CAMBRIDGE
International Education

Cambridge O Level

ADDITIONAL MATHEMATICS **4037/13**

Paper 1 **October/November 2025**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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 descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors 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 descriptors.

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).

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 descriptors 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
	Incorrect
	Follow through
Highlighter	Highlight a key point in the working
	Ignore subsequent work
	Method mark awarded zero
	Method mark awarded one
	Method mark awarded two

Annotation	Meaning
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
XP	Correct answer from incorrect working

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
1(a)	$(x - 3)(x + 2)$	**M1**	
	$x * 3$, $x * -2$	**A1**	* can be any inequality sign or =
	$x \geqslant 3$, $x \leqslant -2$	**A1**	Do not allow **and** between inequalities Do not accept $-2 \geqslant x \geqslant 3$

Question	Answer	Marks	Guidance
1(b)	$x * 3$	**B1**	* can be any inequality sign or =
	$-3x + 4 < x + 2$ or $3x - 4 > -x - 2$	**M1**	
	$x * \frac{1}{2}$	**A1**	* can be any inequality sign or =
	$\frac{1}{2} < x < 3$	**A1**	Do not accept $\frac{1}{2} < x$, $x < 3$ unless and is between the inequalities
	Alternative method:		
	$9x^2 - 24x + 16 * x^2 + 4x + 4$	**(M1)**	Square both sides * can be any inequality sign or =
	$(2x - 1)(x - 3) * 0$	**(M1)**	* can be any inequality sign or =
	Critical values $\frac{1}{2}$, 3	**(A1)**	
	$\frac{1}{2} < x < 3$	**(A1)**	Do not accept $\frac{1}{2} < x$, $x < 3$ unless 'and' is between the inequalities
2	$2xe^{3x} + 3x^2e^{3x}$ isw	**3**	**B1** for $3e^{3x}$ **M1** for use of product rule **A1 FT** *their* $3e^{3x}$
3	$x = \frac{\pi}{15}$	**B1**	Allow for $5x = \frac{\pi}{3}$
	$\frac{dy}{dx} = 5\cos 5x \left[= \frac{5}{2} \right]$	**B1**	For differentiation
	$\frac{\delta y}{\delta x} = \frac{0.01}{\delta x} = their \frac{5}{2}$ oe	**DM1**	**Dep** on previous **B1 FT** *their* $\frac{5}{2}$ Allow if $\delta x = \frac{0.01}{5\cos 5x}$
	$\delta x = 0.004$ or $\frac{1}{250}$	**A1**	

Question	Answer	Marks	Guidance
4(a)	Velocity at time T is $2T$ soi	**B1**	
	$\frac{1}{2}(8+4-T)\times 2T = 27$	**M1**	For an attempt trapezium area or three areas **and** = 27 using *their* 2T
	$(T-3)(T-9) = 0$	**M1**	**Dep** on previous **M1** for solving *their* 3-term quadratic by factorising, completing the square or quadratic formula
	3	**A1**	
	Alternative method		
	Velocity at time T is $2T$ leading to $T = \frac{v}{2}$ soi	**(B1)**	
	$\frac{1}{2}\left(8+4-\frac{v}{2}\right)\times v = 27$	**(M1)**	For an attempt trapezium area = 27 using *their* $\frac{v}{2}$
	$(18-v)(v-6) = 0$	**(M1)**	**Dep** on previous **M1** for solving *their* 3-term quadratic by factorising, completing the square or quadratic formula
	$v = 6$ then $T = 3$	**(A1)**	
4(b)	$a = \frac{0-\textit{their}2T}{8-4}$ oe	**M1**	For an attempt on gradient using *their T*
	−1.5	**A1**	Must be negative

Question	Answer	Marks	Guidance
5	$\frac{dy}{dx} = 3x^2 + 3x - 2$	**M1**	Allow one error in the coefficient of x^2or x
	Gradient of tangent at $A = -2$ nfww	**A1**	
	Gradient of normal at $A = \frac{1}{2}$	**M1**	**Dep** for an attempt $-1 \div$ *their* gradient – must come from differentiation
	Equation of normal is $y - 1 = \frac{1}{2}x$ oe	**M1**	**Dep** for the normal equation using *their* normal gradient **and** $(0, 1)$
	$1+\frac{1}{2}x = x^3 + \frac{3}{2}x^2 - 2x + 1$	**M1**	**Dep** For solving simultaneously curve with normal **FT** *their* normal equation
	$x(2x^2 + 3x - 5) = 0$ oe nfww	**A1**	
	$[x](x - 1)(2x + 5) = 0$	**M1**	For an attempt solve *their* 3-term quadratic or trying to solve *their* cubic using long division
	$x = 1$ and $x = -\frac{5}{2}$ nfww	**A1**	
6(a)	$\frac{2}{\sqrt{3}}$ or $\frac{2\sqrt{3}}{3}$	**3**	**B2** for $[BM =]\frac{\sqrt{3}a}{2}$ or $\sec^2 30 = 1 + \left(\frac{1}{\sqrt{3}}\right)^2$ or $\cos^2 30 = 1 - \left(\frac{\frac{a}{2}}{a}\right)^2$ oe **B1** for $\left[BM^2 =\right] a^2 - \frac{a^2}{4}$ soi

