CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

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.

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

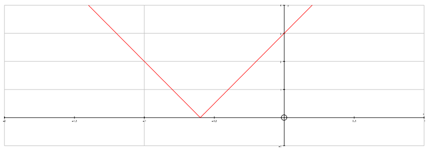
MR –1 A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through √ " marks. MR is not applied when the candidate misreads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

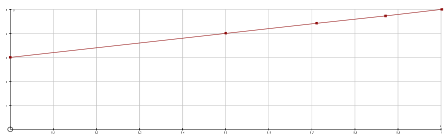
PA –1 This is deducted from A or B marks in the case of premature approximation.

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 **(i)** 	B1 B1 [2]	B1 for shape B1 for 3 and $-\frac{3}{5}$
(ii) $3+5x=\pm 2$, $x=-\frac{1}{5}, -1$	B1, B1 [2]	B1 for each
2 $k-6x=2x^2+xk$ $2x^2+x(k+6)-k=0$ for a tangent $b^2=4ac$ leading to $k^2+20k+36=0$ $(k+18)(k+2)=0$, so $k=-2, -18$	M1 M1 DM1 A1 [4]	M1 for attempt to equate and obtain a 3 term quadratic M1 for use of $b^2=4ac$ DM1 for solution of resulting quadratic
Alternative: $-6=4x+k$ $k-6\left(\frac{-k-6}{4}\right)=\left(\frac{-k-6}{4}\right)\left(2\left(\frac{-k-6}{4}\right)+k\right)$ leading to $k^2+20k+36=0$ $(k+18)(k+2)=0$, so $k=-2, -18$	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)** $\log_q 2=\frac{1}{5}p$ or equivalent $\log_q 4=\frac{2p}{5}$	M1 A1 [2]	M1 for attempt to obtain 32 in terms of 2 or 4
(ii) $\log_q 16q=\log_q 16+\log_q q$ $=\frac{4p}{5}+1$	B1, B1 [2]	B1 for each
4 $5(u^2)-7(u)+2=0$ $(5u-2)(u-1)=0$ $5^x=1$, $x=0$, $5^x=\frac{2}{5}$, $x=-0.569$	M1 DM1 B1 M1, A1 [5]	M1 for attempt to obtain a quadratic equation in terms of u or 5^x DM1 for attempt to solve quadratic B1 for $x=0$ (could be 'spotted') M1 for correct attempt to use logarithms to obtain x.

5 **(i)** $\frac{dy}{dx}=\frac{2x\cos 4x-x^2\left(-4\sin 4x\right)}{\cos^2 4x}$	B1,M1 A1 [3]	B1 for differentiation of $\cos 4x$ M1 for attempt at differentiation of a quotient A1 all else correct
(ii) $\partial y \approx \frac{\pi}{2}p, -1.57p$	M1 A1 [2]	M1 for attempt to use small changes A1 for correct solution only – must have 2nd term in **(i)** correct.
6 **(i)** $\left(x+\frac{2}{x^2}\right)^6 = x^6+12x^3+60...$	B3 [3]	B1 for each correct term
(ii) Independent term = $(2\times'60')+(-4\times'12') = 72$	M1 A1 [2]	M1 for sum of 2 products (2 × their 60)+(–4 × their 12) A1 for 72
7 **(a)** **(i)** $\left(3\sqrt{5}-2\sqrt{2}\right)^2=45-12\sqrt{10}+8$ $= 53-12\sqrt{10}$	B1	Must be convincing
(ii) $\left(-3\sqrt{5}+2\sqrt{2}\right)$	B1 [2]	
(b) $\frac{6\sqrt{3}+7\sqrt{2}}{4\sqrt{3}+5\sqrt{2}}\times\frac{4\sqrt{3}-5\sqrt{2}}{4\sqrt{3}-5\sqrt{2}}$	M1 DM1	M1 for attempt to rationalise, DM1 for attempt to simplify
$=-1+\sqrt{6}$	A1, A1 [4]	A1 for each correct
8 **(i)** $C(13,-2)$	B1, B1 [2]	
(ii) grad $AC=-\frac{1}{2}$ $\therefore$ perp grad 2	M1	M1 for attempt to find grad of perpendicular
perp. equation $y+2=2(x-13)$ $\therefore D(0,-28)$	M1 A1	M1 for attempt to find equation of perpendicular and hence D
Area $=\frac{1}{2}\sqrt{16^2+8^2}\sqrt{13^2+26^2}$ $= 260$	M1 A1 [5]	M1 for attempt to find area of triangle
Or $\frac{1}{2}\begin{vmatrix} -3 & 13 & 0 & -3 \\ 6 & -2 & -28 & 6 \end{vmatrix} = 260$		

