

Q	Answer	Marks	Comments
9(b)(ii)	The mean will be in the centre of the distribution where the frequency density is lower	B1	oe eg there is less data in the centre where the mean will be.
	Additional Guidance		
	It is not normally distributed		B1
	The values are weighted towards the lower end		B1
	(Positive) skew		B1
	As the distribution has a limited range, do not accept references to the mean being affected by extreme values		
	There is significantly/a lot more in the 1st 10 minutes so it affects the mean		B1
	There is more in the 1st 10 minutes so it affects the mean		B0
	Higher number at 0 -10		B0
	Maybe affected by extraneous circumstances/anomalies/outliers		B0
	What about flights delayed by more than one hour		B0

<table>
<tr><th>Q</th><th>Answer</th><th>Marks</th><th>Comments</th></tr>
<tr><td rowspan="11">9(c)</td><td>(The director may be correct because) the histogram for June is narrower (than the one for May).</td><td>B1</td><td>oe
eg
the bars for June go from 0 to 50 but in May they go from 0 to 60.
Condone comments about the range being lower in June.</td></tr>
<tr><td>(The director may be incorrect) as we don’t know the actual maximum and minimum.</td><td>B1</td><td>oe
eg
the maximum for May might be less than 50 and the minimum might be more than 0</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="3">Condone irrelevant/incorrect responses with correct response(s) as long as not contradictory</td></tr>
<tr><td colspan="3">A response for the director being correct cannot be used as a response where the director may not be correct</td></tr>
<tr><td colspan="2">Histogram in June is narrower</td><td rowspan="2">B1</td></tr>
<tr><td colspan="2">Histogram in May is wider</td></tr>
<tr><td colspan="3">Do not allow references to taller/shorter to imply width</td></tr>
<tr><td colspan="3">For either comment, no reference to a month implies June</td></tr>
<tr><td colspan="2">In June, the longest delay was 50 minutes, whereas in May it was 60 minutes</td><td>B0</td></tr>
</table>

Q	Answer	Marks	Comments
10(a)	Points plotted at correct heights (…,2), (…,5), (…,11), (…,14), (…,8)	M1	$\pm\frac{1}{2}$ square tolerance condone one error
	Points plotted at midpoints of intervals (5,…), (15,…), (25,…), (35,…), (45,…)	M1	$\pm\frac{1}{2}$ square tolerance condone one error
	Fully correct frequency polygon	A1	ignore any lines drawn before the 1st point and after the last point mark intention of a straight line SC2 Fully correct polygon with correct bars
	Additional Guidance		
	Bar chart only drawn then all heights must be correct $\pm\frac{1}{2}$ square tolerance for M1		
	Do not allow the 1st and last points being joined		
			

Q	Answer	Marks	Comments
10(b)	$\frac{33}{40}$ or $\frac{32}{39}$ seen	B1	oe eg 0.825 or 0.82(05…)
	$\frac{33}{40} \times \frac{32}{39}$	M1dep	oe
	$\frac{44}{65}$ or $\frac{1353}{2000}$ or [0.6765, 0.6773]	A1	oe condone 0.68 with fully correct working
	Additional Guidance		
	(With replacement) 0.68(0625) or $\frac{1089}{1600}$		SC1

Q	Answer	Marks	Comments
10(c)	Median lies in the interval $30 \leqslant x < 40$	B1	may be implied by their answer or their calculation but not from the mean eg the 14 as the denominator or 30+ or 30 000+ in their calculation or sight of 20.5 or 20
	$(30+)\ \frac{2.5}{14} \times 10$ or $(30\,000+)\ \frac{2.5}{14} \times 10\,000$ or $(30+)\ \frac{2}{14} \times 10$ or $(30\,000+)\ \frac{2}{14} \times 10\,000$	M1	oe
	£31 800 or £31.8 thousands or £31 400 or £31.4 thousands	A1	oe
	Additional Guidance		
	Digits 314 or 318 with no incorrect working	SC2	
	Numbers 142(8.57) or 1.42(857) or 178(5.714) or 1.78(5714) with no incorrect working		

