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

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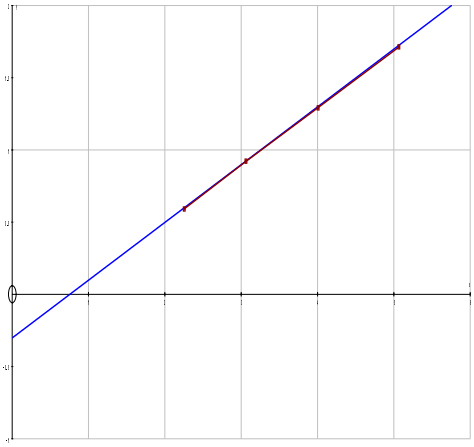
1	(i)	$y = 3(x-1)^2 + 2$ $a = 3,\ b = 1,\ c = 2$	**B1, B1, B1**	**B1** for each, may be given in the form $y = 3(x-1)^2 + 2$
	(ii)	(1, 2)	**√B1**	Follow through on their answers to **(i)** If using differentiation, follow through on their x only.
2		$2^{4x} \times 4^{y} \times 8^{x-y} = 1$ Considering 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 $V = 1024$

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 $(a + bx)^3$
		$64a^3 = 512, \quad a = 2$	**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

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 $\sin x = \frac{2}{3}$
		$x = 41.8^\circ, 138.2^\circ$	**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'

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**	

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)	$\dfrac{dy}{dx} = 3\sqrt{3}\cos 3x - 3\sin 3x$	**B1, B1**	**B1** for $\dfrac{dy}{dx}$
		When $\dfrac{dy}{dx} = 0$, $\tan 3x = \sqrt{3}$, $\quad 3x = \dfrac{\pi}{3}$ or $3x = 60°$,	**M1**	**M1** for attempt to solve $\dfrac{dy}{dx} = 0$
		$x = \dfrac{\pi}{9}$ (0.349) (allow $20°$)	**A1**	
	(iii)	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**	