Cambridge IGCSE™

ADDITIONAL MATHEMATICS **0606/12**

Paper 1 **February/March 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 February/March 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
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
BOD	Benefit of the doubt
C	Communication mark
✗	Incorrect point
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
MR	Misread
O	Omission

Annotation	Meaning
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 point
XP	Not from wrong 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.

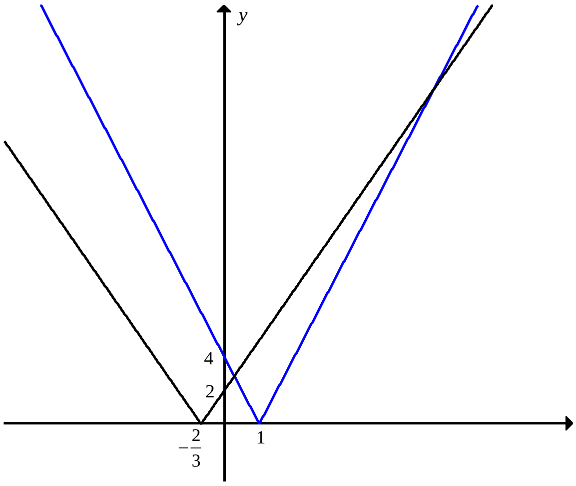
A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.

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	Partial Marks
1(a)	Fully correct, ruled graphs with all intercepts indicated 	3	**M2** for a graph of correct shape with vertex on the x-axis and 1 and 4 oe appropriately indicated or a graph of correct shape with vertex on the x-axis and $-\frac{2}{3}$ and 2 oe appropriately indicated or **M1** for a graph of correct shape with vertex on the x-axis and 1 or 4 oe appropriately indicated or a graph of correct shape with vertex on the x-axis and $-\frac{2}{3}$ or 2 oe appropriately indicated
1(b)	$4(x-1) * 3x+2$ oe and $4(x-1) * -3x-2$ oe OR $7x^2-44x+12 \quad [*0]$ where * is = or any inequality sign	**M2**	**M1** for $4(x-1) * -3x-2$ oe OR **M1** for $(4(x-1))^2 = (3x+2)^2$ oe
	Critical values $\frac{2}{7}$ and 6	**A1**	
	$\frac{2}{7} \leqslant x \leqslant 6$ mark final answer	**A1**	
2	$a=5$	**B1**	
	$b=3$	**B1**	
	$c=-2$	**B1**	

Question	Answer	Marks	Partial Marks
3	$(x-2)^2+(y+1)^2=74$ oe nfww or $x^2+y^2-4x+2y-69=0$ oe nfww	4	**M1** for centre: $\left(\frac{-3+7}{2}, \frac{6-8}{2}\right)$ or $(2,-1)$ soi **M2** for [r =] $\sqrt{74}$ or [r^2 =] 74 or [diameter =] $2\sqrt{74}$ or c = –69 or **M1** for $\left[AB^2=\right](-3-7)^2+(6--8)^2$ oe or $\left[r^2=\right](-3-their\,2)^2+(6-their(-1))^2$ oe or $\left[r^2=\right](7-their\,2)^2+(-8-their(-1))^2$ oe **Alternative method** **M2** for $\frac{y-6}{x-(-3)}\times\frac{y-(-8)}{x-7}=-1$ or **M1** for e.g. $P(x, y)$ on the circumference means $AP\perp BP \rightarrow m_{AP}\times m_{BP}=-1$ **M1** for $\frac{y^2+2y-48}{x^2-4x-21}=-1$ oe **FT** *their* $\left(\frac{y-6}{x-(-3)}\times\frac{y-(-8)}{x-7}\right)$ with at most one sign error
4(a)	$a^2\left(-\frac{1}{2}\right)^3+2a\left(-\frac{1}{2}\right)^2+a\left(-\frac{1}{2}\right)+2=0$ oe, soi	M1	
	Simplifies and solves for a	M1	**FT** *their* quadratic in a providing $\mathrm{p}\left(-\frac{1}{2}\right)=0$ oe attempted
	$a=4$	A1	
4(b)	$2(2x+1)(4x^2+1)$ mark final answer	2	**M1** for $(2x+1)\left(\frac{their\ a^2}{2}x^2\ldots+2\right)$ or $(8x^2+2)$ found as quadratic factor
4(c)	Discriminant of $4x^2+1$ is $0-16<0$ oe and no real roots oe or $4x^2+1=0 \rightarrow 4x^2=-1$ oe and therefore no solution oe [statement that only solution is $x=-\frac{1}{2}$]	1	

