CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2014 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.

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			<u> </u>
1	$LHS = \frac{\sin \theta}{\cos \theta} + \frac{\cos \theta}{1 + \sin \theta}$	B1	B1 for use of $\tan \theta = \frac{\sin \theta}{\cos \theta}$
	$= \frac{\sin\theta(1+\sin\theta)+\cos^2\theta}{\cos\theta(1+\sin\theta)}$	M1	M1 for attempt to obtain a single fraction
	$=\frac{1+\sin\theta}{\cos\theta(1+\sin\theta)}$	DM1	DM1 for use of $\sin^2 \theta + \cos^2 \theta = 1$
	$= \frac{1}{\cos \theta} \text{ leading to } \sec \theta$	A1	A1 for 'finishing off'
	Alternative solution: $LHS = \frac{\sin \theta}{\cos \theta} + \frac{\cos \theta (1-\sin \theta)}{(1+\sin \theta)(1-\sin \theta)}$	B1	B1 for use of $\tan \theta = \frac{\sin \theta}{\cos \theta}$
	$= \frac{\sin \theta}{\cos \theta} + \frac{\cos \theta (1 - \sin \theta)}{\cos^2 \theta}$	M1	M1 for multiplication by $(1 - \sin \theta)$
	$= \frac{\sin \theta}{\cos \theta} + \frac{(1 - \sin \theta)}{\cos \theta}$	DM1	DM1 for use of $\sin^2 \theta + \cos^2 \theta = 1$
	$= \frac{1}{\cos \theta} \text{ leading to } \sec \theta$	A1	A1 for 'finishing off'
	Alternative solution: $LHS = \frac{\tan \theta (1 + \sin \theta) + \cos \theta}{1 + \sin \theta}$	M1	M1 for attempt to obtain a single fraction
	$= \frac{\frac{\sin \theta}{\cos \theta} + \frac{\sin^2}{\cos \theta} + \cos \theta}{1 + \sin \theta}$	B1	B1 for use of $\tan \theta = \frac{\sin \theta}{\cos \theta}$
	$=\frac{\sin\theta+\sin^2\theta+\cos^2\theta}{\cos\theta(1+\sin\theta)}$		
	$=\frac{1+\sin\theta}{\cos\theta(1+\sin\theta)}$	DM1	DM1 for use of $\sin^2 \theta + \cos^2 \theta = 1$
	$= \frac{1}{\cos \theta} \text{ leading to } \sec \theta$	A1	A1 for 'finishing off'

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2	(i) (ii)	$\begin{vmatrix} \mathbf{a} = \sqrt{4^2 + 3^2} = 5 \\ \mathbf{b} + \mathbf{c} = \sqrt{(-3)^2 + 4^2} = 5 \end{vmatrix}$ $\lambda \begin{pmatrix} 4 \\ 3 \end{pmatrix} + \mu \begin{pmatrix} 2 \\ 2 \end{pmatrix} = 7 \begin{pmatrix} -5 \\ 2 \end{pmatrix}$	M1 A1	M1 for finding the modulus of either a or b + c A1 for completion
		$4\lambda + 2\mu = -35 \text{ and } 3\lambda + 2\mu = 14$	M1	M1 for equating like vectors and obtaining 2 linear equations
		leading to $\lambda = -49$, $\mu = 80.5$	DM1 A1	DM1 for solution of simultaneous equations A1 for both
3	(a)	(i) (ii) (iii)	B1 B1 B1	B1 for each
	(b) (i)	2	B1	
	(ii)	0	B1	
4		$k(4x-3) = 4x^{2} + 8x - 8$ $4x^{2} + x(8-4k) + 3k - 8 = 0$ $b^{2} - 4ac = (8-4k)^{2} - 16(3k-8)$ $= 16k^{2} - 112k + 192$ $b^{2} - 4ac < 0, k^{2} - 7k + 12 < 0$ critical values $k = 3, 4$ $\therefore 3 < k < 4$	M1 DM1 DM1 A1 A1	M1 for equating the line and the curve and attempt to obtain a quadratic equation in k DM1 for use of $b^2 - 4ac$ with k DM1 for solution of a 3 term quadratic equation, dependent on both previous M marks A1 for both critical values A1 for the range
5	(i)	$\frac{\mathrm{d}y}{\mathrm{d}x} = 2x\mathrm{e}^{x^2}$	B1B1	B1 for e^{x^2} , B1 for $2xe^{x^2}$
	(ii)	$\frac{1}{2}e^{x^2}$	M1A1	M1 for ke^{x^2} A1 for $\frac{1}{2}e^{x^2}$
	(iii)	$\left(\frac{1}{2}e^4\right) - \left(\frac{1}{2}\right) = 26.8$	DM1 A1	DM1 for correct use of limits A1 for 26.8, allow exact value