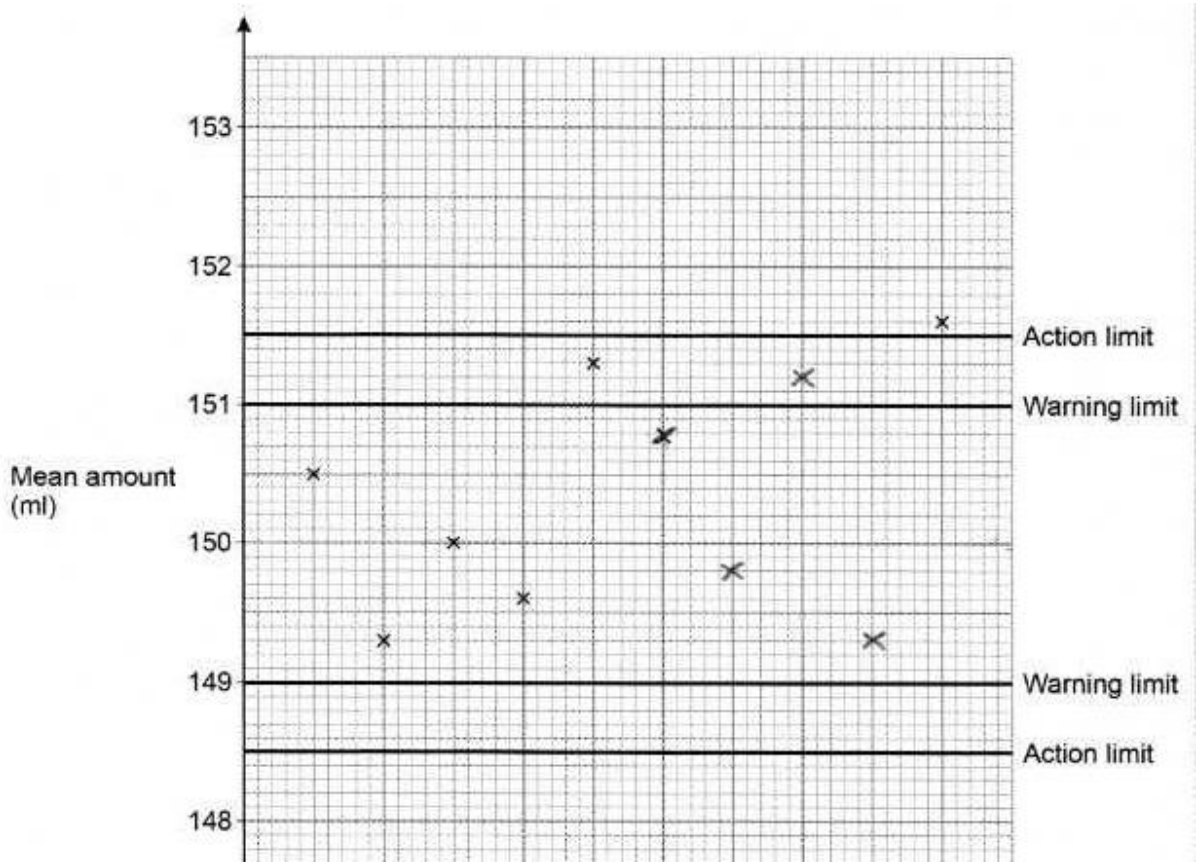
	Answer	Marks	Comments
11(a)	A suitable hypothesis, eg Participants who complete the swim section quickly complete the cycle section quickly or There is a positive correlation between the times taken in the two sections	B1	oe do not accept questions
	Additional Guidance		
	There is no/negative correlation between the times taken in the swimming and cycling sections		B1
	If they finish higher in swimming then they finish higher in cycling		B1
	There is a correlation between swim and cycle times		B0

<table>
<tr><th>Q</th><th>Answer</th><th>Marks</th><th>Comments</th></tr>
<tr><td rowspan="4">11(b)(i)</td><td>Attempts to find sum of squared differences
or
$(\sum d^2) = 28$</td><td>M1</td><td>at least 6 of their squared values should be correct.
Check table for squared differences</td></tr>
<tr><td>$(1-)\dfrac{6\times \text{their } 28}{8(8^2-1)}$
or
$(1-)\dfrac{6\times(\text{their } (4+1+9+...))}{8(8^2-1)}$</td><td>M1dep</td><td>oe
eg $\dfrac{168}{504}$ or $\dfrac{1}{3}$ or 0.33(3…)</td></tr>
<tr><td>$\dfrac{2}{3}$ or [0.666, 0.667] or 0.67</td><td>A1ft</td><td>oe
SC3 for 0.7 with fully correct workings
ft for their $\sum d^2$ (must be ≥ 0)
provided $0 \leq$ SRCC ≤ 1</td></tr>
<tr><td colspan="3">Additional Guidance</td></tr>
<tr><td colspan="3">
<table>
<tr><th>Athlete</th><th>Swim (min : sec)</th><th>Cycle (min : sec)</th><th>Rank Swim</th><th>Rank Cycle</th><th>Difference</th><th></th></tr>
<tr><td>Brownlee</td><td>17:24</td><td>55:04</td><td>1</td><td>3</td><td>–2</td><td>4</td></tr>
<tr><td>Schoeman</td><td>17:25</td><td>55:01</td><td>2</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Murray</td><td>18:20</td><td>55:35</td><td>8</td><td>5</td><td>3</td><td>9</td></tr>
<tr><td>Pereira</td><td>18:03</td><td>55:52</td><td>7</td><td>6</td><td>1</td><td>1</td></tr>
<tr><td>Van Riel</td><td>17:27</td><td>55:03</td><td>4</td><td>2</td><td>2</td><td>4</td></tr>
<tr><td>Mola</td><td>17:37</td><td>56:18</td><td>6</td><td>8</td><td>–2</td><td>4</td></tr>
<tr><td>Royle</td><td>17:26</td><td>55:05</td><td>3</td><td>4</td><td>–1</td><td>1</td></tr>
<tr><td>Bailie</td><td>17:31</td><td>56:11</td><td>5</td><td>7</td><td>–2</td><td>4</td></tr>
</table>
</td></tr>
</table>

