CAMBRIDGE
International Education

Cambridge O Level

ADDITIONAL MATHEMATICS **4037/11**

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
A0	Accuracy mark awarded zero
A1	Accuracy mark awarded one
A2	Accuracy mark awarded two
A3	Accuracy mark awarded three
B0	Independent mark awarded zero
B1	Independent mark awarded one
B2	Independent mark awarded two
B3	Independent mark awarded three
BOD	Benefit of the doubt
C	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	Guidance	Notes
1	**EITHER** Solution 1 $5x+4=3x-2$ and $5x+4=-3x+2$ oe with attempt to solve	**(M1**	for correctly dealing with the modulus function by stating **both** equations, with no extra solutions	
	$x=-3$	**A1**		
	$x=-\frac{1}{4}$	**A1)**		
	OR Solution 2 $(5x+4)^2=(3x-2)^2$ leading to $16x^2+52x+12[=0]$ oe with an attempt to solve	**(M1**	For expanding the two brackets allow one slip in expanding each bracket no missing terms	Attempt to solve *their* 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.
	$x=-3,\quad -\frac{1}{4}$	**2)**	**A1** for each.	

Question	Answer	Marks	Guidance	Notes
2(a)	$(3,\ 4)$	**B1**		Allow without brackets e.g. 3, 4
2(b)	$\sqrt{20}$ or $2\sqrt{5}$ isw	**B1**		
2(c)	$(7,2)$	**2**	**B1** for each	Allow without brackets e.g. 7,2 or $x = 7$ and $y = 2$ or allow as a vector e.g. $\begin{pmatrix}3\\4\end{pmatrix}+\begin{pmatrix}4\\-2\end{pmatrix}=\begin{pmatrix}7\\2\end{pmatrix}$
3	$(9+30\cot\theta+25\cot^2\theta)$ $+(9-30\cot\theta+25\cot^2\theta)$ $-50\text{cosec}^2\theta$	**M1**	For expansion of the two brackets allow one slip in expanding each of brackets Allow in the form $(9\pm k\cot\theta\pm 25\cot^2\theta)$ where $k\neq 0$ Allow unsimplified	Allow if using substitution for $\cot\theta$
	$18+50\cot^2\theta-50\text{cosec}^2\theta$ soi **nfww**	**A1**	Do not allow if wrong coefficient in the expansion of brackets of $\cot\theta$ is used	
	-32 **nfww**	**2**	**M1Dep** for correct use of $\cot^2\theta-\text{cosec}^2\theta=-1$ oe Allow if interms of $\sin\theta$ e.g. $\dfrac{18+50(1-\sin^2\theta)-50}{sin^2\theta}$ Withhold the final **A1** mark for persistent omission of θ	

Question	Answer	Marks	Guidance	Notes
4	$k\ln(3x+2)$	**M1**	For correct attempt to integrate $\frac{1}{3x+2}$ must be in the form of $k\ln(3x+2)$	Allow missing bracket if intention is clear
	$\frac{1}{3}\ln(3x+2)$	**A1**		
	$\frac{1}{3}\left[\ln(3a+2)-\ln 2\right]$ oe	**M1**	**Dep**, for substituting limits, allow with *their k* Must be in the form *their k* $\times\left[\ln(3a+2)-\ln 2\right]$	
	$\frac{1}{3}\ln\left(\frac{3a+2}{2}\right)=\ln 4$ oe	**M1**	**Dep**, allow with *their k* Must be in the form *their k* $\times\left[\frac{\ln((3a+2))}{2}\right]$	
	$a=42$ oe	**A1**		

