OCR
Oxford Cambridge and RSA

…day June 20XX – Morning/Afternoon

AS Level Mathematics B (MEI)

H630/02 Pure Mathematics and Statistics

SAMPLE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 70

This document consists of 16 pages

Text Instructions

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 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. This rule should be applied to each case. When a value is not given in the paper accept any answer that agrees with the correct value to 2 s.f. Follow through should be used so that only one mark is lost for each distinct accuracy error, except for errors due to premature approximation which should be penalised only once in the examination. There is no penalty for using a wrong value for *g*. E marks will be lost except when results agree to the accuracy required in the question.

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.

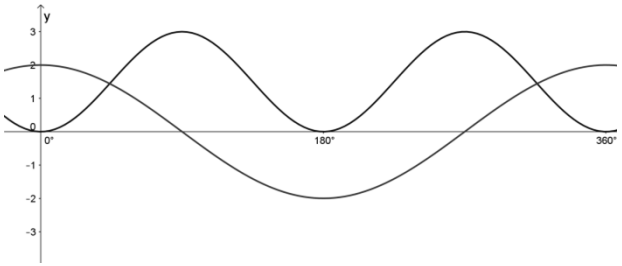
i If a calculator is used, some answers may be obtained with little or no working visible. Allow full marks for correct answers (provided, of course, that there is nothing in the wording of the question specifying that analytical methods are required). Where an answer is wrong but there is some evidence 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	AOs	Guidance	
1			$\frac{1}{3}x^3$ $-\frac{1}{x}$ oe $+ c$	B1 B1 B1 [3]	1.1 1.1 1.1		
2	(i)		$\log_3 x^2 a$	B1 [1]	1.1		
2	(ii)		$x^2 a = 3^2$ $x = [\pm]\frac{3}{\sqrt{a}}$ oe Disregard $x = -\frac{3}{\sqrt{a}}$ as x cannot be negative	M1 A1 A1 [3]	1.1 1.1 2.1	Must be clear that the negative root has been considered and disregarded	

Question			Answer	Marks	AOs	Guidance	
3			$\int_1^3 3x^{-\frac{3}{2}}\,dx$	M1	1.1a	Attempt to integrate (ignore missing limits)	Do not award any A-marks if M0 is given
			$\left[-6x^{-\frac{1}{2}}\right]_1^3$	A1 A1	1.1 1.1	Correct integration Correct limits seen at some point	
			$\frac{-6}{\sqrt{3}}-\frac{-6}{\sqrt{1}}$	M1	1.1	Substitution of limits (condone one error)	
			$\frac{-6}{\sqrt{3}}+6$ $6-2\sqrt{3}$ AG	E1 [5]	2.1	Correct intermediate step using surds which follows from the substitution of limits and is not identical to given answer and completion	Given answer must be seen to score E1
4	(i)		$1-0.51^2$ $=0.7399$	M1 A1 [2]	3.1b 1.1	Accept 0.74 or 0.740	
4	(ii)		$1-0.49^2-0.38^2-0.1^2-0.03^2$	M1	3.1b	For squaring probabilities OR products of pairs	
				M1	1.1	For complementary event OR doubling products of pairs $2 \times (0.1862 + 0.049 + 0.0147 + 0.038 + 0.0114 + 0.003)$	
			$=0.6046$	A1 [3]	1.1		

Question			Answer	Marks	AOs	Guidance	
5	(i)		$\cos A = \frac{100^2 + 120^2 - 135^2}{2 \times 100 \times 120}$	M1	3.1a	$\cos B = \frac{100^2 + 135^2 - 120^2}{2 \times 100 \times 135}$ **OR** $\cos C = \frac{120^2 + 135^2 - 100^2}{2 \times 120 \times 135}$	
			$\cos A = 0.2572916.....$	A1	1.1	$\cos B = 0.512037.....$ **OR** $\cos C = 0.698302.....$	
			$[A =]\ 75.09058\ldots$	A1	1.1	(may be implied) B = 59.200... **OR** C = 45.7090...	
			Area $= \frac{1}{2} \times 100 \times 120 \times \sin(\textit{their } A)$	M1	3.1a	Area = $\frac{1}{2} \times 100 \times 135 \times \sin(\textit{their } B)$ **OR** $\frac{1}{2} \times 120 \times 135 \times \sin(\textit{their } C)$	
			5800 [m²]	A1	1.1	Accept answers to greater degree of accuracy	
				[5]			
5	(ii)		E.g. The sides might only be to the nearest 5 metres so the possible areas cover quite a big range E.g. The sides are no more accurate than to the nearest metre, so could be half a metre out. Taking half a metre off each side would lose more than 1 m^2 of area	E1	3.2b	Correct explanation	
				[1]			

