CAMBRIDGE
International Education

Cambridge O Level

ADDITIONAL MATHEMATICS **4037/12**

Paper 1 Non-calculator **May/June 2026**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **19** printed pages.

[Turn over

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks 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.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	More information required
	Accuracy mark awarded zero
	Accuracy mark awarded one
	Accuracy mark awarded two
	Accuracy mark awarded three
	Independent mark awarded zero
	Independent mark awarded one
	Independent mark awarded two
	Independent mark awarded three
	Benefit of the doubt
	Communication mark

Annotation	Meaning
	Incorrect
FT	Follow through
Highlighter	Highlight a key point in the working
ISW	Ignore subsequent work
M0	Method mark awarded zero
M1	Method mark awarded one
M2	Method mark awarded two
M3	Method mark awarded three
MR	Misread
O	Omission
Off-page comment	Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to.
On-page comment	Allows comments to be entered in speech bubbles on the candidate response.
Pre	Premature rounding/approximation
SC	Special case
SEEN	Indicates that work/page has been seen
TE	Transcription error
	Correct

Annotation	Meaning
XP	Correct answer from incorrect working

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MARK SCHEME NOTES

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

Types of mark

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

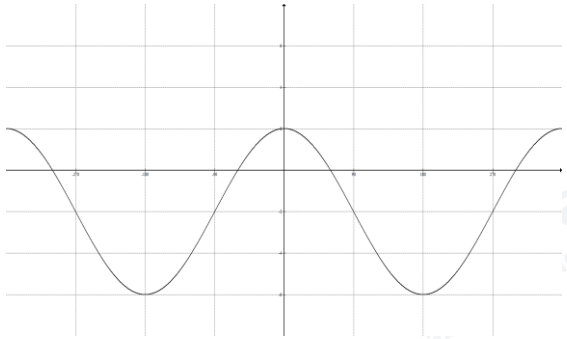
A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.

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

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.

Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent
FT	follow through after error
isw	ignore subsequent working
nfww	not from wrong working
oe	or equivalent
rot	rounded or truncated
SC	Special Case
soi	seen or implied

Question	Answer	Marks	Partial Marks	Guidance
1(a)		**B2**	**B1** for a graph with correct shape attempted, with two full cycles and with correct amplitude or passing through (–270, –2), (–90, –2) (90, –2) (270, –2)	Mark intent For full marks must have some correct curvature at the end points and be a continuous line Maximum of 1 mark if not fully correct
1(b)	4	**B1**		
1(c)	360°	**B1**		Allow 360 and/or 2π
1(d)	$-6 \leqslant k \leqslant 2$	**B1**	If not correct **FT** *their* graph providing at least **B1** awarded in part **1(a)**	Allow $k \geqslant -6,\ k \leqslant 2$ $k \geqslant -6$ and $k \leqslant 2$ $2 \geqslant k \geqslant -6$ but **not** $k \geqslant -6$ **or** $k \leqslant 2$
2(a)	$\frac{5}{3}$ soi	**B1**	For gradient of the perpendicular bisector of *AB*	
	(3, 0) soi	**B1**	For the midpoint of *AB*	
	$c = -5$	**B1**	From $y - 0 = \frac{5}{3}(x - 3)$ oe	Allow embedded in $y = \frac{5}{3}x - 5$ or implied by $(0,\ -5)$