Question	Answer	Marks	Partial Marks
5(a)	$2\left(x-\frac{1}{2}\right)^2+\frac{5}{2}$	3	**B2** for $2\left(x-\frac{1}{2}\right)^2$ or **B1** for $\left(x-\frac{1}{2}\right)^2$ or a = 2 and b = –0.5 oe **B1** for $\frac{5}{2}$ or c = 2.5 oe
5(b)	$\frac{1}{2}$	B1	**FT** –*their b*
5(c)	$\mathrm{f} \geqslant \frac{5}{2}$	B1	**FT** *their c*
5(d)	$\left[\mathrm{f}^{-1}(x)=\right]\frac{1}{2}-\sqrt{\frac{1}{2}\left(x-\frac{5}{2}\right)}$ oe or $\left[\mathrm{f}^{-1}(x)=\right]\frac{2-\sqrt{8x-20}}{4}$ oe	3	**M1 FT** for a complete method to find the inverse with a correct order of operations **FT** an expression of the form f(x) = $a(x+b)^2+c$ **A1 FT** for $\left[\mathrm{f}^{-1}(x)=\right]\frac{1}{2}\pm\sqrt{\frac{1}{2}\left(x-\frac{5}{2}\right)}$ oe **FT** *their* $\frac{1}{2}$ and *their* $\frac{5}{2}$
6(a)	$\cos\theta=-\sqrt{\frac{5}{6}}$ oe, isw	B2	**B1** for $\cos\theta=\sqrt{\frac{5}{6}}$ oe or $\cos\theta=\pm\sqrt{\frac{5}{6}}$ oe
6(b)	$\sin\theta=-\sqrt{\frac{1}{6}}$ oe, isw	B1	
6(c)	$\frac{5-[1]\sqrt{6}}{\sqrt{5}}$	2	**M1** for [$\sec\theta+\cot\theta=$] $\frac{1}{\cos\theta}+\frac{1}{\tan\theta}$ or $\frac{1}{\cos\theta}+\frac{\cos\theta}{\sin\theta}$ soi or for $\frac{1}{their\cos\theta}+\frac{5}{\sqrt{5}}$ oe or $\frac{1}{their\cos\theta}+\frac{their\cos\theta}{their\sin\theta}$

Question	Answer	Marks	Partial Marks
7(a)	$(2x+1)(x+1)=5+2(x+1)$ or $(2x-1)(x+1)=5$ oe	**M1**	
	$2x^2+x-6[=0]$	**A1**	
	Factorises or solves *their* 3-term quadratic e.g. $(x+2)(2x-3)$	**M1**	
	$\left(\frac{3}{2}, 4\right)$	**A1**	
7(b)	Correct plan, difference of integrals oe: $\int_0^k \left(\frac{5}{x+1}+2\right)\mathrm{d}x$ – area correct trapezium soi where $k > 0$	**M1**	or $\int_0^k \left(\frac{5}{x+1}+2\right)\mathrm{d}x - \int_0^k (2x+1)\mathrm{d}x$ soi
	Area of trapezium: $\frac{1}{2}(their\,4+1)\left(their\,\frac{3}{2}\right)$ oe	**B1**	or $\left(their\,\frac{3}{2}\right)^2 + their\,\frac{3}{2}\,[-0]$ or $\frac{15}{4}$ oe
	Integral: $\left[5\ln(x+1)+2x\right]_0^{their\,1.5}$	**B2**	**B1** for $5\ln x + 1$ or for $n\ln(x + 1)$ where n is a constant and $n > 0$
	Correct substitution of upper and lower limits into $5\ln(x+1)+2x$	**M1**	**FT** *their* integral providing at least **B1** awarded and *their* 1.5
	Area of shaded region: $5\ln\left(\frac{5}{2}\right)-\frac{3}{4}$ isw	**A1**	
	Alternative method		
	Correct plan, integral of difference of functions: $\int_0^k \left(\frac{5}{x+1}-2x+1\right)\mathrm{d}x$ soi where $k > 0$	**(M1)**	
	Integral: $\left[5\ln(x+1)+x-x^2\right]_0^{their\,1.5}$	**(B3)**	**B2** for $5\ln(x + 1)$ and one other correct term or $n\ln(x + 1) + x - x^2$ where n is a constant and $n > 0$ or **B1** for $5\ln x + 1$ or for $n\ln(x + 1)$ where n is a constant and $n > 0$
	Area of shaded region: $5\ln\left(\frac{5}{2}\right)-\frac{3}{4}$ isw	**(2)**	**M1FT** for correct substitution of upper and lower limits; **FT** *their* integral providing at least **B1** awarded and *their* 1.5

