CAMBRIDGE
International Education

# Cambridge IGCSE™

**ADDITIONAL MATHEMATICS** **0606/23**

Paper 2 **May/June 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 May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.



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## 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.

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**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.

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## 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 |
|  | Method mark awarded three |

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| 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 |

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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.

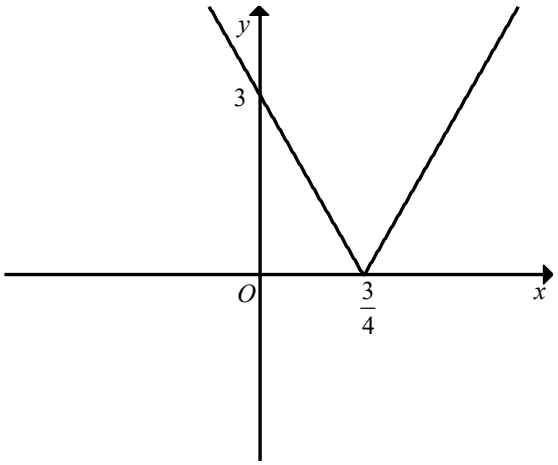
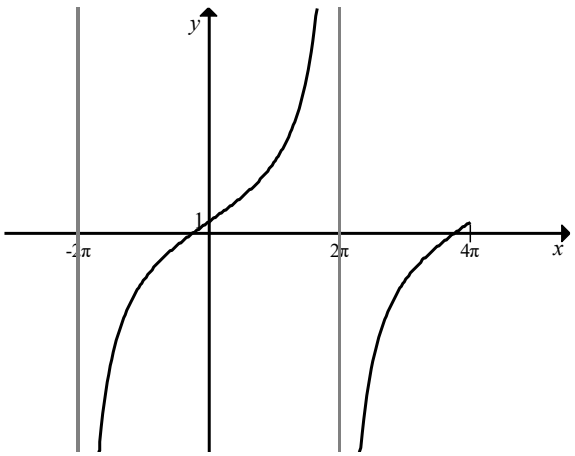
### Abbreviations

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

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 1 | $-2 \leqslant x \leqslant \frac{5}{4}$ mark final answer | **B2** | **B1** for the correct critical values |
| 2 | Attempts to find $y = 4x - 5x^{-2}$ | **M1** | at least one term correct |
| | $\frac{dy}{dx} = 4 + 10x^{-3}$ | **A1** | |
| | Correct completion to given answer $\frac{2(2x^3+5)}{x^3}$ | **A1** | |
| | **Alternative version** | | |
| | $\frac{dy}{dx} = \frac{12x^4 - 8x^4 + 10x}{x^4}$ or equivalent unsimplified form | **(2)** | **M1** for an attempt at the quotient rule with correct structure $\frac{dy}{dx} = \frac{x^2(their 12x^2) - \left(4x^3 - 5\right)(their 2x)}{\left(x^2\right)^2}$ |
| | Correct completion to given answer $\frac{2(2x^3+5)}{x^3}$ | **(A1)** | |
| 3 | $\sqrt{y} = mx^3 + c$ soi | **M1** | |
| | $m = \frac{21-5}{10-2}$ 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** | |

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| 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<br> | **B2** | **FT** *their* $(4x - 3)$ providing B1 has been awarded and the expression is of the form $mx + c$<br><br>**B1 FT** for correct sketch with one intercept correct |
| 4(c) | [When $x = -1$] $y = 7$<br>[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 $mx + c$ |
| | $a = \frac{9-7}{3+1}$ oe<br>or<br><br>$7 = -a + b$ and $9 = 3a + b$ and solves correctly for one unknown | **M1** | **FT** *their* $y$-coordinates |
| | $a = \frac{1}{2}$ , $b = \frac{15}{2}$ | **A1** | |
| 5(a) | $4\pi$ | **B1** | |
| 5(b) | Correct sketch with $y$-intercept and asymptotes marked<br> | **3** | **B1** for correct shape for both sections<br><br>**B2** for asymptotes drawn at $-2\pi$, $2\pi$ and the $y$-intercept marked as 1; must have attempted correct shape<br><br>or **B1** for any two of these; must have attempted correct shape<br><br>or<br><br>If 0 scored then **SC1** for correct graph between $-2\pi$ and $2\pi$ with asymptotes marked at $-2\pi$, $2\pi$ and the $y$-intercept marked as 1 |