Question	Answer	Marks	Partial Marks	Guidance
2(b)	$AD = \sqrt{32}$ oe or $AD^2 = 32$ soi	**B1**		
	$BD = \sqrt{40}$ oe or $BD^2 = 40$ soi	**B1**		
	their $BD = \frac{\sqrt{n}}{2}$ *their* AD oe	**M1**		
	$n = 5$	**A1**		
3(a)	–40	**B1**		
3(b)	$(x+1)(6x^2-7x+2)$ or $(2x-1)(3x^2+x-2)$ or $(3x-2)(2x^2+x-1)$	**3**	**M1** for finding a correct linear factor **M1 Dep** for a quadratic factor with any two terms correct **A1** for a correct quadratic factor	Allow linear factors with fractional terms May use synthetic division to obtain coefficients of quadratic factor and hence the terms Quadratic factor does not have to be part of a product here
	$(x + 1)(3x – 2)(2x – 1)$ oe	**A1**		**SC B4** if all factors spotted by T and I and written as a product **SC B3** if all factors spotted and not written as a product **SC B2** if 2 factors spotted by T and I
3(c)	$u = \pm\sqrt{\frac{2}{3}}$ $u = \pm\sqrt{\frac{1}{2}}$ oe, isw	**2**	**B1FT** for any two solutions using *their* factors of the form $(px-q)$ from **part (b)** where $pq > 0$	Condone excess solutions from $u^2 + 1 = 0$
4(a)	240	**B1**		
	202	**B1**		

Question	Answer	Marks	Partial Marks	Guidance
4(b)	Either $\frac{20}{2}\{240+202\}$ **oe** Or $S_{100}-S_{80}$ $\frac{100}{2}\left(2(400)+99(-2)\right)-\frac{80}{2}\left(2(400)+79(-2)\right)$ or $\frac{100}{2}(400+202)-\frac{80}{2}(400+242)$	**M2**	**M1** for $\frac{their20}{2}\{their240+their202\}$ or **M1** for using correct values from part **4(a)** for $S_{100}-S_{81}$ $\frac{100}{2}\left(2(400)+99(-2)\right)-\frac{81}{2}\left(2(400)+80(-2)\right)$ or $\frac{100}{2}(400+202)-\frac{81}{2}(400+240)$ or $S_{100}-S_{79}$ $\frac{100}{2}\left(2(400)+99(-2)\right)-\frac{79}{2}\left(2(400)+78(-2)\right)$ or $\frac{100}{2}(400+202)-\frac{79}{2}(400+244)$	*their* 20 restricted to 19 or 21 $S_{100}-S_{80}=30100-25680$ $S_{100}-S_{81}=30100-25920$ $S_{100}-S_{79}=30100-25438$ May see allowable sums separately, award M1 when subtraction is seen even if errors are made in subsequent working before subtraction.
	4420	**A1**		**SC B3** for 4420 obtained from listing and adding the individual terms

Question	Answer	Marks	Partial Marks	Guidance
5	$\frac{dy}{dx} = \frac{5(2x-4)^4 \times 2}{(2x-4)^5}$ oe or $\frac{10}{2x-4}$ or $\frac{5}{x-2}$	**B1**		
	$\frac{dy}{dx} = 5$	**M1**	For attempt to substitute $x = 3$ into *their* attempt at $\frac{dy}{dx}$	
	$(y =)$ $\ln 2^5$ or $\ln 32$ or $5\ln 2$	**B1**	For finding the value of y when $x = 3$	
	$y - \ln 32 = 5(x-3)$ oe	**A1**		
6(a)	$2r + r\alpha$	**B1**	Allow $2r + \frac{\alpha}{2\pi}(2\pi r)$	Must be in radians Condone consistent use of θ for α oe.
	$r(2\pi - \alpha)$	**B1**	Allow $r\left(2\pi - \frac{\alpha}{2\pi}(2\pi)\right)$ oe	Must be in radians Condone consistent use of θ for α oe.
	Forms equation that can be solved, with *their* arc lengths in terms of α in radians and r	**M1**	Must have at least **B1** and not involve areas	Condone consistent use of θ for α oe.
	$\alpha = \pi - 1$	**A1**		Allow unsimplified but must be numeric

