OCR
Oxford Cambridge and RSA

GCE

Mathematics B (MEI)

H630/02: Pure Mathematics and Statistics

Advanced Subsidiary GCE

Mark Scheme for November 2020

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 2020

Text Instructions

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
E	Explanation mark 1
SC	Special case
^	Omission sign
MR	Misread
BP	Blank page
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 *. The * may be omitted if only previous M mark.
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.

Subject-specific Marking Instructions for AS Level Mathematics B (MEI)

a Annotations must be used during your marking. For a response awarded zero (or full) marks a single appropriate annotation (cross, tick, M0 or ^) is sufficient, but not required.

For responses that are not awarded either 0 or full marks, you must make it clear how you have arrived at the mark you have awarded and all responses must have enough annotation for a reviewer to decide if the mark awarded is correct without having to mark it independently.

It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

Award NR (No Response)

- if there is nothing written at all in the answer space and no attempt elsewhere in the script
- OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
- OR if there is a mark (e.g. a dash, a question mark, a picture) which isn't an attempt at the question.

Note: Award 0 marks only for an attempt that earns no credit (including copying out the question).
If a candidate uses the answer space for one question to answer another, for example using the space for 8(b) to answer 8(a), then give benefit of doubt unless it is ambiguous for which part it is intended.

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 always 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 method mark may usually be implied by a correct answer unless the question includes the DR statement, the command words "Determine" or "Show that", or some other indication that the method must be given explicitly.

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.** unless a different level of accuracy has been asked for in the question, or the mark scheme specifies an acceptable range.
  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 in any question is lost for each distinct accuracy error.
Candidates using a value of 9.80, 9.81 or 10 for *g* should usually be penalised for any final accuracy marks which do not agree to the value found with 9.8 which is given in the rubric.

g Rules for replaced work and multiple attempts:

- If one attempt is clearly indicated as the one to mark, or only one is left uncrossed out, then mark that attempt and ignore the others.
- If more than one attempt is left not crossed out, then mark the last attempt unless it only repeats part of the first attempt or is substantially less complete.
- if a candidate crosses out all of their attempts, the assessor should attempt to mark the crossed out answer(s) as above and award marks appropriately.

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 or B mark in the question. Marks designated as cao may be awarded as long as there are no other errors. If a candidate corrects the misread in a later part, do not continue to follow through. E marks are lost unless, by chance, the given results are established by equivalent working. 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 that there is nothing in the wording of the question specifying that analytical methods are required such as the bold "In this question you must show detailed reasoning", or the command words "Show" and "Determine. 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	AOs	Guidance	
1			eg $2x - 6x < -3 - 5$ $x > 2$	**M1** **A1** **[2]**	**1.1a** **1.1**	Rearrange to get x terms on one side; number terms on other. Allow one sign error; allow one arithmetic error, allow wrong inequality (or equality) sign for M1	Expect to see $4x > 8$
2	**(a)**		Diagram A is incorrect the cumulative frequencies have been plotted at the left hand end of each class interval, not at the right hand end	**B1** **B1** **[2]**	**2.2a** **2.3**	Accept diagram B is correct Oe, eg Used lower bound not upper bound	
2	**(b)**		35.7 to 35.9 inclusive	**B1** **[1]**	**1.1**	From diagram, but ignore any calculation; allow even if wrong diagram given in (a).	If they say Diagram B is incorrect oe in (a), allow sc B1 for 34.7 to 34.9 inclusive
3	**(a)**		Quota sampling	**B1** **[1]**	**1.2**		
3	**(b)**		non-random	**B1** **[1]**	**2.4**	Or equivalent	Accept 'the procedure is biased', but not 'those chosen might be biased' or 'tedious'. Ignore extra parts of explanation.
3	**(c)**		Positive skew	**B1** **[1]**	**1.2**		

Question			Answer	Marks	AOs	Guidance	
3	(d)		mean is 1.67 sd is 1.31	**B1** **B1** **[2]**	**1.1** **1.1**	CAO CAO Do not allow 1.30 or 1.3	
3	(e)		20	**B1** **[1]**	**1.1**	NB $44 \times \frac{100}{220}$	
3	(f)		(means very similar so) average number of portions of fruit consumed per child is similar to average number of portions of fruits consumed per adult (sd for children is lower so) less variability in number of portions of fruit consumed per day by children	**B1** **B1** **[2]**	**2.2a** **2.5**	Condone mean for children is (slightly) less than for adults BUT must be in context of portions of fruit	ft from (d); answers must be consistent with their answers to (d) and must both be in context
4	(a)		0.0348	**B1** **[1]**	**1.1**	BC 0.03482475	Allow if seen correct to at least 3 sf. We do not want to penalize wrong rounding too often
4	(b)		$P(X \leq 4) = 0.013(337876...)$ or $P(X \leq 3) = 0.004(09062...)$ found Hence 4 is not in CR, or 3 is in CR so CR is $\{0,1,2,3\}$ or $X \leq 3$	**M1** **M1** **A1** **[3]**	**3.1a** **2.2a** **3.2a**	 Allow M1 for one (correct) of these. Both probabilities must be correct	Accept $P(X \leq 4) > 0.01$ or $P(X \leq 3) < 0.01$

