OCR
Oxford Cambridge and RSA

Practice Paper – Set 2

A Level Mathematics B (MEI)

H640/02 Pure Mathematics and Statistics

MARK SCHEME

Duration: 2 hours

MAXIMUM MARK 100

DRAFT V 1.5

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	(i)		$(x-2)^2+(y+3)^2$ seen $(2, -3)$	M1 A1 [2]	1.1 1.1b	ignore other working	
1	(ii)		$(x-2)^2+(y+3)^2-2^2-3^2-12=0$ or better seen $r = 5$	M1 A1 [2]	1.1b 1.1b		

Question			Answer	Marks	AOs		Guidance
2			$\frac{327}{600} \times 50$ 27 cao	M1 A1 [2]	1.1b 1.1b	may be implied by 27.25	
3	(i)		$0.4a + 0.5a + 0.3a + 0.2a + 0.1a = 1$ soi $a = \frac{2}{3}$	M1 A1 [2]	1.1b 1.1b		
3	(ii)		$\frac{2}{3}(0.3 + 0.2 + 0.1)$ 0.4	M1 A1 [2]	1.1b 1.1b	*their* $\frac{2}{3}$	

Question			Answer	Marks	AOs		Guidance
3	(iii)		positive skew	B1 [1]	1.2		
4			<table><tr><th>*AB*</th><th>*BC*</th><th>*AF*</th></tr><tr><td>1</td><td>2</td><td>$\sqrt{20}$</td></tr><tr><td>1</td><td>3</td><td>$\sqrt{15}$</td></tr><tr><td>2</td><td>3</td><td>$\sqrt{12}$</td></tr></table> eg none of the values of *AF* are integers and all possibilities have been covered.	M1 A1 E1 [3]	2.1 1.1 2.4	attempt at proof by exhaustion all cases covered ignore cases where AF < BC supporting comment may be brief but must refer to values of *AF*	
5			multiply by $\frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}}$ $\frac{(\sqrt{5})^2+2\sqrt{3}\sqrt{5}+(\sqrt{3})^2}{(\sqrt{5})^2-(\sqrt{3})^2}$ oe $4+\sqrt{15}$	M1 M1 A1 [3]	1.1b 1.1b 1.1b	 Attempt to expand brackets in numerator or denominator	 Allow one slip, eg sign error
6	(i)		f(3) = 6×27 – 17×9 – 5×3 + 6 = 0	B1 [1]	1.1b	use of Factor theorem with convincing detail	

Question			Answer	Marks	AOs		Guidance
6	(ii)		$(x-3)(6x^2+x-2)$	M1 A1	1.1 1.1b	allow sign errors in trinomial	or attempt at long division
			valid attempt to factorise trinomial	M1	1.1b		
			$(x-3)(2x-1)(3x+2)$	A1 [4]	1.1b		
7			P(correct) = $\frac{2}{5}+\frac{3}{5}\times\frac{1}{3}$	M1	3.1b		
			= 0.6 ($\frac{3}{5}$)	A1	1.1b		
			their 0.6^2	M1	1.1b		
			0.36 ($\frac{9}{25}$)	A1 [4]	1.1b		
8	(i)		$A = 22$ ms^{-1}	B1	1.1b	from $t = 0$	
			$25.3 = 22 + B(1 - e^{-0.2\times2})$	M1	3.3		
			$B = 10$	A1 [3]	1.1b	NB from 10.0097…	
8	(ii)		$22 + 10(1 - e^{-0.2\times5})$	M1	3.4		
			28.3(212…) so good fit	A1 [2]	3.5a		

Question			Answer	Marks	AOs		Guidance
8	(iii)		$-10\times(-0.2)\times e^{-0.2t}$ oe soi	M1*	3.1a		
			substitution of $t = 5$ in *their* derivative	M1dep	1.1b		
			0.74 ms^{-2}	A1	1.1b	0.73575888…to 2 sf or better	
				[3]			
8	(iv)		as $t \to \infty$ oe	M1	3.5a		
			$V \to 32$	A1	3.4		
			$32\times3.6 = 115.2$ kmh^{-1}	B1	1.1b	FT their long term V	
			$115.2 < 121$ so not 10% above the speed limit	E1	3.2a	or 5.2 is 4.7% of 110	
				[4]			
9	(i)		$= 6.8 + 1.5 \times (6.8 - 2.5)$ [= 13.25]	B1	3.1b		
				[1]			
9	(ii)		Strength – large sample size	B1	2.2a		
			Weakness – sample is not random	B1	2.3		
			– removal of outliers may not be justifiable	B1	2.4		
				[3]			

Question			Answer	Marks	AOs		Guidance
9	(iii)		eg pmcc may not be appropriate as scatter does not appear to be linear eg sample not random so calculating a correlation coefficient may not be valid eg correlation and causation are not the same thing eg the results of a hypothesis test are only suggestive, not conclusive (although highly suggestive in this case)	**E1** **E1** **E1** **[3]**	**2.4** **2.4** **2.4**	Allow 1 mark for each distinct (sensible) reason up to a maximum of 3	
10			$na = 6$ $\frac{n(n-1)}{2!}a^2 = -6$ Substitution of $a = \frac{6}{n}$ in second equation oe $18(n-1) = -6n$ soi $n = ¾$ $a = 8$	**M1** **A1** **M1** **A1** **A1** **A1** **[6]**	**3.1a** **2.1** **1.1b** **1.1b** **1.1b** **1.1b**		
11	(i)		eg some people have more than one phone oe	**E1** **[1]**	**2.4**	Some of the other figures in the LDS are greater than 1	