9 **(i)** $0.2 \leqslant y \leqslant 1$	B1 [1]	Must be using correct notation
(ii) $g^{-1}(x) = \dfrac{1+x}{2x}$	M1 A1 [2]	M1 for a valid method to find inverse A1 must have correct notation
(iii) $0.2 \leqslant x \leqslant 1$	√B1 [1]	Follow through on their **(i)**
(iv) $g^2 = \dfrac{1}{2\left(\dfrac{1}{2x-1}\right)-1} = 3$	M1 DM1	M1 for correct attempt to find g^2 DM1 for equating to 3 and attempt to solve.
$\dfrac{2x-1}{3-2x} = 3$ leading to $x = 1.25$	A1 [3]	
10 **(i)**		
<table><tr><td>sin*x*</td><td>0.17</td><td>0.5</td><td>0.71</td><td>0.87</td><td>0.98</td></tr><tr><td>$\sqrt{y}$</td><td>3.35</td><td>4</td><td>4.42</td><td>4.73</td><td>4.97</td></tr></table>	B2,1,0	Can be implied by graph
	M1 A1 [4]	M1 for attempt to plot $\sqrt{y}$ against sin x
(ii) gradient $A = 2$ allow (1.8 – 2.2)	M1,A1	M1 for attempt to calculate the gradient and equate to A
vertical axis intercept $B = 3$, allow (2.8 – 3.2)	B1 [3]	B1 for B
(iii) $\sin x = 0.77$, $y = 20.5$ allow (20 – 22)	M1,A1 [2]	M1 for valid attempt to obtain y
(iv) $\sqrt{y} = 3.5$, $x = 14.5^\circ$ allow (12.5 – 16.5)	M1,A1 [2]	M1 for a complete method to find x

11 **(a)** $\sin\left(2x-\frac{\pi}{3}\right)=\frac{1}{\sqrt{2}}$	M1	M1 for dealing with cosec
$2x-\frac{\pi}{3}=\frac{\pi}{4},\frac{3\pi}{4}$	M1	M1 for a correct order of operations
$x=\frac{7\pi}{24},\frac{13\pi}{24}$ (0.916, 1.70)	A1, A1 [4]	
(b) **(i)** $10\cos^2 y+5\sin y\cos y-5\sin^2 y=7$	M1	M1 for expansion
$10+5\tan y-5\tan^2 y=7\sec^2 y$	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 identity
$12\tan^2 y-5\tan y-3=0$	A1 [4]	
Or $10-15\sin^2 y+5\sin y\cos y=7$		M1 for expansion and use of identity
$3\sec^2 y-15\tan^2 y+5\tan y=0$		M1 for division by $\cos^2$
$3\left(1+\tan^2 y\right)-15\tan^2 y+5\tan y=0$		M1 for use of correct identity
Or $15\cos^2 y+5\sin y\cos y-5=7$		M1 for expansion and use of identity
$15+15\tan y-12\sec^2 y=0$		M1 for division by $\cos^2$
$15+5\tan y-12\left(1+\tan^2 y\right)=0$		M1 for use of correct identity
(ii) $\left(4\tan y-3\right)\left(3\tan y+1\right)=0$	M1	M1 for attempt to solve quadratic
$\tan y=\frac{3}{4},\ y=36.9^\circ$	A1	
$\tan y=-\frac{1}{3},\ y=161.6^\circ$	A1 [3]	

12 EITHER		
(i) $A\,(-1, 0)$ and $B\,(2, 0)$	B1, B1	
$\frac{\mathrm{d}y}{\mathrm{d}x}=(12-6x)2(1+x)+(1+x)^2(-6)$ $=2(1+x)(9-9x)$	M1, A1	M1 for attempt to differentiate a product
When $\frac{\mathrm{d}y}{\mathrm{d}x}=0$, $x=1$ (max)	M1	M1 for attempt to find stationary point
$\therefore C\,(1, 24)$	A1 [6]	
(ii) Area $=\int_{-1}^{2}(12-6x)(1+x)^2\,\mathrm{d}x$ $6\int_{-1}^{2}(2+3x-x^3)\mathrm{d}x$	M1	M1 for attempt to expand out
$=\left[12x+9x^2-\frac{3x^4}{2}\right]_{-1}^{2}$	DM1, A1	DM1 for attempt to integrate an expanded out form
$=\left[(24+36-24)-\left(-12+9-\frac{3}{2}\right)\right]$	DM1	DM1 for correct use of limits
$= 40.5$	A1 [5]	
OR		
(i) $y=x^3-3x^2-9x(+c)$	M1, A1	M1 for attempt to integrate condone omission of c
Passes through (0, 30) leading to $c = 30$	M1	M1 for attempt to find c
$y=x^3-3x^2-9x+30$	A1 [4]	Allow here
(ii) When $\frac{\mathrm{d}y}{\mathrm{d}x}=0$, $3x^2-6x-9=0$	M1	M1 for attempt to set to 0 and solve
leading to $x=-1$ and $x=3$	A1, A1 [3]	A1 for each
(iii) Area $=\int_{-1}^{3}x^3-3x^2-9x+30\,\mathrm{d}x$		
$=\left[\frac{x^4}{4}-x^3-\frac{9x^2}{2}+30x\right]_{-1}^{3}$	M1, A1	M1 for attempt to integrate
$=\left(\frac{81}{4}-27-\frac{81}{2}+90\right)-\left(\frac{1}{4}+1-\frac{9}{2}-30\right)$	DM1	DM1 for correct use of limits
$= 76$	A1 [4]	