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6	(i)	(10 19)	M1	M1 for at least 3 correct elements of a
		$\mathbf{AB} = \begin{bmatrix} 32 & 37 \\ 14 & 14 \end{bmatrix}$	A1	3×2 matrix A1 for all correct
	(ii)	$\mathbf{B}^{-1} = \frac{1}{7} \begin{pmatrix} 5 & -1 \\ -3 & 2 \end{pmatrix}$	B1 B1	B1 for $\frac{1}{7}$, B1 for $\begin{pmatrix} 5 & -1 \\ -3 & 2 \end{pmatrix}$
	(iii)	$2\begin{pmatrix} 2 & 1 \\ 3 & 5 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -3 \\ -22 \end{pmatrix}$	M1	M1 for obtaining in matrix form
		$\begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{7} \begin{pmatrix} 5 & -1 \\ -3 & 2 \end{pmatrix} \begin{pmatrix} -1.5 \\ -11 \end{pmatrix} = \frac{1}{7} \begin{pmatrix} 3.5 \\ -17.5 \end{pmatrix}$	M1	M1 for pre-multiplying by B ⁻¹
		x = 0.5, y = -2.5	A1	A1 for both
7	(i)	$y = 2x^2 - \frac{1}{x+1}(+c)$	B1 B1	B1 for each correct term
		when $x = \frac{1}{2}$, $y = \frac{5}{6}$ so $\frac{5}{6} = \frac{1}{2} - \frac{2}{3} + c$	M1	M1 for attempt to find $+c$, must have at least 1 of the previous B marks
		leading to $c = 1$	A1	Allow A1 for $c = 1$
		$\left(y = 2x^2 - \frac{1}{x+1} + 1\right)$		
	(ii)	When $x = 1, y = \frac{5}{2}$	M1	M1 for using $x = 1$ in their (i) to find y
		$\frac{dy}{dx} = \frac{17}{4}$ so gradient of normal $= -\frac{4}{17}$	B1	B1 for gradient of normal
		Equation of normal $y - \frac{5}{2} = -\frac{4}{17}(x-1)$	DM1	DM1 for attempt at normal equation
		(8x + 34y - 93 = 0)	A1	A1 – allow unsimplified (fractions must not contain decimals)

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8	(i)	$\log p = n \log V + \log k$	B1	B1 for statement, but may be implied by later work.
		lnV 2.30 3.91 4.61 5.30		
		lnp 4.55 2.14 1.10 0.10		
		lgV 1 1.70 2 2.30		
		lgp 1.98 0.93 0.48 0.04		
		$\log P$	M1 A2,1,0	M1 for plotting a suitable graph —1 for each error in points plotted
	(ii)	Use of gradient = n n = -1.5 (allow -1.4 to -1.6)	DM1 A1	DM1 for equating numerical gradient to <i>n</i>
	(iii)	Allow 13 to 16	DM1 A1	DM1 for use of <i>their</i> graph or substitution into <i>their</i> equation.
9	(a)	Distance travelled = area under graph $= \frac{1}{2} (60 + 20) \times 12 = 480$	M1 A1	M1 for realising that area represents distance travelled and attempt to find area
	(b)	2	B1 B1 B1	B1 for velocity of 2 ms ⁻¹ for $0 \le t \le 6$ B1 for velocity of zero for <i>their</i> '6' to <i>their</i> '25' B1 for velocity of 1 ms ⁻¹ for $25 \le t \le 30$
	(c) (i)	$v = 4 - \frac{16}{t+1}$	M1	M1 for attempt at differentiation
		When $v = 0$, $t = 3$	DM1 A1	DM1 for equating velocity to zero and attempt to solve
	(ii)	$a = \frac{16}{(t+1)^2}$ $0.25(t+1)^2 = 16$	M1	M1 for attempt at differentiation and equating to 0.25 with attempt to solve
		$0.25(t+1)^2 = 16$		
		t = 7	A1	