Question			Answer	Marks	AOs		Guidance
11	(ii)		E.g. data missing E.g. removal of outlier data items	B1 B1 [2]	1.1b 1.1b		
11	(iii)		Upper quartile	B1 [1]	1.2		
11	(iv)		X ~ N(996,407^2), p=0.75 1271	M1 A1 [2]	3.4 1.1b	BC allow awrt 1300	if **M0** allow **B2** for awrt 1300 unsupported
11	(v)		p-value = 0.127 > 0.05 not significant Insufficient evidence to suggest that the population mean of the number of mobile phones/1000 population has increased	M1 M1 A1 E1 [4]	1.1b 1.1b 2.2b 2.2b	from screenshot comparison with 0.05 FT	
11	(vi)		Sample size of 12 is small compared to the number of countries in the population so inference may be unreliable	B1 [1]	2.3	Any sensible comment on the premise that 12 is a relatively small sample size	

Question			Answer	Marks	AOs		Guidance
12	(i)		9×22.6 or 11×22.8 or 17×23.7 soi 203.4, 250.8 and 402.9 isw $8 \times 8.9 + 9 \times 22.6^2$ or $10 \times 10.618 + 11 \times 22.8^2$ or $16 \times 16.9925 + 17 \times 23.7^2$ soi 4668.04, 5824.42 and 9820.61 isw	**M1** **A1** **M1** **A1** **[4]**	**3.1a** **1.1b** **2.1** **1.1b**		if **M0** allow **SC1** for use of n instead of $n - 1$ to find all three Σx^2 accept answers to 4 sf or more	
12	(ii)		23.16486 to 3 sf or more 12.7(35…) to 3 sf or more	**B1** **B1** **[2]**	**1.1b** **1.1b**		from $\frac{203.4+250.8+402.9}{37}$ from $\frac{4668.04+5824.42+9820.61-37\times23.1648}{36}$	
12	(iii)		Use of N(26.1, $\frac{12.735}{37}$) $26.1 \pm 1.96 \times \sqrt{\frac{12.735}{37}}$ Critical region: mean < 24.95 and mean > 27.25	**M1** **M1** **A1** **[3]**	**3.3** **3.1a** **3.4**		FT their variance of combined sample allow use of $z = 1.645$ for **M1**	
12	(iv)		The evidence **suggests** that the mean mass of adult voles has changed since the sample mean is inside the critical (rejection) region	**E1** **[1]**	**2.2b**		or 'outside acceptance region'	

Question			Answer	Marks	AOs		Guidance
13			*p* is the probability that a cutting treated with Miracleroot develops into a healthy new tree	B1	2.5	For definition of *p*	
			H_0: $p = 0.8$				
			H_1: $p < 0.8$	B1	1.1	For H_0 and H_1	
			Let $X \sim B(500, 0.8)$	B1	3.3		
			$P(X < 380) = 0.01609$	M1	3.4	BC	
			their 0.01609 > 0.01	M1	1.1		
			so accept H_0	E1	2.2b		
			no evidence to suggest that manufacturer's claim is optimistic	E1	3.2a		
				[7]			
14			[0.8×0.2 =] 0.16 seen	B1	1.1b	or tree diagram with all necessary outcomes and associated probabilities may be implied by 0.38	allow omission of 0.2, 0.5 and 0.9 together with labelling
			0.35×0.5 and 0.45×0.1 seen	B1	3.1a		
			Finds sum of their attempt at these probabilities	M1	2.1		
			0.38	A1	1.1b		
			their 0.16 ÷ *their* 0.38	M1	3.1a		
			$\frac{8}{19}$	A1	1.1b	0.42105263… rounded to 3 sf or more	
				[6]			

Question			Answer	Marks	AOs		Guidance
15			$-4x^2 \times \frac{\cos 2x}{2} - \int (-8x) \times \frac{\cos 2x}{2} \mathrm{d}x$	**M1**	**3.1a**	Integration by parts, allow sign errors only for **M1**	
				A1	**1.1b**	all correct	
			$4x \times \frac{\sin 2x}{2} - \int 2\sin 2x \mathrm{d}x$	**M1**	**2.1**	Integration by parts, allow sign errors only for **M1**	
			$-2x^2 \cos 2x + 2x \sin 2x - \int 2\sin 2x \mathrm{d}x$	**A1**	**1.1b**		
			$-2x^2 \cos 2x + 2x \sin 2x - \left(\frac{-2\cos 2x}{2}\right) + c$	**M1**	**2.1**	convincing attempt, allow sign error and/or omission of + *c* at this stage	
			$-2x^2 \cos 2x + 2x \sin 2x + \cos 2x + c$	**A1**	**1.1b**	all correct AG	
				[6]			

Question			Answer	Marks	AOs		Guidance
16			$\dfrac{\ln x \times 2 - 2x \times \frac{1}{x}}{(\ln x)^2}$	**M1**	**3.1a**	Quotient Rule allow sign errors only	or Product & Chain Rules $2 \times \frac{1}{\ln x} +$ $2x \times (-1) \times (\ln x)^{-2} \times \frac{1}{x}$
				A1	**1.1b**	numerator correct	
				A1	**1.1b**	denominator correct	
			indicates $\frac{dy}{dx} = 0$	**M1**	**2.1**		
			$x = e$	**A1**	**2.4**		
			and $y = 2e$ shown www	**A1**	**3.1a**	AG	
			either finds second derivative *or* considers *their* gradient function either side of $x = e$	**M1**	**2.1**		
			2nd derivative is $\dfrac{4 - 2\ln x}{x(\ln x)^3}$	**A1**	**1.1**		
			$\frac{2}{e}$ (0.7357588..) > 0 so minimum or signs of gradient function either side of $x = e$ identified and explained	**E1** **[9]**	**2.4**	Allow FT if previous M1 awarded, but must be correctly evaluated	Allow decimal equivalent to 2 sf or better

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