CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the October/November 2012 series

0606 ADDITIONAL MATHEMATICS

0606/21 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.

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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 √ " marks. MR is not applied when the candidate misreads his own figures – this is regarded as an error in accuracy.

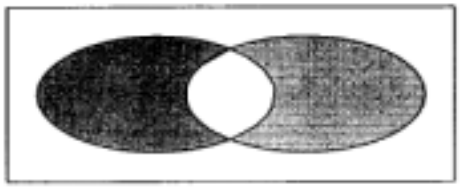
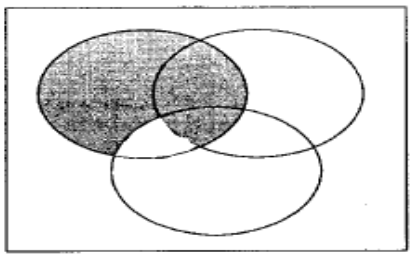
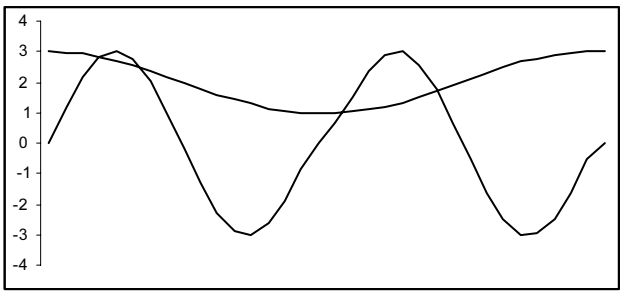
OW –1,2 This is deducted from A or B marks when essential working is omitted.

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 Rearranges to form $ax^2 + bx + c$ Solves 3 term quadratic $x = -\frac{1}{2}$ or $\frac{9}{2}$ $x < -\frac{1}{2}, x > \frac{9}{2}$	M1 M1 A1 A1 [4]
2 (a) (i) $n(P) = 11$ **(ii)** $18 \notin F$ or $18 \notin F'$ **(iii)** $T \subset F$ or $F \supset T$ or $F \cup T = F$ or $F \cap T = T$ o.e. **(b) (i)**  **(ii)** 	B1 B1 B1 [3] B1 B1 [2]
3 (i) Sine curve from –3 to 3 or with two cycles Completely correct Correct Cosine curve  **(ii)** 4	M1 A1 B2,1,0 [4] B1√ [1]
4 (i) $a = 20$ $b = -4$ (4, 20) **(ii)** Negative quadratic shape Correct position with turning point in first quadrant and 4 marked on y-axis	B1 B1 B1√ [3] M1 A1 [2]

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5	**(i)** Matrix multiplication	M1
	$\mathbf{AB} = \begin{pmatrix} -2 & 2 & 8 \\ 1 & 3 & 20 \end{pmatrix}$ or $\mathbf{BC} = \begin{pmatrix} 22 \\ 39 \end{pmatrix}$	A1
	Matrix multiplication	M1
	$\begin{pmatrix} 10 \\ 59 \end{pmatrix}$	A1 [4]
	(ii) $\frac{1}{4}\begin{pmatrix} -3 & 2 \\ -8 & 4 \end{pmatrix}$ or $\begin{pmatrix} -0.75 & 0.5 \\ -2 & 1 \end{pmatrix}$	B1+B1
	Matrix multiplication	M1
	$\frac{1}{4}\begin{pmatrix} 4 & -2 & -4 \\ 4 & -4 & -16 \end{pmatrix}$ or $\begin{pmatrix} 1 & -0.5 & -1 \\ 1 & -1 & -4 \end{pmatrix}$	A1 [4]
6	$\left(\frac{dy}{dx} =\right) 3x^2 + 12x - 34$	B1
	Uses $m_1 m_2 = -1$ after differentiation	M1
	Gradient normal $= -\frac{1}{2}$	A1
	Finds equation of normal $\left(y - 8 = -\frac{1}{2}(x-2)\right)$ or $y = -\frac{1}{2}x + 9$	DM1
	(18, 0)	B1
	(0, 9)	B1
	Midpoint (9, 4.5)	B1√
	Shows midpoint lies on $4y = x + 9$	M1 [8]
7	**(i)** 10sin60 or 10cos30 or 5tan60 or $\sqrt{10^2 - 5^2}$	M1
	$5\sqrt{3}$ or 8.66	A1 [2]
	(ii) $\begin{pmatrix} 16 - 5t \\ 12 + 8.66t \end{pmatrix}$ o.e.	M1A1 [2]
	(iii) Equate x component to 0	M1
	1512 (when $t = 3.2$)	A1 [2]
	(iv) Substitute t into y component	M1
	39.7 km	A1 [2]

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8 **(i)**	Uses $s = r\theta$ $y = 3x - 20$	M1 A1 [2]
(ii)	Uses $A = \frac{1}{2}r^2\theta$ $y^2 = x^2 - 32$	M1 A1 [2]
(iii)	Eliminate y or x $x^2 - 15x + 54 = 0$ or $y^2 - 5y - 14 = 0$ Solve 3 term quadratic $x = 9$ and $y = 7$	M1 A1 M1 A1 [4]
9 **(a)** **(i)**	3628800	B1
(ii)	Evidence of 5! (=120) and 4! =(24) Evidence of 3! 17280	B1 B1 B1 [4]
(b) **(i)**	Evidence of $\frac{6\times5(\times4\times3)}{(4\times3)\times2(\times1)}$ (=15) or $\frac{5\times4}{2(\times1)}(=10)$ Multiplies 150	B1 M1 A1
(ii)	No cousins in 30 ways Older cousin only in 60 ways or younger cousin only in 20 ways 110 (or both cousins in 40 ways B1, subtract from 150 B1 answer 110 B1)	B1 B1 B1 [6]
10 **(i)**	Finds f(2) or f(1) f (2) = 8 + 36 + 2b + c f (1) = 1 + 9 + b + c Solves f(2) = 2f(1) c = 24	M1 A1 A1 M1 A1 [5]
(ii)	Finds quadratic factor (x^2 + x + 3) Uses quadratic formula or finds $b^2 - 4ac$ or completes square $b^2 - 4ac = -11$ oe	M1 A1 M1 A1 [4]

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11 EITHER	
(i) $s_{12} = 49.6$ or $24 + 101n\ 13$	B1
distance is 13.8	B1
	[2]
(ii) $v = (2t - 10) + \frac{10}{1+t}$	B1,B1
Equate to 0 and collect terms	M1
$2t^2 - 8t = 0$	A1
$t = 4$ (or 0)	A1
	[5]
(iii) Differentiates v to find a	M1
$2 - \frac{10}{(1+t)^2}$	A1
1.9	A1
	[3]
11 OR	
(i) $v = 4$	B1
	[1]
(ii) $s = 2e^{2t} - 12t^2$	B1+B1
Uses limits on $\int v\,dt$	M1
638	A1
	[4]
(iii) Differentiates v to find a	M1
$8e^{2t} - 24$	A1
Equate to 0 and solve	M1
$t = \frac{1}{2}\ln 3$ (or 0.549) (or $e^{2t} = 3$)	A1
–1.18 or 12 (1 – 1n 3)	A1
	[5]

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