UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS GCE Ordinary Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

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 must be read in conjunction with the question papers and the report on the examination.

• Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2012 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



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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.

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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 $\sqrt{}$ " 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.

	Dows 4	Marila O alt		ww.dynamicpap	
	Page 4		: Teachers' version L – May/June 2012	Syllabus 4037	Paper 22
1	(i) 7 ∈ <i>P</i>				B1
	(ii) 8 ∉ <i>S</i>				B1
	(iii) $n(N \cap S)$)=6			B1
2	(i) $k\sqrt{4x+1}$				M1 A1
	k = 6 a	llow unsimplified			
	(ii) Use $\partial y =$	$\frac{dy}{l} \times p$			M1
	30 <i>p</i>	$dx_{(x=6)}$			A1√
3			OR		
	Eliminate y $x^2 + (3 - m)x$	10-0	Eliminate y and m ((2 + 2) = 5 + 2 + 2		M1
	· · · ·	$arrow 9b^2 - 4ac \approx 0$	$((2x+3)x-5 = x^2 + 3x + 4)$	•)	A1
	Solve for 2 va		Solve quadratic for <i>x</i> Solve for 2 values of <i>m</i>		M1 M1
	Solve for 2 va				A1
4	(i) $\begin{pmatrix} 4 & 1 & 2 \\ 2 & 5 & 1 \end{pmatrix}$	$\binom{5}{3}$ or transpose			B1
	$+\begin{pmatrix}2&5\\4&3\end{pmatrix}$	$\binom{7}{2}\binom{5}{3}_{1}$ or transpose $\binom{2}{6}\binom{8}{4}_{2}$ or transpose			B1+B1
			$\begin{pmatrix} 40 \\ y \end{pmatrix}$ or $\begin{pmatrix} x \\ 26 \end{pmatrix}$ and $\begin{pmatrix} x \\ 56 \end{pmatrix}$ from	om correct part (i)	B1
	Claire 70	and Denise 82	., ., ., .,		B1
5	(i) $f(2)(=8)$	(k+4k-16-8) = 0			M1
	<i>k</i> = 4				A1
	(ii) Find quad	dratic factor			M1
	$x^2 + 6x +$				A1
		ratic formula or completin	ng square		M1
	$\frac{-6\pm\sqrt{6^2}}{}$	$-4 \times (1) \times 4$			A1
	$-3\pm\sqrt{5}$	2			B1

GCE O LEVEL - May/June 2012 4037 22 6 (i) $(-2)^3$ or 35 -280 B1 B1 (ii) $2^2 \times 21(x^2)$ $3 \times (-280) + 4 \times (84)$ -504 B1 M1 A1 (b) Identify $x^4 \times \left(\frac{3}{x^2}\right)^2$ B1 N1 ×15 only with x^0 $135(x^0)$ B1 B1 7 (i) $\ln y = \ln a + b \ln x$ OR $\lg y = \lg a + b \lg x$ may be implied $\ln x = 1.61$ 3.40 5.01 5.99 $\ln y = 2.19$ 3.09 3.89 4.39 B1 M1 A2, 1, 0 1g x 0.70 1.48 2.18 2.60 $\lg y 0.95$ 1.34 1.69 1.91 (Marks for points and line on graph NOT for table) M1 A1 M1 A1 (ii) Calculates gradient of straight line log graph $a = 4 \pm 0.3$ M1 A1 M1 A1 (iii) Uses suitable graph or formula 32 to 49 A1			· · · ·	. <u>.</u>		v.dynamicpap	
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$\begin{array}{ccc} dx & x^{2} \\ Equate to 0 and solve \\ x = 8 \end{array} & \begin{array}{c} h = 4 \\ x = 8 \end{array} & \begin{array}{c} M1 \\ A1 \end{array}$							
Equate to 0 and solve $h=4$ M1 $x=8$ $x=8$ A1	$\frac{d}{d}$	$\frac{ A }{ x } = 2x - \frac{102}{x^2}$	4 oe				A1√
	E	quate to 0 and					

