Mark Scheme (Results)

Summer 2024

Pearson Edexcel GCE

AS 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.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 30.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes.

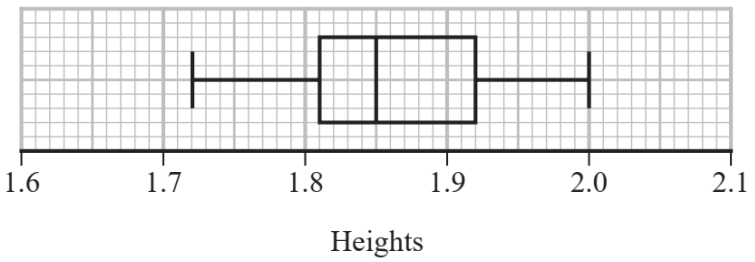
- bod – benefit of doubt
- ft – follow through
- the symbol $\surd$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- * The answer is printed on the paper
- ⌐ The second mark is dependent on gaining the first mark

4. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

5. Where a candidate has made multiple responses and indicates which response they wish to submit, examiners should mark this response.
   If there are several attempts at a question which have not been crossed out, examiners should mark the final answer which is the answer that is the most complete.

6. Ignore wrong working or incorrect statements following a correct answer.

7. Mark schemes will firstly show the solution judged to be the most common response expected from candidates. Where appropriate, alternatives answers are provided in the notes. If examiners are not sure if an answer is acceptable, they will check the mark scheme to see if an alternative answer is given for the method used.

Question	Scheme	Marks	AO
1		B1 B1ft B1 B1ft **(4 marks)**	2.2a 1.1b 2.2a 1.1b
	Notes		
	1st B1 for a box with 2 whiskers (one at each end) with **median** at 1.85 and **lower quartile** at 1.81 do not allow median = upper quartile [=1.85] 2nd B1ft for 1.92 plotted as the **upper quartile** (must be right hand end of box) or for plotting an IQR = 0.11, i.e. their upper quartile at "1.81" + 0.11 3rd B1 for lower whisker ending at 1.72 must be attached to whisker 4th B1ft for upper whisker ending 2.0 must be attached to whisker or for plotting a range of 0.28 i.e. their upper whisker ending at "1.72" + 0.28 for ft condone maximum and/or minimum plotted as outliers by * or ×		

Qu 2	Scheme	Marks	AO
(a)	East Since : The prevailing winds in Camborne/UK are from the South or West or North or East since lowest frequency or Camborne is in South/West (and so wind is less likely to come from East)	B1	2.2b
(b)		(1)	
	e.g. 'wind direction should be in the range 0 to 360'	M1	2.4/1.2
	e.g. 'so he should ignore/remove the value'	A1	1.1b
		(2)	
		(3 marks)	

	Notes
(a)	B1 for East **and** a suitable reason based on: general winds in UK / Camborne allow East and Camborne indicated on a sketch of map contradictory comment e.g. 'Camborne is in the North, so wind is less likely to come from the East' is B0
(b)	M1 for giving a reason which correctly uses 360 for reason allow e.g. 'only goes up to 360' also condone '10 to 360' this mark may be implied by e.g. 'subtract 720'
	A1 for stating appropriate action to take provided M1 clearly scored ignore o.e. or remove o.e. allow e.g. 'reject' , 'discard' , etc. must be suggesting what to do with the value, not just stating that it is an anomaly allow change it to 279

Question	Scheme	Mark	AO
3(a)	[From 3~4 bar and freq in table deduce] fd scale of 1cm = 5 2~3 has freq = **25** **and** 4~6 has freq = 112 – (64+13+3 + "25") = **7**	M1 A1 **(2)**	2.2a 1.1b
(b)	For a bar between 4~6 of height $\frac{"7"}{2}$ = 3.5 small squares or For a bar between 6~8 of height 1.5 small squares For a fully correct histogram with all 3 bars plotted correctly	M1 A1ft **(2)**	2.2a 1.1b
(c)	Require $\int_{(1)}^{(8)} \frac{k}{x^2}\,\mathrm{d}x = 112$ $= \left[\frac{-k}{x}\right]_1^8 = \left(-\frac{k}{8}\right) - \left(-\frac{k}{1}\right) \left[= 112\right]$ i.e. $\left[\frac{7}{8}k = 112 \Rightarrow\right]$ k = **128**	M1 M1 A1 **(3)**	3.4 1.1b 1.1b
		(7 marks)	

	Notes
(a)	M1 for deducing a correct fd scale (seen on graph or in text) may be implied 25 or 7 if 25 or 7 found, then ignore their fd scale A1 for both 25 **and** 7
(b)	Ignore their fd scale in part (b) M1 for a correct bar over 4~6 follow through their "7" from their table or for a correct bar over 6~8 A1ft for a fully correct histogram (all 3 bars correct height and correct width) allow ft on their 4~6 bar
(c)	1st M1 for correct integral expression = 112 (condone missing dx and ignore limits) or attempt to integrate ($x^{-2} \rightarrow x^{-1}$) and set area = 112 (ignore limits) 2nd M1 for correct integration and some use of limits of 1 and 8 (condone missing 112) $\frac{7}{8}k = 112$ implies M1M1 A1 for 128