Question			Answer	Marks	AOs	Guidance	
6	(i)			B1 B1 [2]	1.1a 1.1	Correct shape and symmetry for cosine graph. Correct maximum and minimum values	
6	(ii)		**DR** $2\cos\theta = 3\sin^2\theta$ $2\cos\theta = 3(1-\cos^2\theta)$ $3\cos^2\theta + 2\cos\theta - 3 = 0$ $\cos\theta = \frac{-1}{3} + \frac{\sqrt{10}}{3}$ $\theta = 43.9°,\ 316.1°$ $\cos\theta = \frac{-1}{3} - \frac{\sqrt{10}}{3} < -1$ gives no solution	B1 M1 M1 A1 A1 E1 [6]	1.2 3.1a 1.1 1.1 1.1 2.4	 Correct use of identity **must be seen** Rearranging to zero **must** be seen, condone one error Solve quadratic Or state that graph in part (i) only shows two solutions	

Question			Answer	Marks	AOs	Guidance	
7	(i)		Allocate numbers 001 to 200 to the trees Choose 10 (3 digit) random numbers	B1 B1 [2]	1.2 2.4	 e.g. use calculator to get 10 different random numbers	
7	(ii)		Mean = 27.61kg SD = 4.04 kg (3sf)	B1 B1 [2]	1.1 1.1	**BC** **BC**	
7	(iii)		Upper limit = 27.61 + 2 × 4.04 = 35.69 So the value of 38.1 is an outlier This value should be investigated to check if it is genuine. If so, it should not be removed from the data	M1 A1 B1 [3]	1.1 1.1 2.2b	For mean + 2 × sd OR UQ + 1.5 IQR = 28.3 + 1.5 × 3.2 = 33.1 OR e.g. If the value is not representative of the other 199 trees because e.g. this tree is a different type it should be ignored	

Question			Answer	Marks	AOs	Guidance	
8	(i)		$-0.03e^{-0.03t}$	B1 [1]	1.2		
8	(ii)		Decreasing function because $e^{-0.03t}$ is positive [for all values of t] so the gradient is negative.	E1 [1]	2.2a	Explanation may include a sketch graph of the function $70e^{-0.03t}$ but it must be clear that the graph is of the function and the answer must clearly refer to the gradient of the function and not the trend in the data	
8	(iii)	(*A*)	70	B1 [1]	1.1		
8	(iii)	(*B*)	38.[4168...]	B1 [1]	1.1		
8	(iv)		Data values decreasing so decreasing function is suitable At $t = 0$, calculated D = 70 and this matches the data At $t = 20$, data value is 40 which is not exact but close	E1 B1 B1 [3]	3.5a 3.5a 3.5b		

Question			Answer	Marks	AOs	Guidance	
9	(i)		E.g. There is a greater spread of birth rates for countries in sub-Saharan African than for countries in the Caribbean E.g. The range for countries in Africa is greater than for countries in East and South East Asia but this could be caused by outliers as the IQRs are similar E.g. sub-Saharan Africa has a mixture of economically rich and poor countries resulting in a large IQR E.g. Countries in East and South East Asia tend to have higher life expectancy than countries in sub-Saharan Africa so their populations are older, on average, and have lower birth rates	**B1,** **B1,** **B1** **[3]**	**2.2b** **2.2b** **2.2b**	B1 Correct relevant comment that can be inferred from the source material B1 Distinct correct relevant comment that can be inferred from the source material B1 Third distinct relevant comment that can be inferred from the source material (this mark is only available if the candidate's comments include reference to both features of the LDS and fig 9.1)	
9	(ii)	(*A*)	E.g. The calculation doesn't use the populations as weights E.g. Does not take the populations into account	**E1** **[1]**	**2.3**		
9	(ii)	(*B*)	E.g. Lower because Australia has the highest population but the lowest birth rate oe E.g. answer given is too high as too much weight is given to Papua New Guinea	**E1** **[1]**	**2.2a**		