Question	Answer	Marks	Partial Marks	Guidance
6(b)	$\frac{1}{2}r^2(\pi-1)=18(\pi^2-1)$	**M1**	Allow for using α or *their* numeric α instead of $(\pi-1)$	Must be in radians Condone consistent use of θ for α oe.
	$r^2=\frac{36(\pi^2-1)}{\pi-1}$ or $r^2=36(\pi+1)$ oe	**A1**		
	$r=6\sqrt{\frac{\pi^2-1}{\pi-1}}$ or $r=\sqrt{\frac{36(\pi-1)(\pi+1)}{\pi-1}}$ or $r=\sqrt{36\pi+36}$	**M1**	**Dep** on previous **M1**, for use of *their* numeric α or clear intention to find the square root correctly	
	$r=6\sqrt{\pi+1}$ or $6(\pi+1)^{\frac{1}{2}}$ only	**A1**		
7	$\frac{1}{\sin x}-\sin x$	**M1**		Allow working from right to left.
	$\frac{1-\sin^2 x}{\sin x}$	**A1**		
	$\frac{\cos x}{\sin x}\times\cos x=\frac{\cos x}{\tan x}$	**A1**	fully justified final step	Need to see an extra step after $\frac{\cos^2 x}{\sin x}$ before the given answer For consistent omission of x withhold the last A mark

Question	Answer	Marks	Partial Marks	Guidance
8	**EITHER** Solution 1 $\frac{dy}{dx} = \frac{(x-2)(5)-(5x+1)}{(x-2)^2}$	**(2**	**M1** for correct structure of quotient rule with correct numerator and u and v correct Allow correct use of product rule.	For **M1** du and dv may be incorrect Allow if terms in the numerator are reversed Must have v^2 in the denominator
	$x = -9$	**B1**		
	$\delta x = \frac{h}{their\ \frac{dy}{dx}}$, oe when $x = -9$ or *their* -9 but not for $x = 4$	**M1**	**Dep**	
	$\delta x = -11h$	**A1)**		
	OR Solution 2 Use of $\frac{dx}{dy}$	**(B1**		The value of x does not need to be calculated using this method
	$\frac{dx}{dy} = \frac{(y-5)(2)-(1+2y)}{(y-5)^2}$	**2**	**M1** for correct structure of quotient rule with correct numerator and u and v correct	du and dv may be incorrect Allow if terms in the numerator are reversed Must have v^2 in the denominator
	$\delta x = h \times their\ \frac{dx}{dy}$ when $y = 4$ oe	**M1**	**Dep**	
	$\delta x = -11h$	**A1)**		
9(a)	$\ln \frac{x}{x-1}$ or $\log_e \frac{x}{x-1}$	**2**	**B1** for $\frac{1}{\log_x e} = \ln x$ oe seen	Allow $\ln x$ written as $\log_e x$

Question	Answer	Marks	Partial Marks	Guidance
9(b)	$2\log_5 2x = \log_5\left(4x^2\right)$ or $\log_5(2x)^2$ or $1 = \log_5 5$ soi	**B1**		
	$(2x)^2 = 5(9x-10)$ nfww oe or $\log_5(2x)^2 = \log_5 5(9x-10)$ oe	**M1**		**M0 XP** for e.g. $\log_5(2x)^2 = 1+\log_5(9x-10)$ then $\cancel{\log_5}(2x)^2 = \cancel{\log_5} 5 \times \cancel{\log_5}(9x-10)$ and $(2x)^2 = 5(9x-10)$ Condone use of $\lg_5(\ldots)$ Allow recovery of missing brackets
	$4x^2 - 45x + 50\,[=0]$ nfww	**A1**		
	$(4x-5)(x-10) = 0$	**M1**	For solution of *their* 3 term quadratic	Factorises or solves a 3-term quadratic in form $ax^2 + bx + c = 0$ by: Factorising - factorisation must result in correct a and c for FT equation, or scaled form of FT equation. quadratic formula – discriminant of FT equation must not be negative. Formula must be correct but condone one sign error in substitution. completing the square – must get as far as $(x+\frac{b}{2})^2 = -\frac{c}{a} + \frac{b^2}{4}$ or equivalent, condone one sign error.

