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# GCSE STATISTICS 8382/2H

Higher Tier Paper 2

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Mark scheme

June 2019

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Version 1.0: Final

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 Assessment Writer.

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.

<b>M</b>	Method marks are awarded for a correct method which could lead to a correct answer.
<b>A</b>	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>B</b>	Marks awarded independent of method.
<b>ft</b>	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
<b>SC</b>	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
<b>M dep</b>	A method mark dependent on a previous method mark being awarded.
<b>B dep</b>	A mark that can only be awarded if a previous independent mark has been awarded.
<b>oe</b>	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
<b>[a, b]</b>	Accept values between a and b inclusive.
<b>[a, b)</b>	Accept values $a \leq \text{value} < b$
<b>3.14...</b>	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
<b>Use of brackets</b>	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.

Question	Answer	Mark	Comments	
1	3.75	B1		
2	C	B1		
3	80	B1		
4	Test A	B1		
5(a)	2013	B1	accept twenty thirteen or two thousand and thirteen	
5(b)	4 remaining values correctly plotted	B1		
	Their plots joined by straight lines	B1dep	dependent on at least one correct plot do not accept any part of graph being curved	
	'Year(s)' label on horizontal axis	B1		
	'Attendances (at all A&E hospitals) in millions' label on vertical axis	B1	oe eg (number of) people in millions 'millions' must not be omitted	
	<b>Additional Guidance</b>			
	First B1 : Plotting to tolerance of half a small square			
	Second B1 : Mark intention, so, (for example), forgive small areas of double lines			
	Second B1 : At least one correct plot includes if some or all of the others are omitted			
	Fourth B1 : Accept # for 'number of' eg '# patients – millions' is B1			
	Fourth B1 : Accept 'mil' or (1) 000 000(s) for millions but do not accept 'per million'			
	Fourth B1 : 'frequency of patients in millions'		B1	
	Fourth B1 : 'frequency in millions'		B0	
Ignore graph before 2008 and after 2016				
Ignore any titles to the graph written				

Question	Answer	Mark	Comments
<b>5(c)</b>	Shows patterns in the data more clearly / Avoids a large area of empty graph / Makes plotting / drawing / reading easier	B1	oe positive reason
	Over-exaggerates differences between years / Might not be understood	B1	oe negative reason
	<b>Additional Guidance</b>		
	Ignore irrelevant statements alongside correct ones		
	A correct positive reason given in the negative answer space and vice versa is B0		
	<b>For the positive reason</b>		
	It is more accurate / precise		B1
	Allows data to be plotted without a long graph		B1
	It's not bunched at the top		B1
	Allows you to have a smaller graph		B1
	Allows you to have a bigger graph		B0
	It makes it quicker to draw		B0
	There's no data below 19.5		B0
	Shows the correlation in the graph (it's not a scatter diagram)		B0
	Only shows relevant information		B0
	<b>For the negative reason</b>		
	It is misleading / confusing / distorts the graph		B1
	The graph looks very steep when in fact the numbers are quite close together		B1
	What does it mean?		B1
	Makes differences appear much bigger than they are		B1
Makes differences much bigger than they are		B0	
Allows you to start from 0		B0	
It is too steep between years		B0	

Question	Answer	Mark	Comments
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5(d)	There could be more doctors / nurses / hospitals or The hospital could be more efficient or Quicker treatment may be available or It will vary between hospitals / patients / emergencies / time of day / time of week (so they won't all have longer waiting times)	B1	oe
	<b>Additional Guidance</b>		
	Ignore irrelevant statements alongside correct ones		
	Answers which only reference their answer to a comparison between Major hospitals and All A&E hospitals score zero		
	Hospitals may not have reached capacity		B1
	It will depend upon how serious the problem is		B1
	Some people are now not going to A&E for minor conditions		B0
	They could build more A&E hospitals		B0
	Dan hasn't collected any data / there are no data about waiting times		B0

6(a)	North West and South East and no other regions mentioned	B1	in either order accept NW and SE
	<b>Additional Guidance</b>		
	Ignore any numbers given as part of the answer		

