Cambridge Assessment International Education

Cambridge O Level

ADDITIONAL MATHEMATICS **4037/12**

Paper 1 **May/June 2020**

MARK SCHEME

Maximum Mark: 80

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

This document consists of **9** 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 descriptors 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.

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 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.

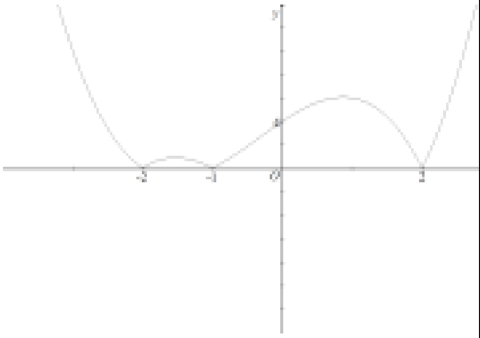
A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.

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

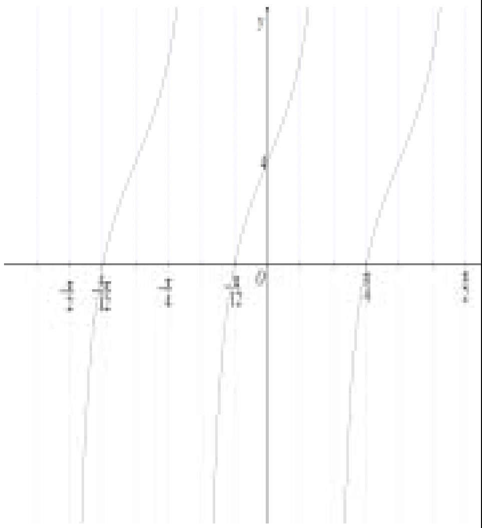
Question	Answer	Marks	Partial Marks
1		**B1**	Shape
		B1	Correct x-coordinates
		B1	Correct y-coordinate and max in first quadrant
2	$\frac{\mathrm{d}r}{\mathrm{d}t}=0.5$	**B1**	
	$\frac{\mathrm{d}V}{\mathrm{d}r}=4\pi r^2$	**B1**	
	$\frac{\mathrm{d}V}{\mathrm{d}t}=\frac{\mathrm{d}V}{\mathrm{d}r}\times\frac{\mathrm{d}r}{\mathrm{d}t}$ $\frac{\mathrm{d}V}{\mathrm{d}t}=\pi r^2$	**M1**	For attempt to use a correct form of the chain rule
	When $r=\frac{1}{4}$, $\frac{\mathrm{d}V}{\mathrm{d}t}=0.125\pi$	**A1**	
3(a)	$4096-384x+15x^2$	**B1**	For 4096
		B1	For $-384x$
		B1	For $15x^2$
3(b)	$(4096-384x+15x^2)\left(x^2-2+\frac{1}{x^2}\right)$	**B1**	For $\left(x^2-2+\frac{1}{x^2}\right)$
	Term independent of x : $-2(4096)+15$	**M1**	For use of 2 appropriate terms
	–8177	**A1**	
4(a)(i)	720	**B1**	
4(a)(ii)	600	**B1**	**FT** on *their* (i) $\times\frac{5}{6}$

Question	Answer	Marks	Partial Marks
4(a)(iii)	Starting with 8: $1\times4\times3\times2\times1=24$	B1	
	Starting with 3, 5 or 7: $3\times4\times3\times2\times2=144$	M1	May be considering each case separately, need all three cases for M1
		A1	
	Total $=168$	A1	
4(a)(iii)	**Alternative** Plan for adding numbers ending in 2 and numbers ending in 8	M1	
	Ending in 2: $\left(\frac{1}{6}\times720\right)\times\frac{4}{5}=96$	B1	Allow unsimplified
	Ending in 8: $\left(\frac{1}{6}\times720\right)\times\frac{3}{5}=72$	B1	Allow unsimplified
	Total $=168$	A1	
4(b)	${}^nC_3=6\,{}^nC_2$	B1	$\frac{n(n-1)(n-2)}{3!}$
	$\frac{n(n-1)(n-2)}{3!}=\frac{6n(n-1)}{2!}$	B1	$\frac{6n(n-1)}{2!}$
	$n(n-1)\left[(n-2)-18\right]=0$	M1	Valid attempt to solve, must have at least one previous B mark
	$n=20$	A1	
4(b)	**Alternative** ${}^nC_3=6\,{}^nC_2$ $(n-2)!2!=(n-3)!3!$	B1	For dealing with $(n-2)!$ and $(n-3)!$ to obtain $(n-2)$
	$(n-2)=6\times3$	B1	For dealing with 2! and 3! To obtain 6
	$n=20$	M1	Valid attempt to solve, must have at least one previous B mark
		A1	
5(a)	$\mathrm{f}>9$	B1	Allow y but not x
5(b)	It is a one-one function because of the restricted domain	B1	