Question			Answer	Marks	AOs	Guidance	
5	(a)		$\frac{1}{8} \times \frac{1}{7}$ $\frac{1}{56}$	**M1** **A1** **[2]**	**1.1a** **1.1**	or $\frac{6!}{8!}$ oe CAO accept 0.0179	0.017857142
5	(b)		${}^5C_3$ or ${}^5C_2 \times {}^3C_1$ seen [10, 30] ${}^8C_3$ is denominator [56] {equiv to ${}^8C_5$} P(3, 0) + P(2, 1) attempted $\frac{5}{7}$ alternatively $\frac{5}{8} \times \frac{4}{7} \times \frac{3}{6}$ or $3 \times \frac{5}{8} \times \frac{4}{7} \times \frac{3}{6}$ seen both correct including ×3 P(3, 0) + P(2, 1) attempted $\frac{5}{7}$	**M1** **B1** **M1** **A1** **[4]** **M1** **A1** **M1** **A1** **[4]**	**1.1a** **1.1** **2.1** **1.1** **1.1a** **1.1** **2.1** **1.1**	OR 3W 10 ways 2W1M 10x3 = 30 ways 1W2M 5x3 = 15 ways 3M 1 way So $\frac{10+30}{10+30+15+1} = \frac{5}{7}$ $\frac{60}{336}$ or $\frac{5}{28}$ or $\frac{180}{336}$ or $\frac{15}{28}$ Allow even if ×3 missing	Allow M1 if the 2 cases are identified and added, whatever the calculation. Allow method by subtraction from 1. This question can be done by tree diagram, with similar working. Allow both M marks for all denoms 8 – eg $\frac{5}{8} \times \frac{4}{8} \times \frac{3}{8} = \frac{60}{512}$ etc leading to $\frac{15}{32}$

Question			Answer	Marks	AOs	Guidance	
6			$\int_a^b \left(x^3 - 5x^2 + 7x - 3\right) \mathrm{d}x$	**M1**	**2.1**	All three brackets expanded. Allow sign errors and one coefficient error	Must be 4 term cubic
				A1	**1.1**	All correct	
			$a = 1$ and $b = 3$	**B1**	**2.2a**		
			$\mathrm{F}[x] = \frac{x^4}{4} - \frac{5x^3}{3} + \frac{7x^2}{2} - 3x$	**M1**	**1.1**	integration of their expanded brackets; condone $+c$ Allow sign errors and one coefficient error	Later M marks both dep on first M1
			F [3] – F[1] evaluated	**M1**	**1.1**	Subst seen, allow sign or num slip $\left[\frac{81}{4} - 45 + \frac{63}{2} - 9\right] - \left[\frac{1}{4} - \frac{5}{3} + \frac{7}{2} - 3\right]$	$\left[-\frac{9}{4}\right] - \left[-\frac{11}{12}\right]$
			$= -\frac{4}{3}$ so required area is $\left\lvert -\frac{4}{3} \right\rvert = \frac{4}{3}$ AG	**A1**	**2.4**	Sign change must be seen; no reliance on decimals	
				[6]			

Question			Answer	Marks	AOs	Guidance	
7			Circle: equation is $(x-2)^2+(y+1)^2=5^2$ oe	M1 A1	1.1 1.1	Allow sign error, reversed 1 and −2, 5 not squared.	
			Line: $m=\frac{1}{2}$	B1	1.1		
			$y-5=$ (their $\frac{1}{2}$)$(x-9)$ oe	M1	1.1a	Or $y-1=$ (their $\frac{1}{2}$)$(x-1)$	Sight of $y=\frac{1}{2}(x+1)$
			Substitution of their $y=\frac{1}{2}(x+1)$ in their attempt at equation of circle	M1	3.1a	Or their $x=2y-1$	
			$5x^2-10x-75=0$ oe	A1	1.1	Or $5y^2-10y-15=0$ oe	$x^2-2x-15=0$
			$x=5$ or $x=-3$	A1	1.1	Or $y=3$ and $y=-1$	
			(5, 3) and (– 3, – 1)	A1	2.5	If A0A0, sc1 for (5, 3) or (– 3, – 1) only	
				[8]			

