Cambridge IGCSE™

ADDITIONAL MATHEMATICS	**0606/23**
Paper 2	**May/June 2025**
MARK SCHEME	
Maximum Mark: 80	

This document consists of **13** printed pages.

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
B3	Independent mark awarded three
BOD	Benefit of the doubt
C	Communication mark
✖	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

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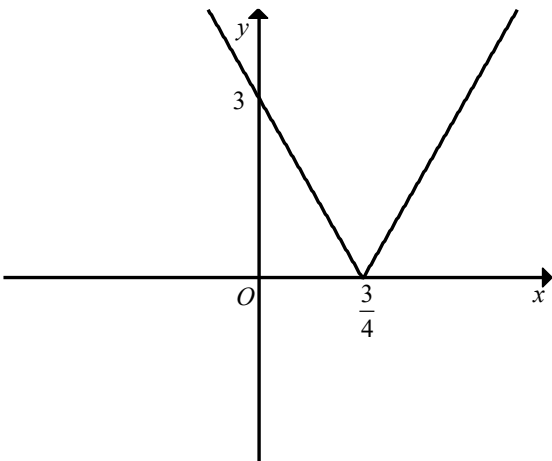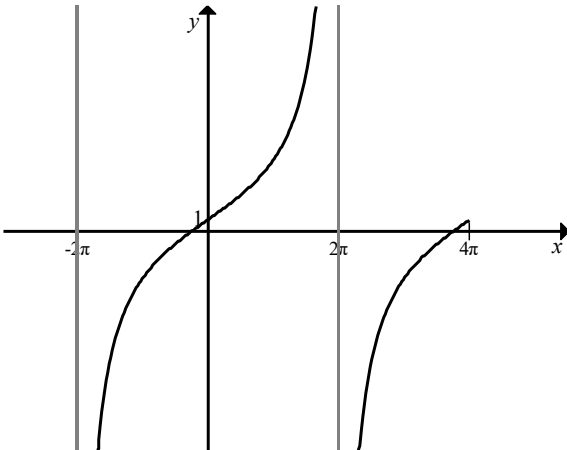
B   Mark for a correct result or statement independent of Method marks.

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	Partial Marks
1	$-2 \leqslant x \leqslant \dfrac{5}{4}$ mark final answer	**B2**	**B1** for the correct critical values
2	Attempts to find $y = 4x - 5x^{-2}$	**M1**	at least one term correct
	$\dfrac{\mathrm{d}y}{\mathrm{d}x} = 4 + 10x^{-3}$	**A1**	
	Correct completion to given answer $\dfrac{2(2x^3 + 5)}{x^3}$	**A1**	
	Alternative version		
	$\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{12x^4 - 8x^4 + 10x}{x^4}$ or equivalent unsimplified form	**(2)**	**M1** for an attempt at the quotient rule with correct structure $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{x^2(their\,12x^2) - \left(4x^3 - 5\right)(their\,2x)}{\left(x^2\right)^2}$
	Correct completion to given answer $\dfrac{2(2x^3 + 5)}{x^3}$	**(A1)**	
3	$\sqrt{y} = mx^3 + c$ soi	**M1**	
	$m = \dfrac{21 - 5}{10 - 2}$ oe or 2	**M1**	
	$c = 5 - 2(2)$ oe or 1	**M1**	**FT** *their m*
	$y = (2x^3 + 1)^2$ oe, isw	**A1**	
	Alternative method		
	$\sqrt{y} = mx^3 + c$ soi	**(M1)**	
	$21 = 10m + c$ and $5 = 2m + c$ and solves to find $m = 2$ or $c = 1$	**(M1)**	
	Finds the other unknown	**(M1)**	**FT** *their m* or *c*
	$y = (2x^3 + 1)^2$ oe, isw	**(A1)**	
4(a)	Range of f is equal to the domain of f oe	**1**	

Question	Answer	Marks	Partial Marks
4(b)	$f^2(x) = 4x - 3$ soi	**B2**	**B1** for correct order of composition
	Correct sketch with both intercepts indicated	**B2**	**FT** *their* $(4x – 3)$ providing B1 has been awarded and the expression is of the form $mx + c$ **B1 FT** for correct sketch with one intercept correct
4(c)	[When $x = –1$] $y = 7$ [When $x = 3$] $y = 9$	**B1**	**FT** *their* $(4x – 3)$ providing it has been formed using a correct order of composition and the expression is of the form $mx + c$
	$a = \dfrac{9-7}{3+1}$ oe or $7 = –a + b$ and $9 = 3a + b$ and solves correctly for one unknown	**M1**	**FT** *their* y-coordinates
	$a = \dfrac{1}{2}$, $b = \dfrac{15}{2}$	**A1**	
5(a)	4π	**B1**	
5(b)	Correct sketch with y-intercept and asymptotes marked	**3**	**B1** for correct shape for both sections **B2** for asymptotes drawn at $–2\pi$, 2π and the y-intercept marked as 1; must have attempted correct shape or **B1** for any two of these; must have attempted correct shape or If 0 scored then **SC1** for correct graph between $–2\pi$ and 2π with asymptotes marked at $–2\pi$, 2π and the y-intercept marked as 1