Question	Answer	Mark	Comments
<b>6(b)</b>	Two correct reasons eg Discusses that bars give misleading impression eg The fastest speed has the shortest bar eg Discusses that diagram is not to scale eg The bars are not drawn to scale eg The speeds are quite similar to each other but the bar lengths are quite different eg There is no scale	B2	oe B1 one correct reason
	<b>Additional Guidance</b>		
	Accept higher for faster and lower for slower		
	There are two bars for each region / row	B1	
	The bars with the numbers on are the same length	B1	
	The bars are drawn as arrows	B1	
	The difference in length between the first two bars is the same as between the second two bars, but there is not the same difference in speed	B1	
	It is not clear how long each bar is	B1	
	Length of arrows don't match the speed	B1	
	Doesn't show units	B1	
	The bars are the wrong way around	B0	
	Some speeds are the same but the bar lengths are different (not true)	B0	
	There should be axes	B0	
	The length of the bar does not correspond to the ranking (it shouldn't it should be proportional to the value)	B0	
The heading says 'How fast are you?' but the data is for regions / shoppers	B0		
The values go in descending order whereas it should be in ascending order	B0		

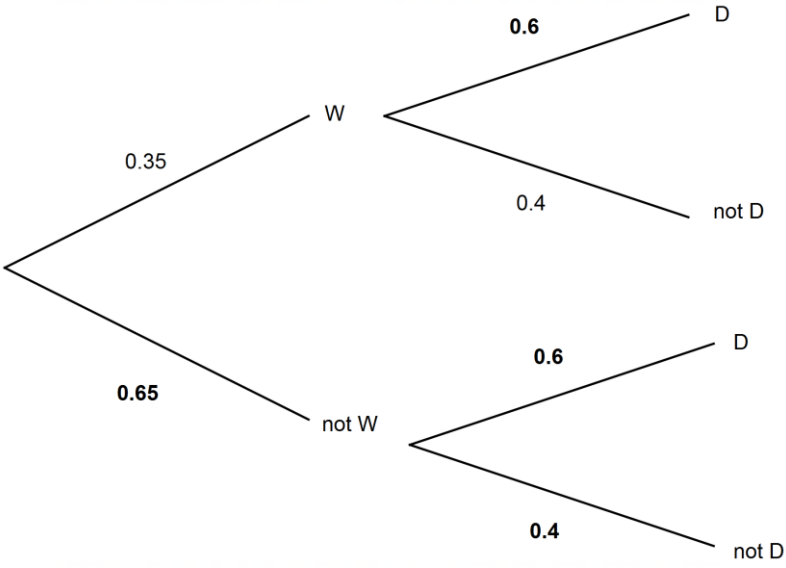


Question	Answer	Mark	Comments																																																		
6(c)(i)	Correct diagram, with ordered leaves and numbers vertically aligned	B3	B2 three or four correct, ordered rows or all numbers correctly placed in rows but not ordered																																																		
	<table border="1"> <tr><td>0</td><td>7</td><td>7</td><td>9</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>1</td><td>0</td><td>2</td><td>3</td><td>4</td><td>6</td><td>7</td><td>8</td><td>8</td><td>9</td></tr> <tr><td>2</td><td>1</td><td>2</td><td>2</td><td>4</td><td>5</td><td>5</td><td>6</td><td>7</td><td></td></tr> <tr><td>3</td><td>1</td><td>2</td><td>2</td><td>4</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>4</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>		0	7	7	9							1	0	2	3	4	6	7	8	8	9	2	1	2	2	4	5	5	6	7		3	1	2	2	4						4	1									B1 correct numbers in at least two rows (not necessarily ordered) but does not score B2
	0		7	7	9																																																
	1		0	2	3	4	6	7	8	8	9																																										
2	1	2	2	4	5	5	6	7																																													
3	1	2	2	4																																																	
4	1																																																				
<b>Additional Guidance</b>																																																					
Condone lack of vertical alignment for B2 and B1																																																					
Marks can be scored for work in white space below question if grid blank or crossed out																																																					

6(c)(ii)	(Walking speeds are) faster (on average) in June	B1	oe eg, (walking speeds are) slower (on average) in December
	<b>Additional Guidance</b>		
	Ignore calculations or average values seen		
	Accept higher for faster pace and lower for slower pace		
	Most / more walkers are faster in June		B1
	Most / more walkers have a faster pace in June		B1
	Walkers are faster in June		B1
	Walkers are slower in December		B1
	All walkers are faster in June		B0
	Most / more walkers are higher in June		B0
	Incorrect month(s) referenced		B0