Question	Answer	Marks	Guidance
6(b)	$\frac{2\sec x}{(\sec x-1)(\sec x+1)}$ soi	**B1**	For adding the two fractions
	$\frac{2\sec x}{(\sec^2 x-1)}$	**B1**	**Dep** on previous **B1** for expanding and simplifying the denominator
	$\frac{2\sec x}{\tan^2 x}$ or $\frac{2}{\tan^2 x\cos x}$	**B1**	**Dep** on previous **B1** for use of $\sec^2 x = 1+\tan^2 x$
	$\frac{2\sec x}{\tan x}\times\cot x$ or $\frac{2\cos x}{\sin^2 x}$ oe or $\frac{2}{\tan x\sin x}$ leading to 2cosec x cot x **AG**	**B1**	**Dep** on previous **B1** with at least one more correct step to get to the given answer
	Alternative method		
	$\frac{1}{\frac{1}{\cos x}-1}+\frac{1}{\frac{1}{\cos x}+1}$ leading to $\frac{\cos x}{1-\cos x}+\frac{\cos x}{1+\cos x}$	**(B1)**	
	$=\frac{\cos x+\cos^2 x+\cos x-\cos^2 x}{1-\cos^2 x}$	**(B1)**	**Dep** on previous **B1** for adding the two fractions
	$=\frac{2\cos x}{\sin^2 x}$	**(B1)**	**Dep** on previous **B1** For use of $\sin^2 x = 1-\cos^2 x$
	= 2cosec $x\times\frac{\cos x}{\sin x}$ oe leading to = 2cosec x cot x **AG**	**(B1)**	**Dep** on previous **B1** with at least one more correct step to get to the given answer
7(a)	$\left[\overrightarrow{OR}=\right]$ $k(-\mathbf{i}+5\mathbf{j})$ or $k\begin{pmatrix}-1\\5\end{pmatrix}$	**B1**	soi
	$\sqrt{1^2+5^2}=\sqrt{26}$	**B1**	For finding the magnitude of $\overrightarrow{PQ}$ allow unsimplified
	$-3\mathbf{i}+15\mathbf{j}$ or $\begin{pmatrix}-3\\15\end{pmatrix}$	**B1**	Allow $3(-\mathbf{i}+5\mathbf{j})$ or $3\begin{pmatrix}-1\\5\end{pmatrix}$ Do notisw

Question	Answer	Marks	Guidance
7(b)	$a(2\mathbf{i} - 3\mathbf{j}) + b(-\mathbf{i} + 5\mathbf{j}) = 10\mathbf{i} + 6\mathbf{j}$ oe	**B1**	
	$2a - b = 10$ oe, $-3a + 5b = 6$ oe or for $\frac{10-2a}{6+3a} = \frac{-1}{5}$ or $\frac{10+b}{6-5b} = \frac{-2}{3}$	**M1**	**Dep** on previous **B1** for equating like vectors
	$a = 8$ or $b = 6$	**A1**	
	$16\mathbf{i} - 24\underline{\mathbf{j}}$ oe	**A1**	Allow $8(2\mathbf{i} - 3\underline{\mathbf{j}})$ or $8\begin{pmatrix} 2 \\ -3 \end{pmatrix}$
8	$-x^4 + 3x^2 + 4$ (= 0)	**M1**	For attempt to solve simultaneously Allow one term error
	$(x^2 - 4)(x^2 + 1) = 0$ oe	**M1**	**Dep** for an attempt to solve *their* 3-term quadratic equation in terms of x^2
	$x = 2$ and -2 only	**A1**	
	$\int(-x^4 + 3x^2 + 4)\mathrm{d}x$	**M1**	For an attempt to integrate *their* quadratic–quartic or the other way around with one term correctly integrated Allow without limits
	$\left[-\frac{x^5}{5} + x^3 + 4x\right]_{-2}^{2}$	**A1**	All correct with correct limits of 2 and -2 or with limits of 0 and 2 or -2 and 0 then double the area of the integral
	$-\frac{32}{5} + 8 + 8 - (\frac{32}{5} - 8 - 8)$	**M1**	**Dep** for correct use of *their* limits into *their* integral substituted correctly If *their* integration – must see substitution of limits to award the mark
	$= \frac{96}{5}$ or 19.2	**A1**	

