CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2014 series

0606 ADDITIONAL MATHEMATICS

0606/13 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	**(i)**	$y = 3(x-1)^2 + 2$ $a = 3,\ b = 1,\ c = 2$	**B1, B1, B1**	**B1** for each, may be given in the form $y = 3(x-1)^2 + 2$
	(ii)	(1, 2)	**√B1**	Follow through on their answers to **(i)** If using differentiation, follow through on their x only.
2		$2^{4x} \times 4^{y} \times 8^{x-y} = 1$ Considering powers of either 2, 4 or 8 $7x - y = 0$ $3^{x+y} = \frac{1}{3}$	**M1**	**M1** for considering powers of either 2, 4 or 8 and forming an equation using these powers
		Considering powers of 3 $x + y = -1$	**B1**	**B1** for equation considering powers of 3
		Solving both simultaneously gives $x = -\frac{1}{8},\ y = -\frac{7}{8}$	**M1** **A1**	**M1** for attempt to solve their equations **A1** for both
3	**(i)**	f(–3) $= -27 + 9p - 3p^2 + 21$ $= 9p - 3p^2 - 6$	**M1** **A1**	**M1** for substitution of $x = -3$ **A1** answer must be simplified
	(ii)	$9p - 3p^2 - 6 < 0$ $(p-1)(p-2) > 0$	**M1**	**M1** for attempt to factorise
		Critical values 1 and 2 $p < 1,\ p > 2$	**A1** **A1**	**A1** for critical values **A1** for correct range
4	**(i)**	$V = x(24-2x)^2$ $= x(576 - 96x + 4x^2)$ $= 4x^3 - 96x^2 + 576x$	**M1** **A1**	**M1** for attempt at a product of 3 lengths, 2 of which must be the same **A1** for expansion to reach given answer
	(ii)	$\frac{dV}{dx} = 12x^2 - 192x + 576$	**M1**	**M1** for attempt to differentiate
		When $\frac{dV}{dx} = 0$, $12x^2 - 192x + 576 = 0$	**DM1**	**DM1** for equating $\frac{dV}{dx}$ to zero and attempt to solve
		leading to $(x-4)(x-12) = 0$ with $x = 4$ the only possible solution $V = 1024$	**A1** **A1**	**A1** for $x = 4$ **A1** for $V = 1024$

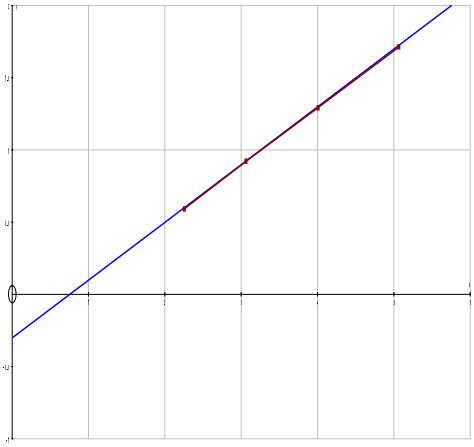
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5	**(i)**	$64 - 960x + 6000x^2$	**B1, B1, B1**	**B1** for each correct term
	(ii)	$(64 - 960x + 6000x^2)(a^3 + 3a^2bx)$,	**B1**	**B1** for first two terms of $(a + bx)^3$
		$64a^3 = 512,\ \ a = 2$	**B1**	**B1** for equating constant term to 512 and obtaining $a = 2$
		$-960a^3 + 3a^2b(64) = 0$	**M1**	**M1** for attempt to equate coefficient of x to zero, must have two terms involved
		leading to $b = 10$	**A1**	**A1** for $b = 10$
6		When $x = 2,\ y = -4$	**B1**	**B1** for $y = -4$
		$\frac{dy}{dx} = x\left(\frac{2x}{3}\right)(x^2 - 12)^{-\frac{2}{3}} + (x^2 - 12)^{\frac{1}{3}}$	**M1, B1** **A1**	**M1** for differentiation of a product **B1** for $\frac{2x}{3}(x^2 - 12)^{-\frac{2}{3}}$
		When $x = 2,\ \frac{dy}{dx} = -\frac{4}{3}$	**M1**	**M1** for attempt at normal equation
		Normal: $y + 4 = \frac{3}{4}(x - 2)$ $(4y = 3x - 22)$	**A1**	**A1** allow unsimplified
7	**(a) (i)**	15120	**B1**	
	(ii)	$(5 \times 4) \times (4 \times 3 \times 2)$ 480	**M1** **A1**	**M1** for attempt to multiply number of ways of getting 4 letters by the number of ways of getting 2 digits.
	(b) (i)	5456	**B1**	
	(ii)	${}^{18}C_2 \times 15$ 2295	**M1** **A1**	**M1** for attempt at an appropriate product, at least one term must be correct.
	(iii)	5456 – Number of ways only girls get tickets 5456 – 455 = 5001	**M1** **A1**	**M1** for a complete correct method *their* **(i)** – number of ways only girls get tickets
		Or 1B 2G 1890 2B 1G 2295 3B 816 Total 5001	**M1** **A1**	**M1** must be considering at least 2 of the cases shown