Question	Answer	Mark	Comments
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6(c)(iii)	The shopping centre is busier in December	B1	oe it is the run-up to Christmas
	<b>Additional Guidance</b>		
	People are Christmas shopping		B1
	References to weather can only be to state or imply underfoot conditions eg More difficult to walk in poor weather in December		B1
	It might be icy / snow / be slippery in December		B1
	You wear less in June so you will be faster		B0
	People have more time in December		B0

7(a)			
	Tree diagram fully correct	B2	B1 for 0.65 on 'not W' branch or 0.6 on either 'D' branch
	<b>Additional Guidance</b>		
	Accept fractions, decimals or percentages		

Question	Answer	Mark	Comments	
7(b)	0.35 × their 0.6 or 0.21 or 0.35 × 0.4 or 0.14 or their 0.65 × their 0.6 or 0.39 or their 0.65 × their 0.4 or 0.26	M1	oe	
	(0.35 × their 0.6) + (0.35 × 0.4) + (their 0.65 × their 0.6) or their 0.21 + their 0.14 + their 0.39 or 0.35 + their 0.39 or 1 – their 0.26	M1dep	oe	
	0.74	A1ft	oe eg $\frac{74}{100}$ or $\frac{37}{50}$ or 74% ft if M2 awarded	
	<b>Additional Guidance</b>			
	Accept equivalent fractions, decimals or percentages throughout			
Work seen in part (a) may be credited in (b) if appropriate				
'Their' probabilities must be [0, 1] or [0, 100]% to allow follow through from (a)				

Question	Answer	Mark	Comments
<b>8(a)</b>	Toby's table covers all possible responses / is exhaustive	B1	oe eg Maxine's data table does not allow for less than 4 g of fat
	Toby's intervals do not overlap / are mutually exclusive	B1	oe eg with Maxine's data table, it is not clear in which interval 8 g belongs
	<b>Additional Guidance</b>		
	Both marks can be earned by a single statement eg Toby's intervals do not overlap and cover all possible responses		B2
	Toby's starts at 0, Maxine's starts at 4 (taken to imply exhaustive)		B1
	Maxine's starts at 4 <b>or</b> Toby's start at 0 (one of these but not both)		B0
	Toby's uses (double) inequalities which are better		B0
	Toby's are easier to understand		B0
	Toby's go higher		B0
	Toby's are more accurate		B0
Toby's have a greater range		B0	

Question	Answer	Mark	Comments
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<p><b>8(b)(i)</b></p>			
	<p>At least 5 points plotted at correct upper class boundaries</p>	<p>B1</p>	<p>±0.5 of a small square tolerance</p>
	<p>At least 5 points plotted at correct vertical heights</p>	<p>B1</p>	<p>±0.5 of a small square tolerance</p>
	<p>Fully correct cumulative frequency graph with points joined with straight lines or a curve</p>	<p>B1dep</p>	<p>dep on B1B1 awarded do not accept double lines or “feathering” on graph ±0.5 of a small square tolerance on line going through points</p>
	<p><b>Additional Guidance</b></p>		
	<p>Cumulative frequency bar chart or step polygon with no plots seen</p>	<p>B0B1B0</p>	
	<p>Cumulative frequency bar chart or step polygon with correct plots seen</p>	<p>B1B1B0</p>	
	<p>Omission of point (5, 0) (and line to second point)</p>	<p>B1B1B0</p>	
<p>Ignore graph after (40, 60)</p>			

Question	Answer	Mark	Comments
8(b)(ii)	$0.7 \times 60$ or 42 or $0.7 \times 61$ or 42.7	M1	oe may be implied by a mark by 42 (or 42.7) on the vertical axis or by an attempt at a line across at 42 (or 42.7)
	Correct 70 <sup>th</sup> percentile for their cumulative frequency graph	A1ft	their graph must be increasing with an attempt to join the points
	<b>Additional Guidance</b>		
	Answer with no apparent working – check their (appropriate) graph to see if it is correct for M1A1ft		

8(b)(iii)	<b>Alternative Method 1: Use of (b)(ii)</b>		
	Yes because the 70 <sup>th</sup> percentile is now less than 25	B1ft	ft their answer to (b)(ii) oe, eg Yes because now 30% of meals contain more than 23 grams of fat
	<b>Alternative Method 2: Use of their graph</b>		
	Yes, because now only 20% of meals contain more than 25 grams of fat	B1ft	read from graph and convert to a percentage ft from their graph (must be increasing) oe
	<b>Alternative Method 3: Use of the data table</b>		
	Yes, because now 80% of meals contain less than 25 grams of fat	B1	oe
	<b>Alternative Method 4 : Calculating number of meals</b>		
	Yes and $30\% \text{ of } 60 = 18$ (5 years ago) and $60 - 48 = 12$ (now)	B1	
	<b>Additional Guidance</b>		
Accept use of inequalities, eg $20\% < 30\%$ and Yes			B1

