OCR
Oxford Cambridge and RSA

Practice Paper – Set 1

A Level Mathematics B (MEI)

H640/02 Pure Mathematics and Statistics

MARK SCHEME

Duration: 2 hours

MAXIMUM MARK 100

Final
Last updated 18/12/17

This document consists of 15 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 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. 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 graphical 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			$\frac{e^{3x}}{3}$ $4e^{3x} + c$	**M1** **A1** **[2]**	**1.1** **1.1**	soi	
2			2^k evaluated for any positive integer k eg $2^4 - 1 = 15 = 5 \times 3$ which is not prime	**M1** **A1** **[2]**	**1.1** **2.4**	Any positive integer which generates any non-prime	
3	**(i)**		Vertical scale	**B1** **[1]**	**2.5**		
3	**(ii)**		The sales are lower in the final time period (assuming a linear vertical scale) so the director is not correct.	**E1** **[1]**	**2.3**		
4			Use of $-1/$ (their ½) $y - 5 = -2(x - 1)$ $y = -2x + 7$	**M1** **M1** **A1** **[3]**	**3.1a** **1.1** **1.1**		

Question			Answer	Marks	AOs	Guidance	
5			$\frac{du}{dx} = 3$	B1	1.1		Other correct methods eg integration by parts, are acceptable
			substitution of $3x = u - 1$	M1	1.1		
			$\int 2(u-1)u^7 du$	A1	1.1		
			$\frac{2u^9}{9} - \frac{2u^8}{8}(+c)$	A1 A1	1.1 1.1	for either term correctly integrated both correct	
			$\frac{2}{9}(3x+1)^9 - \frac{1}{4}(3x+1)^8 + c$	A1 [6]	1.1		
6	(i)		$\tan 45^0 = 1$ and $\tan 60^0 = \sqrt{3}$	B1 [1]	1.2		
6	(ii)		$\tan(60-45) = \frac{\tan 60 - \tan 45}{1 + \tan 60 \times \tan 45}$	M1	3.1a	**DR**	Other correct methods eg use of double angle formula are acceptable
			$\frac{\sqrt{3}-1}{1+\sqrt{3}}$	M1	1.1	Substitution of their surds in correct compound angle formula	
			Multiply numerator and denominator by $\sqrt{3} - 1$	M1	1.1		
			eg $\frac{3 - 2\sqrt{3} + 1}{3 - 1}$				
			$= 2 - \sqrt{3}$	A1 [4]	2.1	**AG** Convincing arithmetic to given result	

Question			Answer	Marks	AOs	Guidance	
7			Use of cosine rule $\cos\theta = \frac{47^2 + 53^2 - 94^2}{2 \times 47 \times 53}$ 140° or 2.44 radians	**M1** **A1** **A1** **[3]**	**3.1** **1.1** **1.1**	allow if lengths incorrectly placed NB – 0.76635889… allow 140.0,140.03 or 140.028 or 2.444, 2.4440 or 2.44395	NB 21.23606 or 0.370(6393…); or 18.73589 or 0.327(0030…)
8	(i)		Negative skew	**B1** **[1]**	**1.2**		
8	(ii)		[They are all less than 0.00005] and the table rounds values [to 4 decimal places]	**E1** **[1]**	**2.4**	Allow equivalent explanation in words	
8	(iii)	(*A*)	18	**B1** **[1]**	**1.1**		
		(*B*)	0	**1** **[1]**	**2.2a**		
9	(a)	i	Mean for world = 7 174 654 290 ÷ 239 = 30 million (approx.) Mean for sample is 9.36 million so much smaller	**M1** **A1** **B1** **[3]**	**1.1** **1.1** **1.1**	Any degree of accuracy	

Question			Answer	Marks	AOs	Guidance	
9	(a)	ii	There are a lot of small countries in the world. Therefore there is no reason to suppose the sample is not random,	B1 E1 [2]	2.4 2.2b		
9	(b)		$0.091 \times 55\,400$ =[$] 5041.40	M1 A1 [2]	3.3 1.1	Condone missing units. Answer can be rounded to 5041 or 5040	
9	(c)	i	Identify physicians per 1000 as highest R^2 with positive correlation and positive correlation	B1 E1 [2]	2.2b 2.4	NB graph C e.g. Reject D as shows negative correlation	
9	(c)	ii	There is hardly any correlation.	E1 [1]	3.5b		
10	(i)		0.4×0.6 or 0.6×0.1 p(in, out) + p(out, out) 0.3	B1 M1 A1 [3]	3.1b 3.1a 1.1	If **B0M0** allow **SC1** for correct tree diagram with all possible outcomes shown.	

Question			Answer	Marks	AOs	Guidance	
10	(ii)		$1 - p(\text{out every night})$ $1 - 0.6 \times 0.1^6$ $= 0.9999994 \approx 1$ so extremely likely	M1 A1 A1 [3]	3.1b 1.1 3.2a		
11			**DR** $\frac{dx}{dt} = -\sin t - 3$ $\frac{dy}{dt} = 3 + 4\sin t - 2\cos 2t$ $\frac{dy}{dx} = \frac{3 + 4\sin t - 2\cos 2t}{-\sin t - 3}$ denominator is always negative since $-1 \leq \sin t \leq 1$ Substitution of $\cos 2t = 1 - 2\sin^2 t$ in numerator $4\sin^2 t + 4\sin t + 1$ seen in numerator Numerator is $(2\sin t + 1)^2$ so numerator is always positive and denominator is always negative, so $\frac{dy}{dx}$ is always negative	B1 B1 M1 E1 M1 A1 E1 [7]	3.1a 1.1 2.1 2.4 1.1 1.1 2.4		