Question	Answer	Marks	Guidance
9(a)	$\log_5(5x-2)^2 - \log_5 x = 1$ oe	**2**	**B1** for $\log_{25} x = \frac{\log_5 x}{\log_5 25} = \frac{\log_5 x}{2}$ **B1** for $2\log_5(5x-2) = \log_5(5x-2)^2$ oe
	$\log_5 \frac{(5x-2)^2}{x} = 1$	**M1**	**Dep** on one of the previous **B1** For correct use of rules of logarithms e.g. dividing *their* logarithms to the same base Accept $\log_5 5$ for 1
	$25x^2 - 25x + 4 = 0$ oe	**M1**	**Dep M1** for forming a 3-term quadratic equation, with an attempt to solve must have at least 2 **B** marks
	$x = \frac{4}{5}$ only	**A1**	
	Alternative method 1		
	$\log_{25}(5x-2)^2 - \log_{25} x = \frac{1}{2}$	**(2)**	**B1** for $\log_5(5x-2) = \frac{\log_{25}(5x-2)}{\log_{25} 5} = \frac{\log_{25}(5x-2)}{\frac{1}{2}}$ oe **B1** for $\frac{1}{2} = \log_{25} 5$ or for $\frac{1}{2} = \frac{1}{2}\log_{25} 25$ soi
	$\log_{25} \frac{(5x-2)^2}{x} = \frac{1}{2}$ or $\log_{25}(5x-2) = \frac{1}{2}\log_{25} 5x$	**(M1)**	**Dep** on one of the previous **B1** For correct use of rules of logarithms e.g. dividing *their* logarithms to the same base or multiplying Accept $\log_{25} 5$ for $\frac{1}{2}$
	$25x^2 - 25x + 4 = 0$ oe	**(M1)**	**Dep M1** for forming a 3-term quadratic equation, with an attempt to solve must have at least 2 **B** marks
	$x = \frac{4}{5}$ only	**(A1)**	

Question	Answer	Marks	Guidance
9(a)	**Alternative method 2**		
	$\log_5(5x-2)-\frac{1}{2}\log_5 x=\frac{1}{2}$ Leading to $\log_5\frac{(5x-2)}{\sqrt{x}}=\log_5\sqrt{5}$	**(2)**	**B1** for $\log_{25}x=\frac{1}{2}\log_5 x$ soi **B1** for $\frac{1}{2}=\log_5\sqrt{5}$ soi
	$\frac{(5x-2)^2}{x}=5$ or $(5x-2)=\sqrt{5x}$	**(M1)**	**Dep** on one of the previous **B1** For correct use of rules of logarithms e.g. dividing *their* logarithms to the same base Accept $\log_{25}5$ for $\frac{1}{2}$
	$25x^2-25x+4=0$ or $5x-\sqrt{5}\sqrt{x}-2=0$	**(M1)**	**Dep M1** for forming a 3-term quadratic equation, with an attempt to solve must have at least 2 **B** marks
	$x=\frac{4}{5}$ only	**(A1)**	
	Alternative method 3		
	$\frac{\log(5x-2)}{\log 5}-\frac{\log x}{2\log 5}=\frac{1}{2}$ Leading to $\log\frac{(5x-2)^2}{x}=\log 5$	**(2)**	**B1** for $\log_5(5x-2)=\frac{\log(5x-2)}{\log 5}$ soi **B1** for $\log_{25}x=\frac{\log x}{2\log 5}$ soi
	$\frac{(5x-2)^2}{x}=5$	**(M1)**	**Dep** on one of the previous **B1** For correct use of rules of logarithms e.g. dividing *their* logarithms to the same base
	$25x^2-25x+4=0$	**(M1)**	**Dep M1** for forming a 3-term quadratic equation, with an attempt to solve must have at least 2 **B** marks
	$x=\frac{4}{5}$ only	**(A1)**	