Question	Answer	Mark	Comments
9(a)	(Extraneous / explanatory / independent) variables / conditions can be controlled (more easily) or The experiment is easier to replicate or More likely / easier to demonstrate a cause and effect	B1	oe eg easier for the experimenter to demonstrate the effect of the independent variable on the response variable
	<b>Additional Guidance</b>		
	More complex / reliable equipment can be used		B1
	It is done in a controlled environment		B1
	They are more reliable / valid		B1
	Fewer (condone less) random factors		B1
	More convenient as you don't have to move from site to site		B1
	It's in a closed environment		B0
	Response / dependent variables can be controlled		B0
	It is done in a laboratory		B0
Quicker / easier / cheaper / more convenient / less biased / accurate		B0	

9(b)(i)	To see the difference in the performance with and without coffee / to compare to the others	B1	oe without a control group, Steve would not know whether a change in scores was due to the coffee
	<b>Additional Guidance</b>		
	To account for extraneous variables		B1
	To have something to compare to / with		B1
	To see if there is a change / improvement in the results		B0
	So that Steve knows whether his hypothesis is true		B0
	To ensure the results are accurate / not biased / fair		B0

Question	Answer	Mark	Comments
<b>9(b)(ii)</b>	No and a correct reason, eg, The improvement in the coffee drinkers' scores is less than that of the control group	B1	oe
	<b>Additional Guidance</b>		
	Must state or imply 'No' or say 'Steve's wrong' (oe)		
	Allow 'did better' or 'got better marks' (oe) for 'increased by more'		
	Allow 'those who drink nothing' (oe) for the control group		
	No, the control group did better		B1
	The control group did better		B0
	No, they all got similar scores		B0
	Yes, though the non-coffee drinkers went up as well		B0



Question	Answer	Mark	Comments
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	(Graph) A	B1	
	A correct reason for A, eg It has the strongest correlation eg Points are closest to the line (of best fit)	B1dep	do not accept strong or close - must be comparative
	Accurate reading from their line of best fit ( $\pm 0.5$ of a small square tolerance)	B1ft	ft from their choice of scatter graph
<b>Additional Guidance</b>			
<b>10</b>	For 3 <sup>rd</sup> B1ft mark : Prediction from Graph A value to be within [4.875, 4.925] Prediction from Graph B value to be within [5.04, 5.09] Prediction from Graph C value to be within [4.935, 4.985]		
	For second mark, ignore irrelevant statements alongside correct ones		
	Condone stronger (not strong) for strongest and closer (not close) for closest		
	A and A's data has the strongest relationship		B1B1dep
	A and the data has the least spread		B1B0dep
	A and the line of best fit is more accurate / more reliable		B1B0dep
	A and it is interpolation / not extrapolation		B1B0dep
	A and it is closest to the (double) mean (point)		B1B0dep
	A and the points are closer together / less scattered		B1B0dep
	A and because they're both about the sepal (not a statistical reason)		B1B0dep

Question	Answer	Mark	Comments
11(a)	12	B1	
11(b)	D	B1	
12(a)	His population should only be passengers staying in standard class cabins	B1	oe eg not all passengers on the ship are staying in standard class cabins
	<b>Additional Guidance</b>		
	He should only ask people in standard class		B1
	Some are in standard, some aren't		B1
12(b)	<b>Alternative Method 1 : using Ran# (or just noting corrections)</b>		
	Assign every passenger in the population a number from (00)1 to 460	B1	oe
	Generate random numbers from a calculator by typing $\boxed{\text{Ran\#}} \times 460$ or $\boxed{\text{Ran\#}}(460)$	B1	oe if they choose to multiply by a value greater than 460 they must also reference ignoring numbers above 460
	Round (up) the answer and ignore repeats	B1	oe allow truncate for 'round'
	<b>Alternative Method 2 : standard method</b>		
	Assign every passenger in the population a number from (00)1 to 460	B1	oe
	(Use the $\boxed{\text{Ran\#}}$ button to) generate random numbers from a calculator (and take the first 3 digits after the decimal point)	B1	oe allow RANINT#
	Ignore any numbers greater than 460 and repeats	B1	oe if RANINT used, may not need to ignore numbers greater than 460
	<b>Additional Guidance</b>		
	If student consistently uses 900 instead of 460 (thinking they are sampling from all 900), mark as per scheme with 900 replacing 460 but withhold one mark		
An acceptable alternative numbering might be (00)0 to 459			

