MARK SCHEME for the October/November 2012 series

0606 ADDITIONAL MATHEMATICS

0606/11

Paper 1, 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.

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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.

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			• • • • • • • • • • • • • • • • • • •			
1	(i) (ii) $3+5x=\pm$	$2, x = -\frac{1}{5}, -1$	B1 [2] B1, B1 [2]	B1 for shape B1 for 3 and $-\frac{3}{5}$ B1 for each		
2	$k-6x = 2x^{2} + 2x^{2} + x(k+6)$ for a tangent <i>b</i> leading to $k^{2} - (k+18)(k+2)$	-k=0 $k^{2}=4ac$	M1 M1 DM1 A1	M1 for attempt to eq 3 term quadratic M1 for use of $b^2 = 4$ DM1 for solution of quadratic	4 <i>ac</i>	
	Alternative: $-6\left(\frac{-k-6}{4}\right)$ leading to k^2 -	$b = 4x + k$ $= \left(\frac{-k-6}{4}\right) \left(2\left(\frac{-k-6}{4}\right) + k\right)$	[4] M1 M1 DM1 A1	M1 for equating gradients M1 for substitution of $x = \frac{-k-6}{4}$ DM1 for solution of resulting quadratic		
3	(i) $\log_q 2 = \frac{1}{5}$ $\log_q 4 = \frac{2}{5}$	<u>p</u> or equivalent 2 <u>p</u> 5	M1 A1 [2]	M1 for attempt to ob 2 or 4	otain 32 in terms of	
	(ii) $\log_q 16q = \frac{4p}{5} + 1$	$= \log_q 16 + \log_q q$	B1, B1 [2]	B1 for each		
4	$5(u^2) - 7(u) + 2$		M1	M1 for attempt to ob equation in terms of	$u \text{ or } 5^x$	
	(5u-2)(u-1) $5^{x} = 1, x = 0,$) = 0	DM1 B1	DM1 for attempt to a B1 for $x = 0$ (could M1 for correct attem logarithms to obtain	be 'spotted') apt to use	
	$5^x = \frac{2}{5}, x = -0$.569	M1, A1 [5]			

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5	(i) $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{2x\mathrm{d}x}{\mathrm{d}x}$	$\frac{\cos 4x - x^2 \left(-4 \sin 4x\right)}{\cos^2 4x}$	B1,M1 A1 [3]	B1 for differentiation of $\cos 4x$ M1 for attempt at differentiation of a quotient A1 all else correct		
	(ii) $\partial y \approx \frac{\pi}{2} p$,	,-1.57 <i>p</i>	M1 A1 [2]	M1 for attempt to use small changes A1 for correct solution only – must have 2^{nd} term in (i) correct.		
6	(ii) Independ	$\int_{-4}^{6} = x^{6} + 12x^{3} + 60$ ent term =) + (-4 × '12 ') = 72	B3 [3] M1 A1 [2]	B1 for each correct ter M1 for sum of 2 produ $(2 \times \text{their } 60)+(-4 \times \text{th})$ A1 for 72	icts	
7	= 53 (ii) (-3)	$\overline{5} - 2\sqrt{2}^{2} = 45 - 12\sqrt{10} + 8$ $3 - 12\sqrt{10}$ $\sqrt{5} + 2\sqrt{2}$	B1 B1 [2]	Must be convincing		
	(b) $\frac{6\sqrt{3}+7\sqrt{4\sqrt{3}+5\sqrt{3}}}{4\sqrt{3}+5\sqrt{6}}$ = -1 + $\sqrt{6}$	$\frac{\sqrt{2}}{\sqrt{2}} \times \frac{4\sqrt{3} - 5\sqrt{2}}{4\sqrt{3} - 5\sqrt{2}}$	M1 DM1 A1, A1 [4]	M1 for attempt to ratio DM1 for attempt to sir A1 for each correct		
8	(i) $C(13, -2)$	2)	B1, B1 [2]			
		$= -\frac{1}{2} \therefore \text{ perp grad } 2$ ation $y + 2 = 2(x - 13)$ -28)	M1 M1 A1	M1 for attempt to find perpendicular M1 for attempt to find perpendicular and hence	equation of	
	= 260	$ \sqrt{16^2 + 8^2} \sqrt{13^2 + 26^2} $ $ \begin{bmatrix} 13 & 0 & -3 \\ -2 & -28 & 6 \end{bmatrix} = 260 $	M1 A1 [5]	M1 for attempt to find	area of triangle	

