Cambridge Assessment International Education

Cambridge O Level

ADDITIONAL MATHEMATICS **4037/02**

Paper 2 Calculator **For examination from 2025**

MARK SCHEME B

Maximum Mark: 80

Specimen

This document has **10** pages. Any blank pages are indicated.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptions for the question
- the specific skills defined in the mark scheme or in the generic level descriptions for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptions.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

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GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptions in mind.

Mathematics-Specific Marking Principles

1 Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.

2 Unless specified in the question, non-integer answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected.

3 Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points.

4 Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).

5 Where a candidate has misread a number or sign in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 A or B mark for the misread.

6 Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

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MARK SCHEME NOTES

The following notes are intended to help with understanding of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Anything in the mark scheme which is in square brackets […] is not required for the mark to be earned, but if present it must be correct.

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 M or B mark is dependent on an earlier mark in the scheme.

Types of mark

M Method mark, awarded for a valid method applied to the problem.

A Accuracy mark, given for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.

B Mark for a correct result or statement independent of Method marks.

Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent on the previous mark(s)
FT	follow through after error
isw	ignore subsequent working (after correct answer obtained)
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	special case
soi	seen or implied

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Question	Answer	Marks	Partial Marks
1(a)	[Distance between centres =] $\sqrt{(15-3)^2+(-4-2)^2}$ oe	**M1**	
	$29 - 17 < 13[.41\ldots] < 29 + 17$ oe	**A1**	
1(b)	$y - 17 = 2(x + 5)$ oe	**B2**	**B1** for gradient $\frac{17-(-0.6)}{-5+13.8}$ oe, soi or for $600 + 30x - 8y - 6x + 9 - 4y + 4 = 17^2$ oe
2(a)	[When $x^4 = 0$] $\lg y = 4$	**B2**	**B1** for $\frac{7-5}{6-2}$ oe and correct use of a point and *their* $\frac{1}{2}$ to find the intercept of the straight line
2(b)	$\lg y = \frac{1}{2}x^4 + 4$ soi	**B1**	**FT** *their* $\frac{1}{2}$ and *their* 4
	$y = 10^{\frac{1}{2}x^4+4}$	**M1**	**FT** *their* $\frac{1}{2}$ and *their* 4
	$A = 10^4$ or 10 000, $b = 10$, $C = \frac{1}{2}$	**A1**	May be embedded
3	$12(8) + a(4) - 12(2) + b = 0$ oe	**B1**	
	$12(-1) + a[1] - 12(-1) + b = -15$ oe	**B1**	
	Correct method of solution	**M1**	**FT** *their* pair of linear equations in a and b
	$a = -19$, $b = 4$	**A2**	**A1** for either correct
	$12x^2 + 5x - 2$	**M2**	**M1** for quadratic factor with 2 correct terms
	$(4x - 1)$ and $(3x + 2)$	**A1**	
4(a)	100	**3**	**M2** for a fully correct method e.g. [starts 2 and ends 4] $1 \times 5 \times 4 \times 1$ or 20 [starts 1, 3 and ends 2, 4] $2 \times 5 \times 4 \times 2$ or 80 OR [ends 4 and starts 1, 2, 3] $3 \times 5 \times 4 \times 1$ or 60 [ends 2 and starts 1, 3] $2 \times 5 \times 4 \times 1$ or 40 or **M1** for a partially correct method equivalent to one of the above statements