Question	Answer	Marks	Partial Marks
8(a)	$10r = 10 + 3d$ soi	**B1**	
	$10r^2 = 10 + 5d$ soi	**B1**	
	$10\left(\frac{10+3d}{10}\right)^2 = 10 + 5d$ oe or $10r^2 = 10 + \frac{5(10r-10)}{3}$ oe	**M1**	
	$9d^2 + 10d = 0$ or $3r^2 - 5r + 2 = 0$ oe	**A1**	
	Correct method to find *d* or *r*	**A1**	**FT** *their* quadratic in *d* or *r*
	$d = -\frac{10}{9}$ and $r = \frac{2}{3}$	**A1**	
8(b)	Appropriate determination for *their r* e.g. $\lvert r \rvert < 1$ so the geometric progression has a sum to infinity oe	**B1**	**STRICT FT** *their r*
9	Correct change of base e.g. $\log_2(x+1) - \frac{4\log_2 2}{\log_2(x+1)} = 3$ or $\frac{\log_{(x+1)}(x+1)}{\log_{(x+1)} 2} - 4\log_{(x+1)} 2 = 3$	**B1**	
	$\left(\log_2(x+1)\right)^2 - 3\log_2(x+1) - 4 \quad [=0]$ oe or $4\left(\log_{(x+1)} 2\right)^2 + 3\log_{(x+1)} 2 - 1 \quad [=0]$ oe	**B1**	
	Factorises or solves e.g. $\left(\log_2(x+1) - 4\right)\left(\log_2(x+1) + 1\right) = 0$ or $\left(4\log_{(x+1)} 2 - 1\right)\left(\log_{(x+1)} 2 + 1\right) = 0$	**M1**	**FT** *their* 3-term quadratic in a suitable logarithm providing correct change of base seen
	$\log_2(x+1) = \mathit{their}\, 4$ and $\log_2(x+1) = \mathit{their}\,(-1)$ or $\log_{(x+1)} 2 = \mathit{their}\, \frac{1}{4}$ and $\log_{(x+1)} 2 = \mathit{their}\,(-1)$ **and** correctly solves as far as *x* = … at least once	**M1**	**dep** on previous **M1** **FT** $\log_2(x+1) = a$ or $\log_{(x+1)} 2 = b$ where *a* and *b* are constants
	$x = 15,\ x = -\frac{1}{2}$ nfww mark final answer	**A1**	