Question	Answer	Marks	Partial Marks
6(a)	8400	**2**	**M1** for $5 \times 8 \times 7 \times 6 \times 5$ oe
6(b)(i)	3 628 800	**2**	**M1** for $7! \times 6!$
6(b)(ii)	1266	**2**	**M1** for $^{13}C_5 - {}^7C_5$
7(a)	–729 729	**2**	**B1** for $^{15}C_5 \left(x^2\right)^{10} \left(-\dfrac{3}{x^4}\right)^5$ oe
7(b)	$\dfrac{9(8)(7)}{6} a^3 = 7 \times \dfrac{9(8)}{2} a^2$ oe	**M2**	**M1** for $\dfrac{9(8)(7)}{6} a^3 [x^3]$ oe or $\dfrac{9(8)}{2} a^2 \left[x^2\right]$ oe
	$a = 3$ nfww	**A1**	
8(a)	$\dfrac{dy}{dx} = 3e^{3x+2} \tan x + e^{3x+2} \sec^2 x$	**3**	**B1** for $\dfrac{d(e^{3x+2})}{dx} = 3e^{3x+2}$ **M1** for correct structure of product rule **A1 FT** *their* $\dfrac{d(e^{3x+2})}{dx} = 3e^{3x+2}$ for all other components of product rule correct
	Correct small changes relationship e.g. $\dfrac{\delta y}{h} = their \left.\dfrac{dy}{dx}\right|_{x=0.1}$	**M1**	
	$13.1h$ or $13.07[68…]h$	**A1**	**dep** on first three marks awarded
8(b)	$y: \ -\dfrac{1}{3}\cos(3x + \pi) + c$	**B2**	**B1** for $-\dfrac{1}{3}\cos(3x + \pi)$ or for $k\cos(3x + \pi) + c$ where k is $\dfrac{1}{3}$ or $k < 0$
	$\dfrac{4}{3} = -\dfrac{1}{3}\cos\left(\dfrac{3\pi}{9} + \pi\right) + c$	**M1**	**FT** *their* k providing **B1** has been awarded
	$\left[y = -\dfrac{1}{3}\cos\left(\dfrac{5\pi}{4} + \pi\right) + \dfrac{7}{6} = \right] \ \dfrac{7 - \sqrt{2}}{6}$ or exact equivalent	**A1**	
9(a)	$n = 31$ OR $n = \dfrac{150 + d}{d}$	**2**	**M1** for $\dfrac{n}{2}\{9 + 159\} = 2604$ oe OR **M1** for $159 = 9 + d(n-1)$ oe

Question	Answer	Marks	Partial Marks
	$d = 5$	**2**	**M1FT** for $[u_{31} =]159 = 9 + 30d$ or $\dfrac{31}{2}\{18 + 30d\} = 2604$ **FT** *their* derived value of *n* OR **M1 FT** for $\dfrac{1}{2}\left(\dfrac{150+d}{d}\right)\left\{18 + \left(\dfrac{150+d}{d} - 1\right)d\right\} = 2604$ **FT** *their* derived expression for *n* in terms of *d*
	$r = \dfrac{11}{16}$ oe, isw or 0.6875	**2**	**M1FT** $[u_{12} =]9 + 11(their5)$ or 64 and $[u_8 =]9 + 7(their5)$ or 44 soi **FT** *their* value of *d*
	$\left[S_6 = \dfrac{64(1 - 0.6875^6)}{1 - 0.6875} = \right]183$ or 183.2 or 183.17[4…]	**A1**	
9(b)(i)	$\cos 45° = 0.707…$ $\cos 135° = -0.707…$ therefore $-1 < \cos\theta < 1$ oe OR $-1 < \cos\theta < 1$ oe $\rightarrow 0° < \theta < 180°$ oe	**B1**	
9(b)(ii)	$\left[\dfrac{a}{1-r} = \right] \dfrac{\sin\theta}{1 - \cos\theta}$	**M1**	
	$\dfrac{\sin\theta}{1 - \cos\theta} \times \dfrac{1 + \cos\theta}{1 + \cos\theta}$	**A1**	
	$\dfrac{\sin\theta(1 + \cos\theta)}{1 - \cos^2\theta} = \dfrac{\sin\theta(1 + \cos\theta)}{\sin^2\theta}$	**A1**	
	$\dfrac{1}{\sin\theta} + \dfrac{\cos\theta}{\sin\theta} = \operatorname{cosec}\theta + \cot\theta$	**A1**	
10(a)	[magnitude direction =] $\sqrt{20^2 + 21^2}$ oe	**B1**	
	[velocity vector =] $\dfrac{58}{29}(20\mathbf{i} + 21\mathbf{j})$	**M1**	Correctly written column vectors are acceptable all through Q10
	[position vector =] $-30\mathbf{j} + t(40\mathbf{i} + 42\mathbf{j})$ or $(40t)\mathbf{i} + (-30 + 42t)\mathbf{j}$ oe	**A1**	