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Question	Answer	Marks	Partial Marks
4(b)	260	**3**	**M2** for a fully correct method e.g. [starts 4 and ends 2, 3, 5, 7] $1 \times 5 \times 4 \times 4$ or 80 [starts 2, 3, 5 and ends 7 or any two of 2, 3, 5] $3 \times 5 \times 4 \times 3$ or 180 OR [ends 7 and starts 2, 3, 4, 5] $4 \times 5 \times 4 \times 1$ or 80 [ends 2, 3, 5 and starts 4 or any two of 2, 3, 5] $3 \times 5 \times 4 \times 3$ or 180 or **M1** for a partially correct method equivalent to one of the above statements
5	$128 + 448ax + 672a^2x^2 + 560a^3x^3$ soi or $448a = b$ $672a^2 = c$ $560a^3 = -15\,120$ soi	**M3**	**M2** for any 3 correct terms or 2 correct equations or **M1** for any 2 correct terms or 1 correct equation or for correct but insufficiently simplified expansion e.g. $2^7 + 7(2^6)(ax) + \frac{7 \times 6}{2}(2^5)(ax)^2 + \frac{7 \times 6 \times 5}{3 \times 2}(2^4)(ax)^3$
	$a = -3$	**A1**	
	$b = -1344$	**A1**	**FT** $448 \times$ *their* a, providing at least **M1** awarded
	$c = 6048$	**A1**	**FT** $672 \times (\textit{their } a)^2$, providing at least **M1** awarded
6(a)	$V = 2x^3 - 195x^2 + 4500x$	**B3**	**B2** for an otherwise correct expression with at most one error or **B1** for $(75 - 2x)(60 - x)x$ soi
6(b)	$\left[\frac{dV}{dx} =\right] 6x^2 - 390x + 4500$	**B1**	**FT** *their* integer values of a, b and c
	Equates *their* $\frac{dV}{dx}$ to 0 and solves for x	**M1**	**FT** *their* values of a, b and c
	$x = 15$ as the only solution	**A1**	

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Question	Answer	Marks	Partial Marks
7(a)	$\dfrac{\cos x(1+\sin x)+\cos x(1-\sin x)}{1-\sin^2 x}$	**M1**	
	$\dfrac{\cos x+\cos x\sin x+\cos x-\cos x\sin x}{1-\sin^2 x}$ or $\dfrac{\cos x(1+\sin x)+\cos x(1-\sin x)}{\cos^2 x}$	**A1**	
	$\dfrac{2\cos x}{1-\sin^2 x}$ or $\dfrac{1+\sin x+1-\sin x}{\cos x}$ or $\dfrac{2\cos x}{\cos^2 x}$	**A1**	
	Completion to the given answer: $\dfrac{2}{\cos x}=2\sec x$ oe	**A1**	must be fully justified and with all previous steps correct
7(b)(i)	$\tan x=\dfrac{5}{4}$	**M1**	
	51.3 or 51.34[0…] rot to 2 or more decimal places –128.7 or –128.65[98…] rot to 2 or more decimal places	**A2**	and no extras in range **A1** for either correct, ignoring extras
7(b)(ii)	$10(1-\cos^2 2x)-9=3\cos 2x$	**M1**	
	$10\cos^2 2x+3\cos 2x-1$ [= 0]	**A1**	
	$(5\cos 2x-1)(2\cos 2x+1)$ [= 0]	**M1**	**FT** *their* 3-term quadratic in solvable form
	$\dfrac{\pi}{3}, \dfrac{2\pi}{3}$ 0.685 or 0.6847[19…] rot to 4 or more significant figures, 2.46 or 2.456[87…] rot to 4 or more significant figures	**A2**	and no extras in range **A1** for one correct, ignoring extras
8(a)(i)	Valid supported explanation: The function is one-one on this domain with support e.g. [it is quadratic and] the turning point is at $x=-1$	**B2**	**B1** for a correct but incomplete statement e.g. The function is one-one on this domain or [it is quadratic and] the turning point is at $x=-1$