Question	Answer	Marks	Guidance	Notes
5(a)	$a^4+4a^2-a^2-28=0$	**B1**	Allow unsimplified	If Trial and improvement used with an answer of $a=2$ only then award 4 marks maybe spotted
	$\left(a^2+7\right)\left(a^2-4\right)=0$ $a^2=4$	**2**	**M1** for correct attempt to solve a 3 term quadratic equation Must be in a^2 or using a substitution for a^2	Attempt to solve *their* 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.
	$a=2$ only	**A1**		
5(b)	$(x-2)\left(2x^2+8x+14\right)$ or $2(x-2)\left(x^2+4x+7\right)$ oe	**2**	**M1FT** for 2 factors using *their a* Must be in the form $(x-a)\left(ax^2+bx+c\right)$ $a\times c=-28$	
5(c)	Discriminant of $2x^2+8x+14$ is $64-\left(4\times2\times14\right)$ $8^2-\left(4\times2\times14\right)$ or the discriminant of x^2+4x+7 is $16-\left(4\times1\times7\right)$	**M1**	Allow for an attempt to use the quadratic formula	-48 or -12
	Discriminant is negative **and** no [real] roots oe	**A1**	If the discriminant is evaluated it must be correct for the mark to be awarded	

Question	Answer	Marks	Guidance	Notes
6(a)	$[k =] -\frac{4}{3}$	**2**	**M1** for a complete method to find the x-coordinate of the stationary point Allow 1 mark for $x * -\frac{4}{3}$ seen	$\frac{dy}{dx} = 6x + 8[= 0]$ or $3\left(x + \frac{4}{3}\right)^2 [-\ldots]$ Or $x(3x + 8)$ leading to symmetry at $x = -\frac{4}{3}$
6(b)	$f \geqslant -\frac{16}{3}$	**2**	**M1** for substitution of *their k,* must show the substitution of *their k* to award the mark and using correct notation e.g. f or y Allow 2 marks for $y \geqslant \frac{-16}{3}$	
6(c)	$3y^2 + 8y = x$ or	**B1**	If using completing the square : **B1** for $x = 3\left(y + \frac{4}{3}\right)^2 - \frac{16}{3}$ oe	Allow **B1** for $y = 3\left(x + \frac{4}{3}\right)^2 - \frac{16}{3}$ oe With the intention of making x the subject of the formulae
	$\frac{-8 + \sqrt{64 + 12x}}{6}$ oe only	**B2**	Allow unsimplified **B1** for $\frac{-8 \pm \sqrt{64 + 12x}}{6}$	$\frac{-4 \pm \sqrt{16 + 3x}}{3}$

Question	Answer	Marks	Guidance	Notes
6(d)(i)	$x \geqslant -\frac{4}{3}$	**B1**	**FT** from *their* answer in part **6(a)**	
6(d)(ii)	$3^{3x^2+8x} = 27$	**B1**	For correct order	
	$3x^2 + 8x = 3$	**B1**		
	$(3x-1)(x+3) = 0$	**M1**	**Dep** On previous **B** marks for solving quadratic with an attempt to find at least one solution	
	$x = \frac{1}{3}$ only	**A1**		

Question	Answer	Marks	Guidance	Notes
7(a)	$\frac{dy}{dx}=\frac{\left(2+e^{x}\right)2e^{2x}-\left(4+e^{2x}\right)e^{x}}{\left(2+e^{x}\right)^{2}}$ or $\frac{dy}{dx}=\frac{\left(4+e^{2x}\right)\times -e^{x}}{\left(2+e^{x}\right)^{2}}+\frac{2e^{2x}}{\left(2+e^{x}\right)}$	**3**	**B1** for $\frac{d}{dx}\left(e^{2x}\right)=2e^{2x}$ **M1** for a correct attempt at differentiating using: Quotient rule - must subtract terms in numerator but condone terms wrong way around, must have v^2 in denominator and must have a convincing attempt at $\frac{du}{dx}$ and $\frac{dv}{dx}$. Product rule – must sum terms in numerator and must have a convincing attempt at $\frac{du}{dx}$ and $\frac{dv}{dx}$. **A1FT** *their* $2e^{2x}$ allow unsimplified.	**Special case: when dealing with numerator only** **B1** for $\frac{d}{dx}\left(e^{2x}\right)=2e^{2x}$ **M1** justification that when $\frac{dy}{dx}=0$ They need to consider numerator only then a correct attempt at differentiating a quotient **A1** for $2e^{2x}\left(2+e^{x}\right)-e^{x}\left(4+e^{2x}\right)=0$ For attempt at differentiating using quotient rule:
	$2e^{2x}\left(2+e^{x}\right)-e^{x}\left(4+e^{2x}\right)=0$ **leading to** $e^{3x}+4e^{2x}-4e^{x}=0$	**M1**	for equating *their* numerator to zero and attempt to simplify to a 3 term equation Must be in the form $pe^{2x}\left(2+e^{x}\right)-e^{x}\left(4+e^{2x}\right)=0$	
	$e^{2x}+4e^{x}-4=0$ **AG** Must justify e.g. stating division by e^{x} or factorising	**A1**		

