OCR
Oxford Cambridge and RSA

Practice Paper – Set 2

A Level Mathematics A
H240/01 Pure Mathematics

MARK SCHEME

Duration: 2 hours

MAXIMUM MARK 100

Final

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 question included the instruction: In this question you must show detailed reasoning.

2. Subject-specific Marking Instructions for A Level Mathematics A

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
Mark for explaining a result or establishing a given result. 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	AO	Guidance	
1	(i)		$(x \pm 3)^2 + (y \pm 2)^2 \ldots$	M1	1.1a	Attempt to complete the square	
			(-3, 2)	A1	1.1	State correct centre www	Ignore constant term(s)
				[2]			
1	(ii)		$13 + k = 16$	M1	1.1a	Attempt to link 9, 4, 16 and k	
			$k = 3$	A1	1.1	Obtain $k = 3$	
				[2]			
2	(i)		$n = \pm 5$	B1	1.2	Identify that $n = \pm 5$	
			$\lvert 2(-5) - 3 \rvert = 13$ $\lvert 2(5) - 3 \rvert = 7$	M1	2.1	Substitute both $n = \pm 5$ into expression	
			13, as $13 > 7$	A1	2.4	Conclude with 13 and explanation	
				[3]			
2	(ii)		$3x - 6 = x - 6$, so $x = 0$	B1	1.1	Obtain $x = 0$	**OR** **M1** square both sides
			$3x - 6 = -x + 6$	M1	1.1a	Attempt to solve equation, with $3x$	**A1** Obtain $x = 0$
			$4x = 12$			and x of opposite signs	
			$x = 3$	A1	1.1	Obtain $x = 3$	**A1** Obtain $x = 3$
				[3]			
3			$b^2 - 4ac = (k - 6)^2 - 8k$	M1	1.1a	Attempt discriminant	
			$k^2 - 20k + 36$	A1	1.1a	Obtain correct 3 term expression	
			$k = 2$, $k = 18$	M1	1.2	Find critical values for k, eg by attempting to solve discriminant > 0	Allow any sign, including =
			$k < 2$, $k > 18$	M1	1.1a	Chooses 'outside region' of their inequality	Allow '**or**' but not '**and**'
			$(\infty, 0) \cup (0, 2) \cup (18, \infty)$	A2	2.3	A1 for stating $k \neq 0$ OR	
					2.5	A1 for $(\infty, 2) \cup (18, \infty)$	Any correct set notation
				[6]			

Question			Answer	Marks	AO	Guidance	
4	(i)		Sketch of $y = \frac{3}{x^2}$	B1	1.1	Must be in both quadrants, with axes intended as asymptotes	
			Sketch of $y = x^2 - 2$	M1	1.1	Positive quadratic, symmetrical in y-axis	
			Intercepts of (0, -2), ($\sqrt{2}$, 0), ($-\sqrt{2}$, 0)	A1	1.1	All 3 intercepts correct	Allow just eg $\sqrt{2}$ if marked on relevant axis
				[3]			
4	(ii)		**DR**				
			$3 = x^4 - 2x^2$	M1	3.1a	Equate and remove fractions	
			$(x^2 - 3)(x^2 + 1) = 0$	M1	1.1a	Attempt to solve disguised quadratic	Could use substitution
			$x^2 = 3$	M1	1.1a	Attempt to find x from their roots	At least one value of x
			$x = \pm\sqrt{3}$	A1	1.1	Correct x values	Allow A1 for one correct
			points are ($\sqrt{3}$, 1) and ($-\sqrt{3}$, 1)	A1	2.2a	Both correct coordinates	(x, y) coordinate A0 if extra roots, or if decimals
			$x^2 = -1$ has no solutions as $x^2 \geq 0$	B1	2.3	Justify no roots for $x^2 = -1$	
				[6]			
5	(i)		$u_{10} = 150 + 9 \times 16$	B1	3.1b	Identify AP, with $a = 150$ and $d = 16$	
			$= 294$ ice creams	M1	1.1	Correct u_{10}	
			profit = $294 \times £1.25 = £367.50$	A1FT	3.2a	Correct profit for their u_{10}	Units required
				[3]			
5	(ii)		£5000 ÷ £1.25 = 4000	B1	3.1b	Identify that 4000 sales are reqd	Or use d = £20
			$S_N = 0.5N(300 + (N - 1)16)$	M1	3.4	Attempt S_N of AP, with $a = 150$ and $d = 16$	Or $d = 20$
			$150N + 8N(N - 1) > 4000$ $8N^2 + 142N - 4000 > 0$	A1	3.1a	Link to 4000 (any sign) and rearrange to 3 term quadratic	Or link to 5000 (any sign) and rearrange to 3 term quadratic
			$N = 15.18$ (and possibly -32.9)	M1	1.1	Attempt to solve quadratic	**BC**
			Week 16	A1	3.2a	Conclude with Week 16 only	Allow 'during Week 16'
				[5]			