Question	Answer	Marks	Partial Marks
5(c)	$x=(2y+3)^2$ or equivalent	M1	For a correct attempt to find the inverse
	$y=\dfrac{\sqrt{x}-3}{2}$	M1	For correct rearrangement
	$\mathrm{f}^{-1}=\dfrac{\sqrt{x}-3}{2}$	A1	Must have correct notation
5(d)	$x>9$	B1	**FT** on *their* (a)
5(e)	$\mathrm{f}(\ln(x+4))=49$	M1	For correct order
	$(2\ln(x+4)+3)^2=49$ $\ln(x+4)=2$	M1	For correct attempt to solve, dep on previous M mark, as far as $x=$
	$x=\mathrm{e}^2-4$	A1	
6(a)	$A\left(-\dfrac{5}{2},\ 0\right)$	B1	
	$x(-5-2x)+3=0$ $2x^2+5x-3=0$ $(2x-1)(x+3)=0$	M1	For attempt to eliminate one variable, obtain a 3-term quadratic equation = 0 and attempt to solve
	$B\left(\dfrac{1}{2},\ -6\right)$	A1	Allow A1 if just the x-coordinates or just the y-coordinates are given
6(b)	Area of triangle $=\dfrac{1}{2}\left(\dfrac{5}{2}+\dfrac{1}{2}\right)\times 6$, $=9$	M1	For attempt at triangle using *their* values
	$\int_{\frac{1}{2}}^{1}-\dfrac{3}{x}\mathrm{d}x=[-3\ln x]_{\frac{1}{2}}^{1}$	M1	For attempt to integrate, must have ln
	$=3\ln\dfrac{1}{2}$	M1	correct application of limits, dep on previous M mark
	$=-3\ln 2$	M1	realisation that value of integral is negative and making the adjustment
		M1	application of log law, dep on previous M mark
	Area = 9 + ln8	A1	

Question	Answer	Marks	Partial Marks
7(a)	$\frac{dy}{dx} = \left(x^2-1\right)\frac{5}{2}(5x+2)^{-\frac{1}{2}} + 2x(5x+2)^{\frac{1}{2}}$	B1	For $\frac{5}{2}(5x+2)^{-\frac{1}{2}}$
		M1	For differentiation of a product
		A1	
	$\frac{dy}{dx} = \frac{(5x+2)^{-\frac{1}{2}}}{2}\left(5\left(x^2-1\right)+4x(5x+2)\right)$ or equivalent	M1	Dep on previous M mark for attempt to simplify
	$\frac{dy}{dx} = \frac{25x^2+8x-5}{2\sqrt{5x+2}}$	A1	
7(b)	$25x^2+8x-5=0$	M1	Equating their numerator in (a) to zero and attempt to solve
	$x=0.315$	A1	
	$y=-1.70$	A1	
7(c)	Consideration of gradient or y values either side of stationary point, remembering that $x>0$.	M1	Must be a complete method making use of *their* (a). Allow consideration of $25x^2+8x-5$ as a 'minimum curve'. Accept 2nd derivative method.
	Minimum	A1	
8(a)	$\mathbf{b}-\mathbf{a}$	B1	
8(b)	$\frac{1}{4}\mathbf{a}+\frac{1}{2}(\mathbf{b}-\mathbf{a})$ or $-\frac{3}{4}\mathbf{a}+\frac{1}{2}(\mathbf{a}+\mathbf{b})$	B1	For $\frac{1}{4}\mathbf{a}$ or $-\frac{3}{4}\mathbf{a}$
		B1	For $\frac{1}{2}(\mathbf{b}-\mathbf{a})$ or $\frac{1}{2}(\mathbf{a}+\mathbf{b})$
	$\frac{1}{2}\mathbf{b}-\frac{1}{4}\mathbf{a}$	B1	Correct and simplified
8(c)	$n\left(\frac{1}{2}\mathbf{b}-\frac{1}{4}\mathbf{a}\right)$	B1	**FT** on *their* answer to (b)
8(d)	$\frac{1}{2}(\mathbf{b}-\mathbf{a})+k\mathbf{b}$	M1	For use of *their* (a) and $k\mathbf{b}$
		A1	

Question	Answer	Marks	Partial Marks
8(e)	$\frac{1}{2}(\mathbf{b}-\mathbf{a})+k\mathbf{b}=n\left(\frac{1}{2}\mathbf{b}-\frac{1}{4}\mathbf{a}\right)$ $-\frac{1}{2}=-\frac{n}{4}$ $\frac{1}{2}+k=\frac{n}{2}$	M1	For equating *their* (c) and (d) and then equating like vectors to obtain 2 equations
	$n=2$	A1	
	$k=\frac{1}{2}$	A1	
9(a)(i)	$v=20\cos 2t$ when $t=\pi$, $v=20$	B1	
9(a)(ii)	$20\cos 2t=0$	M1	Equating *their* (i) to zero, must be a cosine and attempt to solve
	$t=\frac{\pi}{4}$	A1	
9(a)(iii)	$a=-40\sin 2t$	M1	Attempt to differentiate *their* v, dep on previous M mark, and use *their* value for (ii)
	–40	A1	
9(b)(i)	35	B1	
9(b)(ii)	$112.5=\frac{1}{2}(35+x)\times 5$	M1	Use of area under appropriate part of the graph
		A1	
	$x=10$	A1	
9(b)(iii)	$\frac{25}{5}=\frac{10}{t'}$	M1	Using a ratio method or otherwise, find extra time to stop = 2s or equivalent
	$t'=2$	A1	
	27	A1	

Question	Answer	Marks	Partial Marks
10(a)	$3x = -\frac{5\pi}{4} - \frac{\pi}{4}, \ \frac{3\pi}{4}$	**M1**	For a correct attempt to solve, may be implied by one correct solution
	$x = -\frac{\pi}{12}$	**A1**	
	$x = \frac{\pi}{4}$	**A1**	
	$x = -\frac{5\pi}{12}$	**A1**	
10(b)		**B1**	Shape – must have three 'parts' with asymptotes
		B1	For correct *x*-coordinates
		B1	For correct *y*-coordinate