Question	Answer	Marks	Partial Marks
10(b)	[direction vector =] 24**i** + 7**j** or x-component: $\cos\alpha = \dfrac{24}{25}$ and y-component: $\sin\alpha = \dfrac{7}{25}$	**B1**	
	[velocity vector =] $\dfrac{75}{\sqrt{24^2 + 7^2}}\left(24\mathbf{i} + 7\mathbf{j}\right)$ oe	**M1**	**FT** *their* direction vector
	$72\mathbf{i} + 21\mathbf{j}$ oe	**A1**	
	[position vector =] $-10\mathbf{i} + 18\mathbf{j} + t(72\mathbf{i} + 21\mathbf{j})$ or $(-10 + 72t)\mathbf{i} + (18 + 21t)\mathbf{j}$	**A1**	**FT** *their* velocity vector
10(c)	Solves $40t = -10 + 72t$ and $-30 + 42t = 18 + 21t$ or solves one equation and substitutes the value of t into the other equation	**M1**	**FT** *their* position vectors of P and Q at time t
	Shows correctly that the values of t are not consistent e.g. $t = \dfrac{10}{32}$ and $t = \dfrac{48}{21}$ oe so do not collide oe	**A1**	
11	A correct and simplified equation e.g. $n + 1 = \dfrac{437}{n - 3}$	**B2**	**B1** for an equation with $\left[\dfrac{(n+1)!}{n!} = \right] n + 1$ and 437 or $\left[\dfrac{(n-3)!}{(n-4)!} \text{ oe } = \right] n - 3$ and 437 OR for $\dfrac{(n+1)!}{437(n-4)!} = \dfrac{n!}{(n-3)!}$
	$n^2 - 2n - 440\ [= 0]$	**B1**	**dep** on **B2**
	$n = 22$ as only solution	**B1**	**dep** on all previous marks awarded

Question	Answer	Marks	Partial Marks
12(a)	$15(1-\sin^2(3x+1.5))+7\sin(3x+1.5)-13\,[=0]$	**M1**	
	$15\sin^2(3x+1.5)-7\sin(3x+1.5)-2\,[=0]$	**A1**	
	$(5\sin(3x+1.5)+1)(3\sin(3x+1.5)-2)\,[=0]$	**M1**	Factorises or solves *their* 3-term quadratic in $\sin(3x+1.5)$ **dep** on previous **M1**
	$3x+1.5=-0.201[3\ldots]$ or $3x+1.5=0.729[7\ldots]$ or $3x+1.5=2.41[1\ldots]$ or $3x+1.5=\sin^{-1}\left(their-\dfrac{1}{5}\right)$ or $3x+1.5=\sin^{-1}\left(their\,\dfrac{2}{3}\right)$	**M1**	**dep** on previous **M1** **FT** providing $-1\leqslant their\,-\dfrac{1}{5}\leqslant1$ and/or $-1\leqslant their\,\dfrac{2}{3}\leqslant1$
	$x=0.304$ or $0.3039[54\ldots]$ and $x=-0.257$ or $-0.2567[57\ldots]$ and no extras	**A1**	

Question	Answer	Marks	Partial Marks
12(b)	$30(\cos(3x+1.5))(-3\sin(3x+1.5))$ $+21\cos(3x+1.5)$ $\qquad[=0]$	M2	M1 for correctly differentiating $\cos(3x + 1.5)$ or $\sin(3x + 1.5)$
	$(3\cos(3x+1.5))(7-30\sin(3x+1.5))[=0]$ oe	M1	FT a derivative of the form $a\cos(3x+1.5)\sin(3x+1.5)+b\cos(3x+1.5)[=0]$ where $a < 0$ and $b > 0$
	$3x + 1.5 = \dfrac{\pi}{2}$ or $1.57[0...]$ or $\cos^{-1}(0)$ or $3x + 1.5 = 0.235[5...]$ or $3x+1.5=\sin^{-1}\left(\dfrac{their\ 7}{their\ 30}\right)$	M1	**dep** on previous M1 FT $(their\ 3)\cos(3x + 1.5) \times$ $\{(their\ 7)-(their\ 30)\sin(3x+1.5)\}$ providing *their* $3 \neq 0$ and *their* $30 >$ *their* 7
	$x = 0.0236$ or $0.02359[87...]$ and $x = 0.469$ or $0.4686[96...]$ and no extras	A1	**dep** on all previous marks awarded
13	$4\times8^{2x}+8^{x}-3[=0]$ or $4\times\left(2^{3x}\right)^{2}+2^{3x}-3[=0]$ oe	B1	
	$\left(4(8^{x})-3\right)\left(8^{x}+1\right)$ or $\left(4(2^{3x})-3\right)\left(2^{3x}+1\right)$ oe	M1	FT *their* 3-term quadratic in 8^{x} or 2^{3x}
	$8^{x}=\dfrac{3}{4}$ or $2^{3x}=\dfrac{3}{4}$ oe, nfww	A1	
	$x=\log_{8}(0.75)$ or $\dfrac{1}{3}\log_{2}(0.75)$ or $-0.138[34...]$ oe	A1	and no other solutions