Cambridge Assessment International Education

Cambridge IGCSE™

ADDITIONAL MATHEMATICS **0606/02**

Paper 2 **For examination from 2025**

MARK SCHEME

Maximum Mark: 80

Practice

This document has **12** 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 descriptions for the question
- the specific skills defined in the mark scheme or in the generic level descriptions 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 descriptions.

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 descriptions 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 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.

MARK SCHEME NOTES

The following notes are intended to help with understanding of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Anything in the mark scheme which is in square brackets […] is not required for the mark to be earned, but if present it must be correct.

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.

Types of mark

M Method mark, awarded for a valid method applied to the problem.

A Accuracy mark, given 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.

Abbreviations

awrt	answers which round to
cao	correct answer only
dep	dependent on the previous mark(s)
FT	follow through after error
isw	ignore subsequent working (after correct answer obtained)
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)	$P + Q = 500$ and $P + Qe^2 = 600$	**B1**	
	$Q = \frac{100}{(e^2 - 1)} = 15.7$ or 15.6	**2**	**M1** for attempt to solve by removing P from two equations both containing 3 terms **A1** awrt
	$P = 484$ or 485	**A1**	awrt
	$b = 484.3 + 15.65e^4 = 1339$	**B1**	
1(b)	$e^{2t} = \frac{2\,000\,000 - 484.3}{15.65}$	**M1**	Make e^{2t} the subject
	$2t = \ln\left(\frac{2\,000\,000 - 484.3}{15.65}\right)$	**M1**	Take logs correctly where $e^{2t} > 0$ or $e^n > 0$
	$t = 5.88$ or 5.878 to 5.879	**A1**	nfww; no trial and improvement
2	$x^5 + 10x^3 + 40x + ...$	**3**	**M1** for attempt to expand $\left(x + \frac{2}{x}\right)^5$, with at least 2 correct terms oe **A1** for $10x^3$ **A1** for $40x$
	Term in x^2: $(1 \times 40) - (3 \times 10)$	**M1**	For $(1 \times$ *their* $40) \pm (3 \times$ *their* $10)$
	10	**A1**	
3	$\left[F(x) = \int\left(\sec^2\frac{x}{2} + e^x\right)dx = \right] 2\tan\frac{x}{2} + e^x$	**B3**	**B2** for $2\tan\frac{x}{2}$ or $k\tan\frac{x}{2} + e^x$ or **B1** for $k\tan\frac{x}{2}$ where k is a constant
	$F\left(\frac{\pi}{2}\right) - F\left(\frac{\pi}{4}\right)$	**M1**	**FT** providing at least **B1** awarded; necessary working
	3.79 cao	**A1**	3.78877... If zero scored, award **SC1** for an unsupported answer of 3.79
4(a)(i)	$176 + 9d = 149$	**M1**	
	$d = -3$	**A1**	

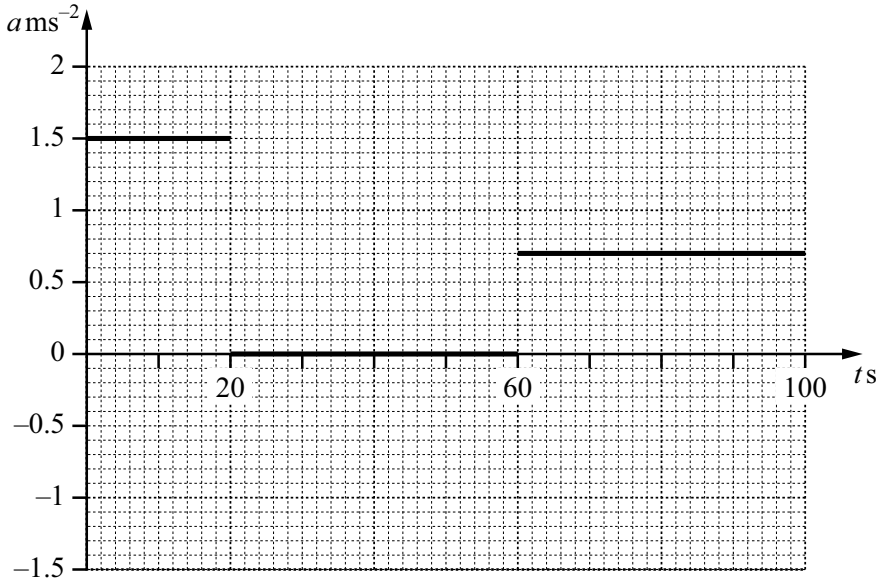
Question	Answer	Marks	Partial Marks
4(a)(ii)	$\frac{n}{2}(352 + (n-1)(-3))$ (< 0)	**M1**	**FT** *their d*
	$\frac{355}{3}$ or 118.3 oe	**A1**	
	119	**A1**	
4(b)(i)	$a = 3$ $r = \frac{2.4}{3} = 0.8$	**B1**	
	$S_8 = \frac{3(1-0.8^8)}{(1-0.8)}$	**M1**	**FT** *their r*
	12.5 or awrt 12.48	**A1**	
4(b)(ii)	15	**B1**	
4(b)(iii)	3(*their* 0.8^9) and use of S_{50}	**M1**	**FT** *their r*
	$\frac{3(\textit{their}\ 0.8^9)(1-\textit{their}\ 0.8^{50})}{1-\textit{their}\ 0.8}$	**M1**	**FT** *their r*
	Correct sum	**A1**	
	2.01 or 2.013[23…]	**A1**	
	Alternative		
	$S_{59} = \frac{3(1-\textit{their}\ 0.8^{59})}{1-\textit{their}\ 0.8}$ or $S_9 = \frac{3(1-\textit{their}\ 0.8^9)}{1-\textit{their}\ 0.8}$	**(M1)**	**FT** *their r*
	$S_{59} = \frac{3(1-0.8^{59})}{1-0.8}$ and $S_9 = \frac{3(1-0.8^9)}{1-0.8}$	**(A1)**	
	Correct plan: $S_{59} - S_9$ oe attempted	**(M1)**	**FT** *their r*
	2.01 or 2.013[23…]	**(A1)**	
5(a)(i)	120	**B1**	
5(a)(ii)	48	**B1**	