Question			Answer	Marks	AOs	Guidance	
12	(i)		$\Phi^{-1}(0.08) = -1.4051$ BC	B1	1.1		
			$\Phi^{-1}(0.81) = 0.8779$ BC	B1	1.1		
			their $-1.4051 = \frac{58-\mu}{\sigma}$	M1	2.1		
			their $0.8779 = \frac{86-\mu}{\sigma}$	M1	1.1		
			obtaining a value for μ or σ from their equations	M1	2.5		
			$\sigma = 12.3$	A1	2.4	allow 2 or 3 s.f.	
			$\mu = 75.2$	A1	1.1		NB 12.2647368787 and 75.2328329886
				[7]			
12	(ii)		$P(X < 90) = 0.849$ FT their μ and σ BC	M1	3.1a	their 12.3×1.645 + their $75.2 > 90$	
			which is less than 0.95 so claim not justified	A1	3.2a	which is greater than 90 so claim not justified	
				[2]			
13	(i)		$k = 5$	B1	3.3	$36 = 9k - 9$	
				[1]			
13	(ii)		$x = 7.5$, model gives $140.25 \approx 140$	B1	3.4		
			so model works well	B1	3.5a		
				[2]			
13	(iii)	*A*	$V = 88.5$	B1	3.1a	NB 88.496878236	
			substitution of $x = 5.20$ and 5.21 to obtain 88.33 and 88.58 respectively	B1	1.1		
				[2]			

Question			Answer	Marks	AOs	Guidance	
13	(iii)	*B*	$\frac{dV}{dt} = 28e^{-0.2t}$ = 10.3 when $t = 5$ $\frac{dV}{dt} = (10x - x^2) \times \frac{dx}{dt}$ $\frac{dx}{dt} = \frac{10.3}{10 \times 5.21 - 5.21^2} = 0.413$ [$cm\,s^{-1}$]	**M1** **A1** **M1** **A1** **[4]**	**1.1** **2.1** **3.4** **1.1**	 NB 10.3006243528 Accept awrt 0.412 or 0.413	
13	(iii)	*C*	Forever for a full glass or more than 70 cm^3 full after 5 seconds from (*A*) so better to fill the two half glasses	**B1** **B1** **[2]**	**3.5b** **3.4**		

Question			Answer	Marks	AOs	Guidance	
14	(i)		H_0 $p = 0.2$ H_1 $p < 0.2$	B1	1.1	For both hypotheses	
			p is the proportion of male adult pilot whales	B1	2.5	Definition of p	
			$X \sim B(43, 0.2)$	M1	3.3	soi	
			$P(X \leq 3) = 0.0178$ BC	B1	3.4		
			$0.0178 < 0.05$ so result is significant	M1	1.1	Comparison of their p-value with 0.05	
			There is sufficient evidence to suggest at the 5% level that the proportion of males in the population of adult pilot whales is less than 20%	A1	2.2b		
				[6]			

Question			Answer	Marks	AOs	Guidance	
14	(ii)		Sample mean is 3.09	B1	1.1		NB 3.09487179487 and 0.294709851552
			Sample variance is 0.295	B1	1.1	soi	
			$H_0 : \mu = 2.98$ $H_1 : \mu \neq 2.98$	B1	1.1	For both hypotheses	
			μ is the population mean length of female pilot whales	B1	2.5		
			$\bar{X} \sim N(2.98, \frac{0.295}{39})$	M1	3.3	soi Comparison of their p-value with 0.025	
			$p(\bar{X} \geq 3.09) = 0.1029$	B1	3.4	**BC**	
			0.1029 > 0.025 so result not significant	M1	1.1		
			There is insufficient evidence at the 5% level to suggest that the mean length of female pilot whales has changed	A1 [8]	2.2b		
15	(i)		f(0.1) = 3.897…and f(0.9) = – 1.194…	B1	1.1		
			sign change so $0.1 < \alpha < 0.9$	E1 [2]	1.2		

Question			Answer	Marks	AOs	Guidance	
15	(ii)		$\left[\frac{dy}{dx} =\right] 2 - \frac{1}{x^2} + \frac{1}{x}$	B1	1.1		
			$x_{r+1} = x_r - \frac{2x_r + \frac{1}{x_r} + \ln x_r - 4}{2 - \frac{1}{x_r^2} + \frac{1}{x_r}}$	M1	1.1		
			$x_{r+1} = x_r - \frac{2x_r^3 + x_r + x_r^2(\ln x_r - 4)}{2x_r^2 - 1 + x_r}$	A1	2.2a	AG	
				[3]			
15	(iii)	(A)	$x_1 = -0.52359\ldots$ which is negative so the iteration stops because f(x) is undefined for $x < 0$	B1 E1	1.1 2.4		
				[2]			
		(B)	gradient is zero at 0.5 so tangent never touches x-axis	B1 E1	1.1 2.4		
				[2]			
		(C)	2.4497, 1.4667, 1.4675, 1.4675 *or* 0.6 is to the right of the turning point so	B1	1.1		
			converges to larger root	E1	2.4		
				[2]			

Question			Answer	Marks	AOs	Guidance	
16			p(G or C) [= 1 – 0.0985] = 0.9015	B1	3.1a		
			P(G and C) = 0.901 + 0.008 – 0.9015[= 0.0075]	M1	1.1	P(G or C) = P(G) + P(C) - P(G and C) used	
			P(C/G) = $\frac{their\ 0.0075}{0.901}$	M1	2.1		
			= 0.00832	A1	1.1		
			This is very unlikely so he is incorrect.	E1	3.2a		
				[5]			