Question	Answer	Marks	Partial Marks	Guidance
9(b)	$x = \frac{5}{4}$, $x = 10$ nfww and no other solutions	**A1**	A0 if either solution is rejected	
10(a)	**EITHER** Solution 1 $\frac{x+5}{11x-1} = \frac{x-1}{x+5}$ oe	**(M1**		
	$x^2 + 10x + 25 = 11x^2 - 12x + 1$	**M1**	**Dep** for expansion, allow one error	
	$10x^2 - 22x - 24 [= 0]$	**A1**		$5x^2 - 11x - 12 [= 0]$
	$x = 3$ only nfww	**2**	**M1 dep** on both previous **M** marks for solution of *their* quadratic equation **A1** for $x = 3$	$(5x + 4)(x - 3) = 0$
	$r = \frac{1}{4}$ oe $a = 128$	**A1)**	For both	
	OR Solution 2 $\frac{5+r}{11r-1} = \frac{-1-5r}{r-1}$ oe	**(M2**	**M1** allow one sign error	
	$(5 + r)(r - 1) = (-1 - 5r)(11r - 1)$	**M1**	**Dep** for expansion, allow one error	
	$56r^2 + 10r - 6 = 0$	**A1**		
	$r = \frac{1}{4}$ oe	**A1**		
	$a = 128$	**A1)**		

Question	Answer	Marks	Partial Marks	Guidance
10(b)	$\frac{128}{1-0.25}$	**M1**	**Dep** on at least one **M** mark in **part 10(a) FT** *their* numeric *a* and *their* numeric *r* or *their* numeric *x*, providing $\lvert their\ r\rvert < 1$	
	512	**A1**		
11(a)	**EITHER** Solution 1 $\overrightarrow{AB} = \begin{pmatrix} -8 \\ 8 \end{pmatrix}$ oe, soi	**(B1**		Allow component vectors throughout
	$\overrightarrow{OC} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$	**2**	**M1** for $\overrightarrow{OC} = \begin{pmatrix} 4 \\ -2 \end{pmatrix} + \frac{3}{4}\left(their \begin{pmatrix} -8 \\ 8 \end{pmatrix}\right)$ oe, soi or $\overrightarrow{OC} = \begin{pmatrix} -4 \\ 6 \end{pmatrix} - \frac{1}{4}\left(their \begin{pmatrix} -8 \\ 8 \end{pmatrix}\right)$ oe, soi	$\overrightarrow{OC} = \overrightarrow{OA} + \overrightarrow{AC}$ $\overrightarrow{OC} = \overrightarrow{OB} + \overrightarrow{BC}$
	$\overrightarrow{OD} = \begin{pmatrix} 3 \\ -1.5 \end{pmatrix}$	**2)**	**M1FT** for $\overrightarrow{OD} = \begin{pmatrix} 5 \\ -5.5 \end{pmatrix} + their \begin{pmatrix} -2 \\ 4 \end{pmatrix}$ Mark final answer, must be a vector	
	OR Solution 2 $\overrightarrow{AB} = \begin{pmatrix} -8 \\ 8 \end{pmatrix}$ oe, soi	**(B1**		Allow component vectors throughout
	$\overrightarrow{AD} = \begin{pmatrix} -1 \\ 0.5 \end{pmatrix}$	**2**	**M1 for** $\overrightarrow{AD} = \frac{3}{4}\left(their \begin{pmatrix} -8 \\ 8 \end{pmatrix}\right) + \begin{pmatrix} 5 \\ -5.5 \end{pmatrix}$	$\overrightarrow{AD} = \overrightarrow{AC} + \overrightarrow{CD}$
	$\overrightarrow{OD} = \begin{pmatrix} 3 \\ -1.5 \end{pmatrix}$	**2)**	**M1FT** for $\overrightarrow{OD} = \begin{pmatrix} 4 \\ -2 \end{pmatrix} + their \begin{pmatrix} -1 \\ 0.5 \end{pmatrix}$ Mark final answer, must be a vector	$\overrightarrow{OD} = \overrightarrow{OA} + \overrightarrow{AD}$

