CAMBRIDGE
International Education

# Cambridge International AS & A Level

**MATHEMATICS** **9709/02**

Paper 2 Pure Mathematics 2 **For examination from 2027**

MARK SCHEME

Maximum Mark: 50

**Specimen**

This document has **10** pages.

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**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:<br><br>• the specific **content** defined in the mark scheme<br>• the specific **skills** defined in the mark scheme or in the level descriptions<br>• 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:<br><br>• marks are not deducted for errors or omissions<br>• 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<br>• 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. |

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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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**Mark Scheme Notes**

Marks are of the following three types.

| | |
|---|---|
| M | Method mark, given for a valid method applied to the problem. Method marks can still be given even if there are numerical errors, algebraic slips or errors in units. However the method must be applied to the specific problem, e.g. by substituting the relevant quantities into a formula. Correct use of a formula without the formula being quoted earns the M mark and in some cases an M mark can be implied from a correct answer. |
| A | Accuracy mark, given for an accurate answer or accurate intermediate step following a correct method. Accuracy marks cannot be given unless the relevant method mark has also been given. |
| B | Mark for a correct statement or step. |
| DM or DB | M marks and B marks are generally independent of each other. The notation DM or DB means a particular M or B mark is dependent on an earlier M or B mark (indicated by *). When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given. |

- A or B marks are given for correct work only (not for results obtained from incorrect working) unless follow through is allowed (see abbreviation FT below).
- Wrong or missing units in an answer should not result in loss of marks unless the guidance indicates otherwise.
- For a numerical answer, allow the A or B mark if the answer is correct to 3 significant figures (sf) or would be correct to 3 sf if rounded (1 decimal point (dp) for angles in degrees). As stated above, an A or B mark is not given if a correct numerical answer is obtained from incorrect working.
- Common alternative solutions are shown in the Answer column as: '**EITHER** Solution 1 **OR** Solution 2 **OR** Solution 3 …'. Round brackets appear in the Partial Marks column around the marks for each alternative solution.
- Square brackets [ ] around text show extra information not needed for the mark to be awarded.
- The total number of marks available for each question is shown at the bottom of the Marks column in bold type.

The following abbreviations may be used in a mark scheme.

| | |
|---|---|
| AG | Answer given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid). |
| CAO | Correct answer only (emphasising that no 'follow through' from an error is allowed). |
| CWO | Correct working only |
| FT | Follow through after error (see Mark Scheme Notes for further details). |
| ISW | Ignore subsequent working |
| OE | Or equivalent form |
| SC | Special case |
| SOI | Seen or implied |

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| Question | Answer | Marks | Partial Marks | Guidance |
|---|---|---|---|---|
| 1(a) | Substitute $x = -1$ and equate to zero | 1 | **M1** | |
| | Obtain answer $a = 7$ | 1 | **A1** | |
| | | **2** | | |
| 1(b) | Substitute $x = -3$ and evaluate expression | 1 | **M1** | |
| | Obtain answer 18 | 1 | **A1** | |
| | | **2** | | |

| Question | | Marks | Partial Marks | Guidance |
|---|---|---|---|---|
| 2 | Use $\sin 2\theta = 2 \sin\theta \cos\theta$ | 1 | **B1** | |
| | Simplify to obtain form $c_1 \sin^2\theta = c_2$ or equivalent | 1 | **M1** | |
| | Find at least one value of $\theta$ from equation of form $\sin\theta = k$ | 1 | **M1** | |
| | Obtain 35.3° and 144.7° | 1 | **A1** | And no others between 0° and 180°.<br>Unsupported answer receives 0 marks. |
| | | **4** | | |

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| Question | Answer | Marks | Partial Marks | Guidance |
|---|---|---|---|---|
| 3(a)(i) | Draw two V-shaped graphs, one with vertex on negative $x$-axis, the other with vertex on positive $x$-axis | 1 | **M1** | |
| | Show graphs in correct relation to each other, with lines (roughly) parallel as appropriate | 1 | **A1** | |
| | | **2** | | |
| 3(a)(ii) | State coordinates $(-2a, 0)$, $(\frac{3}{2}a, 0)$, $(0, 4a)$, $(0, 3a)$ | **1** | **B1** | Accept values inserted at correct points on axes |
| 3(b) | Square both sides to obtain linear equation or inequality and attempt solution<br>**OR** solve linear equation $2x + 4a = -(2x - 3a)$<br>**OR** equivalent<br>**OR** use symmetry of diagram to determine $x$-coordinate of point of intersection | 1 | **M1** | |
| | Obtain value $-\frac{1}{4}a$ and no other | 1 | **A1** | |
| | State answer $x > -\frac{1}{4}a$ | 1 | **A1** | |
| | | **3** | | |

