Cambridge Assessment International Education

Cambridge O Level

ADDITIONAL MATHEMATICS **4037/01**

Paper 1 Non-calculator **For examination from 2025**

MARK SCHEME

Maximum Mark: 80

Specimen

 [Turn over

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.

Maths-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, 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 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.

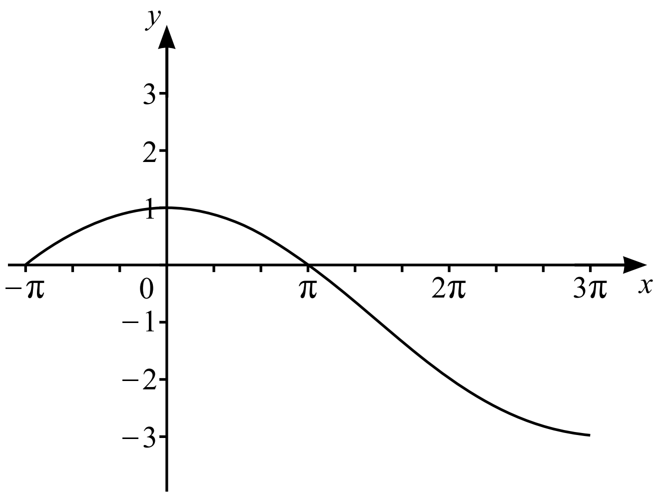
A Accuracy mark, given for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.

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

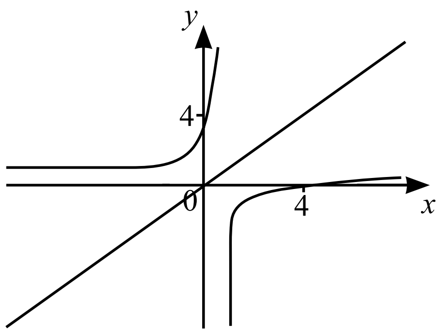
Abbreviations

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	$f(x) = \pm 5(x+1)(2x-1)(x-2)$	**3**	**B1** for ± **B1** for 5 **B1** for $(x+1)(2x-1)(x-2)$ or equivalent factorisation
2(a)	$p(2): 48 + 4a + 2b + 2 = 0$ $2a + b + 25 = 0$	**B1**	For $2a + b + 25 = 0$ or multiple
	$p(1) = -2p(0)$ $a + b + 12 = 0$	**B1**	For $a + b + 12 = 0$
	$a = -13$, $b = 1$	**2**	**M1** for attempt to solve *their* equations in a and b leading to 2 values **A1** for both
2(b)(i)	$p\left(\frac{1}{2}\right) = \frac{6}{8} - \frac{13}{4} + \frac{1}{2} + 2$	**M1**	For attempt to find $p\left(\frac{1}{2}\right)$ using *their* a and b
	0	**A1**	
2(b)(ii)	$(x-2)(2x-1)(3x+1)$	**2**	**M1** for realising that 2 factors are known and 3rd factor can be obtained by observation or algebraic long division, or for making use of $x - 2$ or $2x - 1$ in order to obtain a quadratic factor **A1** Must see all factors together
3(a)	2	**B1**	
3(b)	6π or 1080°	**B1**	

