CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 2012 series

4037 ADDITIONAL MATHEMATICS

4037/22   Paper 2, maximum raw mark 80

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 will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2012 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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Mark Scheme Notes

Marks are of the following three types:

M   Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.

A   Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).

B   Accuracy 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 generally independent unless the scheme specifically says otherwise; and similarly when there are several B marks allocated. The notation DM or DB (or dep*) is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.

•   The symbol $\sqrt{}$ implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only. A and B marks are not given for fortuitously "correct" answers or results obtained from incorrect working.

•   Note: B2 or A2 means that the candidate can earn 2 or 0.
                     B2, 1, 0 means that the candidate can earn anything from 0 to 2.

The following abbreviations may be used in a mark scheme or used on the scripts:
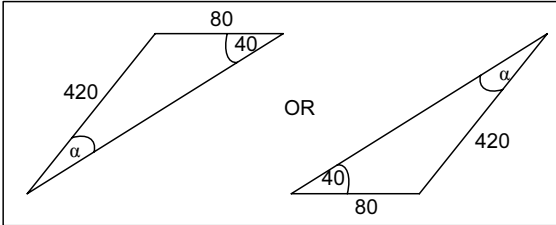
AG   Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)

BOD   Benefit of Doubt (allowed when the validity of a solution may not be absolutely clear)

CAO   Correct Answer Only (emphasising that no "follow through" from a previous error is allowed)

ISW   Ignore Subsequent Working

MR   Misread

PA   Premature Approximation (resulting in basically correct work that is insufficiently accurate)

SOS   See Other Solution (the candidate makes a better attempt at the same question)

Penalties

MR –1   A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through √" marks. MR is not applied when the candidate misreads his own figures – this is regarded as an error in accuracy.

OW –1,2 This is deducted from A or B marks when essential working is omitted.

PA –1   This is deducted from A or B marks in the case of premature approximation.

S –1   Occasionally used for persistent slackness – usually discussed at a meeting.

EX –1   Applied to A or B marks when extra solutions are offered to a particular equation. Again, this is usually discussed at the meeting.

1	$7x + 5 = 3x - 13$	M1	Equate and attempt to solve
	$x = -4.5$ o.e.	A1	
	$7x + 5 = 3x + 13$	M1	Equate
	$x = 0.8$ o.e.	A1	Mark final answers
	OR	[4]	
	Square and Equate	M1	Both expressions must have 3 terms
	$10x^2 + 37x - 36(= 0)$ o.e.	A1	Three terms
	$(5x - 4)(2x + 9)[= 0]$	M1	Factorise or formula of three term
	$x = 0.8$ and $x = -4.5$	A1	quadratic.
	OR		
	Plot $y = \lvert 7x + 5 \rvert$	M1	Shape and intercepts must be correct
	Plot $y = \lvert 3x - 13 \rvert$	M1	Shape and intercepts must be correct
	$x = 0.8$	A1	
	$x = -4.5$	A1	

2	$\left(\dfrac{\mathrm{d}A}{\mathrm{d}r} = \right) 4\pi r + 10\pi$	B1,B1	
	Use $\dfrac{\mathrm{d}A}{\mathrm{d}t} = \dfrac{\mathrm{d}A}{\mathrm{d}r} \times \dfrac{\mathrm{d}r}{\mathrm{d}t}$ with $r = 6$	M1	Their $\dfrac{\mathrm{d}A}{\mathrm{d}r}$
	6.8	A1	Rounds to 6.8
		[4]	

3	Rearrange to $ax^2 + bx + c$ [$= 0$]	M1	
	$(2x - 1)(2x - 7)[< 0]$	M1	Factorise or formula
	0.5 and 3.5	A1	
	$0.5 < x < 3.5$	A1	not $\leqslant$ mark final statement.
		[4]	

4	**(i)**	$8 \ (2^3)$ or 56	B1	
		$-448(x^5)$	B1	Mark final answer
			[2]	
	(ii)	$1120(x^4)$	B1	
		$2 \times$ their 1120 and their -448 used	M1	
		$1792(x^5)$	A1	
			[3]	

5	**(i)**	Evidence of 6, 5, 4, and 3 only	M1	Numbers listed but not added.
		360	A1	
			[2]	
	(ii)	Evidence of 2×3 for outside digits	B1	
		Evidence of 4×3 for inside digits	B1	$^4P_2$ used correctly.
		72	B1	
			[3]	

6	**(i)**	Express as powers of 2	M1	At least one : 2^{6y-9} or 2^{4x-4y} o.e.
		Correctly reaches $3x + 2y = 6$	A1 AG	
			[2]	
	(ii)	Express as powers of 5	M1	Both correct 5^2 and 5^{3x-6} o.e.
		$y = 3x - 4$ o.e.	A1	Three terms
		Attempt to solve simultaneous equations	M1	Equations must be linear
		$x = \dfrac{14}{9}$ and $y = \dfrac{2}{3}$	A1	Accept decimals that round to correct 3sf
			[4]	