Question	Answer	Mark	Comments		
<p>12(c)</p>	<p>Two separate questions <b>and</b> a better balance in the number of positive and negative responses for each of the questions eg How would you rate:- the value for money of standard class cabins? Very poor Poor Good Very good the quality of standard class cabins? Very poor Poor Good Very good or Do you think standard class cabins give value for money? Yes <input type="checkbox"/> No <input type="checkbox"/> Do you think standard class cabins are good quality? Yes <input type="checkbox"/> No <input type="checkbox"/> or Standard class cabins provide good value for money Disagree Neither agree nor disagree Agree Standard class cabins are good quality Disagree Neither agree nor disagree Agree</p>	<p>B2</p>	<p>oe there could be an even or odd number of tick boxes B1 two separate questions <b>or</b> a better balance in the number of positive and negative responses in their single question or all their unacceptable questions or without a question</p>		
	<b>Additional Guidance</b>				
	<p>Allow a scale like, for example,</p> <p><input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> <p>very poor <span style="float: right;">very good</span></p>		at least B1		
	<p>Throughout, ignore any boxes marked ‘don’t know’ or ‘would rather not say’ (oe) eg poor <input type="checkbox"/> average <input type="checkbox"/> good <input type="checkbox"/> don’t know <input type="checkbox"/></p>			at least B1	
	<p>How do rate your cabin for value for money? 5 star 4 star 3 star 2 star 1 star (0 star) (acceptable as ‘better balance’)</p>			at least B1	
<p>Allow reference to scales such as ‘0 – 10’ as a ‘better balance’ with a minimum of 0 and 10 defined as a negative and positive respectively</p>					

Question	Answer	Mark	Comments
<b>13(a)</b>	$0.2 \times 85$ or 17 or $0.35 \times 54$ or 18.9 or $0.45 \times 70$ or 31.5	M1	oe accept $20 \times 85$ or $35 \times 54$ or $45 \times 70$
	$0.2 \times 85 + 0.35 \times 54 + 0.45 \times 70$	M1dep	oe accept $20 \times 85 + 35 \times 54 + 45 \times 70$
	67.4	A1	allow 67 with working digits 674(0) scores M2A0
	<b>Additional Guidance</b>		
	Allow 0.85 for 85 etc for M2		
	67 without working		MOM0A0

Question	Answer	Mark	Comments	
13(b)	$0.2 \times 40$ or 8 or $0.35 \times 32$ or 11.2 or 19.2	M1	oe accept $20 \times 40$ or $35 \times 32$	
	$0.2 \times 40 + 0.35 \times 32 + 0.45 \times n$ where $n$ is either a letter or a number between $90\frac{2}{3}$ and 100 inclusive or $60 - \text{their } 19.2 (= 40.8 \div 0.45)$ or their 8 + their 11.2 + 45	M1dep	oe accept eg $20 \times 40 + 35 \times 32 + 45 \times 100$	
	Yes with correct working, eg a correct evaluation of $0.2 \times 40 + 0.35 \times 32 + 0.45 \times n$ for $90\frac{2}{3} \leq n \leq 100$ or $[90.6, 90.67](\%)$ or $91(\%)$ or $64(.2)$ <b>or</b> Yes, with correct explanation eg 45% still available, 40.8% needed to pass	A1	oe correct working implied by 64(.2) yes can be ticked or implied	
	<b>Additional Guidance</b>			
	Ignore further work carried out on 64(.2)			
'No' ticked is a maximum of M2 scored				

Question	Answer	Mark	Comments
14(a)(i)	$149.76 \div 24 (= 6.24)$	B1	oe eg $\frac{149.76}{24}$
	<b>Additional Guidance</b>		
	Accept $6.24 \times 24 = 149.76$		B1