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10	(a)	1 digit even numbers 2	B 1	
		2 digit ayan nyumbang 4 y 2 = 9	B1	
		2 digit even numbers $4 \times 2 = 8$	DI	
		3 digit even numbers $3 \times 3 \times 2 = 18$	B 1	
		Total = 28	B 1	
	(b) (i)	3M 5W = 35 4M 4W = 175 5M 3W = 210	B1 B1 B1	
		Total = 420	B1	B1 for addition to obtain final answer, must be evaluated.
		or ${}^{12}C_8 - 6M \ 2W - 7M \ 1W$ 495 - 70 - 5 = 420		or: as above, final B1 for subtraction to get final answer
	(ii)	Oldest man in, oldest woman out and vice-versa		
		$^{10}C_7 \times 2 = 240$	B1, B1	B1 for ${}^{10}C_7$, B1 for realising there are 2 identical cases
		Alternative: 1 man out 1 woman in 6 men 4 women		
		$6M \ 1W : {}^{6}C_{6} \times {}^{4}C_{1} = 4$		
		$5M 2W: {}^{6}C_{5} \times {}^{4}C_{2} = 36$		
		$4M 3W: {}^{6}C_{4} \times {}^{4}C_{3} = 60$ $3M 4W: {}^{6}C_{3} \times {}^{4}C_{4} = 20$		
		Total = 120	B 1	All separate cases correct for B1
		There are 2 identical cases to consider, so 240 ways in all.	B 1	B1 for realising there are 2 identical cases, which have integer values

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11 (a)	$5\sin 2x + 3\cos 2x = 0$ $\tan 2x = -0.6$	M1 DM1	In each case the last A mark is for a second correct solution and no extra solutions within the range M1 for use of tan DM1 for dealing with 2x correctly
	$2x = 149^{\circ}, 329^{\circ}$		
	$x = 74.5^{\circ}, 164.5^{\circ}$	A1,A1	A1 for each
	Alternatives: $\sin(2x + 31^{\circ}) = 0$ or $\cos(2x - 59^{\circ}) = 0$	M1	M1 for either, then mark as above
(b)	$2\cot^2 y + 3\csc y = 0$		
	$2(\cos ec^2y - 1) + 3\cos ecy = 0$	M1	M1 for use of correct identity
	$2\csc^2 y + 3\csc y - 2 = 0$		
	$(2\csc y - 1)(\csc y + 2) = 0$	M1	M1 for attempt to factorise a 3 term quadratic equation
	One valid solution		
	$\cos \operatorname{ecy} = -2, \ \sin y = -\frac{1}{2}$		
	$y = 210^{\circ}, 330^{\circ}$	A1,A1	A1 for each
	Alternative:		
	$2\frac{\cos^2 y}{\sin^2 y} + \frac{3}{\sin y} = 0$	M1	M1 for use of $\cot y = \frac{\cos y}{\sin y}$ and
	leads to $2\sin^2 y - 3\sin y - 2 = 0$		$\cos \operatorname{ecy} = \frac{1}{\sin y}$
	and $\sin y = -\frac{1}{2}$ only	M1	M1 for attempt to factorise a 3 term quadratic equation
	$y = 210^{\circ}, 330^{\circ}$	A1A1	
(c)	$3\cos(z+1.2)=2$		
	$\cos(z+1.2) = \frac{2}{3}$		
	(z+1.2) = 0.8411, 5.442, 7.124	M1	M1 for correct order of operations to
	z = 4.24, 5.92	A1 A1A1	end up with 0.8411 radians or better A1 for one of 5.441 or 7.124 (or better) A1 for each valid solution