Question			Answer	Marks	AOs	Guidance	
9	(iii)		[weak] negative	B1 [1]	1.2		
9	(iv)		E.g. Correlation/association does not imply causality E.g. Some countries with low birth rates have quite low physician density E.g. Some countries with low physician density have quite low birth rates E.g. Data do not show what happens after an increase in physicians Therefore it is not possible to be certain	 E1 [1]	 2.3		

Question			Answer	Marks	AOs	Guidance	
10	(i)	(*A*)	$X \sim B(30, 0.92)$, $P(X = 28)$ $= 0.2696$	**B1** **B1** **[2]**	**3.3** **1.1**	**BC**	
10	(i)	(*B*)	$P(X > 27) = 1 - 0.4346$ oe $= 0.5654$	**M1** **A1** **[2]**	**1.1** **1.1**	OR for sum of at least two correct probabilities from $0.2696 + {}_{30}C_{29} \times 0.92^{29} \times 0.08^{1} + 0.92^{30}$ **BC**	
10	(ii)		Let p = probability that a train arrives on time H_0: $p = 0.92$ H_1: $p < 0.92$ Let $X \sim B(18, 0.92)$ $P(X \leq 13) = 0.0116$ [> 1%] $P(X \leq 12) = 0.0021$ [< 1%] The critical region is $X \leq 12$	**B1** **B1** **M1** **M1** **A1** **[5]**	**2.5** **1.1** **1.1** **1.1** **2.2a**	For definition of p For H_0 and H_1 For probability $P(X \leq$ any whole number value 1 to 18), Both $P(X \leq 13)$ and $P(X \leq 12)$ For correct critical region stated	Allow FT from H_1: $p < 0.92$ OR H_1: $p \neq 0.92$

Question			Answer	Marks	AOs	Guidance	
11			**DR** $[y=k](x+1)^2(x-2)$	**M1***	**3.1a**		
			Substitute (0, -3) or (1, -6)	**M1***	**3.1a**		
			$[y=]\frac{3}{2}(x+1)^2(x-2)$	**A1dep**	**1.1**		
			$[y=]\frac{3}{2}x^3-\frac{9}{2}x-3$	**M1***	**1.1**		
			gradient of tangent is $\frac{dy}{dx}=\frac{3}{2}(3x^2-3)$	**A1dep**	**2.1**	FT their f(x) even if the gradient property does not hold for it	
			$t^2=(-t)^2$ therefore the gradients are equal and the tangents are parallel	**E1**	**2.2a**	Not just "the gradient is the same for $-t$". Allow FT from their f(x) if the gradient property holds	
				[6]			
12			$\arcsin x=\theta$				
			$\Rightarrow x=\sin\theta$	**M1**	**1.1**		
			$\arccos y=\theta \Rightarrow y=\cos\theta$	**M1**	**1.1**		
			$\sin^2\theta+\cos^2\theta=1$				
			$\Rightarrow x^2+y^2=1$ AG	**E1**	**2.1**		
				[3]			

Question	AO1	AO2	AO3(PS)	AO3(M)	Total
1	3	0	0	0	**3**
2 i	1	0	0	0	**1**
2 ii	2	1	0	0	**3**
3	4	1	0	0	**5**
4 i	1	0	1	0	**2**
4 ii	2	0	1	0	**3**
5 i	3	0	2	0	**5**
5 ii	0	0	1	0	**1**
6 i	2	0	0	0	**2**
6 ii	4	1	1	0	**6**
7 i	1	1	0	0	**2**
7 ii	2	0	0	0	**2**
7 iii	2	1	0	0	**3**
8 i	1	0	0	0	**1**
8 ii	0	1	0	0	**1**
8 iiiA	1	0	0	0	**1**
8 iiiB	1	0	0	0	**1**
8 iv	0	0	0	3	**3**
9 i	0	3	0	0	**3**
9 iiA	0	1	0	0	**1**
9 iiB	0	1	0	0	**1**
9 iii	1	0	0	0	**1**
9 iv	0	1	0	0	**1**
10 iA	1	0	0	1	**2**
10 iB	2	0	0	0	**2**
10 ii	3	2	0	0	**5**
11	2	2	2	0	**6**
12	2	1	0	0	**3**
Totals	**41**	**17**	**8**	**4**	**70**