14(a)(ii)	$\sqrt{\frac{968.72}{24} - \left(\frac{149.76}{24}\right)^2}$ or $\sqrt{\frac{968.72}{24} - 6.24^2}$	M1	accept without the square root oe eg $\sqrt{40.363... - 38.9376}$
	1.19 or better	A1	must see to at least 2 decimal places
	<b>Additional Guidance</b>		
	$\sqrt{\frac{968.72}{24} - \left(\frac{149.76}{24}\right)^2} = 1.2$		M1A0
	Use of 6.2 instead of 6.24 scores M1A0 if substitution correct unless recovered		
	Condone missing brackets if recovered		
	Missing brackets not recovered		M0A0
Condone square roots poorly placed, eg only covering numerator, unless definitely wrong as revealed by calculation done			

Question	Answer	Mark	Comments
14(a)(iii)	Target not met / unlikely to have been met <b>and either</b> a reason which references mean <b>and</b> standard deviation, eg Her mean is greater than 6 but some of her distances are likely to have been less than 6 km because her standard deviation is 1.2 <b>or</b> A calculation which shows a correct value below 6 using mean and standard deviation eg $6.24 - 1.2 = 5.04$	B2	oe B1 for target not met / unlikely to have been met with incomplete reason eg some of her distances must have been less than 6 km  decision that the target has not been met can be implied
	<b>Additional Guidance</b>		
	Do not accept target partially met / met sometimes / almost met met with mean but not met with standard deviation / other contradictions		B0 B0
	Allow 'may not be true' for 'unlikely to have been met' (oe)		
	Do not allow 'may not be exactly true' as this infers 'partially met'		B0
	The standard deviation shows that some days she walked below 6km		B0
	The standard deviation shows that some days she walked below 6km therefore she didn't meet her target		B1
	(The standard deviation shows that some days she walked below 6km as) $6.24 - 1.2 = 5.04$ therefore she didn't meet her target		B2
	Allow use of [1,4] standard deviations in these calculations		

Question	Answer	Mark	Comments
14(b)	(Erika's mean is greater than Tomasz's so) Erika walks further on average (than Tomasz)	B1	oe Erika generally walks further than Tomasz
	(Tomasz has a greater standard deviation so) the distance walked by Tomasz is more variable (than Erika)	B1	oe the amount Erika walks every day is more consistent
	<b>Additional Guidance</b>		
	Answers should include an interpretation of the mean / standard deviation in context and cannot simply just re-use the words mean and / or standard deviation only		
	The distances walked by Tomasz range more		B1
	The distances that Erika walks vary less / are less spread out		B1
	Erika walks more similar distances each day		B1
	Erika walks similar distances each day (not comparative to Tomasz)		B0
	Tomasz's range / variance is bigger (not accepted as an interpretation)		B0
	Erika's mean is greater (no context or interpretation of mean)		B0
Erika walks further		B0	
The mean distance that Erika walks is greater (no interpretation of mean)		B0	

15(a)	Drinking tea and drinking coffee are not exhaustive events	B1	oe eg some people (eg children) are likely to drink neither tea or coffee. some people may drink a different drink or a cold drink
	<b>Additional Guidance</b>		
	Some people might not have a hot drink at breakfast		B1
	He may be correct but they may not like either		B1
It's true $100 - 18 = 82$		B0	



Question	Answer	Mark	Comments
15(b)	$0.18^1 \times 0.82^4$ or 0.08(138...)	M1	oe
	5 × their 0.08(138...) or ${}^5C_1 \times$ their 0.08(138...)	M1dep	oe ${}^5C_1 \times 0.18^1 \times 0.82^4$ is M2
	[0.4069, 0.407] or 0.41	A1	oe fraction, decimal or percentage SC2 0.0043
	<b>Additional Guidance</b>		
	Accept fractions or decimals in working		
	Some students are doing more work on 0.41, eg $\frac{0.41}{5}$		

15(c)	The choices of the three family members may not be independent or Children may be less likely to drink tea	B1	oe
	<b>Additional Guidance</b>		
	People in families might drink the same thing at breakfast		B1
	They might share a big pot of tea		B1
	The probability of liking tea is not constant		B1
	They may all drink tea		B1
	Parents may tell children what to drink		B1
	Kids don't like tea / There may be children		B1
	None or all of the people may be tea drinkers		B1
	The sample is not random		B1
	There are three outcomes and the binomial should have two		B0

