GCE

Mathematics B (MEI)

H630/02: Pure Mathematics and Statistics

Advanced Subsidiary GCE

Mark Scheme for Autumn 2021

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

© OCR 2021

1. Annotations and abbreviations

Annotation in scoris	Meaning
✓and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
Highlighting	
Other abbreviations in mark scheme	**Meaning**
E1	Mark for explaining a result or establishing a given result
dep*	Mark dependent on a previous mark, indicated by *
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working
AG	Answer given
awrt	Anything which rounds to
BC	By Calculator
DR	This indicates that the instruction **In this question you must show detailed reasoning** appears in the question.

2. Subject-specific Marking Instructions for AS/A Level Mathematics B (MEI)

a Annotations should be used whenever appropriate during your marking. The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded. For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

b An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct solutions leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly. Correct but unfamiliar or unexpected methods are often signalled by a correct result following an apparently incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.
If you are in any doubt whatsoever you should contact your Team Leader.

c The following types of marks are available.

M
A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

E
A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep*' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e The abbreviation FT implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only – differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, what is acceptable will be detailed in the mark scheme. If this is not the case, please escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.
Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f Unless units are specifically requested, there is no penalty for wrong or missing units as long as the answer is numerically correct and expressed either in SI or in the units of the question. (e.g. lengths will be assumed to be in metres unless in a particular question all the lengths are in km, when this would be assumed to be the unspecified unit.) We are usually quite flexible about the accuracy to which the final answer is expressed; over-specification is usually only penalised where the scheme explicitly says so.

- When a value is given in the paper only accept an answer correct to at least as many significant figures as the given value.
- When a value is not given in the paper accept any answer that agrees with the correct value to **2 s.f.**
  NB for Specification A the rubric specifies 3 s.f. as standard, so this statement reads "3 s.f"

Follow through should be used so that only one mark is lost for each distinct accuracy error.

g Rules for replaced work: if a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests; if there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others. NB Follow these maths-specific instructions rather than those in the assessor handbook.

h For a genuine misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A mark in the question. Marks designated as cao may be awarded as long as there are no other errors. E marks are lost unless, by chance, the given results are established by equivalent working. 'Fresh starts' will not affect an earlier decision about a misread. Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

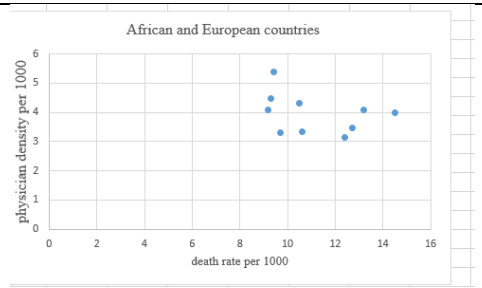
i If a calculator is used, some answers may be obtained with little or no working visible. Allow full marks for correct answers (provided, of course, that there is nothing in the wording of the question specifying that analytical methods are required). Where an answer is wrong but there is some evidence of method, allow appropriate method marks. Wrong answers with no supporting method score zero. If in doubt, consult your Team Leader.

j If in any case the scheme operates with considerable unfairness consult your Team Leader.

Question			Answer	Marks	Guidance	
1			${}_6C_4$, ${}^6C_4$, $\frac{6!}{2!4!}$ or $\binom{6}{4}$ **oe** or 1 6 15 20 15 6 1 **soi**	**M1**	${}_6C_2$, ${}^6C_2$, $\frac{6!}{4!2!}$ or $\binom{6}{2}$	
			3^4 seen	**B1**	Allow for $(3x)^4$ seen	
			1215	**A1**	Condone $1215x^4$	
				[3]		
2	**(a)**		Positive skew	**B1**	Oe	
				[1]		
2	**(b)**		(discrete) uniform	**B1**	Oe	
				[1]		
3			$\tan(-30°) = -\frac{1}{\sqrt{3}}$	**B1**	Marks may be gained in a different order; allow for any correct method.	
			$\tan(-30° + 4 \times 180°) = \tan(690°)$	**B1**	Or $\tan(-30° + 2 \times 360°) =$ $\tan 690°$ Accept $-30° + 4 \times 180° = 690°$	
			completion to $\tan(690°) = -\frac{1}{\sqrt{3}}$	**B1**		
				[3]		
4			$\frac{9x^3}{3}$ **oe**	**B1**		
			$kx^{½}$	**M1**		
			$3x^3 + 12x^{½} + c$	**A1** **A1**	2 elements correct all 3 elements correct	
				[4]		
5	**(a)**		$B = 31$	**B1**		
				[1]		

Question			Answer	Marks	Guidance	
5	(b)		$71 = A\ln 12 + 31$	M1		
			$A = 16$	A1	CAO May see 16.097…A0	
				[2]		
5	(c)		79 or 78.9 or better	B1	from $16\ln 20 + 31$ and 78.9317 Condone 79.2… from unrounded value of A	
				[1]		
5	(d)		$120 = 16\ln X + 31$	M1	FT their A and B; allow sign error	
			exp(their $\frac{120-31}{16}$)	M1	Allow slip in rearrangement	
			awrt $X = 260$	A1	CAO $A = 16.097\ldots$ leads to 250, A0.	
				[3]		
6	(a)		$3p^2 + 0.5p^2 + 2p + 1.5p + 1.5\ p^2 + 0.5p = 1$	M1	Allow if only 3 probs added, or if = 1 omitted.	
			$5p^2 + 4p - 1 = 0$	A1	Allow if one coeff or one sign wrong	
			$p = 0.2$ or -1 **BC**	A1		
			$p = 0.2$ only	A1		
				[4]		
6	(b)		Use of their p to calculate at least two probabilities	B1	Their p must be < 1.	
			Mode is 1	B1	WWW NB 0.12, 0.42, 0.3, 0.16	
				[2]		
7	(a)		Remove Western Sahara since there is no data available (#N/A)	B1	Ignore any comments about removing outliers	advantage

