Mark Scheme (Result)

October 2020

Pearson Edexcel GCE
In AS Level Mathematics
8MA0 Paper 21 Statistics

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question	Scheme	Marks	AOs
1	1 square is $\frac{78}{12\times3+3\times4+2\times2}=\left[\frac{78}{52}=1.5\right]$ **and** $(8\times1+1\times8)\times"1.5"$	M1	3.1a
	24 students took less than 11 minutes	A1	1.1b
	Percentage of students = $\frac{"24"}{78+"24"+1\times8\times"1.5"+3\times4\times"1.5"}\times100$	M1	3.1b
	= 18.18… awrt 18%	A1	1.1b
		(4)	
			Total 4

Notes		
1	**M1:**	For clear use of frequency density to establish the fd scale and then use the area to find frequency of <11 minutes. Allow maximum of 3 errors in either the heights or widths in total if working shown. They may calculate the area using other size squares. Allow for realising they need to find the total number of squares (88) maximum of 4 errors in either the heights or widths and number < 11 minutes(16) - must have a maximum of 1 error in either the heights or widths (and not use the 78 as part of calulation)
	A1:	For correct values seen. Allow for 88 and 16
	M1:	For realising the need to find the total and calculating a percentage. (with "their 24" as the numerator). Allow $(8\times1+2\times8)\times"1.5"$ instead of $"24"+1\times8\times"1.5"$ If working shown can allow maximum of 2 errors in either the heights or widths in the calculation of the total. Allow "their 24" / 132 oe
	A1:	awrt 18

Question	Scheme	Marks	AOs
2(a)	0 to 500 m	B1	1.2
		(1)	
(b)	$1100+1600+1.5\times1600$ [= 5100]	M1	2.1
	5300 > 5100 therefore outlier	A1	1.1b
		(2)	
(c)	As the humidity increases the mean visibility decreases	B1	2.4
		(1)	
(d)	(Hours of) sunshine	B1	2.2b
		(1)	
			(5 marks)

Notes		
(a)	**B1:**	For realising it is the maximum distance and distance given with correct units. Allow 0 to 50dm or < 500m or < 50dm
(b)	**M1:**	Attempt to find Q_3 and the upper limit
	A1:	5100, if a value for the point is stated it must be above 5100 otherwise it is A0. For a statement comparing and conclusion it is an outlier or it is above Q_3 +1.5IQR. Allow accept the point circled is greater than 5100 oe
(c)	**B1:**	For a suitable interpretation of a negative correlation mentioning humidity and visibility
(d)	**B1:**	A correct deduction that the unlabelled variable is the hours of sunshine. Condone missing hours. Do not allow if more than one variable given. Must be quantative variable Not cloud cover since values bigger than 8 Not wind speed since values not integers Not daily mean temperature since mean temperature near to zero are unlikely in June

Question	Scheme	Marks	AOs
3	Overall method	M1	2.1
	$a+b=2c+0.5$ oe **or** $a+b=2(1-a-b)$	B1	2.2a
	$a+b+c=0.75$ oe	B1	1.1b
	$3c=0.25 \quad \left[c=0.0833... \text{ or } \frac{1}{12}\right]$	M1	1.1b
	P(scoring 2,4 or 4,2 or 3,3) = $2\times"\frac{1}{12}"\times 0.15+0.1^2$	M1	3.1b
	= 0.035 oe	A1cso	1.1b
		(6)	
			(6 marks)

Notes		
3	**M1:**	A fully correct method with all the required steps. For gaining 2 correct equations with at least one correct(allow if unsimplified). Attempting to solve to find a value of *c* followed by **correct method** to find the probability
	B1:	Forming a correct equation from the information given in the question
	B1:	A correct equation using the sum of the probabilities equals 1
	M1:	Correct method for solving 2 equations to find *c* Implied by $c=\frac{1}{12}$
	M1:	Recognising the ways to get a total of 6. Condone missing arrangments or repeats. Do not ignore extras written unless ignored in the calculation. May be implied by $m\times"\frac{1}{12}"\times 0.15+n\times 0.1^2$ where *m* and *n* are positive integers
	A1cso:	Cao 0.035, $\frac{7}{200}$ oe