Question	Answer	Mark	Comments
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<b>16(a)</b>	It would not be practical for Luca to collect the data himself or Luca would need to contact every university	B1	oe it would take too long to collect the data himself
	<b>Additional Guidance</b>		
	It would be expensive		B1
	People (with low grades) may lie		B1
	The data has already been collected		B1
	May not be able to find everyone / every result		B1
	People may not remember		B0

<b>16(b)</b>	They would allow him to compare the proportions of students receiving each degree or They would allow him to compare the number of degrees awarded	B1	oe
	<b>Additional Guidance</b>		
	They will allow him to compare the data for the two years		B1
	The two populations are different sizes		B1
	See differences / changes / increases / decreases (between sets of data)		B1
	Gives the correct proportions by using the different radii		B1
	Easy to understand		B0
They are representative of the population		B0	

Question	Answer	Mark	Comments	
16(c)	$\sqrt{\frac{376\ 355}{308\ 395}}$ or 1.1(047....) or $\sqrt{10.98...}$	M1	oe	
	3.3(1...)	A1	seen, or implied by correct radius of pie chart if no working	
	(First =) $\frac{88\ 890}{376\ 355} \times 360$ or 85(.0) or (Upper second =) $\frac{186\ 570}{376\ 355} \times 360$ or 178(.4....) or 178.5 or 179 or (Lower second =) $\frac{81\ 595}{376\ 355} \times 360$ or 78(.0....) or (Third or Pass =) $\frac{19\ 300}{376\ 355} \times 360$ or 18(.4....) or 18.5 or 19	M1		
	All four angles correct	A1	may be implied by correct pie chart if no working	
	Pie chart drawn with <ul style="list-style-type: none"> <li>• radius = 3.3cm</li> <li>• correct angles</li> <li>• sectors labelled</li> </ul>	B2	award B1 for a pie chart satisfying two of the three conditions angle values do not need to be shown	
	<b>Additional Guidance</b>			
	Tolerance on drawing is 2 degrees each sector and 1mm on radius Tolerance on 178.4 is [176, 180] Tolerance on 18.4 is [16, 20]			
	If a circle is drawn free-hand, it is B0, but the other 4 marks may be scored			
	If working is not shown and angles are calculated incorrectly, to judge whether the labelling is appropriate, assume that the largest sector is Upper Second, the next largest is First, the next is Lower Second and the smallest is Third or Pass			
No working, but pie chart drawn with correct radius, correct angles and correct labelling			6 marks	

Question	Answer	Mark	Comments
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16(d)	$\frac{48}{360} \times 308\,395$ or 41 119(.3...)	M1	oe
	88 890 – their 41 119(.3) or 47 770.6(6...) or 47 770.67 or 47 770.7	M1dep	oe
	47 770 or 47 771	A1	allow 47 800 or 48 000 if no wrong working seen SC2 47 742
	<b>Additional Guidance</b>		

16(e)	A suitable reason eg Teaching may have improved or Students may be working harder	B1	oe
	<b>Additional Guidance</b>		
	The subjects / exams students are taking may have changed		B1
	Students are more intelligent		B1
	Students in 2008 performed badly / Students in 2016 performed well		B1
	There are more students so more will get First Class (doesn't mean it is easier)		B0
	Hasn't taken into account other / all the Universities		B0

Question	Answer	Mark	Comments
<b>16(f)</b>	$\frac{83\,720}{347\,470}$ or 0.24(094....) or 24(.094...)% or $\frac{5170}{28\,885}$ or 0.178(9....) or 17.8(9...)% or 0.18 or 18%	M1	oe
	$\frac{83\,720}{347\,470}$ or 0.24(094....) or 24(.094...)% and $\frac{5170}{28\,885}$ or 0.178(9....) or 17.8(9...)% or 0.179(0) or 17.9(0)% or 0.18 or 18%	M1dep	oe
	0.24(094....) and 0.178(9....) (or 0.179(0) or 0.18) and a suitable conclusion eg Students studying full-time are more likely to achieve a first class degree (than students studying part-time) There's a greater proportion / percentage of full-time students achieving a first class degree	A1	oe allow equivalent percentages. allow equivalent fractions if expressed with a common denominator  do not accept 'there are more full-time students getting a first class degree...'
<b>Additional Guidance</b>			
Condone the incorrect concept of "doing" a first class degree in conclusions eg full-time students are more likely to do a first class degree is acceptable as the conclusion			