Question	Answer	Marks	Guidance	Notes
7(b)	$e^x = -2 \pm 2\sqrt{2}$	**2**	**M1** for solution of the given quadratic e.g. $[e^x =] \frac{-4 \pm \sqrt{16 - 4 \times 1 \times -4}}{2}$ oe or $(e^x + 2)^2 - 8 = 0$	Attempt to solve *their* quadratic in form $ax^2 + bx + c = 0$ by: 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.
	$x = \ln(2\sqrt{2} - 2)$ only	**2**	**M1Dep** for taking natural logarithms to both sides	Accept $x = \ln(\sqrt{8} - 2)$ for the final **A1**
8(a)	4	**B1**		
8(b)	$x = 3^4$ or 81	**3**	**M1** for a correct attempt to solve $\log_3 x = k$ where k is a constant **A1** for $\log_3 x = 4$ **A1** for $x = 3^4$ or 81	
8(c)	$\log_x 5 = \frac{4}{\log_x 5}$ or $\frac{1}{\log_5 x} = 4 \log_5 x$ soi	**B1**	If working with log or ln **B1** for $\frac{\log 5}{\log x} = \frac{4 \log x}{\log 5}$	$\log_5 x^4 = \frac{4 \log x}{\log 5}$ $\log_x 5 = \frac{\log 5}{\log x}$
	$(\log_x 5)^2 = 4$ or $(\log_5 x)^2 = \frac{1}{4}$	**B1**		
	$[x =] \sqrt{5}$, $\frac{1}{\sqrt{5}}$ oe	**2**	**B1** for each Do not isw rejected solutions	

Question	Answer	Marks	Guidance	Notes
9(a)(i)	$ar^3 = -8ar^6$	**M1**	Allow **M1** for $-8ar^3 = ar^6$	
	$r = -\frac{1}{2}$	**A1**		
9(a)(ii)	$\frac{99}{32} = a\frac{\left(1-\left(-\frac{1}{2}\right)^5\right)}{\left(1-\left(-\frac{1}{2}\right)\right)}$	**M1**	**FT** Allow if using *their* incorrect r Must see correct substitution of *their* r	
	$a = \frac{9}{2}$ oe	**A1**		
9(b)	$r = \sin^2\theta$ soi **nfww**	**B1**		
	$\frac{\cos\theta\sin\theta}{1-\sin^2\theta}$	**B1**	**Dep** on previous **B1**	
	$\frac{\cos\theta\sin\theta}{\cos^2\theta}$	**B1**	**Dep** on previous **B1**	
	$\frac{\sin\theta}{\cos\theta} = \tan\theta$	**B1**	**Dep** on previous **B1** Withhold this mark for persistent omission of θ	

Question	Answer	Marks	Guidance	Notes
10	$f'(x) = m(2x+10)^{\frac{1}{2}} - nx^2 (+c)$	**M1***	For correct attempt to integrate must be in the form of $m(2x+10)^{\frac{1}{2}} \pm nx^2 (+c)$ m and $n \neq 0$	
	$f'(x) = (2x+10)^{\frac{1}{2}} - x^2 (+c)$	**A1**		Allow unsimplified
	$f'(x) = (2x+10)^{\frac{1}{2}} - x^2 + 5$	**2**	**M1 dep** for substituting $x = 3$ in *their* $f'(x) = 0$ With an attempt to find c	
	$f(x) = p(2x+10)^{\frac{3}{2}} - \frac{x^3}{3}(+5x)$	**M1**	**Dep** For correct attempt to integrate must be in the form of $p(2x+10)^{\frac{3}{2}} \pm q\frac{x^3}{3}(+5x)$ p and $q \neq 0$	
	$f(x) = \frac{1}{3}(2x+10)^{\frac{3}{2}} - \frac{x^3}{3} + 5x(+d)$	**A1**		Allow unsimplified
	$f(x) = \frac{1}{3}(2x+10)^{\frac{3}{2}} - \frac{x^3}{3} + 5x - 6$	**2**	**M1 dep** for substituting $x = 3$ and $y = \frac{64}{3}$ in *their* $f(x)$ For **A1** must be an equation allow $y =$…	