Question			Answer	Marks	Guidance	
				[1]		
7	(b)		6.79 + 2×2.78 or 6.79 − 2×2.78 **soi**	M1	NB 1.23 or 12.35 implies **M1**	
			None of the smallest values are outliers	A1	soi	
			At least 1 of largest values identified	A1		
			13.7,13.7,16.5,17.1,17.1 only	A1	CAO	
				[4]		
7	(c)		Not simple random sampling because every possible sample does not have an equal chance of being selected	B2	oe Allow B1 for: He is using systematic sampling	
				[2]		
8	(a)		$\begin{pmatrix}6\\8\end{pmatrix} - \begin{pmatrix}-3\\20\end{pmatrix}$	M1	May see $\begin{pmatrix}9\\-12\end{pmatrix}$ or $\begin{pmatrix}-9\\12\end{pmatrix}$	
			$\lvert\overrightarrow{AB}\rvert = 15$ or $\sqrt{225}$ so $\lvert\overrightarrow{AB}\rvert < 200$ or $\lvert\overrightarrow{AB}\rvert$ is not greater than 200	A1	May see $\sqrt{9^2 + (-12)^2}$ oe CWO	
				[2]		
8	(b)		$\overrightarrow{AC} = \begin{pmatrix}18\\-24\end{pmatrix} = 2 \times \begin{pmatrix}9\\-12\end{pmatrix}$	M1	FT their AB; allow mark for comparison of their AB and AC	
			so A, B and C are collinear	A1		
				[2]		
9	(a)		The sample is not from the pre-release material because Arun has data from capital cities. The pre-release material only has data for countries	B1		advantage
				[1]		

Question			Answer	Marks	Guidance	
9	(b)		It is possible for the same value to be selected in two different random samples.	B1		
			Different samples (especially when small) might lead to different conclusions being made.	B1		
			So there is no evidence to suggest Arun's statement is correct	B1		
				[3]		
9	(c)		 Many African countries have a lower physician density (and often have a high death rate)	B1	OR European countries generally have a higher physician density (and often have a low death rate)	advantage
				[1]		
10	(a)		$\frac{5-7}{11--3}$ or $\frac{-9-5}{9-11}$ **soi**	M1	All signs reversed in a fraction is correct	
			$\frac{-2}{14}$ and $\frac{14}{2}$ **oe**	A1	Fractions may be cancelled	
			$\frac{-2}{14} \times \frac{14}{2} = -1$ **oe** so lines are perpendicular	A1		
				[3]		
10	(b)		PR is a diameter by angle in a semi-circle	B1	Stated Detailed reasoning required	
			$\left(\frac{-3+9}{2}, \frac{7-9}{2}\right)$	M1	allow one slip eg sign error	
			(3, –1)	A1		

Question			Answer	Marks	Guidance	
				[3]		
11	**(a)**		This is a self-selecting sample.	**B1**	Syllabus says 'self-selected'	
			it may introduce bias	**B1**	Or an explanation of why the sample is biased	
				[2]		
11	**(b)**		$12.2\times15 + 14\times15 + 8.4\times30 + 7.3\times60 + 3.1\times120$ $= 1455$	**M1** **A1**	at least 3 correct terms **AG** WWW. May see $183 + 210 + 252 + 438 + 372$	
				[2]		
11	**(c)**		$\frac{7.3\times60+3.1\times120}{1455}$	**M1**		
			$= \frac{54}{97}$ or 0.5567 correct to 2, 3 or 4 sf.	**A1**		
				[2]		
12	**(a)**		$\bar{X} = 2.1$	**B1**		
			$\frac{604-100\times2.1^2}{99}$ **oe**	**M1**		
			variance = 1.64646…	**A1**	Accept to 3 or 4 sf or as recurring decimal or accept $\frac{163}{99}$	
				[3]		
12	**(b)**		$n = 10$ $p = 0.21$	**B1** **B1FT**	 Ft from their 2.1	
				[2]		
12	**(c)**		binomPdf(n, p, 2) used	**M1**	FT their n and their calculated p; may be implied by 0.301…	

Question			Answer	Marks	Guidance	
			100 × binomPdf(10,0.21,2)	**M1**	FT 100 x their prob from Binomial distribution	
			$f_e = 30.1$	**A1**	Accept 30 for final answer	
				[3]		
13			$\left[\frac{dy}{dx}\right] = 3 - \frac{7}{x^2} + \frac{6}{x^3}$	**M1** **A1**	at least two of three terms correct all correct	
			their $\frac{dy}{dx} = 2$	**M1**		
			$x^3 - 7x + 6 = 0$	**M1**	their $\frac{dy}{dx} = 2$ rearranged to give cubic expression equal to zero	
			Use of Factor theorem with factor of their 6	**M1**		
			Long division **oe** to obtain $(x - 1)(x^2 + x - 6)$ or $(x - 2)(x^2 + 2x - 3)$ or $(x + 3)(x^2 - 3x + 2)$	**M1**	Allow sign error in quotient; quotient and factor may appear separately in algebraic division	
			$(x - 1)(x + 3)(x - 2)$	**A1**		
			Evaluation of f(their 1), f(their 2) and f(their–3) seen	**M1**		
			(1,7) $(2, \frac{35}{4})$ and $(-3, -\frac{35}{3})$	**A1**		
				[9]		

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Cambridge Assessment