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Question	Answer	Marks	Partial Marks
8(a)(ii)	$x^2 + 2x + 5 - y = 0$ or $y = (x + 1)^2 + 4$	**M1**	
	$x = \dfrac{-2 \pm \sqrt{2^2 - 4(1)(5-y)}}{2}$ oe, soi or $x = -1 \pm \sqrt{y-4}$	**A1**	
	Justifies the choice of square root	**B1**	
	$f^{-1}(x) = -1 + \sqrt{x-4}$	**A1**	
8(b)(i)	Valid supported explanation: The range of f is a subset of the domain of g with support e.g. f $\geqslant 5$ oe	**B2**	**B1** for a correct but incomplete statement e.g. The range of f is a subset of the domain of g or f $\geqslant 5$ oe
8(b)(ii)	$\dfrac{5(x^2 + 2x + 5)}{x^2 + 2x + 5 + 2} = 4$ oe	**M1**	
	$x^2 + 2x - 3$ [= 0]	**A1**	
	$(x - 1)(x + 3)$ [= 0]	**M1**	**FT** *their* 3-term quadratic in solvable form
	$x = 1$ as the only solution	**A1**	
9(a)	first term = $3(1.25)^{19}$ and an attempt at S_{12}	**M1**	
	Correct sum $S_{12} = \dfrac{208.166...(1 - 1.25^{12})}{1 - 1.25}$ oe	**M2**	**M1 FT** *their* first term for $S_{12} = \dfrac{\textit{their}\ 208.166...(1 - 1.25^{12})}{1 - 1.25}$
	11 284	**A1**	
	Alternative $S_{19} = \dfrac{3(1 - 1.25^{19})}{1 - 1.25}$ and $S_{31} = \dfrac{3(1 - 1.25^{31})}{1 - 1.25}$ oe	**(B2)**	**B1** for $S_{19} = \dfrac{3(1 - 1.25^{19})}{1 - 1.25}$ or $S_{31} = \dfrac{3(1 - 1.25^{31})}{1 - 1.25}$ oe
	Correct plan: $S_{31} - S_{19}$ oe attempted	**(M1)**	
	11 284	**(A1)**	

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Question	Answer	Marks	Partial Marks
9(b)	$S_{5n} = \frac{5n}{2}\{2(5) + (5n-1)(3)\}$ and $S_n = \frac{n}{2}\{2(5) + (n-1)(3)\}$	**B2**	**B1** for either sum correct
	Forms a correct equation: $\frac{5n}{2}\{2(5) + (5n-1)(3)\} = \frac{23n}{2}\{2(5) + (n-1)(3)\}$ oe	**M1**	**FT** *their* sums providing at least **B1** awarded
	$n = 21$	**A1**	
10(a)(i)	Straight line starting at $\left(\frac{\pi}{2}, 1\right)$ and ending at $(\pi, 0)$	**B1**	
10(a)(ii)	[Distance $\frac{\pi}{2}$ to π: $\frac{1}{2} \times \frac{\pi}{2}$ [$\times$ 1] =] $\frac{\pi}{4}$	**B1**	
	$\left[2\tan\frac{t}{2} - t\right]_0^{\frac{\pi}{2}}$	**M2**	**M1** for $k\tan\frac{t}{2}$ soi
	$2\tan\frac{1}{2}\left(\frac{\pi}{2}\right) - \frac{\pi}{2}[-0]$	**M1**	**dep** on at least **M1** earned
	$2 - \frac{\pi}{4}$ or 1.21 or 1.214[60…] rot to 4 or more significant figures	**A1**	
10(b)(i)	$v = -e^{2t} + 3e^{-2t}$	**B1**	
	$3 - (e^{2t})^2 = 0$ or $3 - e^{4t} = 0$ oe	**M1**	**FT** *their v* providing it is of the form $me^{2t} + ne^{-2t}$, where m and n are constants
	$2t = \ln\sqrt{3}$ or $4t = \ln 3$ oe	**M1**	**dep** on previous **M1**; **FT** *their* 3 which must be > 0
	$t = 0.2747$ cao; nfww	**A1**	
10(b)(ii)	$\frac{4 - e^{2(their\ 0.2747)} - 3e^{-2(their\ 0.2747)}}{2} + \left(\frac{4 - e^{2(their\ 0.2747)} - 3e^{-2(their\ 0.2747)}}{2} - \frac{4 - e^{2(0.5)} - 3e^{-2(0.5)}}{2}\right)$ soi	**M2**	**FT** *their* $t \neq 0$ **M1** for $\frac{4 - e^{2(their\ 0.2747)} - 3e^{-2(their\ 0.2747)}}{2}$ or 0.268 or 0.2679[49…] rot to 4 or more decimal places
	0.447 or 0.4468[58…] rot to 4 or more decimal places	**A1**	

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