Question	Answer	Marks	Partial Marks
3(c)		**3**	**B1** for a <u>curve</u> passing through (–π, 0) and (3π, –3) **B1** for correct shape with max on *y*-axis and a min at $x = 3\pi$ **B1** for passing through (0, 1) and (π, 0) only on the positive *x*-axis
4	$\overrightarrow{OB} = \mathbf{a} + \mathbf{c}$	**B1**	
	$\overrightarrow{DC} = \frac{2}{3}\mathbf{c}$ or $\overrightarrow{OD} = \frac{1}{3}\mathbf{c}$	**B1**	
	$\overrightarrow{CE} = \frac{1}{3}(\mathbf{a} - \mathbf{c})$ or $\overrightarrow{OE} = \frac{1}{3}(\mathbf{a} + 2\mathbf{c})$	**B1**	Allow unsimplified
	$\overrightarrow{DE} = \frac{1}{3}(\mathbf{a} + \mathbf{c})$	**B1**	
	$k = 3$	**B1**	
5(a)	$p = 16$	**2**	**B1** for $\log_a \frac{5p}{4} = \log_a 20$ oe **B1** for 16, nfww
5(b)	$(3(3^x) - 1)(3^x + 3) = 0$	**M1**	For recognition of a correct quadratic in 3^x and an attempt to factorise or use the quadratic formula
	$3^x = \frac{1}{3}$ $x = -1$	**2**	**M1 dep** for a correct attempt to solve $3^x = k$, $k > 0$ **A1** for one solution only, which must be from a correct solution

Question	Answer	Marks	Partial Marks
5(c)	**Either** $\log_y 2 = \frac{1}{\log_2 y}$ **or** $\log_2 y = \frac{1}{\log_y 2}$ **or** $\log_y 2 = \frac{\log_a 2}{\log_a y}$ and $\log_2 y = \frac{\log_a y}{\log_a 2}$	**B1**	May be implied
	Either $4(\log_y 2)^2 - 4(\log_y 2) + 1 = 0$ $(2\log_y 2 - 1)^2 = 0$, $\log_y 2 = \frac{1}{2}$ **or** $(\log_2 y)^2 - 4(\log_2 y) + 4 = 0$ $(\log_2 y - 2)^2 = 0$, $\log_2 y = 2$ **or** $(\log_a y)^2 - 4(\log_a 2)\log_a y + 4(\log_a 2)^2 = 0$ $(\log_a y - 2\log_a 2)^2 = 0$ $\log_a y = 2\log_a 2$	**M1**	For obtaining a 3-term quadratic equation in either $\log_y 2$ or $\log_2 y$ and solving to obtain $\log_y 2 = k$ or $\log_2 y = k$, may be implied or equivalent using an alternative base
	$y = 4$	**A1**	
6(a)(i)	$f(x) > 1$	**B1**	
	$g(x) \in \mathbb{R}$	**B1**	
6(a)(ii)	$g(0) = 1$, $g(1) = 2$	**M1**	For attempt at $g^2(0)$ or $g^2(x)$
6(a)(iii)	Attempt at f(2) or $fg^2(x)$	**M1**	Must have the correct order of operations
	$fg^2(0)$ or $f(2) = 3e^4 + 1$	**A1**	

Question	Answer	Marks	Partial Marks
6(a)(iv)		**B1**	For correct f and (0, 4) , must be in first and second quadrant
		B1	For correct f^{-1} and (4, 0), must be in first and fourth quadrant
		B1	For $y = x$ and/or symmetry implied, by 'matching intercepts'. No intersection.
		B1	For both asymptotes $x = 1$ and $y = 1$
6(b)(i)	Undefined at $x = 0$ oe	**B1**	
6(b)(ii)	$4 = a + b$	**M1**	For attempt at h(1) and differentiation to obtain h′(1), must have the form $h'(x) = \frac{p}{x^3}$ oe
	$b = -8$ $a = 12$	**A1**	For both
7(a)	$a + 4d = \frac{1}{3}(a + 15d)$	**B1**	
	$a + 4d + a + 15d = 33$	**B1**	
	$a = \frac{9}{4}, d = \frac{3}{2}$	**2**	**M1** for attempt to solve *their* equations simultaneously **A1** for both
	$S_{10} = \frac{10}{2}\left(2\left(\frac{9}{4}\right) + 9\left(\frac{3}{2}\right)\right)$	**M1**	For correct use of the sum formula for 10 terms using *their a* and *d*
	90	**A1**	