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

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

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| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 10(b) | [direction vector =] $24\mathbf{i} + 7\mathbf{j}$<br>or<br>$x$-component: $\cos\alpha = \frac{24}{25}$ and<br>$y$-component: $\sin\alpha = \frac{7}{25}$ | **B1** | |
| | [velocity vector =]<br>$\frac{75}{\sqrt{24^2+7^2}}(24\mathbf{i}+7\mathbf{j})$ oe | **M1** | **FT** *their* direction vector |
| | $72\mathbf{i}+21\mathbf{j}$ oe | **A1** | |
| | [position vector =] $-10\mathbf{i} + 18\mathbf{j} + t(72\mathbf{i} + 21\mathbf{j})$<br>or $(-10 + 72t)\mathbf{i} + (18 + 21t)\mathbf{j}$ | **A1** | **FT** *their* velocity vector |
| 10(c) | Solves<br>$40t = -10 + 72t$ and $-30 + 42t = 18 + 21t$<br>or<br>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.<br>$t = \frac{10}{32}$ and $t = \frac{48}{21}$ oe so do not collide oe | **A1** | |
| 11 | A correct and simplified equation e.g.<br>$n+1 = \frac{437}{n-3}$ | **B2** | **B1** for an equation with<br>$\left[\frac{(n+1)!}{n!} =\right]$ $n + 1$ and 437<br>or $\left[\frac{(n-3)!}{(n-4)!}\text{ oe } =\right]$ $n - 3$ and 437<br>OR<br>for $\frac{(n+1)!}{437(n-4)!} = \frac{n!}{(n-3)!}$ |
| | $n^2 - 2n - 440$ [= 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 $\sin(3x + 1.5)$<br>**dep** on previous **M1** |
| | $3x + 1.5 = -0.201[3\ldots]$ or<br>$3x + 1.5 = 0.729[7\ldots]$ or<br>$3x + 1.5 = 2.41[1\ldots]$ or<br>$3x+1.5=\sin^{-1}\left(their-\frac{1}{5}\right)$ or<br>$3x+1.5=\sin^{-1}\left(their\frac{2}{3}\right)$ | **M1** | **dep** on previous **M1**<br>**FT** providing<br>$-1 \leqslant their\ -\frac{1}{5} \leqslant 1$<br>and/or $-1 \leqslant their\ \frac{2}{3} \leqslant 1$ |
| | $x = 0.304$ or $0.3039[54\ldots]$<br>and<br>$x = -0.257$ or $-0.2567[57\ldots]$<br>and no extras | **A1** | |

| Question | Answer | Marks | Partial Marks |
|---|---|---|---|
| 12(b) | $30(\cos(3x+1.5))(-3\sin(3x+1.5))$ $+21\cos(3x+1.5)$ $[=0]$ | **M2** | **M1** for correctly differentiating $\cos(3x + 1.5)$ or $\sin(3x + 1.5)$ |
| | $(3\cos(3x+1.5))\big(7-30\sin(3x+1.5)\big)[=0]$ 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 $b > 0$ |
| | $3x + 1.5 = \frac{\pi}{2}$ or 1.57[0…] or $\cos^{-1}(0)$ or $3x + 1.5 = 0.235[5\ldots]$ or $3x+1.5=\sin^{-1}\left(\frac{\textit{their } 7}{\textit{their } 30}\right)$ | **M1** | **dep** on previous **M1** **FT** (*their* 3)$\cos(3x + 1.5)$ × $\{(\textit{their } 7)-(\textit{their } 30)\sin(3x+1.5)\}$ providing *their* 3 ≠ 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 $4\times(2^{3x})^{2}+2^{3x}-3[=0]$ 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 $2^{3x}$ |
| | $8^{x}=\frac{3}{4}$ or $2^{3x}=\frac{3}{4}$ oe, nfww | **A1** | |
| | $x=\log_{8}(0.75)$ or $\frac{1}{3}\log_{2}(0.75)$ or –0.138[34…] oe | **A1** | and no other solutions |

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