Question	Scheme	Marks	AOs
4(a)	It is not possible to have a sampling frame	B1	2.3
		(1)	
(b)	Quota sampling **and** (catch 85 common carp, 45 mirror carp and 30 leather carp) **or** (ignore any fish caught of a type where the quota is full)	M1	1.1a
	Quota sampling **and** catch 85 common carp, 45 mirror carp and 30 leather carp **and** ignore any fish caught of a type where the quota is full	A1	1.1b
		(2)	
(c)	$\sigma = \sqrt{\frac{3053}{160} - \left(\frac{692}{160}\right)^2}$	M1	1.1b
	$= 0.6129\ldots$ awrt 0.613	A1	1.1b
		(2)	
(d)(i)	This would have no effect as the piece of data would remain in the same class	B1	2.2a
(ii)	This would increase the standard deviation as change in mean is small and $6.4 - 4.6 \approx 3\sigma$ therefore estimate of standard deviation will increase	B1	2.2a
		(2)	
			(7 marks)

Notes		
(a)	**B1:**	For the idea there cannot be a sampling frame/list
(b)	**M1:**	Quota sampling **and** either for the correct numbers of each type **or** for the idea that if quota full ignore the fish.
	A1:	Quota sampling **and** both the correct numbers of each type **and** for the idea that if quota full ignore the fish or sample until all quotas are full
(c)	**M1:**	A correct expression for σ
	A1:	Awrt 0.613 allow s = awrt 0.615
(d)	**B1:**	Correct deduction with suitable explanation Allow range for class. Do not allow there is no differences
	B1:	Correct deduction with suitable explanation. so would increase the standard deviation and a suitable reason. Allow the value is bigger than any others in the table **oe**

Question	Scheme	Marks	AOs
5(a)	Let C = the number of successful calls. $C \sim \mathrm{B}\left(9, \frac{1}{6}\right)$	M1	3.3
	$\mathrm{P}(C \geqslant 3) = 1 - \mathrm{P}(C \leqslant 2) = 0.1782\ldots$ **awrt 0.178**	A1	1.1b
		(2)	
(b)	Let X = the number of occasions when at least 3 calls are successful. $\mathrm{P}(X = 1) = 5 \times (\text{"0.1782..."}) \times (\text{"0.8217..."})^4$	M1	1.1b
	$= 0.4061\ldots$ **awrt 0.406**	A1	1.1b
		(2)	
(c)	$\mathrm{H}_0 : p = \frac{1}{6}$ $\quad$ $\mathrm{H}_1 : p > \frac{1}{6}$	B1	2.5
	Let R = the number of successful calls $R \sim \mathrm{B}\left(35, \frac{1}{6}\right)$	M1	3.3
	$\mathrm{P}(R \geqslant 11) = 1 - \mathrm{P}(R \leqslant 10) = 0.02...$	A1	3.4
	There is sufficient evidence to support that **Rowan** has more successful sales calls than Afrika.	A1	2.2b
		(4)	
			(8 marks)

Notes		
5(a)	**M1:**	For selecting the right model
	A1:	awrt 0.178
(b)	**M1:**	For $5 \times (\text{"their}(a)\text{"}) \times (\text{"1} - \text{their}(a)\text{"})^4$
	A1:	awrt 0.406
(c)	**B1:**	for correctly stating both hypotheses in terms of p or π Accept $p = 0.1\dot{6}$
	M1:	For selecting a suitable model. May be implied by a correct probability or CR
	A1:	Correct probability statement and answer of 0.02 or better (0.02318…) (CR $R \geqslant 11$ and either $\mathrm{P}(R \leqslant 9) = 0.9450$ or $\mathrm{P}(R \leqslant 10) = 0.9768$ or $1 - \mathrm{P}(R \leqslant 10) = 0.0232$)
	A1:	Dependent on M1A1 but can ignore hypotheses. For conclusion in context supporting **Rowan's** belief **/ Rowan** is a better sales person
		Do not accept Rowan can reject H_0