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9	(i) $0.2 \le y \le$	51	B1 [1]	Must be using correct notation		
	(ii) $g^{-1}(x) =$	$=\frac{1+x}{2x}$	M1 A1 [2]	M1 for a valid method A1 must have correct r		
	(iii) $0.2 \le x \le$	_	√B1 [1]	Follow through on their (i)		
	(iv) $g^2 = \frac{1}{2(1-x)^2}$	$\frac{1}{\frac{1}{2x-1}} = 3$	M1 DM1	M1 for correct attempt to find g^2 DM1 for equating to 3 and attempt to solve.		
	$\frac{2x-1}{3-2x} =$	3 leading to $x = 1.25$	A1 [3]			
10	(i) $ \begin{array}{c} \text{sinx} & 0.17 \\ \hline \sqrt{y} & 3.35 \end{array} $	0.50.710.870.9844.424.734.97	B2,1,0	Can be implied by grap	ph	
			M1 A1 [4]	M1 for attempt to plot \sqrt{y} against sin x		
		A = 2 allow (1.8 – 2.2) xis intercept $B = 3$, B - 3.2)	M1,A1 B1 [3]	M1 for attempt to calculate the gradient and equate to A B1 for B		
	(iii) $\sin x = 0$ allow (20)		M1,A1 [2]	M1 for valid attempt to obtain y		
	(iv) $\sqrt{y} = 3.5$ allow (12)		M1,A1 [2]	M1 for a complete method to find x		

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11 (a) $\sin(2x - x)$	11 (a) $\sin\left(2x - \frac{\pi}{3}\right) = \frac{1}{\sqrt{2}}$ $2x - \frac{\pi}{3} = \frac{\pi}{4}, \frac{3\pi}{4}$		M1	M1 for dealing with cosec M1 for a correct order of operations		
$2x - \frac{\pi}{3} =$			M1			
$x = \frac{7\pi}{24}, \frac{1}{24}, \frac{1}{24},$		A1, A1 [4]				
(b) (i)						
2	$\sin y \cos y - 5 \sin^2 y = 7$	M1		for expansion	_	
-	$5\tan^2 y = 7\sec^2 y$	M1	M1	M1 for division by \cos^2		
$10 + 5 \tan y -$	$5\tan^2 y = 7\left(\tan^2 y + 1\right)$	M1	M1 for use of correct ide		dentity	
$12 \tan^2 y - 5 t$ Or	an y - 3 = 0	A1 [4]				
$10-15\sin^2 y$	$+5\sin y\cos y = 7$		M1	for expansion and	use of identity	
$3 \sec^2 y - 15 \tan^2 y$	$an^2 y + 5 \tan y = 0$		M1	for division by cos	2	
$3(1+\tan^2 y)$	$-15\tan^2 y + 5\tan y = 0$		M1	for use of correct i	dentity	
Or						
$15\cos^2 y + 5\sin^2 y$	$\sin y \cos y - 5 = 7$		M1	for expansion and	use of identity	
$15 + 15 \tan y -$	$-12\sec^2 y = 0$		M1	for division by cos	2	
$15 + 5 \tan y - 15$	$15 + 5 \tan y - 12(1 + \tan^2 y) = 0$		M1	for use of correct i	dentity	
	$-3)(3\tan y+1)=0$	M1	M1	for attempt to solve	e quadratic	
$\tan y = \frac{3}{4}$	$y = 36.9^{\circ}$	A1				
$\tan y = -$	$\frac{1}{3}, y = 161.6^{\circ}$	A1 [3]				

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10 EITHED					
12 EITHER (i) A (-1, 0)	(i) $A(-1, 0)$ and $B(2, 0)$				
u A	$(x-6x)2(1+x)+(1+x)^{2}(-6)$ (x)(9-9x)	M1, A1	M1 for attempt to differentiate a product M1 for attempt to find stationary poi		
When $\frac{dy}{dx}$ $\therefore C(1, 24)$	$\frac{y}{z} = 0, \ x = 1 \ (\max)$	M1			
	$\int_{-1}^{2} (12 - 6x)(1 + x)^2 dx$	A1 [6]			
•-1	$(2+3x-x^3)dx$ $2x+9x^2-\frac{3x^4}{2}\Big]^2$	M1	M1 for attempt to expand out DM1 for attempt to integrate an expanded out form DM1 for correct use of limits		
_ L	$\begin{bmatrix} 2 \\ -1 \end{bmatrix}_{-1}$ 6-24)- $\left(-12+9-\frac{3}{2}\right)$	DM1, A1			
= 40.5		DM1 A1 [5]			
OR (i) $y = x^3 - x^3$	$3x^2 - 9x(+c)$	M1, A1	M1 for attempt to integrate condone omission of <i>c</i> M1 for attempt to find <i>c</i> Allow here		
<i>c</i> = 30	rough (0, 30) leading to $3x^2 - 9x + 30$	M1 A1 [4]			
CL.	$x^{2} = 0, \ 3x^{2} - 6x - 9 = 0$ o $x = -1$ and $x = 3$	M1 A1, A1 [3]	M1 for attempt to set to 0 and solve A1 for each		
.	$\int_{-1}^{3} x^{3} - 3x^{2} - 9x + 30 \mathrm{d}x$		M1 for attempt to integrate		
L	$x^{3} - \frac{9x^{2}}{2} + 30x \bigg]_{-1}^{3}$	M1, A1			
$= \left(\frac{81}{4} - 27 - \frac{8}{2}\right)$ $= 76$	$\left(\frac{1}{2}+90\right)-\left(\frac{1}{4}+1-\frac{9}{2}-30\right)$	DM1 A1	DM1 for correct use of limits		
		[4]			