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A (5						
9 (1	a) (i)	tan x	$=\frac{1}{3}$						B1
		x = 5	9(.0)						B1
		x = 2	39(.0) and no oth	ers					B1√
	(ii)	Use si	$\sin^2 y = 1 - \cos^2 y$						B1
		$5\cos^2$	$y^2 y - 9\cos y - 2 = 0$						B1
		Solve	3 term quadratic (in co	sy)				M1
		101.5			• •				A1
		258.5	and no others						B1√
Ø	b) (3	(-z) = (0.927 or 0.93						B1
	2.0	,							B1
			$\pi - 0.927$						M1
	0.7	, 86 or 0.	.785 or 0.79 and no	o othe	ers				A1
10 (:	a) (i)	792							B1
	(ii)	4W, 3	3M and 5W, 2M						M1
		5×35	5 or $(1) \times 21$						B1
		196							A1
л	h) (i)	4×5>	×4×3	or	$\frac{2}{3} \times 6 \times 5 \times 4$	× 3			M1
(·	~, (1)			01	/3.0.00				A 1
		240							A1
	(ii)) 4×4>	× 3×1	or	$\frac{1}{5} \times (240)$				
	(II)			01	5 (240)				M1
		48							A1

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11 E (i) $\frac{\mathrm{d}y}{\mathrm{d}x} =$	$k\cos\frac{1}{2}x \left(\frac{1}{2}\cos\frac{1}{2}x\right)$		M1
Grad	ient tangent $-\frac{1}{4}\sqrt{2}$ or -0.35		A1
y – –	$\frac{\sqrt{2}}{2} = -\frac{1}{4}\sqrt{2}\left(x - \frac{3\pi}{2}\right)$		M1
y = 0	$x = \frac{3\pi}{2} + 2 \text{ or } 6.71$		A1
(ii) MET	HOD A		
∫sin	$\frac{1}{2}xdx = -2\cos\frac{1}{2}x$		B1
-	ify 2π		B1
Use l	imits of 1.5π and (2π) on $k\cos\frac{1}{2}x$ $(2-\sqrt{2} \text{ or } 0.$	586)	M1
Atter	npt at area of triangle $\left(=\frac{\sqrt{2}}{2}=0.707\right)$		M1
	of area of triangle subtract area under curve.		M1
	completely correct		M1
$\frac{3\sqrt{2}}{2}$	-2 or 0.121		A1
MET	HOD B		
	g integral of (equation of line $-$ equation of curve)		M1
∫sin	$\frac{1}{2}xdx = -2\cos\frac{1}{2}x$		B1
Ident	ify 2π		B1
Use l	imits of 1.5π and (2π) on $k\cos\frac{1}{2}x$		M1
Use l	imits of 1.5π and (x_Q) on integral of equation of line	2	M1
	completely correct		M1
$\frac{3\sqrt{2}}{2}$	-2 or 0.121		A1

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1 O (i	i) Uses	product rule		M1	
	(1	$(x)e^{-x}$		A1	
	∫(1-	$-x)e^{-x}dx = xe^{-x}$		M1	
	∫xe	$\int e^{-x} dx = -xe^{-x} + \int e^{-x} dx = -xe^{-x} - e^{-x}$		Alag	
(i	ii) grad	ient tangent $= -\frac{1}{e^2}$ or $= -0.135$		B1	
	y – -	$\frac{2}{e^2} = -\frac{1}{e^2}(x-2)$		M1	
	Uses	line cuts y-axis at $\frac{4}{e^2}$ or 0.541		A1	
	Area	trapezium $\left(= \frac{6}{e^2} \text{ or } 0.812 \right)$		M1	
	Uses	limits of 2 and 0 on $-xe^{-x} - e^{-x}$ (=1 $-\frac{3}{e^2}$ or 0.594)		M1	
	Eval	uate area of trapezium subtract area under curve		M1	
	$\frac{9}{e^2}$ -	1 or 0.218		A1	