Q	Answer	Marks	Comments
11(b)(ii)	There is positive correlation between the swim times and the cycle times or Athletes who were fast in the swimming also tended to be fast in the cycling	B1ft	oe eg positive agreement/ relationship/association between the rankings of the times. ft if –1 ⩽ their (bi) ⩽ 1 (unless clear restart)
	Additional Guidance		
	Ignore any adjectives describing the strength of the relationship		
	Some context should be included, eg reference to times		
	If –0.2 ⩽ their (bi) ⩽ 0.2 then condone no correlation as a comment		
	If –0.2 ⩽ their (bi) ⩽ 0.2, allow correct reference to positive or negative correlation		
	The ranks/positions of the athletes in the two sections were similar		B1
	They do well on both events/sections		B0
	They do well		B0
	Positive correlation		B0
	The times are closely related		B0

Q	Answer	Marks	Comments
11(c)	Yes **and** the value is closer to -1 (or more negative than -0.26) or Yes **and** -0.26 is further from -1 or Yes **and** – 0.26 is closer to 0 (or more positive than -0.5) or Yes **and** -0.5 is further from 0	B1	oe
	Additional Guidance		
	There must be reference to -1 or 0		
	Yes **and** 'it's a bigger negative correlation because it's closer to -1		B1
	Yes **and** the value for cycle and run is closer to 0		B1
	Yes **and** 'a lower number below 0 shows a stronger negative correlation'		B1
	Yes and 'it's a bigger negative correlation'		B0
	-0.5 is smaller than -0.26		B0

Q	Answer	Marks	Comments
12	14.5	B1	

Q	Answer	Marks	Comments
13(a)	All 4 points plotted correctly	B2	$\pm\frac{1}{2}$ square tolerance B1 at least 2 or 3 points plotted correctly
	Additional Guidance		
			

Q	Answer	Marks	Comments
13(b)	$x = 150$	B1	
	$y = 0.5$	B1	

Q	Answer	Marks	Comments
13(c)(i)	Sample 5 was beyond the warning limit so yes (it was appropriate to take another sample immediately)	B1	oe

Q	Answer	Marks	Comments
13(c)(ii)	The machine should be stopped or The machine should be reset	B1	oe
	Additional Guidance		
	The machine should be fixed/adjusted/recalibrated/serviced/ replaced		B1
	Take another sample/retest		B0

Q	Answer	Marks	Comments
14(a)	$\frac{80-60}{15}$ or $1.6\times15+60$	M1	oe
	$1.6 > 1.3333\ldots$ or 84	A1	

Q	Answer	Marks	Comments
14(b)(i)	Daisy's mark was higher than Helen's	B1	oe
	Additional Guidance		
	It's higher/better		B1
	They were both below average		B0

Q	Answer	Marks	Comments
14(b)(ii)	Daisy's mark was below average/the mean	B1	oe
	Additional Guidance		
	Daisy's mark was in the bottom 50% of marks		B1
	Daisy's mark is closer to the mean		B0

Q	Answer	Marks	Comments
15(a)	$\frac{380}{3} \times 405$ or $380 \div \frac{3}{405}$	M1	oe
	51 300 (≈ 51 000)	A1	

Q	Answer	Marks	Comments
	Alternative Method 1 – percentage change		
15(b)	Ticks yes and $\frac{51300 - 59000}{59000} \times 100$ (= 13.1%) or (= -13.1%) or $\frac{7700}{59000} \times 100 \approx 13\%$	B1ft	oe ft on their answer from 15(a) If they use 51000 then $\frac{8000}{59000} \times 100 = 13.6\%$
	Alternative Method 2 – use of multiplier		
	Ticks yes and 59000 x 0.87 = 51330 or 0.13 x 59000 = 7670 and 59000 – 7670 = 51330 or $\frac{51000}{0.87}$ = 58620(.69) or $\frac{51300}{0.87}$ = 58965(.52) or $(1 - \frac{51300}{59000})$ x 100 or $(1 - \frac{51000}{59000})$ x 100	B1ft	oe ft on their answer from 15(a) If they use 51000 then $\frac{8000}{59000} \times 100 = 13.6\%$

	3 **different** comments relating to accuracy and assumptions, eg 3 from • it is assumed that the frogs are caught from the same area(s) a larger sample size is needed (to be more confident about the true size of the population) • (the gap between when the frogs were caught was a week so) there was enough time for the populations to mix • Type of weather/conditions (affecting ease of re-capture) • Time of day when sample is taken • All frogs have an equal chance of being caught • It is assumed that the tags have not fallen off the frogs/tags have fallen off • Frogs might have been born/ die/migrate/hibernate/killed by predators (etc) affecting population size	B3	B2 for any two different comments B1 for any one comment

Additional Guidance	
The tagged frogs may be more susceptible to attack from predators	B1
Where in lake sample taken from	B1
Climate change with reference to time span between estimate and experiment	B1
Changes in habitat/environment between estimate and samples	B1
Changes in habitat/environment between samples	B0
Climate change	B0
Time of year	B0
Human interruption/disturbance	B0