Question	Answer	Marks	Partial Marks
7(b)	$a + ar = 16$	**B1**	
	$\dfrac{a}{1-r} = 25$	**B1**	
	$\dfrac{16}{25} = (1-r)(1+r)$	**M1**	For attempt to obtain and solve an equation in r only
	$r = \pm\dfrac{3}{5}$	**A1**	For both ±
	$a = 10$	**A1**	
	$a = 40$	**A1**	
	Alternative $a + ar = 16$	**(B1)**	
	$\dfrac{a}{1-r} = 25$	**(B1)**	
	$a^2 - 50a + 400 = 0$	**(2)**	**M1** for attempt to obtain a 3-term quadratic equation in a using *their* equations
	$a = 10$ and $a = 40$	**(2)**	**M1** for attempt to solve *their* quadratic
8(a)	$\left[\ln(2x+3) + \ln(3x-1) - \ln x\right]_1^a$	**2**	**B1** for 1 term correct **B1** all correct
	$(\ln(2a+3) + \ln(3a-1) - \ln a) - (\ln 5 + \ln 2)$	**M1**	Correct substitution of limits, dep on first **B1**, ignore equality Must have 3 terms involving x
	$\ln\dfrac{(2a+3)(3a-1)}{10a} = \ln 2.4$	**M1**	For use of both addition and subtraction rules, ignore equality, or for use of addition rule on each side of an equation
	$6a^2 - 17a - 3 = 0$	**A1**	
	$a = 3$	**2**	**M1** for solution of *their* quadratic **A1** for $a = 3$ only
8(b)(i)	$18k\sin^2 kx\cos kx$	**2**	**M1** for $p\sin^2 kx\cos kx$, where p is a multiple of k
8(b)(ii)	$\dfrac{1}{6}\sin^3 2x + c$	**2**	**B1** for $\dfrac{1}{6}\sin^3 2x$

Question	Answer	Marks	Partial Marks
9(a)	$v = \frac{1}{2}(3t+2)^{\frac{2}{3}}\ (+c)$	**M1**	For $k(3t+2)^{\frac{2}{3}}$
	$v = \frac{1}{2}(3t+2)^{\frac{2}{3}} + 6$	**2**	**M1 dep** for use of $s = 4.8$ and $t = 2$ in *their* expression for v to find c
9(b)	$t \geqslant 0$ so $v > 0$ oe	**B1**	
9(c)	$s = \frac{1}{10}(3t+2)^{\frac{5}{3}} + 6t\ (+d)$	**M1**	For $p(3t+2)^{\frac{5}{3}}$
	$s = \frac{1}{10}(3t+2)^{\frac{5}{3}} + 6t - 20$	**2**	**M1 dep** for use of $v = 8$ and $t = 2$ in *their* expression for s to find d
	When $t = \frac{25}{3}$, $s = 54.3$	**A1**	
10	$(x-2)^2 + (y+4)^2 = 9$ oe	**B1**	For equation of the circle
	$(x-2)^2 + (2x+1)^2 = 9$ oe or $\left(\frac{y-1}{2}\right)^2 + (y+4)^2 = 9$	**M1**	For obtaining an equation in one variable using *their* equation for the circle and $y = 2x - 3$ and attempt to solve to obtain either $x = \ldots$ or $y = \ldots$
	$x = \frac{2}{\sqrt{5}}, y = \frac{4}{\sqrt{5}} - 3$ $x = -\frac{2}{\sqrt{5}}, y = -\frac{4}{\sqrt{5}} - 3$	**2**	**A1** for one correct set of coordinates **A1** for a second correct set of coordinates
	$(AB)^2 = \left(\frac{4}{\sqrt{5}}\right)^2 + \left(\frac{8}{\sqrt{5}}\right)^2$	**M1**	For use of Pythagoras' theorem to obtain the length AB, using *their* coordinates for A and B
	$AB = 4$	**A1**	
	$XY = 6$	**B1**	
	Area of kite = 12	**A1**	**FT** on *their* $\frac{1}{2} \times AB \times 6$