Question	Answer	Marks	Partial Marks
5(a)(iii)	Starts with 7 or 9 24	**B1**	May be implied by 12 and 12
	Starts with 8 18	**B1**	
	42	**B1**	
	Alternative		
	Ends with 3 18	**(B1)**	
	Ends with 7 or 9 24	**(B1)**	May be implied by 12 and 12
	42	**(B1)**	
5(b)	${}^{12}C_3 \times {}^{9}C_4 = 220 \times 126$ or ${}^{12}C_5 \times {}^{7}C_4 = 792 \times 35$ or ${}^{12}C_4 \times {}^{8}C_5 = 495 \times 56$ or other equivalents	**M2**	**M1** for one correct combination or value in a product of two or three combinations Must be numeric
	27 720	**A1**	

Question	Answer	Marks	Partial Marks
6(a)	$\frac{dy}{dx} = \frac{(2x+1)\frac{6x}{3x^2-5} - 2\ln(3x^2-5)}{(2x+1)^2}$ or $\frac{dy}{dx} = (2x+1)^{-1}\frac{6x}{3x^2-5} - 2(2x+1)^{-2}\ln(3x^2-5)$	**3**	**B1** for $\frac{6x}{3x^2-5}$ **M1** for attempt at a quotient or equivalent product **A1** for all terms other than $\frac{6x}{3x^2-5}$ correct
	When $x = \sqrt{2}$, $y = 0$	**B1**	May be implied
	When $x = \sqrt{2}$, $\frac{dy}{dx} = \frac{6\sqrt{2}}{2\sqrt{2}+1}$ or $\frac{24-6\sqrt{2}}{7}$ or 2.22 oe Normal: $y = -\frac{(2\sqrt{2}+1)}{6\sqrt{2}}(x-\sqrt{2})$ oe or $y = -\frac{7}{24-6\sqrt{2}}(x-\sqrt{2})$ oe or $y = -\frac{1}{2.22}(x-\sqrt{2})$ oe or $y = -\frac{4+\sqrt{2}}{12}(x-\sqrt{2})$ oe or $y = -0.451(x-\sqrt{2})$ oe or $y = -\frac{9+4\sqrt{2}}{24+6\sqrt{2}}(x-\sqrt{2})$ oe or $y = -0.451x + 0.638$	**2**	**M1** for attempt at normal using *their y* and *their* perpendicular gradient **A1** Allow equivalent surd forms
6(b)	$\frac{6\sqrt{2}}{2\sqrt{2}+1}h$ or $\frac{24-6\sqrt{2}}{7}h$ or other equivalent surd forms or $2.22h$	**B1**	**FT** *their* $\left.\frac{dy}{dx}\right\|_{x=\sqrt{2}}$ from **(a)**