Question			Answer	Marks	AO	Guidance	
5	(iii)		Sales cannot continue to increase for ever Weekly sales could fluctuate depending on the weather	E1 E1 [2]	3.5b 3.5b	Refer to trend not continuing Refer to changes week by week	 Any two different reasons
6			Assume that $\sqrt{7}$ is rational ie $\sqrt{7} = \frac{a}{b}$, where a and b have no common factors	E1	2.1	Proof must start with an assumption for contradiction	Condone not stating that a and b have no common factors
			$b\sqrt{7} = a$, so $7b^2 = a^2$	M1	2.2a	Rearrange and square both sides	
			So a^2 must be a multiple of 7, which means that a is a multiple of 7 as well, so $a = 7k$	E1	2.4	Identify that $a = 7k$	
			$7b^2 = (7k)^2 \Rightarrow 7b^2 = 49k^2 \Rightarrow b^2 = 7k^2$	M1	2.2a	Substitute $a = 7k$ and simplify	
			This implies that b is a multiple of 7, but it was assumed at start that a and b had no common factors, so this contradicts initial assumption. Hence $\sqrt{7}$ cannot be written as $\frac{a}{b}$ so it is irrational.	E1 [5]	2.4	Conclude appropriately	Must have stated at start that a and b have no common factors
7	(i)		$\frac{\sin\theta}{4.8} = \frac{\sin 25}{2.2}$	M1	3.1a	Attempt correct use of the sine rule to find at least one angle	Must use 25^o
			$\theta_1 = 67.2^o$, so bearing is 067^o	A1	1.1	Obtain 067^o, or better	3 figure bearing required
			$\theta_2 = 180^o - 67^o$	M1	3.1a	Attempt correct method for θ_2	180^o – their angle
			$\theta_2 = 112.8^o$	A1 [4]	1.1	Obtain 113^o, or better	
7	(ii)		$d = 4.8\sin 25^o$ $= 2.03$ km	M1 A1 [2]	3.1a 1.1	Attempt perpendicular distance Obtain 2.03 km, or better	Allow alt complete methods

Question			Answer	Marks	AO	Guidance	
7	(iii)		Coastline may not be straight between *P* and *Q*	E1 [1]	3.5b	Any sensible reason	Stations may not be exactly on coastline
8	(i)		$\sec x = (\cos x)^{-1}$ $\frac{dy}{dx} = -(\cos x)^{-2}(-\sin x)$ $\frac{dy}{dx} = \frac{1\times\sin x}{\cos x\times\cos x} = \sec x\tan x$ **A.G.**	B1 M1 A1 [3]	2.1 2.1 2.4	Correct definition for sec*x* soi Attempt chain rule or quotient rule Show given answer	 At least one step needed
8	(ii)		**DR** $\sec^2 2x + 2\sec 2x\tan 2x + \tan^2 2x$ $2\sec^2 2x + 2\sec 2x\tan 2x - 1$ $\int f(x)dx = \tan 2x + \sec 2x - x$ $(\sqrt{3} + 2 - \frac{1}{6}\pi) - (\frac{1}{3}\sqrt{3} + \frac{2}{3}\sqrt{3} - \frac{1}{12}\pi)$ $2 - \frac{1}{12}\pi$	 B1 M1 M1 A1 M1 A1 [6]	 3.1a 1.2 1.1a 1.1 1.1a 1.1	 Correct expansion of bracket Use $\tan^2 2x = \sec^2 2x - 1$ Attempt integration Correct integral Attempt use of limits Obtain $2 - \frac{1}{12}\pi$	 One trig term correct Correct order and subtraction
9	(i)		$\frac{A}{(1-2x)} + \frac{B}{(2+x)} + \frac{C}{(2+x)^2}$ $A(2+x)^2 + B(1-2x)(2+x) + C(1-2x) = 5 + 4x - 3x^2$ $A = 1$ $B = 2$ $C = -3$	M1 M1 A1 A1 A1 [5]	2.1 1.1a 1.1 1.1 1.1	Correct partial fractions Correct equation Correct value for *A* Correct value for *B* Correct value for *C*	

