CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the October/November 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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1	$\frac{dy}{dx} = 2x - \frac{16}{x^2}$ When $\frac{dy}{dx} = 0$, $x = 2, y = 12$	**M1** **A1** **DM1** **A1**	for attempt to differentiate all correct for equating $\frac{dy}{dx}$ to zero and an attempt to solve for x. **A1** for both, but no extra solutions
2 (a)		**B1** **B1** **B1**	for correct shape for max value of 2, starting at (0, 2) and finishing at (180°, 2) for min value of –4
(b) (i)	4	**B1**	must be positive
(ii)	60° or $\frac{\pi}{3}$ or 1.05 rad	**B1**	
3 (i)	$y = 4(x+3)^{\frac{1}{2}}(+c)$ $10 = 4\left(9^{\frac{1}{2}}\right) + c$ $c = -2$ $y = 4(x+3)^{\frac{1}{2}} - 2$	**M1, A1** **M1** **A1**	**M1** for $(x+3)^{\frac{1}{2}}$, **A1** for $4(x+3)^{\frac{1}{2}}$ for a correct attempt to find c, but must be from an attempt to integrate Allow **A1** for $c = -2$
(ii)	$6 = 4(x+3)^{\frac{1}{2}} - 2$ $x = 1$	**A1 ft**	**ft** for substitution into *their* equation to obtain x; must have the first **M1**

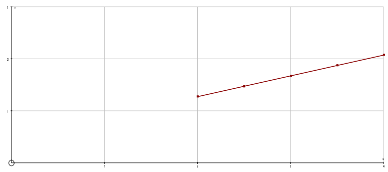
4	(i)	$5y^2 - 7y + 2 = 0$	B1, B1	**B1** for 5, **B1** for –7
	(ii)	$(5y-2)(y-1)=0$	M1	for solution of quadratic equation from **(i)**
		$y=\frac{2}{5},\ x=\frac{\ln 0.4}{\ln 5}$	M1	for use of logarithms to solve equation of the type $5^x = k$
		$x = -0.569$	A1	must be evaluated to 3sf or better
		$y = 1,\ x = 0$	B1	
5	(i)	$\frac{dy}{dx} = 3x^2 - \frac{1}{x}$	M1	for attempt to differentiate
		When $x = 1$, $y = 1$ and $\frac{dy}{dx} = 2$	B1	for $y = 1$
		Tangent: $y-1=2(x-1)$	DM1	for attempt to find equation of tangent
		$(y = 2x-1)$	A1	allow equation unsimplified
	(ii)	Mid-point (5, 9)	B1	for midpoint from given coordinates
		$9 = 2(5)-1$	B1	for checking the mid-point lies on tangent
		Alternative Method: Tangent equation $y = 2x-1$ Equation of line joining (–2, 16) and (12, 2) $y = -x+14$		
		Solve simultaneously $x = 5$, $y = 9$	B1	for a complete method to find the coordinates of the point of intersection
		Mid-point (5, 9)	B1	for midpoint from given coordinates
6	(i)	$(2+px)^6 = 64 + 192px + 240p^2x^2 \ldots$	B1	for $240p^2$ or $240p^2x^2$ or ${}^6C_2 \times 2^4 \times (px)^2$ or ${}^6C_2 \times 2^4 \times p^2$ or ${}^6C_2 \times 2^4 \times p^2x^2$
		$240p^2 = 60$	M1	for equating *their* term in x^2 to 60 and attempt to solve
		$p = \frac{1}{2}$	A1	
	(ii)	$(3-x)(64+192px+240p^2x^2 \ldots)$	B1 ft	**ft** for $192p$, 96 or $192 \times$ *their* p
		Coefficient of x^2 is $180 - 192p$ = 84	M1 A1	for $180 - 192p$

7 **(i)**	$\mathbf{A}^{-1}=\frac{1}{5ab}\begin{pmatrix} b & -2b \\ a & 3a \end{pmatrix}$	**B1, B1**	**B1** for $\frac{1}{5ab}$, **B1** for $\begin{pmatrix} b & -2b \\ a & 3a \end{pmatrix}$
(ii)	$\mathbf{X}=\mathbf{BA}^{-1}$	**M1**	for post-multiplication by inverse matrix
	$=\begin{pmatrix} -a & b \\ 2a & 2b \end{pmatrix}\begin{pmatrix} \frac{1}{5a} & -\frac{2}{5a} \\ \frac{1}{5b} & \frac{3}{5b} \end{pmatrix}$	**DM1**	for correct attempt at matrix multiplication, needs at least one term correct for their BA^{-1} (allow unsimplified)
	$=\begin{pmatrix} 0 & 1 \\ \frac{4}{5} & \frac{2}{5} \end{pmatrix}$	**A1** **A1**	for each correct pair of elements, must be simplified
8 **(i)**	$\overrightarrow{AB}=\begin{pmatrix} 12 \\ 16 \end{pmatrix}$, at P, $x=-2+\frac{1}{4}(12)$ so at P, $x=1$	**B1**	for convincing argument for $x = 1$
	$y=3+\frac{1}{4}(16)$, $y=7$	**B1**	for $y = 7$
(ii)	Gradient of $AB=\frac{16}{12}$, so perp gradient = $-\frac{3}{4}$	**M1**	for finding gradient of perpendicular
	Perp line: $y-7=-\frac{3}{4}(x-1)$	**M1**	for equation of perpendicular through their P
	$(3x+4y=31)$	**A1**	Allow unsimplified
(iii)	$Q\left(0, \frac{31}{4}\right)$	**B1 ft**	**ft** on their perpendicular line, may be implied
		M1	for any valid method of finding the area of the correct triangle, allow use of *their* Q; must be in the form $(0, q)$.
	Area AQB = 12.5	**A1**	