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8	**(i)**	1	**B1**	
	(ii)	$a = 8e^{-2t}$	**M1**	**M1** for attempt to differentiate
		$8e^{-2t} = 6, -2t = \ln \frac{3}{4}$	**DM1**	**DM1** for correct attempt to solve equation in the form $e^{-2t} = \text{constant}$
		$t = 0.144$	**A1**	**A1** must be at least 3 sf
	(iii)	$s = 5t + 2e^{-2t} \quad (+c)$	**M1**	**M1** for attempt to integrate
		When $t = 0$, $s = 0$, *so* $c = -2$	**DM1, A1**	**DM1** for attempt to find c, **A1** c correct
		When $t = 1.5$, $s = 5.60$	**M1, A1**	**M1** for substitution of $t = 1.5$
		Alternative: $s = \left[5t + 2e^{-2t}\right]_0^{1.5}$	**M1** **DM1** **A1** **M1**	**M1** for attempt to integrate **DM1** for attempt to use limits **A1** all correct **M1** for evaluation of square bracket notation
		Leading to $s = 5.60$	**A1**	
	(iv)	Velocity is always +ve, so no change in direction	**B1**	Allow any valid argument.
9	**(i)**	$\cos x(3\sin x - 2) = 0$		
		$\cos x = 0, \ x = 90^\circ$	**B1**	**B1** for 90°
		$\sin x = \frac{2}{3},$	**M1**	**M1** for attempt to solve $\sin x = \frac{2}{3}$
		$x = 41.8°, 138.2°$	**A1,√A1**	Follow through on their first answer
	(ii)	$10\sin^2 y + \cos y = 8$ $10(1 - \cos^2 y) + \cos y = 8$	**M1**	**M1** for use of correct identity
		$10\cos^2 y - \cos y - 2 = 0$	**M1**	**M1** for attempt to reduce to a 3 term quadratic and attempt to solve quadratic
		$(2\cos y - 1)(5\cos y + 2) = 0$ $\cos y = \frac{1}{2}, \ \cos y = -\frac{2}{5}$	**M1**	**M1** for attempt to solve using factors in terms of cos
		$y = 60^\circ, 300^\circ$ and $y = 113.6^\circ, 246.4^\circ$	**A1, A1**	**A1** for any 'pair'

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10	**(i)**	x^2 2.25 3.06 4 5.06 $\lg y$ 0.59 0.92 1.29 1.71	**B1**	
	(ii)		**M1** **A1, 0**	**M1** for plotting log$y$ against x^2 –1 each error, poor point plotting, poor line drawing
	(iii)	Gradient: $\lg b = 0.4,\ b = 2.5$ (allow 2.45 to 2.55)	**M1** **A1**	**M1** for correct use of gradient
		Intercept : $\lg A = -0.3,\ A = 0.5$ (allow 0.4 to 0.6)	**M1** **A1**	**M1** for correct use intercept
	(iv)	2.1 (allow 2 to 2.2)	**M1, A1**	

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11	**(i)**	at A $\quad \sqrt{3}\sin 3x + \cos 3x = 0$	**M1**	**M1** for equating to zero and attempt to solve using tan
		$\tan 3x = -\dfrac{1}{\sqrt{3}},\ 3x = \dfrac{5\pi}{6}\ \ 150°$	**DM1**	**DM1** for dealing with $3x$
		$x = \dfrac{5\pi}{18}(0.873)$ (allow 50°)	**A1**	
	(ii)	$\dfrac{\mathrm{d}y}{\mathrm{d}x} = 3\sqrt{3}\cos 3x - 3\sin 3x$	**B1, B1**	**B1** for $\dfrac{\mathrm{d}y}{\mathrm{d}x}$
		When $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 0$, $\tan 3x = \sqrt{3},\ \ 3x = \dfrac{\pi}{3}$ or $3x = 60°$,	**M1**	**M1** for attempt to solve $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 0$
		$x = \dfrac{\pi}{9}\ (0.349)$ (allow 20°)	**A1**	
	(iii)	$\text{Area} = \left[-\dfrac{\sqrt{3}}{3}\cos 3x + \dfrac{1}{3}x + \dfrac{1}{3}\sin 3x \right]_{\frac{\pi}{9}}^{\frac{5\pi}{18}}$	**M1** **A1, A1**	**M1** for attempt to integrate **A1** for each term
		$= \left(-\dfrac{\sqrt{3}}{3}\cos\dfrac{5\pi}{6} + \dfrac{1}{3}\sin\dfrac{5\pi}{6} \right) - \left(-\dfrac{\sqrt{3}}{3}\cos\dfrac{\pi}{3} + \dfrac{1}{3}\sin\dfrac{\pi}{3} \right)$	**DM1**	**DM1** for correct application of their limits
		$= \dfrac{2}{3}$ or 0.667 or better	**A1**	

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