Question	Answer	Marks	Guidance
9(b)	$e^{3y-7+3y-1}+4e^{-3+3y-1}=5$ oe or $e^{3y-4+3y-1}+4e^{3y-1}=5e^{3}$ or $e^{3y-7}+\frac{4}{e^{3}}=5e^{1-3y}$ or $e^{6y}+4e^{4+3y}=5e^{8}$ or $\frac{e^{3y}}{e^{7}}+\frac{4}{e^{3}}=\frac{5e}{e^{3y}}$ or $\frac{e^{3y-1}}{e^{6}}+\frac{4}{e^{3}}=\frac{5}{e^{3y-1}}$	**B1**	
	$e^{6y-8}+4e^{3y-4}-5\ [=0]$ or $e^{3y-4}+4-5e^{4-3y}[=0]$ or $e^{-7}\left(e^{3y}\right)^{2}+4e^{-3}e^{3y}-5e[=0]$ or $\left(e^{3y-1}\right)^{2}+4e^{3}e^{3y-1}-5e^{6}[=0]$	**B1**	**Dep** for arranging as 3-term quadratic
	$\left(e^{3y-4}-1\right)\left(e^{3y-4}+5\right)=0$ or $\left(e^{-3}\left(e^{3y}\right)-e\right)\left(e^{-4}\left(e^{3y}\right)+5\right)=0$ or $(e^{3y-1}+5e^{3})(e^{3y-1}-e^{3})=0$	**M1**	**Dep** for an attempt at solution
	$e^{3y-4}=1$ or $e^{3y-1}=e^{3}$	**A1**	
	$3y-4=\ln 1$ oe soi or $3y-1=3$	**A1**	
	$y=\frac{4}{3}$	**A1**	
10(a)	$\frac{20}{2}(2a+19d)=3\times\frac{10}{2}(2a+9d)$ oe	**M1**	
	$20a+190d=30a+135d$ oe	**A1**	Correct removal of brackets
	$a=\frac{11}{2}d$ oe	**A1**	

Question	Answer	Marks	Guidance
10(b)	$S_A = \frac{a_1}{1-r}$ soi	**B1**	Allow a for a_1
	$r_b = r^2$ soi	**B1**	
	$S_B = \left[\frac{a_2}{1-r^2}\right] = \frac{a_1 r}{1-r^2}$	**B1**	Allow a for a_1 with r^2
	$k = \frac{S_B}{S_A} = \frac{a_1 r}{1-\textit{their } r^2} \times \frac{1-r}{a_1}$ $\frac{S_B}{S_A} = \frac{\frac{a_1 r}{1-\textit{their } r^2}}{\frac{a_1}{1-r}}$	**M1**	**Dep** on the first and second **B1** for *their* $\frac{S_B}{S_A}$ Allow a for a_1
	$\frac{r}{1+r}$ cao	**A1**	
11(a)	Centre (2, 1)	**B1**	Accept $x = 2$ and $y = 1$
	Radius 2 soi	**B1**	
	$(x-2)^2 + (y-1)^2 = 4$ oe	**B1**	**FT** *their* centre and radius ISW Do not accept 2^2 for 4
11(b)	$(x-2)^2 + (2x + a - 1)^2 = 4$	**M1**	Substitute $y = 2x + a$ into *their* circle equation
	$x^2 - 4x + 4 + 4x^2 + 4(a-1)x + (a-1)^2 = 4$	**A1**	Equivalent must be seen as **AG**
	leading to $5x^2 + 4(a-2)x + (a-1)^2 = 0$ **AG**		
	$16(a-2)^2 - 20(a-1)^2 = 0$	**M1**	for finding the discriminant of the given equation and equating to zero
	$a^2 + 6a - 11 = 0$ $a = -3 \pm \sqrt{20}$ or $\frac{-6 \pm \sqrt{80}}{2}$ oe	**A1**	isw from a correct answer isw
12(a)	${}^{59}C_r 2^{59-r}\left[x^r\right]$ oe	**B1**	Allow for $\binom{59}{r}2^{59-r}$ or $\frac{59!}{(59-r)!r!}\ 2^{59-r}$

Question	Answer	Marks	Guidance
12(b)	$\frac{59!}{(59-r)!r!}2^{59-r}$ $= \frac{59!}{(58-r)!(r+1)!}2^{58-r}$ oe	**B1**	Allow if in terms of n and r e.g.: $\frac{n!}{(n-r)!r!}2^{n-r} =$ $\frac{n!}{(n-(r+1))!(r+1)!}2^{n-(r+1)}$
	$\frac{2}{59-r} = \frac{1}{1+r}$	**B2**	**Dep** on previous **B1** for correctly obtaining either $\frac{2}{59-r}$ or $\frac{1}{r+1}$
	$r = 19$	**B1**	**Dep** on previous **B1** marks