Question	Answer	Marks	Partial Marks
10	[When x = 5] $y=9$	B1	
	$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{2}{3}(5x+2)^{-\frac{1}{3}}\times 5$ oe	B2	**B1** for $\frac{\mathrm{d}y}{\mathrm{d}x}=k(5x+2)^{-\frac{1}{3}}$, $k\neq\frac{10}{3}$
	$\left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\|_{x=5}=\frac{10}{9}$	B1	**FT** *their* $\left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\|_{x=5}$ providing previous **B1** awarded
	Equation of normal e.g. $y-\textit{their}9=-\frac{1}{\textit{their}\frac{10}{9}}(x-5)$ oe, soi	M1	**FT** $\frac{-1}{\textit{their}\left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\|_{x=5}}$ and *their* y-coordinate
	Eliminates one variable e.g. $11-x-\textit{their}9=-\frac{1}{\textit{their}\frac{10}{9}}(x-5)$	M1	**dep** on previous **M** mark
	For Q: $x=-25$, $y=36$	A2	**A1** for each
	Coordinates of R: (35, –18) or $((10-\textit{their}(-25)),\ (18-\textit{their}36))$	B1	**FT** *their* coordinates of Q
11(a)	$[\overrightarrow{OX}=]$ $\mathbf{b}+\lambda\left(\frac{3}{4}\mathbf{a}-\mathbf{b}\right)$ oe or $[\overrightarrow{OX}=]$ $\frac{3}{4}\mathbf{a}+(1-\lambda)\left(\mathbf{b}-\frac{3}{4}\mathbf{a}\right)$ oe	3	**B2** for $\overrightarrow{BN}=\frac{3}{4}\mathbf{a}-\mathbf{b}$ oe, soi or **B1** for $\overrightarrow{ON}=\frac{3}{4}\mathbf{a}$ oe, soi
11(b)	$[\overrightarrow{OX}=]$ $\frac{1}{2}\mathbf{b}+\mu\left(\mathbf{a}-\frac{1}{2}\mathbf{b}\right)$ oe or $[\overrightarrow{OX}=]$ $\mathbf{a}+(1-\mu)\left(\frac{1}{2}\mathbf{b}-\mathbf{a}\right)$ oe	2	**B1** for $\overrightarrow{MA}=\mathbf{a}-\frac{1}{2}\mathbf{b}$
11(c)	$\mathbf{b}+\lambda\left(\frac{3}{4}\mathbf{a}-\mathbf{b}\right)=\frac{1}{2}\mathbf{b}+\mu\left(\mathbf{a}-\frac{1}{2}\mathbf{b}\right)$ soi	M1	**FT** *their* answer to **(a)** in terms of **a**, **b** and λ and **(b)** in terms of **a**, **b** and μ
	$\frac{3}{4}\lambda=\mu$ or $1-\lambda=\frac{1}{2}-\frac{1}{2}\mu$	M1	**FT** *their* answer to **(a)** in terms of **a**, **b** and λ and **(b)** in terms of **a**, **b** and μ
	$\frac{3}{4}\lambda=\mu$ and $1-\lambda=\frac{1}{2}-\frac{1}{2}\mu$	A1	
	$\lambda=\frac{4}{5}$, $\mu=\frac{3}{5}$	A1	

Question	Answer	Marks	Partial Marks
12(a)	$\frac{d}{dx}\left(e^{3x+2}\right) = 3e^{3x+2}$ soi	**B1**	
	$\frac{dy}{dx} = x \times \textit{their}\left(3e^{3x+2}\right) + [1]e^{3x+2}$ oe, isw	**2**	**FT** *their* $3e^{3x+2}$ **M1** for correct structure of product rule
12(b)	$\frac{1}{3}xe^{3x+2} - \frac{1}{9}e^{3x+2} + c$ oe, nfww	**4**	**B3** for $\int 3xe^{3x+2}dx = xe^{3x+2} - \frac{1}{3}e^{3x+2}$ $(+A)$ or better or **B2** for $\int 3xe^{3x+2}dx = xe^{3x+2} - \int e^{3x+2}dx$ or better or $\frac{1}{3}e^{3x+2} + \int 3xe^{3x+2}dx = xe^{3x+2}$ or $\int xe^{3x+2}dx = \frac{x}{3}e^{3x+2} + ke^{3x+2}$ where $k = \frac{1}{9}$ or $-\frac{1}{3}$ or **B1** for $\int 3xe^{3x+2}dx = \int\left(3xe^{3x+2} + e^{3x+2}\right)dx - \int e^{3x+2}dx$ or $\int \frac{dy}{dx}dx = \int 3xe^{3x+2}dx + \int e^{3x+2}dx$ or better