Question	Answer	Marks	Partial Marks	Guidance
11(a)	**OR** Solution 3 $\begin{pmatrix}-4\\6\end{pmatrix}, \begin{pmatrix}-2\\4\end{pmatrix}, \begin{pmatrix}0\\2\end{pmatrix}, \begin{pmatrix}2\\0\end{pmatrix}, \begin{pmatrix}4\\-2\end{pmatrix}$ soi	**(B1**	Line segment split into 4 to obtain position vectors or coordinates	Allow component vectors throughout
	$\overrightarrow{OC} = \begin{pmatrix}-2\\4\end{pmatrix}$	**2**	**M1** using *their* second position vector, allow as coordinates	
	$\overrightarrow{OD} = \begin{pmatrix}3\\-1.5\end{pmatrix}$	**2)**	**M1FT** for $\overrightarrow{OD} = \begin{pmatrix}5\\-5.5\end{pmatrix} - \textit{their}\begin{pmatrix}-2\\4\end{pmatrix}$ Must be a vector for **A1** Mark final answer, must be a vector	
11(b)	$\lambda = 0.75$ or $\frac{3}{4}$	**B1**	Must have full marks in part **(a)**	Please check full marks awarded in part **11(a)**

Question	Answer	Marks	Partial Marks	Guidance
12	$y = -4x + 6$ oe	**B1**		
	Eliminates one unknown e.g. $\frac{10}{4x+1} = -4x + 6$	**M1**	**FT**	
	$0 = -16x^2 + 20x - 4$ soi	**A1**		$0 = 4x^2 - 5x + 1$
	$0 = (4x-1)(x-1)$	**M1**	**Dep FT**	
	$x = \frac{1}{4}, x = 1$	**A1**		
	$y = 5, y = 2$ or $\left[-2x^2 + 6x\right]$ soi	**B1**		
	Area of trapezium = $\frac{21}{8}$	**B1**	May come from integration using $\left[-2x^2 + 6x\right]_{\frac{1}{4}}^{1}$ or from $\frac{1}{2}(5+2) \times \frac{3}{4}$	
	$\int \frac{10}{4x+1}\,dx = \frac{10}{4}\ln(4x+1)$	**2**	**M1** for $k\ln(4x + 1)$ **A1** correct	Allow transcription error
	$\frac{10}{4}\ln 5 - \frac{10}{4}\ln 2$	**M1**	**dep** on all previous **M** marks for correct substitution of *their* limits using the form $k\ln(4x + 1)$	May be embedded in a subtraction of areas
	$\frac{21}{8} - \left(\frac{5}{2}\ln 5 - \frac{5}{2}\ln 2\right)$ oe	**A1**	**A0** if subtraction done the wrong way round.	$\frac{21}{8} - \frac{5}{2}\ln\frac{5}{2}$ or $\frac{21}{8} + \frac{5}{2}\ln\frac{2}{5}$

Question	Answer	Marks	Partial Marks	Guidance
13	$\frac{(n+2)!}{(n-1)!3!} - \frac{n!}{(n-3)!3!}$ soi	**M1**	May be implied by simplification	Must be working from the left-hand side to obtain the right-hand side. Allow recovery
	$\frac{(n+2)(n+1)n}{6} - \frac{n(n-1)(n-2)}{6}$	**A1**	For dealing with the algebraic factorials Allow 3! for 6	
	$\frac{n}{6}\left(n^2+3n+2-[n^2-3n+2]\right)$	**A1**	For correct expansion, may be in cubic form Allow 3! for 6	
	$\frac{n}{6}\times 6n = n^2$	**A1**		