Question			Answer	Marks	AO	Guidance	
9	(ii)		$1 + 2x + 4x^2$	B1	1.1a	Correct expansion of $(1 – 2x)^{-1}$	
			$0.5(1 + 0.5x)^{-1}$ or $0.25(1 + 0.5x)^{-2}$	B1	3.1a	At least one correct expression	
			$1 – 0.5x + 0.25x^2$	M1	1.1	Attempt expansion of $(1 + 0.5x)^{-1}$	
			$1 – x + 0.75x^2$	M1	1.1	Attempt expansion of $(1 + 0.5x)^{-2}$	
			$\frac{5}{4}+\frac{9}{4}x+\frac{59}{16}x^2$	A1FT	1.1a	Correct expansion, following their *A*, *B* and *C*	Any equiv, including decimals
				[5]			
9	(iii)		$\|x\| < 0.5$	B1 [1]	2.5	Any equivalent notation	
10			**DR** $2x – 4y – 4x\frac{dy}{dx} + 24y^2\frac{dy}{dx} = 0$	M1*	1.1a	Attempt implicit differentiation	Deal with at least one *y* term correctly
				A1	1.1	Obtain correct derivative	
			$\frac{dy}{dx} = 0$	M1d*	1.1a	Either rearrange and use, or substitute	
			$2x – 4y = 0$	A1	1.1	Obtain $2x – 4y = 0$, or equiv	
			$x^2 – 2x^2 – x^3 + 4 = 0$	M1	1.1a	Eliminate *x* or *y* from eqn of curve	**OR** $4y^2 – 8y^2 + 8y^3 – 4 = 0$
			$x^3 – x^2 – 4 = 0$	A1	1.1	Obtain correct cubic	**OR** $2y^3 – y^2 – 1 = 0$
			f(2) = 0	B1	3.1a	Identify $x = 2$ as root or $(x – 2)$ as factor	**BC** **OR** f(1) = 0
			$(x – 2)(x^2 + x + 2) = 0$	M1	2.1	Attempt to factorise cubic – any valid method	**OR** $(y- 1)(2y^2 + y + 1) = 0$ Allow for dividing by root of their cubic
				A1	2.1	Correct quadratic quotient	
			$\Delta = -7 < 0$ so quadratic has no real roots, hence just one stationary point	E1	2.4	Justify one stationary point	Correct working only
				[10]			
11	(i)	(a)	2.5m	B1 [1]	3.4	State 2.5m	

Question			Answer	Marks	AO	Guidance	
11	(i)	(b)	$30t = 90$ $t = 3$, hence time is 0300	**M1** **A1** **[2]**	**1.1** **2.2b**	Identify that $30t = 90$ soi Solve for t, and deduce time is 0300	
11	(ii)		$1.7 + 0.8\sin(30t) = 1.2$ $\sin(30t) = -0.625$ $30t = 218.68$ $t = 7.289$ hence time is 0717	**M1** **M1** **A1** **A1FT** **[4]**	**3.4** **1.1a** **1.1** **2.2a**	Equate to 1.3 and rearrange to $\sin(30t) = k$ Attempt to find value for t from angle in third quadrant Obtain 7.29, or better Obtain time as 0717	FT their decimal value for t, as long as 2dp or better
11	(iii)		$a = 1.9$, $b = 1.2$ $c = 30$ $1.9 + 1.2\sin(150 + d) = 3.1$ $150 + d = 90$ $d = -60$	**B1** **B1** **M1** **A1** **[4]**	**3.3** **3.3** **3.1b** **1.1**	Correct values for a and b Correct value for c Attempt to find d eg use f(2) = 3.1 Obtain correct value for d	
11	(iv)		Identify decrease with reason	**B1** **[1]**	**3.5c**	Eg There is a longer time between maximum heights, so the value of c will need decrease to give longer period for the sine model	

Question			Answer	Marks	AO	Guidance	
12	(i)		$2u\mathrm{d}u = \mathrm{d}x$	B1	1.1	Correct relationship soi	
			$\int 2u\mathrm{e}^u \mathrm{d}u$	M1	3.1a	Convert to integrand in terms of u	
				A1	2.4	Fully correct, including du	A0 if du never seen, but all remaining marks available
			$2u\mathrm{e}^u - \int 2\mathrm{e}^u \mathrm{d}u$	M1	1.1a	Attempt integration by parts	
			$2u\mathrm{e}^u - 2\mathrm{e}^u$	A1	1.1	Fully correct in terms of u	Condone no + c
			$2\sqrt{x+1}\mathrm{e}^{\sqrt{x+1}} - 2\mathrm{e}^{\sqrt{x+1}} + c$	A1	1.1	Fully correct in terms of x	+ c now required
				[6]			
12	(ii)		$x = (\ln y)^2 - 1$	B1	2.1	Correct equation in form $x = \mathrm{f}(y)$	
				[1]			
12	(iii)		the equation in **(ii)** gives the area between curve and y-axis	B1	2.4	Identify geometrical relationship	
			$y = \mathrm{e}^4 \Longrightarrow x = 15$, $y = \mathrm{e} \Longrightarrow x = 0$	B1	2.1	Identify x limits	
			area between curve and x-axis is $(8\mathrm{e}^4 - 2\mathrm{e}^4) - (2\mathrm{e} - 2\mathrm{e}) = 6\mathrm{e}^4$	M1	2.2a	Use x limits in integral from **(i)**	
			area of rectangle is $15\mathrm{e}^4$	A1	2.4	Conclude convincingly	
			hence reqd area is $15\mathrm{e}^4 - 6\mathrm{e}^4 = 9\mathrm{e}^4$ **A.G.**				
				[4]			

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