Qu 4	Scheme	Marks	AO
(a)	(i) 0.153588… awrt **0.154**	B1	3.4
	(ii) $P(X \leqslant 14) - P(X \leqslant 11)$ with at least 1 from $P(X \leqslant 14) = 0.97707..$; $P(X \leqslant 11) = 0.797603..$	M1	2.1
	$= 0.17947…$ awrt **0.179**	A1	1.1b
		(3)	
(b)	$H_0 : p = 0.12$ $H_1 : p < 0.12$	B1	2.5
	[D = no. of defective items in sample] $D \sim B(60, 0.12)$	M1	2.1
	$[P(D \leqslant 3)] = 0.06013..$ awrt **0.060** **or** $[P(D \leqslant 2)] =$ awrt 0.0196 with reference to CR [so CR: $D \leqslant 2$] [0.06… > 5% not significant, do not reject H_0]	A1	1.1b
	Insufficient evidence that proportion of defective items has decreased	A1	2.2b
		(4)	
(c)	"**0.06…**"	B1ft	1.2
		(1)	
		(8 marks)	

	Notes
(a)(i)	B1 for awrt 0.154
(ii)	M1 for correct expression for $P(X \leqslant 14) - P(X \leqslant 11)$ [o.e.] with at least one correct probability substituted (2sf truncated or rounded) or correct calculation 0.97707… – 0.797603… (2sf truncated or rounded)
ALT	or $P(X = 12) + P(X = 13) + P(X = 14)$ with at least one from $^{27}C_{12}(0.35)^{12}(0.65)^{15}$ $=0.09176… + {}^{27}C_{13}(0.35)^{13}(0.65)^{14} = 0.05701… + {}^{27}C_{14}(0.35)^{14}(0.65)^{13} = 0.03069…$ with at least one correct probability calculation or value seen (2sf truncated or rounded)
	A1 for awrt 0.179 allow 0.1795 correct answers scores 2 out of 2
(b)	B1 for both hypotheses correct in terms of p or π
	M1 for sight or correct use of B(60, 0.12) (implied by awrt 0.0601 or awrt 0.0405 or awrt 0.0196)
	1st A1 for **final answer** awrt 0.060 (allow 0.06 if $P(D \leqslant 3)$ is seen with B(60, 0.12)) **or** for critical region approach awrt 0.0196 **with** statement of CR or reference to CR NB: $P(D \leqslant 2) =$ awrt 0.0196 **on its own** scores A0 here as it is treated as a p-value but can score B1ft in part (c)
	2nd A1 (**dep on** M1A1 but independent of hypotheses) for a correct inference in context. Must NOT reject H_0 (if stated) **and** mention underlined words o.e. condone e.g. ' proportion of defective items is still 0.12/hasn't changed' allow e.g. 'no' for insufficient allow proportion/probability/percentage but **not** number allow e,g. 'is less than 0.12' for decreased 2nd A0 for contradictory statements e.g. 'reject H_0 so no decrease in proportion of defective items'
SC	A two-tailed test may score maximum in (b) B0M1A1A1 but must be 2×their p-value to 3 sf to score in part (c). Correct ft is 0.120 or better (do not accept 0.12 for the SC).
(c)	B1ft for 0.06 or better allow as a percentage or ft their **final** (p-value) **answer** from part (b) to 1sf [provided it is a probability] NB: using a **critical region** approach in (b) scores B0ft if they state their CR probability as the p-value

Qu 5	Scheme	Marks	AO
(a)	$[2q = 0.3]$ $\left[q = \frac{1-(0.5+0.2)}{2}\right]$ $[q =]$ **0.15**	B1 (1)	1.1b
(b)	Realising require sequence: $\overline{7}, \overline{7}, 7$ may see $0.8\times0.8\times0.2$ o.e. = **0.128** *	M1 A1* (2)	3.4 1.1b
(c)	Possible values for S are: 1, 2, 3 or 4 only $[P(S = 1)] = 0.2$ and $[P(S = 2) = 0.8\times0.2 =] 0.16$ $P(S = 4) = 0.8^3\times0.2 + 0.8^4$ [= 0.512] or $1-\left['P(S=1)' + 'P(S=2)' + 0.128\right]$ s: **1**, **2**, **3**, **4** $P(S = s)$: **0.2** $= \frac{1}{5}$, **0.16** $= \frac{4}{25}$, 0.128 $= \frac{16}{125}$, **0.512** $= \frac{64}{125}$	B1 M1 M1 A1 (4)	3.3 3.4 3.4 1.1b
(d)	[= 1 – P(S = 1 = N)= 1 – 0.2] = **0.8**	B1 (1)	1.1b
		(8 marks)	

Notes

(a) B1 for $q = 0.15$ o.e.

(b) M1 for evidence that a correct sequence has been applied
allow a clear list of all 9 possibilities
e.g. (6,6,7), (6,8,7), (6,10,7), (8,6,7), (8,8,7), (8,10,7), (10,6,7), (10,8,7), (10,10,7)

or e.g. 0.5×0.5×0.2[=0.05] + 4(0.5×0.15×0.2[=0.015]) + 4(0.15×0.15×0.2[=0.0045])

A1* for 0.128 from a correct expression with no incorrect working seen

(c) B1 for a correct sample space for S (e.g. first row of table) condone any letter for B1
if any other values for S are stated they must be attached to a probability of 0
1st M1 for using the given model to find both values of P(S = 1) **and** P(S = 2)
2nd M1 for a correct method to find P(S = 4)
or use of P(S = 4) = 1 – (P(S = 1) + P(S = 2) + 0.128)
i.e. their P(S = 1) + P(S = 2) + P(S = 4) = 0.872
A1 for a fully correct probability distribution, in table or listed separately
must be in terms of S for this mark to be scored

(d) B1 for 0.8

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