Question			Answer	Marks	AOs	Guidance	
8			$3\cos\theta + 8\frac{\sin\theta}{\cos\theta}[=0]$	**M1***	**1.2**		
			$3\cos^2\theta + 8\sin\theta = 0$	**M1dep***	**1.1**	multiplication of all terms of their equation by $\cos\theta$	Condone sign errors and number errors for the three M marks
			$3(1-\sin^2\theta) + 8\sin\theta = 0$	**M1**	**2.4**	dependent on award of previous **M1**	
			$3\sin^2\theta - 8\sin\theta - 3 = 0$	**A1**	**1.1**		
			$\sin\theta = -\frac{1}{3}$ www	**A1**	**1.1a**	from factorising or quadratic formula	May see $\sin\theta = 3$
			$\theta = 341, 199$	**A1**	**2.4**	No wrong values; accept 199.47, 340.53	
				[6]			
9	**(a)**		$Ax^{-\frac{1}{2}}$	**M1**	**1.1**		
			$(+/-)\ Bx^{\frac{1}{2}}$	**M1**	**1.1**		
			$\frac{12}{\sqrt{x}} - 12\sqrt{x}$	**A1**	**1.1**	allow equivalent in index form, but coefficients must be 12 and – 12	Accept mixed, eg $12x^{-0.5} - 12\sqrt{x}$
				[3]			

Question			Answer	Marks	AOs	Guidance	
9	(b)		their $\frac{dy}{dx} = 0$ seen $x = 1$ $y = 32$	M1 A1 A1 [3]	3.1a 1.1 1.1		
9	(c)		their 1 substituted in their $\frac{d^2y}{dx^2}$ $= -12$ so (1, 32) is a (local) maximum	M1 A1 [2]	3.1a 3.2a	NB $-6x^{-\frac{3}{2}} - 6x^{-\frac{1}{2}}$ allow explanation that for $x > 0$ both terms in 2nd derivative are negative so must be a local maximum; 2nd derivative must be correct for this approach	Alternatively, substitution of their $1 \pm \delta$ in their $\frac{dy}{dx}$ (either) Correct values obtained for $\frac{dy}{dx}$ and correct conlusion made
10	(a)		Mass = 23.56×1.816^2 = 77.7 [kg]	M1 A1 [2]	1.1 1.1	Allow M1 for cm used here CAO	
10	(b)		Positive [correlation]	B1 [1]	1.1	Ignore, eg, weak or strong	Accept 'as age increases so does BMI' oe
10	(c)		$28 \leq BMI < 30$	B1 [1]	3.4		
10	(d)		extrapolation	B1 [1]	3.5b	Or equivalent	

Question			Answer	Marks	AOs	Guidance	
10	(e)		eg females in population wider age range in population scatter diagram for whole population shows very weak negative correlation	B1 B1 [2]	2.2b 2.2b	any two distinct comments	
10	(f)		Eg Generate a random number, *n*, between 1 and (eg 20) inclusive and select the *n*th item in the data set OR select every *m*th (eg 16th value). For valid solution.	M1 A1 [2]	1.2 1.1	Random no between 1 and 9 and every 17th item would also work.	Random no between 1 and 31, and then every 15th item also works, etc.
11	(a)		$A = 11$ Substitution of $t = 3$ and $V = 13.8$ $B = 7.0$	B1 M1 A1 [3]	1.1 3.3 1.1	from $t = 0$ and $V = 11$ $13.8 = A + B(1 - e^{-0.17\times3})$ Allow 7, 7.01, 7.009, etc	 Implied by 7.0086
11	(b)		$t = 4$ and $V = 14.453681053\ldots$ to 1 or more dp good fit $t = 5$ and $V = 15.008095476..$ to 1 or more dp good fit	B1 B1 [2]	3.4 1.1	allow **SC1** for two correct values with no comment or incorrect comment(s) If B0B0, allow sc M1 for subst with their values.	Allow full marks if more accurate value of *B* used – 14.458 and 15.013
11	(c)		$\frac{dV}{dt}$ = their $7.0 \times 0.17\ e^{-0.85}$ 0.509 ms^{-2}	M1 A1 [2]	3.1a 1.1	Allow for their $7.0 \times 0.17\ e^{-0.17t}$; condone use of 7.0086 for *B*	

Question			Answer	Marks	AOs	Guidance	
11	(d)		$t \to \infty$, $V \to 11 + 7$ oe	M1	3.3	Allow ft from (a) for M1M1	
			their 18×3.6	M1	1.1	Allow for any attempt to change to km/hr, accept use of 'their 18'	
			$64.8 > 60$ so the motorist is fined	A1	3.5a	Need to show $64.8 > 60$ for full marks	
				[3]			

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