Question	Answer	Marks	Partial Marks
7	$5\frac{\sin x}{\cos x} - 3\frac{\cos x}{\sin x} = \frac{2}{\cos x}$	**B1**	Change $\tan x$, $\cot x$ and $\sec x$ into $\sin x$ and $\cos x$ correctly
	$5\sin^2 x - 3(1 - \sin^2 x) = 2\sin x$	**M1**	Multiply correctly by $\sin x \cos x$ oe and use $\cos^2 x + \sin^2 x = 1$
	$8\sin^2 x - 2\sin x - 3 = 0$	**A1**	Correct 3-term quadratic
	$(2\sin x + 1)(4\sin x - 3) = 0$	**M1**	Factorise or use formula correctly on *their* quadratic
	$\sin x = -\frac{1}{2} \rightarrow x = 210°, 330°$	**A1**	
	$\sin x = \frac{3}{4} \rightarrow x = 48.6°, 131.4°$	**A1**	
8(a)	$\frac{dy}{dx} = (2x - 1) \times \frac{1}{2} \times 4(4x + 3)^{-\frac{1}{2}} + 2(4x + 3)^{\frac{1}{2}}$	**3**	**B1** for $\frac{1}{2} \times 4(4x + 3)^{-\frac{1}{2}}$ oe **M1** for a correct attempt at a product **A1** for all other terms correct
	$\frac{dy}{dx} = 2(4x + 3)^{-\frac{1}{2}}(2x - 1 + 4x + 3)$ or equivalent	**M1**	For attempt to simplify to the given form
	$\frac{dy}{dx} = \frac{4(3x + 1)}{(4x + 3)^{\frac{1}{2}}}$	**A1**	
8(b)	$-\frac{1}{3}$	**B1**	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Partial Marks</th></tr>
<tr><td rowspan="2">8(c)</td><td>For a complete method using
2nd derivative: $\frac{d^2y}{dx^2} = 4\left(\frac{3(4x+3)^{-\frac{1}{2}} - 2(3x+1)(4x+3)^{-\frac{1}{2}}}{4x+3}\right)$
OR
gradient or y values either side or one side of their stationary point, e.g.
<table><tr><td>x</td><td>$< -\frac{1}{3}$</td><td>$-\frac{1}{3}$</td><td>$> -\frac{1}{3}$</td></tr><tr><td>$\frac{dy}{dx}$</td><td>–</td><td>0</td><td>+</td></tr></table><table><tr><td>x</td><td>$< -\frac{1}{3}$</td><td>$-\frac{1}{3}$</td><td>$> -\frac{1}{3}$</td></tr><tr><td>y</td><td>< -2.15</td><td>-2.15</td><td>> -2.15</td></tr></table></td><td>M1</td><td>Must be using values of $x > -\frac{3}{4}$</td></tr>
<tr><td>Minimum</td><td>A1</td><td>Must be from correct work</td></tr>
<tr><td rowspan="3">9(a)(i)</td><td>Finds total area under graph:
$\frac{1}{2}(60 + 40) \times 30 + \frac{1}{2}(30 + V) \times 40$
or
$\frac{1}{2}(20 \times 30) + (40 \times 30) + \frac{1}{2}(30 + V) \times 40$</td><td>M1</td><td>Allow one error in an area but not a missing area;
allow if areas are seen separately</td></tr>
<tr><td>Equates area to 3260 and finds V or $V - 30$</td><td>M1</td><td>dep previous M1</td></tr>
<tr><td>58</td><td>A1</td><td></td></tr>
</table>

Question	Answer	Marks	Partial Marks
9(a)(ii)	Correct a–t graph:  	**2**	**B1** for any two correct sections
9(b)(i)	$v = 3\sin 2t\ (+ c)$	**M1**	Must have $\pm 3\sin 2t$
	$10 = c$	**M1**	**dep** previous **M1**; attempts to find constant
	$v = 3\sin 2t + 10$	**A1**	
9(b)(ii)	$s = -\frac{3}{2}\cos 2t + 10t + d$	**M1**	attempts to integrate *their* v; must have $\pm\frac{3}{2}\cos 2t$
	$d = \frac{3}{2}$	**M1**	**dep** previous **M1**; attempts to find constant
	$s = -\frac{3}{2}\cos 2t + 10t + \frac{3}{2}$ nfww	**A1**	

Question	Answer	Marks	Partial Marks
10(a)	$\angle BOC = 1.5$ rad	**B1**	Check diagram
	$\sin 0.75 = \dfrac{BC/2}{r}$	**M1**	For a complete attempt to find BC – must be using a right-angled triangle to get required result – answer given
	$BC = 2r\sin 0.75$	**A1**	
	Perimeter $= 2r + 2r\sin 0.75 + 4r + 1.5r$	**M1**	**dep** previous **M1** attempt at perimeter
	Correct completion to given answer: $r(7.5 + 2\sin 0.75)$	**A1**	
10(b)	Correct plan, e.g. Rectangle – segment Rectangle – sector + triangle	**M1**	
	rectangle: $(2r + 2r\sin 0.75)r$	**M1**	**FT** *their* $2r\sin 0.75$
	segment: $\frac{1}{2}r^2(1.5 - \sin 1.5)$ $[= 0.251r^2]$	**B1**	
	Area $= 3.11r^2$	**A1**	