9	(i)	$\log y = \log a + x\log b$	B1	for the statement, may be seen or implied in later work,

x	2	2.5	3	3.5	4
$\lg y$	1.27	1.47	1.67	1.87	2.07

	2	2.5	3	3.5	4
$\ln y$	2.93	3.39	3.84	4.31	4.76



			M1	for attempt to draw graph of x against log y
			A2,1,0	–1 each error in points plotted
	(ii)	Gradient = log b $\lg b = 0.4$ or $\ln b = 0.92$	DM1	for attempt to find gradient and equate it to log b, dependent on **M1** in **(i)**
		$b = 2.5$ (allow 2.4 to 2.6)	A1	
		Intercept = log a $\lg a = 0.47$ or $\ln a = 1.10$	DM1	for attempt to equate y-intercept to log a or use *their* equation with *their* gradient and a point on the line, dependent on **M1** in **(i)**
		$a = 3$ (allow 2.8 to 3.2)	A1	
		Alternative method: Simultaneous equations may be used provided points that are on the plotted straight line are used.	DM1 DM1	for a pair of equations using points on the line, dependent on **M1** in **(i)** for solution of these equations, dependent on **M1** in **(i)**
		$a = 3$ (allow 2.8 to 3.2) $b = 2.5$ (allow 2.4 to 2.6)	A1 A1	**A1** for each

10 (a) (i)	360	**B1**	
(ii)	60	**B1**	
(iii)	36	**B1**	
(b) (i)	${}^{8}C_5 \times {}^{12}C_5$	**B1, B1**	**B1** for each, allow unevaluated with no extra terms
	$56 \times 792 = 44352$	**B1**	Final answer must be evaluated and from multiplication
(ii)	4 places are accounted for Gender no longer 'important'	**M1**	for realising that 4 places are accounted or that gender is no longer important
	Need ${}^{16}C_6 = 8008$	**A1**	for 8008
	Alternative Method $\left({}^{6}C_6 \times {}^{10}C_0\right) + \left({}^{6}C_5 \times {}^{10}C_1\right) \ldots \left({}^{6}C_0 \times {}^{10}C_6\right)$	**M1**	for at least 5 of the 7 cases, allow unsimplified
	$1 + 60 + 675 + 2400 + 3150 + 1512 + 210 = 8008$	**A1**	
11 (a)	$2\cos 3x - \dfrac{\cos 3x}{\sin 3x} = 0$ $\cos 3x\left(2 - \dfrac{1}{\sin 3x}\right) = 0$	**M1**	for use of $\cot 3x = \dfrac{\cos 3x}{\sin 3x}$, may be implied
	Leading to $\cos 3x = 0,\ 3x = 90^\circ,\ 270^\circ$	**DM1**	for attempt to solve $\cos 3x = 0$ correctly from correct factorisation to obtain x
	$x = 30^\circ, 90^\circ$	**A1**	**A1** for both, no excess solutions in the range
	and $\sin 3x = \dfrac{1}{2},\ 3x = 30^\circ,\ 150^\circ$	**DM1**	for attempt to solve $\sin 3x = \dfrac{1}{2}$ correctly to obtain x
	$x = 10^\circ, 50^\circ$	**A1**	**A1** for both, condone excess solutions
(b)	$\cos\left(y + \dfrac{\pi}{2}\right) = -\dfrac{1}{2}$ $y + \dfrac{\pi}{2} = \dfrac{2\pi}{3}, \dfrac{4\pi}{3}$	**M1**	for dealing with sec $\left(y + \dfrac{\pi}{2}\right)$ correctly
		DM1	for correct order of operations, must not mix degrees and radians
	so $y = \dfrac{\pi}{6}, \dfrac{5\pi}{6}$ (0.524, 2.62)	**A1, A1**	

12	**(i)**	$\overrightarrow{AQ} = \lambda\mathbf{b} - \mathbf{a}$	**B1**	
	(ii)	$\overrightarrow{BP} = \mu\mathbf{a} - \mathbf{b}$	**B1**	
	(iii)	$\overrightarrow{OR} = \mathbf{a} + \frac{1}{3}(\lambda\mathbf{b} - \mathbf{a})$ or $\lambda\mathbf{b} - \frac{2}{3}(\lambda\mathbf{b} - \mathbf{a})$	**M1**	for $\mathbf{a} + \frac{1}{3}$ *their* **(i)**
		$= \frac{2}{3}\mathbf{a} + \frac{1}{3}\lambda\mathbf{b}$	**A1**	Allow unsimplified
	(iv)	$\overrightarrow{OR} = \mathbf{b} + \frac{7}{8}(\mu\mathbf{a} - \mathbf{b})$ or $\mu\mathbf{a} - \frac{1}{8}(\mu\mathbf{a} - \mathbf{b})$	**M1**	for $\mathbf{b} + \frac{7}{8}$ *their* **(ii)**
		$= \frac{1}{8}\mathbf{b} + \frac{7}{8}\mu\mathbf{a}$	**A1**	Allow unsimplified
	(v)	$\frac{2}{3}\mathbf{a} + \frac{1}{3}\lambda\mathbf{b} = \frac{1}{8}\mathbf{b} + \frac{7}{8}\mu\mathbf{a}$	**M1**	for equating **(iii)** and **(iv)** and then equating like vectors
		$\frac{2}{3} = \frac{7}{8}\mu,\ \mu = \frac{16}{21}$ Allow 0.762	**A1**	
		$\frac{1}{3}\lambda = \frac{1}{8},\ \lambda = \frac{3}{8}$ Allow 0.375	**A1**	