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| Question | Answer | Marks | Partial Marks | Guidance |
|---|---|---|---|---|
| 4(a) | Recognise quadratic equation in $5^x$ and attempt solution for $5^x$ | 1 | **M1** | |
| | Obtain $5^x = 3$ only | 1 | **A1** | |
| | Use logarithms to solve equation of the form $5^x = k$ where $k > 0$ | 1 | **M1** | |
| | Obtain 0.683 | 1 | **A1** | |
| | | **4** | | |
| 4(b) | Use $2\ln x = \ln x^2$ | 1 | **B1** | |
| | Use law for addition or subtraction of logarithms | 1 | **M1*** | |
| | Arrange equation not involving logarithms to the form $y = ...$ | 1 | **DM1** | |
| | Obtain $y = \frac{5}{x^2 - 1}$ | 1 | **A1** | Or equivalent explicit $y = ...$ form |
| | | **4** | | |

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| Question | Answer | Marks | Partial Marks | Guidance |
|---|---|---|---|---|
| 5(a) | Attempt use of quotient rule or equivalent | 1 | **M1** | |
| | Obtain $\frac{2(x+2)\cos 2x - \sin 2x}{(x+2)^2}$ or equivalent | 1 | **A1** | |
| | Equate numerator to zero and attempt rearrangement | 1 | **M1** | |
| | Confirm given result $\tan 2x = 2x + 4$ | 1 | **A1** | AG Showing necessary detail |
| | | **4** | | |
| 5(b) | Consider sign of $\tan 2x - 2x - 4$ for 0.6 and 0.7 or equivalent | 1 | **M1** | |
| | Obtain –2.63 and 0.40 or equivalent and justify conclusion | 1 | **A1** | |
| | | **2** | | |
| 5(c) | Use iteration process correctly at least once | 1 | **M1** | |
| | Obtain final answer 0.694 | 1 | **A1** | |
| | Show sufficient iterations to 5 decimal places to justify answer<br>**OR**<br>show a sign change in the interval (0.6935, 0.6945) | 1 | **A1** | |
| | | **3** | | |

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| Question | Answer | Marks | Partial Marks | Guidance |
|---|---|---|---|---|
| 6(a) | Use product rule to differentiate $y$ | 1 | **M1** | |
| | Obtain $\frac{\mathrm{d}y}{\mathrm{d}t} = 4\mathrm{e}^t + 4t\mathrm{e}^t$ or equivalent | 1 | **A1** | |
| | Use $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{\mathrm{d}y}{\mathrm{d}t} \div \frac{\mathrm{d}x}{\mathrm{d}t}$ | 1 | **M1** | |
| | Obtain given answer $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{2(t+1)}{\mathrm{e}^t}$ correctly | 1 | **A1** | AG |
| | | **4** | | |
| 6(b) | Substitute $t = 0$ to evaluate derivative and find coordinates of point | 1 | **B1** | |
| | Obtain $\frac{\mathrm{d}y}{\mathrm{d}x} = 2$ and coordinates (1, 0) | 1 | **B1** | |
| | Form equation of normal at *their* point, using negative reciprocal of *their* $\frac{\mathrm{d}y}{\mathrm{d}x}$ | 1 | **M1** | |
| | State correct equation of normal $y = -\frac{1}{2}x + \frac{1}{2}$ or equivalent | 1 | **A1** | |
| | | **4** | | |

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| Question | Answer | Marks | Partial Marks | Guidance |
|---|---|---|---|---|
| 7(a) | Replace $\tan^2 x$ by $\sec^2 x - 1$ | 1 | **B1** | |
| | Express $\cos^2 x$ in the form $\pm\frac{1}{2} \pm \frac{1}{2}\cos 2x$ | 1 | **M1** | |
| | Obtain given answer $\sec^2 x + \frac{1}{2}\cos 2x - \frac{1}{2}$ correctly | 1 | **A1** | AG Showing necessary detail |
| | Attempt integration of expression | 1 | **M1** | |
| | Obtain $\tan x + \frac{1}{4}\sin 2x - \frac{1}{2}x$ | 1 | **A1** | |
| | Use limits correctly for integral involving at least $\tan x$ and $\sin 2x$ | 1 | **M1** | |
| | Obtain $\frac{5}{4} - \frac{1}{8}\pi$ or exact equivalent | 1 | **A1** | |
| | | **7** | | |
| 7(b) | State or imply volume is $\int \pi(\tan x + \cos x)^2 \, dx$ | 1 | **B1** | Presence of $\pi$ implied by its appearance later if not shown initially |
| | Attempt expansion and simplification | 1 | **M1** | |
| | Integrate to obtain one additional term of form $k\cos x$ | 1 | **M1** | |
| | Obtain $\pi(\frac{5}{4} - \frac{1}{8}\pi) + \pi(2 - \sqrt{2})$ or equivalent | 1 | **A1** | |
| | | **4** | | |

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