Question	Answer	Marks	Guidance	Notes
11	$\overrightarrow{OX} = \frac{1}{3}\mathbf{a}$	**B1**	Allow on a diagram if direction is clear	
	$\overrightarrow{XB} = \mathbf{b} - \frac{1}{3}\mathbf{a}$	**B1**		
	$\overrightarrow{XY} = \frac{1}{5}\left(\mathbf{b} - \frac{1}{3}\mathbf{a}\right)$ oe	**B1**		
	$\overrightarrow{OZ} = \frac{1}{m}\mathbf{b}$	**B1**	Do not accept $m\overrightarrow{OZ} = \boldsymbol{b}$ unless recovered	
	$\overrightarrow{ZY} = -\frac{1}{m}\mathbf{b} + \frac{1}{3}\mathbf{a} + \frac{1}{5}\left(\mathbf{b} - \frac{1}{3}\mathbf{a}\right)$ oe Or $\overrightarrow{OZ} = \frac{1}{3}\boldsymbol{a} + \frac{1}{5}\left(\boldsymbol{b} - \frac{1}{3}\boldsymbol{a}\right) - \frac{1}{3n}\boldsymbol{a}$ oe Or $\overrightarrow{OX} = \frac{1}{m}\boldsymbol{b} + \frac{1}{3n}\boldsymbol{a} - \frac{1}{5}\left(\boldsymbol{b} - \frac{1}{3}\boldsymbol{a}\right)$	**M1**	**FT** on *their* $-\overrightarrow{OZ} + \overrightarrow{OX} + \overrightarrow{XY}$ Must be in **a** and ***b*** Or **FT** on *their* $\overrightarrow{OY} + \overrightarrow{YZ}$ Must be in **a** and ***b*** Or **FT** on *their* $\overrightarrow{OY} + \overrightarrow{YX}$ Must be in **a** and ***b***	
	$\frac{1}{3}\mathbf{a} = n\left(-\frac{1}{m}\mathbf{b} + \frac{1}{3}\mathbf{a} + \frac{1}{5}\left(\mathbf{b} - \frac{1}{3}\mathbf{a}\right)\right)$ oe Or $\frac{1}{m}\boldsymbol{b} = \frac{1}{3}\boldsymbol{a} + \frac{1}{5}\left(\boldsymbol{b} - \frac{1}{3}\boldsymbol{a}\right) - \frac{\boldsymbol{a}}{3n}$ oe Or $\frac{1}{3}\boldsymbol{a} = \frac{1}{m}\boldsymbol{b} + \frac{1}{3n}\boldsymbol{a} - \frac{1}{5}\left(\boldsymbol{b} - \frac{1}{3}\boldsymbol{a}\right)$ oe	**M1**	**Dep** For use of $\frac{1}{3}\mathbf{a}$ equated to their $\overrightarrow{ZY}$ Or **Dep** For use of $\frac{1}{m}b$ equated to their $\overrightarrow{OZ}$ Or **Dep** For use of $\frac{1}{3}\mathbf{a}$ equated to their $\overrightarrow{OX}$	

Question	Answer	Marks	Guidance	Notes
11	$m = 5,\ n = \frac{5}{4}$	**2**	**A1** for each	
12	$\frac{(n+3)!}{(n-3)!6!} = 12\frac{(n+2)!}{(n-3)!5!}$	**B1**		
	Algebraic factorials simplify to $n+3$ **nfww and** Numerical factorials simplify to 6 soi **nfww**	**B1**	**Dep** correct simplification	
	69	**B1**	**Dep** on both previous **B** marks	