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7	(i)	$\sec^2 4x$	M1	One term only
		$\times 4$	A1 [2]	
	(ii)	$x +$	B1	
		$\tan 4x$	M1	No additional terms
		$\div 4$	A1 [3]	isw
	(iii)	Correct use of limits	M1	Expression must have 2 integrated terms in x from **(ii)**.
		$k = \dfrac{1}{8}$	A1 [2]	Rounds to 0.125. Accept $\dfrac{\pi}{8}$ or 0.125π

8	(i)	$(b=)\dfrac{7-4}{8-2}=\left[\dfrac{1}{2}\right]$	B1 M1	Finding gradient Finding y intercept
		$(\lg a)=3$	M1	$\lg y = c + m\lg x$ is sufficient
		$\lg y = \lg a + b\lg x$ or $\lg y - 4 = b(\lg x - 2)$ or $\lg y = 3 + 0.5\lg x$		
		$a = 1000$ or 10^3	A1	
		$y = 1000x^{0.5}$ or $1000\sqrt{x}$	A1 [5]	
	(ii)	$m = 1$	B1 [1]	
	(iii)	$c = 6$	B1 [1]	

9	(i)		B1	Correct triangle
		$\dfrac{\sin \alpha}{80} = \dfrac{\sin 40}{420}$	M1	Use of sine or cosine rule in any triangle with some of 80,420, their v and an angle.
		$\alpha = 7.03$ or 7 Bearing 223 $(230 - \alpha)$	A1 A1✓ [4]	
	(ii)	$\dfrac{v}{\sin \text{their}133} = \dfrac{420}{\sin 40}$	M1	Use of sine or cosine rule in any triangle with 80 or 420 or both.
		$v = 478$	A1	
		Use time $\dfrac{1000}{v}$	M1	v calculated from a triangle
		2.09 hours or 2 hours 5 minutes	A1 [4]	Units required

10 (i)	Integrate to find v	M1	Increase of powers seen at least once
	$v = 4t - t^2(+ c)$	A1	
	Use $t = 0$, $v = 12$ to find $c = 12$	B1	
	$v = 4t - t^2 + 12$	M1	Solve three term quadratic
	$t = 6$	A1	Do not penalize $t = -2$.
		[5]	
(ii)	Integrate to find s	M1	Increase of powers on at least 2 terms
	$s = 2t^2 - \dfrac{t^3}{3} + 12t$	A1✓	3 terms
		A1	cao
	$s = 72$	**[3]**	
11 (a)	$\tan x = -2.25$	B1	
	114	B1	Rounds to 114.0 isw
	294	B1✓	Their $114 + 180$ from tan function isw
		[3]	
(b)	Uses $\operatorname{cosec} y = \dfrac{1}{\sin y}$	B1	Seen anywhere
	Forms quadratic in $\sin y$: $12\sin^2 y + \sin y - 1$ $[= 0]$	M1	Must be 3 terms
	$(4\sin y - 1)(2\sin y + 1)[= 0]$	M1	Factorise or formula of 3 term quadratic.
	14.5 and 199.5	A1	Any 2 values isw
	165.5 and 340.5	A1	The other 2 values isw
		[5]	
(c)	$\cos\left(\dfrac{z}{3}\right) = \dfrac{3}{5}$	B1	
	$\dfrac{z}{3} = 0.927$	M1	Solves their equation in radians
	$z = 2.78$ to 2.79 inc	A1	isw
	$z = 16.1$	A1	Rounds to isw
		[4]	
12 EITHER			
(i)	$y\, A e^{-\frac{1}{4}x}\,(+ c)$	M1	Integrate : $e^{-\frac{x}{4}}$ seen
		A1	
	$A = -4$	DM1	
	Substitute $(0, 10)$		
	$y = 14 - 4e^{-\frac{1}{4}x}$	A1	
	$14 - 4e$	A1	
		[5]	
(ii)	Tangent at A is $y - 10 = x$	B1	
	Gradient tangent at B is e	B1	
	Tangent at B is $y + 4e - 14 = ex + 4e$	B1✓	With their gradient and answer to **(i)**
	Solve equations of tangents	M1	Two linear equations
	$x = \dfrac{4}{1 - e}$ o.e.	A1	
		[5]	

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12 OR

(i)

$$\frac{dy}{dx} = -\frac{1}{3}e^{-\frac{1}{3}x}$$

M1 $Ae^{-\frac{x}{3}}$ only one term

at $(0, 9)$ $\frac{dy}{dx} = -\frac{1}{3}$

A1

Grad normal = 3   M1   Use of $m_1 m_2 = -1$

Point Q is $(-3, 0)$ A1   Condone $x = -3$

[4]

(ii)

Area rectangle $24 + 3e$ (32.1)   M1   Their $3 \times$ their $(8 + e)$

$$\int_{-3}^{0} 8 + e^{-\frac{x}{3}} \, dx$$

M1   Integrate: $8x$ and $e^{-\frac{x}{3}}$ seen

$$= \left[8x - 3e^{-\frac{x}{3}} \right]_{-3}^{0}$$

A1

$21 + 3e$ (29.1)   M1   Correct use of limits their –3 and 0

Shaded area = 3   A1

A1

[6]