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 √ 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.

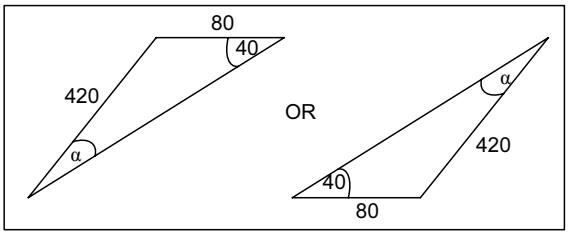
OW –1,2 This is deducted from A or B marks when essential working is omitted.

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	$7x + 5 = 3x - 13$ $x = -4.5$ o.e. $7x + 5 = 3x + 13$ $x = 0.8$ o.e. OR Square and Equate $10x^2 + 37x - 36(= 0)$ o.e. $(5x - 4)(2x + 9)[= 0]$ $x = 0.8$ and $x = -4.5$ OR Plot $y = \lvert 7x + 5 \rvert$ Plot $y = \lvert 3x - 13 \rvert$ $x = 0.8$ $x = -4.5$	M1 A1 M1 A1 [4] M1 A1 M1 A1 M1 M1 A1 A1	Equate and attempt to solve Equate Mark final answers Both expressions must have 3 terms Three terms Factorise or formula of three term quadratic. Shape and intercepts must be correct Shape and intercepts must be correct
2	$\left(\frac{dA}{dr} = \right) 4\pi r + 10\pi$ Use $\frac{dA}{dt} = \frac{dA}{dr} \times \frac{dr}{dt}$ with $r = 6$ 6.8	B1,B1 M1 A1 [4]	 Their $\frac{dA}{dr}$ Rounds to 6.8
3	Rearrange to $ax^2 + bx + c$ [= 0] $(2x - 1)(2x - 7)[< 0]$ 0.5 and 3.5 $0.5 < x < 3.5$	M1 M1 A1 A1 [4]	 Factorise or formula not $\leqslant$ mark final statement.
4	**(i)** 8 (2^3) or 56 $-448(x^5)$ **(ii)** $1120(x^4)$ 2 × their 1120 and their –448 used $1792(x^5)$	B1 B1 [2] B1 M1 A1 [3]	 Mark final answer
5	**(i)** Evidence of 6, 5, 4, and 3 only 360 **(ii)** Evidence of 2 × 3 for outside digits Evidence of 4 × 3 for inside digits 72	M1 A1 [2] B1 B1 B1 [3]	Numbers listed but not added. $^4P_2$ used correctly.
6	**(i)** Express as powers of 2 Correctly reaches $3x + 2y = 6$ **(ii)** Express as powers of 5 $y = 3x - 4$ o.e. Attempt to solve simultaneous equations $x = \frac{14}{9}$ and $y = \frac{2}{3}$	M1 A1 AG [2] M1 A1 M1 A1 [4]	At least one : 2^{6y-9} or 2^{4x-4y} o.e. Both correct 5^2 and 5^{3x-6} o.e. Three terms Equations must be linear Accept decimals that round to correct 3sf

7	**(i)** $\sec^2 4x$ $\times 4$	M1 A1 [2]	One term only
	(ii) $x +$ $\tan 4x$ $\div 4$	B1 M1 A1 [3]	No additional terms isw
	(iii) Correct use of limits $k = \frac{1}{8}$	M1 A1 [2]	Expression must have 2 integrated terms in x from **(ii)**. Rounds to 0.125. Accept $\frac{\pi}{8}$ or 0.125π
8	**(i)** $(b=)\frac{7-4}{8-2}=\left[\frac{1}{2}\right]$ $(\lg a)=3$ $\lg y = \lg a + b\lg x$ or $\lg y - 4 = b(\lg x - 2)$ or $\lg y = 3 + 0.5\lg x$ $a = 1000$ or 10^3 $y = 1000x^{0.5}$ or $1000\sqrt{x}$	B1 M1 M1 A1 A1 [5]	Finding gradient Finding y intercept $\lg y = c + m\lg x$ is sufficient
	(ii) $m = 1$	B1 [1]	
	(iii) $c = 6$	B1 [1]	
9	**(i)**  $\frac{\sin\alpha}{80}=\frac{\sin 40}{420}$ $\alpha = 7.03$ or 7 Bearing 223 $(230 - \alpha)$	B1 M1 A1 A1√ [4]	Correct triangle Use of sine or cosine rule in any triangle with some of 80,420, their v and an angle.
	(ii) $\frac{v}{\sin their 133}=\frac{420}{\sin 40}$ $v = 478$ Use time $\frac{1000}{v}$ 2.09 hours or 2 hours 5minutes	M1 A1 M1 A1 [4]	Use of sine or cosine rule in any triangle with 80 or 420 or both. v calculated from a triangle Units required

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

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]	